San Diego
FORWARD

the 2021 regional plan

DRAFT ENVIRONMENTAL IMPACT REPORT FOR PUBLIC REVIEW

VOLUME 2: APPENDICES A–O

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Appendix A

Notice of Preparation

Appendix A-1

NOP

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November 14, 2016 File Number 3102000

TO: Interested Agencies, Organizations, and Individuals

FROM: SANDAG Staff

SUBJECT: Notice of Preparation of a Program Environmental Impact Report for San Diego Forward: The Regional Plan

Notice of Preparation

The San Diego Association of Governments (SANDAG), as Lead Agency, will prepare a Program Environmental Impact Report (EIR) for San Diego Forward: The Regional Plan (Regional Plan). Responsible and trustee agencies, and other interested agencies, organizations, and individuals are invited to provide written comments on the scope and content of the EIR. An overview of the Regional Plan, its probable environmental effects, and related information is attached. An initial study was not prepared.

Scoping Meeting

A public scoping meeting will be held on Thursday, December 8, 2016, at 12 noon (immediately preceding the Regional Planning Technical Working Group meeting). The meeting will be held at SANDAG, 401 B Street, Suite 800, San Diego, CA 92101. Attendees will have the opportunity to provide verbal and written comments to SANDAG at the scoping meeting.

Submitting Comments

Comments also can be provided in writing to SANDAG. State law requires that responsible and trustee agencies provide comments no later than 30 days after receipt of this notice. For all other parties, SANDAG is providing a 60-day comment period. As such, comments from all other parties must be received by January 13, 2017. Please include a name and contact information, if appropriate.

Contact Information

Please send written comments via mail or email to:

Andrew Martin, Senior Regional Planner
401 B Street, Suite 800
San Diego, CA 92101
andrew.martin@sandag.org

Lead Agency: San Diego Association of Governments (SANDAG)

Project Title: Program Environmental Impact Report for San Diego Forward: The Regional Plan

Project Location: The 18 cities and unincorporated areas of San Diego County

Prepared By:

Andrew Martin

ANDREW MARTIN
Senior Regional Planner
(619) 595-5375

11-10-16
Date

AMA/hbr

Attachment: 1. Plan Information and Scope of Environmental Analysis

Attachment 1. Plan Information and Scope of Environmental Analysis

Background and Plan Overview

The San Diego Association of Governments (SANDAG), as the Lead Agency under the California Environmental Quality Act (CEQA), will prepare a Program Environmental Impact Report (EIR) for an update to San Diego Forward: The Regional Plan (Regional Plan). The Regional Plan will consist of a Regional Transportation Plan (RTP) and a Sustainable Communities Strategy (SCS) that identify the San Diego region's future transportation investments and growth through 2050.

In accordance with state and federal guidelines, the RTP and SCS are updated every four years. On October 9, 2015, the SANDAG Board of Directors adopted the current version of the Regional Plan and certified its EIR. The Regional Plan is scheduled for consideration by the SANDAG Board of Directors in 2019. A new EIR will be prepared for the Regional Plan to evaluate its significant effects on the environment, identify alternatives to the Regional Plan, and indicate the manner in which significant effects can be mitigated or avoided.

Plan Location

The Regional Plan location includes all of San Diego County, including all 18 cities and all unincorporated areas. The Regional Plan considers cross-border and interregional travel patterns with neighboring counties and Mexico.

Senate Bill 375

Senate Bill 375 (Chapter 728, Statutes of 2008) (SB 375) provides for a planning process to coordinate land use planning and RTPs to help California meet the greenhouse gas (GHG) reductions established in Assembly Bill 32 (Chapter 488, Statutes of 2006). SB 375 requires RTPs prepared by Metropolitan Planning Organizations (MPOs), including SANDAG, to incorporate an SCS in their RTPs that demonstrates how the region would achieve GHG emission reduction targets for passenger vehicles set by the Air Resources Board (ARB).

In September 2010, the ARB adopted GHG targets for major MPOs, including SANDAG. The current SANDAG targets are per capita carbon dioxide emission reductions from passenger vehicles of 7 percent by 2020 and 13 percent by 2035, relative to 2005 levels. However, the ARB is expected to adopt a new 2035 target for SANDAG sometime in 2017. SANDAG anticipates that the new 2035 target will be in effect for the Regional Plan.

SB 375 has three major components:

1. Using the regional transportation planning process to achieve reductions in GHG emissions from passenger vehicles;
2. Offering incentives under CEQA to encourage projects that are consistent with an SCS that achieves GHG emission reductions; and
3. Coordinating the regional housing need allocation process with the regional transportation planning process while maintaining local authority over land use decisions.

If an SCS is unable to achieve the GHG emission reduction targets set by the ARB, an Alternative Planning Strategy must be developed to demonstrate how the targets could be achieved.

Resource Topics Addressed in the EIR

The EIR will analyze the Regional Plan's significant environmental effects for the following 16 resource topics:

- Aesthetics and Visual Resources
- Agricultural and Forestry Resources
- Air Quality
- Biological Resources
- Cultural and Paleontological Resources
- Energy
- Geology, Soils, and Mineral Resources
- GHG Emissions
- Hazards and Hazardous Materials
- Hydrology and Water Quality
- Land Use
- Noise and Vibration
- Population and Housing
- Public Services and Utilities
- Transportation
- Water Supply

In addition, the EIR will address cumulative impacts, growth inducing impacts, and other considerations required by CEQA.

Alternatives Analyzed in the EIR

As required by CEQA Guidelines Section 15126.6, the EIR will describe a range of reasonable alternatives to the Regional Plan that would feasibly attain most of the Regional Plan's basic objectives, but would avoid or substantially lessen any of the Regional Plan's significant effects, and evaluate the comparative merits of the alternatives. In addition, the EIR will identify other alternatives that were initially considered, but rejected for reasons including, but not limited to, infeasibility due to economic, legal, or other considerations; inability to meet most of the basic project objectives; or failure to avoid or substantially lessen any of the Regional Plan's significant environmental impacts. SANDAG is seeking input on alternatives as part of the Notice of Preparation process.

Appendix A-2

NOP Comments

Bill Tippets
5850 Soledad Mtn Rd
La Jolla, CA 92037

December 16, 2016

SANDAG (Submitted via email)
401 B Street, Suite 800
San Diego, CA 92101
Attention: Andrew Martin, Senior Regional Planner (andrew.martin@sandag.org)

Re: SANDAG NOP for Preparation of a Program EIR for San Diego Forward: The Regional Transportation Plan/Sustainable Communities Strategy

Dear Mr. Martin:

I am submitting this letter to comment on the NOP issued by SANDAG on November 14, 2016. The project is described as an update to the current 2050 RTP/SCS, a plan that is primarily intended to implement the requirements of SB 375. However, the current RTP/SCS was also prepared to update and incorporate the Regional Comprehensive Plan (RCP). The NOP should have described – and SANDAG must declare - whether this project also includes an update of the RCP component.

As noted in the NOP, SB 375, and thus the RTP, has three primary goals:

1. Using the regional transportation planning process to reduce greenhouse gas (GHG) emissions from passenger vehicles;
2. Offering incentives under CEQA to encourage projects that are consistent with a SCS that achieves the GHG emission reductions; and
3. Coordinating the Regional Housing Need Allocation process with the Regional Transportation Planning process while maintaining local authority over land use decisions.

Preparing an RTP/SCS that achieves these goals is critical to the San Diego Region's continued quality of life and would contribute significantly to larger state, national and global GHG emission objectives. However, to do so the RTP must acknowledge and successfully overcome several misconceptions and fundamental flaws in the previous RTP/SCS (source information is provided at the end of this letter):

1. SANDAG does not seem to acknowledge that building more general purpose freeway lanes is responsible for induced travel (particularly single-passenger vehicle) demand. One of the key reasons that many criticize SANDAG's current approach to transportation system network planning is its retention of general purpose lanes. Induced travel demand is not an "academic fallacy" as some have improperly asserted: building more roads just causes more drivers to use them. This knowledge is addressed in numerous studies and real-world assessments, including a widely cited 2015 UC Davis study that Caltrans has agreed was valid: more freeways do not solve traffic congestion and they lead to an increase in air pollution. Also, the next RTP/SCS needs to effectively integrate HOV lanes and "automated vehicles" (particularly freight trucks, which are expected to be implemented fairly soon and will need transfer stations to local

delivery) into the peripheral (e.g., the cities') transportation networks/smart growth-TOD land uses. Failure to do so will translate into more traffic delays and air pollution. What we don't need is for SANDAG to continue to promote more freeways that haven't, and won't, solve our transportation problems.

2. The next RTP/SCS could greatly improve the region's transit networks, while addressing needed local road/infrastructure repairs and improvements. San Diego's transit systems' (rail, bus, bike, walking) performance has substantial room for improvement. Increased funding for regional and local bikeways, safe (walking) routes are essential, but rail and rapid bus services can be greatly increased and improved. Recent studies have demonstrated that the San Diego metropolitan area's transit ridership is ranked 33rd of the top 75 largest metropolitan areas and our transit stations have among the worst rating in the state. Why is transit lagging? In large part, it seems that SANDAG has not given sufficient consideration – and funding - to leading-edge transit system improvements (one example is the Quickway approach that has been presented to SANDAG). Also, SANDAG could work more effectively with the local jurisdictions to coordinate the housing-jobs-transit mix. Transit works well in other US metropolitan areas; we need the next RTP/SCS to provide real leadership and utilization of new opportunities, and not to essentially rely on the historical approach to "improving" transit.
3. The next RTP/SCS must better understand and plan for our population growth and demographics. For example, millennials, who are expected to dominate housing demand, are not as fixated on single family homes and vehicles as previous generations. A 2015 study by Freddie Mac found that millennials tend to favor rentals and denser housing. A study in the Journal of the American Planning Association (2015) found that millennials are driving less and tending to live in urban areas, lowering their need for cars. Southern California demographics show a trend favoring multi-family housing and higher-density housing that is close to transit and generally more affordable than single family homes. And, San Diego is projected to locate about 80% of new residential growth within the existing developed urban areas, which is where transit works best.

   Regarding housing – and commercial/industrial – development, the RTP/SCS should identify policies, initiatives and incentives that will promote smart growth and seamless integrated transportation networks. The RTP/SCS should encourage/incentivize new developments that achieve net zero GHG emissions. For example, the recently announced FivePoint Net Zero Newhall (Ranch) plan outlines how this 21,500-unit development will meet net zero emissions. The RTP/SCS approach should prioritize San Diego and California-based GHG reduction options (rather than outside CA options) where onsite measures are not fully-sufficient.

SANDAG's update of its current RTP must recognize and address several significant changes in policies, plans and environmental conditions since that version was prepared. Among the most significant changes:

1. The State of California passed and enacted SB 32, which establishes a requirement that the statewide GHG reduction be 40% below the 1990 baseline by 2030 (codifying Executive Order B-30-15). The RTP should demonstrate how the projects that SANDAG is specifically responsible for implementing will meet – or preferably exceed - that reduction level.
2. The City of San Diego has a new, certified Climate Action Plan (CAP) that adopts the same GHG reduction target for 2030 as the State, and establishes a goal of an 80% reduction from the 1990 baseline by 2050. Other cities' CAPs and the County of San Diego's CAP also have or call for similar GHG reduction targets/timelines. A key means to meet these targets will be for the

region to adopt Community Choice Energy (CCE) and to prioritize local, distributed photovoltaic (PV) supply opportunities, not to promote and rely on mega PV facilities (e.g., desert solar).

3. The City of San Diego is preparing its Community Planning Updates that will specify land uses and densities that must be addressed in the RTP (and EIR). Other cities will, through their CAPs and General Plan Updates, specify land uses/densities that must be addressed in the RTP. Similarly, the County's CAP, which is currently in preparation and will be completed before the RTP, may identify opportunities and needs to changes to the RTP to allow the County to achieve its GHG reductions.
4. The State of California's climate policies and legislation establish clear guidance for regional planning agencies, counties and local governments that would complement the intent of international treaties and national policies to reduce GHG emissions. The RTP must, at the very least, fully contribute its "fair share" toward meeting those GHG emission targets/requirements. To that end, SANDAG must have a clear accounting of current GHG emissions – from each sector/major emission component – and be able to monitor/account for any claimed reductions by the project and its mitigation measures.

The RTP/SCS must clearly specify and identify how it will ensure:

1. Timelines/milestones for the project elements and mitigation measures and how these will become binding and legally enforceable.
2. Because the RTP/SCS involves or assumes many actions that are outside of SANDAG's authority (e.g., local land use decisions, economic development, etc.), it must clearly delineate how SANDAG and the local entities will ensure that the RTP/SCS goals, objectives, projects, and mitigation will be implemented.
3. A number of news articles have documented that SANDAGs TransNet program has not generated the (sales tax) revenues that it projected – and are needed to fund RTP projects. SANDAG must provide a more realistic assessment of its proposed revenues and project costs. This is particularly important when identifying the priorities for RTP projects and mitigation.
4. SANDAG has resources/programs, including its Dashboard, for providing summaries of its projects/results. The RTP/SCS must establish monitoring methods for tracking each of its project actions as well as their GHG emission reductions. It must work with the cities and county to integrate GHG emission monitoring so that meaningful, consistent implementation and enforcement mechanisms are established. The public should be able to access data and results of the RTP/SCS and not have to rely on annual or more infrequent formal reporting on the RTP/SCS by SANDAG.

Resource Topics, Alternatives and Cumulative/Growth-Inducing Issues. The NOP does not state what will comprise the "range of reasonable alternatives" to the project nor what the "update" to the current RTP/SCS will encompass, and it is not possible to provide specific comments on potential alternatives and project impacts. The NOP presents a reasonable list of resource topics that will be analyzed in the EIR; many of these had significant, unavoidable impacts in the previous RTP/SCS (Aesthetics/Visual; Agriculture and Forestry; Air Quality; Biological Resources; Cultural and Paleontological Resources; Energy; Mineral Resources; GHGs (consistency with state goals); Hydrology and Water Quality; Land Use; Noise and Vibration; Population and Housing; Public Services and Utilities; Transportation; and Water Supply). Based on the previous RTP/SCS process and EIR, the updated RTP/SCS could result in many of the same significant, unavoidable (and not fully mitigated) impacts.

Given that many cities and the County will have adopted rigorous CAPs (e.g., committing to state targets), the updated RTP/SCS will have to develop new alternatives that are consistent with those plans and presumed changed land uses, transportation and housing needs. For example, the previous RTP projected very little increase (about 3.5%) in total transit from 2012-2050, but as cities and the county become more dependent on density and transit to achieve GHG reductions, SANDAG must develop alternatives to its approaches and project list to better serve and provide incentives to local governments that will improve the jobs-housing-transportation balance. SANDAG must also substantially improve its assessment of and plan for utilization of reasonable technological improvements/innovations in transportation and transit. The likely introduction of self-driving freight trucks and cars, computer-assisted routing, and related advances must be part of the RTP.

San Diego cannot effectively employ, house and transport an additional projected 1.3 million residents by 2050 unless our thinking, planning and funding are based on the "real" facts and best available forecasts of our housing and driving trends. We need a new approach that prioritizes and funds our regional and local transit systems, not one that continues the past failed approach that relies on more freeways.

Please include these comments into the administrative record for the RTP/SCS project and keep me informed of the process to update the RTP/SCS and prepare the EIR.

Thank you,

Bill Tippets

Sources:

Induced travel demand - the real studies documenting it is real:

http://www.sutp.org/files/contents/documents/resources/B_Technical-Documents/GIZ_SUTP_TD1_Demystifying-Induced-Travel-Demand_EN.pdf

UCDavis Study: http://www.dot.ca.gov/newtech/researchreports/reports/2015/10-12-2015-NCST_Brief_InducedTravel_CS6_v3.pdf

CityLab summary of CA DOT/UCD study: http://www.citylab.com/commute/2015/11/californias-dot-admits-that-more-roads-mean-more-traffic/415245/

Young Americans driving less: http://www.citylab.com/commute/2015/07/the-clearest-explanation-yet-for-why-millennials-are-driving-less/398366/

Poor performance of San Diego's transit:

Poor transit ridership rate: http://fivethirtyeight.com/datalab/how-your-citys-public-transit-stacks-up/

Poor transit stop performance (Caltrans rating): http://next10.org/transitscorecard

Housing trends:

http://www.sandiegouniontribune.com/news/2013/may/01/demographics-california-san-housing/

Freddie Mac 2015 US overview with millennials favoring rentals and multifamily housing strong demands: http://www.freddiemac.com/multifamily/pdf/2015_outlook.pdf

Net Zero Housing: http://www.netzeronewhall.com/the-latest/

Automated Vehicles

Google driverless vehicle tests: https://waymo.com/

University of Michigan Mobility Transformation Center campus pilot program: http://www.mtc.umich.edu/test-facility

Future of Automated Freight Trucking: https://www.wired.com/2015/05/worlds-first-self-driving-semi-truck-hits-road/

China Testing Automated Vehicles: https://www.technologyreview.com/s/602854/chinas-driverless-trucks-are-revving-their-engines/?set=602902

TransNet Tax Revenue Shortfall:

http://www.voiceofsandiego.org/topics/politics/sandags-last-tax-hike-is-billions-short-and-measure-a-could-be-too/

From:	Bill Tippets
To:	Martin, Andrew; Gallegos, Gary; Stoll, Muggs; Rundle, Rob
Cc:	Nicole Capretz; Micah Mitrosky; Kayla Race; Colin Parent; Masada Disenhouse; Mike Bullock; Dave Grubb; Mike McCoy; Jim Peugh; Samantha; Alan Hoffman; Jack Shu; WILLIAM TIPPETS; Diane Nygaard; Kathleen Ferrier; Mary Lydon; Michael YOUNG; Mike Stepner; Cary Lowe; Betsy Morris; Vicki Estrada; Brooke Peterson
Subject:	Re: Comments on SANDAG"s NOP for an EIR for the 2019 RTP/SCS
Date:	Sunday, January 08, 2017 3:36:42 PM

Mr. Martin/SANDAG,

Please include the following comments, which augment my previous comment letter, into the record for the NOP for the upcoming EIR for the next iteration/update of San Diego Forward (the RTP/SCS).

As SANDAG prepares the next iteration/update to its RTP/SCS, it will have to address the plan's conformance with revelant, new regulations and standards, including SB 32, which increases the amount of greenhouse gas (GHG) emission reduction that the state of CA - as implemented through regional/local projects - must attain. The new GHG standard, 40% below GHG emissions compared to1990 level by 2030, should be the CEQA threshold of significance for SANDAG's RTP/SCS relative to GHGs.

Based on the existing RTP/SCS approach, there does not appear to be any feasible way to "adjust" the existing RTP to attain this additional GHG reduction: it will require SANDAG and its member cities/county to adopt substantially different and more aggressive approaches and measures to reduce those emissions, particularly from the transportation sector, which is the largest GHG emission sector in our region. The cities and county, most of which have or are in the process of adopting climate action plans (CAPs) that would comply with the state's SB 32 targets/standards, will need assistance, via the RTP/SCS, to help them meet those commitments.

An example of the kind of new thinking that SANDAG should adopt is already occurring elsewhere. For example, Seattle's regional transportation leadership has determined that a significant reduction in vehicle use and concomitant increase in transit is required (see: http://www.citylab.com/commute/2017/01/a-growing-seattle-goes-all-in-on-transit/512321/). Like Seattle, San Diego is not an appropriate place to rely on more cars and freeway/highway lanes to solve its transportation (and in part its GHG emission) problems.

A revamped and substantially improved transportation system network that does not rely on additional vehicles and lanes, and is linked to functioning/effective development/housing (particularly affordable housing), should be the overarching focus and outcome of the next RTP/SCS.

Thank you,

Bill Tippets

On Fri, Dec 16, 2016 at 11:52 AM, Bill Tippets <billtippets@gmail.com> wrote:

> Mr. Martin/SANDAG,
>
> Attached is a letter that comments on the above-referenced NOP. Please include this letter into the project's public record and any publicly-accessible electronic and hard files

associated with the project record. At the end of this letter I have included a number of references and information sources that relate directly to critical elements of the RTP/SCS and opportunities to substantially improve upon the current RTPSCS.

The next RTP/SCS faces and must effectively integrate many new legislative, technical, planning, environmental and physical challenges and opportunities.

Sincerely,

Bill Tippets

CALIFORNIA COASTAL COMMISSION
San Diego District Office
7575 Metropolitan Drive, Suite 103
San Diego, CA 92108-4421
(619) 767-2370

December 19, 2016

Andrew Martin
Associate Regional Planner
SANDAG
401 B Street, Suite 800
San Diego, CA 92101

RE: Update to San Diego Forward, Regional Transportation Plan and Sustainable Community Strategy, Comments on Notice of Preparation of Environmental Impact Report (SCH # 2010041061)

Dear Mr. Martin:

The above referenced Notice of Preparation of an Environmental Impact Report (EIR) for a four year update to San Diego Forward: The Regional Plan (2015), including the Regional Transportation Plan and Sustainable Communities Strategy, was received by Coastal Commission staff on November 18, 2016. We appreciate the opportunity to comment on the environmental review process for the Regional Plan update. One of the primary tenets of the Coastal Act is to protect and enhance public access to the coast, which requires a well-planned and interconnected public transportation system. Several of the policy objective categories of the Regional Plan, including Habitat and Open Space Preservation, Environmental Stewardship, Mobility Choices, and Healthy and Complete Communities, create an opportunity to enhance San Diego's transportation system and protect coastal resources in a manner that is supportive of the Coastal Act. This update provides an opportunity to enhance those sections of the Regional Plan, considering current infrastructure, planned future infrastructure, and environmental conditions including sea level rise. Given the California Coastal Commission's mandate to protect coastal resources through planning and regulation of the use of land and water within the Coastal Zone, we are providing the following comments and topics that should be considered, analyzed, and addressed in the EIR.

1) California Coastal Act and North Coast Corridor Public Works Plan and Transportation and Resource Enhancement Program (NCC PWP/TREP). The transportation corridors located within the San Diego region bisect or are located directly adjacent to sensitive marine resources including coastal lagoon systems and the Pacific Ocean. Impacts to these resources are restricted by Coastal Act policies. Except for certain specific instances, fill of a wetland or other coastal waters is prohibited (Section 30233), and the marine resources (Section 30230), water quality (Section 30231), and environmentally sensitive habitat areas (Section 3024) often associated with the coastal environment are also protected. Many of these coastal systems have already significantly deteriorated due to historical transportation infrastructure development. Future transportation improvements planned for the Coastal Zone should seek to ameliorate and improve these constraints to the greatest extent feasible. Many of these improvements, and policies that will guide project planning and implementation, are identified in the

North Coast Corridor Public Works Plan/Transportation and Resource Enhancement Program (NCC PWP/TREP), adopted in June 2014, and subsequently amended in March 2016 and December 2016. Please review that plan for guidance on current and future planned projects in the Coastal Zone – and please analyze the Regional Plan update for consistency with that plan and for minimization of adverse environmental impacts to coastal resources.

2) Sea Level Rise. Coastal Act Section 30253 requires that new development minimize risks to life and property from hazards and to assure stability and structural integrity without the use of a shoreline protective device. Thus, understanding the potential impacts of climate change and sea level rise is of critical importance when beginning long-range planning efforts so as to ensure that land use decisions and development projects are not designed in a way that will put investments at risk from coastal hazards. Given the proximity of significant portions of the County's key regional infrastructure to the coast, it is imperative that transportation and land use plans carefully anticipate the effects of sea level rise and associated hazards. Ensuring that new coastal infrastructure is designed to adapt to the effects of sea level rise throughout the expected life of the infrastructure is a principal concern of the Coastal Commission, as clarified through the Commission's Sea Level Rise Policy Guidance (2015) and through recent Commission actions on key infrastructure projects throughout California. The 2015 Regional Plan included reference to best available science on climate change and sea level rise (e.g. the 2012 National Research Council Report, *Sea Level Rise for the Coasts of California, Oregon, and Washington*), but the 2015 Regional Plan did not make clear that sea level rise conditions must be modeled for the entirety of the expected life of new infrastructure projects, which in the case of rail and highway bridges is considered to be 100 years. Projects should be modeled to include both tidal and fluvial hydraulics across the range of projected increases in global mean sea level as applied to the local area (e.g. San Diego County open coast) and in the context of storm surge, wave run-up, erosion, and other variables.

If the Regional Plan includes infrastructure improvements that are likely to be temporarily flooded or perpetually inundated by water in the next 75 to 100 years, then the EIR for the Regional Plan update should analyze potential adaptation measures that minimize adverse impacts to coastal resources and enhance public access to the coast. The EIR should analyze whether planned infrastructure would need to be protected from coastal hazards, such as flooding and erosion, with shoreline armoring devices including seawalls and revetments, which adversely affect public access because they block access to the beach and result in the loss of public recreational areas. Additionally, the EIR should analyze alternative infrastructure projects that minimize the need for shoreline armoring and include options for relocation of infrastructure segments away from hazardous conditions.

In a comment letter dated July 15, 2015 on the EIR for the 2015 Regional Plan, Coastal Commission staff expressed similar concerns regarding consideration of sea level rise impacts for the entire expected life of new projects. The SANDAG response to comments on that EIR indicated that "Regional Plan Sections 4.1 to 4.16 incorporates the climate change effects that may exacerbate the proposed Plan's impacts, including sea level rise. Because the proposed Plan horizon year is 2050, the Draft EIR impact analysis appropriately identifies impacts of the proposed Plan out to the year 2050." In fact, the lack of analysis beyond the year 2050 was not appropriate. While the Regional Plan only includes projects anticipated to be constructed prior to 2050, the effects of those projects will be experienced for generations beyond 2050. If the Regional Plan encourages infrastructure improvements to be installed in areas prone to flooding (or in areas subject to other coastal hazards), the flooding and other impacts will not stop in 2050. Therefore, the EIR for this Regional Plan update is an ideal time to correct that error of omission and analyze the potential environmental impacts of planned projects over their expected life.

An example of a future project that must consider the effects of sea level rise and minimize the need for shoreline armoring is the relocation of the rail corridor along the Del Mar bluffs. Replacement of the rail corridor in its current location with protection of the corridor provided with a series of seawalls and revetments is not the environmentally preferable alternative because doing so will fix the back of the beach, resulting in erosion of sandy beach area and loss of public access and recreational opportunities. The Regional Plan should analyze the expected life of the rail corridor along the Del Mar bluffs and other existing infrastructure with consideration given to sea level rise and other environmental impacts. Once the expected life of vulnerable infrastructure is identified, the Regional Plan should identify a plan for removing and relocating that infrastructure. In the case of the rail corridor along the Del Mar bluffs, the plan should include relocation to an inland location (via tunneling) so that is not exposed to coastal hazards. The environmental planning for relocation of the rail tracks will be a lengthy process, and thus the Regional Plan should identify and prioritize the commencement of environmental review for this adaptive management strategy to protect vulnerable infrastructure. Given the anticipated threats to the bluffs in this location in the short term, it is necessary to start these planning and permitting efforts now. The City of Del Mar’s Draft Adaptation Plan Section 5.3.1.3 includes a railroad adaptation strategy, which should be analyzed for environmental concerns in the EIR for the Regional Plan update.

3) Public Access and Recreation. A fundamental pillar of the Coastal Act is the protection and provision of public access to, and along, the coast. Coastal Act sections 30210 and 30212 require that maximum opportunities for public access and recreation be provided in new development projects, consistent with public safety, private property rights, and natural resource protection. Additionally, Section 30252 dictates that new development should maintain and enhance public access through such actions as facilitating transit service, providing non-automobile options, and providing adequate parking.

Accordingly, the EIR should evaluate the Regional Plan update for consistency with the above-mentioned policies. In particular, there should be an analysis of how the plan would maximize access to the coast, including options for non-motorized, bicycle, and pedestrian routes and related amenities throughout the region. This analysis should incorporate evaluation of ways to facilitate access to beaches and coastal areas from the inland portions of the region, as well as options for enhancing connections to public transit, the Coastal Trail, the Coastal Rail Trail, and other visitor-serving recreational opportunities.

Importantly, the EIR should also analyze the potential negative impacts to public access that could arise from the various land use, housing, and transportation scenarios identified by the Regional Plan update. Scenarios that would lead to increased development in coastal communities, or development that would result in additional traffic along critical coastal highway connectors should be analyzed for their potential impacts to traffic congestion. At a minimum, a traffic study at peak recreational periods, as well as peak commuter periods, should be completed for the various scenarios to help understand potential impacts more fully.

4) Concentration of Development. Section 30250 of the Coastal Act generally requires that new development within the Coastal Zone be located within, contiguous with, or in close proximity to existing developed areas, and Section 30253 requires new development to be sited in a manner that will minimize energy consumption and vehicle miles travelled. In this way, the Coastal Act encourages smart growth patterns that recognize a strong urban-rural boundary to ensure protection of coastal resources. Accordingly, the EIR should analyze the extent to which various alternatives, as well as the broader goals of the Sustainable Communities Strategy would be consistent with and mutually supported by such concentration of development.

Finally, the 2015 Regional Plan's greenhouse gas emissions targets for 2035 and 2050 were not consistent with the Executive Order B-30-15 goal of reducing California's GHG emissions to 40 percent below 1990 levels by 2030 and the Executive Order S-3-05 goal of reducing California's GHG emissions to 80 percent below 1990 levels by 2050. While the 2015 Regional Plan included more investment in transit and active transportation than any previous RTP, it failed to prioritize the implementation of public transit and active transportation projects to minimize vehicle miles traveled consistent with Coastal Act Section 30253. The EIR for the 2015 Regional Plan indicated that several of the proposed alternatives with increased focus on transit priorities would reduce impacts to coastal resources while still achieving all of the plan objectives. The Notice of Preparation for the Regional Plan update indicates that the California Air Resource Board is expected to adopt new greenhouse gas reduction targets. Given that those targets are likely to require implementation of new projects and strategies to reduce single-occupant driving, the EIR for the Regional Plan update should include additional analysis of transportation alternatives which are most protective of sensitive coastal and environmental resources while at the same time achieving the plan objectives. While there may be existing constraints that make the environmentally superior alternative infeasible today, the Regional Plan is a long-range planning document and there will likely be changes in policy and funding for transit within its planning horizon – especially if SANDAG advocates for such changes. As such, SANDAG should place a greater emphasis on the prioritization of public transit and active transportation projects and include analysis of such projects in the EIR.

Thank you for the opportunity to comment on the environmental review for the Regional Plan update. We look forward to future collaboration on improvements to the transportation system within the San Diego region, and appreciate the commitments presented within the current (2015) Regional Plan to preserve and enhance coastal resources. If you have any questions or concerns, please do not hesitate to contact us at the Coastal Commission's San Diego, San Francisco, and Long Beach District offices.

Sincerely,

Kanani Brown, Shannon Fiala, and Zach Rehm
Coastal Program Analysts

DEPARTMENT OF TRANSPORTATION
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Serious Drought.
Serious drought.
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January 10, 2017

San Diego Forward: The Regional Plan
Notice of Preparation
SCH # 2010041061

Andrew Martin
San Diego Association of Governments (SANDAG)
401 B Street, Suite 800
San Diego, CA 92101

Dear Mr. Martin:

Thank you for including the California Department of Transportation (Caltrans) in the environmental review process for the San Diego Association of Governments (SANDAG) Notice of Preparation (NOP) for the San Diego Forward: The Regional Plan (Regional Plan). The mission of Caltrans is to provide a safe, sustainable, integrated and efficient transportation system to enhance California's economy and livability. The Local Development-Intergovernmental Review (LD-IGR) Program reviews land use projects and plans to ensure consistency with our mission and state planning priorities.

Caltrans recently approved in June 2016 the California Transportation Plan (CTP) 2040, the first California transportation plan published that provides a pathway for transportation to help meet the State's climate goals. The CTP 2040 is an expression of how the State will reinforce the region's efforts in Sustainable Communities Strategies and take conforming action for the interregional transportation system. Achieving the goal of the CTP 2040 through State-regional partnership efforts helps meet State-regional policy directives of livable communities, economic growth and emission reductions. It is also acknowledged that the CTP 2040 is aspirational in achieving greenhouse gas reductions, while the regional transportation plan must be revenue constrained, making it challenging to achieve desired outcomes.

The CTP 2040 is available here:
http://www.dot.ca.gov/hq/tpp/californiatransportationplan2040/2040.html

Caltrans encourages early collaborative efforts with State, regional, and other stakeholders for the development of the Regional Plan 2019; Caltrans looks forward to working with SANDAG during this process. If you have any questions, please contact Chris Schmidt at (619)220-7360 or chris.schmidt@dot.ca.gov.

Sincerely,

JACOB ARMSTRONG, Branch Chief
Development Review Branch

Circulate San Diego
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January 13, 2017

San Diego Association of Governments
Board of Directors, Chair Ron Roberts
401 B St. Ste. 800
San Diego, CA 92101

RE: Circulate San Diego Comments for SANDAG NOP of Program EIR for the 2019 Regional Plan

Honorable Ron Roberts and SANDAG Board and Committee members:

On behalf of Circulate San Diego, whose mission is to create excellent mobility choices and vibrant, healthy neighborhoods, I am writing to submit comments in response to the Notice of Preparation for the Program Environmental Impact Report (EIR) for the 2019 Regional Plan (Regional Plan), issued by SANDAG on November 14, 2016.

Circulate San Diego is a non-profit organization devoted to transit, active transportation, and sustainable growth. As such, we support SANDAG's efforts to integrate land uses, transportation systems, infrastructure needs, and public investment strategies within a regional smart growth framework. We submit this letter with the aim of providing SANDAG with useful comments to ensure preparation of an EIR that reflects SANDAG's goal to plan for a smart growth transportation network and that it fully complies with CEQA. Thank you for this opportunity to provide valuable feedback on this essential component of the 2019 Regional Plan.

1. **<u>The EIR must contain one or more transit-friendly reasonable alternatives that are financially constrained and do not require an amendment of the 2004 TransNet Ordinance.</u>**

SANDAG's EIR for the 2019 Regional Plan must contain one or more transit-friendly reasonable alternative that will mitigate the environmental impacts of the preferred scenario. For the purpose of this letter, any such alternative will be referred to as a "TransNet-Constrained Transit Alternative." Such an alternative should advance as much transit and active transportation as possible, subject to the following constraints:

> Constraint 1: It must cost approximately the same as SANDAG's preferred alternative, paying for the acceleration of transit through the delay or removal of highway expenditures; and
>
> Constraint 2: It must not delay or remove so much highway expenditures as to violate the text of the 2004 TransNet Extension Ordinance.

a. Both the courts in California and SANDAG agree that SANDAG must analyze a transit-friendly reasonable alternative to its preferred scenario.

The courts in California have found that SANDAG is obligated to consider reasonable alternatives that mitigate the environmental impacts of its preferred scenario by advancing public transit.[1] SANDAG recognized this obligation in its 2015 EIR and analyzed a variety of alternatives that substantially advanced transit to mitigate the greenhouse gas impacts of its preferred scenario.[2]

b. None of the transit-friendly scenarios considered by SANDAG in 2015 were financially or politically viable, and were therefore not reasonable alternatives.

Circulate San Diego wrote a letter to SANDAG in 2015 commenting on the failure to perform a reasonable alternatives analysis for the agency's Draft 2015 Regional Plan.[3] All of SANDAG's transit-friendly alternatives in 2015 were so aggressive with their transit acceleration that they would require either an amendment to the 2004 TransNet Ordinance, or unreasonable expectations about the availability of local, state, or federal funding. While such contingencies may not be legally impossible, they are very unlikely to occur. As such, SANDAG's alternatives were not sufficient to meet SANDAG's obligation to analyze reasonable alternatives for the SANDAG Board and the public to consider.

c. Including one or more TransNet-Constrained Transit Alternative does not preclude SANDAG from analyzing even more ambitious alternatives in its EIR.

Circulate San Diego certainly supports SANDAG if it chooses to analyze alternative Regional Plan scenarios that assume ambitious federal funding, or optimistic views about the willingness of the SANDAG Board to amend TransNet to prioritize transit. Those scenarios could be useful to examine the potential outcomes if the SANDAG board changes or evolves.

However, alternative scenarios that would rely on contingences that are very unlikely to occur are not sufficient to meet SANDAG's obligation to provide a transit-friendly reasonable alternative for mitigating environmental impacts of the preferred scenario. "Unrealistic mitigation measures, similar to unrealistic project alternatives, do not contribute to a useful CEQA analysis."[4] Such alternatives are permissible to analyze, but not sufficient.

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[1] *Cleveland National Forest Foundation v. San Diego Association of Governments*, 231 Cal.App.4th 1056 (2014) (The California Supreme Court did not grant certiorari on this issue).

[2] San Diego Association of Governments, Final EIR for San Diego Forward: The Regional Plan, Chapter 6, Alternatives Analysis (October 9, 2015), available at http://www.sdforward.com/pdfs/EIR_final/Chapter%206.0%20Alternatives%20Analysis.pdf.

[3] Circulate San Diego, Policy Letter: Comments on Draft Environmental Impact Report for SANDAG's 2015 Draft Regional Plan, (July 14, 2015), available at http://www.circulatesd.org/comments_sandag_2015_regional_plan_eir.

[4] *Cleveland National Forest Foundation v. San Diego Association of Governments*, 231 Cal.App.4th 1056 (2014) (*citing Watsonville Pilots Assn. v. City of Watsonville*, 183 Cal.App.4th 1059, 1089 (2010)).

d. <u>Any TransNet-Constrained Transit Alternative should advance only as much transit as is financially viable through the delay or removal of highway projects.</u>

SANDAG can avoid replicating the same deficiencies in its 2015 EIR by providing in the 2019 EIR one or more TransNet-Constrained Transit Alternatives that that are both financially and politically viable. Any TransNet-Constrained Transit Alternative should cost roughly the same as SANDAG's preferred scenario. This will allow the SANDAG Board and the public to make a more apples-to-apples comparison between maintenance of SANDAG's current status quo plans, and the alternative of changing those plans to prioritize transit.

Delaying highway spending will free up near-term resources that SANDAG can dedicate to front-load transit projects. A TransNet-Constrained Transit Alternative should only accelerate as much transit as can be accomplished by freeing up funding through the delay or removal of highway expenditures.

As we stated in 2015, a viable transit-friendly alternative likely could not accelerate all of SANDAG's transit projects into the first ten years of the plan. Accelerating all such transit projects would likely make any Regional Plan financially infeasible. Instead, SANDAG should prepare at least one TransNet-Constrained Transit Alternative that accelerates as much transit as can be financially feasible, given the flexibility the agency has to delay or remove highway projects, as described below.

a. <u>A TransNet-Constrained Transit Alternative should be consistent with the requirements of the 2004 TransNet Extension Ordinance.</u>

When determining how much of SANDAG's highway projects to delay or remove to free up resources to accelerate transit in a TransNet-Constrained Transit Alternative, SANDAG should limit changes to highway plans to be consistent with the text of the 2004 TransNet Extension Ordinance.

In 2015, Circulate San Diego and TransForm California published *TransNet Today,*[6] which explains the substantial flexibility SANDAG has over how to implement the 2004 TransNet Extension Ordinance.

While TransNet does require SANDAG to build certain highway projects, it allows substantial flexibility as to when those projects must be built. SANDAG has itself chosen the order and phasing of TransNet projects, an ordering they can elect to rebalance at their discretion. Such a rebalancing would require only a majority vote by the SANDAG Board, and would be consistent with both the text and the intent of the 2004 TransNet Extension Ordinance approved by the voters.

As explained by *TransNet Today*, if SANDAG were to delay or remove highway projects from its Regional Plan, it could free up other near-term resources planned to be spent on highways, like the State Transportation Improvement Program funds, and instead repurpose them to transit.

Any TransNet-Constrained Transit Alternative should only delay highway projects required by TransNet in a manner that would still allow SANDAG to complete them within the 40-year time horizon required by the text of the 2004 TransNet Extension Ordinance. For highway projects that are not required by the 2004 TransNet Extension Ordinance, they could be delayed or removed entirely as needed in a TransNet-Constrained Transit Alternative, to free up resources to accelerate transit.

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[6] Circulate San Diego, *TransNet Today* (2015), available at http://www.circulatesd.org/transnettoday.

While the TransNet Extension Ordinance is legally capable of amendment with a two thirds vote of the SANDAG Board, that would be politically very difficult, bordering on the impossible. Assuming such an amendment is unreasonable for the purpose of SANDAG's obligation to analyze reasonable alternatives in its EIR. One or more TransNet-Constrained Transit Alternative should be presented to the SANDAG Board that simultaneously advances transit, and preserves the text of TransNet, so that the SANDAG Board can make a real choice within the bounds of the politically possible.

b. <u>A TransNet-Constrained Transit Alternative should present a reasonable alternative for the SANDAG Board to consider, even if it does not solve all of the region's transit challenges in one stroke.</u>

A TransNet-Constrained Transit Alternative that is required to be financially and politically viable may not allow SANDAG to accelerate all of its planned transit projects into early periods. Such a plan may be deemed insufficient to many advocates for transit and active transportation.

However, for the SANDAG Board to reasonably consider a change of direction from the status quo, they must be presented with an option that meets Boardmembers' legal, financial, and political obligations to their constituencies.

If the SANDAG Board were to adopt a TransNet-Constrained Transit Alternative, even with the constraints outlined in this letter, it could present meaningful improvements to the region's transit future. The SANDG Board can only implement such a change if an option is presented to them in the form of a TransNet-Constrained Transit Alternative, consistent with the text of the 2004 TransNet Extension Ordinance.

Transit advocates, including Circulate San Diego, would likely desire even greater progress on transit that this limited transit-alternative could achieve. If SANDAG did adopt such an alternative in 2019, that would not preclude transit supporters from seeking still further improvements to transit through a future ballot measure, or changes to state or federal law.

2. **<u>The EIR should analyze the extent to which the Regional Plan does or does not meet the mode-share goals for local jurisdictions with Climate Action Plans.</u>**

The City of San Diego and other jurisdictions in the region have Climate Action Plans (CAPs) that adopt greenhouse gas reduction targets, as well as mode-share goals for transit, walking, and bicycling.

In 2015, Circulate San Diego and the Climate Action Campaign published a report titled *New Climate for Transportation*.[7] That report detailed how SANDAG's own data predicted that the 2015 Regional Plan would not result in the mode-share outcomes called for by the City of San Diego's CAP.

The EIR for the 2019 Regional Plan should include information and analysis showing to what extent SANDAG data projects mode-share goals in the geographic areas for which cities have mode-share goals

[7] Circulate San Diego and Climate Action Plan, *New Climate for Transportation* (2015), available at http://www.circulatesd.org/new_climate_for_transportation.

in their CAPs. This will help inform SANDAG Boardmembers and the public about whether SANDAG's efforts are sufficient to help cities meet their own climate goals.

Cities with CAPs and advocates like Circulate San Diego will likely be seeking this data in any event. So SANDAG can help a variety of stakeholders in the region by preemptively sharing this information in their Regional Plan EIR.

3. Conclusion.

Circulate San Diego looks forward to working with the SANDAG staff and Board as they develop the 2019 Regional Plan, so that San Diego can enjoy the robust transportation network it deserves.

Sincerely,

Jim Stone
Executive Director
Circulate San Diego

Cc: Andrew Martin, Associate Regional Planner, San Diego Association of Governments, via email to andrew.martin@sandag.org.

City of Del Mar

January 3, 2017

Mr. Andrew Martin
Senior Regional Planner
San Diego Association of Governments (SANDAG)
401 B Street, Suite 800
San Diego, CA 92101

By email: andrew.martin@sandag.org.

Re: Scoping Comments – Program Environmental Impact Report for San Diego Forward: The Regional Plan/Regional Transportation Plan

Dear Mr. Martin:

The City of Del Mar submits the following scoping comments on the proposed Program Environmental Impact Report (EIR) for the San Diego Forward/Regional Transportation Plan (RTP) update. Del Mar urges that the proposed EIR address the topic areas outlined below.

1. The alternative of removing the rail line from the Del Mar bluffs to a tunnel.
2. The environmental hazard implications of attempting to defend the rails on the Del Mar bluffs near, mid, and long-term, including accommodating the planned double tracking and the need to grade separate the Coast Boulevard rail crossing.
3. The near, mid, and long-term coastal access issues raised by leaving and defending the rail line on the bluffs in Del Mar.
4. The near, mid, and long-term safety implications of leaving and defending the rail line on the bluffs in Del Mar.
5. The near, mid, and long-term rail service impacts of the RTP's proposed double tracking of the entire corridor and doubling the number of trains. All the RTP goals for the corridor appear vulnerable to the "weak link" on the Del Mar bluffs. Can the goals of the RTP for the corridor be achieved with the rail line remaining on the bluffs, and at what service, economic, and environmental costs?
6. The near, mid, and long-term impacts to the immediate community from noise, vibration, view blockage, and other reasonably foreseeable impacts that will occur from leaving and defending the rail line on the bluffs, including but not limited to, impacts to the sensitive bluffs and beach from armoring and shoring, and the impacts from the projected increase in train service from the current 50+ trains per day to over 100 trains per day.

DISCUSSION

The 2015 SANDAG RTP contains a Del Mar tunnel option as a 2050 "phase 3" program project at an estimated cost in 2014 dollars of $1.3 billion, including final double tracking.[1] This acknowledges that the rail line needs to be removed from the bluffs. However, no tunnel location or funding source has been identified and no environmental analysis of this option has yet been undertaken by SANDAG. We understand that SANDAG's historical approach has been to focus its program EIR review on RTP updates on proposed phase 1 projects, deferring analysis of later projects. We take issue with any further deferral of analysis of the tunnel option.

It is time for SANDAG to study in earnest the two options this rail line faces. The two alternatives for addressing the Del Mar bluffs are (1) leave the rail line on the bluff in Del Mar, try to double track it and grade Separate Coast Blvd, facing the inevitable need to continuously armor and defend the line against erosion and sea level rise, with the economic, service interruption, and environmental impacts implied, or (2) accelerate the option to remove the rail line from the bluff and place it in a tunnel. The current CEQA analysis needs to evaluate these two alternatives, before regional commitments are made in a 2019 RTP.

Unless this analysis is undertaken now, options will be foreclosed, including what appears to be the feasible alternative of moving the rail line to a tunnel. Large amounts are being spent, and will be spent, on defending the bluff top rail line against erosion and sea level rise. Adverse impacts to the sensitive beach and bluff are inevitable. Hazards, including injuries and deaths, are likely to increase if the line is double tracked and the frequency of rail service is doubled as proposed. These issues and impacts are occurring now, will only accelerate, and key SANDAG decisions are being made now, that need to be addressed in the EIR now.

The "feasibility", as CEQA defines the term,[2] of double tracking the bluffs and grade separating the Coast Blvd crossing is questionable. If feasible at all, it will bring great environmental damage and be very expensive. Without studying these issues now in the EIR SANDAG and the public cannot know whether the option of keeping the rail line on the bluffs is the least environmentally damaging and most cost effective alternative, or whether removing the rail line to a tunnel is.

Reports are that at least $1 billion is projected to be spent on double tracking and other improvements to the Oceanside to San Diego rail corridor, all captive to the <u>weak</u>

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[1] 2015 RTP Appendix A, page 14.

[2] CEQA Guidelines Section 15364: "Feasible" means capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors.

link on the Del Mar bluffs. The entire future of the rail line is at risk due to the weak link on the Del Mar bluffs. Del Mar submits that SANDAG needs to review these issues now to completely understand viable alternatives and achieve CEQA compliance.

Under CEQA: "'Project'" *means the whole of an action, which has a potential for resulting in either a direct physical change in the environment, or a reasonably foreseeable indirect physical change in the environment,...*" Guidelines Section 15378(a).

Guidelines Section 15004(b) (1) & (2) states in part:

"(1) *With public projects, at the earliest feasible time, project sponsors shall incorporate environmental considerations into project conceptualization, design, and planning. ...*"

"(2*) To implement the above principles, public agencies shall not undertake actions concerning the proposed public project that would have a significant adverse effect or limit the choice of alternatives or mitigation measures, before completion of CEQA compliance. ...*"

Guideline Section 15168(b) addresses Program EIRs:

"...

"(b) ***Advantages***. *Use of a program EIR can provide the following advantages. The program EIR can:*

(1) *Provide an occasion for a more exhaustive consideration of effects and alternatives than would be practical in an EIR on an individual action,*
(2) *Ensure consideration of cumulative impacts that might be slighted in a case-by-case analysis,*
(3*) Avoid duplicative reconsideration of basic policy considerations,*
(4) *Allow the lead agency to consider broad policy alternatives and program wide mitigation measures at an early time when the agency has greater flexibility to deal with basic problems or cumulative impacts...*"

It is respectfully submitted that CEQA requires inclusion of the above-listed issues in the scope of the EIR on the 2019 RTP update.

Sincerely,

Terry Sinnott

Terry Sinnott
Mayor, City of Del Mar

January 12, 2017

Andrew Martin
Senior Regional Planner
SANDAG
401 'B' Street, Suite 800
San Diego, CA 92101

Electronic Delivery: andrew.martin@sandag.org

SUBJECT: Notice of Preparation of a Program Environmental Impact Report (EIR) for The Update to the San Diego Forward: The Regional Plan

Dear Mr. Martin:

The City of Santee appreciates the opportunity to submit this letter regarding the preparation of a PEIR for the San Diego Forward: Regional Plan. Among the environmental issues are "transportation" and "greenhouse gas emissions." Since the two are inextricable, scenarios that analyze/demonstrate a reduction in congestion at the convergence of freeways would be expected in the document.

The City of Santee, Caltrans and SANDAG completed a SR-52 Corridor Study in 2016. This study would provide useful information in the development of short-term scenarios that reduce congestion and therefore greenhouse gas emissions, particularly at the convergence of SR-125 and SR-52 in the City of Santee.

Respectfully,

Melanie Kush

Melanie Kush
Director of Development Services
City of Santee
mkush@cityofsanteeca.gov

c. Minjie Mei, Principal Traffic Engineer, City of Santee

County of San Diego

MARK WARDLAW
DIRECTOR

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January 13, 2017

Andrew Martin
Senior Regional Planner
SANDAG
401 B Street, Suite 800
San Diego, CA 92101

Via email to: Andrew.martin@sandag.org

COMMENTS ON THE NOTICE OF PREPARATION OF A PROGRAM ENVIRONMENTAL IMPACT REPORT FOR SAN DIEGO FORWARD: THE REGIONAL PLAN

Dear Mr. Martin,

The County of San Diego (County) has reviewed the Notice of Preparation for the San Diego Forward Regional Plan Program Environmental Impact Report (PEIR). We appreciate the opportunity to provide input for SANDAG's consideration. The County offers the following comments.

TRAFFIC/TRANSPORTATION

The County is currently developing an Active Transportation Plan (ATP) for the unincorporated communities of the county. The ATP will integrate and update several existing plans and documents into a single plan. The ATP will serve as a master plan and policy document to guide the development and maintenance of active transportation infrastructure including sidewalks, pathways, multi-use trails, and bikeways; the ATP will include the Safe Routes to School programs for the unincorporated county. Additionally, the ATP is expected to be one of the implementation measures for the County's Climate Action Plan. Please consider identifying transit improvements and ATP and Transportation Demand Measures (TDM) in the SANDAG Regional Plan and PEIR which will assist the rural unincorporated areas in meeting the region's greenhouse gas (GHG) emission goals.

AIRPORTS

Incorporating the Regional Aviation Strategic Plan (RASP) and Airport Multimodal Accessibility Plan (AMAP) assumptions into the development of the Regional Plan is an important part of planning for the region's future transportation needs. Aviation travel is expected to grow substantially according to projections from the San Diego Regional Airport Authority and SANDAG. Please consider prioritizing the ground transportation network surrounding McClellan-Palomar and Gillespie Field airports to accommodate increased demand as San Diego International Airport nears operational capacity.

CLIMATE CHANGE AND GREENHOUSE GAS

The County is currently developing a Climate Action Plan for the unincorporated county. The largest GHG emission source in the region is the Transportation Sector. The County looks towards the Regional Plan to lead the efforts in reducing GHG emissions in the Transportation Sector. The recommendations noted are important for the local jurisdictions in meeting their share of the region's GHG emission reductions. The County and SANDAG, working collaboratively on the Regional Plan, can move towards an efficient and cleaner multi-modal transportation system. As it relates to SANDAG's Regional Plan, the County requests the following be considered:

a. Analyze alternatives that address multi-modal transportation options for the unincorporated county, particularly as it relates to transit service and alternative fuel infrastructure;

b. Analyze whether the developed/urban communities within the unincorporated county meet the Urban Area Transit Strategy;

c. Analyze an environmentally sustainable transportation system that can reduce vehicle miles traveled, gasoline consumption, and GHG emissions, while providing alternatives modes of transportation for all economic sectors of our population;

d. Clarify whether the Regional Plan GHG emission reductions will be consistent with the Air Resources Board (ARB) 2030 Target Scoping Plan; and

e. SANDAG's 2015 Regional Transportation Plan incorporated the County's 2011 General Plan Update Land Use and Mobility Elements. Since 2011, the County has adopted several general plan amendments (GPA) to the 2011 General Plan. The County requests that SANDAG staff coordinate with County staff to ensure that the adopted GPAs are incorporated in the transportation models and growth forecasts for the Regional Plan and PEIR Analysis.

MULTIPLE SPECIES CONSERVATION PLAN (MSCP)

The proposed Regional Plan covers areas that are critical to the County's Multiple Species Conservation Program (MSCP), both North and South County plans—including the assembly of a Preserve in each. The South County Subarea Plan was adopted in 1997; and the North County Plan is currently in development. As the Regional Plan encourages projects that are consistent with an SCS that achieves GHG reductions, we would anticipate that the PEIR would analyze the effects of the proposed Regional Plan on the MSCP South and North County plans, the assembly of the Preserve and full implementation of the plans. Any effect (direct or indirect) of the Regional Plan on the MSCP should be evaluated (and mitigated, if necessary). SANDAG staff should coordinate with County staff to best determine how to evaluate the MSCP South and NC Plan in the upcoming Regional Plan and PEIR.

PARKS AND RECREATION

The County's trails and pathway network provides safe, secure, healthy, affordable, and convenient travel choices between the places where people live, work, and play while reducing use of personal vehicles, thereby reducing GHG emissions. Please consider incorporating a discussion of the County's Community Trails Master Plan and encourage investment in trails and pathways that connect people with places where they live, work, and play.

VECTOR CONTROL PROGRAM

The County's Vector Control Program (VCP) is responsible for the protection of public health through the surveillance and control of mosquitoes that are vectors for human disease including West Nile virus (WNV). The VCP has completed their review and has the following comments regarding the Regional Plan.

1. The VCP requests that when implementing transportation projects or components of the environmental mitigation program, impacts from possible mosquito breeding sources are considered. Any area that is capable of accumulating and holding at least ½ inch of water for more than 96 hours can support mosquito breeding and development.

2. For your information, the County's Guidelines for Determining Significance for Vectors can be accessed at http://www.sandiegocounty.gov/content/dam/sdc/pds/docs/vector_guidelines.pdf.

3. The California Department of Public Health Best Management Practices for Mosquito Control in California is available at http://www.cdph.ca.gov/HealthInfo/discond/Documents/BMPforMosquitoControl07-12.pdf.

The County looks forward to receiving future documents and/or notices related to this project and providing additional assistance at your request. If you have any questions regarding these comments, please contact Danny Serrano, Land Use / Environmental Planner at (858) 694-3680, or via email at daniel.serrano@sdcounty.ca.gov.

Sincerely,

MARY KOPASKIE, Chief
Advance Planning Division
Planning & Development Services

Email cc: Michael De La Rosa, Policy Advisor, Board of Supervisors, District 1
Adam Wilson, Policy Advisor, Board of Supervisors, District 2
Dustin Steiner, Chief of Staff, Board of Supervisors, District 3
Adrian Granda, Policy Advisor, Board of Supervisors, District 4
Melanie Wilson, Policy Advisor, Board of Supervisors, District 5
Vincent Kattoula, CAO Staff Officer, LUEG
Nick Ortiz, Project Manager, PDS
Everett Hauser, Transportation Specialist, PDS
Bulmaro Canseco, Planner, PDS
Jeff Kashak, Planner, DPW
Richard Chin, Associate Transportation Specialist, DPW
Eric Lardy, Chief, Community Health Division, DEH

Department of Toxic Substances Control

Matthew Rodriquez
Secretary for
Environmental Protection

Barbara A. Lee, Director
5796 Corporate Avenue
Cypress, California 90630

Edmund G. Brown Jr.
Governor

December 28, 2016

Mr. Andrew Martin
Senior Regional Planner
San Diego Association of Governments (SANDAG)
401 B Street, Suite 800
San Diego, California 92101

NOTICE OF PREPARATION (NOP) FOR SAN DIEGO FORWARD: THE REGIONAL PLAN PROJECT ENVIRONMENTAL IMPACT REPORT (SCH# 2010014061)

Dear Mr. Martin:

The Department of Toxic Substances Control (DTSC) has reviewed the subject NOP. The following project description is stated in the NOP: "The San Diego Association of Governments, as the lead agency under the CEQA, will prepare an EIR for an update to San Diego Forward: The Regional Plan. The Regional Plan will consist of a RTP and a SCS that identify the San Diego region's future transportation investments and growth through 2050."

Based on the review of the NOP, DTSC has the following comments:

1. The EIR should identify and determine whether current or historic uses at the project site may have resulted in any release of hazardous wastes/substances. Historic uses of the site are not provided in the NOP. A Phase I Environmental Site Assessment may be appropriate to identify any recognized environmental conditions.

2. If there are any recognized environmental conditions in the project area, then proper investigation, sampling and remedial actions overseen by the appropriate regulatory agencies should be conducted prior to the new development or any construction.

3. If the project plans include discharging wastewater to a storm drain, you may be required to obtain an NPDES permit from the overseeing Regional Water Quality Control Board (RWQCB).

4. If during construction/demolition of the project, soil and/or groundwater contamination is suspected, construction/demolition in the area should cease and appropriate health and safety procedures should be implemented. If it is determined that contaminated soil and/or groundwater exist, the EIR should identify how any required investigation and/or remediation will be conducted, and the appropriate government agency to provide regulatory oversight.

If you have any questions regarding this letter, please contact me at (714) 484-5476 or email at Johnson.Abraham@dtsc.ca.gov.

Sincerely,

Johnson P. Abraham
Project Manager
Brownfields Restoration and School Evaluation Branch
Brownfields and Environmental Restoration Program – Cypress

kl/sh/ja

cc: See next page.

cc: Governor's Office of Planning and Research (via e-mail)
State Clearinghouse
P.O. Box 3044
Sacramento, California 95812-3044
State.clearinghouse@opr.ca.gov

Mr. Guenther W. Moskat, Chief (via e-mail)
Planning and Environmental Analysis Section
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Mr. Shahir Haddad (via e-mail)
Supervising Engineer
Brownfields Restoration and School Evaluation Branch
Brownfields and Environmental Restoration Program – Cypress
Shahir.Haddad@dtsc.ca.gov

CEQA# 2010014061

From:	Dan Silver
To:	Martin, Andrew
Subject:	Notice of Preparation of a Program Environmental Impact Report for San Diego Forward: The Regional Plan
Date:	Friday, December 02, 2016 9:43:53 AM

December 2, 2016

Andrew Martin, Senior Regional Planner
San Diego Association of Governments
401 B Street, Suite 800
San Diego, CA 92101

Dear Mr Martin:

Endangered Habitats League (EHL) appreciates the opportunity to submit comments.

The RTP/SCS DEIR should:

1) at a minimum meet and if feasible exceed the new GHG reduction targets in SB 32;

2) direct transit investments to locations in which mode split can be most cost-effectively shifted to transit, specifically urban locations rather than the more remote unincorporated area; and

3) as a land use baseline for the unincorporated area, continue to use the 2011 County General Plan rather than any unadopted proposed amendments.

Please please EHL on all notification and distribution lists for this project. It would also be appreciated if you could acknowledge recent of these comments.

Yours truly,

Dan Silver

Dan Silver, Executive Director
Endangered Habitats League
8424 Santa Monica Blvd., Suite A 592
Los Angeles, CA 90069-4267

213-804-2750
dsilverla@me.com
www.ehleague.org

January 12, 2017

SANDAG
401 B Street, Suite 800
San Diego, CA 92101-4231

VIA Electronic Mail: andrew.martin@sandag.org

RE: Notice of Preparation of a Program Environmental Impact Report for San Diego Forward: The Regional Plan

Dear Association members:

The Environmental Center of San Diego appreciates the opportunity to make comments on the above referenced Plan. The Environmental Center, a nonprofit organization, is dedicated to the protection and enhancement of the natural environment throughout San Diego.

First you need to work on your regional plan. It is not a rational document for these times when greenhouse gas emissions need to drive the project, not the other way around.

The opportunity for San Diego to be successful in transportation refiguring is at its greatest, with plenty of examples to the north. But first you must engage, authentically, in extensive outreach. Not just lip service to the community but a genuine dialogue that champions new ideas and suggestions.

This requires a shift in direction for SANDAG.

- Start with a plan that does not negatively impact our most vulnerable communities.
- Build on that with projects that DO NOT worsen pollution and traffic congestion.
- Next, create a plan that links funding with projects that reduce greenhouse gas emissions to meet state targets.

Then, and only then, can we start to create a strategy with goals that effectively support substantial mass transit construction, operations and maintenance.

This is not rocket science. You just need to follow the traffic and add the appropriate modalities that lessen the pollution and give good solid alternative transportation choices to the citizens of San Diego.

Sincerely,

Pamela Heatherington
Board of Directors
contactecosd@gmail.com

Please share your comments below. Please note that SANDAG documents are public records and may be disclosed to the public upon request. Thank you.

NAME	ADDRESS	PHONE	EMAIL
Mike Bullock	1800 Bayberry Dr. 92054 Oceanside, CA	760 754 8025	mike_bullock@earthlink.net

☑ Please email me project updates in the future (email address required above).

COMMENTS:

Please read my attached, 3-minute speech

For official use only:
Date Received: 12-8-16

SANDAG

Dec. 8, 2016 SANDAG NOP Meeting, Noon; 364 Words

Mike Bullock
1800 Bayberry Drive
Oceanside, CA 92054
760-754-8025; mike_bullock@earthlink.net

Honorable SANDAG Chair, Board, and Staff:

I'm Mike Bullock, a retired satellite systems engineer and the San Diego Sierra Club Transportation Chair. I appreciate the opportunity to speak on the ***scope*** and ***content*** necessary for your 2019 RTP's EIR and specifically on your November 14th Notice of Preparation (NOP).

Its first paragraph states that an overview of the RTP's probable environmental impacts is attached. However, Attachment 1 of the NOP does ***not*** explain the difference between climate stabilization at a livable level and ***destabilization***, where the climate system's warming feedbacks become large and the planet loses most of its current life forms.

Regarding *Attachment 1*, first, we agree with the 2nd paragraph, of its "***Background and Plan Overview***" Section, that the EIR should evaluate the RTP's significant effects ***on the environment***. Secondly, we agree with the next sentence, that it should indicate how the significant effects ***can be avoided***.

Unfortunately, there is no indication from the rest of *Attachment 1* that SANDAG has any intention of doing either of those two required things. Nearly one third of *Attachment 1* is about SB 375 and yet the connection between SB 375 and the need to stabilize the climate at a livable level is never made because, in fact, there is no significant connection. Climate-stabilizing targets are for passenger vehicles and how they could be achieved, is ***your*** responsibilityes, under CEQA, because ***you*** are selecting transportation options for your RTP. SB 375 does not eliminate the requirements of CEQA.

Therefore, you must identify or create a plan as described in the California Democratic Party 2016 Platform: a [quote] "***plan*** showing how cars and light-duty trucks can hit climate-stabilizing targets, by defining enforceable measures to achieve the needed fleet efficiency and per-capita driving"[end quote]. Some measures will be state responsibilities; others, SANDAG responsibilities. However, under CEQA, you must identify or create such a plan. An obvious mitigation measure is to reallocate money for more freeway lanes to transit. Another is to install systems to improve the way we pay for the use of parking and driving. Such systems will increase economic fairness and choice. May I help? I have written a peer-reviewed Plan, as described above.

Thank you

STATE OF CALIFORNIA Edmund G. Brown Jr., Governor

NATIVE AMERICAN HERITAGE COMMISSION
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November 21, 2016

Andrew Martin
San Diego Association of Governments (SANDAG)
401 B Street, Suite 800
San Diego, CA 92101

sent via e-mail:
andrew.martin@sandag.org

RE: SCH# 2010041061; San Diego Forward: The Regional Plan Project, Notice of Preparation for Draft Environmental Impact Report, San Diego County, California

Dear Mr. Martin:

The Native American Heritage Commission has received the Notice of Preparation (NOP) for the project referenced above. The California Environmental Quality Act (CEQA) (Pub. Resources Code § 21000 et seq.), specifically Public Resources Code section 21084.1, states that a project that may cause a substantial adverse change in the significance of an historical resource is a project that may have a significant effect on the environment. (Pub. Resources Code § 21084.1; Cal. Code Regs., tit.14, § 15064.5 (b) (CEQA Guidelines Section 15064.5 (b)). If there is substantial evidence, in light of the whole record before a lead agency, that a project may have a significant effect on the environment, an environmental impact report (EIR) shall be prepared. (Pub. Resources Code § 21080 (d); Cal. Code Regs., tit. 14, § 15064 subd.(a)(1) (CEQA Guidelines § 15064 (a)(1)). In order to determine whether a project will cause a substantial adverse change in the significance of a historical resource, a lead agency will need to determine whether there are historical resources with the area of project effect (APE).

If your project involves the adoption of or amendment to a general plan or a specific plan, or the designation or proposed designation of open space, on or after March 1, 2005, it may be subject to Senate Bill 18 (Burton, Chapter 905, Statutes of 2004) (SB 18). **CEQA was amended significantly in 2014**. Assembly Bill 52 (Gatto, Chapter 532, Statutes of 2014) (AB 52) amended CEQA to create a **separate category of cultural resources**, "tribal cultural resources" (Pub. Resources Code § 21074) and provides that a project with an effect that may cause a substantial adverse change in the significance of a tribal cultural resource is a project that may have a significant effect on the environment (Pub. Resources Code § 21084.2). Please reference California Natural Resources Agency (2016) "Final Text for tribal cultural resources update to Appendix G: Environmental Checklist Form," http://resources.ca.gov/ceqa/docs/ab52/Clean-final-AB-52-App-G-text-Submitted.pdf. Public agencies shall, when feasible, avoid damaging effects to any tribal cultural resource. (Pub. Resources Code § 21084.3 (a)). **AB 52 applies to any project for which a notice of preparation or a notice of negative declaration or mitigated negative declaration is filed on or after July 1, 2015.**

Both SB 18 and AB 52 have tribal consultation requirements. If your project is also subject to the federal National Environmental Policy Act (42 U.S.C. § 4321 et seq.) (NEPA), the tribal consultation requirements of Section 106 of the National Historic Preservation Act of 1966 (154 U.S.C. 300101, 36 C.F.R. § 800 et seq.) may also apply.

The NAHC recommends **lead agencies consult with all California Native American tribes** that are traditionally and culturally affiliated with the geographic area of your proposed project as early as possible in order to avoid inadvertent discoveries of Native American human remains and best protect tribal cultural resources. Below is a brief summary of portions of AB 52 and SB 18 as well as the NAHC's recommendations for conducting cultural resources assessments. **Consult your legal counsel about compliance with AB 52 and SB 18 as well as compliance with any other applicable laws.**

SB 18

SB 18 applies to local governments and requires **local governments** to contact, provide notice to, refer plans to, and consult with tribes prior to the adoption or amendment of a general plan or a specific plan, or the designation of open space. (Gov. Code § 65352.3). Local governments should consult the Governor's Office of Planning and Research's "Tribal Consultation Guidelines," which can be found online at: https://www.opr.ca.gov/docs/09_14_05_Updated_Guidelines_922.pdf

Some of SB 18's provisions include:

1. Tribal Consultation: If a local government considers a proposal to adopt or amend a general plan or a specific plan, or to designate open space it is required to contact the appropriate tribes identified by the NAHC by requesting a "Tribal Consultation List." If a tribe, once contacted, requests consultation the local government must consult with the tribe on the

plan proposal. **A tribe has 90 days from the date of receipt of notification to request consultation unless a shorter timeframe has been agreed to by the tribe.** (Gov. Code § 65352.3 (a)(2)).

2. No Statutory Time Limit on SB 18 Tribal Consultation. There is no statutory time limit on SB 18 tribal consultation.
3. Confidentiality: Consistent with the guidelines developed and adopted by the Office of Planning and Research pursuant to Gov. Code section 65040.2, the city or county shall protect the confidentiality of the information concerning the specific identity, location, character, and use of places, features and objects described in Public Resources Code sections 5097.9 and 5097.993 that are within the city's or county's jurisdiction. (Gov. Code § 65352.3 (b)).
4. Conclusion of SB 18 Tribal Consultation: Consultation should be concluded at the point in which:
    a. The parties to the consultation come to a mutual agreement concerning the appropriate measures for preservation or mitigation; or
    b. Either the local government or the tribe, acting in good faith and after reasonable effort, concludes that mutual agreement cannot be reached concerning the appropriate measures of preservation or mitigation. (Tribal Consultation Guidelines, Governor's Office of Planning and Research (2005) at p. 18).

Agencies should be aware that neither AB 52 nor SB 18 precludes agencies from initiating tribal consultation with tribes that are traditionally and culturally affiliated with their jurisdictions before the timeframes provided in AB 52 and SB 18. For that reason, we urge you to continue to request Native American Tribal Contact Lists and "Sacred Lands File" searches from the NAHC. The request forms can be found online at: http://nahc.ca.gov/resources/forms/

AB 52

AB 52 has added to CEQA the additional requirements listed below, along with many other requirements:

1. Fourteen Day Period to Provide Notice of Completion of an Application/Decision to Undertake a Project: Within fourteen (14) days of determining that an application for a project is complete or of a decision by a public agency to undertake a project, a **lead agency** shall provide formal notification to a designated contact of, or tribal representative of, traditionally and culturally affiliated California Native American tribes that have requested notice, to be accomplished by at least one written notice that includes:
    a. A brief description of the project.
    b. The lead agency contact information.
    c. Notification that the California Native American tribe has 30 days to request consultation. (Pub. Resources Code § 21080.3.1 (d)).
    d. A "California Native American tribe" is defined as a Native American tribe located in California that is on the contact list maintained by the NAHC for the purposes of Chapter 905 of Statutes of 2004 (SB 18). (Pub. Resources Code § 21073).

2. Begin Consultation Within 30 Days of Receiving a Tribe's Request for Consultation and Before Releasing a Negative Declaration, Mitigated Negative Declaration, or Environmental Impact Report: A **lead agency** shall begin the consultation process within 30 days of receiving a request for consultation from a California Native American tribe that is traditionally and culturally affiliated with the geographic area of the proposed project. (Pub. Resources Code § 21080.3.1, subds. (d) and (e)) and prior to the release of a negative declaration, mitigated negative declaration or environmental impact report. (Pub. Resources Code § 21080.3.1(b)).
    a. For purposes of AB 52, "consultation shall have the same meaning as provided in Gov. Code § 65352.4 (SB 18). (Pub. Resources Code § 21080.3.1 (b)).

3. Mandatory Topics of Consultation If Requested by a Tribe: The following topics of consultation, if a tribe requests to discuss them, are mandatory topics of consultation:
    a. Alternatives to the project.
    b. Recommended mitigation measures.
    c. Significant effects. (Pub. Resources Code § 21080.3.2 (a)).

4. Discretionary Topics of Consultation: The following topics are discretionary topics of consultation:
    a. Type of environmental review necessary.
    b. Significance of the tribal cultural resources.
    c. Significance of the project's impacts on tribal cultural resources.
    d. If necessary, project alternatives or appropriate measures for preservation or mitigation that the tribe may recommend to the lead agency. (Pub. Resources Code § 21080.3.2 (a)).

5. Confidentiality of Information Submitted by a Tribe During the Environmental Review Process: With some exceptions, any information, including but not limited to, the location, description, and use of tribal cultural resources submitted by a California Native American tribe during the environmental review process shall not be included in the environmental document or otherwise disclosed by the lead agency or any other public agency to the public, consistent with Government

Code sections 6254 (r) and 6254.10. Any information submitted by a California Native American tribe during the consultation or environmental review process shall be published in a confidential appendix to the environmental document unless the tribe that provided the information consents, in writing, to the disclosure of some or all of the information to the public. (Pub. Resources Code § 21082.3 (c)(1)).

6. Discussion of Impacts to Tribal Cultural Resources in the Environmental Document: If a project may have a significant impact on a tribal cultural resource, the lead agency's environmental document shall discuss both of the following:
   a. Whether the proposed project has a significant impact on an identified tribal cultural resource.
   b. Whether feasible alternatives or mitigation measures, including those measures that may be agreed to pursuant to Public Resources Code section 21082.3, subdivision (a), avoid or substantially lessen the impact on the identified tribal cultural resource. (Pub. Resources Code § 21082.3 (b)).

7. Conclusion of Consultation: Consultation with a tribe shall be considered concluded when either of the following occurs:
   a. The parties agree to measures to mitigate or avoid a significant effect, if a significant effect exists, on a tribal cultural resource; or
   b. A party, acting in good faith and after reasonable effort, concludes that mutual agreement cannot be reached. (Pub. Resources Code § 21080.3.2 (b)).

8. Recommending Mitigation Measures Agreed Upon in Consultation in the Environmental Document: Any mitigation measures agreed upon in the consultation conducted pursuant to Public Resources Code section 21080.3.2 shall be recommended for inclusion in the environmental document and in an adopted mitigation monitoring and reporting program, if determined to avoid or lessen the impact pursuant to Public Resources Code section 21082.3, subdivision (b), paragraph 2, and shall be fully enforceable. (Pub. Resources Code § 21082.3 (a)).

9. Required Consideration of Feasible Mitigation: If mitigation measures recommended by the staff of the lead agency as a result of the consultation process are not included in the environmental document or if there are no agreed upon mitigation measures at the conclusion of consultation, or if consultation does not occur, and if substantial evidence demonstrates that a project will cause a significant effect to a tribal cultural resource, the lead agency shall consider feasible mitigation pursuant to Public Resources Code section 21084.3 (b). (Pub. Resources Code § 21082.3 (e)).

10. Examples of Mitigation Measures That, If Feasible, May Be Considered to Avoid or Minimize Significant Adverse Impacts to Tribal Cultural Resources:
    a. Avoidance and preservation of the resources in place, including, but not limited to:
       i. Planning and construction to avoid the resources and protect the cultural and natural context.
       ii. Planning greenspace, parks, or other open space, to incorporate the resources with culturally appropriate protection and management criteria.
    b. Treating the resource with culturally appropriate dignity, taking into account the tribal cultural values and meaning of the resource, including, but not limited to, the following:
       i. Protecting the cultural character and integrity of the resource.
       ii. Protecting the traditional use of the resource.
       iii. Protecting the confidentiality of the resource.
    c. Permanent conservation easements or other interests in real property, with culturally appropriate management criteria for the purposes of preserving or utilizing the resources or places.
    d. Protecting the resource. (Pub. Resource Code § 21084.3 (b)).
    e. Please note that a federally recognized California Native American tribe or a nonfederally recognized California Native American tribe that is on the contact list maintained by the NAHC to protect a California prehistoric, archaeological, cultural, spiritual, or ceremonial place may acquire and hold conservation easements if the conservation easement is voluntarily conveyed. (Civ. Code § 815.3 (c)).
    f. Please note that it is the policy of the state that Native American remains and associated grave artifacts shall be repatriated. (Pub. Resources Code § 5097.991).

11. Prerequisites for Certifying an Environmental Impact Report or Adopting a Mitigated Negative Declaration or Negative Declaration with a Significant Impact on an Identified Tribal Cultural Resource: An environmental impact report may not be certified, nor may a mitigated negative declaration or a negative declaration be adopted unless one of the following occurs:
    a. The consultation process between the tribes and the lead agency has occurred as provided in Public Resources Code sections 21080.3.1 and 21080.3.2 and concluded pursuant to Public Resources Code section 21080.3.2.
    b. The tribe that requested consultation failed to provide comments to the lead agency or otherwise failed to engage in the consultation process.
    c. The lead agency provided notice of the project to the tribe in compliance with Public Resources Code section 21080.3.1 (d) and the tribe failed to request consultation within 30 days. (Pub. Resources Code § 21082.3 (d)).

This process should be documented in the Cultural Resources section of your environmental document.

The NAHC's PowerPoint presentation titled, "Tribal Consultation Under AB 52: Requirements and Best Practices" may be found online at: http://nahc.ca.gov/wp-content/uploads/2015/10/AB52TribalConsultation_CalEPAPDF.pdf

NAHC Recommendations for Cultural Resources Assessments

To adequately assess the existence and significance of tribal cultural resources and plan for avoidance, preservation in place, or barring both, mitigation of project-related impacts to tribal cultural resources, the NAHC recommends the following actions:

1. Contact the appropriate regional California Historical Research Information System (CHRIS) Center (http://ohp.parks.ca.gov/?page_id=1068) for an archaeological records search. The records search will determine:
   - **a.** If part or all of the APE has been previously surveyed for cultural resources.
   - **b.** If any known cultural resources have been already been recorded on or adjacent to the APE.
   - **c.** If the probability is low, moderate, or high that cultural resources are located in the APE.
   - **d.** If a survey is required to determine whether previously unrecorded cultural resources are present.

2. If an archaeological inventory survey is required, the final stage is the preparation of a professional report detailing the findings and recommendations of the records search and field survey.
   - **a.** The final report containing site forms, site significance, and mitigation measures should be submitted immediately to the planning department. All information regarding site locations, Native American human remains, and associated funerary objects should be in a separate confidential addendum and not be made available for public disclosure.
   - **b.** The final written report should be submitted within 3 months after work has been completed to the appropriate regional CHRIS center.

3. Contact the NAHC for:
   - **a.** A Sacred Lands File search. Remember that tribes do not always record their sacred sites in the Sacred Lands File, nor are they required to do so. A Sacred Lands File search is not a substitute for consultation with tribes that are traditionally and culturally affiliated with the geographic area of the project's APE.
   - **b.** A Native American Tribal Consultation List of appropriate tribes for consultation concerning the project site and to assist in planning for avoidance, preservation in place, or, failing both, mitigation measures.

4. Remember that the lack of surface evidence of archaeological resources (including tribal cultural resources) does not preclude their subsurface existence.
   - **a.** Lead agencies should include in their mitigation and monitoring reporting program plan provisions for the identification and evaluation of inadvertently discovered archaeological resources per Cal. Code Regs., tit. 14, section 15064.5(f) (CEQA Guidelines section 15064.5(f)). In areas of identified archaeological sensitivity, a certified archaeologist and a culturally affiliated Native American with knowledge of cultural resources should monitor all ground-disturbing activities.
   - **b.** Lead agencies should include in their mitigation and monitoring reporting program plans provisions for the disposition of recovered cultural items that are not burial associated in consultation with culturally affiliated Native Americans.
   - **c.** Lead agencies should include in their mitigation and monitoring reporting program plans provisions for the treatment and disposition of inadvertently discovered Native American human remains. Health and Safety Code section 7050.5, Public Resources Code section 5097.98, and Cal. Code Regs., tit. 14, section 15064.5, subdivisions (d) and (e) (CEQA Guidelines section 15064.5, subds. (d) and (e)) address the processes to be followed in the event of an inadvertent discovery of any Native American human remains and associated grave goods in a location other than a dedicated cemetery.

Please contact me if you need any additional information at gayle.totton@nahc.ca.gov.

Sincerely,

Gayle Totton

Gayle Totton, M.A., PhD.
Associate Governmental Program Analyst

cc: State Clearinghouse

Rancho Bernardo Community Planning Board

P.O. Box 270831, San Diego, CA 92198
www.rbplanningboard.com

January 10, 2017

Andrew Martin, Senior Regional Planner
401 B Street, Suite 800
San Diego, CA 92101

SUBJECT: Notice of Preparation of a Program Environmental Impact Report for San Diego Forward: The Regional Plan

Dear Mr. Martin:

The Rancho Bernardo Community Planning Board (Planning Board) appreciates the opportunity to provide comments on the scope and content of the Environmental Impact Report (EIR) for San Diego Forward: The Regional Plan (Regional Plan). The Regional Plan will consist of a Regional Transportation Plan (RTP) and a Sustainable Communities Strategy (SCS) that identify the San Diego region's future transportation investments and growth through 2050. Per State law, the planning process must coordinate land use planning and RTPs to help California meet the State's greenhouse gas (GHG) reduction targets for passenger vehicles.

The Planning Board discussed this item on December 15, 2016 and approved providing the following list of comments to SANDAG for consideration during the preparation of the draft EIR.

1) Impacts Related to Implementing Higher Density Development
    a. The draft EIR must realistically evaluate both the short and long term effects of higher density development projects on the local and regional transportation system, air quality, GHG emissions, parking, and land use compatibility. In particular, this analysis should address the effects of developing higher density development when either adequate transit options are not yet available to accommodate future residents or the development is not sited within reasonable distance to available transit options. Higher density development does not in and of itself result in few passenger car trips, therefore the EIR must evaluate the adequacy of the SCS proposals to achieve an overall reduction in trips.

    b. Evaluate the adequacy of the SCS to address the consideration of employment destinations when identifying sites of higher density development. Available transit must have adequate routes to get residents to their job sites. Examine the effects to air quality, generation of GHG emissions, and traffic flow from failing to consider employment destinations when identifying sites for high density development.

    c. Evaluate the potential effects of implementing the proposals in the SCS to existing land use, public services, and public facilities.

2) Adequacy and Reliability of Transit Service
When evaluating impacts related to traffic, air quality, and GHG emissions, the EIR must analyze the adequacy and reliability of the current and future transit options in the region. Mitigation for current and predicted future freeway congestion should consider specific improvements to the overall transit system, including increased reliability, expanded commuter bus routes from the south bay to employment centers in the north, and additional commuter bus routes in the north county that provide access to various employment centers in the region. Finally, the adequacy of the system of feeder bus routes available to get commuters from their residences to transit stations must be evaluated. Residences are less likely to use transit if they have to drive to the transit station.

3) Adequacy of Planned Freeway Improvements
One of the alternatives considered in the EIR should include the acceleration of the construction of the I-56 west/I-5 north interchange and the expansion of the proposed improvements to I-56 to include the construction of an HOV lane.

4) Availability of Electric Charging Stations
Analyze how effective the SCS will be in ensuring adequate availability of electric charging stations throughout the region.

5) Current HOV User Policies on the I-15
The draft EIR should analyze the effect that allowing single drivers to pay to use the HOV lanes is having on the overall capacity of the I-15 HOV lanes, particularly during the northbound PM commute. Address if too many cars on these lanes is discouraging carpooling and instead increase congestion and GHG emissions.

6) High-Speed Rail
The EIR should include an alternative for the RTP that stops the high speed rail in Escondido and then efficiently transports travelers to various locations in San Diego County via an effective regional transit system. Additionally, the draft EIR should acknowledge that site-specific CEQA and NEPA evaluation has not yet been completed for a high speed rail alignment and that there are alternatives to this alignment that need to be considered and evaluated as part of that process.

Thank you for the opportunity to provide these comments. The Planning Board requests that it be notified when the draft EIR is made available for public review and comment.

Sincerely,

Mike Lutz
Chair, Rancho Bernardo Community Planning Board

cc: Mayor Kevin Faulconer (SANDAG Board of Directors)
Councilmember Mark Kersey, District 5

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January 13, 2017

Andrew Martin, Senior Regional Planner
San Diego Association of Governments
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San Diego, CA 92101

Via E-mail at andrew.martin@sandag.org
Subject: Comments Regarding *Notice of Preparation – of a Program Environmental Impact Report for San Diego Forward: The Regional Plan*, dated November 14th, 2016 and its Attachment 1, *Plan Information and Scope of Environmental Analysis*

Dear Mr. Martin,

We appreciate the opportunity to comment on this important subject.

Attachment 1's Section Entitled "Background and Plan Overview"

The second paragraph states (with emphasis added):

> *A new EIR will be prepared for the Regional Plan to evaluate its significant effects on the* ***environment****, identify alternatives to the Regional Plan, and indicate the manner in which* ***significant effects can be mitigated or avoided****.*

We note that the "environment" is composed of various important features of the physical world, including our own species. Impacts on these features may or may not be reasonably well predicted by how the Regional Plan ("Plan") is predicted to perform, compared to California climate mandates, such as AB 32, SB 32, SB 375, and Executive orders S-3-05 and B-30-15. The EIR must show compliance or non-compliance with the state's climate mandates. However, the EIR must also show compliance or non-compliance with achieving "climate-stabilizing" targets, where "climate stabilizing" targets means targets that will, considering cumulative impacts and assuming all other entities in the industrial world will also do their part, prevent "climate destabilization". "Climate destabilization" is shorthand for having the world go through a so-called climate tipping point. Going through a tipping point herein means that the warming feedbacks become dominant and our planet's climate changes into one which will no longer support most of its current life forms, including our own species.

The June, 2008 issue of *Scientific American*[1] wrote of a “devastating collapse of the human population”, due to anthropogenic global warming if there is insufficient reductions in our greenhouse gas (GHG) emissions. To avoid this, anthropogenic emissions must first be reduced enough to stop the level of atmospheric CO2_e from continuing to increase. This needs to happen as soon as possible. If it happens too late, we could still suffer a “devastating collapse of the human population”, regardless of our actions after the warming feedbacks become dominant.

Your second-paragraph statement, that is shown above, with emphasis added, mentions “significant effects”. However, to comply with CEQA, the EIR must identify the *most* significant effects. The extinction of humanity, which would come about if we fail to achieve climate-stabilizing targets, is perhaps the most significant effect. Identifying such effects as more fires, more heat, and some amount of sea-level rise, while useful, is insufficient.

Humanity must, as Governor Brown said to the Pope, “reverse course or face extinction.” Covering up this stark reality violates CEQA law, which calls for a reasonable disclosure of likely harm, for the case of insufficient mitigation.

How will you decide which suggested mitigations (ways to reduce GHG emissions) will be ignored and which ones will be implemented? CARB’s updated scoping plan says that all mitigations should be implemented if they are “technologically feasible and cost effective”. Any weaker criterion will violate CEQA law. The NOP should have been clear on that point.

In order to “evaluate” (your word, as shown above, in the second-paragraph statements, with emphasis added) the Plan’s impacts, you will have to make assumptions about what California will do regarding fleet efficiency and what California will do regarding adopting an improved method for having Californians pay for the use of our roads. You would be reasonable if you were to assume that the state will adopt policies to reduce vehicle-miles travelled (VMT) by cars and light-duty trucks, or “Light-duty vehicles” (LDVs), but only if you make it clear to the state exactly how much help you will need. Recognizing that LDVs and their VMT is primarily your responsibility, it becomes obvious to any thoughtful person that you must identify or write a plan showing how LDVs can achieve climate-stabilizing targets. On-road transportation causes 47% of the GHG emissions in San Diego; cars and light-duty trucks cause 41%[2]. You have no choice but to partner with the state. The state must take the lead on fleet efficiency and the “road use charge” (“RUC”, as shown in the work to implement SB 1077). You must take the lead on achieving the needed per-capita driving, assuming the state’s RUC, which should help to reduce VMT. Your primary controls on VMT include land use, complete streets, active-transportation facilities, transit systems, car-parking policies, and teaching adults how to safely ride a bicycle in traffic.

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[1] *Scientific American*, *The Ethics of Climate Change*, Professor John Broome, June 2008, Page 100

[2] San Diego Greenhouse Inventory, Energy Policy Initiatives Center, http://www.sandiego.edu/epic/ghginventory/

The political party that is the majority political party in both California and San Diego County takes the position that many of the above statements are true. For example, the California Democratic Party (CDP) platform (Reference 1) advocates for the following:

> *. . . a state plan showing how cars and light-duty trucks can hit climate-stabilizing targets, by defining enforceable measures to achieve the needed fleet efficiency and per-capita driving*

Reference 2 is such a state plan. SANDAG, CARB or some other entity could write such a plan, which could then be used as a reference document in an EIR. This would show how LDVs could achieve climate-stabilizing targets. It has often been said that having no plan to succeed is having a plan to fail. Given that our survival hangs in the balance, a plan is mandatory. There also is no other way to comply with CEQA, since decision makers must be shown how the worst environmental outcome could be avoided.

Since not stabilizing the climate is an unacceptably bad outcome, it is imperative that the Plan's EIR show how cars and light-duty trucks could achieve climate-stabilizing targets.

Again, the dominant political party in our state is aware of this fairly-obvious reality. Again, from Reference 1:

> *Demand Regional Transportation Plan (RTP) driving-reduction targets, shown by science to support climate stabilization*

No climate-literate, empathetic person would want anything less.

Therefore a Requirements Document, such as Reference 2, is a necessary part of the scope of the EIR.

Attachment 1's Section Entitled "Senate Bill 375"

We appreciate this section. The first sentence says that SB 375 will help meet AB 32. AB 32's explicit target is for year 2020 and to achieve the 1990 emission level in that target year. The importance of that target is less than the targets after 2020, which are as follows:

- 40% below the 1990 level by 2030, from SB 32; and from Executive Order B-30-15
- 80% below the 1990 level by 2050, from Executive Order S-3-05;
- a reasonable climate-stabilizing target, which is 80% below the 1990 level by 2030, as shown in Reference 2.

If CARB gives a 2035 target that is not climate-stabilizing, that fact would not relieve you of your responsibility to figure out how cars and light-duty trucks can achieve a reasonable climate-stabilizing target, for the reasons provided in the above section of this letter.

Attachment 1's Section Entitled "Resource Topics Addressed in the EIR"

We appreciate this section. We note its commitment that the EIR will analyze the Regional Plan's significant environmental effects for GHG emissions. This must mean that you are going to analyze what environmental effects will result from the level of GHG emissions that you are predicting, with a reasonable set of mitigation measures. That set must at least include all of the feasible mitigation measures that have been identified.

As stated in the above sections of this letter, "significant environmental effects" must include a determination as to whether or not the Plan will achieve climate-stabilizing targets, for the sector that is the primary responsibility of SANDAG, LDVs. Again, a plan similar to Reference 2 is required. Reference 2 shows a set of fleet-efficiency requirements that will achieve the most reasonable case derived. The per-capita driving reductions needed that go with that case are shown from near the bottom of Page 16 to near the bottom of Page 18 of Reference 2. They are repeated in the following section.

Enforceable and Feasible Mitigation Measures to Achieve Driving Reductions

Reallocate SANDAG Funds Earmarked for Highway Expansion to Transit and Consider Transit-Design Upgrades

It is well-known that the induced traffic demand resulting from adding highway lanes will cause traffic congestion to remain constant. This is true, even if the new lanes are HOV (High Occupancy Vehicle) lanes; HOT (High Occupancy Toll) lanes; or Managed Lanes, which give priority to moving transit vehicles. Any project that temporarily creates space on a freeway will induce enough traffic to fill that space, returning congestion to the level it was before the project. Therefore, additional lanes will not reduce congestion one iota. The money spent to add lanes is not just a waste of money. With more lanes and the same level of congestion as before, the result is always more frustrated drivers, more air pollution, and more GHG emissions.

The sales tax measure called "Trans-Net", allocates approximately one-third for highway expansion, one-third for transit, and one-third for road maintenance. It has a provision that allows for a reallocation of funds, if supported by at least two-thirds of SANDAG Board members, including a so-called weighted vote, where governments are given a portion of 100 votes, proportional to their population. This feasible mitigation measure is to reallocate the Trans-Net amount, earmarked for all highway expansions, to transit. It is noted that perceived political risk for decision makers does not constitute infeasibility, for a suggested mitigation measure. SANDAG needs to help educate the public about the futility of adding lanes because of induced traffic demand, as well as our responsibility to have a plan showing how cars and light-duty trucks can achieve climate-stabilizing targets. This will reduce political risk.

This money could be used to fund additional transit systems; improve transit operations; and/or redesign and implement the redesign of an existing transit system. A redesign could be the electrification and automation, or even a wholesale technology upgrading of the Coaster/AMTRAK and Sprinter rail lines. These systems need to be frequent and operate 24/7.

The money could also be used to implement a fixed-guideway connection between the San Diego Airport and both the Santa Fe Train Station and the Old Town Transit Center. A trade-off study is needed to find out if this should be done with a trolley extension or an automated system, perhaps using the technology that connects the Oakland Airport to the Coliseum BART station.

A Comprehensive Road-Use Charge (RUC), Pricing-and-Payout System to Improve the Way We Pay for the Use of Roads

Comprehensive means that, for example, pricing, overall, is sufficient to cover all costs, including road maintenance and externalities such as harm to the environment and health; privacy is defined and achieved; the economic interests of low-income drivers doing necessary driving would be protected; that the incentive to drive fuel-efficient cars would be at least as large as it is under the current fuels-excise tax; and, as good technology becomes available, congestion pricing is used, if needed, to protect critical driving from congestion.

The word "*payout*" means that some of the money collected would go to people that are losing money under the current system.

Currently, user fees (gas taxes and tolls) are not enough to cover road costs. Even though general-fund money is being used to operate and maintain roads, California is not doing maintenance with enough frequency to minimize cost. It is well understood that deferred maintenance will cost more than timely maintenance. Besides this, the improved mileage of the Internal Combustion Engine vehicles (ICEs) and the large number of Zero-Emission Vehicles (ZEVs), both of which are needed to have the fleet efficiency needed to achieve climate mandates, mean that gas-tax revenues will drop precipitously over the coming years. In view of these facts, California has passed and is implementing SB 1077, which creates a pilot project road user charge (RUC). The Road User Charge Technical Advisory Committee (RUC TAC) has twice visited San Diego. The first time they met in the SANDAG Board Room. The second time they met at the CALTRANS District 4 office. SANDAG Board Members and SANDAG staff were conspicuously absent from these meetings. SANDAG staff did not inform its Board of these meetings. This is unfortunate because a RUC is the future of road funding. Unfortunately, the SANDAG Board Majority seems to think that a new sales tax can be used to expand roads. The recent defeat of Measure A suggests that this is not true.

SANDAG needs to support California in its efforts to create an effective RUC pricing-and- payout system. As the pilot project finishes, legislation is needed to get the design and implementation moving. SANDAG should lobby for a good system and then, in their EIRs, they should assume a good system. Such a system will play a useful role in reducing per-capita driving.

Improving the Way We Pay for the Use of Car-Parking Facilities

Bundled-cost parking increases the cost of everything, from rent to food; bundled-benefit parking reduces wages. These unsustainable practices are economically unfair to those that drive less or might like to drive less, if they could receive the fair, market-priced compensation for their effort, considering the high cost of providing parking. Surface parking only provides spaces at a rate of 120 cars per acre of land. Parking garage construction costs are over $20,000 per space. Underground parking costs from $60,000 to $100,000 per space. The fourth bullet of the Transportation Sub-plank of the 2016 California Democratic Party Platform (Reference 1) calls for "*shared, convenient and value-priced parking, operated with a system that provides earnings to those paying higher costs or getting a reduced wage, due to the cost of providing the parking*."

This feasible mitigation was ignored by the County in their legally-deficient Climate Action Plan (CAP) which they subsequently rescinded under court order. This is the mitigation measure that was described during oral arguments in Appellate Court, when a Justice asked the Club to describe a feasible mitigation measure that was ignored by the County.

After hearing the description, the Justice commented, "that sounds like feasible mitigation to me."

Here is a brief description of this feasible mitigation measure, which, in this description, happens to be for municipal government employee parking:

> <u>*Demonstration Project to Eliminate the Harm of Bundled-Benefit Parking*</u>
>
> The municipality would develop a Demonstration Project to, in effect, Unbundle the Benefit of Parking ("Demonstration Project") at a city employee location ("Proposed Location").
>
> BACKGROUND: Currently, municipal employees do not have the ability to choose between earnings and driving – employees effectively pay for parking out of their salary, whether or not they use the parking. The Demonstration Project will provide the opportunity for the employees to choose between earnings and driving. This implements the California Air Pollution Control Officers Association (CAPCOA) measure of unbundling the cost of parking.
>
> PROJECT: Parking would be charged at a given rate (for example $0.02/min – roughly $9.60/day). Funds generated from these parking charges would be distributed as earnings to all employees working at the proposed location in proportion to each employee's time spent at work, at the proposed location. Those who decide not to drive will not be charged for parking but will still make earnings based on time spent at work at the location. Implemented correctly, this free market approach will substantially reduce vehicle miles traveled (VMT) and greenhouse gas (GHG) emissions, by reducing the drive-alone mode.
>
> For employees whose parking charges are greater than parking lot earnings, an "add-in" may be included so that no employee loses money, compared to "free parking". With such "add-in" payments, there could be

an “Opt in or Opt out” choice, meaning that those that “Opt out” will see no changes on their pay check, relative to “free parking”.

This project may be helped by receiving a grant to pay the development and installation cost, as well as the “add in” payments, for some specified number of years. The municipality would need to apply for such a grant.

This feasible mitigation measure is actually a demonstration project of a full system implementation, as described in Reference 3. A more detailed description of this demonstration project can be read in Reference 4.

Based on Table 1 of Reference 3, the driving reduction could be 25%, at places of employment. Table 1 shows driving reductions resulting from introducing a price for parking, for 10 cases. Its average reduction in driving is 25% and its smallest, single-case reduction is 15%. Again, these systems can be set up so that no driver loses money. Grant possibilities include the California Air Resources Board’s *Low Carbon Transportation* program and the Strategic Growth Council’s (SGC’s) *Transformative Climate Community* program. Reference 5 has more detail on the SGC grant program.

Good Bicycle Projects and Bicycle Traffic Skills Education

The best criterion for spending money for bicycle transportation is the estimated reduction in driving per the amount spent. It is hoped that the following strategies will come close to maximizing this important parameter.

Projects to Improve Bicycle Access

All of the smart-growth neighborhoods, central business districts, and other high trip destinations or origins, both existing and planned, should be checked to see if bicycle access could be substantially improved with either a traffic calming project, a “complete streets” project, more shoulder width, or a project to overcome some natural or made-made obstacle. One example is to build a Vista Way bicycle bridge over I-5 in Oceanside, to allow those walking or biking to travel between the South Oceanside coastal neighborhood and the regional shopping center, which contains such large stores as Wal-Mart and Stator Brothers grocery store. Currently, those walking or biking from the Vista Way area West of I-5 must travel much further and travel over a steep hill. There are no large grocery stores in the Coastal region of Oceanside, west of I-5. Vista Way was connected for bike riders and pedestrians before the construction of I-5. Given that the highway has caused this problem, funding should come from highway funds, for this project.

League of American Bicyclist Certified Instruction of “Traffic Skills 101”

Most serious injuries to bike riders occur in accidents that do not involve a motor vehicle. Most car-bike accidents are caused by wrong-way riding and errors in intersections; the clear-cut-hit-from-behind accident is rare.

After attending *Traffic Skills 101,* students that pass a rigorous written test and demonstrate proficiency in riding in traffic and other challenging conditions could be paid for their time and effort.

As an example of what could be done in San Diego County, if the average class size was 3 riders per instructor and each rider passes both tests and earns $100 and if the instructor, with overhead, costs $500 dollars, for a total of $800 for each 3 students, that would mean that $160M could teach $160M/$800 = 200,000 classes of 3 students, for a total of 600,000 students. This is approximately 20% of the population of San Diego County. If a significant percentage of the graduates become every-day, utilitarian riders, this will be money well spent.

Eliminate or Greatly Increase the Maximum Height and Density Limits Close to Transit Stops that Meet Appropriate Service Standards

As sprawl is reduced, more compact, transit-oriented development (TOD) will need to be built. This strategy will incentivize a consideration of what level of transit service will be needed, how it can be achieved, and what levels of maximum height and density are appropriate. Having no limits at all is reasonable if models show that the development can function without harming the existing adjacent neighborhoods, given the level of transit service and other supporting transportation policies. One such supporting transportation policy would be the use of car-parking systems described in Reference 3, which support the full sharing of parking**,** less driving, and less car ownership.

Include Plots and Explanation of the Plots, in the EIR, That Leave No Doubt About the Validity of Anthropogenic Climate Change

Figure 1 shows the rise of the world's atmospheric CO2 over the last 50 years. Figure 2 shows both atmospheric temperature (averaged over a year and averaged over all of the earth, derived from an isotope analysis) and atmospheric CO2, over 800,000 years. It could be noted that our species is only around 200,000 years old. Figure 2 shows that when climate deniers say that climate is always changing and so therefore climate change is normal, they are correct, except for one important consideration. There is nothing normal about the outrageous run up of atmospheric CO2, to over 400 PPM, in such a short time that it appears to be an instantaneous spike, on Figure 2. There is no doubt that the spike is the result of our combustion of fossil fuels. Figure 3 covers all of the time of the development of our civilization. Everything was normal until about 150 years ago, which is the start of our industrial revolution, when we started to burn fossil fuels. By doing extensive calculations we know how much CO2 we have produced from the combustion of fossil fuels. Then, by directly measuring the atmospheric CO2 and the acidity of the oceans, we know where all of that CO2 currently resides. We also know that atmospheric CO2 traps heat. There is no doubt that we have an Anthropogenic Global Warming catastrophe in the making. Achieving climate-stabilizing targets is our only hope.

Figure 1 Atmospheric CO2, Increasing Over Recent Decades

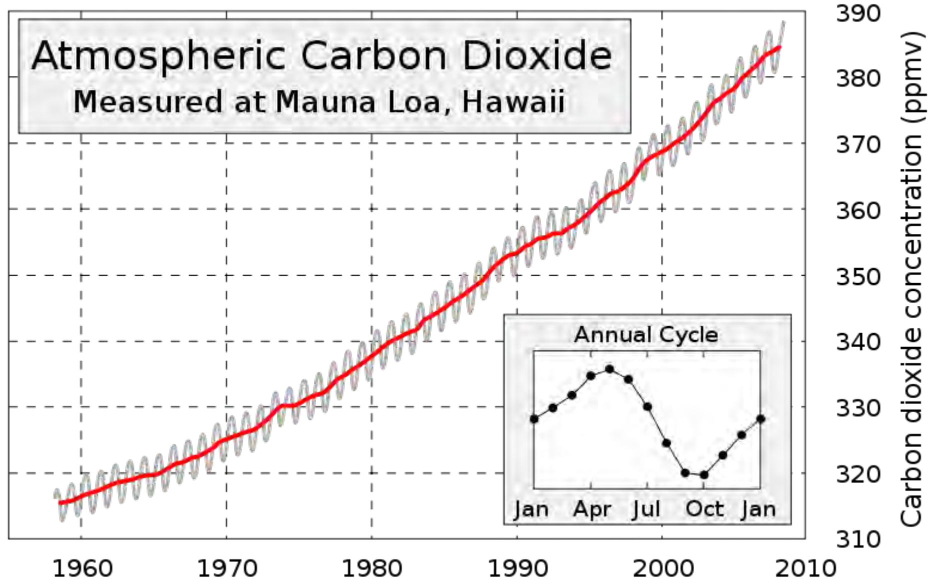


Figure 2 Atmospheric CO2 and Mean Temperature, from 800,000 Years Ago, with Current CO2 PPM Shown

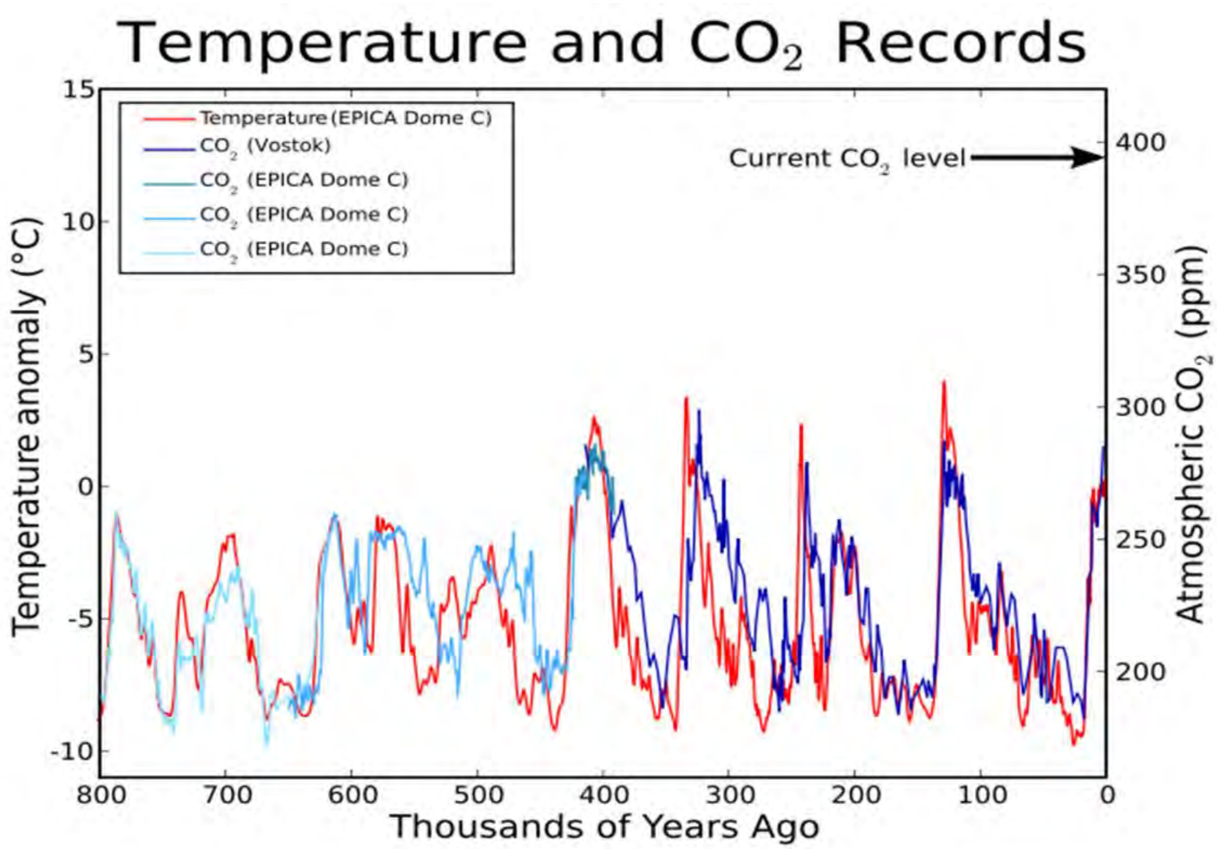
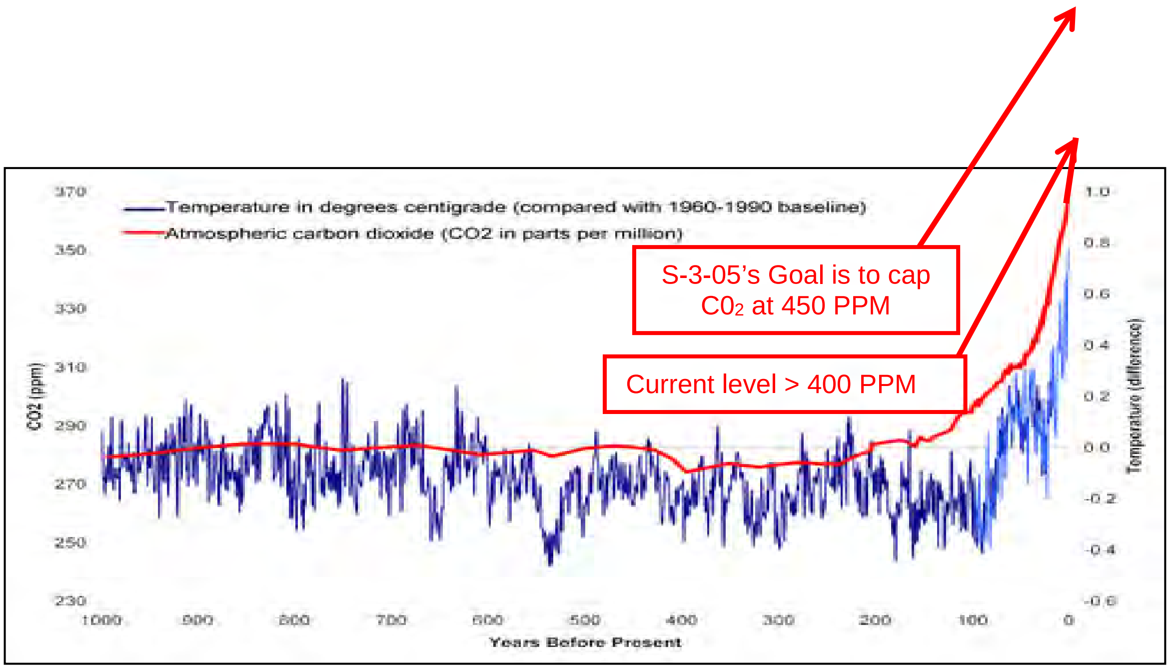


Figure 3 **Atmospheric CO2 and Mean Temperature, Over the Last 1,000 Years**



In Closing

Thank you for your leadership in performing your critical work. Thank you for reading this material and for providing the comments and response as required, in the DEIR. Please let us know if you would like to meet to discuss this letter or related topics.

Respectfully submitted,

Mike Bullock mike_bullock@earthlink.net
Chair, Transportation Subcommittee
Sierra Club San Diego

George Courser
Chair, Conservation Committee
Sierra Club San Diego

References

1.) 2016 California Democratic Party Platform, viewable at http://www.cadem.org/our-california/platform/2016-platform-energy-and-environment, excerpted file attached to email submission of letter

2.) Bullock, Mike R; *Climate-Stabilizing, California Light-Duty Vehicle Requirements, Versus Air Resource Board Goals*, Paper 881-AWMA, from the Air and Waste Management Association's 109th Annual Conference and Exhibition; New Orleans, June 16-25, 2016; Available on request from mike_bullock@earthlink.net and attached to the email submission of this letter

3.) M. Bullock & J. Stewart, *A Plan to Efficiently and Conveniently Unbundle Car Parking Costs*; Paper 2010-A-554-AWMA, from the Air and Waste Management Association's 103rd Annual Conference and Exhibition; Calgary, Canada, June 21-24, 2010; available upon request from Mike Bullock, mike_bullock@earthlink.net. attached to the email submission of this letter

4.) Bullock, Michael*; Equitable and Environmentally-Sound Car-Parking Policy at a Work Site*; Aug. 30, 2015; Available on request from mike_bullock@earthlink.net and attached to the email submission of letter

5.) *Transformative Climate Communities, Draft Scoping Guidelines*, California Strategic Growth Council, November 23, 2016, attached to the email submission of this letter

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The San Diego Chapter of the Sierra Club is San Diego's oldest and largest grassroots environmental organization, founded in 1948. Encompassing San Diego and Imperial Counties, the San Diego Chapter seeks to preserve the special nature of the San Diego and Imperial Valley area through education, activism, and advocacy. The Chapter has over 11,000 members. The National Sierra Club has over 700,000 members in 65 Chapters in all 50 states, and Puerto Rico.

SIERRA CLUB
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From : http://www.cadem.org/our-california/platform/2016-platform-energy-and-environment

From the 2016 California Democratic Party (CDP) Platform

Transportation

- Support vehicle regulations to provide healthier air for all Californians, support strong and workable low-emission and zero-emission vehicle standards that will continue to be a model for the country, support Clean Vehicle Incentive programs to include the installation of charging infrastructure, and provide assistance to small businesses to meet the low-emission standards;
- Demand Regional Transportation Plan (RTP) driving-reduction targets, shown by science to support climate stabilization;
- Work for equitable and environmentally-sound road and parking operations; Support strategies to reduce driving, such as smart growth, "complete streets"; teaching bicycling traffic skills; and improving transit, from local systems to high speed rail
- Work for shared, convenient and value-priced parking, operated with a system that provides earnings to those paying higher costs or getting a reduced wage, due to the cost of providing the parking; and,
- Demand a state plan showing how cars and light-duty trucks can hit climate-stabilizing targets, by defining enforceable measures to achieve the needed fleet efficiency and per-capita driving;
- Support policies, including tax policies and the use of Greenhouse Gas Reduction Fund (GGRF) grants, that empower business owners, especially small business owners, to make investments in transportation infrastructure to ensure that freight moves by lower-emission local, short-line freight railroads, instead of adding to highway congestion and pollution.

Climate-Stabilizing, California Light-Duty Vehicle Requirements, Versus Air Resource Board Goals

Paper 881

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ABSTRACT

An Introduction is provided, including the importance of light-duty vehicles (LDVs: cars and light duty trucks) and a definition of the top-level LDV requirements to limit their carbon dioxide (“CO2”) emissions.

Anthropogenic climate change fundamentals are presented, including its cause, its potential for harm, California mandates, and a greenhouse gas (GHG) reduction road map to avoid disaster.

A 2030 climate-stabilizing GHG reduction target value is calculated, using statements by climate experts. The formula for GHG emissions, as a function of per-capita driving, population, fleet CO2 emissions per mile, and the applicable low-carbon fuel standard (LCFS) is given. The ratio of the 2015 value of car-emission-per-mile to the 2005 value of car-emission-per-mile is obtained.

Internal Combustion Engine (ICE) mileage values from 2000 to 2030 are identified, as either mandates or new requirements. A table is presented that estimates 2015 LDV fleet mileage.

Zero Emission Vehicle (ZEV) parameters are given. A table is shown that uses 2030 ZEV and ICE (ICE LDVs) requirements, named the “Heroic Measures” case, to compute the LDV fleet-equivalent mileage. That equivalent fleet mileage is used, with population and the required emission reduction, to compute a required per-capita driving reduction, with respect to 2005. Measures to achieve this per-capita driving reduction are described, with reductions allocated to each measure. The energy used per year for the Heroic Measures case is estimated

The “Heroic Measures” set of fractions of ZEV’s purchased, as a function of year, is compared to the California Air Resources Board (CARB) goals.

INTRODUCTION

Within the context of working the anthropogenic-climate-change problem and from a systems engineering perspective, the top-level requirement is to reduce greenhouse gas (GHG) emissions enough to support stabilizing our climate at a livable level. This top-level requirement must flow down to the subsystem of LDVs, especially due to the magnitude of their emissions. (As an example, LDVs emit 41% of the GHG in San Diego County[1].)

More specifically, LDV requirements will be identified that, taken together, will result in GHG emission reductions sufficient to “support climate stabilization”. “Support climate stabilization” means that the LDV emission level will be equal to a climate-stabilizing target. Such a target is expressed as an emission level in some target year. The target is based on climate science.

From a systems engineering perspective, at the top level, the needed LDV requirements are

- LDV fleet efficiency, meaning the greenhouse gas (GHG) emissions per mile driven, applicable to the entire fleet, on the road in the year of interest and
- an upper bound on per-capita driving, given the derived fleet efficiency and the predicted population growth.

The fleet efficiency requirement will be developed as a function of lower-level requirements, such as Corporate Average Fuel Efficiency (CAFÉ) requirements, requirements on how fast Battery Electric Vehicles (BEVs) must be added into the fleet each year, and requirements to get low-efficiency vehicles off the roads. The second top-level requirement, the upper bound on per-capita driving, will spawn transportation-system requirements designed to result in less driving, such as better mass transit. This paper will derive a formulae to compute the required per-capita driving levels, based on fleet efficiency, predicted population growth, and the latest, science-based, climate-stabilizing GHG emission target.

In this work, three categories of LDV emission-reduction strategies will be considered: cleaner cars, cleaner fuels, and less driving.

BACKGROUND: OUR ANTHROPOGENIC CLIMATE CHANGE PROBLEM

Purpose of This Section

Before going to work to solve a systems-engineering problem, it is important to understand the nature of the problem. How complex is the problem? How much is at stake if the problem is not solved? Is it reasonable to take a chance and only solve the problem with a reasonably high probability or is there too much at stake to gamble? This section is an attempt to answer these questions.

Basic Cause

Anthropogenic climate change is driven by these two processes[2]: First, our combustion of fossil fuels is adding “great quantities” of CO_2 into our atmosphere. Second, that additional atmospheric CO_2 is trapping additional heat.

California’s First Three Climate Mandates

California’s Governor’s Executive Order S-3-05[3] is similar to the Kyoto Agreement and is based on the greenhouse gas (GHG) reductions that were recommended by climate scientists for industrialized nations back in 2005. In 2005, many climate scientists believed that the reduction-targets of S-3-05 would be sufficient to support stabilizing Earth’s climate at a livable level, with a reasonably high level of certainty. More specifically, this executive order aims for an average, over-the-year, atmospheric temperature rise of “only” 2 degree Celsius, above the preindustrial temperature. It attempts to do this by limiting our earth’s level of atmospheric CO_2_e to 450 PPM by 2050 and then reducing emissions further, so that atmospheric levels would come down to more tolerable levels in subsequent years. The S-3-05 emission targets are 2000 emission levels by 2010, 1990 levels by 2020, and 80% below 1990 levels by 2050.

It was thought that if the world achieved S-3-05, there might be a 50% chance that the maximum temperature rise will be less than 2 degrees Celsius, thus leaving a 50% chance that it would be larger than 2 degrees Celsius. A 2 degree increase would put over a billion people on the planet into a condition described as “water stress” and it would mean a loss of 97% of the earth’s coral reefs.

There would also be a 30% chance that the temperature increase would be greater than 3 degrees Celsius. A temperature change of 3 degree Celsius is described in Reference 3 as being “exponentially worse” than a 2 degree Celsius increase.

The second California climate mandate is AB 32, the *Global Warming Solutions Act of 2006*. It includes provisions for a cap and trade program, to ensure meeting S-3-05’s 2020 target of the 1990 level of emissions. It continues after 2020. AB 32 requires CARB to always implement measures that achieve the maximum *technologically feasible and cost-effective* (words taken from AB 32) greenhouse-gas-emission reductions.

In 2015 Governor Brown signed Executive Order B-30-15. This Executive Order established a mandate to achieve an emission level of 40% below 2020 emissions by 2030, as can be seen by a Google search. If Executive Order S-3-05 is interpreted as a straight line between its 2020 target and its 2050 target, then the B-30-15 target of 2030 is the same as S-3-05’s implied target of 2035, because 2035 is halfway between 2020 and 2050 and 40% down is halfway to 80% down.

California is on track to achieve its S-3-05 second (2020) target. However, the world emission levels have, for most years, been increasing, contrary to the S-3-05 trajectory. In part because the world has been consistently failing to follow S-3-05’s 2010-to-2020 trajectory, if California is still interested in leading the way to stabilizing the climate at a livable level, it must do far better than S-3-05, going forward, as will be shown.

Failing to Achieve these Climate Mandates

What could happen if we fail to achieve S-3-05, AB 32, and B-30-15 or if we achieve them but they turn out to be too little too late and other states and countries follow our example?

It has been written[4] that, “A recent string of reports from impeccable mainstream institutions-the International Energy Agency, the World Bank, the accounting firm of PricewaterhouseCoopers-have warned that the Earth is on a trajectory to warm by at least 4 Degrees Celsius and that this would be incompatible with continued human survival.”

It has also been written[5] that, “Lags in the replacement of fossil-fuel use by clean energy use have put the world on a pace for 6 degree Celsius by the end of this century. Such a large temperature rise occurred 250 million years ago and extinguished 90 percent of the life on Earth. The current rise is of the same magnitude but is occurring faster.”

Pictures That Are Worth a Thousand Words

Figure 1 shows (1) atmospheric CO_2 (in blue) and (2) averaged-over-a-year-then-averaged-over-the surface-of-the-earth world atmospheric temperature (in red). This temperature is with respect to a recent preindustrial value. The data starts 800,000 years ago. It shows that the current value of atmospheric CO_2, which is now over 400 PPM, far exceeds the values of the last 800,000 years. It also shows that we should expect the corresponding temperature to eventually be about 12 or 13 degrees above preindustrial temperatures. This would bring about a human disaster[3,4,5].

Figure 2 shows the average yearly temperature with respect to the 1960-to-1990 baseline temperature (in blue). It also shows atmospheric levels of CO_2 (in red). The S-3-05 goal of 450 PPM is literally "off the chart", in Figure 2. Figure 2 shows that, as expected, temperatures are starting to rise along with the increasing levels of CO_2. The large variations in temperature are primarily due to the random nature of the amount of solar energy being received by the earth.

FURTHER BACKGROUND: CALIFORNIA'S SB 375 AND AN IMPORTANT DATA SET

As shown in the Introduction, LDVs emit significant amounts of CO_2. The question arises: will driving need to be reduced or can cleaner cars and cleaner fuels arrive in time to avoid such behavioral change? Steve Winkelman, of the Center for Clean Air Policy (CCAP), worked on this problem.

SB 375, the *Sustainable Communities and Climate Protection Act of 2008*

Under SB 375, the California Air Resources Board (CARB) has given each Metropolitan Planning Organization (MPO) in California driving-reduction targets, for the years 2020 and 2035. "Driving" means yearly, per capita, vehicle miles travelled (VMT), by LDVs, with respect to 2005. The CARB-provided values are shown at this Wikipedia link, http://en.wikipedia.org/wiki/SB_375. It is important to note that although this link and many other sources show the targets to be "GHG" and not "VMT", SB 375 clearly states that the reductions are to be the result of the MPO's Regional Transportation Plan (RTP), or, more specifically, the Sustainable Communities Strategy (SCS) portion of the RTP. Nothing in the SCS will improve average mileage. That will be done by the state and federal government by their Corporate Average Fleet Efficiency (CAFÉ) standards. The SCS can only reduce GHG by reducing VMT. The only way an SCS can reduce GHG by 12%, for example, is to reduce VMT by 12%.

Under SB 375, every Regional Transportation Plan (RTP) must include a section called a Sustainable Communities Strategy (SCS). The SCS must include driving reduction predictions corresponding to the CARB targets. Each SCS must include only *feasible* transportation, land use, and transportation-related policy data. If the SCS driving-reduction predictions fail to meet the CARB-provided targets, the MPO must prepare an Alternative Planning Strategy (APS). An APS uses *infeasible* transportation, land use, and transportation-related policy assumptions. The total reductions, resulting from both the SCS and the APS, must at least meet the CARB-provided targets.

Critical Data: Useful Factors from Steve Winkelman's Data

Figure 3[6].shows 6 variables as a percent of its 2005 value. The year 2005 is the baseline year of SB 375. The red line is the Caltrans prediction of VMT. The purple line is California's current mandate for a Low Carbon Fuel Standard (LCFS). As shown, by 2020, fuel in California must emit 10% less per gallon than in 2005. The turquoise line is the 1990 GHG emission in California. As shown, it is 12% below the 2005 level. This is important because S-3-05 specifies that in 2020, state GHG emission levels must be at the 1990 level. The green line is the C02 emitted per mile, as specified by AB 1493, also known as "Pavley 1 and 2" named after Senator Fran Pavley. The values shown do not account for the LCFS. The yellow (or gold) line is the S-3-05 mandate, referenced to 2005 emission levels. The blue line is the product of the red, the purple, and the green line and is the percentage of GHG emissions compared to 2005. Since VMT is not being adequately controlled, the blue line is not achieving the S-3-05 line. Figure 3 shows that driving must be reduced. For this reason, Steve Winkelman can be thought of as the true father of SB 375.

Figure 1. Atmospheric CO_2 and Mean Temperature from 800,000 Years Ago

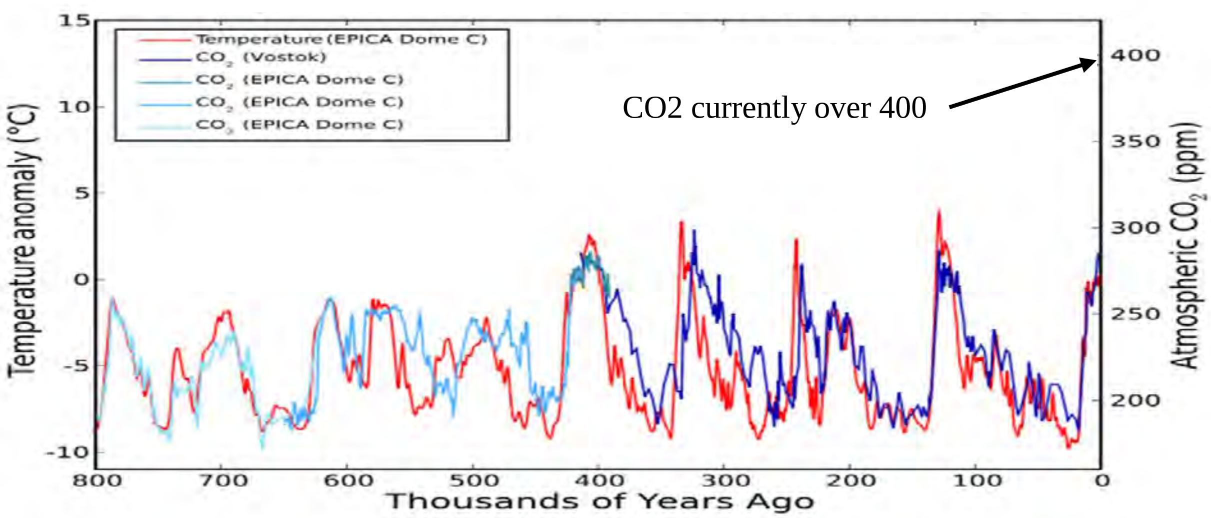
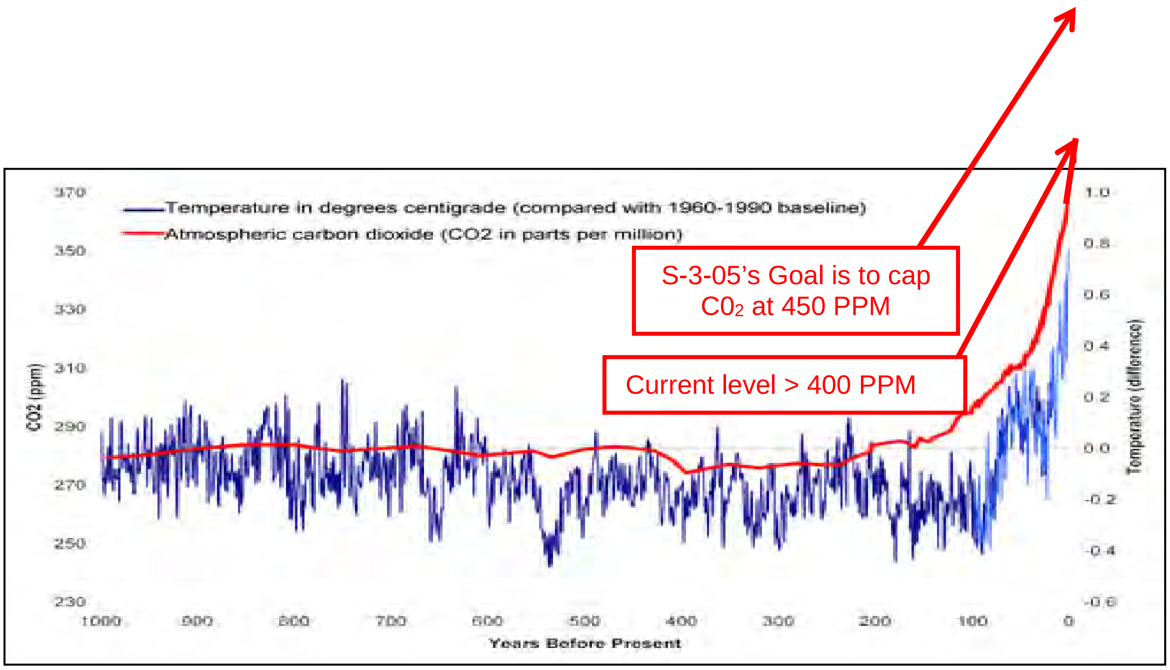
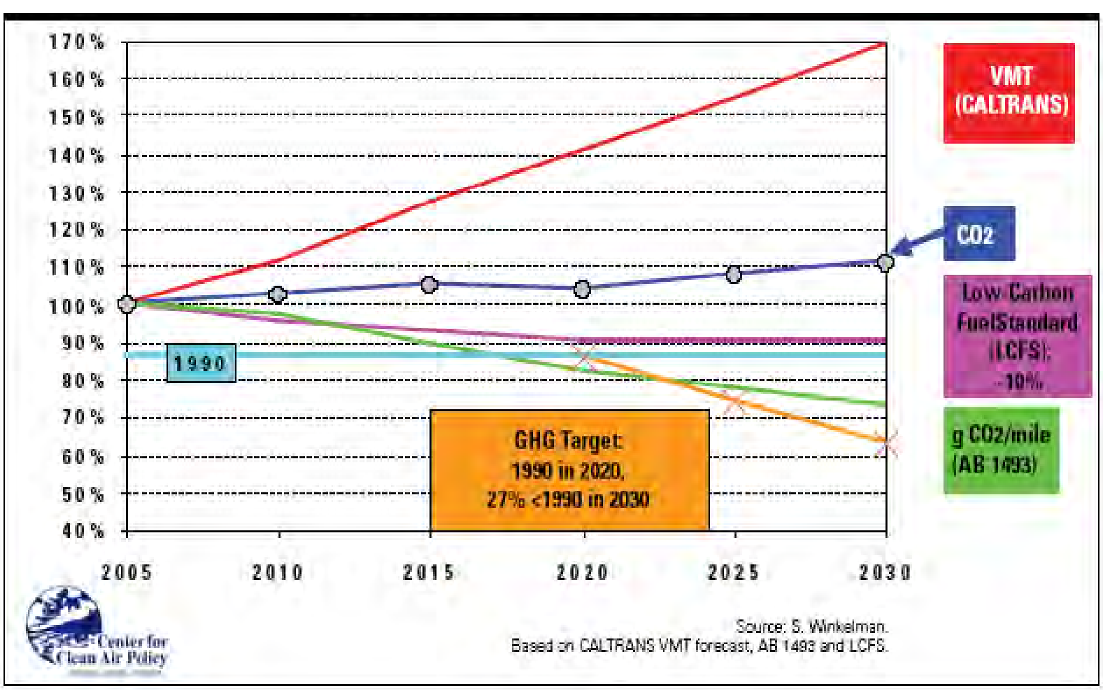


Figure 2. Atmospheric CO_2 and Mean Temperature, Over the Last 1,000 Years



This table provides inspiration for a road map to climate success for LDVs. Climate stabilization targets must be identified and achieved by a set of requirements to define fleet efficiency and per-capita driving.

<u>Figure 3</u> The S-3-05 Trajectory (the Gold Line) AND the CO_2 Emitted from Personal Driving (the Blue Line), where that CO_2 is a Function (the Product) of the California-Fleet-Average CO_2 per Mile (the Green Line), The Predicted Driving (VMT, the Red Line), and the Low-Carbon Fuel Standard (the Purple Line)



THE DEVELOPMENT OF CALIFORNIA'S TOP-LEVEL LDV REQUIREMENTS TO SUPPORT CLIMATE STABILIZATION

It is also clear that cleaner cars will be needed and can probably be achieved. As will be seen, much cleaner cars will be needed if driving reductions are going to remain within what many people would consider achievable. Mileage and equivalent mileage will need to be specified. A significant fleet-fraction of Zero-Emission Vehicles (ZEVs, either Battery-Electric LDVs or Hydrogen Fuel Cell LDVs) will be needed. Since mileage and equivalent mileage is more heuristic than emissions per mile, they will be used instead of CO2 per mile driven.

Since the SB-375 work used 2005 as the reference year, it will remain the reference year here.

GHG Target to Support Climate Stabilization

The primary problem with S-3-05 is that California's resolve and actions have been largely ignored by other states, our federal government, and many countries. Therefore, rather than achieving 2000 levels by 2010 and being on a track to achieve 1990 levels by 2020, world emission have been increasing. Reference 7 states on Page 14 that the required rate of reduction, if commenced in 2020, would be 15%. That rate means that the factor of 0.85 must be achieved, year after year. If this were done for 10 years, the factor would be $(0.85)^{10} = 0.2$. We don't know where world emissions will be in 2020. However, it is fairly safe to assume that California will be emitting at its 1990 level in 2020, in accordance with S-3-05. This situation shows that the correct target for California is to achieve emissions that are reduced to 80% below California's 1990 value by 2030. Note that if the reductions start sooner, the rate of reduction of emissions can be less than 15% and the 2030 target could be relaxed somewhat. However, it is doubtful that the world will get the reduction rate anywhere near the needed 15% by 2020. Therefore, the target, of 80% below 1990 levels by 2030 is considered to be correct for California. Reference 7 also calls into question the advisability of aiming for a 2 degree Celsius increase, given the possibilities of positive feedbacks that would increase warming. This concern for positive feedbacks is another reason that this paper will work towards identifying LDV requirement sets that will support achieving 80% below 1990 values by 2030.

Notes on Methods

The base year is 2005. An intermediate year of 2015 is used. The car efficiency factor of 2015 with respect to 2005 is taken directly from Figure 3. The car efficiency factor of 2030 with respect to 2015 is derived herein, resulting in a set of car-efficiency requirements. It is assumed that cars last 15 years.

Primary Variable Used

Table 1 defines the primary variables that are used.

Table 1 Variable Definitions

Variable Definitions

e_k	**LDV Emitted C02, in Year "*k*"**
L_k	**Low Carbon Fuel Standard (LCFS) Factor that reduces the Per-Gallon CO2 emissions, in Year "*k*"**
C_k	**LDV CO2 emitted per mile driven, average, in Year "*k*", not accounting for the Low Carbon Fuel Standard (LCFS) Factor**
c_k	**LDV CO2 emitted per mile driven, average, in Year "*k*", accounting for the Low Carbon Fuel Standard (LCFS) Factor**
p_k	**Population, in Year "*k*"**
d_k	**Per-capita LDV driving, in Year "*k*"**
D_k	**LDV Driving, in Year "*k*"**
M_k	**LDV Mileage, miles per gallon, in Year "*k*"**
m_k	**LDV Equivalent Mileage, miles per gallon, in Year "*k*" accounting for Low Carbon Fuel Standard (LCFS) Factor, so this is M_k/L_k**
N	**Number of pounds of CO2 per gallon of fuel but not accounting for the Low Carbon Fuel Standard (LCFS) Factor**

Fundamental Equations

The emissions are equal to the CO2 per mile multiplied by the per-capita driving multiplied by the population, since per-capita driving multiplied by the population is total driving. This is true for any year.

Future Year k: $$e_k = c_k * d_k * p_k \qquad \textbf{(Eq. 1)}$$

Base Year i: $$e_i = c_i * d_i * p_i \qquad \textbf{(Eq. 2)}$$

Dividing both sides of Equation 1 by equal values results in an equality. The terms on the right side of the equation can be associated as shown here:

$$\frac{e_k}{e_i} = \frac{c_k}{c_i} * \frac{d_k}{d_i} * \frac{p_k}{p_i} \qquad \textbf{(Eq. 3)}$$

Since carbon dioxide emitted per gallon is just a constant (about 20 pounds per gallon), the constant cancels out of the ratio of emissions per mile, leaving the following relationship.

To work with mileage: $$\frac{m_i}{m_k} = \frac{c_k}{c_i} \qquad \textbf{(Eq. 4)}$$

Putting Equation 4 into Equation 3 results in the following equation:

$$\frac{e_k}{e_i} = \frac{m_i}{m_k} * \frac{d_k}{d_i} * \frac{p_k}{p_i} \qquad \textbf{(Eq. 5)}$$

Showing the base year of 2005, the future year of 2030, introducing the intermediate year of 2015 and the year of 1990 (since emissions in 2030 are with respect to the 1990 value) results in Equation 6.

$$\frac{e_{2030}}{e_{1990}} * \frac{e_{1990}}{e_{2005}} = \frac{c_{2030}}{c_{2015}} * \frac{c_{2015}}{c_{2005}} * \frac{d_{2030}}{d_{2005}} * \frac{p_{2030}}{p_{2005}} \qquad \textbf{(Eq. 6)}$$

The ratio on the far left is the climate-stabilizing target, which is the factor of the 2030 emission to the 1990 emission. It is shown to be 0.20 or 80% less. The next ratio is the emission of 1990 compared to 2005. It is the turquoise line of Figure 3, which is 0.87. The first ratio on the right side of the equation is the fleet emission per mile in 2030 compared to the value in 2015. This ratio will be derived in this report and it will result in a set of car efficiency requirements. Moving to the right, the next ratio is the car efficiency in 2015 compared to 2005. It can obtained by multiplying the purple line 2015 value times the green line 2015 value, which is 0.90 * 0.93.The next term is the independent variable. It is the driving reduction required, compared to the 2005 level of driving. The final term on the far right is the ratio of the population in 2030 to the population in 2005. Reference 8 shows that California's population in 2005 was 35,985,582. Reference 9 shows that California's population in 2030 is predicted to be 44,279,354. Therefore,

$$p_{2030}/p_{2005} = 44279354 \div 35985582 = 1.2305 \qquad \textbf{(Eq. 7)}$$

Putting in the known values results in Equation 8:

$$0.20 * 0.87 = \frac{c_{2030}}{c_{2015}} * 0.90 * 0.93 * \frac{d_{2030}}{d_{2005}} * 1.2305 \qquad \textbf{(Eq. 8)}$$

Combining the values, solving for the independent variable (the per-capita driving ratio), and changing from emission-per-mile to equivalent-miles-per-gallon results in the following:

$$\frac{d_{2030}}{d_{2005}} = 0.1689 * \frac{m_{2030}}{m_{2015}} \qquad \textbf{(Eq. 9)}$$

With the coefficient being so small, it is doubtful that we can get the equivalent mileage in 2030 to be high enough to keep the driving ratio from falling below one. The mileage of the 2005 fleet will be based on the best data we can get and by assuming cars last 15 years. The equivalent mileage in 2030 will need to be as high as possible to keep the driving-reduction factor from going too far below 1, because it is difficult to reduce driving too much. The equivalent mileage will be dependent on the fleet-efficiency requirements in the near future and going out to 2030. Those requirements are among the primary results of this report.

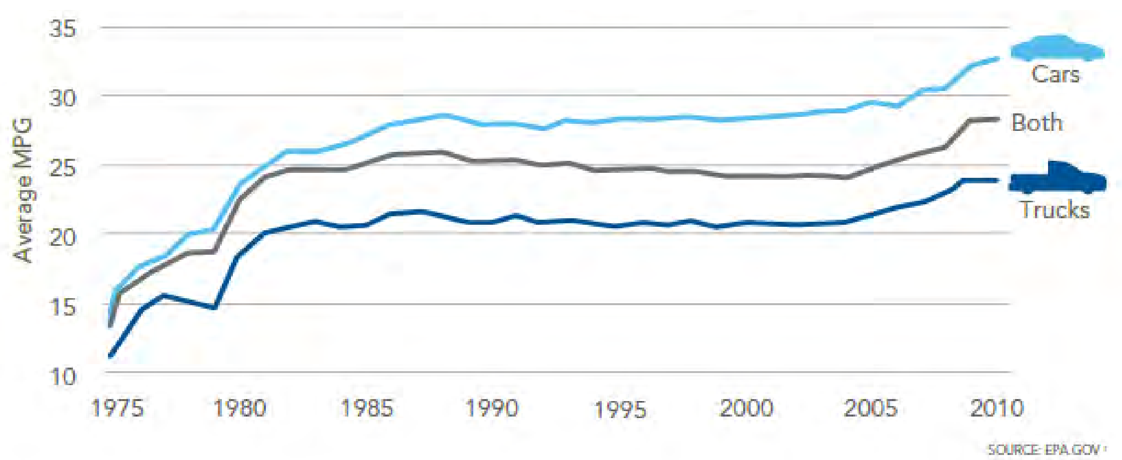
Internal Combustion Engine (ICE) Mileage, from Year 2000 to Year 2030

The years from 2000 to 2011 are taken from a plot produced by the PEW Environment Group,

http://www.pewenvironment.org/uploadedFiles/PEG/Publications/Fact_Sheet/History%20of%20Fuel%20Economy%20Clean%20Energy%20Factsheet.pdf

The plot is shown here as Figure 4. The "Both" values are used.

<u>Figure 4</u> **Mileage Values From the PEW Environment Group**



The values from 2012 to 2025 are taken from the US Energy Information Agency (EIA) as shown on their website, http://www.c2es.org/federal/executive/vehicle-standards#ldv_2012_to_2025. They are the LDV Corporate Average Fleet Efficiency (CAFÉ) values enacted into law in the first term of President Obama. From 2025 to 2030, it is assumed that the yearly ICE improvement in CAFÉ will be 2.5 MPG.

Mileage of California's LDV Fleet in 2015

Table 2 uses these values of the Internal Combustion Engine (ICE) LDV mileage to compute the mileage of the LDV fleet in 2015. It assumes that the fraction of ZEVs being used over these years is small enough to be ignored. The 100 miles driven, nominally, by each set of cars, is an arbitrary value and inconsequential in the final calculation, because it will divide out. It is never-the-less used, so that it is possible to compare the gallons of fuel used for the different years. The "f" factor could be used to account for a set of cars being driven less. It was decided to not use this option by setting all of the values to 1. The Low Carbon Fuel Standard (LCFS) values are taken from Figure 3. The gallons of fuel are computed as shown in Equation 10, using the definition for L_k that is shown in Table 1.

Table 2 Calculation of the Fleet MPG for 2015

LDV Set	Years Old	Model Year	CAFE MPG	LCFS Factor L_{Year}	Factor Driven f	Gallons Used Per f*100 Miles
1	14-15	2001	24.0	1.0	1.0	4.17
2	13-14	2002	24.0	1.0	1.0	4.17

3	**12-13**	**2003**	**24.0**	**1.0**	**1.0**	**4.17**
4	**11-12**	**2004**	**24.0**	**1.0**	**1.0**	**4.17**
5	**10-11**	**2005**	**25.0**	**1.0**	**1.0**	**4.00**
6	**9-10**	**2006**	**25.7**	**.9933**	**1.0**	**3.87**
7	**8-9**	**2007**	**26.3**	**.9867**	**1.0**	**3.75**
8	**7-8**	**2008**	**27.0**	**.9800**	**1.0**	**3.63**
9	**6-7**	**2009**	**28.0**	**.9733**	**1.0**	**3.48**
10	**5-6**	**2010**	**28.0**	**.9667**	**1.0**	**3.45**
11	**4-5**	**2011**	**29.1**	**.9600**	**1.0**	**3.30**
12	**3-4**	**2012**	**29.8**	**.9533**	**1.0**	**3.20**
13	**2-3**	**2013**	**30.6**	**.9467**	**1.0**	**3.09**
14	**1-2**	**2014**	**31.4**	**.9400**	**1.0**	**2.99**
15	**0-1**	**2015**	**32.6**	**.9333**	**1.0**	**2.86**
					Sum of Gallons:	**54.29**
					Miles = 100*Sum(f's):	**1500**
					MPG = Miles/(Sum of Gallons):	**27.63**

$$\boldsymbol{Gallons\ Used\ per\ f * 100\ miles} \ = \frac{\boldsymbol{f x 100}}{(\boldsymbol{CAFE\ MPG})/\boldsymbol{L_k}} \qquad \textbf{(Eq. 10)}$$

How ICE Mileage Values Will Be Used with ZEV Equivalent Mileage Values

As will be seen, after 2015, the net (computed using both ICEs and ZEVs) mileage values for each year are assumed to greatly improve by having a significant fraction of ZEVs. The ICE CAFÉ standards are used in this report as just the ICE contribution to fleet MPG. The ICE MPG values are inadequate by themselves and will therefore need to become less important because ZEVs will need to quickly take over the highways.

Federal requirements will need to change dramatically. Currently, federally-mandated corporate average fuel efficiency (CAFÉ) standards have been implemented, from 2000 to 2025. These standards require that each corporation produce and sell their fleet of cars and light-duty trucks in the needed proportions, so that the combined mileage of the cars they sell, at least meet the specified mileage.

The car companies want to maximize their profits while achieving the required CAFÉ standard. In California, the car companies will already be required to sell a specified number of electric vehicles, which have a particularly-high, equivalent-value of miles-per-gallon. If the laws are not changed, this will allow these companies to sell more low-mileage, high profit cars and light-duty trucks, and still achieve the federal CAFÉ standard.

It will be better to apply the CAFÉ standards to only the ICEs and then require that the fleet of LDVs sold achieve some mandated fraction of ZEVs. The ZEVs will get better and better equivalent mileage, as our electrical grid is powered by more renewable sources of energy. Therefore, their equivalent mileage is not fixed, but will improve over the years. Requirements developed here are for 2030. Therefore a high percentage of all the electricity generated in the state, including both the "in front of the meter" (known as the "Renewable Portfolio Standard" or "RPS") portion and the "behind the meter" portion is assumed to come from sources that do not emit CO2. More specifically, he value of 80% is assumed. This therefore becomes a fleet-efficiency requirement.

ZEV Equivalent Mileage Values

To calculate the mileage of the 2030 fleet of LDVs, it is necessary to derive a formula to compute the equivalent mileage of ZEVs, as a function of the percent of electricity generated without emitting CO2, the equivalent ZEV mileage if the electricity is from 100% fossil fuel, and the equivalent ZEV mileage if the electricity is from 100% non-C02 sources. The variables defined in Table 3 are used.

The derivation of the equation for equivalent ZEV mileage is based on the notion that the ZEV can be imagined to travel "r" fraction of the time on electricity generated from renewables and "(1-r)" fraction of the time on fossil fuel. If the vehicle travels "D" miles, then, using the definitions shown in Table 3, the following equation can be written.

$$\boldsymbol{G = \frac{r \times D}{m_{zr}} + \frac{(1-r) \times D}{m_{zf}}} \qquad \textbf{(Eq. 11)}$$

$$\boldsymbol{m_z = D/G = D/(\frac{r \times D}{m_{zr}} + \frac{(1-r) \times D}{m_{zf}})} \qquad \textbf{(Eq. 12)}$$

Dividing the numerator and the denominator by D and multiplying them both by the product of the two equivalent mileage values results in Equations 13.

$$\boldsymbol{m_z = m_{zr} \times m_{zf} / \left(r \times m_{zf} + (1-r) \times m_{zr}\right)} \qquad \textbf{(Eq. 13)}$$

Again, using the definitions in Table 3 results in the following.

$$\boldsymbol{m_z = Num/(Den\ )} \qquad \textbf{(Eq. 14)}$$

Table 3 Variables Used in the Calculation of ZEV Equivalent Mileage

Variable	Definition
$\boldsymbol{m_z}$	**ZEV Equivalent mileage**
$\boldsymbol{m_{zr}}$	**ZEV Equivalent mileage if the electricity is from renewables**
$\boldsymbol{m_{zf}}$	**ZEV Equivalent mileage if the electricity is from fossil fuels**
$\boldsymbol{r}$	**fraction of electricity generated from sources not emitting CO2**
G	**Gallons of equivalent fuel used**
D	**Arbitrary distance travelled**
Num	$\boldsymbol{m_{zr} \times m_{zf}}$
Den	$\boldsymbol{r \times m_{zf} + (1-r) \times m_{zr}}$

Table 4 shows an assignment of assumed values and the result of a calculation, using Equations 13, 14, and the definitions in Table 3, to produce a ZEV equivalent mileage.

Table 4 Variable Assignment and the Resulting ZEV Mileage

m_{zr}	m_{zf}	r	1-r	Num	Den	m_z
5000	70	0.8	0.2	350000.00	1056.00	331.44

Computing an LDV Fleet Mileage Assuming Heroic Measures (HM)

Table 5 shows the additional definitions that will be used in this calculation. Table 6 computes the 2030 LDV mileage, assuming “Heroic Measures” to reduce the miles driven in poor-mileage ICE’s, in building and selling a significant fraction of ZEVs, and in getting the Low Carbon Fuel Standards to continue to improve beyond the Figure 3 minimum of 0.90.

Table 5 Additional Variables Used in the Calculation of 2030 LDV Mileage

Variable	Definition
D_i	Distance travelled by ICE vehicles
D_z	Distance travelled by ZEVs
G_i	Gallons of Equivalent fuel used by ICE vehicles
G_z	Gallons of Equivalent fuel used by ZEVs

As shown by the values for “f”, government policies must be adopted, in 2030, to reduce the miles driven by the ICE’s, from model years 2016 to 2023. The 2016 model ICE’s are driven only 30% as much as the nominal amount. The 2017 year ICE’s can be driving 10% more. This rate of change continues up to 2023, when the ICE’s are doing less damage, due to the large fraction of ZEVs on the road.

Table 6 Calculation of 2030 LDV Mileage Assuming Heroic Measures

	ICE Parameters and Calculations						ZEVs			Yearly Totals		
Year	CAFÉ MPG	LCFS	Eq. MPG	f	D_i	G_i	z	D_z	G_z	Total Miles	Total Gallons	2030 MPG
2016	34.3	.9267	37.01	.3	30.0	.8105	.04	4	.012	32.8	.7901	41.51
2017	35.1	.9200	38.15	.4	40.0	1.0484	.07	7	.021	44.2	.9962	44.37
2018	36.1	.9133	39.53	.5	47.5	1.2018	.12	12	.036	56.0	1.1494	48.72
2019	37.1	.9000	40.92	.6	54.0	1.3197	.18	18	.054	67.2	1.2567	53.47
2020	38.3	.8500	42.56	.7	52.5	1.2337	.24	24	.072	77.2	1.3225	58.37
2021	40.3	.8000	47.41	.8	48.0	1.0124	.34	34	.103	86.8	1.2162	71.37
2022	42.3	.8000	52.88	.9	40.5	.7660	.48	48	.145	94.8	1.0299	92.05

2023	**44.3**	**.8000**	**55.38**	**1.0**	**30.0**	**.5418**	**.62**	**62**	**.187**	**100.0**	**.8733**	**114.51**
2024	**46.5**	**.8000**	**58.13**	**1.0**	**15.0**	**.2581**	**.76**	**76**	**.229**	**100.0**	**.6422**	**155.71**
2025	**48.7**	**.8000**	**60.88**	**1.0**	**5.0**	**.0821**	**.90**	**90**	**.272**	**100.0**	**.4358**	**229.46**
2026	**51.2**	**.8000**	**64.00**	**1.0**	**5.0**	**.0781**	**.95**	**95**	**.287**	**100.0**	**.3648**	**274.16**
2027	**53.7**	**.8000**	**67.13**	**1.0**	**5.0**	**.0745**	**.98**	**98**	**.296**	**100.0**	**.3255**	**307.24**
2028	**56.2**	**.8000**	**70.25**	**1.0**	**5.0**	**.0712**	**.99**	**99**	**.299**	**100.0**	**.3129**	**319.56**
2029	**58.7**	**.8000**	**73.38**	**1.0**	**5.0**	**.0681**	**.99**	**99**	**.299**	**100.0**	**.3123**	**320.18**
2030	**61.2**	**.8000**	**76.50**	**1.0**	**5.0**	**.0654**	**.99**	**99**	**.299**	**100.0**	**.3118**	**320.75**
Sum of Miles and then Gallons of Equivalent Fuel:										**1259.00**	**11.34**	
Equivalent MPG of LDV Fleet in 2030:										***111.03***		
Sum of ZEV Miles = **865**. Fraction of Miles Driven by ZEVs = **68.7%**												

As shown, the ZEV fraction of the fleet assumes the value of 12%, just 2 years from now (shown in the green field.) It then proceeds upward, to 18% in 2019; 24% in 2020; 34% in 2021; and so on, until it reaches 99% by 2028.

Achieving these fractions of ZEVs might be compared to what was done during World War II, when automobile productions lines were rapidly converted to produce tanks. This reduced the new cars that could be purchased. Besides this, rationing gasoline made it difficult to drive at times and, due to shortages of leather, which was being used to produce boots for soldiers, some citizens found it hard to even buy shoes. These rapid and inconvenient changes were tolerated, because most people agreed that the war needed to be won. The heroic measures assumed here may not be possible unless citizens and the political leaders they elect understand the dire consequences of climate destabilization and therefore accept, and even demand, the measures that are needed to support climate stabilization.

The equivalent miles per gallon of the LDV fleet in 2030, specifically 111.03 miles per gallon, will be considered as a potential 2030 LDV requirement.

Computing the Heroic-Measures (HM) Case Per-Capita and Net Driving Factor Requirements, Based on the Result Shown in Table 6

Plugging the

- equivalent MPG of the LDV fleet in Year 2030, taken from the bottom of Table 6, which is 111.03 MPG (m_{2030}), and
- the MPG of the LDV fleet in Year 2015, taken from the bottom of Table 2, which is 27.63 MPG (m_{2015}),

into Equation 9, gives the following result:

$$\frac{d_{2030}}{d_{2005}} = 0.1687 * \frac{m_{2030}}{m_{2015}} = 0.1687 * \frac{111.03}{27.63} = 0.68 \qquad \textbf{(Eq. 14)}$$

This means that the per-capita driving in 2030 will need to be about 32% less than in year 2005. The net driving can be computed by multiplying the per-capita driving, 0.68, by the population factor of 1.2305, computed in Equation 7, resulting in 0.84 (since 0.68 x 1.2305 = 0.84.) This means that, even with the 23% increase in California's population, the net driving will have to drop by 16%. If this LDV requirement set is selected, all of California's transportation money can be used to improve transit, improve active transportation (mainly walking and biking), and maintain, but not expand, roads. The good news is that there can be little or no congestion because highway capacity now is larger than it was in 2005. Policies will be needed to achieve the required reduction in driving.

Case 2: Computing LDV Requirements that Support Climate Stabilization but Still Allow 2005 Per-Capita Driving

The first step is to use Equation 9 and the value of the mileage in 2015 to compute the needed LDV equivalent fleet mileage for 2030 if the left side of the equation is equal to 1.0.

$$\mathbf{m_{2030} = 1.0 \times m_{2015} / 0.1689 = 27.63 / 0.1689 = 163.59\ MPG} \qquad \textbf{Eq. 15)}$$

Table 7 is constructed, with the fraction of ZEVs selected to achieve the needed equivalent fleet mileage of about 163.59 MPG. Since its ZEV fractions are larger and sooner than in the "Heroic Measures" table, Table 7 is showing what has been called the "Extra-Heroic Measures" (EHM) case. The ICE "f" values are unchanged; as are the LCFS values. The EHM ZEV differences from the HM case are the highlighted "z" values.

This means that with the 23% increase in California's population, computed in Equation 7, the net driving would also increase by 23%. If this LDV requirement set were to be implemented, a lot of California's transportation money would be needed to expand the highway system, leaving less to improve transit, improve active transportation (mainly walking and biking), and maintain roads.

Table 7 Calculation of 2030 LDV Mileage Assuming Extra-Heroic Measures

Year	ICE Parameters and Calculations						ZEVs			Yearly Totals		
	CAFÉ MPG	LCFS	Eq. MPG	f	D_i	G_i	z	D_z	G_z	Total Miles	Total Gallons	2030 MPG
2016	34.3	.9267	37.01	.3	30.0	.8105	.04	0	.012	32.8	.7901	41.51
2017	35.1	.9200	38.15	.4	36.0	.9436	.10	10	.030	46.0	.9738	47.24
2018	36.1	.9133	39.53	.5	35.0	.8855	.25	25	.075	62.5	1.024	61.02
2019	37.1	.9000	40.92	.6	30.0	.7332	.40	40	.121	76.0	1.000	75.96
2020	38.3	.8500	42.56	.7	21.0	.4935	.65	65	.196	89.5	.7718	115.96
2021	40.3	.8000	47.41	.8	8.0	.1687	.90	90	.272	98.0	.4403	222.59

2022	**42.3**	**.8000**	**52.88**	**.9**	**4.5**	**.0851**	**.95**	**95**	**.287**	**99.5**	**.3717**	**267.66**
2023	**44.3**	**.8000**	**55.38**	**1.0**	**5.0**	**.0903**	**.95**	**95**	**.287**	**100.0**	**.3769**	**265.31**
2024	**46.5**	**.8000**	**58.13**	**1.0**	**5.0**	**.0860**	**.98**	**98**	**.296**	**100.0**	**.3301**	**302.95**
2025	**48.7**	**.8000**	**60.88**	**1.0**	**5.0**	**.0821**	**.98**	**98**	**.296**	**100.0**	**.3285**	**304.38**
2026	**51.2**	**.8000**	**64.00**	**1.0**	**5.0**	**.0781**	**.999**	**99**	**.299**	**100.0**	**.3143**	**318.14**
2027	**53.7**	**.8000**	**67.13**	**1.0**	**5.0**	**.0745**	**.99**	**99**	**.299**	**100.0**	**.3136**	**318.88**
2028	**56.2**	**.8000**	**70.25**	**1.0**	**5.0**	**.0712**	**.99**	**99**	**.299**	**100.0**	**.3129**	**319.56**
2029	**58.7**	**.8000**	**73.38**	**1.0**	**5.0**	**.0681**	**.99**	**99**	**.299**	**100.0**	**.3123**	**320.18**
2030	**61.2**	**.8000**	**76.50**	**1.0**	**5.0**	**.0654**	**.99**	**99**	**.299**	**100.0**	**.3118**	**320.75**
Sum of Miles and then Gallons of Equivalent Fuel:										**1304.30**	**7.97**	
Equivalent MPG of LDV Fleet in 2030:										***163.59***		

Comparing the ZEV Fraction Values of the “Heroic-Measures” (HM) Case to the “Extra-Heroic Measures” (EHM) Case

Table 8 shows the direct comparison of the ZEV fractions that are ZEV requirements for the HM Case and the EHM Case. The largest differences are highlighted. The EHM case does not appear to be achievable.

Table 8 HM Case and the EHM Case Which Supports 2005 Per-Capita Driving

Cases	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
HM	**.04**	**.07**	**.12**	**.18**	**.24**	**.34**	**.48**	**.62**	**.76**	**.90**	**.95**	**.98**	**.99**	**.99**	**.99**
EHM	**.04**	**.10**	**.25**	**.40**	**.65**	**.90**	**.95**	**.95**	**.98**	**.98**	**.99**	**.99**	**.99**	**.99**	**.99**

ACHIEVING THE REQUIRED DRIVING REDUCTION OF THE HEROIC-MEASURES (HM) CASE

As shown in Equation 14, in 2030, the per-capita driving will need to at least 32% below the 2005 value. As shown in this link, http://en.wikipedia.org/wiki/SB_375, California’s Metropolitan Planning Organizations (MPOs) are adopting Region Transportation Plans (RTPs) that will achieve reductions in year 2020 and 2035. As also shown there, the targets, for year 2035, range from 0% for Shasta to 16% for Sacramento Area Council of Governments. Since this is for 2030 instead of 2035, and to be reasonably conservative, it is assumed here that the state will achieve a 10% reduction in per-capita driving, in 2030, compared to 2005. This leaves 22% to be achieved by new programs.

The title of each of the following subsections contains the estimated per-capita driving reduction each strategy will achieve, by 2030.

Reallocate Funds Earmarked for Highway Expansion to Transit and Consider Transit-Design Upgrades (3%)

San Diego County has a sales tax measure called "TransNet", which allocates one-third for highway expansion, one-third for transit, and one-third for road maintenance. It has a provision that allows for a reallocation of funds, if supported by at least two-thirds of SANDAG Board members, including a so-called weighted vote, where governments are given a portion of 100 votes, proportional to their population. It is hereby proposed to reallocate the TransNet amount, earmarked for highway expansion, to transit and to do similar reallocations throughout California.

This money could be used to fund additional transit systems; improve transit operations; and/or the redesign and implementation of the redesign of existing transit systems. The redesign could include electrification and automation or even upgrading to a different technology.

A Comprehensive Road-Use Fee Pricing and Payout System to Unbundle the Cost of Operating Roads (7.5%)

Comprehensive means that pricing would be set to cover all costs (including road maintenance and externalities such as harm to the environment and health); that privacy and the interests of low-income drivers doing necessary driving would be protected; that the incentive to drive fuel-efficient cars would be at least as large as it is under the current fuels excise tax; and, as good technology becomes available, that congestion pricing is used to protect critical driving from congestion.

The words *payout* and *unbundle* mean that some of the money collected would go to people that are losing money under the current system.

User fees (gas taxes and tolls) are not enough to cover road costs[10] and California is not properly maintaining its roads. Reference 10 shows that in California user fees amount to only 24.1% of what is spent on roads. Besides this, the improved mileage of the ICEs and the large number of ZEVs needed mean that gas tax revenues will drop precipitously.

This system could be used to help reduce the ICE LDV miles driven in 2016 to 2022, as shown in the "f" column of Tables 6 and 7. This system could probably be implemented in less than 5 years.

Unbundling the Cost of Car Parking (7.5%)

Unbundling the cost of car parking[11] throughout California is conservatively estimated to decrease driving by 7.5%, based on Table 1 of Reference 11. That table shows driving reductions resulting from introducing a price for parking, for 10 cases. Its average reduction in driving is 25% and its smallest reduction is 15%.

Good Bicycle Projects and Bicycle Traffic Skills Education (3%)

The best criterion for spending money for bicycle transportation is the estimated reduction in driving per the amount spent. The following strategies may come close to maximizing this parameter.

Projects to Improve Bicycle Access

All of the smart-growth neighborhoods, central business districts, and other high trip destinations or origins, both existing and planned, should be checked to see if bicycle access could be substantially improved with either a traffic calming project, a "complete streets" project, more shoulder width, or a project to overcome some natural or made-made obstacle.

League of American Bicyclist Certified Instruction of "Traffic Skills 101"

Most serious injuries to bike riders occur in accidents that do not involve a motor vehicle[12]. Most car-bike accidents are caused by wrong-way riding and errors in intersections; the clear-cut-hit-from-behind accident is rare[12].

After attending *Traffic Skills 101*, students that pass a rigorous written test and demonstrate proficiency in riding in traffic and other challenging conditions could be paid for their time and effort.

As an example of what could be done in San Diego County, if the average class size was 3 riders per instructor and each rider passes both tests and earns $100 and if the instructor, with overhead, costs $500 dollars, for a total of $800 for each 3 students, that would mean that $160M could teach $160M/$800 = 200,000 classes of 3 students, for a total of 600,000 students. The population of San Diego County is around 3 million.

Eliminate or Greatly Increase the Maximum Height and Density Limits Close to Transit Stops that Meet Appropriate Service Standards (2%)

As sprawl is reduced, more compact, transit-oriented development (TOD) will need to be built. This strategy will incentivize a consideration of what level of transit service will be needed, how it can be achieved, and what levels of maximum height and density are appropriate. Having no limits at all is reasonable if models show that the development can function without harming the existing adjacent neighborhoods, given the level of transit service and other supporting transportation policies (such as car parking that unbundles the cost and supports the full sharing of parking[11]) that can be assumed.

Net Driving Reduction from All Identified Strategies

By 2030, the sum of these strategies should be realized. They total 23%, resulting in a 1% margin over the needed 22% (which is added to the existing 10% to get the needed 32%.)

ADDITIONAL ELECTRICITY REQUIRED

The URL http://www.energy.ca.gov/2013_energypolicy/documents/2013-06-26_workshop/presentations/09_VMT-Bob_RAS_21Jun2013.pdf shows that Californians drove about 325 Billion miles per year, from 2002 to 2011. This value can be multiplied by the 0.84 factor reduction of driving, computed right after the calculation shown in Equation 14, and the fraction of miles driven by ZEVs, shown at the bottom of Table 6, of 0.687 (from 68.7%), to give the 2030 miles driven by ZEVs = 325 Billion x 0.84 x 0.687 = 188 Billion miles per year.

Using the Tesla information here http://en.wikipedia.org/wiki/Tesla_Roadster, it is assumed that 21.7 kW-h is used per 100 miles, or 0.217 kW-h per mile. The total energy used per year is therefore 188 Billion miles x 0.217 kW-h = 40,699 GW-h.

http://www.cpuc.ca.gov/cfaqs/howhighiscaliforniaselectricitydemandandwheredoesthepowercomefrom.htm, shows that California is using about 265,000 GW-h per year. Therefore the electricity needed to power California's HM ZEV LDF fleet in 2030 is 100% x 40,648/265,000 = 15.34% of the amount of electricity California is currently using. Table 4 shows that 80% (r = 0.80, with "r" defined in Table 3) of electricity must generated without producing CO2. This estimated 15.34% increase in demand should help the California Public Utilities Commission (CPUC) and the California Energy Commission (CEC) with their planning.

COMPARISON WITH CALIFORNIA AIR RESOURCES BOARD (CARB) PLANNING

The following quote[13] allows us to compare the CARB plan for LDVs with what would be required to stabilize the climate at a livable level, in the form of the Heroic Measures case:

> *Regulations on the books in California, set in 2012, require that 2.7 percent of new cars sold in the state this year be, in the regulatory jargon, ZEVs. These are defined as battery-only or fuel-cell cars, and plug-in hybrids. The quota rises every year starting in 2018 and reaches 22 percent in 2025. Nichols wants 100 percent of the new vehicles sold to be zero- or almost-zero-emissions by 2030*

Table 9 shows the values implied by this statement and compares them to the HM values. Table 10, which is similar to Tables 6 and 7, computes the overall mileage of the 2030 fleet, using the CARB values.

Computing the Heroic-Measures (HM) Case Per-Capita and Net Driving Factor Requirements, Based on the Result Shown in Table 10

Plugging the

- equivalent MPG of the LDV fleet in Year 2030, taken from the bottom of Table 10, which is 74.25 MPG, and
- the MPG of the LDV fleet in Year 2015, taken from the bottom of Table 2, which is 27.63 MPG,

into Equation 8, gives the following result:

$$\frac{d_{2030}}{d_{2005}} = 0.1687 * \frac{m_{2030}}{m_{2015}} = 0.1687 * \frac{74.25}{27.63} = 0.45 \qquad \textbf{(Eq. 16)}$$

Table 9 Zero Emission Vehicle (ZEV) % of Fleet, for Two Cases

Year	CARB	Heroic Measures	Year	CARB	Heroic Measures

2016	2.7%	4.0%
2017	2.7%	7.0%
2018	5.1%	12.0%
2019	7.5%	18.0%
2020	9.9%	24.0%
2021	12.4%	34.0%
2022	14.8%	48.0%
2023	17.2%	62.0%
2024	19.6%	76.0%
2025	22.0%	90.0%
2026	37.6%	95.0%
2027	53.2%	98.0%
2028	68.8%	99.0%
2029	84.4%	99.0%
2030	100.0%	99.0%

This means that the per-capita driving will need to be about 55% less in 2030 than in year 2005. The net driving can be computed by multiplying the per-capita driving, 0.45, by the population factor of 1.2305, computed in Equation 7, resulting in 0.55. This means that, even with the 23% increase in California's population, the net driving will have to drop by 45%. If CARB wants the LDV sector to achieve a reasonable climate-stabilizing target, it will need to require ZEV adoption profile closer to the Heroic Measures Case. The adoption profile they have now will required a reduction in driving that will probably be very difficult to achieve.

CONCLUSION

A requirement set named "Heroic Measures" (HM) is quantified. Table 8 shows that the HM LDV efficiency requirements are much easier to achieve than those needed to allow per-capita driving to remain close to its 2005 level, which has been quantified as the "Extra Heroic Measures Case". Strategies to achieve the required HM driving reductions are also allocated and described. They are perhaps about as difficult as achieving the HM LDV fleet efficiency. It is computed that the 2030 fleet of LDV HM ZEVs would require an amount of electricity which is equal to about 15% of what California is using today. The current CARB plan for ZEV adoption is shown to require a very large reduction in driving if LDVs are to achieve a climate-stabilizing target.

Table 10 Calculation of 2030 LDV Mileage Assuming the CARB Values

	ICE Parameters and Calculations	ZEVs	Yearly Totals

Year	CAFÉ MPG	LCFS	Eq. MPG	f	D_i	G_i	z	D_z	G_z	Total Miles	Total Gallons	2030 MPG
2016	34.3	.9267	37.01	.3	30.0	.8105	.03	3	.008	31.9	.79681	40.02
2017	35.1	.9200	38.15	.4	40.0	1.0484	.03	3	.008	41.6	1.0283	40.48
2018	36.1	.9133	39.53	.5	47.5	1.2018	.05	5	.015	52.6	1.2158	43.23
2019	37.1	.9000	40.92	.6	54.0	1.3197	.08	8	.023	63.0	1.3787	45.70
2020	38.3	.8500	42.56	.7	52.5	1.2337	.10	10	.030	73.0	1.5114	48.29
2021	40.3	.8000	47.41	.8	48.0	1.0124	.12	12	.037	82.5	1.5162	54.39
2022	42.3	.8000	52.88	.9	40.5	.7660	.15	15	.045	91.5	1.4954	61.17
2023	44.3	.8000	55.38	1.0	30.0	.5418	.17	17	.052	100.0	1.5475	64.62
2024	46.5	.8000	58.13	1.0	15.0	.2581	.20	20	.059	100.0	1.4425	69.32
2025	48.7	.8000	60.88	1.0	5.0	.0821	.22	22	.066	100.0	1.3477	74.20
2026	51.2	.8000	64.00	1.0	5.0	.0781	.38	38	.113	100.0	1.0884	91.87
2027	53.7	.8000	67.13	1.0	5.0	.0745	.53	53	.161	100.0	.8577	116.59
2028	56.2	.8000	70.25	1.0	5.0	.0712	.69	69	.208	100.0	.6517	153.44
2029	58.7	.8000	73.38	1.0	5.0	.0681	.84	84	.255	100.0	.4673	214.02
2030	61.2	.8000	76.50	1.0	5.0	.0654	1.0	100	.302	100.0	.3017	331.44
Sum of Miles and then Gallons of Equivalent Fuel:										1236.00	16.65	
Equivalent MPG of LDV Fleet in 2030:										***74.25***		

ABREVIATIONS AND ACRONYMS

AB 1493 California's Assembly Bill 1493

HM "Heroic Measures" LDV Case

AB 32	California's Assembly Bill 32	**ICE**	Internal Combustion Engine LDV
APS	Alternative Planning Strategy	**kW-h**	Kilo Watt-hour
CAFE	Corporate Average Fuel Efficiency	**LCFS**	Low Carbon Fuel Standard
CARB	California Air Resources Board	**LDV**	Light-Duty Vehicle
CBD	Center for Biological Diversity	**MPO**	Metropolitan Planning Organization
CEC	California Energy Commission	**Pavley**	Senator Pavley's AB 1493
CEQA	California Environmental Quality Act	**PPM**	Parts per Million
CPUC	California Public Utilities Commission	**RPS**	Renewable Portfolio Standard
CCAP	Center for Clean Air Policy	**RTP**	Regional Transportation Plan
CNFF	Cleveland National Forest Foundation	**S-3-05**	Governor's Executive Order S-3-05
SB 375	California's Senate Bill 375	**SANDAG**	San Diego Association of Governments
CO_2	Carbon Dioxide		
CO_2_e	Carbon Dioxide Equivalent GHG	**SCS**	Sustainable Community Strategy
EHM	"Extra Heroic Measures" LDV Case	**TransNet**	San Diego County sales tax
GEO	Governor's Executive Order	**URL**	Universal Resource Locator
GHG	Greenhouse gas	**VMT**	Vehicle Miles Travelled
GW-h	Giga Watt-Hours	**ZEV**	Zero Emission Vehicle LDV

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KEYWORDS

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A Plan to Efficiently and Conveniently Unbundle Car Parking Costs

Air and Waste Management Association Paper 2010-A-554-AWMA

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ABSTRACT

The *Introduction* shows documented driving reductions due to the pricing of parking. It notes that although the benefits of priced and shared parking are known, such parking has not been widely implemented, due to various concerns. It states that a solution, called "*Intelligent Parking,"* will overcome some of these concerns, because it is easy to use and naturally transparent. It asserts that this description will support a "Request for Proposal" (RFP) process. Eight background information items are provided, including how priced parking would help California achieve greenhouse gas reduction targets. A story demonstrates some of the key features of *Intelligent Parking*. Arguments for less parking, shared parking, and priced parking are made. Barriers to progress are identified. The fair pricing of parking is described. New ways to characterize transportation demand management are presented. Seven goals of *Intelligent Parking* are listed. Eleven definitions and concepts, that together define *Intelligent Parking*, are described. This includes a method to compute a baseline price of parking and how to adjust that price instantaneously to keep the vacancy above 15% ("Congestion Pricing"). An implementation strategy is described.

INTRODUCTION:

It has been well established that appropriately priced parking will significantly reduce driving[1]. Most case studies presented in Table 1 are evaluations of the most general type of "car-parking cash-out": *a program that pays employees extra money each time they get to work without driving*. They show that a price differential between using parking and not using parking will significantly reduce driving, even when transit is described as poor. Since driving *must* be reduced[2], the pricing of parking is desirable.

Shared parking is also recognized as desirable because it can sometimes result in less parking being needed.

Although the advantages of pricing and sharing parking have been recognized for many years, these practices are still rare. This paper identifies some of the reasons for this lack of progress. The pricing and sharing method of this paper has a natural transparency and ease of use that would reduce many of the concerns. This paper also suggests that those governments that have the necessary resources can take the lead role in developing and implementing the described systems. These governments will recover their investments, over time.

This paper describes how parking facilities could be tied together and operated in an optimum system, named *Intelligent Parking*. The description of *Intelligent Parking* is sufficient to support a "Request for Proposal" process, leading to full implementation.

There are two distinct parts to *Intelligent Parking*. The first is how to set the price. The second is how to distribute the earnings. Briefly, the earnings go to the individuals in the group for whom the parking is built.

Table 1 Eleven Cases of Pricing Impact on Parking Demand

Location	Number of Workers @ Number of Firms	1995 $'s Per Mo.	Parking Use Decrease
Group A: Areas with poor public transportation			
West Los Angeles	3500 @ 100+	$81	15%
Cornell University, Ithaca, NY	9000 Faculty & Staff	$34	26%
San Fernando Valley, Los Angeles	850 @ 1	$37	30%
Costa Mesa, CA	Not Shown	$37	22%
	Average for Group	**$47**	**23%**
Group B: Areas with fair public transportation			
Los Angeles Civic Center	10,000+ @ "Several"	$125	36%
Mid-Wilshire Blvd, Los Angeles	1 "Mid-Size" Firm	$89	38%
Washington DC Suburbs	5,500 @ 3	$68	26%
Downtown Los Angeles	5,000 @ 118	$126	25%
	Average for Group	**$102**	**31%**
Group C: Areas with good public transportation			
U. of Washington, Seattle, WA	50,000 employees, students	$18	24%
Downtown Ottawa, Canada	3,500 government staff	$72	18%
Bellevue, WA	430 @ 1	$54	39%*
	Average for Group, except Bellevue, WA Case*	**$45**	**21%**
	Overall Average, Excluding Bellevue, WA Case*		**25%**

* Bellevue, WA case was not used in the averages because its walk/bike facilities also improved and those improvements could have caused part of the decrease in driving.

PERTINENT BACKGROUND INFORMATION

- Vehicle miles traveled (VMT) are a major cause of global warming and pollution[2, 3].
- California's Metropolitan Planning Organizations (MPOs) will need to adopt strategies that reduce vehicle miles traveled (VMT), in order to meet SB375 GHG reduction targets, to be issued by the California Air Resources Board in late 2010, for years 2020 and 2035[2].
- The appropriate pricing of parking is one of the least costly documented tools to reduce VMT.
- New technologies, such as sensors feeding computer-generated billing, offer the potential to efficiently bill drivers for parking and alert law enforcement of trespassers.
- Reformed parking policies can increase fairness, so that, for example, people who use transit or walk do not have to pay higher prices or suffer reduced wages, due to parking.

- Methods to unbundle parking cost are inefficient unless they support the spontaneous sharing of parking spaces. Shared parking with unbundled cost would ultimately allow cities to require significantly less parking.
- Typical systems of timed parking and metered parking are far from ideal. Parking has no automated record keeping, so it is difficult to know where there is too much or too little.
- Good policies will eventually let cities turn parking minimums into parking maximums.

A GLIMPSE INTO A POSSIBLE FUTURE

Jason is driving to work for the first time in several years. He has decided to save money by carrying home a new 3-D, big-screen computer, which he plans to purchase at a store near his office after work. He wanted to avoid paying delivery charges.

Things have been changing around his office development since they unbundled the cost of parking at the near-by train station. Many people who caught the early trains and lived close to the station stopped driving and parking in the best parking spaces; demand for housing close to the station went up; and wealthy riders, who insisted on driving, did so, confidant that they could always find parking as close to the platform as their schedules required, due to congestion pricing. Who would have guessed how much those people were willing to pay? It was shocking. Parking-lot earnings, paid to round-trip train riders, meant that the net cost to ride the train went significantly down. Ridership and neighborhood vitality both went significantly up. All Jason knew was that the price to park at his office had been going up yearly because of increased land values. His parking-lot earnings from his office had been increasing almost every month, due to the ripple effect of train riders parking off-site at cheaper parking. Some of them were using his office parking.

As he pulls out of his driveway, he tells his GPS navigation unit his work hours (it already knew his office location), the location of the store where he plans to buy the computer, and his estimated arrival and departure times at the store. He tells the GPS unit he wants to park once, park no more than 1 block from the store, walk no more than 1 mile total, and pay no more than an average of $2 per hour to park. He is not surprised to hear the GPS tell him that his request is impossible. He tells the GPS he will pay an average of $3 per hour and learns that the GPS has located parking.

It guides him into a church parking lot. He hopes the church will use his money wisely. The GPS tells him the location of a bus stop he could use to get to work and the bus's next arrival time at the stop. With automatic passenger identification and billing, the bus has become easy to use, except that it is often crowded. Jason gets out of the car and walks to work, with no action required regarding the parking.

Three weeks later, when Jason gets his monthly statement for his charges and income for automotive road use, transit use, parking charges, and parking earnings, he finds that the day's parking did indeed cost about $30 for the 10 total hours that he parked. He notes that the parking-lot earnings for his office parking averaged about $10 per day that month. He then notices the parking lot earnings from the store, where he spent about $1000 dollars. He sees that the parking-lot earnings percent for the store that month was 1.7%, giving him about $17. So for the day, Jason only spent a net of about $3 on parking. Then he realized that he should have had the computer delivered after all. If he would have bicycled that day, as he usually did, he would have still gotten the $27 earnings from the two parking facilities and he would have paid nothing for parking. So the choice to drive cost him $30. He remembers that the delivery would have only been $25 dollars. Oh well. He enjoyed his before-work and after-work walks.

THE CASE FOR LESS PARKING

Less parking will support more compact development.[1] This makes walking and biking more enjoyable and less time consuming. There would certainly be less "dead space", which is how parking lots feel to people, whether they arrive by car or not, after they become pedestrians.

Since parking can be expensive, less parking can reduce overhead costs significantly, such as leasing expense and parking-lot maintenance cost. Less overhead means more profit and less expense for everyone. A need for less parking can create redevelopment opportunities at existing developments and reduce project cost at new developments.

At new developments, car-parking costs could prevent a project from getting built.[2]

THE CASE FOR SHARED PARKING

Shared parking for mixed uses means that less parking is needed. For example, shared parking could be used mostly by employees during the day and mostly by residents at night.

Fully shared parking means that very little parking would be off limits to anyone. In a central business district with shared parking, drivers would be more likely to park one time per visit, even when going to several locations. Pedestrian activity adds vitality to any area.

THE CASE FOR APPROPRIATELY-PRICED PARKING

To Reduce Driving Relative to Zero Pricing

Traditional Charging or Paying Cash-out Payments

As shown in the Introduction, this relationship (pricing parking reduces driving) is not new.[3]

Using results like Table 1, at least one study[4] has used an assumption of widespread pricing to show how driving reductions could help meet greenhouse gas (GHG) target reductions. Dr. Silva Send of EPIC http://www.sandiego.edu/epic/ghgpolicy/ assumes that all work locations with 100 employees or more in San Diego County will implement cash-out, to result in 12% less driving to work. Currently, almost all employees in San Diego County "park for free", unless they happen to work in a downtown core area.

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[1] This is especially true of surface parking, which only accommodates 120 cars per acre.

[2] On September 23, 2008, a panel of developers reviewed the Oceanside, Ca. "Coast Highway Vision" http://www.ci.oceanside.ca.us/pdf/chv_finalvisionstrategicplan.pdf. Parts of this plan were described as smart growth.

At the review, developer Tom Wiegel said, "Parking is the number 1 reason to do nothing," where "do nothing" meant "build no project." The other developers at the meeting agreed.

[3] For many years the Victoria Transport Policy Institute (VTPI) has been recognized as a source of reliable information on "Transportation Demand Management", or TDM.

From http://www.vtpi.org/tdm/tdm72.htm#_Price_Parking:

> Even a relatively small parking fee can cause significant travel impacts and provide significant TDM benefits.

"TDM Benefits" refers to the many public and private benefits of having fewer people choosing to drive.

Current, Best-Practice “Unbundling”

The “best-practice” use of the phrase, “unbundled parking cost”, is to describe the case where either the cost of parking, for the case of a condominium, or the rent for parking, for the case of an apartment, is separated from either the purchase price and common fees or the rent of the dwelling unit.

This gives the resident families the choice of selecting the number of parking spaces they would like to rent or buy, including the choice of zero. This would tend to reduce the average number of cars owned per dwelling unit and, in this way, would also tend to reduce driving. Its major drawback is that this method does not encourage sharing.

To Increase Fairness and Protect the US Economy

It is stated above that almost all employees in San Diego County “park for free”. Of course there is really no such thing as “parking for free”. So-called “free parking” always reduces wages or increases costs. At a work site, it reduces everyone’s wage, even those employees that never drive. At an apartment complex, so-called “free parking” increases the rent. Therefore, “free parking” at work or at apartments violates the fundamental rule of the free market, which is that people should pay for what they use and not be forced to pay for what they do not use. Parking should at least be priced to achieve fairness to non-drivers.

The US economy would also benefit. Reductions in driving would lead to reductions in oil imports, which would reduce the US trade deficit.[4]

BARRIERS TO PROGRESS

Given all this, it might seem that the widespread pricing of parking should have happened by now. However there are barriers. In 2007, a majority of the City Council of Cupertino, Ca. indicated that they wanted their City Manger to negotiate reduced parking requirements with any company that would agree to pay sufficient cash-out payments. To this date, no company, including Apple Inc., has expressed an interest. Most companies probably perceive cash-out as expensive. Even if they realize they could get a reduced parking requirement in exchange for paying sufficient cash-out amounts and even if the economics worked in support of this action (quite possible where land is expensive), they want to stay focused on their core business, instead of getting involved in new approaches to parking, real estate, and redevelopment.

On the other hand, simply charging for parking and then giving all the employees a pay raise is probably going to run into opposition from the employees, who will feel that they would be losing a useful benefit.

In addition, neighbors fear the intrusion of parked cars on their streets. Permit parking, which could offer protection, is not always embraced. City Council members know that a sizable fraction of voting citizens believe that there can actually never be too much “free parking”,

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[4] From http://en.wikipedia.org/wiki/Balance_of_trade#Warren_Buffett_on_trade_deficits, Warren Buffet wrote in 2006,

> “The U.S. trade deficit is a bigger threat to the domestic economy than either the federal budget deficit or consumer debt and could lead to political turmoil. Right now, the rest of the world owns $3 trillion more of us than we own of them.”

Professor Shoup's famous book[5] notwithstanding. Some Council members probably feel that way themselves.

It doesn't help that current methods of charging for downtown parking are often very inefficient.[5] For example, downtown Oceanside, California has parking meters that will only accept coins. Besides this, all their on-street, downtown parking is timed, with maximums from 10 minutes to 4 hours. These time limits are enforced by a city employee, who applies chalk from a tire to the street and then records the time. However, by watching the time and moving their car soon enough, drivers can avoid getting a ticket. Of course, they could instead drive to the mall and not have to worry about having coins or elapsed time since parking. It is not surprising that downtown merchants often object to charging for parking.

In summary, those that resist charging for parking, *based on their perceptions*, include

- Companies, *who fear the complexity and expense of paying cash-out payments*;
- Employees, *who fear of losing a current benefit*;
- City leaders, *who fear the political repercussions*;
- Downtown patrons, *who dislike the inconvenience and worry*;
- Downtown business owners, *who fear that it will drive away customers*.

THE COST, VALUE, AND FAIR PRICE OF PARKING

Estimated and Actual Capital Cost

Surface Parking

One acre of surface parking will accommodate 120 cars. Land zoned for mixed use is sometimes expensive. At $1.2 million per acre, the land for a single parking space costs $10,000. Construction cost should be added to this to get the actual, as-built cost of each parking space. Estimated cost can be determined by using appraised land value and construction estimates. For new developments, after the parking is constructed, it is important to note the actual, as-built cost.

Parking-Garage Parking

One acre of parking-garage will accommodate considerably more than 120 cars. The construction cost of the garage and the value of its land can be added together to get the total cost. Dividing that total cost by the number of parking spaces yields the total, as-built cost of each parking space. Adding levels to a parking garage may seem like a way to cut the cost of each parking space, for the case of expensive land. However, there is a limit to the usefulness of this strategy because the taller the parking garage, the more massive the supporting structural members must be on the lower levels, which increases total cost. Parking-garage parking spaces are often said to cost between $20,000 and $40,000. The actual costs should be noted.

Underground Parking

In order to compute an estimate for the cost of a parking space that is under a building, it is necessary to get an estimate of the building cost with and without the underground parking. The difference, divided by the number of parking spaces, yields the cost of each parking space. The

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[5] According to Bern Grush, Chief Scientist of Skymeter Corporation http://www.skymetercorp.com/cms/index.php, often two-thirds of the money collected from parking meters is used for collection and enforcement costs.

cost or value of land plays no role in the cost of this parking. However, it does not follow that this parking is cheap. Underground parking spaces are often said to cost between $60,000 and $90,000 dollars each. Although there will be an "as built" cost of the building with the parking, there will never be an "as built" cost of the building without the parking. However, after the construction is done, the estimate for the cost of the underground parking should be reconsidered and re-estimated if that is needed. The final, best-estimate cost should be noted.

Value

Initially, value and cost are the same. For surface parking and parking-garage parking, the value would initially be the same as the as-built cost. For underground parking, the value would initially be the same as the best-estimate cost. However, over time, the value must be updated. Both construction costs and land-value costs will change. The value assigned to a parking place should always be based on the current conditions.

Fair Pricing

Parking space "values", as described above, must first be converted to a yearly price by using a reasonable conversion factor. This conversion factor could be based on either the "cost of money" or the "earnings potential of money". It is expected that this conversion factor would be 2% to 5% during times of low interest rates and slow growth; but could be over 10% during times of high-interest and high growth. For example, if the surface parking value is $12,000 and it is agreed upon to use 5% as the conversion factor, then each parking spot should generate $600 per year, just to cover capital costs. The amount needed for operations, collection, maintenance, depreciation, and any special applicable tax is then added to the amount that covers capital cost. This sum is the amount that needs to be generated in a year, by the parking space.

The yearly amount of money to cover capital cost needs to be re-calculated every year or so, since both the value and the conversion factor will, in general, change each year. The cost of operations, collection, maintenance, depreciation, and any special applicable tax will also need to be reconsidered.

Once the amount generated per year is known, the base price, per unit year, can be computed by dividing it (the amount generated per year) by the estimated fraction of time that the space will be occupied, over a year. For example, if a parking space needs to generate $900 per year but it will only be occupied 50% of the time, the time rate charge is $1800 per year. This charge rate per year can then be converted to an hourly or even a per-minute rate. The estimated fraction of time that the parking is occupied over a year will need to be reconsidered at least yearly.

NEW DEFINITIONS TO PROMOTE AN OBJECTIVE VIEW OF PRICING

- The "fair price" means the price that accounts for all costs.
- The "baseline amount of driving" means the driving that results from the application of the fair price.
- "Zero transportation demand management" ("zero TDM") is the amount of demand management that results when the fair price is used. It will result in the baseline amount of driving.
- "Negative TDM" refers to the case where the price is set below the fair price. This will cause driving to exceed the baseline amount. Since TDM is commonly thought to be an action that reduces driving, it follows that negative TDM would have the opposite effect.
- "Positive TDM" refers to the case where the price is set above the fair price. This would cause the amount of driving to fall below the baseline amount.

Clearly, so-called “free parking” is an extreme case of negative TDM. The only way to further encourage driving would be to have a system that pays a driver for the time their car is parked.

THE GOALS OF *INTELLIGENT PARKING*

- There is only one agency operating all parking. (“All parking” does not include driveways and garages in single-family homes.) *Intelligent Parking* is designed and installed by regional or state government, using low-bid contractors, with design and start-up costs covered by the overhead portion of collection fees.
- Nearly all parking is shared. Almost always, anyone can park anywhere. Those who want exclusive rights to parking will pay “24/7” (all day, every day).
- Parking is operated so that the potential users of parking will escape the expense of parking by choosing to not use the parking. This characteristic is named “unbundled” because the cost of parking is effectively unbundled from other costs.
- Parking is priced and marketed to eliminate the need to drive around looking for parking.
- Parking at any desired price is made as easy as possible to find and use.
- Records of the use of each parking space are kept, to facilitate decisions to either add or subtract parking spaces.
- The special needs of disabled drivers, the privacy of all drivers, and, if desired, the economic interests of low-income drivers are protected.

DEFINITIONS & CONCEPTS OF *INTELLIGENT PARKING*

Parking Beneficiary Groups

There are at least 7 types of beneficiary groups. Note that in all cases, members of beneficiary groups must be old enough to drive.

1.) People who have already paid for the capital cost of parking. An example of this type of beneficiary group would be the owners of condominiums, where parking has been built and the cost is included in the price of the condominium. Note that although they have technically already paid for the parking, if they borrowed money to pay for some portion of the price, the cost is built into their monthly payment. This illustrates why the value of parking and the cost of borrowing money (rate of return on money) are key input variables to use to compute the appropriate base, hourly charge for parking.

2.) People who are incurring on-going costs of parking. An example of this type of beneficiary group is a set of office workers, where the cost of ‘their” parking is contained in either the building lease or the cost of the building. Either way, the parking costs are reducing the wages that can be paid to these employees.[6]

3.) People who are purchasing or renting something where the cost of the parking is included in the price. Examples of this beneficiary group are people that rent hotel rooms, rent an apartment, buy items, or dine in establishments that have parking.

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[6] Such parking is often said to be “for the benefit of the employees”. Defining this beneficiary group will tend to make this statement true, as opposed to the common situation where the employees benefit only in proportion to their use of the parking.

4.) People who own off-street parking as a business. They could be the individual investors or could be a government or government-formed entity.

5.) People who are said to benefit from parking, even though the money for the parking has been supplied by a source that may have very little relationship to those that are said to benefit. An example of this group would be train riders that make round trips from a station which has parking that is said to be “for riders”. Students at a school with parking would be another example.

6.) People who are considered by many to be the logical beneficiaries of on-street parking. Owners of single-family homes are the beneficiaries of the parking that is along the boundaries of their property. The same status is given to residents of multi-family housing.

7.) Governments. Since they build and maintain the streets, they should get a significant benefit from on-street parking.

Unbundled Cost and Spontaneous Sharing

“Unbundled cost” means those who use the parking can see exactly what it costs and those who don’t use the parking will either avoid its cost entirely or will get earnings to make up for the hidden parking cost they had to pay. This conforms to the usual rule of the free market where a person only pays for what they choose to use. Unbundled cost is fair.

“Spontaneous sharing” means that anyone can park anywhere at any time and for any length of time. Proper pricing makes this feasible.

How to Unbundle

The method of unbundling can be simply stated, using the concept of “beneficiary group” as discussed above. First, the fair price for the parking is charged. The resulting earnings[7] amount is given to the members of the beneficiary group in a manner that is fair to each member. Methods are described below.

Why this Supports Sharing

Members of a beneficiary group benefit financially when “their” parking is used. They will appreciate users increasing their earnings. They are also not obligated to park in “their” parking. If there is less-expensive parking within a reasonable distance, they might park there, to save money. This is fine, because all parking is included in the *Intelligent Parking* system.

Computing the Earnings for Individuals

Intelligent Parking must be rigorous in paying out earnings[7]. For a mixed use, the total number of parking spaces must first be allocated to the various beneficiary groups. For example in an office/housing complex, 63.5% of the parking might have been sold with the office. If so, the housing portion must be paying for the other 36.5%. For this case, it would follow that the first step is to allocate 63.5% of the earnings to the workers and 36.5% to the residents.

[7] The earnings amount is the revenue collected minus the collection cost and any other costs that will have to be paid due to the implementation of *Intelligent Parking*. The costs associated with the parking, paid *before* the implementation of *Intelligent Parking*, should *not* be subtracted from the revenue because they will continue to be paid as they were before the implementation of *Intelligent Parking*. Therefore, these costs will continue to reduce wages and increase the prices of goods and services.

How the monthly earnings are divided up among the members of the beneficiary group depends on the beneficiary group type. For each member, the group's total monthly earnings amount is always multiplied by a quantity and divided by the sum (the sum is the denominator) of that quantity, for all members.

For example, for each employee, the multiplier is the number of hours that the employee worked over the month while the denominator is the total number of hours worked by all employees over the month. At a school, for each student, the numerator is the total time spent at the school, over the month, while the denominator is the sum of the same quantity, for all the students.

For a train station with parking being supplied for passengers that ride on round trips of one day or less, the numerator is the passenger's monthly hours spent on such round trips, over the month; while the denominator is the total number of hours spent by all passengers on such round trips, over the month. Radio Frequency Identification (RFID) units on passengers could support an automated calculation of monthly charges for fares, as well as monthly hours on round trips.

At a shopping center, the numerator is the sum of the money spent by the shopper, over the month, while the denominator is the total amount of money spent by all shoppers over the month.

At a condominium, the numerator is the number of parking places that were paid for (directly or indirectly) by the resident family and the denominator is the total number of parking places at the condominium project; similarly, for apartment complexes.

Where Earnings Are Low

The goal is that if someone doesn't park, they don't pay, either directly or indirectly, because the earnings that they get will balance out their losses (like reduced wages, for example). However, charging for parking that few want to use will not sufficiently compensate the people that have been forced, or are being forced, to pay for such parking. The only remedy in this case is to redevelop the parking or lease the parking in some other way, for storage, for example. The earnings from the new use should go to those that are in the beneficiary group that was associated with the low-performing parking.

Why This Method of Unbundling Will Feel Familiar to Leaders

Developers will still be required to provide parking and will still pass this cost on, as has been discussed. There will be no need to force an owner of an exiting office with parking to break his single business into two separate businesses (office and parking).

Parking beneficiaries are identified that conform to traditional ideas about who should benefit from parking.[8]

Unbundling the Cost of On-Street Parking

The revenue from on-street parking in front of businesses will be split evenly between the city and the business's parking beneficiaries. All of the earnings from on-street parking in front of apartments or single-family homes will be given to the resident families.[9]

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[8] Showing exactly where parking earnings go will reduce the political difficulties of adopting pay parking in a democracy where the high cost of parking is often hidden and rarely discussed.

[9] Although governments own the streets, often, back in history, developers paid for them and this cost became embedded in property values. Admittedly, how to allocate on-street parking earnings is somewhat arbitrary. With

Special Considerations for Condominiums

Unbundling for a condominium owner means that, although their allocated amount of parking has added to their initial cost, their allocated amount of parking also earns money for them. Unbundling for a condominium could also mean that an owner can choose to have control over a single or several parking places. Such parking spaces could be equipped with a red light and a green light. If the red light is lit, this will mean that the space is not available for parking, except for the person who is controlling the spot. If the green light is lit, it will mean that the space is available to anyone. A space that is being reserved with a red light is charged at the full price to the condominium owner that has control over the space. The owner that controls these spaces can change the state of the parking space (available or not available) by either a phone call, on line, or at any pay station system that might be in use for the system. After condominium owners experience the cost of reserving a space for themselves, they might give up on the idea of having their own, personal, unshared parking space; especially since *Intelligent Parking* will give most owners and their guests all the flexibility they need in terms of parking their cars.

Some people think that condominium parking should be gated, for security reasons. However, parking within parking garages needs to be patrolled at the same frequency level as on-street parking, which is enough to ensure that crime around either type of parking is very rare. Cameras can help make parking garages that are open to the public safe from criminal activity.

Special Considerations for Renters

Unbundling for renters means that, although their allocated amount of parking increases their rent, their allocated amount of parking also earns money for them. Therefore, their traditional rent (includes parking) is effectively reduced by the money earned by those parking spaces allocated to them. Renters will be motivated to either not own a car or to park in a cheaper location. Parking in a cheaper location is not a problem because all parking is part of the *Intelligent Parking* system. Renters will welcome anyone to park in “their” parking, because it will increase their earnings.

Special Considerations for Employers

At first, companies may want the option of offering “free parking” to their employees so as to be able to compete with traditional job sites. This means giving employees that drive every single day an “add-in” amount of pay so that the sum of the add-in and their parking-lot earnings equals their charge, for any given monthly statement. The operator of the parking, which sends out statements, can pay out the “add in” amount, in accordance with the company’s instruction. The company will then be billed for these amounts. There could be no requirement for the company to provide any such “add-in” amount to the employees that don’t drive every day. This would allow the company to treat its every-day drivers better than other employees and so this would be a negative TDM. However, this economic discrimination would be substantially less than the current, status-quo, economic discrimination, where drivers get “free” parking and non-drivers get nothing.

Clusters of Parking

Clusters are a contiguous set of parking spaces that are nearly equal in desirability and thus can be assigned the same price. They should probably consist of from 20 to 40 spaces. For off-street

congestion pricing and efficient methods, governments may earn significantly more than they are under current practices.

parking, they could be on either side of the access lane to the parking spaces, so that an observer could see the 20 to 40 cars, and get a feel for the vacancy rate. At a train station, clusters will normally be organized so that their parking spaces are approximately an equal distance from the boarding area. On-street clusters would normally conform to our current understanding of what a block is, which is to say from one cross street to the next cross street. The width of the street and the length of the block should be taken into account in defining on-street clusters of parking and in deciding if the parking on either side of the street should or should not be in the same cluster of parking spaces.

Examples of Good and Bad Technology

Parking Meters or Pay Stations

Parking meters are a relic of an earlier period, before computers. Pay stations do not add enough usefulness to merit their inclusion in *Intelligent Parking*, except as a bridge technology. Once good systems are set up, pay stations should cost additional money to use because of their expense. It would be best to devise an implementation strategy that will minimize their use when the system is first put into effect and will take them out of service as soon as possible.

Radio Frequency Identification Backed Up by Video-Based "Car Present" and License Recognition

Government will eventually enter into an RFID (Radio Frequency Identification) age. Organizers of large athletic events already have. Organizers that put on large open-water swims, foot races, and bike rides have routinely used RFID for many years.[10] An RFID vendor in San Diego[11] states that passive RFID units cost less than $5, are reliable, are durable, and they could be used to identify cars as well as people. He also sees no problem in implementing most of the features of *Intelligent Parking*.[12]

Automatic Data Collection and Sending Out Statements

Note that the "back end database" of Dr. Carta's written statement[12] refers to the ability to send statements of earnings and billing to students.[13]

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[10] For example, over 20,000 people ran the 2008 Bay-to-Breakers foot race in San Francisco. Each runner had a "chip" in their shoe lace. Each runner's start time and finish time were recorded and all results were available as soon as the last runner crossed the finish line.

[11]David R. Carta, PhD, CEO Telaeris Inc., 858-449-3454

[12] Concerning a Final Environmental Impact Report-approved and funded new high school in Carlsbad, California, where the School Board has signed a *Settlement Agreement* to consider "*unbundled parking*", "*cash-out*", and "*pricing*", Dr. Carta wrote, in a January 13th, 2010 written statement to the Board,

> I wanted to send a quick note discussing the technical feasibility of tracking cars into a lot without impacting students or requiring the need for gates. Mike Bullock and I have discussed this project; it can be accomplished straightforwardly by utilizing Radio Frequency Identification and/or Video Cameras integrated with automated license recognition systems. The cars would need to register with the system at the start, but it would be fairly painless for the users after the initial installation. The back end database system can also be implemented both straightforwardly and at a reasonable price.
>
> This is not necessarily a recommendation of the proposal for unbundled parking. Rather it is strictly an unbiased view of the technical feasibility of the proposal to easily and unobtrusively track cars, both registered and unregistered, into a fixed lot.

[13] In an earlier email on this subject, Dr. Carta wrote,

Putting it Together

Certainly, government, and in particular transit agencies and parking agencies, could use RFID-based technology. For example, when a person with an RFID unit which is tied to a billable address or a credit card with an open account gets on a bus or a train, they should not have to pay at that time, visit a pay station, or "swipe a card" that has a positive balance. Utility customers that pay their bills are not required to pre-pay. The same courtesy should be extended to transit riders, people that drive on roads, people that get parking-lot earnings, and people that park cars. There should be one monthly bill or statement, for all four activities.

Global Positioning Systems GPS

An alternative model is to have GPS systems in cars that would detect the car's parking location, that location's current charge rate, and would perform all of the charging functions in the car. The only information the parking-lot-enforcement system would need is whether or not a car being parked is owned by a bill-paying owner. The car owner's responsibility would be to pay the bills indicated by the box in the car. The box would need to process a signal that a bill had been paid. It would also need to process pricing signals.

Not Picking Winners

The purpose of this report is to describe what an ideal system would do, *not* how it is done. How a proposed system works is left to the systems, software, and hardware engineers that work together to submit a proposal based on this description of what an ideal system does.

Privacy

Privacy means that no one can see where someone has parked, without a search warrant. Also, the level of the detail of information that appears on a bill is selected by the customer.[14]

Ease of Use for Drivers

For credit-worthy drivers that have followed the rules of the system, pay parking will not require any actions other than parking. Paying for all parking fees over a month is then done in response to a monthly billing statement. Parking will feel to the consumer like a service provided by a municipality, such as water, energy, or garbage. One important difference is that users belonging to a "beneficiary group" will get an earnings amount in their monthly statement. Those that earn more than what they are charged will receive a check for the difference. This ease of use will make all parking less stressful.

Base Price

Off-Street

This is not too tough - we probably would integrate with a service that already sends physical mail from an electronic submission instead of re-inventing this wheel.

[14] License plates that have no RFID tags fail to use the best technology to accomplish the primary purpose of license plates, which is to identify and help intercept cars used in a crime. Identifying cars is a legitimate government goal. Protecting privacy is also a legitimate goal. Both goals can be realized with good laws, good enforcement, and good systems engineering.

Off-street parking is priced so that even if demand does not threaten to fill the parking beyond 85%, the money generated will at least equate to an agreed-upon return on the parking value and pay all yearly costs. Equation 1 shows the calculation of the hourly rate.

$$r_{BaselineHourly} = \frac{(r_{Investment} \times v_{Parking}) + c_{YOPD}}{(n_{HoursPerYear} \times f_{TO})} \qquad \textbf{(Eq. 1)}$$

where:

$r_{BaselineHourly}$	=	the computed baseline hourly rate to park
$r_{Investment}$	=	yearly return on investment, such as .06
$v_{Parking}$	=	value of a parking space, such as (parking garage) \$40,000
c_{YOPD}	=	yearly operations[15] plus depreciation, per space, such as \$100
$n_{HoursPerYear}$	=	number of hours per year, 24 x 365 = 8760 Hours per Year
f_{TO}	=	fraction of time occupied, such as 0.55.

For the example values given, the base hourly rate of parking, to cover the cost of the investment, operations[15], and depreciation is \$0.519 per hour. This could be rounded up to \$0.52 per hour. This price could also be increased to result in positive TDM, to reduce driving more than the fair-price, zero-TDM amount.

On-Street

If on-street parking is located within walking distance (one-quarter mile) of off-street parking, its base price is set equal to the closest off-street parking's base price. Otherwise, it is set to some agreed-upon value, like fifty cents per hour. However, on-street parking has a special meaning for downtown merchants and for neighborhoods, two powerful political forces in any city. Merchants that have few cars parking on their street, even though it is permitted, are probably failing in their businesses. They would like free parking to help draw visitors to their store front. Neighborhoods that are not impacted by parking would probably prefer no pricing. For these reasons, for any on-street parking cluster, no price is charged until the cluster occupancy reaches 50%. (Time of day is irrelevant.)

Congestion Pricing

The time-rate price of parking is dynamically set on each cluster of parking, to prevent the occupancy rate from exceeding 85% (to reduce the need to drive around looking for parking). An 85% occupancy rate (15% vacancy) results in just over one vacant parking space per city block[5]. If the vacancy rate is above 30%, the price is left at the baseline hourly rate. If vacancies fall below 30%, the price can be calculated in a stair-step method, such as shown in Table 2.

Equation 2 is an alternative method.

In either case, the total charge is time parked, multiplied by the time-averaged, time-rate price. The base multiplier would be adjusted to be just large enough to keep the vacancy rate from falling below a desired level, such as 15%, so it is always easy to find parking.

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[15] This includes money for policing, cleaning, maintenance, any applicable parking tax, and all collection costs. Collection costs will need to include an amount to recover the development and installation costs of *Intelligent Parking*.

Table 2 Hourly Rates for 2 Base Multipliers and a Baseline Hourly Rate of $0.52

Vacancy Rate	Base Multiplier = 2			Base Multiplier = 2.5		
	Multiplication		Hourly Rate	Multiplication		Hourly Rate
	Formula	Value		Formula	Value	
Above 30%	2^0	1	$0.52	2.5^0	1	$0.52
25% to 30%	2^1	2	$1.04	2.5^1	2.5	$1.30
20% to 25%	2^2	4	$2.08	2.5^2	6.25	$3.25
15% to 20%	2^3	8	$4.16	2.5^3	15.625	$8.13
10% to 15%	2^4	16	$8.32	2.5^4	39.0625	$20.31
5% to 10%	2^5	32	$16.64	2.5^5	97.6563	$50.78
Below 5%	2^6	64	$33.28	2.5^6	244.1406	$126.95

$$r_{HourlyRate} = r_{BaselineHourly} \times \left(B^{(30-V)/5}\right), for\ V < 30;\ r_{BaslineHourly}\ , otherwise$$ **(Eq. 2)**

where:

$r_{HourlyRate}$ = the congestion-priced hourly rate to park

$r_{BaselineHourly}$ = the baseline hourly rate to park, such as $0.52 per hour (taken from from Eq. 1.

B = the base of the multiplier being computed, such as 2.50

V = the vacancy rate percent, such as 17.5, for 7 vacancies in a cluster of 40 spaces, 100*(7/40) = 17.5

For the example values given, the hourly rate of parking would be $9.88 per hour.

Pricing Predictions and Notifications

Drivers will develop strategies for their routine trips. The computer system that keeps records of parking use will also provide help for users. The *Intelligent Parking* website will direct a user to an appropriate cluster of parking if the user provides the destination location or locations, the time and date, and the hourly rate they wish to pay. If the walk is going to be long, the website could suggest using transit to get from the cheaply-priced parking to the destination. In such cases, the website may also suggest using transit for the entire trip.

Another user option is to specify the time, location, and the distance the user is willing to walk. In this case, the computer would give the cheapest cluster of parking available at the specified walk distance. The price prediction would be provided.

All price predictions would also have a probability of correctness associated with them. If a user can show that a computer has predicted a much lower price than what actually occurred, with a sufficiently high probability, it would be reasonable to charge the user the predicted price rather than the actual price.

Websites could routinely inform viewers when occupancy rates are expected to be unusually high, due to a special event (for example, a sporting event). The parking system website will always give current and predicted hourly rates for all locations. The hourly rates of parking will also be available at a phone number and possibly at pay stations. The base-price hourly rate, for any parking cluster, would be stable and could therefore be shown on signs. Parking garage entrances could have large video screens showing both predicted and existing price. Users will also learn to look at parking and judge whether congestion pricing applies, or could apply, while their car is parked. It would not be long before these capabilities are added into GPS navigation systems.

Prepaid RFID

To be inclusive, pay stations or convenience stores will offer a pre-paid RFID that can be set on the dashboard of a car. This will support drivers with poor credit or drivers who have not obtained the necessary equipment to support the normal, trouble-free methods. This will also work for drivers that do not trust the system to protect their privacy for a certain trip (by removing or disabling the permanent RFID) or for all trips. No billing would occur.

Enforcement

The system would notify the appropriate law enforcement agency if an unauthorized car was parked. Authorized cars would need either a pre-paid RFID or equipment indicating that their owners had *Intelligent Parking* accounts and were sufficiently paid up on their bills.

IMPLEMENTATION

This description of *Intelligent Parking* will help to implement efficient parking systems. Parking at train stations, schools, and government buildings could introduce many of these concepts. This description of *Intelligent Parking* is sufficient to support a “Request for Proposal” process, which could lead to full implementation. Widespread installation should be done by a government agency, to minimize actions required on the part of the private sector. Laws would simply require the cooperation of all private-sector and government entities.

SUMMARY

A parking plan, *Intelligent Parking* has been described.

1. Technology will make it easy to use for most drivers.
2. Its parking is almost always shared, to support mixed uses.
3. It unbundles cost by charging and having earnings go to the parking beneficiaries.
4. Traditional groups, such as single-family home owners, employees, tenants, train riders, and students benefit from parking. The benefit is equal for drivers and non-drivers.
5. Baseline prices are computed primarily from the value of the parking and an agreed-upon rate of return. On-street parking is free until it is half full, at which time its base price often matches that of the closest off-street parking.
6. For all parking, price is dynamically increased to guarantee availability. Earnings are therefore only limited by what people are willing to pay.
7. Technology helps drivers find parking and decide if they want to drive or use transit.
8. Prepaid RFIDs provide service to those who have poor credit or don’t want to be billed.
9. Disabled and perhaps low-income drivers will have accounts that allow them to park at reduced prices and perhaps avoid congestion pricing. Specially designated spots might also be required for disabled drivers.

10. The system will provide reports showing where additional parking would be a good investment and where it would be wise to convert existing parking to some other use.
11. Privacy will be protected. Law enforcement officials would need a search warrant to see where someone's car has been parked. The level of detail on billing would be selected by the car's owner.
12. Implementations could begin in carefully selected locations and expand.

Global warming, air pollution, trade deficits, and fairness are some of the significant reasons that governments have a responsibility to implement *Intelligent Parking*.

ACKNOWLEGEMENTS

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Dr. Dennis Martinek, Oceanside Planning Commissioner; Sandra Goldberg, California Deputy Attorney General; Jerry Kern, Oceanside, City Council; Amy Volzke, Principal Planner, City of Oceanside; Dr. Nilmini Silva-Send, Senior Policy Analyst of the Energy Policy Initiative Center; Diane Nygaard, Director of Preserve Calavera and founder of Nelson Nygaard, Consulting Associates; Lisa Rodman, Trustee, Carlsbad Unified School District; Dr. Michael McQuary, President, La Jolla Democratic Club; Joan Bullock; Judy Jones, San Diego County Central Committee, California Democratic Party; Patrick Siegman, Principal and Shareholder, Nelson Nygaard; Andy Hamilton, San Diego Air Pollution Control District; Renee Owens, Conservation Chair, San Diego Sierra Club; Caroline Chase, Executive Committee Chair, San Diego Sierra Club; Ed Mainland, Co-Chair, Energy-Climate Committee, Sierra Club California; Bern Grush, Chief Scientist, Skymeter Corporation; and the following San Diego Area Government (SANDAG) employees: Susan Baldwin, Senior Regional Planner; Bob Leiter, former Director of Land Use and Transportation Planning; Coleen Clementson, Principle Planner; and Stephan Vance, Senior Regional Planner.

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KEYWORDS

A&WMA, Parking, Unbundled, Shared, TDM, cash-out, pricing, beneficiary, greenhouse gas, GHG, GPS, RFID

Equitable and Environmentally-Sound Car-Parking Policy at a Work Site

By Mike Bullock mike_bullock@earthlink.net

Aug. 30, 2015

Introduction

This paper describes a parking policy that distributes the benefit of parking to all employees, regardless of how often they choose to drive. It does this by

- Charging a fair price for the parking, per unit of time parked, and by
- Giving the total earnings (*total parking-lot earnings*) to the employees, such that each employee's share of the *total parking-lot earnings* is proportion to the time they spend at the work site served by the parking.

The following, additional, optional action would guarantee that no driver loses money under the policy:

- Adding a *must-drive bonus* to each driver's share of the *parking-lot earnings*, if it happened that their share of the *parking-lot earnings* is less than their parking-lot charge. This means that the employee's *must-drive bonus* would be equal to their *parking-lot charge* minus their share of the *parking-lot earnings*.

If an employer decided to pay a *must-drive bonus* to its employees, it would be possible to allow employees to effectively "opt out" of the program so they would not need to be mailed the car-parking statements. The system would feel like "free parking" to them.

Reference 1 describes a more comprehensive policy that will efficiently and conveniently unbundle the cost (or the benefit) of parking in all circumstances. It is available at the following URL: http://sierraclub.typepad.com/files/mike-bullock-parking-paper.pdf.

The system described herein is less complex because it does not include congestion pricing, price predictions, or policies that are unique to on-street parking. These features can be eliminated, because it is assumed that there will be an adequate supply of parking, so no congestion pricing is needed; that the price can be relatively stable, so no price predictions are needed; and finally, that employees can be successfully required to park only in their employee parking, so there is no need for new, on-street parking policies, designed to protect adjoining neighborhoods from the intrusion of additional parked cars. If the adjoining neighborhoods had permit parking with a 2-hour limit for cars with no permit, very few employees would ever park in those neighborhoods, in any case.

Rationale

This system of “unbundled parking cost” will allow all stakeholders to see the actual value of the parking. It will reduce single-occupancy driving to work. Less driving will reduce traffic congestion, air pollution and greenhouse gas (GHG) emissions.

Parking is expensive to provide. Therefore, if no parking had been provided, the saved money could have been invested to increase employee salaries. The method described in this paper allows employees to gain some of that lost salary back, by driving less.

Providing free or underpriced parking only benefits employees that would drive every day, even if they had a method to recover some of their lost salary.

Methods

The parking is operated on the behalf of the employees, as if it were their own business. Those that drive to work are therefore their own customers.

Charge for parking is proportional to time parked and is charged to the employee associated with the car. (A charge rate that is acceptable to all must be established.) For example, if sixty cents per hour is selected, the charging software could round off the parking duration time to the nearest minute and apply a one-cent-per-minute charge. The data-collection method could be implemented with RFID’s on cars being detected at parking-lot entrances and exits. Unauthorized cars coming into the employee parking facilitiy would be identified with license-plate detection and, if a car belonging to a felon is driven into the parking lot, a warning notice could be sent to authorities, if this is desired by the company leaders.

Earnings (net revenue, minus the cost of collection and distribution) are given to the employees; in proportion to the time they spend at the work site. This could be based on an employee’s schedule or, for more accuracy, could be based on “time-at-the-work-site” data, collected using personal radio frequency identification units (RFIDs) and detectors that are tied to a central, implementing computer. The variables used to compute the amount of money to be paid to an employee are shown in Table 1. The corresponding formula is shown in Figure 1.

Parking statements are automatically sent out monthly, showing the individual’s charges and earnings. If desired, the statements could include a *must-drive bonus*, so that no driver losses money under the system. The *must drive bonus* would probably need to come from funds available for employee compensation.

Implementation

Since this is a new system, it would be prudent for the company leaders to have the vendor take the full responsibility for operating the system, for the first 10 years. This arrangement would ensure that the vendor would debug the system and continue to look for operational efficiencies, over the 10 year period. A sliding scale of vendor-compensation could be specified in the contract, as follows: The vendor could operate the system for 10% of the revenue, for the first 5 years; 5% of the revenue, for the next 3 years; and 2% of the revenue, for the final 2 years. For example, if it is assumed that, on average, 600 cars are parked for 8 hours, for 200 days per year, at a rate of 50 cents per hour, then the yearly revenue would be $480,000 per year. The vendor would therefore collect $240,000 over the first 5 years, $72,000 over the next 3 years, and $28,800 over the last two years. Figure 2 shows contact information and excerpts of received emails, from a San Diego vendor. This vendor has stated that the design and installation of a fully-automated system would be easy to perform.

Table 1 Variables Used to Compute an Employee's Monthly Earnings

Definitions to Compute an Employee's Monthly Earnings	
$T_{Employee}$	The Employee's Monthly Time at the Work Site
$T_{AllEmployees}$	Total Monthly Time at the Work Site, All Employees
$E_{AllEmployees}$	Total Monthly Earnings from the Employee Parking

Figure 1 Formula Used to Compute an Employee's Monthly Earnings

$$E_{Employee} = T_{Employee} * (E_{AllEmployees} / T_{AllEmployees})$$

Introducing a New Price Differential, for Driving, Compared to Not Driving

Table 2 shows that introducing a price differential into the choice of how often to drive will decrease the amount of driving.

Other Benefits

Depending on the work site's location and the size of its access roads, there could be a substantial decrease in local congestion, improving the health of all employees and those living near the congestion. This parking policy will show neighbors that the company is working to be a good citizen. This program will encourage active transportation, meaning modes that provide exercise for the employees. It will also teach the employees the value of parking. It is recommended that the method of determining the selected rate of charge be shared with both the employees and the community at large. This program can be thought of as a demonstration project of a new approach to parking.

Figure 2 One Set of Identified-Vendor Information

David R. Carta, Ph.D., CEO **TELAERIS Inc.** **Innovative Solutions and Rapid Development** **9123 Chesapeake Dr., San Diego, CA 92123** **+1.858.627.9708 : Office** **+1.858.627.9702 : Fax** **+1.858.449.3454 : Mobile** **e-mail: David.Carta@Telaeris.com** **skype: davidcarta**	I reviewed your Intelligent Parking proposal and presentation in their entirety. The identification of vehicles which you suggest for student parking using commercially available RFID technologies is a fairly straightforward process. There are numerous, inexpensive passive (no battery required) RFID tags which have been specifically designed for use on cars and trucks. These tags are installed directly on license plates or windshields, can be read from up to 30 meters away, and can be read as cars drive up to 60 mph. Additionally, automatic license recognition systems, used in conjunction with RFID, can provide a high level of enforcement making it difficult to cheat the system, similar to the Fast Track system which allows tolls to be automatically collected. This is not too tough - we probably would integrate with a service that already sends physical mail from a electronic submission instead of re-inventing this wheel.

Green House Gas Impacts

S-3-05 is a California Governor's Executive Order to drop the state's Year 2020 levels of greenhouse gas (GHG) emissions to the state's level of 1990 emissions and to drop the state's Year 2050 level of GHG emissions to 80% *below* the state's 1990 levels. If the world were to achieve similar reductions, the earth's level of atmospheric C02 would be capped at 450 parts per million (PPM). Figures 3, 4, and 5 show how large 450 PPM is, compared to values over the last 800 thousand years. Reference 2 shows that the goal of S-3-05 is to limit atmospheric C02 to 450 PPM and it also shows that even if this cap is achieved, the risk of a human catastrophe caused by global warming is significant. Reference 3's Figure 1 shows that a significant reduction in driving is critically needed.

Conclusion

Adopting this program would benefit the employer, the employees, and the community, in many ways. They will all gain an added understanding of economics, technology, and the power of the free-market principle that sometimes it is better to have people pay for what they use and not force people to lose money for something they don't use. All the members of the work-place community could take pride in being part of this pioneering effort to reduce driving and greenhouse gas emissions. It would be a demonstration of the fundamental features of Reference 1. It would set an example for other employers.

Table 2 Eleven Cases of Pricing Impact on the Amount of Driving

Impact of Financial Incentives on Parking Demand			
Location	**Scope**	**1995 dollars per mo.**	**Parking Use Decrease**[1]
Group A: Areas with little or no public transportation			
CenturyCityDistrict, West Los Angeles	3500 employees at 100+ firms	$81	15%
Cornell University, Ithaca, NY	9000 faculty & staff	$34	26%
San Fernando Valley, Los Angeles	1 employer, 850 employees	$37	30%
Costa Mesa, CA		$37	22%
Average for Group		**$47**	**23%**
Group B: Areas with fair public transportation			
Los Angeles Civic Center	10000+ employees, several firms	$125	36%
Mid-Wilshire Blvd., Los Angleles	1 mid-size firm	$89	38%
Washington DC Suburbs	5500 employees at 3 worksites	$68	26%
Downtown Los Angeles	5000 employees, 118 firms	$126	25%
Average for Group		**$102**	**31%**
Group C: Areas with good public transportation			
University of Washington, Seattle Wa.	50,000 faculty, staff & students	$18	24%
Downtown Ottowa, Canada	3500+ government staff	$72	18%
Bellevue, WA	1 firm with 430 employees	$54	39%[2]
Average for Group, but not Bellevue Washington		**$45**	**21%**
Over All Average, Excluding Bellevue Washington			**25%**

[1]**Parking vacancy would be higher!** [2]**Not used, since transit & walk/bike facilities also improved.**

Figure 3 Atmospheric CO2, Increasing Over Recent Decades

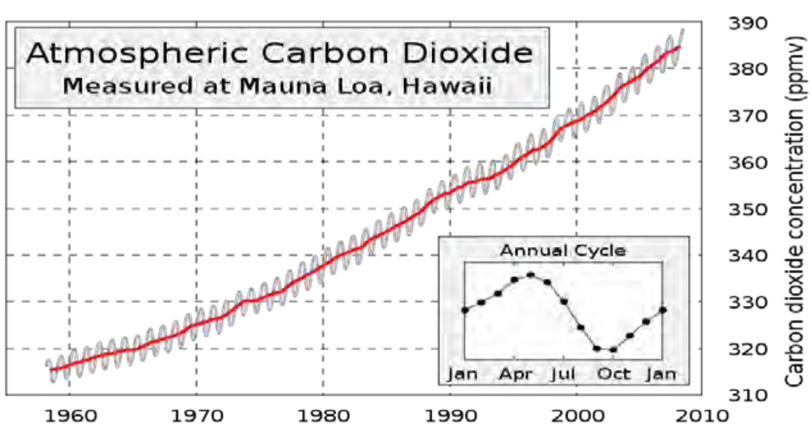


Figure 4 Atmospheric CO2 and Mean Temperature, 800,000 Years Ago, with 450 PPM C02 Shown

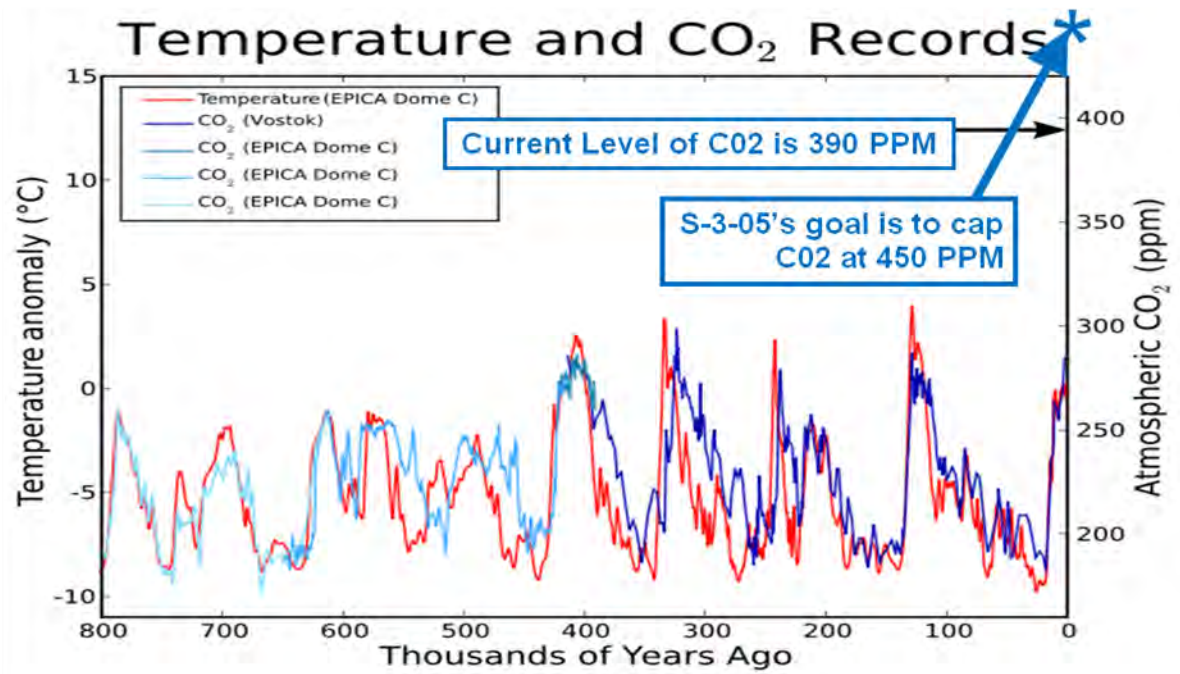
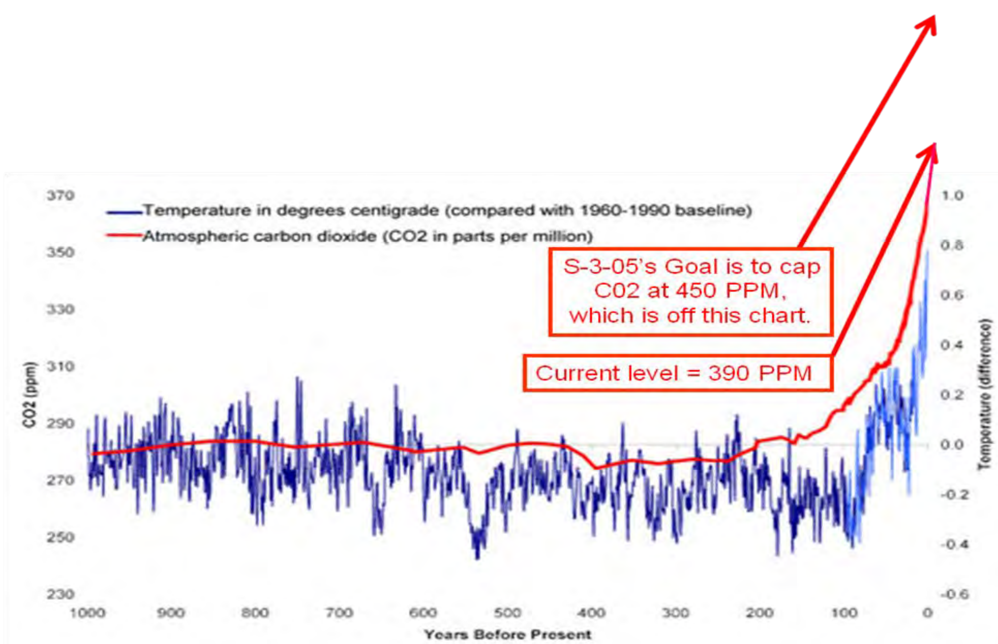


Figure 5 Atmospheric CO2 and Mean Temperature, Over the Last 1,000 Years



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Transformative Climate Communities Program

DRAFT SCOPING GUIDELINES

CALIFORNIA STRATEGIC GROWTH COUNCIL

CALIFORNIA CLIMATE INVESTMENTS

NOVEMBER 2016

Draft Scoping Guidelines: Transformative Climate Communities Program

These Draft Scoping Guidelines for the Transformative Climate Communities Program are being made available for public comment. This scoping document does not represent the full Draft Guidelines for the program, but is intended to provide an initial framework. The Strategic Growth Council (SGC) recognizes that many areas presented in the document require additional work and discussion, and we look forward to public input to help inform development of the Draft Guidelines.

Comments are due to SGC by 5:00pm on January 9, 2016.

Please submit comments to:

tccpubliccomments@sgc.ca.gov

or:

Strategic Growth Council
ATTN: Mackenzie Wieser
1400 Tenth Street
Sacramento, CA 95814

SGC plans to release the Draft Guidelines for the Program in late January or early February of 2017. Release of the Draft Guidelines will be accompanied by multiple public workshops throughout the state as well as additional public comment periods to inform development of the Program.

TABLE OF CONTENTS

I. INTRODUCTION

A. BACKGROUND

Assembly Bill 2722 established the Transformative Climate Communities Program, administered by the SGC, to "…fund the development and implementation of neighborhood-level transformative climate community plans that include multiple, coordinated greenhouse gas emissions reduction projects that provide local economic, environmental, and health benefits to disadvantaged communities as described in Section 39711 of the Health and Safety Code." (Pub. Resources Code § 75240.)

The Transformative Climate Communities Program (Program) will accelerate greenhouse gas reduction and advance local climate action in disadvantaged communities through an integrated, community-based approach. The Program is an opportunity to realize the State's vision of Vibrant Communities and Landscapes, demonstrating how community engagement coupled with strategic investments in transportation, housing, energy, natural resources, and waste can reduce greenhouse gas emissions and other pollution, while also addressing growing equity issues and enhancing economic opportunity and community resilience.

Strong local engagement and cross-sector partnerships are critical to realizing this vision. In addition to reducing greenhouse gas emissions, the Program will serve as a model for catalyzing local, multi-sector partnerships that leverage private and public funds to sustain community revitalization and equitable development, while meeting the State's climate goals.

B. WHAT IS A TRANSFORMATIVE CLIMATE COMMUNITY?

Transformative climate communities integrate building and infrastructure projects with community-driven, multi-sector partnerships that reduce greenhouse gas emissions, increase climate resiliency, expand economic opportunities, and reduce health, environmental and social inequities to create beautiful places with equitable access.

The SGC anticipates making substantial, concentrated investments in communities, but recognizes this is but one piece of a truly transformative effort. In partnership with the SGC, awarded applicants will use the state investment in concert with multiple related efforts driven by community engagement, which may include additional financing, philanthropic funding, parallel and connected capital investments, business and workforce development projects, public health programs, K-12 and higher education programs, career and technical training, entrepreneurship support, volunteer programs, civil society projects, and other efforts associated with community-wide transformation.

Applicants must develop an integrated plan with measurable goals, and demonstrate the community leadership, human and social capital, and internal and external accountability needed to monitor a set of criteria that become core and ongoing components of transformation.

B. PROGRAM SUMMARY

The Program will award competitive funding totaling approximately $140 million in Implementation Grants for the implementation of transformative, neighborhood-level plans in three communities. Through a complimentary program, the SGC will also award approximately $1.5 million in Planning

Grants in up to ten communities, intended to facilitate community readiness for future implementation funding through State and/or other sources.[1]

On September 23, 2016, the SGC released a Notice of Proposed Rulemaking to allocate a minimum of half of the Implementation Grant funds in the City of Fresno, a minimum of one-fourth in the City of Los Angeles, and the remaining Implementation Grant funds in a third location to be determined.

The SGC may award grants over multiple years and prioritize investment in the State's most disadvantaged communities.

The SGC intends to seek long term funding for the program. With this initial appropriation, the SGC hopes to provide diverse models of neighborhood-level transformation that can be studied, replicated and adapted based on measured outcomes that include not only deep greenhouse gas reduction, but also the maximization of climate, public health, environmental, workforce and economic benefits.

II. Program Requirements

The Program seeks well-organized communities that demonstrate multi-sector partnerships capable of governing and implementing a transformative vision for a designated area, including integrated projects that will achieve **all** of the Primary Objectives and Performance Criteria listed below.

A. Eligibility

1. Eligible applicants may include but are not limited to: nonprofit organizations, community-based organizations, faith-based organizations, coalitions or associations of nonprofit organizations, community development finance institutions, community development corporations, local governments, joint powers authorities, and/or tribal governments.
2. Joint applications including multiple entities are strongly encouraged, and must include the identification of a lead applicant and co-applicants.
3. Applicants must demonstrate capacity and readiness to implement coordinated projects, including:
    i. Ability to govern and implement large infrastructure projects, including evidence of past performance, letters of support from local and/or regional governments, and the ability to work with multiple levels of government as needed for project implementation.
    ii. Evidence of diverse community support, such as from elected officials, key stakeholders, community foundations, state, regional and local government agencies, local health departments, community groups, and private partners.
    iii. Partnerships that provide the ability to attract and leverage additional public, private, and philanthropic funding.
    iv. Partnerships that ensure the ability to collect data and analyze outcomes over time; support from universities and community colleges for data collection and analysis are encouraged.
4. Applicants must demonstrate alignment with one or more up-to-date, adopted community or neighborhood plan for the targeted area of investment that reflect best practices in sustainable development and community revitalization, and reflect comprehensive and documented

[1] Planning grants will be funded through SGC's Sustainable Communities Planning Grants and Incentives Program.

community engagement. Priority will be given to proposals that prioritize focused implementation of:

   a. Specific plans for multi-modal hubs that prioritize district-scale and regional transit and active transportation connectivity to employment and service centers.
   b. Well-integrated plans that coordinate housing, multi-modal transportation connectivity, renewable energy generation, water efficiency, storm water management and other urban greening improvements;
   c. Physical and programmatic connectivity to low-income and disadvantaged residents to improve access to jobs; workforce development and economic opportunity for low-income and disadvantaged residents; and integration of affordability and equitable access to infrastructure and supportive services for low-income and disadvantaged residents.

5. Applicants from cities within the High Speed Rail Initial Operating Segment must demonstrate that their proposals support implementation of an integrated Station Area Plan.

B. Primary Objectives

1. **Maximize greenhouse gas emissions reduction.** Develop and deploy integrated projects that accelerate greenhouse gas emissions reduction.
2. **Build, strengthen and sustain local leadership and grassroots engagement in civic and community development.** Forge enduring, multi-sector commitment to local partnerships and community engagement while implementing adopted community, specific, or other local plans.
3. **Implement Sustainable Communities Strategies**. Implement projects that are prioritized in adopted regional Sustainable Communities Strategies, focus on infill development and yield the highest reductions in greenhouse gases.
4. **Improve environmental, social and health equity.** Promote equitable distribution of the benefits and burdens of investment and development, and improve the public health and well-being of residents.
5. **Expand economic opportunity.** Provide access to quality local job opportunities and workforce training through projects, and direct community benefit through economic development and investment opportunities.
6. **Increase resilience.** Invest in projects that increase the resilience of communities, economies, and infrastructure in the face of a changing climate and other pressures.
7. **Leverage funding.** Secure a minimum of 100% match of awarded grant amount through other funding sources.
8. **Quantify and evaluate impacts.** Commitment to monitor performance criteria tied to specific goals, and share data with the State and across community partners.

C. Performance Criteria

The Performance Criteria support the Primary Objectives, and applicants must implement projects that meet all criteria. For each criterion, applicants must identify a specific goal as well as metrics that can measure performance and ongoing progress toward the goal. Example metrics are included with some of the criteria.

1. *Greenhouse Gas Reduction.* Meet or exceed a path toward long-term emissions reduction that aligns with State goals, including implementation of SB 375. Potential metrics: Baseline and ongoing greenhouse gas emissions inventories consistent with the State's inventory, GGRF quantification methodologies, or other ARB-developed approaches.

2. *Equitable Development.* Promote equity and opportunity, and ensure equitable distribution of the benefits and burdens of investment and development, including strategies that result in mixed-income neighborhoods where families choose to live and businesses choose to invest. Potential metrics: Percentage of mixed-income housing in the community relative to current poverty rates and concentration of existing subsidized housing; community income diversity; number of jobs that can be accessed by disadvantaged community residents; measured engagement in the community from past and current planning processes.
3. *Community Engagement and Leadership Development.* Demonstrate engagement of community organizations and local stakeholders throughout development and implementation of projects, and provide opportunities for community leadership and input throughout activities and decision-making. Potential metrics: Number and location of community meetings held regarding projects; diversity of perspectives from engaged partners and local residents; contracted partnerships with community-based organizations; establishment of community benefits agreement; other metrics associated with comprehensive, community-driven planning processes that result in environmental clearance and formal adoption of community or specific plans.
4. *Educational and Economic Opportunities.* Develop local "green" jobs for low-income residents, support expansion of local businesses, encourage businesses to locate in the community, attract private investment, promote use of local goods and services, increase availability of and participation in high-performing educational and job training opportunities. Potential metrics: number of jobs created, hours performed by disadvantaged community residents, number of contracts with local businesses, participation in education, apprenticeship and workforce training programs, high school graduation rates, economic output.
5. *Access and Mobility.* Prioritize active transportation facilities and public transit. Accelerate compact development, zero and near-zero emission transportation, as well as non-auto oriented transportation options through first/last mile, safe and accessible biking and walking routes, and safe and reliable transit options. Potential metrics: percentage change of walking, biking and other non-motorized trips, reduction in vehicle miles traveled, implementation of transit-oriented development, pedestrian and cyclist injuries/fatalities.
6. *Anti-Displacement Strategies.* Avoid physical and economic displacement of low-income disadvantaged community residents and businesses. Potential metrics: displacement, metrics associated with implementing pre-emptive policies and commitments by local governments to protect existing residents and businesses.
7. *Criteria Air Pollutant Reduction.* Reduce criteria air pollutants, particularly pollutants that do not comply with current standards or that pose a particular pollution burden to the community, as defined by the Office of Environmental Health Hazard Assessment. Potential metrics: Localized air quality monitoring at the beginning, throughout and after project implementation.
8. *Land Preservation and Restoration.* Promote land conservation that protects habitats, connects migration corridors, provides ecosystem services, and protects agricultural lands, especially those at risk for near-term urban development. Potential metrics: percentage of land preserved, number of species/habitats protected, economic assessment of ecosystem services, percentage of development in greenfield versus urbanized area.
9. *Decarbonized Energy and Energy Efficiency.* Accelerate the State's zero net energy objectives; minimize the need for new energy infrastructure costs such as transmission and distribution upgrades; implement significant deployment of building retrofits; deploy smart-grid technologies, and support grid reliability and resiliency by incorporating energy storage.

Potential metrics: change in energy use for low-income and disadvantaged communities; emissions of energy sector.

10. *Urban Greening and Green Infrastructure.* Enhancement and expansion of neighborhood parks and community space; greening of public lands and structures, including incorporation of riparian habitat for water capture and provision of other public and wildlife benefits; green streets and alleyways; non-motorized urban trails that provide safe routes for travel between residences, workplaces, commercial centers, and schools; and urban heat island mitigation. Potential metrics: number of trees planted, green infrastructure elements incorporated into project.
11. *Efficient Water Usage.* Implement greywater and recycling systems; drought-resistant landscaping and permeable surfaces; limit urban growth boundaries based on water availability. Potential metrics: Measured reduction in water use, amount of water-efficient fixtures and appliances.
12. *Materials Management.* Implement projects that reduce waste, including food waste recycling and composting, reduced single-use products, waste-to-energy projects. Potential metrics: Materials recycled, measured reduction in landfill tonnage.
13. *Health and Well-Being.* Improve human health and community well-being; increase access to primary care; provide access to parks, trails, and natural areas as well as access to healthy, local and affordable food, and other opportunities to support socially and economically diverse populations. Potential metrics: birth weight, life expectancy, access to healthy food, other physical and mental health outcomes for low-income and disadvantaged communities.
14. *Climate Resiliency.* Develop projects while considering climate change scenarios and impacts, including more extreme heat days, sea level rise, and more variable water systems. Potential metrics: infrastructure preparedness for climate change impacts, including buildings designed for extreme heat days, tree canopy, impervious surfaces; as well as human vulnerability and resilience to climate change, including share of population in high risk locations, social cohesion, asthma emergency department visits, violent crime rate, and heat-related illnesses.

III. Application Process

A. Implementation Grants

Implementation Grants will be awarded through a two-phase competitive process.

1. Concept Proposal
   - i. Applicants must provide a concept proposal describing a vision and plan for district-scale transformation that contains specific goals and metrics, and meets all Primary Objectives and Performance Criteria.
   - ii. Applications must present coordinated and collaborative proposals that encompass multiple, mutually-reinforcing projects and initiatives concentrated within a discrete and focused geographical area.
   - iii. Applicants must identify goals and metrics tied to specific Project Components within a single Project Area.
     - a. *Goals*: goals must be identified for each Performance Criterion, and should be accompanied by a description of how each goal supports the Primary Objectives of the Program.
     - b. *Metrics*: at least one metric must be identified for each Performance Criterion for the purpose of measuring progress toward each criterion and goal. Metrics must be tied to all Project Components.

c. *Project Components*: Project Components must be identified that result in quantifiable greenhouse gas reductions that provide local economic, environmental and health benefits. Projects should be implementing adopted local land use plans with CEQA clearance to ensure implementation in a timely period. Project Components that are quantifiable through existing GGRF programs are eligible for funding (e.g., an affordable housing and transportation Project Component funded through the Affordable Housing and Sustainable Communities Program). Those that do not have a quantification methodology must be part of a project with a quantifiable component or identify non-GGRF funding.

d. *Project Area*: a Project Area must be defined by the applicant and should be a focused, concentrated geography ideally encompassing no more than two square miles. A Project Area must include only census tracts that are within the top 5% of disadvantaged communities, per CalEnviroScreen 2.0, or the Project Area's boundaries must align with an existing jurisdictionally recognized neighborhood boundary in which at least 51% of the census tracts are within the top 5%. Priority will be given to project areas that encompass significant public infrastructure investment commitments, including major passenger and freight transportation infrastructure hubs. For cities served by the High Speed Rail Initial Operating Segment, priority will be given to projects that concentrate investment within a one-mile radius of the station.

iv. Applicants must demonstrate proof of a community engagement process, form the necessary partnerships for integrated projects, identify opportunities for collaboration, and ensure that the proposal implements up-to-date, adopted specific plans for the Project Area that have been developed through a documented collaborative, community visioning process with participation by a local government. Examples include specific plans, community plans, station area plans, and neighborhood plans.

v. Recently adopted community and/or specific plans may serve as the basis for Concept Proposals.

vi. Budget: applicants must provide a proposed budget containing estimated total project costs, including a breakdown of costs and proposed sources of funding (in addition to Program funding) for each Project Component.

a. Project Components funded through GGRF must meet all GGRF criteria. Funding Guidelines for GGRF programs are available at http://www.arb.ca.gov/cc/capandtrade/auctionproceeds/fundingguidelines.htm. Additional guidance may be developed by ARB.

b. Applicants must demonstrate the extent to which non-GGRF funding sources are leveraged to meet proposed project costs.

vii. Application scoring and selection:

a. Concept Proposals and required supporting documents will be reviewed to assess eligibility and readiness to determine whether an applicant will be invited to submit to the next phase (Full Application). The Concept Proposal is part of the competitive process and as such, all information should be well thought-out and edited for accuracy.

b. Applicants will be notified whether or not they are invited to participate in the Full Application Phase. An invitation to apply does not guarantee the project will compete successfully for funding.

2. Full Application
   i. Those invited to submit Full Applications will further develop their Concept Proposals, including but not limited to:
      a. Creation of detailed infrastructure and development budgets, and an implementation strategy for all plan components.
      b. Additional analysis and project development that may be needed to secure project financing.
      c. Additional detail on how the proposed Project Components address Program Performance Criteria and meet Primary Objectives.
   ii. Invited applicants will work with SGC staff to determine additional establishment, alignment and/or coordination of project governance structures, including local, State and Federal partnerships.
   iii. Project Components funded in whole or part by GGRF funds must demonstrate greenhouse gas emission reductions and other co-benefits. Applicants must submit estimated greenhouse gas emission reductions for all GGRF-funded project components, using ARB-approved quantification methodologies.
   iv. Full Applications are subject to further review and approval by the SGC. An invitation to apply does not guarantee the applicant will compete successfully for funding.
   v. Final Implementation Grant awards shall be determined on a competitive basis based on readiness and a fully developed application.
   vi. Granting of funds is contingent upon the implementation of projects that reduce greenhouse gas emissions.

3. Award Implementation
   i. Applicants must begin project-level implementation within one year of having received an Implementation Grant, and funds may be disbursed over multiple years.
   ii. GGRF funding must be expended within five years of award notification.

4. Outcomes
   i. *Primary Objectives and Performance Criteria.* For each Performance Criterion, applicants must identify goals and metrics to assess those goals towards the achievement of Primary Objectives. Each metric must include a timeline for monitoring and reporting throughout the project for a minimum of 5 years, in addition to any other reporting requirements (e.g., as required by the GGRF Funding Guidelines).
   ii. *Reporting.* Applicants are responsible for fulfilling reporting requirements, which include financial, disadvantaged community benefits, and greenhouse gas reduction reporting annually. Reporting includes estimates at project application and development and measured outcomes as project components are implemented.

B. Planning Grants

1. Planning Grants are intended to provide funding for those communities needing assistance in developing local plans, policies, partnerships or other efforts aligned with the Program.
2. Eligible applicants include Cities, Counties, Metropolitan Planning Organizations, Joint Powers Authorities, Regional Transportation Planning Agencies, Councils of Governments, or combinations thereof.

3. The SGC welcomes proposals focused on undertaking a local planning effort aligned with the Primary Objectives and/or Performance Criteria of the Program, as well as the following:
   i. Be consistent with the State's Planning Priorities, in summary below, and identified in Section 65041.1 of the Government Code. These priorities are intended to promote equity, strengthen the economy, protect the environment, and promote public health and safety in the state, including urban, suburban, and rural communities.
      a. Promote infill development and equity by rehabilitating, maintaining and improving existing infrastructure.
      b. Protect, preserve and enhance environmental and agricultural lands and natural and recreational resources.
      c. Encourage location- and resource-efficient new development.
   ii. Reduce greenhouse gas emissions, on as permanent a basis as is feasible, consistent with The California Global Warming Solutions Act of 2006 (Division 25.5, section 38500 et. seq. of the Health and Safety Code) and any applicable Regional Plan.
   iii. Connect state policies or programs, regional planning efforts, and local plans through coordination and collaboration.
   iv. Promote environmental, social and health equity.
   v. Apply State of California best practices for climate change vulnerability assessment, resilience planning, and adaptation to the effects of climate change on the proposed project.
4. Applicants must submit a proposed budget and timeline.
5. The SGC may prioritize proposals located within the most disadvantaged communities, as described in Section 39711 of the Health and Safety Code.
6. The SGC may prioritize proposals from designees of Federal place-based initiatives, including the Promise Zone Initiative and the Strong Cities Strong Communities Initiative.
7. The highest scoring applicants will be awarded Planning Grants.
8. Planning Grant recipients may be prioritized for future Program funding, should funding be available, including funding from other GGRF programs.

IV. TECHNICAL ASSISTANCE & SUPPORT

The SGC recognizes that the State's most disadvantaged communities often lack the capacity and institutional resources to seek competitive grants, and may not be prepared to apply to the Program or to develop and implement transformative plans.

We are committed to supporting applicants by offering ongoing outreach, support and technical assistance throughout all phases of the application process to achieve Program outcomes, including before and after the granting of funds.

In addition to statewide outreach conducted by the SGC and partner organizations, grant recipients will be eligible for:

- **Technical Assistance:** The SGC and the California Environmental Protection Agency will partner with third party entities to offer assistance in assessing and integrating planning and implementation efforts, strengthening organizational capacity and developing project priorities.
- **Streamlined Application:** SGC will provide a streamlined set of requirements to facilitate project integration and implementation.

- **Financing:** The SGC will partner with other State agencies to coordinate access to financing vehicle(s) (e.g., loan loss reserve, infrastructure financing mechanisms) to attract and leverage additional capital to the extent possible.

STATE OF CALIFORNIA
GOVERNOR'S OFFICE *of* PLANNING AND RESEARCH
STATE CLEARINGHOUSE AND PLANNING UNIT

EDMUND G. BROWN JR.
GOVERNOR

KEN ALEX
DIRECTOR

Notice of Preparation

November 15, 2016

To: Reviewing Agencies

Re: San Diego Forward: The Regional Plan
SCH# 2010041061

Attached for your review and comment is the Notice of Preparation (NOP) for the San Diego Forward: The Regional Plan draft Environmental Impact Report (EIR).

Responsible agencies must transmit their comments on the scope and content of the NOP, focusing on specific information related to their own statutory responsibility, within 30 days of receipt of the NOP from the Lead Agency. This is a courtesy notice provided by the State Clearinghouse with a reminder for you to comment in a timely manner. We encourage other agencies to also respond to this notice and express their concerns early in the environmental review process.

Please direct your comments to:

Andrew Martin
San Diego Association of Governments (SANDAG)
401 B Street, Suite 800
San Diego, CA 92101

with a copy to the State Clearinghouse in the Office of Planning and Research. Please refer to the SCH number noted above in all correspondence concerning this project.

If you have any questions about the environmental document review process, please call the State Clearinghouse at (916) 445-0613.

Sincerely,

Scott Morgan
Director, State Clearinghouse

Attachments
cc: Lead Agency

Document Details Report
State Clearinghouse Data Base

SCH# **2010041061**
Project Title San Diego Forward: The Regional Plan
Lead Agency San Diego Association of Governments

Type **NOP** Notice of Preparation

Description Note: Review Per Lead

The San Diego Association of Governments, as the lead agency under the CEQA, will prepare an EIR for an update to San Diego Forward: The Regional Plan. The Regional Plan will consist of a RTP and a SCS that identify the San Diego region's future transportation investments and growth through 2050.

Lead Agency Contact

Name Andrew Martin
Agency San Diego Association of Governments (SANDAG)
Phone 619-595-5375 ***Fax***
email
Address 401 B Street, Suite 800
City San Diego ***State*** CA ***Zip*** 92101

Project Location

County San Diego
City
Region
Cross Streets
Lat / Long
Parcel No.
Township ***Range*** ***Section*** ***Base***

Proximity to:

Highways
Airports
Railways
Waterways
Schools
Land Use n/a

Project Issues Archaeologic-Historic; Biological Resources; Drainage/Absorption; Economics/Jobs; Flood Plain/Flooding; Forest Land/Fire Hazard; Geologic/Seismic; Minerals; Noise; Population/Housing Balance; Public Services; Recreation/Parks; Schools/Universities; Soil Erosion/Compaction/Grading; Toxic/Hazardous; Traffic/Circulation; Vegetation; Water Quality; Water Supply; Wetland/Riparian; Growth Inducing; Landuse; Cumulative Effects; Other Issues; Aesthetic/Visual; Agricultural Land; Air Quality; Coastal Zone; Fiscal Impacts; Septic System; Sewer Capacity; Solid Waste

Reviewing Agencies Resources Agency; California Coastal Commission; Department of Parks and Recreation; Department of Fish and Wildlife, Region 5; Office of Emergency Services, California; Native American Heritage Commission; Public Utilities Commission; Caltrans, Division of Aeronautics; Caltrans, Division of Transportation Planning; California Highway Patrol; Air Resources Board; Air Resources Board, Transportation Projects; Caltrans, District 11; Department of Toxic Substances Control; Regional Water Quality Control Board, Region 7; Regional Water Quality Control Board, Region 9

Date Received 11/15/2016 ***Start of Review*** 11/15/2016 ***End of Review*** 01/13/2017

Note: Blanks in data fields result from insufficient information provided by lead agency.

Print Form

Appendix C

Notice of Completion & Environmental Document Transmittal

20100041061

SCH #

Mail to: State Clearinghouse, P.O. Box 3044, Sacramento, CA 95812-3044 (916) 445-0613
For Hand Delivery/Street Address: 1400 Tenth Street, Sacramento, CA 95814

Project Title: Program Environmental Impact Report for San Diego Forward: The Regional Plan

Lead Agency: San Diego Association of Governments (SANDAG) — Contact Person: Andrew Martin
Mailing Address: 401 B Street, Suite 800 — Phone: 619-595-5375
City: San Diego — Zip: 92101 — County: San Diego

Project Location: County: San Diego — City/Nearest Community: All 18 cities and unincorporated areas
Cross Streets: ______ Zip Code: ______
Longitude/Latitude (degrees, minutes and seconds): ___° ___′ ___″ N / ___° ___′ ___″ W Total Acres: ~2.7 million acres
Assessor's Parcel No.: ______ Section: ______ Twp.: ______ Range: ______ Base: ______
Within 2 Miles: State Hwy #: ______ Waterways: ______
Airports: ______ Railways: ______ Schools: ______

Document Type:

CEQA: ☒ NOP ☐ Early Cons ☐ Neg Dec ☐ Mit Neg Dec ☐ Draft EIR ☐ Supplement/Subsequent EIR (Prior SCH No.) ______ Other: ______

NEPA: ☐ NOI ☐ EA ☐ Draft EIS ☐ FONSI — Other: ☐ Joint Document ☐ Final Document ☐ Other: ______

Governor's Office of Planning & Research
NOV 15 2016
STATE CLEARINGHOUSE

Local Action Type:

☐ General Plan Update ☐ General Plan Amendment ☐ General Plan Element ☐ Community Plan ☐ Specific Plan ☐ Master Plan ☐ Planned Unit Development ☐ Site Plan ☐ Rezone ☐ Prezone ☐ Use Permit ☐ Land Division (Subdivision, etc.) ☐ Annexation ☐ Redevelopment ☐ Coastal Permit ☒ Other: RTP/SCS

Development Type:

☐ Residential: Units ____ Acres ____
☐ Office: Sq.ft. ____ Acres ____ Employees ____
☐ Commercial: Sq.ft. ____ Acres ____ Employees ____
☐ Industrial: Sq.ft. ____ Acres ____ Employees ____
☐ Educational: ______
☐ Recreational: ______
☐ Water Facilities: Type ______ MGD ______
☐ Transportation: Type ______
☐ Mining: Mineral ______
☐ Power: Type ______ MW ______
☐ Waste Treatment: Type ______ MGD ______
☐ Hazardous Waste: Type ______
☐ Other: ______

Project Issues Discussed in Document:

☒ Aesthetic/Visual ☒ Agricultural Land ☒ Air Quality ☒ Archeological/Historical ☒ Biological Resources ☒ Coastal Zone ☒ Drainage/Absorption ☒ Economic/Jobs ☒ Fiscal ☒ Flood Plain/Flooding ☒ Forest Land/Fire Hazard ☒ Geologic/Seismic ☒ Minerals ☒ Noise ☒ Population/Housing Balance ☒ Public Services/Facilities ☒ Recreation/Parks ☒ Schools/Universities ☒ Septic Systems ☒ Sewer Capacity ☒ Soil Erosion/Compaction/Grading ☒ Solid Waste ☒ Toxic/Hazardous ☒ Traffic/Circulation ☒ Vegetation ☒ Water Quality ☒ Water Supply/Groundwater ☒ Wetland/Riparian ☒ Growth Inducement ☒ Land Use ☒ Cumulative Effects ☒ Other: GHG Emissions

Present Land Use/Zoning/General Plan Designation:
N/A. The project area includes all of San Diego County.

Project Description: *(please use a separate page if necessary)*
The San Diego Association of Governments (SANDAG), as the Lead Agency under the California Environmental Quality Act (CEQA), will prepare a Program Environmental Impact Report (EIR) for an update to San Diego Forward: The Regional Plan (Regional Plan). The Regional Plan will consist of a Regional Transportation Plan (RTP) and a Sustainable Communities Strategy (SCS) that identify the San Diego region's future transportation investments and growth through 2050. Please also see Attachment 1 to the NOP.

Note: The State Clearinghouse will assign identification numbers for all new projects. If a SCH number already exists for a project (e.g. Notice of Preparation or previous draft document) please fill in.

Revised 2010

NOP Distribution List

County: San Diego

SCH# 2010041061

Resources Agency

- [x] **Resources Agency**
  Nadell Gayou
  - [ ] **Dept. of Boating & Waterways**
    Denise Peterson
  - [x] **California Coastal Commission**
    Elizabeth A. Fuchs
  - [ ] **Colorado River Board**
    Lisa Johansen
  - [ ] **Dept. of Conservation**
    Elizabeth Carpenter
  - [ ] **California Energy Commission**
    Eric Knight
  - [ ] **Cal Fire**
    Dan Foster
  - [ ] **Central Valley Flood Protection Board**
    James Herota
  - [ ] **Office of Historic Preservation**
    Ron Parsons
- [x] **Dept of Parks & Recreation**
  Environmental Stewardship Section
  - [ ] **California Department of Resources, Recycling & Recovery**
    Sue O'Leary
  - [ ] **S.F. Bay Conservation & Dev't. Comm.**
    Steve Goldbeck
  - [ ] **Dept. of Water Resources**
    Resources Agency
    Nadell Gayou

Fish and Game

- [ ] **Depart. of Fish & Wildlife**
  Scott Flint
  Environmental Services Division
- [ ] **Fish & Wildlife Region 1**
  Curt Babcock
- [ ] **Fish & Wildlife Region 1E**
  Laurie Harnsberger
- [ ] **Fish & Wildlife Region 2**
  Jeff Drongesen
- [ ] **Fish & Wildlife Region 3**
  Craig Weightman
- [ ] **Fish & Wildlife Region 4**
  Julie Vance
- [x] **Fish & Wildlife Region 5**
  Leslie Newton-Reed
  Habitat Conservation Program
- [ ] **Fish & Wildlife Region 6**
  Tiffany Ellis
  Habitat Conservation Program
- [ ] **Fish & Wildlife Region 6 I/M**
  Heidi Calvert
  Inyo/Mono, Habitat Conservation Program
- [ ] **Dept. of Fish & Wildlife M**
  William Paznokas
  Marine Region

Other Departments

- [ ] **Food & Agriculture**
  Sandra Schubert
  Dept. of Food and Agriculture
- [ ] **Depart. of General Services**
  Public School Construction
- [ ] **Dept. of General Services**
  Cathy Buck/George Carollo
  Environmental Services Section
- [ ] **Delta Stewardship Council**
  Kevan Samsam
- [ ] **Housing & Comm. Dev.**
  CEQA Coordinator
  Housing Policy Division

Independent Commissions,Boards

- [ ] **Delta Protection Commission**
  Erik Vink
- [x] **OES (Office of Emergency Services)**
  Monique Wilber
- [x] **Native American Heritage Comm.**
  Debbie Treadway
- [x] **Public Utilities Commission**
  Supervisor
- [ ] **Santa Monica Bay Restoration**
  Guangyu Wang
- [ ] **State Lands Commission**
  Jennifer Deleong
- [ ] **Tahoe Regional Planning Agency (TRPA)**
  Cherry Jacques

Cal State Transportation Agency CalSTA

- [x] **Caltrans - Division of Aeronautics**
  Philip Crimmins
- [x] **Caltrans – Planning HQ LD-IGR**
  Terri Pencovic
- [x] **California Highway Patrol**
  Suzann Ikeuchi
  Office of Special Projects

Dept. of Transportation

- [ ] **Caltrans, District 1**
  Rex Jackman
- [ ] **Caltrans, District 2**
  Marcelino Gonzalez
- [ ] **Caltrans, District 3**
  Eric Federicks – South
  Susan Zanchi - North
- [ ] **Caltrans, District 4**
  Patricia Maurice
- [ ] **Caltrans, District 5**
  Larry Newland
- [ ] **Caltrans, District 6**
  Michael Navarro
- [ ] **Caltrans, District 7**
  Dianna Watson
- [ ] **Caltrans, District 8**
  Mark Roberts
- [ ] **Caltrans, District 9**
  Gayle Rosander
- [ ] **Caltrans, District 10**
  Tom Dumas
- [x] **Caltrans, District 11**
  Jacob Armstrong
- [ ] **Caltrans, District 12**
  Maureen El Harake

Cal EPA

Air Resources Board

- [x] Airport & Freight
  Cathi Slaminski
  - [x] Transportation Projects
    Nesamani Kalandiyur
  - [ ] Industrial/Energy Projects
    Mike Tollstrup
- [ ] **State Water Resources Control Board**
  Regional Programs Unit
  Division of Financial Assistance
- [ ] **State Water Resources Control Board**
  Cindy Forbes – Asst Deputy
  Division of Drinking Water
- [ ] **State Water Resources Control Board**
  Div. Drinking Water #________
- [ ] **State Water Resources Control Board**
  Student Intern, 401 Water Quality Certification Unit
  Division of Water Quality
- [ ] **State Water Resouces Control Board**
  Phil Crader
  Division of Water Rights
- [x] **Dept. of Toxic Substances Control**
  CEQA Tracking Center
- [ ] **Department of Pesticide Regulation**
  CEQA Coordinator

Regional Water Quality Control Board (RWQCB)

- [ ] **RWQCB 1**
  Cathleen Hudson
  North Coast Region (1)
- [ ] **RWQCB 2**
  Environmental Document Coordinator
  San Francisco Bay Region (2)
- [ ] **RWQCB 3**
  Central Coast Region (3)
- [ ] **RWQCB 4**
  Teresa Rodgers
  Los Angeles Region (4)
- [ ] **RWQCB 5S**
  Central Valley Region (5)
  - [ ] **RWQCB 5F**
    Central Valley Region (5)
    Fresno Branch Office
  - [ ] **RWQCB 5R**
    Central Valley Region (5)
    Redding Branch Office
- [ ] **RWQCB 6**
  Lahontan Region (6)
  - [ ] **RWQCB 6V**
    Lahontan Region (6)
    Victorville Branch Office
- [x] **RWQCB 7**
  Colorado River Basin Region (7)
- [ ] **RWQCB 8**
  Santa Ana Region (8)
- [x] **RWQCB 9**
  San Diego Region (9)

- [ ] **Other** ________________
  ____
  ____

- [ ] ________________
  Conservancy

From: Sue Prelozni
To: Martin, Andrew
Cc: Sue Prelozni
Subject: Information for Sustainable Communities Strategy
Date: Monday, January 16, 2017 3:17:03 PM

Hello Andrew,
I received information and a request for feedback to SANDAG regarding the planning for Sustainable Communities Strategy. I apologize to be a day late.
I am not sure the proper protocol but would like to submit that the work of our organization, Sustainable Surplus Exchange, Inc., be included in the planning. We are a 501(c)(3) nonprofit that takes corporate excess and turns it into community assets.
We have repurposed more than $2.5 million of still usable assets from 300 corporations, and we have redistributed it to more than 400 local schools, nonprofits and start-up companies. As a result, we have diverted about 500,000 pounds of solid waste from the landfill.

Please let me know what information you need to help further this excellent opportunity for San Diego communities. Thank you!

Celebrate a New Year!!
Sue

Sue A Prelozni, MA
Founder, CEO
888.780.4416 - ext 4

Turning Corporate Excess into Community Assets

www.SustainableSurplus.org l Watch our video

SWIA

January 9, 2017

SANDAG
401 B Street, Suite 800
San Diego, CA 92101
Attention: Andrew Martin, Senior Regional Planner (andrew.martin@sandag.org)

Re: SANDAG NOP for Preparation of a Program EIR for San Diego Forward: The Regional Transportation Plan/Sustainable Communities Strategy

Dear Mr. Martin:

The Southwest Wetlands Interpretive Association (SWIA) is a non-profit organization dedicated to the education in and acquisition, preservation and restoration of wetlands throughout southern California and particularly in the Tijuana River watershed. SWIA was founded in 1979 and worked to establish the Tijuana Slough National Wildlife Refuge in 1980, the Tijuana River National Estuarine Research Reserve in 1982, the San Diego Bay National Wildlife Refuge in 1999, designation of the Tijuana Estuary as a Wetland of International Importance under the Ramsar Convention in 2005 and a State Marine Conservation Area under the State Marine Life Protection Act in 2010. Historical losses of wetlands (particularly vegetated and shallow-subtidal types) have occurred from development, but climate change and sea level rise represent a significant additional threat. The SWIA staff does research on and supports planning that will substantially reduce climate change forces (especially GHG emissions) and land uses that allow for wetlands to be maintained or expanded.

We provide the following comments on the NOP issued by SANDAG on November 14, 2016. The project is described as an update to the current 2050 RTP/SCS, a plan that is primarily intended to implement the requirements of SB 375 whereby regional planning agencies identify implementable measures to reduce greenhouse gas (GHG) emissions - primarily through reducing passenger vehicle miles traveled and improving land uses. Because the current RTP/SCS was also prepared to update and incorporate the Regional Comprehensive Plan (RCP), the NOP should have described – and SANDAG must declare - whether this project also includes an update of the RCP component.

This RTP is a required update to the previous (2015) RTP/SCS. SWIA and many other commenters considered that to be an inadequate plan to improve the region's transportation system network or to help guide land use changes that would significantly reduce the region's GHG emissions. Our comments are based on our participation in SANDAGs previous SB 375 efforts, state-level and other regional-level SB 375 planning, and local climate action planning (CAP) efforts over the past decade.

Southwest Wetlands Interpretive Association ▪ P.O. Box 575 ▪ Imperial Beach, CA 91933
tel. (619) 575-0550 ▪ fax (619) 424-6420 ▪ www.swia4earth.org

As noted in the NOP, SB 375, and thus the RTP, has three primary goals:

1. Using the regional transportation planning process to reduce greenhouse gas (GHG) emissions from passenger vehicles;
2. Offering incentives under CEQA to encourage projects that are consistent with a SCS that achieves the GHG emission reductions; and
3. Coordinating the Regional Housing Need Allocation process with the Regional Transportation Planning process while maintaining local authority over land use decisions.

Preparing an RTP/SCS that achieves these goals is critical to the San Diego Region's continued quality of life and would contribute significantly to larger state, national and global GHG emission objectives. However, to do so the RTP must acknowledge and successfully overcome several misconceptions and fundamental flaws in the previous RTP/SCS (source information is provided at the end of this letter):

1. SANDAG does not seem to acknowledge that building more general purpose freeway lanes is responsible for induced travel (particularly single-passenger vehicle) demand. One of the key reasons that many criticize SANDAG's current approach to transportation system network planning is its retention of general purpose lanes. Induced travel demand is not an "academic fallacy" as some have improperly asserted: building more roads just causes more drivers to use them. This knowledge is addressed in numerous studies and real-world assessments, including a widely cited 2015 UC Davis study that Caltrans has agreed was valid: more freeways do not solve traffic congestion and they lead to an increase in air pollution. Also, the next RTP/SCS needs to effectively integrate HOV lanes and "automated vehicles" (particularly freight trucks, which are expected to be implemented fairly soon and will need transfer stations to local delivery) into the peripheral (e.g., the cities') transportation networks/smart growth-TOD land uses. Failure to do so will translate into more traffic delays and air pollution. What we don't need is for SANDAG to continue to promote more freeways that haven't, and won't, solve our transportation problems.
2. The next RTP/SCS could greatly improve the region's transit networks, while addressing needed local road/infrastructure repairs and improvements. San Diego's transit systems' (rail, bus, bike, walking) performance has substantial room for improvement. Increased funding for regional and local bikeways, safe (walking) routes are essential, but rail and rapid bus services can be greatly increased and improved. Recent studies have demonstrated that the San Diego metropolitan area's transit ridership is ranked 33rd of the top 75 largest metropolitan areas and our transit stations have among the worst rating in the state. Why is transit lagging? In large part, it seems that SANDAG has not given sufficient consideration – and funding - to leading-edge transit system improvements (one example is the Quickway approach that has been presented to SANDAG). Also, SANDAG could work more effectively with the local jurisdictions to coordinate the housing-jobs-transit mix. Transit works well in other US metropolitan areas; we need the next RTP/SCS to provide real leadership and utilization of new opportunities, and not to essentially rely on the historical approach to "improving" transit.
3. The next RTP/SCS must better understand and plan for our population growth and demographics. For example, millennials, who are expected to dominate housing demand, are not as fixated on single family homes and vehicles as previous generations. A 2015 study by Freddie Mac found that millennials tend to favor rentals and denser housing. A study in the Journal of the American Planning Association (2015) found that millennials are driving less and tending to live in urban areas, lowering their need for cars. Southern California demographics show a trend favoring multi-family housing and higher-density housing that is close to transit and generally more affordable than single family homes. And, San Diego

is projected to locate about 80% of new residential growth within the existing developed urban areas, which is where transit works best.

Regarding housing – and commercial/industrial – development, the RTP/SCS should identify policies, initiatives and incentives that will promote smart growth and seamless integrated transportation networks. The RTP/SCS should encourage/incentivize new developments that achieve net zero GHG emissions. For example, the recently announced Five Point Net Zero Newhall (Ranch) plan outlines how this 21,500-unit development will meet net zero emissions. The RTP/SCS approach should prioritize San Diego and California-based GHG reduction options (rather than outside CA options) where onsite measures are not fully-sufficient.

SANDAG's update of its current RTP must recognize and address several significant changes in policies, plans and environmental conditions since that version was prepared. Among the most significant changes:

1. The State of California passed and enacted SB 32, which establishes a requirement that the statewide GHG reduction be 40% below the 1990 baseline by 2030 (codifying Executive Order B-30-15). The RTP should demonstrate how the projects that SANDAG is specifically responsible for implementing will meet – or preferably exceed - that reduction level.
2. The City of San Diego has a new, certified Climate Action Plan (CAP) that adopts the same GHG reduction target for 2030 as the State, and establishes a goal of an 80% reduction from the 1990 baseline by 2050. Other cities' CAPs and the County of San Diego's CAP also have or call for similar GHG reduction targets/timelines. A key means to meet these targets will be for the region to adopt Community Choice Energy (CCE) and to prioritize local, distributed photovoltaic (PV) supply opportunities, not to promote and rely on mega PV facilities (e.g., desert solar).
3. The City of San Diego is preparing its Community Planning Updates that will specify land uses and densities that must be addressed in the RTP (and EIR). Other cities will, through their CAPs and General Plan Updates, specify land uses/densities that must be addressed in the RTP. Similarly, the County's CAP, which is currently in preparation and will be completed before the RTP, may identify opportunities and needs to changes to the RTP to allow the County to achieve its GHG reductions.
4. The State of California's climate policies and legislation establish clear guidance for regional planning agencies, counties and local governments that would complement the intent of international treaties and national policies to reduce GHG emissions. The RTP must, at the very least, fully contribute its "fair share" toward meeting those GHG emission targets/requirements.To that end, SANDAG must have a clear accounting of current GHG emissions – from each sector/major emission component – and be able to monitor/account for any claimed reductions by the project and its mitigation measures.

The RTP/SCS must clearly specify and identify how it will ensure:

1. Timelines/milestones for the project elements and mitigation measures and how these will become binding and legally enforceable.
2. Because the RTP/SCS involves or assumes many actions that are outside of SANDAG's authority (e.g., local land use decisions, economic development, etc.), it must clearly delineate how SANDAG and the local entities will ensure that the RTP/SCS goals, objectives, projects, and mitigation will be implemented.
3. A number of news articles have documented that SANDAGs TransNet program has not generated the (sales tax) revenues that it projected – and are needed to fund RTP projects. SANDAG must provide a more realistic assessment of its proposed revenues and project costs. This is particularly important when identifying the priorities for RTP projects and mitigation.

4. SANDAG has resources/programs, including its Dashboard, for providing summaries of its projects/results. The RTP/SCS must establish monitoring methods for tracking each of its project actions as well as their GHG emission reductions. It must work with the cities and county to integrate GHG emission monitoring so that meaningful, consistentimplementation and enforcement mechanisms are established. The public should be able to access data and results of the RTP/SCS and not have to rely on annual or more infrequent formal reporting on the RTP/SCS by SANDAG.

Resource Topics, Alternatives and Cumulative/Growth-Inducing Issues. The NOP does not state what will comprise the "range of reasonable alternatives" to the project nor what the "update" to the current RTP/SCS will encompass, and it is not possible to provide specific comments on potential alternatives and project impacts. The NOP presents a reasonable list of resource topics that will be analyzed in the EIR; many of these had significant, unavoidable impacts in the previous RTP/SCS (Aesthetics/Visual; Agriculture and Forestry; Air Quality; Biological Resources; Cultural and Paleontological Resources; Energy; Mineral Resources; GHGs (consistency with state goals); Hydrology and Water Quality; Land Use; Noise and Vibration; Population and Housing; Public Services and Utilities; Transportation; and Water Supply). Based on the previous RTP/SCS process and EIR, the updated RTP/SCS could result in many of the same significant, unavoidable (and not fully mitigated) impacts.

Given that many cities and the County will have adopted rigorous CAPs (e.g., committing to state targets), the updated RTP/SCS will have to develop new alternatives that are consistent with those plans and presumed changed land uses, transportation and housing needs. For example, the previous RTP projected very little increase (about 3.5%) in total transit from 2012-2050, but as cities and the county become more dependent on density and transit to achieve GHG reductions, SANDAG must develop alternatives to its approaches and project list to better serve and provide incentives to local governments that will improve the jobs-housing-transportation balance. SANDAG must also substantially improve its assessment of and plan for utilization of reasonable technological improvements/innovations in transportation and transit. The likely introduction of self-driving freight trucks and cars, computer-assisted routing, and related advances must be part of the RTP.

San Diego cannot effectively employ, house and transport an additional projected 1.3 million residents by 2050 unless our thinking, planning and funding are based on the "real" facts and best available forecasts of our housing and driving trends. We need a new approach that prioritizes and funds our regional and local transit systems, not one that continues the past failed approach that relies on more freeways.

Please include these comments into the administrative record for the RTP/SCS project and keep me informed of the process to update the RTP/SCS and prepare the EIR.

Sincerely,

Michael A. McCoy

Bill Tippets

Michael A. McCoy

President, SWIA

Bill Tippets

Board Member, SWIA

Sources:

Induced travel demand:
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Unified Port of San Diego

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January 12, 2017

San Diego Association of Governments
Andrew Martin, Senior Regional Planner
401 B Street, Suite 800
San Diego, CA 92101
Andrew.martin@sandag.org

Re: San Diego Unified Port District Comments on the Notice of Preparation of a Program Environmental Impact Report for San Diego Forward: The Regional Plan

Dear Mr. Martin,

Thank you for the opportunity to comment on the preparation of the Program Environmental Impact Report (PEIR) for San Diego Forward: The Regional Plan (Regional Plan) dated November 14, 2016. The mission of the San Diego Unified Port District (District) is to protect the Tidelands Trust resources by providing economic vitality and community benefit through a balanced approach to maritime industry, tourism, water, and land recreation, environmental stewardship and public safety. The District was created with the San Diego Unified Port District Act (hereafter "Port Act") adopted by the California State Legislature in 1962 and as amended. The Port Act recognizes the Public Trust Doctrine, and states that tidelands and submerged lands are only to be used for statewide purposes. To this end, the District is charged with management of tidelands and diverse waterfront uses along San Diego Bay that promotes commerce, navigation, fisheries, and recreation on granted lands. When issuing discretionary permits and/or project approvals for projects and activities located within tidelands, the District often times serves as the lead agency under CEQA.

District staff members have reviewed the Notice of Preparation (NOP) and we are providing the following comments on the Regional Plan and associated PEIR:

__Comments on San Diego Forward: The Regional Plan__

Consistency with the updated Port Master Plan
The District is currently involved in a multi-year "Integrated Planning" process leading to an update of its Port Master Plan. This process includes updates to land and water use designations and new Baywide and Planning District goals and policies for land and water use, mobility, natural resources, resiliency, coastal access, and economic development.

Due to the nature and geography of the District's jurisdictional boundaries with our member cities of San Diego, National City, Chula Vista, Imperial Beach and Coronado, it is important for SANDAG staff and District staff to continue and work collaboratively together. Through coordination and collaboration our agencies can ensure our planning policies are utilizing the most accurate and up-to-date land and water use designations, transportation routes, maritime operations (i.e., cruise ship and cargo terminal), and recreational resource information on

District tidelands. District staff is ready to work closely with SANDAG staff to provide any adiditional information for the preparation of the PEIR.

Regional Plan as a Catalyst for Future Partnerships

We envision the Regional Plan as a catalyst for future partnerships pertaining to planning and implementation of land use and mobility programs or projects. Through a coordinated and collaborative process, there may be opportunities for partner agencies to utilize the Regional Plan for streamlining projects or optimizing environmental mitigation strategies. We encourage SANDAG to explore opportunities for future partnerships that maximize the potential benefits of the Regional Plan.

<u>Comments on the PEIR</u>

Shared Infrastructure Improvements
The District and adjacent jurisdictions have an extensive multi-modal transportation system that accommodates passenger vehicles and trucks, pedestrian and cyclist movements, as well as a public transit system in place. The PEIR should consider the impact of shared infrastructure improvements that enhance the connection to the waterfront, optimize existing and future infrastructure connections from upland neighborhoods, and maximize public access to the waterfront.

Transportation System Investments for Commuters and Visitor
The District sees many opportunities to work with SANDAG to improve access to existing and future public transit facilities. Specifically, the District is interested in the concept of "mobility hubs" at key locations and near major District employment centers, such as the Tenth Avenue Marine Terminal and the National City Marine Terminal (i.e., Working Waterfront), as well as activity centers and waterfront destinations for which the District is responsible for land use planning.

Additionally, traffic congestion has increased substantially for air travelers and employees to and from Lindbergh Field. The congestion reduces the level of service on arterial roads connecting the freeway to the airport. The adopted Regional Plan states: "The high-speed trains will arrive at the future Intermodal Transportation Center (ITC) to be located adjacent to the San Diego International Airport." (p55) The District supports and encourages the accelerated evaluation of an ITC adjacent to the airport serving air travelers, employees, *and* visitors to District tidelands. As part of the transportation impact analyses for the PEIR, the District encourages SANDAG to evaluate the impacts of mobility hubs on reducing vehicle miles traveled, level of service, and greenhouse gas emissions on or near District tidelands.

As noted during the August 2014 Economic Competitiveness Working Groups at a session during SANDAG's Regional Plan public outreach, the provision of adequate parking near the waterfront remains a challenge. The PEIR should consider evaluating alternative solutions that utilize shared parking sites to accommodate the parking needs of the District and adjacent jurisdictions' stakeholders. The PEIR should also consider review of regional parking management strategies as a mechanism to encourage and sustain activity and growth while optimizing land uses.

Goods and People Movement in the Working Waterfront

Goods movement and maritime-dependent manufacturing are of primary importance to the District. Growth for maritime facilities is partially constrained by freight rail lines and arterial roads that serve to move goods and personnel in, out, and around the District tidelands. This includes the movement of goods to and from the cargo terminals, through the District's Working Waterfront, and onto major area freeways. As these primary transportation arteries are facing capacity limitations, the PEIR should consider evaluating the Regional Plan's "Goods Movement Strategy" that is intended to improve freight and personnel mobility.

The District's Integrated Planning Vision includes the potential development of a multi-modal corridor for freight and service vehicles intended to separate large trucks, buses, and cargo from personal vehicle, pedestrian, and bicycle traffic. This multi-modal corridor could improve the efficiency of maritime commerce and mitigate some community concerns, particularly by reducing truck traffic and emissions in adjacent residential neighborhoods. SANDAG staff should coordinate closely with District staff in regards to future planning of this multi-modal corridor.

In addition, while there is already a high use of transit (i.e., light rail) by employees in the Working Waterfront, additional use is constrained, in part, by transit system capacity limitations in this corridor. Future improvements to transit service in this corridor and potentially shuttle services from transit stations to work sites, could help reduce the reliance on passenger cars for workers and relieve parking pressure. The transportation impact analyses should consider impacts to local and regional arterials and roads from implementation of expanded transit services.

The District appreciates the opportunity to work cooperatively with the San Diego Association of Governments (SANDAG) during this process and looks forward to continued collaboration.

If you have any questions regarding these comments, please contact me at (619) 686-6473 or via email at jgiffen@portofsandiego.org.

Respectfully,

Jason H. Giffen
Assistant Vice President, Planning & Green Port

JG/te

Appendix B

Transportation Projects and Phasing Tables

Contents

Table B-1: Rural Corridors

Rural Corridors					
Project ID	**Year Built**	**Category**	**Project Name**	**Description**	**Cost ($2020) Millions**
AT092	2050	Active Transportation	I-8 Corridor – Lake Jennings Park Road to Dunbar Lane	On-Street	$23
AT093	2050	Active Transportation	I-8 Corridor – Olde Highway 80 to Willows Road	On-Street	$55
AT095	2050	Active Transportation	I-8 Corridor – Willows Road to SR 79	On-Street	$22
CC047	2035	Complete Corridor: Rural	I-8 (I-8 to West Willows Road)	Interchange Improvements	$11
CC048	2050	Complete Corridor: Rural	I-8 (I-8 to East Willows Road)	Interchange Improvements	$11
CC049	2035	Complete Corridor: Rural	SR 94 (SR 94 to Melody Road/Daisy Drive)	Intersection Improvements	$8
CC051	2050	Complete Corridor: Rural	SR 76 (SR 79 to Valley Center Road)	Facility Improvements	$693
CC052	2035	Complete Corridor: Rural	SR 76 (Rice Canyon Road to Pala Reservation)	Straightening	$60
CC053	2050	Complete Corridor: Rural	SR 76 (Harolds Road to Pauma Rancho)	Straightening	$21
CC054	2050	Complete Corridor: Rural	SR 76 (SR 76 to Pala Mission Road)	Intersection Improvements	$1
CC055	2035	Complete Corridor: Rural	SR 76 (SR 76 to Cole Grade Road)	Intersection Improvements	$1
CC056	2050	Complete Corridor: Rural	SR 76 (West Reservation Boundary to East Reservation Boundary)	Shoulder Widening	$40
CC057	2035	Complete Corridor: Rural	SR 76 (SR 76 to Pauma Reservation Road)	Intersection Improvements	$1
CC058	2035	Complete Corridor: Rural	SR 76 (Pala Casino to Rice Canyon Road)	Facility Improvements	$1
CC059	2050	Complete Corridor: Rural	SR 79 (Deer Canyon Rd to San Felipe Rd)	Shoulder Widening	$226
CC060	2035	Complete Corridor: Rural	SR 79 (SR 79 to Schoolhouse Canyon Road)	Intersection Improvements	$1
CC062	2050	Complete Corridor: Rural	SR 94 (Jamul Reservation to Tecate Road)	Shoulder Widening/Straightening	$252
CC144	2035	Complete Corridor: ATDM/SIS	SR 76	ATDM	$159
CC145	2025	Complete Corridor: ATDM/SIS	SR 76	SIS	$55
CC146	2035	Complete Corridor: ATDM/SIS	SR 79	ATDM	$40
CC147	2025	Complete Corridor: ATDM/SIS	SR 79	SIS	$14

Table B-2: San Vicente

San Vicente						
Project ID	**Year Built**	**Category**	**Project Name**	**Description**	**Connecting Corridor(s)**	**Cost ($2020) Millions**
CC143	2025	Complete Corridor: ATDM/SIS	SR 67	SIS	N/A	$26
CC142	2035	Complete Corridor: ATDM/SIS	SR 67	ATDM	N/A	$74
CC050	2035	Complete Corridor: Rural	SR 67 (Mapleview to Dye Road)	Shoulder Widening/ Straightening	N/A	$206
CC061	2050	Complete Corridor: Rural	SR 78 (Deer Canyon Road to Santa Ysabel)	Intersection Improvements	N/A	$4

Table B-3: Arterials

Arterials					
TIP ID	**Year Built**	**Lead**	**Category**	**Project Name**	**Description**
CB04B	2025	Carlsbad	Local Improvements – RAS	El Camino Real and Cannon Road	In Carlsbad, along the east side of El Camino Real just south of Cannon Road, widen to prime arterial standards with three through lanes, a right turn lane, and a sidewalk approaching the intersection
CB22	2025	Carlsbad	Local Improvements – Street and Road	Avenida Encinas – Widen from Palomar Airport Road to Embarcadero Lane	In Carlsbad, Avenida Encinas from Palomar Airport Road southerly to existing improvements adjacent to Embarcadero Lane, roadway widening to secondary arterial standards
CB31	2025	Carlsbad	Local Improvements – RAS	El Camino Real Widening – La Costa Avenue to Arenal Road	In Carlsbad, along El Camino Real from 700 feet north of La Costa Avenue to Arenal Road, widening along the southbound side of the roadway to provide three travel lanes and a bike lane in accordance with prime arterial standards
CB32	2025	Carlsbad	Local Improvements – RAS	El Camino Real Widening – Poinsettia to Camino Vida Roble	In Carlsbad, widen El Camino Real from 900 feet north of Cassia Road to Camino Vida Roble, along the northbound side of the roadway to provide three travel lanes and a bike lane in accordance with prime arterial standards
CB59	2025	Carlsbad	Local Improvements – RAS	El Camino Real Widening – Sunny Creek to Jackspar	In Carlsbad, on El Camino Real from Sunny Creek to Jackspar, widen along the northbound side of the El Camino Real to provide three travel lanes (currently two lanes northbound), sidewalk, and a bike lane
CHV69	2025	Chula Vista	Ops/Maintenance – Highway Bridge Program	Heritage Road Bridge	Heritage Road from Main Street/Nirvana Avenue to Entertainment Circle, widen and lengthen bridge over Otay River from four-lane to six-lane bridge that accommodates shoulders, sidewalk, and median; project is on Heritage Road from the intersection of Main Street and Nirvana Avenue to Entertainment Circle
CHV87	2025	Chula Vista	Local Improvements – Street and Road	E Street Extension from Bay Boulevard to H Street	Extension of E Street and F Street west of Bay Boulevard, and the realignment of Gun Powder Point Drive for Chula Vista Bayfront redevelopment. Project includes construction of a roundabout at E Street, F Street, and Gunpowder Point Drive, and Class I and II bike paths, and sidewalks
CNTY14A	2025	San Diego County	Local Improvements – RAS	South Santa Fe Avenue South	South Santa Fe from 700 feet south of Woodland Drive to Smilax Road, widening of South Santa Fe Avenue to a five-lane major road with a center left turn lane, curb, gutter, sidewalk, bike lanes, and drainage improvements from 700 feet south of Woodland Drive to Smilax Road
CNTY21	2025	San Diego County	Local Improvements – RAS	Bradley Avenue Widening and Overpass at SR 67	Widen Bradley Avenue from Magnolia Avenue to Mollison Avenue; widen from two lanes to four lanes plus sidewalks. Replace two-lane bridge over SR 67 with a six-lane bridge that accommodates turn pockets
CNTY34	2025	San Diego County	Local Improvements – RAS	Dye Road Extension	Dye Road to San Vicente Road – in Ramona, study, design, and construct a two-lane community collector road with intermittent turn lanes, bike lanes, curb, gutter, and pathway/walkway
CNTY98	2025	San Diego County	Local Improvements – RAS	Otay Lakes Road	Four-lane boulevard with raised median from the City/County boundary to Strada Piazza, and two-lane community collector with intermittent turn lanes to the east
ESC04	2025	Escondido	Local Improvements – RAS	Citracado Parkway II	West Valley to Harmony Grove, widen from two to four lanes with raised medians, construct bridge over Escondido Creek

Table B-3: Arterials (Continued)

Arterials					
TIP ID	**Year Built**	**Lead**	**Category**	**Project Name**	**Description**
ESC08	2025	Escondido	Local Improvements – Street and Road	Felicita Ave/Juniper Street	Widen from two to four lanes with left turn pockets, raised medians on Felicita; new traffic signals at Juniper and Chestnut, Juniper, and 13th Avenue, Juniper and 15th Avenue; modify traffic signal at Juniper and Felicita
ESC24	2025	Escondido	Local Improvements – RAS	Centre City Parkway	Mission Road to SR 78, widen four lanes to six lanes with intersection improvements
NC01	2025	National City	Local Improvements – RAS	Plaza Blvd Widening	Phase II of Plaza Boulevard from Highland Avenue to N Avenue, widen from two to three lanes, including a new traffic lane in each direction, new sidewalks, sidewalk widening, traffic signal upgrades, and interconnection at Plaza Boulevard
NC01	2025	National City	Local Improvements – RAS	Plaza Blvd Widening	Phase III of Plaza Boulevard from I-805 to Euclid Avenue, widen from two to three lanes, including a new traffic lane in each direction, new sidewalks, sidewalk widening, traffic signal upgrades, and interconnection at Plaza Boulevard
O22	2025	Oceanside	Local Improvements – RAS	College Boulevard Improvements from Avenida de la Plate to Waring Road	In Oceanside, widen from the existing four lanes to six lanes with bike lanes and raised median
SD102A	2025	San Diego	Local Improvements – Street and Road	Otay Truck Route Widening (Ph. 4)	Phase II (from Britannia to La Media Rd) of Otay Truck Route in San Diego from Drucker Lane to La Media, add one lane (total three lanes) for trucks; from Britannia to La Media, add one lane for trucks and one lane for emergency vehicles (border patrol/fire department access); add one lane for trucks along Britannia from Britannia Court to the Otay Truck Route
SD250	2025	San Diego	Local Improvements – RAS	La Media Road Improvements	In San Diego, on La Media Road from SR 905 to Siempre Viva Road, widen La Media Road to a six-lane primary arterial from SR 905 to Airway Road, and a to a five-lane major between Airway Road and Siempre Viva Road with three southbound lanes and two northbound lanes. This project will also improve drainage at the intersection of La Media Road and Airway Road (S-15018)
SD34	2025	San Diego	Ops/Maintenance – Highway Bridge Program	El Camino Real	In San Diego on El Camino Real from San Dieguito Road to Via de la Valle, reconstruct and widen from two to four lanes and extend transition lane and additional grading to avoid biological impacts (CIP 52-479.0)
SD70	2025	San Diego	Ops/Maintenance – Highway Bridge Program	West Mission Bay Drive Bridge	In San Diego, replace bridge and increase from four- to six-lane bridge including Class II bike lane (52-643/S00871)
SM19	2025	San Marcos	Local Improvements – Street and Road	Grand Avenue Bridge and Street Improvements	From Discovery Street to San Marcos Boulevard, construct four-lane arterial bridge and a six-lane arterial street from Craven to Grand Avenue
SM24	2025	San Marcos	Local Improvements – RAS	Woodland Parkway Interchange and Barham Drive Widening and Street Improvements #88005	From La Moree Road to Rancheros Drive, modify existing ramps at Woodland Parkway and Barham Drive; widen and realign SR 78 undercrossing and associated work

Table B-3: Arterials (Continued)

Arterials					
TIP ID	**Year Built**	**Lead**	**Category**	**Project Name**	**Description**
SM31	2025	San Marcos	Local Improvements – RAS	San Marcos Creek Specific Plan - Discovery Street Widening and Flood Control Improvements #88265	From Via Vera Cruz to Bent Avenue/Craven Road, widen roadway to four-lane secondary arterial
SM32	2025	San Marcos	Local Improvements – Street and Road	Via Vera Cruz Bridge and Street Improvements #88264	From San Marcos Boulevard to Discovery Street, widen to four-lane secondary arterial and construct a bridge at San Marcos Creek
SM42	2025	San Marcos	Local Improvements – RAS	Discovery St. from Craven to Twin Oaks #ST007	In the City of San Marcos, on Discovery Street from Craven Road to west of Twin Oaks Valley Road, construct approximately 5,100 lineal feet of a new six-lane roadway
SM48	2025	San Marcos	Local Improvements – Street and Road	San Marcos Creek Specific Plan: Creekside Drive and Pad Grading #88505	Construct approximately 3,000 feet of a two-lane collector road from Via Vera Cruz to Grand Avenue in the City of San Marcos. The road will include two 12-foot lanes, diagonal parking on the north side, and parallel parking on the south side. In addition, the project will include a ten-foot bike trail meandering along the south side
SM69	2025	San Marcos	Local Improvements – Street and Road	Twin Oaks Valley Road and Barham Drive Improvements #ST008	This project involves surface improvements including asphalt, concrete, medians, sidewalks, signage, and traffic lights. Underground improvements include utility and drainage improvements, relocations, and water treatment within the public right-of-way to accommodate the construction of additional lanes
CB12	2035	Carlsbad	Local Improvements – RAS	College Boulevard Reach A	In Carlsbad, from Badger Lane to Cannon Road, construct a new segment of College Boulevard to provide four-lane roadway with raised median, bike lanes, and sidewalks/trails in accordance with major arterial standards
CNTY35	2035	San Diego County	Local Improvements – Street and Road	Ramona Street Extension	From Boundary Avenue to Warnock Drive – in the community of Ramona, construct new road extension, two lanes with intermittent turn lanes, bike lanes, and walkway/pathway
SD190	2035	San Diego	Local Improvements – RAS	Palm Avenue/Interstate 805 Interchange	Improvements to the Palm Avenue Bridge over I-805, including repairs to the bridge approaches; a new Project Study Report and Preliminary Environmental Assessment Report. Phase II of the project will include widening of the bridge, realignment of existing ramps, possible addition of northbound looping entrance ramp, restriping of traffic lanes, and signal modifications
SD190	2035	San Diego	Local Improvements – RAS	Palm Avenue/Interstate 805 Interchange	Improvements to the Palm Avenue Bridge over I-805, including repairs to the bridge approaches; a new Project Study Report and Preliminary Environmental Assessment Report. Phase III will provide the ultimate build-out of the project which will incorporate improvements of Phase II plus the northbound and southbound entrance ramps (CIP 52-640.0)
SM10	2035	San Marcos	Local Improvements – Street and Road	SR 78/Smilax Interchange Improvements	Construct new interchange at Smilax Road interchange and SR 78 improvements

Table B-4: South Bay to Sorrento

South Bay to Sorrento						
Project ID	Year Built	Category	Project Name	Description	Connecting Corridor(s)	Cost ($2020) Millions
AT002	2025	Active Transportation	Central Avenue Bikeway	Off-Street and On-Street	I-8, I-15, SR 94	$4
AT004	2025	Active Transportation	North Park/Mid-City Bikeways: Orange Bikeway	On-Street	I-8, I-15	$11
AT005	2025	Active Transportation	North Park/Mid-City Bikeways: Howard Bikeway	On-Street	I-8, CMH	$9
AT006	2025	Active Transportation	North Park/Mid-City Bikeways: Robinson Bikeway	Off-Street and On-Street	I-8	$5
AT008	2025	Active Transportation	Bayshore Bkwy: 8B Ada Street to Palomar Street	Off-Street	N/A	$3
AT015	2035	Active Transportation	Bayshore Bikeway: Segment 8B Main Street to Ada Street	Off-Street	N/A	$5
AT019	2035	Active Transportation	Chula Vista (J Street)	On-Street	N/A	$9
AT021	2035	Active Transportation	City Heights/Fairmount Corridor	Off-Street and On-Street	I-8	$44
AT022	2035	Active Transportation	Coastal Rail Trail Connections – Oceanside and Carlsbad	Off-Street and On-Street	I-5 NCC	$0.3
AT032	2035	Active Transportation	Coastal Rail Trail San Diego – Carmel Valley to Roselle via Sorrento	Off-Street	I-5 NCC, SR 56	$20
AT033	2035	Active Transportation	Coastal Rail Trail San Diego – Del Mar to Sorrento via Carmel Valley	Off-Street	I-5 NCC, SR 56	$23
AT036	2035	Active Transportation	Coastal Rail Trail San Diego – Roselle Canyon	Off-Street	I-5 NCC	$12
AT037	2035	Active Transportation	Coastal Rail Trail San Diego – UTC to Rose Canyon	Off-Street	I-5 NCC, CCT	$11
AT040	2035	Active Transportation	Encanto to Chula Vista National City connections	On-Street	I-15	$35
AT066	2050	Active Transportation	Bay to Ranch Bikeway	On-Street	N/A	$27
AT067	2050	Active Transportation	Border Access Corridor	Off-Street	N/A	$3
AT070	2050	Active Transportation	Central Coast Corridor	On-Street	SR 56, CCT	$65
AT071	2050	Active Transportation	Chula Vista Greenbelt	On-Street	N/A	$34
AT072	2050	Active Transportation	Clairemont – Centre City Corridor	Off-Street and On-Street	I-8, CCT, CMH	$52
AT096	2050	Active Transportation	I-805 Connector	Off-Street	N/A	$7
AT097	2050	Active Transportation	I-805 Connector – Bonita Road to Floyd Avenue	Off-Street	N/A	$10

Table B-4: South Bay to Sorrento (Continued)

South Bay to Sorrento						
Project ID	**Year Built**	**Category**	**Project Name**	**Description**	**Connecting Corridor(s)**	**Cost ($2020) Millions**
AT098	2050	Active Transportation	Imperial Beach Connector	On-Street	N/A	$10
AT100	2050	Active Transportation	Kearny Mesa to Beaches Corridor – Genesee Avenue to Linda Vista Road	On-Street	N/A	$8
AT101	2050	Active Transportation	Kearny Mesa to Beaches Corridor – Linda Vista Road to I-15 Bikeway	On-Street	I-15	$14
AT107	2050	Active Transportation	Mira Mesa Corridor – I-805 to Scranton Road	On-Street	N/A	$2
AT108	2050	Active Transportation	Mira Mesa Corridor – Scranton Road to I-15 Bikeway	On-Street	I-15	$30
AT109	2050	Active Transportation	Mira Mesa Corridor – Sorrento Valley Boulevard to Mira Mesa Boulevard	On-Street	N/A	$7
AT122	2050	Active Transportation	SR 56 Bikeway – El Camino Real to Caminito Pointe	Off-Street	I-5 NCC, SR 56	$5
AT123	2050	Active Transportation	SR 905 Corridor	Off-Street	SR 125	$74
CC119	2025	Complete Corridor: ATDM/SIS	I-5	SIS	I-5 NCC	$69
CC121	2025	Complete Corridor: ATDM/SIS	I-805	SIS	N/A	$37
CC135	2025	Complete Corridor: ATDM/SIS	SR 54	SIS	N/A	$16
CC141	2025	Complete Corridor: ATDM/SIS	SR 905	SIS	SR 125	$30
CC118	2035	Complete Corridor: ATDM/SIS	I-5	ATDM	I-5 NCC	$888
CC120	2035	Complete Corridor: ATDM/SIS	I-805	ATDM	N/A	$478
CC134	2035	Complete Corridor: ATDM/SIS	SR 54	ATDM	N/A	$73
CC140	2035	Complete Corridor: ATDM/SIS	SR 905	ATDM	SR 125	$157
CC114	2035	Complete Corridor: Transit Operational Improvement	I-805 (Nobel Drive)	North and South	CCT	$49
CC115	2050	Complete Corridor: DAR	SR 905 (Beyer Boulevard)	East	N/A	$42
CC116	2050	Complete Corridor: DAR	SR 905 (Siempre Viva Road)	North	SR 125	$42
CC106	2050	Complete Corridor: C	I-5 (SR 94)	North to East	I-15, SR 94, CMH	$182
CC038	2035	Complete Corridor: ML	SR 163 (I-8 to I-805)	8F to 6F+2ML	I-8, CMH	$36

Table B-4: South Bay to Sorrento (Continued)

South Bay to Sorrento						
Project ID	**Year Built**	**Category**	**Project Name**	**Description**	**Connecting Corridor(s)**	**Cost ($2020) Millions**
CC039	2035	Complete Corridor: ML	SR 163 (I-805 to SR 52)	8F to 6F+2ML	I-15, CCT	$27
CC040	2050	Complete Corridor: ML	SR 54 (I-805 to SR 125)	6F to 4F+2ML	SR 125	$48
CC045	2025	Complete Corridor: ML/Goods Movement	SR 11/Otay Mesa East (SR 125 to Mexico)	— to 4T + POE	SR 125	$482
CC001	2035	Complete Corridor: ML/Goods Movement	I-5 (SR 905 to H Street)	8F to 6F+2ML	N/A	$51
CC002	2035	Complete Corridor: ML/Goods Movement	I-5 (H Street to Pacific Highway)	8F to 6F+4ML	I-8, I-15, SR 94, CMH	$378
CC005	2035	Complete Corridor: ML/Goods Movement	I-5 (I-805 to SR 56)	8F/14F+2HOV to 6F/12F+4ML	I-5 NCC, SR 56	$25
CC017	2035	Complete Corridor: ML/Goods Movement	I-805 (Palm Avenue to H Street)	8F +2ML to 6F+4ML	N/A	$46
CC018	2035	Complete Corridor: ML/Goods Movement	I-805 (H Street to I-15)	8F +2ML to 6F+ 4ML	I-15, SR 94	$163
CC019	2035	Complete Corridor: ML/Goods Movement	I-805 (I-15 to I-8)	8F to 6F+4ML	I-8, I-15, SR 94	$96
CC020	2035	Complete Corridor: ML/Goods Movement	I-805 (I-8 to Mesa College Drive)	10F to 6F+4ML	I-8, I-15	$56
CC021	2035	Complete Corridor: ML/Goods Movement	I-805 (Mesa College Drive to Balboa Avenue)	8F to 6F+4ML	CCT	$58
CC022	2035	Complete Corridor: ML/Goods Movement	I-805 (Balboa Avenue to NB Bypass Lane)	8F +2ML to 6F+4ML	CCT	$149
CC016	2050	Complete Corridor: ML/Goods Movement	I-805 (SR 905 to Palm Avenue)	8F to 6F+4ML	N/A	$60
CC041	2050	Complete Corridor: ML/Goods Movement	SR 905 (I-5 to Border)	6F to 4F+2ML	SR 125	$193

Table B-4: South Bay to Sorrento (Continued)

South Bay to Sorrento						
Project ID	**Year Built**	**Category**	**Project Name**	**Description**	**Connecting Corridor(s)**	**Cost ($2020) Millions**
CC063	2035	Complete Corridor: MLC	I-5 (I-805)	North to North and South to South	N/A	$84
CC069	2035	Complete Corridor: MLC	I-5 (SR 15)	North to North and South to South	I-15, SR 94	$274
CC070	2035	Complete Corridor: MLC	I-5 (SR 15)	South to North and South to North	I-15, SR 94	$274
CC084	2035	Complete Corridor: MLC	I-805 (SR 94)	North to West and East to South	I-15, SR 94	$140
CC085	2035	Complete Corridor: MLC	I-805 (SR 52)	West to North and South to East	CCT	$149
CC087	2035	Complete Corridor: MLC	I-805 (SR 163)	North to North and South to South	N/A	$267
CC090	2035	Complete Corridor: MLC	I-805 (I-8)	North to East and West to South	I-8, I-15	$202
CC092	2035	Complete Corridor: MLC	I-805 (I-8)	South to East and West to North	I-8, I-15	$202
CC071	2050	Complete Corridor: MLC	I-5 (SR 905)	South to East and West to North	N/A	$202
CC086	2050	Complete Corridor: MLC	I-805 (SR 52)	North to West and East to South	CCT	$126
CC089	2050	Complete Corridor: MLC	I-805 (I-8)	North to West and East to South	I-8, I-15	$202
CC091	2050	Complete Corridor: MLC	I-805 (I-8)	South to West and East to North	I-8, I-15	$202
CC093	2050	Complete Corridor: MLC	I-805 (SR 54)	South to East and West to North	N/A	$219
CC094	2050	Complete Corridor: MLC	I-805 (SR 54)	North to East and West to South	N/A	$219

Table B-4: South Bay to Sorrento (Continued)

South Bay to Sorrento						
Project ID	Year Built	Category	Project Name	Description	Connecting Corridor(s)	Cost ($2020) Millions
CC095	2050	Complete Corridor: MLC	I-805 (SR 905)	South to West and East to North	N/A	$202
CC096	2050	Complete Corridor: MLC	I-805 (SR 905)	South to East and West to North	N/A	$202
GM01	2025	Goods Movement: Border	Otay Mesa CVEF Modernization	Otay Mesa Port of Entry Commercial Vehicle Enforcement Facility (CVEF) modernization: Improvements to the CVEF to reflect GSA's proposed Otay Mesa POE Modernization Project	N/A	$6
GM02	2025	Goods Movement: Border	OME POE Pilot Programs	Pilot programs for streamlining commercial vehicle operations for reducing wait times at OME POE	N/A	$20
GM03	2025	Goods Movement: Border	Otay Mesa Southbound Truck Route	Improvements to the Otay Mesa POE southbound truck route, including Otay Truck Route and La Media Road	N/A	$49
GM04	2050	Goods Movement: Border	Otay Mesa POE Bridge	Otay Mesa Port of Entry: Bridge between POE and CVEF to coincide with improvements at both facilities	N/A	$50
GM07	2025	Goods Movement: Roadways	RBMS and Tolling Equipment	Border Wait Times – SR 11 tolling equipment, and Regional Border Management System	N/A	$35

Table B-4: South Bay to Sorrento (Continued)

South Bay to Sorrento						
Project ID	**Year Built**	**Category**	**Project Name**	**Description**	**Connecting Corridor(s)**	**Cost ($2020) Millions**
GM06	2035	Goods Movement: Roadways	Harbor Drive 2.0	Designated Freight Route: Dedicated lanes (where feasible) and signal priority for truck freight along Harbor Drive between TAMT/Cesar Chavez Parkway, NCMT and connections to I-5. Includes freight signal prioritization, queue jumps, delineators, and signage. Generally aligned in the #1 lanes and median	N/A	$32
GM08	2035	Goods Movement: Roadways	I-5 Working Waterfront Access	I-5 Working Waterfront Access Bottleneck Relief between SR 94 and SR 54	N/A	$50
GM09	2035	Goods Movement: Roadways	Vesta Bridge – Phase 1	Vesta Bridge Phase 1 and operational improvements SR 15, Main, Harbor, and 32nd Streets	N/A	$55

Table B-4: South Bay to Sorrento (Continued)

South Bay to Sorrento						
Project ID	Year Built	Category	Project Name	Description	Connecting Corridor(s)	Cost ($2020) Millions
GM05	2050	Goods Movement: Roadways	Harbor Drive Multimodal Corridor Improvements	Harbor Drive Multimodal Corridor Improvements, including but not limited to: ITS systems expanding the Designated Freight Route, removing height and weight conflicts along the truck route, improvements at 28th Street and 32nd Street, pedestrian crossings and bridges, various truck improvements, bikeway accommodations, streetscape, safety, and parking improvements	N/A	$192
TL21	2025	Transit Leap	*Rapid* 12	Spring Valley to Downtown via Southeast San Diego (Light version of *Rapid*)	I-15, SR 94, SR 125, CMH	$18
TL02	2035	Transit Leap	Commuter Rail 582	Sorrento Mesa to National City via UTC, Kearny Mesa, and University Heights	I-8, I-15, SR 94, CCT	$12,660
TL22	2035	Transit Leap	*Rapid* 12	Spring Valley to Downtown via Southeast San Diego (Full version of *Rapid*)	I-15, SR 94, SR 125, CMH	$73
TL25	2035	Transit Leap	*Rapid* 41	Fashion Valley to UTC/UC San Diego via Linda Vista and Clairemont	I-8, CCT, CMH	$58
TL28	2035	Transit Leap	*Rapid* 120	Kearny Mesa to Downtown via Mission Valley	I-8, I-15, CCT, CMH	$109
TL35	2035	Transit Leap	*Rapid* 295	South Bay to Sorrento Valley via La Mesa and Kearny Mesa	I-8, I-15, SR 94, SR 125, CCT	$91

Table B-4: South Bay to Sorrento (Continued)

South Bay to Sorrento						
Project ID	**Year Built**	**Category**	**Project Name**	**Description**	**Connecting Corridor(s)**	**Cost ($2020) Millions**
TL43	2035	Transit Leap	*Rapid* 625	SDSU to Palomar Station via East San Diego, Southeast San Diego, National City	I-8, I-15, SR 94	$197
TL44	2035	Transit Leap	*Rapid* 630	Iris Trolley/Palomar to Kearny Mesa via I-5/163 and City College	I-8, I-15, SR 94, CCT, CMH	$36
TL46	2035	Transit Leap	*Rapid* 637	North Park to 32nd Street Trolley Station via Golden Hill	I-8, I-15, SR 94	$103
TL48	2035	Transit Leap	*Rapid* 640	San Ysidro to Central Mobility Hub via I-5 and City College	I-8, I-15, SR 94, CMH	$28
TL49	2035	Transit Leap	*Rapid* 709	H Street Trolley Station to Millennia via H Street Corridor, Southwestern College	SR 125	$99
TL53	2035	Transit Leap	*Rapid* 950	Otay Mesa POE to Imperial Beach via 905	SR 125	$6
TL57	2035	Transit Leap	San Ysidro Mobility Hub	San Ysidro Mobility Hub	N/A	$200
TL58	2035	Transit Leap	Ferry	San Diego – Coronado – Military Ferry	SR 94, CMH	$—
TL59	2035	Transit Leap	*Rapid* 950	Otay Mesa POE to Imperial Beach via 905 (Full version of *Rapid*)	SR 125	$22
TL03	2050	Transit Leap	Commuter Rail 582	National City to U.S. Border	I-15, SR 94	$2,977
TL04	2050	Transit Leap	Commuter Rail 583	Central Mobility Hub to U.S. Border via downtown San Diego	I-8, I-15, SR 94, CMH	$7,581
TL13	2050	Transit Leap	LRT 510	Blue Line (San Ysidro to UTC, Double/Third tracking and Grade Separations at Taylor/Ash)	I-8, I-15, SR94, CCT, CMH	$510

Table B-4: South Bay to Sorrento (Continued)

South Bay to Sorrento						
Project ID	**Year Built**	**Category**	**Project Name**	**Description**	**Connecting Corridor(s)**	**Cost ($2020) Millions**
TL34	2050	Transit Leap	*Rapid* 293	Imperial Beach to Otay Ranch via Palomar Street	SR 125	$111
TL45	2050	Transit Leap	*Rapid* 635	Eastlake to Palomar Trolley via Main Street Corridor	SR 125	$116
TL47	2050	Transit Leap	*Rapid* 638	Iris Trolley to Otay Mesa via Otay, Airway Drive, SR 905 Corridor	SR 125	$91
TL12	2035	Transit Leap/ Goods Movement	LRT 510	Blue Line (San Ysidro to UTC, Double/Third tracking and Grade Separations at28th Street, 32nd Street, E Street, H Street, Palomar St, and Blue/ Orange Track Connections at 12th/ Imperial)	I-8, I-15, SR 94, CCT, CMH	$510
TL07	2050	Transit Leap/ Goods Movement	Commuter Rail 398	Oceanside to downtown San Diego (Build Sorrento Mesa and UTC tunnels, add station at Balboa Avenue)	SR 56, CCT	$6,651

Note: The South Bay to Sorrento Comprehensive Multimodal Corridor Plan is completing a more detailed ridership analysis of the Purple Commuter Rail alignment (Rt. 581). The analysis is studying an alignment that would include stations in City Heights and at San Diego State University (west campus).

Table B-5: Central Mobility Hub

Central Mobility Hub						
Project ID	Year Built	Category	Project Name	Description	Connecting Corridor(s)	Cost ($2020) Millions
AT001	2025	Active Transportation	Pershing Bikeway	Off-Street and On-Street	I-15, SR 94, SB2S	$23
AT007	2025	Active Transportation	Uptown Bikeways: Washington Street and Mission Valley Bikeways	On-Street	I-8	$18
AT010	2025	Active Transportation	Uptown Bikeways: Mission Hills and Old Town Bikeways	On-Street	I-8	$6
AT011	2035	Active Transportation	Pacific Coast Highway/ Central Mobility Bikeway	On-Street	I-8	$35
AT012	2035	Active Transportation	El Prado: Cross-Park	On-Street	N/A	$1
AT014	2035	Active Transportation	Uptown Bikeways: Park Boulevard Bikeway	On-Street	I-8	$4
AT016	2035	Active Transportation	Bayshore Bikeway Upgrades	Off-Street	SB2S	$17
AT017	2035	Active Transportation	Central Coast Corridor	Off-Street and On-Street	I-8	$37
AT020	2035	Active Transportation	City Heights – Old Town Corridor	On-Street	I-8	$5
AT034	2035	Active Transportation	Coastal Rail Trail San Diego – Mission Bay (Clairemont to Tecolote)	Off-Street and On-Street	I-8	$15
AT035	2035	Active Transportation	Coastal Rail Trail San Diego – Pacific Highway (Fiesta Island Road to Taylor Street)	On-Street	I-8	$6
AT042	2035	Active Transportation	Harbor Drive (Downtown to Ocean Beach)	Off-Street	I-8	$2
AT047	2035	Active Transportation	Imperial Beach Connector	On-Street	N/A	$10
AT048	2035	Active Transportation	Imperial Bikeway to J Street Cycle Track Connector	On-Street	SR 94	$3

Table B-5: Central Mobility Hub (Continued)

Central Mobility Hub						
Project ID	**Year Built**	**Category**	**Project Name**	**Description**	**Connecting Corridor(s)**	**Cost ($2020) Millions**
AT054	2035	Active Transportation	North Park to Downtown	On-Street	I-15, SR 94, SB2S	$3
AT055	2035	Active Transportation	Pacific Beach to East Mission Bay	Off-Street and On-Street	N/A	$23
AT102	2050	Active Transportation	Kearny Mesa to Beaches Corridor – Mission Boulevard to Pacific Beach Drive	On-Street	N/A	$7
CC103	2050	Complete Corridor: C	I-5 (I-8)	East to North and South to West	I-8	$449
CC117	2035	Complete Corridor: AIRC	Complete Corridor Elements	Airport Connectivity	N/A	$836
CC003	2035	Complete Corridor: ML/Goods Movement	I-5 (Pacific Highway to SR 52)	8F to 6F+4ML	I-8, CCT	$353
MHLA1	2035	Mobility Hubs	Central Mobility Hub Land Acquisition	Central Mobility Hub land acquisition	N/A	$2,420
TL23	2035	Transit Leap	*Rapid* 28	Point Loma to Kearny Mesa via Central Mobility Hub, Linda Vista	I-8, I-15, CCT, SB2S	$105
TL52	2035	Transit Leap	*Rapid* 910	Coronado to Downtown via Coronado Bridge	I-15, SR 94, SB2S	$51
TL56	2035	Transit Leap	Airport Connection Automated People Mover	Central Mobility Hub to Airport via Car Rental Lot and Harbor Island East Basin	I-8	$1,398
TL18	2050	Transit Leap	Tram 555	Tram: Downtown to Logan Heights, Golden Hill, South Park, North Park, University Heights, Hillcrest	I-8, I-15, SB2S	$1,175
TL05	2025	Transit Leap/ Goods Movement	Commuter Rail 398	Oceanside to downtown San Diego (includes upgrades to Pacific Surfliner/COASTER/Metrolink/Freight LOSSAN services from Orange County to Downtown San Diego, add station at Gaslamp)	N/A	$298

Table B-6: State Route 125

State Route 125						
Project ID	Year Built	Category	Project Name	Description	Connecting Corridor(s)	Cost ($2020) Millions
AT051	2035	Active Transportation	La Mesa Corridor – SR 125 Corridor to East County Northern Loop	On-Street	I-8	$6
AT076	2050	Active Transportation	East County Southern Loop	On-Street	SR 94	$26
AT082	2050	Active Transportation	Grossmont College	On-Street	I-8, CCT	$1
AT115	2050	Active Transportation	SR 125 Connector – Bonita Road to U.S.–Mexico Border	Off-Street and On-Street	SB2S	$85
AT116	2050	Active Transportation	SR 125 Corridor – East County Southern Loop to La Mesa/Lemon Grove/El Cajon connections	On-Street	I-8, SR 94	$32
AT117	2050	Active Transportation	SR 125 Corridor – Grossmont College to Santee – El Cajon Corridor	On-Street	N/A	$12
AT118	2050	Active Transportation	SR 125 Corridor – Sweetwater Bikeway to East County Southern Loop	On-Street	SB2S	$34
CC139	2025	Complete Corridor: ATDM/SIS	SR 125	SIS	N/A	$35
CC138	2035	Complete Corridor: ATDM/SIS	SR 125	ATDM	N/A	$180
CC112	2035	Complete Corridor: DAR	SR 125 (Spring Street/SR 94)	South	I-8, SR 94	$42
CC113	2050	Complete Corridor: DAR	SR 125 (Jamacha Boulevard)	North and South	N/A	$49
CC042	2035	Complete Corridor: ML	SR 125 (SR 54 to Amaya Drive)	6F/8F to 4F/6F+2ML	I-8, SR 94	$59
CC043	2050	Complete Corridor: ML	SR 125 (Amaya Drive to Mission Gorge Road)	6F to 4F+2ML	I-8, CCT	$40
CC044	2050	Complete Corridor: ML	SR 125 (SR 905 to SR 54)	4T to 4F+2ML	SB2S	$227
CC097	2035	Complete Corridor: MLC	SR 125 (I-8)	North to West and East to South	I-8, SR 94	$202
CC098	2035	Complete Corridor: MLC	SR 125 (I-8)	North to East and West to South	I-8, SR 94	$202
CC099	2035	Complete Corridor: MLC	SR 125 (SR 94)	North to West and East to South	SR 94	$203
CC100	2050	Complete Corridor: MLC	SR 125 (SR 52)	North to West and East to South	CCT	$202
CC101	2050	Complete Corridor: MLC	SR 125 (SR 54)	South to South and North to North	N/A	$202
CC102	2050	Complete Corridor: MLC	SR 125 (SR 54)	North to West and East to South	N/A	$202

Table B-6: State Route 125 (Continued)

State Route 125						
Project ID	**Year Built**	**Category**	**Project Name**	**Description**	**Connecting Corridor(s)**	**Cost ($2020) Millions**
TL033	2035	Transit Leap	Rapid 292	Pacific Beach to Otay Mesa via Kearny Mesa, El Cajon, Jamacha, and Otay Lakes (Full version of Rapid)	I-8, I-15, SR 94, CCT, SB2S A	$89

Table B-7: Interstate 15

Interstate 15						
Project ID	Year Built	Category	Project Name	Description	Connecting Corridor(s)	Cost ($2020) Millions
AT013	2035	Active Transportation	North Park/Mid-City Bikeways: Monroe Bikeway	On-Street	I-8	$6
AT044	2035	Active Transportation	Hillcrest to Balboa Park	On-Street	N/A	$6
AT045	2035	Active Transportation	I-15 Bikeway – Camino del Rio South to Rancho Mission Road	Off-Street and On-Street	I-8, SB2S	$4
AT046	2035	Active Transportation	I-15 Bikeway – Rancho Mission Road to Murphy Canyon Bike Path	Off-Street	I-8, SB2S	$3
AT052	2035	Active Transportation	Mira Mesa Neighborhood Bikeway	On-Street	SB2S	$26
AT053	2035	Active Transportation	Mission Valley – Chula Vista Corridor	On-Street	I-8	$2
AT057	2035	Active Transportation	San Diego River Bikeway – Camino Del Rio North to Father Junipero Serra Trail (Roadway ALT)	On-Street	I-8	$27
AT058	2035	Active Transportation	San Diego River Trail – Camino Del Rio North	On-Street	I-8	$1
AT064	2035	Active Transportation	San Diego River Trail – Rancho Mission Road to Camino Del Rio North	Off-Street	I-8	$1
AT084	2050	Active Transportation	I-15 Bikeway – Citracado Parkway to Country Club Lane	On-Street	North County Corridor	$31
AT085	2050	Active Transportation	I-15 Bikeway – Country Club Lane to Rainbow Valley Boulevard	On-Street	N/A	$128
AT086	2050	Active Transportation	I-15 Bikeway – Murphy Canyon Road to Affinity Court	Off-Street and On-Street	CCT, SB2S	$85
AT087	2050	Active Transportation	I-15 Bikeway – Poway Road Interchange to Carmel Mountain Road	Off-Street	SR 56	$76
AT088	2050	Active Transportation	I-15 Bikeway – Rancho Bernardo Community Park	Off-Street	N/A	$4
AT090	2050	Active Transportation	I-15 Bikeway – Via Rancho Parkway to Citracado Parkway	Off-Street and On-Street	North County Corridor	$5
AT091	2050	Active Transportation	I-15 Bikeway – Via Rancho Parkway to Lost Oak Lane	Off-Street	North County Corridor	$12

Table B-7: Interstate 15 (Continued)

Interstate 15						
Project ID	**Year Built**	**Category**	**Project Name**	**Description**	**Connecting Corridor(s)**	**Cost ($2020) Millions**
AT105	2050	Active Transportation	Mid-County Bikeway – Inland Rail Trail Connection	On-Street	North County Corridor	$12
AT111	2050	Active Transportation	Poway Loop	On-Street	SR 56	$41
CC123	2025	Complete Corridor: ATDM/SIS	I-15	SIS	N/A	$55
CC137	2025	Complete Corridor: ATDM/SIS	SR 163	SIS	N/A	$19
CC122	2035	Complete Corridor: ATDM/SIS	I-15	ATDM	N/A	$663
CC136	2035	Complete Corridor: ATDM/SIS	SR 163	ATDM	N/A	$101
CC110	2035	Complete Corridor: DAR	I-15 (Clairemont Mesa Boulevard)	North and South	N/A	$49
CC011	2035	Complete Corridor: ML/Goods Movement	I-15 (I-5 to I-805)	6F to 6F+2ML	SR 94, SB2S	$103
CC012	2035	Complete Corridor: ML/Goods Movement	I-15 (I-805 to I-8)	8F+2TL to 6F+2TL+2ML	I-8, SR 94, SB2S	$115
CC013	2035	Complete Corridor: ML/Goods Movement	I-15 (I-8 to SR 163)	8F to 6F+4ML	I-8, CCT, SB2S	$241
CC014	2050	Complete Corridor: ML/Goods Movement	I-15 (Valley Parkway to SR 76)	8F to 6F+3ML	N/A	$408
CC015	2050	Complete Corridor: ML/Goods Movement	I-15 (SR 76 to County Line)	8F to 6F+3ML	North County Corridor	$199
CC073	2035	Complete Corridor: MLC	I-15 (SR 78)	East to South and North to West	North County Corridor	$147
CC074	2035	Complete Corridor: MLC	I-15 (SR 52)	West to North and South to East	CCT, SB2S	$181

Table B-7: Interstate 15 (Continued)

Interstate 15						
Project ID	**Year Built**	**Category**	**Project Name**	**Description**	**Connecting Corridor(s)**	**Cost ($2020) Millions**
CC075	2035	Complete Corridor: MLC	I-15 (SR 52)	North to West and East to South	CCT, SB2S	$196
CC076	2035	Complete Corridor: MLC	I-15 (SR 52)	North to East and West to South	CCT, SB2S	$196
CC077	2035	Complete Corridor: MLC	I-15 (SR 52)	South to West and East to North	CCT, SB2S	$196
CC079	2035	Complete Corridor: MLC	I-15 (I-8)	North to West and East to South	I-8, SB2S	$202
CC080	2035	Complete Corridor: MLC	I-15 (I-8)	North to East and West to South	I-8, SB2S	$202
CC081	2035	Complete Corridor: MLC	I-15 (I-8)	South to West and East to North	I-8, SB2S	$202
CC082	2035	Complete Corridor: MLC	I-15 (I-8)	South to East and West to North	I-8, SB2S	$202
CC083	2035	Complete Corridor: MLC	I-805 (SR 15)	North to North and South to South	SR 94, SB2S	$112
CC072	2050	Complete Corridor: MLC	I-15 (SR 78)	South to West and East to North	North County Corridor	$147
CC078	2050	Complete Corridor: MLC	I-15 (SR 56)	South to West and East to North	SR 56	$239
TL29	2035	Transit Leap	*Rapid* 235	Escondido to Downtown San Diego via I-15 (DAR stations)	I-8, SR 56, SR 94, CCT, North County Corridor, SB2S	$34
TL30	2035	Transit Leap	*Rapid* 237	UC San Diego to Rancho Bernardo via Sorrento Valley and Mira Mesa	SR 56, CCT, SB2S	$54
TL31	2035	Transit Leap	*Rapid* 238	UC San Diego to Rancho Bernardo via Sorrento Valley and Carroll Canyon	SR 56, CCT, SB2S	$78

Table B-8: Interstate 5 North Coast Corridor

Interstate 5 North Coast Corridor						
Project ID	Year Built	Category	Project Name	Description	Connecting Corridor(s)	Cost ($2020) Millions
AT028	2035	Active Transportation	Coastal Rail Trail Del Mar	Off-Street	SR 56	$26
AT029	2035	Active Transportation	Coastal Rail Trail Encinitas – Carlsbad to Leucadia Boulevard	Off-Street	N/A	$12
AT080	2050	Active Transportation	Encinitas to San Marcos Corridor – Leucadia Boulevard to El Camino Real	Off-Street	N/A	$6
CC111	2035	Complete Corridor: DAR	I-5 (Voigt)	North and South	N/A	$49
CC104	2050	Complete Corridor: C	I-5 (SR 56)	West to North and South to East	SR 56	$379
CC046	2025	Complete Corridor: ML	I-5 (Manchester to Vandegrift)	8F to 8F+2HOV/HOT	North County Corridor	$171
CC004	2035	Complete Corridor: ML/Goods Movement	I-5 (SR 52 to I-805)	8F to 6F+4ML	CCT, SB2S	$190
CC007	2050	Complete Corridor: ML/Goods Movement	I-5 (Via de La Valle to La Costa)	8F to 6F+4ML	N/A	$316
CC008	2050	Complete Corridor: ML/Goods Movement	I-5 (La Costa to Cassidy Street)	8F to 6F+4ML	North County Corridor	$302
CC009	2050	Complete Corridor: ML/Goods Movement	I-5 (Cassidy Street to Harbor Drive)	8F to 6F+4ML	North County Corridor	$121
CC010	2050	Complete Corridor: ML/Goods Movement	I-5 (Harbor Drive to County Line)	8F to 6F+2ML	N/A	$197
TL40	2035	Transit Leap	*Rapid* 473	Oceanside to Solana Beach to UTC/UC San Diego via Highway 101 Coastal Communities, Carmel Valley	SR 56, CCT, North County Corridor, SB2S	$156
TL06	2035	Transit Leap/Goods Movement	Commuter Rail 398	Oceanside to downtown San Diego (Build Del Mar tunnel, add stations at Central Mobility Hub and Camp Pendleton, and Grade Separation at Leucadia Boulevard)	North County Corridor	$2,630

Table B-9: State Route 94

State Route 94						
Project ID	**Year Built**	**Category**	**Project Name**	**Description**	**Connecting Corridor(s)**	**Cost ($2020) Millions**
AT018	2035	Active Transportation	Centre City – La Mesa Corridor	On-Street	I-8, SR 125, CMH, SB2S,	$66
AT038	2035	Active Transportation	Downtown San Diego to Encanto	On-Street	CMH, SB2S	$11
AT039	2035	Active Transportation	Downtown to Southeast	On-Street	CMH	$3
AT041	2035	Active Transportation	Encanto, Lincoln Heights to Lemon Grove	On-Street	SR 125	$22
AT075	2050	Active Transportation	East County Northern Loop	On-Street	I-8, SR 125	$56
AT083	2050	Active Transportation	Hillcrest – El Cajon Corridor	On-Street	I-8, I-15, SB2S	$18
CC133	2025	Complete Corridor: ATDM/SIS	SR 94	SIS	N/A	$73
CC132	2035	Complete Corridor: ATDM/SIS	SR 94	ATDM	N/A	$255
CC108	2025	Complete Corridor: Interchange and Arterial Operational improvements	SR 94 (SR 125)	South to East, Including Aux lane to Lemon Avenue	I-8, SR 125	$96
CC109	2050	Complete Corridor: C	SR 94 (SR 125)	West to North	I-8, SR 125	$112
CC032	2035	Complete Corridor: ML	SR 94 (I-5 to I-15)	8F to 6F+3ML	I-15, SB2S	$39
CC033	2035	Complete Corridor: ML	SR 94 (I-15 to I-805)	8F to 6F+3ML	I-15, SB2S	$23
CC034	2035	Complete Corridor: ML	SR 94 (I-805 to SR 125)	8F to 6F+3ML	I-8, I-15, SR 125, SB2S	$162
TL014	2035	Transit Leap	LRT 520	Orange Line (El Cajon to Downtown, Double/Third tracking and Grade Separations at Euclid Avenue, Broadway/ Lemon Grove Avenue, Allison Avenue/University Avenue, and Severin Drive)	I-8, I-15, SR 125, CMH, SB2S	$274
TL015	2050	Transit Leap	LRT 520	Orange Line (El Cajon to Downtown, Double/Third tracking)	I-8, I-15, SR 125, CCT, CMH	$274

Table B-10: Interstate 8

Interstate 8						
Project ID	**Year Built**	**Category**	**Project Name**	**Description**	**Connecting Corridor(s)**	**Cost ($2020) Millions**
AT043	2035	Active Transportation	Hillcrest – El Cajon Corridor	On-Street	SR 94, SR 125	$26
AT050	2035	Active Transportation	Kearny Mesa to Beaches Corridor – Clairemont Drive (Mission Bay to Burgener)	On-Street	N/A	$6
AT056	2035	Active Transportation	San Diego River Bikeway Connections	Off-Street	N/A	$16
AT060	2035	Active Transportation	San Diego River Trail – I-805 to Fenton Parkway	Off-Street	I-15, SB2S	$5
AT062	2035	Active Transportation	San Diego River Trail – Qualcomm Stadium to Ward Road	Off-Street	I-15	$2
AT063	2035	Active Transportation	San Diego River Trail – Qualcomm Way to I-805	Off-Street	I-15, SB2S	$3
AT103	2050	Active Transportation	La Mesa Regional Bike Network Connector	On-Street	SR 94	$2
AT112	2050	Active Transportation	San Diego River Bikeway Connections	Off-Street	CCT, CMH	$11
AT114	2050	Active Transportation	Santee – El Cajon Corridor	On-Street	SR 125, CCT	$16
CC125	2025	Complete Corridor: ATDM/SIS	I-8	SIS	N/A	$94
CC124	2035	Complete Corridor: ATDM/SIS	I-8	ATDM	N/A	$396
CC024	2035	Complete Corridor: ML/Goods Movement	I-8 (I-805 to College Avenue)	8F to 6F+4ML	I-15, SB2S	$161
CC025	2035	Complete Corridor: ML/Goods Movement	I-8 (College Avenue to Johnson Avenue)	8F to 6F+4ML	SR 94, SR 125	$281

Table B-10: Interstate 8 (Continued)

Interstate 8						
Project ID	**Year Built**	**Category**	**Project Name**	**Description**	**Connecting Corridor(s)**	**Cost ($2020) Millions**
CC026	2035	Complete Corridor: ML/Goods Movement	I-8 (Johnson Avenue to Mollison Avenue)	6F to 4F+4ML	SR 125, CCT	$48
CC027	2035	Complete Corridor: ML/Goods Movement	I-8 (Mollison Avenue to Greenfield Drive)	4F/6F to 4F+4ML	N/A	$106
CC023	2050	Complete Corridor: ML/Goods Movement	I-8 (I-5 to I-805)	8F to 6F+4ML	I-15, SB2S	$179
CC067	2050	Complete Corridor: MLC	I-5 (I-8)	South to East and West to North	CMH	$202
CC068	2050	Complete Corridor: MLC	I-5 (I-8)	North to East and West to South	CMH	$202
TL19	2025	Transit Leap	*Rapid* 10	La Mesa to Ocean Beach via Mid-City, Hillcrest, Old Town (Light version of *Rapid*)	I-15, CMH, SR 94, SR 125, SB2S	$36
TL16	2035	Transit Leap	LRT 530	Green Line (Santee to Downtown, Double/Third tracking and Grade Separations)	I-15, SR 94, SR 125, CCT, CMH, SB2S	$384
TL20	2035	Transit Leap	*Rapid* 10	La Mesa to Ocean Beach via Mid-City, Hillcrest, Central Mobility Hub (Full version of *Rapid*)	I-15, SR 94, SR 125, CMH, S2BS	$146
TL01	2050	Transit Leap	Commuter Rail 581	581: Downtown to El Cajon via SDSU and La Mesa 581B: Central Mobility Hub to El Cajon via SDSU and La Mesa	I-15, SR 94, SR 125, CMH, SB2S	$9,774
TL17	2050	Transit Leap	LRT 530	Green Line (Santee to Downtown, Double/Third tracking and Grade Separations)	I-15, SR 94, SR 125, CCT, CMH, SB2S	$384

Table B-11: Coast, Canyons, and Trails

Coast, Canyons, and Trails						
Project ID	**Year Built**	**Category**	**Project Name**	**Description**	**Connecting Corridor(s)**	**Cost ($2020) Millions**
AT009	2025	Active Transportation	San Diego River Trail: Carlton Oaks Segment	Off-Street	N/A	$19
AT023	2035	Active Transportation	Coastal Rail Trail – Rose Canyon	Off-Street	SB2S	$31
AT059	2035	Active Transportation	San Diego River Trail – Father Junipero Serra Trail to West Hills Parkway	On-Street	N/A	$17
AT061	2035	Active Transportation	San Diego River Trail – Mast Park to Lakeside baseball park	Off-Street	N/A	$30
AT065	2035	Active Transportation	Santee – El Cajon Corridor – Forester Creek Connection	Off-Street	N/A	$4
AT081	2050	Active Transportation	Gilman Connector	On-Street	N/A	$13
AT094	2050	Active Transportation	I-8 Corridor – San Diego River Trail to Olde Highway 80	On-Street	N/A	$30
AT099	2050	Active Transportation	Kearny Mesa to Beaches Corridor – Clairemont Drive to Genesee Avenue	On-Street	N/A	$14
AT110	2050	Active Transportation	Pacific Beach to Mission Beach	On-Street	N/A	$13
AT119	2050	Active Transportation	SR 52 Bikeway – I-5 to Santo Road	Off-Street	I-15, SB2S	$82
AT120	2050	Active Transportation	SR 52 Bikeway – SR 52/Mast Drive to San Diego River Trail	Off-Street	N/A	$6
CC131	2025	Complete Corridor: ATDM/SIS	SR 52	SIS	N/A	$30
CC130	2035	Complete Corridor: ATDM/SIS	SR 52	ATDM	N/A	$155
CC029	2035	Complete Corridor: ML	SR 52 (I-805 to I-15)	6F to 4F+3ML	I-15	$92
CC030	2035	Complete Corridor: ML	SR 52 (I-15 to Mast Boulevard)	6F to 4F+3ML	I-15	$153
CC031	2035	Complete Corridor: ML	SR 52 (Mast Boulevard to SR 125)	4F to 4F+3ML	N/A	$103
CC028	2050	Complete Corridor: ML	SR 52 (I-5 to I-805)	4F to 4F+3ML	SB2S	$214
CC065	2050	Complete Corridor: MLC	I-5 (SR 52)	South to East and West to North	N/A	$202
CC066	2050	Complete Corridor: MLC	I-5 (SR 52)	North to East and West to South	N/A	$202
TL32	2025	Transit Leap	*Rapid* 292	Pacific Beach to Kearny Mesa (Light version of *Rapid*)	I-15, SB2S	$34

Table B-11: Coast, Canyons, and Trails (Continued)

Coast, Canyons, and Trails						
Project ID	**Year Built**	**Category**	**Project Name**	**Description**	**Connecting Corridor(s)**	**Cost ($2020) Millions**
TL24	2035	Transit Leap	*Rapid* 30	Balboa Station to Sorrento Mesa via Pacific Beach, La Jolla, UTC	SB2S	$189
TL50	2035	Transit Leap	*Rapid* 870	El Cajon to UTC via Santee, SR 52, I-805	I-8, I-15, SR 125, SB2S	$62
TL51	2035	Transit Leap	*Rapid* 890	El Cajon to Sorrento Mesa via Santee, SR 52, I-805	I-5 NCC, I-8, I-15, SR 125, SB2S	$107

Table B-12: State Route 56

State Route 56						
Project ID	**Year Built**	**Category**	**Project Name**	**Description**	**Connecting Corridor(s)**	**Cost ($2020) Millions**
AT104	2050	Active Transportation	Mid-County Bikeway – Coastal Rail Trail connection	On-Street	N/A	$34
AT121	2050	Active Transportation	SR 56 Bikeway – Azuaga Street to Rancho Peñasquitos Boulevard	Off-Street	I-15	$6
CC129	2025	Complete Corridor: ATDM/SIS	SR 56	SIS	N/A	$16
CC128	2035	Complete Corridor: ATDM/SIS	SR 56	ATDM	N/A	$84
CC107	2050	Complete Corridor: C	I-15 (SR 56)	North to West	I-15	$106
CC035	2050	Complete Corridor: ML	SR 56 (I-5 to I-15)	4F to 4F+3ML	I-15	$549
CC006	2050	Complete Corridor: ML/Goods Movement	I-5 (SR 56 to Via de La Valle)	8F/10F+2HOV to 6F/8F+4ML	I-5 NCC	$37
TL026	2050	Transit Leap	*Rapid* 103	Solana Beach to Sabre Springs via Del Mar Heights and SR 56	I-15	$53
TL027	2050	Transit Leap	*Rapid* 104	Sorrento Valley to Sabre Springs via SR 56	I-15, SB2S	$11

Table B-13: North County

North County						
Project ID	**Year Built**	**Category**	**Project Name**	**Description**	**Connecting Corridor(s)**	**Cost ($2020) Millions**
AT003	2025	Active Transportation	Inland Rail Trail: Phase 4	Off-Street	N/A	$37
AT024	2035	Active Transportation	Coastal Rail Trail Carlsbad	Off-Street	I-5 NCC	$6
AT025	2035	Active Transportation	Coastal Rail Trail Carlsbad – Reach 3 Tamarack to Cannon	Off-Street	I-5 NCC	$11
AT026	2035	Active Transportation	Coastal Rail Trail Carlsbad – Reach 4 Cannon to Palomar Airport Road	Off-Street	I-5 NCC	$8
AT027	2035	Active Transportation	Coastal Rail Trail Carlsbad – Reach 5 Palomar Airport Rd to Poinsettia Station	Off-Street	I-5 NCC	$9
AT030	2035	Active Transportation	Coastal Rail Trail Oceanside – Alta Loma Marsh bridge	Off-Street	I-5 NCC	$4
AT031	2035	Active Transportation	Coastal Rail Trail Oceanside – Broadway to Eaton	Off-Street	I-5 NCC	$1
AT049	2035	Active Transportation	Inland Rail Trail: Oceanside	Off-Street	I-5 NCC	$68
AT068	2050	Active Transportation	Camp Pendleton Trail	On-Street	N/A	$96
AT069	2050	Active Transportation	Carlsbad – San Marcos Corridor	On-Street	N/A	$61
AT073	2050	Active Transportation	Coastal Rail Trail Connections	On-Street	N/A	$16
AT074	2050	Active Transportation	Coastal Rail Trail – Oceanside Segment 1 ALT	On-Street	N/A	$6
AT077	2050	Active Transportation	El Camino Real	On-Street	I-5 NCC	$120
AT078	2050	Active Transportation	Encinitas – San Marcos Corridor	On-Street	I-5 NCC	$41
AT079	2050	Active Transportation	Encinitas to San Marcos Corridor – Double Peak Drive to San Marcos Boulevard	Off-Street	N/A	$30
AT106	2050	Active Transportation	Mid-County Bikeway – Rancho Santa Fe segment	On-Street	I-15	$53
AT113	2050	Active Transportation	San Luis Rey River Trail	Off-Street	I-15	$97
AT124	2050	Active Transportation	Vista Way Connector	On-Street	N/A	$27
CC127	2025	Complete Corridor: ATDM/SIS	SR 78	SIS	N/A	$112
CC126	2035	Complete Corridor: ATDM/SIS	SR 78	ATDM	N/A	$388

Table B-13: North County (Continued)

North County						
Project ID	**Year Built**	**Category**	**Project Name**	**Description**	**Connecting Corridor(s)**	**Cost ($2020) Millions**
CC036	2035	Complete Corridor: ML	SR 78 (I-5 to Twin Oaks)	6F to 4F+4ML	N/A	$507
CC037	2035	Complete Corridor: ML	SR 78 (Twin Oaks to I-15)	6F to 4F+4ML	I-15	$145
CC064	2035	Complete Corridor: MLC	I-5 (SR 78)	South to East and West to North, North to East and West to South	N/A	$352
TL37	2025	Transit Leap	*Rapid* 450	Oceanside to Escondido via Palomar Airport Road and SR 78 (Light version of *Rapid*)	I-5 NCC, I-15	$8
TL10	2035	Transit Leap	LRT 399	SPRINTER (Oceanside to Escondido, Double-tracking and Grade Separations at El Camino Real, Melrose Drive, Vista Village Drive/ Main Street, North Drive, Civic Center, Auto Parkway and Mission Avenue)	I-15	$376
TL36	2035	Transit Leap	*Rapid* 440	Carlsbad to Escondido Transit Center via Palomar Airport Road	I-5 NCC, I-15	$71
TL38	2035	Transit Leap	*Rapid* 450	Oceanside to Escondido via Palomar Airport Road and SR 78 (Full version of *Rapid*)	I-5 NCC, I-15	$31
TL39	2035	Transit Leap	*Rapid* 471	Downtown Escondido to East Escondido	I-15	$85
TL41	2035	Transit Leap	*Rapid* 474	Oceanside to Vista via Mission Avenue/Santa Fe Road Corridor	I-5 NCC	$71
TL42	2035	Transit Leap	*Rapid* 477	Carlsbad Village to SR 76 via College Boulevard, Plaza Camino Real	I-5 NCC	$108
TL11	2050	Transit Leap	LRT 399	SPRINTER (Oceanside to Escondido, Extension to North County Fair)	I-5 NCC, I-15	$376

Table B-14: Mobility Hubs and Flexible Fleets

Mobility Hubs and Flexible Fleets					
Project ID	**Year Built**	**Category**	**Project Name**	**Description**	**Cost ($2020) Millions**
MH1	2025	Mobility Hubs	Mobility Hub Amenities	Mobility Hub amenities including secure micromobility parking and e-charging, interactive travel kiosks, electric vehicle charging infrastructure, passenger loading zones, parcel delivery lockers, and carshare parking	$152
MH2	2035	Mobility Hubs	Mobility Hub Amenities	Mobility Hub amenities including secure micromobility parking and e-charging, interactive travel kiosks, electric vehicle charging infrastructure, passenger loading zones, parcel delivery lockers, and carshare parking	$247
MH3	2050	Mobility Hubs	Mobility Hub Amenities	Mobility Hub amenities including secure micromobility parking and e-charging, interactive travel kiosks, electric vehicle charging infrastructure, passenger loading zones, parcel delivery lockers, and carshare parking	$285
MHLA2	2035	Mobility Hubs	Other Mobility Hub Land Acquisition	Land acquisition for additional future Mobility Hub anchor stations	$66
CCSI1	2035	Mobility Hubs	Complete Streets Improvements	Complete streets improvements within Mobility Hubs such as pedestrian, micromobility, and other traffic calming treatments that complement the Adopted Regional Bike Network.	$1,809
CCSI2	2050	Mobility Hubs	Complete Streets Improvements	Complete streets improvements within Mobility Hubs such as pedestrian, micromobility, and other traffic calming treatments that complement the Adopted Regional Bike Network.	$667
FF1	2025	Flexible Fleets	Flexible Fleets Operations	Operations for Flexible Fleet services including micromobility, ridehail/carshare, rideshare microtransit, and last mile delivery	$161
FF2	2035	Flexible Fleets	Flexible Fleets Operations	Operations for Flexible Fleet services including micromobility, ridehail/carshare, rideshare microtransit, and last mile delivery	$538
FF3	2050	Flexible Fleets	Flexible Fleets Operations	Operations for Flexible Fleet services including micromobility, ridehail/carshare, rideshare microtransit, and last mile delivery	$1,094

Table B-15: Next Operating System

Next Operating System					
Project ID	**Year Built**	**Category**	**Project Name**	**Description**	**Cost ($2020) Millions**
NO01	2025	Next OS	Data Hub	High speed data analytics, data repository, and data performance management platform that will bring together public transportation data and develop a public–private information exchange with companies such as TNCs	$32
NO02	2035	Next OS	Curb Access and Parking	Dynamic management of curb including access and pricing rules	$12
NO03	2035	Next OS	Transit Optimization	Dynamic transit routing, scheduling, and communications	$7
NO04	2035	Next OS	Mobility as a Service	Application to plan, book, and pay across public and private shared services	$10
NO05	2025	Next OS	Smart Intersections	Intersection safety and signal timing systems that give priority to transit, freight, and emergency vehicles and reduce intersection vehicle and pedestrian conflicts	$19
NO06	2035	Next OS	Next Generation ICMS	Provide coordinated response and control for real-time operations across freeway, arterials, and transit networks	$7
NO07	2025	Next OS/Goods Movement	Regional Border Management System	Regional Border Management System with wait times and dynamic tolling to reduce crossborder wait times	$15
NO08	2035	Next OS	Systems and Software	Enables regional transportation system operators to collect, analyze, and share data to improve transportation systems management and operations	$63
NO09	2035	Next OS	Operations	Next OS Ongoing Operations and Future System Upgrades	$63

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Appendix C

Climate Change Projections, Impacts, and Adaptation

APPENDIX C
CLIMATE CHANGE PROJECTIONS, IMPACTS, AND ADAPTATION

C.1 INTRODUCTION

This report describes how climate may change in the San Diego region in the future due to the effects of global warming, and how those changes could affect each of the resource areas discussed in the Environmental Impact Report (EIR). The discussions of potential impacts of climate change on each resource topic in this report inform the resource area sections throughout Chapter 4, *Environmental Impact Analysis Approach,* of the EIR. The EIR sections evaluate whether *San Diego Forward: The 2021 Regional Plan* (the proposed Plan) would magnify a climate change impact (e.g., creating more housing development in high wildfire risk zones).

There is a higher degree of certainty for some future climate projections than others. Consequently, the specific impacts stemming from these projections can often be difficult to quantify. Thus, for several resource areas, there may be a range of generalized, qualitative climate-related impacts. For other resource areas more quantitative impact projections may exist. As a result, the degree of certainty around climate impacts will vary; the impacts described present the potential effects that climate change may have on the San Diego region.

C.2 CLIMATE CHANGE PROJECTIONS AND GENERAL IMPACTS ON THE REGION

Projected Changes in Climate for the San Diego Region

The findings below summarize the projected impacts of climate change in the San Diego region, as described in the 2018 *California's Fourth Climate Change Assessment: San Diego Region Report* (Kalansky et al. 2018) and original sources referenced in San Diego Association of Government's (SANDAG's) *Climate Change White Paper* (2018). Several of the climate projections discussed below reference Representative Concentration Pathways (RCPs), which are four different potential trajectories of greenhouse gas (GHG) concentrations between 2000 and 2100. RCPs were adopted by the International Panel on Climate Change (IPCC) in 2014 and are widely used to represent future concentrations of GHG emissions. RCPs 4.5 and 8.5 are the two RCPs referenced below. RCP 4.5 is often described as an intermediate pathway and RCP 8.5 as a high, but potentially realistic, pathway.[1] More information on RCPs can be found in van Vuuren et al. (2011).

Temperature

Annual average temperature for the San Diego region is projected to increase 4.8°F by 2050 under RCP 8.5 (CEP and SDF 2015); by 2100, projected temperature increases range from 4–6°F under the RCP 4.5 scenario or 7–9°F under the RCP 8.5 scenario (Kalansky et al. 2018). Coastal areas, due to the ventilation system provided by marine layer clouds, may be 0.9°F cooler than inland areas by 2050 (Kalansky et al. 2018).

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[1] The 2021 IPCC 6th Assessment Report was released August 9, 2021. In general, the report found that "Global surface temperature will continue to increase until at least the mid-century under all emissions scenarios considered…" and that "many changes in the climate system become larger in direct relation to increasing global warming." This EIA analysis does not incorporate the latest climate projections of climate change provided by the AR6 report.

Heat wave frequency, intensity, and duration are projected to increase, with the length of the heat wave increasing by 20–50 percent under a 6˚F annual average temperature increase (Kalansky et al. 2018). The region is projected to experience up to 15 extreme heat days by 2050; San Diego currently experiences an average of 2 extreme heat days per year, so this is a more than seven-fold increase (CEP and SDF 2015). By 2100 under RCP 8.5, the temperature of the hottest day of the year may also rise—by about 10°F for the coasts and about 7°F for the deserts (Kalansky et al. 2018).

Precipitation

In general, precipitation will remain highly variable but will contain more contrast, with wetter winters, drier springs and autumns, more intense precipitation events, and more frequent and severe droughts (Kalansky et al. 2018). The San Diego region is projected to experience 16 percent fewer rainy days and 8 percent more rainfall during the biggest rainstorms by 2050 (CEP and SDF 2015).

By 2100, the average wettest day every 5 years is projected to increase in rainfall by 10–25 percent under RCP 4.5 and by 15–30 percent under RCP 8.5. Stronger seasonal dryness may occur in the region due to longer dry warm seasons and increased evapotranspiration (Kalansky et al. 2018). Furthermore, a 12 percent decrease in runoff and streamflow is projected under RCP 8.5 due to less snowpack and greater evaporation (CEP and SDF 2015).

Sea-Level Rise

Sea levels in the San Diego region have already risen about 0.6 feet over the last century and are expected to rise even faster in the future (Kalansky et al. 2018). Both the Ocean Protection Council (OPC 2018) and Kalansky et al. (2018) provide sea-level rise projections for the San Diego region; see Table C-1.

Table C-1
Sea-Level Rise Projections

	OPC Sea-Level Rise Guidance (OPC 2018[1])	*San Diego Region Report* (Kalansky et al. 2018[2])
2030	0.4 to 0.6 feet (4.8 to 7.2 inches)	0.3 feet (3.6 inches)
2050	0.7 to 1.2 feet (8.4 to 14.4 inches)	0.7 to 0.8 feet (8.4 to 9.6 inches)
2100	1.1 to 3.6 feet (13.2 to 43.2 inches)	2.5 to 4.6 feet (30 to 55.2 inches)

[1] There is a 66% probability that sea-level rise will occur between these two values. Numbers for 2030 and 2050 consider RCP 8.5 projections, while numbers for 2100 consider both RCP 2.6 and RCP 8.5 projections. Projections are with respect to a baseline of the average relative sea level over 1991–2009.
[2] Lower limits are RCP 4.5 projections and upper limits are RCP 8.5 projections; numbers are in the 50th percentile likelihood. Projections are with respect to a baseline of the year 2000.

This rise is projected to occur more rapidly and be more uncertain in the second half of the century, and high tides, wind-driven waves, and storms may contribute to more extreme events along coastlines (Kalansky et al. 2018).

Wildfire

The San Diego region can expect a longer and less predictable fire season (CEP and SDF 2015). Santa Ana wind events, which are also projected to increase in frequency and intensity, may drive more frequent large, catastrophic wildfires due to drier autumns that occur before the peak of the Santa Ana wind season in December and January, and other factors, such as development and presence of dead fuels (Kalansky et al. 2018).

C.3 CLIMATE CHANGE IMPACTS ON RESOURCE TOPICS

Table C-2 summarizes the impacts of climate change on the resource topics discussed in this report. The sections that follow the table analyze each of the resource areas in more detail.

Table C-2
Summary of Potential Climate Change Impacts on Resource Topics

Resource Topic	Temperature	Precipitation	Sea-Level Rise	Wildfire
Aesthetics and Visual Resources	Damage to trees/ vegetation	Damage to trees/ vegetation	Coastline views altered	Damage to trees/ vegetation
Agricultural and Forestry Resources	Heat stress on crops and livestock	Insufficient water for crops	N/A	Damaged land from burning
Air Quality	Increased ozone formation; worsened indoor air quality	Increased dust; decreased rain to clear air	N/A	Increased particulate matter, leading to reduced air quality
Biological Resources	Species shifts from temperature changes; heat stress	Damage to riparian habitats; insufficient water for species from drought	Damage to coastal habitats and species from erosion and saltwater intrusion	Damage to habitats, species, and migratory pathways; vegetation shifts
Cultural Resources	Deterioration of cultural resources from heat stress	Erosion and damage to cultural sites and resources	Damage to coastal cultural sites	Damage to cultural sites or resources
Energy	Increased energy demand; decreased equipment efficiency	Reduced hydropower generation	Damage to coastal power plants and infrastructure	Damage to electrical infrastructure
Geology, Soils, and Paleontology	N/A	Increased occurrence of landslides; increased subsidence; damage to soil	Cliff erosion	Increased occurrence of landslides; damage to soil
Greenhouse Gas Emissions	Increase in GHG emissions due to increased cooling	Increased GHG emissions due to increased need for conveyance or	N/A	Increased GHG emissions from forests burned by increased wildfires

Resource Topic	Temperature	Precipitation	Sea-Level Rise	Wildfire
	and energy demand	treatment of water sources		
Hazards and Hazardous Materials	Increased human health hazard	Increased human health hazard; increased nonpoint source pollution causing health hazards	Potential disruptions to emergency response	Potential human health hazard
Hydrology and Water Quality	Altered rates of stratification; changes to lake nutrients, dissolved oxygen, and bacteria content	Heavier storms and more drought; decreased streamflow; increased risk of flooding; worsened water quality from flooding	Worsened groundwater quality from saltwater intrusion; increased risk of coastal flooding and tsunamis	Increased sediments in water from wildfire
Land Use	N/A	Reduced inhabitable land from inland flooding	Reduced inhabitable land from cliff erosion and coastal flooding	Reduced inhabitable land from wildfire
Mineral Resources	Damage to equipment, reduced work safety and efficiency	Damage to mining sites	Damage to coastal mining sites	Damage to mining sites
Noise and Vibration	N/A	N/A	N/A	N/A
Population and Housing	Urban heat island effect	Damage to/ destruction of homes from flooding; potential housing shifts	Damage to/ destruction of homes along coast	Damage to/ destruction of homes; potential housing shifts
Public Services and Utilities	Increased needs for emergency management, cooling facilities, and water treatment; worsened solid waste management efficiency	Increased emergency management needs; damage to facilities; increased water treatment required	Damage to coastal facilities; increased water treatment required	Increased emergency management needs; damage to facilities; increased water treatment required

Resource Topic	Temperature	Precipitation	Sea-Level Rise	Wildfire
Transportation	Damage to infrastructure; reduced safety and efficiency in maintenance	Damage to infrastructure	Damage to coastal infrastructure	Damage to infrastructure
Tribal Cultural Resources	Loss of material and ecological culture	Loss of material and ecological culture; loss of access to cultural sites; reduced water availability	Loss of material and ecological culture	Loss of material and ecological culture; damage to forest resources
Water Supply	Increased water demand and reduced imported water supply due to snowpack loss	Changes in water timing and availability; increased water demand and reduced imported water supply due to snowpack loss	Saltwater intrusion into coastal groundwater sources	N/A
Wildfire	Increased wildfire risk due to higher temperatures	Increased wildfire risk due to higher incidence of drought	N/A	Increased wildfire

Aesthetics and Visual Resources

There are limited studies on the effects of climate change on aesthetics, so it is difficult to draw firm conclusions about how climate change will affect aesthetics and visual resources in the San Diego region. This section qualitatively discusses selected potential aesthetic and visual impacts.

Sea-level rise could affect coastline appearance. Sea levels in the San Diego region are likely to rise 8.4 to 14.4 inches by 2050 (see Section F.2), potentially altering coastline views through enhanced coastal erosion and coastal flooding. However, it is not possible to draw specific conclusions on this effect or determine whether this aesthetic impact would be positive or negative. In addition, many local communities in California, including several in the San Diego region, are exploring options for protecting coastlines in response to sea-level rise. In general, adaptation options range from beach nourishment, to establishing natural barriers, to building seawalls or other barriers, to managed retreat from the coastline. Each of these options involves significant investment, negotiation, or consideration of impacts on residents. Seawalls and other engineered adaptation measures could alter coastline views.

Climate change could damage scenic natural resources such as trees and vegetation, including those within state scenic highways. The SANDAG region's natural scenic resources attract tourism and contribute to the health and well-being of residents and visitors. Potential impacts on natural resources are described in the sections that follow in greater detail.

Agricultural and Forestry Resources

Climate change may limit the availability and viability of agricultural land, due to higher temperatures, reduced availability of water for irrigation, changed pest and disease regimes, and destructive events like wildfire. Forests could also be negatively affected by high temperatures and wildfire, especially when these effects are combined with land use changes and poor management. In addition to potentially reducing agricultural and forest viability and production rates, climate change impacts on plant growth and soil microbial communities may also negatively impact soil carbon storage rates and levels (Bradford et al. 2016, Ren et al. 2020).

Higher temperatures may worsen crop yield and quality, decrease the number of pollinators available, decrease the number of "chill hours" needed for some crops to grow, increase evapotranspiration, and increase the spread of crop pests and diseases (Gonzalez et al. 2018). Higher temperatures can also cause heat stress on livestock, spread livestock diseases, or require higher costs in cooling livestock facilities; all of these may reduce livestock and dairy production (Bright et al. 2018). As noted in Section F.2, temperatures are projected to increase in the San Diego region in the future.

Water supplies and irrigation may be constrained in the San Diego region by 2050 due to fewer rainy days and a decrease in runoff and streamflow, as well as longer and more intense droughts (see Section F.2). Snowpack in the Sierra Nevada Mountains is also projected to melt earlier; projections for 2070–2099 indicate 35–52 percent of snowpack remaining by April 1, compared to the 100 percent remaining post-April 1 snowpack from 1961–1990. This projected difference in seasonal water availability can affect crop yield and quality, especially for crops that are more sensitive to the timing of rainfall and irrigation (Gonzalez et al. 2018).

Using the Cal-Adapt wildfire tool (Cal-Adapt 2021), the County of San Diego estimates a 40 percent increase in annual average acres of burned land by 2100 compared to the annual average between 1950 and 2005 under a high-emissions scenario (County of San Diego 2018). Rainstorms are projected to be heavier by 2050 (see Section F.2), which may result in more soil erosion. Furthermore, the increase in atmospheric carbon dioxide from climate change could accelerate the spread of weeds (Reidmiller et al. 2018). Thus, climate change is expected to have a negative impact on agricultural resources in the San Diego region.

Impacts of climate change can also result in conversion, or loss, of forest land. Forest lands in the San Diego region face some of the same threats listed for agriculture, including higher temperatures, wildfire, pests, drought, and flooding (Bright et al. 2018). In California, land use and forest management practices have led to the growth of trees that are less resilient to drought and wildfire (Bright et al. 2018). Certain tree species in Southern California, such as conifer forests, are especially vulnerable—warmer and drier climates in the past have increased the burn area of these forests by 650 percent. Wildfires in the southwestern United States can also convert forest to woodland or grassland (Melillo et al. 2014) and may have a positive feedback cycle on climate change by reducing the amounts of sequestered carbon. Forests in the United States absorb and hold about 16 percent of the carbon dioxide emitted in the country per year; burning this wood releases this carbon back into the atmosphere (Melillo et al. 2014). Warm temperatures and drought can also increase the spread of insect attacks, such as bark beetles, which have already killed off 102 million trees in California since 2010 (Bright et al. 2018). However, the consequences of climate change on forestry resources in the San Diego region have not yet been quantified.

Air Quality

Climate change may worsen air quality in the San Diego region by influencing ozone, wildfire, and indoor air pollution. Quantitative estimates of the extent of this impact are not available for the region. However, nationwide, assuming no change in regulatory controls or population characteristics, estimates of additional premature deaths per year by 2050 from combined ozone and particulate matter due to climate change range from 1,000–4,300 (Melillo et al. 2014).

Ozone forms through a combination of heat, precursor chemicals, and methane emissions (Reidmiller et al. 2018). Therefore, higher temperatures can lead to more ozone formation and thus to poorer air quality. Studies regarding the overall air quality impact on the San Diego region are not available. In general, given anticipated temperatures rises in the region (see Section F.2), higher temperatures will increase ozone (Pfister et al. 2014).

Wildfires can emit particulate matter, carbon monoxide, nitrogen oxide, and other volatile organic compounds, further worsening air quality. The negative health impacts of wildfire smoke can spread across the San Diego region, exacerbating respiratory and asthma-related conditions (Reidmiller et al. 2018). A significant increase in the areas of wildfire is also projected for the San Diego region (see Section F.2). Furthermore, precipitation during dry seasons, which can help fight wildfires and may play a part in clearing away air pollution (Kim et al. 2007), is projected to decrease from climate change (see Section F.2).

Droughts, which are anticipated to be longer and more severe in the region (see Section F.2), may also cause health and air quality issues by stirring up more dust. In the southwestern United States, this can be dangerous due to the spores of the fungi *Coccidiodes*, which cause valley fever and reside in indoor and outdoor dust (Crimmins et al. 2016). However, the consequences of climate change on drought and resulting outdoor air quality in the San Diego region have not yet been quantified.

Climate change may also worsen the intensity of odors coming from landfills. After heavy rains, the Miramar Landfill in the City of San Diego has received complaints of odors from residents living nearby (Patton 2019). Studies on landfill odors have also shown that odor pollution is worse in high temperatures, high humidity, and low air pressure (Ying et al. 2012). Because temperatures and intense precipitation are expected to increase in the San Diego region, this may exacerbate air quality issues due to landfill odors in the future.

Biological Resources

Climate change may result in significant impacts on biological resources, including adverse effects on habitats and wetlands, species health and productivity, and migratory pathways and timing. For example, a study of San Luis Obispo County found that sea-level rise along the coast could lead to increased erosion of coastal bluffs and beaches, coastal flooding, permanent inundation of coastal wetlands, and saltwater intrusion into freshwater supplies, all of which affect ecosystem health (Moser and Ekstrom 2012). (See Section F.2 for details about how climate conditions in the San Diego region are expected to change.)

Habitat – Upland and Inland

The combination of human-driven land use change and changing climatic conditions could negatively affect available habitat areas, including San Diego's scrublands and forests. As the habitat areas change, the species that depend on them could be negatively affected (USFWS 2010).

Shrublands are the most extensive vegetation type in the San Diego region, including coastal sage scrub and chaparral (Jennings et al. 2018). Coastal sage scrub habitats in the San Diego region support many plants, insects, mammals, and birds, including the Coastal California gnatcatcher, which is considered "threatened" under the Endangered Species Act, and the Quino checkerspot butterfly, which is considered "endangered" (Messner et al. 2011). According to EcoAdapt (2017), sage scrub habitat in Southern California is moderately vulnerable to climate change due to its sensitivity to climate stressors, exposure to projected climate change impacts, and moderate adaptive capacity. The area of chaparral and coastal sage scrub could decrease by 38–44 percent by 2070 (PRBO Conservation Science 2011). Higher temperatures and shifting rainfall patterns could affect plant germination, recruitment, and habitat composition (EcoAdapt 2017). Although sage scrub is adapted to wildfire patterns, increasingly severe or frequent wildfires could prevent the habitat from recovering, and it could create conditions conducive for invasive species (EcoAdapt 2017). Changes in fire intensity and frequency could result in a transition from scrublands to nonnative grasslands, which would change the habitat quality for native species (PRBO Conservation Science 2011, Jennings et al. 2018). However, no detailed modeling has been conducted to quantify the impact of climate change on scrubland in the San Diego region.

Additionally, climate change projections for California indicate that forest habitats will be substantially affected by rising temperatures and extended periods of drought (Messner et al. 2011). In particular, warmer winter temperatures are conducive for the survival and reproduction of pests that can cause damage to trees (Messner et al. 2011). Again, modeling has not been conducted to quantify what this impact would be for the San Diego region.

The projected habitat losses in Southern California may be more extensive when considered in conjunction with land-use change and development. There is the potential for compounding negative impacts on habitats. By 2050, ten species across California could lose more than 40 percent of their habitat due to the cumulative impact of climate change and development, and the impacts along the coast of Southern California are projected to be even more severe (Riordan et al. 2014). For example, areas of central California are suitable Cor sage scrub migration due to climate change. However, habitat fragmentation due to land-use change and other factors may reduce the ability for these species to seek refuge (EcoAdapt 2017). Detailed studies on the San Diego region have not been completed, so conclusions cannot be made for that specific region.

Habitat – Riparian and Coastal

Sea-level rise, temperature, erosion, droughts, and precipitation-related flooding may all have far-reaching consequences for California's wetlands and riparian and coastal habitats (Griggs and Russell 2012). In riparian habitats, sea-level rise may increase saltwater intrusion into freshwater ecosystems, which may threaten species living in these environments (ICLEI 2012). Higher water temperatures in streams and estuaries, particularly in the San Diego region where water levels are relatively shallow, may cause thermal stress for species living there, making the habitat unsuitable (Jennings et al. 2018). Also, more frequent or intense drought conditions can change stream levels, particularly in areas with seasonal waterways like Southern California, which could damage riparian habitats (Hilberg et al. 2017, Jennings et al. 2018). The consequences of climate change on riparian habitats in the San Diego region have not been quantified, but given the impacts discussed in Section F.2, it is possible that they will be affected.

When sea level rises, intertidal coastal habitats are flooded more often. According to the *Sea Level Rise Adaptation Strategy for San Diego Bay*, habitat for endangered and threatened species is vulnerable to flooding due to sea-level rise and erosion, which would force species to shift habitats toward higher elevations or farther inland (ICLEI 2012). According to Messner et al. (2011), loss of rocky beach habitat is of particular concern in the San Diego region because the two main intertidal marine reserves, Cabrillo National Monument and Scripps Coastal Reserve, are bordered by steep cliffs and could lose much of their intertidal habitats by 2050. Thus, coastal habitats could be at risk due to sea-level rise. In San Diego County, 6.1 square kilometers of land with "Conserved" or "Highly Conserved" conservation management status are exposed to 2 feet of sea-level rise (Heady et al. 2018).

Sea-level rise is expected to increase coastal flooding and inundate existing wetland areas. According to Heberger et al. (2009), sea-level rise of 1.4 meters is estimated to flood about 150 square miles of land adjacent to current wetlands, possibly creating additional wetland areas or inundating existing areas. The San Diego region has 14 square miles of coastal wetlands (Heberger et al. 2009), and sea-level rise may force these existing coastal wetlands to move inland if there is available land and if no barriers impede movement. The region has 5.8 square miles of wetland migration area (or 3.4 percent of the total area in the state). In total, 64 percent of this area, or 3.7 square miles, is viable wetland habitat, and an additional 6 percent is viable with a loss of value (Heberger et al. 2009). Wetland migration into this area would increase competition for other land uses. Development in this buffer zone may impede inland migration and thereby contribute to the loss of valuable habitat. Conversely, some species may not be able to migrate quickly enough to keep pace with sea-level rise, and they may be damaged by permanent inundation. Increasingly, wetland areas in the San Diego region may become inundated, although the full significance of this impact is not well researched.

In the San Diego region, precipitation is highly variable year-to-year. More frequent or severe heavy precipitation events could have negative impacts on stream and riparian habitats due to increased streamflow. Additionally, many riparian systems in Southern California rely on seasonal flow for species breeding and rearing, which could be disrupted by changing precipitation conditions. Shifts in streamside ecosystems could have destabilizing effects on the banks and increase erosion problems. (Jennings et al. 2018.)

Species

The dynamics between climate conditions and ecosystem health are complex due to great interdependencies between different parts of the system. The full ramifications of climate change impacts on candidate, sensitive, or special-status species within the San Diego region are not known from the literature. However, some studies provide overarching projections of the impacts on plants and wildlife within the region that are useful for decision making. The San Diego region is a recognized biodiversity hotspot, with more taxa of plants and mammals than any other county in the country (Jennings et al. 2018). Climate change is projected to compound environmental stressors from human-caused disturbances, habitat fragmentation, and landscape changes (Jennings et al. 2018). Given the impacts described in Section F.2, changes such as warmer temperatures, more variable precipitation resulting in high intensity flooding, more frequent droughts, and destructive fires could all affect species success.

Although there is still uncertainty around how individual species will be affected by higher temperatures, studies suggest that species will shift their ranges northwards and to higher elevations (Jennings et al. 2018). If habitats within the region become unsuitable, species may die or relocate to new habitats. For example, projected changes in temperature would make the San Diego region surpass the threshold for the California owl (Jennings et al. 2018). Also in the region, animals and short-lived plants are expected to experience increased mortality and reduced reproductive success due to changes in temperature (Jennings et al. 2018). Examples of temperature-affected species include the endangered species: Laguna Mountains skipper and Hermes copper butterfly (Jennings et al. 2018). Extreme temperatures could also alter the timing of ecological phenomena, such as breeding, flowering, or the emergence of pests, and heat waves may increase mortality and decrease reproductive success (Jennings et al. 2018). The endangered Quino checkerspot butterfly (*Euphydryas editha quino*) may adapt to increased temperature and resulting impacts on larval mortality by shifting its elevational or latitudinal range; unfortunately, habitat degradation results in the inhabitability of these new ranges (Parmesan et al. 2014). The special-status species Otay tarplant (*Deinandra conjugens),* an annual herbaceous plant endemic to San Diego County, may be impacted by hotter and drier conditions that reduce germination rates or misalign plant phenology with pollinator phenology (USFWS 2009). Modeling has shown that increases in temperature combined with decreased precipitation significantly increases the probability for extinction of the endangered peninsular bighorn sheep (*Ovis canadensis nelson – population 2),* especially for those that inhabit lower elevations (University of California-Berkeley 2004). Thus, climate change may have a negative impact on biodiversity in the San Diego region.

While the exact nature of climate impacts on aquatic species within the San Diego region is not known at this time, warmer water temperatures and changes in the seasonal distribution of precipitation may affect them. Changes in seasonal streams and flow rates may disrupt riparian species (Jennings et al. 2018). Temperature and precipitation changes could affect aquatic species through degradation of aquatic ecosystems and the introduction of invasive species (California Natural Resources Agency 2009). Additionally, fish populations could be directly affected by changes in temperature and precipitation, affecting nutrient availability, shifting habitat, changing the food web, and reducing physical health (Moser and Ekstrom 2012). Projections indicate that the endangered fish species, the tidewater goby (*Eucyclogobius newberryi*), which inhabits the mouth of the San Luis Rey River, may be impacted by sea-level rise, as coastal lagoons become inundated and increase in salinity, interrupting the tidewater goby's reproduction process, which requires a specific salinity range (Cayan et al. 2006). Also, inundation of coastal wetlands may affect fish reproduction success and the food web indirectly (Moser and Ekstrom 2012). Because climate change may alter the hydrology of vernal pool habitat, the existence of special-status species such as the annual herb, spreading navarretia (*Navarretia fossalis),* is expected to be further threatened by drier conditions (USFS 2009). Bird species may also be impacted by altered hydrology, especially riparian-dependent species such as the endangered southwestern willow flycatcher (*Empidonax trailli extimus)* or the endangered least Bell's vireo (*Vireo belli pusillus*) (Gardali et al. 2012).

Droughts can also cause ecosystem damage, such as the oak tree die off during the drought of 2012–2016. Extreme drought events could change the habitat suitability to favor more deeply rooted and drought-tolerant species of plants, while also making plants more susceptible to pests and pathogens. In the San Diego region, animals that are dependent on arthropod populations may also be negatively affected by increases in droughts. (Jennings et al. 2018.)

Fire is a natural process that has shaped the region's plant communities and therefore its animal habitat (Jennings et al. 2018). However, more frequent or intense wildfires may shorten the interval between fires, preventing recovery of native vegetation (Jennings et al. 2018). Increased frequency of wildfire creates conditions for invasive species incursions and hybridization of some grass species, as is the case for the endangered species, San Bernardino blue grass (*Poa atropurpurea*); its largest known stands are found in the high fire-risk San Bernardino Mountains (USFS 2009).

Migratory Pathways

If habitats change and species face environmental stresses due to changing temperature and precipitation patterns, plant and animal species may migrate to new habitats. While animals can move rather quickly to new habitats, unless blocked by other factors, rapidly changing conditions may surpass the pace that vegetation can move. Some climates, such as alpine climates, could disappear entirely in the future, while desert climates could expand significantly (Moser et al. 2012). Some habitats may expand while others are lost (Moser et al. 2012). If there is no suitable habitat nearby, species will be unable to migrate. The extent to which habitat migration causes negative and/or positive impacts is unknown at this point, although studies tend to acknowledge risks to certain industries like agriculture or fishing.

Wildlife can move more quickly than vegetation when climate conditions change. However, animal species could face greater challenges due to climate change if they are unable to migrate to areas with suitable climatic conditions (Moser et al. 2012). Therefore, identifying and protecting migration corridors is important to allow species to move to suitable habitats (Moser et al. 2012). In addition to land migratory routes, the San Diego region is part of the Pacific Flyway, where many migratory birds stop to feed during their migrations. Changes in climate, such as rising temperatures and drought, are disrupting these migration patterns; species such as the house wren and the Cassin's kingbird are no longer migrating south in the numbers they did previously (Murphy 2018). According to the National Audubon Society, more than half of the bird species in North America could be at risk due to climate change, and more will be endangered due to habitat loss (Langham et al. 2015). Warmer temperatures may change the ranges and habitats of species that are important for feeding or nesting, which may endanger protected species that use these resources.

Cultural Resources

Sea-level rise presents a risk to cultural resources within the San Diego region, although the extent to which this will damage cultural resources is not known. According to a study by Lipps and Pedersen (2015), 4.6 feet of sea-level rise could affect 194 Native American cultural sites in Southern California. Additionally, historic districts could experience more frequent or severe flooding impacts due to sea-level rise. For example, the Cabrillo National Monument could be vulnerable to sea-level rise and increased storm frequency and intensity, although the extent of this risk is not fully understood (Smith 2018).

Changes in temperature and precipitation could also damage cultural resources, although the extent to which these could negatively affect archaeological and cultural resources in the San Diego region has not been quantified. Higher temperatures can cause faster rates of deterioration due to thermal stress and biological activity, more rapid decay of organic materials, heat stress on culturally significant vegetation, and loss of culturally significant habitat and species due to disease and temperature changes (Rockman et al. 2016). Heavy precipitation and flooding could damage cultural resources due to site erosion and destabilization, direct physical damage to the site, loss of artifacts due to flooding, and increased risk of post-flood subsidence (Rockman et al. 2016).

Cultural resources in the San Diego region may also be threatened due to more intense or frequent wildfires as observed from past events. In 2002, the Pines Fire covered nearly 100 square miles in San Diego County. In the process of recovery, archaeologists identified 249 cultural sites within or immediately adjacent to the fire, and another 50 within the area of bulldozer activity, including rock shelters, Native American settlements, and rock art (Waechter 2012). Wildfires can increase damage to archaeologically relevant structures, alter the artifacts exposed to extreme heat, increase susceptibility to erosion and flooding, and exacerbate damages due to firefighting activities (Rockman et al. 2016). Wildfire could also damage historical structures or alter their distinct physical characteristics as older buildings may not have as robust defenses against wildfire as modern buildings (Rockman et al. 2016).

It is possible that sea-level rise, flooding, wildfire, and landslides could reveal or damage human remains. Remains exposed to the environment from climate hazards may then be further damaged by extreme weather. For example, changes in temperature and precipitation could speed deterioration and decay, cause thermal stress, and cause erosion (Rockman et al. 2016).

Energy

Climate change could lead to an increase in energy usage in California. For example, *Our Changing Climate 2012: Vulnerability & Adaptation to the Increasing Risks of from Climate Change in California* (Moser et al. 2012) explains that increases in average temperature and extreme heat events will drive up the demand for summer cooling. This can occur both in buildings and in transportation (e.g., personal vehicles, buses, subways, etc.). This will be exacerbated by new residential development and expanded use of air conditioning, should the net result of the growth of energy demand from new housing stock outpace energy efficiency gains in the existing housing stock. Growing demand will probably not be offset by the decreased heating needs in winter, particularly because California's residential sector uses relatively little electricity for heating (Moser et al. 2012). Climate impacts on other sectors may also increase energy demand. For example, drought conditions may cause more pumping, conveyance, or treatment of water, all of which require energy.

There have been some studies that have attempted to quantify the net effect on energy demand. However, some of these are increasingly dated, and none are focused specifically on the San Diego region. As a result, it is difficult to draw conclusions about how much energy usage in the San Diego region will increase due to climate change. However, these studies do provide some context to the potential extent of energy increases. These studies include the following:

- Auffhammer and Aroonruengsawat (2012) modeled energy demand increases of 18–55 percent by 2100 in California due to climate change, holding population constant. When considering a population increase of 0.18 percent per year, energy demand would increase by 65–70 percent during that timeframe. It is expected that demand for electricity will increase as households operate air conditioners more often and install air conditioners where few are used. However, their study did not account for energy efficiency improvements of buildings, equipment, or the electricity system.
- Guegan et al. (2012), citing Franco and Sanstad (2006), found that, relative to the base period 1961–1990, electricity demand in California would increase by 3.1–20.3 percent, and peak load would increase by 4.1–19.3 percent by 2100.
- The U.S. Environmental Protection Agency (EPA) report *Climate Change and Space Heating Energy Demand: A Review of the Literature* found that in warm weather (above 68°F/20°C), one degree of additional warming increases electricity use by 0–8 percent, although that estimate is nationwide rather than specific to the San Diego region (Ranson et al. 2014). By 2050, temperature in the San Diego region is expected to increase by 4.8°F under RCP 8.5 relative to 1985 (CEP and SDF 2015).

Climate change would cause impacts outside of increased demand for energy. For example, variation in rainfall may alter hydropower generation, storage potential, and generation capacity substantially. In particular, a summer water shortage is of concern because it reduces hydropower capacity when summer energy demand is the highest (Guegan et al. 2012). If hydropower is reduced, it is not clear what energy source would replace it, although the state's renewable energy requirements may help limit the extent that hydropower is replaced by fossil fuels. Moreover, the actual amount of reduction in hydropower due to climate change has not been quantified.

Finally, climate change could contribute to the need for new or expanded energy facilities, although there is insufficient research to draw definitive conclusions about the extent to which climate change would do so. Climate change could contribute to this impact via the following ways:

- The projected increase in demand due to climate change (discussed above) could necessitate the building or expansion of additional generation facilities.
- Additional transmission capacity might be needed, not only due to additional load needing to be transmitted, but also because higher temperatures reduce the carrying capacity of the transmission lines—which in turn may lead to greater generation needs. According to Bartos et al. (2016), by mid-century (2040–2060) in the United States, increases in air temperature may reduce transmission capacity in the

summer by 1.9–5.8 percent relative to the 1990–2010 base period. Simultaneously, peak summer loads may rise by 4.2–15.0 percent on average due to higher temperatures (Bartos et al. 2016). Sathaye et al. (2012) suggests a similar effect, estimating that climate change in California may reduce transmission capacity by 7–8 percent by the end of the twenty-first century.

- Higher temperatures can decrease generation capacity of natural gas-fired power plants, while increasing energy demand. Under a high emission scenario, generation capacity may decrease by 3–6 percent in California and reduce transformer and substation capability by 2–4 percent (Sathaye et al. 2012). A decrease in generation capacity may necessitate the expansion/building of additional facilities.
- According to the County of San Diego's Climate Action Plan (2018), wildfire can damage electrical infrastructure, including severing transmission lines when fire comes in direct contact with the lines and affecting transmission capacity due to heat and smoke. Key transmission corridors are vulnerable to more frequent wildfires. One study sited in *Our Changing Climate 2012: Vulnerability & Adaptation to the Increasing Risks of from Climate Change in California* found that some major transmission lines would face a 40 percent increase in the probability of wildfire exposure (Moser et al. 2012).
- Sea-level rise and increased storm frequency and/or intensity could affect coastal power plants, leading to flooding of some facilities. Additionally, offshore water intake pipes may be damaged by storm surge and debris (Perez 2009).
- According to Heberger et al. (2009), an estimated 1.4 meters of sea-level rise would accelerate erosion and result in a loss of 41 square miles of California's coast by 2100. Given a 1.4-meter sea-level rise scenario, a 100-year flood event could cause flooding at 30 California coastal power plants, with a combined capacity of more than 10,000 megawatts, and at least one natural gas storage facility by the end of the century; however, only one of these facilities is in the San Diego region.

Geology, Soils, and Paleontological Resources

Changes in precipitation patterns, as well as sea-level rise, could have geologic impacts on the San Diego region by inducing more landslides, land subsidence, and coastal erosion. Soil may also face erosion as well as nutrient loss, and destructive impacts like wildfire and flooding have the potential to damage both soils and paleontological resources.

Climate change could increase the occurrence of landslides in Southern California by worsening the weather conditions that lead to their occurrence. Periods of dryness followed by extreme precipitation events can cause conditions suitable Cor landslides. Also, wildfires in summer can burn away trees or vegetation that hold soil in place on slopes, and heavy rainfall in the winter may create a debris flow that then results in a landslide (Highland 2005). Both wildfires and storm intensity are projected to increase in the San Diego region by 2050 (see Section F.2), creating conditions that could bring more landslides to the area.

Climate change may also influence the geology of the land by worsening land subsidence, which occurs with excessive extraction of groundwater. Increased stress on groundwater supplies could result from longer and more intense droughts, increased evaporation, higher temperatures, and decreased precipitation and streamflow, all of which are expected to occur in the region (see Section F.2). In 2017, the San Diego County Water Authority sourced 3 percent of its supplies from groundwater. However, it intends to double this number by 2035 in an attempt to diversify its supply portfolio (SDCWA 2016).

Wildfires and heavy storms can damage soil structure, decrease moisture retention, and increase soil erosion. These changes can especially harm topsoil, which is important to the health of crops and vegetation (County of

San Diego 2018), and also remove soil that otherwise acts as carbon storage. Other effects of climate change, such as the warming of soils, may lead to higher decomposition rates, which release more carbon dioxide into the atmosphere (Melillo et al. 2014). However, the consequences of climate change on soils in the San Diego region have not yet been quantified.

Along the coast, sea-level rise in the region is expected to result in cliff erosion, further altering the geology. A projected increase in sea level of 1.6 to 6.6 feet along the Southern California coast could result in cliff retreats ranging from 62 to 135 feet by 2100 (Limber et al. 2018); those sea-level rise projections for all of Southern California are slightly higher than projections for just the San Diego region (see Section F.2). Coastal bluff erosion rates vary depending on sea-level rise, wave energy, coastal slope, beach width and height, and rock strength. Marine erosion can be concentrated at points due to wave refraction, and occurs more quickly in weaker rocks (Johnsson 2003). The timing of coastal bluff retreat or collapse is also dependent on specific geologic conditions: it may occur catastrophically through sudden slope failure or more gradually through erosion by marine, subaerial, and groundwater processes (Johnsson 2003). In 2018, U.S. Geological Survey (USGS) researchers combined five different computer models that forecast how cliffs retreat, producing a range of values for each section of coastline instead of each model yielding one number (Limber et al. 2018). A USGS research geologist noted that sea-level rise combined with coastal change, cliff retreat, and extreme storms could expose more than 250,000 residents and $50 billion in property to erosion or flooding in Southern California by the end of the century (USGS 2018).

One limit in the USGS study is that it does not factor in the linkage of long-term cliff retreat rates to annual landslide probabilities. Projected increases in extreme heat days, combined with decreased precipitation projected in the summer, can increase evaporation and the likelihood of drought and wildfires. Wildfires may precondition the landscape for cascading climate hazard events, with implications for both the proposed Plan and surrounding study area. For example, wildfires clear landscape and vegetation, which destabilizes the ground and can create hydrophobic soil (or water-repellant soil, due to the combustion of vegetative materials' resulting gas, which condenses and forms a waxy coating on the ground). In turn, hydrophobic soils increase the likelihood of a landslide during heavy precipitation events. Landslide sediments are often subjected to increased groundwater percolation, which tends to have a negative effect on the preservation of fossils, and gravitationally induced movements of sediment can also destroy fossil remains through abrasion and breakage. Further, when the original stratigraphic position of the sediments and fossils contained within are disturbed, there are varying degrees of scientific information loss with the severity of changes to the slide mass.

It is possible that sea-level rise, along with disaster events like flooding and wildfire, could damage paleontological resources. As with cultural resources, more intense and frequent wildfires and the fire recovery process could have negative impacts on resources within the San Diego region (Waechter 2012). Impacts similar to those discussed under *Cultural Resources* above could also adversely affect paleontological resources, although such impacts have not been discussed in the literature. For example, changes in temperature and precipitation could also damage paleontological resources by speeding deterioration and decay and causing thermal stress (Rockman et al. 2016). Additionally, heavy precipitation and flooding could cause erosion or direct damage to the resources. However, no studies investigate the extent to which paleontological resources could be affected by climate change.

Greenhouse Gas Emissions

Greenhouse gas emissions are responsible for climate change, but some impacts of climate change can also release more GHGs into the atmosphere, resulting in a positive feedback cycle. A biological example of this would be soil carbon sequestration; the combination of increased temperatures and decreased rainfall will likely result in decreased plant productivity and reproduction. As fewer or less robust plants pull less carbon dioxide out of the atmosphere, soil erosion and loss will increase and there will be less carbon from dead plants available to become incorporated into the soil, thus reducing soil carbon sequestration (Ren et al. 2020). An anthropogenic example is that hotter temperatures in the San Diego region may incentivize more people to use air conditioning more often; in the next decade, summer energy demand in California could increase by 1 gigawatt. This increase in energy use could release more GHGs if the energy is purchased from a carbon-based power plant (Moser et al. 2012). The projected growth in energy demand may be exacerbated by new residential development and expanded use of air conditioning and will likely not be offset by decreased heating needs in winter due to the relatively low use of electricity for heating in California (see *Energy* above for more details on how climate change may increase energy demand and associated GHGs).

Some adaptation measures to climate change can also have effects on energy use and, therefore, possible GHG emissions. The San Diego County Water Authority plans to increase its reliance on seawater desalination 2 percent by the year 2035 (SDCWA 2016). This water treatment process is highly energy-intensive, however; this could increase GHG emissions if the energy comes from a carbon-based source (Kelley 2011). For perspective, San Diego Gas & Electric, the largest utility in the San Diego region, draws at least 29 percent of its power from natural gas (CEC 2018), although this percentage may change in the future, as California has instituted a Renewable Portfolio Standard (RPS) of 50 percent by 2030 (CPUC 2018). Furthermore, the California Executive Order B-55-18, signed in 2018, mandates a goal for carbon neutrality by 2045. Thus, it is uncertain to what degree the region and state's mitigation practices will counteract the increase in GHG emissions from climate change.

Climate change may also increase the amount of GHG emissions associated with transportation. Impacts in the region—such as heavy rainfall, increased wildfire, and sea-level rise (see Section F.2)—can lead to landslides and flooding of road infrastructure. These may cause more traffic disruptions and congestion, which would increase commuting times and vehicle idling, and thus contribute more greenhouse gases (WSP 2018).

An increase in wildfire frequency and intensity brought about by climate change can also increase GHG emissions in the region. Fires that burn through forests remove trees that serve as carbon reservoirs. Forests in the United States absorb and hold about 11 percent of the carbon dioxide emitted in the country per year; burning this wood releases this carbon back into the atmosphere (Reidmiller et al. 2018). However, the consequences of climate change on the amount of GHG emissions from increased wildfires in the San Diego region have not yet been quantified.

Higher temperatures from climate change can harm some of the mitigation measures used to reduce GHG emissions. For example, attempts to use more solar energy to help reduce GHG emissions may be challenged by high temperatures, which can render solar panels less efficient (Omubo-Pepple et al. 2009). For perspective, San Diego Gas & Electric's power mix consists of 20 percent solar energy, though this may not be limited to photovoltaics (CEC 2018). However, the consequences of climate change on GHG mitigation techniques in the San Diego region have not yet been quantified.

Hazards and Hazardous Materials

Many of the impacts from climate change are hazardous to human lives and the infrastructure they depend upon. These impacts, which are projected to occur in the San Diego region, include higher temperatures, sea-level rise, and higher rates of coastal and inland flooding, tsunamis, and wildfire (see Section F.2). The region may also face various indirect impacts of climate change mentioned elsewhere in this report, such as worsened air quality, higher rates of temperature-related illnesses and diseases, landslides, and beach erosion. Climate change may also worsen hazards in the region associated with hazardous materials, sensitive infrastructure, dangers to public health, and obstructions of emergency response.

Flooding of hazardous material sites could introduce toxic substances to humans and the environment by contaminating drinking water supplies, buildings, and ecosystems. Such sites include Superfund sites, hazardous waste generators, facilities required to report emissions for the Toxics Release Inventory, facilities regulated under the National Pollutant Discharge Elimination System, major dischargers of air pollutants with Title V permits, and brownfield properties. Heberger et al. (2009) found no hazardous material sites in the San Diego region in areas vulnerable to a 100-year flood event. However, a 1.4-meter rise in sea level could bring 13 of those sites into areas vulnerable to a 100-year storm (Heberger et al. 2009). Note, however, that this 1.4-meter sea-level rise scenario is the upper limit of current estimates in the San Diego region (see Section F.2); it is not clear how many sites would be within the inundation zones under other scenarios. Thus, impacts of climate change would have an unknown impact on hazardous material sites in the San Diego region.

A combination of sea-level rise and storm flooding may obstruct emergency response vehicles and plans in the case of an emergency. In San Diego County, a 1.4-meter rise in sea level could make more vehicle infrastructure along the coast vulnerable to a 100-year storm. This sea-level rise would bring 8 miles of highways (compared to 0.62 mile in 2000), 57 miles of roads (compared to 12 miles in 2000), and 9.8 miles of railways (compared to 3 miles in 2000) into vulnerable areas (Heberger et al. 2009). Once again, this 1.4 meter of sea-level rise is in the upper limit of current estimates of sea-level rise in the San Diego region (see Section F.2), and it is uncertain if lower estimates will bring highways and roads into areas vulnerable to flooding from a 100-year storm. More frequent wildfires may also obstruct roads for emergency vehicles, though the probability and extent of this occurring is unknown.

Hydrology and Water Quality

Climate change could alter the hydrology in the San Diego region. CEP and SDF (2015) projects longer and more intense droughts, fewer rainy days, and more rainfall during the biggest rainstorms by 2050. These changes increase flooding to the region, which could lead to impacts on drainage, such as more soil erosion, mudflow, and landslides (County of San Diego 2018). Due to less snowpack and more evaporation, the San Diego region expects to see a decrease in runoff and streamflow (see Section F.2). Thus, climate change may have a negative impact on hydrology in the San Diego region.

Climate change can also worsen water quality in a variety of the region's water resources through increased nonpoint water pollution during severe storm events, saltwater intrusion resulting from sea-level rise, sediments from increased incidence of wildfires, and higher temperatures. Heavier storms may decrease both beach and surface water quality because rainfall can cause runoff from nonpoint sources of contamination—such as trash, fertilizers, sediments, metals, sewage, and other fluids—which then drain into the ocean and streams. As a result, California health officials recommend that people stay out of beach waters for at least 3 days following rain events of at least 0.1 inch. In 2017–2018, beaches in San Diego County faced two closures and ten health warnings, and 24 sewage spills (totaling 187,001 gallons) reached a water body (Heal the Bay 2018). More intense rainstorms from climate change may worsen this hazardous runoff; the San Diego region may see 8 percent more precipitation during its heaviest storms (CEP and SDF 2015).

Along the coast, saltwater intrusion from sea-level rise can infiltrate groundwater, worsening the quality of this freshwater resource. Projected increases in wildfires across the region may also worsen water quality for surface waterways by increasing sediment flows (Meixner and Wohlgemuth 2004). Also, higher temperatures may alter rates of stratification in lakes, potentially removing dissolved oxygen and leading to excess nutrients in lakes (Melillo et al. 2014). These higher temperatures may also reduce general water quality by changing water chemistry and promoting growth of bacteria (Duran-Encalada et al. 2017), algae, and parasites (Major et al. 2011). However, the available literature has not quantified the extent to which this would affect water quality in the San Diego region.

Land Use

Climate change may pose threats to land use in the San Diego region by damaging or removing habitable land and physically dividing communities (e.g., through landslides), especially along the coast. The region expects to see increases in the intensity of wildfires and heavy storms that can lead to flooding, both of which may make some areas uninhabitable (CEP and SDF 2015). Indirect impacts, such as landslides and erosion, can also reduce available buildable land (County of San Diego 2018). Along the coast, sea-level rise in the region is expected to result in cliff erosion. A projected rise in sea level of 1.6 to 6.6 feet along the Southern California coast could result in cliff retreats ranging from 62 to 135 feet by 2100 (Limber et al. 2018). The upper range of these sea-level rise projections for all of Southern California are slightly higher than the upper range of projections for just the San Diego region (see Section F.2). However, studies have not quantified the extent to which climate change would affect land use in the region.

To respond to climate change, local governments in the San Diego region may build structures that increase the resilience of housing, infrastructure, and ecosystems. The County has already built some levees and structures to protect against flooding (County of San Diego 2018) and incorporated climate projections into projects, such as the North Coast Corridor Program, which considers sea-level rise adaptation in its analysis and design (SANDAG 2019). SANDAG has also produced a sea-level rise infrastructure guidance document titled *Regional Transportation Infrastructure Sea Level Rise Assessment and Adaptation Guidance for Transportation Infrastructure*, which analyzes potential sea-level rise impacts on transportation facilities (Dudek 2020). Other member cities may have resilience measures of their own. For example, the City of San Diego plans on having 35 percent canopy cover by 2035, which can reduce the urban heat island effect (City of San Diego 2018) and therefore provide greater thermal comfort under new climate conditions. However, it is unknown to what extent this would affect land use in the region.

Mineral Resources

Climate impacts such as wildfires and flooding may affect mineral resources by damaging mining sites (ICMM 2013). However, studies have not quantified the extent of these effects in the San Diego region.

Noise and Vibration

No studies were found that investigate the impacts of climate change on noise and vibration.

Population and Housing

Climate change-related disasters, such as flooding, wildfire, and sea-level rise, can destroy homes and threaten displacement. For example, a 2015 study looking at the effects of a potential El Niño storm found that 54,560 residents in the San Diego region (1.75 percent of the regionwide population), in 21,706 housing units, reside in areas that are susceptible to flooding during heavy storms and 100-year flood events. These areas include floodplains and places near coastal inlets and rivers and are mostly spread throughout the region (NUSIPR 2015).

Population and housing could be affected by increases in wildfire. In San Diego County, under a high-emissions scenario, the Cal-Adapt wildfire tool estimates a 40 percent increase in annual average acres of burned land by 2100 compared to the annual average between 1950 and 2005. In 2010, 91 percent of residents in the unincorporated county lived in wildfire areas marked Very High, High, or Moderate Risk; and increased wildfire incidence may worsen these risks (County of San Diego 2018). Thus, the effects of climate change may have a negative impact on housing in the San Diego region.

Compared to flooding and wildfire, the housing exposed to sea-level rise is lower—7,498 people live in areas at risk of inundation from a 4.6-foot rise in sea level (County of San Diego 2018). While this is a small percentage of the region's population overall, this impact could be significant for local communities on the coast. Current projections of sea-level rise for the region place the maximum at 4.6 feet by 2100 (see Section F.2). An assessment of costs from coastal flooding–related damage to private residential and commercial structures found that in Carlsbad, a 100-year storm could result in losses of $1.1 million by 2050, and chronic inundation could result in losses of $37.1 million by 2100. In Del Mar, damage to private residential and commercial structures from a 100-year storm can currently result in losses of $46.7 million (Nexus Planning & Research 2017).

High temperatures may make certain parts of the San Diego region more uncomfortable or more damaging to human health than others, possibly resulting in population or housing shifts. Because of the urban heat island effect, although the San Diego region may experience a 4.8°F increase in temperature from climate change by 2050 (see Section F.2), and dense urban areas may feel much hotter (Reidmiller et al. 2018). Threats from flooding, storms, and wildfire may also potentially lead to housing shifts. An analysis of nationwide differences in home price appreciation between 2007 and 2017 found that there was a slight correlation between homes exposed to high wildfire, flooding, and hurricane surge risk and a decrease in house prices. Homes in high-risk areas are worth less than they were a decade earlier, indicating that people are starting to consider climate change impacts when buying houses (Flavelle and McCartney 2018). However, it is uncertain if this pattern will affect population or housing shifts in the San Diego region in a similar way.

Public Services and Utilities

Public Services

Public services in San Diego include fire and police protection, emergency response services, schools, libraries, and recreation facilities. Climate change, particularly extreme events, could increase the demand on some public services, although the extent of this impact has not been quantified. For example, higher demand on public services can be expected to combat increased severity and frequency of wildfires, extreme heat events, flooding, or landslides; this increased demand could conceivably require expanded or additional public service facilities. Moreover, the existing facilities themselves may experience impacts; according to Kalansky et al. (2018), critical facilities at risk from both flood (0.5-foot exposure threshold) and wildfire (50 percent burned threshold) could increase by the end of the century, which could lead to losses of over $1.7 billion. Projected increased damage to public facilities may put more strain on facility maintenance services that must respond to requests for repairs on public property. These departments may have to conduct more upkeep on County-owned buildings due to a projected increase in damages from climate hazards.

As temperatures warm and landscapes experience longer dry seasons, wildfire risks are likely to increase (see Section F.2). With climate change, more resources will be needed for fire management (Kalansky et al. 2018). More frequent or severe wildfires may strain existing fire-fighting capacity, requiring the expansion of fire stations or the addition of new facilities and operations. As development continues, particularly dense development, fire risk increases (Kalansky et al. 2018). Compounding impacts of climate change and development may require additional facilities to be built, although this has not been discussed in the literature. However, Kalansky et al. (2018) acknowledges that more modeling work is required to understand the vulnerability of critical assets, including public services like hospitals and fire stations, to increased wildfire risk.

During extreme heat events, which are expected to become more severe (see Section F.2), additional cooling centers may be required to prevent heat-related illnesses or fatalities. In 2017, a heat wave in the San Diego region closed 85 schools to protect children from the extreme heat (Kalansky et al. 2018). This type of event could become more common, particularly threatening disadvantaged communities and vulnerable populations, including children, elderly, and homeless populations. Often, public facilities, such as libraries and community centers are used as cooling centers (Kalansky et al. 2018). Increases in extreme heat could require additional public facilities to be made available near disadvantaged and vulnerable populations for cooling centers.

Climate change is included in the region's hazard mitigation plans because of the expected increase in hazard events, including floods, landslides, extreme heat, and sea-level rise. Emergency response to severe events may require greater emergency management capacity from the region (Kalansky et al. 2018). Also, there may be a greater need for monitoring and assessments to provide hazard warning and preparation (Kalansky et al. 2018).

Additionally, climate change conditions, such as sea-level rise and flooding, could contribute to deterioration or damage of existing public facilities. Across the state, damages due to inundation from 50 centimeters of sea-level rise could reach $18 billion dollars, some of which could include damages to public facilities, although this impact has not been separately quantified (Kalansky et al. 2018). Assessments of damage to public infrastructure in some San Diego County cities have been conducted; for example, damage to city structures in the City of Del Mar may result in losses of $1.7 million under a current 100-year storm (Nexus Planning & Research 2017). The City of Del Mar also conducted a Coastal Hazards, Vulnerability and Risk Assessment, and found that the City's fire station is vulnerable to even relatively low levels of sea-level rise, which could inhibit fire response capacity in the future (Kalansky et al. 2018). If buildings become inundated or temporarily flooded, new construction may be required to repair, retrofit, or relocate facilities, although the extent of climate impacts on public facilities is not discussed in the literature.

Climate change impacts may also damage recreational facilities and parks through destructive hazards such as wildfire, flooding, and landslides. Coastal parks and facilities, such as the Waterfront Park in the City of San Diego, may be particularly vulnerable to inundation from sea-level rise and coastal flooding (County of San Diego Parks and Recreation 2019). Climate hazards that affect outdoor conditions, such as extreme heat, air quality from wildfires, and heavy precipitation, may also influence the number of people who visit parks and recreational centers. Indoor centers may see a rise in visitation as people prefer to exercise away from climate hazards, or both inside and outside centers may see a dip in visitation if extreme weather makes it difficult to go outside altogether.

Utilities

Utilities in the San Diego region, including wastewater collection and treatment, stormwater drainage, and solid waste management systems, may face risks and challenges from climate change. According to the *Sea Level Rise Adaptation Strategy for San Diego Bay*, stormwater management and wastewater collection and treatment are two vulnerable sectors to sea-level rise (ICLEI 2012). For example, impacts on wastewater collection and treatment include increased treatment costs or more extensive treatment processes caused by reduced water quality due to higher temperatures, more sedimentation and runoff due to extreme precipitation, increased contaminant levels due to droughts, and sedimentation due to wildfires. Stormwater drainage and facilities may be physically damaged, and existing capacity may be strained or exceeded due to changing precipitation or flooding patterns, although the impacts within the San Diego region have not been well documented. Lastly, climate change may make solid waste management collection and processing more challenging due to impeded access to collection routes, degradation of landfill sites, and other impacts. The consequences of climate change on public services and utilities in the San Diego region have not yet been quantified; however, the subsections below posit some potential impacts.

Wastewater Collection and Treatment

Although no research was found on the impacts of climate change on wastewater treatment within the San Diego region, it is possible that higher temperatures would increase treatment costs or require changes in operations. The costs could increase because higher air and water temperatures reduce water quality and quantity by changing water chemistry, promoting bacterial growth, and increasing evapotranspiration (Duran-Encalada et al. 2017). Warmer temperatures also increase the solubility of contaminants in the water supply and can lead to biological and chemical degradation by aiding the growth of more algae, microbes, and parasites (Major et al. 2011). These changes could make it costlier to treat wastewater.

Both extreme precipitation and drought can cause challenges for wastewater treatment facilities. Extreme precipitation may cause more intense or frequent floods, which may overwhelm the current wastewater intake systems (Major et al. 2011). Drought conditions could reduce the inflow of water, which increases the concentration of pollutants, including salinity, in the wastewater treatment stream (Tran et al. 2017). Increased pollutants can make it more expensive or demanding to treat water to the necessary level (Tran et al. 2017). Drought impacts on Southern California's wastewater treatment facilities have been documented in some studies, but the full extent in the San Diego region is not known at this time.

Sea-level rise can also cause several problems for wastewater treatment, including overwhelming capacity and making treatment more difficult. As with extreme precipitation, sea-level rise could increase the risk of flooding or of overloading the treatment system. According to the *Sea Level Rise Adaptation Strategy for San Diego Bay*, sanitary sewers in low-lying locations could be vulnerable to floodwater inflow that could exceed system capacity, potentially resulting in the discharge of wastewater into the Bay (ICLEI 2012). Also, the wastewater collection system surrounding the Bay could be vulnerable to permanent inundation (ICLEI 2012).

Water quality in the watershed may be reduced after more frequent or intense wildfires due to erosion and sedimentation (EPA 2015). Although the impacts in the San Diego region were not found in the reviewed literature, it is possible that degraded water quality from saltwater intrusion, greater contamination from pollutants, and sedimentation from wildfires may require more extensive water treatment processes to reach the required quality for discharge. If freshwater availability is reduced due to climate change, there may be a demand for more water recycling to meet irrigation and non-potable water needs. In this case, there could be increased pressure on wastewater treatment plants to process and recycle water for these purposes (Major et al. 2011), although demand could potentially be met by other means.

Flooding and erosion exacerbated by climate change may present other physical risks to facilities and equipment of the utility. Erosion could wash away soils that support or cover infrastructure (ICLEI 2012), although this risk has not been quantified in the San Diego region.

Stormwater Drainage Facilities

Changes in the timing and intensity of precipitation, as well as sea-level rise, could affect stormwater management in the San Diego region (County of San Diego 2018).

While total annual precipitation may not change in the San Diego region, the pattern of precipitation may. As noted in Section F.2, more intense precipitation events could occur, and the San Diego region's current stormwater system may not be equipped to handle the quantity of runoff from a particular event (County of San Diego 2018, Ascent Environmental Inc. 2017, Tuler 2016). When not sufficiently managed, stormwater can flood and erode roadways, and transport debris and sand that block drainage systems/culverts. If the stormwater system is overwhelmed, this could increase the likelihood or severity of flooding (Tuler 2016, Major et al. 2011). Changes in the timing and intensity of precipitation may overwhelm the current stormwater system, although this risk has not yet been quantified.

According to ICLEI (2012), storm sewers around the San Diego Bay are highly vulnerable to flooding and inundation due to sea-level rise. Sea-level rise could exacerbate the flooding impacts of extreme precipitation. As sea levels rise, storm drain outfalls are inundated and unable to handle precipitation events (Tuler 2016). Due to impeded drainage, higher sea levels may exacerbate riverine flooding as well (Ascent Environmental Inc. 2017). Sea-level rise may overwhelm stormwater system capacity in the San Diego region, although the risk has not yet been quantified for the whole region.

Flooding and erosion exacerbated by climate change may present other physical risks to facilities and equipment of the utility. Erosion could wash away soils that support or cover infrastructure (ICLEI 2012), although this risk has not been quantified in the San Diego region.

Solid Waste Management

Little information is available on how climate change may affect solid waste management, including waste collection, recovery, recycling, and composting, within the San Diego region. However, several resources describe potential impacts that may be relevant. The extent to which these impacts would occur in the San Diego region is not addressed in the literature.

Higher temperatures could have impacts on waste collection, processing, and disposal. Decomposition rates, odor, and pest activity may increase under higher temperatures, which could necessitate more frequent waste collection. Also, higher temperatures could overheat collection vehicles or processing equipment. (USAID 2012.)

Extreme precipitation events could cause flooding along collection routes, access roads, and facilities. Sea-level rise may narrow collection routes, damage low-lying processing facilities, and lead to material damage of coastal solid waste management facilities. (USAID 2012.)

Flooding and erosion exacerbated by climate change may present other physical risks to facilities and equipment of the utility. Erosion could wash away soils that support or cover infrastructure (ICLEI 2012), although this risk has not been quantified in the San Diego region.

Transportation

Climate change could impact transportation infrastructure and operations, as well as transportation use behavior. For example, sea-level rise may cause erosion and increase the frequency or duration of flooding on roads, which disrupts functionality and damages infrastructure (County of San Diego 2018, Biging et al. 2012). For example, an assessment of damage costs on city transportation infrastructure in Carlsbad found that bluff erosion could result in losses of $5.8 million by 2050 (Nexus Planning & Research 2017). Flooding and inundation on roads and railways, and in subway tunnels may cut off access to local transportation facilities and damage components exposed to more frequent inundation (ICLEI 2012, Biging et al. 2012). More frequent and intense rainfall may cause bridge scour due to erosion of sediment and increase streamflow, which could exacerbate bridge damages (Biging et al. 2012, Reidmiller et al. 2018). Also, saturated soils may destabilize the substructure of transportation infrastructure and cause pavement degradation (ICLEI 2012). Extreme events and higher sea levels could disrupt segments of transportation corridors, leading to longer travel times (Moser et al. 2012). Flooding could cause damage and delays at ports and airports, negatively affecting commerce and flight plans, and higher tides at ports could contribute to erosion and cause periodic traffic disruptions (Biging et al. 2012).

In addition to flooding, higher temperatures can damage and degrade pavements, railroad tracks, and other infrastructure, as well as present safety concerns for passengers and employees. Under extreme high temperatures, joints on bridges and highways may expand/contract and pavement may deteriorate more rapidly, and pavement binders may not remain intact (Reidmiller et al. 2018, WSP 2018). Rail tracks can buckle under high temperatures and airplanes may face challenges due to hot weather (Reidmiller et al. 2018). The impacts of climate change on transportation are complex, and although these impacts have been explored to some degree within the San Diego region, their extent requires further investigation.

The projected increase in climate impacts may increase maintenance requirements and costs to repair damage to transit infrastructure and roadways. Extreme heat and precipitation events may also necessitate changes in maintenance schedules to work around heavy rainfall and protect outdoor workers from extreme heat (WSP 2018).

Additionally, higher temperatures and changes in precipitation may change transit ridership, bicycling, and walking patterns (Melillo et al. 2014). The literature does not make conclusions about whether the impacts of climate change could increase vehicle miles traveled (VMT); however, if changes in climate cause people to drive rather than walk or take alternative forms of transit, it is possible that VMT would increase. However, if people adapt by moving closer to work or working from home, VMT may not increase. specifically studied within the San Diego region.

Increasing wildfire frequency and intensity may pose threats to driver safety, operations, and infrastructure. Wildfires could cause additional traffic, block roads, and require detours, in addition to reducing visibility due to smoke (WSP 2018). Additionally, wildfires may contribute to landslide exposure, which can damage transportation infrastructure (WSP 2018).

Tribal Cultural Resources

There is limited research on climate impacts on tribal cultural resources (TCRs) in the San Diego region; however, there is some information about national impacts that could be relevant to tribes in the region. Climate change could pose various physical, economic, and social threats to TCRs (Marchand et al. 2017). Potential climate impacts include loss or damage of material culture; losses of ecological resources, including agricultural land, traditional foods, forests and forest products; threats to tribal rights to fish, hunt, and gather; and loss of water supplies (Marchand et al. 2017, NWIFC 2016). While many similar impacts could occur for the general population, they may be more severe for indigenous populations who are more socio-economically vulnerable (Marchand et al. 2017).

Sea-level rise and coastal erosion could damage or destroy coastal TCRs that are exposed to temporary or permanent coastal flooding (NWIFC 2016). Above-ground structures may be particularly exposed to coastal flooding, but a rising water table or salinization of water could potentially affect below-ground TCRs, such as archeological resources.

Extreme precipitation events may lead to more severe, more extensive, or more frequent flooding events on tribal lands. To the extent that TCRs are exposed to these floods, the TCRs may be physically damaged from the water or the debris it carries, or from the resulting erosion (Curry et al. 2011; Flanigan, Thompson, and Reed 2018). Extreme precipitation can also contribute to soil destabilization and landslides, which could damage or destroy TCRs.

Changes in temperature and precipitation could also damage cultural resources, although the extent to which these could negatively affect archaeological and cultural resources in the San Diego region has not been quantified. If freeze/thaw cycles become more frequent or dramatic, which can happen under warming scenarios, when temperatures rise above freezing during the day and then dip below freezing at night, rather than just staying below freezing, this can physically damage TCRs. Freeze/thaw cycles negatively affect stone and brick buildings structures (Rockman et al. 2016). Higher temperatures can cause faster rates of deterioration due to thermal stress and biological activity, more rapid decay of organic materials, heat stress on culturally significant vegetation, and loss of culturally significant habitat and species due to disease and temperature changes (Rockman et al. 2016). Heavy precipitation and flooding could damage cultural resources due to site erosion and destabilization, direct physical damage to the site, loss of artifacts due to flooding, and increased risk of post-flood subsidence (Rockman et al. 2016).

More frequent and intense wildfires may damage or destroy TCRs (Rockman et al. 2016, Curry et al. 2011, NWIFC 2016), particularly above-ground TCRs. Wildfires can increase damage to archaeologically relevant structures, alter the artifacts exposed to extreme heat, increase susceptibility to erosion and flooding, and exacerbate damages due to firefighting activities (Rockman et al. 2016). Wildfire could damage historical structures or alter their distinct physical characteristics as older buildings may not have as robust defenses against wildfire as modern buildings (Rockman et al. 2016). Wildfires can also contribute to soil destabilization and landslides, which present risks to TCRs (Santin and Doerr 2016, NWIFC 2016).

It is possible that sea-level rise, flooding, wildfire, and landslides could reveal or damage human remains. Remains exposed to the environment from climate hazards may then be further damaged by extreme weather. For example, changes in temperature and precipitation could speed deterioration and decay, cause thermal stress, and cause erosion (Rockman et al. 2016).

Water Supply

Climate change may have an impact on both imported and local water supplies for the San Diego region. Supply could be reduced by changes in snowpack and snowpack melt, which would affect the timing of water availability, reduced precipitation, increased evaporation from higher temperatures, and saltwater intrusion due to sea-level rise. Meanwhile, demand could be increased due to evapotranspiration and drought.

Effects such as reduced snowpack and precipitation, as well as more precipitation falling as rain rather than snow in the mountains, can decrease water supplies coming from the mountain ranges. These effects reduce the amount of runoff and streamflow from melted snow, potentially decreasing this source of water. Such changes have already affected the Colorado River, which has seen a decline in streamflow by 16.5 percent between 1916 and 2014; over half of this decline can be attributed to warming temperatures (Xiao et al. 2018).

A shift in the timing of melting snowpack can also affect supplies (CEP and SDF 2015). This snowpack usually melts in the spring and summer, releasing water when it is most needed; however, snow has melted earlier in recent years, reducing the amount of water available later in the year (Reidmiller et al. 2018). Snowpack in the Sierra Nevada Mountains is also projected to melt earlier; projections for 2070–2099 indicate 35–52 percent of snowpack remaining by April 1, compared to the 100 percent remaining post-April 1 snowpack from 1961–1990 (Gonzalez et al. 2018). The San Diego region draws from mountain water; the San Diego County Water Authority (SDCWA) bought 40 percent of its water from the Metropolitan Water District (MWD) in 2017 (SDCWA 2016). MWD draws from the Sierra Nevada mountain range and the Colorado River, which is also supplied by mountain water.

Other impacts of climate change, such as reduced precipitation, increased evaporation, and increased drought, can also reduce water volumes in water sources. These changes would affect the Colorado River (CEP and SDF 2015), groundwater supply, and other surface water sources (SDF 2008).

Sea-level rise could result in saltwater intrusion along coastline water sources. Saltwater intrusion degrades freshwater supply, decreasing the amount of drinking water available to the San Diego region. Saltwater intrusion would affect the Bay-Delta (Kibel 2015), which MWD also sources from, as well as groundwater wells located along the coast (USGS n.d.).

Future water supplies are also vulnerable to impacts of climate change although the San Diego region plans on diversifying its water portfolio, and the net impact has not been quantified. The SDCWA plans on reducing its reliance on MWD sources to 2 percent of its supplies by 2035. However, the other two imported water sources that feed the San Diego region (the Imperial Irrigation District Transfer and the All American & Coachella Canal Lining, which made up 38 percent of the region’s water supplies in 2017 and will constitute 45 percent of the supply by 2035) still originally source their water from the Colorado River (SDCWA 2016).

Part of the region’s future water supply plan includes increasing reliance on local water supplies, from 22 percent in 2017 to 51 percent in 2035 (SDCWA 2016). The increase in extraction from local groundwater may result in subsidence, permanently reducing availability of groundwater supply (Melillo et al. 2014). Other supplies, such as seawater desalination, consume large amounts of energy, a resource that may also be compromised by climate change (see *Energy* above) (Kelley 2011). The largest-growing water supply that the County plans on drawing from is potable reuse, from 0 percent in 2017 to 17 percent by 2035 (SDCWA 2016). Not much research exists on the effects of climate change on potable reuse, so the impact this will have on the San Diego region’s water supply is unknown.

Climate change impacts such as drought and evapotranspiration may increase water demand due to increased demand across sectors, including agricultural demand for irrigation to make up for lack of rainfall and to adjust to higher temperatures, and household demand. Christian-Smith et al. (2012) forecast a 10 percent increase in urban demand due to climate change by 2055 in California under a medium-to-high emissions scenario, without water conservation strategies. Because many water distributors across California other than SDCWA also buy from MWD, this statewide increase in demand can put stress on water supplies. In the San Diego region specifically, the demand totaled 477,000 acre-feet in 2017, while the demand forecasted in 2035 will total 632,000 acre-feet under RCP 8.5, having increased from a combination of population growth, rising temperatures, and more drought and evaporation (SDCWA 2016). This increase in demand may come from all sectors (though residential use dominates), where higher temperatures, drought, and evapotranspiration may require various operations to source more water (Christian-Smith et al. 2012). However, the exact increases in water demand in the region resulting from climate change are not quantified.

Wildfire

Due to its semi-arid climate, shrubland, and the nearby presence of the Santa Ana winds, the San Diego region experiences wildfire, and the high temperatures and droughts caused by climate change could increase their intensity or frequency. By 2050, the fire season in the San Diego region may be longer and less predictable, with larger and more catastrophic fires, and climate change may drive factors that may worsen wildfires, such as more frequent and intense dry Santa Ana winds, drier autumns, and increased development and presence of dead fuels (CEP and SDF 2015, Kalansky et al. 2018). The annual average of acres burned was 21,042 between 1950 and 2005. Under a high-emissions scenario, the Cal-Adapt wildfire tool anticipates an annual average of 20,972 acres of burned land by 2050 (a negligible decrease) and 29,499 acres by 2100 (a 40 percent increase). Under a low-emissions scenario, the tool estimates an annual average of 17,971 acres burned by 2050 (a 14.6 percent decrease) and 24,546 acres by 2099 (a 16.6 percent increase) (County of San Diego 2018). Thus, climate change is expected to increase wildfire occurrence in the San Diego region in the longer term.

In addition, installation of above-ground electrical distribution infrastructure in rural areas and high fire-risk areas could increase the risk of ignition, such as from downed wires or sparks from faulty infrastructure (Mitchell 2013). Combined with climate change effects that can increase wildfire risk, this could potentially result in more wildfires in the future. Also, as impervious surfaces continue to increase, this could worsen impacts of flooding and runoff. Climate change is also expected to increase risk of flooding and landslides in the future due to increased frequency and intensity of extreme precipitation events. Furthermore, climate change may increase the potential for heavy rainfall to occur after wildfire, resulting in potential landslides as flooding washes away soil destabilized from wildfire (Bedsworth et al. 2018).

C.4 CLIMATE CHANGE ADAPTATION INITIATIVES

Since the first “Safeguarding California” statewide climate adaptation strategy was produced in 2009, state agencies, and regional and local organizations have assessed climate risks and produced a variety of guidance documents on adapting to climate change across different sectors. SANDAG’s 2018 *Climate Change White Paper* summarizes the key adaptation initiatives at the state, regional, and local levels that are relevant for the San Diego region. The discussion below summarizes the information in that white paper.

At a state level, the most recent guidance for how to assess climate vulnerability and develop an adaptation framework and strategies is the 2020 update to the *California Adaptation Planning Guide* (OES 2020). The guide lays out a step-wise assessment process. Additionally, state agencies have produced numerous guidance documents on considering climate change adaptation in planning and decision making, including:

- The California Coastal Commission *Sea Level Rise Policy Guidance* (2015) recommends steps for addressing sea-level rise through Local Coastal Programs and Coastal Development Permits, and their 2017 *Draft Residential Adaptation Policy Guidance* discusses sea-level rise adaptation strategies related to residential development. In 2018 the Coastal Commission adopted a Science Update to the Sea Level Rise Policy Guidance that synthesizes the best available sea-level rise science. The update includes sea-level rise projection tables recommended for use in the 2018 Ocean Protection Council *Sea Level Rise Guidance* for use in planning, permitting, investment and other decisions.
- The *Safeguarding California Plan* (Bright et al. 2018) includes adaptation measures for 10 sectors.
- The *California Water Plan Update* (2018) and *California Water Action Plan* (2016 update) provide resources for handling climate impacts on water resources.

At the regional level, SANDAG is undertaking a number of initiatives through implementation of the 2015 Regional Plan (currently undergoing a 2021 update), which recognizes the risks climate change presents to the region. In an effort to develop strategies to enhance the region's adaptive capacity, SANDAG has also produced studies and guidance for adaptation at the regional level, such as *Regional Transportation Infrastructure Sea Level Rise Assessment and Adaptation Guidance for Transportation Infrastructure*, which analyzes potential sea-level rise impacts on transportation facilities (Dudek 2021).

Some local governments are including climate adaptation strategies in their Climate Action Plans, general plans, local hazard mitigation plans, and/or updates to their Local Coastal Programs (LCPs). There is also a requirement to include adaptation strategies in local planning-level documents, including general plans and hazard mitigation plans. State-level legislation (SB 379) requires that local jurisdictions include climate adaptation and resilience strategies in the general plan safety element. Legislative requirements are summarized below.

- **SB 379**
  - Requires the safety element to be reviewed and updated as necessary to address climate adaptation and resiliency strategies.
  - Requires the update to include a set of goals, policies, and objectives based on a vulnerability assessment, identifying the risks that climate change poses to the local jurisdiction and the geographic areas at risk from climate change impacts.
  - The safety element update must include:
  - A vulnerability assessment identifying the risks that climate change poses to the local jurisdiction.

    a) A set of goals, policies, and objectives based on a vulnerability assessment for the protection of the community.
    b) A set of feasible implementation strategies to carry out the goals, policies, and objectives.

- **SB 1035** (climate change impacts provisions)
  - Requires review and revision of the safety element to identify new information to address flooding and fires.

- **SB 182**
  - Requires updating planning requirements to reduce development pressure in high-fire risk areas.

The *San Diego Region Report* (Kalansky et al. 2018) also lists some of the ongoing adaptation initiatives that agencies and local governments are undertaking in the San Diego region, as follows.

- *Coast:* Several local governments are conducting or have completed vulnerability assessments, LCPs with sea-level rise vulnerability analyses, Land Use Plan (LUP) updates, and other coastal adaptation planning efforts, such as coastal protection structures and restoration programs. In particular, public agencies have begun to explore more natural adaptation approaches, such as living shorelines.
- *Infrastructure:* Green streets in the region are designed to help with stormwater management and accommodate more diverse transportation options.
- *Emergency management:* The County's Office of Emergency Services is working with regional partners on communication systems that give emergency warnings to the public. The University of California, San Diego has developed a program to better monitor weather conditions to inform hazard warning.

- *Ecosystems:* Natural resource management in the region's national forests are conducting extensive tree and plant restoration to recover from wildfire, as well as reducing the risk of wildfire ignition in national forest areas.
- *Water:* To adapt to climate change impacts such as drought, the SDCWA is carrying out water efficiency and conservation programs, diversifying its water portfolio to include more local sources, undertaking more collaborative and holistic management and planning, analyzing the effects of climate change on its supplies, and considering climate change impacts in its initiatives, such as its Integrated Regional Water Management Program (IRWMP).
- *Energy:* San Diego Gas & Electric (SDG&E) has built a microgrid, which can operate independently from the main power grid, for Borrego Springs. This microgrid can provide power in case of an emergency; this option is being explored for future locations.
- *Wildfire:* To mitigate wildfire risk, SDG&E has invested in grid resiliency and modernizing energy assets and uses tools to assess wildfire threats.
- *Health:* The County of San Diego is working on better communicating health risks from heat events and natural disasters to the public, especially for vulnerable communities. The County also has programs to mitigate impacts of vector-borne diseases from the spread of mosquitos, and programs to provide cooler green space and improved air quality.

Please see SANDAG (2018) and Kalansky et al. (2018) for more details about adaptation initiatives at the state, regional, and local levels. Specific adaptation measures can be found within the referenced resources.

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Appendix D

Air Quality Technical Report for San Diego Forward: The 2021 Regional Plan Program Environmental Impact

APPENDIX D

AIR QUALITY TECHNICAL REPORT FOR SAN DIEGO FORWARD: THE 2021 REGIONAL PLAN PROGRAM ENVIRONMENTAL IMPACT REPORT

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Acronyms and Abbreviations

2015 Regional Plan	San Diego Forward: The 2015 Regional Plan
2019 Federal RTP	2019 Federal Regional Transportation Plan
AADT	average annual daily traffic
AAQS	ambient air quality standards
ABM	activity-based model
ASFs	age sensitivity factors
ASL	above sea level
Caltrans	California Department of Transportation's
CARB	California Air Resources Board
CEQA	California Environmental Quality Act
CPF	cancer potency factor
CVA	Chula Vista
DPM	diesel particulate matter
DTN	San Diego-Beardsley Street
DVN	Otay Mesa-Donovan
DVs	PM design values
ED	exposure duration
EIR	environmental impact report
EPA	United States Environmental Protection Agency
ESC	Escondido
ETW	Equivalent Test Weight
FAH	fraction of time at home
FEM	Federal Equivalent Method
FHWA	Federal Highway Administration
FR	Federal Register
FSD	Floyd Smith Drive
GLC	ground-level concentrations
GVWR	gross vehicle weight rating
HARP	Hotspots Analysis and Reporting Program
HI	Hazard Indices
HQ	hazard quotient
HRA	Health Risk Assessment
KVR	Kearny Villa Road
MSATs	mobile source air toxics
NAAQS	National Ambient Air Quality Standards
NATA	National Air Toxics Assessment
NKX	Miramar Marine Corps Air Station

OEHHA	Office of Environmental Health Hazard Assessment
PAH	polycyclic aromatic hydrocarbons
PEF	potency equivalency factors
PEN	Camp Pendleton
PES	Perkins Elementary School
PM10	particulate matter up to 10 microns
PM2.5	particulate matter up to 2.5 microns in size
POM	polycyclic organic matter
proposed Plan	San Diego Forward: The 2021 Regional Plan
PSD	Prevention of Significant Deterioration
REL	Reference Exposure Level
RH	Release Height
RSEI	Risk-Screening Environmental Indicators
SAFE	Safer Affordable Fuel-Efficient
SANDAG	San Diego Association of Governments'
SCAQMD	South Coast Air Quality Management District
SDAPCD	San Diego Air Pollution Control District
SILs	significant impact levels
TACs	toxic air contaminants
TOG	Total Organic Gases
TRI	Toxics Release Inventory
URF	Unit Risk Factor
VH	Vehicle Height
VMT	vehicle miles traveled
VOC	volatile organic compounds
ZEV	zero-emission vehicle
ZMU	zero-emission multiple units

1 INTRODUCTION

San Diego Forward: The 2021 Regional Plan (proposed Plan) serves as San Diego Association of Governments' (SANDAG) update to *San Diego Forward: The 2015 Regional Plan* (2015 Regional Plan), adopted in October 2015, and the 2019 Federal Regional Transportation Plan (2019 Federal RTP), adopted in October 2019. The proposed Plan includes land use and transportation improvements to increase mobility and transportation connectivity, reduce single-occupancy passenger car travel, and support increased population growth.

ICF worked with SANDAG to develop a comprehensive technical study to evaluate the potential impacts of air pollution on the region to support the proposed Plan's environmental impact report (EIR). This technical report documents the approach, technical methods, and results of the air quality technical work.

2 TECHNICAL METHODOLOGY

This section provides an overview of the general approach used in this analysis. It is followed by a more detailed discussion of the analysis approach for the emissions (Chapter 3), air quality (Chapter 4), and health risk assessment (Chapter 5) modeling.

2.1 OVERVIEW OF APPROACH

The analysis performed in this report includes the following general steps:

1. Quantify emissions for all sources of criteria pollutants and toxic air contaminants (TACs) associated with the proposed Plan.

2. Conduct dispersion modeling for base and regional plan years to estimate ambient PM10 and PM2.5 concentrations resulting from the operational emissions under the proposed Plan.

3. Perform dispersion modeling for base and regional plan years to estimate TAC concentrations at sensitive receptors.

4. Quantify human health risk based on exposure to the modeled TAC concentrations.

The methodologies used in these assessments are described below. This technical report focuses on the methodologies, data sources, analysis methods, and results pertaining to the Localized Particulate Matter (PM) Impact Analysis (Impact AQ-4) and Health Risk Assessment (HRA) (Impact AQ-5) in support of the findings in the EIR.

2.1.1 GENERAL PARAMETERS: MODELED YEARS AND CASES

A baseline year and three future years were modeled for the proposed Plan: the baseline year is 2016, and the future years are 2025, 2035, and 2050.

All four cases are similar but differ in that the pollutant source and, potentially, the receptor location could change over time with implementation of the Plan (e.g., if a roadway is widened or new residential land uses are developed within assessment domains).

2.2 POLLUTANTS

Air pollutants negatively impact air quality and subsequently human and environmental health. The EIR analysis included emissions projections for all criteria air pollutants, with additional analysis of concentrations and risks associated with two categories of air pollutants: PM and TACs, as these are the pollutants most likely to cause significant air quality impacts under the proposed Plan. Both are described below.

2.2.1 PARTICULATE MATTER

This analysis addresses concentrations of the criteria pollutants PM10 and PM2.5 that would result from the proposed Plan. Particulate matter is a complex mixture of materials that can include metals, soot, soil, dust, and other organic and inorganic particles. Particulate matter can be divided into many size fractions, measured in microns (a micron is one-millionth of a meter). The California Air Resources Board (CARB) and the United States Environmental Protection Agency (EPA) have developed air quality standards for two size classes of particles: particles up to 10 microns in size (PM10) and particles up to 2.5 microns in size (PM2.5). PM2.5 particles are a subset of PM10 (CARB 2021a).

2.2.2 TOXIC AIR CONTAMINANTS

This analysis also addresses health risk changes from concentrations of the non-criteria TACs associated with Plan implementation. A TAC is an air pollutant for which an air quality standard has not been set but which may cause or contribute to an increase in mortality or an increase in serious illness, or which may pose a present or potential hazard to human health (Section 39655 of the California Health and Safety Code). CARB has formally identified over 200 substances and groups of substances as TACs (CARB 2021b).

Internal combustion engines, including diesel and gasoline fueled, emit TACs. Engine exhaust includes a complex mixture of air pollutants, including both gaseous and solid materials. The solid material in diesel exhaust is known as diesel particulate matter (DPM). More than 90% of DPM is less than one micron in size. Thus, DPM is a subset of both PM10 and PM2.5 (CARB 2021a). Other TACs are also emitted from fuel combustion. In total, the Federal Highway Administration (FHWA) has identified nine priority TACs from mobile sources, called mobile source air toxics (MSATs):[1]

- 1,3-butadiene
- acetaldehyde
- acrolein
- benzene
- DPM
- ethylbenzene
- formaldehyde
- naphthalene

[1] FHWA's MSAT guidance is available at: https://www.fhwa.dot.gov/environMent/air_quality/air_toxics/policy_and_guidance/msat/.

- polycyclic organic matter (POM) / polycyclic aromatic hydrocarbons (PAH)[2]

CARB notes that the top three TACs for potential cancer risk are DPM; 1,3-butadiene; and benzene. These TACs are primarily generated by fossil fuel–powered motor vehicles (CARB 2002). CARB considers the risk from whole diesel exhaust to be represented by DPM concentrations.

This analysis includes all nine priority MSATs identified by FHWA for the sake of completeness and full disclosure, as these nine priority MSATs include CARB's top three emitters. Along with mobile on-road and rail sources, stationary sources that may influence incremental risks due to changes in land use under the proposed Plan are included in the HRA, as described below. Risks from TAC emissions from those sources are included, based on available information, even if they are not in the list of priority MSATs.

3 EMISSION SOURCES

As a first step in performing this assessment, ICF developed an emissions inventory of the pollutants used in the air quality and health risk analyses, including link-based emissions for on-road mobile sources and source-based emissions for passenger and freight rail and other major stationary sources. The emissions inventory was compiled using a combination of best available and industry-accepted protocols and tools developed by CARB, EPA, and other agencies.

The analysis focused on sources of emissions that will be affected by the two components of the proposed Plan: (1) regional growth and land use changes that could modify the location of sensitive receptors in the region, and (2) changes in the location and activity along the transportation network that could modify the quantity of emissions along passenger and freight corridors, as well as the changes in the emissions rate of the fleet over time. Particulate matter and TAC emissions are included from the following sources:

- On-road vehicle exhaust, which includes PM10, PM2.5, and MSATs.
- On-road fugitive brake wear, tire wear, and re-entrained PM10 and PM2.5 road dust emissions.
- Passenger rail and freight rail exhaust as indicated by SANDAG, which includes PM10, PM2.5, and MSATs (mainly DPM).
- Stationary sources and additional sources identified for cumulative risk.

3.1 ON-ROAD SOURCES

This section discusses both exhaust and fugitive emissions from on-road mobile sources. The emissions inventory for mobile on-road sources on the regional highway and roadway networks considered parameters in SANDAG's activity-based model (ABM), such as vehicle speeds, vehicle types, and time of day. The mobile source PM and TAC emissions inventory generally followed the following steps:

1. Determine baseline PM10, PM2.5, organic gas, and DPM speed-resolved emission factors from CARB's latest Emission Factor model (EMFAC2017[3]) representing the fleet described by the ABM and EMFAC2017 for the San Diego region and corresponding to the vehicle types considered in SANDAG's ABM.

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[2] See Section 3.1 for information on treatment and reporting of these compounds.

[3] EMFAC2017 was used for all road-link emissions modeling per SANDAG direction on February 2, 2021.

2. Determine emission factors for the priority MSATs[4] from literature values, applied to PM and organic exhaust emissions, and brake and tire wear emissions, as appropriate.[5,6,7]
3. Determine road dust PM10 and PM2.5 emission factors using CARB methods.
4. Extract activity data from the ABM outputs to determine vehicle activity on specific roadway segments.
5. Link the activity and emissions factors and develop a database of emissions by link, time of day, and bus, light- and heavy-duty vehicles for major links, and spatially aggregated emissions for the less trafficked "minor links."

For both PM and TACs, ICF first built a complete, link-based emissions inventory database for the entire San Diego region for the modeled scenario in each analyzed year. SANDAG provided data for vehicular traffic on all roadway links in the ABM model in the same five daily periods simulated by the model and for the three vehicle types modeled.[8] The output of this database is emissions by link, resolved by vehicle type and hour. Only direct PM emissions were considered. Secondary PM was not included.[9]

Speciation[10] of MSATs for non-diesel vehicles was based on standard, accepted models and approaches (identified above).[6] Only exhaust emissions were speciated.[5, 11] Of the nine MSATs identified in Section 2.2.2, *Toxic Air Contaminants,* one applies only to diesel vehicles: DPM, which is defined as whole exhaust particulate matter from diesel vehicles. All cancer risk from diesel exhaust was included in the California Office of

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[4] Both gasoline and diesel were speciated into MSATs in the modeling. Cancer and chronic risk from diesel exhaust was captured by DPM, so only gasoline was speciated for the risk endpoints to avoid double counting diesel risk diesel. However, for acute non-cancer risk, the speciated components of all fuels are added together.

[5] Organic gases were specified according to their emissions of total organic gases (TOG), tracked separately by fuel type and bus, light-, and heavy-duty vehicle categories. The parameters were set by the speciation profiles selected.

[6] There are various sources for developing speciation, which include CT-EMFAC, MOVES, SPECIATE, or other sources, such as those used by CARB. Each has advantages and disadvantages. ICF used MOVES2014b in the EIR as it was the most comprehensive and consistent available source at the time of analysis.

[7] Due to uncertainty and relative risk, ICF did not speciate fugitive sources, such as brake wear, tire wear, or road dust to include in health risk. See footnote 11.

[8] Only a single average day type was available and used. Higher resolution is not likely to dramatically alter the long-term concentrations for HRA or annual PM concentrations, although it could affect the 24-hour average PM and acute risk results. Also, vehicle types from EMFAC and the activity-based model (ABM) were harmonized and emissions aggregated to the three modeled vehicle types—bus, light, and heavy duty.

[9] Secondary PM is particulate matter formed in the atmosphere through chemical reactions, especially nitrogen and sulfur oxides (NO_X and SO_X, respectively), including emissions from mobile sources. CARB has estimated secondary PM to be nearly half of total PM in the San Diego Air Basin. See: https://www.sdapcd.org/content/dam/sdc/apcd/PDF/Air%20Quality%20Planning/PM-Measures.pdf. However, the approach here was not for complete regional photochemical assessment, but an analysis of nearby, direct impacts, similar to a hotspot assessment and following Caltrans guidance for project-level assessments (http://www.dot.ca.gov/env/air/aq-analysis.html). Per EPA guidance, "PM hot-spot analyses include only directly emitted $PM_{2.5}$ or PM_{10} emissions. $PM_{2.5}$ and PM_{10} precursors are not considered in PM hot-spot analyses, since precursors take time at the regional level to form into secondary PM." EPA-420-B-15-084, November 2015. Available at: https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100NMXM.pdf.

[10] Speciation provides a breakdown of the chemical composition of PM and organic gas (VOC) emissions into its various components, such as MSATs.

[11] Brake and tire wear can be significant contributors to overall PM, but cancer risk is typically driven by diesel exhaust PM concentrations. Furthermore, speciation profiles of brake and tire wear are uncertain (e.g., see U.S. Environmental Protection Agency. 2014. *Brake and Tire Wear Emissions from On-road Vehicles in MOVES2014*. EPA-420-R-14-013. December. Available: https://cfpub.epa.gov/si/si_public_file_download.cfm?p_download_id=525701).

Environmental Health Hazard Assessment's (OEHHA) assigned Unit Risk Factor (URF) for DPM (OEHHA 2019a); no further speciation of diesel exhaust was included for cancer risk. Likewise, chronic risk from diesel exposure was captured in OEHHA's Reference Exposure Level (REL)[12] for diesel particulate exhaust, which was used (OEHHA 2019a). Speciation of gaseous components of diesel exhaust (which are minor) could contribute to the overall acute non-cancer characterization and was included. The remaining eight species apply only to non-diesel engines, which are primarily gasoline. Of these, six have speciation factors available through the California Department of Transportation's (Caltrans) CT-EMFAC model. Another MSAT, POM, has both particulate and gaseous components and, while recently included in CT-EMFAC, its speciation does not show variations after 2021. Caltrans has posted guidance on determining POM and naphthalene emissions based on U.S. Department of Transportation's Federal Highway Administration policies,[13] but it relies on older EPA speciation data. To use a consistent source and rely on current data for speciation factors for all MSATs and the different vehicle and fuel types, ICF determined and applied speciation factors from EPA's MOVES2014b mobile source emission model, current at the time of analysis, for all on-road mobile sources (EPA 2015a, 2016). Although not California-specific, ICF concluded this represents the most current and consistent set of available data for speciation of MSAT emissions.

Multiple species that are components of POM and polycyclic aromatic hydrocarbons (PAH) are included. For emissions calculations, ICF summarized PAH emissions as benzo[a]pyrene equivalents through toxicity weighting. This calculation was done by multiplying the emissions of PAHs that ICF had previously speciated out using MOVES with the benzo[a]pyrene-normalized potency equivalency factors (PEF) according to OEHHA guidance.[14] If a particular PAH was not listed in the OEHHA guidance document then OEHHA has not determined its cancer potency, and for the purposes of this assessment ICF did not include that PAH's emissions in the HRA. These PAH emissions, weighted by their individual PEF's, were summed to create the benzo[a]pyrene equivalent. Table 1 outlines components of PAH according to EPA's substance registry as well as those used specifically in the toxicity weighting calculations, and their corresponding PEF.[15]

Table 1. Polycyclic Aromatic Hydrocarbon Species and Corresponding Potential Equivalency Factors

Species of Polycyclic Aromatic Hydrocarbon	Potency Equivalency Factor
Acenaphthene	Not available
Acenaphthylene	Not available
Anthracene	Not available
Benzo[a]anthracene	0.1
Benzo[a]pyrene	1.0
Benzo[b]fluoranthene	0.1
Benzo[g,h,i]perylene	Not available
Benzo[k]fluoranthene	0.1

[12] An REL is the concentration level at or below which no adverse non-cancer health effects are anticipated for the specified exposure duration. RELs are based on the most sensitive, relevant, and adverse health effect reported in the medical and toxicological literature, and RELs are meant to err on the side of public health protection.

[13] http:// www.fhwa.dot.gov/environment/air_quality/air_toxics/policy_and_guidance/msat/2016msat.pdf.

[14] *OEHHA Technical Support Document for Cancer Potency Factors, Appendix A*. Available: https:/ /oehha.ca.gov/media/downloads/crnr/appendixa.pdf.

[15] EPA substance registry, PAH entry: https://sor.epa.gov/sor_internet/registry/substreg/substance/details.do?displayPopup=&id=6012.

Species of Polycyclic Aromatic Hydrocarbon	Potency Equivalency Factor
Chrysene	0.01
Dibenzo[a,h]anthracene	1.05
Fluoranthene	Not available
Fluorene	Not available
Indeno[1,2,3-c,d]pyrene	0.1
Phenanthrene	Not available
Pyrene	Not available

3.1.1 SAFER AFFORDABLE FUEL-EFFICIENT (SAFE) VEHICLES RULE

The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule was issued in two parts jointly by the National Highway Traffic Safety Administration and EPA. Part 2 (SAFE-2), enacted March 2020, reduced progress in fuel economy and carbon dioxide standards for model years 2021–2026 passenger cars and light trucks. Part 1 (SAFE-1), enacted in September 2019, withdrew California's waiver of preemption under Section 209 of the Clean Air Act, which in part eliminated California's ability to enact its zero-emission vehicle (ZEV) mandate. CARB has concluded that the loss of the ZEV sales requirement will increase gasoline vehicle emissions and thus will lead to an underestimate in emissions starting in 2021 when predicted with the EMFAC2017 model. CARB has released off-model adjustment factors that may be applied to gasoline vehicle emissions from calendar year 2021 to correct for the impacts of the SAFE rule.[16] In April 2021, in response to President Biden's Executive Order 13990, the EPA began the process of repealing SAFE-1,[17] with plans to begin the repeal of SAFE-2 in summer 2021.

The SAFE rule does not affect the 2016 baseline emissions included in this analysis. The rule would increase emissions for horizon years under the Plan: 2025, 2035, and 2050. However, the status of the rule is highly uncertain given the current presidential Executive Order calling for its repeal. Even if the rule were maintained, the impact on emissions is very small. CARB correction factors for 2050—the year with the largest magnitude—are 1.0318 for PM Exhaust and 1.0257 and 1.0117 for Evaporative and Exhaust Total Organic Gas (TOG) emissions, respectively, for gasoline vehicles. When applied to the total San Diego regional fleet in 2050, these factors are reduced to increases of 1.2% and 0.7% in PM and TOG exhaust. The proposed Plan anticipates approximately 82% reduction in exhaust PM between 2016-2050 (Section 7.1). When including emissions of brake wear, tire wear, and road dust, the SAFE factors for exhaust PM have a negligible impact on PM emissions and thus on air quality. Similarly, the factors have negligible impact for health risk as they do not apply to diesel exhaust and would lead to only a very small increase in gasoline TACs. Thus, the SAFE Rule correction factors were not applied to emissions projections in this analysis due to uncertainty in SAFE Rule implementation and its insignificant impact on results.

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[16] California Air Resources Board (CARB). 2019. *EMFAC Off-Model Adjustment Factors to Account for the SAFE Vehicle Rule Part One*. November 20. Available: https://www.arb.ca.gov/msei/emfac_off_model_adjustment_factors_final_draft.pdf.

[17] U.S. Environmental Protection Agency (EPA). 2021. *EPA Reconsiders Previous Administration's Withdrawal of California's Waiver to Enforce Greenhouse Gas Standards for Cars and Light Trucks*. April 26. Available: https://www.epa.gov/newsreleases/epa-reconsiders-previous-administrations-withdrawal-californias-waiver-enforce.

3.1.2 MAJOR LINKS

Major links are those links in the ABM with significant amounts of traffic that justified modeling as individual sources. The distinction between major and minor links was based on vehicle activity (average annual daily traffic [AADT]) thresholds. Per SANDAG direction, ICF used a threshold of 100,000 vehicles per day (both directions), consistent with CARB guidance for urban roads (CARB 2005).[18] A threshold of 50,000 vehicles per day was used for one-way links. Links considered zone connectors were not included in major links.

The shape of major links was determined from the geospatial data provided by SANDAG and consistent with that in the ABM. To simplify modeling without notable impacts on risk results, ICF reprocessed the geospatial data so that the vertices of each polyline were 60 feet apart or more; for a curvy link, this can have the effect of straightening the roadway in nominal 60-foot increments while also creating sources the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) can accept. ICF assigned each major link to the modeling subdomain(s) it intersected (see Section 4.2, *Assessment Domain*). Major links intersecting multiple modeling subdomains were assigned to each of those modeling subdomains, and in such cases, ICF modeled the whole major link for each modeling subdomain (even the parts of the link lying beyond a modeling subdomain's boundary). In these cases, though some emissions technically occurred outside a given modeling subdomain, those "outside" sections of links were relatively short, and their emissions were released relatively close to the modeling subdomain boundary line.[19] Major links were converted to polygons by buffering each link 6 feet on each side of the link for every lane (Uchitel pers. comm.). This creates a 12-foot width for each lane of traffic.

Exhaust emissions on major links were calculated according to the general equation:

$$E = EF \times AD$$

where EF is the pollutant-, vehicle type-, and speed-specific emission factor, in grams per vehicle mile, while AD is activity data, in terms of vehicle miles traveled. Emissions were calculated for all hours of the day. SANDAG provided available information regarding on-road activity for determining these emissions, to include ABM outputs describing traffic and speeds on each link in the modeled road network. All hours within one ABM time period were assigned that period's traffic values (e.g., if the a.m.-peak in the ABM represents 6–9 a.m., those 3 hours will all be assigned that period's traffic uniformly). The 3–4 p.m. hour was split between two ABM time periods; ICF recalculated emissions for the 3–4 p.m. hour as the time-weighted average of the emissions of those two periods.

Emissions were aggregated into three vehicle types: light-duty vehicles, heavy-duty vehicles, and buses, based on those reported in the ABM. Fuel mix for each was based on EMFAC2017 defaults for the region. ICF considered light-duty vehicles to be vehicles below 8,500 pounds gross vehicle weight rating (GVWR), consistent with EMFAC. The EMFAC vehicle class breakdown by GVWR is shown in Table 2.

Table 2. Vehicle Type, Descriptions, and EMFAC Category

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[18] This document recommends thresholds of 100,000 vehicles per day for urban and 50,000 for rural roads. Given the focus on developed areas, ICF used the urban threshold throughout the assessment domain.

[19] No double counting of these impacts occurs in concentrations as each modeling subdomain is modeled separately.

Vehicle Type	Description	EMFAC Vehicle Category
Light-Duty Vehicles	Passenger Cars	LDA
	Light-Duty Trucks (GVWR <6,000 pounds and ETW ≤3,750 pounds)	LDT1
	Light-Duty Trucks (GVWR <6,000 pounds and ETW 3,751–5,750 pounds)	LDT2
	Motorcycles	MCY
	Motor Homes	MH
Heavy-Duty Vehicles	Medium-Duty Trucks (GVWR 6,000–8,500 pounds)	MDV
	Light-Heavy-Duty Trucks (GVWR 8,501–10,000 pounds)	LHD1
	Light-Heavy-Duty Trucks (GVWR 10,001–14,000 pounds)	LHD2
	Medium-Heavy Duty Diesel (GVWR 14,001–33,000 pounds)	MHDT
	Heavy-Heavy Duty Diesel (GVWR >33,000 pounds)	HHDT
Buses	School Buses, Urban Buses, Motor Coach, Other Buses, and All Other Buses	SBUS, UBUS, OBUS

Source: CARB 2015a.

Notes: GVWR is the maximum operating weight of a vehicle, including cargo and passengers. Equivalent Test Weight (ETW) is equal to GVWR plus one-half of the difference between the GVWR and the curb weight (i.e., weight at purchase without cargo or passengers) of the vehicle.

ICF considered trucks heavy-duty vehicles, and, consistent with EMFAC classifications, considered motor homes to be light-duty. Buses were modelled as a separate category from heavy-duty vehicles to more accurately represent EMFAC emission factors for buses. SBUS and OBUS categories were not provided in the ABM. SBUS and OBUS vehicle miles traveled (VMT) were spread throughout all links, with the contribution of SBUS/OBUS VMT to each link proportional to the VMT of the link VMT compared to the total VMT of the ABM. SBUS was only added to morning and late afternoon minor links, to reflect school pick-ups and drop-offs within neighborhoods and residential areas. OBUS was only added to morning, midday, and late afternoon major links, in order to reflect routes of bus operators, such as Greyhound.[20]

3.1.3 MINOR LINKS

Minor links[21] were classified as those links in the ABM below the 100,000 AADT (for two-way segments, or 50,000 AADT for one-way links) count threshold used to determine major links. Emissions on minor links were calculated as they were for major links, based on emission factors and activity data. The same vehicle and time designations employed for major links were used for minor links. However, unlike major links, minor links were aggregated at the U.S. census tract level. Mapping of links to census tracts was based on the link's centroid. ICF aggregated the emissions from individual minor links to an area, defined as the census tract boundary. Because the boundaries of the modeling subdomains (discussed in Section 4.2 below) did not align with the tracts, to limit inter-domain influences ICF clipped at the modeling subdomain boundaries any tract intersecting more than one modeling subdomain, creating partial tracts within each of the intersecting modeling subdomains. Each partial tract carried with it the emissions of the minor links within it. As with major links, to simplify modeling without notable effects on risk results, ICF reprocessed the tract geospatial data so

[20] Sample Greyhound schedules are available at: http://extranet.greyhound.com/revsup/schedules2/pageset.html.

[21] Minor links may have a small impact only. Areas with minor links were chosen based on SANDAG's needs, provided data, and feedback on the approach.

that the vertices of each polygon were 300 feet apart or more. For curvy areas of a tract boundary, this can have the effect of straightening the tract boundary in nominal 300-foot increments but was able to be modeled within AERMOD.

3.1.4 OUTPUT

The output of this emissions modeling was a database of emissions for the designated pollutants by link (for major links) or by census tract (for minor links). This emissions database reported emissions by vehicle type (light and heavy) and hour.[22] This represented the emissions strength and temporal profile of the sources in the dispersion model.

Comparisons were drawn between the emissions modeling performed, SANDAG's conformity results, and default EMFAC inventory outputs. SANDAG's conformity results used the same data as the time-, speed- and link-resolved activity data used in the emissions modelling, except for EMFAC categories SBUS and OBUS. SBUS and OBUS were allocated according to the method described in Section 3.1.2, *Major Links,* in the emissions model, while the conformity results added EMFAC emissions data for SBUS and OBUS directly to their emissions results, without spatial or temporal allocation. The conformity results also represented natural gas buses with gasoline emission factors. ICF compared the inventory to that from SANDAG's conformity results to verify that the time-, speed, and link-resolved emissions estimation methods were comparable to those used elsewhere. Percent difference of total emissions was used as a comparison tool between these methods, with percent difference calculated as the difference between the emissions model and the conformity results, normalized to the conformity results. A difference of less than 5% was seen between most pollutants, except for TOG, which saw differences of 20% in 2035 and 2050. This difference in TOG is attributed to the difference in estimating bus emissions. The bus fleet in San Diego is composed of buses that use natural gas, diesel, and gasoline as fuel. Though buses make up less than 1% of the total VMT, emissions from natural gas buses are responsible for over 20% of the total emitted TOG within San Diego County. For this reason, small deviations in the calculation of bus emissions can result in major differences in estimations of TOG, which is why the method to allocate bus emissions in Section 3.1.2 was used.

3.2 PASSENGER AND FREIGHT RAIL

The analysis also included emissions from rail sources identified by SANDAG. SANDAG provided ICF with the activity and geospatial polygons for future rail lines, while for existing (2016) rail lines SANDAG provided rail lines by type of rail. Existing rail lines were selected to remove any that were used only for light rail. The remaining existing rail lines were simplified by removing points less than 60 feet apart. The simplified rail lines were buffered by 25 feet to create 50-foot-wide rail corridors to match the size of the future rail corridors. The existing rail polygons were combined with the future planned rail polygons for each year to get the full extent of rail for each of the planned future years. Rail sources were assigned to the modeling subdomain in which they are located, except some rail geospatial segments were relatively long, so ICF clipped the rail segments at modeling subdomain boundaries, creating a defined portion in each modeling subdomain.

Emissions were estimated based on the projected rail activity for the various analysis years and relevant emissions factors from CARB and EPA. MSAT and PAH emission factors were calculated based on EPA emission

[22] Note that the ABM presents traffic volumes by five daily time periods. The database translated these into hourly outputs for use in the AERMOD.

factors.[23] Gaseous MSATs were calculated as a component of volatile organic compounds (VOC), while gaseous and particulate PAHs were calculated as components of VOC and PM2.5, respectively. For passenger rail, the analysis considered locomotive fleet turnover and rail activity for each analysis year, as provided by SANDAG staff. Freight rail emissions were taken directly from CARB's freight emissions model in EMFAC.[24] Countywide rail emissions were calculated by rail line for each year, and each line was assigned the same spatial emission rate. The 3–4 p.m. hour was split between two ABM time periods; ICF recalculated emissions for the 3–4 p.m. hour as the time-weighted average of the emissions of those two periods.

Passenger (commuter) rail emissions were estimated based on estimated fuel consumption, which were derived from daily train and daily train mile activity, provided by SANDAG, and assumed fuel economy for each rail line, based on rail line reporting to the U.S. Department of Transportation. Table 3 summarizes the estimated passenger line fuel consumption by line and by year under the Plan. All results are unmitigated and do not account for zero emission efforts in the Plan years.

Table 3. Passenger Rail Fuel Use, Gallons per Day

Rail Line	Year			
	2016	2025	2035	2050
398 (COASTER)	2,624	5,027	7,399	7,131
399 (SPRINTER)	869	869	1,738	2,818
Amtrak/Pacific Surfliner	3,173	4,231	4,760	4,760
Metrolink	886	886	1,107	1,107
581A	0	0	0	8,702
581B	0	0	0	7,901
582	0	0	10,410	17,723
583	0	0	0	11,638
Total	7,553	11,013	25,414	61,780

3.3 STATIONARY AND OTHER SOURCES

In the HRA, ICF also considered chronic and cancer risks from stationary sources. The proposed Plan would not directly affect the emissions strength or profile of these sources, and no data is readily available to project future emissions from stationary sources; thus, the analysis assumed future pollutant concentrations from these sources remains static in time. As a consequence of this assumption, the only influence the proposed Plan was assumed to have on incremental concentrations from stationary sources is when sensitive receptors are new or relocated as a result of the proposed Plan. (See Section 4.5 for discussion of receptor types and locations.)

[23] MSAT and PAH emission factors available in tables 11 and 12: https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100PUQI.pdf.

[24] The *2016 Line haul Locomotive Model & Update* and the *2017 Passenger Rail Emissions Model* are available at: https://www.arb.ca.gov/msei/ordiesel.htm.

ICF attempted to obtain current risk and/or facility information from the San Diego Air Pollution Control District (SDAPCD). However, ICF was informed[25] that limited data exists and that which does is often extremely dated. SDAPCD did not provide any data for use. Instead, current concentrations from stationary sources were determined from EPA's Risk-Screening Environmental Indicators (RSEI) model.[26] RSEI is a screening-level model that assesses the potential risk from industrial emissions, as captured in EPA's Toxics Release Inventory (TRI). The most current data currently available is for year 2016. An intermediate product of the RSEI model is estimated annual average pollutant concentrations by emitting facility on an 810-meter by 810-meter grid across the entire country modeled with AERMOD.[27] ICF extracted and processed this data for the modeling subdomains. ICF then modeled existing cancer and chronic risk from these concentrations with California-specific risk values using CARB's Hotspots Analysis and Reporting Program (HARP). As this approach does not predict short-term concentrations, no acute risks were attributed to stationary sources. ICF assigned concentrations on this 810-meter grid to any sensitive receptors where incremental changes are likely due to the Plan. Given the lack of available information, ICF relied on RSEI long-term average concentration data only from major stationary sources and did not conduct any emission or dispersion modeling for stationary sources specific to this analysis. Note that while these stationary sources do influence the cumulative risk impact analysis, they are already captured in existing background concentrations for PM and are thus only included in the incremental risk calculation to support risks from new sensitive-receptor locations. ICF was also unable to identify similar sources of concentration data from sources operating south of the U.S.-Mexican border. Thus, these sources were not included in this analysis. ICF also did not model emissions from other source categories, including general area sources or from industrial and goods movement facilities not affected by the proposed Plan, such as Port of San Diego activities, the airport, landfills, or other major stationary sources that were outside the proposed Plan and unavailable through SDAPCD or RSEI.

4 DISPERSION MODELING

ICF conducted dispersion modeling with the emissions discussed in Chapter 3, *Emission Sources,* to estimate localized PM10, PM2.5, and TAC concentrations under baseline (2016) conditions and three future-year (2025, 2035, and 2050) conditions with implementation of the proposed Plan.

4.1 MODELING PLATFORM

ICF conducted dispersion modeling using AERMOD (EPA 2019)—EPA's preferred model for near-field pollutant dispersion calculations for distances up to 50 kilometers from emission sources. AERMOD is widely used for assessments of dispersion of emissions from stationary and mobile sources. It is a steady-state plume dispersion model that utilizes hourly meteorological data, local land-cover conditions, and elevation data, along with spatiotemporal characterizations of emissions, to estimate air pollutant concentrations at locations that the user specifies. It also has built-in processing features that assist in evaluating concentrations of PM against the forms of the 24-hour National Ambient Air Quality Standards (NAAQS). The model is updated periodically to repair bugs and add enhancements based on revised understandings of the parameters impacting pollutant dispersion. ICF used the most current version available when model setup began (version 19191).

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[25] Meeting with Archi dela Cruz, APCD September 5, 2018.

[26] https://www.epa.gov/rsei. Specific guidance and custom outputs for California were provided by Cynthia Gould, EPA contractor at Abt Associates per personal communication October 8, 2018.

[27] Complete information on the calculation approach in RSEI is available in *EPA's Risk-Screening Environmental Indicators (RSEI) Methodology, RSEI Version 2.3.6*, January 2018.

4.2 ASSESSMENT DOMAIN

ICF developed an assessment domain covering the more populated areas (western portion) of the county. Due to the size limitations of the AERMOD model, ICF divided this overall assessment domain into six modeling subdomains. Each of these was modeled as an individual case (Figure 1) with associated meteorological data and background data on air pollutants. Because some of these have background that exceed the appliable standard, some modeling subdomains are modeled compared to a significant impact level based on the applicable PM design values (DVs) for each. These are broadly consistent with work done in the previous EIR (SANDAG 2015) and based on available data from meteorological stations and air quality monitors. ICF designed these modeling subdomains to reflect the different population centers, land uses, terrain features, meteorological conditions, and ambient PM air quality across the populated areas of San Diego County, while also keeping the modeling as efficient as possible and limiting modeling subdomain size so that most receptors were not farther than 50 kilometers from emission sources (per *Federal Register* [FR] EPA guidance for AERMOD [82 FR 5182 Jan. 17, 2017]). ICF has also assigned each modeling subdomain a name for reference purposes.

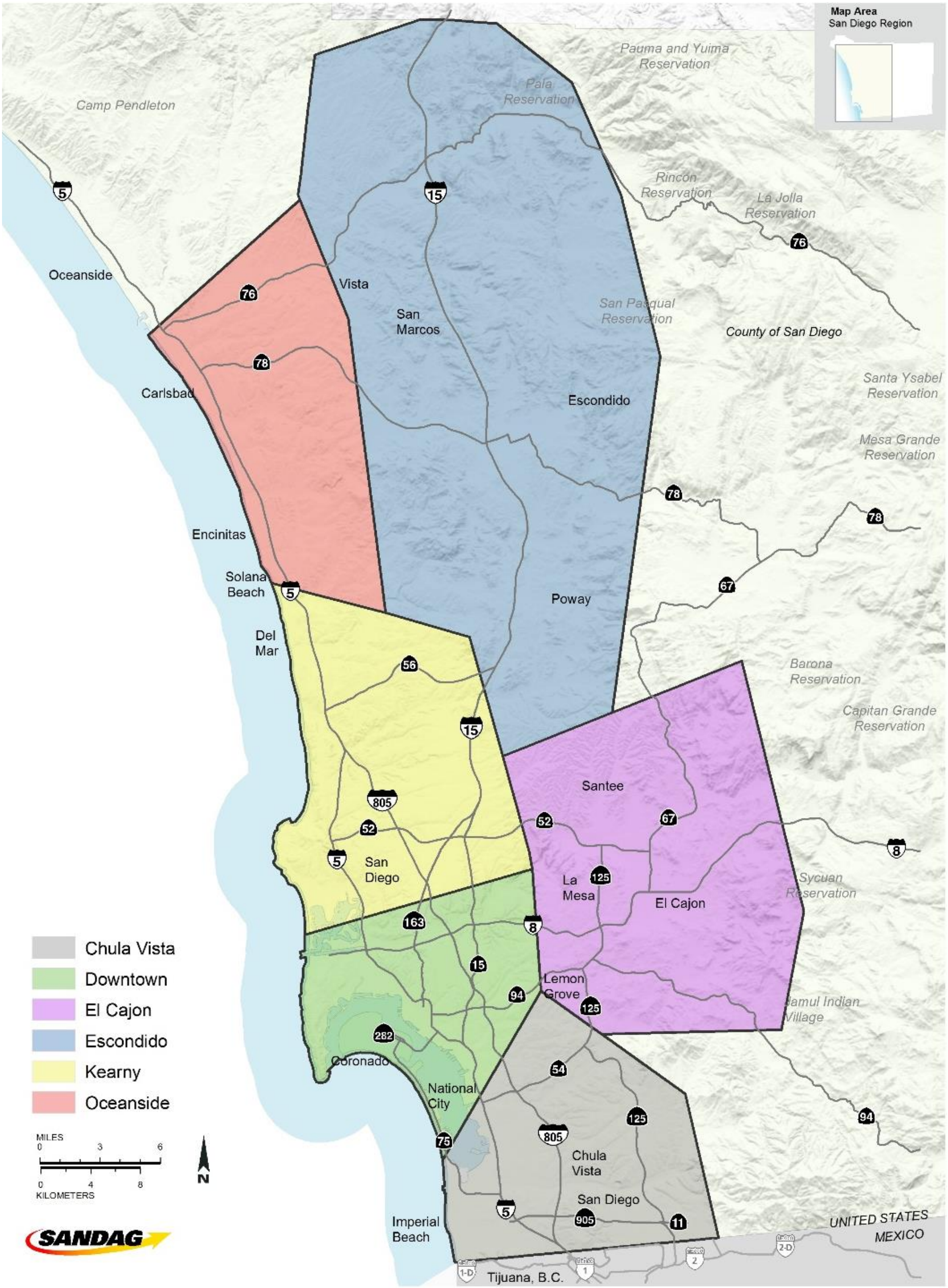

Figure 1. Subdomains for Dispersion Modeling

In the following subsections, ICF provides brief discussions of the characteristics of each modeling subdomain and the meteorological and PM stations selected for each. Section 4.3, *Meteorology,* provides further discussion of the meteorological stations and their data used for each modeling subdomain. Section 4.7, *Background Concentrations Data,* provides further discussion of the PM monitors and their respective DVs assigned for each modeling subdomain.

4.2.1 OCEANSIDE

The Oceanside modeling subdomain consists of the coastal region between the cities of Encinitas and Oceanside. The northern border runs along Camp Pendleton but does not include it (consistent with the analysis in the EIR for the 2015 Reginal Plan [SANDAG 2015]). Most areas are within about 14 kilometers of the coast, with some substantial terrain features peaking near 200 meters above sea level (ASL).

ICF used SDAPCD's Camp Pendleton (PEN) station for meteorology and SDAPCD's Kearny Villa Road (KVR) monitor for PM DVs. Although not within this modeling subdomain, the KVR monitor is the closest one that has adequately complete data to calculate 2016 DVs for the NAAQS and CAAQS.

4.2.2 ESCONDIDO

This inland modeling subdomain along the Interstate 15 corridor generally has rough terrain with most elevations at 100–400 meters ASL. The northern edge of this modeling subdomain incorporates the Fallbrook area and abuts the county border, while the southern edge is near Poway and is intended to align with the ridge that lies between the cities of Escondido and El Cajon. The north-south extent of this modeling subdomain, at about 60 kilometers, is longer than the 50 kilometers recommended AERMOD distance between a source and a receptor. That AERMOD limitation is related to the effectiveness and accuracy of the model's steady-state Gaussian dispersion calculations at long distances of plume travel within a model timestep of 1 hour. However, unlike tall smokestacks where the impact on air quality can be on the scale of tens of kilometers, the direct impact of near-ground roadway emissions is on the scale of hundreds of meters, such that the impact of their emissions will be negligible several kilometers away, let alone 50 or 60 kilometers away. This will minimize the impact of any possible model errors on the contribution, say, of major-link emissions near Poway to the air quality in Fallbrook (as a hypothetical example).

ICF used SDAPCD's Escondido (ESC) station for meteorological data and SDAPCD's KVR monitor for PM DVs for this modeling subdomain. Though the KVR monitor is not located within this modeling subdomain, the ESC PM monitor was shut down in 2015, preventing the calculation of 2016 DVs for all NAAQS and CAAQS.

4.2.3 KEARNY

This modeling subdomain features coastal cities extending from Pacific Beach in the south to Solana Beach in the north, and inland communities such as Mira Mesa and Kearny Mesa surrounding Marine Corps Air Station Miramar. This modeling subdomain has coastal and inland rugged terrain, with some elevations in the eastern portion at greater than 200 meters ASL.

ICF used SDAPCD's KVR station for meteorology and SDAPCD's KVR monitor for PM DVs in this modeling subdomain.

4.2.4 EL CAJON

This inland modeling subdomain is centered around the city of El Cajon. The terrain in this area is generally 100–300 meters ASL and features an inland valley surrounded by mountainous features.

ICF used SDAPCD's Lexington Elementary School (LES) station in El Cajon for meteorological data and SDAPCD's KVR monitor for most of the ambient air quality standards (AAQS) for this modeling subdomain. For the 24-hour PM10 CAAQS, the highest observed value in the year is compared with the standard level. During 2016, SDAPCD's Floyd Smith Drive (FSD) monitor was moved to its current LES location (SDAPCD 2017). Considering the FSD and LES datasets together, the 2016 record of PM10 data is 95% complete, and the highest 24-hour PM10 value from that superset (actually from the LES location) is larger than at the KVR monitor. To be health-protective, ICF utilized the LES station for the 24-hour PM10 CAAQS. All other AAQS require at least 3 full years of data; accordingly, ICF used the KVR site to determine the remainder of DVs for the El Cajon modeling subdomain.

4.2.5 DOWNTOWN

This urban modeling subdomain encompasses downtown San Diego, the Port of San Diego, Point Loma, Mission Valley, and Mid-City, with an eastern edge just east of San Diego State University and a southern edge following a diagonal from the Silver Strand to west of Lemon Grove. Most terrain elevations are less than 150 meters ASL. This is a primarily coastal area that extends 20 kilometers inland.

For this modeling subdomain, ICF used SDAPCD's Perkins Elementary School (PES) station in downtown for meteorological data and the San Diego-Beardsley Street (DTN) SDAPCD monitor for most PM DVs. Although DTN was permanently closed on November 24, 2016, the data still meet completeness requirements for calculating 2016 DVs for most of the AAQS.[28] ICF used DVs from the Chula Vista (CVA) SDAPCD monitor (which is not within this modeling subdomain) for the AAQS, which require a more complete dataset than what is available from DTN—that is, the 2016 $PM_{2.5}$ 24-hour and annual NAAQS.

4.2.6 CHULA VISTA

This modeling subdomain covers the southernmost extent of San Diego County, south of the Downtown modeling subdomain and north of the International Border and extends from Imperial Beach along the coast to the Otay Mesa area, including the Port of Entry. This area is coastal and extends inland approximately 20 kilometers, with terrain in the eastern portion of this modeling subdomain around 160–200 meters ASL.

ICF used CVA for meteorology and PM DVs in this modeling subdomain. While the Otay Mesa-Donovan (DVN) monitor had higher DVs, ICF did not utilize it because it is non-FEM (Federal Equivalent Method), and ICF is aware of some technical issues with the monitor that caused reporting problems.

4.3 METEOROLOGY

AERMOD requires meteorological data as input for the model. These typically are processed using AERMET, a pre-processor to AERMOD. AERMET requires observed surface meteorological data, upper-air meteorological data, and surface parameter data. SDAPCD provided three consecutive years of AERMET-processed, AERMOD-

[28] Beardsley Street station closed in November 2016 (https://ww3.arb.ca.gov/qaweb/site.php?s_arb_code=80142). Sherman Elementary station opened in its place in 2019. There are no PM data for this area during this time gap.

ready meteorological files from SDAPCD-operated stations near to or within each modeling subdomain, supplemented as needed with data from other stations, as indicated in Figure 2 and Table 4. These data utilized the latest AERMET version at the time (v19191), 1-minute-averaged wind data where available (via EPA's AERMINUTE preprocessor), and the sigma-theta AERMET option coupled with onsite measurements of turbulence. Calm winds occurred 3% or less of the time at each station, and missing hours of meteorological data occurred less than 2% of the time. Upper-air data were from the Miramar Marine Corps Air Station (NKX).

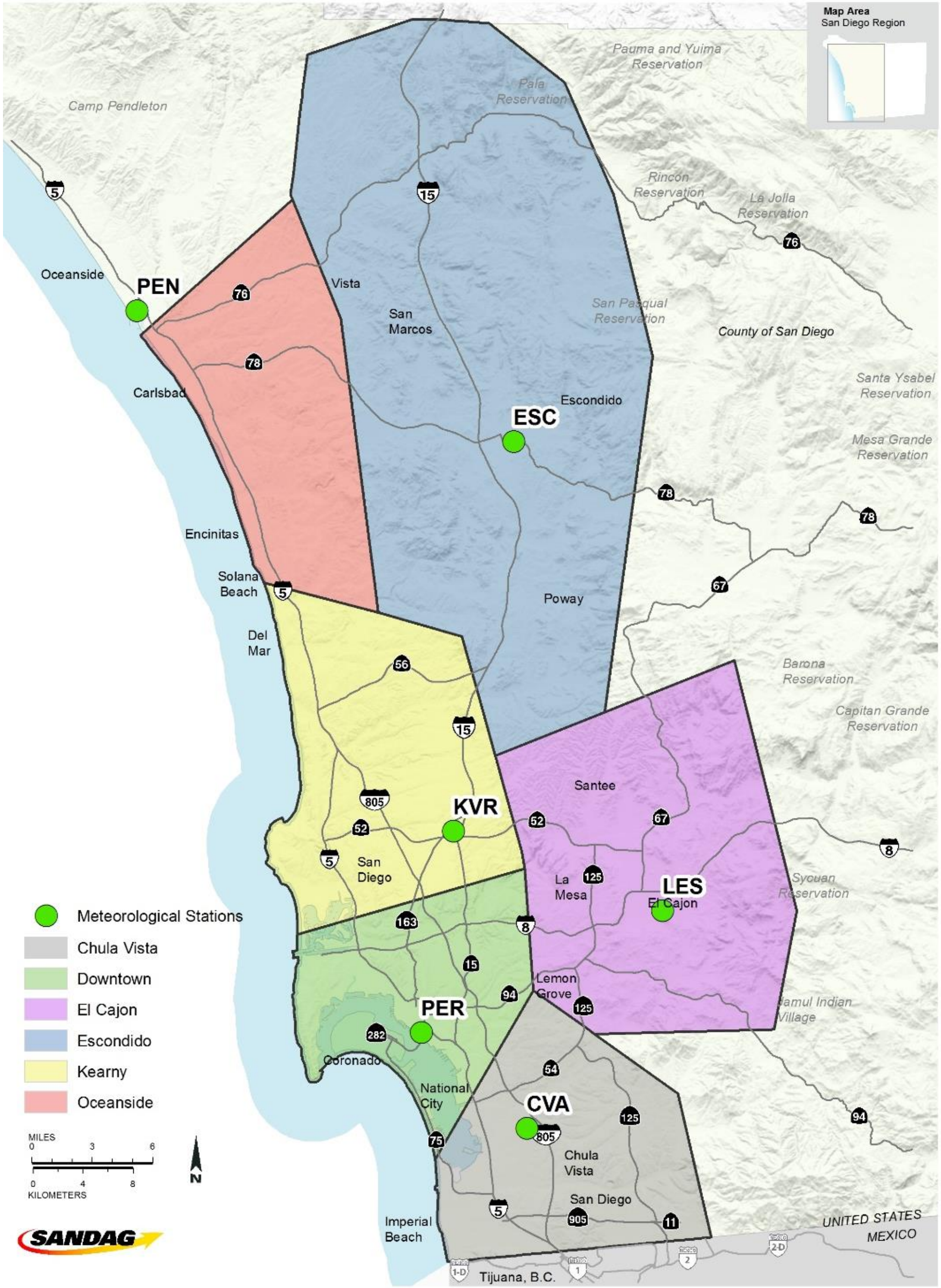

Figure 2. Sources of Meteorological Data

Note that the labels in the map indicate the station abbreviation for the onsite station (see Table 4). All onsite stations are managed by SDAPCD.

Table 4. Metadata on Each Meteorological Station

Modeling Subdomain (Abbreviation)	Station Metadata					
	Name	Latitude	Longitude	Elevation. (meters)[1]	ASOS 1-Minute Winds/Cloud-Cover Substitutions/ Temperature Substitutions[2]	Period
Oceanside (OCE)	On site: SDAPCD's Camp Pendleton (CMP) Supplemental Surface: CARB's McClellan-Palomar Airport (CRQ)	33.217	-117.396	16	Yes/ Yes/ Yes	2010–2012
Escondido (ESC)	On site: SDAPCD's Escondido (ESC) Supplemental Surface: Ramona Airport (RNM)	33.128	-117.075	200	Yes/ Yes/ Yes	2010–2012
Kearny (KVR)	On site: SDAPCD's Kearny Villa Rd. (KVR) Supplemental Surface: Marine Corps Air Station (NKX)	32.836	-117.129	134	No/ No/ Yes	2014–2016
El Cajon (LES)	On site: SDAPCD's Lexington Elementary School (LES) Supplemental Surface: Marine Corps Air Station (NKX)	32.791	-116.942	144	No/ Yes/ Yes	2010–2012
Downtown (DTN)	On site: SDAPCD's Perkins Elementary School (PES) Supplemental Surface: San Diego Int'l Airport (KSAN)	32.701	-117.150	8	Yes/ Yes/ Yes	2010–2012
Chula Vista (CVA)	On site: SDAPCD's Chula Vista (CVA) Supplemental Surface: San Diego Int'l Airport (KSAN)	32.631	-117.059	55	Yes/ Yes/ Yes	2010–2012

[1] Elevations were supplied by SDAPCD directly.

[2] "ASOS 1-Minute Winds" refers to whether the meteorological processing utilized 1-minute data on winds (applies only to ASOS stations). "Cloud-cover Substitutions" and "Temperature Substitutions" refers to whether the meteorological processing utilized interpolation to fill in small gaps of missing cloud-cover or temperature data.

ASOS = Automated Surface Observing System .

4.4 SOURCE REPRESENTATION

As discussed earlier (Sections 3.1, *On-Road Sources,* and 3.2, *Passenger and Freight Rail*), ICF modeled emission sources as polygons, from data supplied by SANDAG which ICF simplified to reduce the number of vertices without substantially impacting concentration gradients (which also improves model runtime). The spatial representations of the major links and the rail were mostly contiguous segments, while ICF modeled minor-link emissions aggregated to partial tract polygons (the portions of a tract within a given modeling subdomain). Because major-link segments were relatively short, ICF allowed them to cross beyond the boundaries of the modeling subdomain and be modeled as part of both modeling subdomains; rail segments were longer and ICF clipped them at modeling subdomain boundaries.

For efficiency in modeling, ICF aggregated emissions from on-road brake wear, tire wear, road dust, and exhaust into total PM10 and total PM2.5 emissions. ICF also aggregated TAC emissions based on toxicity weighting to benzene, utilizing OEHHA reference values—see the toxicity reference values and corresponding toxicity-equivalency factors in Table 5 that ICF used to aggregate TAC emissions to benzene-equivalents. ICF used actual emissions for each road and rail source (in units of grams per square meter per second), with temporal profiles based on those in the ABM, utilizing the AERMOD HROFDAY profile to represent the hourly variation in emissions throughout the day.[29]

Table 5. Inhalation Toxicity Reference Levels Used to Aggregate Emissions of Toxic Air Contaminants Based on Toxicity Weighting to Benzene

Chemical	Acute REL ($\mu g/m^3$)	Chronic REL ($\mu g/m^3$)	CSF $(mg/kg\text{-}d)^{-1}$	Acute Non-Cancer TEF	Chronic Non-Cancer TEF	Cancer TEF
1,3-Butadiene	660	2	0.6	2.44E+01	6.67E-01	1.67E-01
Acetaldehyde	470	140	0.01	1.74E+01	4.67E+01	10
Acrolein	2.5	0.35		9.26E-02	1.17E-01	
Benzene	27	3	0.1	1	1	1
DPM		5	1.1		1.67E+00	9.09E-02
Ethylbenzene		2000	0.0087		6.67E+02	1.15E+01
Formaldehyde	55	9	0.021	2.04E+00	3	4.76E+00
Naphthalene		9	0.12		3	8.33E-01
POM as Benzo[a]pyrene			3.9			2.56E-02

Sources: RELs: OEHHA 2019b, CSFs: OEHHA, 2019a.

DPM = diesel particulate matter; POM = polycyclic organic matter; REL = non-cancer reference exposure level; CSF = cancer slope factor; TEF = toxicity-equivalency factor (ICF multiplied emissions by these TEFs to toxicity-weight them to benzene); µg = microgram; m^3 = cubic meter; mg = milligram; kg = kilogram; d = day.

The absence of an REL or CSF means that OEHHA has not promulgated a value, and therefore ICF did not include that chemical in that risk metric (e.g., ICF did not include ethylbenzene emissions in assessments of acute risk). ICF used DPM only from diesel engines and the other TACs only from non-diesel engines. As noted earlier in Section 3.1 *On-Road Sources*, emissions of POM were already aggregated and toxicity-weighted to benzo[a]pyrene.

[29] Consistent with the ABM annualized vehicle-travel information, ICF did not include weekday/weekend variation in release profiles in the dispersion modeling.

ICF modeled two of each major- and minor-link polygon—one polygon for activity from light-duty vehicles and another for activity from heavy-duty vehicles. When SANDAG characterized north- and south-bound links from the same roadway as separate segments, ICF kept them separate in the modeling. ICF set the source release heights and the parameter for the initial vertical plume as indicated in Table 6, based on default vehicle heights and formulas provided by EPA (EPA 2015b, 2019).

Table 6. Characterizations of Source and Plume Height for On-Road Sources

Source Type	Vehicle Height (VH; meters)	Release Height (meters) = (VH × 1.7)/2	Initial Vertical Plume Parameter (SigmaZ; meters) = (VH*1.7)/2.15
On-road light duty (including exhaust, brake, dust)	1.53	1.3005	1.2098
On-road heavy-duty (including exhaust, brake, dust)	4	3.4	3.1628

Sources: VH = EPA 2015b. RH = EPA 2015b, EPA 2019, SigmaZ = EPA 2019.

ICF modeled two of each rail polygon—one polygon for daytime activity and another for nighttime activity. ICF defined daytime as 6 a.m. through 5:59 p.m. ICF set the source release heights and the parameter for the initial vertical plume as indicated in Table 7 (ENVIRON International, Corporation 2008: Table 4-1). ENVIRON used these height and vertical-plume values for arriving-departing line haul, while they used much higher values for switcher activities.

Table 7. Characterizations of Source and Plume Height for Rail Sources

Source Type	Release Height (meters)		Initial Vertical Plume Parameter (SigmaZ; meters)	
	Daytime	Nighttime	Daytime	Nighttime
Switcher (rail yard)[1]	37.76	37.3	8.78	8.67
All Other Rail[2]	4.76	11.25	1.11	2.62

[1] Activity Subcategory D (Switching) (ENVIRON International, Corporation, 2008: Table 4-1).

[2] Activity Subcategory E (Arriving-Departing Line Haul) (ENVIRON International, Corporation, 2008: Table 4-1).

ICF did not directly model dispersion of stationary-source emissions. ICF based concentrations on EPA's RSEI modeling (see Section 3.3, *Stationary and Other Sources*).

4.5 RECEPTORS

Receptors are specific locations where air pollutant concentrations are simulated in the dispersion model. Our analysis had two types of receptors: those used for the HRA and those used for PM evaluation. Those for the HRA evaluation are referred to here and in the body of the EIR as *sensitive receptors*; they represent sensitive land uses such as residences, schools, and parks. The second type, *ambient receptors,* are used to determine the ambient air quality impacts of the Plan, specifically the incremental changes PM concentrations across the modeled areas. In practice in the dispersion modeling the locations of both types of receptors were at the same place for both HRA and PM assessment. In the ambient air quality analysis these locations are referred to as ambient receptors. In the HRA (Section 5) these represent different types of sensitive receptors based on the land use in which they occur (e.g., schools, parks, or residential).

ICF first created a regular grid of receptors across the assessment domain, which was consistent across analysis years and spaced at 50 meters, consistent with CARB and South Coast Air Quality Management District (SCAQMD) recommendations (CARB 2005, SCAQMD n.d.). The consistency of the receptor grid across analysis years was to support incremental-risk calculations, except where changes in land use caused receptors to be in or out of a given year of modeling (e.g., a residential area projected to exist in 2050 where none existed in 2016, or vice versa) or where AADT or construction plans changed source locations or designations (e.g., a new major link is built in 2035, or AADT projections cause a link to go from minor to major status). ICF created the grid of receptors for a given analysis year to extend 500 feet (approximately 152 meters) from major links and rail lines, also including a 10-foot (approximately 3-meter) right-of-way buffer adjacent to a major link to account for the shoulder. No receptors were placed within a source. This approach ensured that receptor definitions were consistent with both available land-use definitions and specific sources defined in the proposed Plan. The 10-foot road edge buffer forming the inside boundary of receptors defined the road shoulder, setting the closest area of public access to the major link, and representing the "fenceline" of the project area, consistent with Caltrans road cross-sections provided by SANDAG (Uchitel pers. comm.); ICF assumed no shoulder for rail. The 500-foot outer boundary of receptors was a distance judged to provide adequate representation of the near-road or near-rail concentration gradient, consistent with CARB guidance (2005) for siting new sensitive land uses within 500 feet of a freeway, or urban road with more than 100,000 vehicles/day. Table 8 indicates the number of receptors for each modeling subdomain and analysis year.

In determining health risk, the subset of the gridded receptors that were sensitive receptors represented residential, school, and recreational land uses, based on SANDAG's land-use models. The land-use models had codes facilitating identification of schools and recreational areas; for residential areas there were data on all four analysis years, and ICF required a land-use polygon to have at least one dwelling unit to be considered residential.[30] Recreational and school land uses do not change in this analysis.[31] Some land-use polygons could have multiple land uses.

Table 8. Number of Modeling Receptors, by Modeling Subdomain and Analysis Year

Modeling Subdomain	Analysis Year			
	2016	2025	2035	2050
Chula Vista	2,093	2,179	2,950	3,083
Downtown	3,004	3,499	4,418	5,711
El Cajon	1,645	1,953	1,906	2,522
Escondido	2,046	2,155	2,138	2,391
Kearny	2,253	2,331	3,156	3,733
Oceanside	2,909	3,068	3,151	3,153
Total	**13,950**	**15,185**	**17,719**	**20,593**

30 Please note residential sensitive-receptor zones here represent residential land uses, not specific houses. These were used to characterize incremental health risk in residential locations. This is independent of the population in these areas, which could change, for example, if more residents move into the area due to denser housing stock.

31 Note that there can still be "new" recreational or school receptors that are "turned on" by a new source. For example, a new rail that comes near an existing school that was not previously near enough to a source to be included in the modeling would be a "new" receptor for the modeling even though the land use is unchanged. This is explained further in Section 7.3.

ICF placed all ambient receptors for PM analysis at ground level (i.e., flagpole receptors at 0-meter height), consistent with SCAQMD guidelines (SDAPCD guidelines do not include guidance on receptor heights). ICF placed all sensitive receptors for HRA analysis a standard breathing height of 1.2 meters, consistent with HARP modeling default (CARB 2015b). These are heights above ground level, with terrain included.

Note that these sensitive receptors represent land use, not necessarily the "density" of a land use. That is, a residential sensitive receptor indicates that the land around that sensitive receptor is used for residential purposes (possibly among others); however, it does not indicate how many people live at that residence. This is explained further with the scope of the HRA in Chapter 5, *Estimating Health Risks*.

All receptors were modeled considering the underlying terrain elevation. ICF included terrain modeling in the analysis for all modeling subdomains, utilizing EPA's current version (version 18081) of AERMOD's terrain processor, AERMAP.

4.6 OTHER MODEL SPECIFICATIONS

Other model specifications were consistent with regulatory applications of AERMOD.

ICF used the version of AERMOD current at the time of modeling (19191) to conduct all dispersion analyses. ICF included only model regulatory default (DFAULT) options except for use of the FASTALL computation method, which optimizes model runtime for area sources through a hybrid approach. As mentioned in Section 4.3, the meteorological data obtained from SDACPD were processed with 1-minute-averaged wind data where available (via EPA's AERMINUTE preprocessor), the sigma-theta AERMET option coupled with onsite measurements of turbulence, and typically with substitutions of missing temperature and cloud-cover values.

SDAPCD guidance for HRAs recommends rural dispersion throughout the San Diego region except on a case-by-case basis (SDAPCD 2019). ICF used urban dispersion for modeling subdomains containing more than 50% of their land area designated as Census Urban Areas (i.e., for all modeling subdomains except Escondido). For the Escondido modeling subdomain (the only modeling subdomain with 50% or less of its land area designated as Census Urban Area), urban dispersion settings were on a source-by-source basis: if more than 50% of a major link segment, rail segment, or partial tract was in a Census Urban Area, then ICF modeled that source segment with urban dispersion. ICF used an urban population of 3,337,685 (U.S. Census Bureau 2017), for the San Diego-Carlsbad Major Statistical Area, consistent with the relatively isolated nature of San Diego's urban area (EPA 2018), for the urban dispersion setting.

This analysis excluded impacts of any trees or other mitigating barriers such as sound walls that could affect dispersion between sources and receptors.

4.7 BACKGROUND CONCENTRATIONS DATA

ICF did not include background concentrations in any AERMOD simulation. Background is important for establishment of cumulative risk, but not incremental risk (Chapter 5). It is also relevant for the PM thresholds (Section 6.1). Both are discussed below.

San Diego currently is in nonattainment for both the PM2.5 CAAQS (for which there is an annual standard) and the PM10 CAAQS (for which there are 24-hour and annual standards; both must not be exceeded for a region to be considered in attainment for PM10 CAAQS; CARB 2019).[32,33] The monitor DVs based on 2016 data (CARB, n.d.-) show exceedances of the 24-hour PM10 CAAQS and the 24-hour and annual PM2.5 CAAQS at the Otay Mesa-Donovan monitor in the Chula Vista area, which ICF excluded from this analysis. (Because of this, none of the modeled subdomains are treated as nonattainment for PM2.5 for modeling purposes, although the county is thus designated. See discussion further below). The monitor DVs also show exceedances of the 24-hour PM10 CAAQS at the monitor ICF selected for the Downtown modeling subdomain, as well as the annual PM10 CAAQS at the Downtown monitor and the monitor ICF selected for the Chula Vista modeling subdomain. All other modeling subdomains and standards show exceedances of the applicable standards based on the 2016 monitor DVs.

For computation of PM thresholds, ICF assigned to each model subdomain a single background concentration (2016 DV [CARB n.d.]) for each pollutant and averaging period. There are relatively few available monitors to calculate PM DVs and other information related to AAQS for the modeling subdomains for the baseline project year of 2016. Therefore, ICF used a limited number of monitors to describe the baseline air quality across the assessment domain.

Table 9 presents the assignment of PM monitors and 2016 DVs to each modeling subdomain. Table 10 provides the metadata for each of the PM monitors chosen.

Table 9. Assignments of Monitors and Design Values (in micrograms per cubic meter) for Particulate Matter for each Modeling Subdomain

Modeling Subdomain	National Standards[1]						California Standards[2]					
	PM2.5				PM10		PM2.5		PM10			
	Annual (12.0)[3]		24 Hour (35)[4]		24 Hour (150)[5]		Annual (12)[6]		Annual (20)[g]		24 Hour (50)[7]	
	Monitor	DV	Monitor	DV	Monitor	DV	Monitor	DV	Monitor	DV	Monitor	DV
Oceanside	KVR	7.6	KVR	15	KVR	39	KVR	8	KVR	20	KVR	35
Escondido	KVR	7.6	KVR	15	KVR	39	KVR	8	KVR	20	KVR	35
Kearny	KVR	7.6	KVR	15	KVR	39	KVR	8	KVR	20	KVR	35
El Cajon	KVR	7.6	KVR	15	KVR	39	KVR	8	KVR	20	FSD/LES	44[i]
Downtown	CVA	8.8	CVA	19	DTN	53	DTN	10	**DTN**	**24**	**DTN**	**51**
Chula Vista	CVA	8.8	CVA	19	CVA	48	CVA	9[j]	**CVA**	**23**	CVA	48

[1] NAAQS available in Title 40, Part 50 of the Code of Federal Regulations: https://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title40/40cfr50_main_02.tpl

[2] CAAQS available in Section 70200 of Title 17 of California Code of Regulations: https://ww3.arb.ca.gov/regs/title17/70200.pdf, and summarized along with NAAQS by CARB: https://ww2.arb.ca.gov/sites/default/files/2020-07/aaqs2.pdf.

[3] The PM2.5 National Annual DV is calculated as the average of three consecutive national averages (shown here: average of 2014–2016).

[4] The PM2.5 National 24-hour DV is calculated as the average of three consecutive annual 98th percentile values (shown here: average of 2014–2016).

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[32] CARB Area Designations for State PM2.5 Ambient Air Quality Standards: https://www.arb.ca.gov/desig/adm/2019/state_pm25.pdf?_ga=2.133211788.342428628.1625676234-2022182663.1612965600.

[33] CARB Area Designations for State PM10 Ambient Air Quality Standards: https://www.arb.ca.gov/desig/adm/2019/state_pm10.pdf?_ga=2.226854559.342428628.1625676234-2022182663.1612965600.

[5] The PM10 National 24-hour NAAQS standard is violated when the sum of exceedances over 3 years is greater than three. The DV given is the maximum 24-hour average concentration of PM10 over 2014–2016, which is a conservative overestimate of air quality with regard to 24-hour PM10.

[6] The PM2.5 State Annual DV is the maximum of three consecutive annual averages (shown here: maximum of 2014–2016).

[7] The PM10 State Annual DV is the maximum of three consecutive annual averages (shown here: maximum of 2014–2016).

[8] The PM10 State 24-hour DV is calculated as the maximum 24-hour PM10 average observed within the year (shown here: maximum in 2016).

[9] During 2016, the FSD monitor was moved to its current LES location. Considering the FSD and LES datasets together, the 2016 record of PM10 data is 95% complete, and the highest 24-hour PM10 value from that superset (actually from the LES location) is larger than at the KVR monitor.

[10] The Otay Mesa-Donovan monitor has a DV of 13 for 2016 (for the annual PM2.5 CAAQS), but ICF did not utilize it because it is non-FEM, and ICF was aware of some technical issues with the monitor that caused reporting problems.

Notes:

PM = particulate matter; PM10 = PM with aerodynamic diameter less than or equal to 10 micrometers; PM2.5 = PM with aerodynamic diameter less than or equal to 2.5 micrometers; DV = design value; KVR = Kearny Villa Road; CVA = Chula Vista; DTN = 1110 Beardsley Street; LES = Lexington Elementary School; FSD = Floyd Smith Drive.

Bold underline indicates an exceedance or violation of the standard. Parenthetical values in the third header row indicate the standard-level concentrations.

Table 10. Metadata on Monitoring Stations for Particulate Matter

Name	Latitude	Longitude	Elevation (meters)	Agency	Notes
Chula Vista (CVR)	32.63	-117.06	55	SDAPCD	Not available
Beardsley Street (DTN)	32.70	-117.15	141	SDAPCD	Not available
Kearny Villa Road (KVR)	32.85	-117.12	134	SDAPCD	Not available
Floyd Smith Drive (FSD)	32.82	-116.97	119	SDAPCD	FSD was moved back to its original site, LES, in late 2016.
Lexington Elementary School (LES)	32.79	-116.94	144	SDAPCD	Data from FSD and LES are combined in 2016 to create a complete record.

All the selected sites are either Federal Reference (FRM) or Federal Equivalent Method (FEM) for the pollutant they are supporting (SDAPCD 2017). This ensures that the DVs extracted are commensurate with their purpose here.

ICF chose PM monitors according to the amount of data completeness required to calculate 2016 DVs for all AAQS. When a modeling subdomain contained more than one PM monitor with DVs available for a given AAQS, ICF selected the monitor with the higher DV to be conservative.

- With one exception, ICF used KVR in the Escondido, El Cajon, and Oceanside modeling subdomains because it is the closest monitor to these modeling subdomains with the data completeness necessary to calculate DVs for 2016.
- The exception is for the 24-hour PM10 CAAQS specifically for the El Cajon modeling subdomain. During 2016, SDAPCD's FSD monitor was moved to its current LES location. Considering the FSD and LES datasets together, the 2016 record of PM10 data is 95% complete, and the highest 24-hour PM10 value from that superset (actually from the LES location) is larger than at the KVR monitor. To be conservative, ICF utilized the LES station for the 24-hour PM10 CAAQS.

- ICF used CVA DVs in the Downtown modeling subdomain for the PM2.5 24-hour and annual NAAQS, instead of DTN DVs due to data-completeness issues.

ICF considered the Pala Airpad Tribal monitor to the northeast of the overall assessment domain, but rejected it due to the lack of certified data along with low DVs for the data that were available. ICF considered the Otay Mesa-Donovan monitor but ultimately rejected it as the particulate monitors are not operated according to FEM/FRM standards, and ICF was made aware of some technical issues with the monitor that caused reporting problems during this period.

Figure 3 shows the locations of the PM monitors described in Table 9. Table 10 summarizes the monitoring station assignments by modeling subdomain.

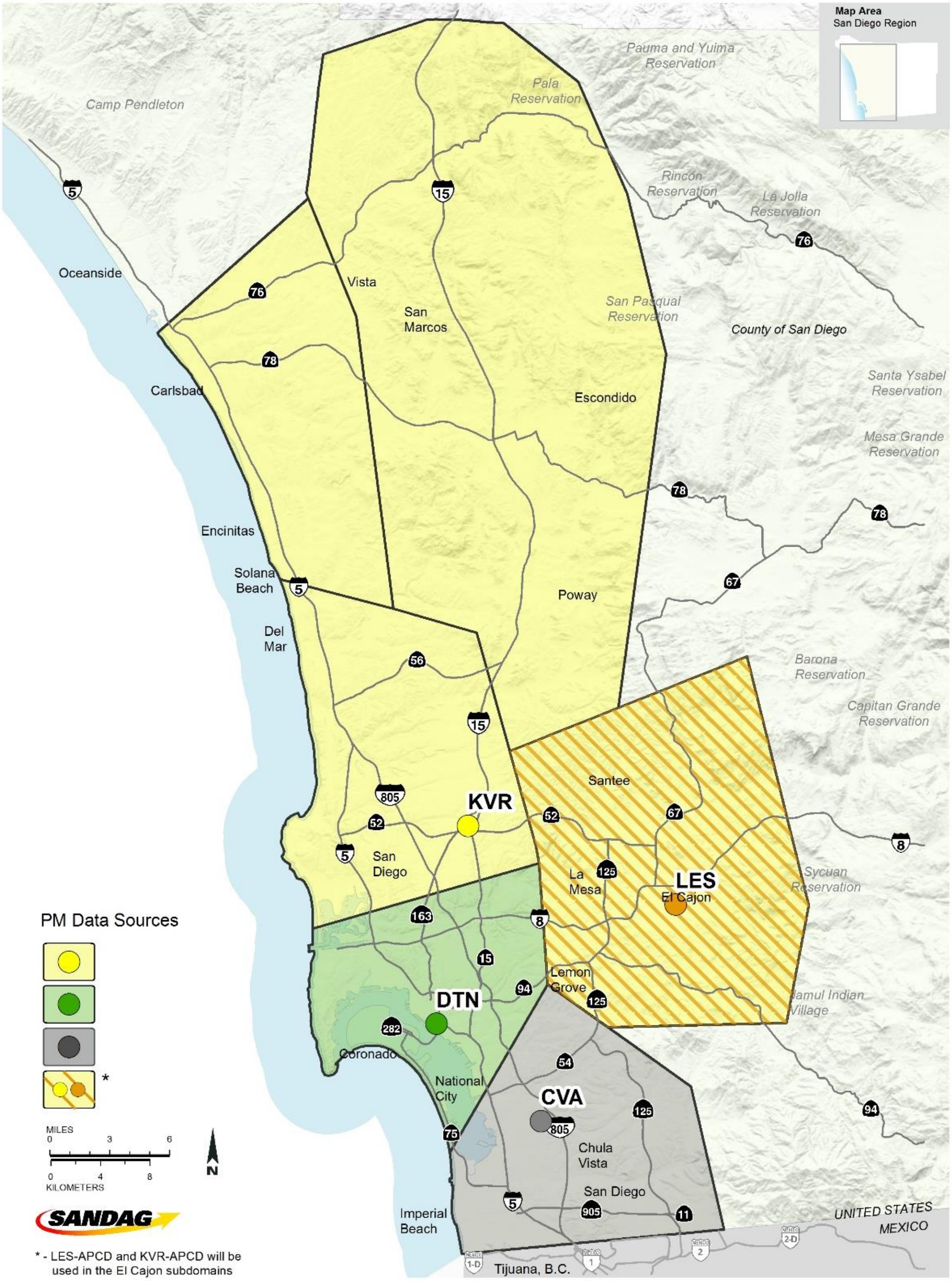

Figure 3. Sources of 2016 Design Values for Particulate Matter

Notes: Labels in the map indicate the monitor abbreviation (see Table 9 and Table 10). All monitors are managed by SDAPCD.

4.8 OUTPUTS

4.8.1 PARTICULATE MATTER

For PM2.5 modeling, ICF used AERMOD to determine the 24-hour-average NAAQS DVs, specifically the highest multi-year average of the 98th percentile 24-hour PM2.5 concentrations, which equates to the multi-year average of the annual eighth-highest 24-hour values. In AERMOD, ICF achieved this by setting the AERMOD keyword POLLID to PM2.5 and the output rank to 8TH, which outputs the multi-year average of the annual eight-highest 24-hour values at each ambient receptor. For PM2.5 annual standards, ICF modeled each year of meteorological data separately with annual-average outputs, so that ICF could identify the maximum annual concentration at each ambient receptor for the CAAQS DV and the multi-year-average annual concentration at each ambient receptor for the NAAQS DV.

For PM10 modeling, ICF used AERMOD to determine the 24-hour-average NAAQS DVs. The 24-hour NAAQS is violated when the 24-hour-average concentration exceeds the standard more than once per year on average over 3 years, such that the DV equates the High-N+1-High value of 24-hour-average concentrations over N years. In AERMOD, ICF arrived at this DV by setting the POLLID to PM10 and the output rank to 4TH, because N is 3 here. For the 24-hour CAAQS, ICF used AERMOD to determine the highest 24-hour-average concentration in the 3-year modeling period, which ICF used as the CAAQS DV though it is a conservative estimate because the CAAQS form refers to 1 year of analysis rather than 3 years (i.e., the highest 24-hour-average in 1 year rather than across 3 years). For the PM10 annual CAAQS, ICF modeled each year of meteorological data separately with annual-average outputs, so that ICF could identify the maximum annual concentration at each ambient receptor for the CAAQS DV.

ICF compared these DVs against PM thresholds, as described in Section 6.1.

4.8.2 HEALTH RISK ASSESSMENT

HRA dispersion modeling produces only interim results. ICF used AERMOD to output toxicity-weighted TAC concentrations as maximum 1-hour-average concentrations (for acute assessment) and period-average concentrations (for chronic non-cancer and cancer assessment) at each sensitive receptor for the 3-year modeling period. These concentrations were benzene-equivalents based on relative toxicity for a given health endpoint as discussed in Section 4.4, *Source Representation*. ICF used these AERMOD outputs in the HARP model to estimate cancer and acute and chronic non-cancer health risks for each sensitive-receptor type and modeling subdomain (Chapter 5).

5 ESTIMATING HEALTH RISKS

The health risks associated with pollutant exposure were estimated by translating the toxicity weighed TAC concentrations from Chapter 4 into exposure risks. ICF evaluated both incremental and cumulative health impacts from the proposed Plan. Incremental risks are evaluated for cancer, acute non-cancer, and chronic non-cancer endpoints. Only cancer health impacts were evaluated for cumulative risks. The exposure parameters used in HARP2 to estimate excess lifetime cancer risks and non-cancer Hazard Indices (HI) for all potentially exposed populations are consistent with updated risk assessment guidelines from OEHHA. This section summarizes the methods and tools used to estimate health risks from exposures to TACs associated with the proposed Plan.

5.1 POLLUTANTS ASSESSED

As discussed in Section 2.2, health risks associated with the proposed Plan were estimated for the following nine priority MSATs: 1,3-butadiene acetaldehyde, acrolein, benzene, DPM, ethylbenzene, formaldehyde, naphthalene, and POM. Only exhaust emissions were speciated, consistent with FHWA's approach for priority MSATs.

TACs can result in a variety of health impacts. For this assessment, cancer and short (acute) and long-term (chronic) non-carcinogenic impacts were assessed. The severity of adverse health impacts from TACs are dependent on the toxicity of the compound and the level of exposure. These priority MSAT pollutants do not have substantial multi-pathway exposure mechanisms.[34] Accordingly, this analysis considers the inhalation pathway only. All analyses were performed using OEHHA's HARP2 model.

As discussed in Section 4.4, ICF used toxicity weighting to expedite the air quality modeling and risk assessment. TAC emissions were scaled based on toxicity weighting to benzene, utilizing OEHHA reference values for a given endpoint. Because of the relative differences in the health benchmark values used to assess cancer, non-cancer acute, and non-cancer chronic health effects, different toxicity weightings were used for each of the endpoints. This approach allows a single AERMOD simulation to represent the compound effects of all considered TACs, because although HARP can consider multi-pollutant impacts, AERMOD is a single pollutant model. However, this approach requires modeling the three health effects endpoints separately in HARP to accommodate the different weighting factors by different endpoint. See Section 4.4 and Table 5 for more information on this approach.

5.2 HEALTH EFFECTS ENDPOINTS

As noted, ICF used a benzene toxicity-weighting approach to estimate health effects from exposure to TAC emissions under the proposed Plan of the nine MSATs. Sections 5.2.1 and 5.2.2 provide more detail on carcinogenic and non-carcinogenic health evaluations, respectively.

5.2.1 CARCINOGENIC EFFECTS

Excess lifetime cancer risks are estimated as the increased likelihood that an individual will develop cancer over a lifetime as a direct result of exposure to potential carcinogens. The estimated risk is expressed as a unitless probability. The cancer risk attributed to a chemical is calculated by multiplying the chemical intake or dose at the human exchange boundaries (e.g., lungs) by the chemical-specific cancer potency factor (CPF). Cancer-risk age sensitivity factors (ASFs) are included to account for an anticipated special sensitivity to carcinogens of infants and children. The use of CPFs and ASFs is recommended by OEHHA in its 2015 Health Risk Guidelines and included in HARP.

Consistent with both OEHHA and SDAPCD recommendations for a 30-year exposure duration for estimating cancer risk for residential sensitive receptors, ICF determined cancer increments using a 30-year continuous exposure to the level of emissions associated with the proposed Plan in a given year. This is true for each of the three modeled Plan years and the baseline (2016) at a given location. For example, the cancer risk associated with year 2025 is estimated as 30 years of exposure to the 2025 level of emissions. The incremental risk for 2025 is based on 30-years of exposure at 2025 levels minus the risk from 30 years of exposure at the existing

[34] See Table 5.1 of OEHHA's Hot Spot Guidance, https://oehha.ca.gov/media/downloads/crnr/2015guidancemanual.pdf.

(2016) levels of emissions. These incremental risks are then compared to the incremental cancer risk thresholds (Section 6.2). The 30-year exposure applies only to the residential and recreational exposure scenarios. For the school scenario, an exposure duration of 13 years was used, although the same mathematical construct applies. See Section 5.3 for more detail on exposure settings.

Section 7.3, *HRA,* provides results for incremental changes in cancer risk and cumulative cancer risk for each Plan year.

5.2.2 NON-CARCINOGENIC EFFECTS

The potential for exposure to result in chronic non-cancer effects is evaluated by comparing the estimated annual-average air concentration to the chemical-specific non-cancer chronic RELs, using HARP. Acute non-cancer effects utilize the peak 1-hour air concentration in comparison with the acute RELs. When calculated for a single chemical, the comparisons yield a ratio termed a hazard quotient (HQ). Consistent with OEHHA guidance, to assess the potential for adverse non-cancer health effects from simultaneous exposure to multiple chemicals, the chronic or acute HQs for all chemicals are summed for each target organ system, yielding an HI. Conservatively, HIs were reported for the most impacted organ system. Non-cancer chronic HIs utilized the period average concentrations from AERMOD. Non-cancer risks relied on the same sources and pollutants identified earlier.

ICF reports incremental changes in chronic and acute HI, similar to that discussed for cancer end points. Note that there is no quantitative evaluation of cumulative non-cancer impacts due to lack of data on background non-cancer risks.[35]

5.3 EXPOSURE SCENARIOS ASSESSED

For a given ambient concentration of pollutant, the potential for adverse health effects is a function of the types of persons exposed (e.g., adults, children, pregnant women) and the duration and extent of exposure. Based on guidance from the most recent version of the *Air Toxic Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* dated February 2015 (OEHHA 2015), health impacts were assessed for Residential, School, and Recreational exposure scenarios.

Residential

For residential sensitive receptors, lifetime cancer risks were conservatively based on an assumed 30-year exposure duration (ED) to TAC air concentrations with exposure beginning in the third trimester.[36] All HRA modeling was performed with HARP and included OEHHA's ASFs, as appropriate, and OEHHA-derived inhalation rates (i.e., 95th percentile inhalation rate).

OEHHA guidance suggests that the fraction of time at home (FAH) for residential sensitive receptors be set to 1 for ages less than 16 years for cases where a school lies within a 1 per million cancer isopleth of the site. For

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[35] As discussed in Section 5.4.4, cumulative cancer risks rely on EPA's National Air Toxics Assessment (NATA), which reports cumulative cancer risks only. No attempt to calculate cumulative non-cancer risks was made given the lack of data.

[36] Note that ICF did not assess occupational cancer risk or 8-hour chronic HI.

the current assessment, ICF conservatively used an FAH of 1 for ages less than 16 for all residential sensitive receptors, regardless of school location. All other inputs were HARP default values for inhalation exposure.[37]

Non-cancer risks for the resident scenario were based on the relevant exposure parameters described above.

School

To assess health effects on sensitive receptors, a K-12 student scenario was evaluated. To assess cancer risks for the school scenario an ED of 13 years was used, with exposure beginning at age 5.[38] For school sensitive receptors, the fraction of time exposed was set to 12% (6 hours per day, 180 days per year) for all exposed ages starting at age 5. Preschools were not assessed.

Non-cancer risks for the school scenario were based on the relevant exposure parameters described above.

Recreational

To assess cancer risks for recreational sensitive receptors, the ED was set to 30 years and the fraction of time exposed was set to 4% (2 hours per day, 180 days per year), assuming the average amount of time spent daily in such locations.

Non-cancer risks for the recreational scenario were based on the relevant exposure parameters described above.

5.4 RISK ESTIMATION METHODS

The current version of CARB's HARP model[39] (version 21081) was used to estimate the short- and long-term health impacts from exposure to the pollutants emitted from operation of the road network and selected additional sources influenced by or expected to have compounding effects on the road emissions from the proposed Plan.

Estimated ground-level concentrations (GLC) (discussed below) were used as inputs to HARP to calculate cancer, non-cancer acute, and non-cancer chronic health endpoints, for each modeled sensitive receptor in each modeled subdomain, for each assessed year, and for residential, school, and recreational sensitive receptors.

5.4.1 GROUND-LEVEL CONCENTRATIONS

GLCs for all TACs were based on the output of the air dispersion modeling, conducted with AERMOD, as described in Chapter 4. As noted in Section 2.2.2, the full universe of TACs evaluated was: 1,3-butadiene, acetaldehyde, acrolein, benzene, DPM, ethylbenzene, formaldehyde, naphthalene, and POM/PAH. POM/PAH comprised benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene,

[37] Note that HARP was also used to translate TAC concentrations for stationary sources from the RSEI model to California-relevant risks. In that case, residential parameters were also used as described here. However, those did not include the conservative FAH approximation included for Plan sources. This is a small inconsistency that subtracts out in incremental risk calculation for most sensitive receptors. See Section 5.4.2.

[38] The 13-year exposure duration represents K–12 schools and is consistent with the approach OEHHA recommends. This is a conservative overestimate for other school types, such as K–5, as it assumes exposure will occur at the same location even if the student is at a different location for grades 5–12.

[39] Available at: https://www.arb.ca.gov/toxics/harp/admrt.htm.

dibenzo[a,h]anthracene, and indeno[1,2,3-c,d]pyrene, all expressed as benzo[a]pyrene-equivalents based on their OEHHA cancer PEFs. As indicated in Section 4.4, ICF did not include some TACs for some exposure scenarios due to absence of a promulgated toxicity reference value—assessments of acute non-cancer risks did not include exposures to DPM, ethylbenzene, naphthalene, and POM/PAH (benzo[a]pyrene), while assessments of chronic non-cancer risks also did not include exposures to POM/PAH. Cancer assessments did not include exposures to acrolein. ICF also did not include emissions of acenaphthene, acenaphthylene, anthracene, benzo[g,h,i]perylene, fluoranthene, fluorene, phenanthrene, and pyrene in the expression of POM/PAH emissions as benzo[a]pyrene-equivalents for the same reason. Finally, ICF expressed all TAC emissions as benzene-equivalents (toxicity-weighted).

The AERMOD modeling resulted in GLCs for benzene (actually, the sum of all TACs represented as benzene-risk-equivalent concentrations). The AERMOD output PLOTFILE files expressed the largest hourly concentration at each sensitive receptor in the multi-year modeling (for use in acute risk assessment) and the multi-year-average concentration at each sensitive receptor (for use in chronic non-cancer and cancer risk assessment) of this pseudo-pollutant, which is input to the HARP model.

5.4.2 STATIONARY SOURCES

The proposed Plan has the potential to place new sensitive receptors at locations that previously were uninhabited and potentially in areas with high levels of pollutants due to nearby stationary sources. ICF assessed risks from both the mobile sources directly affected by the proposed Plan, and indirectly from nearby stationary sources for all sensitive receptors.

Data from EPA's RSEI model was used to estimate chronic non-cancer and cancer risks for stationary sources within the modeling subdomains. Chemical-specific GLCs were taken from the RSEI model for stationary sources in San Diego county, then modeled using HARP to determine the risks in a manner consistent with OEHHA's approach. These risks were calculated using chemical-specific GLCs at centroid points of an 810- by 810-meter grid across San Diego County. Cancer and chronic non-cancer risks were assessed assuming a 30-year ED with exposure starting in the 3rd trimester. As stationary source impacts are not the primary concern, ICF approximated this step by conservatively modeling only with a residential exposure scenario but tempered the approach by using the default FAH values for children under the age of 16. The resulting risk on the 810-meter grid was then interpolated using a (12-point, power of 2) inverse distance weighting approach in ArcGIS to interpolate stationary risks to each sensitive-receptor point in each modeling subdomain. This interpolated value is that used in the increment calculation. As noted above, the same stationary source risk is used for all years as there is no projection of 2016 stationary source concentrations to future years.

Finally, as the stationary sources concentrations from RSEI reflect only long-term exposure concentrations and are not appropriate for short-term, acute assessments, we did not include them in calculations of acute incremental risks from the proposed Plan.

5.4.3 INCREMENTAL HEALTH RISK ESTIMATION

Incremental risk is computed as the difference in risk values between the assessed plan year and the existing year for each sensitive receptor. For mobile source risks (i.e., risks associated directly with Plan emissions), incremental risks are calculated as:

$$Mobile\ incremental\ risk = Plan\ year\ risk - 2016\ risk$$

This is the form used for estimating acute exposures because the stationary source data does not include short-term concentrations. For chronic and cancer risk, however, ICF accounts for the potential for the Plan to result in new sensitive receptors relocated to areas of high concentrations of stationary source pollutants by adding stationary source risks to those mobile source risks to estimate a "total" incremental risk at a given sensitive receptor location:

$$Total\ incremental\ risk = (Plan\ year\ risk + stationary\ risk) - (2016\ risk + stationary\ risk)$$

In cases where a sensitive receptor exists in both the Plan year and the existing year (i.e., 2016), stationary risks, which are constant across the years assessed, cancel out as can be seen in the total incremental risk formula above. Stationary risks, therefore, only affect the total incremental risk in cases where a sensitive receptor "turns off" (receptor exists in 2016, but not in the Plan year) or "turns on" (receptor does not exist in 2016 but does exist in the Plan year). In the first case where a sensitive receptor "turns off," a sensitive receptor exists in 2016, which is not there in the assessed Plan year, resulting in a negative incremental risk. However, when a sensitive receptor "turns on," the total risk from the baseline 2016 year is zero, leaving the sum of the Plan year risk and stationary risk as total incremental risk. In this situation, the incremental risk is equal to the "total" risk (Plan plus stationary).

The summary results distinguish between risks that arise from existing sensitive receptors (receptors that exists in 2016) and risks that arise from new sensitive receptors (receptors that do not exist in 2016 but exist in the subsequent Plan years).

5.4.4 CUMULATIVE HEALTH RISK ESTIMATION

SDAPCD does not define a cumulative heath risk threshold and does not provide existing or expected cumulative risk values across the San Diego region to use in assessing cumulative health risk for the proposed Plan. ICF estimated cumulative health risk impacts by combining the health risk increment from the proposed Plan with the EPA's most recent assessment of risks in the modeled areas based on the 2014 National Air Toxics Assessment (NATA).[40] The 2014 NATA assessment includes emissions, ambient concentrations, and exposure estimates for about 180 air toxics plus DPM. NATA also provides estimates of cancer risk based on those chemicals for which there are carcinogenic health benchmarks for inhalation exposures. Because EPA does not have a carcinogenic health benchmark for DPM, DPM is not included in the risk estimates under NATA. However, DPM concentrations are provided under NATA. ICF used these DPM concentrations in HARP to calculate DPM cancer risks, then added those risks to the NATA cancer risk data to develop a total cancer risk, inclusive of DPM. ICF believes the NATA to be the most complete dataset to provide background risk levels for the modeled areas (i.e., risks to residents before the implementation of the Plan). NATA results were used because the data were easily accessible, efficient to use, and sufficiently timely (i.e., based on 2014 emissions). NATA data is reported at the Census Tract level. The sensitive receptors were given the NATA plus DPM risk value of the Census Tract in which they lie.

ICF computed cumulative risk at each modeled location in each year as:

$$cumulative\ cancer\ risk = cancer\ risk_{NATA} + cancer\ risk_{\ NATA\ DPM} +\ mobile\ incremental\ risk$$

[40] https://www.epa.gov/national-air-toxics-assessment/2014-nata-assessment-results.

The first term was taken directly from NATA risk results and includes the risk for all carcinogenic pollutants and sources; however, as noted previously, it does not include risks from exposures to DPM. The second term was computed using residential exposure and cancer unit risk factors for DPM from OEHHA with the HARP tool for each sensitive receptor, following the same approach used for the other TACs described above, but based on total DPM concentrations from NATA, by census tract. It should be noted that these include all sources. This allows for the inclusion of DPM background risk values, using OEHHA methods, because NATA does not include DPM in their carcinogenic risk assessment. The third term is the mobile source cancer risk increment from the proposed Plan (project year minus existing), as discussed in Section 5.4.3, *Incremental Health Risk Estimation*. This term corrects the NATA values for the difference in mobile sources expected under the proposed Plan between project and existing years.

Note that the cumulative assessment is not an incremental evaluation. It is an estimate of the total risk from all sources in each modeling subdomain, from long-term exposure to the level of emissions associated with the proposed Plan and other sources that are included in NATA. Cumulative risks are reported for each of the proposed Plan years in Section 7.3. Note also that the mobile increment is essential to the cumulative risk calculation. Thus, cumulative risks are calculated only for sensitive receptors that exist in both the baseline and future years. (i.e., those receptors that are neither “turned on” or “turned off”). Finally, because NATA uses daily time-activity patterns to estimate long-term exposures, the NATA results were only used to estimate cumulative risks for residential sensitive receptors. School and recreational sensitive receptors would be inconsistent with the NATA characterization of risk given the small fraction of time spent in those environments.

6 THRESHOLDS

This section discusses the thresholds by which pollutant concentrations and risk are evaluated for significance.

6.1 PARTICULATE MATTER THRESHOLDS

As noted in Section 4.7, *Background Concentrations Data,* the San Diego region is currently in attainment of the PM10 and PM2.5 NAAQS and nonattainment of both PM10 and PM2.5 CAAQS.

The proposed Plan would have a significant local PM air-quality impact if it causes a new violation of the PM standards or contributes substantially to an existing or projected violation of the PM standards. Impacts were based on incremental concentration changes, similar to that used in the previous EIR (Section 4.3 of the EIR for the 2015 Regional Plan [SANDAG 2015]). These thresholds must be based on incremental concentration to avoid double counting that would occur if project concentrations were added to background and compared to the NAAQS or CAAQS. Any ambient receptor in a proposed Plan analysis year but not in the baseline year (e.g., a receptor modeled for 2050 but not for 2016, such as from a change in land use or new or expanded sources) could not be included in calculations of PM increments. That is, Plan increments cannot be calculated at ambient receptors that do not have modeled PM concentrations for the baseline year, and air-quality impacts cannot be determined at locations without Plan increments because the existing sources are already included in the monitored (background) concentrations.

For modeling subdomains where the monitored DVs were below the applicable standard(s), ICF established subdomain-, pollutant-, and averaging-period–specific thresholds of incremental concentration. This threshold was the difference between the applicable NAAQS or CAAQS level for PM concentrations and the monitored DV for the subdomain. ICF then computed the incremental change in modeled PM DV between the Plan and existing (2016) conditions. Where the maximum of these modeled increments across the modeling subdomain was at or below the PM threshold, implementation of the proposed Plan would not cause a new exceedance of the applicable standard(s).

For the remaining areas (those where the monitored DVs are above the PM standard[s]; i.e., nonattainment modeling subdomains), ICF determined if the proposed Plan would significantly contribute to existing violations by comparing the maximum incremental concentrations to a significant change threshold. Because SANDAG does not have its own incremental thresholds, ICF used thresholds from relevant agencies based on substantial evidence, discussed in part here. The most relevant thresholds are those recommended by SDAPCD. The SDAPCD has not published formal guidance regarding California Environmental Quality Act (CEQA) compliance, but air-district rulemaking often is the source for CEQA thresholds (SDAPCD 1998).[41] SDAPCD Rule 20.2 (New Source Review for non-major stationary sources) defines an incremental increase as 5.0 μg/m^3 for 24-hour PM10 and 3.0 μg/m^3 for annual PM10 (SDAPCD 1998). The County of San Diego suggests the 5.0 μg/m^3 24-hour PM10 threshold in its CEQA guidance (County of San Diego 2007). Neither SDAPCD nor the County provide recommendations for analyzing ambient PM2.5. The federal significant impact levels (SILs), intended to define when changes are not meaningful and do not contribute to a violation of the NAAQS under the Prevention of Significant Deterioration (PSD) program, would imply less-than-significant impacts in all Class I, II, or III areas. The federal annual SILs are 1.0 and 0.2 μg/m^3, and the federal 24-hour SILs are 5.0 and 1.2 μg/m^3 for PM10 and PM2.5, respectively.

Based on this review of relevant thresholds, ICF used the incremental thresholds presented in Table 11 (the source for each is summarized in parentheses).

Table 11. Significant Impact Levels Utilized when Monitor Design Values Were Above the Threshold Concentration for Particulate Matter

Time Scale	PM10	PM2.5
Annual	3.0 (SDAPCD, San Diego County)	0.2 (EPA)
24-hour	5.0 (SDAPCD, San Diego County, EPA)	1.2 (EPA)

As mentioned, SDAPCD Rule 20.2 defines an incremental increase of both 24-hour and annual PM10 (5.0 μg/m^3 and 3.0 μg/m^3, respectively). The County of San Diego, in its CEQA guidance, defines a significant impact on ambient air as an exceedance of the SDAPCD's 24-hour PM10 standard (defined as 5.0 μg/m^3). As noted, neither the SDAPCD nor County has provided recommendations for analyzing ambient PM2.5 concentrations. For PM2.5, ICF believes the SCAQMD PM2.5 Significant Change Thresholds are the most appropriate for use in the San Diego region over the more conservative federal SILs given the logic above about air quality in the South Coast region being much worse than the San Diego region and the fact that the use of SCAQMD Significant Change Thresholds are already conservative and health-protective. Note that the PM2.5 thresholds shown in Table 11 are more conservative than those used in the previous EIR (SANDAG 2015);). The PM10 thresholds also differ for the reasons discussed.

ICF shows each subdomain-, pollutant-, and averaging-period–specific threshold of incremental concentration in Section 7.2, *Particulate Matter,* alongside the results of the PM assessment.

[41] For example, SCAQMD's *Significant Change Threshold* is based on rulemaking for New Source Review, and County of San Diego Screening Level Thresholds for mass emissions are based on permit levels for New Source Review.

6.2 HRA THRESHOLDS

The HRA considered incremental changes in cancer, chronic, and acute risks at residential, school, and recreational sensitive receptor locations. Each is defined in terms of an incremental change (increase) in risk from the proposed Plan relative to existing conditions.

- Carcinogenic health impacts are represented as the estimated excess 30-year cancer risk increment. A significant cancer health impact is defined as an excess cancer risk increment (net new) of 10 in a million or greater under the proposed Plan relative to baseline conditions anywhere in the modeling subdomain.
- A significant chronic non-cancer health impact is defined as an incremental chronic HI of 1.0 or greater anywhere in the modeling subdomain.
- A significant acute health impact is also defined as an incremental acute HI of 1.0 or greater anywhere in the modeling subdomain.

These criteria are consistent with SDAPCD levels of significance for public notification.[42]

ICF also considered cumulative health risks in each modeled subdomain under the proposed Plan. As above, these only apply for residential sensitive receptor types and only for cancer health risks. A significant cumulative health impact is determined by exceedance of the following cumulative threshold:

- A cancer risk of 100 per million or greater for residential sensitive receptors.

Note that a cumulative cancer risk of 100 per million was also used in the previous EIR (SANDAG 2015).

7 RESULTS

ICF first developed an inventory of the pollutant emissions associated with the Plan. This included link-based emissions for on-road mobile sources and source-based emissions for passenger and freight rail and other major stationary sources. ICF then conducted dispersion modeling to estimate localized PM10, PM2.5, and TAC concentrations under baseline (2016) conditions and three future-year (2025, 2035, and 2050) conditions with implementation of the proposed Plan. ICF then assessed incremental carcinogenic, acute non-cancer, and chronic non-cancer risks based on the modeled concentrations of TACs from the Plan and supplemented with additional risk values for potentially exposed populations. The methodology and details of these analyses are described in Chapters 2, 3 and 4, above. Here we summarize the results of each analysis step.

7.1 MASS EMISSIONS

ICF started with link- and time-resolved ABM outputs for 2016, 2025, 2035, and 2050. Vehicle speeds are time resolved, congested speeds from the ABM. Those activity data were coupled with EMFAC-based, speed resolved emission factors for San Diego County for the same years from EMFAC. ICF also incorporated road dust emissions into the air quality modeling determined with the CARB method and used MOVES-based speciation values to compute MSAT emissions; however, the summary Table 12 does not show MSAT or road dust emissions. Table 12 represents total road emissions in the assessment domain, although these were split among major and minor links based on an AADT threshold, vehicle type, and time period as described above for dispersion modeling. These emissions levels were compared against both SANDAG-provided conformity results and EMFAC model defaults to quality assure results, as described in Section 3.1. Figure 4 summarizes

[42] https://www.sdapcd.org/content/dam/sdc/apcd/PDF/Misc/APCD_HRA_Guidelines.pdf.

emissions of all pollutants in each year. Figure 5 summarizes the PM emissions by component and year. Although exhaust PM is dramatically reduced over this time period compared to the 2016 baseline (82% reduction by 2050 for both PM2.5 and PM10), total PM (exhaust plus brake and tire wear plus road dust) is reduced, then steadily increases over time due to increased vehicle miles traveled, so the net change by 2050 is only slightly different from the 2016 baseline. Specifically, total road emissions of PM2.5 show a 9% decrease by 2050, while PM10 shows a 2% increase in region-wide emissions.

Table 12. Average Daily On-Road Emissions (tons) and Vehicle Miles Traveled (millions of miles) Modeled for the Plan and Baseline Conditions[1]

Year	PM2.5	PM10	TOG	ROG	NO_X	SO_X	CO	VMT
2016	3.6	14.	9.0	6.4	33.	0.36	145	85.
2025	3.2	13.	3.8	2.4	11.	0.28	67.	85.
2035	3.2	13.	3.2	1.8	8.0	0.24	53.	87.
2050	3.3	14.	3.1	1.6	7.5	0.23	51.	90.

Year	Buta-diene[1,3]	Acetal-dehyde	Acrolein	Benzene	Ethyl-Benzene	Formal-dehyde	Naph-thalene	PAH[2]	DPM
2016	0.023	0.11	0.012	0.26	0.12	0.22	0.023	7.5E-05	0.53
2025	0.0020	0.032	0.0029	0.10	0.041	0.079	0.0065	4.4E-05	0.093
2035	7.2E-05	0.025	0.0020	0.075	0.028	0.055	0.0046	2.4E-05	0.078
2050	5.7E-05	0.024	0.0018	0.068	0.025	0.052	0.0042	1.8E-05	0.071

[1] Top table shows criteria pollutants and precursors; bottom table shows air toxics.

[2] PAH values are the sum of the individual components, toxicity-weighted.

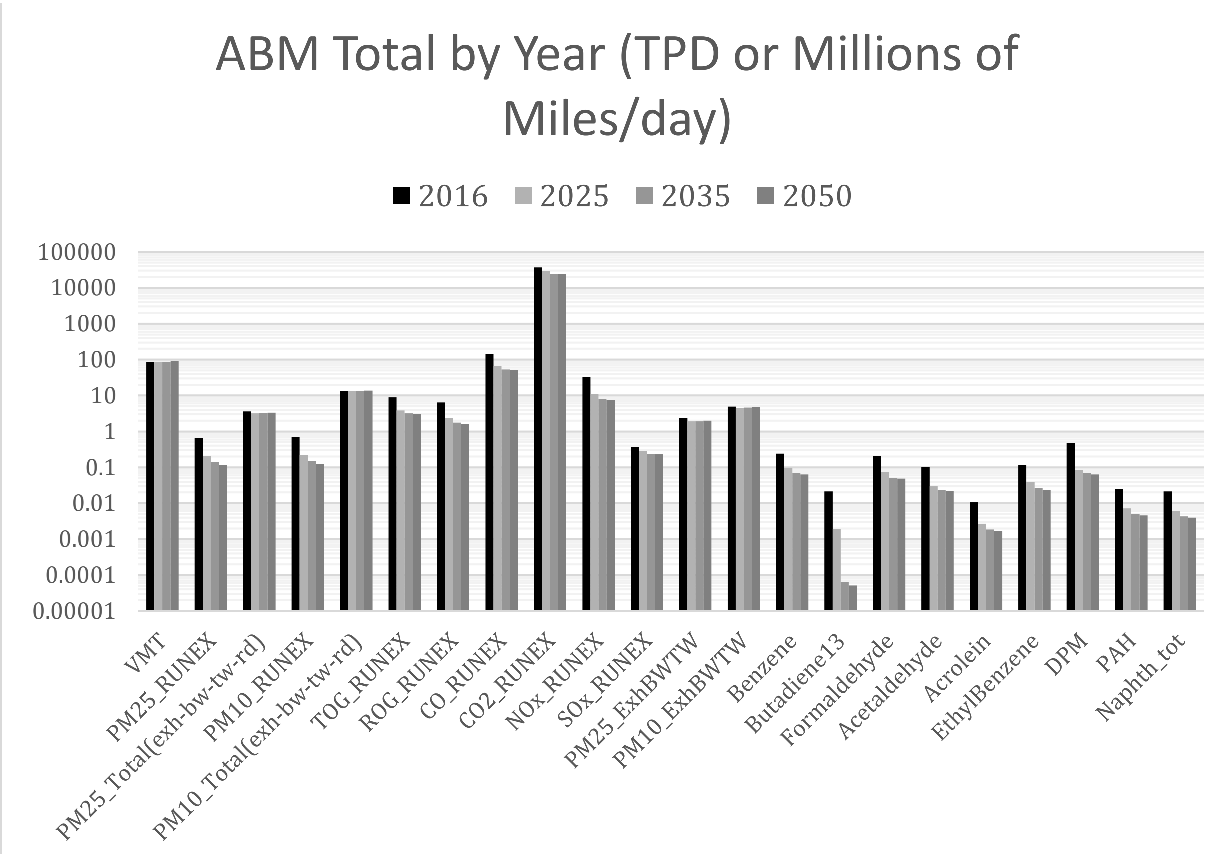

Figure 4. Summary of all Pollutant Emissions by Year

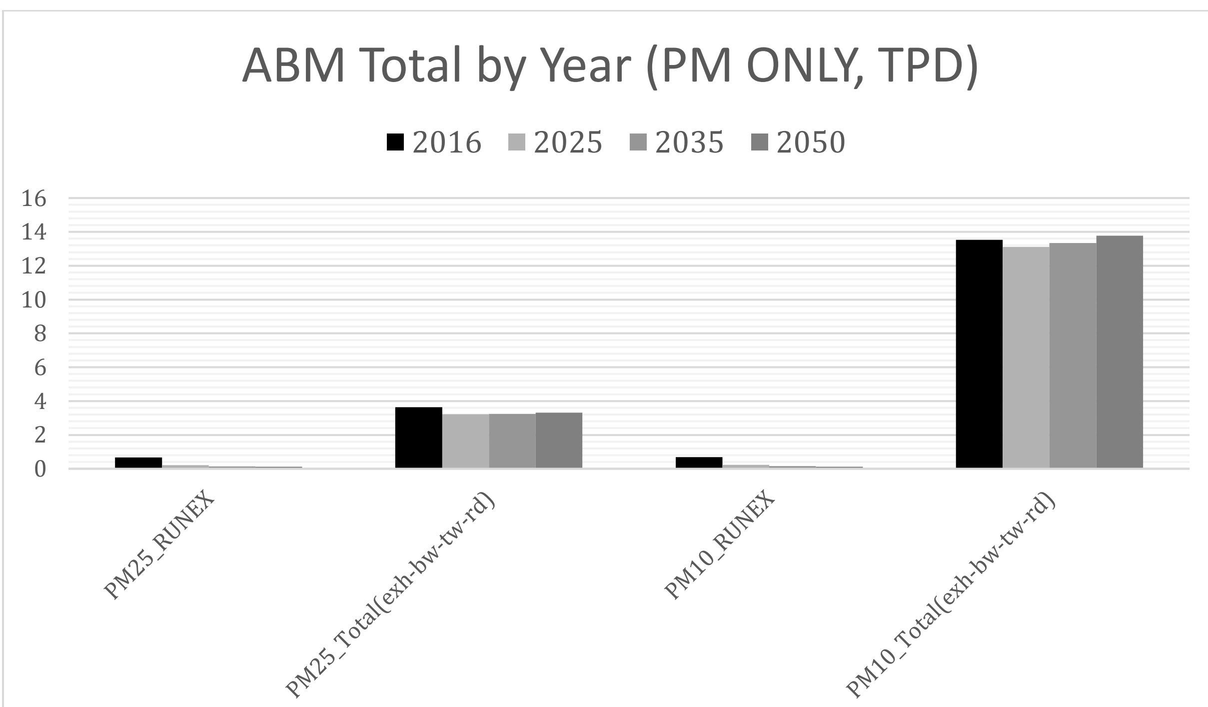

Figure 5. ABM-Based Calculation of PM2.5 and PM10 Emissions by Year

Note: exh=exhaust; bw=brake wear; tw=tire wear; rd=road dust; RUNEX=running exhaust.

Table 13 and Table 14 show the Rail emissions under the Plan by year. Table 13 shows the criteria pollutants and precursors, while Table 14 shows the mobile source air toxic pollutants calculated for rail countywide.

Table 13. Average Daily Emissions of Criteria Pollutants and Precursors (tons) for Rail Activity Under the Plan and Baseline Conditions

Year	PM10	PM25	VOC	NO_X	SO_X	NH_3
2016	0.067	0.064	0.13	2.3	0.029	0.0013
2025	0.016	0.015	0.039	0.82	0.051	0.0017
2035	0.016	0.015	0.041	0.84	0.12	0.0031
2050	0.033	0.031	0.078	1.7	0.28	0.0066

Table 14. Average Daily Emissions of Air Toxics (tons) for Rail Activity Under the Plan and Baseline Conditions

Year	1,3-Buta-diene	Acetal-dehyde	Acrolein	Benzene	Ethyl-Benzene	Formal-dehyde	Naph-thalene	PAH[1]	DPM
2016	2.4E-04	0.011	0.0032	0.0041	9.4E-04	0.031	7.3E-04	2.3E-07	0.067
2025	5.0E-05	0.0032	5.7E-04	0.0011	2.3E-04	0.010	3.8E-04	1.3E-07	0.016
2035	3.8E-05	0.0029	4.9E-04	0.0007	2.6E-04	0.009	4.5E-04	9.3E-08	0.016
2050	6.9E-05	0.006	8.7E-04	0.0012	4.9E-04	0.017	1.2E-03	1.7E-07	0.033

[1] PAH values are the sum of the individual components, toxicity-weighted.

7.2 PARTICULATE MATTER

As discussed above, ICF modeled both pollutants (PM2.5 and PM10) at each ambient receptor and year for all applicable DVs. ICF then differenced the modeled concentrations between the Plan year and the 2016 baseline year to show whether the increment is positive—that is, whether the Plan would lead to an increased concentration of the pollutant at any ambient receptor in any future year relative to current conditions. Note that ICF calculated this increment only at ambient receptors that existed in both the baseline and Plan years (i.e., existing ambient receptors. See Section 6.1.) A positive increment alone does not necessarily indicate that a significant air quality impact would result—that is determined by comparing this increment to the thresholds applicable to each modeling subdomain discussed in Section 6.1.

Table 15 shows the results of this analysis. The first column shows the modeling subdomain (or whole assessment domain) to which the results apply. The second column shows which of the six air quality standards is being evaluated (NAAQS or CAAQS; 24-hour or annual averaging period). The third column shows the applicable threshold, which varies by air quality standard, averaging period, and modeling subdomain (described further in Section 6.1). The rest of the columns show the resulting data, grouped by modeled year (2025, 2035, and 2050). In each case there are two datasets. The first is the approximate land area with ambient receptors (a) exceeding the applicable ambient air quality threshold, or (b) showing a positive increment (i.e., an increase in concentrations) but less than the applicable threshold. As ambient receptors are placed on a regular grid, this area is estimated from the number of receptors observed beyond each metric. The number is indicative of the total land area matching each of these categories, which was thus estimated.[43] If at least one ambient receptor's incremental concentration exceeds the applicable threshold (see red shading in Table 15), a significant air quality impact is observed. However, the number of ambient receptors or total land area is not itself indicative of any standard. The second dataset for each year is shown by the third column—the maximum incremental concentration increase in a modeling subdomain for a given standard and year, where values of 0 indicate no change in concentration and all other values quantify the increase in concentration relative to 2016. Because these are incremental concentrations relative to 2016, Table 15 does not show results for the 2016 baseline year.

Across the entire modeled area, a small number of ambient receptors showed incremental concentrations that exceeded either or both PM10 CAAQS thresholds (i.e., that exhibited significant PM10 ambient concentration impacts), particularly for the annual standard. For the PM10 annual CAAQS, the Kearny, El Cajon, and Escondido modeling subdomains all showed exceedances in at least 1 year, with incremental concentrations up to 4 $\mu g/m^3$ in Escondido in 2050, which is compared to a threshold of 0 (the monitored DV was equal to the standard, such that any incremental concentration above 0 would trigger an exceedance in this case). For the PM10 24-hour CAAQS, all exceedances occurred in the Chula Vista modeling subdomain, where the maximum exceedance was at most a factor of 2 above the threshold. At many other ambient receptors, the modeled incremental concentrations were above 0, up to a value of 15 $\mu g/m^3$, meaning the Plan was causing higher concentrations than the 2016 baseline conditions, but those increments did not exceed the thresholds. No locations in the entire modeling domain showed an increase in PM10 above the NAAQS level.

No locations in the entire assessment domain showed an increase in PM2.5 that exceeded any of the relevant thresholds. Thus, there are no significant air quality impacts for PM2.5 anywhere in the assessment domain. This is important as PM2.5 is the pollutant most associated with adverse health impacts.

[43] Each receptor is determined from a regularly spaced, 50-m grid. See Section 4.5. Thus, the total land area represented by a single receptor is approximately 2,500 m2 (0.62 acres). This is approximate as it simplifies receptors at the edges of a source.

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Table 15. Summary of Results for Incremental Concentrations of Particulate Matter for Plan by Year, Relative to the 2016 Baseline

Modeling Sub-domain	Standard	Threshold (µg/m³)	2025 Approximate Land Area (acres) Above Threshold	2025 Approximate Land Area (acres) With Positive Increment but Not Above Threshold	2025 Maximum Incremental Concentration Value (µg/m³)	2035 Approximate Land Area (acres) Above Threshold	2035 Approximate Land Area (acres) With Positive Increment but Not Above Threshold	2035 Maximum Incremental Concentration Value (µg/m³)	2050 Approximate Land Area (acres) Above Threshold	2050 Approximate Land Area (acres) With Positive Increment but Not Above Threshold	2050 Maximum Incremental Concentration Value (µg/m³)
Whole Assessment Domain	PM2.5 Annual NAAQS	Varies	0	18	0.6	0	117	0.6	0	232	0.7
	PM2.5 24 Hour NAAQS		0	1	1	0	34	1	0	30	2
	PM10 24 Hour NAAQS		0	168	4	0	376	10	0	687	10
	PM2.5 Annual CAAQS		0	1	1	0	1	1	0	5	1
	PM10 Annual CAAQS		33	33	2	113	19	3	273	16	4
	PM10 24 Hour CAAQS		1	179	6	6	475	14	2	716	15
Kearny	PM2.5 Annual NAAQS	4.4	0	0	0	0	0	0	0	13	0.1
	PM2.5 24 Hour NAAQS	20	0	0	0	0	0	0	0	0	0
	PM10 24 Hour NAAQS	111	0	0	0	0	0	0	0	38	1
	PM2.5 Annual CAAQS	4	0	0	0	0	0	0	0	0	0
	PM10 Annual CAAQS	0	0	0	0	0	0	0	6	0	1
	PM10 24 Hour CAAQS	15	0	0	0	0	0	0	0	12	1
Downtown	PM2.5 Annual NAAQS	3.2	0	0	0	0	0	0	0	0	0
	PM2.5 24 Hour NAAQS	16	0	0	0	0	0	0	0	0	0
	PM10 24 Hour NAAQS	97	0	31	1	0	30	1	0	27	1
	PM2.5 Annual CAAQS	2	0	0	0	0	0	0	0	0	0
	PM10 Annual CAAQS	3 (SIL)	0	22	1	0	7	1	0	12	1
	PM10 24 Hour CAAQS	5 (SIL)	0	32	1	0	25	1	0	25	1
Chula Vista	PM2.5 Annual NAAQS	3.2	0	13	0.6	0	12	0.3	0	17	0.2
	PM2.5 24 Hour NAAQS	16	0	1	1	0	6	1	0	0	0
	PM10 24 Hour NAAQS	102	0	20	4	0	12	3	0	20	2
	PM2.5 Annual CAAQS	3	0	1	1	0	0	0	0	0	0
	PM10 Annual CAAQS	3 (SIL)	0	11	2	0	12	1	0	4	1
	PM10 24 Hour CAAQS	2	1	23	4	6	18	3	2	30	3
El Cajon	PM2.5 Annual NAAQS	4.4	0	0	0	0	2	0.1	0	14	0.6
	PM2.5 24 Hour NAAQS	20	0	0	0	0	0	0	0	3	1
	PM10 24 Hour NAAQS	111	0	0	0	0	0	0	0	24	6
	PM2.5 Annual CAAQS	4	0	0	0	0	0	0	0	1	1
	PM10 Annual CAAQS	0	0	0	0	1	0	1	25	0	3
	PM10 24 Hour CAAQS	6	0	0	0	0	0	0	0	25	6
Escondido	PM2.5 Annual NAAQS	4.4	0	5	0.1	0	103	0.6	0	188	0.7
	PM2.5 24 Hour NAAQS	20	0	0	0	0	28	1	0	27	2

Modeling Sub-domain	Standard	Threshold (μg/m³)	2025 Approximate Land Area (acres): Above Threshold	2025 Approximate Land Area (acres): With Positive Increment but Not Above Threshold	2025 Maximum Incremental Concentration: Value (μg/m³)	2035 Approximate Land Area (acres): Above Threshold	2035 Approximate Land Area (acres): With Positive Increment but Not Above Threshold	2035 Maximum Incremental Concentration: Value (μg/m³)	2050 Approximate Land Area (acres): Above Threshold	2050 Approximate Land Area (acres): With Positive Increment but Not Above Threshold	2050 Maximum Incremental Concentration: Value (μg/m³)
	PM10 24 Hour NAAQS	111	0	117	4	0	334	10	0	551	10
	PM2.5 Annual CAAQS	4	0	0	0	0	1	1	0	4	1
	PM10 Annual CAAQS	0	33	0	1	112	0	3	242	0	4
	PM10 24 Hour CAAQS	15	0	124	6	0	431	14	0	609	15
Oceanside	PM2.5 Annual NAAQS	4.4	0	0	0	0	0	0	0	0	0
	PM2.5 24 Hour NAAQS	20	0	0	0	0	0	0	0	0	0
	PM10 24 Hour NAAQS	111	0	0	0	0	0	0	0	27	1
	PM2.5 Annual CAAQS	4	0	0	0	0	0	0	0	0	0
	PM10 Annual CAAQS	0	0	0	0	0	0	0	0	0	0
	PM10 24 Hour CAAQS	15	0	0	0	0	1	1	0	15	1

Notes:

PM = particulate matter; PM10 = PM with aerodynamic diameter less than or equal to 10 micrometers; PM2.5 = PM with aerodynamic diameter less than or equal to 2.5 micrometers; NAAQS = National Ambient Air Quality Standard; CAAQS = California Ambient Air Quality Standard; μg/m³ = micrograms per cubic meter; SIL = significant impact threshold.

Thresholds: All values were derived from monitored design values and the standard concentration, except where "(SIL)" indicates usage of a significant impact level due to the monitored design-value concentration being above the standard concentration (see Sections 4.7 and 6.1).

Shading: "Above Threshold" column = red shading indicates one or more ambient receptors had maximum incremental concentration values above the given threshold; "With Positive Increment but Not Above Threshold" column = orange shading indicates one or more ambient receptors had an incremental concentration above 0 but below the threshold; "Value (μg/m³)" = orange shading indicates a value above 0, while red shading indicates a value above the threshold.

7.3 HRA

Table 16 through Table 19 summarize the results of the HRA described in Chapter 5 and Section 6.2.

Table 16, Table 18, and Table 19 show results by modeling subdomain, by receptor type, by year, and by health endpoint. All tables show both risks and corresponding areas. Table 16 shows 2016 risk values and 2025, 2035, and 2050 incremental changes in HI or cancer risk per million relative to 2016. Cancer risks are shown first for each modeling subdomain and receptor type. For 2016, maximum risks and area exceeding the 10 per million risk threshold are shown. For the projected years, incremental risk and incremental area are shown. These are followed by acute risks and chronic risks, with the same layout. Table 16 presents the analysis for "sensitive receptors near existing emission sources"—that is, those that are exposed to existing rail and/or roadway buffers, not those driven by new sources "turning on" new receptors.

Table 18 and Table 19 have a similar layout. They also show results by subdomain and year with results grouped first for cancer, then acute, and finally chronic risks. Table 18 and Table 19 are both for cases where new receptors are "turned on" due to two types of changes in the proposed Plan. Thus, these tables do not show values for 2016 and list the total value in future years. Those changes are new emission sources, such as new rail lines (Table 18) or new land uses, such as new residential development (Table 19). In each case, the maximum value is shown (cancer risks per million or HI) followed by the land area (in acreage)—based on number of sensitive receptors—exceeding the threshold. Cancer impacts are shown first, then acute, then chronic. As in Section 7.2, the impacted area is estimated from the number of sensitive receptors exceeding thresholds. This does not indicate number of units (see footnote 43).

Table 17 shows the cumulative cancer risk impacts by year under the Plan for residential land uses.

Table 16. Results Summary of the Maximum Health Impacts at Existing Sensitive Receptors

Cancer		2016		2025		2035		2050	
Modeling Subdomain	Type of Sensitive Receptor	Maximum Cancer Risk	Area (acres) Exceeding 10 per Million	Maximum Incremental Cancer Risk	Incremental Area (acres) Exceeding 10 per Million	Maximum Incremental Cancer Risk	Incremental Area (acres) Exceeding 10 per Million	Maximum Incremental Cancer Risk	Incremental Area (acres) Exceeding 10 per Million
Chula Vista	Residential	265	1,201	-5	0	-6	0	-6	0
Chula Vista	Recreational	11	2	-1	0	-1	0	-1	0
Chula Vista	School	0	0	0	0	0	0	0	0
Downtown	Residential	447	1,423	-26	0	-31	0	-32	0
Downtown	Recreational	13	22	-1	0	-2	0	-2	0
Downtown	School	8	0	-4	0	-5	0	-5	0
El Cajon	Residential	314	995	-12	0	-14	0	-14	0
El Cajon	Recreational	7	0	-2	0	-2	0	-2	0
El Cajon	School	0	0	0	0	0	0	0	0
Escondido	Residential	416	1,229	-5	0	-6	0	-5	0
Escondido	Recreational	8	0	-2	0	-3	0	-3	0
Escondido	School	5	0	-3	0	-4	0	-4	0
Kearny	Residential	401	1,025	-10	0	-11	0	-11	0
Kearny	Recreational	7	0	0	0	0	0	0	0
Kearny	School	11	2	-3	0	-3	0	-3	0
Oceanside	Residential	255	1,690	-10	0	-12	0	-12	0
Oceanside	Recreational	8	0	-1	0	-1	0	-1	0
Oceanside	School	8	0	-1	0	-1	0	-1	0
Regional Maximum and Sum of Area		447	7,590	0	0	0	0	0	0

Acute		2016		2025		2035		2050	
Modeling Subdomain	Type of Sensitive Receptor	Maximum Acute Risk	Area (acres) Exceeding 1.0 Hazard Index	Maximum Incremental Acute Risk	Incremental Area (acres) Exceeding 1.0 Hazard Index	Maximum Incremental Acute Risk	Incremental Area (acres) Exceeding 1.0 Hazard Index	Maximum Incremental Acute Risk	Incremental Area (acres) Exceeding 1.0 Hazard Index
Chula Vista	Residential	1.8	49	-0.1	0	0	0	0.5	0
Chula Vista	Recreational	1.2	10	-0.1	0	-0.1	0	0.2	0
Chula Vista	School	0	0	0	0	0	0	0	0
Downtown	Residential	2.1	314	-0.3	0	-0.2	0	-0.2	0
Downtown	Recreational	2.3	131	-0.3	0	-0.3	0	-0.3	0
Downtown	School	1	1	-0.6	0	-0.6	0	-0.6	0
El Cajon	Residential	1.7	70	-0.2	0	-0.2	0	0.2	0
El Cajon	Recreational	1.1	2	-0.2	0	-0.2	0	-0.2	0
El Cajon	School	0	0	0	0	0	0	0	0
Escondido	Residential	6.9	751	-0.3	0	-0.3	0	-0.3	0
Escondido	Recreational	2.3	17	-0.4	0	-0.5	0	-0.5	0
Escondido	School	1	1	-0.6	0	-0.7	0	-0.7	0
Kearny	Residential	2	153	-0.2	0	-0.2	0	-0.2	0
Kearny	Recreational	1.5	7	-0.2	0	-0.3	0	-0.3	0
Kearny	School	1.5	4	-0.4	0	-0.4	0	-0.4	0
Oceanside	Residential	2.3	261	-0.1	0	-0.2	0	-0.2	0
Oceanside	Recreational	1.8	43	-0.2	0	-0.2	0	-0.2	0
Oceanside	School	1.5	2	-0.4	0	-0.4	0	-0.4	0
Regional Maximum and Sum of Area		6.9	1,815	0	0	0.0	0	0.5	0

Chronic		2016		2025		2035		2050	
Modeling Subdomain	Type of Sensitive Receptor	Maximum Chronic Risk	Area (acres) Exceeding 1.0 Hazard Index	Maximum Incremental Chronic Risk	Incremental Area (acres) Exceeding 1.0 Hazard Index	Maximum Incremental Chronic Risk	Incremental Area (acres) Exceeding 1.0 Hazard Index	Maximum Incremental Chronic Risk	Incremental Area (acres) Exceeding 1.0 Hazard Index
Chula Vista	Residential	31.6	1,205	-0.6	0	-0.8	0	-0.8	0
Chula Vista	Recreational	31.3	88	-1.8	0	-2.1	0	-2.2	0
Chula Vista	School	0	0	0	0	0	0	0	0
Downtown	Residential	52.9	1,423	-3.3	0	-3.8	0	-4	0
Downtown	Recreational	37	431	-4.1	0	-4.8	0	-4.9	0
Downtown	School	17.3	7	-9.7	0	-11.2	0	-11.6	0
El Cajon	Residential	37.2	995	-1.5	0	-1.7	0	-1.8	0
El Cajon	Recreational	20.2	22	-5.3	0	-6	0	-6.1	0
El Cajon	School	0	0	0	0	0	0	0	0
Escondido	Residential	49.2	1,232	-0.6	0	-0.8	0	-0.6	0
Escondido	Recreational	23.6	32	-6.8	0	-7.9	0	-8	0
Escondido	School	12.3	4	-7.2	0	-8.3	0	-8.4	0
Kearny	Residential	47.6	1,025	-1.2	0	-1.4	0	-1.4	0
Kearny	Recreational	20.1	368	-0.8	0	-0.9	0	-0.9	0
Kearny	School	24.9	36	-6.4	0	-7.3	0	-7.5	0
Oceanside	Residential	30.2	1,690	-1.2	0	-1.4	0	-1.5	0
Oceanside	Recreational	22.4	102	-1.7	0	-2	0	-2	0
Oceanside	School	18.8	7	-2.4	0	-2.7	0	-2.8	0
Regional Maximum and Sum of Area		52.9	8,666	0	0	0	0	0	0

Notes:
HI = Hazard Index; Risk = cancer risk values in risks per million; Mobile increment = HI/risk increment from 2016 baseline year, without stationary risks (acute has no stationary HI); Total increment = HI/risk increment from 2016 baseline year, including stationary risks; Cumulative = sum of mobile increment cancer risk, NATA 2014 cancer risk, and NATA 2014 DPM cancer risk (only for the cancer scenario and for residential sensitive receptors that exist in both the plan year and in the 2016 baseline year)
Thresholds: Non-cancer (acute and chronic) HI threshold of 1; incremental cancer threshold of 10; cumulative cancer threshold of 100.
Rounding: Non-cancer HIs were rounded to one decimal place; cancer risks were rounded to a whole number.

Table 17. Results Summary of the Maximum Cumulative Health Impacts at Existing Sensitive Receptors

Modeling Subdomain	Type of Sensitive Receptor	Maximum Cumulative Cancer Risk (per million)				Area (Acres) Exceeding 100 per million			
		2016	2025	2035	2050	2016	2025	2035	2050
Chula Vista	Residential	619	544	559	558	1,205	1,166	1,133	1,126
Downtown	Residential	1,015	946	928	922	1,423	1,405	1,373	1,371
El Cajon	Residential	479	453	449	449	995	977	896	954
Escondido	Residential	392	346	339	339	1,232	1,226	1,200	1,183
Kearny	Residential	476	422	413	412	1,025	1,013	1,001	994
Oceanside	Residential	378	361	358	357	1,690	1,653	1,611	1,604
Regional Maximum and Sum of Area	Residential	1,015	946	928	922	7,570	7,439	7,214	7,232

Table 18. Results Summary of the Maximum Health Impacts from New Emission Sources[1]

Cancer		2025		2035		2050	
Modeling Subdomain	Type of Sensitive Receptor	Maximum Cancer Risk	Area (acres) Exceeding 10 per million	Maximum Cancer Risk	Area (acres) Exceeding 10 per million	Maximum Cancer Risk	Area (acres) Exceeding 10 per million
Chula Vista	Residential	26	5	59	418	24	408
Chula Vista	Recreational	1	0	2	0	2	0
Chula Vista	School	0	0	0	0	0	0
Downtown	Residential	54	2	123	527	110	1,236
Downtown	Recreational	3	0	2	0	3	0
Downtown	School	0	0	0	0	0	0
El Cajon	Residential	0	0	132	2	131	324
El Cajon	Recreational	0	0	0	0	1	0
El Cajon	School	0	0	0	0	1	0
Escondido	Residential	0	0	0	0	24	150
Escondido	Recreational	0	0	0	0	0	0
Escondido	School	0	0	0	0	0	0
Kearny	Residential	0	0	33	309	30	359
Kearny	Recreational	0	0	1	0	1	0
Kearny	School	0	0	0	0	0	0
Oceanside	Residential	8	0	12	5	46	4
Oceanside	Recreational	0	0	0	0	0	0
Oceanside	School	0	0	0	0	0	0
Regional Maximum and Sum of Area		54	7	132	1,261	131	2,480

Acute		2025		2035		2050	
Modeling Subdomain	**Type of Sensitive Receptor**	**Maximum Acute Risk**	**Area (acres) Exceeding 1.0 Hazard Index**	**Maximum Acute Risk**	**Area (acres) Exceeding 1.0 Hazard Index**	**Maximum Acute Risk**	**Area (acres) Exceeding 1.0 Hazard Index**
Chula Vista	Residential	0.1	0	0.3	0	0.8	0
Chula Vista	Recreational	0.1	0	0.2	0	0.6	0
Chula Vista	School	0	0	0	0	0	0
Downtown	Residential	0.2	0	0.5	0	0.9	0
Downtown	Recreational	0.3	0	0.2	0	0.3	0
Downtown	School	0	0	0	0	0	0
El Cajon	Residential	0	0	0.8	0	0.8	0
El Cajon	Recreational	0	0	0	0	0.3	0
El Cajon	School	0	0	0	0	0.2	0
Escondido	Residential	0	0	0	0	0.3	0
Escondido	Recreational	0	0	0	0	0	0
Escondido	School	0	0	0	0	0	0
Kearny	Residential	0	0	0.3	0	0.5	0
Kearny	Recreational	0	0	0.2	0	0.3	0
Kearny	School	0	0	0	0	0	0
Oceanside	Residential	0.1	0	0.1	0	0.3	0
Oceanside	Recreational	0	0	0	0	0	0
Oceanside	School	0	0	0	0	0	0
Regional Maximum and Sum of Area		0.3	0	0.8	0	0.9	0

Chronic		2025		2035		2050	
Modeling Subdomain	**Type of Sensitive Receptor**	**Maximum Chronic Risk**	**Area (acres) Exceeding 1.0 Hazard Index**	**Maximum Chronic Risk**	**Area (acres) Exceeding 1.0 Hazard Index**	**Maximum Chronic Risk**	**Area (acres) Exceeding 1.0 Hazard Index**
Chula Vista	Residential	2.7	5	6.1	418	2	401
Chula Vista	Recreational	1.5	4	3	74	3.1	158
Chula Vista	School	0	0	0	0	0	0
Downtown	Residential	5.4	2	13.2	527	11.6	1,236
Downtown	Recreational	6.8	1	4.7	24	4.3	43
Downtown	School	0	0	0	0	0	0
El Cajon	Residential	0	0	14.2	2	13.8	324
El Cajon	Recreational	0	0	0	0	2.5	2
El Cajon	School	0	0	0	0	2.2	1
Escondido	Residential	0	0	0	0	2.5	150
Escondido	Recreational	0	0	0	0	0	0
Escondido	School	0	0	0	0	0	0
Kearny	Residential	0	0	3	313	2.7	362
Kearny	Recreational	0	0	2.3	25	2.5	96
Kearny	School	0	0	0	0	0	0
Oceanside	Residential	0.9	0	1.3	6	4.8	4
Oceanside	Recreational	0	0	0	0	0	0
Oceanside	School	0	0	0	0	0	0
Regional Maximum and Sum of Area		6.8	12	14.2	1,389	13.8	2,777

[1] Results show maximum health values and number of sensitive receptors above threshold by Year, Subdomain, and Receptor. Cancer Impacts are Shown First, then Acute, then Chronic.

Notes: HI = Hazard Index; Risk = cancer risk values in risks per million; Mobile increment = HI/risk increment from 2016 baseline year, without stationary risks (acute has no stationary HI); Total increment = HI/risk increment from 2016 baseline year, including stationary risks; Cumulative = sum of mobile increment cancer risk, NATA 2014 cancer risk, and NATA 2014 DPM cancer risk (only for the cancer scenario and for residential sensitive receptors that exist in both the plan year and in the 2016 baseline year)

Thresholds: Non-cancer (acute and chronic) HI threshold of 1; incremental cancer threshold of 10; cumulative cancer threshold of 100.

Rounding: Non-cancer HIs were rounded to one decimal place; cancer risks were rounded to a whole number.

Table 19. Results Summary of the Maximum Health Impacts at New Land Use Sensitive Receptors[1]

Cancer		2025		2035		2050	
Modeling Subdomain	**Type of Sensitive Receptor**	**Maximum Cancer Risk**	**Area (acres) Exceeding 10 per million**	**Maximum Cancer Risk**	**Area (acres) Exceeding 10 per million**	**Maximum Cancer Risk**	**Area (acres) Exceeding 10 per million**
Chula Vista	Residential	53	83	34	86	29	86
Chula Vista	Recreational	0	0	0	0	0	0
Chula Vista	School	0	0	0	0	0	0
Downtown	Residential	149	381	137	436	133	472
Downtown	Recreational	0	0	0	0	0	0
Downtown	School	0	0	0	0	0	0
El Cajon	Residential	138	209	122	259	106	262
El Cajon	Recreational	0	0	0	0	0	0
El Cajon	School	0	0	0	0	0	0
Escondido	Residential	120	69	57	68	77	93
Escondido	Recreational	0	0	0	0	0	0
Escondido	School	0	0	0	0	0	0
Kearny	Residential	58	69	40	140	37	147
Kearny	Recreational	0	0	0	0	0	0
Kearny	School	0	0	0	0	0	0
Oceanside	Residential	57	137	38	166	33	163
Oceanside	Recreational	0	0	0	0	0	0
Oceanside	School	0	0	0	0	0	0
Regional Maximum and Sum of Area		149	948	137	1,156	133	1,224

Acute		2025		2035		2050	
Modeling Subdomain	**Type of Sensitive Receptor**	**Maximum Acute Risk**	**Area (acres) Exceeding 1.0 Hazard Index**	**Maximum Acute Risk**	**Area (acres) Exceeding 1.0 Hazard Index**	**Maximum Acute Risk**	**Area (acres) Exceeding 1.0 Hazard Index**
Chula Vista	Residential	0.3	0	0.2	0	0.5	0
Chula Vista	Recreational	0	0	0	0	0	0
Chula Vista	School	0	0	0	0	0	0
Downtown	Residential	0.6	0	0.4	0	0.6	0
Downtown	Recreational	0	0	0	0	0	0
Downtown	School	0	0	0	0	0	0
El Cajon	Residential	0.5	0	0.7	0	0.7	0
El Cajon	Recreational	0	0	0	0	0	0
El Cajon	School	0	0	0	0	0	0
Escondido	Residential	2.1	5	1.4	2	1.5	2
Escondido	Recreational	0	0	0	0	0	0
Escondido	School	0	0	0	0	0	0
Kearny	Residential	0.3	0	0.2	0	0.3	0
Kearny	Recreational	0	0	0	0	0	0
Kearny	School	0	0	0	0	0	0
Oceanside	Residential	0.4	0	0.3	0	0.3	0
Oceanside	Recreational	0	0	0	0	0	0
Oceanside	School	0	0	0	0	0	0
Regional Maximum and Sum of Area		2.1	5	1.4	2	1.5	2

Chronic		2025		2035		2050	
Modeling Subdomain	**Type of Sensitive Receptor**	**Maximum Chronic Risk**	**Area (acres) Exceeding 1.0 Hazard Index**	**Maximum Chronic Risk**	**Area (acres) Exceeding 1.0 Hazard Index**	**Maximum Chronic Risk**	**Area (acres) Exceeding 1.0 Hazard Index**
Chula Vista	Residential	5.4	83	3.4	88	2.8	82
Chula Vista	Recreational	0	0	0	0	0	0
Chula Vista	School	0	0	0	0	0	0
Downtown	Residential	13.2	381	8	436	7.1	472
Downtown	Recreational	0	0	0	0	0	0
Downtown	School	0	0	0	0	0	0
El Cajon	Residential	14.9	210	13.2	259	11.2	262
El Cajon	Recreational	0	0	0	0	0	0
El Cajon	School	0	0	0	0	0	0
Escondido	Residential	12.9	69	5.9	70	7.9	93
Escondido	Recreational	0	0	0	0	0	0
Escondido	School	0	0	0	0	0	0
Kearny	Residential	6.3	69	4.2	141	3.8	148
Kearny	Recreational	0	0	0	0	0	0
Kearny	School	0	0	0	0	0	0
Oceanside	Residential	6.1	138	4	167	3.4	161
Oceanside	Recreational	0	0	0	0	0	0
Oceanside	School	0	0	0	0	0	0
Regional Maximum and Sum of Area		14.9	950	13.2	1,162	11.2	1,218

[1] Results show maximum health values and number of sensitive receptors above threshold by Year, Subdomain, and Receptor. Cancer Impacts are Shown First, then Acute, then Chronic.

Notes: HI = Hazard Index; Risk = cancer risk values in risks per million; Mobile increment = HI/risk increment from 2016 baseline year, without stationary risks (acute has no stationary HI); Total increment = HI/risk increment from 2016 baseline year, including stationary risks; Cumulative = sum of mobile increment cancer risk, NATA 2014 cancer risk, and NATA 2014 DPM cancer risk (only for the cancer scenario and for residential sensitive receptors that exist in both the plan year and in the 2016 baseline year)

Thresholds: Non-cancer (acute and chronic) HI threshold of 1; incremental cancer threshold of 10; cumulative cancer threshold of 100.

Rounding: Non-cancer HIs were rounded to one decimal place; cancer risks were rounded to a whole number.

Table 16 shows that the increment in cancer risk is less than or equal to zero for all receptor types for all modeling subdomains for all three projected years. That is, the proposed Plan does not increase cancer risk for existing sensitive receptors in any year. For acute health risk, the maximum incremental risk does increase for any type of receptor until 2050. In 2050 there is a maximum increase in incremental acute risk for residential and recreational receptors in in the Chula Vista subdomain and residential receptors in the El Cajon subdomain. However, none of these increases are above the significance threshold of 1.0 incremental HI. As for cancer, incremental chronic risks are less than or equal to zero in all subdomains and all projected years.

Table 17 shows that cumulative risks exceed the 100 per million cancer risk threshold in all domains and all years. However, the increment compared to 2016 is always negative. That is, total cancer risk to which residents are exposed is being reduced in every year under the proposed Plan.

For sensitive receptors that are "turned on" in future years (Table 18 and Table 19), the cancer and non-cancer risks can be significant, because there is no 2016 risk from which to increment. That is, these are new receptors for the modeling, with no recorded value in 2016. Without a 2016 modeled value from which to calculate a difference, the reported values for a future year are the value alone in that future year (there is no baseline value to subtract from the projected year to compute an increment). Note that this does not mean there is no risk in these locations in 2016, just that it was not modeled. Note also that the cancer and chronic risks presented here include both mobile (rail and on-road) and stationary risks, while acute considers only mobile sources under the proposed Plan. For new receptors activated by new emissions sources (Table 18), the cancer risk exceeds 10 per million only for residential receptors, but in all three modeled years. The chronic risk HI exceeds 1.0 for residential and recreational receptors in multiple subdomains for all three years. The acute risk HI does not exceed 1.0 in any subdomain or year for these "new" receptors.

For new sensitive receptors "turned on" by new land uses (Table 19), the cancer risk exceeds 10 per million only for residential receptors, but in all three modeled years and every modeling subdomain. Similarly, the chronic risk HI exceeds 1.0 only for new residential receptors in all subdomains for all years. The acute risk HI also exceeds 1.0 only in the Escondido subdomain, but for all years for these "new" receptors.

Also, note that all rail emissions in this analysis are conservatively modeled as if all trains are diesel fueled and at- or above-grade. The proposed Plan considers tunneling or other approaches to move these sources underground and locating portals, adits, windows and other venting features away from sensitive receptors, which would reduce or eliminate the passenger rail impacts on public health. The engineering to support such a reduction would be conducted at the individual project level and is not included in this analysis but is included as a mitigation measure in the EIR. Similarly, it is anticipated that locomotives in the proposed Plan would eventually move to zero emissions technology, such as zero-emission multiple units (ZMU), hydrogen fuel cell, or hybridization of locomotives. This would eliminate or reduce PM and MSAT emissions from the vehicles, and thus the health impacts, because there would be no exhaust emissions. SANDAG anticipates that the cost assumptions already in the proposed Plan for rail equipment are adequate to introduce ZMU trains by 2035. (Veeh pers. comm.) This is discussed further in the body of the EIR (Section 4.3, *Air Quality*).

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Appendix E

Biological Resources Appendix

APPENDIX E
BIOLOGICAL RESOURCES APPENDIX

Appendix E-1 Vegetation Communities
Appendix E-2 Sensitive Plant Species
Appendix E-3 Sensitive Wildlife Species
Appendix E-4 Draft Natural Community Conservation Plans and Habitat Conservation Plans
Appendix E-5 Land Use Categories
Appendix E-6 Project-by-Project Impacts on Vegetation Communities for Each Horizon Year
Appendix E-7 Impacted Listed Plant Species

APPENDIX E-1
VEGETATION COMMUNITIES

Aggregated Vegetation Communities for Purposes of this EIR (Shaded) Modified Holland Vegetation Communities[1] (Unshaded)
Riparian and Wetlands
Beach/Coastal/Saltpan/Mudflats
13300 Saltpan/Mudflats
13400 Beach
21000 Coastal Dunes
21100 Active Coastal Dunes
21200 Foredunes
21230 Southern Foredunes
Marsh
46000 Alkali Playa Community
52000 Marsh and Swamp
52100 Coastal Salt Marsh
52120 Southern Coastal Salt Marsh
52300 Alkali Marsh
52310 Cismontane Alkali Marsh
52400 Freshwater Marsh
52410 Coastal and Valley Freshwater Marsh
52420 Transmontane Freshwater Marsh
52430 Montane Freshwater Marsh
52440 Emergent Wetland
Meadows and Seeps
45000 Meadow and Seep
45100 Montane Meadow
45110 Wet Montane Meadow
45120 Dry Montane Meadows
45300 Alkali Meadows and Seeps
45320 Alkali Seep
45400 Freshwater Seep
Open Water and Streams
13000 Unvegetated Habitat
13100 Open Water
13110 Marine
13111 Subtidal
13112 Intertidal
13120 Bay
13121 Deep Bay

[1] Based on Vegetation Communities from County of San Diego 2017.

Aggregated Vegetation Communities for Purposes of this EIR (Shaded) Modified Holland Vegetation Communities[1] (Unshaded)
13122 Intermediate Bay
13123 Shallow Bay
13130 Estuarine
13131 Subtidal
13132 Intertidal
13133 Brackish Water
13140 Freshwater
13200 Non-Vegetated Channel, Floodway, Lakeshore Fringe
Riparian Forest/Woodland
61000 Riparian Forests
61300 Southern Riparian Forest
61310 Southern Coast Live Oak Riparian Forest
61320 Southern Arroyo Willow Riparian Forest
61330 Southern Cottonwood–Willow Riparian Forest
61500 Montane Riparian Forest
61510 White Alder Riparian Forest
61800 Colorado Riparian Forest
61810 Sonoran Cottonwood–Willow Riparian Forest
61820 Mesquite Bosque
62000 Riparian Woodlands
62200 Desert Dry Wash Woodland
62300 Desert Fan Palm Oasis Woodland
62400 Southern Sycamore–Alder Riparian Woodland
Riparian Scrub
63300 Southern Riparian Scrub
63310 Mule Fat Scrub
63320 Southern Willow Scrub
63321 Arundo Donax Dominant/Southern Willow Scrub
63400 Great Valley Scrub
63410 Great Valley Willow Scrub
63500 Montane Riparian Scrub
63800 Colorado Riparian Scrub
63810 Tamarisk Scrub
63820 Arrowweed Scrub
Vernal Pools
44000 Vernal Pool
44300 Southern Vernal Pool
44320 San Diego Mesa Vernal Pool
44321 San Diego Mesa Hardpan Vernal Pool (northern mesas)
44322 San Diego Mesa Claypan Vernal Pool (southern mesas)

Aggregated Vegetation Communities for Purposes of this EIR (Shaded) Modified Holland Vegetation Communities[1] (Unshaded)
Chaparral
37100 Upper Sonoran Mixed Chaparral
37120 Southern Mixed Chaparral
37121 Granitic Southern Mixed Chaparral
37122 Mafic Southern Mixed Chaparral
37130 Northern Mixed Chaparral
37131 Granitic Northern Mixed Chaparral
37132 Mafic Northern Mixed Chaparral
37200 Chamise Chaparral
37210 Granitic Chamise Chaparral
37220 Mafic Chamise Chaparral
37300 Red Shank Chaparral (near Campo and Chihuahua Valley)
37400 Semi-Desert Chaparral
37500 Montane Chaparral
37510 Mixed Montane Chaparral
37520 Montane Manzanita Chaparral
37530 Montane Ceanothus Chaparral
37540 Montane Scrub Oak Chaparral
37800 Upper Sonoran Ceanothus Chaparral
37810 Buck Brush Chaparral
37830 Ceanothus Crassifolius Chaparral
37900 Scrub Oak Chaparral
37A00 Interior Live Oak Chaparral
37B00 Upper Sonoran Manzanita Chaparral
37C00 Maritime Chaparral
37C30 Southern Maritime Chaparral
Coastal Scrub
31000 Coastal Bluff Scrub
31200 Southern Coastal Bluff Scrub
32000 Coastal Scrub
32400 Maritime Succulent Scrub (Point Loma, etc.)
32500 Diegan Coastal Sage Scrub
32510 Coastal form
32520 Inland form (>1,000 ft. elevation)
32700 Riversidian Sage Scrub
32710 Riversidian Upland Sage Scrub
32720 Alluvial Fan Scrub
37G00 Coastal Sage-Chaparral Scrub
37K00 Flat-topped Buckwheat
Desert Dunes

Aggregated Vegetation Communities for Purposes of this EIR (Shaded) Modified Holland Vegetation Communities[1] (Unshaded)
22000 Desert Dunes
22100 Active Desert Dunes (very little in Borrego Valley)
22300 Stabilized and Partially-Stabilized Desert Sand Field
24000 Stabilized Alkaline Dunes
25000 Badlands/Mudhill Forbs
Desert Scrub
29000 Acacia Scrub
33000 Sonoran Desert Scrub
33100 Sonoran Creosote Bush Scrub
33200 Sonoran Desert Mixed Scrub
33210 Sonoran Mixed Woody Scrub
33220 Sonoran Mixed Woody and Succulent Scrub
33230 Sonoran Wash Scrub
33300 Colorado Desert Wash Scrub
33600 Encelia Scrub
34000 Mojavean Desert Scrub
34300 Blackbush Scrub
36110 Desert Saltbush Scrub
36120 Desert Sink Scrub
39000 Upper Sonoran Subshrub Scrub
Oak Woodland
71100 Oak Woodland
71120 Black Oak Woodland (Cuyamaca and Mesa Grande)
71160 Coast Live Oak Woodland
71161 Open Coast Live Oak Woodland
71162 Dense Coast Live Oak Woodland
71180 Engelmann Oak Woodland
71181 Open Engelmann Oak Woodland
71182 Dense Engelmann Oak Woodland
77000 Mixed Oak Woodland
81300 Oak Forest
81310 Coast Live Oak Forest
81320 Canyon Live Oak Forest
81340 Black Oak Forest
Forest/Woodland
71000 Cismontane Woodland
71200 Walnut Woodland
71210 California Walnut Woodland
72000 Pinon and Juniper Woodlands
72300 Peninsular Pinon and Juniper Woodlands

Aggregated Vegetation Communities for Purposes of this EIR (Shaded) Modified Holland Vegetation Communities[1] (Unshaded)
72310 Peninsular Pinon Woodland
72320 Peninsular Juniper Woodland and Scrub
75000 Sonoran Thorn Woodland
75100 Elephant Tree Woodland
78000 Undifferentiated Open Woodland
79000 Undifferentiated Dense Woodland
79100 Eucalyptus Woodland
81000 Broadleaved Upland Forest
81100 Mixed Evergreen Forest
30000 Closed-cone Coniferous Forest
83100 Coastal Closed-cone Coniferous Forest
83140 Torrey Pine Forest
83200 Interior Closed-cone Coniferous Forest
83230 Southern Interior Cypress Forest
84000 Lower Montane Coniferous Forest
84100 Coast Range, Klamath and Peninsular Coniferous Forest
84140 Coulter Pine Forest
84150 Bigcone Spruce (Bigcone Douglas Fir)–Canyon Oak Forest
84200 Sierran Coniferous Forest
84230 Sierran Mixed Coniferous Forest
84500 Mixed Oak/Coniferous/Bigcone/Coulter
85000 Upper Montane Coniferous Forest
85100 Jeffrey Pine Forest
Grasslands
42000 Valley and Foothill Grassland
42100 Native Grassland
42110 Valley Needlegrass Grassland
42120 Valley Sacaton Grassland
42200 Nonnative Grassland
42210 Artichoke Thistle Dominant / Nonnative Grassland
42300 Wildflower Field
42400 Foothill/Mountain Perennial Grassland
42470 Transmontane Dropseed Grassland
Other Cover Types
Agriculture
18000 General Agriculture
18100 Orchards and Vineyards
18200 Intensive Agriculture – Dairies, Nurseries, Chicken Ranches
18300 Extensive Agriculture – Field/Pasture, Row Crops
18310 Field/Pasture

Aggregated Vegetation Communities for Purposes of this EIR (Shaded) Modified Holland Vegetation Communities[1] (Unshaded)
18320 Row Crops
Disturbed Habitat
11000 Nonnative Vegetation
11200 Disturbed Wetland
11300 Disturbed Habitat
Urban/Developed
12000 Urban/Developed

APPENDIX E-2
SENSITIVE PLANT SPECIES

Species[1]	State/Federal Status[2]	CRPR List/Code[2]	Regional HCP/NCCP Coverage[3]	Habitat
Abronia maritima red sand-verbena	--/--	4.2	–	Coastal dunes. Elevation range 0–10 meters (m).
Abronia villosa var. *aurita* chaparral sand-verbena	--/--	1B.1	–	Chaparral, coastal scrub, desert dunes. Elevation range 80–1,600 m.
Acanthomintha ilicifolia San Diego thorn-mint	FT/SE	1B.1	NE, MSCP (covered in all approved MSCP Subarea Plans	Chaparral, coastal sage scrub, valley and foothill grassland, vernal pools. Found in clay soils. Elevation range below 1,000 m.
Acmispon haydonii pygmy lotus	--/--	1B.3	–	Creosote bush scrub to pinyon–juniper woodland; rocky sites. Elevation range 600–1,200 m.
Acmispon prostratus Nuttall's acmispon	--/--	1B.1	MSCP (covered in all approved MSCP Subarea Plans except Poway)	*Lotus nuttallinaus* (Nuttall's lotus) is now considered a synonym of this species (Jepson Flora Project 2013). Coastal scrub, beaches, and disturbed areas. Elevation range 0–30 m.
Adolphia californica California adolphia	--/--	2B.1	–	Coastal sage scrub, chaparral, valley and foothill grassland. Found in sandy/gravelly to clay soils. Elevation range below 400 m.
Agave shawii Shaw's agave	--/	2B.1	NE, MSCP (covered in all approved MSCP Subarea Plans except for Poway)	Coastal scrub, maritime succulent scrub, coastal bluff scrub. Has also been found adjacent to Torrey Pine forest. Elevation range below 300 m.
Ambrosia chenopodiifolia San Diego bur-sage	--/--	2B.1	–	Coastal sage scrub, maritime succulent scrub. Found on slopes of canyons in open succulent scrub, usually with little herbaceous cover. Elevation range 55–150 m.
Ambrosia monogyra singlewhorl burrobrush	--/--	2B.2	–	Coastal scrub, maritime succulent scrub, chaparral, Sonoran desert scrub. Elevation range 10–500 m.

Species[1]	State/Federal Status[2]	CRPR List/Code[2]	Regional HCP/NCCP Coverage[3]	Habitat
Ambrosia pumila San Diego ambrosia	FE	1B.1	NE, MSCP (covered in all approved MSCP Subarea Plans except for Poway)	Coastal sage scrub, valley and foothill grassland. Found in sandy loam of clay soil. In valleys; persists where disturbance has been superficial. Elevation range 20–415 m.
Androsace elongata ssp. *acuta* California androsace	--/--	4.2	–	Chaparral, cismontane woodland, coastal scrub, meadows and seeps, pinyon–juniper woodland, valley and foothill grassland. Elevation range 150–1,200 m.
Aphanisma blitoides aphanisma	--/--	1B.2	–	Coastal scrub, coastal bluff scrub, alkaline areas, coastal dunes. Found on bluffs and slopes near the ocean in sandy or clay soils. In steep decline on the islands and the mainland. Elevation range 1–305 m.
Arctostaphylos glandulosa ssp. *crassifolia* Del Mar manzanita	FE	1B.1	MSCP (covered in all approved MSCP Subarea Plans except for Poway)	Coastal chaparral, closed-coned coniferous forest. Found onsandy coastal mesas and ocean bluffs; in chaparral or Torrey pine forest. Elevation range 0–365 m.
Arctostaphylos otayensis Otay manzanita	--/--	1B.2	MSCP (covered in all approved MSCP Subarea Plans except for Poway)	Chaparral, cismontane woodland. Found in metavolcanic soils with other chaparral associates. Elevation range 275–1,700 m.
Arctostaphylos rainbowensis Rainbow manzanita	--/--	1B.1	–	Chaparral. Usually found in gabbro chaparral in Riverside and San Diego counties. Elevation range 270–790 m.
Artemisia palmeri San Diego sagewort	--/--	4.2	–	Chaparral, coastal scrub, riparian forest, riparian scrub, riparian woodland. Sandy, mesic soils. Elevation range 15–915 m.
Asplenium vespertinum western spleenwort	--/--	4.2	–	Chaparral, cismontane woodland, coastal scrub/rocky. Elevation range 180–1,000 m.
Astragalus crotalariae Salton milk-vetch	--/--	4.3	–	Sonoran desert scrub (sandy or gravelly). Elevation range 0–250 m.

Species[1]	State/Federal Status[2]	CRPR List/Code[2]	Regional HCP/NCCP Coverage[3]	Habitat
Astragalus deanei Dean's milk-vetch	--/--	1B.1	–	Chaparral, coastal scrub, riparian forest. Found on open, brushy south- facing slopes in Diegan coastal sage, sometimes on recently burned-over hillsides. Elevation range 75–670 m.
Astragalus douglasii var. *perstrictus* Jacumba milk-vetch	--/--	1B.2	–	Chaparral, cismontane woodland, valley and foothill grassland. Found on stony hillsides and gravelly or sandy flats in open oak woodland. Elevation range 900–1,370 m.
Astragalus insularis var. *harwoodii* Harwood's milk-vetch	--/--	2B.2	–	Desert dunes, creosote bush scrub. Found in open sandy flats or stony desert washes; mostly in creosote bush scrub. Elevation range (-50)–500 m.
Astragalus lentiginosus var. *borreganus* Borrego milk-vetch	--/--	4.3	–	Mojavean desert scrub, Sonoran desert scrub/sandy. Elevation range 30–270 m.
Astragalus magdalenae var. *peirsonii* Peirson's milk-vetch	FT/SE	1B.2	–	Sand dune and sandy areas. Elevation range 50–250 m.
Astragalus nutans Providence Mountains milk-vetch	--/--	4.3	–	Joshua tree woodland, Mojavean desert scrub, pinyon–juniper woodland, Sonoran desert scrub/sandy or gravelly. Elevation range 450–1,950 m.
Astragalus oocarpus San Diego milk-vetch	--/--	1B.2	–	Chaparral, cismontane woodland, meadows. Found in openings in chaparral or on gravelly flats and slopes in thin oak woodland. Elevation range 305–1,500 m.
Astragalus pachypus var. *jaegeri* Jaeger's milk-vetch	--/--	1B.1	–	Coastal scrub, chaparral, valley and foothill grassland, cismontane woodland. Found on dry ridges, in valleys and on open sandy slopes; often in grassland and oak-chaparral. Elevation range 365–915 m.
Astragalus sabulonum gravel milk-vetch	–	2B.2	–	Desert sands to gravel. Elevation range 50–900 m.

Species[1]	State/Federal Status[2]	CRPR List/Code[2]	Regional HCP/NCCP Coverage[3]	Habitat
Astragalus tener var. *titi* coastal dunes milk-vetch	FE/SE	1B.1	MSCP (covered in all approved MSCP Subarea Plans except for Poway)	Coastal bluff scrub, coastal dunes. Found in moist, sandy depressions of bluffs or dunes along and near the Pacific Ocean; one recorded occurrence on a clay terrace. Elevation range 1–50 m.
Atriplex coulteri Coulter's saltbush	--/--	1B.2	–	Coastal bluff scrub, coastal dunes, coastal scrub, valley and foothill grassland. Found on ocean bluffs and ridge tops, as well as alkaline low places. Elevation range 10–440 m.
Atriplex pacifica South Coast saltscale	--/--	1B.2	–	Coastal scrub, Diegan sage scrub, coastal bluff scrub, chenopod. Found in alkaline soils. Elevation range 1–500 m.
Atriplex parishii Parish's brittlescale	--/--	1B.1	–	Alkali meadows, vernal pools, chenopod scrub, playas. Usually found on drying alkali flats with fine soils. Elevation range 4–140 m.
Atriplex serenana var. *davidsonii* Davidson's saltscale	--/--	1B.2	–	Coastal scrub, coastal bluff scrub. Found in alkaline soils. Elevation range 3–250 m.
Ayenia compacta California ayenia	--/--	2B.3	–	Mojavean desert scrub, Sonoran desert scrub. Found in sandy and gravelly washes in the desert; also found in dry desert canyons. Elevation range 150–1,095 m.
Azolla microphylla Mexican mosquito fern	--/--	4.2	–	Marshes and swamps. Elevation range 30–100 m.
Baccharis vanessae Encinitas baccharis	FT/SE	1B.1	NE, MSCP (covered in all approved MSCP Subarea Plans), MHCP, Carlsbad HMP	Chaparral. Found on sandstone soils in steep, open, rocky areas with chaparral associates. Elevation range 60–720 m.
Berberis fremontii Fremont barberry	--/--	2B.3	–	Chaparral, pinyon–juniper woodland, Joshua tree woodland. Found on dry, rocky points and slopes. Elevation range 840–1,850 m.
Berberis higginsiae Fremont's mahonia	--/--	3.2	–	Rocky slopes, pinyon–juniper woodland or chaparral areas. Elevation range 700–1,900 m.

Species[1]	State/Federal Status[2]	CRPR List/Code[2]	Regional HCP/NCCP Coverage[3]	Habitat
Berberis nevinii Nevin's barberry	FE/SE	1B.1	NE, MSCP (covered in all approved MSCP Subarea Plans except Poway)	Chaparral, cismontane woodland, coastal scrub, riparian scrub. Found on steep, north-facing slopes or in low-grade sandy washes. Elevation range 290–1,575 m.
Bergerocactus emoryi golden-spined cereus	--/--	2B.2	–	Coastal scrub, sometimes chaparral margins. Limited to the coastal belt. Usually found in clay soils. Elevation range 3–395 m.
Bloomeria clevelandii San Diego goldenstar	--/--	1B.1	MSCP (covered in all approved MSCP Subarea Plans)	*Muilla c.* is now considered a synonym of this species (Baldwin 2012). Chaparral, coastal sage scrub, valley and foothill grassland, vernal pools, mesa grasslands, scrub edges; clay soils. Often on mounds between vernal pools in fine, sandy loam. Elevation range 50–1,090 m.
Boechera hirshbergiae Hirshberg's rock cress	--/--	1B.2	–	Pebble (or pavement) plains. Known occurrence at elevation of 1,400 m.
Brodiaea filifolia thread-leaved brodiaea	FT/SE	1B.1	NE, MSCP (covered in all approved MSCP Subarea Plans except for Poway), MHCP, Carlsbad HMP	Cismontane woodland, coastal scrub, playas, valley and foothill grassland, vernal pools. Usually associated with annual grassland and vernal pools; often surrounded by shrubland habitats. Found in clay soils. Elevation range 25–860 m.
Brodiaea orcuttii Orcutt's brodiaea	--/--	1B.1	NE, MSCP (covered in all approved MSCP Subarea Plans), MHCP, Carlsbad HPM	Closed-cone coniferous forest, meadows, cismontane woodland, chaparral, valley and foothill grassland, vernal pools. Found in mesic, clay soils; sometimes serpentine; usually in vernal pools and small drainages. Elevation range 30–165 m.
Brodiaea santarosae Santa rosa Basalt brodiaea	--/--	1B.2	–	Valley and foothill grassland/basaltic. Elevation range 580–1,045 m.
Bursera microphylla little-leaf elephant tree	--/--	2B.3	–	Sonoran desert scrub. Found on hillsides, in washes, and on canyon sides in California; rocky sites. Elevation range 200–700 m.

Species[1]	State/Federal Status[2]	CRPR List/Code[2]	Regional HCP/NCCP Coverage[3]	Habitat
Calamagrostis densa dense reed grass	--/--		MSCP (covered in all approved MSCP Subarea Plans except Poway)	Dry slopes. Associated with chaparral habitats. Elevation range 20–2,450 m.
Calandrinia breweri Brewer's calandrinia	--/--	4.2	–	Chaparral, coastal scrub/sandy or loamy, disturbed sites and burns. Elevation range 10–1,220 m
California macrophylla round-leaved filaree	--/--	1B.1	–	Cismontane woodland, valley and foothill grassland. Found in clay soils. Elevation range 15–1,200 m.
Calliandra eriophylla pink fairy-duster	--/--	2B.3	–	Sonoran desert scrub. Found in sandy or rocky sites in the desert. Elevation range 120–1,500 m.
Calochortus catalinae Catalina mariposa lily	--/--	4.2	–	Found in heavy soils in open grassland or scrub. Elevation range 1–700 m.
Calochortus dunnii Dunn's mariposa lily	SR	1B.2	NE, MSCP (covered in all approved MSCP Subarea Plans except for Poway)	Closed-cone coniferous forest, chaparral. Found in gabbro or metavolcanic soils; also known from sandstone; often associated with chaparral. Elevation range 375–1,830 m.
Camissoniopsis lewisii Lewis' evening-primrose	--/--	3	–	Coastal bluff scrub, cismontane woodland, coastal dunes, coastal scrub, valley and foothill grassland/sandy or clay. Elevation range 0–300 m.
Carex obispoensis San Luis Obispo sedge	--/--	1B.2	–	Closed-cone coniferous forest, chaparral, coastal prairie, coastal scrub, valley and foothill grassland/often serpentinite seeps, sometimes gabbro; often on clay soils. Elevation range 10–790 m.
Carlowrightia arizonica Arizona carlowrightia	--/--	2B.2	–	Sonoran desert scrub. Found in sandy, granitic alluvium, associated with palm oasis in California. Elevation range 285–350 m.
Castilleja lasiorhyncha San Bernardino Mountains owl's-clover	--/--	1B.2	–	Meadows, flats, and open forest. Elevation Range 1,000–2,400 m.

Species[1]	State/Federal Status[2]	CRPR List/Code[2]	Regional HCP/NCCP Coverage[3]	Habitat
Caulanthus simulans Payson's jewel-flower	--/--	4.2	MSCP (covered in all approved MSCP Subarea Plans except for Poway)	Chaparral, coastal scrub/sandy, granitic. Elevation range 90–2,200 m.
Ceanothus cyaneus Lakeside ceanothus	--/--	1B.2	NE, MSCP (covered in all approved MSCP Subarea Plans)	Closed-cone coniferous forest, chaparral. Elevation range 100–1,515 m.
Ceanothus otayensis Otay Mountain ceanothus	--/--	1B.2	–	Chaparral in metavolcanic or gabbroic soils. Elevation range 600–1,100 m.
Ceanothus verrucosus wart-stemmed ceanothus	--/--	2B.2	MSCP (covered in all approved MSCP Subarea Plans except for Poway)	Chaparral. Elevation range 1–380 m.
Centromadia parryi ssp. *australis* southern tarplant	--/	1B.1	–	Marshes and swamps (margins), vernal pools, valley and foothill grasslands, alkaline locales, salt marshes. Elevation range 0–640 m.
Centromadia pungens ssp. *laevis* smooth tarplant	--/--	1B.1	–	Valley and foothill grassland, chenopod scrub, meadows, playas, riparian woodland. Found in alkali meadow, alkali scrub, also in disturbed places. Elevation range 0–480 m.
Chaenactis carphoclinia var. *peirsonii* Peirson's pincushion	--/--	1B.3	–	Sonoran desert scrub. Found on open rocky or sandy sites. Elevation range 3–80 m.
Chaenactis glabriuscula var. *orcuttiana* Orcutt's pincushion	--/--	1B.1	–	Coastal bluff scrub, coastal dunes. Found on sandy sites. Elevation range 3–100 m.
Chaenactis parishii Parish's chaenactis	--/--	1B.3	–	Chaparral. Found on rocky sites. Elevation range 1,300–2,500 m.
Chamaebatia australis southern mountain misery	--/--	4.2	–	Chaparral (gabbroic or metavolcanic). Elevation range 300–780 m.

Species[1]	State/Federal Status[2]	CRPR List/Code[2]	Regional HCP/NCCP Coverage[3]	Habitat
Chamaesyce abramsiana Abram's spurge	--/--	2B.2	–	Mojave desert scrub, Sonoran desert scrub/sandy. Elevation range 0–915 m.
Chamaesyce arizonica Arizona spurge	--/--	2B.3	–	Sonoran desert scrub. Found in sandy soils. Elevation range 50–300 m.
Chamaesyce platysperma flat-seeded spurge	--/--	1B.2	–	Sonoran desert scrub, desert dunes. Found in sandy places or shifting dunes. Possibly a waif in California; more common in Arizona and Mexico. Elevation range 60–950 m.
Chamaesyce revoluta revolute spurge	--/--	4.3	–	Mojavean desert scrub in rocky areas. Elevation range 1,095–3,100 m.
Chloropyron maritimum ssp. *maritimum* salt marsh bird's-beak	FE/SE	1B.2	MSCP (covered in all approved MSCP Subarea Plans except for Poway)	Formally *Cordylanthus maritimus* ssp. *maritimus* (Jepson Flora Project 2013). Coastal salt marsh, coastal dunes. Limited to the higher zones of the salt marsh habitat. Elevation range 0–30 m.
Chorizanthe leptotheca Peninsular spineflower	--/--	4.2	–	Chaparral, coastal scrub, lower montane coniferous forest/alluvial fan, granitic soils. Elevation range 300–1,900 m.
Chorizanthe orcuttiana Orcutt's spineflower	FE/SE	1B.1	NE, MHCP, Carlsbad HMP	Coastal scrub, chaparral, closed-cone coniferous forest. Found from Del Mar to Point Loma, in San Diego County. Found in sandy sites and openings; sometimes in transition zones. Elevation range 3–125 m.
Chorizanthe polygonoides var. *longispina* long-spined spineflower	--/--	1B.2	–	Chaparral, coastal scrub, meadows, valley and foothill grassland. Found in gabbroic clay. Elevation range 30–1,450 m.
Chorizanthe xanti var. *leucotheca* white-bracted spineflower	--/--	1B.2	–	Mojavean desert scrub, pinyon–juniper woodland/sandy or gravelly. Elevation range 300–1,200 m.
Cistanthe maritima seaside calandrinia	--/--	4.2	–	Coastal bluff scrub, coastal scrub, valley and foothill grassland/sandy. Elevation range 5–300 m.
Clarkia delicata delicate clarkia	--/--	1B.2	–	Cismontane woodland, chaparral. Elevation range 235–1,000 m.

Species[1]	State/Federal Status[2]	CRPR List/Code[2]	Regional HCP/NCCP Coverage[3]	Habitat
Clinopodium chandleri San Miguel savory	--/--	1B.2	MSCP (covered in all approved MSCP Subarea Plans except Poway)	Chaparral, Cismontane woodland, coastal scrub, riparian woodland, valley and foothill grassland. Rocky, gabbroic or metavolcanic substrate. Elevation range 120–1,005 m.
Colubrina californica Las Animas colubrina	--/--	2B.3	–	Mojavean desert scrub. Found on narrow, steep, rocky ravines or washes. Elevation range 10–1000 m.
Comarostaphylis diversifolia ssp. *diversifolia* summer holly	--/--	1B.2	MSCP (Poway MSCP Subarea Plan only)	Chaparral. Often found in mixed chaparral in California, sometimes post-burn. Elevation range 30–550 m.
Convolvulus simulans small-flowered morning-glory	--/--	4.2	–	In chaparral open areas, coastal scrub, valley and foothill grassland/clay, serpentinite seeps. Elevation range 30–700 m.
Cordylanthus parviflorus small-flowered bird's-beak	--/--	2B.3	–	Dry sagebrush scrub, pinyon–juniper and Joshua-tree woodland. Elevation range 700–2,200 m.
Corethrogyne filaginifolia var. *incana* San Diego sand aster	--/--	1B.1	–	Coastal scrub, coastal bluff scrub, chaparral. *C. f.* var. *i.* is now considered a synonym of *C. f.* var. *f.* (Baldwin 2012) and is therefore no longer considered sensitive.
Corethrogyne filaginifolia var. *linifolia* Del Mar Mesa sand aster	--/--	1B.1	MSCP (covered in all approved MSCP Subarea Plans except for Poway), Carlsbad HMP	Chaparral, coastal scrub. *C. f.* var. *l.* is now considered a synonym of *C. f.* var. *f.* (Baldwin 2012) and is therefore no longer considered sensitive.
Cryptantha costata ribbed cryptantha	--/--	4.3	–	Desert dunes, Mojavean desert scrub, Sonoran desert scrub/sandy. Elevation range 0–500 m.
Cryptantha ganderi Gander's cryptantha	--/--	1B.1	–	Sonoran desert scrub, desert dunes. Found on dunes and in washes. Elevation range 170–400 m.
Cryptantha holoptera winged cryptantha	--/--	4.3	–	Mojavean desert scrub, Sonoran desert scrub. Elevation range 100–1,690 m.

Species[1]	State/Federal Status[2]	CRPR List/Code[2]	Regional HCP/NCCP Coverage[3]	Habitat
Cryptantha wigginsii Wiggins' cryptantha	--/--	1B.2	–	This is a recently rediscovered species (Simpson et al. 2013). Closed mixed coastal succulent scrub community, maritime succulent scrub, or coastal sage scrub. Elevation range 6–274 m.
Cylindropuntia californica var. *californica* snake cholla	--/--	1B.1	NE, MSCP (covered in all approved MSCP Subarea Plans except for Poway)	Chaparral, coastal scrub. Elevation range 30–150 m.
Cylindropuntia fosbergii pink teddy-bear cholla	--/--	1B.1	–	Sonoran desert scrub. Elevation range 85–850 m.
Cylindropuntia wolfii Wolf's cholla	--/--	4.3	–	Sonoran desert scrub. Elevation range 100–1,200 m.
Deinandra conjugens Otay tarplant	FT/SE	1B.1	NE, MSCP (covered in all approved MSCP Subarea Plans except for Poway)	Coastal scrub, valley and foothill grassland. Found on coastal plains, mesas, and river bottoms; often in open, disturbed areas; clay soils. Elevation range 25–300 m.
Deinandra floribunda Tecate tarplant	--/--	1B.2	–	Chaparral, coastal scrub. Often in little drainages or disturbed areas. Elevation range 70–1,220 m.
Deinandra mohavensis Mojave tarplant	SE	1B.3	–	Riparian scrub, chaparral. Found in low sand bars in riverbeds; mostly in riparian areas or ephemeral grassy areas. Elevation range 850–1,600 m.
Deinandra paniculata paniculate tarplant	--/--	4.2	–	Coastal scrub, valley and foothill grassland, vernal pools/usually vernally mesic. Elevation range 25–940 m.
Delphinium hesperium ssp. *cuyamacae* Cuyamaca larkspur	SR	1B.2	–	Lower montane coniferous forest, meadows. Found on dried edge of grassy meadows, also described as in mesic sites. Elevation range 1,210–1,630 m.

Species[1]	State/Federal Status[2]	CRPR List/Code[2]	Regional HCP/NCCP Coverage[3]	Habitat
Delphinium parishii ssp. *subglobosum* Colorado desert larkspur	--/--	4.3	–	Chaparral, cismontane woodland, pinyon–juniper woodland, Sonoran desert scrub. Elevation range 600–1,800 m.
Dichondra occidentalis western dichondra	--/--	4.2	–	Chaparral, cismontane woodland, coastal scrub, valley and foothill grassland. Elevation range 50–500 m.
Dicranostegia orcuttiana Orcutt's bird's-beak	--/--	2B.1	MSCP (covered in all approved MSCP Subarea Plans except for Poway)	Coastal scrub. Found in coastal scrub associations on slopes; also reported from intermittently moist swales, and in washes. Elevation range 100–200 m.
Dieteria asteroides var. *lagunensis* Mount Laguna aster	SR	2B.1	–	Cismontane woodland, lower montane coniferous forest. Found in openings in woodland or forest. Elevation range 800–2,400 m.
Digitaria californica var. *californica* Arizona cottontop	--/--	2B.3	–	Mojavean desert scrub, Sonoran desert scrub/rocky. Elevation range290–1,490 m.
Ditaxis serrata var. *californica* California ditaxis	--/--	3.2	–	Sonoran desert scrub. Elevation range 30–1,000 m.
Downingia concolor var. *brevior* Cuyamaca Lake downingia	SE	1B.1	–	Meadows (mesic), vernal pools. Found on shores of Cuyamaca Lake in San Diego County. Located in vernal seeps, lakes, and pools, and on mudflats, with *Orthocarpus*, *Limnanthes*, and *Collinsia*. Elevation range 1,400–1,500 m.
Dudleya alainae Banner dudleya	--/--	3.2	–	Desert mountains, rocky, shaded slopes. Possible hybrid; needs further study. Elevation range 240–1,700 m.
Dudleya attenuata ssp. *attenuata* Orcutt's dudleya	--/--	2B.1	–	Coastal scrub, coastal bluff scrub, chaparral. Found on rocky mesas, canyons, and ridges. Elevation range 3–50 m.
Dudleya blochmaniae ssp. *blochmaniae* Blochman's dudleya	FSC	1B.1	NE, MHCP, Carlsbad HMP	Coastal scrub, coastal bluff scrub, valley and foothill grassland. Found on open, rocky slopes; often in shallow clays over serpentine or in rocky areas with little soil. Elevation range 5–450 m.

Species[1]	State/Federal Status[2]	CRPR List/Code[2]	Regional HCP/NCCP Coverage[3]	Habitat
Dudleya brevifolia short-leaved dudleya	SE	1B.1	NE, MSCP(covered in all approved MSCP Subarea Plans except Poway)	Chaparral, coastal scrub. Found on Torrey sandstone soils; in pebbly openings. Elevation range 30–250 m.
Dudleya multicaulis many-stemmed dudleya	--/--	1B.2	–	Chaparral, coastal scrub, valley and foothill grassland. Found in heavy, often clayey soils or grassy slopes. Elevation range 0–790 m.
Dudleya variegata variegated dudleya	--/--	1B.2	NE, MSCP (covered in all approved MSCP Subarea Plans except Poway)	Chaparral, coastal scrub, cismontane woodland, valley and foothill grassland, vernal pools. Found in rocky or clay soils; sometimes associated with vernal pool margins. Elevation range 3–550 m.
Dudleya viscida sticky dudleya	--/FSC	1B.2	MSCP (covered in all approved MSCP Subarea Plans except for Poway)	Coastal scrub, coastal bluff scrub, chaparral. Found on north and south-facing cliffs and banks. Elevation range 10–550 m.
Eriastrum harwoodii Harwood's woollystar	--/--	1B.2	–	Desert dunes. Elevation range 200–915 m.
Ericameria cuneata var. *macrocephala* Laguna Mountains goldenbush	--/--	1B.3	–	Chaparral. Endemic to the Laguna Mountains. Found among boulders; in crevices in granitic outcrops and in rocky soil. Elevation range 1,185–1,850 m.
Ericameria palmeri ssp. *palmeri* Palmer's goldenbush	--/--	1B.1	NE, MSCP (covered in all approved MSCP Subarea Plans)	Coastal scrub, chaparral. Found on granitic soils, on steep hillsides. Elevation range 100–600 m.
Eriogonum evanidum vanishing wild buckwheat	--/--	1B.1	–	Sandy areas. Elevation range 1,100–2,100 m.
Eryngium aristulatum var. *hooveri* Hoover's button-celery	--/--	1B.1	–	Vernal pools, seasonal wetlands, occasionally alkaline soils. Elevation range less than 50 m.

Species[1]	State/Federal Status[2]	CRPR List/Code[2]	Regional HCP/NCCP Coverage[3]	Habitat
Eryngium aristulatum var. *parishii* San Diego button-celery	FE/SE	1B.1	MSCP NE (covered in all approved MSCP and MHCP Subarea Plans except Poway, and in the VPHCP)	Vernal pools, coastal scrub, valley and foothill grassland. Found on San Diego mesa hardpan and claypan vernal pools, and in southern interior basalt flow vernal pools; usually surrounded by scrub. Elevation range 15–620 m.
Eryngium pendletonense Pendleton button-celery	--/--	1B.1	–	Coastal scrub, valley and foothill grassland, vernal pools. Located in vernally mesic sites. Elevation range 15–110 m.
Erysimum ammophilum coast wallflower	--/--	1B.2	MSCP (covered in all approved MSCP Subarea Plans except Poway)	Coastal dunes, bluff scrub. Elevation range 0–60 m.
Eucnide rupestris rock nettle	--/--	2B.2	–	Sonoran desert scrub. Elevation range 500–600 m.
Euphorbia misera cliff spurge	--/--	2B.2	MHCP	Coastal scrub, coastal bluff scrub. Found on rocky sites. Elevation range 10–500 m.
Ferocactus viridescens San Diego barrel cactus	--/FSC	B.1	MSCP (covered in all approved MSCP Subarea Plans)	Chaparral, Diegan coastal scrub, valley and foothill grassland. Often on exposed, level, or south-sloping areas; often in coastal scrub near crest of slopes. Elevation range 3–485 m.
Frankenia palmeri Palmer's frankenia	--/--	2B.1	–	Coastal dunes, marshes (coastal salt), playas. Elevation range 0–10 m.
Fraxinus parryi chaparral ash	--/--	2B.2	–	Chaparral. Elevation range 213–620 m.
Fremontodendron mexicanum Mexican flannelbush	FE/SR	1B.1	–	Closed-cone coniferous forest, chaparral, cismontane woodland. Usually scattered along the borders of creeks or in dry canyons; sometimes on gabbro soils. Elevation range 10–490 m.

Species[1]	**State/Federal Status[2]**	**CRPR List/Code[2]**	**Regional HCP/NCCP Coverage[3]**	**Habitat**
Funastrum utahense Utah vine milkweed	--/--	4.2	–	Mojavean desert scrub, Sonoran desert scrub. Sandy or gravelly soils. Elevation range 150–1,435 m.
Galium angustifolium ssp. *borregoense* Borrego bedstraw	SR	1B.3	–	Sonoran desert scrub. Found on steep walls and (usually north-facing) slopes in rocky watersheds or canyons. Elevation range 350–1,100 m.
Galium angustifolium ssp. *jacinticum* San Jacinto Mountains bedstraw	--/--	1B.3	–	Lower montane coniferous forest. Elevation range 1,350–2,100 m.
Galium johnstonii Johnston's bedstraw	--/--	4.3	–	Open mixed forest. Elevation range 1,650–2,300 m.
Galium proliferum desert bedstraw	--/--	2B.2	–	Joshua tree woodland, Mojavean desert scrub, pinyon–juniper woodland/rocky, carbonate (limestone). Elevation range 1,190–1,570 m.
Gentiana fremontii Fremont's gentian	--/--	2B.3	–	Wet mountain meadows. Elevation range 2,400–2,700 m.
Geothallus tuberosus Campbell's liverwort	--/--	1B.1	–	Coastal scrub, vernal pools. Elevation range 10–600 m.
Geraea viscida sticky geraea	--/--	2B.3	–	Chaparral. Loamy coarse sand to gravelly sand soils; often In post- burned areas and in bulldozed areas. Elevation range 450–1,700 m.
Gilia mexicana El Paso gilia	--/--	2B.3	–	Desert mountains; one occurrence recorded at Whale Peak. Elevation range 1,000–1,475 m.
Githopsis diffusa ssp. *filicaulis* Mission Canyon bluecup	--/--	3.1	–	Chaparral. Elevation range 450–700 m.
Grindelia hallii San Diego gumplant	--/--	1B.2	–	Meadows, valley and foothill grassland, chaparral, lower montane coniferous forest. Elevation range 180–1,660 m.
Harpagonella palmeri Palmer's grapplinghook	--/--	4.2	–	Chaparral, coastal scrub, valley and foothill grassland/clay. Elevation range 20–955 m.
Hazardia orcuttii Orcutt's hazardia	FSC/FC/ST	1B.1	NE, MHCP	Chaparral, coastal scrub, often on clay; in grassy edges of chaparral and coastal scrub. Elevation range 0–85 m.

Species[1]	State/Federal Status[2]	CRPR List/Code[2]	Regional HCP/NCCP Coverage[3]	Habitat
Helianthus niveus ssp. *tephrodes* Algodones Dunes sunflower	SE	1B.2	–	Desert dunes. Elevation range 50–100m.
Herissantia crispa curly herissantia	--/--	2B.3	–	Sonoran desert scrub. Elevation range 700–725 m.
Hesperevax caulescens hogwallow starfish	--/--	4.2	–	Drying shrink-swell clay of vernal pools, flats, steep slopes, occasionally in serpentine soils. Elevation range 0–500 m.
Hesperocyparis forbesii Tecate cypress	--/--	1B.1	MSCP (covered in approved MSCP Subarea Plans except Poway)	Closed-cone coniferous forest, chaparral. Primarily on north-facing slopes; groves often associated with chaparral. Elevation range 250–1,500 m.
Hesperocyparis stephensonii Cuyamaca cypress	--/--	1B.1	–	Closed-cone coniferous forest, chaparral, riparian forest. Restricted to the southwest slopes of Cuyamaca Peak, on gabbroic rock. Elevation range 1,030–1,420 m.
Heterotheca sessiliflora ssp. *sessiliflora* beach goldenaster	--/--	1B.1	–	Coastal chaparral, coastal dunes, coastal scrub. Elevation range 0–1,225 m.
Heuchera brevistaminea Laguna Mountains alumroot	--/--	1B.3	–	Broadleaved upland forest, chaparral, cismontane woodland, riparian forest, steep, rocky slopes. Elevation range 1,360–2,000 m.
Heuchera rubescens var. *versicolor* San Diego County alumroot	--/--	3.3	–	Chaparral, lower montane coniferous forest rocky outcrops. Elevation range 1,500–4,000 m.
Holocarpha virgata ssp. *elongata* graceful tarplant	--/--	4.2	–	Chaparral, cismontane woodland, coastal scrub, valley and foothill grassland. Elevation range 60–1,100 m.
Hordeum intercedens vernal barley	--/--	3.2	–	Coastal dunes, coastal scrub, valley and foothill grassland (saline flats and depressions), vernal pools. Elevation range 5–1,000 m.
Horkelia cuneata ssp. *puberula* mesa horkelia	--/--	1B.1	–	Chaparral, cismontane woodland, coastal scrub, sandy or gravelly sites. Elevation range 70–810 m.

Species[1]	State/Federal Status[2]	CRPR List/Code[2]	Regional HCP/NCCP Coverage[3]	Habitat
Horkelia truncata Ramona horkelia	--/--	1B.3	–	Mixed chaparral, vernal streams, and disturbed areas near roads. Clay soil. Elevation range 400–1,300 m.
Horsfordia newberryi Newberry's velvet-mallow	--/--	4.3	–	Sonoran desert scrub (rocky). Elevation range 3–800 m.
Hosackia crassifolia var. *otayensis* Otay Mountain lotus	--/--	1B.1	–	Chaparral, metavolcanic, often in disturbed areas. Elevation range 910–1,005 m.
Hulsea californica San Diego sunflower	--/--	1B.3	–	Lower montane coniferous forest, upper montane coniferous forest, and chaparral. Coarse to fine sandy loam in disturbed chaparral openings at high elevations. Elevation range 1,000–2,915 m.
Hulsea mexicana Mexican hulsea	--/--	2B.3	–	Chaparral. Volcanic soils or burns and disturbed sites. Elevation range 665–1,200 m.
Hulsea vestita ssp. *Callicarpha* beautiful hulsea	--/--	4.2	–	Chaparral, lower montane coniferous forest/rocky or gravelly, granitic. Elevation range 915–3,050 m.
Hymenothrix wrightii Wright's hymenothrix	--/--	4.3	–	Cismontane woodland, lower montane coniferous forest, valley and foothill grassland. Elevation range 1,400–1,550 m.
Ipomopsis tenuifolia slender-leaved ipomopsis	--/--	2B.3	–	Chaparral, pinyon–juniper woodland, Sonoran desert scrub. Dry rocky or gravelly slopes. Elevation range 100–1,200 m.
Isocoma menziesii var. *decumbens* decumbent goldenbush	--/--	1B.2	–	Coastal sage scrub intermixed with grasslands. Sandy soils; often in disturbed sites. Elevation range 10–910 m.
Iva hayesiana San Diego marsh-elder	--/--	2B.2	–	Marshes and swamps, playas, and river washes. Elevation range 10–500 m.
Juglans californica Southern California black walnut	--/--	4.2	–	Chaparral, cismontane woodland, coastal scrub/alluvial. Elevation range 50–900 m.

Species[1]	**State/Federal Status**[2]	**CRPR List/Code**[2]	**Regional HCP/NCCP Coverage**[3]	**Habitat**
Juncus acutus ssp. *leopoldii* southwestern spiny rush	--/--	4.2	–	Coastal dunes (mesic), meadows and seeps (alkaline seeps), marshes and swamps (coastal salt). Elevation range 3–900 m.
Juncus cooperi Cooper's rush	--/--	4.3	–	Meadows and seeps (mesic, alkaline or saline). Elevation range 0–1,770 m.
Juncus luciensis Santa Lucia dwarf rush	--/--	1B.2	–	Chaparral, great basin scrub, lower montane coniferous forest, meadows and seeps, vernal pools. Elevation range 300–2,040 m.
Lasthenia glabrata ssp. *coulteri* Coulter's goldfields	--/--	1B.1	–	Tidal marsh, vernal pools, alkaline marsh. Usually found on alkaline soils in playas, sinks, and grasslands. Elevation range 1–1,400 m.
Lathyrus splendens pride-of-California		4.3	–	Chaparral. Elevation range 200–1,525 m.
Lepechinia cardiophylla heart-leaved pitcher sage	--/--	1B.2	NE, MSCP (covered in all approved MSCP Subarea Plans)	Closed-cone coniferous forest, chaparral, cismontane woodland. Elevation range 550–1,370 m.
Lepechinia ganderi Gander's pitcher sage	--/--	1B.3	NE, MSCP (covered in all approved MSCP Subarea Plans except Poway)	Closed-cone coniferous forest, chaparral, coastal sage scrub, valley and foothill grassland. Usually found in chaparral or coastal scrub; sometimes in Tecate cypress woodland. Gabbro or metavolcanic substrate. Elevation range 300–1,000 m.
Lepidium flavum var. *felipense* Borrego Valley pepper-grass	--/--	1B.2	–	Sonoran desert scrub, pinyon–juniper woodland. Sandy, clay, or silty soils. Elevation range 450–840 m.
Lepidium virginicum var. *robinsonii* Robinson's pepper-grass	--/--	4.3	–	Chaparral, coastal scrub. Dry soils, shrubland. Elevation range 1–945 m.
Leptosiphon floribundus ssp. *hallii* Santa Rosa Mountains leptosiphon	--/--	1B.3	–	Sonoran desert scrub. Desert canyons. Elevation range 900–1,275 m.

Species[1]	State/Federal Status[2]	CRPR List/Code[2]	Regional HCP/NCCP Coverage[3]	Habitat
Leptosyne maritima sea dahlia	--/--	2B.2	–	Coastal scrub, coastal bluff scrub. Occurs on a variety of soil types, including sandstone. Elevation range 5–150 m.
Lessingia glandulifera var. *tomentosa* Warner Springs lessingia	--/--	1B.3	–	Chaparral. Sandy soils; Warner Ranch; San Diego County along roadsides in high desert chaparral. Elevation range 860–1,220 m.
Lewisia brachycalyx short-sepaled lewisia	--/--	2B.2	–	Lower montane coniferous forest, meadows. Dry to moist meadows in rich loam. Elevation range 1,400–2,300 m.
Lilium humboldtii ssp. *ocellatum* ocellated Humboldt lilly		4.2	–	Chaparral cismontane woodland, coastal scrub, lower montane coniferous forest, riparian woodland/openings. Elevation range 30–1,800 m.
Lilium parryi lemon lily	--/--	1B.2	–	Lower montane coniferous forest, meadows and seeps, riparian forest, upper montane coniferous forest. Wet, mountainous terrain; generally found in forested areas; on shady edges of streams, in open boggy meadows and seeps. Elevation range 1,300–2,790 m.
Limnanthes alba ssp. *parishii* Parish's meadowfoam	SE	1B.2	–	Meadows and seeps, vernal pools. Vernally moist areas and temporary seeps of highland meadows and plateaus; often bordering lakes and streams. Elevation range 600–1,760 m.
Linanthus bellus desert beauty	--/--	2B.1	–	Chaparral. Dry slopes and flats; open sandy spots in chaparral, mostly in loamy coarse sandy DG soil types. Elevation range 920–1,400 m.
Linanthus maculatus Little San Bernardino Mtns. linanthus	--/--	1B.2	–	Sandy washes in desert mountains, flat areas. Elevation range 900–1,100 m.
Linanthus orcuttii Orcutt's linanthus	--/--	1B.3	–	Chaparral, lower montane coniferous forest. Sometimes in disturbed areas; often in gravelly clearings. Elevation range 1,060–2,000 m.
Lupinus excubitus var. *medius* Mountain Springs bush lupine	--/--	1B.3	–	Pinyon–juniper woodland, Sonoran desert scrub. Dry, sandy, gently sloping canyon washes, sandy soil pockets, and flats in steeper slopes and drainages. Elevation range 425–1,370 m.

Species[1]	State/Federal Status[2]	CRPR List/Code[2]	Regional HCP/NCCP Coverage[3]	Habitat
Lycium californicum California box-thorn	--/--	4.2	–	Coastal bluff scrub, coastal scrub. Elevation range 5–150 m.
Lycium parishii Parish's desert-thorn	--/--	2B.3	–	Coastal scrub, Sonoran desert scrub. Elevation range 300–1,000 m.
Lyrocarpa coulteri Palmer's lyrepod	--/--	4.3	–	Sonoran desert scrub (gravelly or rocky). Elevation range 120–795 m.
Malacothamnus aboriginum Indian Valley bush-mallow	--/--	1B.2	–	Chaparral, cismontane woodland. Rocky, granitic soils, often in burned areas. Elevation range 150–1,700 m.
Malperia tenuis brown turbans	--/--	2B.3	–	Sonoran desert scrub. Sandy places and rocky slopes. Elevation range 15–335 m.
Matelea parvifolia spearleaf	--/--	2B.3	–	Mojavean desert scrub, Sonoran desert scrub. Dry rocky ledges and slopes. Elevation range 440–1,095 m.
Mentzelia hirsutissima hairy stickleaf	--/--	2B.3	–	Sonoran desert scrub. Washes, fans, slopes; coarse rubble and talus slopes; rocky sites. Elevation range -5–800 m.
Mentzelia tricuspis spiny-hair blazing star	--/--	2B.1	–	Sandy or gravelly slopes or washes in creosote-bush scrub. Elevation range 150–1,280 m.
Mentzelia tridentata creamy blazing star	--/--	1B.3	–	Mojavean desert scrub. Elevation range 700–1,160 m.
Microseris douglasii ssp. *platycarpha* small-flowered microseris		4.2	–	Cismontane woodland, coastal scrub, valley and foothill grassland, vernal pools/clay. Elevation range 15–1,070 m.
Mimulus aurantiacus var. *aridus* Jacumba monkey flower	--/--	4.3	–	Rocky chaparral, Sonoran desert scrub. Elevation range 750–1,200 m.
Mimulus clevelandii Cleveland’s bush monkey flower	--/--	4.2	–	Chaparral, cismontane woodland, lower montane coniferous forest/gabbroic, often in disturbed areas, openings, rocky. Elevation range 815–2,000 m.
Mimulus diffuses Palomar monkeyflower	--/--	4.3	–	Chaparral, yellow pine forest. Elevation range 0–2,100 m.
Mirabilis tenuiloba slender-lobed four o'clock	--/--	4.3	–	Sonoran desert scrub. Elevation range 300–1,095 m.

Species[1]	State/Federal Status[2]	CRPR List/Code[2]	Regional HCP/NCCP Coverage[3]	Habitat
Mobergia calculiformis light gray lichen	--/--	3	–	Coastal scrub. Abundant on cobbles in right habitat; only known from one site in Baja California and one in the San Diego area.
Monardella hypoleuca ssp. *intermedia* intermediate monardella	--/--	1B.3	–	Chaparral, oak woodland, occasionally conifer forest, dry slopes. Elevation range 200–1,250 m.
Monardella hypoleuca ssp. *lanata* felt-leaved monardella	--/--	1B.2	NE, MSCP (covered in all approved MSCP Subarea Plans except Poway)	Chaparral, cismontane woodland. Occurs in understory in mixed chaparral, chamise chaparral, and southern oak woodland; sandy soil. Elevation range 300–1,575 m.
Monardella macrantha ssp. *Hallii* Hall's monardella	--/--	1B.3	–	Broadleaved upland forest, chaparral, lower montane coniferous forest, cismontane woodland, valley and foothill grassland. Dry slopes and ridges in openings within the above communities. Elevation range 695–2,195 m.
Monardella nana ssp. *leptosiphon* San Felipe monardella	--/--	1B.2	–	Chaparral, lower montane coniferous forest. Sometimes in openings and fuel breaks or in the understory of forest or chaparral. Elevation range 1,200–1,855 m.
Monardella stoneana Jennifer's monardella	--/--	1B.2	–	Coastal scrub, chaparral, closed cone coniferous forest, riparian scrub. Usually found In rocky, intermittent streambeds. Elevation range 10–660 m.
Monardella viminea willowy monardella	FE/SE	1B.1	MSCP (covered in all approved MSCP Subarea Plans)	Coastal scrub/alluvial ephemeral washes with adjacent coastal scrub, chaparral, or sycamore woodland. In canyons, in rocky and sandy places, sometimes in washes or floodplains. Elevation range 50–225 m.
Mucronea californica California spineflower	--/--	4.2	–	Chaparral, cismontane woodland, coastal dunes, coastal scrub, valley and foothill grassland/sandy. Elevation range 0–1,400 m.
Muhlenbergia appressa appressed muhly	--/--	2B.2	–	Coastal scrub, Mojavean desert scrub, valley and foothill grassland/rocky. Elevation range 20–1,600 m.
Myosurus minimus ssp. *apus* little mousetail	--/--	3.1	NE, Carlsbad HMP	Vernal pools. Alkaline soils. Elevation range 20–640 m.

Species[1]	State/Federal Status[2]	CRPR List/Code[2]	Regional HCP/NCCP Coverage[3]	Habitat
Nama stenocarpum mud nama	--/--	2B.2	–	Marshes and swamps. Lake shores, riverbanks, intermittently wet areas. Elevation range 5–500 m.
Nasturtium gambelii Gambel's water cress	FE/ST	1B.1	–	Marshes and swamps. Freshwater and brackish marshes at the margins of lakes and along streams, in or just above the water level. Elevation range 5–1,305 m.
Navarretia fossalis spreading navarretia	FT	1B.1	NE, MSCP (covered in Chula Vista and City of San Diego Subarea Plans (CDFW only), and in VPHCP), Carlsbad HMP	Vernal pools, chenopod scrub, marshes and swamps, playas. San Diego hardpan and San Diego claypan vernal pools; in swales and vernal pools, often surrounded by other habitat types. Elevation range 30–1,300 m.
Navarretia peninsularis Baja navarretia	--/--	1B.2	–	Lower montane coniferous forest, chaparral. Wet areas in open forest. Elevation range 1,500–2,425 m.
Navarretia prostrata prostrate navarretia	--/--	1B.1	MSCP (covered in La Mesa and South County approved MSCP Subarea Plans)	Coastal scrub, valley and foothill grassland, vernal pools. Alkaline soils in grassland, or in vernal pools. Elevation range 15–700 m.
Nemacaulis denudata var. *denudata* coast woolly-heads	--/--	1B.2	–	Mildly protected coastal sand dunes. Elevation range 0–100 m.
Nemacaulis denudata var. *gracilis* slender woolly-heads	--/--	2B.2	–	Coastal dunes, desert dunes, Sonoran desert scrub. In dunes or sand. Elevation range 0–560 m.
Nemacladus twisselmannii Twisselmann's nemacladus	--/--	1B.2	–	Granitic sands, rocks, yellow pine forest and near pinyon pine woodland. Elevation of the known occurrence is 1,213 m.
Nolina cismontana chaparral nolina	--/--	1B.2	–	Chaparral, coastal scrub. Primarily on sandstone and shale substrates; also known from gabbro. Elevation range 140–1,275 m.

Species[1]	State/Federal Status[2]	CRPR List/Code[2]	Regional HCP/NCCP Coverage[3]	Habitat
Nolina interrata Dehesa nolina	SE/PT	1B.1	NE, MSCP (covered in all approved MSCP Subarea Plans except Poway)	Chaparral. Typically on rocky hillsides or ravines on ultramafic soils (gabbro or metavolcanic). Elevation range 180–855 m
Ophioglossum californicum California adder's-tongue	--/--	4.2	–	Chaparral, valley and foothill grassland, vernal pools (margins)/mesic. Elevation range 60–525m.
Orcuttia californica California Orcutt grass	FE/SE	1B.1	NE, MSCP (covered in all approved MSCP Subarea Plans except Poway), VPHCP, and Carlsbad HMP	Vernal pools. Elevation range 15–660 m.
Ornithostaphylos oppositifolia Baja California birdbush	SE	2B.1	–	Chaparral. Associated with *Ceanothus verrucosus* and *Salvia mellifera* in California. Elevation range 55–800 m.
Orobanche parishii ssp. *brachyloba* short-lobed broomrape	--/--	4.2	–	Coastal bluff scrub, coastal dunes, coastal scrub/sandy. Elevation range 60–525 m.
Packera ganderi Gander's ragwort	SR	1B.2	MSCP (covered in all approved MSCP Subarea Plans except Poway	Recently burned sites and gabbro outcrops. Elevation range 400–1,200 m.
Penstemon clevelandii var. *connatus* San Jacinto beardtongue	--/--	4.3	–	Chaparral, pinyon–juniper woodland, Sonoran desert scrub/rocky. Elevation range 400–1,500 m.
Penstemon thurberi Thurber's beardtongue	--/--	4.2	–	Chaparral, Joshua tree woodland, pinyon–juniper woodland, Sonoran desert scrub. Elevation range 500–1,200 m.
Pentachaeta aurea ssp. *aurea* golden-rayed pentachaeta	--/--	4.2	–	Chaparral, cismontane woodland, coastal scrub, lower montane coniferous forest, riparian woodland, valley and foothill grassland. Elevation range 80–1,850 m.

Species[1]	State/Federal Status[2]	CRPR List/Code[2]	Regional HCP/NCCP Coverage[3]	Habitat
Perideridia gairdneri ssp. *gairdneri* Gairdner's yampah	--/--	4.2	–	Broadleaved upland forest, chaparral, coastal prairie, valley and foothill grassland, vernal pools/vernally mesic. Elevation range 6–300 m.
Phacelia ramosissima var. *austrolitoralis* south coast branching phacelia	--/--	3.2	–	Chaparral, coastal dunes, coastal scrub, marshes and swamps (coastal salt)/sandy, sometimes rocky. Elevation range 0–365 m.
Phacelia stellaris Brand's phacelia	FC	1B.1	–	Coastal scrub, coastal dunes. Open areas. Elevation range 5–1,515 m.
Pholistoma auritum var. *arizonicum* Arizona pholistoma	--/--	2B.3	–	Mojavean desert scrub. Elevation range 275–835 m.
Pickeringia montana var. *tomentosa* Montane chaparral pea	--/--	4.3	–	Chaparral/gabbroic, granitic, clay. Elevation range 0–1,700 m.
Pilostyles thurberi Thurber's pilostyles	--/--	4.3	–	Sonoran desert scrub. Elevation range 0–365 m.
Pinus torreyana ssp. *torreyana* Torrey pine	--/--	1B.2	MSCP (covered in all approved MSCP Subarea Plans except Poway), Carlsbad HMP	Closed-cone coniferous forest, southern maritime chaparral. On dry, sandstone slopes. Elevation range 70–160 m.
Piperia cooperi chaparral rein orchid	--/--	4.2	–	Chaparral, cismontane woodland, valley and foothill grassland. Elevation range 15–585 m.
Piperia leptopetala narrow-petaled rein orchid	--/--	4.3	–	Cismontane woodland, lower montane coniferous forest, upper montane coniferous forest. Elevation range 380–2,225 m.
Poa atropurpurea San Bernardino blue grass	FE	1B.2	–	Meadows and seeps. Mesic meadows of open pine forests and grassy slopes, loamy alluvial to sandy loam soil. Elevation range 1,350–2,455 m.

Species[1]	State/Federal Status[2]	CRPR List/Code[2]	Regional HCP/NCCP Coverage[3]	Habitat
Pogogyne abramsii San Diego mesa mint	FE/SE	1B.1	MSCP (covered in all approved MSCP Subarea Plans except Poway) and VPHCP	Vernal pools. Vernal pools within grasslands, chamise chaparral or coastal sage scrub communities. Elevation range 90–200 m.
Pogogyne nudiuscula Otay Mesa mint	FE/SE	1B.1	MSCP (covered in all approved MSCP Subarea Plans except Poway) and VPHCP	Vernal pools. Dry beds of vernal pools and moist swales with *Eryngium aristulatum* var. *parishii* and *Orcuttia californica*. Elevation range 85–250 m.
Polygala acanthoclada thorny milkwort	--/--	2B.3	–	Desert scrub, Joshua-tree or pinyon–juniper woodland, generally in loose, sandy or gravelly soil. Elevation range 945–1,830 m.
Polygala cornuta var. *fishiae* Fish's milkwort	--/--	4.3	–	Chaparral, cismontane woodland, riparian woodland. Elevation range 100–1,000 m.
Proboscidea althaeifolia desert unicorn-plant	--/--	4.3	–	Sandy areas in Sonoran desert scrub. Elevation range 150–1,000 m.
Pseudognaphalium leucocephalum white rabbit-tobacco	--/--	2B.2	–	Chaparral, cismontane woodland, coastal scrub, riparian woodland/sandy, gravelly. Elevation range 0–2,100 m.
Pseudorontium cyathiferum Deep Canyon snapdragon	--/--	2B.3	–	Desert washes or rocky slopes. Elevation range 0–800 m.
Psilocarphus brevissimus var. *multiflorus* Delta woolly-marbles	--/--	4.2	–	Vernal pools and flats, Elevation range 10–500 m.
Quercus cedrosensis Cedros Island oak	--/--	2B.2	–	Closed-cone coniferous forest, chaparral, coastal scrub. Elevation range 225–488 m.

Species[1]	State/Federal Status[2]	CRPR List/Code[2]	Regional HCP/NCCP Coverage[3]	Habitat
Quercus dumosa Nuttall's scrub oak	--/FSC	1B.1	MHCP	Closed-cone coniferous forest, chaparral, coastal scrub. More common scrub oak now is *Q. berberidifolia*. Generally on sandy soils near the coast; sometimes on clay loam. Elevation range 15–400 m.
Quercus engelmannii Engelmann oak	--/--	4.2	–	Occurs in canyons and on open slopes in foothill and coastal regions, where it is associated with Engelmann oak woodland, chaparral, and grassland. Elevation ranges up to 1,300 m.
Rhus aromatica var. *simplicifolia* single-leaved skunkbrush	--/--	2B.3	–	Pinyon–juniper woodland. Elevation range 1,220–1,370 m.
Ribes amarum var. *hoffmannii* Hoffmann's bitter gooseberry	--/--	3	–	Chaparral, riparian woodland. Elevation range 150–1,190 m.
Ribes canthariforme Moreno currant	--/--	1B.3	–	Chaparral. Among boulders in oak–manzanita thickets; shaded or partially shaded sites. Elevation range 340–1,200 m.
Ribes viburnifolium Santa Catalina Island currant	--/--	1B.2	–	Chaparral. Among shrubs in canyons. Elevation range 30–300 m.
Romneya coulteri Coulter's matilija poppy	--/--	4.2	–	Chaparral, coastal scrub; often in burns. Elevation range 20–1,200 m.
Rosa minutifolia small-leaved rose	SE	2B.1	MSCP (covered in all approved MSCP Subarea Plans except Poway)	Coastal scrub, chaparral. In California, on cobbly soil at the head of a small, dry canyon on Otay Mesa. Elevation range 150–160 m.
Rubus glaucifolius Cuyamaca raspberry	--/--	3.1	–	The variety *R. c.* var. *ganderi* is no longer recognized as a separate taxa (Baldwin 2012). Lower montane coniferous forest. Open, moist forest; gabbro soils. Elevation range 1,200–1,730 m.
Rupertia rigida Parish's rupertia	--/--	4.3	–	Chaparral, cismontane woodland, lower montane coniferous forest, meadows and seeps, pebble plain, valley and foothill grassland. Elevation range 700–25,00 m.

Species[1]	State/Federal Status[2]	CRPR List/Code[2]	Regional HCP/NCCP Coverage[3]	Habitat
Saltugilia caruifolia caraway-leaved woodland-gilia	--/--	4.3	–	Chaparral, lower montane coniferous forest/sandy, openings. Elevation range 1,400–2,300 m.
Salvia eremostachya desert sage	--/--	4.3	–	Sonoran desert scrub (rocky or gravelly). Elevation range 700–1,400 m.
Salvia munzii Munz' sage	--/--	2B.2	–	Coastal scrub, chaparral. Rolling hills and slopes, in rocky soil. Elevation range 120–1,090 m.
Schizymenium shevockii Shevock's copper-moss	--/--	1B.2	–	Cismontane woodland. On metamorphic rocks, mesic sites. On rocks along roads. Elevation range 750–1,400 m.
Scutellaria bolanderi ssp. *austromontana* southern skullcap	--/--	1B.2	–	Chaparral, cismontane woodland, lower montane coniferous forest. In gravelly soils on stream banks or in mesic sites in oak or pine woodland. Elevation range 425–2,000 m.
Selaginella asprella bluish spike-moss	--/--	4.3	–	Cismontane woodland, lower montane coniferous forest, pinyon–juniper woodland, subalpine coniferous forest, upper montane coniferous forest/granitic, rocky. Elevation range 1,600–2,700 m.
Selaginella cinerascens ashy spike-moss	--/--	4.1	–	Chaparral, coastal scrub. Elevation range 20–640 m.
Selaginella eremophila desert spike-moss	--/--	2B.2	–	Sonoran desert scrub. Shaded sites, gravelly soils; crevices or among rocks. Elevation range 300–2,425 m.
Senecio aphanactis rayless ragwort	--/--	2B.2	–	Cismontane woodland, coastal scrub. Drying alkaline flats. Elevation range 20–575 m.
Senecio astephanus San Gabriel ragwort	--/--	4.3	–	Coastal bluff scrub, chaparral/rocky slopes. Elevation range 400–1,500 m.
Senna covesii Coves' cassia	--/--	2B.2	–	Sonoran desert scrub. Dry, sandy desert washes, slopes. Elevation range 200–1,070 m.
Sibaropsis hammittii Hammitt's clay-cress	--/--	1B.2	–	Valley and foothill grassland, chaparral. Mesic microsites in open areas on clay soils in grassland. Elevation range 730–1,065 m.

Species[1]	State/Federal Status[2]	CRPR List/Code[2]	Regional HCP/NCCP Coverage[3]	Habitat
Sidalcea neomexicana Salt Spring checkerbloom	--/--	2B.2	–	Alkali playas, brackish marshes, chaparral, coastal scrub, lower montane coniferous forest, Mojavean desert scrub. Elevation range 0–1,500 m.
Solanum xanti [S.tenuilobatum] narrow-leaved nightshade	--/--		MSCP (covered in all approved MSCP Subarea Plans)	*S. tenuilobatum* is considered a synonym of *S. xanti*, (Baldwin 2012), a common species, and is therefore no longer considered sensitive.
Spermolepis echinata bristly scaleseed	--/--	2B.3	–	Sonoran desert scrub. Sandy or rocky sites. Elevation range 60–1,500 m.
Sphaerocarpos drewei bottle liverwort	--/--	1B.1	–	Chaparral, coastal scrub. In openings; on soil. Elevation range 90–600 m.
Sphenopholis obtusata prairie wedge grass	--/--	2B.2	–	Wet meadows, stream banks, and ponds. Elevation range 240–2,870 m.
Stemodia durantifolia purple stemodia	--/--	2B.1	–	Sonoran desert scrub, sandy soils; mesic sites. Elevation range 180–300 m.
Stipa diegoensis San Diego County needle grass	--/--	4.2	–	Chaparral, coastal scrub. Found in rocky, often mesic substrates. Elevation ranges up to 2,280 m.
Streptanthus bernardinus Laguna Mountains jewel-flower	--/--	4.3	–	Chaparral, lower montane coniferous forest. Elevation range 670–2,500 m.
Streptanthus campestris southern jewel-flower	--/--	1B.3	–	Chaparral, lower montane coniferous forest, pinyon–juniper woodland, open, rocky areas. Elevation range 600–2,790 m.
Stylocline citroleum oil neststraw	--/--	1B.1	–	Open, stable, often crusted sand, clay, dry drainage edges, between *Atriplex* shrubs. Elevation range 60–300 m.
Suaeda esteroa estuary seablite	--/--	1B.2	–	Coastal salt marshes and swamps, in clay, silt, and sand substrates. Elevation range 0–5 m.
Suaeda taxifolia woolly seablite	--/--	4.2	–	Coastal bluff scrub, coastal dunes, marshes and swamps (margins of coastal salt). Elevation range 0–50 m.

Species[1]	State/Federal Status[2]	CRPR List/Code[2]	Regional HCP/NCCP Coverage[3]	Habitat
Symphyotrichum defoliatum San Bernardino aster	--/--	1B.2	–	Meadows and seeps, marshes and swamps, coastal scrub, cismontane woodland, lower montane coniferous forest, grassland. Vernally mesic grassland or near ditches, streams and springs; disturbed areas. Elevation range 2–2,040 m.
Tetracoccus dioicus Parry's tetracoccus	--/--	1B.2	MSCP (covered in all approved MSCP Subarea Plans except Poway)	Chaparral, coastal scrub, stony, decomposed gabbro soil. Elevation range 150–1,000 m.
Texosporium sancti-jacobi woven-spored lichen	--/--	3	–	Chaparral, open sites. Elevation range 290–660 m.
Thermopsis californica var. *semota* velvety false lupine	--/--	1B.2	–	Lower montane coniferous forest. Elevation range 1,000–1,870 m.
Triquetrella californica coastal triquetrella	--/--	1B.2	–	Coastal bluff scrub, coastal scrub. Moss growing on soil. Elevation range 10–100 m.
Viguiera laciniata San Diego County viguiera	--/--	4.2	–	Chaparral, coastal scrub. Elevation range 60–750 m.
Viguiera purisimae La Purisima viguiera	--/--	2B.3	–	Coastal bluff scrub, chaparral. Elevation range 365–425 m.
Wislizenia refracta ssp. *palmeri* Palmer's jackass clover	--/--	2B.2	–	Chenopod scrub, desert dunes, Sonoran desert scrub, Sonoran thorn woodland. Elevation range 0–300 m.

[1]Botanical species nomenclature follows Rebman and Simpson (2014) *Checklist of the Vascular Plants of San Diego County*. Elevation follows Baldwin et al. 2012 and Jepson Flora Project. Occurrences cross-checked with CalFlora 2021 and CNDDB 2021.
[2]Sensitivity Codes:
State Listed Plants: SE = State-listed, endangered; SR = State-listed, rare; ST = State-listed, threatened
Federal Candidates and Listed Plants: FE = Federally listed, endangered; FT = Federally listed, threatened; FC = Candidate for federal listing
CRPR Threat Code Extensions: .1 = Seriously endangered in California; .2 = Fairly endangered in California; .3 = Not very threatened in California
California Rare Plant Rank (CaRPR): 1A = Species presumed extinct; 1B = Species rare, threatened, or endangered in California and elsewhere; 2A = Plants Presumed Extirpated in California, but more common elsewhere. These species are eligible for state listing; 2B = Species rare, threatened, or endangered in California but which are more common elsewhere. These species are eligible for state listing; 3 = Species for which more information is needed. Distribution, endangerment, and/or taxonomic information is needed.
4 = A watch list of species of limited distribution. These species need to be monitored for changes in the status of their populations.

[3]HC/NCCP coverage is based on the cities of Chula Vista, La Mesa, Poway, and San Diego and the County of San Diego (South County), which have adopted Subarea Plans (i.e., NCCP/HCP) under the San Diego County MSCP, and the City of Carlsbad, which has an adopted Subarea Plan (i.e., NCCP/HCP) under the MHCP. Codes are as follows: MSCP = Multiple Species Conservation Program covered species; MHCP = Multiple Habitat Conservation Program covered species; NE = MSCP or MHCP narrow endemic species; OW = Obligate Wetland Species

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APPENDIX E-3
SENSITIVE WILDLIFE SPECIES

Species[1]	Sensitivity Status[2]	Regional HCP/NCC Coverage[3]	Habitat
Crustaceans			
Branchinecta sandiegonensis San Diego fairy shrimp	FE, IUCN:EN	MSCP: (covered in all approved MSCP Subarea Plans and the VPHCP)	Vernal pools. Endemic to mesas in San Diego and Orange counties.
Streptocephalus woottoni Riverside fairy shrimp	FE, IUCN:EN	MSCP: (covered in all approved MSCP Subarea Plans and the VPHCP)	Endemic to western Riverside, Orange, and San Diego counties in areas of tectonic swales/earth slump basins in grassland and coastal sage scrub.
Insects			
Euphyes vestris harbisoni dun skipper	FSC	MHCP	This species is restricted to riparian areas, intermittent streams, and oak woodlands where its larval host plant, San Diego sedge (*Carex spissa*), is present.
Cicindela hirticollis gravida sandy beach tiger beetle	–	–	Inhabits areas adjacent to non-brackish water along the coast of California from San Francisco Bay to northern Mexico. Prefers clean, dry, light-colored sand in the upper zone. Subterranean larvae prefer moist sand not affected by wave action.
Anomala carlsoni Carlson's dune beetle	–	–	Host preferences unknown. Known primarily from creosote bush scrub. Once found in Borrego Springs, San Diego County.
Callophrys thornei Thorne's hairstreak	BLM:S2	MSCP: (covered in all approved MSCP Subarea Plans)	Occurs exclusively in cypress woodland.
Cicindela gabbii western tidal-flat tiger beetle	–	–	Inhabits estuaries and mudflats along the coast of southern California. Generally found on dark-colored mud in the lower zone; occasionally found on dry saline flats of estuaries.

Species[1]	Sensitivity Status[2]	Regional HCP/NCC Coverage[3]	Habitat
Cicindela latesignata latesignata western beach tiger beetle	–	–	Mudflats and beaches in coastal southern California.
Cicindela senilis frosti senile tiger beetle	–	–	Inhabits marine shoreline, from central California coast south to salt marshes of San Diego. Also found at Lake Elsinore. Inhabits dark- colored mud in the lower zone and dried salt pans in the upper zone.
Coelus globosus globose dune beetle	IUCN:VU	–	Inhabits coastal sand dune habitat, from Bodega Head in Sonoma County south to Ensenada, Mexico. Inhabits foredunes and sand hummocks; it burrows beneath the sand surface, and is most common beneath dune vegetation.
Danaus plexippus monarch butterfly	USFS:S	–	Roosts located in wind-protected tree groves (eucalyptus, Monterey pine, cypress), with nectar and water sources nearby. Winter roost sites extend along the coast from northern Mendocino to Baja California, Mexico.
Euphydryas editha quino quino checkerspot butterfly	FE, Xerces:CI	–	Sunny openings within chaparral and coastal sage shrublands in parts of Riverside and San Diego counties. Host plants include *Plantago erecta, p. patagonica, Castilleja exserta, Anterrhinum coulterianum, Cordylanthus rigidus, and Collinsia concolor.*
Halictus harmonius haromonius halictid bee	Xerces:CI	–	Known only from the foothills of the San Bernardino Mountains and possibly found in San Jacinto Mountains. Habitat preferences not well studied to date.
Lycaena hermes Hermes copper butterfly	FC, IUCN:VU, USFS:S	MHCP	Found in southern mixed chaparral and coastal sage scrub at western edge of Laguna mountains. Host plant is *Rhamnus crocea*.

Species[1]	Sensitivity Status[2]	Regional HCP/NCC Coverage[3]	Habitat
Melitta californica California mellitid bee	–	–	Found in desert regions. Habitat preferences not well studied to date.
Oliarces clara Cheeseweed owlfly (cheeseweed moth lacewing)	–	–	Occurs in bajadas in association with creosote bush scrub.
Panoquina errans wandering (saltmarsh) skipper	FSC, IUCN:NT	MSCP (covered in all approved MSCP Subarea Plans) MHCP: OW	Southern California coastal salt marshes. Requires moist saltgrass for larval development.
Parnopes borregoensis Borrego parnopes cuckoo wasp	–	–	Found in Anza-Borrego Desert State Park. Habitat preferences not well studied to date.
Pyrgus ruralis lagunae Laguna Mountains skipper	FE, Xerces:CI	–	Only in a few open meadows in yellow pine forest between 5,000 and 6,000 feet above sea level in the vicinity of Mount Laguna and Palomar mountains. Host plant is *Horkelia bolanderi clevelandi.*
Mollusks			
Helminthoglypta coelata mesa shoulderband	IUCN:VU	–	Found in rock slides, beneath bark and rotten logs, and among coastal vegetation. Known only from a few locations in coastal San Diego County.
Helminthoglypta milleri peak shoulderband	–	–	Found in rock piles. Known only from the type locality at Cuyamaca peak in San Diego County.
Rothelix warnerfontis Warner Springs shoulderband	USFS:S	–	Abandoned wood rat nests and fallen logs and leaf mold of *Quercus agrifolia*.

Species[1]	Sensitivity Status[2]	Regional HCP/NCC Coverage[3]	Habitat
Tryonia imitator mimic tryonia California brackishwater snail	IUCN:DD	–	Found only in permanently submerged areas in a variety of sediment types; able to withstand a wide range of salinities. Inhabits coastal lagoons, estuaries, and salt marshes, from Sonoma County south to San Diego County.
Fish			
Cyprinodon macularius desert pupfish	FE, CE, AFS:EN	–	Desert ponds, springs, marshes and streams in southern California.
Gasterosteus aculeatus williamsoni unarmored threespine stickleback	FE, CE, CFP, AFS:EN	–	Found in weedy pools, backwaters, and among emergent vegetation at the stream edge in small streams.
Gila orcuttii arroyo chub	CSC, AFS:VU, USFS:S	–	Found in weedy pools, backwaters, and among emergent vegetation at the stream edge in small streams.
Oncorhynchus mykiss irideus southern steelhead – southern California DPS	FE, CSC, AFS:EN	–	Federal listing refers to populations from Santa Maria River south to southern extent of range (San Mateo Creek in San Diego County).
Eucyclogobius newberryi tidewater goby	FE, CSC, AFS:EN, IUCN:VU	–	Found in shallow lagoons and lower stream reaches with still but not stagnant water and high oxygen levels. Brackish water habitats are along the California coast from Agua Hedionda Llagoon, San Diego County to the mouth of the Smith River.
Amphibians			
Anaxyrus californicus Arroyo toad	FE, CSC, IUCN:EN	MSCP: (covered in all approved MSCP Subarea Plans)	Rivers with sandy banks, willows, cottonwoods, and sycamores; loose, gravelly areas of streams in drier parts of range.

Species[1]	Sensitivity Status[2]	Regional HCP/NCC Coverage[3]	Habitat
Ensatina klauberi large-blotched salamander	CSC, USFS:S	–	Moist shaded evergreen and deciduous forests and oak woodlands and higher elevations. Found under rocks, logs, other debris, especially bark that has peeled off and fallen beside logs and trees. Most common where there is a lot of coarse woody debris on the forest floor.
Rana draytonii California red-legged frog	FT, CSC, IUCN:VU	MSCP: (covered in all approved MSCP Subarea Plans)	Slow parts of streams, lakes, reservoirs, ponds, and other usually permanent water sources; primarily in wooded areas in lowlands and foothills, but also can be found in grassland. Typical habitat consists of deep-water pools ringed by thick vegetation (especially arroyo willow or native cattails). Extirpated in San Diego County.
Rana muscosa Southern mountain yellow-legged frog	FE, CE, CSC, IUCN:EN, USFS:S	–	Always encountered within a few feet of water. Federal listing refers to populations in the San Gabriel, San Jacinto and San Bernardino mountains only.
Spea hammondii western spadefoot	CSC, BLM:S, IUCN:NT	–	Occurs primarily in grassland and coastal sage scrub habitats, but can be found in valley-foothill hardwood woodlands. Vernal pools are essential for breeding.
Taricha torosa Coast Range newt	CSC	–	Lives in terrestrial habitats oak forests and chaparral, grasslands and breeds in ponds, reservoirs, coastal drainages, or slow moving streams.
Reptiles			
Anniella pulchra pulchra silvery legless lizard	CSC, USFS:S	MSCP (Poway MSCP only)	Sandy or loose loamy soils under sparse vegetation. Prefers soils with high moisture content.

Species[1]	Sensitivity Status[2]	Regional HCP/NCC Coverage[3]	Habitat
Aspidoscelis hyperythra orangethroat whiptail	CSC, IUCN:LC	MSCP (covered in all approved MSCP Subarea Plans) MHCP	Inhabits low-elevation coastal sage scrub, chaparral, riparian habitats, and valley-foothill hardwood habitats.
Aspidoscelis tigris stejnegeri coastal whiptail Aspidoscelis tigris stejnegeri		MSCP (Poway MSCP only)	Found in areas with sparse vegetation, open areas, and in woodland and riparian areas.
Charina trivirgata rosy boa	IUCN:LC, USFS:S	MSCP (Poway MSCP only)	Desert, scrub chaparral from the coast to the Mojave and Colorado deserts. Prefers habitats with a mix of brushy cover and rocky soil such as coastal canyons and hillsides, desert canyons, washes, and mountains.
Chelonia mydas green turtle	FT	–	Warm waters of San Diego Bay and adjacent ocean areas.
Coleonyx switaki barefoot gecko	CT, IUCN:LC, BLM:S	–	Found in arid rocky areas on flatlands, canyons, and thornscrub, especially where there are large boulders and rock outcrops, and where vegetation is sparse.
Coleonyx variegatus abbotti San Diego banded gecko	–	–	Found in granite or rocky outcrops in coastal scrub and chaparral habitats in coastal and cismontane southern California.
Crotalus ruber red-diamond rattlesnake	CSC, USFS:S	MSCP (Poway MSCP only)	Occurs in rocky areas and dense vegetation in chaparral, woodland, grassland, and desert areas from coastal San Diego County to the eastern slopes of the mountains.
Diadophis punctatus similis San Diego ringneck snake	USFS:S	MSCP (Poway MSCP only)	Moist habitats, including wet meadows, rocky hillsides, gardens, farmland, grassland, chaparral, mixed coniferous forests, and woodlands.
Emys marmorata western pond turtle	CSC, BLM:S, IUCN:VU, USFS:S	MSCP: (covered in all approved MSCP Subarea Plans)	Slow-moving permanent or intermittent streams, small ponds, and small lakes.

Species[1]	Sensitivity Status[2]	Regional HCP/NCC Coverage[3]	Habitat
Lampropeltis zonata (pulchra) California mountain kingsnake (San Diego population)	CSC, IUCN:LC, BLM:S, USFS:S	–	Inhabits a variety of habitats, including valley-foothill hardwood, coniferous, chaparral, riparian, and wet meadows.
Phrynosoma blainvillii Coast horned lizard	CSC, BLM:S, IUCN:LC	MSCP (covered in all approved MSCP Subarea Plans)	Prefers friable, rocky, or shallow sandy soils in coastal sage scrub and chaparral.
Phrynosoma mcallii flat-tailed horned lizard	CCE, CSC, BLM:S, IUCN:NT	–	Restricted to fine wind-blown sand in desert washes, desert flats, and areas with creosote bush scrub in eastern San Diego county.
Plestiodon skiltonianus interparietalis Coronado island skink	CSC, BLM:S	MSCP (Poway MSCP only)	Prefers early successional stages or open areas. Found in rocky areas close to streams and on dry hillsides in grassland, scrub, chaparral, pinon-juniper and juniper sage woodland, pine-oak and pine forests in coast ranges of southern California.
Salvadora hexalepis virgultea coast patch-nosed snake	CSC	MSCP (Poway MSCP only)	Coastal sage scrub and chaparral in coastal southern California.
Sceloporus orcutti Granite Spiny Lizard	–	MSCP (Poway MSCP only)	Found on the desert slopes of the mountains and on the coastal side inland to near the coast and north to the Santa Ana River where there are large boulders and granite cliffs~~is~~ with mixed vegetation, including chaparral, scrub, and forest/woodland areas.
Thamnophis hammondii two-striped garter snake	CSC, BLM:S, IUCN:LC, USFS:S	MSCP (Poway MSCP only)	Highly aquatic, found in or near permanent fresh water. Often along streams with rocky beds and riparian from sea level to about 7,000 feet in elevation.

Species[1]	Sensitivity Status[2]	Regional HCP/NCC Coverage[3]	Habitat
Thamnophis sirtalis ssp. south coast garter snake	CSC	–	Utilizes a wide variety of habitats including forests, mixed woodlands, grassland, chaparral, farmlands, ponds, marshes, and/or streams.
Uma notata Colorado Desert fringe-toed lizard	CSC, BLM:S, IUCN:NT	–	Colorado desert region; in sand dunes, dry lakebeds, sandy beaches or riverbanks, desert washes, or sparse desert scrub. Requires fine, loose, windblown sand (for burrowing).
Xantusia gracilis sandstone night lizard	CSC, IUCN:VU	–	Inhabits a very small area of sandstone and mudstone.
Birds			
Ardea alba great egret	CDF:S, IUCN:LC (nesting colony)	–	Nests in tall, large trees in proximity to ponds, lakes, streams, or other water sources.
Ardea herodias great blue heron	CDF:S, IUCN:LC (nesting colony)	–	Nests in dense reeds in proximity to ponds, lakes, or other permanent water sources.
Botaurus lentiginosus American bittern	IUCN:LC	–	Nests in tall, large trees in proximity to ponds, lakes, streams, or other water sources.
Egretta thula snowy egret	IUCN:LC (nesting colony)	–	Nests in tall, large trees in proximity to ponds, lakes, streams, or other water sources.
Egretta rufescens Reddish egret	–	MSCP (covered in all approved MSCP Subarea Plans except Poway)	Salt marsh and estuarine habitats.
Aquila chrysaetos golden eagle	BCC, SSC, BEPA, CFP, CWL, CDF:S, BLM:S, IUCN:LC (nesting and wintering)	MSCP: NENE, MSCP (covered in all approved MSCP Subarea Plans)	Rolling foothills, mountain areas, sage-juniper flats, and desert. Cliff- walled canyons provide nesting habitat in most parts of range; also large trees in open areas.

Species[1]	Sensitivity Status[2]	Regional HCP/NCC Coverage[3]	Habitat
Icteria virens yellow-breasted chat	CSC, IUCN:LC (nesting)	MHCP: OW	Summer breeding resident; inhabits riparian thickets of willow and other brushy tangles near watercourses. Nests in low, dense riparian, consisting of willow, blackberry, wild grape; forages and nests within 10 feet of ground.
Accipiter cooperii Cooper's hawk	SSC, CWL, IUCN:LC (nesting)	MSCP (covered in all approved MSCP Subarea Plans) MHCP	Nests mainly in riparian growths of deciduous trees, as in canyon bottoms on river floodplains; also, live oaks.
Agelaius tricolor tricolored blackbird	BCC, CSC, ABC:WLBCC, BLM:S, IUCN:EN (nesting)	MSCP (covered in all approved MSCP Subarea Plans)	Freshwater marshes with cattails and other emergent vegetation.
Aimophila ruficeps canescens southern California rufous-crowned sparrow	FSC, SSC, CWL	MSCP (covered in all approved MSCP Subarea Plans) MHCP	Grassy or rocky slopes with open scrub at elevations from sea level to 2,000 feet. Occurs mainly in coastal sage scrub.
Ammodramus savannarum grasshopper sparrow	CSC, IUCN:LC (nesting)	–	Favors native grasslands with a mix of grasses, forbs, and scattered shrubs.
Amphispiza belli Bell's sparrow	BCC, CWL, ABC:WLBCC	–	Occurs mainly in coastal sage scrub and chaparral habitats.
Asio otus long-eared owl	CSC, IUCN:LC (nesting)	–	Riparian bottomlands grown to tall willows and cottonwoods; also belts of live oak paralleling stream courses.
Athene cunicularia burrowing owl	BCC, CSC, BLM:S, IUCN:LC (burrow sites & some wintering sites)	MSCP: (covered in all approved MSCP Subarea Plans)	Open, dry annual or perennial grasslands, deserts, and scrublands characterized by low-growing vegetation. Subterranean nester, dependent upon burrowing mammals, most notably, the California ground squirrel.
Baeolophus inornatus oak titmouse	BCC, ABC:WLBCC, IUCN:LC (nesting)	–	Nests primarily in tree cavities in oak trees, but also known to use sycamores.
Branta bernicla Brant	CSC, IUCN:LC (wintering and staging)	–	Brackish water marsh, lagoons, and estuarine environments where eel grass is prevalent.

Species[1]	Sensitivity Status[2]	Regional HCP/NCC Coverage[3]	Habitat
Branta canadensis Canada goose	–	MSCP (covered in all approved MSCP Subarea Plans except Poway)	Salt marsh, freshwater marsh, grassland, agricultural fields.
Buteo regalis ferruginous hawk	BCC, SSC, CWL, IUCN:LC (wintering)	MSCP (covered in all approved MSCP Subarea Plans)	Open grasslands, sagebrush flats, desert scrub, low foothills, and fringes of pinyon–juniper habitats.
Buteo swainsoni Swainson's hawk	BCC, CT, BLM:S, ABC:WLBCC, IUCN:LC, USFS:S (nesting)	MSCP (covered in all approved MSCP Subarea Plans)	Inhabits grasslands, scrub, and agricultural habitats.
Calypte costae Costa's hummingbird	ABC:WLBCC, IUCN:LC (nesting)	–	Common and widespread breeder in a variety of habitats from desert scrublands, chaparral, sycamore, oak, and riparian woodlands.
Campylorhynchus brunneicapillus sandiegensis coastal cactus wren	BCC, CSC, USFS:S	MSCP: NENE, MSCP (covered in all approved MSCP Subarea Plans)	Coastal sage scrub with extensive stands of tall prickly pear or cholla cacti (*Opuntia* sp.).
Cardinalis cardinalis northern cardinal	CWL, IUCN:LC	–	Known to occasionally occur in the Tijuana River Valley.
Charadrius montanus mountain plover	FPT, BCC, CSC, ABC:WLBCC, BLM:S, IUCN:NT (wintering)	MSCP (covered in all Approved MSCP Subarea Plans except Poway)	Associated with dirt or short growing agricultural fields and grassland. Prefers recently plowed or burned fields.
Charadrius nivosus nivosus western snowy plover	FT, BCC, CSC, ABC:WLBCC (nesting)	MSCP (covered in all Approved MSCP Subarea Plans except Poway) MHCP: OW	Sandy beaches, salt pond levees, and shores of large alkali lakes. Requires sandy, gravelly or friable soils for nesting.
Chondestes grammacus lark sparrow	IUCN:LC (nesting)	–	Occurs in open habitats adjacent to trees, brush, shrubs, and chaparral.
Circus cyaneus northern harrier	CSC, IUCN:LC (nesting)	MSCP (covered in all approved MSCP Subarea Plans)	Coastal salt and fresh-water marsh. Nests and forages in grasslands, from salt grass in desert sink to mountain cienagas.
Cistothorus palustris clarkae Clark's marsh wren	CSC	–	Nests along the coast in coastal salt marsh, fresh water marsh, and areas of permanent water with reedy vegetation.

Species[1]	Sensitivity Status[2]	Regional HCP/NCC Coverage[3]	Habitat
Coccyzus americanus (western DPS) western yellow-billed cuckoo	FT, BCC,CE, BLM:S, USFS:S (nesting)	–	Riparian forest nester, along the broad, lower flood-bottoms of larger river systems often mixed with cottonwoods, with lower story of blackberry, nettles, or wild grape.
Contopis cooperi olive-sided flycatcher	BCC, CSC, ABC:WLBCC, IUCN:NT (nesting)	–	An uncommon summer resident of coniferous woodlands in San Diego County.
Dendroica petechia yellow warbler	BCC, CSC (nesting)	–	A fairly common summer breeding resident found along mature riparian woodlands consisting of cottonwood, willow, alder, and ash trees. Restricted to this increasingly patchy habitat.
Elanus leucurus white-tailed kite	CFP, BLM:S, IUCN:LC (nesting)	–	Open grasslands, meadows, or marshes for foraging and isolated, dense-topped trees for nesting and perching.
Empidonax traillii extimus southwestern willow flycatcher	FE, CE, ABC:WLBCC (nesting)	MSCP: (covered in all approved MSCP Subarea Plans) MHCP: OW	Restricted to a few colonies in riparian woodlands scattered throughout southern California. Riparian forests are integral to this species' persistence.
Eremophila alpestris actia California horned lark	CWL, IUCN:LC	–	Found year-round in coastal strand, grasslands, and sandy deserts of San Diego County. Typically a disturbance regime species exploiting the open ground following plowed fields or fire in search of insects.
Falco columbarius merlin Falco columbarius	CWL, IUCN:LC (wintering)	–	Marshes, deserts, seacoasts, near coastal lakes and lagoons, open woodlands, and fields. May roost in conifers.
Falco mexicanus prairie falcon	BCC, CSC, IUCN:LC (nesting)	–	Inhabits dry, open terrain, either level or hilly. Breeding sites located on cliffs.
Falco peregrinus anatum American peregrine falcon	CE, FP, BCC, CFP, CDF:S (nesting)	MSCP: NENE, MSCP (covered in all approved MSCP Subarea Plans) MHCP	Coastal wetland areas, extensive riparian areas, and lakes.

Species[1]	Sensitivity Status[2]	Regional HCP/NCC Coverage[3]	Habitat
Gelochelidon nilotica gull-billed tern	BCC, CSC, ABC:WLBCC, IUCN:LC (nesting colony)	–	Only nesting is in south San Diego Bay salt works on bare dirt along the tops of dikes.
Haematopus bachmani black oystercatcher	BCC, IUCN:LC (nesting)	–	Rocky shoreline around Point Loma and North Island.
Haliaeetus leucocephalus bald eagle	BCC, CE, CFP, BEPA, BLM:S, CDF:S, IUCN:LC, USFS:S (nesting and wintering)	MSCP (covered in all approved MSCP Subarea Plans)	Occurs primarily near large lakes with open water. Also, known to nest in grasslands near small ponds.
Hydroprogne caspia Caspian tern	BCC, IUCN:LC (nesting colony)	–	Only nesting is in south San Diego Bay salt works on bare dirt along the tops of dikes.
Ixobrychus exilis least bittern	BCC, CSC, IUCN:LC (nesting)	–	Colonial nester in marshlands and borders of ponds and reservoirs that provide ample cover.
Lanius ludovicianus loggerhead shrike	BCC, CSC, IUCN:LC (nesting)	–	Uncommon year- round resident of San Diego County. Found in grassland, chaparral, desert, and desert edge scrub, particularly near dense vegetation that it uses for concealing and protecting the nest.
Passerculus sandwichensis rostratus large-billed savannah sparrow	FSC, CSC (wintering)	MSCP (covered in all approved MSCP Subarea Plans except Poway) MHCP: OW	Found along beaches and shores with marsh habitat.
Laterallus jamaicensis coturniculus California black rail	BCC, CT, CFP, BLM:S, ABC:WLBCC, IUCN:NT	–	Inhabits freshwater marshes, wet meadows, and shallow margins of saltwater marshes bordering larger bays. Extirpated in San Diego County.
Numenius americanus long-billed curlew	BCC, SSC, CWL, ABC:WLBCC, IUCN:LC (nesting)	MSCP (covered in all Approved MSCP Subarea Plans except Poway)	Tidal mudflats, coastal strand, salt marshes, fallow agricultural fields, and grasslands along the coast. Uncommon migrant and winter visitor to San Diego County.

Species[1]	Sensitivity Status[2]	Regional HCP/NCC Coverage[3]	Habitat
Nycticorax nycticorax black-crowned night heron	IUCN: LC (nesting colony)	–	Nests in tall, large trees in proximity to ponds, lakes, streams, or other water sources.
Oreothlypis luciae Lucy's warbler	BCC, CSC, BLM:S, ABC:WLBCC, IUCN:LC (nesting)	–	Nests in Borrego Valley mesquite bosque.
Pandion haliaetus Osprey	SSC, CWL, CDF:S, IUCN:LC (nesting)	MHCP: OW	Ocean shore, bays, freshwater lakes, and larger streams.
Parabuteo unicinctus Harris' hawk	CDFW: WL, IUCN:LC (nesting)	–	Nests in tall oak and other tree species in eastern San Diego County near the desert and desert transition zone.
Passerculus sandwichensis beldingi Belding's savannah sparrow	CE, FSC	MSCP: (covered in all Approved MSCP Subarea Plans except Poway) MHCP: OW	Occurs primarily in grassland, saline emergent wetland, and wet meadow habitats.
Pelecanus occidentalis californicus California brown pelican	FE, CE, CFP, BLM:S, USFS:S, (nesting colony & communal roosts)	MSCP (covered in all approved MSCP Subarea Plans except Poway) MHCP: OW	Open ocean, coastal strand, harbors, bays, and estuaries.
Phalacrocorax auritus double-crested cormorant	CWL, IUCN:LC (nesting colony)	–	Nests along coast on sequestered islets. Usually on ground with sloping surface, or in tall trees along lake margins.
Picoides albolarvatus white-headed woodpecker	BCC, ABC:WLBCC, IUCN:LC (nesting)	–	Breeds in few locations in high elevation coniferous forests where sugar pine is dominant.
Picoides nuttallii Nuttall's woodpecker	BCC, ABC:WLBCC, IUCN:LC (nesting)	–	Breeds throughout San Diego County (except in desert regions) in oak and riparian forests.
Piranga rubra summer tanager	CSC: IUCN:LC (nesting)	–	Nests in mature riparian vegetation where Fremont cottonwood (*Populus fremontii*) is a dominant species.
Plegadis chihi white-faced ibis	FSC, SSC, CWL, IUCN:LC (nesting colony)	MSCP (covered in all approved MSCP Subarea Plans except Poway) MHCP: OW	Shallow fresh-water marsh. Dense tule thickets for nesting interspersed with areas of shallow water for foraging.

Species[1]	Sensitivity Status[2]	Regional HCP/NCC Coverage[3]	Habitat
Polioptila californica californica coastal California gnatcatcher	FT, CSC, ABC:WLBCC	MSCP (covered in all approved MSCP Subarea Plans) MHCP	Diegan coastal sage scrub dominated by California sagebrush (*Artemisia californica*) and flat-topped buckwheat (*Eriogonum fasciculatum*) below 2,500 feet elevation in Riverside County and below 1,000 feet elevation along the coastal slope; generally avoids steep slopes above 25% and dense, tall vegetation for nesting.
Progene subis purple martin	CSC, IUCN:LC (nesting)	–	Found throughout the United States but is rare in San Diego County. Restricted to mountain region of San Diego County. Nests in isolated snags with holes.
Pyrocephalus rubinus vermillion flycatcher	CSC, IUCN:LC (nesting)	–	Breeds in golf courses and areas with short grass, often near sources of water. Also nests in desert riparian areas.
Rallus obsoletus Ridgway's rail	FE, CE, CFP, ABC:WLBCC	MSCP: (covered in all approved MSCP Subarea Plans except Poway) MHCP: OW	Found in salt marshes traversed by tidal sloughs, where cordgrass and pickleweed are the dominant vegetation. Requires dense growth of either pickleweed or cordgrass for nesting.
Riparia riparia bank swallow	CT, BLM:S, IUCN:LC (nesting)	–	Colonial nester. Nests primarily in riparian and other lowland habitats west of the desert. Requires vertical banks/cliffs with fine- textured/sandy soils near streams, rivers, lakes, or ocean. Only known colony extirpated from San Diego County.
Rynchops niger black skimmer	BCC, CSC, ABC:WLBCC, IUCN:LC (nesting colony)	–	Nests in south San Diego Bay salt works on bare dirt along the tops of dikes.
Selasphorus sasin Allen's hummingbird	BCC, ABC:WLBCC, IUCN:LC (nesting)	–	Breeds in a slender strip along the coast primarily in the San Onofre State Beach area.

Species[1]	Sensitivity Status[2]	Regional HCP/NCC Coverage[3]	Habitat
Sialia mexicana western bluebird	–	MSCP (covered in all Approved MSCP Subarea Plans except Poway)	Frequents open woodlands for foraging, but requires suitable roosting and nesting cavities usually in snags. Availability of snags may limit population density
Spinus lawrencei Lawrence's goldfinch	BCC, ABC:WLBCC, IUCN:LC (nesting)	–	Nests in areas with abundant food sources near meadows, creeks, oak and riparian woodland.
Spizella atrogularis black-chinned sparrow	BCC, ABC:WLBCC, IUCN:LC (nesting)	–	Nests in dry semi-open chaparral. Prefers areas with steep-chaparral covered slopes. Also nests in buckwheat and big sagebrush.
Spizella breweri Brewer's sparrow	BCC, ABC:WLBCC, IUCN:LC (nesting)	–	Nests in desert transition areas in the eastern part of San Diego County in big sagebrush habitat.
Spizella passerina chipping sparrow	IUCN:LC (nesting)	–	Nests in coniferous forests.
Sterna elegans elegant tern	FSC, SSC, CWL, ABC:WLBCC, IUCN:NT (nesting colony)	MSCP (covered in all Approved MSCP Subarea Plans except Poway) MHCP (OW)	Estuarine and intertidal zones of beaches and mudflats for foraging, and beaches, mudflats, and lagoon shoreline for roosting habitat.
Sterna forsteri Forsters' tern	IUCN:LC (nesting colony)	–	Nests in south San Diego Bay salt works and other coastal sites in lightly vegetated sandy areas.
Sternula antillarum browni California least tern	FE,CE, CFP, ABC:WLBCC (nesting colony)	MSCP: (covered in all Approved MSCP Subarea Plans except Poway) MHCP	Colonial breeder on bare or sparsely vegetated, flat substrates: sand beaches, alkali flats, land fills, or paved areas.
Strix occidentalis occidentalis California spotted owl	BCC, CSC, ABC:WLBCC, BLM:S, USFS:S, IUCN:NT	–	Nests in large oak and coniferous trees in mountainous areas, Prefers closed canopy forests with nearby permanent water, and an abundant source of woodrats (*Neotoma* species).
Toxostoma bendirei Bendire's thrasher	BCC, CSC, BLM:S, ABC:WLBCC, IUCN:VU	–	Historically nested in Ocotillo Wells.

Species[1]	Sensitivity Status[2]	Regional HCP/NCC Coverage[3]	Habitat
Toxostoma crissale crissal thrasher	CSC, IUCN:LC	–	Nests in Borrego Valley mesquite bosque.
Toxostoma lecontei Le Conte's thrasher	BCC, CSC, ABC:WLBCC, IUCN:LC	–	Nests in desert washes in Anza-Borrego and Clark Dry Lake.
Vireo bellii pusillus least Bell's vireo	FE, CE, ABC:WLBCC, IUCN:NT (nesting)	MSCP: (covered in all approved MSCP Subarea Plans) MHCP: OW	Riparian woodland with understory of dense young willows or mulefat and willow canopy. Nests often placed along internal or external edges of riparian thickets.
Vireo vicinior gray vireo	BCC, CSC, ABC:WLBCC, BLM:S, USFS:S, IUCN:LC (nesting)	–	Nests in dry chaparral habitat (chamise and redshank are important species) along primarily on south-facing slopes.
Xanthocephalus xanthocephalus yellow-headed blackbird	CSC, IUCN:LC (nesting)	–	Nests in deeply flooded freshwater marshes. Only confirmed nesting was in Boulevard at Tule Lake.
Mammals			
California leaf-nosed bat *Macrotus californicus*	CSC, BLM:S, IUCN:LC, WBWG:H	–	Desert riparian, desert wash, desert scrub, desert succulent scrub, alkali scrub, and palm oasis habitats.
western yellow bat *Lasiurus xanthinus*	CSC, IUCN:LC, WBWG:H	–	Found in valley foothill riparian, desert riparian, desert wash, and palm oasis habitats. Roosts in trees, particularly palms forages over water and among trees.
Antrozous pallidus pallid bat	CSC, BLM:S, IUCN:LC, USFS:S, WBWG:H	–	Deserts, grasslands, shrublands, woodlands, and forests. Most common in open, dry habitats with rocky areas for roosting.
Chaetodipus californicus femoralis Dulzura pocket mouse	CSC	MSCP (Poway MSCP only)	Variety of habitats including coastal scrub, chaparral, and grassland in San Diego County.

Species[1]	Sensitivity Status[2]	Regional HCP/NCC Coverage[3]	Habitat
Chaetodipus fallax fallax northwestern San Diego pocket mouse	CSC	MSCP (Poway MSCP only)	Coastal scrub, chaparral, grasslands, and sagebrush in western San Diego County.
Chaetodipus fallax pallidus pallid San Diego pocket mouse	CSC	–	Desert wash, desert scrub, desert succulent scrub, and pinyon- juniper in eastern San Diego County. Sandy herbaceous areas, usually in association with rocks or coarse gravel.
Choeronycteris mexicana Mexican long-tongued bat	CSC, IUCN:NT, WBWG:H	–	Occasionally found in San Diego County, which is on the periphery of their range. Feeds on nectar and pollen of night-blooming succulents. Roosts in relatively well-lit caves and around buildings.
Corynorhinus townsendii Townsend's big-eared bat	CCT, CSC, BLM:S, IUCN:LC, USFS:S, WBWG:H	–	Throughout California in a wide variety of habitats. Most common in mesic sites. Roosts in the open, hanging from walls and ceilings.
Dipodomys merriami collinus earthquake Merriam's kangaroo rat	–	–	Occurs in a variety of shrub-land type habitats including sage scrub and chaparral.
Dipodomys stephensi Stephens' kangaroo rat	FE, CT, IUCN:EN	–	Primarily annual and perennial grasslands, but also occurs in coastal scrub and sagebrush with sparse canopy cover. Prefers buckwheat, chamise, brome grass, and filaree.
Euderma maculatum spotted bat	CSC, BLM:S, IUCN:LC, WBWG:H	–	Associated with prominent rock features; extreme, low desert habitats to high elevation forests.
Eumops perotis californicus western mastiff bat	CSC, BLM:S, WBWG:H	–	Many open, semi-arid to arid habitats, including conifer and deciduous woodlands, coastal scrub, grasslands, and chaparral. Roosts in crevices in cliff faces, high buildings, trees, and tunnels.

Species[1]	Sensitivity Status[2]	Regional HCP/NCC Coverage[3]	Habitat
Lasionycteris noctivagans silver-haired bat	IUCN:LC, WBWG:M	–	Primarily a coastal and montane forest dweller feeding over streams, ponds, and open brushy areas.
Lasiurus blossevillii western red bat	CSC, IUCN:LC, WBWG:H	–	Prefers habitat edges and mosaics with trees that are protected from above and open below with open areas for foraging. Roosts primarily in trees, 2–40 feet above ground, from sea level up through mixed conifer forests.
Lasiurus cinereus hoary bat	IUCN:LC, WBWG:M	–	Prefers open habitats or habitat mosaics, with access to trees for cover and open areas or habitat edges for feeding. Roosts in dense foliage of medium to large trees.
Lepus californicus bennettii San Diego black-tailed jackrabbit	CSC	–	Typical habitats include early stages of chaparral, open coastal sage scrub, and grasslands near the edges of brush.
Myotis ciliolabrum western small-footed myotis	BLM:S, IUCN:LC, WBWG:M	–	Desert scrub, semi-arid regions, and rocky canyons. it roosts under tree bark or bridges and in buildings.
Myotis evotis long-eared myotis	BLM:S, IUCN:LC, WBWG:M	–	Feeds along habitat edges, in open habitats, and over water. This species roosts in buildings, crevices, spaces under bark, and snags.
Myotis thysanodes fringed myotis	BLM:S, IUCN:LC, USFS:S, WBWG:H	–	Desert scrub, semi-arid regions, and rocky canyons. it roosts under tree bark or bridges and in buildings.
Myotis volans long-legged myotis	IUCN:LC, WBWG:H	–	Most common in woodland and forest habitats above 4000 feet. Trees are important day roosts; caves and mines are night roosts.
Myotis yumanensis Yuma myotis	BLM:S, IUCN:LC, WBWG:LM	–	Desert scrub, semi-arid regions, and rocky canyons. It roosts under tree bark or bridges and in buildings.

Species[1]	Sensitivity Status[2]	Regional HCP/NCC Coverage[3]	Habitat
Neotoma albigula venusta Colorado Valley woodrat	–	–	Brushland and rocky cliffs with shallow caves.
Neotoma lepida intermedia San Diego desert woodrat	CSC	–	Common to abundant in Joshua tree, piñyon-juniper, mixed and chamise-redshank chaparral, sagebrush, and most desert habitats.
Nyctinomops femorosaccus pocketed free-tailed bats	CSC, IUCN:LC, WBWG:M	–	Variety of arid areas in southern California including: pine-juniper woodlands, desert scrub, palm oasis, desert wash, and desert riparian.
Nyctinomops macrotis big free -tailed bat	CSC, IUCN:LC, WBWG:MH	–	Rugged, rocky habitats in arid landscapes; found in desert scrub, woodlands, and evergreen forests.
Odocoileus hemionus southern mule deer	–	MSCP (covered in all approved MSCP Subarea Plans)	Coastal sage scrub, chaparral, riparian woodland, oak woodland.
Onychomys torridus ramona southern grasshopper mouse	CSC	–	This species inhabits a variety of low, open and semi-open scrub habitats, including coastal sage scrub, mixed chaparral, low sagebrush, riparian scrub, and annual grassland with scattered shrubs.
Ovis canadensis nelsoni pop. 2 peninsular bighorn sheep DPS	FE, CT, CFP	–	Optimal habitat includes steep walled canyons and ridges bisected by rocky or sandy washes, with available water.
Perognathus longimembris brevinasus Los Angeles pocket mouse	CSC,	–	Open ground with fine sandy soils. May not dig extensive burrows, hiding under weeds and dead leaves instead.
Perognathus longimembris internationalis Jacumba pocket mouse	CSC	–	Desert riparian, desert scrub, desert wash, coastal scrub, and sagebrush.

Species[1]	Sensitivity Status[2]	Regional HCP/NCC Coverage[3]	Habitat
Perognathus longimembris pacificus Pacific pocket mouse	FE, CSC	–	Plant communities suitable for the Pacific pocket mouse consist of shrublands with firm, fine-grain, sandy substrates in the immediate vicinity of the ocean. These communities include coastal strand, coastal dunes, river alluvium, and coastal sage scrub growing on marine terraces.
Puma concolor mountain lion	CDFW Legally protected species	MSCP (covered in all approved MSCP Subarea Plans)	Forest and shrubland habitats throughout California where deer, their primary prey, are found.
Taxidea taxus American badger	CSC, IUCN:LC	MSCP (covered in all approved MSCP Subarea Plans)	Coastal sage scrub, mixed chaparral, grassland, oak woodland, chamise chaparral, mixed conifer, pinyon–juniper, desert scrub, desert wash, montane meadow, open areas, and sandy soils.

[1]Avian species nomenclature follows the American Ornithologists Union checklist found at: http://checklist.aou.org/taxa/.
Non-avian species nomenclature follows the California Department of Fish and Wildlife (CDFW) Online Special Animals List at https://www.dfg.ca.gov/biogeodata/cnddb/plants_and_animals.asp.

[2]Sensitivity Codes

Federal – U.S. Fish and Wildlife Service USFWS)

FE = Federally endangered
FT = Federally threatened
FPT = Federally proposed threatened
FC = Federal candidate
BCC = Federal Birds of Conservation Concern

State – California Department of Fish and Wildlife (CDFW)

CE = California endangered
CT = California threatened
CCT = California candidate threatened
CCE = California candidate endangered
CFP = California fully protected species

ABC – American Bird Conservancy

WLBCC = U.S. Watch List of Birds of Conservation Concern

AFS – American Fisheries Society

EN = Endangered
VU = Vulnerable

BLM – Bureau of Land Management

S = Sensitive

CDF – California Department of Forestry and Fire Protection

S = Sensitive

USFS – U.S. Forest Service

S = Sensitive

WBWG – Western Bat Working Group

H = High Priority

Species[1]	Sensitivity Status[2]	Regional HCP/NCC Coverage[3]	Habitat

CSC = California species of special concern
CWL = California watch list

IUCN – International Union for Conservation of Nature
DD = Data Deficient
EN = Endangered
LC = Least Concern
NT = Near Threatened
VU = Vulnerable

LM = Low-Medium Priority
M = Medium Priority
MH = Medium-High Priority

Xerces Society
CI **= Critically Imperiled**

[3]HC/NCCP coverage is based on the cities of Chula Vista, La Mesa, Poway, and San Diego and the County of San Diego (South County) that have adopted Subarea Plans (i.e., NCCP/HCP) under the San Diego County MSCP and the City of Carlsbad that has an adopted Subarea Plan (i.e., NCCP/HCP) under the MHCP. Codes are as follows:

MSCP = Multiple Species Conservation Program covered species
MHCP = Multiple Habitat Conservation Program covered species
NE = MSCP or MHCP narrow endemic species
OW = Obligate Wetland Species

APPENDIX E-4
DRAFT NATURAL COMMUNITY CONSERVATION PLANS AND HABITAT CONSERVATION PLANS

This appendix describes unapproved and unadopted (i.e., draft) plans that do not require analysis under CEQA (see CEQA Guidelines Section 15125(d)(e)) in the San Diego Region. Discussion of these draft plans is included for additional context on the NCCP/HCPs in the San Diego region.

DRAFT SAN DIEGO NORTH COUNTY MULTIPLE SPECIES CONSERVATION PROGRAM SUBREGIONAL PLAN

The Draft North County MSCP plan is in progress. The County of San Diego produced a preliminary administrative draft of the plan for agency and stakeholder review in November 2006. A second public review of the draft plan occurred in 2009. The Draft North County MSCP would complement the South County MSCP Subarea Plan adopted by the County of San Diego Board of Supervisors in 1997. In March 2021, the County re-instated the third planning agreement with the U.S. Fish and Wildlife Service and California Department of Fish and Game for both the North and East County MSCP.

The study area for this draft plan encompasses about 296,677 acres of unincorporated land roughly in the areas north of the San Dieguito River, Elfin Forest and Harmony Grove, north of MCB Camp Pendleton, DeLuz, Fallbrook, Rainbow, Pauma Valley, Lilac, Valley Center, Rancho Guejito, and the majority of Ramona. The Subarea Plan is expected to cover 63 species.

DRAFT SAN DIEGO EAST COUNTY MULTIPLE SPECIES CONSERVATION PROGRAM SUBREGIONAL PLAN

The Draft East County MSCP plan is in progress, and the planning agreement was re-instated in March 2021. Development started in the fall of 2004. The East County MSCP would complement the South County MSCP Subarea Plan adopted by the County of San Diego Board of Supervisors in 1997. A preliminary draft map was released in December 2008, but a draft plan has not been released.

The Draft East County MSCP study area covers 1,551,600 acres in eastern San Diego County. Native American Reservations are excluded from the study area. The East County MSCP Subarea Plan will cover the backcountry communities of Central Mountain, Cuyamaca, Descanso, Pine Valley, Desert/Borrego Springs, Julian, Mountain Empire, Boulevard, Jacumba, Lake Morena/Campo, Potrero, Tecate, portions of Dulzura, and Palomar/North Mountain. The East County MSCP proposes to cover up to 254 species.

CITY OF SAN DIEGO DRAFT VERNAL POOL HABITAT CONSERVATION PLAN

The City of San Diego prepared a separate Vernal Pool Habitat Conservation Plan (VPHCP) to cover seven threatened and endangered vernal species, five plant and two crustacean species, not covered under the City's MSCP subarea plan. The VPHCP was prepared in 2017 and went into effect on January 20, 2018. The Draft Vernal Pool HCP is a comprehensive and legally binding planning document to preserve vernal pool species and their habitat within the City's jurisdiction. The VPHCP Plan Area encompasses 206,124 acres in the southwestern portion of the County, and establishes a new preserve boundary and updated conditions of coverage for San Diego and Riverside fairy shrimp, San Diego button celery, spreading navarretia, California orcutt grass, San Diego mesa mint and Otay mesa mint.

APPENDIX E-5
LAND USE CATEGORIES

The table below details which land use classifications are categorized as undeveloped and developed (i.e., spaced rural residential land use and other developed land uses) for purposes of biological resources analysis in this EIR.

Land Use Code	Land Use Description	Regional Growth Analysis Category
1000	Spaced Rural Residential	Developed – Spaced Rural Residential
1100	Single Family Residential	Developed – Other Developed Land Use
1110	Single Family Detached	Developed – Other Developed Land Use
1120	Single Family Multiple-Units	Developed – Other Developed Land Use
1190	Single Family Residential Without Units	Developed – Other Developed Land Use
1200	Multi-Family Residential	Developed – Other Developed Land Use
1280	Single Room Occupancy Units (SRO's)	Developed – Other Developed Land Use
1290	Multi-Family Residential Without Units	Developed – Other Developed Land Use
1300	Mobile Home Park	Developed – Other Developed Land Use
1401	Jail/Prison	Developed – Other Developed Land Use
1402	Dormitory	Developed – Other Developed Land Use
1403	Military Barracks	Developed – Other Developed Land Use
1404	Monastery	Developed – Other Developed Land Use
1409	Other Group Quarters Facility	Developed – Other Developed Land Use
1501	Hotel/Motel (Low-Rise)	Developed – Other Developed Land Use
1502	Hotel/Motel (High-Rise)	Developed – Other Developed Land Use
1503	Resort	Developed – Other Developed Land Use
2001	Heavy Industry	Developed – Other Developed Land Use
2101	Industrial Park	Developed – Other Developed Land Use
2103	Light Industry - General	Developed – Other Developed Land Use
2104	Warehousing	Developed – Other Developed Land Use
2105	Public Storage	Developed – Other Developed Land Use
2201	Extractive Industry	Developed – Other Developed Land Use
2301	Junkyard/Dump/Landfill	Developed – Other Developed Land Use
4101	Commercial Airport	Developed – Other Developed Land Use
4102	Military Airport	Developed – Other Developed Land Use
4103	General Aviation Airport	Developed – Other Developed Land Use
4104	Airstrip	Developed – Other Developed Land Use
4111	Rail Station/Transit Center	Developed – Other Developed Land Use
4112	Freeway	Developed – Other Developed Land Use
4113	Communications and Utilities	Developed – Other Developed Land Use
4114	Parking Lot - Surface	Developed – Other Developed Land Use
4115	Parking Lot - Structure	Developed – Other Developed Land Use

Land Use Code	Land Use Description	Regional Growth Analysis Category
4116	Park and Ride Lot	Developed – Other Developed Land Use
4117	Railroad Right of Way	Developed – Other Developed Land Use
4118	Road Right of Way	Developed – Other Developed Land Use
4119	Other Transportation	Developed – Other Developed Land Use
4120	Marine Terminal	Developed – Other Developed Land Use
5001	Wholesale Trade	Developed – Other Developed Land Use
5002	Regional Shopping Center	Developed – Other Developed Land Use
5003	Community Shopping Center	Developed – Other Developed Land Use
5004	Neighborhood Shopping Center	Developed – Other Developed Land Use
5005	Specialty Commercial	Developed – Other Developed Land Use
5006	Automobile Dealership	Developed – Other Developed Land Use
5007	Arterial Commercial	Developed – Other Developed Land Use
5008	Service Station	Developed – Other Developed Land Use
5009	Other Retail Trade and Strip Commercial	Developed – Other Developed Land Use
6001	Office (High-Rise)	Developed – Other Developed Land Use
6002	Office (Low-Rise)	Developed – Other Developed Land Use
6003	Government Office/Civic Center	Developed – Other Developed Land Use
6101	Cemetery	Developed – Other Developed Land Use
6102	Religious Facility	Developed – Other Developed Land Use
6103	Library	Developed – Other Developed Land Use
6104	Post Office	Developed – Other Developed Land Use
6105	Fire/Police Station	Developed – Other Developed Land Use
6108	Mission	Developed – Other Developed Land Use
6109	Other Public Services	Developed – Other Developed Land Use
6501	UCSD/VA Hospital/Balboa Hospital	Developed – Other Developed Land Use
6502	Hospital - General	Developed – Other Developed Land Use
6509	Other Health Care	Developed – Other Developed Land Use
6701	Military Use	Developed – Other Developed Land Use
6702	Military Training	Developed – Other Developed Land Use
6703	Weapons Facility	Developed – Other Developed Land Use
6800	Schools	Developed – Other Developed Land Use
6801	SDSU/CSU San Marcos/UCSD	Developed – Other Developed Land Use
6802	Other University or College	Developed – Other Developed Land Use
6803	Junior College	Developed – Other Developed Land Use
6804	Senior High School	Developed – Other Developed Land Use
6805	Junior High School or Middle School	Developed – Other Developed Land Use
6806	Elementary School	Developed – Other Developed Land Use
6807	School District Office	Developed – Other Developed Land Use
6809	Other School	Developed – Other Developed Land Use

Land Use Code	Land Use Description	Regional Growth Analysis Category
7201	Tourist Attraction	Developed – Other Developed Land Use
7202	Stadium/Arena	Developed – Other Developed Land Use
7203	Racetrack	Developed – Other Developed Land Use
7204	Golf Course	Developed – Other Developed Land Use
7205	Golf Course Clubhouse	Developed – Other Developed Land Use
7206	Convention Center	Developed – Other Developed Land Use
7207	Marina	Developed – Other Developed Land Use
7208	Olympic Training Center	Developed – Other Developed Land Use
7209	Casino	Developed – Other Developed Land Use
7210	Other Recreation - High	Developed – Other Developed Land Use
7211	Other Recreation - Low	Developed – Other Developed Land Use
7601	Park - Active	Developed – Other Developed Land Use
7603	Open Space Park or Preserve	Undeveloped
7604	Beach - Active	Developed – Other Developed Land Use
7605	Beach - Passive	Undeveloped
7606	Landscape Open Space	Developed – Other Developed Land Use
7607	Residential Recreation	Developed – Other Developed Land Use
7609	Undevelopable Natural Area	Undeveloped
8000	Agriculture	Developed – Other Developed Land Use
8001	Orchard or Vineyard	Developed – Other Developed Land Use
8002	Intensive Agriculture	Developed – Other Developed Land Use
8003	Field Crops	Developed – Other Developed Land Use
9101	Vacant and Undeveloped Land	Undeveloped
9200	Water	Undeveloped
9201	Bay or Lagoon	Undeveloped
9202	Lake/Reservoir/Large Pond	Undeveloped
9300	Indian Reservation	Developed – Other Developed Land Use
9400	Public/Semi-Public	Developed – Other Developed Land Use
9501	Residential Under Construction	Developed – Other Developed Land Use
9502	Commercial Under Construction	Developed – Other Developed Land Use
9503	Industrial Under Construction	Developed – Other Developed Land Use
9504	Office Under Construction	Developed – Other Developed Land Use
9505	School Under Construction	Developed – Other Developed Land Use
9506	Road Under Construction	Developed – Other Developed Land Use
9507	Freeway Under Construction	Developed – Other Developed Land Use
9700	Mixed Use	Developed – Other Developed Land Use

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Appendix E-6
Project-by-Project Impacts on Vegetation Communities for Each Horizon Year

Table E-6-1
Estimated Direct Impacts To Vegetation Communities For Each Transportation Network Improvement (Acres) Up To The Year 2025[1]

	Riparian and Wetlands												Uplands									
PROJECT[1]		Beach/Coastal Dunes/Saltpan/Mudflats		Marsh	Meadows and Seeps	Non-Vegetated Channel, Floodway, Lakeshore Fringe	Open Water	Riparian Forest/Woodland	Riparian Scrub	Vernal Pools	**Riparian and Wetlands Total**	Badlands	Chaparral	Coastal Scrub	Desert Dunes	Desert Scrub	Oak Woodland	Forest/Woodland	Grasslands	Great Basin Scrub	**Uplands Total**	**Total[2]**
Active Transportation																						
San Diego River Trail: Carlton Oaks Segment	–						<0.1		1.6		**1.6**											**1.6**
SR 125 Connector – Bonita Road to U.S.–Mexico Border																			0.1		**0.1**	**0.1**
Complete Corridor: ML/Goods Movement																						
SR 11/Otay Mesa East (SR 125 to Mexico)																			0.1		**0.1**	**0.1**
Local Improvements																						
Citracado Parkway II									0.4		**0.4**			0.3			1.5				**1.8**	**2.2**
Discovery St. from Craven to Twin Oaks #ST007									<0.1		**<0.1**			0.5		0.1			<0.1		**0.6**	**0.6**
La Media Road Improvements																			0.1		**0.1**	**0.1**
Otay Lakes Road				<0.1							**<0.1**			0.2					<0.1		**0.2**	**0.2**
Plaza Blvd Widening																						
San Marcos Creek Specific Plan – Discovery Street Widening and Flood Control Improvements #88265									0.1		**0.1**											**0.1**
Woodland Parkway Interchange and Barham Drive Widening and Street Improvements #88005																						
E Street Extension from Bay Boulevard to H Street				<0.1							**<0.1**											**<0.1**
Grand Avenue Bridge and Street Improvements									0.2		**0.2**								0.7		**0.7**	**0.9**
Otay Truck Route Widening (Ph. 4)																			0.6		**0.6**	**0.6**
San Marcos Creek Specific Plan: Creekside Drive and Pad Grading #88505																						

	Riparian and Wetlands												Uplands									
PROJECT[1]		Beach/Coastal Dunes/Saltpan/Mudflats		Marsh	Meadows and Seeps	Non-Vegetated Channel, Floodway, Lakeshore Fringe	Open Water	Riparian Forest/Woodland	Riparian Scrub	Vernal Pools	**Riparian and Wetlands Total**	Badlands	Chaparral	Coastal Scrub	Desert Dunes	Desert Scrub	Oak Woodland	Forest/Woodland	Grasslands	Great Basin Scrub	**Uplands Total**	**Total[2]**
Twin Oaks Valley Road and Barham Drive Improvements #ST008																						
Via Vera Cruz Bridge and Street Improvements #88264									<0.1		**<0.1**											**<0.1**
Ops/Maintenance – Highway Bridge Program																						
El Camino Real				<0.1							**<0.1**											**<0.1**
Heritage Road Bridge				<0.1							**<0.1**			0.3							**0.3**	**0.3**
West Mission Bay Drive Bridge																						

[1] Only includes transportation network improvements that will result in direct impacts to undeveloped vegetation communities.
[2] Acreages have been rounded after summation.

Table E-6-2
Estimated Direct Impacts To Vegetation Communities For Each Transportation Network Improvement (Acres) Up To The Year 2035[1]

	Riparian and Wetlands											Uplands									
PROJECT[1]		Beach/Coastal Dunes/Saltpan/Mudflats		Marsh	Meadows and Seeps	Non-Vegetated Channel, Floodway, Lakeshore Fringe	Open Water	Riparian Forest/Woodland	Riparian Scrub	Vernal Pools	**Riparian and Wetlands Total**	Badlands	Chaparral	Coastal Scrub	Desert Dunes	Desert Scrub	Forest/Woodland	Grasslands	Great Basin Scrub	**Uplands Total**	**Total[2]**
Active Transportation																					
Coastal Rail Trail – Rose Canyon								0.1	0.2		**0.3**			0.1				0.5		**0.6**	**0.9**
Coastal Rail Trail Carlsbad – Reach 4 Cannon to Palomar Airport Road																					
Coastal Rail Trail Carlsbad – Reach 5 Palomar Airport Rd to Poinsettia Station																					
Coastal Rail Trail San Diego – Carmel Valley to Roselle via Sorrento																					
Coastal Rail Trail San Diego – Del Mar to Sorrento via Carmel Valley				<0.1							**<0.1**		<0.1					<0.1		**0.1**	**0.1**
Coastal Rail Trail San Diego – Roselle Canyon									0.6		**0.6**		0.1					0.2		**0.3**	**0.9**
Inland Rail Trail: Oceanside				<0.1					0.1		**0.1**			0.8			0.1	<0.1		**0.9**	**1.0**
San Diego River Bikeway Connections							0.1	0.2	0.2		**0.5**						<0.1			**<0.1**	**0.5**
San Diego River Trail – Mast Park to Lakeside baseball park								0.4	0.1		**0.5**			0.1				0.9		**1.0**	**1.5**
Santee – El Cajon Corridor								0.3	0.1		**0.4**										**0.4**
Complete Corridors																					
SR 163 (I-8 to I-805)							<0.1		<0.1		**0.1**										**0.1**
SR 52 (I-15 to Mast Boulevard)								<0.1			**<0.1**										**<0.1**
SR 52 (Mast Boulevard to SR 125)								<0.1			**<0.1**										**<0.1**
SR 78 (I-5 to Twin Oaks)								<0.1			**<0.1**										**<0.1**
SR 94 (I-805 to SR 125)																					
I-15 (I-5 to I-805)														0.1						**0.1**	**0.1**
I-15 (I-805 to I-8)														0.5						**0.5**	**0.5**
I-5 (Pacific Highway to SR 52)														0.1						**0.1**	**0.1**
I-5 (SR 52 to I-805)														0.1						**0.1**	**0.1**
SR 125 (SR 94)																					
Local Improvements																					
College Boulevard Reach A								<0.1	0.4		**0.4**			1.4			0.4	0.3		**2.1**	**2.5**

PROJECT[1]	Riparian and Wetlands										**Riparian and Wetlands Total**	Uplands								**Uplands Total**	**Total[2]**
		Beach/Coastal Dunes/Saltpan/Mudflats		Marsh	Meadows and Seeps	Non-Vegetated Channel, Floodway, Lakeshore Fringe	Open Water	Riparian Forest/Woodland	Riparian Scrub	Vernal Pools		Badlands	Chaparral	Coastal Scrub	Desert Dunes	Desert Scrub	Forest/Woodland	Grasslands	Great Basin Scrub		
SR 78/Smilax Interchange Improvements																					
Transit Leap																					
Airport Connection Automated People Mover																					
Commuter Rail 582				<0.1			0.2	1.2	0.2		**1.6**		1.4	1.6				1.6		**4.6**	**6.2**
LRT 399									0.2		**0.2**										**0.2**
Commuter Rail 398														0.6						**0.6**	**0.6**
LRT 510																					

[1] Only includes transportation network improvements that will result in direct impacts to undeveloped vegetation communities.

[2] Acreages have been rounded after summation.

Table E-6-3
Estimated Direct Impacts To Vegetation Communities For Each Transportation Network Improvement (Acres) Up To The Year 2050[1]

PROJECT[1]	Riparian and Wetlands										**Riparian and Wetlands Total**	Uplands								**Uplands Total**	**Total[2]**
		Beach/Coastal Dunes/Saltpan/Mudflats		Marsh	Meadows and Seeps	Non-Vegetated Channel, Floodway, Lakeshore Fringe	Open Water	Riparian Forest/Woodland	Riparian Scrub	Vernal Pools		Badlands	Chaparral	Coastal Scrub	Desert Dunes	Desert Scrub	Forest/Woodland	Grasslands	Great Basin Scrub		
Active Transportation																					
Encinitas to San Marcos Corridor – Double Peak Drive to San Marcos Boulevard													0.1	<0.1						**0.1**	**0.1**
Encinitas to San Marcos Corridor – Leucadia Boulevard to El Camino Real									<0.1		**<0.1**										**<0.1**
I-15 Bikeway – Via Rancho Parkway to Lost Oak Lane																					
I-805 CONNECTOR																					
San Diego River Trail – Mast Park to Lakeside baseball park																					
San Luis Rey River Trail							0.8	3.6	2.3		**6.7**			0.1				0.6		**0.7**	**7.4**
SR 125 Connector – Bonita Road to U.S.–Mexico Border									<0.1		**<0.1**			<0.1				0.1		**0.1**	**0.1**
SR 52 Bikeway – I-5 to Santo Road								1.9			**1.9**		0.3	0.7				0.3		**1.3**	**2.2**
SR 56 Bikeway – Azuaga Street to Rancho Peñasquitos Boulevard																					
SR 905 Corridor														0.1						**0.1**	**0.1**
Complete Corridors																					
I-5 (I-8)				0.3			0.3		0.1		**0.7**										**0.7**
I-5 (SR 56)																					
SR 125 (SR 905 to SR 54)									<0.1		**<0.1**							0.3		**0.3**	**0.3**
SR 52 (I-5 to I-805)																					
I-5 (La Costa to Cassidy Street)				<0.1			<0.1				**<0.1**										**<0.1**
I-5 (SR 56 to Via de La Valle)				<0.1			<0.1				**0.1**										**0.1**
I-5 (Via de La Valle to La Costa)				<0.1			<0.1				**0.1**										**0.1**
SR 78 (SR 78 to Deer Canyon Drive)																					
Transit Leap																					
Commuter Rail 582				<0.1			0.1		1.2		**1.3**							1.0		**1.0**	**2.3**
Commuter Rail 583				<0.1			1.4		1.2		**2.6**							1.0		**1.0**	**3.6**
LRT 399								0.3			**0.3**										**0.3**
LRT 510							<0.1				**<0.1**										**<0.1**
Tram 555																					

	Riparian and Wetlands											Uplands									
PROJECT[1]		Beach/Coastal Dunes/Saltpan/Mudflats		Marsh	Meadows and Seeps	Non-Vegetated Channel, Floodway, Lakeshore Fringe	Open Water	Riparian Forest/Woodland	Riparian Scrub	Vernal Pools	**Riparian and Wetlands Total**	Badlands	Chaparral	Coastal Scrub	Desert Dunes	Desert Scrub	Forest/Woodland	Grasslands	Great Basin Scrub	**Uplands Total**	**Total[2]**
Commuter Rail 398				0.2					0.4		**0.6**		1.1	2.7				6.3		**10.1**	**10.7**

[1] Only includes transportation network improvements that will result in direct impacts to undeveloped vegetation communities.

[2] Acreages have been rounded after summation.

APPENDIX E-7
IMPACTED LISTED PLANT SPECIES

Table E-7-1
Impacted Listed Plant Species within the San Diego Region Up to the Year 2025

	Vernal Pool Species[1]					Wetland/Riparian Species[1]					Uplands Species[1]																	
Regional Growth and Land Use Change / Transportation Network Improvement[2]	San Diego Button-Celery	Otay Mesa mint	Spreading navarretia	California Orcutt grass	San Diego mesa mint	Salt marsh bird’s-beak	Willowy monardella	Parish’s meadowfoam	Mojave tarplant	San Berardino blue grass	San Diego thorn-mint	San Diego ambrosia	Del Mar manzanita	Coastal dunes milk-vetch	Encinitas baccharis	Nevin’s barbery	Thread-leaved brodiaea	Orcut’s spineflower	Otay tarplant	Short-leaved dudleya	Mexican flannelbush	Orcutt’s hazardia	Peirson’s milk-vetch	Gander’s ragwort	Small-leaved rose	Cuyamaca larkspur	Dehesa nolina	Dunn’s mariposa lily
Regional Growth and Land Use Change	X	X	X		X	X					X	X	X				X	X	X									
Active Transportation																												
San Diego River Trail: Carlton Oaks Segment												X																
SR 125 Connector – Bonita Road to U.S.–Mexico Border																			X									
Local Improvements																												
Avenida Encinas – Widen from Palomar Airport Road to Embarcadero Lane	X																											
Otay Truck Route Widening (Ph. 4)																			X									
Ops/Maintenance – Highway Bridge Program																												
El Camino Real													X															

[1] Species potential impact based on known locations existing data sources (e.g., CNDDB, SANDAG) and presence of suitable habitat. Listed species not shown are not anticipated to be impacted.
[2] Transportation network improvements not listed are not anticipated to impact listed plant species.

Table E-7-2
Impacted Listed Wildlife Species within the San Diego Region Up to the Year 2025

Regional Growth and Land Use Change / Transportation Network Improvement[2]	Aquatic Species[1]				Wetland/Riparian Species[1]									Uplands Species[1]									
	Tidewater goby	Southern steelhead	San Diego fairy shrimp	Riverside fairy shrimp	Arroyo toad	Tricolored blackbird	Western snowy plover	California least tern	Light-footed Ridgway's rail	Southwestern willow flycatcher	Western yellow-billed cuckoo	Belding's savannah sparrow	Least Bell's vireo	Barefoot gecko	Laguna Mountains skipper	Quino checkerspot butterfly	Coastal California butterfly	Stephens' kangaroo rat	Pacific pocket mouse	Peninsular bighorn sheep	Townsend's big-eared bat	Hermes copper butterfly	Flat-tailed horned lizard
Regional Growth and Land Use Change			X	X			X	X	X	X			X			X	X						
San Diego River Trail: Carlton Oaks Segment													X										
Local Improvements																							
Avenida Encinas – Widen from Palomar Airport Road to Embarcadero Lane			X														X						
Grand Avenue Bridge and Street Improvements																	X						
Otay Truck Route Widening (Ph. 4)			X																				
Discovery St. from Craven to Twin Oaks #ST007																	X						
Otay Lakes Road																X							
Ops/Maintenance – Highway Bridge Program																							
El Camino Real																	X						
Heritage Road Bridge																	X						
Complete Corridors																							
SR 11/Otay Mesa East (SR 125 to Mexico)			X																				

[1] Species potential impacts based on known locations from existing data sources (e.g., CNDDB, SANDAG) and presence of suitable habitat. Species not listed are not anticipated to be impacted.
[2] Transportation network improvements not listed are not anticipated to impact any listed wildlife species.

Table E-7-3
Impacted Listed Plant Species within the San Diego Region Up to the Year 2035

	Vernal Pool Species[1]					Wetland/Riparian Species[1]					Uplands Species[1]																	
Regional Growth and Land Use Change / Transportation Network Improvement[2]	San Diego Button-Celery	Otay Mesa mint	Spreading navarretia	California Orcutt grass	San Diego mesa mint	Salt marsh bird’s-beak	Willowy monardella	Parish’s meadowfoam	Mojave tarplant	San Berardino blue grass	San Diego thorn-mint	San Diego ambrosia	Del Mar manzanita	Coastal dunes milk-vetch	Encinitas baccharis	Nevin’s barbery	Thread-leaved brodiaea	Orcut’s spineflower	Otay tarplant	Short-leaved dudleya	Mexican flannelbush	Orcutt’s hazardia	Peirson’s milk-vetch	Gander’s ragwort	Small-leaved rose	Cuyamaca larkspur	Dehesa nolina	Dunn’s mariposa lily
2025 Summary	X	X	X		X	X					X	X	X				X	X	X									
2035 Regional Growth and Land Use Change	X				X	X	X					X	X				X		X					X				X
Coastal Rail Trail – Rose Canyon			X																							X		
Coastal Rail Trail Carlsbad – Reach 5 Palomar Airport Rd to Poinsettia Station	X																							X				
Coastal Rail Trail San Diego – UTC to Rose Canyon			X																							X		
San Diego River Bikeway Connections												X																
Santee – El Cajon Corridor												X																
Complete Corridors																												
I-15 (SR 52)					X																							
SR 125 (Jamacha Road to Amaya Drive)																			X									
SR 163 (I-805 to SR 52)	X				X																							
SR 52 (I-15 to Mast Boulevard)												X																
SR 52 (I-805 to I-15)	X		X		X																							
SR 52 (Mast Boulevard to SR 125)												X																
SR 78 (I-5 to Twin Oaks)	X																											
I-15 (Clairemont Mesa Boulevard)					X																							
I-15 (I-8 to SR 163)					X																							
I-5 (H Street to Pacific Highway)						X																						
I-5 (I-805 to SR 56)													X															
Transit Leap																												
LRT 399																	X											
Commuter Rail 398	X		X									X																

[1] Species potential impact based on known locations existing data sources (e.g., CNDDB, SANDAG) and presence of suitable habitat. Listed species not shown are not anticipated to be impacted.
[2] Transportation network improvements not listed are not anticipated to impact listed plant species.

Table E-7-4
Impacted Listed Wildlife Species within the San Diego Region Up to the Year 2035

Regional Growth and Land Use Change / Transportation Network Improvement[2]	Aquatic Species[1]				Wetland/Riparian Species[1]									Uplands Species[1]										
	Tidewater goby	Southern steelhead	San Diego fairy shrimp	Riverside fairy shrimp	Arroyo toad	Tricolored blackbird	Western snowy plover	California least tern	Light-footed Ridway's rail	Southwestern willow flycatcher	Western yellow-billed cuckoo	Belding's savannah sparrow	Least Bell's vireo	Barefoot gecko	Laguna Mountains skipper	Quino checkerspot butterfly	Coastal California butterfly	Stephens' kangaroo rat	Pacific pocket mouse	Peninsular bighorn sheep	Townsend's big-eared bat	Hermes copper butterfly	Flat-tailed horned lizard
2025 Summary			X	X			X	X	X	X			X			X	X						
2035 Regional Growth and Land Use Change			X		X				X				X				X	X					
Active Transportation																							
Coastal Rail Trail – Rose Canyon			X														X						
Coastal Rail Trail Carlsbad							X	X									X						
Coastal Rail Trail Carlsbad – Reach 4 Cannon to Palomar Airport Road			X																				
Coastal Rail Trail Carlsbad – Reach 5 Palomar Airport Rd to Poinsettia Station			X														X						
Coastal Rail Trail Del Mar																	X						
Coastal Rail Trail San Diego – Carmel Valley to Roselle via Sorrento									X				X										
Coastal Rail Trail San Diego – Del Mar to Sorrento via Carmel Valley									X								X						
Coastal Rail Trail San Diego – Mission Bay (Clairemont to Tecolote)			X																				
Coastal Rail Trail San Diego – Pacific Highway (Fiesta Island Road to Taylor Street)													X										
Coastal Rail Trail San Diego – UTC to Rose Canyon			X																				
Inland Rail Trail: Oceanside													X				X						
San Diego River Bikeway Connections													X										
San Diego River Trail – Mast Park to Lakeside baseball park													X										
Santee – El Cajon Corridor													X										
Local Improvements																							
College Boulevard Reach A													X				X						
Palm Avenue/Interstate 805 Interchange																	X						
Complete Corridors																							
I-15 (I-8)																	X						
I-15 (SR 52)													X				X						
I-5 (I-805)									X														
I-5 (SR 78)								X					X										

	Aquatic Species[1]				Wetland/Riparian Species[1]									Uplands Species[1]									
Regional Growth and Land Use Change / Transportation Network Improvement[2]	**Tidewater goby**	**Southern steelhead**	**San Diego fairy shrimp**	**Riverside fairy shrimp**	**Arroyo toad**	**Tricolored blackbird**	**Western snowy plover**	**California least tern**	**Light-footed Ridway’ s rail**	**Southwestern willow flycatcher**	**Western yellow-billed cuckoo**	**Belding’ s savannah sparrow**	**Least Bell’ s vireo**	**Barefoot gecko**	**Laguna Mountains skipper**	**Quino checkerspot butterfly**	**Coastal California butterfly**	**Stephens’ kangaroo rat**	**Pacific pocket mouse**	**Peninsular bighorn sheep**	**Townsend’ s big-eared bat**	**Hermes copper butterfly**	**Flat-tailed horned lizard**
SR 125 (Jamacha Road to Amaya Drive)																	X						
SR 52 (I-15 to Mast Boulevard)													X			X							
SR 52 (I-805 to I-15)			X																				
SR 52 (Mast Boulevard to SR 125)													X			X							
SR 78 (I-5 to Twin Oaks)								X					X				X						
SR 94 (I-805 to SR 125)																	X						
I-805 (Nobel Drive)																	X						
I-15 (I-5 to I-805)																	X						
I-15 (I-8 to SR 163)													X				X						
I-15 (I-805 to I-8)																	X						
I-5 (La Costa to Cassidy Street)																							
I-5 (Pacific Highway to SR 52)			X										X				X						
I-5 (SR 52 to I-805)			X										X				X						
I-5 (SR 905 to H Street)													X										
I-805 (Balboa Avenue to NB Bypass Lane)			X														X						
I-805 (H Street to I-15)									X														
I-805 (I-8 to Mesa College Drive)																	X						
I-805 (Palm Avenue to H Street)									X														
Transit Leap																							
Commuter Rail 582																	X						
LRT 399													X				X						
LRT 510			X														X						
Commuter Rail 398									X								X						

[1] Species potential impacts based on known locations from existing data sources (e.g., CNDDB, SANDAG) and presence of suitable habitat. Species not listed are not anticipated to be impacted.
[2] Transportation network improvements not listed are not anticipated to impact any listed wildlife species.

Table E-7-5
Impacted Listed Plant Species within the San Diego Region Up to the Year 2050

Regional Growth and Land Use Change / Transportation Network Improvement[2]	Vernal Pool Species[1]					Wetland/Riparian Species[1]					Uplands Species[1]																	
	San Diego Button-Celery	Otay Mesa mint	Spreading navarretia	California Orcutt grass	San Diego mesa mint	Salt marsh bird’s-beak	Willowy monardella	Parish’s meadowfoam	Mojave tarplant	San Berardino blue grass	San Diego thorn-mint	San Diego ambrosia	Del Mar manzanita	Coastal dunes milk-vetch	Encinitas baccharis	Nevin’s barbery	Thread-leaved brodiaea	Orcut’s spineflower	Otay tarplant	Short-leaved dudleya	Mexican flannelbush	Orcutt’s hazardia	Peirson’s milk-vetch	Gander’s ragwort	Small-leaved rose	Cuyamaca larkspur	Dehesa nolina	Dunn’s mariposa lily
2025 Summary	X	X	X		X	X					X	X	X				X	X	X									
2035 Summary	X	X	x		X	X	X					X	X				X		X					X		X		X
2050 Regional Growth and Land Use Change	X				X												X		X									
Active Transportation																												
Encinitas to San Marcos Corridor – Leucadia Boulevard to El Camino Real													X															
I-15 Bikeway – Murphy Canyon Road to Affinity Court	X				X																							
San Luis Rey River Trail												X																
Santee – El Cajon Corridor																												
SR 125 Connector – Bonita Road to U.S.–Mexico Border	X	X	X								X								X									
SR 52 Bikeway – I-5 to Santo Road	X		X		X																							
SR 52 Bikeway – SR 52/Mast Drive to San Diego River Trail												X																
SR 905 Corridor	X	X										X							X									
Complete Corridors																												
SR 125 (SR 54)																			X									
SR 125 (Amaya Drive to Mission Gorge Road)					X																							
SR 125 (SR 905 to SR 54)	X	X	X								X								X									
SR 54 (Valley Road to SR 125)																			X									
SR 56 (I-5 to I-15)	X				X																							
I-5 (Harbor Drive to County Line)	X		X														X											
I-5 (La Costa to Cassidy Street)													X															
I-5 (SR 56 to Via de La Valle)													X															
I-5 (Via de La Valle to La Costa)													X															
SR 905 (I-5 to Border)																			X									
I-5 (SR 56)													X															
Transit Leap																												
Commuter Rail 582	X											X							X									
Commuter Rail 583	X											X							X									

	Vernal Pool Species[1]					Wetland/Riparian Species[1]					Uplands Species[1]																	
Regional Growth and Land Use Change / Transportation Network Improvement[2]	San Diego Button-Celery	Otay Mesa mint	Spreading navarretia	California Orcutt grass	San Diego mesa mint	Salt marsh bird’s-beak	Willowy monardella	Parish’s meadowfoam	Mojave tarplant	San Berardino blue grass	San Diego thorn-mint	San Diego ambrosia	Del Mar manzanita	Coastal dunes milk-vetch	Encinitas baccharis	Nevin’s barbery	Thread-leaved brodiaea	Orcut’s spineflower	Otay tarplant	Short-leaved dudleya	Mexican flannelbush	Orcutt’s hazardia	Peirson’s milk-vetch	Gander’s ragwort	Small-leaved rose	Cuyamaca larkspur	Dehesa nolina	Dunn’s mariposa lily

[1] Species potential impact based on known locations existing data sources (e.g., CNDDB, SANDAG) and presence of suitable habitat. Listed species not shown are not anticipated to be impacted.
[2] Transportation network improvements not listed are not anticipated to impact listed plant species.

Table E-7-6
Impacted Listed Wildlife Species within the San Diego Region Up to the Year 2050

Regional Growth and Land Use Change / Transportation Network Improvement[2]	Aquatic Species[1]				Wetland/Riparian Species[1]									Uplands Species[1]									
	Tidewater goby	Southern steelhead	San Diego fairy shrimp	Riverside fairy shrimp	Arroyo toad	Tricolored blackbird	Western snowy plover	California least tern	Light-footed Ridgway's rail	Southwestern willow flycatcher	Western yellow-billed cuckoo	Belding's savannah sparrow	Least Bell's vireo	Barefoot gecko	Laguna Mountains skipper	Quino checkerspot butterfly	Coastal California butterfly	Stephens' kangaroo rat	Pacific pocket mouse	Peninsular bighorn sheep	Townsend's big-eared bat	Hermes copper butterfly	Flat-tailed horned lizard
2025 Summary			X	X			X	X	X	X			X			X	X						
2035 Summary			X		X		X	X	X				X				X	X					
2050 Regional Growth and Land Use Change			X	X									X				X						
Active Transportation																							
Border Access Corridor			X																				
Encinitas to San Marcos Corridor – Double Peak Drive to San Marcos Boulevard																	X						
I-15 Bikeway – Poway Road interchange to Carmel Mountain Road																	X						
I-805 CONNECTOR									X				X										
San Luis Rey River Trail					X					X	X		X				X						
Santee – El Cajon Corridor																							
SR 125 Connector – Bonita Road to U.S.–Mexico Border			X	X									X				X						
SR 52 Bikeway – I-5 to Santo Road			X														X						
SR 52 Bikeway – SR 52/Mast Drive to San Diego River Trail													X										
SR 905 Corridor			X	X													X						
Complete Corridors																							
I-5 (SR 52)																	X						
I-5 (SR 78)																							
I-805 (SR 54)									X														
SR 125 (SR 52)													X										
SR 125 (SR 54)													X				X						
SR 125 (SR 905 to SR 54)			X	X									X			X	X						
SR 52 (I-5 to I-805)																	X						
SR 56 (I-5 to I-15)																	X						
I-15 (SR 76 to County Line)													X				X						
I-15 (Valley Parkway to SR 76)													X				X						
I-5 (Cassidy Street to Harbor Drive)								X															
I-5 (Harbor Drive to County Line)			X	X			X						X				X						
I-5 (La Costa to Cassidy Street)									X				X				X						

Regional Growth and Land Use Change / Transportation Network Improvement[2]	Aquatic Species[1]				Wetland/Riparian Species[1]									Uplands Species[1]									
	Tidewater goby	Southern steelhead	San Diego fairy shrimp	Riverside fairy shrimp	Arroyo toad	Tricolored blackbird	Western snowy plover	California least tern	Light-footed Ridway’s rail	Southwestern willow flycatcher	Western yellow-billed cuckoo	Belding’s savannah sparrow	Least Bell’s vireo	Barefoot gecko	Laguna Mountains skipper	Quino checkerspot butterfly	Coastal California butterfly	Stephens’ kangaroo rat	Pacific pocket mouse	Peninsular bighorn sheep	Townsend’s big-eared bat	Hermes copper butterfly	Flat-tailed horned lizard
I-5 (SR 56 to Via de La Valle)									X				X				X						
I-5 (Via de La Valle to La Costa)									X				X				X						
I-805 (Palm Avenue to H Street)													X				X						
I-805 (SR 905 to Palm Avenue)													X				X						
SR 905 (I-5 to Border)			X	X													X						
I-5 (SR 56)																	X						
Transit Leap																							
Commuter Rail 582									X				X				X						
Commuter Rail 583									X				X				X						
LRT 399																							
LRT 510			X														X						
Commuter Rail 398													X										

[1] Species potential impacts based on known locations from existing data sources (e.g., CNDDB, SANDAG) and presence of suitable habitat. Species not listed are not anticipated to be impacted.
[2] Transportation network improvements not listed are not anticipated to impact any listed wildlife species.

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Appendix F

Energy Appendix

Workbook Summary: contains the energy calculations performed to support the energy analysis found in the San Diego Forward PEIR section 4.6, Energy.

Category	2016		2025		2035		2050	
	Energy Use	Trillion Btu	Energy Use	Trillion Btu	Energy Use	Trillion Btu	Energy Use	Trillion Btu
Regional Growth and Land Use Change	**--**	**123**	**--**	**122**	**--**	**126**	**--**	**129**
Electricity (GWh)	18,842	64	17,475	60	18,078	62	18,191	62
Natural Gas (million therms)	585	59	629	63	648	65	671	67
Transportation Network Improvements and Programs	**--**	**168**	**--**	**133**	**--**	**113**	**--**	**112**
Vehicle, Gasoline (million gallons)	1,247	150	937	113	764	92	739	89
Vehicle, Diesel (million gallons)	123	17	132	18	135	19	145	20
Rail, Diesel (million gallons)	11	1	16	2	18	3	19	3
Total Construction (million gallons)	20	3	24	3	29	4	34	5
Total Energy Use	**--**	**294**	**--**	**259**	**--**	**243**	**--**	**245**
Per Capita Energy Use (MMBtu/person)	**89**		**75**		**67**		**65**	
Total Energy Use, Percent Change 2016 to Plan Year	--		**-12%**		**-17%**		**-17%**	
Per Capita Energy Use, Percent Change 2016 to Plan Year	--		**-17%**		**-25%**		**-27%**	

Table. Summary Energy Metrics.

Variable	Unit	Existing	Projected				
		2016	2025	2030	2035	2045	2050
Population	people	3,287,280	3,470,848	3,552,485	3,620,348	3,719,685	3,746,073
Vehicle, Gasoline	million gallons/yr	1,247	937	831	764	740	739
Vehicle, Diesel	million gallons/yr	123	132	133	135	141	145
Rail, Diesel	million gallons/yr	11	16	17	18	19	19
Construction/Mining, Diesel	million gallons/yr	20	24	27	29	32	34
Electricity	GWh/yr	18,842	17,475	18,029	18,078	18,158	18,191
Building	GWh/yr	17,843	16,242	16,746	16,751	16,761	16,766
Water	GWh/yr	999	1,233	1,283	1,327	1,397	1,425
Natural Gas	Million therms/yr	585	629	640	648	663	671
Total	Trillion Btu	294	259	250	243	244	245
Vehicle, Gasoline	Trillion Btu	150	113	100	92	89	89
Vehicle, Diesel	Trillion Btu	17	18	18	19	19	20
Rail, Diesel	Trillion Btu	1	2	2	3	3	3
Construction/Mining, Diesel	Trillion Btu	3	3	4	4	4	5
Electricity	Trillion Btu	64	60	62	62	62	62
Natural Gas	Trillion Btu	59	63	64	65	66	67
Per capita energy use	MMBtu/person	89	75	70	67	66	65
Total Energy Use, Percent Change from Existing to Proposed	%	n/a	-12%	-15%	-17%	-17%	-17%
Per Capita Energy Use, Percent Change from Existing to Proposed	%	n/a	-17%	-21%	-25%	-27%	-27%

Table. All Vehicle Fuel

Variable	2016	2025	2030	2035	2045	2050
Million gallons/yr	1,370	1,069	964	898	881	884
Gasoline	1,247	937	831	764	740	739
Diesel	123	132	133	135	141	145

Table. Heavy-Duty Trucks and Vehicles VMT Interim Calculations.

Variable	**2016**	**2025**	**2030**	**2035**	**2045**	**2050**
VMT/yr						
Gasoline	27,437,526,770	27,358,183,022	27,893,380,141	27,495,007,250	28,203,160,549	28,316,802,881
Diesel	256,573,419	354,959,139	379,721,125	381,593,100	396,374,490	398,830,015
Million gallons/yr	1,183	888	785	718	696	694
Gasoline	1,172	877	774	708	686	685
Diesel	11	11	11	10	10	10

Table. Passenger Cars and Light-Duty Vehicles VMT Interim Calculations.

Variable	**2016**	**2025**	**2030**	**2035**	**2045**	**2050**
VMT/weekday	79,810,087	79,864,963	81,478,678	81,193,649	83,299,109	83,644,722
VMT/yr	27,694,100,189	27,713,142,161	28,273,101,266	28,174,196,203	28,904,790,823	29,024,718,534
VMT avoided/weekday*	0	0	0	857,625	879,700	890,737
VMT avoided/yr*	0	0	0	297,595,853	305,255,784	309,085,638
Net VMT/yr	27,694,100,189	27,713,142,161	28,273,101,266	27,876,600,350	28,599,535,039	28,715,632,896

*From vanpool, carshare, pooled rides, and TDM ordinance

Table. Vehicle Categorization Schema

GHG Inventory Vehicle Category	**EMFAC Vehicle Categories**
Light Duty	LDA, LDT1, LDT2, MDV
Heavy-Duty Trucks and Vehicles	All other EMFAC vehicle categories

Table. Light Duty VMT by Vehicle Type

Sum of VMT	**Column Labels**						
Row Labels	**2016**	**2025**	**2030**	**2035**	**2045**	**2050**	
LDA	17,504,808,098	20,650,975,214	21,683,016,594	22,446,609,398	23,597,830,662	24,095,139,627	
LDT1	2,021,598,099	2,102,149,677	2,155,388,408	2,212,821,429	2,320,295,658	2,373,524,944	
LDT2	6,642,125,276	6,146,130,486	6,134,462,457	6,217,847,390	6,469,428,511	6,596,119,561	
MDV	4,385,144,715	4,054,059,988	4,027,173,817	4,087,653,387	4,264,985,307	4,344,998,081	
Grand Total	**30,553,676,188**	**32,953,315,366**	**34,000,041,276**	**34,964,931,604**	**36,652,540,138**	**37,409,782,214**	
	% total						
	2016	2025	2030	2035	2045	2050	annualizer
	57.29%	62.67%	63.77%	64.20%	64.38%	64.41%	347
	6.62%	6.38%	6.34%	6.33%	6.33%	6.34%	347
	21.74%	18.65%	18.04%	17.78%	17.65%	17.63%	347
	14.35%	12.30%	11.84%	11.69%	11.64%	11.61%	347
	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	347
	Annual VMT						
	2016	2025	2030	2035	2045	2050	
	15,866,500,197	17,367,096,619	18,030,746,461	18,087,127,538	18,609,634,055	18,694,432,427	
	1,832,392,932	1,767,869,855	1,792,336,493	1,783,056,973	1,829,822,991	1,841,520,837	
	6,020,476,284	5,168,784,567	5,101,178,462	5,010,244,387	5,101,896,817	5,117,659,135	
	3,974,730,777	3,409,391,120	3,348,839,851	3,293,767,305	3,363,436,960	3,371,106,135	
	27,694,100,189	27,713,142,161	28,273,101,266	28,174,196,203	28,904,790,823	29,024,718,534	

Sum of Fuel Consumption	**Column Labels**					
Row Labels	**2016**	**2025**	**2030**	**2035**	**2045**	**2050**
LDA	641,579	582,144	536,268	515,339	517,935	527,168
LDT1	87,601	72,986	66,222	62,667	61,059	61,762
LDT2	322,698	223,184	190,644	174,868	169,219	170,891
MDV	253,027	177,586	150,664	138,558	134,298	135,266
Grand Total	**1,304,904**	**1,055,899**	**943,798**	**891,431**	**882,510**	**895,087**
	mile/gal					
	2016	2025	2030	2035	2045	2050
	27	35	40	44	46	46
	23	29	33	35	38	38
	21	28	32	36	38	39
	17	23	27	30	32	32
	23	31	36	39	42	42
	Annual gallons					
	2016	2025	2030	2035	2045	2050
	581,532,052	489,572,313	445,939,671	415,251,908	408,451,630	409,008,278
	79,401,992	61,380,086	55,067,604	50,495,701	48,152,278	47,918,477
	292,495,830	187,693,304	158,531,866	140,905,811	133,448,566	132,587,449
	229,346,155	149,346,433	125,286,042	111,647,747	105,909,657	104,947,349
	1,182,776,029	887,992,137	784,825,183	718,301,167	695,962,131	694,461,553

Table. Light Duty VMT by Fuel Type

Sum of VMT	**Column Labels**											
Row Labels	**2016**	**2025**	**2030**	**2035**	**2045**	**2050**	% total					
Gasoline	**30,133,567,413**	**31,647,660,643**	**32,178,857,338**	**32,816,568,124**	**34,211,080,865**	**34,899,130,457**	99%	99%	99%	99%	99%	99%
LDA	17,195,958,298	19,693,709,795	20,349,257,066	20,875,961,037	21,819,898,206	22,268,918,337						
LDT1	2,018,319,387	2,068,157,775	2,096,866,975	2,137,374,131	2,227,693,366	2,276,962,980						
LDT2	6,611,005,270	6,008,096,843	5,934,881,159	5,978,993,214	6,195,837,105	6,314,421,711						
MDV	4,308,284,459	3,877,696,229	3,797,852,139	3,824,239,742	3,967,652,189	4,038,827,428						
Diesel	**281,784,597**	**410,613,028**	**438,060,638**	**455,449,088**	**480,811,351**	**491,539,274**	1%	1%	1%	1%	1%	1%
LDA	177,688,482	239,541,619	250,948,659	258,947,446	272,242,576	278,038,817						
LDT1	1,275,292	558,366	295,891	294,476	311,309	319,108						
LDT2	26,094,546	50,651,982	56,875,566	60,088,853	64,076,415	65,649,184						
MDV	76,726,277	119,861,061	129,940,521	136,118,312	144,181,050	147,532,166						
Grand Total	**30,415,352,010**	**32,058,273,670**	**32,616,917,976**	**33,272,017,212**	**34,691,892,216**	**35,390,669,731**						

Table. Light Duty VMT by Fuel Type

Sum of VMT	**Column Labels**											
Row Labels	**2016**	**2025**	**2030**	**2035**	**2045**	**2050**	% total					
Diesel	**281,784,597**	**410,613,028**	**438,060,638**	**455,449,088**	**480,811,351**	**491,539,274**	1%	1%	1%	1%	1%	1%
LDA	177,688,482	239,541,619	250,948,659	258,947,446	272,242,576	278,038,817						
LDT1	1,275,292	558,366	295,891	294,476	311,309	319,108						
LDT2	26,094,546	50,651,982	56,875,566	60,088,853	64,076,415	65,649,184						
MDV	76,726,277	119,861,061	129,940,521	136,118,312	144,181,050	147,532,166						
Electricity	**138,324,178**	**895,041,696**	**1,383,123,300**	**1,692,914,392**	**1,960,647,922**	**2,019,112,483**	0%	3%	4%	5%	5%	5%
LDA	131,161,318	717,723,801	1,082,810,869	1,311,700,915	1,505,689,880	1,548,182,473						
LDT1	2,003,421	33,433,536	58,225,542	75,152,822	92,290,983	96,242,856						
LDT2	5,025,460	87,381,661	142,705,732	178,765,322	209,514,990	216,048,667						
MDV	133,979	56,502,698	99,381,157	127,295,333	153,152,068	158,638,487						
Gasoline	**30,133,567,413**	**31,647,660,643**	**32,178,857,338**	**32,816,568,124**	**34,211,080,865**	**34,899,130,457**	99%	96%	95%	94%	93%	93%
LDA	17,195,958,298	19,693,709,795	20,349,257,066	20,875,961,037	21,819,898,206	22,268,918,337						
LDT1	2,018,319,387	2,068,157,775	2,096,866,975	2,137,374,131	2,227,693,366	2,276,962,980						
LDT2	6,611,005,270	6,008,096,843	5,934,881,159	5,978,993,214	6,195,837,105	6,314,421,711						
MDV	4,308,284,459	3,877,696,229	3,797,852,139	3,824,239,742	3,967,652,189	4,038,827,428						
Grand Total	**30,553,676,188**	**32,953,315,366**	**34,000,041,276**	**34,964,931,604**	**36,652,540,138**	**37,409,782,214**						

Table. Heavy-Duty Trucks and Vehicles VMT Interim Calculations.

Variable	2016	2025	2030	2035	2045	2050
VMT/weekday	4,885,875	5,308,169	5,687,090	6,022,658	6,482,166	6,691,132
VMT/yr	1,580,284,412	1,710,569,386	1,830,653,972	1,937,151,520	2,082,185,257	2,148,097,676
Gasoline	634,668,655	570,228,125	580,577,347	594,002,437	606,360,400	612,257,747
Diesel	945,615,757	1,140,341,261	1,250,076,625	1,343,149,083	1,475,824,857	1,535,839,929
Million gallons/yr	188	181	179	180	185	190
Gasoline	75	60	57	55	54	54
Diesel	112	120	122	125	131	136

Table. Heavy Duty VMT by Vehicle Type

Sum of VMT	**Column Labels**						% total							Annual VMT					
Row Labels	**2016**	**2025**	**2030**	**2035**	**2045**	**2050**	2016	2025	2030	2035	2045	2050	annualizer	2016	2025	2030	2035	2045	2050
MCY	246,993,424	215,042,767	209,182,424	209,007,858	215,307,911	218,678,705	10.71%	8.57%	7.97%	7.57%	7.08%	6.91%	347	181,543,791	157,872,559	157,379,809	158,300,202	159,354,617	160,344,915
MH	52,612,192	38,114,048	34,409,102	32,762,105	32,412,034	32,816,502	2.28%	1.52%	1.31%	1.19%	1.07%	1.04%	327	36,441,873	26,368,484	24,395,821	23,383,469	22,606,286	22,675,625
OBUS	25,333,771	19,632,699	18,665,215	18,547,994	19,154,119	19,419,145	1.10%	0.78%	0.71%	0.67%	0.63%	0.61%	327	17,547,455	13,582,512	13,233,511	13,238,356	13,359,344	13,418,287
SBUS	25,464,384	29,738,729	29,461,319	29,474,455	34,357,845	35,900,276	1.10%	1.19%	1.12%	1.07%	1.13%	1.13%	327	17,637,924	20,574,178	20,887,876	21,036,957	23,963,423	24,806,459
UBUS	40,105,938	58,713,467	67,946,221	77,178,975	84,278,222	87,827,846	1.74%	2.34%	2.59%	2.80%	2.77%	2.77%	327	27,779,407	40,619,803	48,173,412	55,085,353	58,781,181	60,687,494
All Other Buses	8,935,152	8,860,062	8,973,530	8,902,817	9,119,115	9,330,794	0.39%	0.35%	0.34%	0.32%	0.30%	0.29%	292	5,526,515	5,473,586	5,681,206	5,674,135	5,679,508	5,757,324
LHD1	821,237,215	800,676,137	806,533,163	826,814,647	870,838,554	889,496,949	35.60%	31.91%	30.75%	29.96%	28.65%	28.09%	327	568,830,543	553,932,661	571,826,568	590,126,741	607,380,143	614,626,724
LHD2	179,977,650	214,244,148	226,449,146	237,664,193	255,551,889	262,082,930	7.80%	8.54%	8.63%	8.61%	8.41%	8.28%	327	124,661,648	148,220,767	160,550,916	169,629,307	178,238,713	181,094,688
Motor Coach	6,296,747	7,638,494	8,181,736	8,657,400	9,607,012	10,080,993	0.27%	0.30%	0.31%	0.31%	0.32%	0.32%	292	3,894,625	4,718,923	5,179,915	5,517,721	5,983,377	6,220,215
PTO	7,957,995	8,957,158	9,446,264	9,927,143	11,021,133	11,570,748	0.35%	0.36%	0.36%	0.36%	0.36%	0.37%	312	5,259,262	5,912,582	6,390,120	6,760,336	7,334,255	7,628,431
T6 Ag	174,597	84,914	48,803	21,625	2,372	203	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	312	115,388	56,051	33,014	14,726	1,578	134
T6 CAIRP heavy	4,641,610	5,543,352	5,923,099	6,263,015	6,947,221	7,289,845	0.20%	0.22%	0.23%	0.23%	0.23%	0.23%	312	3,067,537	3,659,143	4,006,803	4,265,082	4,623,181	4,806,092
T6 CAIRP small	644,484	802,281	862,684	913,596	1,013,928	1,063,966	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	312	425,925	529,582	583,580	622,154	674,741	701,458
T6 instate construction heavy	14,909,859	14,327,558	14,969,724	17,787,539	25,636,325	29,196,254	0.65%	0.57%	0.57%	0.64%	0.84%	0.92%	312	9,853,594	9,457,560	10,126,578	12,113,226	17,060,256	19,248,680
T6 instate construction small	38,996,365	37,473,371	39,152,939	46,522,864	67,051,169	76,362,074	1.69%	1.49%	1.49%	1.69%	2.21%	2.41%	312	25,771,830	24,736,013	26,485,813	31,681,842	44,620,675	50,344,442
T6 instate heavy	91,671,286	137,988,971	153,797,748	167,062,963	191,123,786	201,791,909	3.97%	5.50%	5.86%	6.05%	6.29%	6.37%	312	60,583,513	91,085,932	104,039,659	113,769,056	127,187,527	133,038,569
T6 instate small	141,127,326	188,934,382	209,375,759	224,622,358	251,582,143	264,242,921	6.12%	7.53%	7.98%	8.14%	8.28%	8.34%	312	93,267,909	124,714,780	141,636,550	152,966,721	167,420,870	174,211,644
T6 OOS heavy	2,660,774	3,201,039	3,423,822	3,621,232	4,017,270	4,215,418	0.12%	0.13%	0.13%	0.13%	0.13%	0.13%	312	1,758,446	2,112,992	2,316,115	2,466,041	2,673,381	2,779,166
T6 OOS small	369,896	463,881	499,339	529,016	587,258	616,284	0.02%	0.02%	0.02%	0.02%	0.02%	0.02%	312	244,456	306,206	337,788	360,257	390,804	406,307
T6 Public	10,410,523	12,208,216	12,692,317	13,098,757	13,794,338	14,103,244	0.45%	0.49%	0.48%	0.47%	0.45%	0.45%	312	6,880,083	8,058,592	8,585,980	8,920,189	9,179,746	9,298,071
T6 utility	1,581,764	1,709,574	1,779,197	1,846,478	1,960,612	2,009,260	0.07%	0.07%	0.07%	0.07%	0.06%	0.06%	312	1,045,353	1,128,482	1,203,575	1,257,443	1,304,732	1,324,677
T6TS	57,719,363	73,232,341	81,097,375	86,512,233	92,658,230	94,818,511	2.50%	2.92%	3.09%	3.14%	3.05%	2.99%	327	39,979,358	50,664,412	57,497,492	61,746,829	64,625,950	65,517,921
T7 Ag	82,012	54,482	27,213	14,417	2,404	407	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	312	54,200	35,963	18,409	9,818	1,600	269
T7 CAIRP	91,957,823	111,411,480	119,286,313	126,193,867	140,007,084	146,913,499	3.99%	4.44%	4.55%	4.57%	4.61%	4.64%	312	60,772,878	73,542,243	80,693,687	85,937,403	93,170,793	96,858,005
T7 CAIRP construction	10,709,881	10,291,609	10,752,882	12,776,944	18,414,795	20,971,923	0.46%	0.41%	0.41%	0.46%	0.61%	0.66%	312	7,077,922	6,793,448	7,274,009	8,701,036	12,254,530	13,826,494
T7 NNOOS	112,103,588	135,812,157	145,406,333	153,824,799	170,661,782	179,080,283	4.86%	5.41%	5.54%	5.57%	5.62%	5.66%	312	74,086,767	89,649,026	98,363,113	104,753,932	113,570,636	118,065,114
T7 NOOS	36,129,918	43,772,830	46,867,399	49,581,536	55,008,826	57,722,369	1.57%	1.74%	1.79%	1.80%	1.81%	1.82%	312	23,877,459	28,894,258	31,704,419	33,764,782	36,606,833	38,055,546
T7 other port	22,213,312	30,960,899	34,157,514	36,904,512	42,398,390	45,145,870	0.96%	1.23%	1.30%	1.34%	1.40%	1.43%	312	14,680,283	20,437,157	23,106,554	25,131,791	28,214,941	29,764,037
T7 POLA	7,001,685	11,425,325	14,970,929	17,972,429	24,178,834	27,200,593	0.30%	0.46%	0.57%	0.65%	0.80%	0.86%	312	4,627,258	7,541,808	10,127,394	12,239,136	16,090,337	17,932,969
T7 Public	9,335,495	9,434,991	9,317,731	9,300,547	9,463,423	9,591,877	0.40%	0.38%	0.36%	0.34%	0.31%	0.30%	312	6,169,621	6,227,997	6,303,171	6,333,627	6,297,643	6,323,790
T7 Single	40,078,056	45,110,038	47,573,275	49,995,077	55,504,628	58,272,597	1.74%	1.80%	1.81%	1.81%	1.83%	1.84%	312	26,486,695	29,776,944	32,181,923	34,046,402	36,936,776	38,418,305
T7 single construction	26,569,246	25,531,590	26,675,924	31,697,247	45,683,719	52,027,483	1.15%	1.02%	1.02%	1.15%	1.50%	1.64%	312	17,559,023	16,853,294	18,045,479	21,585,669	30,401,235	34,300,988
T7 SWCV	16,435,264	20,321,568	22,308,461	24,186,214	26,665,142	27,603,130	0.71%	0.81%	0.85%	0.88%	0.88%	0.87%	312	10,861,700	13,414,181	15,091,019	16,470,692	17,744,905	18,198,356
T7 tractor	130,872,499	164,645,965	179,141,088	191,263,605	213,594,831	224,292,263	5.67%	6.56%	6.83%	6.93%	7.03%	7.08%	312	86,490,722	108,682,100	121,183,683	130,249,574	142,141,378	147,872,737
T7 tractor construction	21,917,289	21,061,314	22,005,288	26,147,438	37,685,046	42,918,093	0.95%	0.84%	0.84%	0.95%	1.24%	1.36%	312	14,484,648	13,902,484	14,885,931	17,806,277	25,078,343	28,295,295
T7 utility	762,787	823,888	857,839	890,763	946,295	969,891	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	312	504,109	543,845	580,303	606,605	629,733	639,435
T7IS	627,583	706,586	765,560	810,713	862,100	881,373	0.03%	0.03%	0.03%	0.03%	0.03%	0.03%	327	434,696	488,838	542,777	578,634	601,286	609,013
Grand Total	**2,306,618,751**	**2,508,952,308**	**2,622,984,678**	**2,759,299,369**	**3,039,099,784**	**3,166,506,427**	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%		1,580,284,412	1,710,569,386	1,830,653,972	1,937,151,520	2,082,185,257	2,148,097,676

Sum of Fuel Consumption	**Column Labels**						mile/gal						Annual gallons					
Row Labels	**2016**	**2025**	**2030**	**2035**	**2045**	**2050**	2016	2025	2030	2035	2045	2050	2016	2025	2030	2035	2045	2050
MCY	6,762	5,905	5,749	5,751	5,943	6,031	37	36	36	36	36	36	4,969,937	4,335,259	4,325,155	4,355,988	4,398,548	4,421,945
MH	10,148	6,564	5,427	4,846	4,509	4,510	5	6	6	7	7	7	7,029,231	4,541,425	3,847,495	3,458,720	3,144,878	3,116,512
OBUS	5,603	3,938	3,437	3,223	3,178	3,191	5	5	5	6	6	6	3,880,794	2,724,499	2,436,658	2,300,597	2,216,470	2,205,245
SBUS	3,272	3,512	3,203	2,904	3,042	3,096	8	8	9	10	11	12	2,266,679	2,429,674	2,270,894	2,072,905	2,121,501	2,138,983
UBUS	9,638	13,956	15,880	17,891	19,510	20,332	4	4	4	4	4	4	6,675,817	9,654,862	11,259,044	12,769,573	13,607,749	14,049,092
All Other Buses	1,127	931	881	838	824	828	8	10	10	11	11	11	697,356	575,263	557,804	533,801	513,419	510,895
LHD1	78,693	66,170	60,927	58,838	58,579	59,154	10	12	13	14	15	15	54,507,091	45,778,131	43,196,718	41,994,761	40,856,839	40,874,126
LHD2	16,692	17,147	16,633	16,489	16,771	17,008	11	12	14	14	15	15	11,561,826	11,862,548	11,792,457	11,768,489	11,697,062	11,752,009
Motor Coach	1,076	1,136	1,121	1,124	1,169	1,223	6	7	7	8	8	8	665,775	701,719	709,677	716,327	728,076	754,367
PTO	1,733	1,678	1,672	1,659	1,651	1,683	5	5	6	6	7	7	1,145,393	1,107,835	1,130,772	1,130,027	1,098,672	1,109,304
T6 Ag	20	10	6	3	0	0	9	9	9	8	5	2	12,926	6,284	3,878	1,927	325	72
T6 CAIRP heavy	463	451	427	428	466	490	10	12	14	15	15	15	305,930	297,776	288,991	291,733	309,824	323,177
T6 CAIRP small	68	71	69	70	76	80	9	11	12	13	13	13	44,870	46,715	46,881	47,621	50,705	52,842
T6 instate construction heavy	1,949	1,642	1,663	1,914	2,527	2,797	8	9	9	9	10	10	1,288,127	1,083,670	1,124,654	1,303,464	1,681,852	1,843,824
T6 instate construction small	5,089	4,243	4,079	4,558	6,241	7,067	8	9	10	10	11	11	3,363,520	2,800,837	2,759,502	3,104,069	4,153,337	4,659,248
T6 instate heavy	10,380	12,429	12,829	13,292	14,188	14,697	9	11	12	13	13	14	6,860,108	8,204,227	8,678,567	9,051,480	9,441,809	9,689,567
T6 instate small	16,389	18,124	18,495	18,727	20,045	20,945	9	10	11	12	13	13	10,830,879	11,963,832	12,511,446	12,752,984	13,339,156	13,808,617
T6 OOS heavy	265	260	247	247	269	283	10	12	14	15	15	15	175,368	171,911	166,913	168,461	179,112	186,864
T6 OOS small	39	41	40	41	44	46	9	11	12	13	13	13	25,755	27,030	27,164	27,607	29,427	30,654
T6 Public	1,561	1,570	1,499	1,445	1,402	1,407	7	8	8	9	10	10	1,031,301	1,036,030	1,014,051	983,775	932,872	927,567
T6 utility	197	176	165	161	167	171	8	10	11	11	12	12	130,105	116,004	111,576	109,853	110,925	112,690
T6TS	12,823	14,328	14,661	14,859	15,274	15,554	5	5	6	6	6	6	8,881,904	9,912,712	10,394,271	10,605,505	10,652,758	10,747,834
T7 Ag	14	10	6	3	1	0	6	5	5	4	3	1	9,443	6,568	3,913	2,353	626	309
T7 CAIRP	14,955	15,264	13,955	13,331	14,215	14,956	6	7	9	9	10	10	9,883,736	10,076,013	9,439,826	9,078,136	9,459,956	9,860,564
T7 CAIRP construction	2,061	1,639	1,514	1,673	2,339	2,669	5	6	7	8	8	8	1,361,976	1,081,966	1,023,959	1,139,501	1,556,278	1,759,614
T7 NNOOS	17,799	17,498	16,653	16,766	18,254	19,376	6	8	9	9	9	9	11,762,849	11,550,047	11,264,977	11,417,250	12,147,371	12,774,177
T7 NOOS	5,982	6,156	5,633	5,369	5,717	6,015	6	7	8	9	10	10	3,953,532	4,063,629	3,810,471	3,656,186	3,804,351	3,965,931
T7 other port	4,303	4,862	4,543	4,457	4,866	5,185	5	6	8	8	9	9	2,843,855	3,209,670	3,073,042	3,035,050	3,238,363	3,418,100
T7 POLA	1,409	1,891	2,281	2,397	2,850	3,164	5	6	7	7	8	9	931,248	1,248,495	1,543,342	1,632,501	1,896,638	2,085,709
T7 Public	1,993	1,762	1,583	1,433	1,283	1,251	5	5	6	6	7	8	1,316,885	1,163,258	1,070,863	975,768	853,968	824,660
T7 Single	7,080	6,645	6,600	6,518	6,460	6,583	6	7	7	8	9	9	4,679,271	4,386,317	4,464,605	4,438,610	4,299,247	4,339,866
T7 single construction	5,269	4,360	4,269	4,772	6,197	6,876	5	6	6	7	7	8	3,482,456	2,877,917	2,888,071	3,249,953	4,123,831	4,533,528
T7 SWCV	7,352	8,201	8,291	8,383	8,517	8,657	2	2	3	3	3	3	4,858,651	5,413,148	5,608,358	5,708,509	5,667,999	5,707,181
T7 tractor	19,817	20,408	20,177	19,577	19,728	20,466	7	8	9	10	11	11	13,096,284	13,471,464	13,649,064	13,332,116	13,128,359	13,493,173
T7 tractor construction	4,374	3,628	3,535	3,893	5,017	5,609	5	6	6	7	8	8	2,890,946	2,394,999	2,391,319	2,650,804	3,338,690	3,698,129
T7 utility	139	135	128	120	114	115	5	6	7	7	8	8	92,024	89,434	86,327	81,555	75,804	75,497
T7IS	173	161	155	152	153	156	4	4	5	5	6	6	120,066	111,331	110,097	108,496	106,713	107,503
Grand Total	**276,710**	**266,902**	**258,430**	**258,152**	**271,586**	**281,670**							187,633,916	180,522,500	179,082,801	180,056,454	184,963,510	189,959,374

Table. Heavy Duty and Other VMT by Fuel Type

Sum of VMT	**Column Labels**											
Row Labels	**2016**	**2025**	**2030**	**2035**	**2045**	**2050**	% total					
Gasoline	**912,757,168**	**816,983,740**	**809,866,787**	**821,753,174**	**859,251,932**	**876,166,951**	40%	33%	32%	31%	29%	29%
MCY	246,993,424	215,042,767	209,182,424	209,007,858	215,307,911	218,678,705						
MH	40,337,490	27,096,179	23,782,012	22,380,204	22,284,999	22,652,361						
OBUS	25,333,771	19,632,699	18,665,215	18,547,994	19,154,119	19,419,145						
SBUS	1,869,671	5,657,701	7,793,071	9,937,289	14,400,188	15,707,251						
UBUS	10,362,860	15,170,807	17,556,433	19,942,058	21,776,413	22,693,590						
LHD1	466,185,318	396,021,132	385,679,370	387,701,490	402,112,119	408,900,464						
LHD2	63,327,686	64,423,528	65,345,327	66,913,335	70,695,852	72,415,550						
T6TS	57,719,363	73,232,341	81,097,375	86,512,233	92,658,230	94,818,511						
T7IS	627,583	706,586	765,560	810,713	862,100	881,373						
Diesel	**1,359,949,877**	**1,633,802,733**	**1,743,773,754**	**1,858,135,509**	**2,091,339,342**	**2,197,852,447**	60%	67%	68%	69%	71%	71%
MH	12,274,702	11,017,868	10,627,090	10,381,901	10,127,035	10,164,141						
SBUS	23,594,713	24,081,029	21,668,249	19,537,166	19,957,657	20,193,025						
UBUS	859,382	0	0	0	0	0						
All Other Buses	8,935,152	8,860,062	8,973,530	8,902,817	9,119,115	9,330,794						
LHD1	355,051,896	404,655,004	420,853,794	439,113,157	468,726,434	480,596,485						
LHD2	116,649,963	149,820,620	161,103,819	170,750,858	184,856,037	189,667,380						
Motor Coach	6,296,747	7,638,494	8,181,736	8,657,400	9,607,012	10,080,993						
PTO	7,957,995	8,957,158	9,446,264	9,927,143	11,021,133	11,570,748						
T6 Ag	174,597	84,914	48,803	21,625	2,372	203						
T6 CAIRP heavy	4,641,610	5,543,352	5,923,099	6,263,015	6,947,221	7,289,845						
T6 CAIRP small	644,484	802,281	862,684	913,596	1,013,928	1,063,966						
T6 instate construction h	14,909,859	14,327,558	14,969,724	17,787,539	25,636,325	29,196,254						
T6 instate construction sı	38,996,365	37,473,371	39,152,939	46,522,864	67,051,169	76,362,074						
T6 instate heavy	91,671,286	137,988,971	153,797,748	167,062,963	191,123,786	201,791,909						
T6 instate small	141,127,326	188,934,382	209,375,759	224,622,358	251,582,143	264,242,921						
T6 OOS heavy	2,660,774	3,201,039	3,423,822	3,621,232	4,017,270	4,215,418						
T6 OOS small	369,896	463,881	499,339	529,016	587,258	616,284						
T6 Public	10,410,523	12,208,216	12,692,317	13,098,757	13,794,338	14,103,244						
T6 utility	1,581,764	1,709,574	1,779,197	1,846,478	1,960,612	2,009,260						
T7 Ag	82,012	54,482	27,213	14,417	2,404	407						
T7 CAIRP	91,957,823	111,411,480	119,286,313	126,193,867	140,007,084	146,913,499						
T7 CAIRP construction	10,709,881	10,291,609	10,752,882	12,776,944	18,414,795	20,971,923						
T7 NNOOS	112,103,588	135,812,157	145,406,333	153,824,799	170,661,782	179,080,283						
T7 NOOS	36,129,918	43,772,830	46,867,399	49,581,536	55,008,826	57,722,369						
T7 other port	22,213,312	30,960,899	34,157,514	36,904,512	42,398,390	45,145,870						
T7 POLA	7,001,685	11,425,325	14,970,929	17,972,429	24,178,834	27,200,593						
T7 Public	9,335,495	9,434,991	9,317,731	9,300,547	9,463,423	9,591,877						
T7 Single	40,078,056	45,110,038	47,573,275	49,995,077	55,504,628	58,272,597						
T7 single construction	26,569,246	25,531,590	26,675,924	31,697,247	45,683,719	52,027,483						
T7 SWCV	11,407,254	5,698,392	3,354,112	2,012,445	658,441	250,356						
T7 tractor	130,872,499	164,645,965	179,141,088	191,263,605	213,594,831	224,292,263						
T7 tractor construction	21,917,289	21,061,314	22,005,288	26,147,438	37,685,046	42,918,093						
T7 utility	762,787	823,888	857,839	890,763	946,295	969,891						
Grand Total	**2,272,707,045**	**2,450,786,473**	**2,553,640,541**	**2,679,888,683**	**2,950,591,273**	**3,074,019,397**						

Table. Heavy Duty and Other VMT by Fuel Type

Sum of VMT	**Column Labels**											
Row Labels	**2016**	**2025**	**2030**	**2035**	**2045**	**2050**	% total					
Diesel	**1,359,949,877**	**1,633,802,733**	**1,743,773,754**	**1,858,135,509**	**2,091,339,342**	**2,197,852,447**	59%	65%	66%	67%	69%	69%
MH	12,274,702	11,017,868	10,627,090	10,381,901	10,127,035	10,164,141						
SBUS	23,594,713	24,081,029	21,668,249	19,537,166	19,957,657	20,193,025						
UBUS	859,382	0	0	0	0	0						
All Other Buses	8,935,152	8,860,062	8,973,530	8,902,817	9,119,115	9,330,794						
LHD1	355,051,896	404,655,004	420,853,794	439,113,157	468,726,434	480,596,485						
LHD2	116,649,963	149,820,620	161,103,819	170,750,858	184,856,037	189,667,380						
Motor Coach	6,296,747	7,638,494	8,181,736	8,657,400	9,607,012	10,080,993						
PTO	7,957,995	8,957,158	9,446,264	9,927,143	11,021,133	11,570,748						
T6 Ag	174,597	84,914	48,803	21,625	2,372	203						
T6 CAIRP heavy	4,641,610	5,543,352	5,923,099	6,263,015	6,947,221	7,289,845						
T6 CAIRP small	644,484	802,281	862,684	913,596	1,013,928	1,063,966						
T6 instate construction h	14,909,859	14,327,558	14,969,724	17,787,539	25,636,325	29,196,254						
T6 instate construction sı	38,996,365	37,473,371	39,152,939	46,522,864	67,051,169	76,362,074						
T6 instate heavy	91,671,286	137,988,971	153,797,748	167,062,963	191,123,786	201,791,909						
T6 instate small	141,127,326	188,934,382	209,375,759	224,622,358	251,582,143	264,242,921						
T6 OOS heavy	2,660,774	3,201,039	3,423,822	3,621,232	4,017,270	4,215,418						
T6 OOS small	369,896	463,881	499,339	529,016	587,258	616,284						
T6 Public	10,410,523	12,208,216	12,692,317	13,098,757	13,794,338	14,103,244						
T6 utility	1,581,764	1,709,574	1,779,197	1,846,478	1,960,612	2,009,260						
T7 Ag	82,012	54,482	27,213	14,417	2,404	407						
T7 CAIRP	91,957,823	111,411,480	119,286,313	126,193,867	140,007,084	146,913,499						
T7 CAIRP construction	10,709,881	10,291,609	10,752,882	12,776,944	18,414,795	20,971,923						
T7 NNOOS	112,103,588	135,812,157	145,406,333	153,824,799	170,661,782	179,080,283						
T7 NOOS	36,129,918	43,772,830	46,867,399	49,581,536	55,008,826	57,722,369						
T7 other port	22,213,312	30,960,899	34,157,514	36,904,512	42,398,390	45,145,870						
T7 POLA	7,001,685	11,425,325	14,970,929	17,972,429	24,178,834	27,200,593						
T7 Public	9,335,495	9,434,991	9,317,731	9,300,547	9,463,423	9,591,877						
T7 Single	40,078,056	45,110,038	47,573,275	49,995,077	55,504,628	58,272,597						
T7 single construction	26,569,246	25,531,590	26,675,924	31,697,247	45,683,719	52,027,483						
T7 SWCV	11,407,254	5,698,392	3,354,112	2,012,445	658,441	250,356						
T7 tractor	130,872,499	164,645,965	179,141,088	191,263,605	213,594,831	224,292,263						
T7 tractor construction	21,917,289	21,061,314	22,005,288	26,147,438	37,685,046	42,918,093						
T7 utility	762,787	823,888	857,839	890,763	946,295	969,891						
Gasoline	**912,757,168**	**816,983,740**	**809,866,787**	**821,753,174**	**859,251,932**	**876,166,951**	40%	33%	31%	30%	28%	28%
MCY	246,993,424	215,042,767	209,182,424	209,007,858	215,307,911	218,678,705						
MH	40,337,490	27,096,179	23,782,012	22,380,204	22,284,999	22,652,361						
OBUS	25,333,771	19,632,699	18,665,215	18,547,994	19,154,119	19,419,145						
SBUS	1,869,671	5,657,701	7,793,071	9,937,289	14,400,188	15,707,251						
UBUS	10,362,860	15,170,807	17,556,433	19,942,058	21,776,413	22,693,590						
LHD1	466,185,318	396,021,132	385,679,370	387,701,490	402,112,119	408,900,464						
LHD2	63,327,686	64,423,528	65,345,327	66,913,335	70,695,852	72,415,550						
T6TS	57,719,363	73,232,341	81,097,375	86,512,233	92,658,230	94,818,511						
T7IS	627,583	706,586	765,560	810,713	862,100	881,373						
Natural Gas	**33,911,706**	**58,165,835**	**69,344,137**	**79,410,686**	**88,508,511**	**92,487,029**						
UBUS	28,883,696	43,542,659	50,389,788	57,236,917	62,501,809	65,134,256						
T7 SWCV	5,028,010	14,623,176	18,954,349	22,173,769	26,006,702	27,352,774						
Grand Total	**2,306,618,751**	**2,508,952,308**	**2,622,984,678**	**2,759,299,369**	**3,039,099,784**	**3,166,506,427**						

EMFAC2011 Category	Operation Days (days/yr)
LDA	347
LDT1	347
LDT2	347
LHD1	327
LHD2	327
MCY	347
MDV	347
MH	327
Motor Coach	292
OBUS	327
PTO	312
SBUS	327
T6 Ag	312
T6 CAIRP heavy	312
T6 CAIRP small	312
T6 instate construction heavy	312
T6 instate construction small	312
T6 instate heavy	312
T6 instate small	312
T6 OOS heavy	312
T6 OOS small	312
T6 Public	312
T6 utility	312
T6TS	327
T7 Ag	312
T7 CAIRP	312
T7 CAIRP construction	312
T7 NNOOS	312
T7 NOOS	312
T7 other port	312
T7 POLA	312
T7 Public	312
T7 Single	312
T7 single construction	312
T7 SWCV	312
T7 tractor	312
T7 tractor construction	312
T7 utility	312
T7IS	327
UBUS	327
All Other Buses	292

Source: https://arb.ca.gov/emfac/emissions-inventory/a5a25cd71dfd245b33eb8fc3464ef085f405772f

Source: EMFAC2017 (v1.0.3) Emissions Inventory
Region Type: County
Region: San Diego
Calendar Year: 2016, 2025, 2030, 2035, 2045, 2050
Season: Annual
Vehicle Classification: EMFAC2011 Categories
Units: miles/year for VMT, trips/year for Trips, tons/year for Emissions, 1000 gallons/year for Fuel Consumption

Region	Calendar Y	Vehicle Category	Model Year	Speed	Fuel	Population	VMT	Trips	Fuel Consumption
San Diego	2016	All Other Buses	Aggregate	Aggregate	Diesel	632.57	8935151.903	1551567.696	1127.469884
San Diego	2016	LDA	Aggregate	Aggregate	Gasoline	1266609.588	17195958298	2062838229	637236.277
San Diego	2016	LDA	Aggregate	Aggregate	Diesel	12811.59844	177688482.4	20785433.13	4342.322442
San Diego	2016	LDA	Aggregate	Aggregate	Electricity	10580.71806	131161317.8	18616637.66	0
San Diego	2016	LDT1	Aggregate	Aggregate	Gasoline	163099.2886	2018319387	255389369.3	87542.78766
San Diego	2016	LDT1	Aggregate	Aggregate	Diesel	184.6174236	1275291.569	222638.1525	57.91930369
San Diego	2016	LDT1	Aggregate	Aggregate	Electricity	178.3081176	2003420.748	302903.5565	0
San Diego	2016	LDT2	Aggregate	Aggregate	Gasoline	501018.1334	6611005270	810482800.9	321819.27
San Diego	2016	LDT2	Aggregate	Aggregate	Diesel	1635.745032	26094545.76	2814366.55	878.4456999
San Diego	2016	LDT2	Aggregate	Aggregate	Electricity	384.3180677	5025460.323	689664.6553	0
San Diego	2016	LHD1	Aggregate	Aggregate	Gasoline	38986.8833	466185318.5	189936795.9	57870.39221
San Diego	2016	LHD1	Aggregate	Aggregate	Diesel	28052.57443	355051896.4	115387213.5	20823.08158
San Diego	2016	LHD2	Aggregate	Aggregate	Gasoline	5239.023081	63327686.39	25523539.55	9004.019734
San Diego	2016	LHD2	Aggregate	Aggregate	Diesel	8845.521604	116649963.2	36383829.65	7688.125672
San Diego	2016	MCY	Aggregate	Aggregate	Gasoline	76496.10058	246993424	53088293.8	6761.683836
San Diego	2016	MDV	Aggregate	Aggregate	Gasoline	328469.0614	4308284459	527728842.2	249655.2209
San Diego	2016	MDV	Aggregate	Aggregate	Diesel	4704.007685	76726277.47	8068981.05	3372.250737
San Diego	2016	MDV	Aggregate	Aggregate	Electricity	17.0157265	133979.1424	26068.40973	0
San Diego	2016	MH	Aggregate	Aggregate	Gasoline	14000.57285	40337490.49	458001.8596	8848.554342
San Diego	2016	MH	Aggregate	Aggregate	Diesel	3649.52793	12274701.9	119339.5633	1299.751577
San Diego	2016	Motor Coach	Aggregate	Aggregate	Diesel	176.61	6296746.663	752923.752	1076.4109
San Diego	2016	OBUS	Aggregate	Aggregate	Gasoline	1343.113707	25333771.03	8787477.227	5602.814757
San Diego	2016	PTO	Aggregate	Aggregate	Diesel	0	7957995.419	0	1733.139389
San Diego	2016	SBUS	Aggregate	Aggregate	Gasoline	104.1712449	1869670.92	136255.9883	217.2113937
San Diego	2016	SBUS	Aggregate	Aggregate	Diesel	2317.11	23594712.93	8743694.903	3055.259218
San Diego	2016	T6 Ag	Aggregate	Aggregate	Diesel	36.92	174597.4196	50683.776	19.5589275
San Diego	2016	T6 CAIRP heavy	Aggregate	Aggregate	Diesel	74.96046859	4641610.304	341459.9265	462.9139599
San Diego	2016	T6 CAIRP small	Aggregate	Aggregate	Diesel	38.69132489	644483.5154	176246.7232	67.89511699
San Diego	2016	T6 instate construction heavy	Aggregate	Aggregate	Diesel	746.5099714	14909859.12	1052982.078	1949.115595
San Diego	2016	T6 instate construction small	Aggregate	Aggregate	Diesel	2667.580742	38996365.04	3762728.992	5089.474501
San Diego	2016	T6 instate heavy	Aggregate	Aggregate	Diesel	2297.04	91671286.36	8270347.216	10380.29811
San Diego	2016	T6 instate small	Aggregate	Aggregate	Diesel	9806.75	141127325.7	35308583.03	16388.62704
San Diego	2016	T6 OOS heavy	Aggregate	Aggregate	Diesel	42.99669893	2660774.02	195858.563	265.3557266
San Diego	2016	T6 OOS small	Aggregate	Aggregate	Diesel	22.22493051	369895.5164	101239.0035	38.97121698
San Diego	2016	T6 Public	Aggregate	Aggregate	Diesel	2212.41	10410522.79	2093824.822	1560.501795
San Diego	2016	T6 utility	Aggregate	Aggregate	Diesel	300.34	1581764.408	1077619.92	196.8675076
San Diego	2016	T6TS	Aggregate	Aggregate	Gasoline	3585.063903	57719362.61	23455696.45	12823.06282
San Diego	2016	T7 Ag	Aggregate	Aggregate	Diesel	14.11	82011.80352	19370.208	14.28887027
San Diego	2016	T7 CAIRP	Aggregate	Aggregate	Diesel	1465.896431	91957822.59	6677451.424	14955.46875
San Diego	2016	T7 CAIRP construction	Aggregate	Aggregate	Diesel	170.5991616	10709881.32	240636.9191	2060.858976
San Diego	2016	T7 NNOOS	Aggregate	Aggregate	Diesel	1726.046016	112103588	7862484.814	17798.82789
San Diego	2016	T7 NOOS	Aggregate	Aggregate	Diesel	575.9658246	36129917.82	2623639.524	5982.244218
San Diego	2016	T7 other port	Aggregate	Aggregate	Diesel	439.85	22213311.74	1042972.32	4303.148018
San Diego	2016	T7 POLA	Aggregate	Aggregate	Diesel	202.46	7001685.348	480073.152	1409.107071
San Diego	2016	T7 Public	Aggregate	Aggregate	Diesel	1478.99	9335494.732	1399716.135	1992.630629
San Diego	2016	T7 Single	Aggregate	Aggregate	Diesel	2110.16	40078055.6	7597497.597	7080.38836
San Diego	2016	T7 single construction	Aggregate	Aggregate	Diesel	1322.027951	26569245.69	1864773.134	5269.4408
San Diego	2016	T7 SWCV	Aggregate	Aggregate	Diesel	896.7167489	11407253.98	1091124.94	5169.023308
San Diego	2016	T7 SWCV	Aggregate	Aggregate	Natural Gas	398.5732511	5028009.78	484983.932	2182.792408
San Diego	2016	T7 tractor	Aggregate	Aggregate	Diesel	2951.95	130872498.6	11696806.68	19816.50009
San Diego	2016	T7 tractor construction	Aggregate	Aggregate	Diesel	1023.733251	21917288.51	1444016.566	4374.404342
San Diego	2016	T7 utility	Aggregate	Aggregate	Diesel	120.53	762787.3663	432461.64	139.245151
San Diego	2016	T7IS	Aggregate	Aggregate	Gasoline	29.97103453	627583.4712	196088.97	173.3425858
San Diego	2016	UBUS	Aggregate	Aggregate	Gasoline	301.626309	10362860.46	394527.2122	2012.820298
San Diego	2016	UBUS	Aggregate	Aggregate	Diesel	25	859381.7791	32700	181.6428383
San Diego	2016	UBUS	Aggregate	Aggregate	Natural Gas	784.293125	28883695.73	1025855.407	7443.608444
San Diego	2025	All Other Buses	Aggregate	Aggregate	Diesel	563.3042773	8860062.319	1381672.731	931.1754905
San Diego	2025	LDA	Aggregate	Aggregate	Gasoline	1519467.966	19693709795	2490713882	577401.5542
San Diego	2025	LDA	Aggregate	Aggregate	Diesel	18671.09045	239541618.9	30359601.39	4742.135689
San Diego	2025	LDA	Aggregate	Aggregate	Electricity	46846.2012	717723800.8	80414742.39	0
San Diego	2025	LDT1	Aggregate	Aggregate	Gasoline	173946.4981	2068157775	275002758.2	72962.71422
San Diego	2025	LDT1	Aggregate	Aggregate	Diesel	88.98633906	558366.009	100913.3157	23.50039121
San Diego	2025	LDT1	Aggregate	Aggregate	Electricity	2074.792295	33433535.87	3618102.495	0
San Diego	2025	LDT2	Aggregate	Aggregate	Gasoline	487846.2103	6008096843	786637533.5	221832.8479
San Diego	2025	LDT2	Aggregate	Aggregate	Diesel	3717.387288	50651982.15	6245010.142	1350.672479
San Diego	2025	LDT2	Aggregate	Aggregate	Electricity	7882.174997	87381660.64	13732928.51	0
San Diego	2025	LHD1	Aggregate	Aggregate	Gasoline	33781.5608	396021132.3	164577439.3	45065.5205
San Diego	2025	LHD1	Aggregate	Aggregate	Diesel	33448.59921	404655004.5	137582405	21103.99727
San Diego	2025	LHD2	Aggregate	Aggregate	Gasoline	5525.568531	64423528.18	26919535.33	8392.196728
San Diego	2025	LHD2	Aggregate	Aggregate	Diesel	12294.59157	149820619.7	50570711.99	8754.398083
San Diego	2025	MCY	Aggregate	Aggregate	Gasoline	81028.57501	215042766.6	56233831.06	5905.180981
San Diego	2025	MDV	Aggregate	Aggregate	Gasoline	317946.1921	3877696229	507859711.6	173397.6427
San Diego	2025	MDV	Aggregate	Aggregate	Diesel	8729.716022	119861060.5	14550151.05	4188.142857
San Diego	2025	MDV	Aggregate	Aggregate	Electricity	4973.835827	56502698.5	8736059.09	0
San Diego	2025	MH	Aggregate	Aggregate	Gasoline	9512.058939	27096179.08	311168.745	5468.622403
San Diego	2025	MH	Aggregate	Aggregate	Diesel	3889.548074	11017868.49	127188.222	1095.732342
San Diego	2025	Motor Coach	Aggregate	Aggregate	Diesel	197.2277533	7638493.906	840821.3581	1135.868866
San Diego	2025	OBUS	Aggregate	Aggregate	Gasoline	1227.727046	19632699.48	8032546.615	3938.098775
San Diego	2025	PTO	Aggregate	Aggregate	Diesel	0	8957157.899	0	1678.294743

San Diego	2025	SBUS	Aggregate	Aggregate	Gasoline	338.3875584	5657700.829	442610.9264	562.147249
San Diego	2025	SBUS	Aggregate	Aggregate	Diesel	2355.631184	24081028.62	8889055.925	2949.799399
San Diego	2025	T6 Ag	Aggregate	Aggregate	Diesel	33.10501267	84914.05645	45446.56139	9.520463774
San Diego	2025	T6 CAIRP heavy	Aggregate	Aggregate	Diesel	95.15954831	5543352.358	433470.7745	451.1097231
San Diego	2025	T6 CAIRP small	Aggregate	Aggregate	Diesel	51.85743694	802280.8979	236220.9967	70.77058475
San Diego	2025	T6 instate construction heavy	Aggregate	Aggregate	Diesel	722.3244737	14327558.02	1018867.469	1641.685895
San Diego	2025	T6 instate construction small	Aggregate	Aggregate	Diesel	2242.121803	37473371.04	3162602.195	4243.076484
San Diego	2025	T6 instate heavy	Aggregate	Aggregate	Diesel	3375.286924	137988971	12152507.06	12428.84448
San Diego	2025	T6 instate small	Aggregate	Aggregate	Diesel	11968.91474	188934381.7	43093320.39	18124.38937
San Diego	2025	T6 OOS heavy	Aggregate	Aggregate	Diesel	54.90145843	3201039.05	250087.1235	260.4340982
San Diego	2025	T6 OOS small	Aggregate	Aggregate	Diesel	30.1285727	463880.7751	137241.6744	40.94797511
San Diego	2025	T6 Public	Aggregate	Aggregate	Diesel	2494.029279	12208216.38	2360349.307	1569.514794
San Diego	2025	T6 utility	Aggregate	Aggregate	Diesel	329.1235539	1709573.601	1180895.311	175.7376843
San Diego	2025	T6TS	Aggregate	Aggregate	Gasoline	3848.928068	73232340.69	25182058.36	14328.22569
San Diego	2025	T7 Ag	Aggregate	Aggregate	Diesel	19.62275013	54481.7403	26938.11138	9.949420439
San Diego	2025	T7 CAIRP	Aggregate	Aggregate	Diesel	1944.733287	111411480.3	8858649.071	15264.47279
San Diego	2025	T7 CAIRP construction	Aggregate	Aggregate	Diesel	180.5612918	10291609.39	254688.901	1639.104362
San Diego	2025	T7 NNOOS	Aggregate	Aggregate	Diesel	2286.546631	135812157.2	10415677.21	17497.53289
San Diego	2025	T7 NOOS	Aggregate	Aggregate	Diesel	774.6757845	43772829.79	3528803.133	6156.120547
San Diego	2025	T7 other port	Aggregate	Aggregate	Diesel	554.4483313	30960898.9	1314707.883	4862.430535
San Diego	2025	T7 POLA	Aggregate	Aggregate	Diesel	256.2133664	11425324.6	607533.1344	1891.384175
San Diego	2025	T7 Public	Aggregate	Aggregate	Diesel	1491.919045	9434991.028	1411952.182	1762.256412
San Diego	2025	T7 Single	Aggregate	Aggregate	Diesel	2236.419762	45110037.57	8052087.884	6644.971422
San Diego	2025	T7 single construction	Aggregate	Aggregate	Diesel	1169.491076	25531589.95	1649613.79	4359.848329
San Diego	2025	T7 SWCV	Aggregate	Aggregate	Diesel	447.0093384	5698392.119	543920.963	2563.651912
San Diego	2025	T7 SWCV	Aggregate	Aggregate	Natural Gas	1151.00669	14623176.11	1400544.941	5636.897542
San Diego	2025	T7 tractor	Aggregate	Aggregate	Diesel	4111.835052	164645964.5	16292735.21	20408.34912
San Diego	2025	T7 tractor construction	Aggregate	Aggregate	Diesel	994.6787284	21061313.89	1403034.004	3628.260755
San Diego	2025	T7 utility	Aggregate	Aggregate	Diesel	130.1828545	823887.9997	467096.082	135.4865876
San Diego	2025	T7IS	Aggregate	Aggregate	Gasoline	16.62122221	706585.5041	108746.2744	160.9223488
San Diego	2025	UBUS	Aggregate	Aggregate	Gasoline	441.5686833	15170807.43	577571.8377	2562.950429
San Diego	2025	UBUS	Aggregate	Aggregate	Diesel	0	0	0	0
San Diego	2025	UBUS	Aggregate	Aggregate	Natural Gas	1184.772312	43542659.18	1549682.184	11392.56794
San Diego	2030	All Other Buses	Aggregate	Aggregate	Diesel	613.4794578	8973529.8	1504742.414	881.0571069
San Diego	2030	LDA	Aggregate	Aggregate	Gasoline	1642233.743	20349257066	2684428583	531835.1582
San Diego	2030	LDA	Aggregate	Aggregate	Diesel	19966.86312	250948659	32812167.43	4433.11656
San Diego	2030	LDA	Aggregate	Aggregate	Electricity	76256.60494	1082810869	129216024	0
San Diego	2030	LDT1	Aggregate	Aggregate	Gasoline	182473.2949	2096866975	288894784.1	66211.35793
San Diego	2030	LDT1	Aggregate	Aggregate	Diesel	28.12216079	295891.4267	42300.27726	10.62411782
San Diego	2030	LDT1	Aggregate	Aggregate	Electricity	3981.488616	58225542.01	6812094.696	0
San Diego	2030	LDT2	Aggregate	Aggregate	Gasoline	498608.6046	5934881159	803430289	189286.4972
San Diego	2030	LDT2	Aggregate	Aggregate	Diesel	4503.738581	56875566.37	7457806.885	1357.250999
San Diego	2030	LDT2	Aggregate	Aggregate	Electricity	14169.28609	142705731.7	24200794.27	0
San Diego	2030	LHD1	Aggregate	Aggregate	Gasoline	33194.36976	385679369.6	161716754.5	40677.93318
San Diego	2030	LHD1	Aggregate	Aggregate	Diesel	35932.03746	420853793.7	147797404	20248.90702
San Diego	2030	LHD2	Aggregate	Aggregate	Gasoline	5741.233774	65345327.19	27970216.01	7917.098383
San Diego	2030	LHD2	Aggregate	Aggregate	Diesel	13961.1029	161103819	57425487.45	8715.580944
San Diego	2030	MCY	Aggregate	Aggregate	Gasoline	83414.78362	209182424.3	57889859.83	5748.809004
San Diego	2030	MDV	Aggregate	Aggregate	Gasoline	319606.7094	3797852139	511355299	146620.1887
San Diego	2030	MDV	Aggregate	Aggregate	Diesel	10205.13272	129940521.2	16800257.31	4043.530356
San Diego	2030	MDV	Aggregate	Aggregate	Electricity	9702.140973	99381157.49	16666908.74	0
San Diego	2030	MH	Aggregate	Aggregate	Gasoline	8002.770737	23782012.42	261795.2794	4430.615056
San Diego	2030	MH	Aggregate	Aggregate	Diesel	3887.577657	10627090.06	127123.7894	996.0865154
San Diego	2030	Motor Coach	Aggregate	Aggregate	Diesel	239.5316429	8181736.253	1021171.3	1120.943752
San Diego	2030	OBUS	Aggregate	Aggregate	Gasoline	1198.728979	18665214.77	7842823.399	3436.785302
San Diego	2030	PTO	Aggregate	Aggregate	Diesel	0	9446264.252	0	1671.575918
San Diego	2030	SBUS	Aggregate	Aggregate	Gasoline	482.5880773	7793070.732	631225.2051	728.9238665
San Diego	2030	SBUS	Aggregate	Aggregate	Diesel	2105.939873	21668248.55	7946837.108	2474.059544
San Diego	2030	T6 Ag	Aggregate	Aggregate	Diesel	32.04637347	48803.21485	43993.26151	5.732670005
San Diego	2030	T6 CAIRP heavy	Aggregate	Aggregate	Diesel	107.1564036	5923099.18	488118.8496	427.2036764
San Diego	2030	T6 CAIRP small	Aggregate	Aggregate	Diesel	60.14519629	862684.1096	273973.3981	69.30189824
San Diego	2030	T6 instate construction heavy	Aggregate	Aggregate	Diesel	789.0022022	14969723.57	1112919.063	1662.532271
San Diego	2030	T6 instate construction small	Aggregate	Aggregate	Diesel	2524.906357	39152939.03	3561481.083	4079.26393
San Diego	2030	T6 instate heavy	Aggregate	Aggregate	Diesel	4379.210608	153797748.5	15767070.78	12829.18496
San Diego	2030	T6 instate small	Aggregate	Aggregate	Diesel	14321.15447	209375758.9	51562410.77	18495.17953
San Diego	2030	T6 OOS heavy	Aggregate	Aggregate	Diesel	61.70583852	3423821.636	281082.4356	246.7408467
San Diego	2030	T6 OOS small	Aggregate	Aggregate	Diesel	35.03517545	499339.3351	159592.2312	40.15614622
San Diego	2030	T6 Public	Aggregate	Aggregate	Diesel	2601.994143	12692317.27	2462527.255	1499.031417
San Diego	2030	T6 utility	Aggregate	Aggregate	Diesel	342.9929684	1779197.087	1230658.771	164.938996
San Diego	2030	T6TS	Aggregate	Aggregate	Gasoline	4351.311471	81097375.34	28468960.05	14660.60587
San Diego	2030	T7 Ag	Aggregate	Aggregate	Diesel	22.70735266	27212.90007	31172.65374	5.784421481
San Diego	2030	T7 CAIRP	Aggregate	Aggregate	Diesel	1911.363002	119286313	8706640.748	13954.52433
San Diego	2030	T7 CAIRP construction	Aggregate	Aggregate	Diesel	187.0642289	10752882.48	263861.553	1513.677836
San Diego	2030	T7 NNOOS	Aggregate	Aggregate	Diesel	2600.456402	145406332.9	11845599	16652.57439
San Diego	2030	T7 NOOS	Aggregate	Aggregate	Diesel	762.3278927	46867399.37	3472556.017	5632.869296
San Diego	2030	T7 other port	Aggregate	Aggregate	Diesel	584.8015982	34157513.51	1386681.55	4542.756859
San Diego	2030	T7 POLA	Aggregate	Aggregate	Diesel	272.5151157	14970929.38	646187.8423	2281.462465
San Diego	2030	T7 Public	Aggregate	Aggregate	Diesel	1473.856271	9317730.742	1394857.574	1583.015032
San Diego	2030	T7 Single	Aggregate	Aggregate	Diesel	2240.606031	47573274.93	8067160.279	6599.850433
San Diego	2030	T7 single construction	Aggregate	Aggregate	Diesel	1203.016045	26675923.65	1696902.096	4269.321863
San Diego	2030	T7 SWCV	Aggregate	Aggregate	Diesel	263.1127361	3354112.348	320155.5772	1501.026068
San Diego	2030	T7 SWCV	Aggregate	Aggregate	Natural Gas	1490.96442	18954349.09	1814205.507	6789.590249
San Diego	2030	T7 tractor	Aggregate	Aggregate	Diesel	4849.775432	179141087.5	19216750.17	20176.87648
San Diego	2030	T7 tractor construction	Aggregate	Aggregate	Diesel	1010.270128	22005288.44	1425026.294	3534.992722
San Diego	2030	T7 utility	Aggregate	Aggregate	Diesel	135.7250549	857838.917	486981.4971	127.6142521
San Diego	2030	T7IS	Aggregate	Aggregate	Gasoline	17.28435662	765560.334	113084.9082	155.2859303
San Diego	2030	UBUS	Aggregate	Aggregate	Gasoline	511.0058213	17556432.79	668395.6142	2696.265558
San Diego	2030	UBUS	Aggregate	Aggregate	Diesel	0	0	0	0

San Diego	2030	UBUS	Aggregate	Aggregate	Natural Gas	1371.078999	50389787.95	1793371.331	13184.06118
San Diego	2035	All Other Buses	Aggregate	Aggregate	Diesel	611.6771106	8902816.636	1500321.617	837.5436453
San Diego	2035	LDA	Aggregate	Aggregate	Gasoline	1743038.203	20875961037	2842907795	511050.6015
San Diego	2035	LDA	Aggregate	Aggregate	Diesel	21358.48464	258947446.4	35007747.16	4288.130467
San Diego	2035	LDA	Aggregate	Aggregate	Electricity	99028.05263	1311700915	165476703.5	0
San Diego	2035	LDT1	Aggregate	Aggregate	Gasoline	190874.4617	2137374131	302680483.3	62656.84504
San Diego	2035	LDT1	Aggregate	Aggregate	Diesel	26.57831443	294476.2194	41796.41903	9.671032483
San Diego	2035	LDT1	Aggregate	Aggregate	Electricity	5624.399908	75152821.93	9425523.145	0
San Diego	2035	LDT2	Aggregate	Aggregate	Gasoline	514959.2047	5978993214	829882591.5	173533.6939
San Diego	2035	LDT2	Aggregate	Aggregate	Diesel	4992.107416	60088853.42	8195051.638	1334.189582
San Diego	2035	LDT2	Aggregate	Aggregate	Electricity	19320.86035	178765322.1	32380707.24	0
San Diego	2035	LHD1	Aggregate	Aggregate	Gasoline	33746.39232	387701490.4	164406105	38827.39072
San Diego	2035	LHD1	Aggregate	Aggregate	Diesel	38715.06475	439113156.7	159244687.2	20010.61999
San Diego	2035	LHD2	Aggregate	Aggregate	Gasoline	6005.465647	66913335	29257504.23	7712.263847
San Diego	2035	LHD2	Aggregate	Aggregate	Diesel	15477.50558	170750857.9	63662828.7	8776.328315
San Diego	2035	MCY	Aggregate	Aggregate	Gasoline	87039.41453	209007857.8	60405353.68	5751.324124
San Diego	2035	MDV	Aggregate	Aggregate	Gasoline	328931.1203	3824239742	526886718.9	134613.2829
San Diego	2035	MDV	Aggregate	Aggregate	Diesel	11266.00447	136118312	18369806.58	3944.559574
San Diego	2035	MDV	Aggregate	Aggregate	Electricity	13614.9908	127295332.7	22901405.49	0
San Diego	2035	MH	Aggregate	Aggregate	Gasoline	7284.507707	22380204.1	238298.6834	3919.626496
San Diego	2035	MH	Aggregate	Aggregate	Diesel	3866.456944	10381900.92	126433.1421	926.3165331
San Diego	2035	Motor Coach	Aggregate	Aggregate	Diesel	248.0662509	8657399.649	1057556.041	1123.929641
San Diego	2035	OBUS	Aggregate	Aggregate	Gasoline	1214.404945	18547993.54	7945385.224	3223.319692
San Diego	2035	PTO	Aggregate	Aggregate	Diesel	0	9927143.199	0	1659.375738
San Diego	2035	SBUS	Aggregate	Aggregate	Gasoline	632.5586018	9937288.729	827386.6512	895.9174119
San Diego	2035	SBUS	Aggregate	Aggregate	Diesel	1879.159687	19537166.46	7091074.216	2008.387691
San Diego	2035	T6 Ag	Aggregate	Aggregate	Diesel	28.6470221	21624.56314	39326.63194	2.829650429
San Diego	2035	T6 CAIRP heavy	Aggregate	Aggregate	Diesel	117.3429093	6263015.081	534520.4203	428.3917038
San Diego	2035	T6 CAIRP small	Aggregate	Aggregate	Diesel	66.148717	913595.9401	301320.6357	69.92927553
San Diego	2035	T6 instate construction heavy	Aggregate	Aggregate	Diesel	902.5365107	17787538.62	1273063.732	1914.057872
San Diego	2035	T6 instate construction small	Aggregate	Aggregate	Diesel	2999.446004	46522864.1	4230838.175	4558.137604
San Diego	2035	T6 instate heavy	Aggregate	Aggregate	Diesel	5141.515468	167062962.6	18511701.21	13291.54904
San Diego	2035	T6 instate small	Aggregate	Aggregate	Diesel	15664.5821	224622358.1	56399336.96	18726.98406
San Diego	2035	T6 OOS heavy	Aggregate	Aggregate	Diesel	67.37741218	3621232.455	306917.588	247.3754559
San Diego	2035	T6 OOS small	Aggregate	Aggregate	Diesel	38.53069177	529015.7661	175515.0072	40.53861311
San Diego	2035	T6 Public	Aggregate	Aggregate	Diesel	2703.675781	13098756.97	2558758.756	1444.614567
San Diego	2035	T6 utility	Aggregate	Aggregate	Diesel	354.7571583	1846478.296	1272868.684	161.311833
San Diego	2035	T6TS	Aggregate	Aggregate	Gasoline	4823.928101	86512233.47	31561109.18	14859.1582
San Diego	2035	T7 Ag	Aggregate	Aggregate	Diesel	18.20796032	14417.29064	24995.88793	3.454590867
San Diego	2035	T7 CAIRP	Aggregate	Aggregate	Diesel	1910.924219	126193867.1	8704642.001	13330.69262
San Diego	2035	T7 CAIRP construction	Aggregate	Aggregate	Diesel	223.7263033	12776943.51	315574.8707	1673.287918
San Diego	2035	T7 NNOOS	Aggregate	Aggregate	Diesel	2866.920009	153824799.3	13059394.03	16765.53954
San Diego	2035	T7 NOOS	Aggregate	Aggregate	Diesel	760.3066866	49581536.04	3463349.019	5368.888247
San Diego	2035	T7 other port	Aggregate	Aggregate	Diesel	714.6992734	36904511.7	1694694.917	4456.786519
San Diego	2035	T7 POLA	Aggregate	Aggregate	Diesel	288.9300811	17972429	685111.0082	2397.228056
San Diego	2035	T7 Public	Aggregate	Aggregate	Diesel	1471.217675	9300547.319	1392360.407	1432.856142
San Diego	2035	T7 Single	Aggregate	Aggregate	Diesel	2158.955024	49995077.42	7773180.994	6517.829692
San Diego	2035	T7 single construction	Aggregate	Aggregate	Diesel	1364.097118	31697246.78	1924113.371	4772.358465
San Diego	2035	T7 SWCV	Aggregate	Aggregate	Diesel	157.8658471	2012444.532	192091.1628	897.2761476
San Diego	2035	T7 SWCV	Aggregate	Aggregate	Natural Gas	1743.611948	22173769.02	2121627.018	7485.323495
San Diego	2035	T7 tractor	Aggregate	Aggregate	Diesel	5045.278191	191263604.6	19991410.3	19577.40379
San Diego	2035	T7 tractor construction	Aggregate	Aggregate	Diesel	1132.570255	26147437.94	1597535.5	3892.545505
San Diego	2035	T7 utility	Aggregate	Aggregate	Diesel	140.8511269	890762.9723	505373.8435	119.7582877
San Diego	2035	T7IS	Aggregate	Aggregate	Gasoline	19.08407476	810712.8351	124859.7729	152.0118654
San Diego	2035	UBUS	Aggregate	Aggregate	Gasoline	580.4429593	19942058.15	759219.3908	2915.635871
San Diego	2035	UBUS	Aggregate	Aggregate	Diesel	0	0	0	0
San Diego	2035	UBUS	Aggregate	Aggregate	Natural Gas	1557.385687	57236916.72	2037060.478	14975.55443
San Diego	2045	All Other Buses	Aggregate	Aggregate	Diesel	652.6350636	9119115.173	1600783.284	824.354453
San Diego	2045	LDA	Aggregate	Aggregate	Gasoline	1908861.705	21819898206	3108480513	513594.5097
San Diego	2045	LDA	Aggregate	Aggregate	Diesel	23713.53999	272242575.8	38690642.2	4340.037673
San Diego	2045	LDA	Aggregate	Aggregate	Electricity	124642.7801	1505689880	204667617.8	0
San Diego	2045	LDT1	Aggregate	Aggregate	Gasoline	206849.8783	2227693366	328686725.3	61049.70686
San Diego	2045	LDT1	Aggregate	Aggregate	Diesel	28.89377049	311309.1498	45889.59286	9.489910131
San Diego	2045	LDT1	Aggregate	Aggregate	Electricity	7885.519568	92290983.19	12804343.58	0
San Diego	2045	LDT2	Aggregate	Aggregate	Gasoline	554308.9665	6195837105	894685328.8	167863.725
San Diego	2045	LDT2	Aggregate	Aggregate	Diesel	5658.786199	64076415.43	9202985.47	1354.898633
San Diego	2045	LDT2	Aggregate	Aggregate	Electricity	25178.75891	209514990.4	41267622.37	0
San Diego	2045	LHD1	Aggregate	Aggregate	Gasoline	36189.15398	402112119.5	176306782.5	38378.53139
San Diego	2045	LHD1	Aggregate	Aggregate	Diesel	43533.11784	468726434.5	179062537.5	20200.45101
San Diego	2045	LHD2	Aggregate	Aggregate	Gasoline	6633.809952	70695852.16	32318680.04	7746.84048
San Diego	2045	LHD2	Aggregate	Aggregate	Diesel	17939.81155	184856036.8	73790905.34	9023.961545
San Diego	2045	MCY	Aggregate	Aggregate	Gasoline	95734.09488	215307910.9	66439461.84	5942.985354
San Diego	2045	MDV	Aggregate	Aggregate	Gasoline	355290.3266	3967652189	569004761.7	130344.1207
San Diego	2045	MDV	Aggregate	Aggregate	Diesel	12697.80821	144181050.3	20519435.13	3953.961219
San Diego	2045	MDV	Aggregate	Aggregate	Electricity	18523.2832	153152068.3	30290294.63	0
San Diego	2045	MH	Aggregate	Aggregate	Gasoline	7213.784379	22284999.24	235985.1055	3667.081592
San Diego	2045	MH	Aggregate	Aggregate	Diesel	3770.189121	10127034.73	123285.1842	841.9242115
San Diego	2045	Motor Coach	Aggregate	Aggregate	Diesel	263.2677903	9607012.063	1122363.244	1169.011081
San Diego	2045	OBUS	Aggregate	Aggregate	Gasoline	1272.341636	19154118.98	8324442.746	3177.890017
San Diego	2045	PTO	Aggregate	Aggregate	Diesel	0	11021132.92	0	1650.966802
San Diego	2045	SBUS	Aggregate	Aggregate	Gasoline	955.8013175	14400187.79	1250188.123	1257.333742
San Diego	2045	SBUS	Aggregate	Aggregate	Diesel	1924.169345	19957657.01	7260919.72	1784.394267
San Diego	2045	T6 Ag	Aggregate	Aggregate	Diesel	12.04746011	2371.762871	16538.75324	0.488816731
San Diego	2045	T6 CAIRP heavy	Aggregate	Aggregate	Diesel	136.4681845	6947221.09	621639.874	465.5699066
San Diego	2045	T6 CAIRP small	Aggregate	Aggregate	Diesel	77.32115256	1013928.173	352213.3142	76.19435839
San Diego	2045	T6 instate construction heavy	Aggregate	Aggregate	Diesel	1227.217915	25636324.79	1731039.798	2527.307499
San Diego	2045	T6 instate construction small	Aggregate	Aggregate	Diesel	4345.834093	67051168.76	6129972.254	6241.189694
San Diego	2045	T6 instate heavy	Aggregate	Aggregate	Diesel	6122.739286	191123785.9	22044535.49	14188.1393

San Diego	2045	T6 instate small	Aggregate	Aggregate	Diesel	18004.96953	251582142.8	64825753.86	20044.65379
San Diego	2045	T6 OOS heavy	Aggregate	Aggregate	Diesel	78.37822674	4017270.154	357028.4984	269.1501344
San Diego	2045	T6 OOS small	Aggregate	Aggregate	Diesel	45.44282511	587257.7175	207001.1569	44.21910132
San Diego	2045	T6 Public	Aggregate	Aggregate	Diesel	2850.455162	13794338.22	2697670.762	1401.820778
San Diego	2045	T6 utility	Aggregate	Aggregate	Diesel	377.1489303	1960611.647	1353210.362	166.6855942
San Diego	2045	T6TS	Aggregate	Aggregate	Gasoline	5548.102099	92658229.94	36299101.56	15273.51997
San Diego	2045	T7 Ag	Aggregate	Aggregate	Diesel	8.811886625	2404.427997	12096.95796	0.940755572
San Diego	2045	T7 CAIRP	Aggregate	Aggregate	Diesel	2156.806611	140007084.1	9824685.476	14215.40794
San Diego	2045	T7 CAIRP construction	Aggregate	Aggregate	Diesel	337.9790179	18414794.79	476732.8798	2338.608368
San Diego	2045	T7 NNOOS	Aggregate	Aggregate	Diesel	3357.556672	170661782	15294342.15	18253.76675
San Diego	2045	T7 NOOS	Aggregate	Aggregate	Diesel	857.0370741	55008826.13	3903975.28	5716.770918
San Diego	2045	T7 other port	Aggregate	Aggregate	Diesel	799.972335	42398389.95	1896894.401	4866.264439
San Diego	2045	T7 POLA	Aggregate	Aggregate	Diesel	371.0181754	24178833.86	879758.2976	2850.064127
San Diego	2045	T7 Public	Aggregate	Aggregate	Diesel	1496.993116	9463422.584	1416754.284	1283.252225
San Diego	2045	T7 Single	Aggregate	Aggregate	Diesel	2235.158064	55504628.35	8047545.221	6460.447018
San Diego	2045	T7 single construction	Aggregate	Aggregate	Diesel	1919.592182	45683718.84	2707661.306	6196.850888
San Diego	2045	T7 SWCV	Aggregate	Aggregate	Diesel	51.65125821	658440.6575	62849.25099	290.7905501
San Diego	2045	T7 SWCV	Aggregate	Aggregate	Natural Gas	2044.450461	26006701.6	2487687.321	8226.471478
San Diego	2045	T7 tractor	Aggregate	Aggregate	Diesel	5477.218601	213594831	21702930.98	19727.89121
San Diego	2045	T7 tractor construction	Aggregate	Aggregate	Diesel	1627.180163	37685046.01	2295202.495	5017.025957
San Diego	2045	T7 utility	Aggregate	Aggregate	Diesel	149.5872623	946294.6804	536719.0971	113.9099102
San Diego	2045	T7IS	Aggregate	Aggregate	Gasoline	21.76573987	862100.3333	142404.8779	153.0014319
San Diego	2045	UBUS	Aggregate	Aggregate	Gasoline	633.834548	21776412.67	829055.5887	3157.203959
San Diego	2045	UBUS	Aggregate	Aggregate	Diesel	0	0	0	0
San Diego	2045	UBUS	Aggregate	Aggregate	Natural Gas	1700.640583	62501809.44	2224437.882	16353.06901
San Diego	2050	All Other Buses	Aggregate	Aggregate	Diesel	668.515373	9330794.001	1639734.507	827.9993474
San Diego	2050	LDA	Aggregate	Aggregate	Gasoline	1984769.241	22268918337	3230721558	522747.8755
San Diego	2050	LDA	Aggregate	Aggregate	Diesel	24757.05275	278038816.7	40317047.1	4420.392371
San Diego	2050	LDA	Aggregate	Aggregate	Electricity	131719.3089	1548182473	215433032.7	0
San Diego	2050	LDT1	Aggregate	Aggregate	Gasoline	215573.5634	2276962980	342157146.5	61752.21002
San Diego	2050	LDT1	Aggregate	Aggregate	Diesel	30.21544177	319108.0756	47927.79281	9.622552946
San Diego	2050	LDT1	Aggregate	Aggregate	Electricity	8579.835995	96242855.76	13798138.68	0
San Diego	2050	LDT2	Aggregate	Aggregate	Gasoline	573677.8344	6314421711	927099504.2	169509.4685
San Diego	2050	LDT2	Aggregate	Aggregate	Diesel	5933.293957	65649183.72	9618831.453	1381.683687
San Diego	2050	LDT2	Aggregate	Aggregate	Electricity	26782.84924	216048666.8	43662098.94	0
San Diego	2050	LHD1	Aggregate	Aggregate	Gasoline	37220.56344	408900464.3	181331616.3	38672.98555
San Diego	2050	LHD1	Aggregate	Aggregate	Diesel	45579.04691	480596484.8	187477952.4	20480.65912
San Diego	2050	LHD2	Aggregate	Aggregate	Gasoline	6935.191989	72415549.94	33786956.9	7857.45102
San Diego	2050	LHD2	Aggregate	Aggregate	Diesel	18810.36348	189667380.5	77371701.88	9150.231571
San Diego	2050	MCY	Aggregate	Aggregate	Gasoline	97544.93542	218678705.2	67696185.18	6030.656882
San Diego	2050	MDV	Aggregate	Aggregate	Gasoline	365954.7073	4038827428	587913781.2	131245.4078
San Diego	2050	MDV	Aggregate	Aggregate	Diesel	13299.44946	147532165.7	21427361.47	4020.588341
San Diego	2050	MDV	Aggregate	Aggregate	Electricity	19881.93485	158638487.3	32284479.27	0
San Diego	2050	MH	Aggregate	Aggregate	Gasoline	7428.153399	22652360.9	242997.7764	3683.815351
San Diego	2050	MH	Aggregate	Aggregate	Diesel	3787.416703	10164140.77	123848.5262	826.4474703
San Diego	2050	Motor Coach	Aggregate	Aggregate	Diesel	278.5000184	10080993.07	1187301.279	1222.589517
San Diego	2050	OBUS	Aggregate	Aggregate	Gasoline	1273.243951	19419144.56	8330346.244	3191.463397
San Diego	2050	PTO	Aggregate	Aggregate	Diesel	0	11570747.56	0	1682.583997
San Diego	2050	SBUS	Aggregate	Aggregate	Gasoline	1060.500402	15707250.86	1387134.526	1346.72196
San Diego	2050	SBUS	Aggregate	Aggregate	Diesel	1953.477463	20193025.37	7371514.919	1748.845545
San Diego	2050	T6 Ag	Aggregate	Aggregate	Diesel	4.358011937	202.6367926	5982.678787	0.108469511
San Diego	2050	T6 CAIRP heavy	Aggregate	Aggregate	Diesel	144.6690838	7289844.512	658996.6103	490.1920567
San Diego	2050	T6 CAIRP small	Aggregate	Aggregate	Diesel	81.9592414	1063966.136	373340.7364	80.15038862
San Diego	2050	T6 instate construction heavy	Aggregate	Aggregate	Diesel	1381.065848	29196253.69	1948048.441	2796.699048
San Diego	2050	T6 instate construction small	Aggregate	Aggregate	Diesel	4996.50376	76362074.1	7047767.762	7067.113208
San Diego	2050	T6 instate heavy	Aggregate	Aggregate	Diesel	6563.181803	201791908.7	23630320.91	14697.06242
San Diego	2050	T6 instate small	Aggregate	Aggregate	Diesel	19148.16736	264242921.2	68941765.34	20944.80728
San Diego	2050	T6 OOS heavy	Aggregate	Aggregate	Diesel	83.05815047	4215418.349	378346.487	283.433587
San Diego	2050	T6 OOS small	Aggregate	Aggregate	Diesel	48.2981979	616284.1792	220007.9511	46.49625207
San Diego	2050	T6 Public	Aggregate	Aggregate	Diesel	2913.74673	14103244.2	2757569.902	1406.925989
San Diego	2050	T6 utility	Aggregate	Aggregate	Diesel	386.5910021	2009260.222	1387088.516	170.9268071
San Diego	2050	T6TS	Aggregate	Aggregate	Gasoline	5833.186337	94818511.45	38164298.26	15554.42597
San Diego	2050	T7 Ag	Aggregate	Aggregate	Diesel	6.394001405	407.3170204	8777.685129	0.468804961
San Diego	2050	T7 CAIRP	Aggregate	Aggregate	Diesel	2284.858289	146913498.7	10407986.48	14956.42998
San Diego	2050	T7 CAIRP construction	Aggregate	Aggregate	Diesel	389.0692146	20971922.64	548797.6391	2668.969864
San Diego	2050	T7 NNOOS	Aggregate	Aggregate	Diesel	3568.65276	179080282.9	16255927.05	19375.77605
San Diego	2050	T7 NOOS	Aggregate	Aggregate	Diesel	908.3344705	57722368.69	4137645.18	6015.494026
San Diego	2050	T7 other port	Aggregate	Aggregate	Diesel	853.9405871	45145869.6	2024863.92	5184.548121
San Diego	2050	T7 POLA	Aggregate	Aggregate	Diesel	419.0447928	27200593.23	993639.0126	3163.588099
San Diego	2050	T7 Public	Aggregate	Aggregate	Diesel	1517.302813	9591877.038	1435975.38	1250.83754
San Diego	2050	T7 Single	Aggregate	Aggregate	Diesel	2327.839541	58272597.49	8381239.014	6582.676164
San Diego	2050	T7 single construction	Aggregate	Aggregate	Diesel	2187.337235	52027482.71	3085326.377	6876.421412
San Diego	2050	T7 SWCV	Aggregate	Aggregate	Diesel	19.63915009	250356.2419	23896.91783	109.2583901
San Diego	2050	T7 SWCV	Aggregate	Aggregate	Natural Gas	2150.18011	27352773.7	2616339.158	8547.35176
San Diego	2050	T7 tractor	Aggregate	Aggregate	Diesel	5804.709355	224292263.2	23000580.35	20466.34343
San Diego	2050	T7 tractor construction	Aggregate	Aggregate	Diesel	1867.644035	42918092.69	2634386.373	5609.293922
San Diego	2050	T7 utility	Aggregate	Aggregate	Diesel	153.3617708	969890.5235	550262.0337	114.5129468
San Diego	2050	T7IS	Aggregate	Aggregate	Gasoline	22.76642075	881373.3173	148951.9487	155.5805149
San Diego	2050	UBUS	Aggregate	Aggregate	Gasoline	660.5303423	22693589.93	863973.6877	3290.228262
San Diego	2050	UBUS	Aggregate	Aggregate	Diesel	0	0	0	0
San Diego	2050	UBUS	Aggregate	Aggregate	Natural Gas	1772.268031	65134255.8	2318126.585	17041.8263

Table. Conversions and Constants

Conversion or Constant	Value	Source
Light duty weekdays per year	347	Appendix X of EIR. Original source: EMFAC2017.
btus per gallon, gasoline	120,286	U.S. EIA. 2021. https://www.eia.gov/energyexplained/units-and-calculators/
btus per gallon, diesel	137,381	U.S. EIA. 2021. https://www.eia.gov/energyexplained/units-and-calculators/
MWh to GWh	0.001	Conversion
kWh to GWh	0.000001	Conversion
Imported Treated Water Energy Intensity (kWh/acre-foot)	1,862	Appendix X of EIR.
Imported Untreated Water Energy Intensity (kWh/acre-foot)	1,817	Appendix X of EIR.
Avg Local Water Energy Intensity (kWh/acre-foot)	522	Appendix X of EIR.
kWh to Btu	3,412	Conversion
Therm to Btu	99,976	Conversion
Trillion	1,000,000,000,000	Standard
Million	1,000,000	Standard
btu to MMBtu	1,000,000	Conversion
Transport fuels CO2 content (gram/gallon)	10,210	TCR. 2021. https://www.theclimateregistry.org/wp-content/uploads/2021/05/2021-Default-Emission-Factor-Document.pdf?mc_cid=4b45d12237&mc_eid=5f138d1baa
Diesel construction/mining equipment CH4 content (gram/gallon)	0.20	TCR. 2021. https://www.theclimateregistry.org/wp-content/uploads/2021/05/2021-Default-Emission-Factor-Document.pdf?mc_cid=4b45d12237&mc_eid=5f138d1baa
Diesel construction/mining equipment N2O content (gram/gallon)	0.47	TCR. 2021. https://www.theclimateregistry.org/wp-content/uploads/2021/05/2021-Default-Emission-Factor-Document.pdf?mc_cid=4b45d12237&mc_eid=5f138d1baa
Diesel construction/mining equipment CO2e content (gram/gallon)	10,355	Calculation
Diesel rail CH4 content (gram/gallon)	0.80	TCR. 2021. https://www.theclimateregistry.org/wp-content/uploads/2021/05/2021-Default-Emission-Factor-Document.pdf?mc_cid=4b45d12237&mc_eid=5f138d1baa
Diesel rail N2O content (gram/gallon)	0.26	TCR. 2021. https://www.theclimateregistry.org/wp-content/uploads/2021/05/2021-Default-Emission-Factor-Document.pdf?mc_cid=4b45d12237&mc_eid=5f138d1baa
Diesel rail CO2e content (gram/gallon)	10,210	Calculation
CO2 GWP	1	Appendix X of EIR. Original Source: AR4
CH4 GWP	25	Appendix X of EIR. Original Source: AR4
N2O GWP	298	Appendix X of EIR. Original Source: AR4
MT to gram	1,000,000	Conversion

Table X.2: Demographic Estimates and Projections in the San Diego Region

Demographic Estimates and Projections in the San Diego Region				
Year	**Population**	**Jobs**	**Manufacturing Jobs***	**Housing Units**
2016	3,287,280	1,646,419	109,234	1,182,983
2025	3,470,848	1,761,747	116,046	1,288,216
2030	3,552,485	1,842,250	121,359	1,351,366
2035	3,620,348	1,921,475	126,618	1,409,866
2045	3,719,685	2,044,625	134,848	1,460,855
2050	3,746,073	2,086,318	137,503	1,471,299

*Manufacturing jobs are included in jobs.

2016 population and housing data are estimates. The rest are projections based on SANDAG Series 14 Regional Growth Forecast (2021 Regional Plan)

Source: SANDAG 2020, 2021

Table X.3: Summary of 2016 Greenhouse Gas Inventory and Greenhouse Gas Projections

Summary of 2016 Greenhouse Gas Inventory and Greenhouse Gas Projections

Greenhouse Gas Emissions (MMT CO_2e)						
Emissions Category	**2016**	**2025**	**2030**	**2035**	**2045**	**2050**
Passenger Cars and Light-Duty Vehicles* (No SAFE Rule Impact)	10.5	8.0 (7.8)	7.4 (6.9)	6.5 (5.9)	6.4 (5.7)	6.4 (5.7)
Electricity	5.3	3.4	1.9	1.3	0.2	0.2
Natural Gas	3.1	3.3	3.4	3.4	3.5	3.6
Industrial	2.1	2.2	2.3	2.4	2.5	2.5
Heavy-Duty Trucks and Vehicles	1.8	1.7	1.7	1.7	1.7	1.7
Other Fuels	1.1	1.4	1.4	1.5	1.5	1.5
Off-Road Transportation	0.62	0.72	0.79	0.83	0.91	0.95
Solid Waste	0.59	0.62	0.64	0.65	0.67	0.67
Water	0.24	0.28	0.22	0.15	-	-
Aviation	0.21	0.29	0.32	0.34	0.40	0.43
Rail	0.11	0.17	0.18	0.19	0.20	0.20
Wastewater	0.07	0.08	0.08	0.08	0.08	0.08
Agriculture	0.05	0.06	0.06	0.06	0.06	0.06
Marine Vessels	0.05	0.06	0.06	0.06	0.08	0.08
Soil Management	0.05	0.04	0.04	0.04	0.04	0.04
Total* (Total: No SAFE Rule Impact)	**26**	**22 (22)**	**20 (20)**	**19 (18)**	**18 (18)**	**18 (18)**

MMT – million metric tons, SAFE Rule – Federal Safer Affordable Fuel-Efficiency Vehicles Rule, April 2020
*Includes GHG impact of SAFE Rule
2016 is an inventory year, the rest are forecast years. The GHG emissions projections include the impact of federal and State regulations and regional policies and programs to reduce GHG emissions.

Source: Energy Policy Initiatives Center, University of San Diego 2021

grams CO2e						mil gal diesel/yr					
2016	**2025**	**2030**	**2035**	**2045**	**2050**	**2016**	**2025**	**2030**	**2035**	**2045**	**2050**
1.10E+11	1.70E+11	1.80E+11	1.90E+11	2.00E+11	2.00E+11	11	16	17	18	19	19

Table X.4: Key Inputs and 2016 Greenhouse Gas Emissions from On-Road Transportation – Passenger Car and Light-Duty Vehicles

Key Inputs and 2016 Greenhouse Gas Emissions from On-Road Transportation – Passenger Car and Light-Duty Vehicles	
VMT (Miles per weekday)*	79,810,087
CO_2 Emissions (Tons per weekday)**	32,805
Conversion Factor (Tons CO_2 per weekday to MT CO_2e per year)	319
GHG Emissions (MT CO_2e)	10,468,161
GHG Emissions (MMT CO_2e)	**10.5**

*SANDAG ABM14.2.0 VMT **EMFAC2017 model run with custom VMT inputs from ABM14.2.0 Passenger car and light-duty vehicles are EMFAC2017 vehicle classes LDA, LDT1, LDT2, and MDV.

Source: CARB 2016, 2017; SANDAG 2021; Energy Policy Initiatives Center, University of San Diego 2021

Table X.5: Projected Greenhouse Gas Emissions from On-Road Transportation – Passenger Car and Light-Duty Vehicles after Federal and State Regulations

Projected Greenhouse Gas Emissions from On-Road Transportation – Passenger Car and Light-Duty Vehicles after Federal and State Regulations					
Projection Year	**2025**	**2030**	**2035**	**2045**	**2050**
VMT (Miles per weekday)*	79,864,963	81,478,678	81,193,649	83,299,109	83,644,722
CO_2 Emissions (Tons per weekday)**	24,532	21,672	19,784	19,232	19,056
Conversion Factor (Tons CO_2 per weekday to MT CO_2e per year)	318	318	317	317	318
GHG Emissions (MT CO_2e)	7,793,133	6,880,756	6,280,927	6,106,409	6,050,681
GHG Emissions (MMT CO_2e)	7.8	6.9	6.3	6.1	6.1

*2025, 2030, 2035, and 2050 VMT direct outputs of SANDAG ABM14.2.0, 2045 VMT is interpolated linearly between 2040 and 2050 VMT

**EMFAC2017 model run with custom VMT inputs from SANDAG ABM14.2.0, 2045 CO_2 emissions are interpolated linearly between 2040 and 2050

Source: CARB 2016, 2017; SANDAG 2021; Energy Policy Initiatives Center, University of San Diego 2021

Table X.7: Projected Greenhouse Gas Reductions from SANDAG Shared Mobility Strategies

Projected Greenhouse Gas Reductions from SANDAG Shared Mobility Strategies		
Projection Year	**2035**	**2050**
Vehicle Trips Avoided		
Vanpool Strategy (Trips avoided per weekday)*	7,152	7,644
Pooled Rides Strategy (Trips avoided per weekday)*	2,108	2,074
Transportation Demand Management Ordinance Strategy (Trips avoided per weekday)*	43,779	65,824
Total (Trips avoided per weekday)	53,040	75,542
Total (Trips avoided per year)**	18,404,726	26,212,919
GHG Emissions per Trip Start (Grams CO_2e per trip)***	46	42
GHG Reduction due to Trips Avoided (MT CO_2e)	839	1,095
Vehicle Miles Avoided		
Vanpool Strategy (Miles avoided per weekday)*	308,326	329,148
Carshare (Miles avoided per weekday)*	179,225	-
Pooled Rides Strategy (Miles avoided per weekday)*	11,839	11,636
Transportation Demand Management Ordinance Strategy (Miles avoided per weekday)*	358,235	549,952
Total (Miles avoided per weekday)	857,625	890,737
Total (Miles avoided per year)**	297,595,853	309,085,638
GHG Emissions per Mile (Grams CO_2e per mile)***	217	201
GHG Reduction due to Miles Avoided (MT CO_2e)	64,464	62,145
Total (Trips + Miles Avoided)		
GHG Reduction from Shared Mobility Strategies (MT CO_2e)	65,302	63,240
GHG Reduction from Shared Mobility Strategies (MMT CO_2e)	0.07	0.06

*GHG reduction from the programs and program design are described in 2021 Regional Plan Appendix S. The carshare strategy does not have trips avoided or miles avoided in 2050

**347 weekdays per year, EMFAC2017 assumptions for passenger car and light-duty vehicle classes: LDA, LDT1, LDT2, and MDV

***Based on the total number of trips, VMT, start exhaust (EMFAC2017 process STARTEX), and running exhaust (EMFAC2017 process RUNEX) CO_2e emissions from LDA, LDT1, LDT2, and MDV vehicle classes (EMFAC2017 model run with ABM14.2.0 inputs)

Source: CARB 2016, 2017; SANDAG 2021; Energy Policy Initiatives Center, University of San Diego 2021

Table. Interpolated miles avoided/yr.

Year	Miles Avoided/yr
2035	857,625
2050	890,737
2045	879,700

Table X.10: Projected Emissions from On-Road Transportation – Passenger Car and Light-Duty Vehicles with SAFE Rule Impact

Projected GHG Emissions from On-Road Transportation – Passenger Car and Light-Duty Vehicles after Federal and State Regulations with SAFE Rule Impact					
Projection Year	**2025**	**2030**	**2035**	**2045**	**2050**
VMT (Miles per weekday)*	79,864,963	81,478,678	81,193,649	83,299,109	83,644,722
Adjusted CO_2 Emissions (Tons per weekday)**	25,282	23,175	21,732	21,548	21,449
Conversion Factor (Tons CO_2 per weekday to MT CO_2e per year)	318	317	317	317	318
GHG Emissions after Federal and State Regulations (MT CO_2e)	8,029,070	7,353,905	6,899,075	6,841,355	6,810,213
GHG Emissions after Federal and State Regulations (MMT CO_2e)	8.0	7.4	6.9	6.8	6.8
GHG Reduction from SANDAG EV Strategies (MMT CO_2e)***	N/A	N/A	-0.38	-0.33	-0.31
GHG Reduction from SANDAG Shared Mobility Strategies (MMT CO_2e)***	N/A	N/A	-0.07	-0.07	-0.07
GHG Emissions (MMT CO_2e)	**8.0**	**7.4**	**6.5**	**6.4**	**6.4**

*2025, 2030, 2035 and 2050 VMT direct outputs of SANDAG ABM14.2.0, 2045 VMT is interpolated linearly between 2040 and 2050 VMT

**EMFAC2017 model run with custom VMT inputs from SANDAG adjusted with SAFE Rule impact, as shown in Table X.9, 2045 CO_2 adjusted emissions are interpolated linearly between 2040 and 2050 adjusted emissions

***GHG reductions from EV strategies (Table X.6) and from EV strategies (
Table X.7) with SAFE Rule adjustment factors (Table X.9), 2045 GHG reductions are interpolated linearly between 2035 and 2050 GHG reductions

Source: CARB 2017, 2020; SANDAG 2021; Energy Policy Initiatives Center, University of San Diego 2021

Table X.11: Key Inputs and 2016 Greenhouse Gas Emissions from Electricity

Key Inputs and 2016 Greenhouse Gas Emissions from Electricity	
Electricity Sales – Bundled (MWh)	14,482,332
Electricity Sales – Direct Access (MWh)	3,360,561
Transmission and Distribution Loss Factor	1.082
SDG&E Electricity Emission Factor (lbs CO_2e/MWh)	527
Direct Access Electricity Emission Factor (lbs CO_2e/MWh)	836
GHG Emissions (MT CO_2e)	5,121,950
GHG Emissions associated with Electricity for Water Treatment – Excluded (MT CO_2e)	-58,925
GHG Emissions Associated with Natural Gas Used at On-site Self-serve Electric Generation – Added (MT CO_2e)	204,014
GHG Emissions (MT CO_2e)	5,267,039
GHG Emissions (MMT CO_2e)	**5.3**

Source: CEC 2020, SDG&E 2018, Energy Policy Initiatives Center, University of San Diego 2020

Table X.13: Projected Electricity Sales of Electric Retail Providers

Projected Electricity Sales of Retail Electricity Providers					
Retail Electricity Supplier	**2025**	**2030**	**2035**	**2045**	**2050**
Projected Electricity Sales (GWh)					
San Diego Community Power*	7,408	7,189	7,459	8,031	8,333
SDG&E Bundled and Clean Energy Alliance	5,775	6,403	6,137	5,573	5,275
ESPs for Direct Access	3,059	3,154	3,155	3,157	3,158

*Estimated based on the projected demand through 2030 in SDCP Implementation Plan and SDG&E Planning Area electricity sales in CEC 2020–2030 energy demand forecast, 2021 version

Source: Energy Policy Initiatives Center, University of San Diego 2020

Table X.15: Key Inputs and 2016 Greenhouse Gas Emissions from Natural Gas

Key Inputs and 2016 Greenhouse Gas Emissions from Natural Gas	
Natural Gas Sales (Therms)	585,460,937
Natural Gas Emission Factor (MT CO_2e/Therm)	0.00545
GHG Emissions (MT CO_2e)	3,192,578
GHG Emissions Associated with Heat Output from Utility-level Co-generation Plants – Included (MT CO_2e) (1)	118,239
GHG Emissions from Natural Gas used to Generate Electricity for Sales to Utility – Excluded (MT CO_2e)* (2)	-3,593
GHG Emissions from Natural Gas Used at On-site Self-serve Electric Generation – Excluded (MT CO_2e) (3)	-204,014
Total Adjustment (MT CO_2e) (1+2+3)	-89,369
GHG Emissions (MT CO_2e)	3,103,209
GHG Emissions (MMT CO_2e)	**3.1**

* Does not include power plants generating electricity for utility sales only

Source: CARB 2019, SDG&E 2018, Energy Policy Initiatives Center, University of San Diego 2020

Table X.16: Projected Greenhouse Gas Emissions from Natural Gas

Projected GHG Emissions from Natural Gas					
Projection Year	**2025**	**2030**	**2035**	**2045**	**2050**
Projected Natural Gas Sales (therms)*	628,689,290	640,276,291	647,766,840	663,011,857	670,768,387
Natural Gas Emission Factor (MT CO_2e/therm)	0.00545	0.00545	0.00545	0.00545	0.00545
GHG Emissions from Natural Gas Sales (MT CO_2e)	3,428,892	3,492,088	3,532,942	3,616,089	3,658,393
Total Adjustment for Co-generation Plants (MT CO_2e)**	-89,369	-89,369	-89,369	-89,369	-89,369
GHG Emissions (MT CO_2e)	3,339,523	3,402,719	3,443,573	3,526,720	3,569,024
GHG Emissions (MMT CO_2e)	3.3	3.4	3.4	3.5	3.6

*Estimated based on CEC 2020–2030 energy demand forecast, 2020 version

**Calculated in Table X.15

Source: Energy Policy Initiatives Center, University of San Diego 2020

Table X.19: Key Inputs and 2016 Greenhouse Gas Emissions from On-Road Transportation – Heavy-Duty Trucks and Vehicles

Key Inputs and 2016 Greenhouse Gas Emissions from On-Road Transportation – Heavy-Duty Trucks and Vehicles	
VMT (Miles per weekday)*	4,885,875
CO_2 Emissions (Tons per weekday)**	5,935
Conversion Factor (Tons CO_2 per weekday to MT CO_2e per year)	300
GHG Emissions (MT CO_2e)	1,781,508
GHG Emissions (MMT CO_2e)	**1.8**

*SANDAG ABM14.2.0 VMT **EMFAC2017 model run with custom VMT inputs from SANDAG

Heavy-duty trucks and vehicles are EMFAC2017 vehicle categories except LDA, LDT1, LDT2, and MDV. Conversion factors are different for each vehicle class.

Source: CARB 2016, 2017; SANDAG 2021; Energy Policy Initiatives Center, University of San Diego 2021

Table X.20: Key Inputs and Projected Greenhouse Gas Emissions from On-Road Transportation – Heavy-Duty Trucks and Vehicles

Key Inputs and Projected Greenhouse Gas Emissions from On-Road Transportation – Heavy-Duty Trucks and Vehicles					
Projection Year	**2025**	**2030**	**2035**	**3045**	**2050**
VMT (Miles per weekday)*	5,308,169	5,687,090	6,022,658	6,482,166	6,691,132
CO_2 Emissions (Tons per weekday)**	5,640	5,607	5,599	5,675	5,733
Conversion Factor (MT CO_2e per year/ Tons per weekday)	299	299	299	299	299
GHG Emissions (MT CO_2e)	1,688,305	1,677,676	1,674,691	1,697,570	1,715,365
GHG Emissions (MMT CO_2e)	1.7	1.7	1.7	1.7	1.7

*SANDAG ABM14.2.0 VMT **EMFAC2017 model run with custom VMT inputs from SANDAG ABM14.2.0

Source: CARB 2016, 2017; SANDAG 2021; Energy Policy Initiatives Center, University of San Diego 2021

2016 Greenhouse Gas Emissions from Off-Road Transportation

Subcategories	GHG Emissions (MMT CO_2e)
Agriculture	0.010
Airport Ground Support	0.017
Cargo Handling Equipment	0.002
Construction and Mining	0.204
Industrial	0.097
Lawn	0.052
Light Commercial	0.071
Military Tactical Support	0.022
Pleasure crafts	0.066
Portable Equipment	0.068
Recreational Vehicles	0.003
Transportation Refrigeration Unit	0.008
Total	**0.62**

Source: CARB: ORION 2017, SORE 2020, PC2014 Pleasure Craft model, RV 2018 Recreational Vehicle model; Energy Policy Initiatives Center, University of San Diego 2020

grams CO2e	mil gal diesel/yr
2.04E+11	20

Projected Greenhouse Gas Emissions from Off-Road Transportation						grams CO2e					mil gal diesel/yr				
Projection Year	**2025**	**2030**	**2035**	**2045**	**2050**	**2025**	**2030**	**2035**	**2045**	**2050**	**2025**	**2030**	**2035**	**2045**	**2050**
Agriculture (MMT CO_2e)	0.005	0.005	0.005	0.005	0.005										
Airport Ground Support (MMT CO_2e)	0.02	0.02	0.02	0.03	0.03										
Cargo Handling Equipment (MMT CO_2e)	0.004	0.005	0.006	0.006	0.006										
Construction and Mining (MMT CO_2e)	0.25	0.28	0.30	0.33	0.35	2.50E+11	2.80E+11	3.00E+11	3.30E+11	3.50E+11	24	27	29	32	34
Industrial (MMT CO_2e)	0.11	0.11	0.11	0.12	0.12										
Lawn (MMT CO_2e)	0.060	0.061	0.063	0.065	0.066										
Light Commercial (MMT CO_2e)	0.090	0.095	0.099	0.11	0.11										
Military Tactical Support (MMT CO_2e)	0.022	0.022	0.022	0.022	0.022										
Pleasure Crafts (MMT CO_2e)	0.074	0.079	0.085	0.097	0.104										
Portable Equipment (MMT CO_2e)	0.081	0.090	0.099	0.121	0.133										
Recreational Vehicles (MMT CO_2e)	0.004	0.004	0.004	0.005	0.005										
Transportation Refrigeration Unit (MMT CO_2e)	0.010	0.010	0.011	0.012	0.012										
Total (MMT CO_2e)	**0.72**	**0.79**	**0.83**	**0.91**	**0.95**										

Source: CARB: ORION 2017, SORE 2020, PC2014 Pleasure Craft model, RV 2018 Recreational Vehicle model; Energy Policy Initiatives Center, University of San Diego 2020

Table X.29: 2016 Upstream Emissions from Water Supply

2016 Upstream Emissions from Water Supply		
Water Source	Imported Treated Water	Imported Raw Water
Water Demand (Acre-feet)	138,312	282,726
Energy Intensity (kWh/Acre-foot)*	1,862	1,817
California Average Electricity Emission Factor (lbs CO_2e/MWh)*	530	530
Upstream GHG Emissions (MT CO_2e)		185,411

*Includes water conveyance from the State Water Project & Colorado River to Metropolitan Water District and SDCWA system. The difference between energy intensity for treated and raw water is the water treatment energy intensity. **eGRID 2016 CAMX subregion emission factor.

Source: Energy Policy Initiatives Center, University of San Diego 2020

Imported Treated Water (kWh)	257,536,944
Imported Raw Water (kWh)	513,713,142
Local Treated Water (kWh)	227,985,529
All Water (GWh)	999

Table X.30: 2016 Emissions from Local Water Treatment

2016 Emissions from Local Water Treatment

Water Treatment Plant	Plant Operator	Water Treated (Acre-feet)	Water Treatment Energy Intensity (kWh/Acre-foot)	Water Treatment Electricity Use (kWh)	% of Water Treated	Local Weighted kWh/Acre-Foot
R.M Levy WTP	Helix WD	42,767	58	2,493,844	10%	5.69
R.E. Badger Filtration Plant	Santa Fe ID	12,685	44	558,346	3%	1.28
Combined Miramar, Otay and Alvarado WTP*	City of San Diego	163,823	56	9,151,144	38%	21.03
Escondido-Vista WTP	Escondido + Vista ID	30,678	47	1,441,875	7%	3.30
David C. McCollum WTP	Olivenhain MWD	21,301	142	3,018,745	5%	6.93
Richard A. Reynolds Ground Water Desalination Facility	Sweetwater Authority	1,855	1,174	2,178,583	0%	4.99
Robert A. Perdue WTP	Sweetwater	13,347	141	1,879,760	3%	4.31
Lester J. Berglund WTP	City of Poway	10,329	208	2,150,666	2%	4.92
Robert A. Weese WFP	City of Oceanside	11,878	29	348,546	3%	0.79
Mission Basin Groundwater	City of Oceanside	2,997	1,257	3,766,499	1%	8.63
Twin Oaks Valley WTP	SDCWA	79,538	33	2,661,602	18%	6.02
Carlsbad Desalination Plant**	SDCWA	45,107	4,397	198,335,919	10%	454.58
Total Water Treatment Electricity Use (kWh)				227,985,529	436,305	522.48
SDG&E Electricity Emission Factor (lbs CO_2e/MWh)				527		
Transmission and Distribution Loss Factor				1.082		
Local Treatment GHG Emissions (MT CO_2e)				58,925		

<-- local water treatement energy intensity to assume for projected emissions

ID: irrigation district; WD: water district; WFP: water filtration plant; WTP: water treatment plant

*The electricity use and energy intensity include both water treatment and conveyance from nearby reservoirs for City of San Diego WTPs and both water extraction and treatment for Sweetwater Authority's brackish water desalination plant. The data associated with water treatment cannot be separated out.

**The water treated at the plant includes SDCWA wholesale water and local supply for individual SDCWA member agencies that have separate contracts with the plant. The energy intensity is the high efficiency estimate from the Plant's Environmental Impact Report (2008).

Source: Energy Policy Initiatives Center, University of San Diego 2020

Table X.33: Projected Greenhouse Gas Emissions from Water

Projected Greenhouse Gas Emissions from Water					
Projection Year	**2025**	**2030**	**2035**	**2045**	**2050**
Projected Upstream Emissions					
Imported Treated Water (Acre-feet)	170,707	177,593	183,634	193,411	193,411
Imported Raw Water (Acre-feet)	348,945	363,020	375,368	395,354	406,000
California Average Emission Factor (lbs CO_2e/MWh)	493	370	249	—	—
Upstream Emissions (MT CO_2e)*	212,754	166,002	115,863	—	—
Projected Local Emissions					
Water Treated at Local Water Treatment Plants (Acre-feet)	538,496	560,218	579,273	610,115	626,544
San Diego Region Emission Factor (lbs CO_2e/MWh)	493	370	249	—	—
Local Emissions (MT CO_2e)**	68,048	53,095	37,058	—	—
Projected Total Emissions					
Total (Upstream + Local) Emissions (MT CO_2e)	280,803	219,097	152,921	—	—
Total Emissions (MMT CO_2e)	**0.28**	**0.22**	**0.15**	**—**	**—**

*Assume upstream energy intensities 1,862 kWh/acre-foot for imported treated water and 1,817 kWh/acre-foot for imported untreated water remain unchanged (Table X.29).

**Assume energy intensities at local water treatment plants remain unchanged (Table X.30).

Source: Energy Policy Initiatives Center, University of San Diego 2020

Imported Treated Water (kWh)	317,856,434	330,678,166	341,926,508	360,131,282	360,131,282
Imported Raw Water (kWh)	634,033,065	659,607,340	682,043,656	718,358,218	737,702,000
Local Treated Water (kWh)	281,351,833	292,701,081	302,656,882	318,771,121	327,354,898
All Water (GWh)	1,233	1,283	1,327	1,397	1,425

Appendix G

GWP Summaries Using AR4 and AR5 Values

Industrial designation or common name	Chemical formula	GWP values for 100-year time horizon			
		Second Assessment Report (SAR)	Fourth Assessment Report (AR4)	Fifth Assessment Report (AR5) - no climate-carbon feedback	Fifth Assessment Report (AR5) - climate-carbon feedback
Carbon dioxide	CO_2	1	1	1	1
Methane	CH_4	21	25	28	34
Nitrous oxide	N_2O	310	298	265	298
HFC-23	CHF_3	11,700	14,800	12,400	13,856
HFC-32	CH_2F_2	650	675	677	817
HFC-125	CHF_2CF_3	2,800	3,500	3,170	
HFC-134a	CH_2FCF_3	1,300	1,430	1,300	1,549
HFC-143a	CH_3CF_3	3,800	4,470	4,800	5,508
HFC-152a	CH_3CHF_2	140	124	138	
HFC-227ea	CF_3CHFCF_3	2,900	3,220	3,350	
HFC-236fa	$CF_3CH_2CF_3$	6,300	9,810	8,060	8,998
Sulfur hexafluoride	SF_6	23,900	22,800	23,500	26,087
Nitrogen trifluoride	NF_3		17,200	16,100	17,885
PFC-14	CF_4	6,500	7,390	6,630	7,349
PFC-116	C_2F_6	9,200	12,200	11,100	12,340
PFC-218	C_3F_8	7,000	8,830	8,900	9,878
PFC-318	$c\text{-}C_4F_8$	8,700	10,300	9,540	10,592

Appendix H

Appendix X of the proposed Plan; 2016 GHG Emissions Inventory and Projections for the San Diego Region

Appendix X: 2016 Greenhouse Gas Emissions Inventory and Projections for the San Diego Region

Introduction

The San Diego Association of Governments (SANDAG) contracted the Energy Policy Initiatives Center (EPIC), housed at the University of San Diego (USD), to estimate the 2016 greenhouse gas (GHG) emissions for the San Diego region and to project GHG emissions for the years 2025, 2030, 2035, 2045, and 2050. The projections take into account the effect of existing federal and California (State) regulations and regional policies to reduce GHG emissions. GHG emissions estimates and projections are to be included in San Diego Forward: The 2021 Regional Plan (2021 Regional Plan) and its associated Environmental Impact Report (EIR). This appendix summarizes the methodologies and data used to conduct this analysis.

To the extent possible, EPIC followed the same methods used in developing the 2012 GHG emissions inventory and projections for San Diego Forward: The 2015 Regional Plan.[1] The 2016 GHG inventory and projections include 15 emissions categories and calculated based on the U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions and California Air Resources Board (CARB) California statewide GHG inventory methodology.

Overview of the Appendix

This appendix includes the following sections:

- **Background** provides common background sources and assumptions used for the inventory and projections.
- **Summary of Results** provides the results of the 2016 GHG inventory and the GHG projections.
- **Method to Calculate Emissions Inventory and Projections by Category** includes subsections that cover the methods used to develop the inventory and projections by emissions category. Each subsection also describes how the methods to calculate the 2016 GHG inventory may vary from those used in the previous 2012 GHG inventory.

[1] SANDAG: San Diego Forward: 2015 Regional Plan (2015).

Background

Greenhouse Gases

The primary GHGs included in this document are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Each GHG has a different capacity to trap heat in the atmosphere, known as its global warming potential (GWP), which is normalized relative to CO_2 and expressed in carbon dioxide equivalents (CO_2e). The 100-year GWPs reported by the Intergovernmental Panel on Climate Change (IPCC) are used by CARB to estimate GHG emissions inventories statewide.[2] The GWPs in this document are from the IPCC Fourth Assessment Report (AR4), provided in Table X.1.[3]

Table X.1: Global Warming Potentials in the Regional Greenhouse Gas Inventory and Projections

Global Warming Potentials used in the Regional Greenhouse Gas Inventory and Projections	
Greenhouse Gas	**Global Warming Potential**
Carbon dioxide (CO_2)	1
Methane (CH_4)	25
Nitrous oxide (N_2O)	298
Difluoromethane (HFC-32)	675
1,1,1,2-Tetrafluoroethane (HFC-134a)	1,430
Pentafluoroethane (HFC-125)	3,500
1,1,1-Trifluoroethane (HFC-143a)	4,470
Carbon tetrafluoride (CF_4)	7,390
Octafluoropropane (C_3F_8)	8,830
1,1,1,3,3,3-Hexafluoropropane (HFC – 236fa)	9,810
Octafluorocyclobutane (C_4F_8)	10,300
Hexafluoroethane (C_2F_6)	12,200
Fluoroform (HFC-23)	14,800
Nitrogen trifluoride (NF_3)	17,200
Sulfur hexafluoride (SF_6)	22,800

Source: IPCC 2013

2 CARB: Current California GHG Emission Inventory Data. 2000–2018 GHG Inventory (2020 Edition).
3 IPCC Fourth Assessment Report: Climate Change 2007: Direct Global Warming Potentials (2013).

Demographics

SANDAG estimates and forecasts population, housing, and employment for the San Diego region. The demographic estimates and projections are provided in Table X.2.[4]

Table X.2: Demographic Estimates and Projections in the San Diego Region

Demographic Estimates and Projections in the San Diego Region				
Year	**Population**	**Jobs**	**Manufacturing Jobs***	**Housing Units**
2016	3,287,280	1,646,419	109,234	1,182,983
2025	3,470,848	1,761,747	116,046	1,288,216
2030	3,552,485	1,842,250	121,359	1,351,366
2035	3,620,348	1,921,475	126,618	1,409,866
2045	3,719,685	2,044,625	134,848	1,460,855
2050	3,746,073	2,086,318	137,503	1,471,299

*Manufacturing jobs are included in jobs.

2016 population and housing data are estimates. The rest are projections based on SANDAG Series 14 Regional Growth Forecast (2021 Regional Plan)

Source: SANDAG 2020, 2021

Rounding of Values in Tables and Figures

Rounding is used only for the final GHG values within the tables and figures throughout the document. Values are rounded to the nearest integer of a higher order of magnitude. Values are not rounded in the intermediary steps in the actual calculation. Because of rounding, some totals may not equal the exact values summed in any table or figure.

Summary of Results

Table X.3 provides a summary of the 2016 GHG inventory and the GHG projections in the San Diego region.

[4] 2016 population and housing are from the SANDAG Demographic & Socio-Economic Estimates (August 19, 2020, Version). SANDAG Data Surfer, accessed on December 10, 2020. Other estimates and projections are based on SANDAG Series 14 Growth Forecast, provided by SANDAG staff to EPIC, March 29, 2021.

Table X.3: Summary of 2016 Greenhouse Gas Inventory and Greenhouse Gas Projections

Summary of 2016 Greenhouse Gas Inventory and Greenhouse Gas Projections						
Greenhouse Gas Emissions (MMT CO_2e)						
Emissions Category	**2016**	**2025**	**2030**	**2035**	**2045**	**2050**
Passenger Cars and Light-Duty Vehicles* (No SAFE Rule Impact)	10.5	8.0 (7.8)	7.4 (6.9)	6.5 (5.9)	6.4 (5.7)	6.4 (5.7)
Electricity	5.3	3.4	1.9	1.3	0.2	0.2
Natural Gas	3.1	3.3	3.4	3.4	3.5	3.6
Industrial	2.1	2.2	2.3	2.4	2.5	2.5
Heavy-Duty Trucks and Vehicles	1.8	1.7	1.7	1.7	1.7	1.7
Other Fuels	1.1	1.4	1.4	1.5	1.5	1.5
Off-Road Transportation	0.62	0.72	0.79	0.83	0.91	0.95
Solid Waste	0.59	0.62	0.64	0.65	0.67	0.67
Water	0.24	0.28	0.22	0.15	-	-
Aviation	0.21	0.29	0.32	0.34	0.40	0.43
Rail	0.11	0.17	0.18	0.19	0.20	0.20
Wastewater	0.07	0.08	0.08	0.08	0.08	0.08
Agriculture	0.05	0.06	0.06	0.06	0.06	0.06
Marine Vessels	0.05	0.06	0.06	0.06	0.08	0.08
Soil Management	0.05	0.04	0.04	0.04	0.04	0.04
Total* (Total: No SAFE Rule Impact)	**26**	**22 (22)**	**20 (20)**	**19 (18)**	**18 (18)**	**18 (18)**

MMT – million metric tons, SAFE Rule – Federal Safer Affordable Fuel-Efficiency Vehicles Rule, April 2020

*Includes GHG impact of SAFE Rule

2016 is an inventory year, the rest are forecast years. The GHG emissions projections include the impact of federal and State regulations and regional policies and programs to reduce GHG emissions.

Source: Energy Policy Initiatives Center, University of San Diego 2021

In September 2019, the U.S. Environmental Protection Agency (EPA) and the National Highway Traffic Safety Administration (NHTSA) published the "Safer Affordable Fuel-Efficiency (SAFE) Vehicles Rule Part One: One National Program" (SAFE Rule Part One). The SAFE Rule Part One revoked California's authority to set its own GHG emissions standards and set zero-emissions vehicle (ZEV) mandates. In April 2020, EPA and NHTSA issued the Final SAFE Rule that relaxed federal GHG emissions and Corporate Average Fuel Economy (CAFE) standards for model year 2021–2026 vehicles. The GHG emissions from passenger car and light-duty vehicles and total GHG emissions with and without the SAFE rule impact are shown in Table X.3. The method to adjust on-road transportation emissions with SAFE Rule is discussed in the section *On-Road Transportation – Passenger Car and Light-Duty Vehicles*.

The previous 2012 GHG inventory included the following land use and development influences on the regional inventory: (1) carbon sequestration from vegetation cover, (2) vegetation displaced by development, and (3) vegetation burning due to wildfires. This inventory excludes emissions and sequestration estimates from vegetation and follows CARB's approach to track statewide GHG emissions from anthropogenic activities not including the GHG flux associated with carbon stocks in California's natural and working lands[5] and wildfire emissions. This is because wildfires are part of Earth's carbon cycle and it is difficult to determine how much of the wildfire emissions are from anthropogenic activities.[6]***Error! Reference source not found.***, [7]

The forecast includes the regional effects of existing federal and State polices and regulations to reduce GHG emissions. The projected reductions are based on the current implementation timeline of these regulations. Many regulations do not extend beyond 2025 or 2030, and therefore are assumed to have no additional impact after 2025 or 2030.

Method to Calculate Emissions Inventory and Projections by Category

On-Road Transportation – Passenger Car and Light-Duty Vehicles

The passenger car and light-duty vehicles emissions category is the largest contributor of GHG emissions in the San Diego region, accounting for 41% of total GHG emissions in the 2016 inventory and 32% of total GHG emissions in the 2050 projection. Tailpipe GHG emissions from on-road transportation are the result of fuel combustion (i.e., gasoline, diesel, natural gas) from mobile vehicles on freeways, highways, and local roads. The vehicle classes included in this emissions category are passenger cars and light-duty vehicles. The GHG emissions from other vehicles are accounted for in the subsection titled On-Road Transportation – Heavy-Duty Trucks and Vehicles.

Method Used to Estimate 2016 Emissions

EPIC used EMFAC2017, CARB's on-road mobile sources model, to estimate the on-road transportation emissions for passenger cars and light-duty vehicles.[8] SANDAG provided the input file to run EMFAC2017 under custom mode, as well as the output file containing all emissions results.[9] The input file, from SANDAG's activity-based model (ABM14.2.1), includes vehicle miles traveled (VMT) on an average weekday by EMFAC vehicle

5 CARB began a natural and working lands carbon and GHG flux assessment in 2018 based on IPCC principles. See arb.ca.gov/nwl-inventory.

6 CARB: Frequently Asked Questions: Wildfire Emissions.

7 California Senate Bill 901 (Dodd, 2018) (SB 901) requires that the state develop a report assessing GHG emissions from wildfire and forest management activities by December 2020 and every five years thereafter. The SB 901 2020 report provides wildfire estimates for the years 2000–2019. See California Wildfire Burn Acreages and Preliminary Emissions Estimates.

8 CARB: Mobile Source Emissions Inventory. EMFAC 2017.

9 Files provided by SANDAG staff, December 11, 2020.

categories and fuel types. The output file, from an EMFAC2017 custom model run, provides CO_2 emissions in tons per weekday for each vehicle category and each fuel type. This passenger car and light-duty vehicles emissions category covers the GHG emissions from EMFAC2017 vehicle classes LDA, LDT1, LDT2, and MDV.[10]

To convert the emissions output from tons of CO_2 per weekday to metric tons of CO_2e per year, EPIC used the weekday-to-year conversion factor and CO_2-to-CO_2e (CO_2, CH_4, and N_2O) conversion factor for each EMFAC vehicle category, based on statewide GHG inventory assumptions and EMFAC2017 default run results, respectively.[11] The weekday-to-annual conversion factors for LDA, LDT1, LDT2 and MDV are all 347 weekdays per year; the CO_2 to CO_2e conversion factors range from 1.01 for gasoline LDT2 to 1.05 for diesel LDA.[12] The key inputs and results are shown in Table X.4.

Table X.4: Key Inputs and 2016 Greenhouse Gas Emissions from On-Road Transportation – Passenger Car and Light-Duty Vehicles

Key Inputs and 2016 Greenhouse Gas Emissions from On-Road Transportation – Passenger Car and Light-Duty Vehicles	
VMT (Miles per weekday)*	79,810,087
CO_2 Emissions (Tons per weekday)**	32,805
Conversion Factor (Tons CO_2 per weekday to MT CO_2e per year)	319
GHG Emissions (MT CO_2e)	10,468,161
GHG Emissions (MMT CO_2e)	**10.5**

*SANDAG ABM14.2.0 VMT **EMFAC2017 model run with custom VMT inputs from ABM14.2.0

Passenger car and light-duty vehicles are EMFAC2017 vehicle classes LDA, LDT1, LDT2, and MDV.

Source: CARB 2016, 2017; SANDAG 2021; Energy Policy Initiatives Center, University of San Diego 2021

Difference from Previous 2012 Inventory

Methods to estimate emissions from passenger car and light-duty vehicles are the same in both 2012 and 2016 regional GHG inventories. However, ABM1 (the previous version of SANDAG's ABM) and EMFAC2014 were both used to calculate the 2012 GHG emissions. ABM2+ is used for analysis related to the 2021 Regional Plan (additional information included in Appendix S), and EMFAC2017 described below includes new regulations that are not reflected in EMFAC2014.

10 LDA: passenger cars; LDT1: light-duty trucks with gross vehicle weight rating (GVWR) smaller than 6,000 lbs. and equivalent test weight (ETW) no larger than 3,750 lbs.; LDT2: light-duty trucks with GVWR smaller than 6,000 lbs. and ETW between 3,750 and 5,750 lbs.; and MDV: medium-duty trucks with GVWR between 6,000 and 8,500 lbs.

11 This approach is recommended by CARB EMFAC staff. Personal communication, January 27, 2020.

12 The weekday-to-year conversion factors are based on CARB's California's 2004–2014 Greenhouse Gas Emission Inventory Technical Support Document. 2016 Edition, accessed March 23, 2020. The CO_2-to-CO_2e conversion factors are based on EMFAC2017 default 2016 emissions run for San Diego region by vehicle category and fuel type, January 14, 2020, model run.

Method Used to Develop Emissions Projections

The method used to develop projections is similar to the method used to estimate 2016 emissions, based on an EMFAC2017 model run with SANDAG VMT inputs. For forecast years, EMFAC2017 model results include the effect of all key federal and State laws, regulations, and legislative actions that were adopted as of December 2017. The updated regulation for passenger cars and light-duty vehicles since the release of EMFAC2014 is the California Advanced Clean Car (ACC) Program, which includes:

- Tailpipe emissions standards equivalent to CAFE standards for vehicle model years 2017–2025
- A ZEV program that requires manufacturers to produce increasing numbers of ZEVs and plug-in hybrid electric vehicles for model years 2017–2025

The impact of the ACC Program had already been incorporated into the previous version, EMFAC2014; however, EMFAC2017 includes updated assumptions in the ACC regulation based on its 2017 midterm review.

With the same tons of CO_2 per weekday to MT CO_2e per year conversion method discussed in the previous inventory method section, the key inputs and results are shown in Table X.5.[13]

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13 VMT input files and emission output files were provided by SANDAG Staff, March 18, 2021.

Table X.5: Projected Greenhouse Gas Emissions from On-Road Transportation – Passenger Car and Light-Duty Vehicles after Federal and State Regulations

Projected Greenhouse Gas Emissions from On-Road Transportation – Passenger Car and Light-Duty Vehicles after Federal and State Regulations					
Projection Year	**2025**	**2030**	**2035**	**2045**	**2050**
VMT (Miles per weekday)*	79,864,963	81,478,678	81,193,649	83,299,109	83,644,722
CO_2 Emissions (Tons per weekday)**	24,532	21,672	19,784	19,232	19,056
Conversion Factor (Tons CO_2 per weekday to MT CO_2e per year)	318	318	317	317	318
GHG Emissions (MT CO_2e)	7,793,133	6,880,756	6,280,927	6,106,409	6,050,681
GHG Emissions (MMT CO_2e)	7.8	6.9	6.3	6.1	6.1

*2025, 2030, 2035, and 2050 VMT direct outputs of SANDAG ABM14.2.0, 2045 VMT is interpolated linearly between 2040 and 2050 VMT

**EMFAC2017 model run with custom VMT inputs from SANDAG ABM14.2.0, 2045 CO_2 emissions are interpolated linearly between 2040 and 2050

Source: CARB 2016, 2017; SANDAG 2021; Energy Policy Initiatives Center, University of San Diego 2021

The VMT projected under ABM do not capture the miles and trips avoided as a result of the following SANDAG off-model strategies in the 2021 Regional Plan:

- Shared mobility strategies:
  - Vanpool
  - Carshare
  - Pooled ride
  - Regional transportation demand management ordinance
- Electric vehicle (EV) strategies:
  - EV charger program
  - EV incentive program

The detailed strategy descriptions and the methods to estimate CO_2 reductions due to the strategies are provided in Appendix S. EPIC converted the annual CO_2 reductions (EV strategies) and weekday CO_2 reductions (shared mobility strategies) to annual CO_2e reductions using the same conversion method as described above. For the shared mobility strategies, only the GHG reductions from running exhaust and start exhaust processes are included in this appendix to be consistent with Appendix S. The projected GHG reductions from EV strategies and shared mobility strategies are shown in Table X.6 and

Table X.7, respectively.

Table X.6: Projected Greenhouse Gas Reductions from SANDAG Electric Vehicle Off-Model Strategies

Projected Greenhouse Gas Reductions from SANDAG Electric Vehicle Off-Model Strategies		
Projection Year	**2035**	**2050**
GHG Reduction from EV Strategies: Regional Charger Program (MT CO_2 per year)*	105,078	273,096
GHG Reduction from EV Strategies: Vehicle Incentive Program (MT CO_2 per year)*	233,926	—
GHG Reduction from EV Strategies: Combined EV Charger and EV Incentive Programs (MT CO_2 per year)*	339,004	273,096
Conversion Factor (MT CO_2e per MT CO_2)**	1.01	1.01
GHG Reduction from SANDAG EV Strategies (MT CO_2e)	341,837	275,379
GHG Reduction from SANDAG EV Strategies (MMT CO_2e)	0.34	0.28

*GHG reduction from the programs and program design are described in 2021 Regional Plan Appendix S. Because off-model strategies are intended for use in complying with SB 375 GHG emissions reduction targets, 2035 is the primary year of analysis and reductions associated with interim years are not provided.

**EMFAC2017 assumptions for passenger car and light-duty vehicle classes: LDA, LDT1, LDT2, and MDV

Source: CARB 2017; SANDAG 2021; Energy Policy Initiatives Center, University of San Diego 2021

Table X.7: Projected Greenhouse Gas Reductions from SANDAG Shared Mobility Strategies

Projected Greenhouse Gas Reductions from SANDAG Shared Mobility Strategies		
Projection Year	**2035**	**2050**
Vehicle Trips Avoided		
Vanpool Strategy (Trips avoided per weekday)*	7,152	7,644
Pooled Rides Strategy (Trips avoided per weekday)*	2,108	2,074
Transportation Demand Management Ordinance Strategy (Trips avoided per weekday)*	43,779	65,824
Total (Trips avoided per weekday)	53,040	75,542
Total (Trips avoided per year)**	18,404,726	26,212,919
GHG Emissions per Trip Start (Grams CO_2e per trip)***	46	42
GHG Reduction due to Trips Avoided (MT CO_2e)	839	1,095
Vehicle Miles Avoided		
Vanpool Strategy (Miles avoided per weekday)*	308,326	329,148
Carshare (Miles avoided per weekday)*	179,225	-
Pooled Rides Strategy (Miles avoided per weekday)*	11,839	11,636
Transportation Demand Management Ordinance Strategy (Miles avoided per weekday)*	358,235	549,952
Total (Miles avoided per weekday)	857,625	890,737
Total (Miles avoided per year)**	297,595,853	309,085,638
GHG Emissions per Mile (Grams CO_2e per mile)***	217	201
GHG Reduction due to Miles Avoided (MT CO_2e)	64,464	62,145
Total (Trips + Miles Avoided)		
GHG Reduction from Shared Mobility Strategies (MT CO_2e)	65,302	63,240
GHG Reduction from Shared Mobility Strategies (MMT CO_2e)	0.07	0.06

*GHG reduction from the programs and program design are described in 2021 Regional Plan Appendix S. The carshare strategy does not have trips avoided or miles avoided in 2050

**347 weekdays per year, EMFAC2017 assumptions for passenger car and light-duty vehicle classes: LDA, LDT1, LDT2, and MDV

***Based on the total number of trips, VMT, start exhaust (EMFAC2017 process STARTEX), and running exhaust (EMFAC2017 process RUNEX) CO_2e emissions from LDA, LDT1, LDT2, and MDV vehicle classes (EMFAC2017 model run with ABM14.2.0 inputs)

Source: CARB 2016, 2017; SANDAG 2021; Energy Policy Initiatives Center, University of San Diego 2021

The projected emissions from passenger car and light-duty vehicles after impacts of federal and State regulations and SANDAG programs are shown in Table X.8.

Table X.8: Projected Greenhouse Gas Emissions from On-Road Transportation – Passenger Car and Light-Duty Vehicles

Projected Greenhouse Gas Emissions from On-Road Transportation – Passenger Car and Light-Duty Vehicles					
Projection Year	**2025**	**2030**	**2035**	**2045**	**2050**
GHG Emissions after Federal and State Regulations (MMT CO_2e)	7.8	6.9	6.3	6.1	6.1
GHG Reduction from SANDAG Electric Vehicle Strategies* (MMT CO_2e)	N/A	N/A	−0.34	−0.30	−0.28
GHG Reduction from SANDAG Shared Mobility Strategies* (MMT CO_2e)	N/A	N/A	−0.07	−0.06	−0.06
GHG Emissions (MMT CO_2e)	**7.8**	**6.9**	**5.9**	**5.7**	**5.7**

*2045 GHG reductions are interpolated linearly between 2035 and 2050 GHG reductions in Table X.6 and

Table X.7

Source: SANDAG 2021; Energy Policy Initiatives Center, University of San Diego 2021

In April 2020, EPA and NHTSA issued the Final SAFE Rule that relaxed federal GHG emissions and CAFE standards for model year 2021–2026 vehicles. In June 2020, CARB released off-model adjustment factors to adjust tailpipe CO_2 emissions outputs from EMFAC models to account for the impacts of the SAFE Rule. The adjustment factors are for gasoline light-duty vehicles (EMFAC2017 vehicle categories LDA, LDT1, LDT2, and MDV) only and in the form of multipliers applied to emissions outputs from the EMFAC model. The SAFE Rule adjustment factors and projection results are shown in Table X.9.[14]

[14] CARB: EMFAC Off-Model Adjustment Factors for Carbon Dioxide (CO2) Emissions to Account for the SAFE Vehicles Rule Part One and the Final SAFE Rule (2020), accessed September 3, 2020. Method to apply adjustment factors were confirmed by CARB EMFAC staff. Personal communication between EPIC and CARB, June 30, 2020.

Table X.9: SAFE Rule Adjustment Factors and Projected Emissions: On-Road Transportation – Passenger Car and Light-Duty Vehicles

SAFE Rule Adjustment Factors and Projected Emissions: On-Road Transportation – Passenger Car and Light-Duty Vehicles			
EMFAC 2017 Vehicle Category	CO_2 Emissions (Tons per weekday)*	SAFE Rule Adjustment Factor**	Adjusted CO_2 Emissions (Tons per weekday)**
2025 Projection			
LDA – GAS	13,398	1.031	13,812
LDT1 – GAS	1,689	1.031	1,742
LDT2 – GAS	5,144	1.031	5,303
MDV – GAS	4,024	1.031	4,148
The Rest of Non-Gas of LDV	277	N/A	277
Total LDV	24,532	N/A	**25,282**
2030 Projection			
LDA – GAS	12,194	1.070	13,050
LDT1 – GAS	1,517	1.070	1,623
LDT2 – GAS	4,337	1.070	4,642
MDV – GAS	3,363	1.070	3,599
The Rest of Non-Gas of LDV	261	N/A	261
Total LDV	21,672	N/A	**23,175**
2035 Projection			
LDA – GAS	11,324	1.100	12,453
LDT1 – GAS	1,388	1.100	1,527
LDT2 – GAS	3,843	1.100	4,226
MDV – GAS	2,984	1.100	3,281
The Rest of Non-Gas of LDV	245	N/A	245
Total LDV	19,784	N/A	**21,732**
2050 Projection			
LDA – GAS	11,110	1.127	12,523
LDT1 – GAS	1,313	1.127	1,480
LDT2 – GAS	3,601	1.127	4,059
MDV – GAS	2,791	1.127	3,146
The Rest of Non-Gas of LDV	241	N/A	241
Total LDV	19,056	N/A	**21,449**

*EMFAC2017 model run with custom VMT inputs from SANDAG ABM14.2.0 VMT **Adjustment factors are applied to gasoline light-duty vehicles only

GAS: gasoline vehicles; Non-GAS: non-gasoline (diesel and electric) vehicles.

Passenger car and light-duty vehicles are EMFAC2017 vehicle categories LDA, LDT1, LDT2, and MDV.

Source: CARB 2017, 2020; SANDAG 2021; Energy Policy Initiatives Center, University of San Diego 2021

Using the same conversion method for tons of CO_2 per weekday to MT CO_2e per year discussed in the inventory method section, the results are shown in Table X.10.

Table X.10: Projected Emissions from On-Road Transportation – Passenger Car and Light-Duty Vehicles with SAFE Rule Impact

Projected GHG Emissions from On-Road Transportation – Passenger Car and Light-Duty Vehicles after Federal and State Regulations with SAFE Rule Impact

Projection Year	2025	2030	2035	2045	2050
VMT (Miles per weekday)*	79,864,963	81,478,678	81,193,649	83,299,109	83,644,722
Adjusted CO_2 Emissions (Tons per weekday)**	25,282	23,175	21,732	21,548	21,449
Conversion Factor (Tons CO_2 per weekday to MT CO_2e per year)	318	317	317	317	318
GHG Emissions after Federal and State Regulations (MT CO_2e)	8,029,070	7,353,905	6,899,075	6,841,355	6,810,213
GHG Emissions after Federal and State Regulations (MMT CO_2e)	8.0	7.4	6.9	6.8	6.8
GHG Reduction from SANDAG EV Strategies (MMT CO_2e)***	N/A	N/A	−0.38	−0.33	−0.31
GHG Reduction from SANDAG Shared Mobility Strategies (MMT CO_2e)***	N/A	N/A	−0.07	−0.07	−0.07
GHG Emissions (MMT CO_2e)	**8.0**	**7.4**	**6.5**	**6.4**	**6.4**

*2025, 2030, 2035 and 2050 VMT direct outputs of SANDAG ABM14.2.0, 2045 VMT is interpolated linearly between 2040 and 2050 VMT

**EMFAC2017 model run with custom VMT inputs from SANDAG adjusted with SAFE Rule impact, as shown in Table X.9, 2045 CO_2 adjusted emissions are interpolated linearly between 2040 and 2050 adjusted emissions

***GHG reductions from EV strategies (Table X.6) and from EV strategies (

Table X.7) with SAFE Rule adjustment factors (Table X.9), 2045 GHG reductions are interpolated linearly between 2035 and 2050 GHG reductions

Source: CARB 2017, 2020; SANDAG 2021; Energy Policy Initiatives Center, University of San Diego 2021

Electricity

GHG emissions from electricity use in the San Diego region account for 20% of total emissions in the 2016 inventory and 1% in the 2050 projection.

Method Used to Estimate 2016 Emissions

To estimate GHG emissions from grid-supply electricity use, EPIC adjusted the 2016 electricity sales with transmission and distribution losses, and multiplied sales by the electricity emission factor, expressed in pounds of CO_2e per megawatt-hour (lbs CO_2e/MWh).

The local utility, San Diego Gas & Electric (SDG&E), provided the 2016 San Diego regional electricity sales by bundled and Direct Access (DA) supply for each customer class. The San Diego regional electricity sales account for electricity sales to all local jurisdictions, including military bases and tribal reservations.[15] The transmission and distribution loss factor, 0.082, is the loss estimate for the entire SDG&E service territory (larger than San Diego region) and accounts for the difference between electricity generated for load and electricity sales.[16]

SDG&E and electric service providers (ESPs) for DA customers have different power mixes in their electricity supplies. The SDG&E 2016 bundled emission factor, 527 lbs CO_2e/MWh, was calculated using Federal Energy Regulatory Commission Form 1 data, the California Energy Commission (CEC) Power Source Disclosure Program data on SDG&E-owned and purchased power, and EPA's Emissions and Generating Resource Integrated Database (eGRID) on specific power plant emissions. EPIC's technical working paper, "Estimating Annual Average Greenhouse Gas Emission Factors for the Electricity Sector: A Method for Inventories," describes the detailed method to calculate the SDG&E bundled electricity emission factor.[17] The DA emission factor, 836 lbs CO_2e/MWh, is a default taken from the California Public Utilities Commission Decision 14-12-037.[18]

Two adjustments are made to the emissions estimate based on grid-supply electricity:

- Emissions associated with electricity use at water treatment plants in the San Diego region were allocated to the water category and removed from the electricity category. The method used to identify electricity use at water treatment plants is discussed in the *Water* section of this appendix.
- Emissions associated with natural gas used for on-site self-serve electric generation, mostly attributed to co-generation plants, were removed from the natural gas category and allocated to the electricity category. EPIC used the CEC Quarterly Fuel and Energy Report (QFER) Power Plant Owner Reporting database, U.S. Energy

15 Electricity sales data provided by SDG&E to EPIC, August 16, 2018.

16 Loss factor is from CEC Energy Demand 2019 Forecast. For each forecast cycle, utilities provide the estimates, which remain relatively stable. Personal communication with CEC staff. March 23, 2020.

17 EPIC: Estimating annual average greenhouse gas emission factors for the electric sector: a method for inventories (2016), accessed May 7, 2020.

18 D.14-12-037, December 18, 2014 in Rulemaking 11-03-012 (filed March 24, 2011). The recommended emission factor is 0.379 MT CO_2e/MWh (836 lbs CO_2e/MWh).

Information Administration (EIA) Form 923 data, and the 2016 SDG&E Power Source Disclosure Program to identify the self-serve electric generation plants.

With the adjustments, the key inputs and results are shown in Table X.11.

Table X.11: Key Inputs and 2016 Greenhouse Gas Emissions from Electricity

Key Inputs and 2016 Greenhouse Gas Emissions from Electricity	
Electricity Sales – Bundled (MWh)	14,482,332
Electricity Sales – Direct Access (MWh)	3,360,561
Transmission and Distribution Loss Factor	1.082
SDG&E Electricity Emission Factor (lbs CO_2e/MWh)	527
Direct Access Electricity Emission Factor (lbs CO_2e/MWh)	836
GHG Emissions (MT CO_2e)	5,121,950
GHG Emissions associated with Electricity for Water Treatment – Excluded (MT CO_2e)	−58,925
GHG Emissions Associated with Natural Gas Used at On-site Self-serve Electric Generation – Added (MT CO_2e)	204,014
GHG Emissions (MT CO_2e)	5,267,039
GHG Emissions (MMT CO_2e)	**5.3**

Source: CEC 2020, SDG&E 2018, Energy Policy Initiatives Center, University of San Diego 2020

Difference from Previous 2012 Inventory

Methods to estimates emissions from electricity are the same in both the 2012 and 2016 GHG inventories. However, source data have been updated and refined. For example, the DA emission factor was not available for the 2012 inventory but was available for the 2016 inventory.

Method Used to Develop Emissions Projections

To project emissions for the electricity category, EPIC estimated the impact of federal and State policies and regulations on separately reducing electricity use and reducing the electricity emission factor (by increasing renewable or zero-carbon electricity).

Senate Bill 100 (de León, 2018) (Chapter 312, Statutes of 2018) (SB 100), the 100 Percent Clean Energy Act of 2018, increases California's Renewable Portfolio Standard (RPS) to 60% by 2030.[19] The legislation also provides goals for the years leading up to 2030 and establishes a State policy requiring eligible renewable resources and zero-carbon resources to supply 100% of all retail electricity sales by 2045. All retail electricity providers must meet these RPS requirements, including utilities (e.g., SDG&E), ESPs for DA

[19] California Senate Bill 100 (de León, 2018) (Chapter 312, Statutes of 2018).

customers, and other local renewable programs (e.g., Community Choice Energy programs). EPIC assumed that all retail electricity providers will meet the 2030 and 2045 SB 100 targets.

In addition, San Diego Community Power (SDCP), a Community Choice Energy (CCE) program formed by the cities of Chula Vista, Encinitas, Imperial Beach, La Mesa, and San Diego, started delivering power in March 2021. SDCP plans to start with 55% GHG-free electricity in 2021 and to supply 100% renewable electricity by 2030 or 2035.[20] Because SDCP will be operational by time the 2021 Regional Plan is adopted, the impact of SDCP delivering GHG-free electricity above the 2030 RPS target is included in the emissions projection. Another CCE program, Clean Energy Alliance (CEA), formed by the cities of Carlsbad, Del Mar, and Solana Beach, started delivering power in May 2021. Because the planned renewable content in CEA's electricity supply is consistent with the RPS target, 60% renewable by 2030, the impact of the CEA is not shown separately.[21] The projected renewable or GHG-free content and electricity emission factors for each supplier are shown in Table X.12.

[20] SDCP: Community Choice Aggregation Implementation Plan and Statement of Intent (2019), accessed August 4, 2020. SDCP: Board of Directors Meeting, May 28, 2020, SDCP Renewable and GHG-Free Targets, accessed August 4, 2020.

[21] CEA: Community Choice Aggregation Implementation Plan and Statement of Intent (2019), accessed December 22, 2020.

Table X.12: Projected Renewable or Greenhouse Gas–Free Content and Emission Factors of Retail Electricity Providers

Projected Renewable or Greenhouse Gas–Free Content and Emission Factors of Retail Electricity Providers					
Retail Electricity Provider	**2025**	**2030**	**2035**	**2045**	**2050**
Projected Renewable or GHG-free Content (%)*					
San Diego Community Power	67%	100%	100%	100%	100%
SDG&E Bundled and Clean Energy Alliance	47%	60%	73%	100%	100%
ESPs for Direct Access	47%	60%	73%	100%	100%
Projected Electricity Emission Factor (lbs CO_2e/MWh)**					
San Diego Community Power	308	—	—	—	—
SDG&E Bundled and Clean Energy Alliance	493	370	249	—	—
ESPs for Direct Access	493	370	249	—	—

*Based on SB 100 RPS targets and CCE programs' implementation plans
**Calculated based on 2016 SDG&E bundled electricity emission factor of 527 lbs CO_2e/MWh and 43% renewable provided in its 2018 Power Source Disclosure.

Source: Energy Policy Initiatives Center, University of San Diego 2020

The latest CEC California Energy Demand 2020–2030 Revised Forecast projects electricity sales in the SDG&E planning area (service area) through 2030. The electricity sales account for the impact of behind-the-meter photovoltaic (PV) and non-PV self-generation, behind-the-meter storage, current electricity rate structure, and appliance and building energy efficiency standards up to 2019.[22] EPIC applied the rate of increase from CEC's Demand Forecast electricity sales projection for the SDG&E planning area to the 2016 San Diego region's electricity sales. As no forecast is available for after 2030, EPIC used the 2029–2030 annual electricity sales increase, 0.7%, as the post-2030 annual increase. Assuming existing DA customers remain and there are no additional new retail electricity suppliers in San Diego region, the projected electricity sales by supplier are shown in Table X.13.

22 CEC: Final 2020 Integrated Energy Policy Report Update Volume III: California Energy Demand Forecast Update (March 2021).

Table X.13: Projected Electricity Sales of Electric Retail Providers

Projected Electricity Sales of Retail Electricity Providers					
Retail Electricity Supplier	**2025**	**2030**	**2035**	**2045**	**2050**
Projected Electricity Sales (GWh)					
San Diego Community Power*	7,408	7,189	7,459	8,031	8,333
SDG&E Bundled and Clean Energy Alliance	5,775	6,403	6,137	5,573	5,275
ESPs for Direct Access	3,059	3,154	3,155	3,157	3,158

*Estimated based on the projected demand through 2030 in SDCP Implementation Plan and SDG&E Planning Area electricity sales in CEC 2020–2030 energy demand forecast, 2021 version

Source: Energy Policy Initiatives Center, University of San Diego 2020

With the projected electricity sales and emission factor of each supplier, assuming 2016 self-serve co-generation plants will still be operational at existing levels in the forecast years, the projected emissions are shown in Table X.14.

Table X.14: Projected Greenhouse Gas Emissions from Electricity

Projected Greenhouse Gas Emissions from Electricity					
Projection Year	**2025**	**2030**	**2035**	**2045**	**2050**
GHG Emissions from Electricity Sales (MT CO_2e)*	3,256,139	1,733,379	1,137,543	—	—
GHG Emissions from Water Treatment Excluded (MT CO_2e)	68,048	53,095	37,058	—	—
GHG Emissions from On-site Self-serve Electricity Generation Included (MT CO_2e)	204,104	204,104	204,104	204,104	204,104
Adjusted GHG Emissions (MT CO_2e)	3,392,104	1,884,298	1,304,499	204,104	204,014
GHG Emissions (MMT CO_2e)	**3.4**	**1.9**	**1.3**	**0.2**	**0.2**

*Electricity sales from SDCP, SDG&E, Clean Energy Alliance, and ESPs for DA

Source: Energy Policy Initiatives Center, University of San Diego 2020

Natural Gas

The combustion of natural gas for building end-use accounts for 12% of total emissions in the 2016 inventory and 10% in the 2050 projection. This category calculates emissions from building end-use natural gas for purposes other than electric generation, not for utility-level electric generation (UEG) and not for on-site self-serve electric generation, as they are accounted for under the electricity category. However, emissions associated with natural gas use for heat output from any of the co-generation plants are captured in this category.

Method Used to Estimate 2016 Emissions

To estimate GHG emissions from metered natural gas end-use, EPIC multiplied the metered natural gas sales by the constant natural gas emission factor.

SDG&E provided the 2016 San Diego regional natural gas sales by customer class. The San Diego regional natural gas sales account for natural gas sales to all local jurisdictions, including military bases and tribal reservations. The natural gas use for UEG purposes, either at co-generation or electric generation plants, is excluded.[23] However, certain co-generation plants may have dual purposes that generate electricity use for both on-site use and sales to the utility. EPIC used the natural gas emission factor, 0.00545 MT CO_2e per therm, based on CARB's statewide inventory data.[24]

Three adjustments are made to the emissions estimate based on natural gas sales:

- Emissions associated with natural gas used at on-site self-serve electric generation, mostly co-generation plants, were removed from this category and allocated to the electricity category. EPIC used CEC QFER Power Plant Owner Reporting database, EIA Form 923, and the 2016 SDG&E Power Source Disclosure Program to identify the self-serve electric generation plants.
- Emissions associated with natural gas used for utility electric sales at dual-purpose (both on-site use and utility sales) co-generation plants were removed from this category because they are already accounted for in the electricity emission factor calculation. The method to identify the plants is the same as above.
- Emissions associated with heat output from utility-level co-generation plants were estimated separately and added to this category. This natural gas use is not captured in the SDG&E natural gas sales. EPIC assumed that excess heat output was sold by the plants for other use (e.g., to another industrial customer nearby). The method to identify the plants is the same as above.

With these adjustments, the key inputs and results are shown in Table X.15.

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23 Natural gas sales data provided by SDG&E, August 16, 2018.

24 CARB: Documentation of California's Greenhouse Gas Inventory (11th Edition), accessed March 23, 2020. The natural gas emission factor is also used in CARB Mandatory GHG Reporting (MRR) and is the same under each customer class (e.g., residential, commercial).

Table X.15: Key Inputs and 2016 Greenhouse Gas Emissions from Natural Gas

Key Inputs and 2016 Greenhouse Gas Emissions from Natural Gas	
Natural Gas Sales (Therms)	585,460,937
Natural Gas Emission Factor (MT CO_2e/Therm)	0.00545
GHG Emissions (MT CO_2e)	3,192,578
GHG Emissions Associated with Heat Output from Utility-level Co-generation Plants – Included (MT CO_2e) (1)	118,239
GHG Emissions from Natural Gas used to Generate Electricity for Sales to Utility – Excluded (MT CO_2e)* (2)	−3,593
GHG Emissions from Natural Gas Used at On-site Self-serve Electric Generation – Excluded (MT CO_2e) (3)	−204,014
Total Adjustment (MT CO_2e) (1+2+3)	−89,369
GHG Emissions (MT CO_2e)	3,103,209
GHG Emissions (MMT CO_2e)	**3.1**

* Does not include power plants generating electricity for utility sales only

Source: CARB 2019, SDG&E 2018, Energy Policy Initiatives Center, University of San Diego 2020

Difference from Previous 2012 Inventory

Methods to estimate emissions from natural gas are the same in both the 2012 and 2016 inventories. However, the source data (e.g., the data associated with co-generation plants in the San Diego region) have been updated and refined.

Method Used to Develop Emissions Projections

To project emissions for the natural gas category, EPIC estimated the impact of federal and State polices and regulations on reducing natural gas use. The natural gas emission factor, 0.00545 MT CO_2e per therm, is a constant.

The 2020 version of the CEC California Energy Demand 2020–2030 Forecast projects natural gas sales in the SDG&E planning area through 2030.[25] The natural gas sales already account for the impact of the current natural gas rate structure, as well as appliance and building energy efficiency standards up to 2019. Unlike SDG&E's electricity service area, SDG&E's natural gas service area matches the boundaries of the San Diego region. EPIC applied the rate of increase from the CEC Demand Forecast for the SDG&E planning area to 2016 natural gas sales for the San Diego region. Since no forecast is available after 2030, EPIC used the 2029–2030 annual natural gas sales increase, 0.2%, as a

[25] The CEC Energy Demand Forecast has a one-year cycle for the electricity demand forecast, but a two-year cycle for the natural gas demand forecast.

post-2030 annual increase. Assuming the 2016 co-generation plants adjustment does not change, the projected emissions are shown in Table X.16.

Table X.16: Projected Greenhouse Gas Emissions from Natural Gas

Projected GHG Emissions from Natural Gas					
Projection Year	**2025**	**2030**	**2035**	**2045**	**2050**
Projected Natural Gas Sales (therms)*	628,689,290	640,276,291	647,766,840	663,011,857	670,768,387
Natural Gas Emission Factor (MT CO_2e/therm)	0.00545	0.00545	0.00545	0.00545	0.00545
GHG Emissions from Natural Gas Sales (MT CO_2e)	3,428,892	3,492,088	3,532,942	3,616,089	3,658,393
Total Adjustment for Co-generation Plants (MT CO_2e)**	−89,369	−89,369	−89,369	−89,369	−89,369
GHG Emissions (MT CO_2e)	3,339,523	3,402,719	3,443,573	3,526,720	3,569,024
GHG Emissions (MMT CO_2e)	3.3	3.4	3.4	3.5	3.6

*Estimated based on CEC 2020–2030 energy demand forecast, 2020 version
**Calculated in Table X.15

Source: Energy Policy Initiatives Center, University of San Diego 2020

Industrial

Emissions from GHGs with high GWPs used in industrial processes and the processing of materials to manufacture items (e.g., mineral aggregate products, chemicals, metals, refrigerants, electronics, and other consumer goods) account for 8% of total emissions in the 2016 inventory and 14% in the 2050 projection. GHGs with high GWPs are used in air conditioning units and refrigeration, as well as in the manufacturing of electronics, fire protection equipment, insulation, and aerosols. This category focuses on industrial processes that directly release CO_2 and other GHGs with high GWPs (i.e., SF_6, C_2F_6, C_3F_8, CF_4, C_4F_8, HFC-23, NF_3, HFC-125, HFC-134a, HFC-143a, HFC-236fa, HFC-32) by processes other than fuel consumption.

Method Used to Estimate 2016 Emissions

Similar to the method used in the other fuels category, EPIC scaled down the industrial emissions in the CARB statewide GHG inventory to the San Diego region based on the San Diego region to State ratio relevant to each economic sector.[26]

The following are the IPCC category numbers, subcategory numbers, headings, codes, and fuel types used within each type of activity in the statewide inventory. Only those categories, subcategories, activities, and fuel types causing emissions in the San Diego region are shown:

- 2D1: Industrial Lubricant Use
  - Not Specified Industrial > Fuel consumption – Lubricants > CO_2
  - Not Specified Transportation > Fuel consumption – Lubricants > CO_2
- 2D3: Industrial Solvent Use
  - Solvents & Chemicals: Evaporative losses: Fugitives > Fugitive emissions > CO_2
- 2E: Electronic Industry
  - Manufacturing: Electric & Electronic Equip.: Semiconductors & Related Products > Semiconductor manufacture > C_2F_6
  - Manufacturing: Electric & Electronic Equip.: Semiconductors & Related Products > Semiconductor manufacture > C_3F_8
  - Manufacturing: Electric & Electronic Equip.: Semiconductors & Related Products > Semiconductor manufacture > C_4F_8
  - Manufacturing: Electric & Electronic Equip.: Semiconductors & Related Products > Semiconductor manufacture > CF_4
  - Manufacturing: Electric & Electronic Equip.: Semiconductors & Related Products > Semiconductor manufacture > HFC-23
  - Manufacturing: Electric & Electronic Equip.: Semiconductors & Related Products > Semiconductor manufacture > NF_3
  - Manufacturing: Electric & Electronic Equip.: Semiconductors & Related Products > Semiconductor manufacture > SF_6
- 2F: Product Uses as – Not Specified Commercial
  - Use of substitutes for ozone depleting substances > CF_4
  - Use of substitutes for ozone depleting substances > HFC-125
  - Use of substitutes for ozone depleting substances > HFC-134a
  - Use of substitutes for ozone depleting substances > HFC-143a

[26] CARB: CARB Greenhouse Gas Emission Inventory – Query Tool for years 2000 to 2017 (12th edition), accessed on June 5, 2020.

- Use of substitutes for ozone depleting substances > HFC-236fa
- Use of substitutes for ozone depleting substances > HFC-32
- Use of substitutes for ozone depleting substances > Other ODS substitutes

- 2G1b: Other Industrial Product – Electrical
  - Imported Electricity: Transmission and Distribution > Electricity transmitted > SF_6
  - In State Generation: Transmission and Distribution > Electricity transmitted > SF_6
- 2G4: Other Industrial Product – CO_2, Limestone
  - Not Specified Industrial > CO_2 consumption > CO_2
  - Not Specified Industrial > Limestone and dolomite consumption > CO_2
  - Not Specified Industrial > Soda ash consumption > CO_2

EPIC used different ratios to scale down the activities above to the San Diego region. Table X.17 shows the ratios used and their values in 2016.

Table X.17: Key Inputs and 2016 Greenhouse Gas Emissions for Industrial

Key Inputs and 2016 Greenhouse Gas Emissions from Industrial				
Economic Sector/Industry	**Basis for Ratio Value**	**California (MMT CO_2e)**	**Ratio Value**	**San Diego Region (MMT CO_2e)**
Industrial Lubricant and Limestone Use	San Diego manufacturing sector employees/ California manufacturing sector employees	1.93	9%	0.17
Industrial lubricant Use - Not Specified Transportation (Lubricant, ODS)	San Diego VMT/California statewide VMT	5.55	9%	0.51
Industrial Solvent Use – Solvents and Chemicals	San Diego manufacturing sector employees/ California manufacturing sector employees	0.79	9%	0.07
Electronic Industry – Semiconductor Manufacture	San Diego semiconductor manufacturing sector employees/California semiconductor manufacturing sector employees	0.16	7%	0.01
Not Specified Residential (ODS)	San Diego total residential units/California total residential units	3.17	9%	0.27
Not Specified Commercial (ODS)	San Diego total employees/California total employees	11.9	9%	1.01
Imported Electricity – Transmission and Distribution	San Diego purchased electricity/California purchased electricity	0.03	11%	0.004
In State Generation – Transmission and Distribution	San Diego in-county electricity generated/ California in-state electricity generated	0.07	3%	0.002
Total GHG Emissions (MMT CO_2e)		**24**	**N/A**	**2.1**

ODS: Emissions from use of substitutes for Ozone-Depleting Substances

Source: 2016 County Business Patterns; SANDAG ABM14.2.0 VMT; EMFAC2017 statewide on-road emission inventory; SANDAG Demographic data; Energy Policy Initiatives Center, University of San Diego 2021

Emissions from the following categories were included in CARB's statewide inventory but not in the 2016 regional inventory because Economic Census data indicated no economic activity in the San Diego region.[27] The categories are:

- 2A1: Manufacturing: Stone, Clay, Glass, and Cement: Cement > Clinker Production> CO_2
- 2A2: Manufacturing: Stone, Clay, Glass, and Cement: Lime > Lime Production> CO_2
- 2B2: Manufacturing: Chemical and Allied Products: Nitric Acid > Nitric Acid Production > N_2O
- 2H3: Petroleum Refining: Transformation > Fuel Consumption > CO_2

Difference from Previous 2012 Inventory

Methods to estimates emissions from the Industrial sector are the same in both the 2012 and 2016 inventories.

Similar to the other fuels category, there are no empirical data for industrial activities in San Diego region. For the 2016 inventory, EPIC used the same methodology as the 2012 inventory. However, refinements were made on the downscaling ratios. For industrial (not specified) lubricant use, the 2012 inventory used the VMT ratio. In the 2012 inventory, the emissions, due to use of substitutes for Ozone-Depleting Substances (ODS), were a single category and were scaled down based on the population ratio. For the 2016 inventory, EPIC used CARB's categories and categorized these emissions into not-specified transportation, not-specified commercial, and not-specified residential sectors. The ratios to scale down these emissions were discussed in the previous section. For the emissions due to soda ash and limestone consumption, which is a not-specified industrial activity, EPIC used the ratio of the manufacturing sector employees instead of the ratio of population used in the 2012 inventory.

Method Used to Develop Emissions Projections

EPIC projected emissions for the Industrial sector are based on the San Diego regional population, housing, jobs, and VMT projections. Each specific industry is projected separately based on the type of activity as shown in Table X.17. For example, the emissions from transportation lubricants use were projected based on San Diego regional VMT forecast and the emissions from solvents and chemicals were projected based on the San Diego regional manufacturing jobs forecast. The projected emissions are shown in Table X.18.

27 Confirmed by San Diego Economic Development Corporation research team, personal communication.

Table X.18: Projected Greenhouse Gas Emissions from Industrial

Projected Greenhouse Gas Emissions from Industrial					
Projection Year	**2025**	**2030**	**2035**	**2045**	**2050**
Manufacturing Sector Jobs Increase Compared with 2016 (%)	15%	21%	26%	34%	37%
Population Increase Compared with 2016 (%)	6%	8%	10%	13%	14%
VMT Increase Compared with 2016 (%)	1%	3%	3%	5%	6%
Housing Increase Compared with 2016 (%)	9%	14%	19%	23%	24%
Jobs Increase Compared with 2016 (%)	12%	12%	17%	24%	27%
Total GHG Emissions (MMT CO_2e)	**2.2**	**2.3**	**2.4**	**2.5**	**2.5**

Source: SANDAG 2021, Energy Policy Initiatives Center, University of San Diego 2021

On-Road Transportation – Heavy-Duty Trucks and Vehicles

The on-road transportation heavy-duty trucks and vehicles category accounts for 7% of total GHG emissions in the 2016 inventory and 10% in the 2050 projection. Vehicle classes included in this category are taken from EMFAC2017.[28]

Method Used to Estimate 2016 Emissions

EPIC used the same method to estimate emissions from this category and the on-road transportation passenger cars and light-duty vehicles category, with an EMFAC2017 model run of VMT from SANDAG ABM14.2.1 and tons of CO_2 per weekday to MT CO_2e per year conversion. The key inputs and results are shown in Table X.19.

28 Vehicle classes are all except LDA, LDT1, LDT2, and MDV as shown in EMFAC2017 Technical Documentation, Table 6.1-1.

Table X.19: Key Inputs and 2016 Greenhouse Gas Emissions from On-Road Transportation – Heavy-Duty Trucks and Vehicles

Key Inputs and 2016 Greenhouse Gas Emissions from On-Road Transportation – Heavy-Duty Trucks and Vehicles	
VMT (Miles per weekday)*	4,885,875
CO_2 Emissions (Tons per weekday)**	5,935
Conversion Factor (Tons CO_2 per weekday to MT CO_2e per year)	300
GHG Emissions (MT CO_2e)	1,781,508
GHG Emissions (MMT CO_2e)	**1.8**

*SANDAG ABM14.2.0 VMT **EMFAC2017 model run with custom VMT inputs from SANDAG
Heavy-duty trucks and vehicles are EMFAC2017 vehicle categories except LDA, LDT1, LDT2, and MDV. Conversion factors are different for each vehicle class.

Source: CARB 2016, 2017; SANDAG 2021; Energy Policy Initiatives Center, University of San Diego 2021

Difference from Previous 2012 Inventory

Methods to estimate emissions from heavy-duty trucks and vehicles are the same in both 2012 and 2016 inventories. However, the previous versions of the SANDAG ABM and EMFAC2014 were used to calculate these emissions in the 2012 GHG inventory. The SANDAG ABM has undergone changes, and EMFAC2017 includes new regulations that were not reflected in EMFAC2014.

Method Used to Develop Emissions Projections

The method used to develop the GHG projections for heavy-duty trucks and vehicles is the same as the method used to project emissions from passenger cars and light-duty vehicles. The new and updated regulations for heavy-duty trucks and vehicles since the release of EMFAC2014 are:

- SB 1 (The Road Repair and Accountability Act of 2017) and the CARB Tractor Trailer GHG Regulation require medium-duty or heavy-duty vehicles to verify compliance with CARB's Truck and Bus Regulation. EMFAC2017 assumes full compliance by 2023. CARB's Tractor-Trailer GHG Regulation includes aerodynamic and tire improvement requirements to reduce GHG emissions from heavy-duty trucks.
- U.S. EPA's Phase 2 GHG Regulation for heavy-duty vehicles (heavy-duty trucks, tractors, and buses) built upon the Phase 1 standards with new requirements beginning with model year 2018 for trailers and model year 2021 for engines and vehicles, with phase-in through model year 2027.[29]

Using the same conversion method from tons of CO_2 per weekday to MT CO_2e per year discussed in the inventory method section, the key inputs and results are shown in Table X.20.

[29] CARB: EMFAC2014 Volume III - Technical Documentation (2018), accessed April 30, 2020.

Table X.20: Key Inputs and Projected Greenhouse Gas Emissions from On-Road Transportation – Heavy-Duty Trucks and Vehicles

Key Inputs and Projected Greenhouse Gas Emissions from On-Road Transportation – Heavy-Duty Trucks and Vehicles					
Projection Year	**2025**	**2030**	**2035**	**3045**	**2050**
VMT (Miles per weekday)*	5,308,169	5,687,090	6,022,658	6,482,166	6,691,132
CO_2 Emissions (Tons per weekday)**	5,640	5,607	5,599	5,675	5,733
Conversion Factor (MT CO_2e per year/ Tons per weekday)	299	299	299	299	299
GHG Emissions (MT CO_2e)	1,688,305	1,677,676	1,674,691	1,697,570	1,715,365
GHG Emissions (MMT CO_2e)	1.7	1.7	1.7	1.7	1.7

*SANDAG ABM14.2.0 VMT **EMFAC2017 model run with custom VMT inputs from SANDAG ABM14.2.0

Source: CARB 2016, 2017; SANDAG 2021; Energy Policy Initiatives Center, University of San Diego 2021

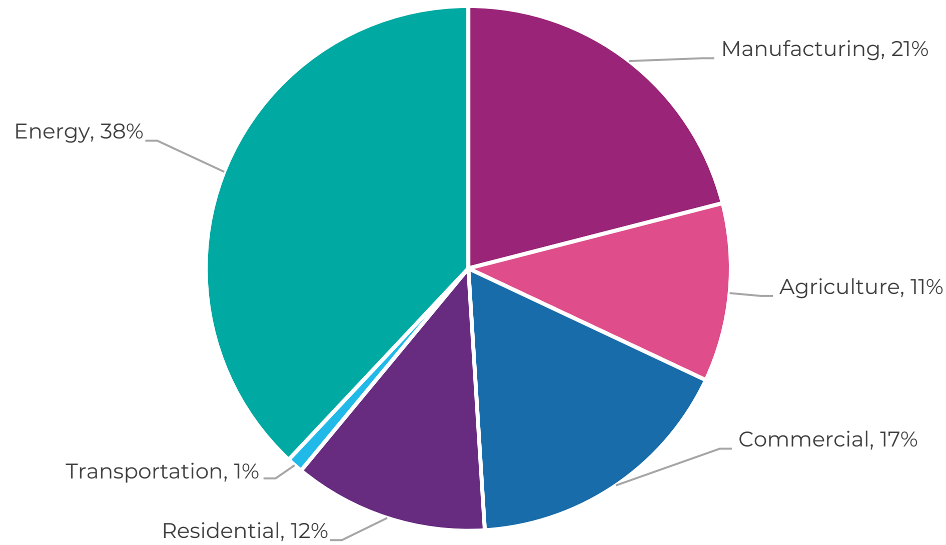
Other Fuels

The Other Fuels category accounts for 4% of total emissions in the 2016 inventory and 9% in the 2050 projection. These fuels include distillate (other than in power production), kerosene, gasoline (other than in transportation), liquefied petroleum gas (LPG), residual fuel oil (other than in power production), and wood (wet).

Emissions from this category are divided into the following economic sectors, according to the CARB statewide GHG inventory: agriculture, commercial, residential, transport, energy, and manufacturing. The relative distribution of emissions by economic sector is provided in

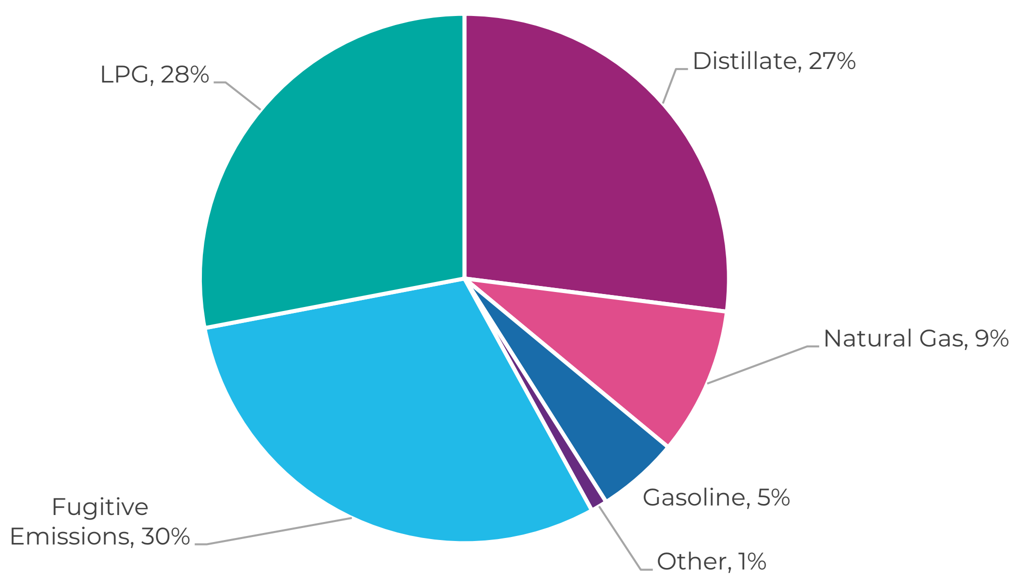
Figure X.1 and by fuel type in Figure X.2.

Figure X.1: Relative Distribution of 2016 Greenhouse Gas Emissions from Other Fuels by Economic Sectors



Source: Energy Policy Initiatives Center, University of San Diego 2020

Figure X.2: Relative Distribution of 2016 Greenhouse Gas Emissions from Other Fuels by Fuel Type



Source: Energy Policy Initiatives Center, University of San Diego 2020

Method Used to Estimate 2016 Emissions

The GHG emissions from the CARB statewide inventory were the basis of the regional estimates.[30] EPIC scaled down the statewide emissions by economic sector to the San Diego region based on whether a particular category had any economic activity in San Diego region using relevant economic, population, employment, or transportation data. Therefore, not all of CARB's statewide emissions from these economic sectors are included in the 2016 regional inventory.

CARB uses the IPCC category and subcategory names and codes, as specified in the IPCC 2006 Guidelines for GHG Inventories, to be consistent with the EPA national inventory. Below are only those IPCC categories, subcategories, activities, and fuel types with GHG emissions in the San Diego region, based on economic activity data in the San Diego region.

CARB agriculture sector: EPIC scaled down the emissions from the following categories to San Diego region using the 2016 ratio of the revenue generated by agricultural activities in the San Diego region to the statewide agricultural revenue.[31]

- 1A4c: Agriculture/Forestry/Fishing/Fish Farms > Ag Energy Use
    - Distillate > CH_4, CO_2, N_2O
    - Kerosene > CH_4, CO_2, N_2O
    - Gasoline > CH_4, CO_2, N_2O
    - Ethanol > CH_4, CO_2, N_2O

CARB commercial sector: EPIC scaled down the emissions from the following categories to San Diego region using the 2016 ratio of the number of employees in the San Diego region's manufacturing sector to the statewide manufacturing sector.[32]

- 1A4a: Commercial/Institutional > Not Specified Commercial
    - Distillate > CH_4, CO_2, N_2O
    - Kerosene > CH_4, CO_2, N_2O
    - Gasoline > CH_4, CO_2, N_2O
    - LPG > CH_4, CO_2, N_2O
    - Residual Fuel Oil > CH_4, CO_2, N_2O
    - Wood (wet) > CH_4, N_2O

[30] CARB Greenhouse Gas Emission Inventory – Query Tool for years 2000 to 2017 (12th edition), accessed on May 25, 2020.

[31] California Department of Food & Agriculture: California Agricultural Statistics Review, 2016–2017. accessed May 28, 2020.

[32] 2016 County Business Patterns, accessed on May 30, 2020. The 2012 North American Industry Classification System (NAICS) Code for manufacturing Sector is 31-33.

CARB residential sector: EPIC scaled down the emissions from the following categories to the San Diego region using the 2016 ratio of the San Diego regional population to the statewide population.[33]

- 1A4b: Residential > Household Use
  - Distillate > CH_4, CO_2, N_2O
  - Kerosene > CH_4, CO_2, N_2O
  - LPG > CH_4, CO_2, N_2O
  - Wood (wet) > CH_4, N_2O

CARB transportation sector: This category included the emissions from LPG fuel combustion. EPIC scaled down the emissions from the following categories to the San Diego region using the 2016 ratio of San Diego regional VMT to statewide VMT.[34]

- 1A3: Transport > Not Specified Transportation
  - LPG > CH_4, CO_2, N_2O
  - Residual Fuel Oil > CH_4, CO_2, N_2O

CARB energy sector: This category included the emissions from the transmission and distribution of electricity (e.g., fugitive and fuel combustion emissions from natural gas pipelines used for electric generation, non-natural gas pipelines and natural gas storage). EPIC scaled down the emissions from the following categories to the San Diego region using the 2016 ratio of total establishments for transmission and distribution activities in the San Diego region to the statewide establishments for the same activities.[35]

- 1B2: Oil and Natural Gas
  - Not Specified Industrial > Fugitives > Fugitive Emissions > CH_4
  - Pipelines > Natural Gas > Fugitives > Fugitive Emissions > CH_4, CO_2
- 1A1: Energy Industries > Pipelines
  - Natural Gas Pipelines > Natural Gas > CH_4, CO_2, N_2O
  - Non- Natural Gas Pipelines > Natural Gas > CH_4, CO_2, N_2O

CARB manufacturing sector: EPIC scaled down the emissions from the following categories to the San Diego region using the 2016 ratio of the number of employees in the San Diego region's manufacturing sector and the statewide manufacturing sector.[36]

33 San Diego demographic data are shown in Table X.2. Statewide population projections are from California Department of Finance, accessed on May 30, 2020.

34 San Diego regional 2016 VMT are provided in Table X.4 and Table X.19. California statewide VMT is from EMFAC2017, accessed on June 1, 2020.

35 2016 County Business Patterns, accessed on May 30, 2020. The 2012 NAICS Code for Electric Power Generation, Transmission and Distribution is 2211.

36 2016 County Business Patterns, accessed on May 30, 2020. The 2012 NAICS Code for manufacturing Sector is 31-33.

- 1A2f: Manufacturing Industries and Construction > Non-Metallic Minerals > Stone, Clay, Glass, and Cement > Cement
  - Distillate > CH_4, CO_2, N_2O
  - LPG > CH_4, CO_2, N_2O
  - MSW > CH_4, CO_2, N_2O
  - Petroleum Coke > CH_4, CO_2, N_2O
  - Residual Fuel Oil > CH_4, CO_2, N_2O
  - Tires > CH_4, CO_2, N_2O
- 1A2k: Manufacturing Industries and Construction > Construction
  - Gasoline > CH_4, CO_2, N_2O
- 1A2m: Manufacturing Industries and Construction > Non-Specified Industry
  - Distillate > CH_4, CO_2, N_2O
  - Gasoline > CH_4, CO_2, N_2O
  - Kerosene > CH_4, CO_2, N_2O
  - LPG > CH_4, CO_2, N_2O
  - Petroleum Coke > CH_4, CO_2, N_2O
  - Residual Fuel Oil > CH_4, CO_2, N_2O
- 1B2: Oil and Natural Gas > Manufacturing
  - Chemicals and Allied Products > Fugitives > Fugitive Emissions > CH_4
  - Construction > Fugitives > Fugitive Emissions > CH_4
  - Electric and Electronic Equipment > Fugitives > Fugitive Emissions > CH_4
  - Food Products > Fugitives > Fugitive Emissions > CH_4
  - Fugitives > Fugitive Emissions > CH_4
  - Plastic and Rubber > Fugitives > Fugitive Emissions > CH_4
  - Primary Metals > Fugitives > Fugitive Emissions > CH_4
  - Pulp and Paper > Fugitives > Fugitive Emissions > CH_4
  - Storage Tanks > Fugitives > Fugitive Emissions > CH_4

Several categories were included in CARB's statewide inventory, but not in this 2016 regional inventory, because 2016 business patterns in data for the San Diego region indicated no economic activities under these categories. The categories are:

- 1A1b: Petroleum Refining
  - Associated Gas > CH_4, CO_2, N_2O

- Catalyst Coke> CH_4, CO_2, N_2O
- Distillate> CH_4, CO_2, N_2O
- LPG > CH_4, CO_2, N_2O
- Petroleum Coke > CH_4, CO_2, N_2O
- Refinery Gas > CH_4, CO_2, N_2O
- Residual Fuel Oil > CH_4, CO_2, N_2O

- 1A1c: Manufacture of Solid Fuels and Other Energy Industries
  - Associated Gas > CH_4, CO_2, N_2O
  - Crude Oil > CH_4, CO_2, N_2O
  - Distillate > CH_4, CO_2, N_2O
  - Residual Fuel Oil > CH_4, CO_2, N_2O
- 1B2: Oil and Natural Gas > Manufacturing: Stone, Clay, Glass, and Cement: Fugitives > Fugitive Emissions > CH_4
- 1B2a: Oil > Petroleum Refining: Process Losses: Fugitives > Fugitive Emissions > CH_4
- 1B3: Other Emissions from Energy Production > In State Generation: Merchant Owned > Geothermal Power – Geothermal > CO_2
- 1B3: Other Emissions from Energy Production > In State Generation: Utility Owned > Geothermal power > CO_2

The key inputs and results are shown in Table X.21.

Table X.21: Key Inputs and 2016 Greenhouse Gas Emissions from Other Fuels

Key Inputs and 2016 Greenhouse Gas Emissions from Other Fuels	
Economic Sectors Associated with Other Fuels*	**2016 Emissions (MMT CO_2e)**
Agriculture	0.12
Commercial	0.20
Residential	0.13
Transportation	0.01
Energy	0.44
Manufacturing	0.24
Total GHG Emissions	**1.1**

*Economic sectors used in CARB statewide GHG inventory.

Source: California Ag Stats review 2016–2017; 2016 County Business Patterns; SANDAG ABM14.2.0 VMT; EMFAC2014 statewide on-road emission inventory; Energy Policy Initiatives Center, University of San Diego 2020

Difference from Previous 2012 Inventory

Methods to estimates emissions from other fuels are the same in both the 2012 and 2016 inventories. However, estimates were refined with different ratios to scale down the statewide emissions. For the energy sector, the ratio of establishments for transmission and distribution activities was used for the 2016 inventory instead of the ratio of energy consumption in the 2012 inventory, because emissions under this sector are due to the transmission and distribution pipelines. For the manufacturing sector, the ratio of the number of employees in the manufacturing sector was used for the 2016 inventory instead of the ratio of the total employees in all sectors, so the emissions are specific to the manufacturing sector.

Method Used to Develop Emissions Projections

Except for the agriculture sector, EPIC projected emissions for the other fuels sector based on the San Diego regional population, jobs, and VMT projections. The projected emissions associated with the manufacturing, energy, and commercial sectors were based on the jobs forecast. The projected emissions associated with the residential sector were based on the population forecast. The projected emissions associated with the transportation sector were based on the VMT forecast.

For the agriculture sector, EPIC used Microsoft Excel's GROWTH function to project San Diego regional and statewide agriculture revenue. The GROWTH function predicts the growth with existing data. The projected emissions for the agriculture sector were based on the annual growth rate of ratio of San Diego region to California agriculture revenue. The projected emissions are shown in Table X.22.

Table X.22: Projected Greenhouse Gas Emissions from Other Fuels

Projected Greenhouse Gas Emissions from Other Fuels					
Projection Year	**2025**	**2030**	**2035**	**2045**	**2050**
Total Agricultural GHG Emissions (MMT CO_2e)	0.12	0.10	0.08	0.08	0.06
Total Commercial GHG Emissions (MMT CO_2e)	0.20	0.23	0.24	0.25	0.26
Total Residential GHG Emissions (MMT CO_2e)	0.13	0.14	0.14	0.15	0.15
Total Transportation GHG Emissions (MMT CO_2e)	0.01	0.01	0.01	0.01	0.01
Total Energy (Electricity Transmission and Distribution) GHG Emissions (MMT CO_2e)	0.44	0.61	0.64	0.67	0.71
Total Manufacturing GHG Emissions (MMT CO_2e)	0.24	0.28	0.29	0.31	0.33
Total GHG Emissions (MMT CO_2e)	**1.1**	**1.4**	**1.4**	**1.5**	**1.5**

Source: Energy Policy Initiatives Center, University of San Diego 2020

Off-Road Transportation

The off-road transportation category includes the following subcategories by equipment type: construction and mining equipment, cargo handling equipment, industrial equipment, airport ground support, pleasure craft, recreational equipment, lawn and garden equipment, agricultural equipment, transport refrigeration units, military tactical support equipment, and other portable equipment. The GHG emissions from off-road equipment fuel combustion account for 2% of total emissions in the 2016 inventory and 5% in the 2050 projection.

Method Used to Estimate 2016 Emissions

CARB released the OFFROAD ORION model in 2017 and the SORE model in 2020.[37] The ORION 2017 model generates off-road equipment emission data by county, vehicle category, vehicle type, Horsepower (HP), and fuel type. SORE 2020 is a standalone Microsoft Access model that generates emission data for off-road vehicles with engines less than or equal to 25 HP. EPIC used ORION 2017 to generate 2016 regional off-road emissions for HP greater than or equal to 25. For the vehicles with HP equal to 25, data may overlap with SORE 2020 results. EPIC used SORE 2020 results for the overlapping vehicles because SORE 2020 is the latest and most recently updated model. Pleasure crafts and recreation vehicles are subcategories in ORION 2017; however, no San Diego regional data were available. EPIC used CARB's pleasure craft model, PC2014, and recreational vehicle model, RV 2018, to generate the emission data for the respective subcategories.[38] Like SORE 2020, both these models are standalone Microsoft Access models.

37 CARB: ORION 2017 and SORE 2020 Small Off Road Engine Model.

38 CARB: PC2014 Pleasure Craft model and RV 2018 Recreational Vehicle model.

Table X.23 shows the different databases used to generate the emissions for the different vehicle subcategories.

Table X.23: Databases Used to Estimate Off-Road Emissions

Databases Used to Estimate Off-Road Emissions	
Databases/Models	**Vehicle Subcategories**
ORION 2017, SORE 2020	Agriculture
ORION 2017, SORE 2020	Airport Ground Support
ORION 2017, SORE 2020	Cargo Handling Equipment
ORION 2017, SORE 2020	Construction and Mining
ORION 2017, SORE 2020	Industrial
SORE 2020	Lawn
ORION 2017, SORE 2020	Light Commercial
ORION 2017	Military Tactical Support
PC2014	Pleasure crafts
ORION 2017	Portable Equipment
RV 2018	Recreational Vehicles
ORION 2017, SORE 2020	Transportation Refrigeration Unit

Source: CARB: ORION 2017, SORE 2020, PC2014 Pleasure Craft model, RV 2018 Recreational Vehicle model; Energy Policy Initiatives Center, University of San Diego 2020

The key inputs and 2016 GHG emissions are shown in Table X.24.

Table X.24: Key Inputs and 2016 Greenhouse Gas Emissions from Off-Road Transportation

2016 Greenhouse Gas Emissions from Off-Road Transportation	
Subcategories	**GHG Emissions (MMT CO_2e)**
Agriculture	0.010
Airport Ground Support	0.017
Cargo Handling Equipment	0.002
Construction and Mining	0.204
Industrial	0.097
Lawn	0.052
Light Commercial	0.071
Military Tactical Support	0.022
Pleasure crafts	0.066
Portable Equipment	0.068
Recreational Vehicles	0.003
Transportation Refrigeration Unit	0.008
Total	**0.62**

Source: CARB: ORION 2017, SORE 2020, PC2014 Pleasure Craft model, RV 2018 Recreational Vehicle model; Energy Policy Initiatives Center, University of San Diego 2020

Difference from Previous 2012 Inventory

The previous 2012 inventory also relied on CARB's models to calculate emissions from off-road equipment. However, at that time, CARB had not yet developed ORION 2017, SORE 2020, or RV 2018 models; therefore, emissions were generated from either the 2007 or the 2011 OFFROAD model.

Method Used to Develop Emissions Projections

EPIC used the same models described in the previous section to generate emission projections for the subcategories, as shown in Table X.25.

Table X.25: Projected Greenhouse Gas Emissions from Off-Road Transportation

Projected Greenhouse Gas Emissions from Off-Road Transportation					
Projection Year	**2025**	**2030**	**2035**	**2045**	**2050**
Agriculture (MMT CO_2e)	0.005	0.005	0.005	0.005	0.005
Airport Ground Support (MMT CO_2e)	0.02	0.02	0.02	0.03	0.03
Cargo Handling Equipment (MMT CO_2e)	0.004	0.005	0.006	0.006	0.006
Construction and Mining (MMT CO_2e)	0.25	0.28	0.30	0.33	0.35
Industrial (MMT CO_2e)	0.11	0.11	0.11	0.12	0.12
Lawn (MMT CO_2e)	0.060	0.061	0.063	0.065	0.066
Light Commercial (MMT CO_2e)	0.090	0.095	0.099	0.11	0.11
Military Tactical Support (MMT CO_2e)	0.022	0.022	0.022	0.022	0.022
Pleasure Crafts (MMT CO_2e)	0.074	0.079	0.085	0.097	0.104
Portable Equipment (MMT CO_2e)	0.081	0.090	0.099	0.121	0.133
Recreational Vehicles (MMT CO_2e)	0.004	0.004	0.004	0.005	0.005
Transportation Refrigeration Unit (MMT CO_2e)	0.010	0.010	0.011	0.012	0.012
Total (MMT CO_2e)	**0.72**	**0.79**	**0.83**	**0.91**	**0.95**

Source: CARB: ORION 2017, SORE 2020, PC2014 Pleasure Craft model, RV 2018 Recreational Vehicle model; Energy Policy Initiatives Center, University of San Diego 2020

Solid Waste

Emissions from solid waste are a result of biodegradable, carbon-bearing waste decomposing in largely anaerobic environments and producing landfill gas. The degradation process can take 5 to 50 years. Emissions from solid waste contribute to 2% of total emissions in the 2016 inventory and 4% in the 2050 projection. For this inventory, EPIC calculated the future emissions due to the waste disposed in 2016. Emissions due to waste-in-place are not calculated to be consistent with emissions included in the 2012 GHG inventory.

Method Used to Estimate 2016 Emissions

EPIC estimated the emissions from solid waste using method SW.4 from the ICLEI U.S. Community Protocol.[39] The emissions are based on the disposed waste in a given year, the characterization of the waste stream, and emissions factor of each type of waste. Because a waste characterization study for the entire region was not available, EPIC used the waste characterization studies from the Cities of Chula Vista, Oceanside, and

[39] ICLEI: U.S. Community Protocol Appendix E, accessed in May 2020.

San Diego to estimate the waste composition in the region.[40] The solid waste emission factors, MT CO_2e per short ton of waste by type, are from the EPA Waste Reduction Model (WARM).[41] Table X.26 shows the waste composition derived and the corresponding emission factors.

Table X.26: Estimated San Diego Region Solid Waste Composition

Estimated San Diego Region Waste Composition		
Type of Waste	**Percentage of Total Composition***	**Landfill Methane Without Recovery (MT CO_2e/short ton)**
Paper	17%	2.12
Plastic	9.9%	0
Glass	1.9%	0
Metal	3.5%	0
Organics	40.4%	1.03
Electronics	0.8%	0
Inerts and Other	21.2%	0.07
Household Hazardous Waste	0.2%	0
Special Waste	2.9%	0
Mixed Residue	2.1%	0

*The composition was derived from the waste composition of the City of Chula Vista, the City of Oceanside, and the City of San Diego.

Source: Energy Policy Initiatives Center, University of San Diego 2020

The 2016 emissions from solid waste are provided in Table X.27.

40 The City of Chula Vista and the City of Oceanside's waste characterization studies were provided by the jurisdictions. Personal communication. City of San Diego Waste Characterization Study.

41 U.S. EPA Waste Reduction Model (WARM) Version 15.

Table X.27: Key Inputs and 2016 Greenhouse Gas Emissions from Solid Waste

Key Inputs and 2016 Greenhouse Gas Emissions from Solid Waste	
Total Waste Disposal (Short tons)	3,317,216
Mixed Waste Emission Factor (MT CO_2e/short ton)*	0.79
Landfill Gas Capture Rate	0.75
Oxidation Rate	0.10
Total GHG Emissions (MMT CO_2e)	**0.59**

*Weighted average from Table X.26

Source: Energy Policy Initiatives Center, University of San Diego 2020

Difference from Previous 2012 Inventory

Because a waste characterization study was not available for the San Diego region, the previous 2012 inventory used the 2008 statewide waste characterization study. For the 2016 GHG inventory, EPIC used the more recent waste characterization studies available for the cities of Chula Vista, Oceanside, and San Diego.

Method Used to Develop Emissions Projections

EPIC projected the emissions, as shown in Table X.28, based on per capita waste disposal in 2016 and population growth.

Table X.28: Projected Greenhouse Gas Emissions from Solid Waste

Projected Greenhouse Gas Emissions from Solid Waste					
Projection Year	**2025**	**2030**	**2035**	**2045**	**2050**
Total Waste Disposal (Short tons)	3,470,848	3,552,485	3,620,348	3,719,685	3,746,073
Mixed Waste Emission Factor (MT CO_2e/short ton)	0.79	0.79	0.79	0.79	0.79
Landfill Gas Capture Rate	0.75	0.75	0.75	0.75	0.75
Oxidation Rate	0.10	0.10	0.10	0.10	0.10
Total GHG Emissions (MMT CO_2e)	**0.62**	**0.64**	**0.65**	**0.67**	**0.67**

Source: Energy Policy Initiatives Center, University of San Diego 2020

Water

The GHG emissions from energy associated with upstream supply and conveyance, and treatment of water account for 1% of total emissions in the 2016 inventory and none in the 2050 projection. This category does not include emissions associated with electricity used for water distribution and water end-use (e.g., water heating at homes). The emissions from energy used for water distribution and water end-use use are captured in the electricity and natural gas categories, discussed in previous sections.

Method Used to Estimate 2016 Emissions

The San Diego County Water Authority (SDCWA) is the water wholesaler for the San Diego region. SDCWA imports raw and treated water on behalf of its 24 member agencies. The raw water sources, from the State Water Project and Colorado River, vary year by year depending on water availability; therefore, the energy needed to supply and convey water differs as well. The latest available upstream energy intensity, in kWh per acre-foot of water, is from the average of fiscal years 2013 and 2014 in the SDCWA 2015 Urban Water Management Plan. EPIC calculated the GHG emissions from upstream water supply by multiplying the water supplies with their respective energy intensities and the California average electricity GHG emission factor in 2016.[42] The upstream emissions are shown in Table X.29.[43]

Table X.29: 2016 Upstream Emissions from Water Supply

2016 Upstream Emissions from Water Supply		
Water Source	**Imported Treated Water**	**Imported Raw Water**
Water Demand (Acre-feet)	138,312	282,726
Energy Intensity (kWh/Acre-foot)*	1,862	1,817
California Average Electricity Emission Factor (lbs CO_2e/MWh)**	530	530
Upstream GHG Emissions (MT CO_2e)		185,411

*Includes water conveyance from the State Water Project & Colorado River to Metropolitan Water District and SDCWA system. The difference between energy intensity for treated and raw water is the water treatment energy intensity.
**eGRID 2016 CAMX subregion emission factor.

Source: Energy Policy Initiatives Center, University of San Diego 2020

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42 SDCWA 2016: Urban Water Management Plan 2015, Metropolitan Water District of Southern California, Urban Water Management Plan 2015. The Western Electricity Coordinating Council CAMX (eGRID Subregion) emission rate from eGRID was used as representative of the average California electricity emission rate for upstream electricity. U.S. EPA. eGRID 2016 Edition, released February 15, 2018, accessed June 29, 2018.

43 2016 water source and demand for each SDCWA member agency were provided by SDCWA staff to EPIC, October 23, 2018.

SDCWA has its own water treatment plant (WTP), Twin Oaks WTP, and many SDCWA member agencies have their own WTPs. Member agencies that do not have WTPs may purchase treated water from other member agencies or from SDCWA. For example, the City of San Diego and the City of Del Mar are member agencies of the SDCWA, but the City of San Diego provides water treatment service for the City of Del Mar. Local water treatment energy intensity depends on water sources, treatment level, capacity, and efficiency of the WTP. For example, brackish groundwater requires advanced treatment, such as reverse osmosis, to remove the salinity in the water, so its treatment has a higher energy intensity than surface water treatment with conventional methods. Table X.30 below shows the WTPs in San Diego region, the water treated, and the associated electricity use for water treatment in 2016.[44] EPIC calculated the GHG emissions from water treatment by multiplying the electricity used for water treatment with SDG&E 2016 electricity GHG emission factor.

44 Data were collected by EPIC from 2018 to 2020 for the development of SANDAG's 2016 and 2018 "ReCAP Snapshots" (greenhouse gas inventory and Climate Action Plan monitoring reports prepared for local jurisdictions).

Table X.30: 2016 Emissions from Local Water Treatment

2016 Emissions from Local Water Treatment				
Water Treatment Plant	**Plant Operator**	**Water Treated (Acre-feet)**	**Water Treatment Energy Intensity (kWh/Acre-foot)**	**Water Treatment Electricity Use (kWh)**
R.M Levy WTP	Helix WD	42,767	58	2,493,844
R.E. Badger Filtration Plant	Santa Fe ID	12,685	44	558,346
Combined Miramar, Otay and Alvarado WTP*	City of San Diego	163,823	56	9,151,144
Escondido-Vista WTP	Escondido + Vista ID	30,678	47	1,441,875
David C. McCollum WTP	Olivenhain MWD	21,301	142	3,018,745
Richard A. Reynolds Ground Water Desalination Facility	Sweetwater Authority	1,855	1,174	2,178,583
Robert A. Perdue WTP	Sweetwater	13,347	141	1,879,760
Lester J. Berglund WTP	City of Poway	10,329	208	2,150,666
Robert A. Weese WFP	City of Oceanside	11,878	29	348,546
Mission Basin Groundwater	City of Oceanside	2,997	1,257	3,766,499
Twin Oaks Valley WTP	SDCWA	79,538	33	2,661,602
Carlsbad Desalination Plant**	SDCWA	45,107	4,397	198,335,919
Total Water Treatment Electricity Use (kWh)				227,985,529
SDG&E Electricity Emission Factor (lbs CO_2e/MWh)				527
Transmission and Distribution Loss Factor				1.082
Local Treatment GHG Emissions (MT CO_2e)				58,925

ID: irrigation district; WD: water district; WFP: water filtration plant; WTP: water treatment plant

*The electricity use and energy intensity include both water treatment and conveyance from nearby reservoirs for City of San Diego WTPs and both water extraction and treatment for Sweetwater Authority's brackish water desalination plant. The data associated with water treatment cannot be separated out.

**The water treated at the plant includes SDCWA wholesale water and local supply for individual SDCWA member agencies that have separate contracts with the plant. The energy intensity is the high efficiency estimate from the Plant's Environmental Impact Report (2008).

Source: Energy Policy Initiatives Center, University of San Diego 2020

Combining the upstream and local emissions, the total 2016 emissions from water are shown in Table X.31.

Table X.31: 2016 Greenhouse Gas Emissions from Water Supply, Treatment and Distribution

2016 Greenhouse Gas Emissions from Water Supply, Treatment, and Distribution	
Upstream GHG Emissions (MT CO_2e)	185,411
Local Treatment GHG Emissions (MT CO_2e)	58,925
Total (Upstream + Local) GHG Emissions (MT CO_2e)	244,337
Total (Upstream + Local) GHG Emissions (MMT CO_2e)	**0.24**

Source: Energy Policy Initiatives Center, University of San Diego 2020

Difference from Previous 2012 Inventory

The methods to calculate water emissions are different. Due to data availability, the 2012 GHG emissions from water use were based on default per capita water production and Southern California–specific water-energy intensities. 2016 emissions from water use were based on region-specific water production data and specific treatment facility information.

Method Used to Develop Emissions Projections

To project emissions for the water category, EPIC estimated the impact of federal and State polices and regulations on reducing the electricity emission factor (increasing renewable or zero-carbon electricity) and increasing water efficiency, respectively.

As discussed in the

Electricity section, all retail electricity suppliers must meet the RPS requirement of 60% renewable electricity by 2030 and 100% renewable or zero-carbon electricity by 2045. EPIC assumed all retail electricity providers that provide electricity for water supply and treatment will meet the 2030 and 2045 RPS targets. The renewable or GHG-free content and emission factors for water-related electricity use are shown in Table X.32.

Table X.32: Projected Renewable or Greenhouse Gas–Free Content and Emission Factors for Water-Related Electricity Use

Projected Renewable or Greenhouse Gas–Free Content and Emission Factors for Water-related Electricity Use

Projection Year	2025	2030	2035	2045	2050
Projected Renewable or GHG-free Content (%)*					
California Average	47%	60%	73%	100%	100%
San Diego Region	47%	60%	73%	100%	100%
Projected Electricity Emission Factor (lbs CO_2e/MWh)**					
California Average	493	370	249	—	—
San Diego Region	493	370	249	—	—

Retail electricity suppliers in San Diego region may be SDCP, CEA, SDG&E, or others. SDG&E's projected renewable content and emission factors are used as a conservative approach.

*Estimated based on 2016 California average and SDG&E renewable content, and SB 100 RPS targets

**Calculated based on 2016 SDG&E bundled electricity emission factor of 527 lbs CO_2e/MWh and 43% renewable content.

Source: Energy Policy Initiatives Center, University of San Diego 2020

SDCWA's preliminary 2020 Urban Water Management Plan estimates the long-range water demand in its service area through 2045. The water demand forecasts include a baseline demand forecast (based on the SANDAG projected growth forecast, local weather data, historical water use, and retail rates) and a long-range demand forecast with additional water conservation savings. The additional water conservation savings include both "active" program savings (from implementation of water conservation programs) and "passive" code-based water savings (future savings from appliance standards, plumbing code changes, and updated Model Water Efficient Landscape Ordinances).[45] EPIC applied the long-range demand forecast rate of increase to the 2016 water demand to be consistent with the projection methods in other emissions categories. As no forecast is available after 2045, EPIC used the 2040–2045 annual demand increases as the 2045–2050 annual increases. Assuming the water-energy intensities are fixed, the projected emissions are shown in Table X.33.

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45 SDCWA Water Planning and Environmental Committee November 4, 2020, Meeting: Report on Preparation of Draft 2020 Urban Water Management Plan. (Presentation), accessed January 3, 2021.

Table X.33: Projected Greenhouse Gas Emissions from Water

Projected Greenhouse Gas Emissions from Water					
Projection Year	**2025**	**2030**	**2035**	**2045**	**2050**
Projected Upstream Emissions					
Imported Treated Water (Acre-feet)	170,707	177,593	183,634	193,411	193,411
Imported Raw Water (Acre-feet)	348,945	363,020	375,368	395,354	406,000
California Average Emission Factor (lbs CO_2e/MWh)	493	370	249	—	—
Upstream Emissions (MT CO_2e)*	212,754	166,002	115,863	—	—
Projected Local Emissions					
Water Treated at Local Water Treatment Plants (Acre-feet)	538,496	560,218	579,273	610,115	626,544
San Diego Region Emission Factor (lbs CO_2e/MWh)	493	370	249	—	—
Local Emissions (MT CO_2e)**	68,048	53,095	37,058	—	—
Projected Total Emissions					
Total (Upstream + Local) Emissions (MT CO_2e)	280,803	219,097	152,921	—	—
Total Emissions (MMT CO_2e)	**0.28**	**0.22**	**0.15**	**—**	**—**

*Assume upstream energy intensities 1,862 kWh/acre-foot for imported treated water and 1,817 kWh/acre-foot for imported untreated water remain unchanged (Table X.29).
**Assume energy intensities at local water treatment plants remain unchanged (Table X.30).

Source: Energy Policy Initiatives Center, University of San Diego 2020

Civil Aviation

The GHG emissions from commercial aviation operations account for 1% of total emissions in the 2016 inventory and 2% in the 2050 projection. The San Diego International Airport (SAN) and McClellan-Palomar Airport (CRQ) are the only airports in the San Diego region in 2016 with scheduled commercial flights services, while other airports operate on a private and on-demand basis.[46] Because 99% of commercial passengers in the San Diego region are covered by SAN and CRQ, this category does not include the GHG emissions associated with aviation operations at other municipal airports in the San Diego region.[47] GHG emissions in this category are from combustion of jet fuel and aviation gasoline used by commercial aircrafts.

[46] Airports with scheduled commercial flights follow Federal aviation Administration (FAA)'s FAR Part 139 rules. On-demand basis refers to aviation operators allowed under FAA rules to accept paying passengers (FAR Part 135 operators).

[47] FAA: Passenger Boarding (Enplanement) and All-Cargo Data for U.S. Airports, CY2016. Airports included are SAN, CRQ, Miramar MCAS, North Island NAS, Montgomery-Gibbs, Brown Field, and Gillespie Field.

Method Used to Estimate 2016 Emissions

EPIC used the aircraft emissions reported in the SAN 2016 GHG Emissions Inventory (SAN GHG Inventory)—developed by the San Diego County Regional Airport Authority—and CRQ 2016 Emissions Inventory—developed for the CRQ Master Plan Program Environmental Impact Report (PEIR). The aircraft emissions in the SAN GHG Inventory are calculated based on the Airport GHG Emissions Management Guidance Manual and include emissions from aircraft start up, take off, and up to mixing height (3,000 feet).[48] The aircraft emissions in CRQ 2016 Emissions Inventory include emissions from fuel combustion and emissions from auxiliary power units.[49]

The 2016 aircraft emissions were 213,353 (0.2 MMT CO_2e), with 95% from SAN aircraft emissions and 5% from CRQ aircraft emissions.

Difference from Previous 2012 Inventory

In both inventories, emissions from the SAN GHG Inventories were used directly. However, the 2016 Airport GHG inventory is calculated with Airports Council International's Airport Carbon and Emissions Reporting Tool, which no longer includes the emissions from aircrafts during cruise (above mixing height: 3,000 feet). The 2012 Airport GHG Inventory included emissions from the entire flight. In addition, aircraft emissions from CRQ were added to 2016 GHG emissions.

Method Used to Develop Emissions Projections

To project emissions for the civil aviation category, EPIC applied the rate of increase of the projected passengers served at the SAN to the 2016 aircraft emissions. In 2016, SAN served a total of 20,729,353 passengers.[50] The draft SAN Development Plan projects the number of passengers served with the proposed Terminal 1 replacement and Terminal 2 modification. Under the constrained demand scenario, the SAN Development Plan projects an average increase of 1.6% per year in passengers from 2018 to 2050.[51] EPIC applied the 1.6% annual increase to the SAN aircraft emissions in 2016. For CRQ, the projected 2036 aircraft emissions under proposed CRQ Master Plan are used directly and kept fixed through 2050.[52] The projected emissions are shown in Table X.34.

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48 San Diego County Regional Airport Authority: 2016 Greenhouse Gas Emissions Inventory (October 16, 2018), provided by Airport Authority staff to EPIC, August 7, 2018.

49 CRQ Master Plan Update PEIR: Appendix H – Climate Change Technical Report (2018).

50 San Diego International Airport: Air Traffic Report, January 2017, accessed December 23, 2020.

51 San Diego County Regional Airport Authority: Airport Development Plan Recirculated Draft EIR (September 2019), accessed January 10, 2021.

52 CRQ Master Plan Update PEIR: Appendix H – Climate Change Technical Report (2018).

Table X.34: 2016 Greenhouse Gas Emissions and Projected Greenhouse Gas Emissions from Civil Aviation

2016 Greenhouse Gas Emissions and Projected Greenhouse Gas Emissions from Civil Aviation						
Year	**2016**	**2025**	**2030**	**2035**	**2045**	**2050**
SAN Airport Total Passengers*	20,729,353	27,736,698	30,027,785	32,508,118	38,100,345	41,247,483
SAN Passengers Increase Compared with 2016	0%	34%	45%	57%	84%	99%
SAN GHG Emissions (MT CO_2e)	202,422	270,849	293,221	317,442	372,050	402,781
CRQ GHG Emissions (MT CO_2e)	10,931	18,204	22,244	26,284	27,093	27,093
Total GHG Emissions (MT CO_2e)	213,353	289,052	315,465	343,726	399,142	429,874
Total GHG Emissions (MMT CO_2e)	**0.21**	**0.29**	**0.32**	**0.34**	**0.40**	**0.43**

SAN: San Diego International Airport; CRQ: McClellan-Palomar Airport

*2016 total passengers are from the San Diego International Airport 2017 Air Traffic Report, and the rest are based on an annual increase of 1.6%.

Source: Energy Policy Initiatives Center, University of San Diego 2021

Rail

The rail category includes GHG emissions from both passenger and freight rail resulting from the combustion of fuels in internal combustion engines. Emissions from rail contribute to 0.4% of total emissions in the 2016 inventory and 1% in the 2050 projection.

Method Used to Estimate 2016 Emissions

Detailed activity or fuel consumption data for rail were not available for the San Diego region. EPIC scaled the emissions from the CARB statewide inventory to the San Diego region, based on the ratio of 2016 County Business Pattern establishments for support activities for rail transportation to that of the State.[53]

Because the rail category in CARB's statewide inventory is not separated into freight and passenger rail subcategories, EPIC used the number of support establishments for rail in the San Diego region to capture both freight and passenger rail activities. However, it may not represent the exact ratio of all rail in the region compared to the state. The most recent 2018 County Business Pattern data do not show any data on support establishments for rail transportation for the San Diego region; therefore, the method used in this appendix may be limited. Table X.35 shows the key inputs and 2016 GHG emissions from rail.

Table X.35: Key Inputs and 2016 Greenhouse Gas Emissions from Rail

Key Inputs and 2016 Greenhouse Gas Emissions from Rail	
Support Activities for Rail Transportation in California	78
Support Activities for Rail Transportation in San Diego Region	4
Total Rail Emissions in California (MMT CO_2e)	2.17
Total Rail Emissions in San Diego (MMT CO_2e)	**0.11**

Support Activities for Rail Transportation: NAICS 4882. Industries under NACIS 4882 provide services support rail transportation.

Source: Energy Policy Initiatives Center, University of San Diego 2020

Difference from Previous 2012 Inventory

Methods to estimates emissions from rail are the same in both the 2012 and 2016 inventories.

Method Used to Develop Emissions Projections

EPIC projected the emissions from rail based on the SANDAG jobs forecast, as shown in Table X.36.

53 CARB: CARB Greenhouse Gas Emission Inventory – Query Tool, accessed on October 25, 2020. U.S. Census Bureau: 2016 County Business Patterns, accessed on October 25, 2020. The NAICS Code for rail transportation support activities is 4882.

Table X.36: Projected Greenhouse Gas Emissions from Rail

Projected Greenhouse Gas Emissions from Rail					
Projection Year	**2025**	**2030**	**2035**	**2045**	**2050**
Total GHG Emissions (MMT CO_2e)	0.17	0.19	0.19	0.20	0.20

Source: Energy Policy Initiatives Center, University of San Diego 2020

Wastewater

The GHG emissions from domestic wastewater treatment account for 0.3% of total emissions in the 2016 inventory and 0.5% in the 2050 projection. This category presents emissions from community-generated wastewater treated at centralized wastewater treatment plants and on-site septic systems. Emissions associated with the energy used to collect and treat wastewater are not included in this category but are included in the electricity and natural gas category.

Method Used to Estimate 2016 Emissions

In 2019, SANDAG, in collaboration with local jurisdictions, prepared the 2016 Regional Climate Action Planning Framework (ReCAP) Snapshots to assist local jurisdictions with monitoring community-wide GHG emissions and Climate Action Plan (CAP) implementation.[54] EPIC calculated the 2016 community-wide GHG emissions inventories for 16 (out of 19) jurisdictions in the San Diego region and used the wastewater emissions from these 16 GHG inventories directly in this category.

The City of Coronado postponed preparation of a ReCAP Snapshot due to the ongoing CAP development; however, 2016 wastewater flow was collected during the data-collection process. The GHG emissions shown in Table X.37 for Coronado include wastewater flow from military bases in Coronado to the Point Loma Wastewater Treatment Plant (WWTP). Depending on the boundary determined in the future Coronado CAP, the wastewater emissions estimated here may differ from those calculated under the CAP.

The City of San Diego and the unincorporated County of San Diego (the County) report community-wide GHG emissions separately under their own CAP monitoring processes. The 2016 wastewater emissions from the City of San Diego are taken directly from its 2019 CAP Annual Report.[55] For the County, EPIC estimated the 2016 wastewater emissions using its 2014 (CAP baseline year) wastewater emissions and population increase.[56]

The key inputs and 2016 wastewater emissions are show in Table X.37.

[54] SANDAG: Climate Action. November 2019 ReCAP Snapshots (with 2016 GHG Emissions Inventories).

[55] City of San Diego CAP: 2019 Annual Report Appendix (2020), accessed November 2, 2020.

[56] County of San Diego CAP Appendix A: 2014 Greenhouse Gas Emissions Inventory and Projections (2017), accessed May 20, 2020.

Table X.37: Key Inputs and 2016 Greenhouse Gas Emissions from Wastewater

Key Inputs and 2016 Greenhouse Gas Emissions from Wastewater	
Local Jurisdiction	**2016 Wastewater Emissions (MT CO_2e)**
Carlsbad	2,972
Chula Vista	2,577
Coronado	260
Del Mar	87
El Cajon	1,161
Encinitas	1,916
Escondido	4,986
Imperial Beach	353
La Mesa	734
Lemon Grove	260
National City	656
Oceanside	5,751
Poway	1,140
San Diego*	21,257
San Marcos	2,915
Santee	584
Solana Beach	619
Vista	3,207
Unincorporated County of San Diego**	21,583
Total	73,014
Total (MMT CO_2e)	**0.07**

*2016 emissions reported in the City of San Diego CAP 2019 Annual Report.
**Estimated based on 2014 wastewater emissions reported in the County of San Diego CAP Appendix A (21,183 MT CO_2e), 2014 population (498,159), and 2016 population (507,555).

All wastewater emissions are from SANDAG November 2019 ReCAP Snapshots (with 2016 GHG Emissions), except City of San Diego and County of San Diego.

Source: SANDAG 2019, Energy Policy Initiatives Center, University of San Diego 2020

Difference from Previous 2012 Inventory

The methods to calculate wastewater emissions are different from those used in the previous 2012 inventory. Due to data availability, the 2012 wastewater emissions were based on a default per capita wastewater production in California and Point Loma WWTP's wastewater emission factor. The 2016 wastewater emissions were based on jurisdictional wastewater flow data and specific wastewater treatment facility information.

Method Used to Develop Emissions Projections

To project emissions for the wastewater category, EPIC applied the population rate of increase from 2016 to 2050 to the 2016 wastewater emissions. The projected emissions are shown in Table X.38.

Table X.38: Projected Greenhouse Gas Emissions from Wastewater

Projected Greenhouse Gas Emissions from Wastewater						
Year	**2016**	**2025**	**2030**	**2035**	**2045**	**2050**
San Diego Region Population*	3,287,280	3,470,848	3,552,485	3,620,348	3,719,685	3,746,073
Population Increase Compared with 2016 (%)	—	6%	8%	10%	13%	14%
Total GHG Emissions (MT CO_2e)	73,014	77,091	78,904	80,412	82,618	83,204
Total GHG Emissions (MMT CO_2e)	**0.07**	**0.08**	**0.08**	**0.08**	**0.08**	**0.08**

*2016 population data are estimates, the rest are from SANDAG Series 14 Growth Forecast, as shown in Table X.2.

Source: Energy Policy Initiatives Center, University of San Diego 2021

Agriculture

GHG emissions from livestock (from enteric fermentation and manure management) are included in this category. Enteric fermentation is a microbial fermentation process that occurs in the stomach of ruminant animals, producing CH_4 that is released through flatulence and eructation. Manure management is the process by which manure is stabilized or stored. CH_4 and N_2O emissions result from livestock manure, and the amount of gas produced depends on the manure management system involved. The agriculture category contributes to 0.2% of total emissions in the 2016 inventory and 0.3% in the 2050 projection.

Method Used to Estimate 2016 Emissions

EPIC followed the ICLEI *U.S. Community Protocol for Emissions from Domestic Animal Production within a Community* (A.1 and A.2) to calculate the emissions from agriculture.[57] Method A.1 addresses enteric fermentation from livestock production. CH_4 emissions due to enteric fermentation are derived from the livestock population and emission factors for each animal type. Method A.2 addresses emissions from manure management. Emissions from manure management are derived from data on animal populations, animal characteristics, and manure management practices. Method A.2 is broken up into three subcategories, including CH_4 emissions from manure management (A.2.1), direct N_2O emissions from manure management (A.2.3), and indirect N_2O emissions from manure management (A.2.4).

All the emission factors and other factors used for the calculations were taken from the ICLEI protocol. Table X.39 shows the factors used to calculate the agriculture emissions.

[57] ICLEI: U.S. Community Protocol for Emissions from Domestic Animal Production within a Community, accessed August 3, 2020.

Table X.39: Factors Used to Calculate Greenhouse Gas Emissions from Agriculture

Factors Used to Calculate Greenhouse Gas Emissions from Agriculture							
	Dairy Cattle	Other Cattle, including Calves	Beef Cattle	Sheep	Goats	Swine	Horses
Methane Emissions from Enteric Fermentation (A.1)							
Enteric Fermentation Emission Factor (kg CH_4/head/year)	147	54	100	8	5	1.5	18
Methane Emissions from manure (without anaerobic digester) (A.2.1)							
Percentage Dry Lot	0	0.11	1	0.5	0.5	0	0.5
Percentage Pasture	0	0	0	0.5	0.5	0.2	0.5
Percentage Liquid Slurry	0.2	0.09	0.01	0	0	0.07	0
Percentage Daily Spread	0.1	0.01	0	0	0	0	0
Percentage Solid Storage	0.09	0	0	0	0	0	0
Percentage Anaerobic Lagoon	0.6	0.21	0	0	0	0.43	0
Percentage Dip Pit	0	0.58	0	0	0	0.27	0
Volatile Solid (VS) (kg/animal/yr)	2,025	1,252	1,259	0	0	0	0
Average VS (kg/day/1,000 kg animal mass)	0	0	0	8.3	9.5	5.4	6.1
Typical Animal Mass	0	0	0	25	64	39	450
Max CH_4 Producing Capacity per Pound of Manure (m^3 kg vs)	0.24	0.17	0.33	0.36	0.17	0.48	0.33
Methane Conversion Factor Pasture	0.015	0	0	0.015	0.015	0.015	0.015
Methane Conversion Factor Dry Lot	0	0.015	0.015	0.015	0.015	0	0.015
Methane Conversion Factor Liquid Slurry	0.34	0.35	0.43	0	0	0.33	0
Methane Conversion Factor Daily Spread	0.005	0.005	0	0	0	0	0
Methane Conversion Factor Solid Storage	0.04	0	0	0	0	0.04	0

Factors Used to Calculate Greenhouse Gas Emissions from Agriculture							
	Dairy Cattle	**Other Cattle, including Calves**	**Beef Cattle**	**Sheep**	**Goats**	**Swine**	**Horses**
Methane Conversion Factor Anaerobic Lagoon	0.73	0.75	0	0	0	0.73	0
Methane Conversion Factor Dip Pit	0	0.35	0	0	0	0.33	0
Direct Nitrous Oxide Emissions from Manure (A.2.3)							
The daily rate of Kjeldahl nitrogen excreted (kg N/animal/year)	156	54.7	52.3	0.45	0.45	0.54	0.25
Direct N_2O Emission Factor Dry lot	0	0.03	0.02	0.03	0.03	0	0.03
Direct N_2O Emission Factor Pasture	0	0	0	0	0	0	0
Direct N_2O Emission Factor daily spread	0	0	0	0	0	0	0
Direct N_2O Emission Factor solid storage	0.005	0	0	0	0	0.005	0
Direct N_2O Emission Factor liquid/slurry	0.005	0.08	0.005	0	0	0.08	0
Direct N_2O Emission Factor Dip Pit	0	0.002	0	0	0	0.002	0
Direct N_2O Emission Factor Anaerobic Lagoon	0	0	0	0	0	0	0
Indirect Nitrous Oxide Emissions from Manure (A.2.4)							
Frac Gas, Pasture*	0	0	0	0	0	0	0
Frac Gas, Liquid/Slurry	26	26	26	0	0	26	0
Frac Gas, Daily Spread	10	10	0	0	0	0	0
Frac Gas, Dry Lot	0	23	23	23	23	0	23
Frac Gas, Solid Storage	27	0	0	0	0	45	0
Frac gas, anerobic lagoon	43	43	0	0	0	58	0

Factors Used to Calculate Greenhouse Gas Emissions from Agriculture

	Dairy Cattle	Other Cattle, including Calves	Beef Cattle	Sheep	Goats	Swine	Horses
Frac Gas, Dip Pit	0	24	0	0	0	34	0
Frac Runoff/Leach, Pasture**	0	0	0	0	0	0	0
Frac Runoff/Leach, Daily Spread	0	0	0	0	0	0	0
Frac Runoff/Leach, Solid Spread	0	0	0	0	0	0	0
Frac Runoff/Leach, Liquid/Slurry	0.8	0.8	0	0	0	0.8	0
Frac Runoff/Leach, Anaerobic Lagoon	0.8	0.8	0	0	0	0.8	0
Frac Runoff/Leach, Dry Lot	0	3.9	3.9	3.9	3.9	0	0
Frac Runoff/Leach, Dip Pit	0	0	0	0	0	0	0

*Frac Gas = Nitrogen lost through volatilization

**Frac Runoff/Leach = Nitrogen lost through runoff and leaching

Source: ICLEI 2013, Energy Policy Initiatives Center, University of San Diego 2020

Table X.40 shows the GHG emissions from agriculture.

Table X.40: 2016 GHG Emissions from Agriculture

2016 Emissions from Agriculture	
Animal Population (Head)	
Dairy Cattle	1,800
Other cattle, including calves	5,400
Beef Cattle	3,700
Sheep	928
Goats	2,700
Swine	1,220
Horses	6,813
CH_4 Emission from Enteric Fermentation (A.1)	
Dairy Cattle Enteric Fermentation Emissions (MT CO_2e)	6,615
Other Cattle Enteric Fermentation Emissions (MT CO_2e)	7,290
Beef Cattle Enteric Fermentation Emissions (MT CO_2e)	9,250
Sheep Enteric Fermentation Emissions (MT CO_2e)	186
Goats Enteric Fermentation Emissions (MT CO_2e)	338
Swine Enteric Fermentation Emissions (MT CO_2e)	46
Horses Enteric Fermentation Emissions (MT CO_2e)	3,066
Total CO_2e emissions from Enteric Fermentation (MMT CO_2e)	0.027
CH_4 Emissions from Manure (Without Anaerobic Digester) (A.2.1)	
CH_4 Emissions from Volatile Solids (VS) Excreted from Beef Cattle (MT CO_2e)	491
CH_4 Emissions from VS Excreted from Dairy Cattle (MT CO_2e)	7,385
CH_4 Emissions from VS Excreted from Other Cattle (MT CO_2e)	7,486
CH_4 Emissions from VS Excreted from Swine (MT CO_2e)	321
CH_4 Emissions from VS Excreted from Sheep (MT CO_2e)	6.3
CH_4 Emissions from VS Excreted from Goats (MT CO_2e)	22
CH_4 Emissions from VS Excreted from Horses (MT CO_2e)	3076
Total CH_4 Emissions from Volatile Solids (VS) Excreted from Domesticated Animals (MMT CO_2e)	0.019
Direct N_2O Emissions from Manure (A.2.3)	
Direct N_2O Emissions from Beef Cattle	1,817
Direct N_2O Emissions from Dairy Cattle (MT CO_2e)	191
Direct N_2O Emissions from Other Cattle (MT CO_2e)	1,613
Direct N_2O Emissions from Swine (MT CO_2e)	28
Direct N_2O Emissions from Sheep (MT CO_2e)	27

2016 Emissions from Agriculture	
Direct N_2O Emissions from Goats (MT CO_2e)	200
Direct N_2O Emissions from Horses (MT CO_2e)	1,967
Total Direct N_2O Emissions from Manure (MMT CO_2e)	0.006
Indirect N_2O Emissions from Manure (A.2.4)	
Indirect N_2O Emissions from Beef Cattle	237
Indirect N_2O Emissions from Dairy Cattle (MT CO_2e)	389
Indirect N_2O Emissions from Other Cattle (MT CO_2e)	526
Indirect N_2O Emissions from Swine (MT CO_2e)	524
Indirect N_2O Emissions from Sheep (MT CO_2e)	2.9
Indirect N_2O Emissions from Goats (MT CO_2e)	17
Indirect N_2O Emissions from Horses (MT CO_2e)	151
Total Indirect N_2O Emissions from Manure (MMT CO_2e)	0.002
Total GHG Emissions from Agriculture (MMT CO_2e)	**0.05**

Source: Energy Policy Initiatives Center, University of San Diego 2020

Difference from Previous 2012 Inventory

Methods to estimate emissions from agriculture are the same in both the 2012 and 2016 inventories.

Method Used to Develop Emissions Projections

While the previous inventory used a logarithmic decay function to project the emissions out to 2050, the current inventory used a constant value for the years 2020–2050. Because livestock population in the San Diego region does not have a definitive growth pattern, a constant number was used for the emission projections. EPIC projected both enteric fermentation and manure management emission estimates to 2050 (Table X.41), based on the average 2017–2019 cattle population, which was kept constant for the years 2020–2050.[58]

Table X.41: Projected Emissions for Agriculture

Projected Emissions from Agriculture					
Projection Year	**2025**	**2030**	**2035**	**2045**	**2050**
Total GHG Emission (MMT CO_2e)	0.06	0.06	0.06	0.06	0.06

Source: Energy Policy Initiatives Center, University of San Diego 2020

[58] County of San Diego: 2017 County of San Diego Crop Statistics and Annual Report, 2018 County of San Diego Crop Statistics and Annual Report, 2019 County of San Diego Crop Statistics and Annual Report.

Marine Vessels

The GHG emissions from marine vessels in the San Diego region are largely attributed to the Port of San Diego, which serves as a transshipment facility for San Diego, Orange, Riverside, San Bernardino, and Imperial Counties, as well as northern Baja California and Arizona. The GHG emissions from marine vessels account for 0.2% of total emissions in the 2016 inventory and 0.5% in the 2050 projection.

The emissions are from the following two subcategories:

- **Ocean-Going Vessels (OGV):** These include auto carriers, bulk carriers, passenger cruise vessels, general cargo vessels, refrigerated vessels (reefers), roll-on roll-off vessels, and tankers for bulk liquids.
- **Commercial Harbor Craft (CHC):** These include tugboats, towboats, pilot boats, work boats, ferries, and sports and commercial fishing vessels.

The emissions from OGV or CHC beyond the Port's landside and waterside boundary (24 nautical miles from the coastline) are not included in the 2016 inventory.

Method Used to Estimate 2016 Emissions

EPIC used the OGV and CHC emissions reported in the Port of San Diego 2016 Maritime Air Emissions Inventory, developed by the San Diego Unified Port District.[59] The 2016 emissions are shown in Table X.42.

Table X.42: 2016 Greenhouse Gas Emissions from Marine Vessels

2016 Greenhouse Gas Emissions from Marine Vessels	
Vessel Type	**2016 Emissions**
OGV (MT CO_2e)	22,500
CHC (MT CO_2e)	25,500
Total GHG Emissions (MT CO_2e)	48,000
Total GHG Emissions (MMT CO_2e)	**0.05**

Source: San Diego Unified Port District 2018

Difference from Previous 2012 Inventory

In both 2012 and 2016 inventories, emissions from the Port of San Diego Maritime Air Emissions Inventories are used directly. Port-related operations data were refined in the 2016 inventory; however, emission boundaries and methods to calculate emissions are the same.

[59] San Diego Unified Port District: Port of San Diego 2016 Maritime Air Emissions Inventory (2018), accessed May 8, 2020. Other emissions from the 2016 Port of San Diego inventory, e.g., cargo handling equipment, locomotives, on-road vehicles, are included in "Other categories" of this regional inventory.

Method Used to Develop Emissions Projections

To project emissions for the marine vessel category, EPIC used the projected OGV and CHC emissions in the San Diego region in the CARB ORION database.[60] The emissions from the ORION database include the impacts of adopted rules and regulations in each subcategory, as shown below:

- OGV Clean Fuel Regulation (beginning in 2009) and North American Emission Control Area (beginning in 2015)
- OGV At-Berth Regulation (2007) and proposed regulation (implementation through 2029)
- CHC Regulation (2007, amended in 2010, fully implemented by 2022)[61]

Because the boundaries are different for the OGV and CHC emissions reported by the San Diego Unified Port District 2016 maritime air emissions and the ORION database, EPIC applied the rate of increase of the projected emissions in the ORION database to the 2016 Port District-calculated maritime emissions. The projected emissions are shown in Table X.43.

Table X.43: 2016 Greenhouse Gas Emissions and Projected Greenhouse Gas Emissions from Marine Vessels

2016 Greenhouse Gas Emissions and Projected Greenhouse Gas Emissions from Marine Vessels

Year	2016	2025	2030	2035	2045	2050
Ocean-Going Vessel Emissions from ORION Compared with 2016*	—	31%	52%	75%	128%	156%
Ocean-Going Vessel Emissions	22,500	29,525	34,204	39,264	51,412	57,501
Commercial Harbor Craft Emissions from ORION Compared with 2016*	—	0.4%	1%	0.4%	−1%	−2%
Commercial Harbor Craft Emissions	25,500	25,606	25,646	25,613	25,211	24,867
Total GHG Emissions (MT CO_2e)	48,000	55,131	59,850	64,877	76,623	82,368
Total GHG Emissions (MMT CO_2e)	**0.05**	**0.06**	**0.06**	**0.06**	**0.08**	**0.08**

*San Diego region only. Emissions in ORION database are reported in tons per day.

Source: Energy Policy Initiatives Center, University of San Diego 2020

60 CARB: Emissions Inventory Offroad Emissions, accessed December 23, 2020.

61 CARB: Mobil Source Emissions Inventory – Off-Road Diesel Equipment Documentation.

Soil Management

Emissions from synthetic fertilizer use and crop residue or soil management contribute to 0.2% of total emissions in the 2016 inventory and 0.2% in the 2050 projection. The emissions are broken into two subcategories: farm emissions and non-farm emissions. The farm emissions account for the emissions due to agricultural soil management activities, such as synthetic fertilizers used for cultivation purposes to enhance the soil's nutrients and emissions due to crop residue. The non-farm emissions account for synthetic fertilizers used for residential or commercial purposes.

Farm emissions due to agricultural synthetic fertilizer use include direct N_2O emissions, indirect N_2O emissions, and CO_2 emissions from urea and lime application. The non-farm emissions only include direct N_2O and indirect N_2O emissions. The N_2O emissions from crop residues are due to the nitrogen content in the residue.

Method Used to Estimate 2016 Emissions

EPIC followed the IPCC method to calculate the direct and indirect N_2O and CO_2 emissions from managed soils.[62] The IPCC method calculates emissions from manure management, fertilizer application, and agricultural activities. Because the emissions from manure management are accounted for in the agriculture category, this section does not include these emissions.

To calculate the direct and indirect N_2O emissions from fertilizer applications for both farm and non-farm activities, EPIC multiplied the tonnage used by the nitrogen content of each synthetic fertilizer.[63] The nitrogen content of each fertilizer is based on the specific chemical content.[64] If the specific chemical content of a fertilizer is not given, code 97 fertilizer with a 25-15-17 Nitrogen-Phosphorous-Potassium (NPK) composition is used.

The farm use soil management has N_2O emissions from crop residue and from crop burning activities. Because the San Diego region does not have agricultural burning activities in 2016, EPIC only considered the emissions due to crop residue. Among the crops that have nitrogen content in their residue, only oats/hay are grown in the San Diego region. EPIC calculated the emissions from crop residue using the total nitrogen content in the crop residue based on the acres of crop cultivated.[65] The CO_2 emissions from urea application and from liming are based on the total quantities of urea and lime applied and their respective emission factors.[63] Table X.44 shows the key inputs and results for the soil management emissions.

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62 IPCC: N_2O emissions from managed soils and CO_2 emissions from Urea and Lime application, accessed on August 2, 2020.

63 California Department of Food & Agriculture: 2016 Fertilizing Material Tonnage Report, accessed on August 3, 2020.

64 International Fertilizer Association: fertilizer converter, accessed on August 3, 2020. This database provides information on the nitrogen content percentage by weight of a given fertilizer.

65 California Department of Agriculture Weights & Measures: 2016 County of San Diego Crop Statistics and Annual report, accessed on August 4, 2020.

Table X.44: Key Inputs and 2016 Greenhouse Gas Emissions from Soil Management

Key Inputs and 2016 Greenhouse Gas Emissions from Soil Management	
Total Nitrogen in Farm Use Synthetic Fertilizers (Tons)	3,013
Total Nitrogen in Non-Farm Use Synthetic Fertilizers (Tons)	5,247
N_2O Emitted per Unit of Nitrogen (kg N_2O-N/kg N)	0.01
N_2O Emitted per Unit of Nitrogen Volatilized (kg N-N_2O/kg NH_3- N + NO_x-N volatilized)	0.01
N_2O emitted per Unit of Nitrogen Leached/Runoff (kg N_2O-N/kg N leaching/runoff)	0.0075
Total Area of Oats harvested (Acres)	2,100
Total Nitrogen in Crop (Oats/Hay) Residue (kg N)	7,990
Amount on Lime Applied (Tons)	216
Carbon Content of Lime (Ton C/ton of Lime)	0.125
Amount of Urea Applied (Tons)	559
Carbon Content of Urea (Ton C/ton of Urea)	0.2
Direct N_2O Emissions from Farm Activities – Synthetic Fertilizers and Crop Residue (MMT of CO_2e)	0.013
Direct N_2O Emissions from Non-Farm Activities – Synthetic Fertilizer (MMT of CO_2e)	0.022
Indirect N_2O Emissions from Farm Activities – Synthetic Fertilizers and Crop Residue (MMT of CO_2e)	0.004
Indirect N_2O Emissions from Non-Farm Activities – Synthetic Fertilizer (MMT of CO_2e)	0.007
CO_2 Emissions from Farm Urea Applications (MMT CO_2e)	4 x 10-4
CO_2 Emissions from Farm Lime Applications (MMT CO_2e)	1 x 10-4
Total Farm Emissions (MMT CO_2e)	0.02
Total Non-Farm Emissions (MMT CO_2e)	0.03
Total GHG emissions from Soil Management Sector (MMT CO_2e)	**0.05**

Source: County of San Diego 2016; International Fertilizer Association IPCC 2006; Energy Policy Initiatives Center, University of San Diego 2020.

Difference from Previous 2012 Inventory

The previous 2012 inventory did not include emissions from soil management activities (fertilizer application and crop residue).

Method Used to Develop Emissions Projections

Direct and indirect N_2O and CO_2 emissions were projected to 2050 using the Microsoft Excel GROWTH function. EPIC calculated the emissions for the years 2016–2019 using the available data for oats harvested, fertilizer use, and the IPCC emission factors and projected the activity data out to 2050 with these values.[66] Table X.45 shows the projection results for soil management emissions.

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66 County of San Diego: 2017 County of San Diego Crop Statistics and Annual Report, 2018 County of San Diego Crop Statistics and Annual Report, 2019 County of San Diego Crop Statistics and Annual Report. California Department of Food and Agriculture: 2017 Fertilizing Tonnage Report. 2018 Fertilizing Tonnage Report. 2019 Fertilizing Tonnage Report, accessed on April 22, 2020.

Table X.45: Projected Greenhouse Gas Emissions from Soil Management

Projected Greenhouse Gas Emissions from Soil Management					
Projection Year	**2025**	**2030**	**2035**	**2045**	**2050**
Oats Harvested (Acres)	2,091	2,131	2,172	2,255	2,298
Crop Residue Nitrogen (kg N)	7,996	8,176	8,359	8,738	8,935
Farm Nitrogen (kg N)	2,545,395	2,639,806	2,737,717	2,944,571	3,053,786
Non-Farm Nitrogen (kg N)	3,034,402	3,148,316	3,266,506	3,516,362	3,648,369
N_2O Emitted per Unit of Nitrogen (kg N_2O-N/kg N)	0.01	0.01	0.01	0.01	0.01
Farm Nitrogen Volatilized (kg N)	254,540	263,981	273,772	294,457	305,379
Non-Farm Nitrogen Volatilized (kg N)	303,440	314,832	326,651	351,636	364,837
N_2O Emitted per Unit of Nitrogen Volatilized (kg N-N_2O/kg NH_3- N + NOx-N volatilized)	0.01	0.01	0.01	0.01	0.01
Farm Nitrogen Leached (kg N)	763,619	791,942	821,315	883,371	916,136
Non-Farm Nitrogen Leached (kg N)	910,321	944,495	979,952	1,054,909	1,094,511
N_2O Emitted per Unit of Nitrogen Leached/Runoff (kg N_2O-N/kg N leaching/runoff)	0.0075	0.0075	0.0075	0.0075	0.0075
Amount on Lime Applied (tons)	195	198	200	206	208
Carbon Content of Lime (Ton C/ton of Lime)	0.125	0.125	0.125	0.125	0.125
Amount of Urea Applied (tons)	500	508	516	532	540
Carbon Content of Urea (ton C/ton of Urea)	0.2	0.2	0.2	0.2	0.2
Total Farm Emissions (MMT CO_2e)	0.02	0.02	0.02	0.02	0.02
Total Non-Farm Emissions (MMT CO_2e)	0.02	0.02	0.02	0.02	0.02
Total GHG Emissions (MMT CO_2e)	**0.04**	**0.04**	**0.04**	**0.04**	**0.04**

Source: Energy Policy Initiatives Center, University of San Diego 2020

Appendix I

Appendix D of the proposed Plan; Sustainable Communities Strategy Documentation and Related Information

Appendix D: Sustainable Communities Strategy Documentation and Related Information

This appendix includes documentation in support of the Sustainable Communities Strategy (SCS) pursuant to California Senate Bill 375 (Steinberg, 2008) (SB 375) and describes how San Diego Forward: The 2021 Regional Plan (2021 Regional Plan) fulfills requirements of the SCS as described in SB 375,[1] including:

- Submittal of the Technical Methodology to Estimate Greenhouse Gas (GHG) Emissions for San Diego Forward: The 2021 Regional Plan and SCS from SANDAG to California Air Resources Board (CARB) and letter from CARB accepting this Technical Methodology
- SB 375 GHG Targets set by CARB and Results of GHG Emissions Reductions
- Matrix that outlines the requirements of the SCS as described in SB 375 and California Assembly Bill 805 (Gonzalez Fletcher, 2017) (AB 805) and where the 2021 Regional Plan addresses the requirements—either in specific chapters of the 2021 Regional Plan or in specified appendices
- Resource areas and farmland in the region
- SB 375 Areas for Transit Priority Projects and California Senate Bill 743 (Steinberg, 2013) (SB 743) Transit Priority Areas

The following tables and figures are included in this appendix:

- Table D.1: Summary of CO_2 Per Capita Reductions
- Table D.2: Quantification Approach for 2021 Regional Plan Strategies
- Table D.3: Strategies Applied in ABM2+
- Table D.4: Off-Model Strategies
- Table D.5: Sustainable Communities Strategy and Regional Comprehensive Plan Regulation Information
- Figure D.1: 2035 Sustainable Communities Strategy Land Use Pattern
- Figure D.2: 2050 Sustainable Communities Strategy Land Use Pattern
- Figure D.3: Existing San Diego Region Wetlands

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1 Pursuant to Government Code Section 65080(d)(2), SANDAG is required to adopt and submit its update to San Diego Forward: The 2015 Regional Plan by December 31, 2021.

- Figure D.4: Existing San Diego Region Important Agricultural Lands
- Figure D.5: Existing San Diego Region Habitat Conservation Lands
- Figure D.6: Existing San Diego Region Generalized Vegetation
- Figure D.7: Potential Aggregate Supply Sites
- Figure D.8: 2035 Potential Areas for Transit Priority Projects
- Figure D.9: 2050 Potential Areas for Transit Priority Projects
- Figure D.10: 2035 Transit Priority Areas
- Figure D.11: 2050 Transit Priority Areas

Technical Methodology to Estimate Greenhouse Gas Emissions

Pursuant to SB 375, CARB is required to review each metropolitan planning organization's (MPO's) proposed technical methodology for quantifying GHG emissions reductions from the SCS as well as the final quantification. The Technical Methodology to Estimate GHG Emissions for San Diego Forward: The 2021 Regional Plan and SCS was first submitted to CARB on September 25, 2020. SANDAG coordinated with CARB staff on review and edits to the Technical Methodology prior to submitting a Final Technical Methodology to CARB on February 26, 2021. Attachment 1 includes:

- April 20, 2021, correspondence from CARB to SANDAG regarding Technical Methodology to Estimate GHG Emissions

- February 26, 2021, correspondence from SANDAG to CARB regarding Technical Methodology to Estimate GHG Emissions for San Diego Forward: The 2021 Regional Plan and SCS

SB 375 Greenhouse Gas–Reduction Targets Set by California Air Resources Board and Results of Greenhouse Gas Emissions Reductions

In 2010, CARB established the original SB 375 regional GHG-reduction targets for each MPO for years 2020 and 2035. For the San Diego region, the reductions were set at 7% and 13% per capita for cars and light trucks from 2005, respectively. In 2018, CARB approved updated targets that reflect more aggressive per capita GHG reductions of 15% for 2020 and 19% for 2035 compared to 2005.

2020 Greenhouse Gas–Reduction Target

SANDAG has prepared an estimate for GHG reductions in 2020 using a fusion of existing data and estimated regional travel. Because there are no direct methods for measuring either vehicle miles traveled (VMT) or GHG emissions, SANDAG must deploy estimation techniques to determine whether the 2020 GHG-reduction target was met. In line with CARB SCS evaluation guidelines, SANDAG adjusted the regional VMT estimate for 2020 from the activity-based model system (ABM2+) based on observed freeway counts, speeds, and VMT estimates from the Caltrans Performance Monitoring System (PeMS). The adjusted VMT data tables are then used within EMFAC 2014 for CO_2 emissions modeling. Based on this methodology, the San Diego region reduced per capita CO_2 emissions by 17% in 2020 compared to 2005 baseline, which exceeds the 2020 target set for SANDAG of 15% reduction. Attachment 2 contains the methodology for calculating the estimate for GHG reductions in 2020.

PeMS measured data for 2020 is significantly impacted by COVID-19 due to intermittent stay-home orders; changes in employment, employee work location, and telecommuting; tourism travel; package and food delivery; crossborder travel restrictions; virus transmission fear on transit vehicles; and transportation costs for gasoline, among many other impacts.

2035 Greenhouse Gas–Reduction Target

Implementation of the SCS is estimated to result in a 20% GHG emissions reduction for cars and light-duty trucks by 2035. The GHG reductions for the 2021 Regional Plan were calculated using the CARB model EMFAC 2014 and adjustment factors provided by CARB to account for differences in emissions rates between EMFAC 2007 (used to set the original targets in 2010) and EMFAC 2014. Off-model calculators were used to calculate emission reductions associated with strategies that are not accounted for in SANDAG travel demand modeling tools (see Table D.4). Table D.1 summarizes the CO_2 per capita reductions from on-model and off-model strategies after accounting for the EMFAC adjustment factor and induced demand adjustment factor. Attachment 3 contains the methodology for calculating the induced demand adjustment factor.

Table D.1: Summary of CO_2 Per Capita Reductions

Summary of CO_2 Per Capita Reductions as Compared to 2005: On- and Off-Model Results and CARB Adjustment Factors

	2035
Per Capita Reduction (On-Model Results Only)	–19.03%
Per Capita Reduction (Off-Model Results Only)	–3.05%
CARB Adjustment Factor for EMFAC 2007–2014	1.7%
Induced Demand Adjustment Factor	0.38%
Per Capita Reductions	**–20.0%**

2050 Estimated Greenhouse Gas Reduction

While the state does not set a 2050 target for GHG emissions reduction, similar methods were used to estimate per capita CO_2 emissions reductions from cars and light-duty trucks as a percent reduction compared to 2005 levels. It is important to note that after 2035, SANDAG is not proposing to continue the regional electric vehicle incentive program due to Executive Order N-79-20 requiring all new cars and passenger trucks sold in California be zero-emission vehicles. After 2035, SANDAG also assumes that free-floating carsharing programs may sunset due to the rise and popularity of on-demand ridehailing services. These assumptions result in lower “off-model” reductions in 2050 (see Table D.4). For 2050, on-model reduction is −19.68% and off-model reduction is −2.61%. After applying the CARB adjustment factor of 1.6% and an induced demand adjustment factor of 0.43%, estimated reductions for 2050 are −20.3%.

2021 Regional Plan Strategy Quantification

The strategies in the 2021 Regional Plan that contribute to GHG reductions toward the region’s target span a wide range of scenarios employing methods to influence the performance of the region’s transportation system. The elements of these strategies can be broken down into Transportation System Infrastructure and Operations, Demand Management, Land Use, and Zero-Emission Vehicles. As described in Table D.2, some strategies included in the 2021 Regional Plan are a continuation or expansion of strategies from the 2015 Regional Plan, while some strategies are new for the 2021 Regional Plan. The quantification approach for each strategy is indicated in Table D.2. Chapter 3 and Appendix B describe the commitments or key actions that implement the 2021 Regional Plan strategies.

The two main quantification approaches are the SANDAG regional travel demand model ABM2+ and a set of off-model calculators developed to handle elements that cannot be treated by ABM2+. Appendix S includes documentation of the travel demand model and off-model calculators. The selected approach for each strategy element is based first upon a determination of whether that element can be represented in the ABM2+ travel demand model. This determination has been made based upon the ABM2+ technical documentation, the ABM2+ sensitivity analysis report, and the findings of the ABM2+ technical advisory committee. As described in the Technical Methodology submitted to CARB (Attachment 1), those elements that cannot be represented in ABM2+ were then considered for off-model quantification based upon the expected impact of that element on the overall performance of the transportation system as well as an identification of a feasible off-model methodology and associated recommendations from CARB and prior off-model developments (at SANDAG and other MPOs). SANDAG contracted with the University of California Institute of Transportation Studies (UCITS) through the UC Irvine campus to validate the overall quantification approaches along with the development and updating of the off-model quantification approach. The UCITS assessment is also included in Appendix S.

Table D.2: Quantification Approach for 2021 Regional Plan Strategies

Quantification Approach for 2021 Regional Plan Strategies		
Strategy	**Inclusion in Prior SCS?**	**Quantification Approach**
Transportation System Infrastructure and Operations		
Complete Corridors and Transit Leap: • Managed Lanes • High-Occupancy Vehicle (HOV)/ High-Occupancy Toll (HOT) policies • Regional Bike Network • Commuter rail • Light Rail • Next Generation *Rapid* • Local Bus	Yes. 2021 SCS expands on these strategies	Coded as transportation network improvements in ABM2+
Mobility Hubs and Flexible Fleets: • Local complete streets • Parking management • Microtransit • Micromobility • Pooled Transportation Network Companies (TNCs) • E-bikes	Mobility Hubs were introduced in the prior SCS, but investment and specific geographic information was limited, as were associated strategies and fleet assumptions	Mobility Hubs are used as a geographic area for applying complete streets, parking, microtransit, and micromobility strategies in ABM2+ Pooled TNCs and e-bikes are reflected in mode choices in ABM2+
Next OS: • Active Transportation Demand Management (ATDM) • Smart Signals	Yes. 2021 SCS expands on these strategies	ATDM reflected as improved travel reliability in ABM2+ Smart signals reflected as reduced intersection delays in ABM2+
Demand Management		
Telework	Yes. Ability to capture primarily and occasional telework is new	Primarily and occasional teleworker assumptions applied in ABM2+
Pooled rides (private)	Yes, off-model in prior SCS	Off-Model
Vanpool	Yes, off-model in prior SCS	Off-Model
Carshare	Yes, off-model in prior SCS	Off-Model
Regional TDM Ordinance	No, new off-model calculator	Off-Model

Quantification Approach for 2021 Regional Plan Strategies		
Strategy	**Inclusion in Prior SCS?**	**Quantification Approach**
Pricing Strategies: • Road user charge • Transit Fare Subsidies • Congestion Pricing/Toll Rates • Parking • TNC Fees	Carryover pricing strategies include congestion pricing/toll rates, parking pricing New pricing strategies include road user charge, transit fare subsidies, and TNC fees	Pricing strategies reflected in ABM2+ as follows: • Road user charge: per-mile charge added to the auto operating cost • Transit Fare Subsidies: one-way and daily transit fares defined for each service type • Congestion Pricing/Tolled Rates: per-mile tolls defined by time of day for each managed lane corridor and fixed-fee tolls for the State Route 125 toll road • Parking: hourly, daily, and monthly rates applied to certain Mobility Hub areas and charged to auto trips destined for those specified areas • TNC Fees: applied as fixed fee per trip
Land Use		
SCS Land Use Pattern that considers: • Job–Housing Balance • Mixing of uses • Transit-oriented development • Regional Housing Needs Assessment	Yes. The 2021 SCS includes expanded land use policies reflected in the SCS land use pattern	Mobility Hub areas used as a framework for the allocation of housing and jobs in the land use pattern developed in Integrated Land Use, Demographic, and Economic Model (I-LUDEM) and impact modeled in ABM2+
Zero-Emission Vehicles		
Regional EV Charger Program	Yes, off-model in prior SCS. The 2021 SCS includes an expanded EV charger program	Off-Model
Regional EV Incentive Program	No. The EV incentive program is a new SCS strategy	Off-Model

Strategies Applied in ABM2+

Strategies applied in ABM2+ have underlying parameters used to represent the modes and policies described in Table D.2. Table D.3 defines the assumptions used to apply various strategies to ABM2+ for the year 2035.

Table D.3: Strategies Applied in ABM2+

Strategies Applied in ABM2+		
Category	**Input Description**	**2035**
Managed Lanes	HOV and Toll Assumptions	ML3+ (All ML Facilities are Priced) – Vehicles carrying three or more persons are allowed and pay no toll for use. SOVs and two-person vehicles that pay a toll are permitted to use the facility.
Pricing	Managed Lane/HOT Rates	$0.30/mile a.m. and p.m. peak $0.30/mile off-peak
	Regional Road User Charge	2 cents/mile, in $2020
Parking Cost	Urban Shed, Major Employment Centers, U.S–Mexico Border	Hourly: $3.25 Daily: $25 Monthly: $350
	Central Mobility Hub	Hourly: $5 Daily: $39 Monthly: $450
	Coastal Communities	Hourly: $2.25 Daily: $16 Monthly: $250 (add in Imperial Beach, Coronado, and La Jolla)
	Suburban Communities	Hourly: $1.50 Daily: $12 Monthly: $150
Telework	Rates for primary and occasional teleworkers	Primarily telework: 10.9% Occasional telework: 11.8%
TNCs	TNC Fee (single, $2020)	Fixed: $1.25/trip
	TNC Fee (shared, $2020)	Fixed: $0.65/trip
Micromobility	Speed	15 mph average
	Cost ($2020)	Micromobility cost: $1 fixed +$0.20/min $0 for access/egress to transit
	Wait time	3 minutes in urban, 5 minutes suburban
	Constant	60 minutes
	Value of time ($2020)	$15
E-Bikes	Personally owned e-bike	36% of privately owned bikes are e-bikes

Strategies Applied in ABM2+		
Category	**Input Description**	**2035**
Microtransit	Speed	17 mph
	Flat fare $2020	$1.25 one way / $3 day
	Wait time	4 minutes
	Access time	0 minutes
	Constant	120 minutes
	Max distance	3 miles
Transit Fares	Local bus, Arterial *Rapid*, Some non-Express Freeway *Rapid*s, Express Bus, Trolley, SPRINTER	$1.25 one way/$3 day
	Express Freeway *Rapid*	$2.50 one way/$6 day
	Commuter Rail	$3 one way/$6 day
	COASTER Connection, Automated People Mover	Free
Active Transportation Demand Management (ATDM)	Capacity increase from Integrated and Cooperative Management of roadway system yielding increase in travel reliability	7% unreliability reduction
Smart Signals	Benefits from reduced intersection delays	Delay at signalized intersections decreased by 20% (Arterials)

Off-Model Strategies

SANDAG has included five off-model strategies to estimate GHG emission reductions from programs that cannot be applied in ABM2+. These include vanpool, carshare, pooled rides, Regional TDM Ordinance, and electric vehicle (EV) programs. The EV programs consist of both a vehicle incentive program and an EV charging incentive program. Both EV programs are modeled in a single calculator to capture the interactions between the two programs and avoid double counting of emissions reductions. Details on the methods and assumptions of the off-model calculators are included in Appendix S. Table D.4 summarizes the CO_2 reductions associated with each off-model strategy.

Table D.4: Off-Model Strategies

Summary of Off-Model Strategies: Percent Per Capita CO_2 Reduction as Compared to 2005		
Off-Model Strategy	**2035**	**2050**
Vanpool	0.30%	0.31%
Carshare	0.17%	—
Pooled Rides	0.01%	0.01%
Regional TDM Ordinance	0.39%	0.60%
EV Programs (Vehicle Incentive and Charger Program)	2.18%	1.69%
Total	**3.05%**	**2.61%**

Table D.5: Sustainable Communities Strategy and Regional Comprehensive Plan Regulation Information

Sustainable Communities Strategy and Regional Comprehensive Plan Regulation Information		
	Regulatory Text	**Addressed**
SCS Requirement	**CGC Section 65080(b)(2)(B)** Each metropolitan planning organization shall prepare a sustainable communities strategy subject to the requirements of Part 450 of Title 23 of and Part 93 of Title 40 of the Code of Federal Regulations, including the requirement to utilize the most recent planning assumptions considering local general plans and other factors. The sustainable communities strategy shall:	The focus of Chapter 2 is the Sustainable Communities Strategy (SCS); however, components of the SCS are integrated throughout the Regional Plan chapters and appendices.
Land Use	CGC Section 65080(b)(2)(B)(i) identify the general location of uses, residential densities, and building intensities within the region	See Regional Plan Chapter 2 and Appendices D (Sustainable Communities Strategy Documentation and Related Information) and F (Regional Growth Forecast and SCS Land Use Pattern)
Housing Goals	CGC Section 65080(b)(2)(B)(vi) consider the state housing goals specified in Sections 65580 and 65581	See Regional Plan Chapter 2 and Appendix K (Regional Housing Needs Assessment)
	CGC Section 65080(b)(2)(B)(ii) identify areas within the region sufficient to house all the population of the region, including all economic segments of the population, over the course of the planning period of the regional transportation plan taking into account net migration into the region, population growth, household formation and employment growth	See Regional Plan Chapter 2 and Appendices F (Regional Growth Forecast and SCS Land Use Pattern) and K (Regional Housing Needs Assessment)
	CGC Section 65080(b)(2)(B)(iii) identify areas within the region sufficient to house an eight-year projection of the regional housing need for the region pursuant to Section 65584	See Regional Plan Chapter 2 and Appendices F (Regional Growth Forecast and SCS Land Use Pattern), and K (Regional Housing Needs Assessment)
Natural Resources	CGC Section 65080(b)(2)(B)(v) gather and consider the best practically available scientific information regarding resource areas and farmland in the region as defined in subdivisions (a) and (b) of Section 65080.01	See Regional Plan Chapter 2 and Appendices D (Sustainable Communities Strategy Documentation and Related Information) and AA (Regional Habitat Conservation Vision).
Transportation Network	CGC Section 65080(b)(2)(B)(iv) identify a transportation network to service the transportation needs of the region	See Regional Plan Chapters 1 and 2. Also see Appendices A (Transportation Projects, Programs, and Phasing) and T (Network Development Methodology).

Sustainable Communities Strategy and Regional Comprehensive Plan Regulation Information		
	Regulatory Text	**Addressed**
Meeting Greenhouse Gas Reduction Targets	CGC Section 65080(b)(2)(B)(vii) set forth a forecasted development pattern for the region, which, when integrated with the transportation network and other transportation measures and policies, will reduce the greenhouse gas emissions from automobiles and light trucks to achieve, if there is a feasible way to do so, the greenhouse gas emission reduction targets approved by the state board	See Regional Plan Chapters 2 and 3. Also see Appendices B (Implementation Actions), D (Sustainable Communities Strategy Documentation and Related Information) and F (Regional Growth Forecast and SCS Land Use Pattern)
Meeting Federal Air Quality Requirements	CGC Section 65080(b)(2)(B)(viii) allow the regional transportation plan to comply with Section 176 of the federal Clean Air Act (42 U.S.C. §7506).	See Regional Plan Chapter 2 and Appendix C (Air Quality Planning and Transportation Conformity).
Informational Meetings	**CGC Section 65080(b)(2)(E)** The metropolitan planning organization shall conduct at least two informational meetings in each county within the region for members of the board of supervisors and city councils on the sustainable communities strategy and alternative planning strategy, if any. The metropolitan planning organization may conduct only one informational meeting if it is attended by representatives of the county board of supervisors and city council members representing a majority of the population in the incorporated areas of that county.	See Appendix G (Public Involvement Program)
Public Participation Plan	**CGC Section 65080(b)(2)(F)** Each metropolitan planning organization shall adopt a public participation plan, for development of the sustainable communities strategy and an alternative planning strategy, if any, that includes all of the following:	See Appendix G (Public Involvement Program)
Public Participation Plan – Outreach	CGC Section 65080(b)(2)(F)(i) Outreach efforts to encourage the active participation of a broad range of stakeholder groups in the planning process, consistent with the agency's adopted Federal Public Participation Plan, including, but not limited to, affordable housing advocates, transportation advocates, neighborhood and community groups, environmental advocates, home builder representatives, broad-based business organizations, landowners, commercial property interests, and homeowner associations.	See Appendix G (Public Involvement Program)

Sustainable Communities Strategy and Regional Comprehensive Plan Regulation Information		
	Regulatory Text	**Addressed**
Public Participation Plan – Consultation	CGC Section 65080(b)(2)(F)(ii) Consultation with congestion management agencies, transportation agencies, and transportation commissions.	See Appendix G (Public Involvement Program)
Public Participation – Workshops	CGC Section 65080(b)(2)(F)(iii) Three workshops throughout the region to provide the public with the information and tools necessary to provide a clear understanding of the issues and policy choices. Each workshop, to the extent practicable, shall include urban simulation computer modeling to create visual representations of the SCS and the alternative planning strategy.	See Appendix G (Public Involvement Program)
Public Participation Plan – SCS Public Review	CGC Section 65080(b)(2)(F)(iv) Preparation and circulation of a draft SCS and an alternative planning strategy, if one is prepared, not less than 55 days before adoption of a final regional transportation plan.	See Appendix G (Public Involvement Program)
Public Participation Plan – Public Hearings	CGC Section 65080(b)(2)(F)(v) At least three public hearings on the draft sustainable communities strategy in the regional transportation plan and alternative planning strategy, if one is prepared. If the metropolitan transportation organization consists of a single county, at least two public hearings shall be held. To the maximum extent feasible, the hearings shall be in different parts of the region to maximize the opportunity for participation by members of the public throughout the region.	See Appendix G (Public Involvement Program)
Public Participation Plan – Public Notice	CGC Section 65080(b)(2)(F)(vi) A process for enabling members of the public to provide a single request to receive notices, information, and updates.	See Appendix G (Public Involvement Program)
Consideration of Spheres of Influence adopted by Local Agency Formation Committee	**CGC Section 65080(b)(2)(G)** In preparing a sustainable communities strategy, the metropolitan planning organization shall consider spheres of influence that have been adopted by the local agency formation commissions within its region.	See Appendix F (Regional Growth Forecast and SCS Land Use Pattern).

Sustainable Communities Strategy and Regional Comprehensive Plan Regulation Information

	Regulatory Text	Addressed
CARB Greenhouse Gas Reduction Targets for San Diego Region	**CGC Section 65080(b)(2)(H)** Prior to adopting a sustainable communities strategy, the metropolitan planning organization shall quantify the reduction in greenhouse gas emissions projected to be achieved by the sustainable communities strategy and set forth the difference, if any, between the amount of that reduction and the target for the region established by the state board.	See Regional Plan Chapter 2. Also see Appendices D (Sustainable Communities Strategy Documentation and Related Information) and S (Travel Demand Modeling Tools)
Consideration of Financial Incentives for Cities and Counties with Resource Areas or Farmlands	**CGC Section 65080(b)(4)(C)** The metropolitan planning organization or county transportation agency, whichever entity is appropriate, shall consider financial incentives for cities and counties that have resource areas or farmland, as defined in Section 65080.01, for the purposes of, for example, transportation investments for the preservation and safety of the city street or county road system and farm-to-market and interconnectivity transportation needs. The metropolitan planning organization or county transportation agency, whichever entity is appropriate, shall also consider financial assistance for counties to address countywide service responsibilities in counties that contribute towards the greenhouse gas emission reduction targets by implementing policies for growth to occur within their cities.	See Regional Plan Chapter 3 and Appendix B (Implementation Actions)
Regional Comprehensive Plan Requirements from AB 805	**PUC 132360.1(b)** The regional comprehensive plan shall address the greenhouse gas emissions reduction targets set by the State Air Resources Board as required by Section 65080 of the Government Code and include strategies that provide for mode shift to public transportation.	See Regional Plan Chapter 2. Also see Appendices A (Transportation Projects, Programs, and Phasing), B (Implementation Actions) and T (Network Development Methodology)
	PUC 132360.1(c) The regional comprehensive plan shall identify disadvantaged communities as designated pursuant to Section 39711 of the Health and Safety Code and include transportation strategies to reduce pollution exposure in these communities.	See Regional Plan Chapter 2. Also see Appendix H (Social Equity Engagement and Analysis)

Resource Areas and Farmland in the San Diego Region

The following maps show projected land use and natural resource areas for 2035 and 2050. The land use maps in Figures D.1 (2035 Land Use) and D.2 (2050 Land Use) were generated using the Series 14 Regional Growth Forecast and SCS Land Use Pattern where future development and growth is concentrated in urbanized areas near existing and future transportation networks (detailed information can be found in Appendix F). San Diego's vast amounts of natural land and resources are valuable for conservation and recreation. Figures D.3 through D.7 show where vegetation, habitat conservation lands, wetlands, important agricultural lands, and other natural resources are located within the San Diego region. One of the strategies of the 2021 Regional Plan is to preserve natural resources and farmland to the extent feasible for current and future residents and visitors to the region.

Figure D.1: 2035 Sustainable Communities Strategy Land Use Pattern

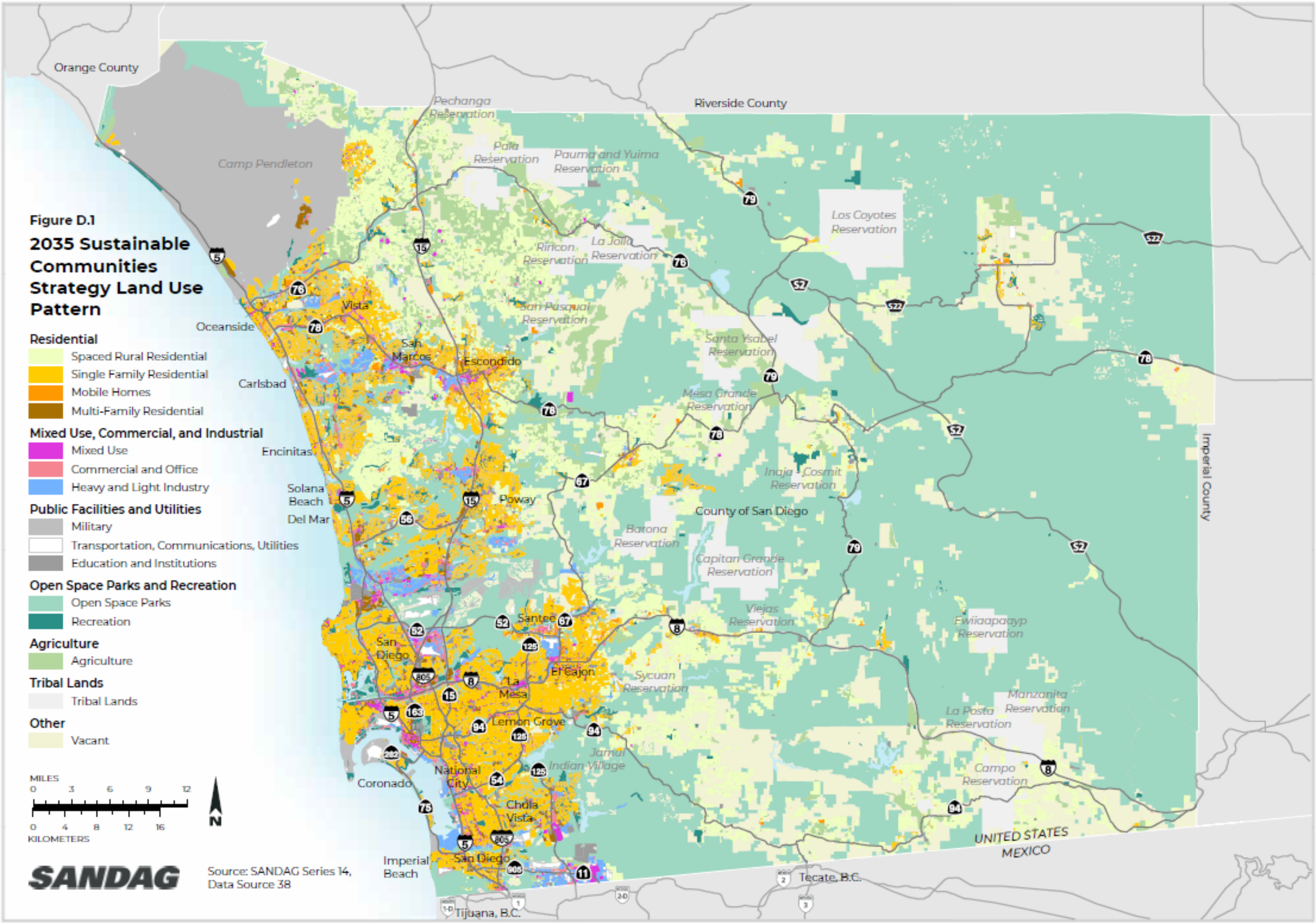


Figure D.2: 2050 Sustainable Communities Strategy Land Use Pattern

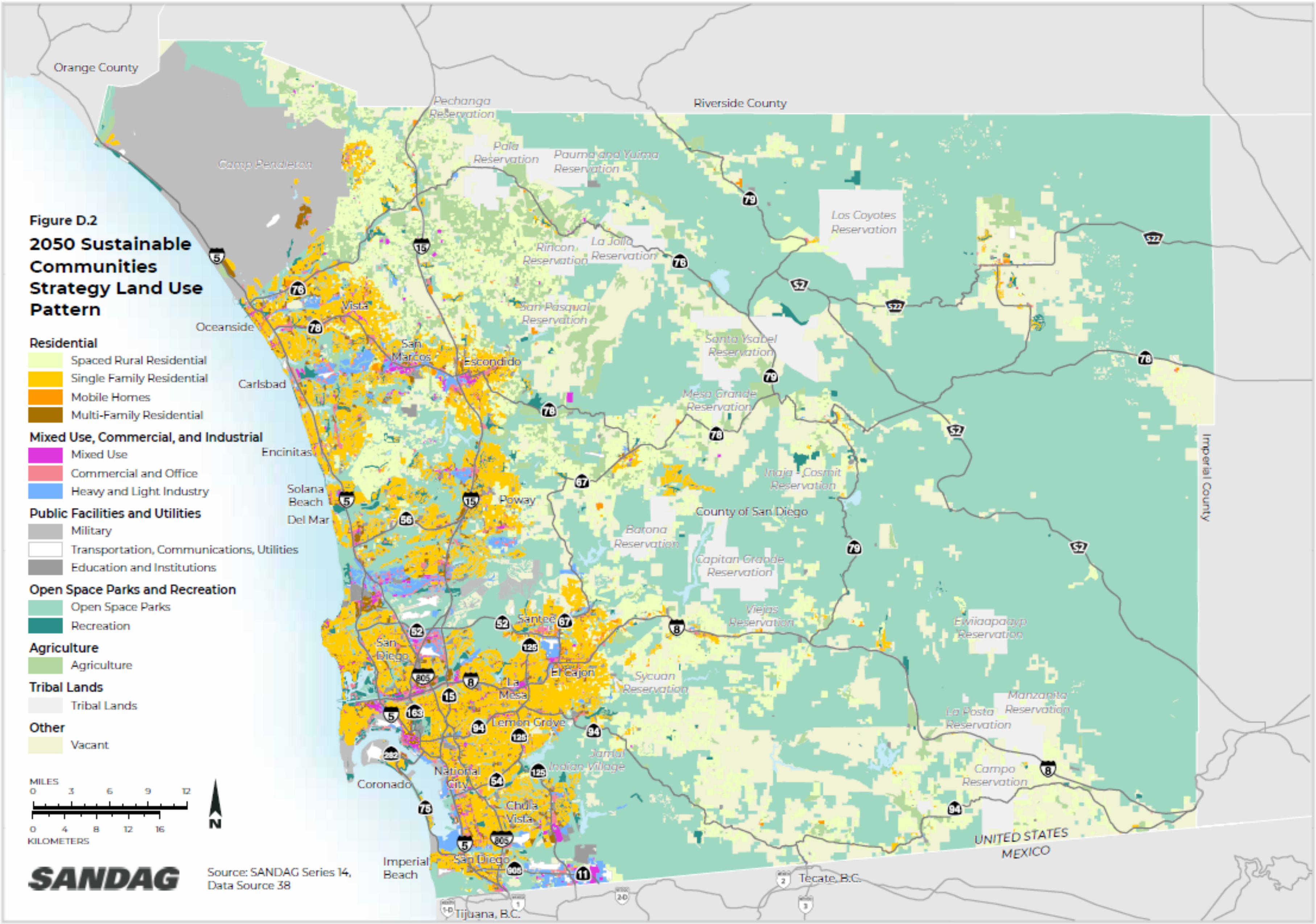


Figure D.3: Existing San Diego Region Wetlands

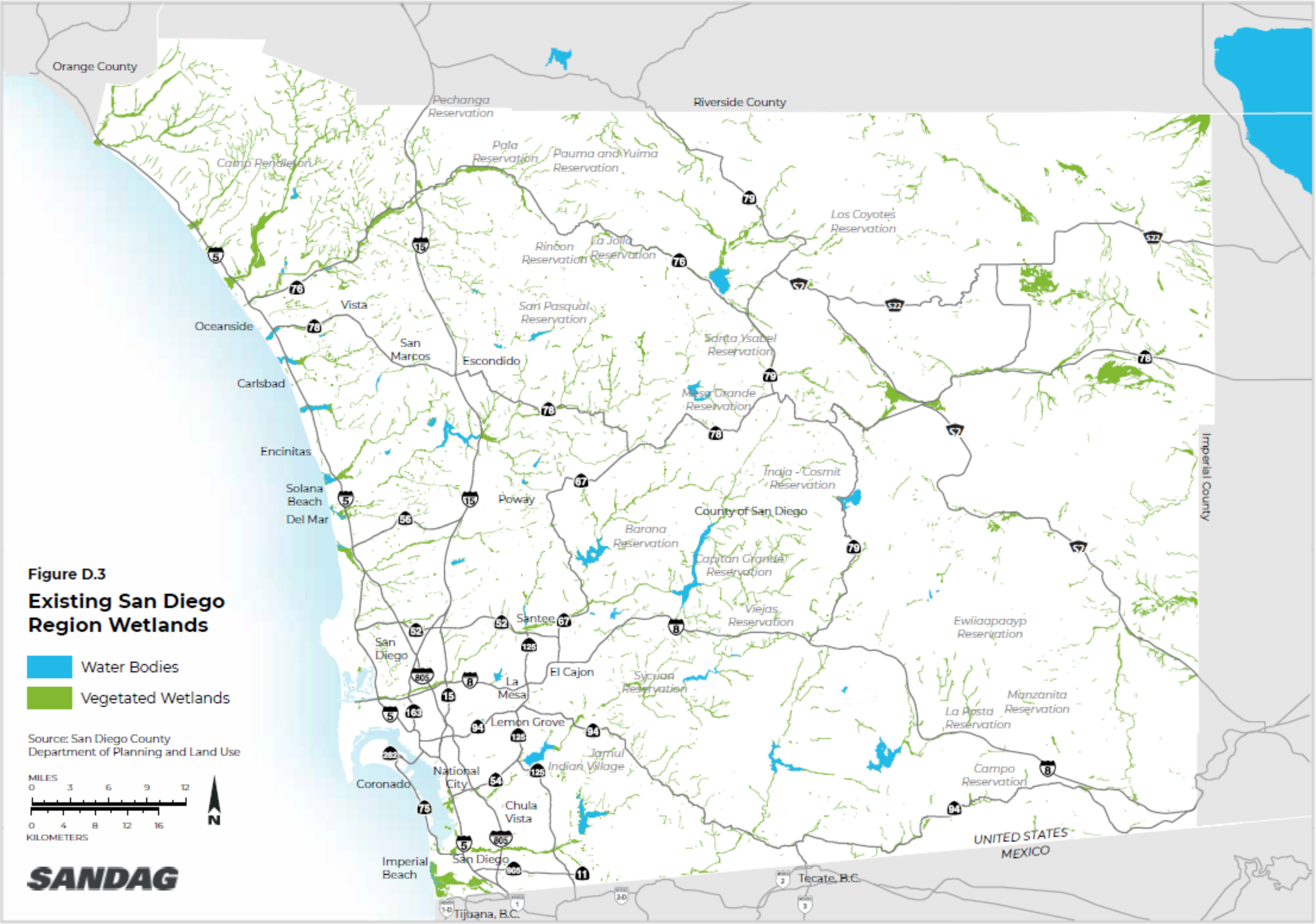


Figure D.4: Existing San Diego Region Important Agricultural Lands

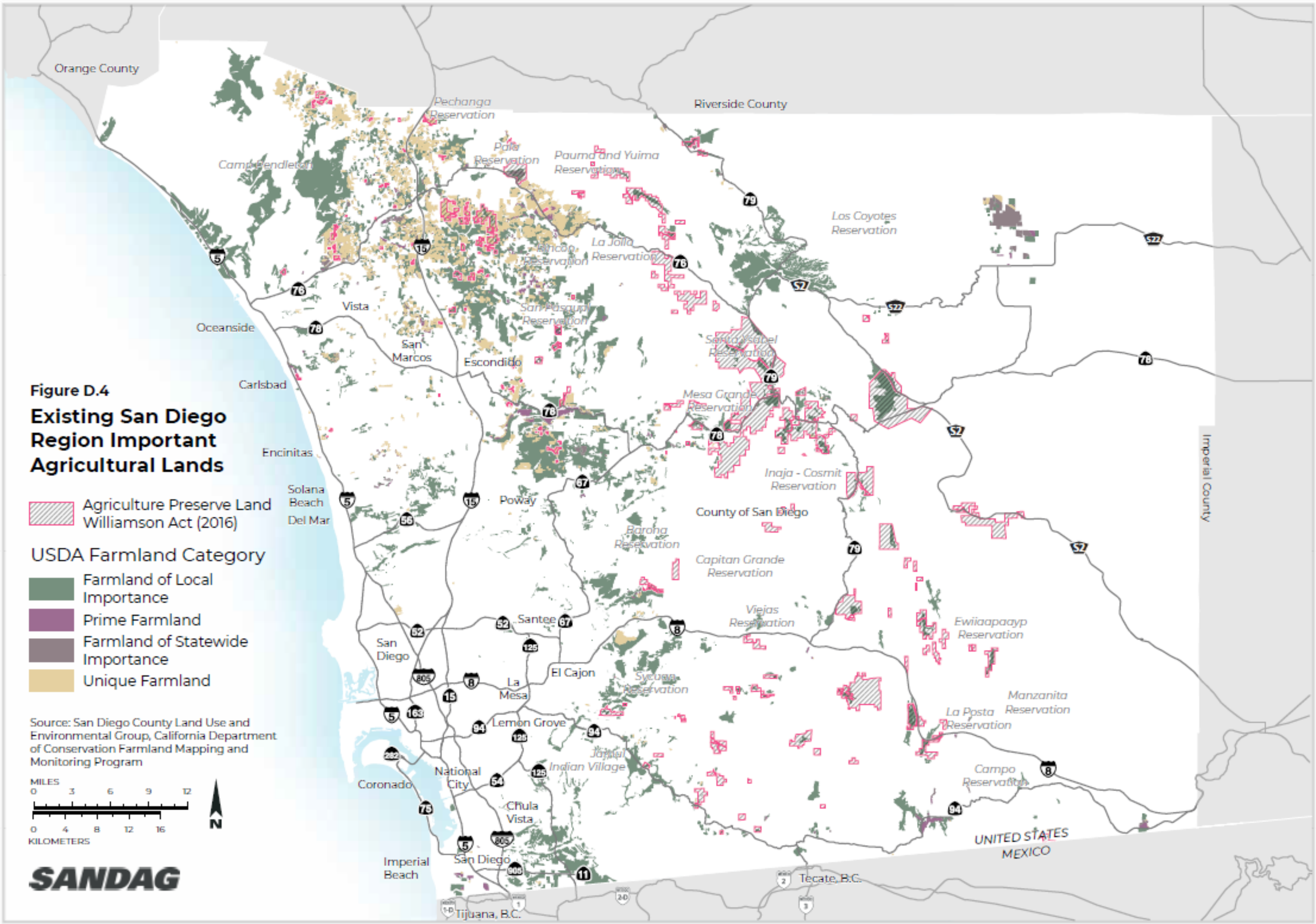


Figure D.5: Existing San Diego Region Habitat Conservation Lands

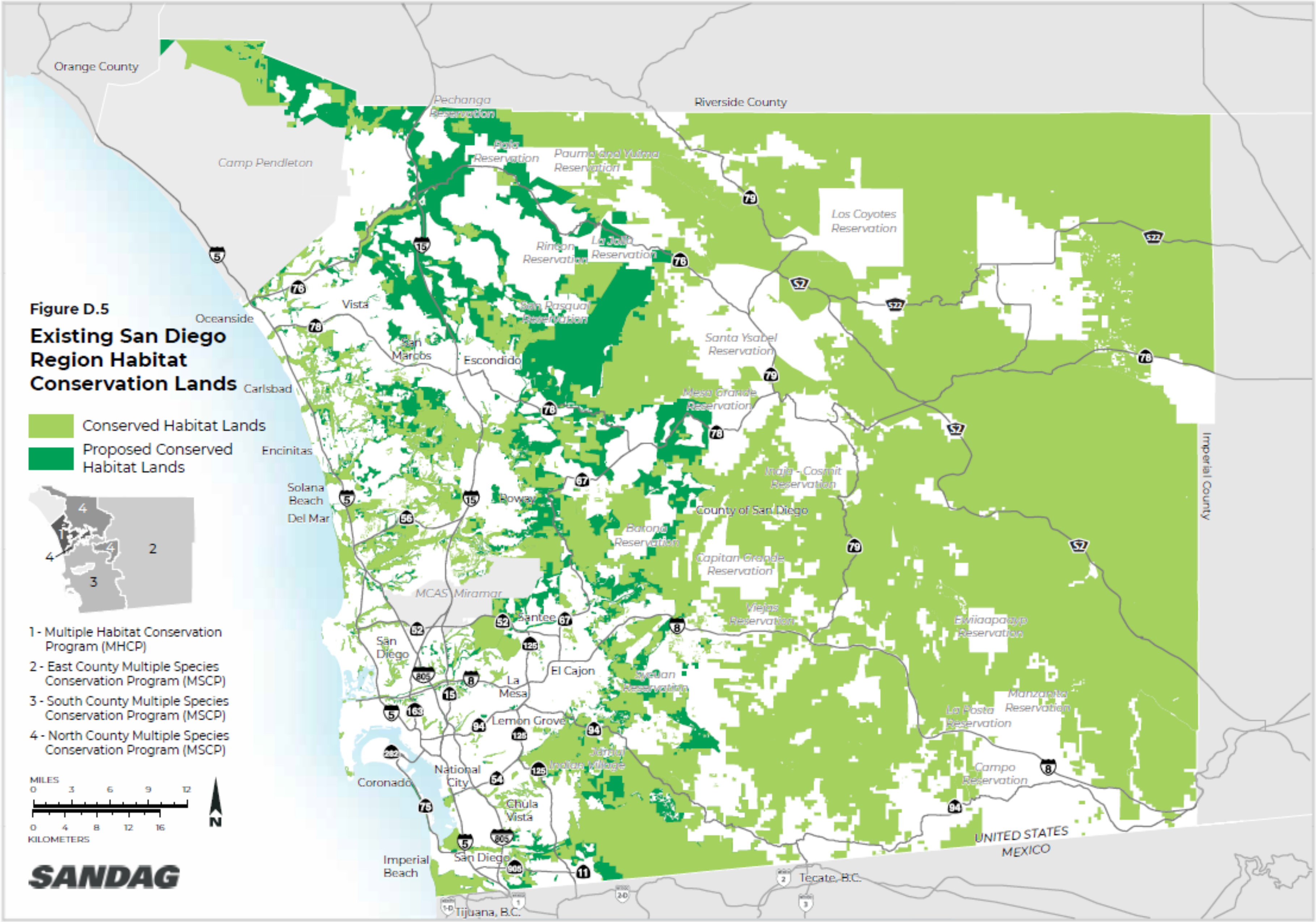


Figure D.6: Existing San Diego Region Generalized Vegetation

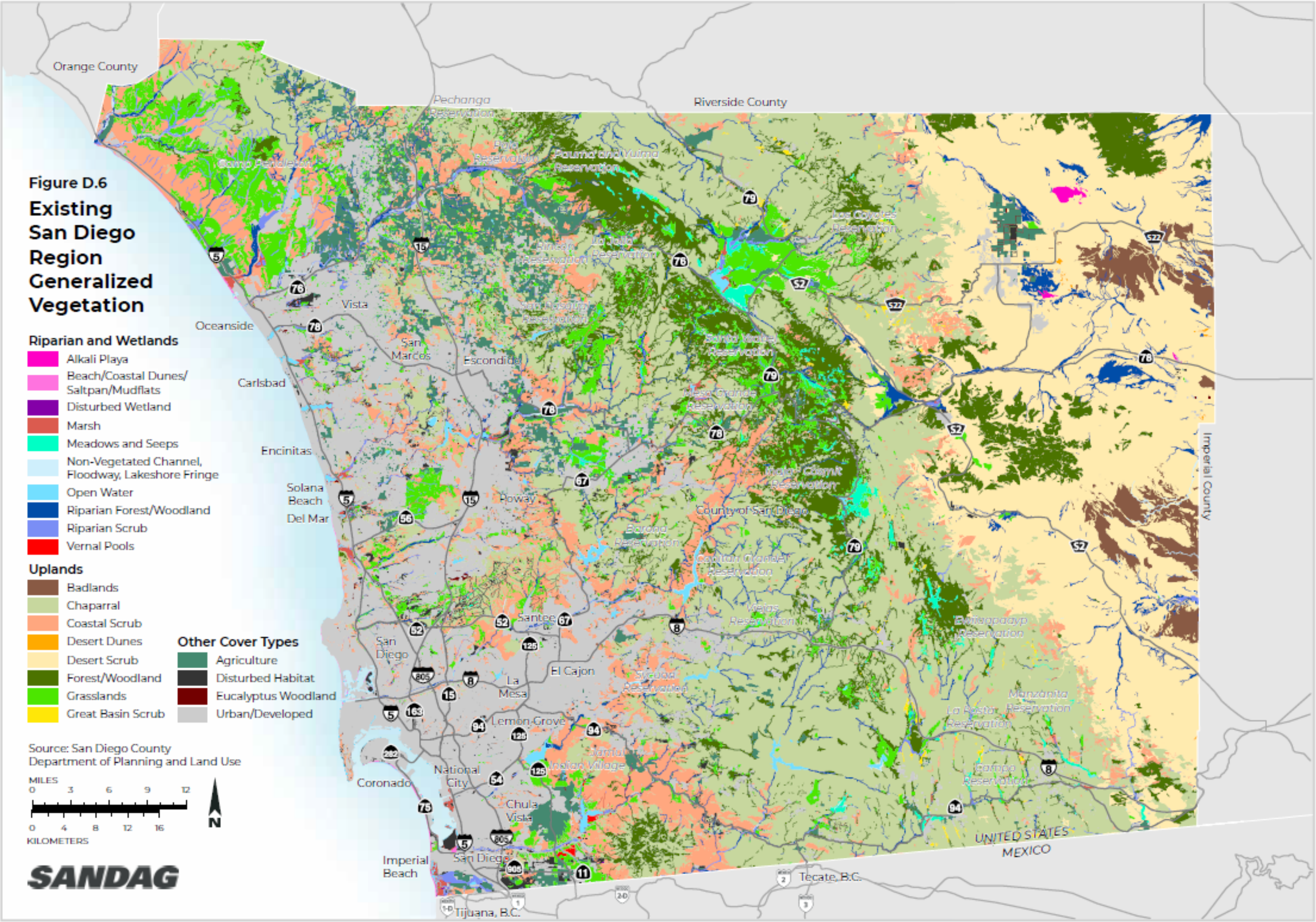
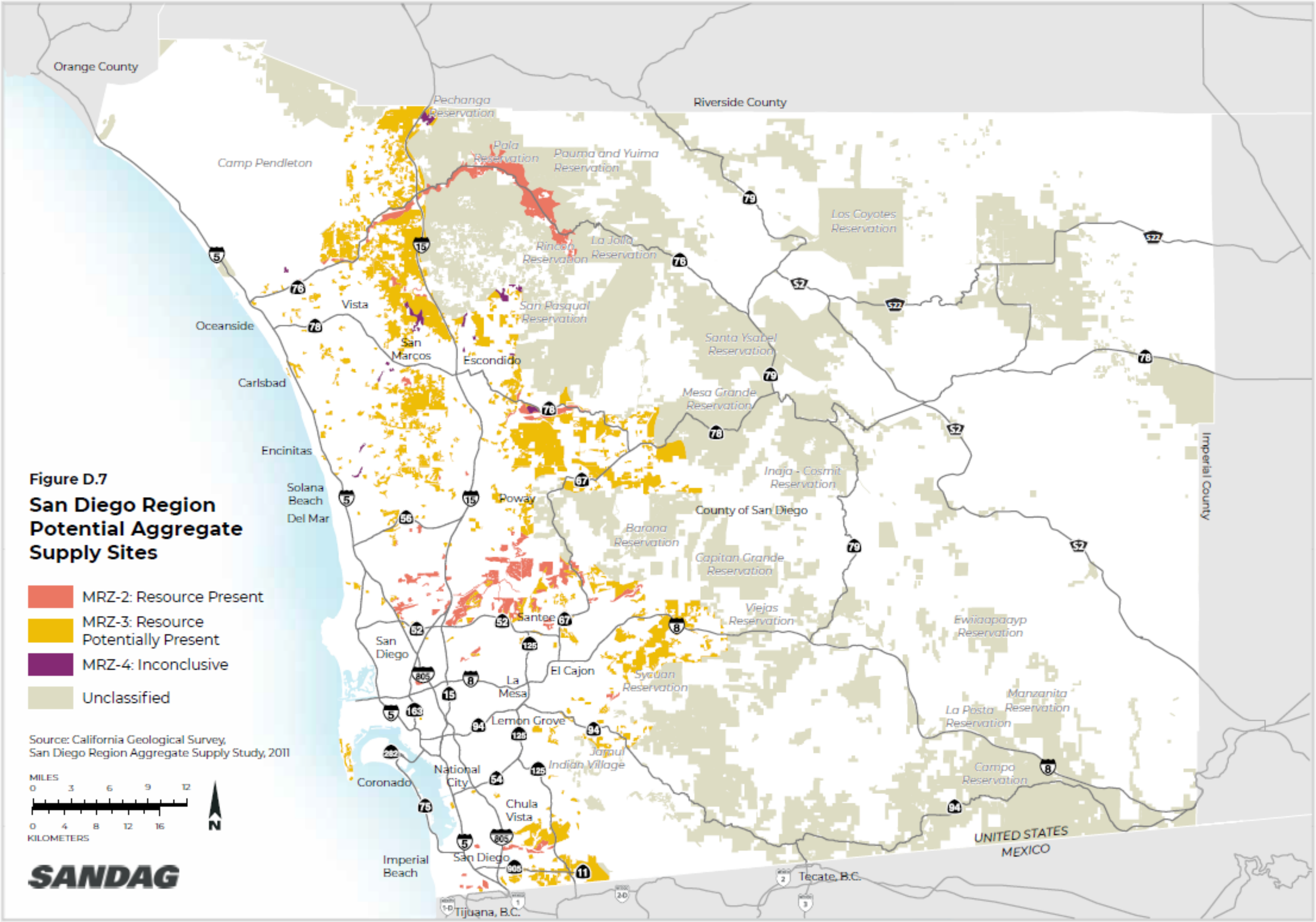


Figure D.7: Potential Aggregate Supply Sites



Transit Priority Projects under SB 375

SB 375 provides a streamlined environmental review for Transit Priority Projects[2] that, among other things, are located within a half-mile of a "major transit stop," defined in Public Resources Code Section 21064.3,[3] or "high-quality transit corridor," defined as a corridor with fixed-route bus service with service intervals no longer than 15 minutes during peak commute hours. Figures D.8 and D.9 depict potential areas for Transit Priority Projects based on the 2035 and 2050 transit systems, respectively.

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2 "Transit Priority Project" is defined in Public Resources Code Section 21155.1

3 "Major transit stop" means a site containing any of the following:

a. An existing rail or bus rapid transit station
b. A ferry terminal served by either a bus or rail transit service
c. The intersection of two or more major bus routes with a frequency of service interval of 15 minutes or less during the morning and afternoon peak commute periods

Figure D.8: 2035 Potential Areas for Transit Priority Projects

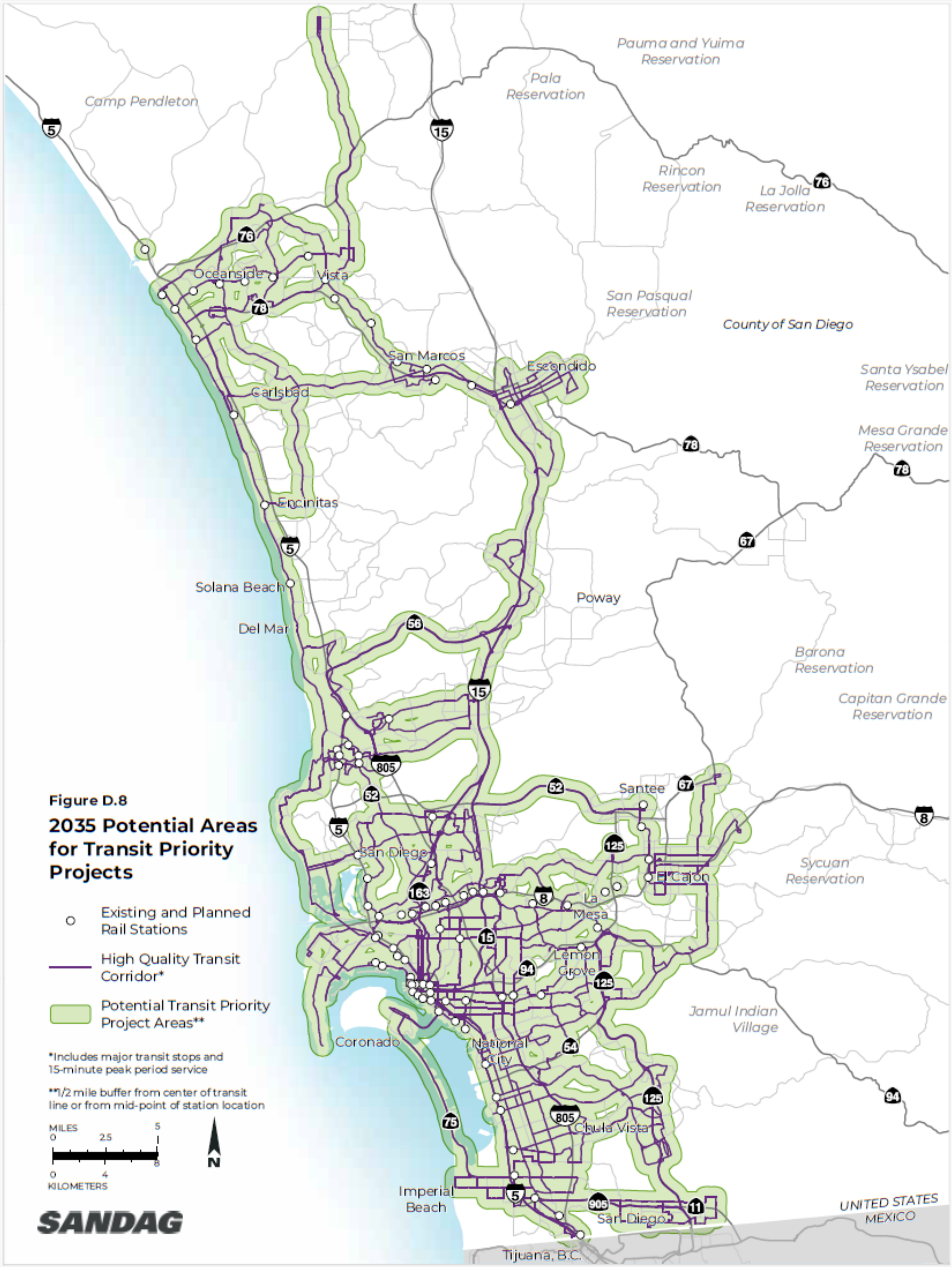
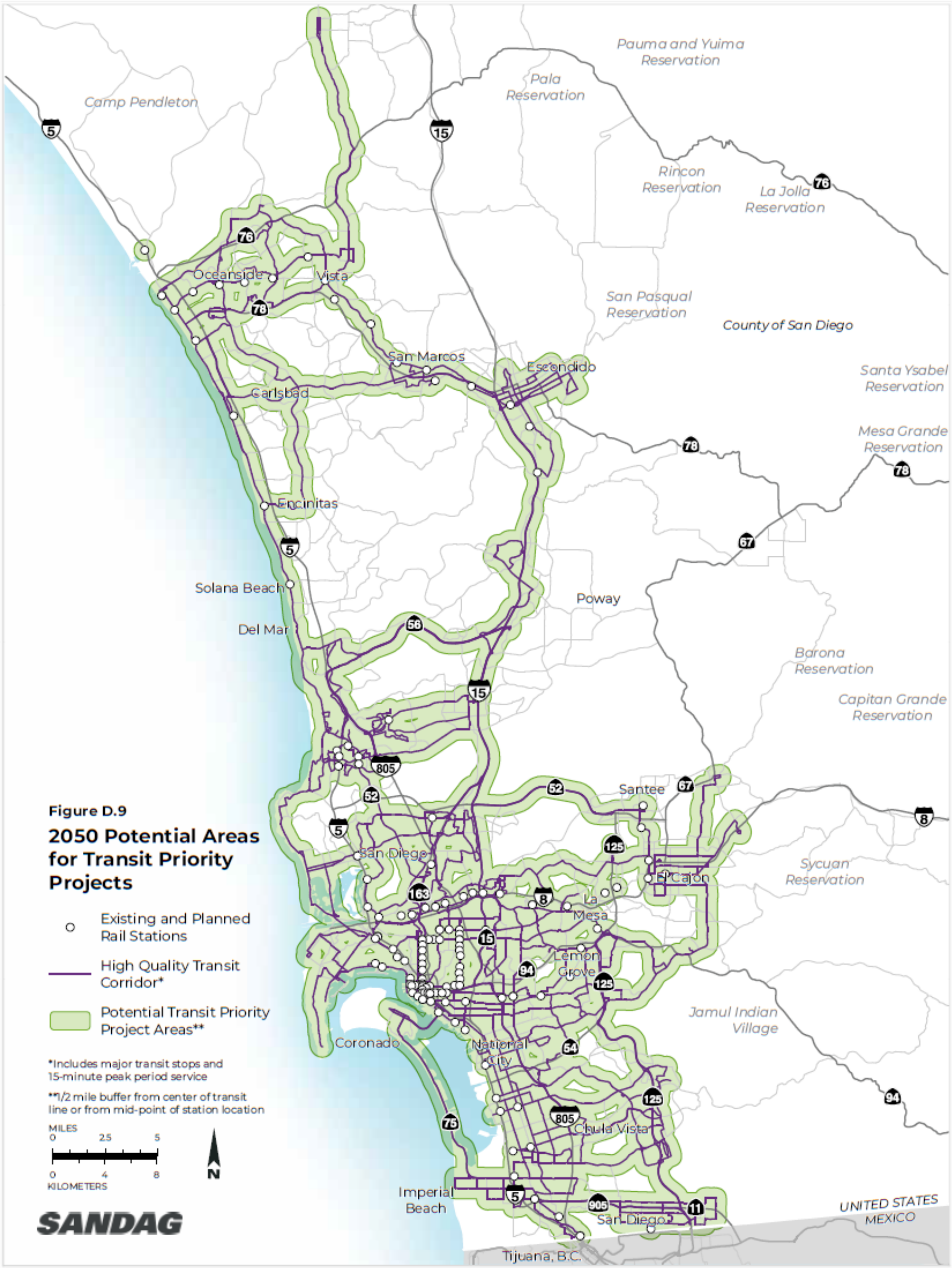


Figure D.9: 2050 Potential Areas for Transit Priority Projects



Transit Priority Areas under SB 743

SB 743 provides for streamlined environmental review for projects within Transit Priority Areas, which is an area within a half mile of a "major transit stop," defined in Public Resources Code 21064.3.[4] Figures D.10 and D.11 depict Transit Priority Areas as defined by SB 743 based on the 2035 and 2050 transit systems, respectively.

[4] "Major transit stop" means a site containing any of the following:

a. An existing rail or bus rapid transit station
b. A ferry terminal served by either a bus or rail transit service
c. The intersection of two or more major bus routes with a frequency of service interval of 15 minutes or less during the morning and afternoon peak commute periods

Figure D.10: 2035 Transit Priority Areas

Figure D.11: 2050 Transit Priority Areas

Attachments

Attachment 1: A) Correspondence from CARB to SANDAG regarding Technical Methodology to Estimate GHG Emissions and B) Correspondence from SANDAG to CARB regarding Technical Methodology to Estimate GHG Emissions for San Diego Forward: The 2021 Regional Plan and SCS

Attachment 2: SB 375 2020 Greenhouse Gas Reduction Estimate

Attachment 3: SB 375 Greenhouse Gas Adjustment Due to Induced Demand

April 20, 2021

Mr. Hasan Ikhrata
Executive Director
San Diego Association of Governments
401 B Street, Suite 800, San Diego, CA 92101
hasan.ikhrata@sandag.org

RE: CARB Review of San Diego Association of Governments' 2021 RTP/SCS Senate Bill 375 Greenhouse Gas Emissions Technical Quantification Methodology

Dear Mr. Ikhrata:

California Air Resources Board (CARB) staff appreciates San Diego Association of Governments' (SANDAG) Senate Bill 375 (SB 375) technical quantification methodology submittal on September 28, 2020, pursuant to requirements under California Government Code section 65080 (b) (2) (J) (i), as well as additional information SANDAG has provided in response to CARB staff's concerns transmitted on November 23, 2020 and February 26, 2021. CARB staff has reviewed all materials that SANDAG has provided on its proposed technical methods and planning analysis tools for assessing SB 375 transportation-related greenhouse gas emissions from its 2021 SCS. Based on our review, staff believes there are no aspects of the submitted technical methodology that would yield inaccurate estimates of greenhouse gas emissions and does not have further changes to suggest.

However, CARB is requesting SANDAG document, at the time of submittal, details on how various strategies in the SCS interact. Specifically, CARB staff requests that SANDAG document and demonstrate how it has avoided double-counting of GHG emission reductions across multiple off-model strategies in their SCS submittal as described below. We appreciate SANDAG staff's expressed willingness to continue to work with CARB staff on its quantification methods.

Off Model Strategy Calculation Methods

For strategies that will be quantified off-model, CARB staff requests SANDAG include a discussion of how it intends to address potential double counting among any strategies overlap off-model and travel demand model quantification. In addition, SANDAG should provide details on the quantification for each off-model strategy in accordance with CARB's *Final Sustainable Communities Strategy Program and Evaluation Guidelines* (SCS Evaluation Guidelines). This should include information on the current and future level of deployment, target population, funding sources, key assumptions, data sources, and step-by-step emission calculations.

CARB staff will conduct its final evaluation, as outlined in the SCS Evaluation Guidelines, once SANDAG submits the final SCS to CARB. The SCS Evaluation Guidelines are intended to clarify the scope of CARB's updated evaluation process, and will focus on changes to land use and transportation strategies and investments that MPOs are making from one SCS to the next. As part of the final review process, CARB staff may request additional information to conduct and support our final evaluation pursuant to SB 375.

We look forward to continuing our collaboration with SANDAG as it finalizes and adopts its 2021 SCS. If you have any questions, please contact me at *nicole.dolney@arb.ca.gov*.

Sincerely,

Nicole Dolney Bourne

Nicole Dolney Bourne
Chief, Transportation Planning Branch
Sustainable Transportation and Communities Division

cc: Ms. Elisa Arias, Director of Integrated Transportation Planning
Elisa.Arias@sandag.org

Mr. Phil Trom, AICP, Principal Regional Planner
Phil.Trom@sandag.org

Technical Methodology to Estimate Greenhouse Gas Emissions for San Diego Forward: The 2021 Regional Plan and Sustainable Communities Strategy from the San Diego Association of Governments

Introduction

California Senate Bill 375 (Steinberg, 2008) (SB 375) requires that metropolitan planning organizations (MPOs) submit a description of the technical methodology they intend to use to estimate the greenhouse gas (GHG) emissions from their Sustainable Communities Strategy (SCS) to the California Air Resources Board (CARB). This technical methodology is submitted in compliance with Government Code § 65080(b)(2)(J)(i) and reflects the best available information as of February 2021.

San Diego Forward: The 2021 Regional Plan (2021 Regional Plan) serves as the long-range planning document for the San Diego region, and it also functions as the Regional Transportation Plan (RTP) and SCS, which will comply with state and federal regulations including SB 375 and federal air quality conformity.

This report describes the proposed technical methodology to estimate GHG emissions for the 2021 Regional Plan. Components currently under development are noted in this report. San Diego Association of Governments (SANDAG) staff will provide information to CARB on those components as they are finalized.

SANDAG has completed two Regional Plan/SCS cycles to date, adopting the latest SCS (San Diego Forward: The 2015 Regional Plan) in October 2015. CARB accepted that SANDAG's first SCS (2050 Regional Transportation Plan) and second SCS (San Diego Forward: The 2015 Regional Plan) if implemented, would meet or exceed the applicable targets of 7% reduction for 2020 and 13% reduction for 2035 relative to 2005. The target achievement for the 2050 Regional Transportation Plan was estimated at 14% for 2020 and 13% for 2035. The target achievement for the 2015 Regional Plan was estimated at 15% for 2020 and 21% for 2035.

For the 2021 Regional Plan, slated for adoption in late 2021, the 2035 per capita GHG target has been updated through a CARB action in March 2018. For the San Diego Region, the updated target is now 19% per capita reduction by 2035 relative to 2005. The 2021 Regional Plan also will include the new 15% per capita reduction target for 2020, although that date will have passed when SANDAG releases the Draft 2021 Regional Plan in 2021.

The 2021 Regional Plan will include strategies and investments that influence travel decisions and land use patterns between 2021 and 2050, a 30-year time horizon. Table 1 displays the proposed analysis years to be used in forecasting GHG emissions for the 2021 Regional Plan. The year 2035 target for the 2021 Regional Plan will be at the midpoint between adoption (2021) and the Regional Plan's horizon year (2050). An additional 2025 phasing year has been selected. Additional interim years will be modeled for the purposes of meeting federal air quality conformity requirements.

Table 1. Analysis Years for the 2021 Regional Plan

Year	Purpose
2005	Base Year for SB 375 GHG emission-reduction Target Setting
2016	Base Year for 2021 Regional Plan/SCS
2020	SB 375 GHG Emission Reduction Target
2025	Interim Phase Year
2035	SB 375 GHG Emission Reduction Target
2050	Horizon Year

Progress Made to Date

The development of the 2021 Regional Plan was initiated with a rethinking of the vision for the San Diego region including a reimagining of mobility solutions to be included in the Regional Plan. The vision that was subsequently developed was shaped by five interrelated strategies for mobility, collectively known as the 5 Big Moves. The strategies that comprise the 5 Big Moves are Complete Corridors, Transit Leap, Mobility Hubs, Flexible Fleets, and a next-generation transportation operating system known as the Next OS. In short, these investments are being planned to achieve vastly more efficient and accessible major corridors of travel, a completely new high-speed and high-capacity public transit network, a new network of Mobility Hubs where people and multiple mobility options come together, Flexible Fleets of vehicles that offer people quick mobility options when and where they need them, and a regionwide digital platform that unifies the 5 Big Moves.

The development of the new vision for the San Diego Region was created in three phases:

Phase 1: Concept Development

The general concept for the Vision was informed significantly by early work on the 2019 Regional Plan, which led to the 2019 Federal Regional Transportation Plan (2019 Federal RTP). This work included reviewing case studies and best practices, consulting with transportation operators in the region, interviewing private-sector providers, and gathering other perspectives, including significant community input gained through two outreach programs in 2018. Insights gained from these previous efforts—in conjunction with more recent work—have served as the foundation for the 2021 Regional Plan.

SANDAG also conducted a series of focus groups, each with a diverse cross-section of the region's residents, to gather feedback on how each of the 5 Big Moves could improve participants' lives. In this sense, the Vision reflects the views and opinions of real people from communities throughout the region. SANDAG designed the Vision based on both data analysis and what people told the agency in these focus groups. This process is known as Human-Centered Design. For example, individuals in focus groups were asked what they thought about SANDAG's ideas for Flexible Fleets and then what they thought would make Flexible Fleets a viable alternative to driving alone. Many residents said they would view a Flexible Fleet service as a real alternative to driving if it could get them from their home to a public transit station within ten minutes. SANDAG also went on a roadshow throughout the region and hosted visiting hours at SANDAG in the Vision Lab that allowed staff to engage with community organizations, individuals, and groups to communicate and gather feedback on the 5 Big Moves. SANDAG professionals relied on all of this feedback as they built the Vision.

Meanwhile, a Vision Advisory Panel was convened to gain insights from private industry leaders about how emerging technology might enhance personal mobility and how public–private partnerships might accelerate their adoption in the region. The Panel consisted of executives and thought leaders in the fields of wireless communications, intelligent transportation systems, original equipment manufacturing (auto, bus, truck), data analytics, artificial intelligence and automation, fleet-management systems, and venture funding based in Southern California.

Phase 2: Network Development

Once SANDAG developed a conceptual idea for what a future regional transportation network might look like, it was time to actually build the network. This required a series of iterative analyses in which data related to population, employment, and demographics were repeatedly analyzed in order to reach the best answer to a given question—where a new commuter rail line might be needed most, or where to situate a Mobility Hub, for example. Decisions about how to build each network were based on data analysis as well as feedback from residents, professional judgment, and SANDAG's deep knowledge of the region's diverse communities.

SANDAG gathered data from numerous sources, including surveys by the federal government on the location of employees and employers, the U.S. Census Bureau, land use information from local jurisdictions, individual traveler data from cellular devices, goods-movement data from trucking and other commercial transport operations, and citizen feedback. Data was primarily analyzed using the geographic information system (GIS) tool, ArcGIS, and geospatial statistical methods. GIS in transportation planning can take numerous sources of data and visualize them on maps to model traffic patterns, plan new routes and services, and assess the environmental impacts of new transportation infrastructure. ArcGIS is a GIS tool maintained by the Environmental Systems Research Institute (ESRI), and all SANDAG's geospatial analyses use the ArcGIS platform.

Phase 3: Network Refinement

The final steps in the development of the Vision for the 2021 Regional Plan were to refine critical elements of the network and to verify that the Vision network would meet future mobility needs. With the Transit Leap and Mobility Hubs networks developed, a process known as a propensity analysis was conducted to ensure that each service would be located where it would be needed most based on the area's demographics and how people in that particular area travel. Transit Leap and Complete Corridors networks were evaluated to ensure that sufficient freeway and transit capacity would be available to meet future travel demands on every major corridor in the region.[1]

Schedule

Working toward a late 2021 adoption date, the 2021 Regional Plan has achieved the following interim milestones. Future work will be developed based on the activities surrounding the development of the transportation vision (noted as "anticipated").

- On February 22, 2019, the Board of Directors unanimously approved an action plan to develop a bold new vision for San Diego Forward: The 2021 Regional Plan.
- On April 26, 2019, staff introduced the 5 Big Moves as key strategies for developing a transportation system that provides safe, convenient, equitable, and attractive travel choices

[1] More information about the development of the Regional Transportation Vision, including the Summary Report and timeline, can be found at sandag.org/uploads/meetingid/meetingid_5317_27885.pdf

that will meet state and federal requirements, including a Sustainable Communities Strategy that achieves the greenhouse gas emission reduction targets set by CARB. This phase included the start of the public process for scenario development.

- On July 12, 2019, staff presented more detail on the 5 Big Moves to the Board for discussion. The presentation showed how key employment and commute data was being used to develop new solutions to longstanding commute challenges. The Board directed staff to continue development of the 2021 Regional Plan, focusing on the 5 Big Moves and conforming to all state and federal requirements, while also prioritizing specific corridors using the Complete Corridors model.
- On September 27, 2019, the Board allocated $593.4 million over the next five fiscal years to advance planning for 12 Complete Corridors and a Central Mobility Hub with transit connectivity to the airport. The Board action also included funding for regional programs related to the 5 Big Moves (Regional Electric Vehicle Charger Incentive Program, Flexible Fleets Pilot, and Smart Center Concept of Operations).
- On October 8, 2019, Governor Gavin Newsom signed Assembly Bill 1730 (Gonzalez) into law. This law, in effect, keeps the region in compliance with state laws to ensure important state funds continue to flow to the region while the 2021 Regional Plan is being developed. Also in October, the Board approved the 2019 Federal RTP to keep important transportation funding coming to the region while the vision is being developed. In November, the U.S. Department of Transportation issued the 2019 Federal RTP air quality conformity finding.
- From January through August 2020, staff delivered a series of presentations to the Policy Advisory Committees and Board on topics related to the Regional Plan in preparation for the presentation of the vision. Presentation topics included our regional economy, data-driven planning, big data, regulatory requirements, environmental impact reports, transportation modeling, lessons learned from COVID-19, and the Regional Vision.
- In February 2021,staff conducted the SCS Information Session.
- Spring/Summer 2021 (anticipated): Staff will release the Draft 2021 Regional Plan and Draft EIR for public comments and conduct outreach and workshops.
- Summer 2021 (anticipated): Staff will address public comments and finalize the Plan and EIR.
- Late 2021 (anticipated): Staff will seek Board adoption of the 2021 Regional Plan. The adopted 2021 Regional Plan will be submitted to CARB requesting acceptance of the SCS. It will also be submitted to the California Transportation Commission and Caltrans to comply with state requirements, and to the U.S. Federal Highway Administration, the U.S. Federal Transit Administration, and the U.S. Environmental Protection Agency to seek the air quality conformity finding.

2015 Regional Plan CARB SCS Evaluation Recommendations

During CARB's review of the 2015 Regional Plan and SCS, two recommendations were provided to SANDAG regarding the modeling methodology. These recommendations are as follows:

- CARB staff recommends that SANDAG should consider using the latest version of the California Household Travel Survey. They should revisit and recalibrate the mode choice model using the latest household travel survey data.

- CARB staff recommends that SANDAG should consider conducting stated preference surveys of households and firms to improve the location choice model of their ABM. Further, SANDAG should collect floor space rent data to improve the economic characteristics of land use model.

As stated in this technical methodology, SANDAG conducted a 2016–2017 Household Travel Survey for the purposes of the updated SCS as discussed in the Travel Demand Modeling section of this document. The recent travel survey was used to update the mode choice model used in the preparation of the 2021 Regional Plan SCS.

SANDAG implemented a population synthesizer that handles the evolution of households using historical data to determine if a household is created, dissolved, or has members added or subtracted. This is similar to a household location choice model but retains greater consistency between forecast years due to the evolutionary aspects.

Floor space rent is not a specific variable in the land use model used in the 2021 Regional Plan and SCS, but the model used does consider patterns of past development, of which cost of floor space is an attribute. The land use system being developed for the 2025 Regional Plan does take cost of floor space into account for both residential and non-residential land uses by type (office, industrial, retail).

Overview of Existing Conditions

Since the adoption of the current Sustainable Communities Strategy in 2015, several notable changes have occurred in the region that are likely to influence the development of the 2021 Regional Plan. These changes include completion of key transportation projects, updated plans and policies from local jurisdictions, new outlooks on regional growth and funding availability, and emergence of new mobility services. In recognition of these changes, SANDAG pursued an extension in the adoption schedule for its third SCS to allow for time to develop and evaluate a Regional Vision to inform the 2021 Regional Plan. This Vision provides the framework for the 2021 Regional Plan centered around the 5 Big Moves.

Key transportation projects completed since 2015:

- South Bay *Rapid*
- State Route 15 Transit Only Lanes
- Interstate 805 High-Occupancy Vehicle lanes (State Route 52 to Carroll Canyon Road)
- Significant progress on Mid-Coast Trolley
- Sweetwater Bikeway – Plaza Bonita Segment
- Bayshore Bikeway – 32nd Street to Vesta Street
- Inland Rail Trail (Phase 1)
- State Route 15 Commuter Bikeway
- Bayshore Bikeway – National City Segment
- Coastal Rail Trail – Encinitas (Chesterfield Drive to Santa Fe Drive)

Updated plans and policies from local jurisdictions:

- Climate Action Plans: 17 of the region’s 19 jurisdictions have an adopted CAP (up from 9 in 2015)

- Updated Community Plans/Specific Plans
- Jurisdictions are currently updating housing elements to reflect Cycle 6 RHNA and incorporate many new housing laws

New outlook on regional growth and funding availability:

- Updated population forecast for San Diego region is 6.5% lower in 2050 compared to prior plan
- In 2016, SANDAG sales tax initiative failed at the ballot
- In 2020, Metropolitan Transit System decides to withhold additional transit specific sales tax initiative due to challenges of bringing such a measure forward during the current pandemic

Emergence of new mobility services:

- Since 2015, bikeshare and scootershare services launched in several jurisdictions, military bases, and college campuses
- In 2017, SANDAG partnered with Waze Carpool to encourage dynamic ridesharing with major employers including military bases
- The neighborhood electric vehicle (NEV) service also known as Free Ride Everywhere Downtown (FRED), operated by Circuit, operates in Downtown San Diego and continues to grow. FRED transported 194,600 riders in 2018 compared to 132,000 riders in 2017
- In 2018, ridehailing companies Uber and Lyft started providing shared rides, otherwise known as "pooled ridehailing," which matches passengers with similar origin and destination with the same driver
- In 2019, SANDAG received a Caltrans planning grant to conduct a statewide ridehailing survey in partnership with SCAG and MTC. The 2019 Transportation Study, which will be completed in Spring 2021, will help the agencies gain insight on the relative travel behaviors of people across California and how new services such as Uber, Lyft, and electric scooters are changing travel choices statewide
- In 2019, SANDAG, North County Transit District, and the City of Carlsbad partnered to deploy a microtransit pilot to serve commuters traveling to the Carlsbad employment center
- In 2019, the City of Oceanside partnered with FordX to launch Hoot Rides, a neighborhood electric vehicle rideshare pilot. The all-electric shuttles served the Downtown Oceanside area, providing residents and visitors with an affordable and convenient connection to the nearby Oceanside Transit Center and community events

The Importance of Data

Data analysis combined with stakeholder input will continue to guide the development of a comprehensive vision for a transportation ecosystem that leverages technology to create a safe, adaptable, and equitable transportation network with fast, fair, and clean choices to move around the region seamlessly.

Thoughts on the Pandemic

Since March 2020, economic conditions have changed dramatically due to the COVID-19 pandemic. It is anticipated that these declining conditions will influence short-term growth forecasts, transit, shared mobility ridership, and the certainty of near-term revenue sources, particularly those tied to economic activity. SANDAG will continue to evaluate both economic and social conditions related to the pandemic and if/how these will impact the development of the 2021 Regional Plan.

SANDAG conducts ongoing research and data collection, and surveyed thousands of residents and businesses across the region, to truly understand the impacts of COVID-19 on socioeconomic and travel patterns. During the early stay-at-home orders, freeway traffic levels sharply declined along with vehicle emissions, but traffic and air quality are now returning to pre-COVID conditions. Although many reported driving less during the health crisis, survey results showed that 78% of respondents reported using online shopping and deliveries more than usual. Border crossings for both pedestrians and privately owned vehicles were down substantially. Transit ridership plummeted, reaching its lowest level in April 2020 with a 70% reduction compared to the same period in 2019, but data shows that ridership is recovering, and many essential workers continue to rely on public transit. Survey results suggest that the fear of riding public transit may not be as profound as expected. Three in every five residents recently surveyed said they would use public transit at least occasionally once a vaccine for COVID-19 was available. Many businesses transitioned to telework and will consider offering telework options in the future, but according to a survey of some of the largest employers in the region, most employers will continue to offer telework on a part-time basis for a portion of their workforce. Like telework, we also saw more people biking and walking to get around. Overall, COVID-19 revealed immense disparities across the region and inequities in access to opportunities, jobs, education, healthcare, and other community resources.

Population and Employment Growth Forecasts

SANDAG will create a population, housing, and jobs forecast for the 2021 Regional Plan in two steps: first, by developing a regionwide forecast of population, jobs, and housing units, and second, by allocating this regionwide total to the subregional level.

At the region level, the 2021 Regional Plan will use population projections developed by the California Department of Finance (DOF) in January 2020. These publicly available projections include detailed data by age, race, ethnicity, and sex for single-year increments out to 2050. SANDAG is involved in review of the projections from DOF and was able to provide input and feedback in the development of the 2020 projections series before finalization.

SANDAG decided to use these projections as the regionwide population controls because recent state-level changes narrowed the threshold for alignment between DOF population projections and an agency-developed population projection. With the passage of California Assembly Bill 1086 (Daly, 2017), councils of governments would be required to confer with the state to use an agency-developed population projection that fell outside a 1.5% threshold below or above the DOF population projection. This margin of variance from the state numbers is much smaller than in previous years, leaving less room for a council of governments to vary from state-level inputs or methodology when developing its own population projection. Due to this recent change, SANDAG elected to use the DOF population projection.

Rates of household formation, unemployment, and labor force participation are then applied to this cohort-specific regionwide population total to arrive at the number of households and jobs in the region. Goals were set for the housing unit forecast to achieve a healthy vacancy rate of 4% in the region and household headship rates from the 2010 decennial census were used as targets for 2050. These controls are used to arrive at the forecast of housing units at the region level.

The combination of a vacancy rate of 4% and a smaller household size derived from the application of household headship rates applied to an aging population results in a relative increase in housing units in this forecast even though population increases are lower than in previous forecast versions.

The higher employment numbers in this forecast as compared to previous forecasts can also be attributed to differences in the characteristics of the population. Future employment is estimated based on historic labor force participation rates with assumptions about how they will change in the future. When these rates are applied to the age, race, ethnicity, and sex structure of the population in the latest DOF projections, the result is higher employment counts than in previous forecast versions. The future assumptions about labor force participation were included in future assumptions covered in the Peer Review Panels held about the Series 14 forecast.

An economic forecast will also be developed based on the cohort-specific regionwide forecast. Specifically, income growth is calculated based on historically observed rates and forecasted to arrive at median household income and household income by five income categories. All demographic and economic rates are based on observed data and rely on historical trends to forecast future conditions.

SANDAG vetted the use of the DOF projections along with the socioeconomic and demographic rates used in the regionwide forecast with the Board of Directors as well as with three expert panels comprising industry professionals and regional stakeholders.

This methodology differs from the regional growth forecast methodology used in the 2015 Regional Plan. For the 2015 Regional Plan/SCS, the regionwide data was developed using a model called the Demographic and Economic Forecasting Model (DEFM). The use of the DOF population projections in conjunction with the socioeconomic and demographic rates described above is a replacement of the DEFM methodology. The allocation of the regional population, housing units, and jobs to subregional areas is performed using the Integrated Land Use, Demographic, and Economic Model (I-LUDEM), described in the Land Use Modeling section below.

The draft regionwide population total in 2050 for the 2021 Regional Plan/SCS is 3.7 million persons, which is lower than the previous regionwide population of 4.1 million persons from the 2015 Regional Plan/SCS. This lower projected growth can be attributed to falling fertility rates and lower rates of domestic and international migration to the region. Jobs in the region are projected to rise by almost 460,000 jobs between 2016 and 2050. The increase in jobs between 2012 and 2050 in the 2015 Regional Plan and 2021 Regional Plan was similar at about 460,000 more jobs.

Regional Growth	2015 Regional Plan/SCS	2021 (Draft) Regional Plan/SCS
Population		
Base year (2012/2016)	3,143,429	3,309,510
2020	3,435,713	3,383,954
2035	3,853,698	3,620,348
Housing		
Base year (2012/2016)	1,165,818	1,190,555
2020	1,249,684	1,226,461
2035	1,394,783	1,409,866
Employment		
Base year (2012/2016)	1,450,913	1,646,419
2020	1,624,124	1,704,071
2035	1,769,938	1,921,475

Quantification Approaches

2021 Regional Plan Strategy Quantification

The strategies under consideration in the 2021 Regional Plan span a wide range of scenarios employing methods to influence the performance of the region's transportation system. The elements of these strategies can be broken down into Transportation System Infrastructure and Operations, Demand Management, Land Use, and Zero Emission Vehicles. The two main quantification approaches are SANDAG's regional travel demand model ABM2+ and a set of off-model calculators developed to handle elements that cannot be treated by ABM2+. The selected approach for each strategy element is based first upon a determination of whether that element can be represented in the ABM2+ travel demand model. This determination has been made based upon the ABM2+ technical documentation, the ABM2+ sensitivity analysis report, and the findings of the ABM2+ technical advisory committee. Those elements that cannot be represented in ABM2+ were then considered for off-model quantification based upon the expected impact of that element on the overall performance of the transportation system and its associated externalities as well as an identification of a feasible off-model methodology and associated recommendations from CARB and prior off-model developments (at SANDAG and other MPOs). SANDAG contracted with the University of California, Institute of Transportation Studies through the U.C. Irvine campus to validate the overall quantification approaches along with the development and updating of the off-model quantification approach.

Regional Plan/SCS Strategy	Inclusion in Prior SCS?	Quantification Approach
Transportation System Infrastructure and Operations		
Description of the 5 Big Moves available in the Vision for the 2021 Regional Plan Network Development Summary Report: sdforward.com/summary		
Complete Corridors and Transit Leap: • Managed Lanes • HOV/HOT policies • Regional Bike Network • Commuter rail • Light Rail • Next Generation Rapid • Local Bus	Yes. 2021 SCS is likely to expand on these strategies	Coded as transportation network improvements in ABM2+
Mobility Hubs and Flexible Fleets: • Local complete streets • Parking management • Microtransit • Micromobility • Pooled TNCs • E-bikes	Mobility Hubs were introduced in the prior SCS, but investment and specific geographic information was limited, as were associated strategies and fleet assumptions	Mobility Hubs are used as a geographic area for applying complete streets, parking, microtransit, and micromobility strategies in ABM2+ Pooled TNCs and E-bikes are reflected in mode choices in ABM2+
Next OS: • Active Transportation Demand Management (ATDM) • Smart Signals	Yes. 2021 SCS is likely to expand on these strategies	ATDM reflected as improved travel reliability in ABM2+ Smart signals reflected as reduced intersection delays in ABM2+
Demand Management		
Telework	Yes. Ability to capture primarily and occasional telework is new	Primarily and occasional teleworker assumptions applied in ABM2+
Pooled rides (private)	Yes, off-model in prior SCS	Off-Model
Vanpool	Yes, off-model in prior SCS	Off-Model
Carshare	Yes, off-model in prior SCS	Off-Model
Regional TDM Ordinance	No, new off-model calculator	Off-Model

Regional Plan/SCS Strategy	Inclusion in Prior SCS?	Quantification Approach
Pricing Strategies: • Road user charge • Transit Fare Subsidies • Congestion Pricing/Toll Rates • Parking • TNC Fees	Carryover pricing strategies include congestion pricing/toll rates, parking pricing New pricing strategies include road user charge, transit fare subsidies, and TNC fees	Pricing strategies reflected in ABM2+ as follows: • Road user charge: per-mile charge added to the auto operating cost • Transit Fare Subsidies: one-way and daily transit fares defined for each service type • Congestion Pricing/Tolled Rates: per-mile tolls defined by time of day for each managed lane corridor and fixed-fee tolls for the State Route 125 toll road • Parking: hourly, daily, and monthly rates applied to certain Mobility Hub areas and charged to auto trips destined for those specified areas • TNC Fees: applied as fixed fee per trip
Land Use		
SCS Land Use Pattern that considers: • Job–Housing Balance • Mixing of uses • Transit-oriented development • Housing needs	Yes. The 2021 SCS will likely include expanded land use policies reflected in the SCS land use pattern	Mobility Hub areas used as a framework for the allocation of housing and jobs in the land use pattern developed in Integrated Land Use, Demographic, and Economic Model (I-LUDEM) and impact modeled in ABM2+
Zero Emission Vehicles		
Regional EV Charger Program	Yes, off-model in prior SCS. The 2021 SCS will likely include an expanded EV charger program	Off-Model
Regional EV Incentive Program	No. The EV incentive program would be a new SCS strategy	Off-Model

Interregional Travel

The external travel models predict characteristics of all vehicle trips and selected transit trips crossing the San Diego County border. This includes both trips that travel through the region without stopping and trips that are destined for locations within the region. The external–external, external–internal, and internal–external trips in San Diego County were segmented into these trip types: U.S.–U.S., U.S.–Mexico, Mexico–San Diego County, San Diego County–Mexico, U.S.–San Diego County, and San Diego County–U.S.

Here, "U.S." represents locations in the United States outside of San Diego County. The total count of trips by production and attraction location was estimated in a series of steps:

1. The number of trips made by Mexican residents to attractions in San Diego was based on 2010–2011 Cross Border Survey data.
2. The trips in the 2016–2017 Household Travel Survey were expanded to estimate the total number of trips made by San Diego residents to attractions in Mexico.
3. The number of Mexico–San Diego County (1) and San Diego County–Mexico (2) trips was subtracted from the total number of border crossings to derive an estimate of the number of U.S.–Mexico trips. The distribution of U.S.–Mexico trips among external stations on the U.S. side of San Diego County is assumed to be proportional to the total volume at each external station, regardless of the port of entry at the Mexican border.
4. The number of U.S.–Mexico trips was then subtracted from the total number of trips in the SCAG cordon survey to arrive at an estimate of the combined total of U.S.–U.S., U.S.–SD, and SD–U.S. trips with routes through San Diego County.
5. Finally, the actual amounts of U.S.–U.S., U.S.–SD, and SD–U.S. trips at each external station were estimated from the remaining trips (4) according to their proportions in the successfully geocoded responses in the SCAG cordon survey.

Details of the interregional travel survey can be found in the SANDAG ABM2 Model Update (2018) report from the ABM2+ wiki reports and documents list at github.com/SANDAG/ABM/wiki/Reports-and-Documents.

EMFAC Version

For the 2021 Regional Plan, SANDAG will use EMFAC 2014 for CO_2 emissions modeling for SB 375 purposes. SANDAG will use EMFAC 2014 based on the 2019 SCS Guidelines, which state that MPOs should use the same version of EMFAC as they used for the second SCS (i.e., 2015 Regional Plan). In addition, SANDAG will use the EMFAC adjustment to the percent reduction in CO_2 per capita methodology developed by CARB for the second SCS. The adjustment for SANDAG is +1.8% per capita reduction for 2020 and +1.7% per capita reduction for 2035; that is, the 2021 Regional Plan SCS has to reduce the estimated change in CO_2 by nearly two additional percentage points. The applied methodology can be found in Appendix A.

2020 GHG Quantification

SANDAG's 2020 GHG target will be evaluated using a fusion of existing data and estimated regional travel. 2020 will be a historic year when the SCS is submitted, but because there are no direct methods for measuring either VMT or GHG, SANDAG will need to deploy estimation techniques to determine whether the 2020 GHG target was met. Sources of VMT estimates are available from Caltrans Highway Performance Monitoring System (PeMS) for freeway VMT and regional estimates from Caltrans Highway Performance Monitoring System (HPMS). HPMS data will not be available for 2020 until after the adoption of the SCS, but historical data may be used to assist with estimation techniques. PeMS freeway VMT and speed data for weekday traffic can be used to scale ABM weekday regional VMT estimates. The adjusted VMT data tables can then be used within EMFAC 2014 for CO_2 emissions modeling. PeMS measured data for 2020 will be significantly impacted by COVID-19 due to changes in employment, employee work location and telecommuting, tourism travel, package and food delivery, crossborder restrictions, virus transmission fear on transit vehicles, and transportation costs for gasoline, among many other impacts.

Land Use/Travel Demand Modeling

Land Use Modeling

As a part of a regular data-collection process, SANDAG updates the land use datasets that are used as the base year of the forecast. This process includes updating housing units, employment, and school inventories at the parcel level. This is done with a variety of external data sources such as census data, assessor data, aerial imagery, employment datasets, and other San Diego–specific sources. For the 2021 Regional Plan/SCS this process was completed in order to create the base year file for 2016.

Once the regional growth forecast data are created, SANDAG staff uses parcel-level data on future residential and non-residential capacity to allocate the population, housing units, and jobs to the subregional areas. For the 2021 Regional Plan/SCS, this parcel-level capacity was developed based on input from local jurisdiction staff on in-process projects and updated planning assumptions.

After this capacity is developed, staff programmatically allocates the housing units and jobs that were forecasted at the region level to specific parcels using a subregional allocation model called the Integrated Land Use, Demographic, and Economic Model (I-LUDEM). This is done in part by using controls developed at subregional levels that ensure targets of vacancy rates and household headship rates are met. Housing growth is prioritized or constrained in the region based on measures such as areas within the County Water Authority, areas outside of the CalFire "Very High" hazard areas, areas relatively close to transit, and areas with higher density capacity, which are weighted more heavily than areas with less dense capacity.

After housing units are assigned to the subregional areas, households that represent an occupied housing unit are developed to accommodate the forecasted population in the region. These households are developed based on the application of cohort-specific household headship rates and sociodemographic characteristics to the projected population. These demographic rates are assigned to members of each household based on data from the American Community Survey (ACS) or the 2010 decennial census.

As an SCS strategy, SANDAG may intensify or prioritize residential and non-residential development within certain areas to align the land use pattern with anticipated transportation investments. In some cases, this housing unit or job capacity is higher than the capacity that was developed in conjunction with local jurisdictions for the 2015 Regional Plan/SCS. Additionally, for the 2021 Regional Plan/SCS, the 6th Cycle Regional Housing Needs Assessment (RHNA) Plan is used as a control to ensure that each jurisdiction reaches the total number of housing units that has been allocated by the analysis year 2035. As a result, SANDAG will have a policy-driven SCS Land Use Pattern for use in the 2021 Regional Plan/SCS. This is in addition to a baseline regional growth forecast with a subregional allocation that is consistent with adopted plans.

This subregional allocation method used in the 2021 Regional Plan/SCS is different in some respects from the method used in the 2015 Regional Plan/SCS. First, the subregional model used a tool called the PECAS in the 2015 plan that is not used in the 2021 RP/SCS. Second, the integration of the yearly population estimates as the base year of the forecast in the I-LUDEM model is new to the 2021 Regional Plan/SCS; in the 2015 Regional Plan/SCS the yearly estimates and the subregional forecast were created from two separate processes.

Travel Demand Modeling

SANDAG will use an update of its second-generation Activity Based Model (ABM2+) for the analysis of the 2021 Regional Plan. ABM2+ provides a systematic analytical platform and is intensively data-driven so that different alternatives and inputs can be evaluated in an iterative and controlled environment.

SANDAG first used an ABM for the 2015 Regional Plan/SCS, the second SCS for the San Diego Region. SANDAG has since completed the development of ABM2 and applied it in the 2019 Federal RTP. The major enhancements to ABM2+ from ABM[2] include the following items:

- Implementation of emerging technologies such as micromobility (e-scooter), transportation network company (TNC), microtransit, and autonomous vehicle
- Incorporation of Strategic Highway Research Program recommendations regarding improving the sensitivity of travel models to pricing and reliability
- Implementation of an airport ground access model for the Cross Border Xpress (CBX) facility that serves the Tijuana International Airport
- Replacement of an asserted, aggregate commercial vehicle model with a disaggregate commercial vehicle model
- Update of volume-delay function parameters based upon an analysis of INRIX travel time data
- Calibration and validation using the 2016–2017 SANDAG Household Travel Survey, 2015 Transit On-Board Survey, 2018 Commute Behavior Survey, and 2019 SB1 TNC Survey and reflection of telecommute travel patterns observed from the surveys and Census American Community Survey (ACS) data
- Update of the algorithm used to find transit paths
- Update of the heavy truck model, which models external–internal truck flows, to incorporate the latest Freight Analysis Framework (FAF4) data and projections

To guide ABM2+ development, SANDAG formed an ABM Technical Advisory Committee (TAC). The 11-member TAC is comprised of nationally recognized leaders in the travel demand modeling field who come from a vast array of organizations, such as Federal Highway Administration, CARB, major MPOs, academia, and independent consultancies.

SANDAG hosted two rounds of TAC review and evaluation. The first TAC meeting was held in May 2019 to evaluate modeling strategies to address emerging technologies, such as Transportation Network Companies (TNCs), connected and autonomous vehicles (CAV), transformative modes (e.g., high-speed rail), micromobility (e.g., e-scooters, dockless bicycles), and pricing options. The second TAC meeting was held in March 2020 to follow up on implementing TAC's short-term model recommendations from the first meeting and to evaluate ABM2+ and its usage for the 2021 Regional

[2] See reports "SANDAG ABM2+ Enhancements to support 2021 RTP (2020)" and "SANDAG ABM2 Model Update (2018)" from the SANDAG ABM2+ reports and documents wiki: github.com/SANDAG/ABM/wiki/Reports-and-Documents

Plan. The TAC gave very high remarks on ABM2+, concluding that it not only remained well above the state of the practice, but that some components were state-of-the-art for travel demand models. The new mobility features in ABM2+ go beyond the state of the practice, especially for transportation network company (TNC) and autonomous vehicle (AV) components.

Due to the future uncertainty in autonomous vehicle (penetration rates, level of AV, public policies and regulations), SANDAG will turn off AV components when developing the 2021 SCS based upon the recommendation from the TAC.

Draft ABM2+ Sensitivity Tests

As part of model evaluation for TAC and for addressing CARB's Final Sustainable Communities Strategy Program and Evaluation Guidelines, sensitivity tests were conducted to examine the responsiveness of ABM2+ to potential SANDAG 2021 Regional Plan strategies in February 2020. The extent of sensitivity analysis significantly exceeded the typical validation level for MPOs according to the TAC members. The sensitivity tests include land use, transit infrastructure and active transportation, local/regional pricing, new mobility, and exogenous variables. Tests in new mobility category, including autonomous vehicles (AV), transportation network companies (TNC), and micromobility (e-scooter, e-bike, etc.), were part of validation of the newly implemented features. Most sensitivity tests were conducted using forecast year 2035 and revenue-constrained networks from the 2019 Federal RTP, with 2035 revenue-constrained scenario as the baseline scenario to derive elasticity. To account for the full potential impact of population growth on VMT and mode shares, staff used two 2050 land use scenarios: job housing balance and mix of land use to lower VMT prepared in August 2019. After the TAC meeting, SANDAG conducted additional sensitivity tests on teleworking. The original TAC meeting sensitivity testing report is included as Appendix B.

Induced Travel Analysis

Induced travel refers to the phenomenon that occurs after improvements are made to some aspect of the transportation system in which users of the transportation system engage in more travel.

Induced travel could be reflected in two categories: short-term and long-term. Both short-term and long-term induced travel are attributed to increased vehicle travel due to added capacity to the roadway system (either a new roadway or an existing roadway expansion).

Short-term induced travel could come from individual and household travel response to added capacity, such as:

- choosing to travel at a different time of day (e.g., shifting from before the peak hour to peak hour)
- choosing to travel on a different route (e.g., using the now-faster roadway rather than a slower, alternative route)
- choosing to travel more frequently and to add more stops on a tour (or fewer stops but more tours)
- choosing to travel by car rather than by walking, biking, or public transportation
- choosing to travel to a different place, such as a more distant but newer grocery store or destination

SANDAG ABM2+ explicitly captures all the above short-term induced travel behaviors through simulating changes in time of day, route assignment, frequency, mode, and location choice in response to the improved accessibility brought about by a roadway widening in a congested corridor. Depending on the scale of the response, the outcome may be only a very minor reduction in congestion in the corridor. The table below matches the above behaviors to the SANDAG model components that represent the behavior in question. The table also includes the broad time frame in which the response is expected.

Response to Increase in Supply	Timeframe of Change	ABM2+ Component(s)
Travel at a different time of day or on a different day	Short (within weeks of the improvement)	Scheduling, Daily Activity Pattern
Travel on a different route	Short	Assignment
Travel more frequently	Short	Daily Activity Pattern, Tour Generation, Stop Frequency
Travel by a different travel mode	Short	Mode Choice
Travel to a different place (e.g., grocery store)	Short	Activity Location Choice
Choose to work or go to school in a different place	Medium (within months of the improvement)	Work or School Location Choice

SANDAG's past efforts of sensitivity testing using a draft version of ABM2 for a 2016 forecast year and network with 50% freeway capacity increase result in a 1.4% VMT increase compared to the base year 2016 scenario, an elasticity of 0.2, which is within the range from SB 375 Research on Impacts of Transportation and Land Use-Related Policies.[3] SANDAG will evaluate the VMT elasticity due to a change of capacity in ABM2+. Capacity changes will be evaluated for facilities that may be included in the Regional Plan, including general purpose lanes, managed lanes, HOV lanes, operational improvements on general purpose facilities, and freeway connectors. Repurposed general-purpose lanes will assume no added or reduced induced demand VMT. Where the ABM2+ elasticity is less than documented research, where available, SANDAG plans to use the difference as a VMT adjustment factor to the induced travel VMT calculated from the National Center for Sustainable Transportations (NCST) Induced Travel Calculator (annual VMT factored to an average weekday). If the facility type is not included in the available research from CARB, SANDAG will further adjust the induced travel VMT using an adjustment factor based on a method such as the ratio of vehicle capacity between the facilities.

Elasticity research = freeway elasticity X (facility capacity / freeway general purpose lane capacity)

Induced Travel VMT = (NCST Induced Travel VMT) x (annual VMT to average weekday VMT adjustment factor) x (1 – (elasticity ABM2+ / elasticity research))

If additional research or methodology recommendations are brought forward by peer reviews of the analysis and evaluation performed, SANDAG will modify, adapt, document, and communicate the new methodology. For example, if new research is identified that articulates an acceptable induced demand VMT elasticity range for HOV lanes, SANDAG will work to incorporate the new information.

[3] Senate Bill 375 – Research on Impacts of Transportation and Land Use–Related Policies. arb.ca.gov/our-work/programs/sustainable-communities-program/research-effects-transportation-and-land-use

Long-term induced travel effects include potential household relocation to outer suburbs due to increased access provided by new or expanded roadways and potential land use development in areas with higher-than-average VMT without policies intervention. The relationship between land use and transportation accessibility is complicated and not explicitly represented in ABM2+. However, the SANDAG planning process does consider the land-development plans of local jurisdictions, and the 2021 Regional Plan will consider an SCS land use pattern that complements the proposed transportation system.

Project Selection

Compared to prior plans, SANDAG took a different approach in identifying roadway projects and considers them one part of our system of complete corridors. Because growth in the San Diego region is expected to occur primarily in the western third of the region, travel demand is anticipated to occur primarily on existing major corridors. In identifying projects for the Vision network, SANDAG staff proposed a Managed Lane network to support maximizing the use of existing facilities and creating a seamless systemwide Managed Lanes network that will provide more transportation choices traveling from one end of the region to another. Managed lanes will offer priority and access to transit and high occupancy vehicles which creates higher person capacity on those lanes than general purpose lanes. Developing the Vision network included assessing and estimating increased person capacity opportunity of Managed Lanes as well as transit services that will be available to meet future travel corridor demands.

The next step in the project selection process was to evaluate the projects as corridor "bundles" to determine which corridors had both the most need and opportunity to provide multi-modal alternatives. This was a departure from past Regional Transportation Plans (RTP), where SANDAG utilized transportation project evaluation criteria to prioritize projects by mode specific categories (e.g., highways individually, transit service individually, active transportation individually, etc.).

While the previous mode specific analysis was effective in targeting key issues (such as congestion) it did not speak to the full suite of impacts of those corresponding potential "solutions" such as inducing additional VMT. In contrast, the multimodal bundles evaluated for the 2021 Regional Plan were created to better reflect choices travelers face when traveling to and from regional destinations. Additionally, the bundle analysis allowed the projects to recognize demand inducing characteristics (i.e., congestion) but to leverage this characteristic to reward projects that provide *alternatives* to solving congestion by traditional means (i.e., roadway capacity). For example, previous congestion only scoring on corridors would have emphasized capacity increasing projects that alleviated congestion. The more congestion, the more need to quickly act to provide additional capacity, etc. Alternatively, a multimodal perspective was seen as a way to provide congestion relief alternatives and score those multimodal projects accordingly, thereby rewarding alternative modes and corridors which are multimodal. The following "Mobility and Safety" criteria subset of the project bundle evaluation criteria showcase the dynamic nature of the analysis which speaks to congestion (10 max points) but also speaks to availability of transit capacity to serve those congested corridors (3 max points), combined person peak throughput capacity (5 max points), and transit reliability (5 max points).

Mobility and Safety		30
MS1 Person Peak Throughput Capacity (PTC)	Transit PTC (MS2) + Vehicle PTC(MS3) times vehicle occupancy	5
MS2 Transit PTC	Peak transit capacity (transit rider capacity per number of vehicles/headways per hour)	3
MS3 Vehicle PTC	Peak vehicle capacity (vehicles per lane per hour)	2
MS4 Congestion	Travel time reliability and average peak hour of excessive delay per lane (NPMRDS data)	10
MS5 Safety	Safety incidents (fatalities, serious injuries, and visible injuries)	5
MS6 Transit Reliability	Transit reliability measured by miles of dedicated guideway and transit priority investments.	5

Additionally, multimodal projects (on congested corridors) were awarded points under the "Environment and Quality of Life" evaluation category with access to transit (10 max points), mode availability (2 max points), bike and pedestrian access (2 max points), communities of concern transit access (10 max points), and number of transit stations within mobility hubs (max 5 points)

Environment and Quality of Life		35
EQL1 Access to Transit	People and jobs within ½ mile of a transit station or within a mobility hub[4]	10
EQL2 Activity Centers	Activity Centers within ¼ mile of a transit station	3
EQL3 Network Connectivity	Number of direct connectors and direct access ramps	2
EQL4 Mode Availability	Measure of mode availability (in miles) for transit, managed lanes, and general-purpose lanes.	2
EQL5 Bike and Pedestrian Access	Portion of projects that are located within a mobility hub[5]	3
EQL6 Communities of Concern	Communities of concern (seniors, minorities, low-income residents) within ½ mile of a transit station or within a mobility hub.	10
EQL7 Transit access to future density	Number of transit stations located within mobility hubs[6]	5

The multimodal scoring examples highlight how traditional capacity enhancing projects would score well under the congested corridors criteria (max 10 points) but would score poorly under virtually all of the other categories.

Auto Operating Cost

Common travel-modeling practice assumes that as a person considers whether to drive or take another mode of transportation, two driving cost components are considered: 1) fuel cost per mile of

[4] Mobility hubs offer increased services and infrastructure improvements to access transit
[5] Captures concentration of bicycle and pedestrian improvements focused in mobility hub areas
[6] Mobility hub areas are used as a proxy for future density.

travel and 2) non-fuel operating costs. Fuel cost per mile is calculated based on forecasts for how much gas will cost, as well as the fuel efficiency of a vehicle. Non-fuel operating costs comprise vehicle maintenance, repair, and tires. Auto operating cost (AOC) does not typically include the costs associated with the purchase of a vehicle (purchase/lease costs, insurance, depreciation, registration and license fees) as these are part of a long-term auto ownership decision-making process.

For the 2015 SCS and SB 375 GHG target-setting, SANDAG and the other large MPOs in the state developed a consistent approach to define, estimate, and forecast AOC. After the 2nd SCS cycle, CARB produced an AOC draft calculator that provides a framework for producing an average AOC for all fuel types.

In addition to the CARB AOC draft calculator, SANDAG uses the Oil Price Information Service (OPIS) by IHS Markit for current and historical gasoline prices and the U.S. Energy Information Administration (EIA) for future gasoline prices. The OPIS data was purchased for San Diego County specifically.

The EIA publishes an Annual Energy Outlook forecast with several variations of forecasts for economic growth, oil prices, and resources and technology based on different assumptions (which effectively results in a range of forecasts). The Big 4 MPO group for the 2nd SCS used the U.S. EIA AEO (Annual Energy Outlook) low forecast plus 75% of the difference between the high and low oil price forecast with an adjustment from U.S. costs to California costs. U.S. to San Diego cost differences have been escalating in recent years with the 2019 San Diego average costs reaching $1 per gallon higher than the U.S. average.

For the 2021 Regional Plan and third SCS, SANDAG plans to use the CARB draft AOC calculator assumptions for alternative fuel prices, maintenance, fuel consumed, and fuel efficiency. The only exception to the CARB draft AOC calculator is for gasoline fuel costs. Gasoline fuel costs will be based on the 2020 US EIA AEO low forecast plus 75% of the difference between the high and low oil price forecast with adjustment from U.S. costs to San Diego costs. The gasoline fuel cost calculation is consistent with the methodology applied in the second SCS and 2018 target setting. Additionally, the US EIA fuel forecasts are historically volatile with forecasts being heavily factored based on the current year starting price. Using a forecast that is higher than reference case brings the fuel costs somewhat closer to the assumptions used over the past decade and more in line with historic average fuel costs. SANDAG will hold the 2019 U.S. to San Diego cost difference of $1 constant through the forecasted years. Maintenance costs are under review by SANDAG as the values in the CARB draft AOC calculator use the AAA costs which are based on national current-year costs of automobiles. SANDAG is reviewing the cost differences from national to California and whether the fleet age may impact maintenance costs through the forecast.

The table below compares the 2035 AOC used in the 2015 SCS with draft values for use in the 2021 SCS. Note that 2035 draft AOC for use in the 2021 Regional Plan SCS is lower by almost 35% from 2015 Regional Plan SCS. The more detailed AOC calculations for 2020, 2025, 2035, and 2050 are located in Appendix C.

2035 Forecasts of Auto Operating Costs (Prices in Year 2010 Dollars)

Factor	2015 SCS	2021 SCS (draft)
Pass. Veh. Fleet MPG	27.2	36.8 (gas)
Gasoline Prices ($/gallon)	$4.87	$4.04 (gas)
Non-Fuel Costs ($/mile)	$0.088	$0.069 (gas)
AOC ($/mile)	$0.267	$0.174 (all fuels)

Approach to Incremental Progress Reporting

As part of the modeling effort to provide the Incremental Progress reporting, SANDAG plans to analyze the 2015 Regional Plan SCS2 networks and policies within the ABM2+ model system, including updated exogenous variables. The tables below demonstrate the proposed approach for normalizing key factors and input assumptions. SANDAG will compare this analysis to the 2015 SCS2 results for key regional transportation metrics such as VMT, trip mode share, and SB 375 passenger vehicle GHG per capita.

All GHG results will be analyzed using EMFAC 2014.

Several categories of factors are identified below with description as to what SCS, ABM, or Growth Forecast are used to define them. The categories include, but are not limited to, the following items:

- **Networks and Policies** – would include items such as highway, transit, and active transportation projects; on-model strategies such as HOV policies, toll rates for managed lanes and toll roads, parking, local mileage-based user fees, traffic signal improvements, ATDM, and transit fares.
- **ABM Version** – would include changes to travel behavior collected from recent household, transit, and other travel surveys; improvements to methodologies such as new model components or modified procedures.
- **Interregional Travel** – changes to airport demand forecasts, international crossborder demand, and interregional domestic travel such as trips from Orange County, Los Angeles County, Riverside County, and Imperial County.
- **Demographics and Land Use** – Regional growth forecasts for housing and employment land use, population (households, group quarters, military) by age, race, and ethnicity, households by income, and employment by category.
- **Telework** – telecommuting patterns are updated with each ABM version based on new surveys, census data, and projections, but can also be modified based on regional policies.

The three model runs that will be used are:

1. SCS2 2035 Scenario (as submitted)
2. SCS2 2035 Network and Policy Scenario with Updated Exogenous Variables
3. SCS3 2035 Scenario

Incremental Progress Land Use and Demographics

Incremental progress model runs will perform a stepwise advancement to the land use and demographic data. SCS2 used SANDAG's Series 13 Growth Forecast. For the 2021 Regional Plan and SCS3, SANDAG updated the zoning and land use information from the local jurisdictions and updated the economic growth forecast detailed in the earlier Land Use Modeling section. SANDAG has produced two versions of the Series 14 forecast, one based on baseline estimates of growth and growth patterns from local jurisdictions (Baseline) and another with focused growth patterns for population and employment within our Mobility Hubs and Smart Growth Opportunity Areas (SCS3 Land Use). The incremental step (Model Run 2) between SCS2 and SCS3, where SANDAG will allow exogenous variables and land use to update, will use the Baseline forecast which would occur in the region without larger policy influence from the regional plan implementation. The 3rd model run will use the SCS3 Land Use which includes policy changes being facilitated by the 2021 Regional Plan.

In the 2015 Regional Plan (SCS2), SANDAG had one land use scenario that was also referred to as the Series 13 Regional Growth Forecast. In the 2021 Regional Plan (SCS3), SANDAG has prepared the Series 14 Regional Growth Forecast and will have both a "baseline land use scenario" and an "SCS land use scenario" with differing assumptions about the distribution of housing and jobs in the region.

Incremental Progress Off-Model Adjustments

Off-model calculators are developed using inputs from the specific ABM version the calculator was designed for. Applying SCS2 off-model assumptions within the SCS3 calculator framework is not currently possible. Instead, SANDAG will add the SCS2 off-model adjustments to Model Run 2 GHG results.

Incremental Progress Model Run Details

Model Run 1: SCS2 2035 Scenario (as submitted)

Factor or Assumption	Details
SCS Networks and Policies	SCS2 2035 regional networks and policies
Version of SANDAG ABM	ABM1
Auto Operating Cost; Vehicle Fleet Efficiency	SCS2 AOC assumptions
Interregional Travel	SCS2 assumptions
Demographics; Household Income; Household Demographics	2015 Series 13 growth forecast and regional median income
Telework	SCS2 assumptions
Off-Model Adjustments	SCS2 ABM1 off-model adjustment calculators

Model Run 2: SCS2 2035 Network and Policy Scenario with Updated Exogenous Variables

Factor or Assumption	Details
SCS Networks and Policies	SCS2 2035 regional networks and policies
Version of SANDAG ABM	ABM2+
Auto Operating Cost; Vehicle Fleet Efficiency	SCS3 AOC assumptions
Interregional Travel	SCS3 assumptions
Demographics; Household Income; Household Demographics	2021 Series 14 baseline growth forecast (based on existing general plans, community plans, and planned development) and regional median income
Telework	SCS3 baseline assumptions
Off-Model Adjustments	SCS2 ABM1 off-model adjustments applied as is (no modification due to changed ABM 2+ model run outputs values)

Model Run 3: SCS 3 2035 Scenario

Factor or Assumption	Details
SCS Networks and Policies	SCS3 2035 regional networks and policies
Version of SANDAG ABM	ABM2+
Auto Operating Cost; Vehicle Fleet Efficiency	SCS3 AOC assumptions
Interregional Travel	SCS3 assumptions
Demographics; Household Income; Household Demographics	2021 Series 14 SCS3 land use scenario (applied policy land use changes to the baseline land use to coordinate with proposed mobility hub mobility options) and regional median income
Telework	SCS3 policy assumptions
Off-Model Adjustments	SCS3 ABM2+ off-model adjustment calculators

Off-Model Strategies

In instances where the impacts of certain 2021 Regional Plan/SCS policies under consideration cannot be measured in ABM2+, SANDAG will rely on off-model techniques based on academic literature reviews, collaboration with other MPOs and research institutions, and consultation with CARB's Policies and Practices Guidelines.

For the 2021 Regional Plan, the off-model analysis will include an evaluation of a suite of current and prospective shared mobility strategies including vanpool, carshare, carpool, the implementation of a regional transportation demand management ordinance (TDMO), and electric vehicle strategies, including an EV charger program and EV incentive program. Strategies proposed in this methodology include programs facilitated and administered by SANDAG as well as services operated by third parties. To support this evaluation, SANDAG is partnering with the University of California, Institute of Transportation Studies to review and validate SANDAG's travel behavior modeling and off-model methodologies. Additionally, SANDAG, as one of the four largest MPOs in California, has partnered with the Metropolitan Transportation Commission, the Sacramento Area Council of Governments, and the Southern California Association of Governments to establish the Future Mobility Research Program and jointly fund research on the potential impacts of transportation technologies. This cooperative effort developed a consistent approach to evaluating the range of potential changes to travel behavior associated with emerging technologies and provided recommendations on how to model travel behavior and incorporate technology into each MPO's RTP/SCS.

The methods employed for the off-model calculators are based on the Travel Demand Management (TDM) Calculators developed by WSP USA and the EV Calculators developed by Ascent Environmental. ITS Irvine was contracted in March 2020 to conduct a methodological review of these calculators, which is reflected herein and in Appendices D and E. The methodological review generally affirmed the approaches adopted by WSP USA and Ascent Environmental, with some suggestions adopted to improve the methodological validity of the calculators. WSP USA developed calculators to evaluate the benefits of carshare, bikeshare, vanpool, microtransit, pooled rides, and community-based travel planning. The bikeshare, microtransit, and community-based travel planning calculators were originally developed for use in the deferred 2019 SCS but are not being used for the 2021 Regional Plan. In the case of bikeshare and microtransit, the behavior represented by the calculator is now captured by ABM2+. The programs represented in the community-based travel planning calculator are now captured in the more broad-based TDMO off-model calculator developed by ITS Irvine. For the calculators developed by WSP and Ascent Environmental that are being used in the 2021 Regional Plan (carshare, vanpool, pooled rides, EV programs), ITS Irvine will be updating parameters based upon new or updated data sources and more recent findings in the literature.

TDM off-model calculators

The methodology for off-model estimation of VMT and GHG emission reductions from the TDM strategies share a common overall methodology that is implemented in a series of Excel spreadsheet calculators for strategies involving vanpool, carshare, bikeshare (captured in ABM2+), pooled rides, and a regional travel demand management ordinance. These strategies are part of SANDAG's regional TDM Program, also known as iCommute. iCommute works with employers throughout the region to design and implement commuter benefit programs and provides residents with information about vanpool and carpool services, shared mobility, support for biking, information about teleworking, and transit solutions.

The VMT reductions are based on historical data, applicable research, and case study findings for each strategy. Where possible and if available, local data were used to inform the assumptions used in the methodology. To minimize double-counting, the methodology intentionally employs a conservative approach to estimate reasonable program impacts. While the off-model calculators utilize mode-based inputs from ABM2+ to estimate program impacts, calculator outputs remain off-model and do not interact or feed back into ABM2+.

In general, the research is used to estimate the following methodological parameters:

1. **Population that has access to the mobility service, or market**. The market may be defined in terms of persons or households.
2. **Level of supply/geographic extent**. The level of supply may be defined as a function of cities, neighborhoods, or employers in which the program or service is available.
3. **Regional infrastructure improvements**. Regional investments in transportation infrastructure (such as managed lanes) may help facilitate use of a mobility service and induce mode shift away from driving alone.
4. **Baseline VMT**. An estimate of the average VMT per person or per household, among persons/households that do not participate in the program or mobility service.
5. **Project VMT**. An estimate of the average VMT per person or per household expected among persons per households that participate in the program or mobility service. This is estimated directly from average trip lengths and indirectly from mode shifts, changes in car occupancy, and/or reductions in average number of trips.
6. **GHG emission factors**. Based on total trip forecasts produced by the SANDAG ABM and Carbon Dioxide (CO_2) estimates developed with EMFAC 2014.

Common Scenario Inputs to TDM off-model calculators

Though the methodologies of the individual TDM calculators differ, they operate on similar sets of input data, which are summarized in Table OM.1. Generally, these data are drawn from the regional growth and travel demand forecasts produced by I-LUDEM and ABM2+ and include population and employment forecasts, travel demand and travel time forecasts, and regional running and cold start emissions totals for the determination of regional emissions factors that are applied to compute emissions savings by program.

Table OM.1. Common scenario inputs to TDM off-model calculators

Data	Source(s)	Details
Employment forecast	I-LUDEM	For each scenario year and Master Geography Reference Area (MGRA): • jobs by industry category (SANDAG ABM classification)
Regional Population Forecast	I-LUDEM	For each scenario year and MGRA: • total households • adult population • MGRA residential area • household density • population density • college student enrollment
Travel times between San Diego MSAs	SANDAG ABM	For each scenario year & MSA pair: • AM travel time, general purpose lanes • AM travel time, managed lanes
Regional Trip Data	SANDAG ABM	Regional trips for each scenario year & MSA pair: • Time period (EA, AM, MD, PM, NT) • Trip mode (drive alone, carpool, non-motorized, and transit) • Trip purpose (Work, School, Other) • Household auto ownership (0, 1, and 2+)
Emission factors	SANDAG ABM + EMFAC 2014	For each scenario year: • Trips (cold starts) regional emissions (ton) • Running CO_2 regional emissions (ton) • Regional VMT • Regional trips

In addition to the scenario inputs, certain model parameters are used across the TDM calculators, as shown in Table OM.2. These parameters capture common behavioral characteristics that are consistent across all models (on- and off-model).

Table OM.2. Common parameters for TDM off-model calculators

Parameters	Source(s)	Notes
Marginal disutility of travel time	SANDAG ABM	Used in the calculation of demand elasticity
Median value of time	SANDAG ABM	Used to calculate an average coefficient of cost, for the demand elasticity formulas
Auto operating cost	SANDAG ABM	Used to calculate the cost of driving alone and accounts for fuel and vehicle maintenance. Expressed in cents per mile in (2010 $)
Coefficient of in-vehicle travel time	SANDAG ABM Trip mode choice model, Work tours	Used to calculate elasticity of demand with respect to travel time and with respect to trip cost. Input to the demand elasticity formula

The following sections detail specific program characteristics along with the methodologies and assumptions for each TDM off-model calculator.

Vanpool

Program Overview, Rationale, and Performance to Date

The SANDAG Vanpool program is offered by iCommute. This program provides a subsidy of up to $400 per month for eligible vanpool groups. The program requires that vanpools have either an origin or destination in San Diego County, maintain 80% vehicle occupancy, and travel at least 20 miles within the County. Vanpools have been shown to reduce greenhouse gas emissions since only one (albeit larger) vehicle is required to transport the same number of people that would normally take 7 to 15 single-occupant vehicles to transport. In FY 2019, the vehicle miles traveled reduction attributed to the vanpool program was approximately 93 million miles.

Based on historic trends, the 2015 Regional Plan envisioned the Vanpool Program to grow 13% by 2020 (approximately 811 vanpools), 62% by 2035 (approximately 1,163 vanpools), and 110% by 2050 (approximately 1,512 vanpools). Since the adoption of the 2015 Regional Plan, the program has implemented improved program administration and policies to facilitate monthly surveying to track program performance. The iCommute team works closely with major employers and conducts targeted marketing campaigns to encourage the formation of vanpools in the region. In 2019, the program even grew to offer more diverse and affordable vehicles from three vanpool vendors, including an all-electric vanpool service. Despite these improvements, as of May 2020, the Vanpool Program has 590 registered vanpools with an average daily round trip of 103 miles (or 51.5 miles one way). Reductions in vanpool participation vary but are largely attributed to major employers who have withdrawn support and contributions for employees that vanpool. In recent months, due to COVID-19, the program has seen many employers withdraw financial support for vanpooling and shift employees to teleworking where possible, leading to a further decrease in vanpools.

More than 85% of vanpools in the SANDAG program use vehicles with a maximum occupancy of seven to eight passengers, and almost half of vanpools originate from Riverside County. The influx of vanpools traveling into the region from Riverside County can leverage managed lanes on the Interstate 15 that allow vanpoolers to use the high-occupancy vehicle lanes free of charge and offer travel time reliability.

More than half of the vanpools are military or federal employees who also benefit from the Transportation Incentive Program (TIP) stipend, making vanpooling a cost-effective alternative to driving alone. Participation in the Vanpool Program is expected to grow through iCommute outreach and incentives. Vanpools can also leverage managed lanes and high-occupancy vehicles for travel and can take advantage of priority parking for rideshare at employment sites and within mobility hubs.

Off-model Calculator Assumptions and Methodology

The following assumptions are incorporated into the off-model calculator for the Vanpool Program. The calculation of VMT reductions is based on the Regional Vanpool Program data including vanpool fleet and trip information. This data includes the total number of active vanpools, vehicle type, vanpooler industries, commute trip origin and destination, distance traveled within San Diego County, and vehicle occupancy. Historical program data indicates that the Vanpool program caters to a workforce that commutes long distances to work (50 miles one way on average) and that work for large employers that have fixed schedules.

Based on existing vanpool program trends, the vanpool off-model calculator estimates that vanpooling in the region will continue to grow relative to the total workers employed in San Diego County. Therefore, as the region adds jobs within industries that have historically had higher rates of vanpooling (i.e., military, biotech, federal employers), it is assumed that enrollment in the Vanpool Program will also grow. While employers in the region are currently implementing telework policies due to COVID-19, the industries in which vanpooling thrives are those that in large part are considered "non-teleworkable," such as manufacturing and military, which require employees to perform their job duties on site. As such, the employment-based vanpool growth projections are only based on those jobs sectors where vanpooling is suitable.

Vanpools in the San Diego region can also leverage the exclusive use of managed lanes (High-Occupancy Vehicle and Interstate-15 Express Lanes) to shorten their commute time during peak travel periods. The reliability of the managed lanes makes vanpooling an attractive option. Consistent with this assumption, the vanpool off-model calculator assumes that as the region's managed lane network expands, commuters who choose to vanpool are likely to experience shorter travel times than commuters driving alone. This travel time savings will encourage a shift from driving alone to vanpooling.

Based on historical program participation data, three vanpool markets were defined based on the vanpoolers' employer industry: military vanpools, federal non-military vanpools, and non-federal vanpools. This segmentation was used to calculate employment growth factors that are specific to each of these industries. The travel time savings methodology also varies depending on industry type since the destinations of the future military vanpools are defined. Other inputs used to derive the impact of vanpooling on GHG and VMT, such as average distance traveled and average vehicle occupancy, also vary by type of industry and are based on historical Vanpool Program data.

The vanpool program off-model GHG-reduction methodology is as follows:

1. Segment active vanpools in program and summarize their associated travel characteristics (average round-trip mileage, occupancy) into three targeted markets: federal, military, non-federal
2. Estimate vanpool growth due to employment for each vanpool market
    - Vanpool growth due to employment for each MSA = Base year vanpools * percent change in employment markets (federal, military, non-federal) using SANDAG employment forecasts
    - The total number of vanpools were multiplied within the destination MSA by the employment growth rate at the MSA, which was calculated as future year employment divided by 2016

employment. The new vanpools due to employment growth were then distributed to origin MSAs in the proportions observed in 2016.

3. Estimate vanpool growth due to managed lane investments for each vanpool market using SANDAG model travel times
   - Calculate average MSA to MSA travel time savings, defined as the difference between the travel time experienced when using all available highways, and the travel time experienced using general-purpose lanes only (excluding HOV and Express Lanes). For trip origins outside of San Diego County, the travel time savings are computed only over the portion of the trip that occurs within San Diego County. Since the specific location of military bases is known, the travel time savings associated with military vanpools is computed specifically to the zones that comprise the military bases, rather than an average over all of the MSA destinations.
   - Uses a logit discrete choice model to model vanpool mode shifts. Formula for logit elasticity with respect to travel time:
     elasticity = (marginal disutility wrt travel time) * (travel time) / (1 – probability of vanpooling)
   - Compute the demand induced by travel time savings by applying the demand elasticity formula to the estimated number of vanpools for each scenario year, after accounting for employment growth.
     elasticity wrt travel time * % change in travel time
4. Estimate VMT reduction for each vanpool market
   - VMT Reduction = total vanpools [2 + 3] * average occupancy (exc. driver) * round-trip mileage within San Diego County only

The detailed Vanpool off-model calculator information is included as Appendix F.

Carshare

Program Overview, Rationale, and Performance to Date

Carshare services offer access to vehicles as short-term rentals 24 hours a day, seven days a week. Carshare can provide first-mile/last-mile connections to transit or fill gaps in the region’s transit services by providing an efficient transportation alternative for commute and non-commute trips. As part of the 2015 Regional Plan, SANDAG sought to incentivize and expand the reach of carshare to employment centers and urban communities that are not currently served by this mobility option (and that the private market may be hesitant to enter) in order to complement and improve access to regional transit services. Since the adoption of the 2015 Regional Plan, the carshare market in the region has changed with the exit of one-way carshare service provider, car2go, from the region. To date, only round-trip and peer-to-peer services exist in the San Diego region. These services include ZipCar, Turo, and Getaround.

As part of the Regional Vision of the 2021 Regional Plan, Flexible Fleets are envisioned to operate throughout the region. Flexible Fleets are shared, on-demand vehicles like micromobility, carshare, rideshare, microtransit, and last-mile delivery. Fleets could provide more travel options that reduce the reliance on owning a personal vehicle and offer reliable connections to and from transit. To help encourage deployment of Flexible Fleets like carshare in the region, SANDAG is currently developing a Flexible Fleet Implementation Strategic Plan that will outline opportunities for Flexible Fleets in the region and will provide a roadmap for deployment in the next ten years. To complement the Strategic Plan, SANDAG is planning to procure a bench of Flexible Fleet providers including microtransit, carshare, on-demand rideshare, and micromobility. The bench will be available for SANDAG and its partners like transit agencies, cities, and non-profit organizations to implement services that meet community needs.

The expansion of carshare services is envisioned as part of the Regional Mobility Hub network to support connections to transit and reduce the reliance on driving. SANDAG will support carsharing through iCommute outreach and incentives as well as the provision of infrastructure (e.g., electric vehicle chargers, designated/priority parking, or curb space) needed to support carsharing in mobility hubs.

Research indicates that households that participate in carsharing tend to own fewer motor vehicles than non-member households.[7] With fewer cars, carshare households shift some trips to transit and non-motorized modes, which helps to contribute to overall trip-making reductions. Estimates of the VMT reductions attributed to carshare participation have been reported to be seven miles per day[8] and up to 1,200 miles per year[9] for round-trip carshare. A survey of car2go users in five North American cities, including San Diego, found that carshare households reported decreases in VMT ranging from 6% to 16%, with San Diego users reporting an average 10% VMT reduction, or approximately 1.4 miles per day.[10] Similar behavior has been reported for participants in London's free-floating carshare service, with carshare members exhibiting a net decrease in VMT of approximately 1.5 miles per day.[11]

Off-model Calculator Assumptions and Methodology

The carsharing methodology only accounts for VMT and GHG emission benefits associated with round-trip carshare service. While the off-model calculator is able to account for the VMT reduction impacts of free-floating carshare service, it is assumed that this type of service will not return to the San Diego region due to the rise and popularity of on-demand ridehailing service providers like Uber, Lyft, and Waze Carpool.

Based on market trends in the San Diego region, it is expected that carshare will remain a viable transportation option in neighborhoods that exhibit similar supporting land uses as those where carsharing is provided today. In support of regional mobility hub planning efforts, the SANDAG TDM program seeks to promote and encourage the provision of carshare within the region's employment centers, colleges, military bases, and within the proposed mobility hub network. Given the future trend toward mobility-as-a-service, it is assumed that carsharing will evolve to be part of a fleet of shared, electric, and on-demand vehicles by the year 2050; therefore, carshare coverage areas are only defined up until 2035. Within these defined carshare service areas, it is assumed that participation in the carshare program may vary depending on the supporting density.[12] The population density thresholds that support carshare participation in the region are based on the car2go service area prior to their exit from the San Diego market. Based on the 2016–2017 San Diego Regional Transportation Study and available research on carshare participation rates, it is assumed that areas with a population greater than 17 people/acre will have a 2% participation rate. Areas with a population density lower than 17 people/acre will have a 0.5% participation rate. These density thresholds are specific to carshare trends exhibited in the San Diego region. VMT reduction impacts from round-trip carshare also assume a daily

[7] Martin, E. and S. Shaheen (2016). Impacts of car2go on Vehicle Ownership, Modal Shift, Vehicle Miles Traveled, and Greenhouse Gas Emissions. An Analysis of Five North American Cities.

[8] Cervero, R. A. Golub, and Nee (2007) "City CarShare: Longer-Term Travel-Demand and Car Ownership Impacts", Presented at the 87th Transportation Research Board Annual Meeting, Washington, D.C.

[9] Martin, E., and S. Shaheen (2010), "Greenhouse Gas Emission Impacts of Carsharing in North America," Mineta Transportation Institute. MTI Report 09-11.

[10] Martin, E. and S. Shaheen (2016). Impacts of car2go on Vehicle Ownership, Modal Shift, Vehicle Miles Traveled, and Greenhouse Gas Emissions. An Analysis of Five North American Cities.

[11] Le Vine, S., M. Lee-Gosselin, A. Sivakumar, J. Polak. (2014). "A new approach to predict the market and impacts of round-trip and point-to-point carsharing systems: Case study of London." Transportation Research Part D: Transport and Environment, Vol. 32, pp. 218–229.

[12] Transportation Sustainability Center (2018), Carshare Market Outlook. its.berkeley.edu/node/13158

average reduction of seven miles per day per round-trip carshare member based on the latest available research.[13]

The carshare program off-model GHG reduction methodology is as follows:

1. Defines geographic areas (MGRAs) and target markets deemed suitable for carsharing
   - Mobility hubs – general population
   - Colleges/universities – college staff and students
   - Military – military personnel on base
2. Estimate "eligible adult population" within carshare coverage areas through 2035 using SANDAG population forecast
   - Segment population within coverage area into higher-density areas (>17 persons/acre) or lower-density areas (<=17 persons/acre) as participation varies by density
3. Estimate carshare participation by applying the participation rate to eligible populations
   - Carshare participation rates = 2% in high-density areas or 0.5% in low-density areas
4. Estimate VMT reduction = total carshare membership [3] * round-trip carshare VMT reduction

The detailed Carshare off-model calculator information is included as Appendix G.

Pooled Rides

Program Overview, Rationale, and Performance to Date

As part of the 2015 Regional Plan, SANDAG planned to launch a formal carpool incentive program in the summer of 2016. The program would provide incentives for carpoolers and drivers for a set period of time to encourage and facilitate carpool creation. This carpool incentive program was formally launched in 2017 as part of the iCommute Program and in partnership with Waze Carpool. The program provides incentives to employees for forming new carpoolers (passengers and drivers) through the Waze carpool app, which links drivers with passengers headed in the same direction. To date, more than 200 employees have participated in the Carpool Incentive Program and about 130 rides have been completed through the incentive program. Outside of the carpool incentive program, iCommute and Waze have also implemented other promotions as part of Rideshare Week or with specific employers like the military to encourage pooling to work. SANDAG envisions encouraging pooling though continued incentives and outreach with iCommute. Participants in the Program can also leverage managed lanes and high-occupancy vehicles for travel and can take advantage of priority parking for rideshare at employment sites and within mobility hubs.

Off-model Calculator Assumptions and Methodology

The pooled rides off-model calculator accounts for the VMT and GHG benefits of SANDAG's carpool incentive program. Uber reports that 20% of their rides globally, and 30% of the rides in New York and Los Angeles, are on Uber Pool;[14] however, it is not necessarily the case that a ride on Uber Pool is, in fact, a pooled ride. Moreover, the total number of rides served by Uber and Lyft in San Diego is unknown. While there is a limited, but growing, body of research on pooled rides, data on pooled TNC trips is limited due to lack of data sharing from app-enabled companies that offer pooled services. To help remedy this,

[13] Cervero, R. A. Golub, and Nee (2007) "City CarShare: Longer-Term Travel-Demand and Car Ownership Impacts", Presented at the 87th Transportation Research Board Annual Meeting, Washington, D.C.

[14] TechCrunch (2016). Interview with David Plouffe, Chief Advisor for Uber. techcrunch.com/2016/05/10/uber-says-that-20-of-its-rides-globally-are-now-on-uber-pool/?ncid=rss

SANDAG, in partnership with MTC and SCAG, received a Caltrans planning grant to conduct a statewide ridehailing survey. The survey, known as the 2019 Transportation Study, evaluates the impact of ridehailing activity, including pooled ridehailing trips, throughout the state. Data from the 2019 Transportation Study are being used to inform the development of the pooled rides off-model calculator.

The structure of the off-model methodology for pooled rides is structured around the Waze carpool model, which is the current carpool incentive program partner, in which the driver and passenger(s) are matched based on their similar origin and destination and meet at a common pick-up location, thereby mitigating route deviations or additional trip links. Building on the success of the existing carpool incentive program, the pooled rides off-model calculator assumes that the SANDAG carpool incentive program will continue to provide a minor trip subsidy that will lower the cost of pooling per trip. Non-work trips will not be subsidized by SANDAG. The calculator employs a reimbursement model based on the Waze Carpool service to compute a pooled ride index factor representing the cost ratio of pooling to driving alone.

To estimate the impacts of app-enabled pooled rides throughout the region, regional survey data of app-enabled ridesharing activity was used as a proxy to estimate pooled ride use. Data on app-enabled pooled ride utilization data was gathered through the 2016–2017 San Diego Regional Transportation Study, 2018 Commute Behavior Survey, and the 2019 Transportation Study. Generally, these studies show that the app-enabled rideshare mode share decreases with increasing auto ownership. Self-administered internet-based surveys conducted in several U.S. metropolitan areas reported that on-demand ride-hailing use was predominantly for discretionary travel, with few users indicating it was their primary mode for work trips (Clewlow and Mishra, 2017). Contrary to this expectation, the 2016–2017 San Diego Regional Transportation Study reports that app-enabled ridehailing use is higher for work than for non-work trips.

Similar to the vanpool off-model calculator, the pooled rides off-model calculator also assumes that commuters that pool in the San Diego region can leverage the exclusive use of managed lanes (High-Occupancy Vehicle and Interstate 15 Express Lanes) to shorten their commute time during peak travel periods. The reliability of the managed lanes makes pooling an attractive option. As the region's managed lane network expands, commuters who choose to pool to work are likely to experience shorter travel times than commuters driving alone, which will encourage a shift from driving alone to vanpooling. While both the vanpool and pooled rides calculator focus on the commuting population, the target market within the pooled rides off-model calculator focuses on the workforces that commute short distances to work (ten miles one way on average) rather than the longer-distance commuters captured within the vanpool off-model calculator.

The pooled rides program off-model GHG-reduction methodology is as follows:

1. Estimate baseline pooling target market
   - Pooling market = drive-alone trips from SANDAG ABM2+ * pooled ride mode share based on 2019 Transportation Study
2. Estimate increase in pooled rides due to managed lane investments
   - New pooled trips due to managed lanes = elasticity with respect to travel time * % change in travel time
   - Uses a logit discrete choice model to model pooled ride mode shifts. Formula for logit elasticity with respect to travel time:
   - elasticity = (marginal disutility with respect to travel time) * (travel time) / (1 – probability of app-enabled pooling)

3. Total pooled ride trips = baseline pooling market [1] + pooled trips induced by managed lane time savings [2]
4. Estimate vehicle trips required to serve the person trips = total pooled ride trips [3] / minimum vehicle occupancy required per Carpool Incentive Program
5. Estimate vehicles replaced by pooling = total pooled ride trips [3] – vehicle trips required to serve pooled trip demand [4]
6. Estimate person miles traveled reduced by pooled trips = total pooled ride trips [3] * average trip distance based on SANDAG ABM2+
7. Estimated VMT reduction = total person miles [6] * proportion of vehicles eliminated by pooled riding [5/3]

The detailed Pooled Rides off-model calculator information is included as Appendix H.

Regional TDM Ordinance

Program Overview, Rationale, and Performance to Date

The SANDAG iCommute Program works with more than 200 employers on a voluntary basis to implement commuter benefit programs. Since the adoption of the 2015 Regional Plan, the iCommute program has expanded to a team of seven Account Executives that work with employers of all sizes throughout the region. Employers survey their employees to track their mode share over time. Employers are rewarded and recognized through the iCommute Diamond Awards for measurably reducing single-occupant vehicle trips by employees. On average, the employers that work with iCommute have reduced their drive-alone mode share by 10%. As part of the 2021 Regional Plan, SANDAG is exploring a regional TDM ordinance that would require employers with more than 250 employees to implement and monitor a commuter program that would require them to demonstrate reductions in their drive-alone rate by encouraging employees reduce solo commute trips. Employers must demonstrate the achievement of this drive-alone reduction targets through application of one or more Travel Demand Management (TDM) strategies, including, but not limited to:

- **Commuter services**. Offering programs like secured bike lockers and free rides home in case of an emergency can make it easier for commuters to use transit and other alternatives to driving alone.
- **Financial Subsidies and Incentives**. Financial incentives and pre-tax commuter benefits for commuters can lower the out-of-pocket cost for commuters who choose alternatives to driving alone.
- **Marketing, Education, and Outreach**. Outreach events, educational campaigns, and marketing strategies help raise awareness of alternative commute options.
- **Parking Management**. Employers can offer cash incentives, transit passes in lieu of a parking space, and preferred parking for high-occupancy vehicles as incentives to choosing an alternative commute option. Charging for parking at the workplace can act as a disincentive to drive alone.
- **Telework and Flexible Work Schedules**. Employers can develop workplace policies that promote telework, flexible schedules, and/or compressed work schedules to reduce peak commute trips.
- **On-Site Amenities**. Secured bike lockers and showers can offer convenience for commuters who choose to bike to work.
- **Employer-Provided Transit**. Employer-provided transit can help to serve the first-mile/last-mile connection to transit and/or provide direct pooling options for employees traveling from the same direction.

In the near term, SANDAG will conduct necessary research and outreach to develop a policy and legislative framework for implementation. Next, SANDAG will phase in a pilot program with employers, after which the program will be evaluated and refined for full implementation in the region. Since the impact of this type of regulation cannot be modeled in SANDAG's ABM2+ model, capturing the impacts of a TDMO program requires the development of an off-model calculator.

Off-Model Calculator Assumptions and Methodology

The TDMO will be employer-based, meaning that the regulations will require that employers demonstrate that their employees (as a group) are meeting their proposed drive-alone reduction targets. SANDAG intends to expand existing iCommute Employer Program offerings to assist employers with implementing and monitoring their TDM programs. Further, it is assumed that the ordinance will only apply to specific employers, namely larger employers with at least 250 employees. These employers will be provided with options from a set of TDM strategies to achieve the target. It is assumed that the suite of strategies available to employers will be flexible and build upon other SANDAG commuter programs like the Vanpool Program, Carpool Incentive Program, Try Transit Program, and more.

The TDMO off-model calculator computes the impact of large employers implementing a commuter program that would achieve the desired drive-alone reduction targets. Given the success of the voluntary iCommute Employer Program, with which employers have reduced their drive-alone rate by 10%, SANDAG anticipates that the TDMO program will achieve an average drive-alone reduction target of 15% by 2035. The off-model calculator computes the target reductions in drive-alone commute trips in each MSA. Since the options in the TDMO program includes employer-sponsored vanpool and pooled-ride programs, the calculator allows for the trip reductions computed by the vanpool and pooled-ride calculators for large employers to be subtracted from the computed excess to avoid double-counting.

The TDMO off-model GHG reduction methodology is as follows:

1. Estimate fraction of a.m. and p.m. trips associated with large employers (LEs).
   - The fraction of employees impacted for each MSA is the number of employees working for firms with > 250 employees divided by the number of employees working for all firms.
   - The fraction of a.m. and p.m. trips impacted for each MSA pair is assumed to be the same as the fraction of employees associated with LEs at the employment end of the trip. The employment end of trips in a period (the fraction of trips for which work is the origin and the fraction for which work is the destination) is determined from work trip-directionality analysis of the OD and period obtained from the ABM2+ forecast. The origin-to-work fraction is combined with the work-to-destination fraction to produce a total fraction for each MSA OD pair.
2. Forecast the number of drive-alone a.m./p.m. trips associated with LEs for each MSA OD pair, computed as the period-specific fraction of LE OD trips times the forecast number of drive-alone OD trips during that period.
3. Compute target drive-alone trip splits for LE work trips in the a.m. and p.m. periods between each MSA origin and destination
   - Target is a 15% in 2035 and 25% in 2050 reduction in ABM 2+ forecast drive-alone shares
4. Establish LE drive-alone trips allowance for each MSA OD pair by applying drive-alone-reduction targets to drive-alone trips associated with large employers
   - Computed as target drive-alone LE work trip splits [3] times the forecast total work trips (from ABM2+) times the large employer fraction [1]
5. Estimate TDMO trip reductions
   - Assumes that ABM2+ forecast trips exceeding the established drive-alone allowance in the target year are reduced by the TDMO. TDMO-required reductions in a.m./p.m. drive-alone work

trips for each MSA OD pair computed as the difference between the forecast [2] and the allowance [4]. If this value is less than zero, the ABM2+ forecast exceeds the TDMO target, so the TDMO will not reduce additional trips and the reductions are set to zero for this period.

- Upon implementation and monitoring of TDMO, SANDAG program data will inform these assumptions.

6. Estimate baseline VMT reduction = TDMO trip reductions [5] * average trip distance based on SANDAG ABM2+
7. Deduct other calculator drive-alone work trip and VMT reductions (vanpool and pooled rides) between TDMO phasing and target year to avoid double counting

The detailed Regional TDM Ordinance off-model calculator information is included as Appendix I.

Electric Vehicle Programs Calculator

Program Overview, Rationale, and Performance to Date

In the 2021 Regional Plan/SCS, SANDAG will consider two types of electric vehicle (EV) programs: EV Charger Program and Vehicle Incentive Program. The EV Charger Program, which was included in the 2015 Regional Plan, would incentivize the installation of public and workplace Level 2 charging. The 2015 Regional Plan assumed that the EV Charger Program would incentivize Level 1 and Level 2 charging. Based on market changes since 2015, the EV Charger Program is now focused only on Level 2 charging. The investment in charging infrastructure would extend the electric range for plug-in hybrid electric vehicles and lead to a reduction in GHG emissions beyond what is estimated in EMFAC. The Vehicle Incentive Program would offer rebates for the purchase of EVs. The vehicle rebates would be in addition to the state's investment in the Clean Vehicle Rebate Project and GHG emission reductions would be proportional to regional and state rebate amounts.

The 2015 Regional Plan called for SANDAG to establish an incentive program in 2020 for public EV chargers as a GHG-reduction measure for the SCS and as a GHG-mitigation measure in the EIR. SANDAG also committed $30 million from 2020–2050 for the program to achieve the GHG reductions. Since the Plan was adopted, SANDAG received a Caltrans Sustainable Communities Planning Grant in 2018 (that ended in June 2020) to research and develop the charger incentive program. This project helped SANDAG establish partnerships with the San Diego County Air Pollution Control District (APCD) and California Energy Commission's (CEC's) California Electric Vehicle Infrastructure Project (CALeVIP) to offer a more comprehensive rebate program as the San Diego County Incentive Project (SDCIP).

In September 2019, the Board approved the establishment of OWP 3502000 for the regional EV charger program (SDCIP) with a budget of $9 million for FYs 2020–2025. SDCIP partners have committed budgets for three years to start, and SANDAG will seek to continue partnerships with state and local co-funders for future program years and will coordinate with the local utility San Diego Gas & Electric (SDG&E). SDCIP opened on October 27, 2020, to great demand. A project requirements webinar was held August 27, 2020; a pre-launch webinar for participants was held October 6, 2020; and a workforce training webinar for electricians and a permit streamlining webinar for local governments were held October 22, 2020, and October 20, 2020, respectively. News about these and future SDCIP events will be available at the SDCIP website. Eligible rebate applicants will be able to apply for up to $80,000 per DC fast charger and up to $6,000 per Level 2 charger. With a three-year combined incentive budget of about $21.7 million, SDCIP is expected to help fund approximately 1,100 Level 2 chargers and 250 DC fast chargers in the San Diego region. On opening day, SDCIP's three-year budget was fully reserved, with wait-list applications exceeding $50 million in projects.

Since the 2015 Regional Plan, SANDAG ran the Plug-in San Diego project through two consecutive CEC grants. Plug-in SD implemented recommendations from the Regional EV Readiness Plan through a combination of resource development, training, and technical assistance through an EV Expert. SANDAG is continuing some of this technical assistance in SDCIP to ensure a successful infrastructure incentive program. Since 2016, SDG&E's Power Your Drive (PYD) Program has also added about 3,000 EV chargers at workplaces, fleets, and multifamily residences in the region. SANDAG serves on the Program Advisory Council for SDG&E's PYD and other EV infrastructure programs. SDG&E and SANDAG are coordinating on future EV infrastructure planning and investments.

Off-model Calculator Methodology and Assumptions

The EV off-model calculator estimates the CO_2 reductions and costs associated with implementation of both a Regional Electric Vehicle Charger Program (RECP) and Vehicle Incentive Program (VIP). Both programs are included in a single calculator to account for the interactions between the two programs. The calculator expands upon MTC's EV off-model methodology and applies a similar methodology to calculate emission reductions from SANDAG's proposed version of the RECP and VIP. Recent policies, research, studies, and models used to develop the 2021 Regional Plan EV off-model calculator include:

- EO B-16-12 and EO B-48-18, which set a target of 1.5 million ZEVs and 5 million ZEVs in the State by 2025 and 2030, respectively
- California Plug-In Electric Vehicle Infrastructure Projections: 2017–2025, published by the California Energy Commission (CEC) in March 2018, including projections of the PEV vehicle fleet mix, charger inventory, and charging demand by county that would achieve the 1.5 million ZEV statewide target by 2025 established in EO B-16-12 and 250,000 EV chargers statewide, including 10,000 DC Fast Chargers, by 2025 established in EO B-48-18 (CEC 2018)
- Electric Vehicle Infrastructure Projection Tool (EVI-Pro), released in early 2018 by the National Renewable Energy Laboratory's (NREL) and CEC, which estimates the public charging infrastructure needed to support a targeted PEV mix by 2025 for various regions across the state by county. Although this tool is not publicly available at this time, NREL and CEC released a web-based data viewer that summarizes the results of the tool for California, including anticipated charger counts and charger loads. The results of EVI-Pro were used to develop projections in CEC's California Plug-In Electric Vehicle Infrastructure Projections: 2017–2025 report. (NREL 2018a, NREL 2018b)
- EMFAC2017, released in late 2017 by CARB, which updates the statewide vehicle population, emissions, and VMT forecasts by fuel type, vehicle class, and other factors, accounting for adjusted ZEV forecasts that are generally more conservative than previously assumed in EMFAC 2014 (CARB 2017b). EMFAC2017 also accounts for a minimum regulatory compliance scenario under the ZEV mandate in the State's Advanced Clean Cars Program. This mandate requires vehicle manufacturers to produce an increasing number of ZEVs for model years 2018 through 2025.

EV Off-Model calculator includes the following key methods and assumptions used in the model's calculations. The differences from MTC's approach resulted in a more complex calculator, but also one that accounts for San Diego–specific factors.

- CO_2 reductions from the RECP and VIP were calculated in two key steps. First, the difference was taken between the total eVMT supported by each respective program and the eVMT anticipated in a business-as-usual (BAU) forecast for a given milestone year. In cases where the program's eVMT would result in more eVMT than the BAU forecast, the additional eVMT was attributed to the displacement of the same VMT from equivalent gasoline light-duty vehicles (LDV), which was then translated to CO_2 reductions associated with the reduced gasoline LDV VMT. Second, the resulting CO_2 reductions were scaled to SANDAG-related efforts by applying the ratio of SANDAG incentives to non-SANDAG incentives on a dollar-per-dollar basis. To avoid double-counting reductions between the RECP and VIP, the calculator assumes that the reductions from additional PHEVs under VIP would be a subset of any additional PHEV eVMT supported by RECP because the RECP is assumed to extend the electric range of any PHEVs purchased under the VIP.

- The BAU forecast was based on a combination of 2018 vehicle populations from DMV registration data, EMFAC2017 ZEV growth rates, and adjustment of EMFAC's daily VMT per vehicle forecasts to SANDAG travel demand modeling.
- CO_2 reductions from the RECP were based on the difference between the total eVMT supported by a targeted number of all non-residential chargers, including existing and new chargers, in the SANDAG region and the eVMT anticipated in the BAU forecast for the SANDAG region for a given milestone year. The targeted total number of chargers in the SANDAG region was calculated using local PEV-to-charger ratios estimated by CEC's EVI-Pro analysis. EVI-Pro estimates that these ratios would change over time and vary by PEV type. The targeted total number of chargers would be equal to the sum of all existing chargers as of 2018 and any new chargers added starting from 2018. To estimate the number of chargers needed to be incentivized by SANDAG, the number of existing non-residential chargers was subtracted from the targeted number of all non-residential chargers in the region.
- EV chargers were assumed to charge both BEVs and PHEVs. The eVMT provided to each type of vehicle per charger by non-residential charger type (e.g., public versus workplace) reflect the findings and assumptions in CEC's 2018 study and EVI-Pro runs.
- CO_2 reductions from the VIP were based the difference between the targeted EV population for a given milestone year and the EV population anticipated in the BAU forecast. Average VMT and eVMT per vehicle per day were based on EMFAC2017 defaults, which vary by calendar year and vehicle type.
- As SB 375 only requires MPOs to address tailpipe emissions; upstream emissions from additional electricity demand from EVs are ignored.

The detailed Electric Vehicles Programs off-model calculator information is included as Appendix J.

Other Data-Collection Efforts

SANDAG regularly collects data to support monitoring of the Regional Plan/SCS, updating of modeling/forecasting tools, developing strategies for the Regional Plan/SCS, and informing local jurisdiction planning and monitoring efforts. Data also are compiled to support calibration and validation of the activity-based model (ABM) where modeled results are compared against base year observed data as follows:

- Compiled transportation project information from local jurisdictions
- Census data
- Traffic counts
    - Passenger and commercial vehicle counts
    - Bike counts
    - Transit ridership
    - Observed travel time and speeds
    - Traffic volumes
- Parking inventory and cost information
- Day/overnight visitors
- Commuters into San Diego County

Additional Data-Collection Efforts

Some data-collection efforts at SANDAG are focused on supporting local jurisdictions' planning and monitoring activities. To support monitoring of Climate Action Plans, SANDAG developed a Regional Climate Action Planning (ReCAP) Framework and prepares customized reports, called ReCAP Snapshots, for each jurisdiction on their GHG emissions inventory and activity data related to CAP measures.[15] The Snapshots compile data across several sectors, including clean energy, energy-efficiency, active transportation, transit ridership, and water use. In support of California Senate Bill 743 (Steinberg, 2013) implementation, SANDAG developed a web-based map application for local jurisdictions to access VMT data derived from the ABM.[16]

Additionally, a variety of data are collected for performance-monitoring efforts for the 2021 Regional Plan. Per federal requirements, performance-monitoring data will be included in the Federal System Performance Report and Federal Congestion Management Process Appendix as part of the 2021 Regional Plan.

[15] SANDAG Climate Action Programs:
sandag.org/index.asp?classid=17&subclassid=46&projectid=565&fuseaction=projects.detail

[16] SANDAG SB 743 VMT Maps:
arcgis.com/apps/webappviewer/index.html?id=5b4af92bc0dd4b7babbce21a7423402a

Appendices

Appendix A: EMFAC GHG Version Adjustment

1. Jon Taylor Email
2. CARB Methodology to Calculate CO2 Adjustments to EMFAC Output for SB 375 Target Demonstrations
3. Applied SB 375 CO2 Adjustments

Appendix B: SANDAG ABM2+ Sensitivity Testing Report

Appendix C: SANDAG Auto Operating Cost Calculations

Appendix D: Ascent Environmental Electric Vehicle Calculations Memo

Appendix E: WP TDM Off-Model Memo

Appendix F: SANDAG Vanpool Calculator Review and Comparison

Appendix G: SANDAG Carshare Calculator Review and Comparison

Appendix H: SANDAG Pooled Rides Calculator Review and Comparison

Appendix I: SANDAG Regional TDM Ordinance Calculator Review and Comparison

Appendix J: SANDAG Electric Vehicle Programs Calculator Review and Comparison

Appendix A
EMFAC GHG Version Adjustment

From: Taylor, Jonathan@ARB [mailto:jonathan.taylor@arb.ca.gov]
Sent: Tuesday, June 30, 2015 5:24 PM
To: Daniels, Clint; 'Guoxiong Huang'; Bruce Griesenbeck (BGriesenbeck@sacog.org); David Ory; Tanisha Taylor (Taylor@sjcog.org); ehahn@Stancog.org; Matt Fell (matt.fell@mcagov.org); terri.king@co.kings.ca.us; jeff@maderactc.org; Kai Han (KHan@fresnocog.org); RBrady@tularecog.org; Vincent Liu (vliu@kerncog.org); Bhupendra Patel (BPatel@ambag.org); JWorthley@slocog.org; blasagna@bcag.org; 'Andrew Orfila'; Sean Tiedgen (stiedgen@srta.ca.gov); Norberg, Keith@TRPA
Cc: Ken Kirkey; ggarry@sacog.org; Stoll, Muggs; Huasha Liu (LIU@scag.ca.gov) (LIU@scag.ca.gov); Mike Bitner (mbitner@fresnocog.org); rball@kerncog.org; terri.king@co.kings.ca.us; patricia@maderactc.org; Marjie.Kirn@mcagov.org; nguyen@sjcog.org; Park, Rosa@DOT; BKimball@tularecog.org; cdevine@bcag.org; hadamson@ambag.org; SDevencenzi@slocog.org; pimhof@sbcag.org; dlittle@srta.ca.gov; Haven, Nick@TRPA; Kalandiyur, Nesamani@ARB; Roberts, Terry@ARB
Subject: Methodology to Adjust EMFAC Output for SB 375 Target Demonstrations

To All MPO Technical Staff,

Now that many of the MPOs are working on their second round of SCSs, and with ARB recently releasing a new version of EMFAC, we want to provide guidance on how to deal with changes arising from different EMFAC versions as you do your GHG quantification determinations for the second round of SCSs.

We request that you use the attached methodology if you will be using a different version of EMFAC for quantifying reductions from your second SCS than the EMFAC version you used for your first SCS. Our intent with this methodology is to maintain the same level of stringency for meeting the current targets even though there are emission rate changes when switching EMFAC versions. When targets are updated next year, they will probably be based on EMFAC 2014, therefore, this methodology would not be required with the new targets until a new version of EMFAC was released to supersede EMFAC 2014. Our plan is to update the methodology at that time.

Please look over this methodology and let us know if you have any questions or concerns. For general questions, please contact me by email at jonathan.taylor@arb.ca.gov or by phone at 916-445-8699. For specific technical questions on the adjustment calculations, please contact Nesamani Kalandiyur at nesamani.kalandiyur@arb.ca.gov or 916-324-0466.

I'd like to take this opportunity to thank all of you for your generous assistance and patience as ARB staff have evaluated your SCSs. I am sure you are all proud of your accomplishments in meeting the goals of SB 375, and we ARB staff look forward to continuing to work with all of you.

Best,

Jon

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Methodology to Calculate CO2 Adjustment to EMFAC Output for SB 375 Target Demonstrations

Background:

In 2010, ARB established regional SB 375 greenhouse gas (GHG) targets in the form of a percent reduction per capita from 2005 for passenger vehicles using the ARB Emission Factor model, EMFAC 2007. EMFAC is a California-specific computer model that calculates weekday emissions of air pollutants from all on-road motor vehicles including passenger cars, trucks, and buses. ARB updates the EMFAC model periodically to reflect the latest planning assumptions (such as vehicle fleet mix) and emissions estimation data and methods. Since the time when targets were set using EMFAC2007, ARB has released two subsequent versions, EMFAC2011[1] and EMFAC2014[2].

ARB has improved the carbon dioxide (CO2) emission rates in EMFAC2011 and EMFAC2014, based on recent emission testing data and updated energy consumption for air conditioning. In addition, vehicle fleet mix has been updated in EMFAC2011 and again in EMFAC2014 based on the latest available Department of Motor Vehicle data at the time of model development. These changes have lowered the overall CO2 emission rates in EMFAC2011 and EMFAC2014 compared to EMFAC2007.

Purpose:

Some metropolitan planning organizations (MPOs) used EMFAC 2007 to quantify GHG emissions reductions from their first Regional Transportation Plan/Sustainable Communities Strategy (RTP/SCS); others used EMFAC 2011. As MPOs estimate GHG emissions reductions from subsequent RTP/SCSs, they will use the latest approved version of EMFAC, but using a different model will influence their estimates and their ability to achieve SB 375 targets. The goal of this methodology is to hold each MPO to the same level of stringency in achieving their SB 375 targets regardless of the version of EMFAC used for its second RTP/SCS.

ARB staff has developed this methodology to allow MPOs to adjust the calculation of percent reduction in per capita CO2 emissions used to meet the established targets when using either EMFAC2011 or EMFAC2014 for their second RTP/SCS. This method will neutralize the changes in fleet average emission rates between the version used for the first RTP/SCS and the version used for the second RTP/SCS. The methodology adjusts for the small benefit or disbenefits resulting from the use of a different version of EMFAC by accounting for changes in emission rates, and applies an

[1] EMFAC2011 was approved by USEPA in March 2013.
[2] EMFAC2014 is under review for USEPA approval.

adjustment when quantifying the percent reduction in per capita CO2 emissions using EMFAC2011 or EMFAC2014.

Applicability:

The adjustment is applicable when the first RTP/SCS was developed using either EMFAC2007 or EMFAC2011 and the second RTP/SCS will be developed using a different version of the model (EMFAC2011 or EMFAC2014).

- Hold the 2005 baseline CO2 per capita estimated in the first RTP/SCS constant. Use both the human population and transportation activity data (VMT and speed distribution) from the first RTP/SCS to calculate the adjustment.
- Add the adjustment to the percent reduction in CO2 per capita calculated with EMFAC2011 or EMFAC2014 for the second RTP/SCS. This will allow equivalent comparison to the first RTP/SCS where emissions were established with EMFAC 2007 or EMFAC2011.

Example Adjustment Calculation (hypothetical for illustration purposes):

In this example, the first RTP/SCS was developed using EMFAC2007 and the second RTP/SCS using EMFAC2011 to calculate the CO2 per capita.

Step1: Compile the CO2 per capita numbers from the MPO's first adopted RTP/SCS using EMFAC 2007 without any off-model adjustments for calendar years (CY) 2005, 2020, and 2035 for passenger vehicles.

Calendar Year	EMFAC2007 CO2 Per capita (lbs/day)
2005	30.0
2020	28.8
2035	27.6

Step 2: Calculate the percent reductions in CO2 per capita from the 2005 base year for CY 2020 and 2035 from Step 1.

Calendar Year	EMFAC2007 Percent Reductions (%)
2020	4.0%
2035	8.0%

Step 3: Develop the input files for the EMFAC2011 model using the same activity data for CY 2020 and 2035 from the first adopted RTP/SCS (same activity data used in Step 1) and execute the model.

Step 4: Calculate the CO_2 per capita for CY 2020 and 2035 using the EMFAC2011 output from Step 3; do not include Pavley I, LCFS, and ACC benefits for passenger vehicles.

Calendar Year	EMFAC2011 CO2 Per capita (lbs/day)
2020	28.2
2035	27.9

Step 5: Calculate the percent reductions in CO_2 per capita for CY 2020 and 2035 calculated in Step 4 from base year 2005 established in Step 1.

Calendar Year	EMFAC2011 Percent Reductions (%)
2020	6.0%
2035	7.0%

Step 6: Calculate the difference in percent reductions between Step 5 and Step 2 (subtract Step 5 results from Step 2 results) for CY 2020 and 2035; this yields the adjustment for the respective CY.

Calendar Year	EMFAC2011 Adjustment (%)
2020	-2.0%
2035	+1.0%

Step 7: Develop the input files for the EMFAC2011 model using the activity data from the new/second RTP/SCS for CY 2020 and 2035 without any off-model adjustments and execute the model.

Step 8: Calculate the CO_2 per capita for CY 2020 and 2035 using the EMFAC2011 output from Step 7; do not include Pavley I, LCFS, and ACC benefits for passenger vehicles.

Calendar Year	EMFAC2011 CO2 Per capita (lbs/day)
2020	26.4
2035	26.1

Step 9: Calculate the percent reductions in CO_2 per capita for CY 2020 and 2035 calculated in Step 8 from base year 2005 established in Step 1.

Calendar Year	EMFAC2011 Percent Reductions (%)
2020	12.0%
2035	13.0%

Step 10: Add the adjustment factors from Step 6 to the percent reductions calculated for the new/second RTP/SCS (Step 9) using EMFAC 2011 for CY 2020 and 2035.

Calendar Year	Adjusted Percent Reductions (%)
2020	10.0%
2035	14.0%

Follow the same steps to adjust for use of EMFAC2007 or EMFAC2011 to EMFAC2014. Do not include any off-model adjustments during application of the EMFAC adjustment factor.

Appendix A3 – Applied SB 375 CO2 Adjustments

SB375 CO2 Adjustment for Differences between EMFAC2007 and EMFAC2014

Step 1	CO2 per Capita from 1st adopted RTP/SCS using EMFAC2007 without any off-model adjustments for passenger vehicles			
	Calendar Year	EMFAC2007 CO2	EMFAC2007 CO2/Capita	Notes
	2005	*39,511*	26.0	2005 Pop = 3,034,388
	2020	41,111	23.3	Series 12 Activity & Pop
	2035	48,297	24.0	Series 12 Activity & Pop

Step 2	Calculate percent reductions in CO2 per capita from the 2005 base year from Step 1			
	Calendar Year		EMFAC2007 CO2/Capita Percent Reduction	Notes
	2020		-10.5%	
	2035		-7.7%	

Step 3	Develop Input Files for EMFAC2014 from 1st SCS activity data

Step 4	Calculate CO2 using EMFAC2014 using output from Step 3 (for certain versions of EMFAC you would need to exclude Pavley I, LCFS, and ACC benefits for PVs)			
	Calendar Year	EMFAC2014 CO2 (tons)	EMFAC2014 CO2 (lbs)/Capita	Notes
	2020	40,288	22.79	Series 12 Activity & Pop
	2035	47,424	23.56	Series 12 Activity & Pop

Step 5	Calculate the percent reductions in CO2 per capita calculated in Step 4 from base year 2005 established in Step 1			
	Calendar Year		EMFAC2014 CO2/Capita % Reduction	Notes
	2020		-12.3%	
	2035		-9.4%	

Step 6	Calculate the difference in percent reductions between Step 5 and Step 2 (subtract Step 5 results from Step 2 results)			
	Calendar Year		EMFAC2014 Adjustment %	Notes
	2020		-1.8%	
	2035		-1.7%	

Appendix B
SANDAG ABM2+ Sensitivity Testing Report

SANDAG ABM2+
Sensitivity Testing Report

September 2020

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Objectives

San Diego Association of Governments (SANDAG) modeling staff conducted a series of sensitivity tests to demonstrate the effects of various inputs on vehicle miles traveled (VMT), mode share, trip length, and transit boardings using Activity Based Model (ABM2+). This work was performed in response to the Final Sustainable Communities Strategy Program and Evaluation Guidelines issued by the California Air Resources Board (CARB) and to examine the responsiveness of ABM2+ to potential SANDAG 2021 Regional Plan strategies. Since draft ABM2+ software versions were used in this study, the performance metrics varied slightly. These metrics are for sensitivity testing analysis only and should not be interpreted as final ABM2+ performance metrics.

Description of Sensitivity Tests

In February 2020, to prepare for the ABM2+ technical advisory committee (TAC) peer review held in March 2020, the modeling staff conducted a series of sensitivity tests. Following CARB's sensitivity test guidelines, staff conducted land use, transit infrastructure and active transportation, local/regional pricing, new mobility, and exogenous variable sensitivity tests as described in Table 1. Some tests were adjusted either to conform to the ABM2+ structure or to set with testing values that are more in line with Regional Plan (RTP) strategies. Tests in the new mobility category, including autonomous vehicles (AV), transportation network companies (TNC), and micromobility (E-Scooter, E-Bike, etc.), were beyond CARB's recommendations. Most sensitivity tests were based on 2035 model runs using 2035 revenue constrained networks from the 2019 Federal RTP. The Population forecast was prepared by SANDAG Economic and Demographic Analysis (EDAM) staff in August 2019. The 2035 revenue constrained scenario was used as the baseline scenario to derive elasticity. Land use–related tests used the 2050 forecast to account for the full potential impact of population growth on VMT and mode share.

Table 1. Descriptions of ABM2+ Sensitivity Tests

CARB Category	Description	Test ID	Scenario	Year
Land Use	baseline	1	baseline	2050
	job/housing balance	2	new downtown	2050

	mix of land use	3	low VMT	2050
	street pattern via intersection density	4	10%	2050
		5	–10%	2050
	residential density	6	50%	2050
		7	–50%	2050
Transit and Active Transportation	2035 baseline without AV	8	2035 baseline without AV	2035
	transit headways (frequencies)	9	50%	2035
		10	–50%	2035
	self-owned E-Bike	11	12 mph	2035
		12	15 mph	2035
Local/Regional Pricing	mileage-based fee via AOC	13	50%	2035
		14	–50%	2035
	transit fare	15	50%	2035
		16	free	2035
		17	–50%	2035
	managed lane/toll price	18	50%	2035
		19	–50%	2035
	parking costs	20	high	2035
		21	very high	2035
Exogenous Variables	free flow speed	22	reduce 5 mph on freeways	2035
		23	reduce 5 mph on all roads	2035
	household income	24	–1/3	2035
		25	1/3	2035
	regional employment	26	10%	2035
		27	–10%	2035
New Mobilities	2035 baseline with AV	28	2035 baseline with AV	2035
	TNC cost (all)	29	50%	2035
		30	–50%	2035
	pooled TNC cost	31	–50%	2035
		32	–75%	2035
	TNC wait time	33	–50%	2035
		34	50%	2035
	micromobility speed	35	30mph	2035
	micromobility focus	36	micromobility speed 20 mph, constant 0, cost and access time halved	2035
	access to micromobility	37	good	2035
		38	very good	2035
	micromobility cost	39	-50%	2035

		40	50%	2035
	AV household penetration rate	41	50%	2035
		42	0%	2035
	AV in-vehicle time coefficient	43	Reduce from 0.75 to 0.6	2035
		44	Increase from 0.75 to 0.9	2035
	AV operating cost scaler	45	Reduce from 0.7 to 0.5	2035
		46	Increase from 0.7 to 0.9	2035
	AV terminal time scaler	47	Reduce from 0.65 to 0.5	2035
		48	Increase from 0.65 to 0.8	2035
	TNC optimization	49	TNC optimization	2035
		50	TNC transit optimization	2035
	AV and TNC combos	51	20% household AV penetration rate and 30 min TNC benefits	2035
		52	20% household AV penetration rate and 7.5 min TNC benefits	2035
		53	50% household AV penetration rate and 15 min TNC benefits	2035
Telework	existing pattern	54	Existing telework rates	2035
	moderate growth pattern	55	Moderate telework rate growth	2035
	maximum growth pattern	56	Maximum telework rate growth	2035

Baseline Scenarios

Staff created three baseline scenarios to ensure consistency when comparing results from multiple scenarios in the same test group, including:

- 2050 baseline without AV
- 2035 baseline without AV
- 2035 baseline with AV (20% household AV penetration rate)

The 2050 baseline without AV was used for comparing scenarios in the land use test category. The 2035 baseline without AV, a business as usual scenario, was used for comparing ‘conventional’ tests, such as transit fare, transit service, and AOC tests. The 2035 baseline with AV was used for comparing all new mobility tests that assume a 20% household AV penetration rate. During the three-month testing period, there were a few minor software changes, which resulted in slightly different software versions. All comparisons in this report were checked to ensure the same software version was used for baseline and build tests in each test group.

Description of Test Input Changes

Land Use

Staff tested three 2050 population growth alternatives: business as usual – baseline, jobs close to housing, and low VMT.

- *Test 1 2050 Baseline without AV:* 2050 baseline using revenue constrained networks (Figures 10, 11, and 12 in Appendix B) and land use (Figures 3 and 6 in Appendix B) from the 2019 Federal RTP. The impact of AVs was not included.
- *Test 2 2050 Jobs close to housing:* This alternative represents a job/housing balance scenario with population growth concentrated in one of San Diego's job centers, Sorrento Valley.
- *Test 3 2050 Low VMT:* This alternative represents a scenario with population growth concentrated in urban cores with good transit, walk, and bike accessibilities. The construction of this Low VMT land use alternative is described in Figures 13, 14, and 15 in Appendix B.
- *Test 4 and 5 Intersection density:* In the MGRA input file, intersection densities were set to be 10 percent less or 10 percent more than the corresponding values in the 2050 baseline scenario. It should be noted that road networks were not changed, only the intersection density variable was modified. These tests fall into the controlled-variable test category per CARB's guidelines which define the controlled-variable land use tests as: these *are simply hypothesis testing which holds all other variables constant, neglecting the supply-demand interaction between inter-dependent variables in reality, to determine the change in model outputs (e.g., VMT, VHT, vehicle trips, mode share) with respect to the change in a single land use related variable (e.g., residential density, employment density, compact housing development).*
- *Tests 6 and 7 Residential density:* In the MGRA[1] input file, residential densities were set to be 50 percent less or 50 percent more than the corresponding values in the 2050 baseline scenario. It should be noted that households were not re-distributed, only the residential density variable was modified. These tests fall into CARB's controlled-variable test category.

Transit and Active Transportation

These tests evaluated transit and active transportation-related strategies through a more frequent transit service and the expansion of self-owned E-Bikes that operate at faster speeds than regular bikes.

- *Test 8 2035 Baseline without AVs:* This is a 2035 baseline scenario with revenue constrained networks (Figures 7, 8, and 9 in Appendix B) and land use (Figures 2 and 5 in Appendix B) from the 2019 Federal RTP. The impact of AVs was not included.
- *Tests 9 and 10 Transit Frequency:* For each scenario's transit route attribute table, the frequencies by route were set to be 50 percent less or 50 percent more than the corresponding values in the 2035 baseline.
- *Tests 11 and 12 Self-Owned E-Bike:* In the two test scenarios, bike speed was increased from 10mph to 12mph and 15mph, respectively, to represent the impact of self-owned E-Bikes. Maximum bike distance thresholds were scaled up. Additionally, distance coefficients used to calculate bike logsums were scaled to reflect bike speed changes.

Local/Regional Pricing

These tests evaluated local/regional pricing-related strategies through mileage-based pricing (auto operating cost), reduction in transit fare cost, tolled roadways, and parking pricing.

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[1] MGRA – Master Geographic Reference Areas are approximately 23,000 geographic areas in San Diego County created by overlaying unique combinations of jurisdictional, census and other geographies to create the basic building blocks for spatial analysis by SANDAG.

- *Test 13 and 14 Mileage-base fees:* Fuel and maintenance costs were set to be 50 percent less or 50 percent more than the corresponding values in the 2035 baseline.
- *Tests 15, 16 and 17 Transit Fare:* For each scenario's transit route attribute table, the fares by route were set to be 50 percent less, free, or 50 percent more than the corresponding values in the 2035 baseline. The zone-based fare for commuter rail was updated in the same manner as the route-based fare assumption.
- *Test 18 and 19 Managed lane/Toll price:* The toll price of managed lanes/toll roads were set to be 50 percent less or 50 percent more than the corresponding values in the 2035 baseline.

Test 20 and 21 Parking cost scenarios: Staff constructed two test scenarios using the 2035 parking fee schedule provided by SANDAG planning staff. Each of the 6,556 MGRAs in mobility hubs is given hourly, daily, and monthly parking fees by mobility hub type as described in Table 2.

Table 2. Descriptions of ABM2+ Sensitivity Tests

Mobility Hub Type	# of MGRAs	Hourly	Daily	Monthly
1 – Urban Shed High	855	$6.5	$39	$571
2 – Tier 1 Employment Centers	391	$4.9	$29	$408
3 – Other Urban Shed Tracts	908	$4.9	$29	$408
4 – Costal	1,780	$3.3	$20	$245
5 – Child Shed	2,622	$1.6	$10	$131

Note: 2010 $ value

SANDAG Data Solutions (DS) staff provided 2035 parking space data for MGRAs in mobility hubs (5,689 out of 6,556 mobility hub MGRAs). Since the 2035 baseline parking data was prepared at an earlier time using slightly different data sources and methodologies, a small portion of the estimated MGRA parking spaces were lower than those in the 2035 baseline scenario. For any given MGRA, if parking space data was not provided or was lower than 2035 baseline parking spaces, then staff used the 2035 baseline parking space data.

There are four parking area types ("parkarea") in ABM:

1. Designates a parking constrained MGRA. Parking charges apply and are calculated as a weighted average of parking costs in MGRAs in parkarea 1 or 2 within walking distance (3/4 mile). The parking costs are weighted inversely by distance and by the number of spaces. Trips with destinations in a MGRA in parkarea 1 may choose to park in a different MGRA. A parking location choice model is applied to auto trips with destinations in parkarea 1.
2. This is a reserve area of parking for parkarea 1, e.g. a residential or commercial area immediately around downtown. Trips with destinations in parkarea 1 may choose to park in a MGRA in parkarea 2, and parking charges may apply. In the base year, parkarea 2 MGRAs were constrained to be a quarter-mile buffer around downtown.
3. Only trips with destinations in the same MGRA may park here. Parking charges apply but are not calculated as a weighted average of walkable MGRAs.
4. Only trips with destinations in the same MGRA may park here. Parking charges do not apply (free parking)

High parking cost scenario: First, staff set parkarea to 1 for all 6,556 MGRAs in mobility hubs. Staff then updated the 2035 baseline parking costs using data from Table 2. All the updated costs were decreased by 50 percent. The parking cost in this scenario is higher than the 2035 baseline.

Very high parking cost scenario: First, staff set parkarea to 1 for all 6,556 MGRAs in mobility hubs. Staff then updated the 2035 baseline parking cost using data from Table 2. All the updated costs were increased by 50 percent over the values in Table 2. The parking cost in this scenario is much higher than the 2035 baseline.

Exogenous Variables

These tests evaluated exogenous factors through free flow speeds, household income, regional employment, and telework rates. CARB recommended that MPOs should conduct sensitivity tests on some of the most common exogenous variables in the travel demand model such as income distribution and auto operating cost. Auto operating cost tests are included in the pricing section.

- *Tests 22 and 23 Free flow speed:* Staff wrote Python scripts to create two modified networks with free flow speed reduced by 5mph on freeways and all roads, respectively.
- *Tests 24 and 25 Household income:* Household income was set to be one-third less or one-third more than the corresponding values in the 2035 baseline.
- *Tests 26 and 27 Regional total employment:* In the persons file, the number of full-time workers was set to be 10 percent less or 10 percent more than the corresponding values in the 2035 baseline. In the MGRA input file, employment at each MGRA was set to be 10 percent less or 10 percent more than the corresponding values in the 2035 baseline.
- *Test 54 Existing pattern:* Represents a business as usual scenario with permanent and occasional telework rates at 7% and 8%, respectively (same as the 2016/2017 household survey).
- *Test 55 Moderate growth pattern:* Represents a moderate telework growth scenario with permanent and occasional telework rates at 9% and 12%, respectively.
- *Test 56 Maximum growth pattern:* Represents a maximum telework growth scenario with permanent and occasional telework rates at 25% and 13%, respectively (same as the 2016/2017 household survey).

New mobility

These tests evaluated new mobility-related strategies through autonomous vehicles (AV), transportation network companies (TNC), and micromobility modes such as E-Scooters and shared E-Bikes. Since there are limited studies evaluating the impact of new mobility-related strategies, CARB's guidelines indicated that the current practice of the quantification of the GHG benefit is generally conducted through off-model analysis. ABM2+ was enhanced with explicit modeling of AV, TNC, and micromobilities. Staff were able to test new mobility scenarios beyond CARB's recommendations. Since some new mobility modes are included in multiple model components (e.g. resident model, airport model, visitor model, and cross border model), staff made changes to all model components whereas the new mobility modes apply.

- *Test 28 2035 baseline with AV:* 2035 baseline with AV using revenue constrained networks and land use from the 2019 Federal RTP. The impact of AV was included (the default AV penetration rate is 20 percent).

- *Tests 29 and 30 TNC cost:* Costs for single and pooled TNC modes was set to be 50 percent less or 50 percent more than the default values in the 2035 baseline.
- *Tests 31 and 32 Pooled TNC cost:* Costs for only the pooled TNC mode was set to be 50 or 75 percent less than the default values in the 2035 baseline.
- *Tests 33 and 34 TNC wait time:* Wait times for single and pooled TNC modes was set to be 50 percent less or 50 percent more than the corresponding default values in the 2035 baseline.
- *Test 35 Micromobility speed:* The micromobility mode speed was increased from 12 to 30 mph.
- *Test 36 Micromobility focus:* The micromobility mode speed was increased from 12 to 20 mph. The micromobility variable cost and fixed cost were set to $0.1/minute and $0.5, respectively (reduced by 50 percent compared with the default in the 2035 baseline). The micromobility constant was set to 0 (default is 60 in the 2035 baseline). Lastly, the micromobility access time was reduced by half in the MGRA-based input file from 5, 10, and 120 minutes to 2.5, 5, and 60 minutes for urban, suburban, rural MGRAs.
- *Test 37 and 38 Access to micromobility:* Access time to micromobility was specified in number of minutes by MGRA, to represent spatial differences in the availability of micromobility options such as E-Scooters. The baseline micromobility accessibility was estimated by SANDAG planning staff to be 5 minutes in the urban cores, 15 minutes in suburban areas within the City of San Diego, and unavailable elsewhere. For these sensitivity tests, the micromobility access time was set to 3, 5, and 15 minutes and 1, 3, and 5 minutes for urban, suburban, and rural MGRAs respectively.
- *Tests 39 and 40 Micromobility cost:* Costs for micromobility mode was set to be 50 percent less or 50 percent more than the default values in the 2035 baseline
- *Tests 41 and 42 Household AV penetration rate:* AV penetration rates were set to 50 percent and 100 percent (default is 20 percent in the 2035 baseline).
- *Test 43 and 44 AV in-vehicle time coefficient:* AV in-vehicle time coefficients were set to 0.6 and 0.9 (default is 0.75 in the 2035 baseline).
- *Tests 45 and 46 AV operating cost:* AV operating cost scalers were set to 0.5 and 0.9 (the default is 0.7 in the 2035 baseline).
- *Tests 47 and 48 AV terminal time:* AV terminal time scalers were set to 0.5 and 0.8 (the default is 0.65 in the 2035 baseline).
- *Test 49 TNC optimization:* The assumption was made that the TNC fleet is autonomous and much more widely available than current. The AV penetration rate was set to 0 percent. TNC wait time was set to be 50 percent less than the default values in the 2035 baseline. In mode choice UEC files, the alternative-specific constants (ASCs) of all TNC modes (TNC-Transit, single, and pooled-TNC) were increased by 30 minutes of equivalent in-vehicle time benefit, and Taxi alternative was turn off.
- *Test 50 TNC Transit optimization:* The AV penetration rate was set to 0 percent. The ASCs for TNC-Transit mode were increased by 30 minutes of equivalent in-vehicle time benefit.
- *Test 51 TNC benefits and 20 percent AV penetration rate:* The AV penetration rate was set to 20 percent. TNC wait time was set to be 50 percent less than the default values in the 2035 baseline. The ASCs for all TNC modes (TNC-Transit, single, and pooled) were increased by 30 minutes of equivalent in-vehicle time benefit, and the Taxi alternative was turned off.

- *Test 52 TNC benefits and 20 percent AV penetration:* The AV penetration rate was set to 20 percent. TNC wait time was set to be 50 percent less than the default values in the 2035 baseline. The ASCs for all TNC modes (TNC-Transit, single, and pooled) were increased by 7.5 minutes of equivalent in-vehicle time benefit, and the Taxi alternative was turned off.
- *Test 53 TNC benefits and 50 percent AV penetration:* The AV penetration rate was set to 50 percent. TNC wait time was set to be 50 percent less than the default values in the 2035 baseline. The ASCs for all TNC modes (TNC-Transit, single, and pooled) were increased by 15 minutes of equivalent in-vehicle time benefit, and the Taxi alternative was turned off.

Results and Findings

This section describes the sensitivity testing results and key findings. While some tests were simply hypothetical and were designed to mechanically examine the model's responsiveness to key variables, some other tests shed some insights of whether and how much the model responds to potential policy dials. The performance metrics analyzed include VMT, mode share, transit boardings, trip distance by mode, total trips, and in some cases test specific outputs such as toll road volumes. The analysis varied slightly, depending on the travel markets affected by the change of tested variables. While some analyses were based on metrics of all models including special market models like visitor, cross border, and truck models, some other analyses were for San Diego county resident models only.

Land Use

Land Use Tests (Tests 2 & 3)

Compared with the 2050 baseline, the low VMT land use alternative test had the following results:

- Total personal trips made by San Diego residents decreased by 1.2% (Figure 4)
- Average auto ownership decreased from 1.69 to 1.64 (Figure 2). Households without cars increased from 10.6% to 12.2% (Figure 3).
- VMT decreased by 3.7% (Figure 1)
- San Diego resident mode shares (Figure 5):
  - Drive alone (DA) decreased from 45.4% to 44.6%
  - Shared ride 2 (SR2) decreased from 23.6% to 23.3%
  - Shared ride 3 (SR3) decreased from 16.0% to 15.4%
  - Transit increased from 2.9% to 3.1%
  - Active modes (walk, bike, and micromobility) increased from 10.7% to 12.0%
- Transit boarding increased by nearly 5% (Figure 6)
- Average San Diego resident trip distance decreased from 6.1 miles to 5.9 miles; Trip distance of non-mandatory trips such as recreational, eating out, maintenance, shopping, and visiting all decreased. Work trip distance change was insignificant (Table 3).

Compared with the 2050 baseline, the jobs close to housing alternative test had the following results:

- VMT decreased by 2.0% (Figure 1)

- Average auto ownership decreased from 1.69 to 1.66 (Figure 2). Households without cars increased from 10.6% to 11.1% (Figure 3).
- Total personal trips made by San Diego residents decreased by 0.4% (Figure 4)
- San Diego resident mode shares (Figure 5):
    - DA decreased from 45.4% to 45.2%
    - SR2 decreased from 23.6% to 23.4%
    - SR3 decreased from 16.0% to 15.9%
    - Transit increased from 2.9% to 3.0%
    - Active modes (walk, bike, and micromobility) increased from 10.7% to 10.9%
- Transit boarding increased by 2.7% (Figure 6)
- Average San Diego resident trip distance decreased from 6.1 miles to 6.0 miles. Work trip distance decreased. Trip distance of non-mandatory trips such as recreational, eating out, maintenance, and shopping also decreased (Table 3).

These results confirm that ABM2+ is sensitive to land use alternatives. When households and population growth are concentrated in urban core areas, the model indicated lower VMT, lower auto mode shares, higher walk, bike, and transit mode shares, and shorter trip distances. Another interesting finding was that total person trips decreased, which may be caused by reduced auto ownership. It should be noted that the tested alternatives did not include employment growth.

Figure 1. VMT Change: Land Use Alternatives vs 2050 Baseline (tests 2 and 3)

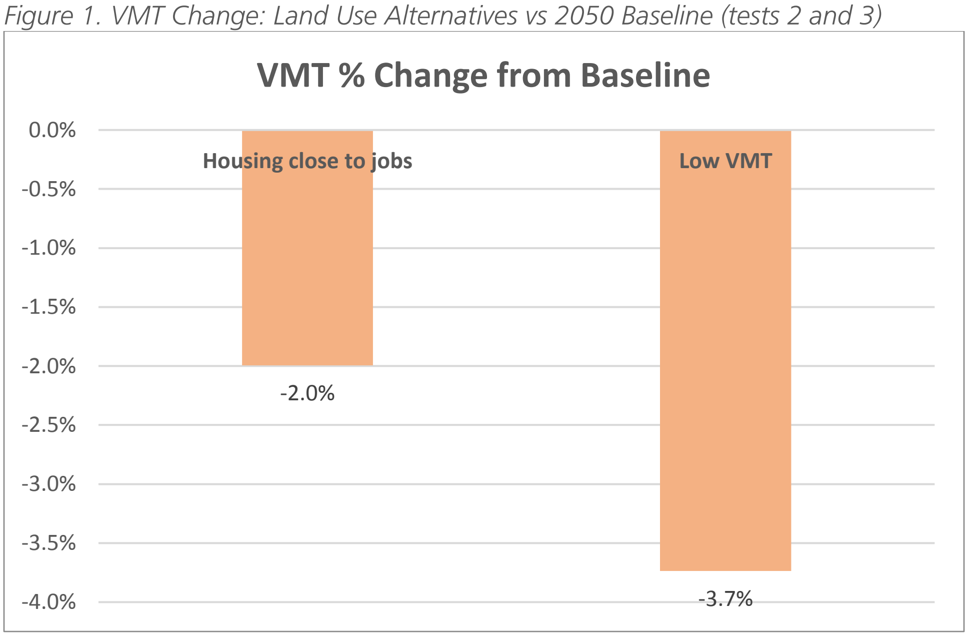


Figure 2. Average Auto Ownership: Land Use Alternatives vs 2050 Baseline (tests 2 and 3)

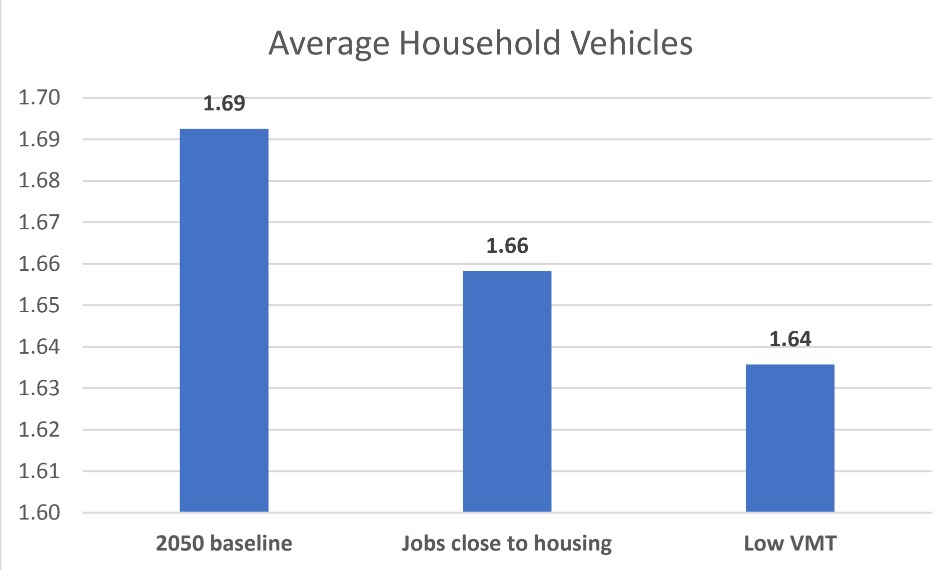


Figure 3. Average Auto Ownership by Number of Vehs: Land Use Alternatives vs 2050 Baseline (tests 2 and 3)

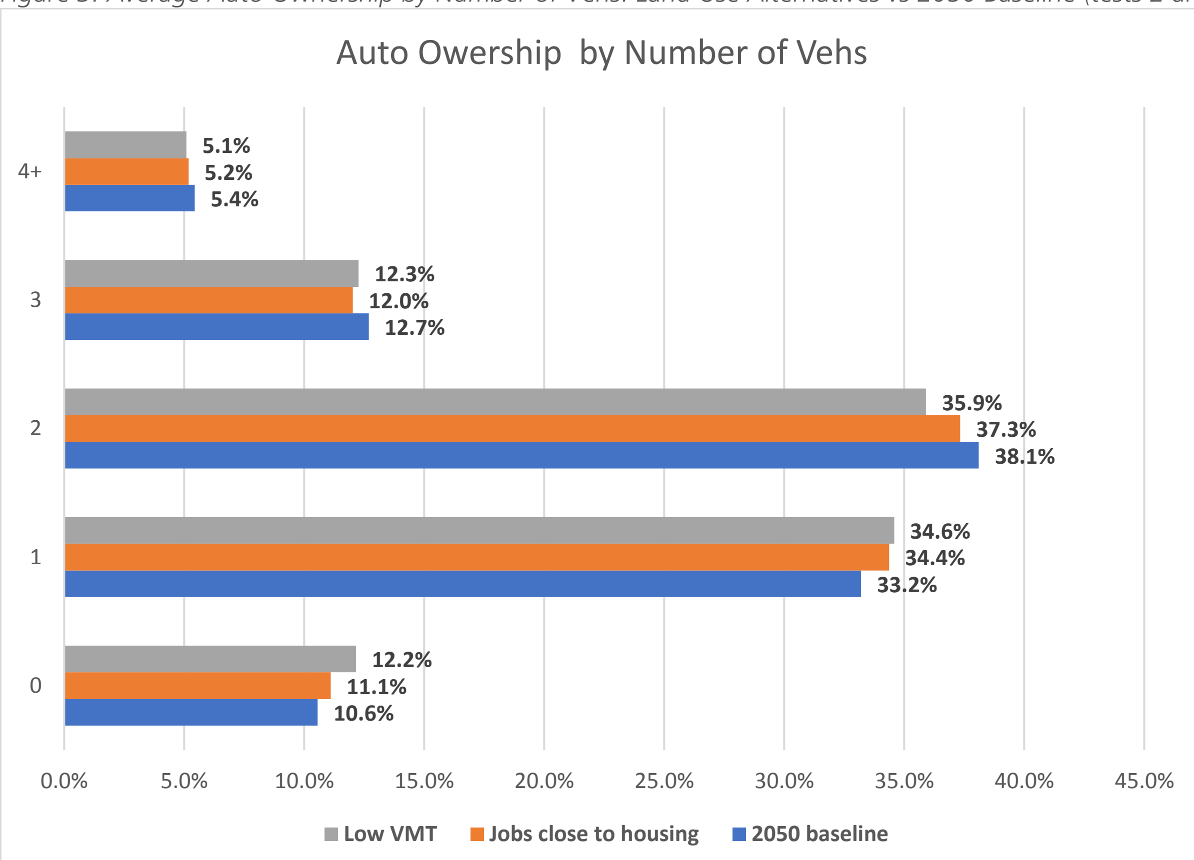


Figure 4. Total Person Trips: Land Use Alternatives vs 2050 Baseline (tests 2 and 3)

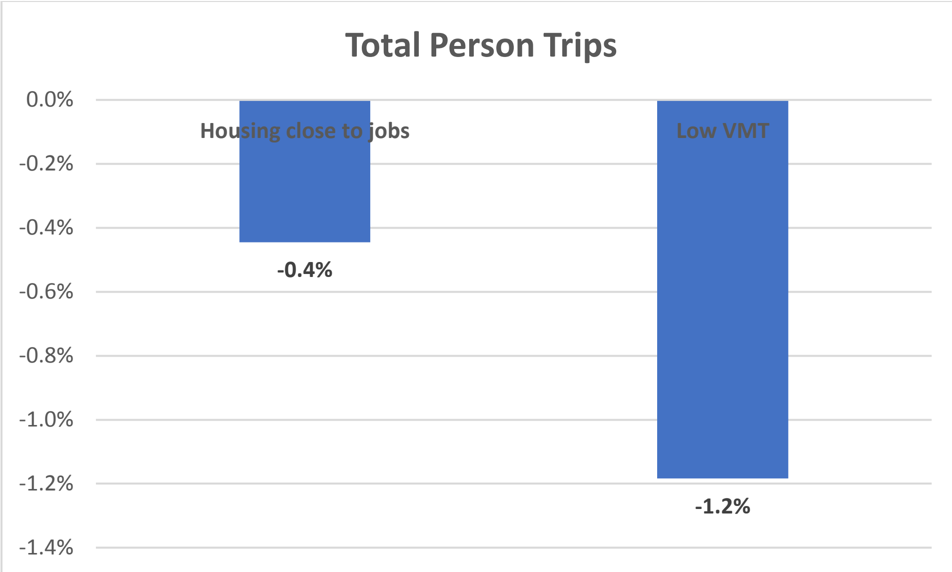


Figure 5. Mode Share of Person Trips: Land Use Alternatives vs 2050 Baseline (tests 2 and 3)

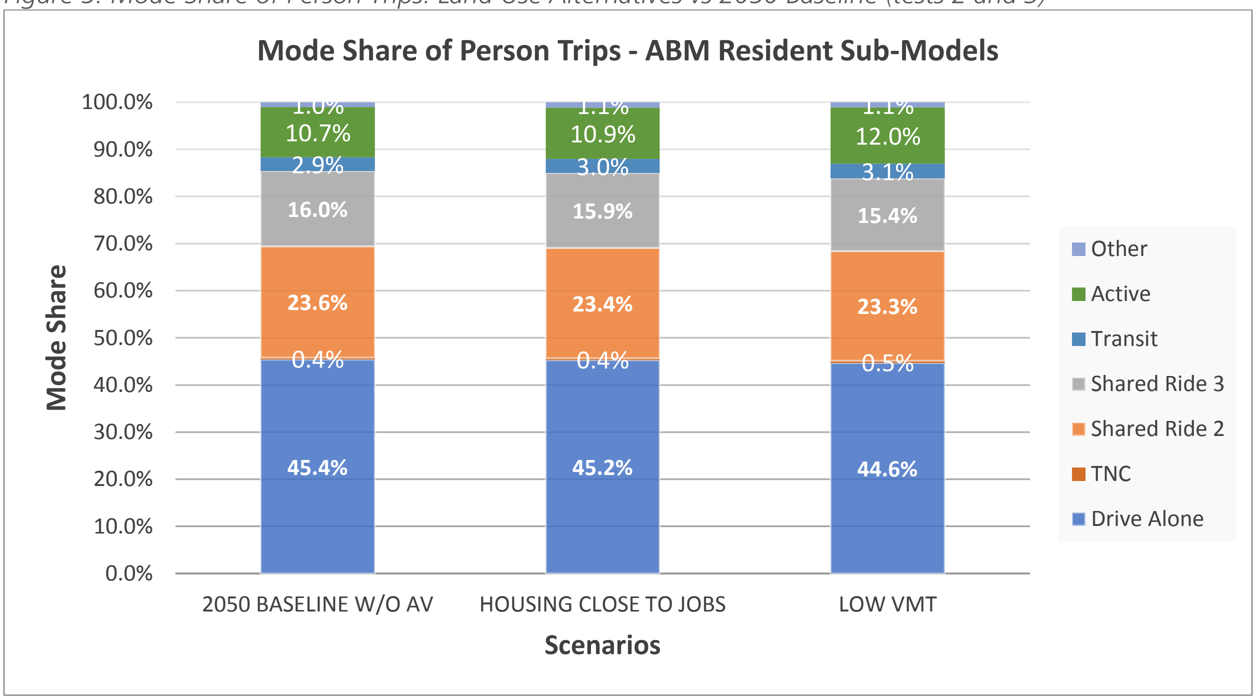


Figure 6. Transit Boarding Change from Baseline: Land Use Alternatives vs 2050 Baseline (tests 2 and 3)

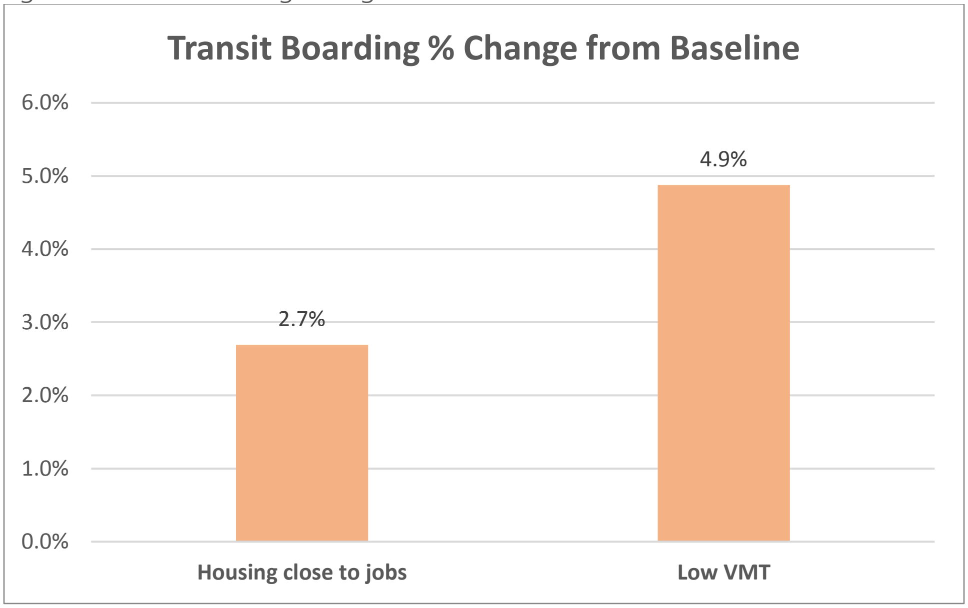


Table 3. Person Trip Distance by Purpose: Land Use Alternatives vs 2050 Baseline (tests 2 and 3)

Alternative	Rec.	Dining	Escort	Home	Maint.	School	Shop	Univ	Visit	Work	Total
2050 baseline w/o AV	4.9	5.3	5.2	6.0	5.1	4.6	4.2	8.2	5.8	10.3	6.1
Housing close to jobs	4.7	5.2	5.1	5.9	4.9	4.6	4.2	8.1	5.8	10.2	6.0
Low VMT	4.6	5.1	4.9	5.7	4.9	4.3	4.0	8.2	5.6	10.3	5.9

Residential Density & Intersection Density Tests (Tests 4-7)

Compared with the 2050 baseline, the 50% higher residential density test had the following results:

- VMT decreased by 1.1% (Figure 7)
- San Diego resident mode shares (Figure 8):
    - DA decreased from 45.4% to 44.8%
    - SR3 decreased from 16.0% to 15.7%
    - Transit increased from 2.9% to 3.3%
    - Active modes (walk, bike, and micromobility) increased from 10.7% to 11.1%
- Transit boarding increased by over 10% (Figure 9)

Compared with the 2050 baseline, the 50% lower residential density test had the following results:

- VMT increased by 0.9 % (Figure 7)
- San Diego resident mode shares (Figure 8):
    - DA increased from 45.4% to 46.0%
    - Transit decreased from 2.9% to 2.6%
    - Active mode (walk, bike, and micromobility) decreased from 10.7% to 10.2%

- Transit boarding decreased by nearly 10% (Figure 9)

These results confirm that the ABM2+ is sensitive to residential density. When residential density increased, the model indicated lower VMT, lower auto mode shares, and higher walk, bike, and transit mode shares. When residential density decreased, the opposite effects were observed. It should be noted that these are simply hypothesis tests which hold all other variables constant, neglecting the supply-demand interaction between inter-dependent variables. In the SANDAG model, residential densities are calculated from the synthetic population and MGRA acreage. Since the synthetic population was not altered, the test results should not be interpreted as the effects of +-50% population changes.

Compared with the 2050 baseline, the 10% higher intersection density test had the following results:

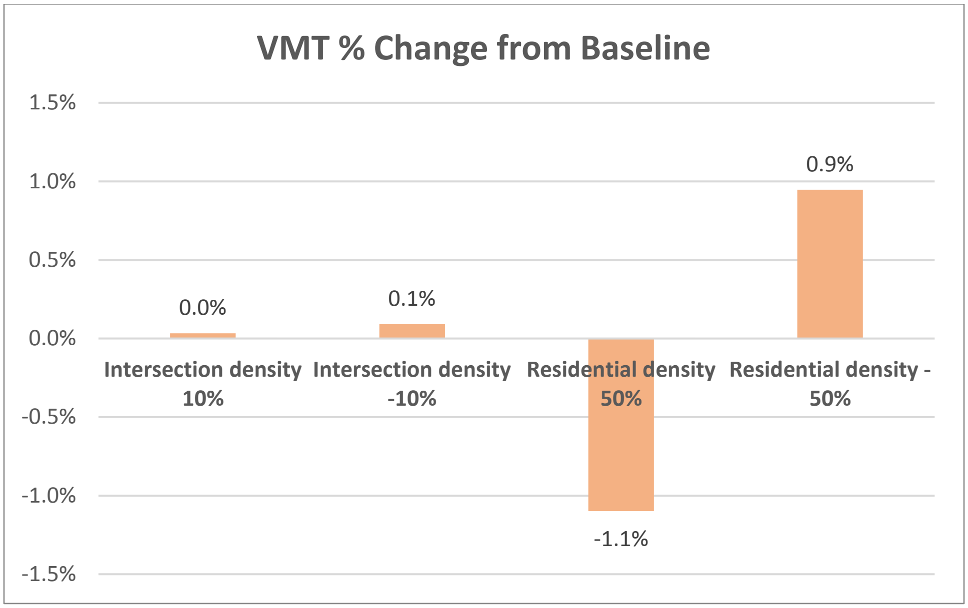
- Insignificant VMT change (Figure 7)
- Active mode (walk, bike, and micromobility) increased slightly from 10.7% to 10.8% (Figure 8)
- Transit boarding increased slightly by 1.0% (Figure 9)

Compared with the 2050 baseline, the 10% lower intersection density test had the following results:

- Insignificant VMT change (Figure 7)
- Active mode (walk, bike, and micromobility) decreased slightly from 10.7% to 10.4% (Figure 8)
- Insignificant Transit boarding change (Figure 9)

Although ABM2+ responds to intersection density changes in the expected direction, the impact of +-10% intersection density changes were limited. When intersection density increased, the model indicated slightly higher walk, bike, and transit mode shares. When intersection density decreased, the opposite effects were observed. It should be noted that these are simply hypothesis tests which holds all other variables constant, neglecting the supply-demand interaction between inter-dependent variables. In the SANDAG model, walk and bike times are calculated between each MGRA using an all-streets network. In this test, only the intersection density variable at the MGRA level was changed; the actual network was not altered from the baseline scenario. Therefore, the non-motorized times and distances in the model were unchanged from the baseline scenario; the test results should not be interpreted as the effects of +-10% road network build in the region.

Figure 7. VMT Change: Residential Density & Intersection Density Tests (Tests 4-7)



VMT % Change from Baseline
1.5%
1.0%
0.5%
0.0%
-0.5%
-1.0%
-1.5%
0.0%
0.1%
-1.1%
0.9%
Intersection density 10%
Intersection density -10%
Residential density 50%
Residential density -50%

Figure 8. Mode Share of Person Trips: Residential Density & Intersection Density Tests (Tests 4-7)

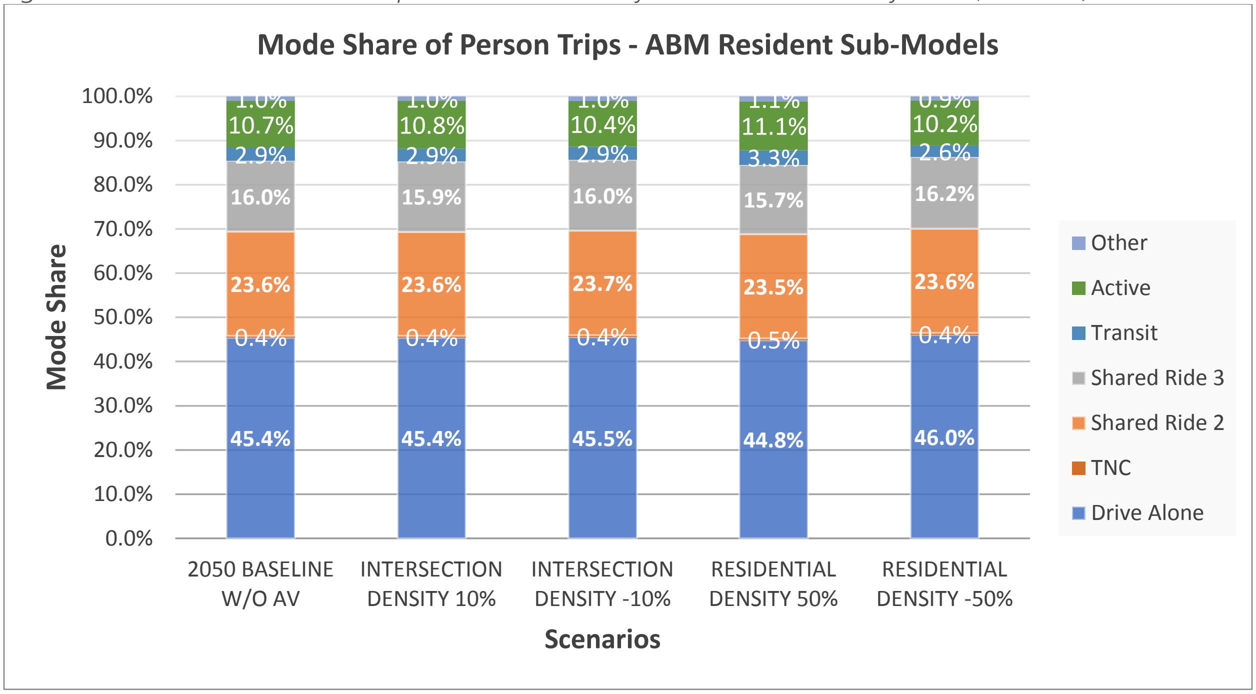
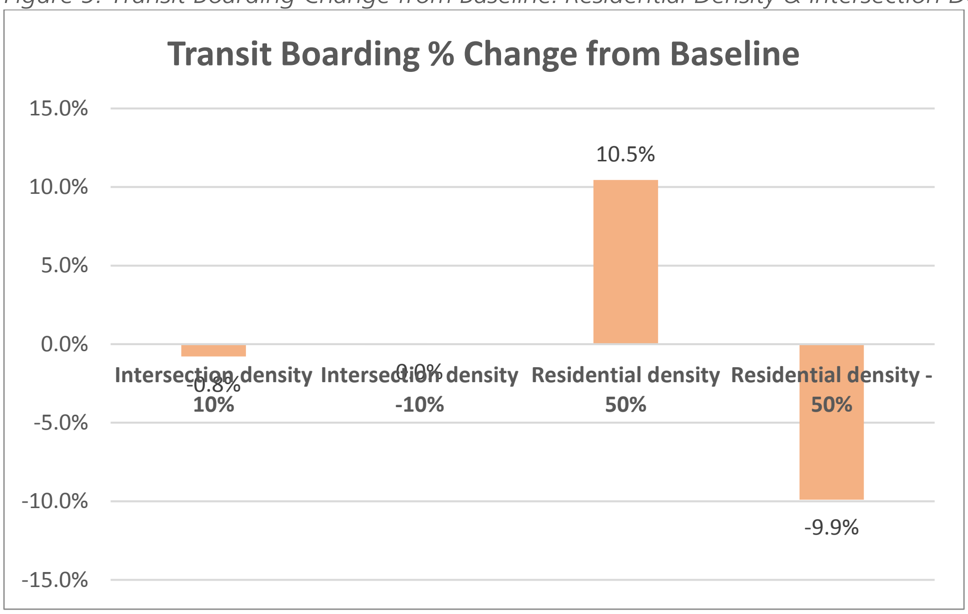


Figure 9. Transit Boarding Change from Baseline: Residential Density & Intersection Density Tests (Tests 4-7)



Transit and Active Transportation

Transit Headway Tests (Tests 9 & 10)

Compared with the 2035 baseline, the 50% more frequent transit services test had the following results:

- VMT increased by 0.3% (Figure 10)

- Mode share for all models (Figure 11):
    - DA decreased from 45.3% to 45.1%
    - Transit increased from 2.7% to 3.1%
- Transit boarding increased by over 16% (Figure 12), suggesting that a 1 percent increase in transit frequency will lead to a ridership increase of 0.32% (elasticity of 0.32).

Compared with the 2035 baseline, the 50% less frequent transit services test had the following results:

- Insignificant VMT change (Figure 13)
- Mode share changes of all models (Figure 11):
    - DA increased from 45.3% to 45.5%
    - Transit decreased from 2.7% to 2.5%
- Transit boarding decreased by over 11% (Figure 12), suggesting that a 1 percent decrease in transit frequency will lead to a ridership decrease of 0.22% (elasticity of 0.22).

The results confirm that ABM2+ is sensitive to transit frequency. When transit services frequency improved, the model indicated higher transit mode share, lower drive alone mode share, and higher transit boardings. When transit services frequency was decreased, the opposite effects were observed. It should be noted that transit boardings changed the most on routes whose headways were changed the most; in other words, reducing headway from 60 minutes to 30 minutes has a much larger effect than changing the headway from 10 minutes to 5 minutes. Another interesting finding was that VMT increased slightly when transit services improved. This may be caused by the additional bus VMT generated by the more frequent services (Table 4).

Figure 10. VMT Change: Transit Headway Tests (Tests 9 & 10)

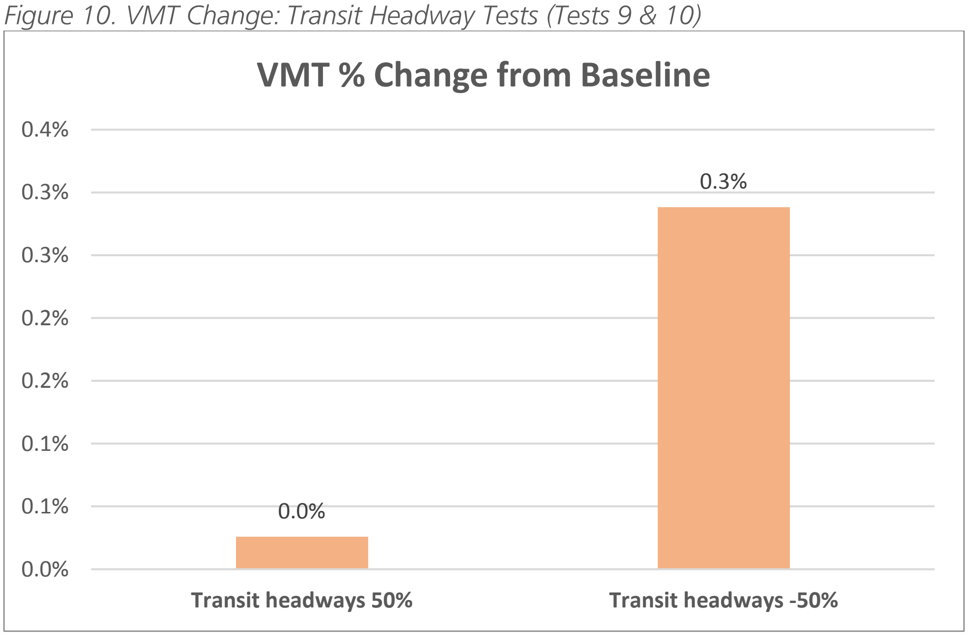


Figure 11. Mode Share of Person Trips: Transit Headway Tests (Tests 9 & 10)

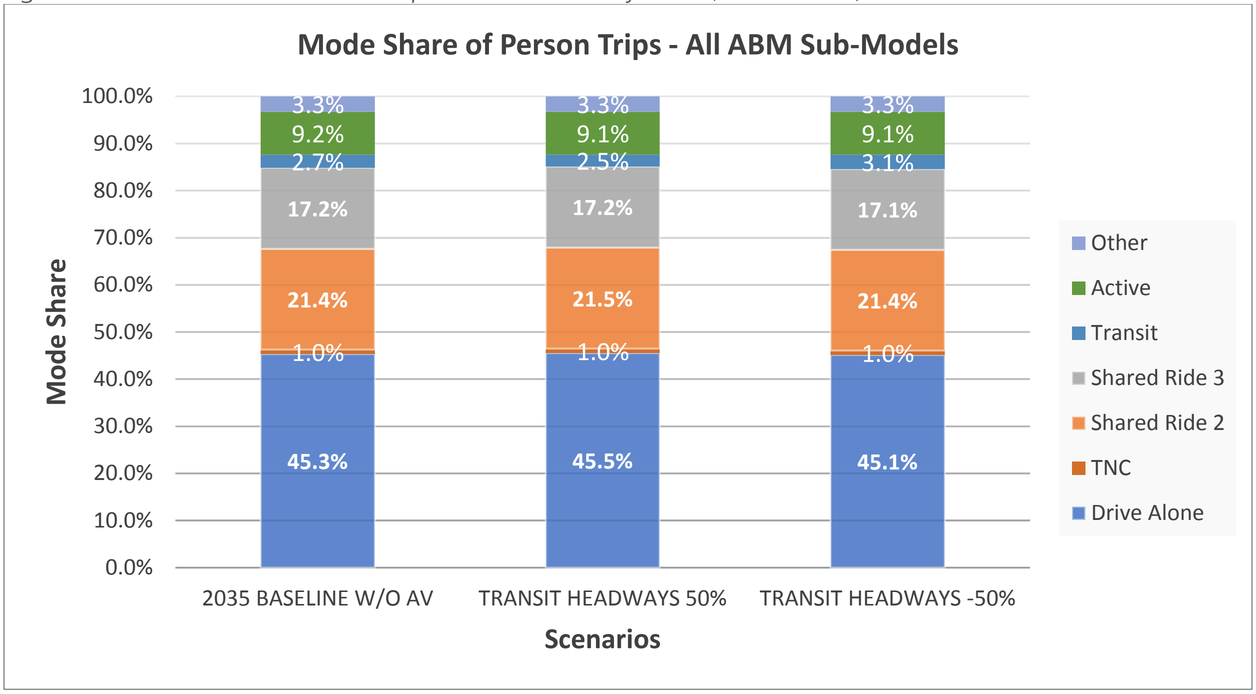


Figure 12. Transit Boarding Change from Baseline: Transit Headway Tests (Tests 9 & 10)

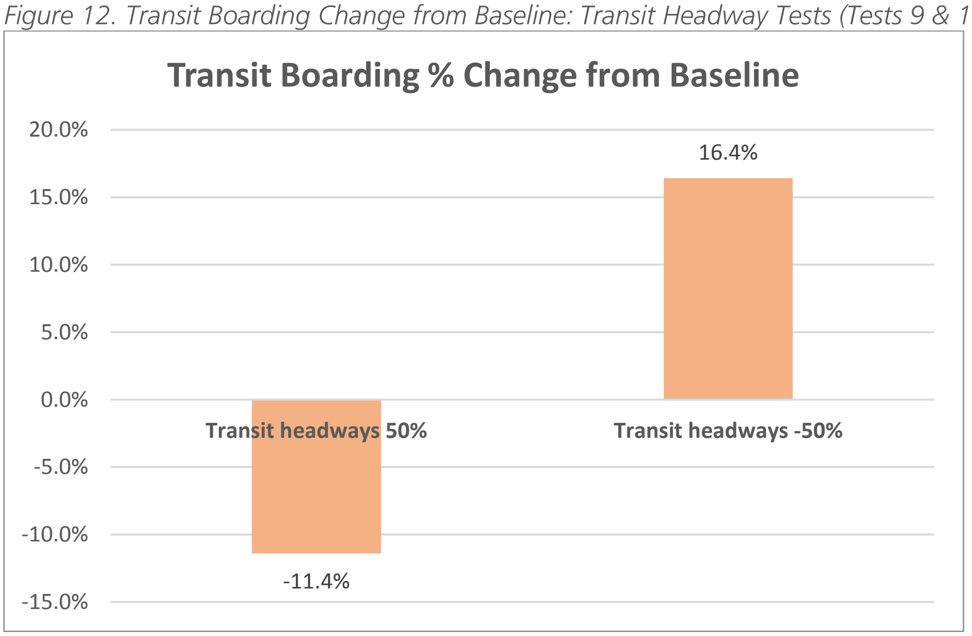


Figure 13. VMT Change from Baseline (Bus Excluded): Transit Headway Tests (Tests 9 & 10)

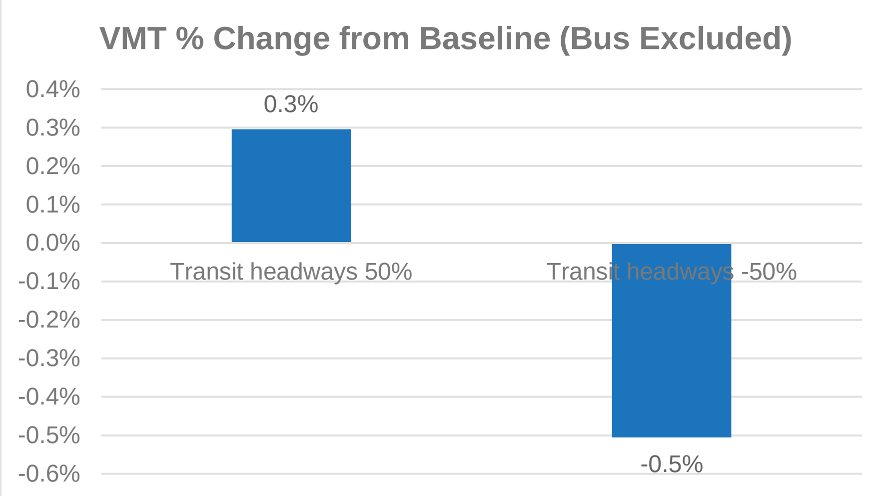


Table 4. VMT by Mode: Transit Headway Tests (Tests 9 & 10)

description	Auto	Truck	Bus	Total	VMT % Change	Total (Bus Excluded)	VMT % Change
2035 baseline w/o AV	90,028,010	4,911,338	762,403	95,701,751	-	94,939,348	
Transit headways 50%	90,306,080	4,914,248	506,083	95,726,411	0.0%	95,220,328	0.3%
Transit headways -50%	89,563,664	4,895,720	1,518,248	95,977,632	0.3%	94,459,384	-0.5%

Self-Owned E-Bike Tests (Tests 11&12)

The average regular bike speed is 10mph. To test the impact of faster self-owned E-Bikes, staff created two scenarios by increasing the average bike speed to 12mph and 15mph. If the E-Bike speed is 15mph, the average 12mph bike speed scenario represents that 40% of all bikes are E-Bike. The average 15mph bike speed scenario represents that 100% of all bikes are E-Bikes.

Compared with the 2035 baseline, the test which increased bike speed from 10 mph to 12 mph had the following results:

- VMT decreased slightly by 0.1% (Figure 14)
- Mode shares of all models (Figure 16):
    - DA decreased from 45.8% to 45.7%
    - Active mode (walk, bike, and micromobility) increased from 10.0% to 10.1%
- Average bike distance increased from 3.3 miles to 3.6 miles (Table 5)

Compared with the 2035 baseline (with AV), the test which increased bike speed from 10 mph to 15 mph had the following results:

- VMT decreased by 0.3% (Figure 14)
- Mode share changes (Figure 16):
    - DA decreased from 45.8% to 45.6%

    - Active mode (walk, bike, and micromobility) increased from 10.0% to 10.3%
- Average bike distance increased from 3.3 miles to 4.1 miles; Transit, regular TNC, and pool TNC distances all increased slightly (Table 5).

The results confirm that ABM2+ is sensitive to bike speed. When bike speed increased, the model indicated lower VMT, lower drive alone mode share, and higher active mode (walk, bike, and micromobility) mode share. The slightly lowered transit mode share suggests that there is competition between transit mode and bike mode (Figure 15). As bike speed increased, the average bike distance also increased.

Figure 14. VMT Change: Self-Owned E-Bike Tests (Tests 11&12)

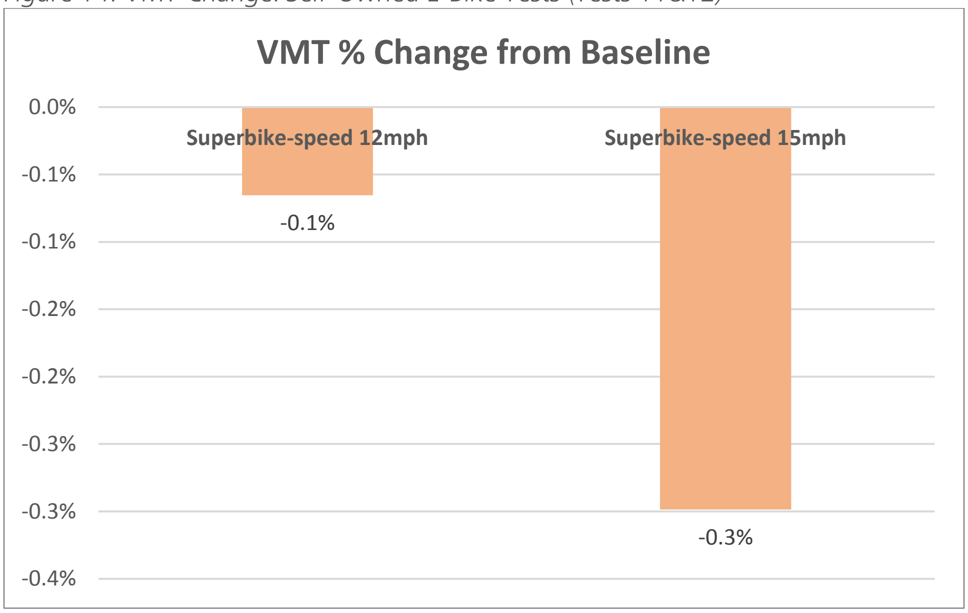


Figure 15. Transit Boarding Change: Self-Owned E-Bike Tests (Tests 11&12)

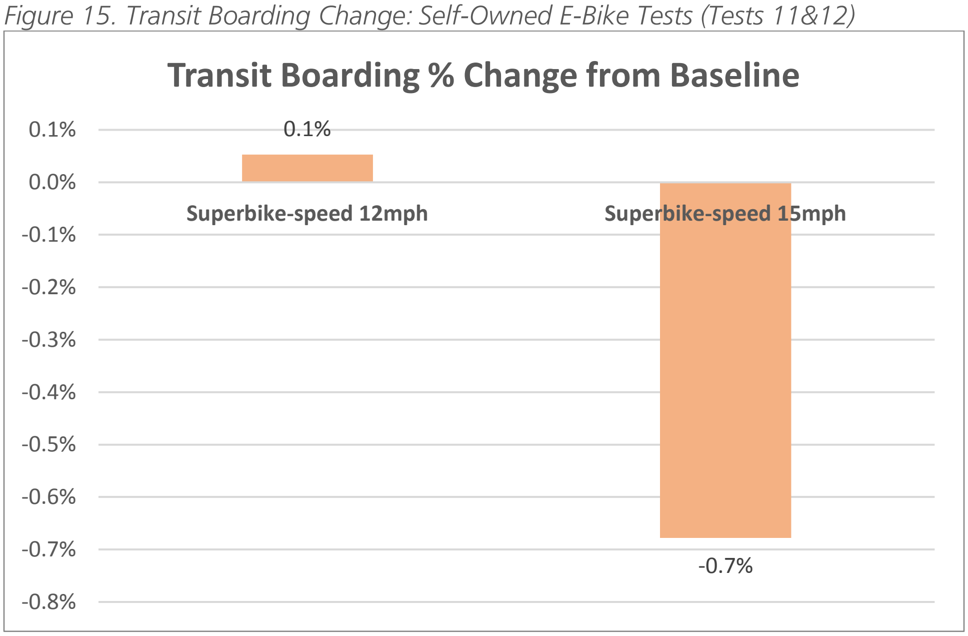


Figure 16. Mode Share of Person Trips: Self-Owned E-Bike Tests (Tests 11&12)

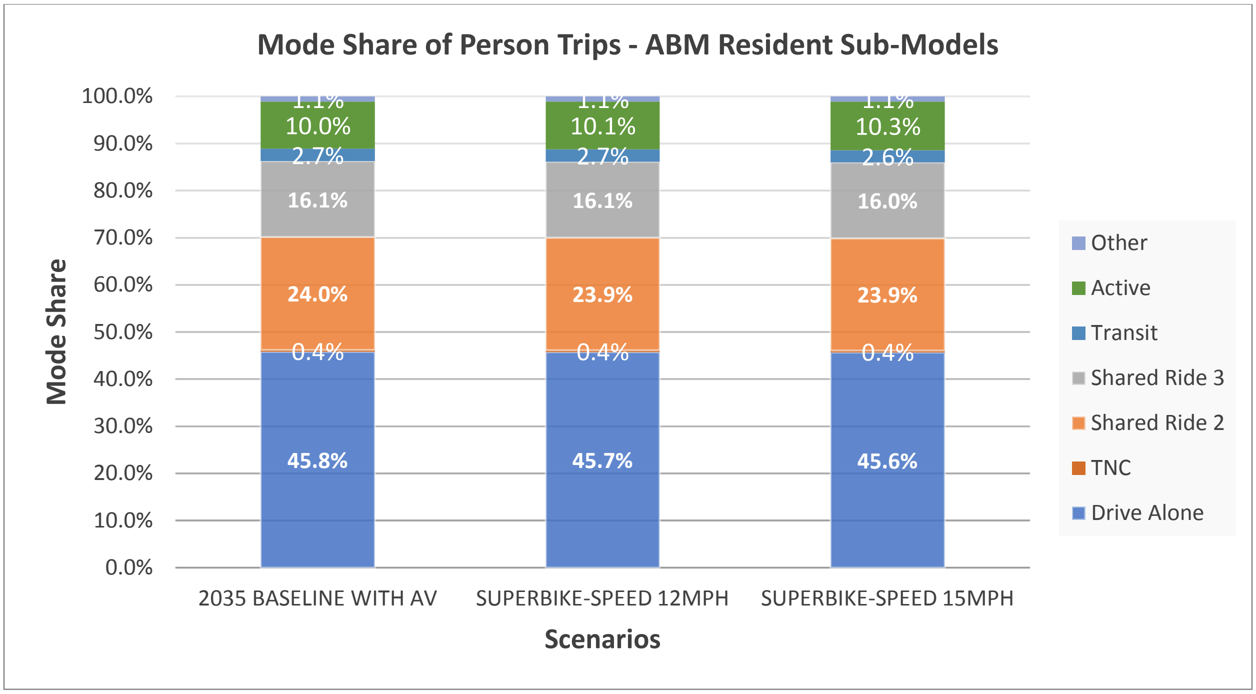


Table 5. Trip Length by Mode: Self-Owned E-Bike Tests (Tests 11&12)

description	DA	SR2	SR3	TNC	Pooled TNC	Walk	Bike	Transit	Total
2035 baseline with AV	8.0	7.2	8.3	7.7	6.0	0.8	3.3	9.1	7.3
Superbike-speed 12mph	7.9	7.2	8.3	7.8	6.1	0.8	3.0	9.2	7.3
Superbike-speed 15mph	8.0	7.2	8.3	7.7	6.1	0.8	2.7	9.2	7.3

Local/Regional Pricing

Auto Operating Cost (AOC) Tests (Tests 13 & 14)

Compared with the 2035 baseline, the 50% AOC increase test had the following results:

- VMT decreased by 5% (Figure 17), suggesting that a 1 percent increase in AOC will lead to a VMT decrease of 0.1% (elasticity of -0.1).
- Mode shares for all models (Figure 18):
    - DA decreased from 45.3% to 44.9%
    - SR2 decreased from 21.4% to 21.3%
    - SR3 decreased from 17.2% to 16.8%
    - Transit mode share increased from 2.7% to 3.1%
    - Active modes (walk, bike, and micromobility) increased from 9.2% to 9.5%
- Transit boarding increased by nearly 14% (Figure 19)
- Average trip distance decreased from 7.2 miles to 7.0 miles; DA, SR2, and SR3 trip distances all decreased; Transit trip distance increased (Table 6).

- Total person trips for San Diego residents and all travelers decreased by 1.5% and 1.7%, respectively (Figure 20).

Compared with the 2035 baseline, the 50% AOC decrease test had the following results:

- VMT increased by 3.8% (Figure 17), suggesting that a 1 percent decrease in AOC will lead to a VMT increase of 0.08% (elasticity of -0.08).
- Mode share changes for all models (Figure 18):
  - DA increased from 45.3% to 45.7%
  - SR2 increased from 21.4% to 21.6%
  - SR3 increased from 17.2% to 17.6%
  - Transit mode share decreased from 2.6% to 2.3%
  - Active mode (walk, bike, and micromobility) decreased from 9.2% to 8.8%
- Transit boarding decreased by nearly 14% (Figure 19).
- Average trip distance increased from 7.2 miles to 7.5 miles; DA, SR2, and SR3 trip distances all increased; Transit trip distance decreased (Table 6).
- Total personal trips for San Diego residents and all travelers increased by 1.8% and 2.0% respectively (Figure 20).

The results confirm that auto operating cost is a key variable that affects VMT and mode share. When AOC increased, the model indicated lower auto mode share, higher transit, walk, bike, and micromobility mode shares, and shorter trip distance. The AOC increase, essentially making driving less affordable, lowered overall travel demand by 1.7%. The combined effect of mode share shifts toward non-auto modes, reduced travel demand, and shorter trip distance resulted in significant VMT decrease. When AOC decreased, the opposite effects were observed.

Figure 17. VMT Change from Baseline: Auto Operating Cost (AOC) Tests (Tests 13 & 14)

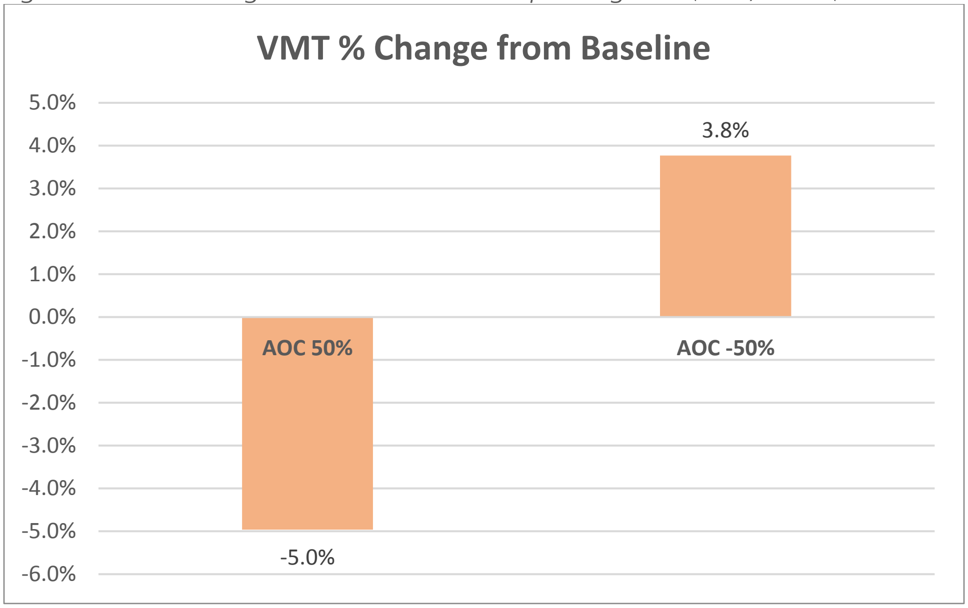


Figure 18. Mode Share of Person Trips: Auto Operating Cost (AOC) Tests (Tests 13 & 14)

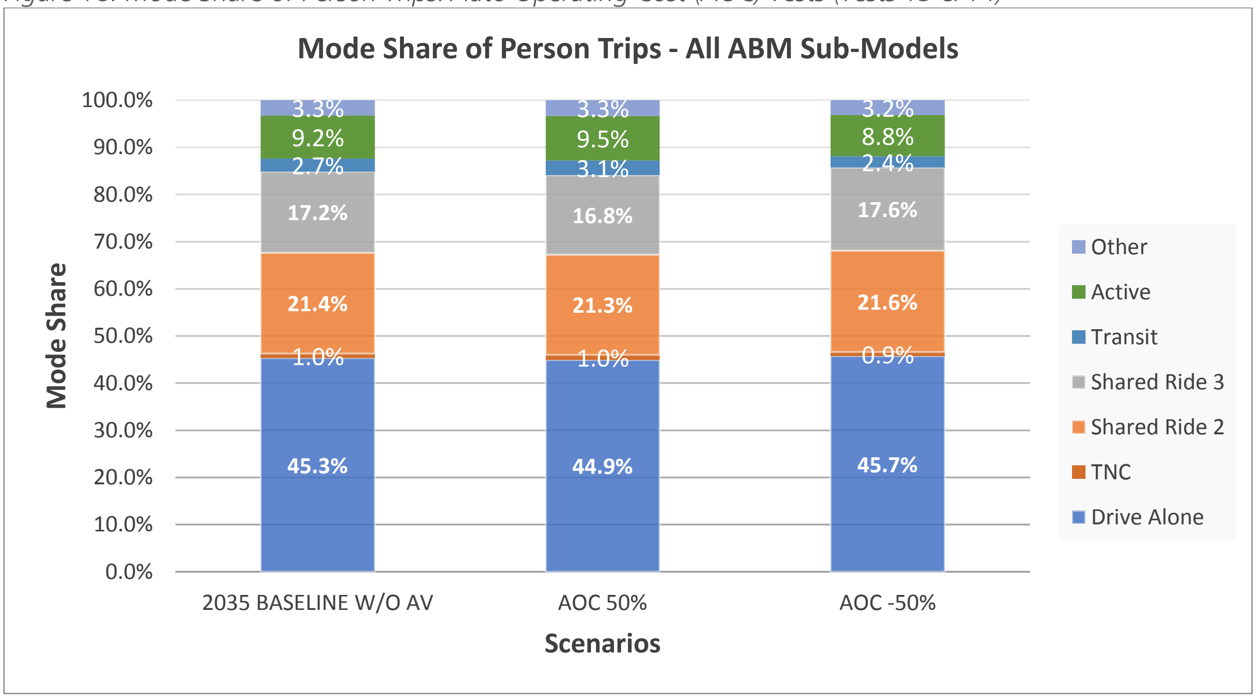


Figure 19. Transit Boarding Change from Baseline: Auto Operating Cost (AOC) Tests (Tests 13 & 14)

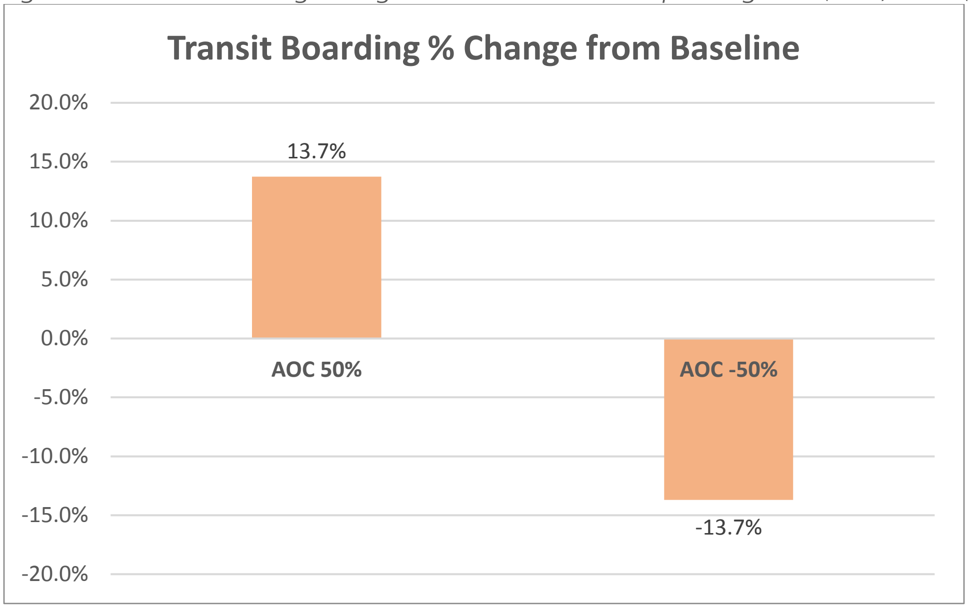


Figure 20. Total Person Trips Change from Baseline: *Auto Operating Cost (AOC) Tests (Tests 13 & 14)*

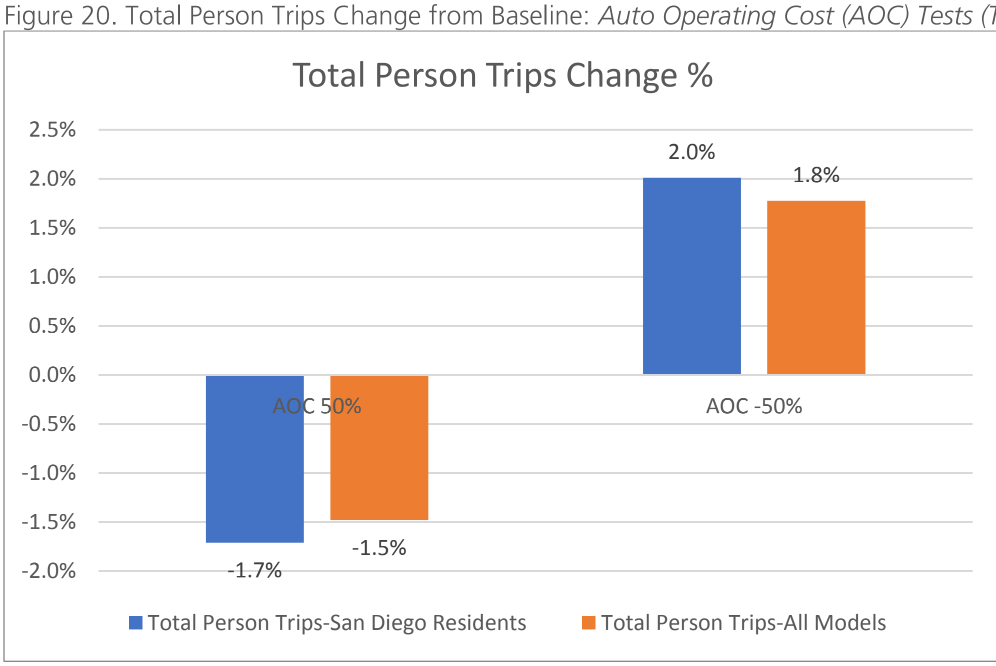


Table 6. Person Trip Distance by Mode: Auto Operating Cost (AOC) Tests (Tests 13 & 14)

description	DA	SR2	SR3	TNC	Pooled TNC	Walk	Bike	Transit	Total
2035 baseline w/o AV	7.9	7.2	7.8	7.6	4.8	0.8	3.2	9.2	7.2
AOC 50%	7.7	7.0	7.4	7.8	5.0	0.8	3.3	9.7	7.0
AOC -50%	8.2	7.5	8.4	7.5	4.6	0.8	3.0	8.8	7.5

Transit Fare Tests (Tests 15-17)

Compared with the 2035 baseline, the free transit fare test had the following results:

- VMT decreased by 1.1% (Figure 21)
- Mode shares for all models (Figure 22):
  - DA decreased from 45.3% to 44.6%
  - SR3 decreased from 17.2% to 16.9%
  - Transit increased from 2.7% to 4.0%
  - Active modes (walk, bike, and micromobility) decreased slightly from 9.2% to 9.0%
- Transit boarding increased by nearly 50% (Figure 23), suggesting that a 1 percent decrease in transit fare will lead to a transit ridership increase of 0.5% (elasticity of -0.5).

Compared with the 2035 baseline, the 50% fare decrease test had the following results:

- VMT decreased by 0.5% (Figure 21)
- Mode shares of all models (Figure 22):
  - DA decreased from 45.3% to 45.0%
  - Transit increased from 2.7% to 3.3%
  - Active modes (walk, bike, and micromobility) decreased slightly from 9.2% to 9.1%
- Transit boarding increased by over 20% (Figure 23), suggesting that a 1 percent decrease in transit fare will lead to transit ridership increase of 0.4% (elasticity of -0.4).

Compared with the 2035 baseline, the 50% fare increase test had the following results:

- VMT increased by 0.4% (Figure 21)
- Mode share changes (Figure 22):
  - DA increased from 45.3% to 45.6%
  - Transit decreased from 2.7% to 2.3%
- Transit boarding decreased by 17% (Figure 23), suggesting that a 1 percent increase in transit fare will lead to a transit ridership decrease of 0.38% (elasticity of -0.38).

The results confirm that ABM2+ is sensitive to transit fares. When transit fares decreased, the model indicated lower VMT, higher transit mode share, and lower drive alone mode share. The slightly lower walk, bike, and micromobility mode shares suggest that there is competition between transit mode and walk, bike, and micromobility modes. When transit fares increased, the opposite effects were observed.

Figure 21. Total Person Trips Change from Baseline: *Transit Fare Tests (Tests 15-17)*

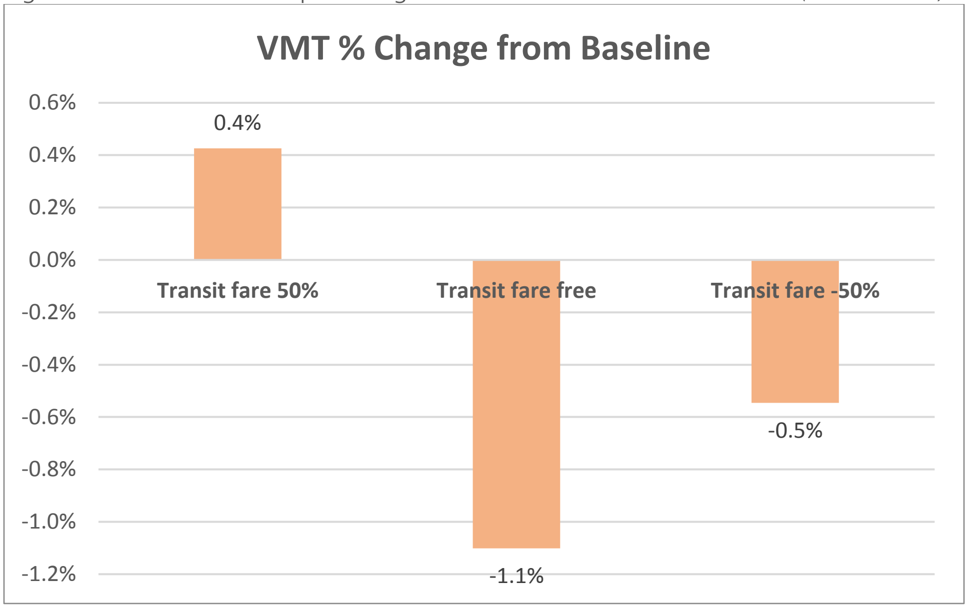


Figure 22. Mode Share of Person Trips: *Transit Fare Tests (Tests 15-17)*

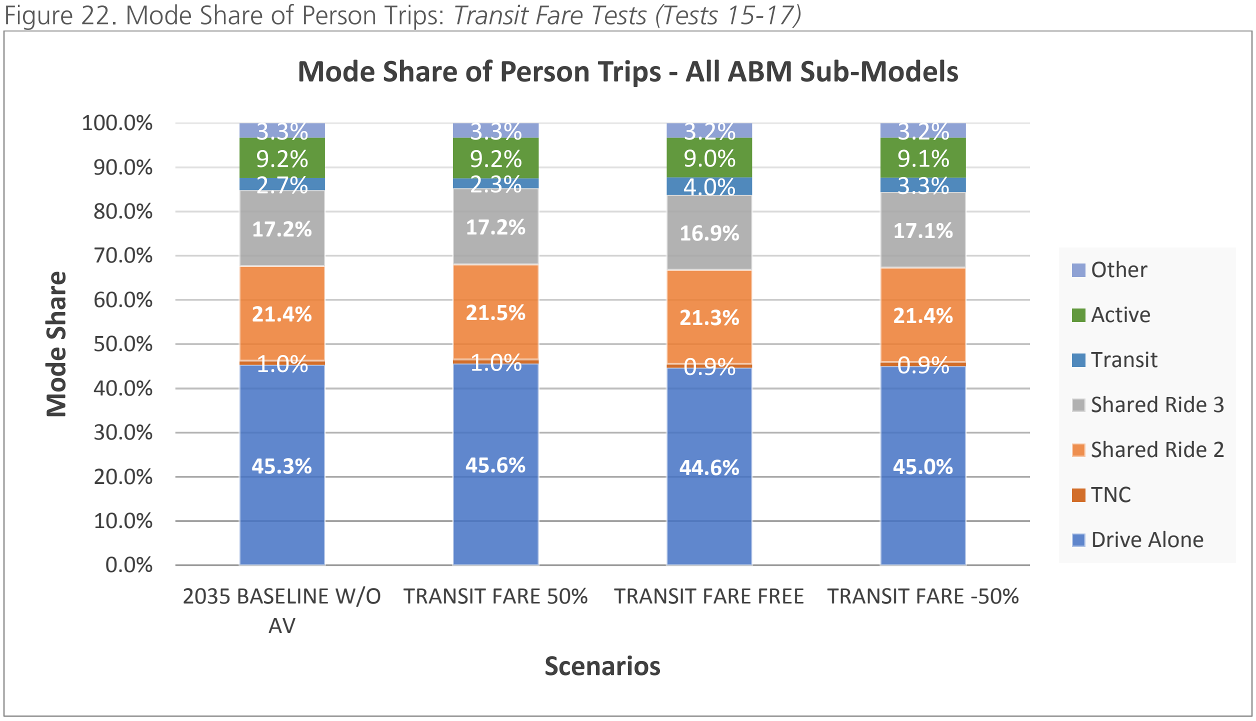
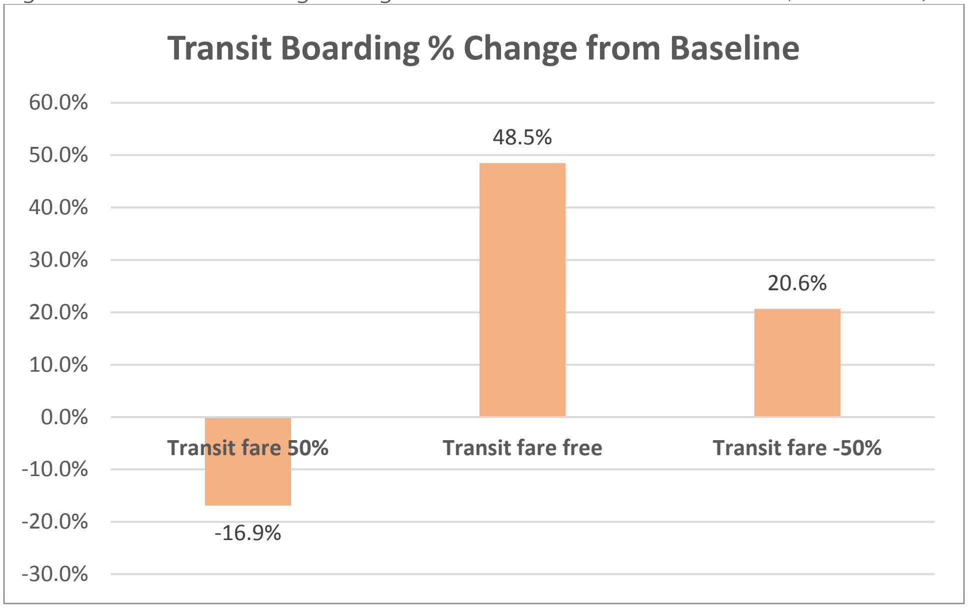


Figure 23. Transit Boarding Change from Baseline: *Transit Fare Tests (Tests 15-17)*



Managed Lane/Toll Price Tests (Tests 18 & 19)

Compared with the 2035 baseline, the 50% toll increase test had the following results:

- VMT decreased slightly by 0.1% (Figure 24)
- Percent of VMT on toll roads decreased from 3.2% to 2.6% (Figure 27)
- Insignificant mode share changes (Figure 25)
- Toll road volumes decreased significantly by 20% (Figure 26).

Compared with the 2035 baseline, the 50% toll decrease test had the following results:

- VMT increased by 0.2% (Figure 24)
- Percent of VMT on toll roads increased from 3.2% to 4.1% (Figure 27)
- Insignificant mode share changes (Figure 25)
- Toll road volumes increased by 33% (Table 26)

The results confirm that ABM2+ is sensitive to managed lane/toll pricing. When toll price increased, both traffic volumes and VMT on toll roads decreased significantly. However, the model only indicated slightly lower VMT primarily because toll roads are only a very small portion of San Diego's transportation system. Also note that on I-15, only single-occupant vehicles are tolled; therefore changing the toll cost only affects the price for SOV usage of the facility, and when SOV usage decreases, there is additional capacity for high-occupancy vehicles which may take advantage of the increased available capacity. When managed lane/toll price decreased, the opposite effects were observed.

Figure 24. VMT Change from Baseline: Managed Lane/Toll Price Tests (Tests 18 & 19)

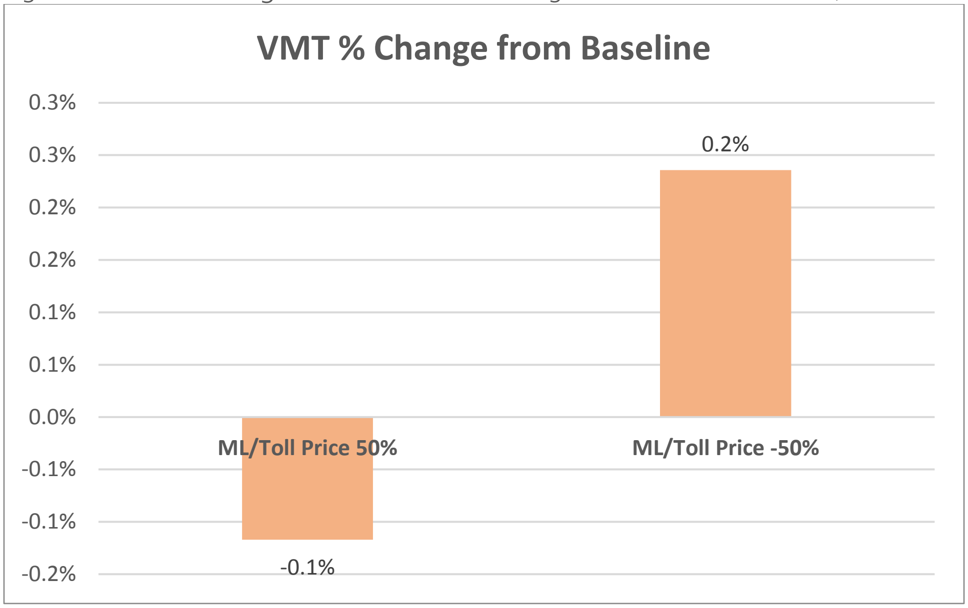


Figure 25. Mode Share of Person Trips: Managed Lane/Toll Price Tests (Tests 18 & 19)

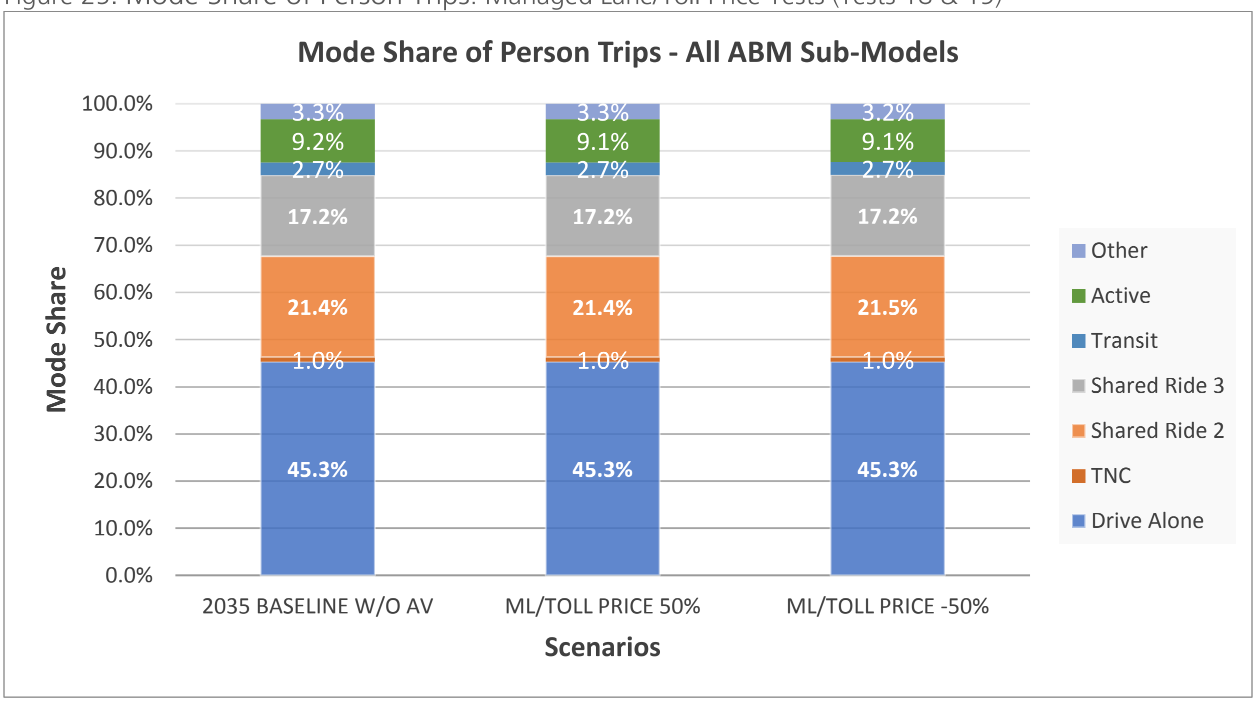


Figure 26. Toll Road Volumes Change from Baseline: Managed Lane/Toll Price Tests (Tests 18 & 19)

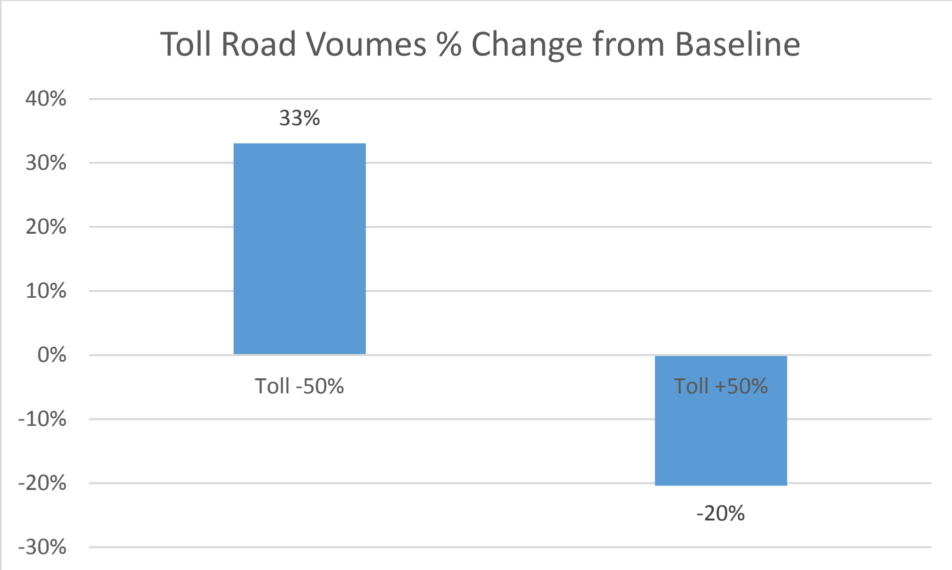
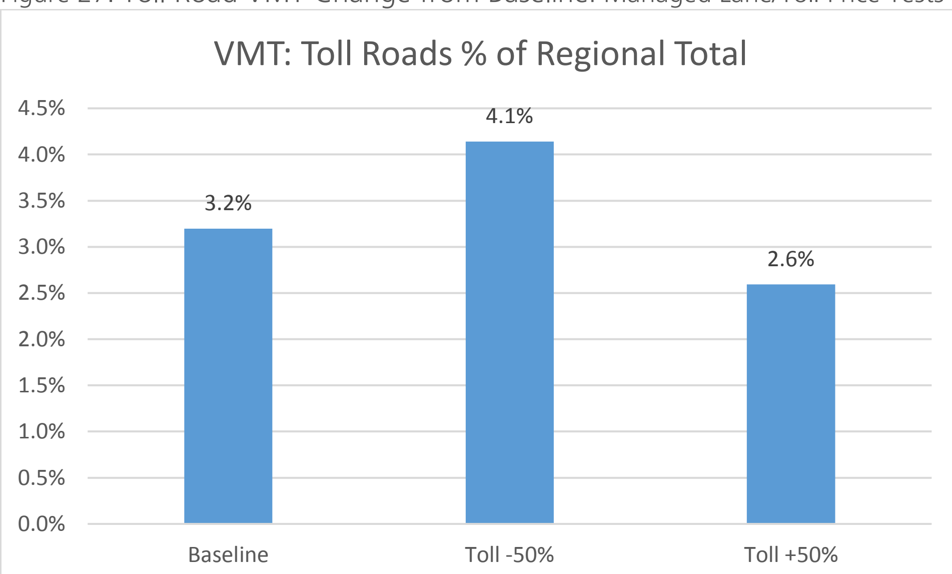


Figure 27. Toll Road VMT Change from Baseline: Managed Lane/Toll Price Tests (Tests 18 & 19)



Parking Cost Tests (Tests 20 & 21)

In comparison with the baseline, the high parking cost test had the following results:

- VMT decreased by 1.4% (Figure 28)
- Mode shares for all models (Figure 29):
  - DA decreased from 45.3% to 44.1%
  - SR3 increased from 17.2% to 17.4%

  - Transit increased from 2.7% to 3.2%
  - Active modes (walk, bike, and micromobility) increased from 9.2% to 9.5%
- Transit boarding increased by over 17% (Figure 30)
- Although the overall trip distance change was insignificant, DA trip distance increased slightly from 7.9 miles to 8.0 miles (Table 7).
- Total person and vehicle trips decreased by 0.2% and 0.4%, respectively (Figure 31).

In comparison with the baseline, a very high parking cost had the following results:

- VMT decreased by 2.8% (Figure 28);
- Mode share changes (Figure 29):
  - DA decreased from 45.3% to 42.7%
  - SR3 increased from 17.2% to 17.8%
  - Transit mode share increased from 2.7% to 3.6%
  - Active modes (walk, bike, and micromobility) increased from 9.2% to 10.1%
- Transit boarding increased by nearly 30% (Figure 30)
- Although the overall trip distance change was insignificant, DA trip distance increased from 7.9 miles to 8.1 miles (Table 7).
- Total person and vehicle trips decreased by 0.5% and 1.2%, respectively (Figure 31).

The results confirm that parking cost is a key variable that affects VMT and mode shares. When parking price increased, the model indicated lower VMT, lower DA mode share, higher transit mode share, and higher walk, bike, and micromobility mode shares. The slightly increased drive alone distance indicated that drivers park further away from destinations to avoid high parking fees.

Figure 28. VMT Change from Baseline: Parking Cost Tests (Tests 20 & 21)

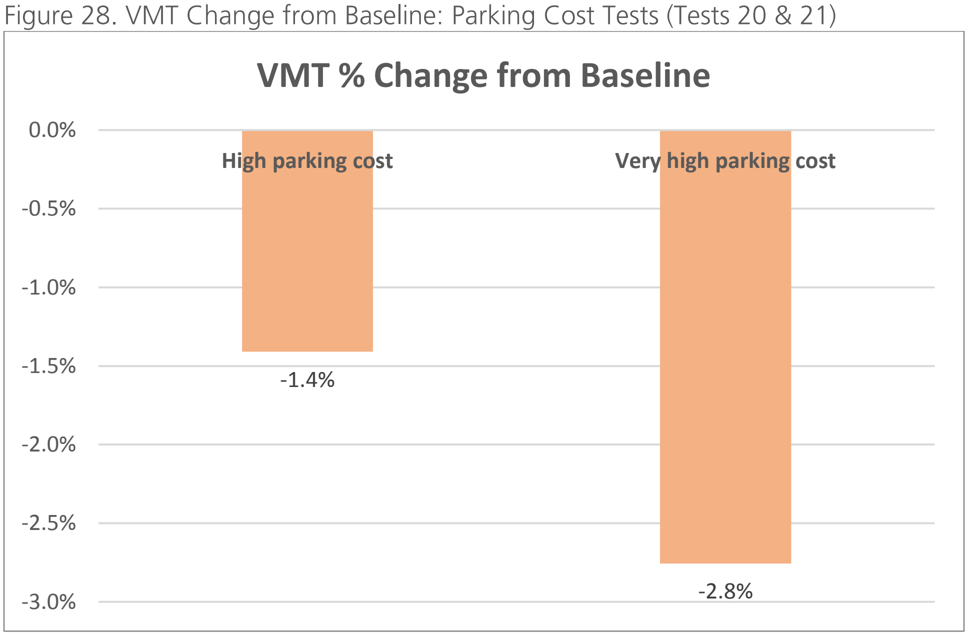


Figure 29. Mode Share of Person Trips: Parking Cost Tests (Tests 20 & 21)

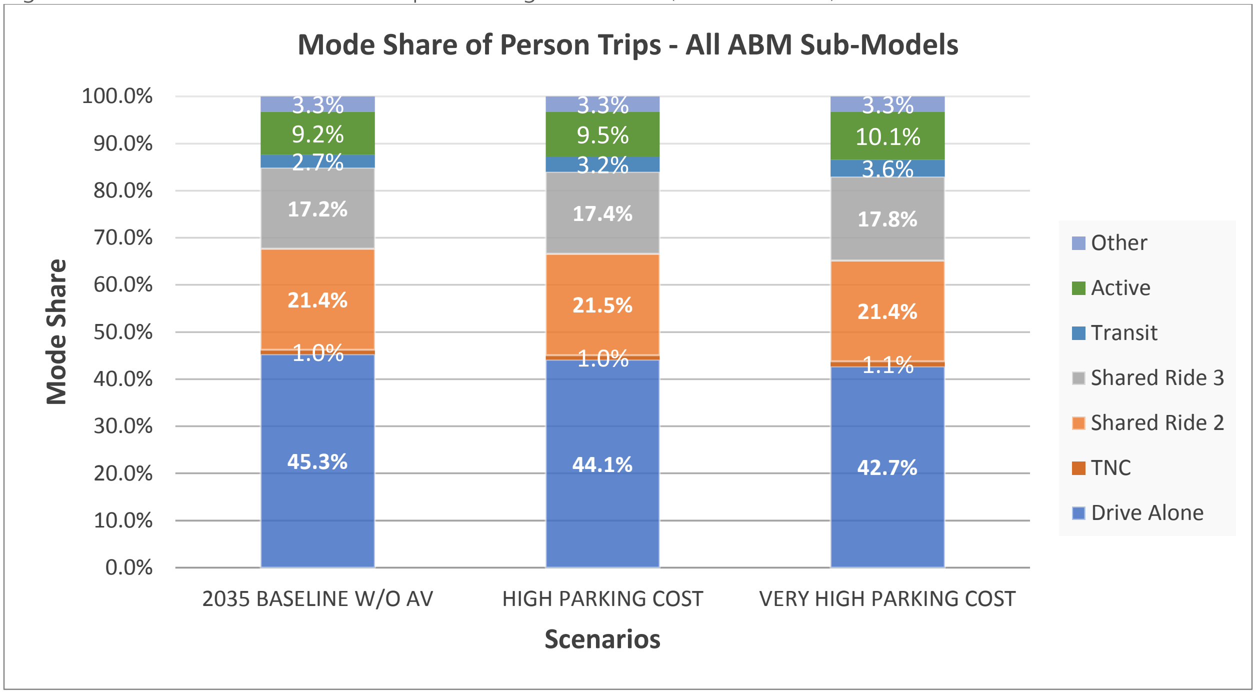


Figure 30. Transit Boarding Change from Baseline: Parking Cost Tests (Tests 20 & 21)

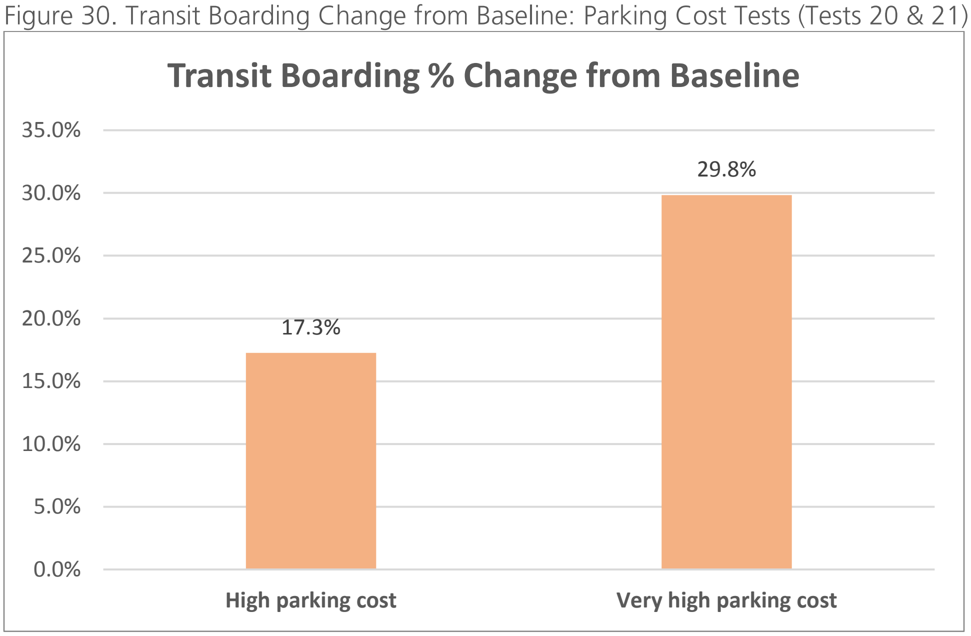


Figure 31. Total Person Trips and Trips Change from Baseline: Parking Cost Tests (Tests 20 & 21)

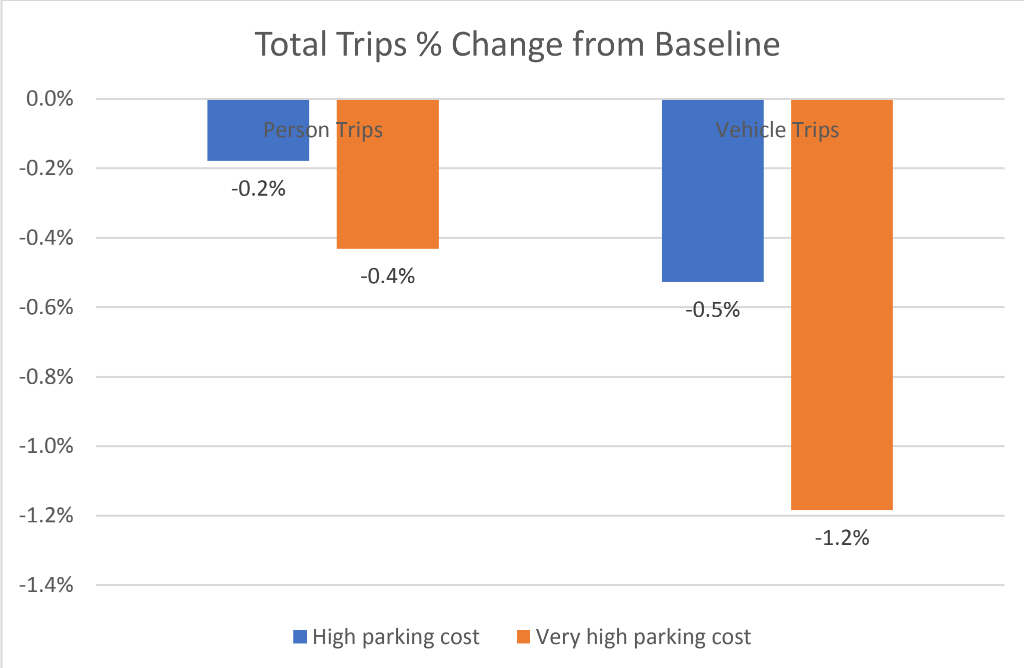


Table 7. Person Trip Distance by Mode: Parking Cost Tests (Tests 20 & 21)

description	DA	SR2	SR3	TNC	Pooled TNC	Walk	Bike	Transit	Total
2035 baseline w/o AV	7.9	7.2	7.8	7.6	4.8	0.8	3.2	9.2	7.2
High parking cost	8.0	7.2	7.8	7.5	4.7	0.8	3.2	9.2	7.2
Very high parking cost	8.1	7.3	7.8	7.3	4.7	0.8	3.2	9.2	7.2

Exogenous Variables

Free Flow Speed Tests (Tests 22 & 23)

Compared with the 2035 baseline, the 5mph free flow speed decrease on freeways test had the following results:

- VMT decreased by nearly 0.5% (Figure 32)
- Insignificant mode share changes (Figure 33)
- Average trip distance decreased slightly from 7.3 miles to 7.2 miles. DA, SR3, and truck trip distances all decreased (Table 8).

Compared with the 2035 baseline, the 5mph free flow speed decrease on all roadways test had the following results:

- VMT decreased by 1.3% (Figure 32)
- Insignificant mode share changes (Figure 33)
- Average trip distance decreased slightly from 7.3 miles to 7.2 miles. DA, SR3, and truck trip distances all decreased (Table 8).

The results lead to the conclusion that reducing free flow speed results in lower VMT. Although mode share changes were insignificant, average trip distance decreased, indicating that the lowered free flow speed discouraged longer trips.

Figure 32. VMT Change from Baseline: Free Flow Speed Tests (Tests 22 & 23)

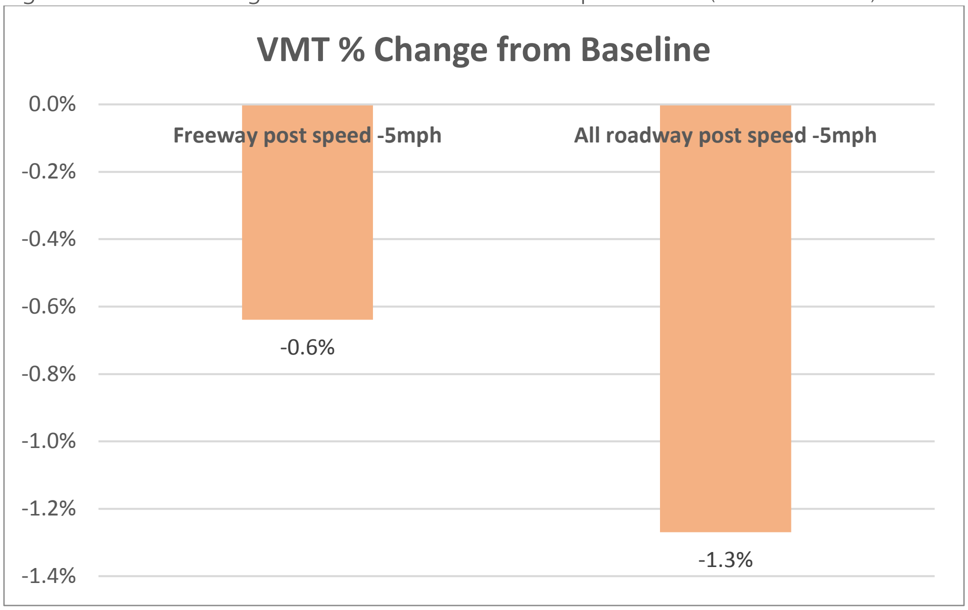


Figure 33. Mode Share of Person Trips: Free Flow Speed Tests (Tests 22 & 23)

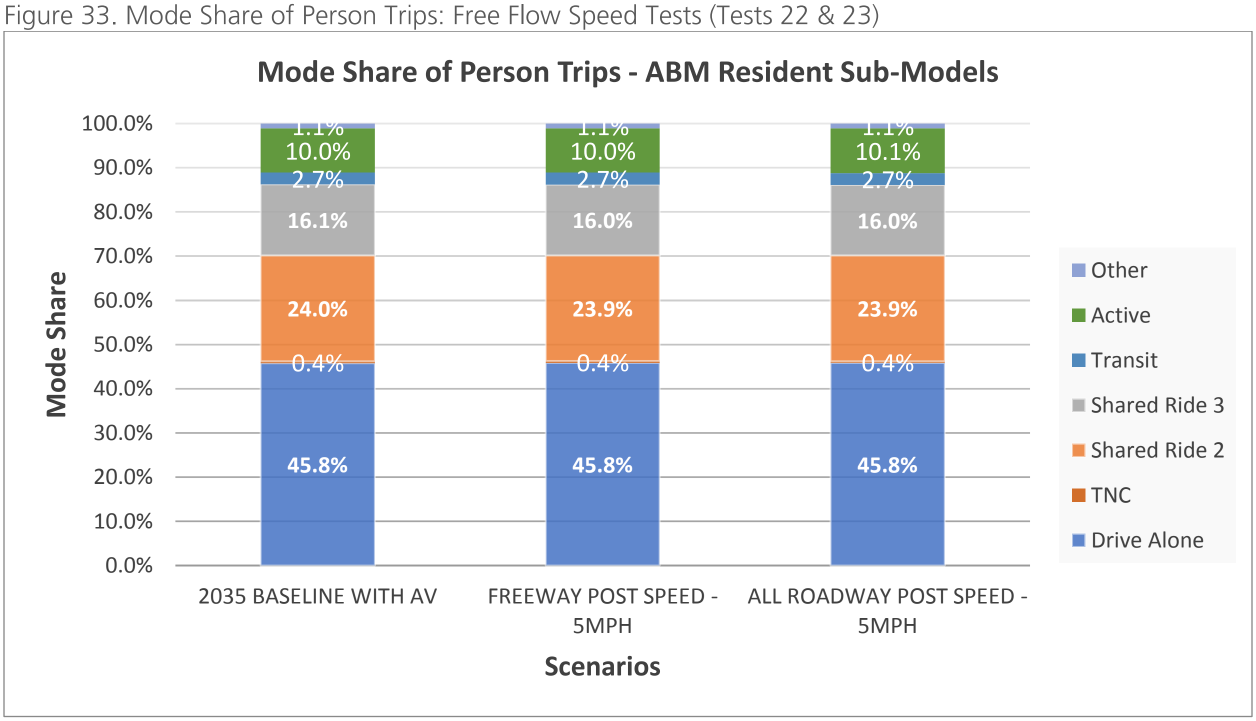


Figure 34. Transit Boarding Change from Baseline: Free Flow Speed Tests (Tests 22 & 23)

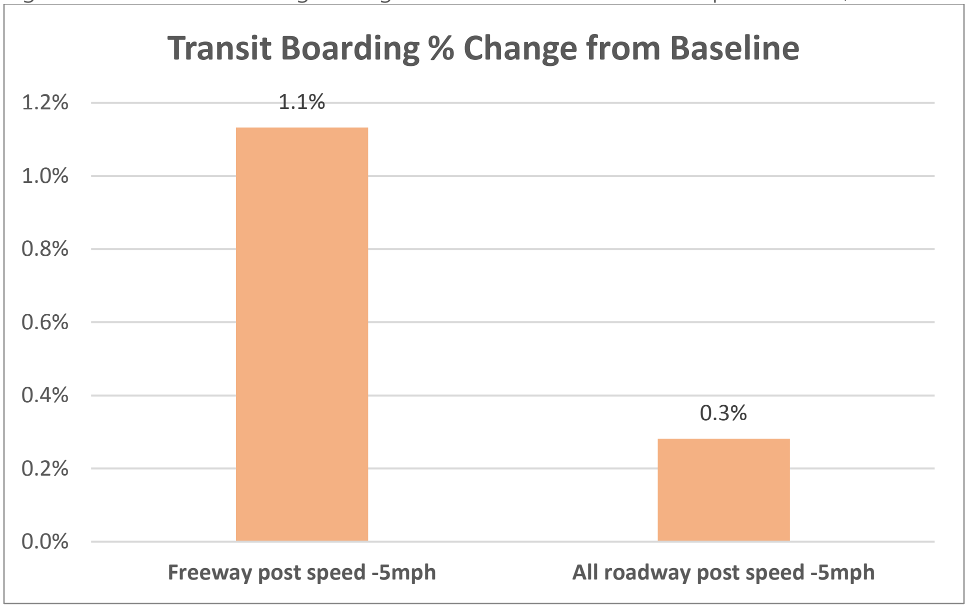


Table 8. Person Trip Distance by Mode: Free Flow Speed Tests (Tests 22 & 23)

description	DA	SR2	SR3	TNC	Pooled TNC	Walk	Bike	Transit	Total
2035 baseline with AV	8.0	7.2	8.3	7.7	6.0	0.8	3.3	9.1	7.3
Freeway post speed -5mph	7.9	7.2	8.2	7.7	6.1	0.8	3.3	9.2	7.2
All roadway post speed -5mph	7.9	7.2	8.2	7.7	6.1	0.8	3.4	9.2	7.2

Household Income Tests (Tests 24 & 25)

In comparison with the 2035 baseline, a test with household income lowered by a third had the following results:

- VMT decreased by 3.3% (Figure 35)
- San Diego resident mode shares (Figure 36):
  - DA decreased from 45.8% to 45.5%
  - SR3 decreased from 16.6% to 16.4%
  - Transit increased from 2.6% to 2.8%
  - Active mode (walk, bike, and micromobility) increased from 9.9% to 10.2%
- Transit boarding increased by 5.5% (Figure 37)
- Trip distance of DA, SR2, and SR3 all decreased; TNC and Taxi trip distance also decreased (Table 9).
- Total person trips of San Diego residents decreased by 2.6% (Figure 38)

In comparison with the 2035 baseline, a test with household income increased by a third had the following results:

- VMT increased by 2% (Figure 35)
- Mode share changes (Figure 36):
  - DA increased from 45.8% to 45.9%
  - SR3 increased from 16.6% to 16.8%
  - Transit decreased from 2.6% to 2.4%
  - Active mode (walk, bike, and micromobility) decreased slightly from 9.9% to 9.8%
- Transit boarding decreased by 3.5% (Figure 37)
- Trip distance of DA, SR2, and SR3 all increased; TNC and Taxi trip distance also increased (Table 9).
- Total person trips of San Diego residents increased by 1.6% (Figure 38)

The results suggest that ABM2+ is sensitive to household income. When household income increased, the model indicated higher VMT, higher auto mode share, lower transit, walk, bike, and micromobility mode shares. The results confirm that a population with higher income would generate more travel demand. With higher income, the distance of auto modes, TNC, and taxi all increased, indicating a higher income encouraged driving or using mobility as a service. When household income decreased, the opposite effects were observed. It should be noted that these are simply hypothesis tests which hold all other variables constant, neglecting the supply-demand interaction between inter-dependent variables. The test results should not be interpreted as the effects of +-1/3 household income changes in San Diego.

Figure 35. VMT Change from Baseline: Household Income Tests (Tests 24 & 25)

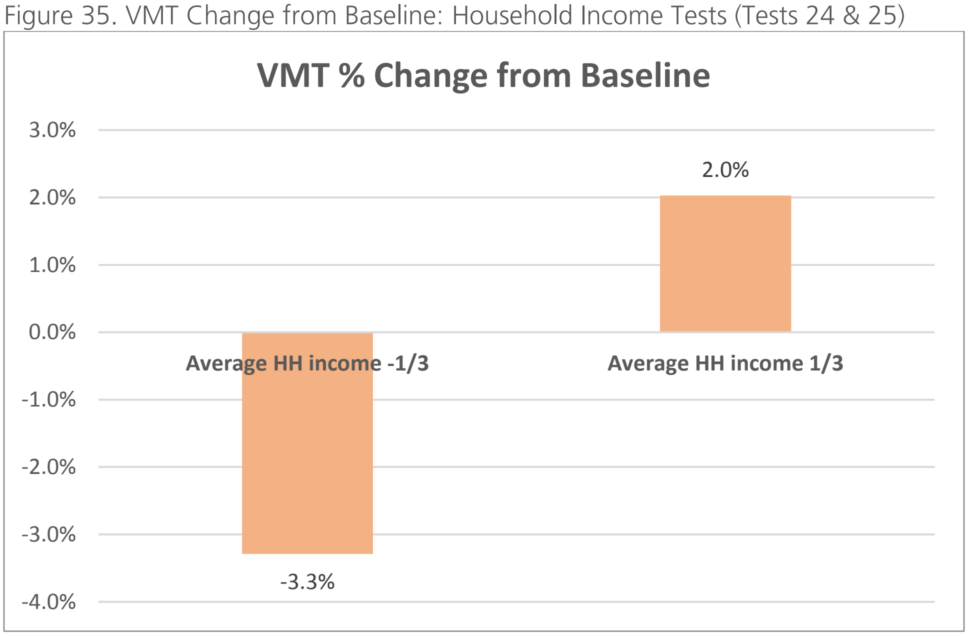


Figure 36. Mode Share of Person Trips: Household Income Tests (Tests 24 & 25)

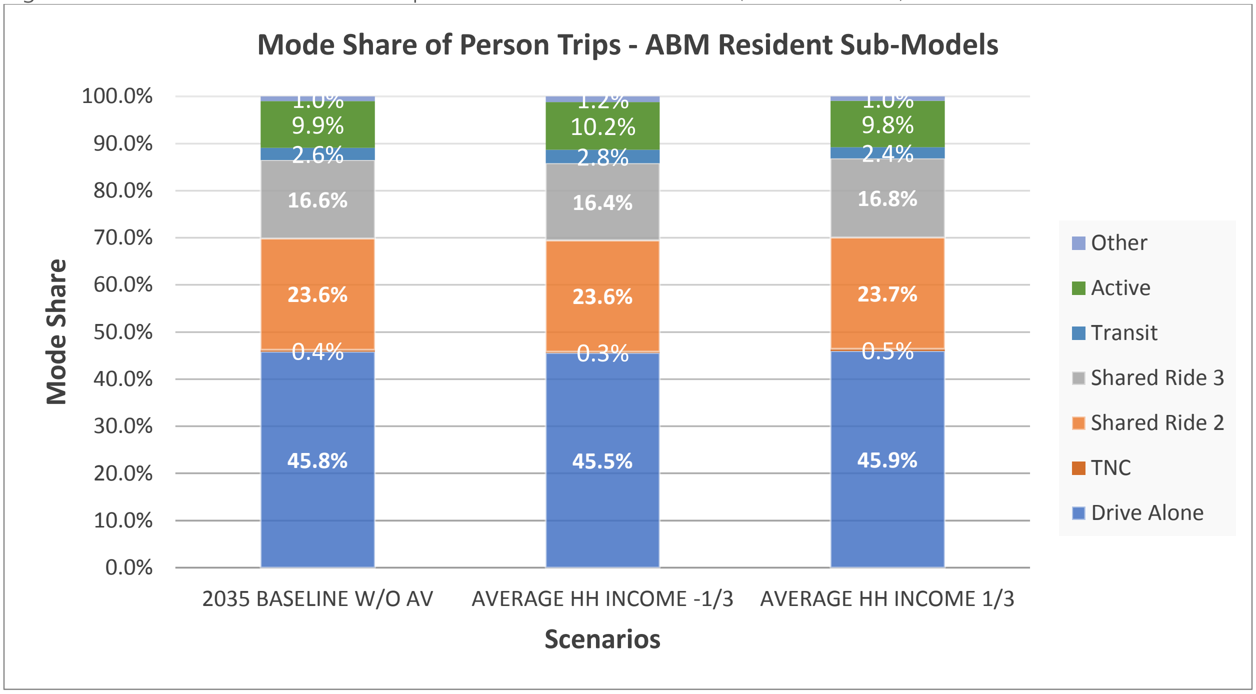


Figure 37. Transit Boarding Change from Baseline: Household Income Tests (Tests 24 & 25)

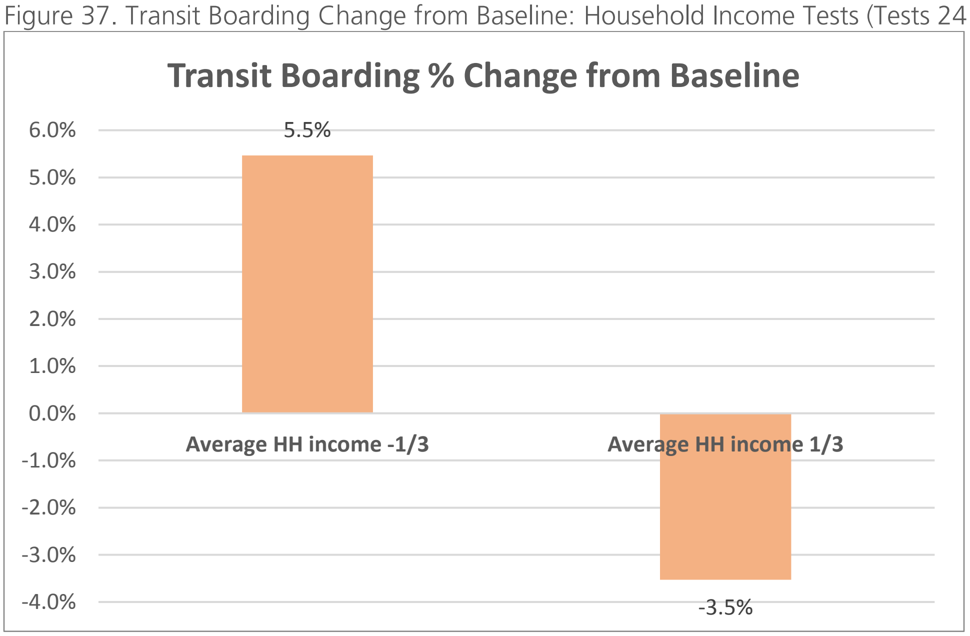


Figure 38. Total Person Trips Change from Baseline: Household Income Tests (Tests 24 & 25)

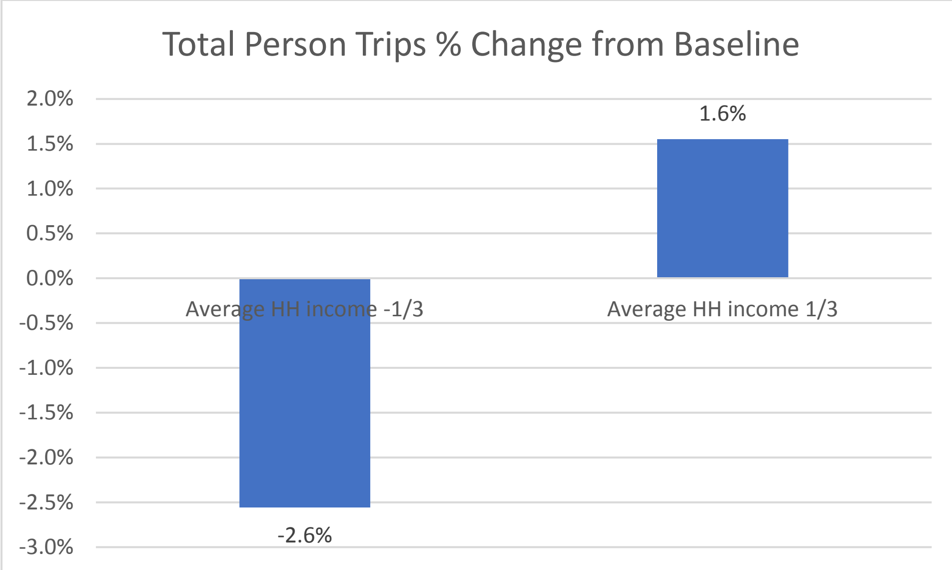


Table 9. Person Trip Distance by Mode: Household Income Tests (Tests 24 & 25)

description	DA	SR2	SR3	TNC	Pooled TNC	Walk	Bike	Transit	Taxi	Total
2035 baseline w/o AV	7.5	5.7	5.9	3.3	3.6	0.8	3.2	8.9	0.9	6.1
Average HH income -1/3	7.4	5.6	5.8	3.1	3.4	0.8	3.3	9.0	0.8	6.1
Average HH income 1/3	7.6	5.8	6.0	3.5	3.7	0.8	3.1	8.9	1.0	6.2

Regional Employment Tests (Tests 26 & 27)

In comparison with the 2035 baseline, a test with 10% larger regional employment had the following results:

- VMT increased by over 4% (Figure 39)
- San Diego resident mode shares (Figure 41):
  - DA increased from 45.8% to 47.9%
  - SR2 decreased from 23.6% to 22.5%
  - SR3 decreased from 16.6% to 15.7%
  - Transit increased from 2.6% to 2.7%
  - Active mode (walk, bike, and micromobility) decreased slightly from 9.9% to 9.8%
- Transit boarding increased by over 5% (Figure 40)

- Average trip distance of San Diego residents increased from 6.1 miles to 6.3 miles; While work trip length decreased from 10.3 miles to 10.1 miles, non-mandatory trip distance in general increased (Table 10).
- Total person trips of San Diego residents increased by 1.6% (Figure 42).

In comparison with the 2035 baseline, a test with 10% smaller reginal employment had the following results:

- VMT decreased by over 6% (Figure 39)
- Mode share changes (Figure 41):
    - DA decreased from 45.8% to 42.7%
    - SR2 increased from 23.6% to 25.0%
    - SR3 increased from 16.6% to 18.4%
    - Active mode (walk, bike, and micromobility) decreased slightly from 9.9% to 9.8%
- Transit boarding decreased by nearly 2% (Figure 40).
- Average trip distance of San Diego residents decreased from 6.1 miles to 5.9 miles; While work trip length increased from 10.3 miles to 10.5 miles, non-mandatory trip distance in general decreased (Table 10).
- Total person trips of San Diego residents decreased by 0.5% (Figure 42).

The experiments suggest that ABM2+ is sensitive to regional employment. When regional employment increased, the model indicated higher VMT, high travel demand, higher DA mode share, lower shared ride auto mode shares, and lower walk, bike, and micromobility mode shares. Although overall trip distance increased, work trip distance decreased, indicating the abundance of jobs allow workers to choose jobs closer to home. When regional employment decreased, the opposite effects were observed. It should be noted that these are simply hypothesis tests which hold all other variables constant, neglecting the supply-demand interaction between inter-dependent variables. The test results should not be interpreted as the effects of +-10% regional employment changes in San Diego.

Figure 39. VMT Change from Baseline: Regional Employment Tests (Tests 26 & 27)

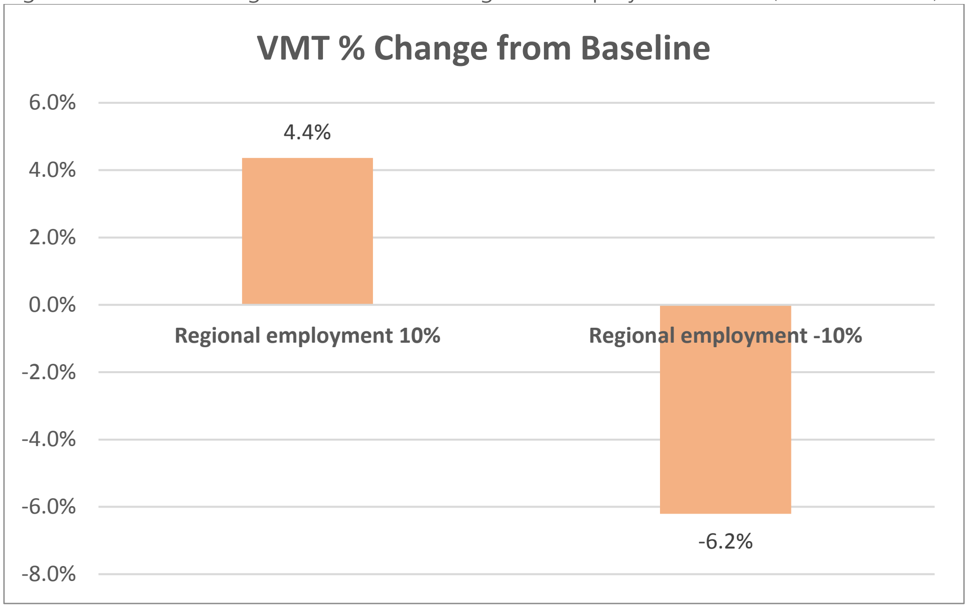


Figure 40. Transit Boarding Change from Baseline: Regional Employment Tests (Tests 26 & 27)

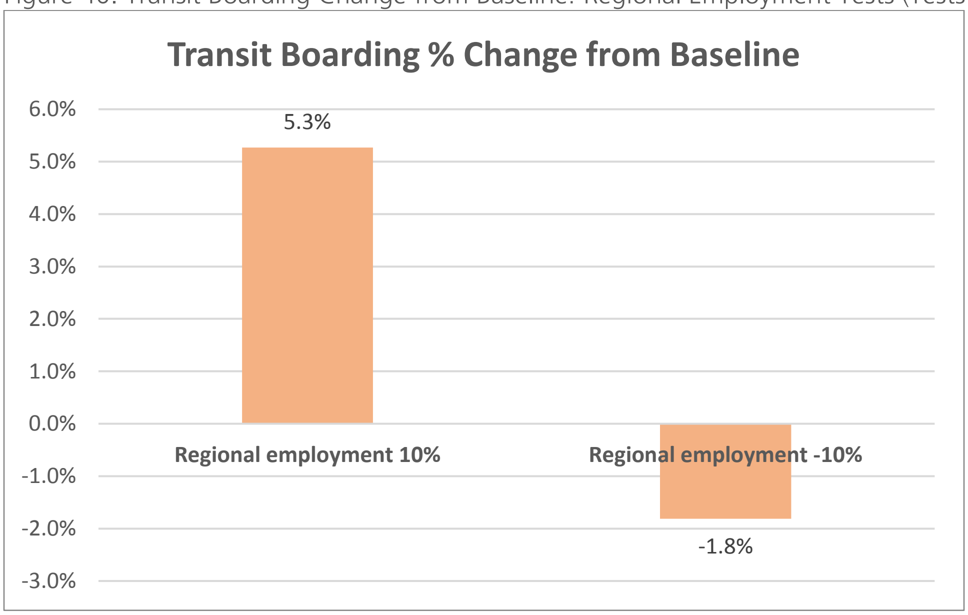


Figure 41. Mode Share of Person Trips: Regional Employment Tests (Tests 26 & 27)

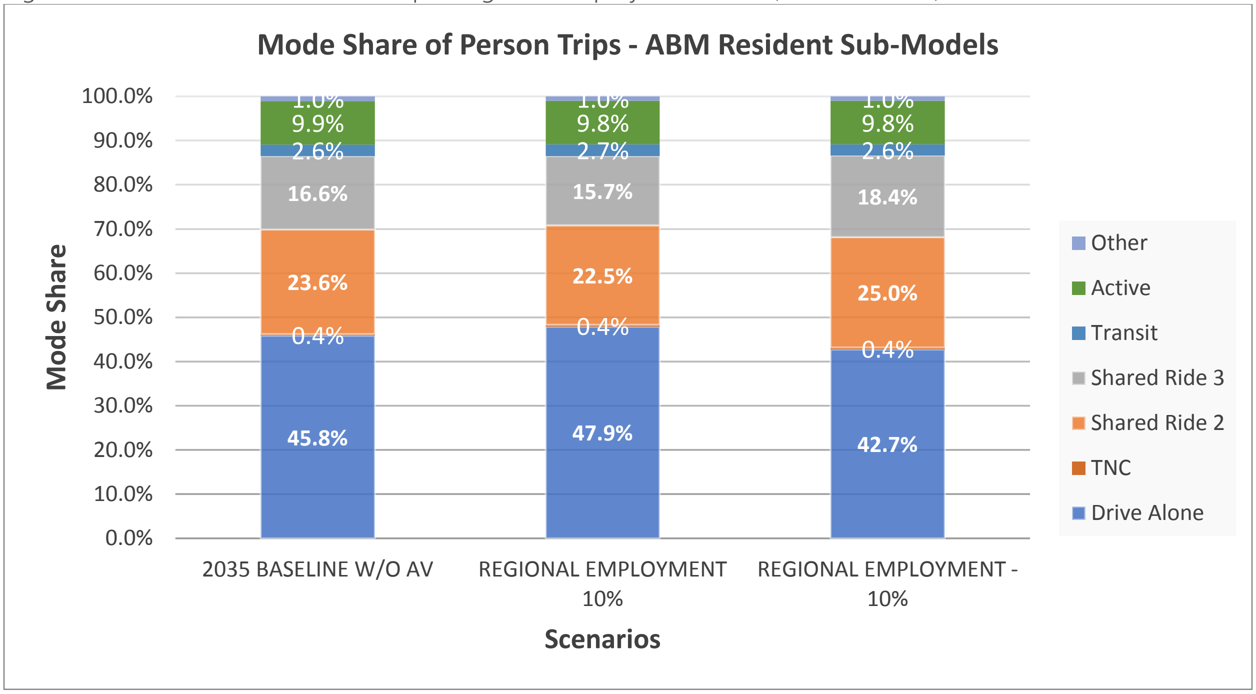


Figure 42. Total Person Trips Change from Baseline: Regional Employment Tests (Tests 26 & 27)

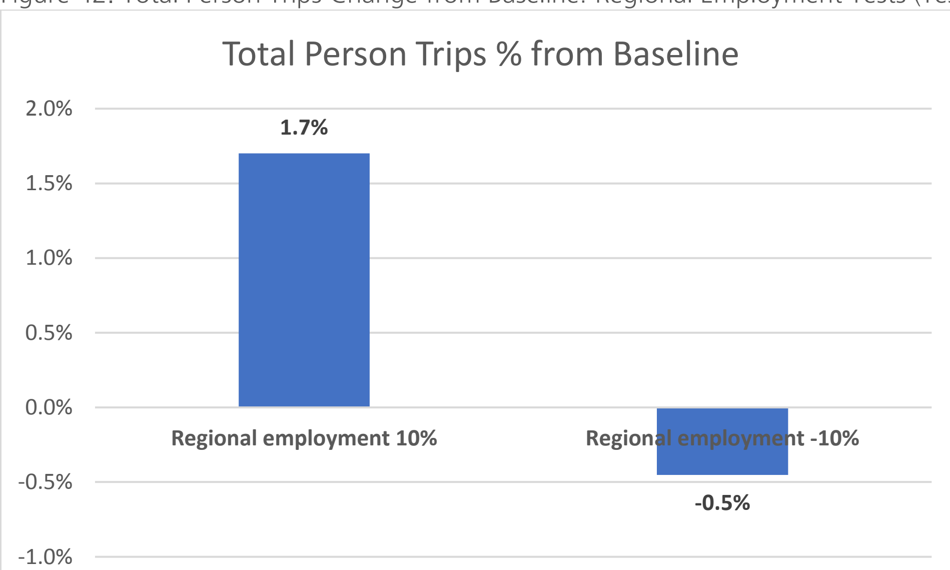


Table 10. Person Trip Distance by Purpose: Household Income Tests (Tests 24 & 25)

description	Rec.	Dining	Escort	Maint.	School	Shop	Univ.	Visit	Work	Total
2035 baseline w/o AV	5.0	5.3	5.2	5.2	4.6	4.3	8.2	6.0	10.3	6.1
Regional employment 10%	5.0	5.4	5.3	5.2	4.6	4.3	8.3	6.0	10.1	6.3
Regional employment -10%	4.9	5.2	5.0	5.2	4.6	4.2	8.3	5.8	10.5	5.9

New mobility

TNC Cost Tests (Tests 29 & 30)

In comparison with the 2035 baseline, a test with 50% higher TNC cost had the following results:

- Insignificant VMT change (Figure 43)
- Mode shares for all models (Figure 44):
    - DA increased from 45.3% to 45.4%
    - TNC decreased significantly from 0.8% to 0.4%
    - Insignificant transit mode share change.
- Transit boarding increased by over 1% (Figure 46)
- Total TNC trips decreased by 35%, suggesting that a 1 percent increase in TNC cost will lead to a TNC trip decrease of 0.7% (elasticity of -0.7) (Figure 47).
- Deadhead TNC VMT (no passengers) increased slightly from 41.9% to 42.3% and pooled TNC VMT decreased from 11.6% to 11.0% (Figure 46).
- Although average trip distance change was insignificant, regular TNC trip distance increased from 7.7 miles to 9.1 miles, pooled TNC trip distance increased from 6.0 miles to 6.2 miles (Table 11).

In comparison with the 2035 baseline, a test with 50% lower TNC cost had the following results:

- VMT increased by 0.4% (Figure 43)
- Mode shares for all models (Figure 44):
    - DA decreased from 45.3% to 45.2%
    - SR3 decreased from 16.7% to 16.1%
    - Transit decreased from 2.7% to 2.6%
    - TNC increased from 0.8% to 1.8%
- Transit boarding decreased by 2% (Figure 46)
- Total TNC trips increased by 97%, suggesting that a 1 percent decrease in TNC cost will lead to a TNC trip increase of 2.0% (elasticity of -2.0) (Figure 47).
- Deadhead TNC trips (no passenger) decreased from 41.9% to 41% and pooled TNC increased from 11.6% to 13.1% (Figure 46).
- Although average trip distance change was insignificant, regular TNC trip distance decreased from 7.7 miles to 7.6 miles, pooled TNC trip distance increased from 6.0 miles to 6.6 miles (Table 11).

The results suggest that the TNC cost increase did not have a significant impact on VMT and mode shares, except for the significant TNC mode share decrease. The TNC cost increase caused a significant TNC trip distance increase from 7.7 miles to 9.1 miles. Deadhead TNC VMT did not change much, but pooled TNC VMT decreased.

When TNC cost decreased, VMT increased, TNC mode share increased significantly, and transit mode share decreased. This suggests a competition between TNC and transit. As TNC became more affordable, mode shares shifted from transit to TNC and caused more VMT. As TNC cost decreased, among the three auto modes (DA, SR2, and SR3), only SR3 mode share increased significantly, which needs more investigation. Deadhead TNC VMT decreased slightly, but pooled TNC VMT increased.

Figure 43. VMT Change from Baseline: TNC Cost Tests (Tests 29 & 30)

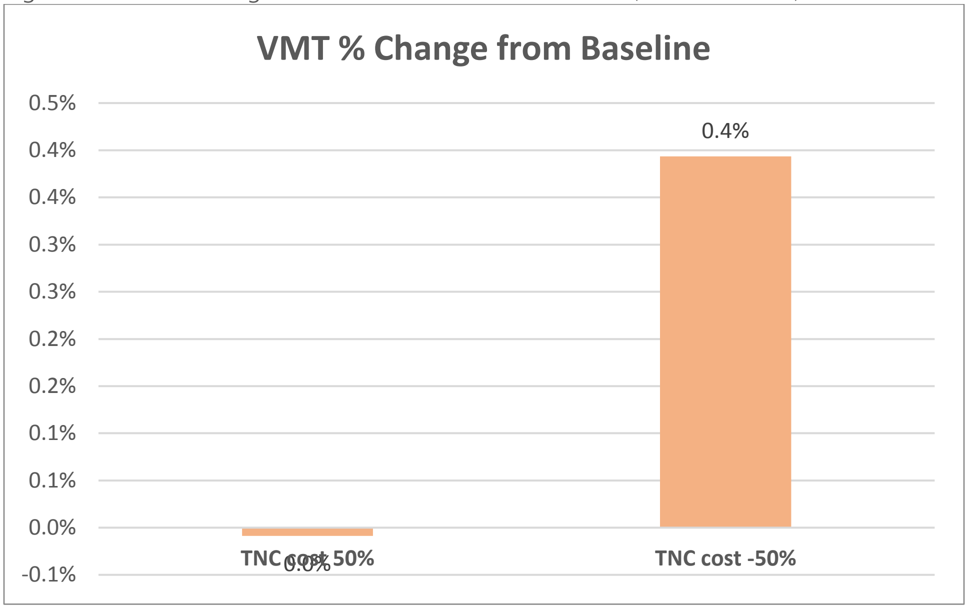


Figure 44. Mode Share of Person Trips: TNC Cost Tests (Tests 29 & 30)

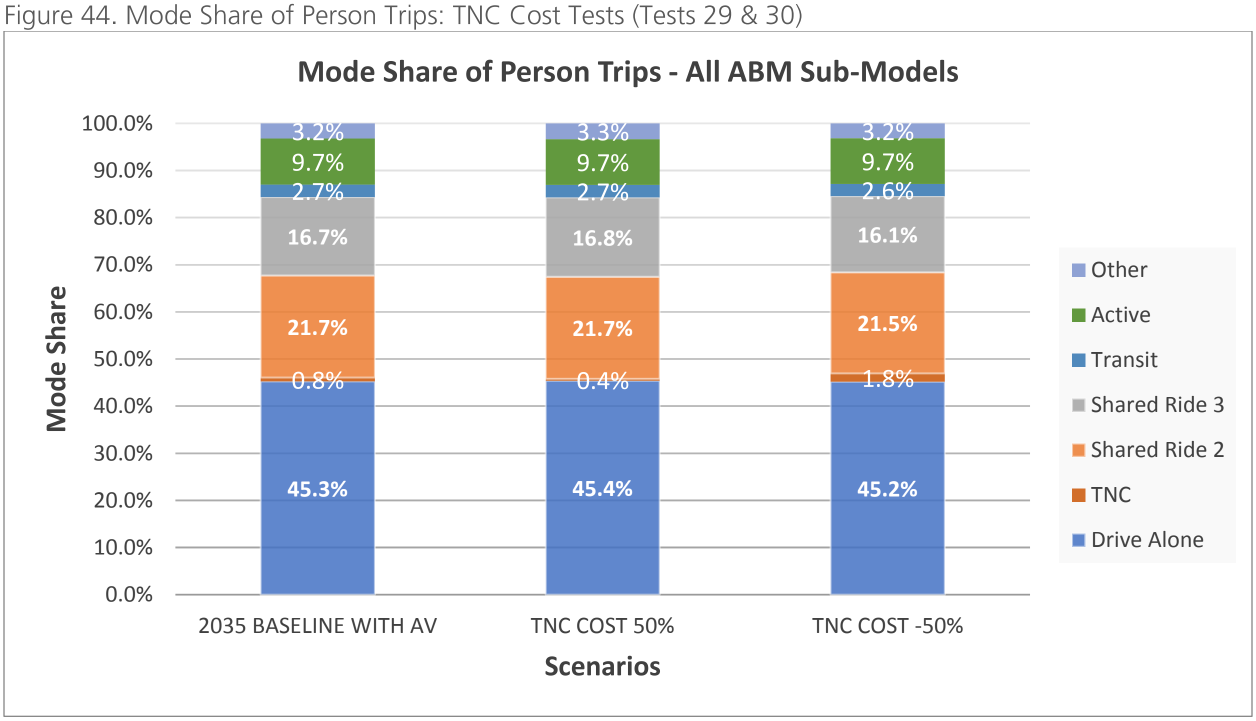


Figure 45. Transit Boarding Change from Baseline: TNC Cost Tests (Tests 29 & 30)

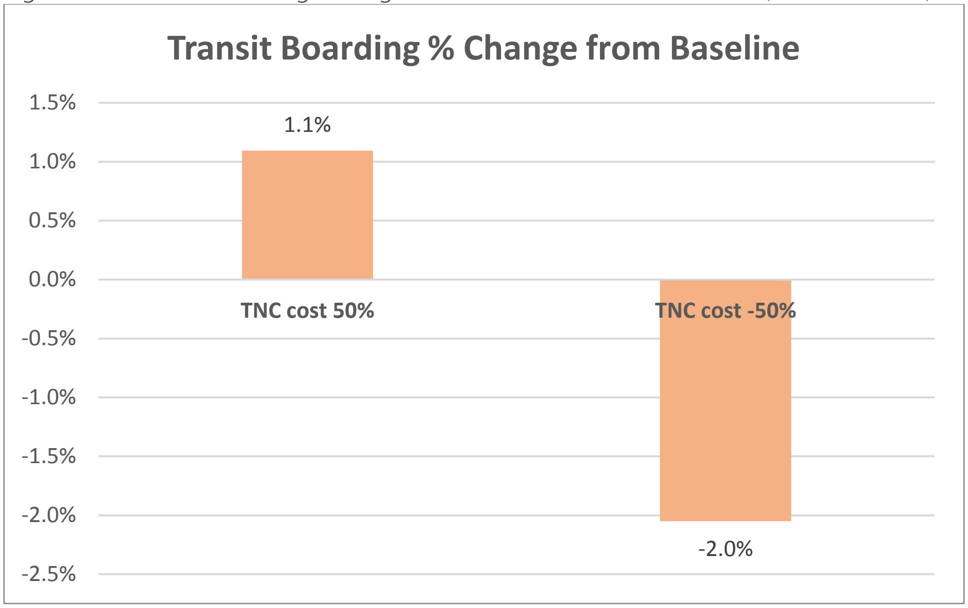


Figure 46. Share of TNC Trips by Number of Passengers: TNC Cost Tests (Tests 29 & 30)

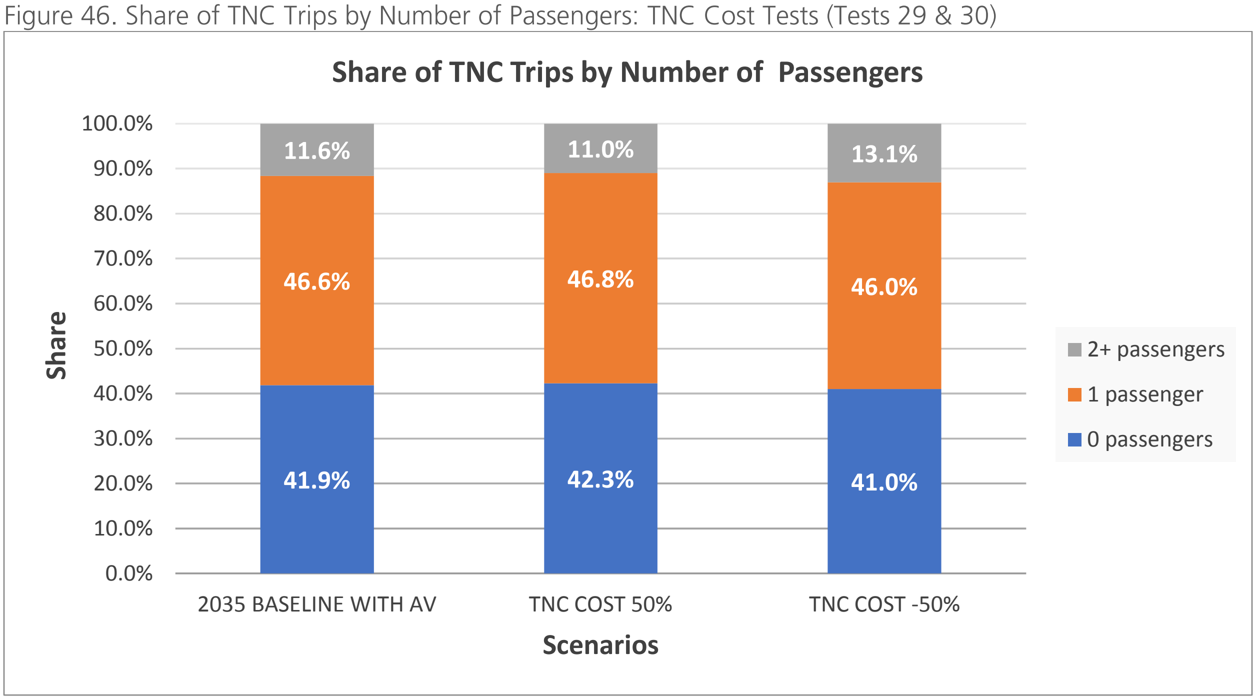


Figure 47. TNC Trips Change from Baseline: TNC Cost Tests (Tests 29 & 30)

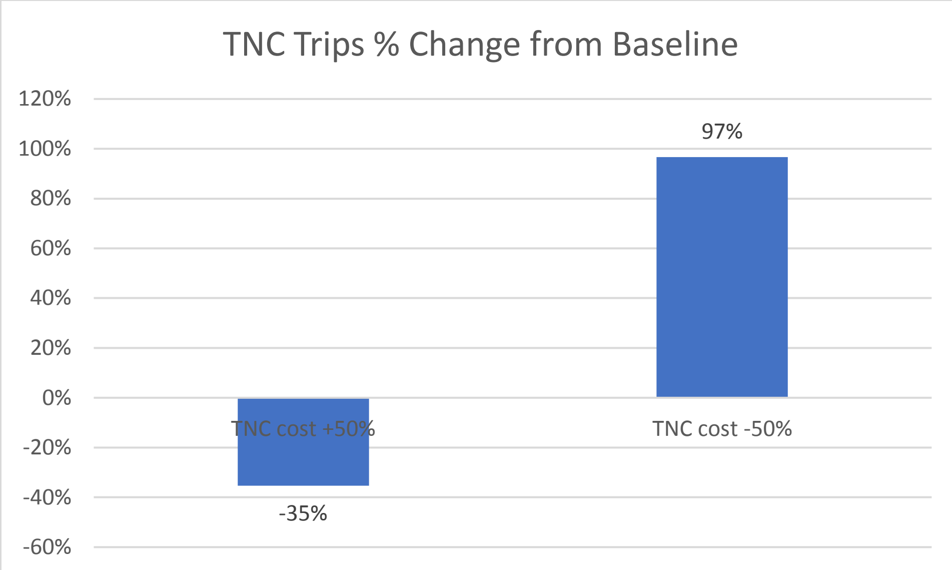


Table 11. Person Trip Distance by Mode: Household Income Tests (Tests 24 & 25)

description	DA	SR2	SR3	TNC	Pooled TNC	Walk	Bike	Transit	Total
2035 baseline with AV	8.0	7.2	8.3	7.7	6.0	0.8	3.3	9.1	7.3
TNC cost 50%	7.9	7.2	8.3	9.1	6.2	0.8	3.3	9.1	7.3
TNC cost -50%	8.0	7.2	8.2	7.6	6.6	0.8	3.3	9.2	7.3

Pooled TNC Cost Tests (Tests 31 & 32)

In comparison with the 2035 baseline, a test with 50% lower pooled TNC cost had the following results:

- Insignificant VMT change (Figure 48)
- VMT generated by TNC increased by 1.0% (Figure 49)
- Among all TNC VMT, pooled TNC VMT decreased from 9.6% to 9.3% and deadhead TNC VMT decreased from 31.7% to 31.1% (Figure 51).
- Mode shares for all models (Figure 50):
    - DA decreased from 45.4% to 45.3%
    - Transit decreased from 2.7% to 2.6%.
    - Pooled TNC increased from 0.1% to 0.2%, a 100% increase, suggesting that a 1 percent decrease in pooled TNC cost will lead to a pooled TNC trip increase of 2% (elasticity of -2.0).
- Transit boarding decreased by nearly 1% (Figure 52)
- Although average trip distance change was insignificant, pooled TNC trip distance increased from 8.7 miles to 9.4 miles (Table 12).

In comparison with the 2035 baseline, a test with 75% lower pooled TNC cost had the following results:

- VMT increased by 0.1% (Figure 46)
- TNC VMT increased by 2.6% (Figure 49)
- Among all TNC VMT, pooled TNC VMT increased from 9.6% to 12.8% and deadhead TNC VMT decreased from 31.7% to 29.1% (Figure51).
- Mode share changes (Figure 50):
    - DA decreased from 45.4% to 45.1%
    - Transit decreased from 2.7% to 2.6%.
    - Pooled TNC increased from 0.1% to 0.4%, a 300% increase, suggesting that a 1 percent decrease in pooled TNC cost will lead to pooled TNC trip increase of 4% (elasticity of -4.0).
- Transit boarding decreased by nearly 2% (Figure 52)
- Although the average trip distance change was insignificant, pooled TNC trip distance increased from 8.7 miles to 10.7 miles (Table 12).

The results suggest pooled TNC cost reductions had significant impact on pooled TNC trips, but limited impact on overall VMT. When pooled TNC costs decreased, pooled TNC mode share was higher, and both drive alone and transit mode shares were lower, indicating that TNC competes with both drive alone and transit modes. Pooled TNC trip distance increased and regular TNC trip distance decreased. This suggests two findings. First, travelers tend to take longer pooled TNC trips as the cost becomes more affordable. Second, more affordable pooled TNC shifted longer regular TNC trips to pooled TNC trips. In the 50% cost reduction test, pooled TNC VMT was slighter lower than baseline, which is counter intuitive and needs further investigation.

Figure 48. VMT Change from Baseline: Pooled TNC Cost Tests (Tests 31 & 32)

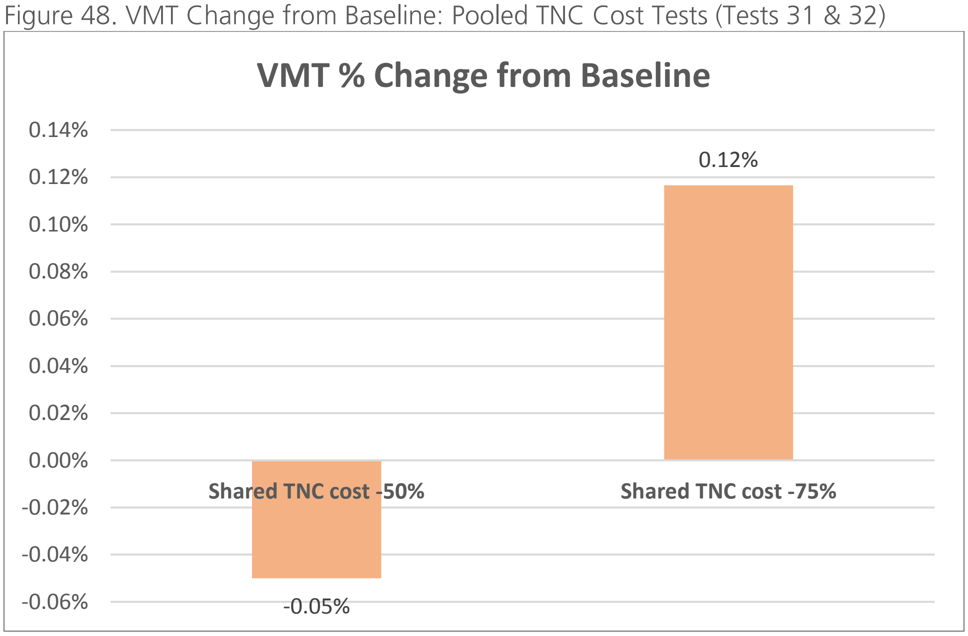


Figure 49. TNC VMT Change from Baseline: Pooled TNC Cost Tests (Tests 31 & 32)

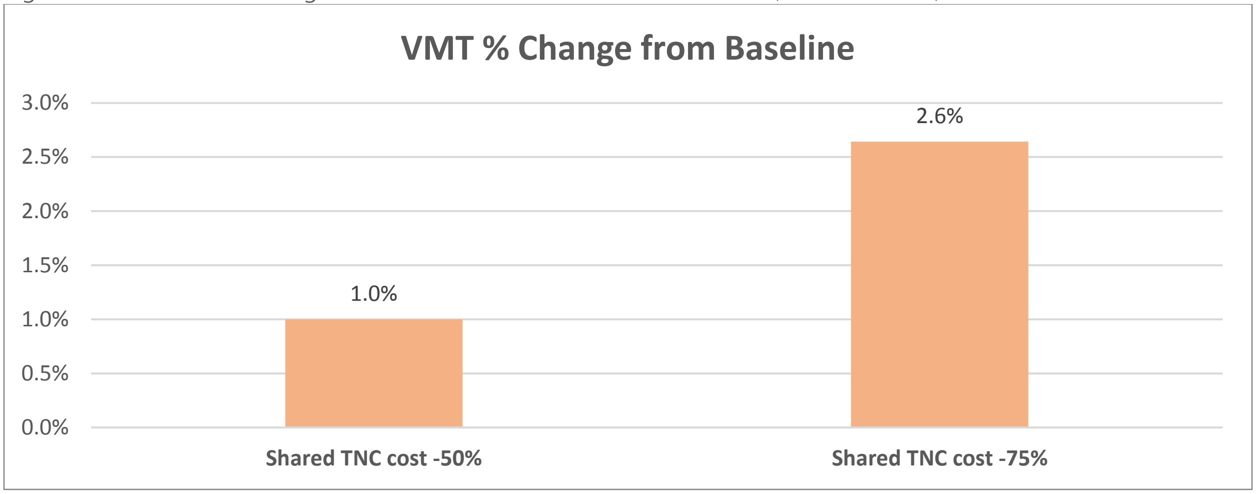


Figure 50. Mode Share of Person Trips: Pooled TNC Cost Tests (Tests 31 & 32)

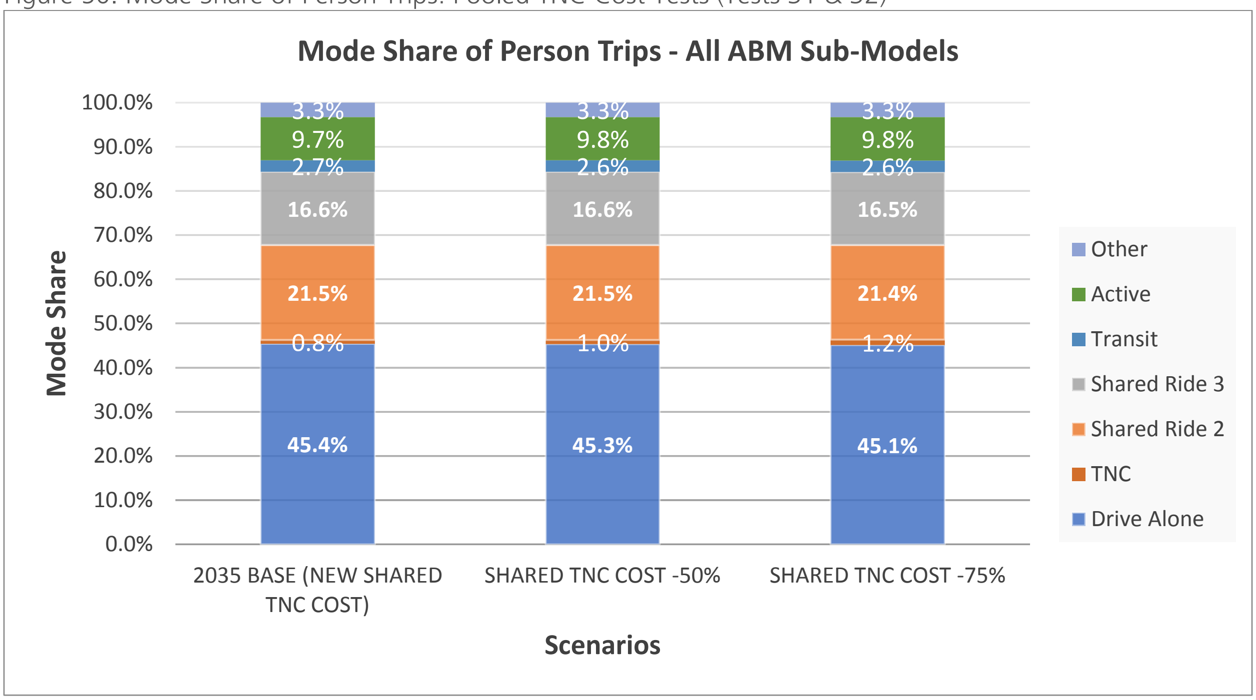


Figure 51. Share of TNC VMT by Occupancy: Pooled TNC Cost Tests (Tests 31 & 32)

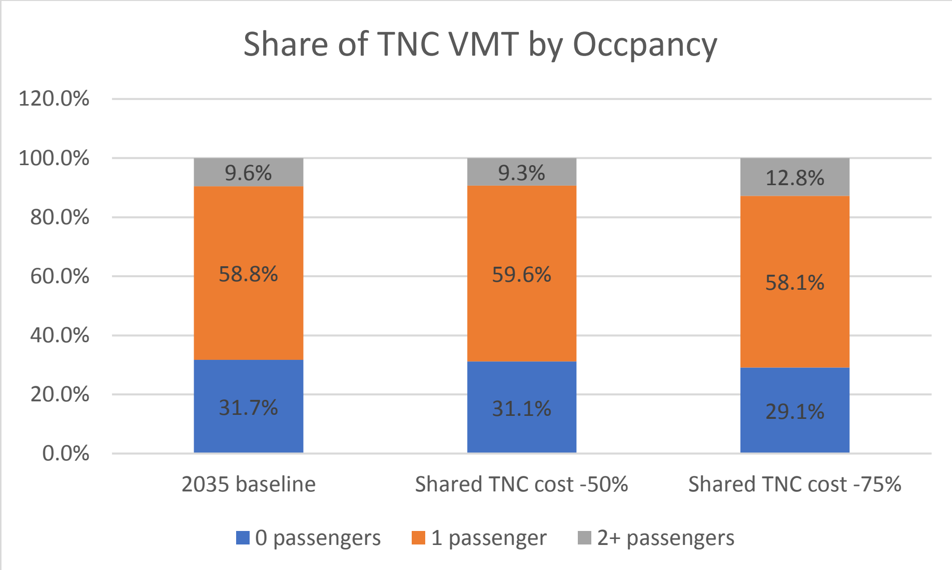


Figure 52. Transit Boarding Change from Baseline: Pooled TNC Cost Tests (Tests 31 & 32)

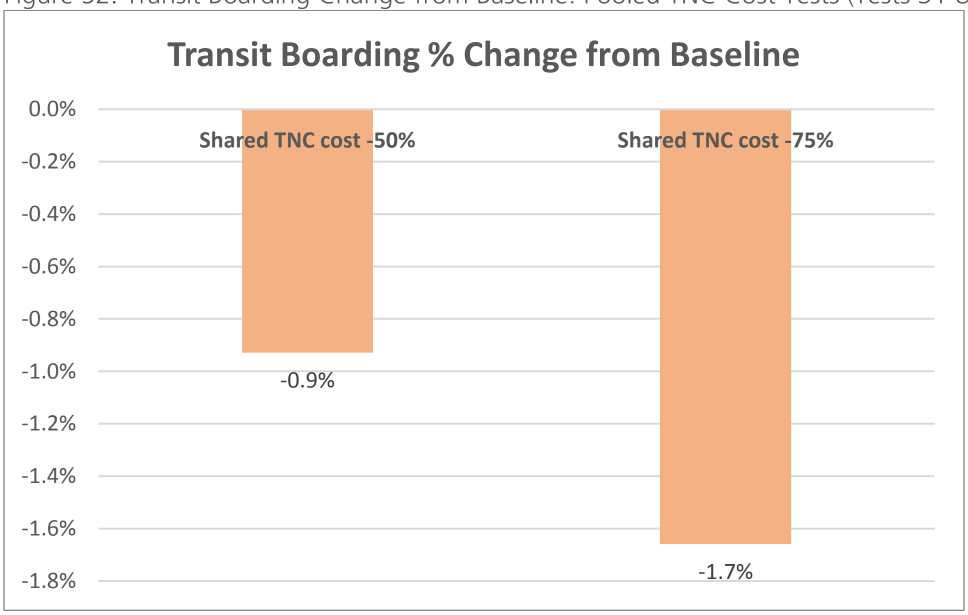


Table 12. Person Trip Distance by Mode: Pooled TNC Cost Tests (Tests 31 & 32)

description	DA	SR2	SR3	TNC	Pooled TNC	Walk	Bike	Transit	Total
2035 base (new Shared TNC cost)	7.9	7.2	8.3	7.7	8.7	0.8	3.3	9.1	7.2
Shared TNC cost - 50%	7.9	7.2	8.3	7.4	9.4	0.8	3.3	9.1	7.2
Shared TNC cost - 75%	7.9	7.2	8.3	7.1	10.7	0.8	3.3	9.1	7.2

TNC Wait Time Tests (Tests 33 & 34)

Compared with the 2035 baseline, a 50% TNC wait time decrease test had the following results:

- Mode share changes were insignificant, except TNC mode share which increased from 0.8% to 0.9% (Figure 53).
- Total TNC trips increased by 13%, suggesting that a 1 percent decrease in TNC wait time will lead to a TNC trip increase of 0.26% (elasticity of -0.26) (Figure 54).
- Share of TNC VMT increased from 0.85% to 0.95% (Figure 55)

Compared with the 2035 baseline, a 50% TNC wait time increase test had the following results:

- Mode share changes were insignificant except TNC mode share which decreased from 0.8% to 0.7% (Figure 53).
- Total TNC trips decreased by 9%, suggesting that a 1 percent increase in TNC wait time will lead to a TNC trip decrease of 0.18% (elasticity of -0.18) (Figure 54).
- Share of TNC VMT decreased from 0.85% to 0.79% (Figure 55)

The results suggest TNC wait time had significant impact on TNC trips but limited impact on regional VMT because of the very small TNC mode share. When TNC wait time decreased, both TNC trips and TNC VMT increased. When TNC wait time increased, the opposite effects were observed.

Figure 53. Transit Boarding Change from Baseline: TNC Wait Time Tests (Tests 33 & 34)

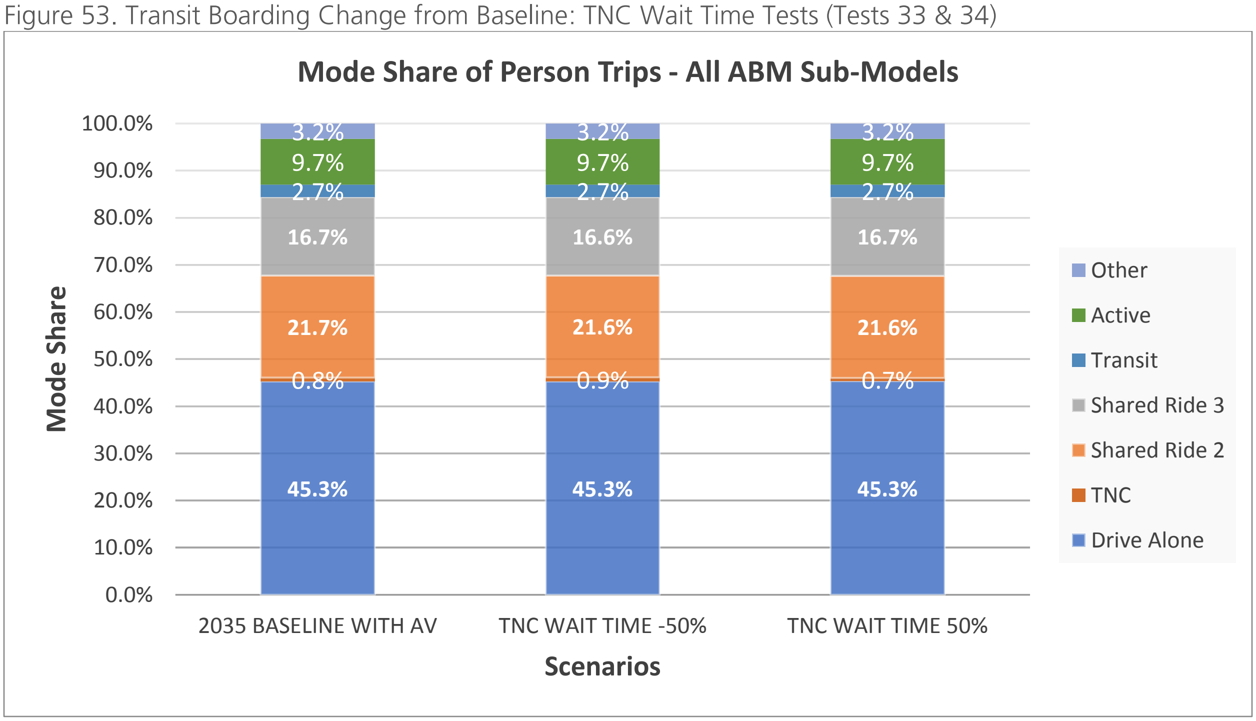


Figure 54. TNC Trips Change from Baseline: TNC Wait Time Tests (Tests 33 & 34)

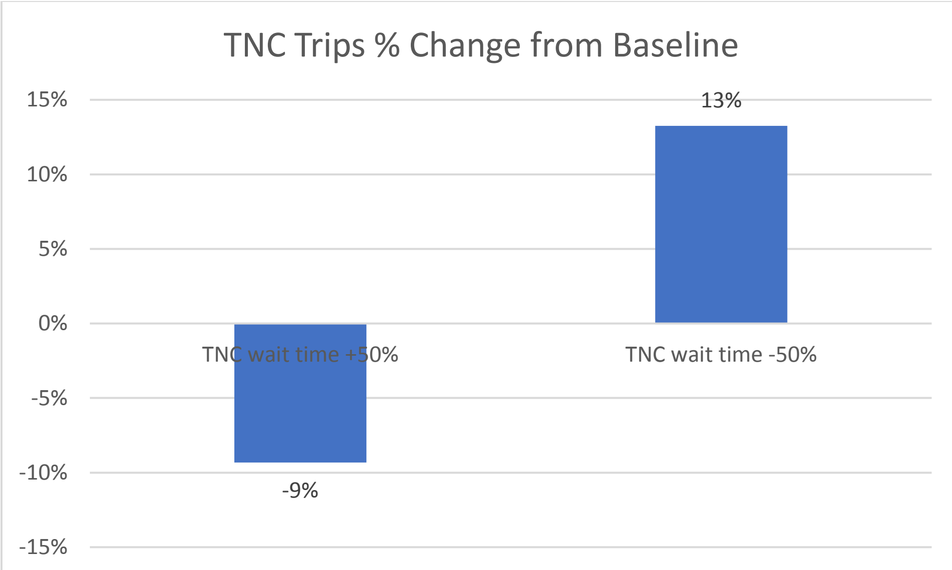
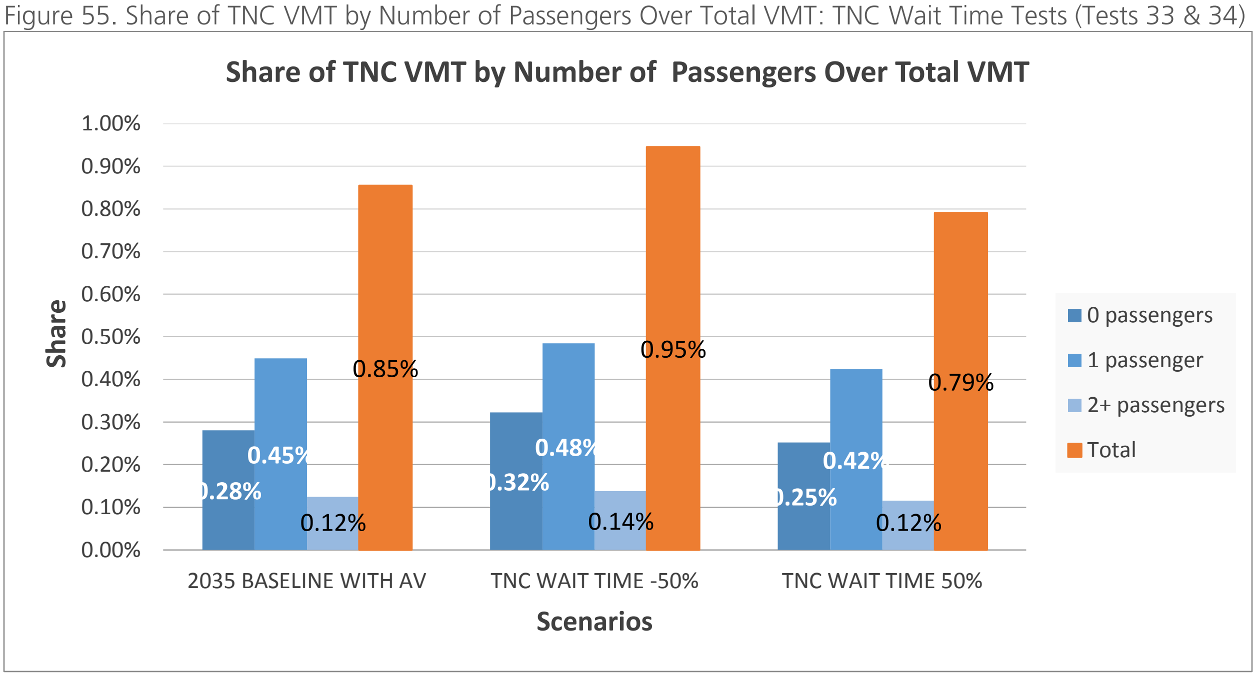


Figure 55. Share of TNC VMT by Number of Passengers Over Total VMT: TNC Wait Time Tests (Tests 33 & 34)



Micromobility Speed Tests (Tests 35 & 36)

In comparison with the 2035 baseline, a test increasing micromobility speed from 12mph to 30 mph had the following results:

- VMT decreased slightly by 0.1% (Figure 56)
- Insignificant mode share changes (Figure 57)

- Transit boarding decreased by nearly 1% (Figure 58)
- Total micromobility trips increased by 33% (Figure 59)
- Although average trip distance change was insignificant, micromobility trip distance increased from 0.9 miles to 1.0 mile (Table 13).

In comparison with the 2035 baseline, a micromobility focus test with micromobility speed set to 20mph, 0 constant, and halved wait time and costs had the following results:

- VMT decreased by 0.8% (Figure 56)
- Mode share changes of all models (Figure 57):
    - DA decreased from 45.3% to 44.6%
    - SR2 decreased from 21.7% to 21.3%
    - SR3 decreased from 16.7% to 16.3%
    - Transit decreased from 2.7% to 2.5%
    - Active modes (walk, bike, and micromobility) increased from 9.7% to 11.4%, with the micromobility mode increasing significantly from 0.1% to 1.7%.
- Transit boarding decreased by nearly 5% (Figure 58)
- Total micromobility trips increased significantly by over 15 times (Figure 59)
- Although average trip distance change was insignificant, micromobility trip distance decreased from 0.9 miles to 0.6 mile (Table 13).

The results suggest micromobility speed alone had limited impact on VMT and mode shares, primarily because speed is one of many variables in the micromobility choice structure. When micromobility speed increased, the model indicated higher micromobility trips, but the overall mode share impact was insignificant. The test of giving significant benefit to micromobility by reducing cost, wait time, penalty constant, and increasing speed suggested that the model is sensitive to micromobility if enough benefit is given to micromobility.

Figure 56. TNC Trips Change from Baseline: Micromobility Speed Tests (Tests 35 & 36)

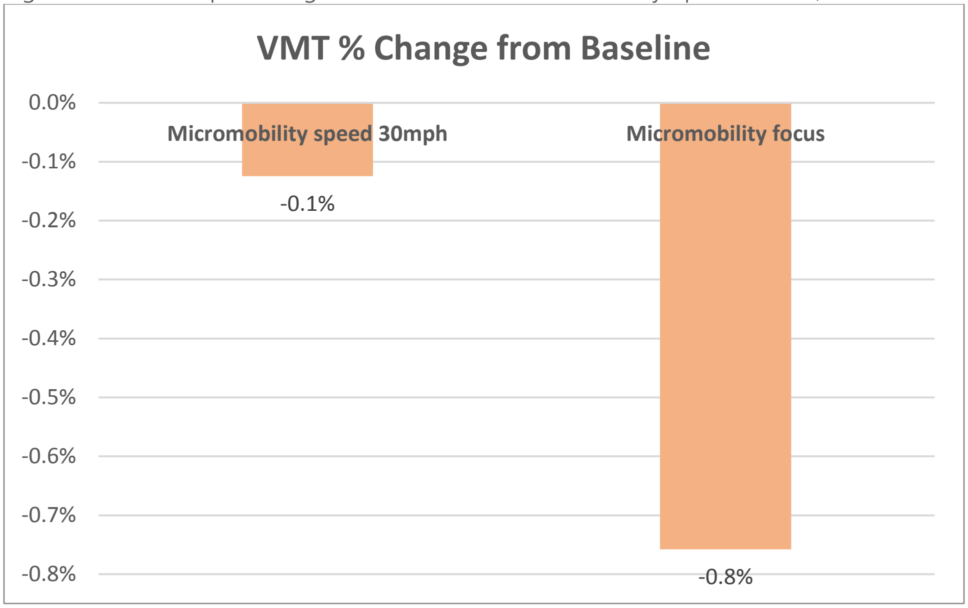


Figure 57. Mode Share of Person Trips: Micromobility Speed Tests (Tests 35 & 36)

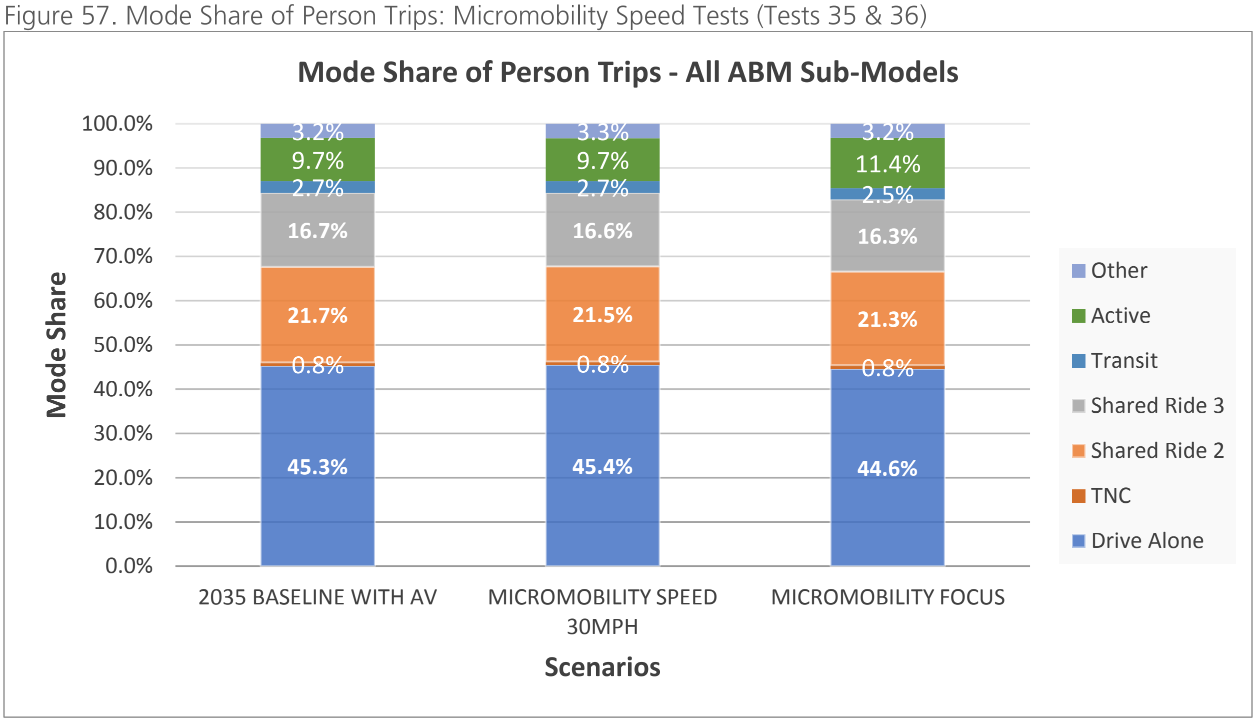


Figure 58. Transit Boarding Change from Baseline: Micromobility Speed Tests (Tests 35 & 36)

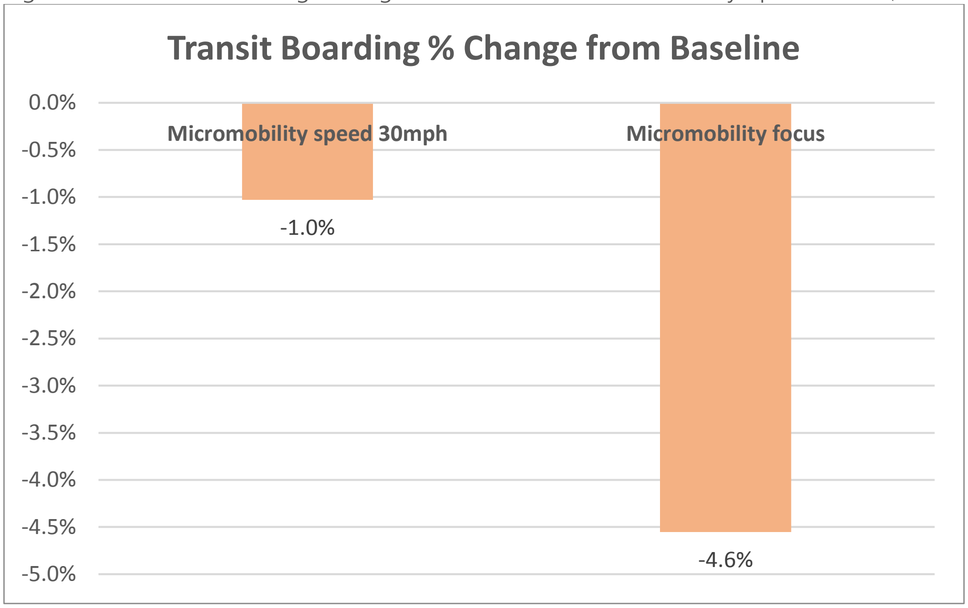


Figure 59. Micromobility Trips Change from Baseline: Micromobility Speed Tests (Tests 35 & 36)

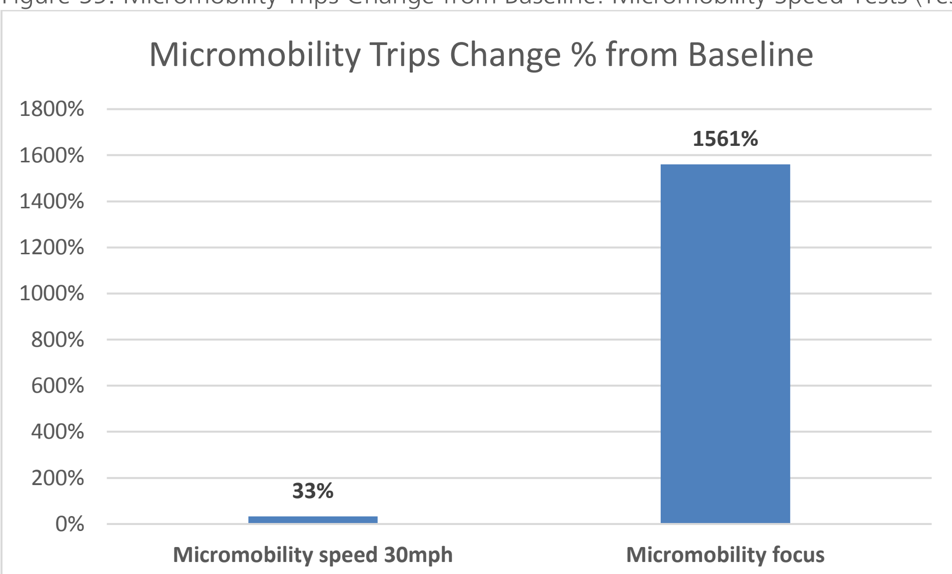


Table 13. Person Trip Distance by Mode: Micromobility Speed Tests (Tests 35 & 36)

description	DA	SR2	SR3	TNC	Pooled TNC	Walk	MM	Bike	Transit	Total
2035 baseline with AV	8.0	7.2	8.3	7.7	6.0	0.8	0.9	3.3	9.1	7.3
Micromobility speed 30mph	7.9	7.2	8.3	7.7	8.7	0.8	1.0	3.3	9.1	7.2
Micromobility focus	8.0	7.3	8.4	7.9	6.2	0.7	0.6	3.5	9.4	7.2

Micromobility Access Time Tests (Tests 37 & 38)

In comparison with the 2035 baseline, a test improving micromobility access time (see description of test 37 in the previous chapter) had the following results:

- Insignificant VMT change
- Insignificant mode share changes
- Total MM trips increased by over 120% (Figure 60).
- The share of micromobility trips for the total walk and micromobility trips increased from 2.0% to 4.0% (Figure 62).

In comparison with the 2035 baseline, a test significantly improving micromobility access time (see description of test 38 in the previous chapter) had the following results:

- Insignificant VMT change
- Insignificant mode share changes
- Total MM trips increased by 375% (Figure 60)
- The share of micromobility trips for the total walk and micromobility trips increased from 2.0% to 9.0% (Figure 62).

The results suggest micromobility access time had significant impact on micromobility trips and the share of micromobility trips, but limited impact on VMT and mode shares. When access time was improved, the total micromobility trips and share of micromobility increased significantly, but the effect on VMT was insignificant. This is likely due to the low share of micromobility and the relatively short trip length of micromobility trips. In the 'Good MM Access' scenario, the change in total walk and micromobility trips was negative but very small - possibly insignificant when compared to Monte Carlo simulation error.

Figure 60. Micromobility Trips Change from Baseline: Micromobility Access Time Tests (Tests 37 & 38)

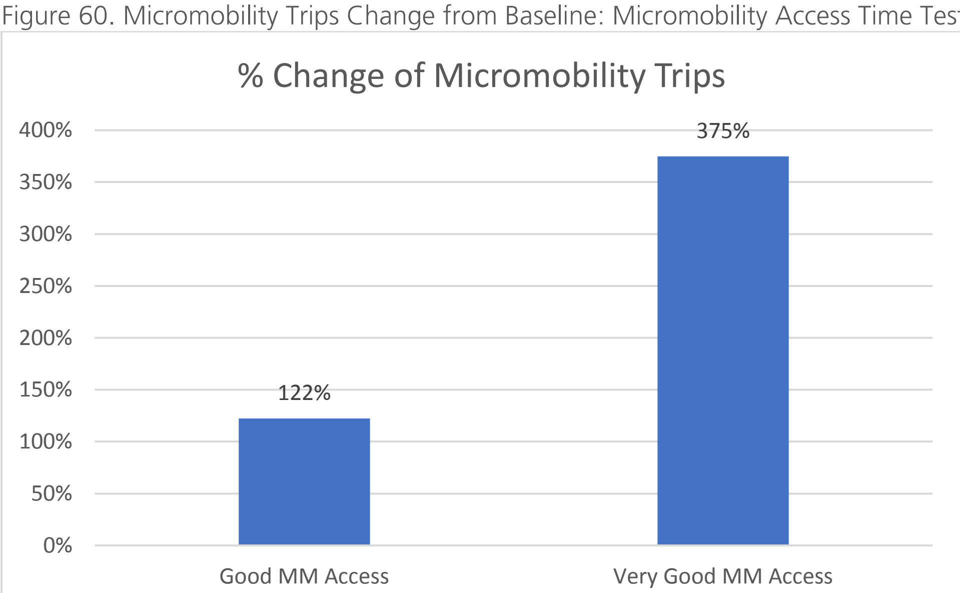


Figure 61. Walk & Micromobility Trips Change from Baseline: Micromobility Access Time Tests (Tests 37 & 38)

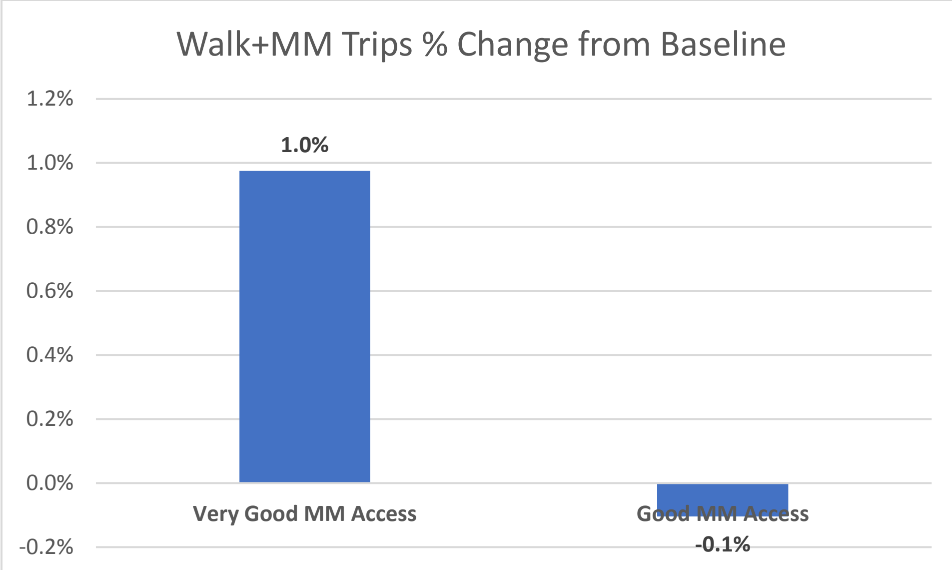
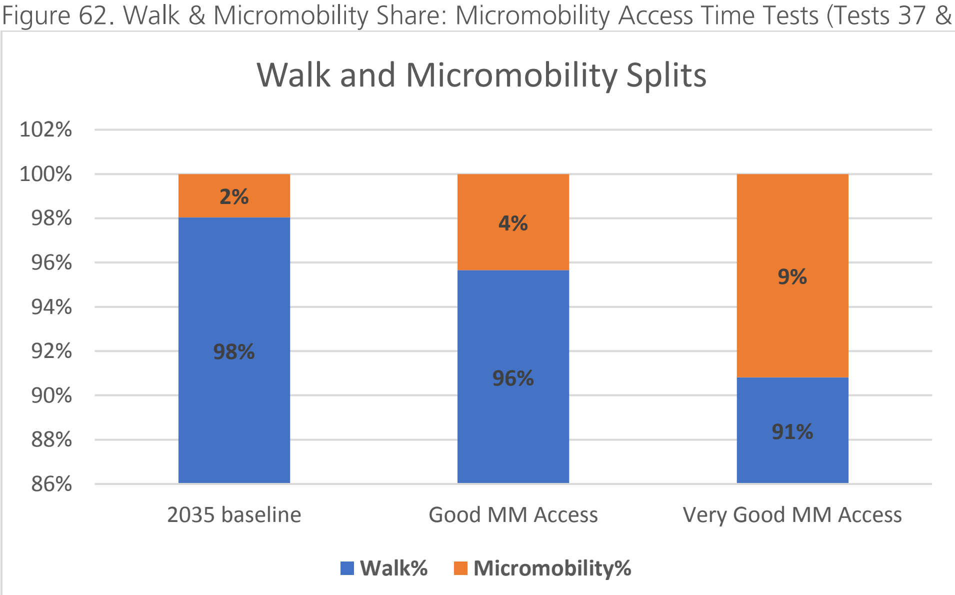


Figure 62. Walk & Micromobility Share: Micromobility Access Time Tests (Tests 37 & 38)



Micromobility Cost Tests (Tests 39 & 40)

In comparison with the 2035 baseline, a test increasing micromobility cost by 50% had the following results:

- Insignificant VMT change
- Insignificant mode share changes

- Total micromobility trips decreased by 40%, suggesting that a 1 percent increase in micromobility cost will lead to a micromobility trip decrease of 0.8% (elasticity of -0.8) (Figure 63).
- The share of micromobility trips for the total walk and micromobility trips decreased from 2.0% to 1.2% (Figure 65).

In comparison with the 2035 baseline, a test decreasing micromobility cost by 50% had the following results:

- Insignificant VMT change
- Insignificant mode share changes
- Total micromobility trips increased by 19%, suggesting that a 1 percent decrease in micromobility cost will lead to a micromobility trip increase of -0.38% (elasticity of -0.38) (Figure 63).
- The share of micromobility trips for the total walk and micromobility trips increased from 2.0% to 2.3% (Figure 65).

The results suggest micromobility cost had significant impact on micromobility trips and the share of micromobility trips, but limited impact on VMT or total walk and micromobility trip share. The number of micromobility trips responded reasonably to changes in cost, with derived elasticity of -0.4 to -0.8. However, the total share of walk and micromobility trips predicted by the model was not sensitive to these cost changes. This is in part due to the way that the model is formulated, where most of the model competition is between the micromobility and walk mode. Simply increasing or decreasing the cost of the mode was not enough to change the generalized walk time and subsequently impact the competition between walk\micromobility and other modes in the model.

Figure 63. Micromobility Trips Change from Baseline: Micromobility Cost Tests (Tests 39 & 40)

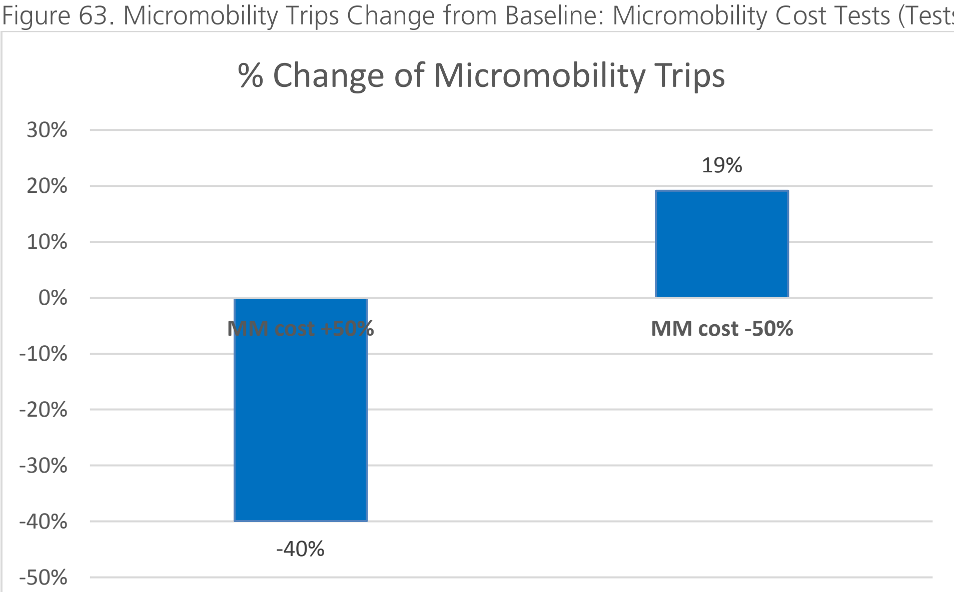


Figure 64. Walk & Micromobility Trips Change from Baseline: Micromobility Cost Tests (Tests 39 & 40)

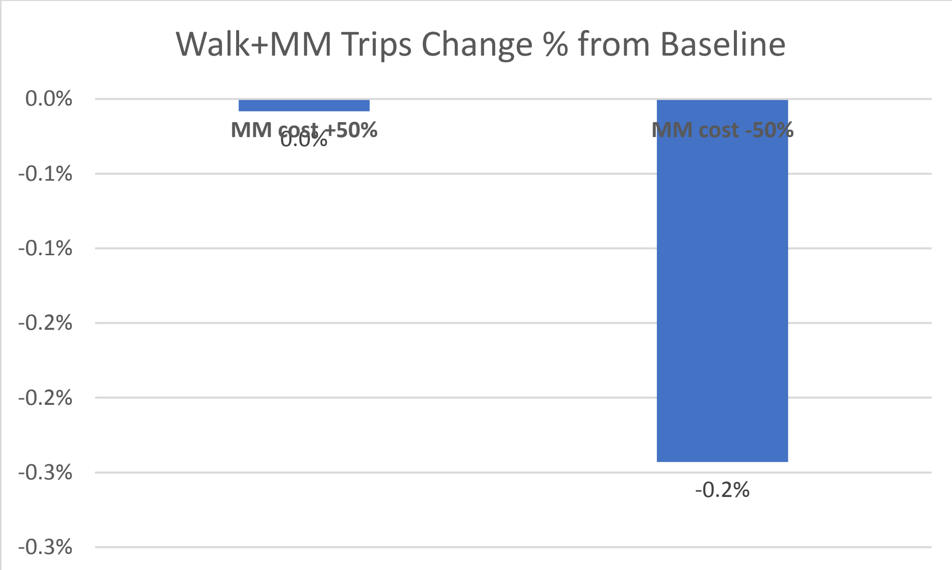
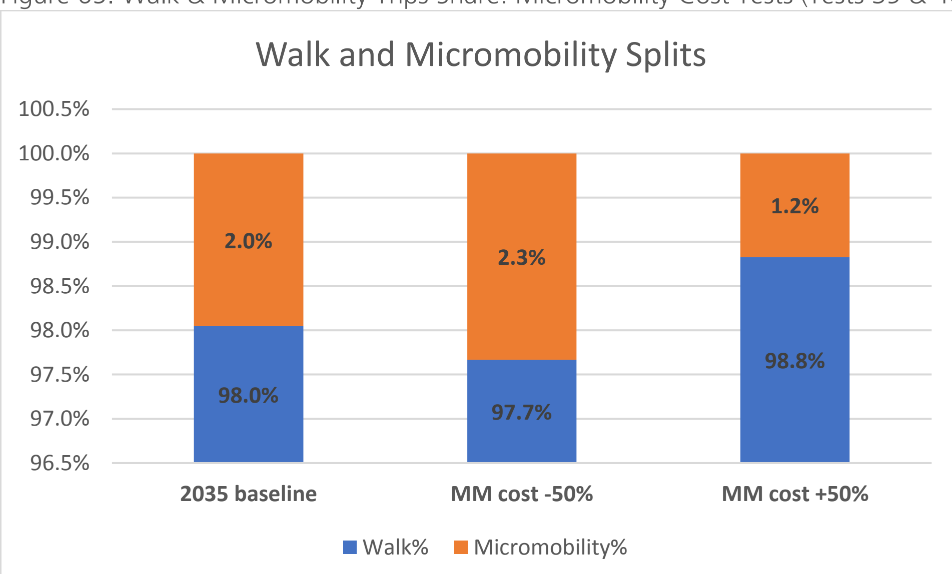


Figure 65. Walk & Micromobility Trips Share: Micromobility Cost Tests (Tests 39 & 40)



AV Penetration Rate Tests (Tests 41 & 42)

Compared with the 2035 baseline without AV, the 20% AV penetration test had the following results:

- VMT increased by 12%, suggesting that a 1 percent increase in AV penetration rate will lead to a VMT increase of 0.6% (elasticity of 0.6) (Figure 66).

- AV trips account for 19% of regional total vehicle trips, suggesting that a 1 percent increase in AV penetration rate will lead to an AV trip increase of 0.95% (elasticity of 0.95) (Figure 67).
- About 40% of AV VMT was generated by ‘zombie’ AV trips with no passengers; only 2% of AV VMT was generated by trips with 2 or more passengers (Figure 68).
- Total trips decreased slightly by 0.3% (Figure 69)
- Mode share changes for San Diego resident models (Figure 70):
    - SR2 increased from 23.6% to 24.0%
    - SR3 decreased from 16.6% to 16.1%
    - Transit increased from 2.6% to 2.7%
- Transit boarding increased by nearly 3% (Figure 71)
- Average trip distance increased from 6.1 miles to 6.2 miles (Table 14).

Compared with the 2035 baseline without AV, the 50% AV penetration test had the following results:

- VMT increased by 21%, suggesting that a 1 percent increase in AV penetration rate will lead to a VMT increase of 0.4% (elasticity of 0.4) (Figure 66).
- AV trips account for 33% of regional total vehicle trips, suggesting that a 1 percent increase in AV penetration rate will lead to an AV trip increase of 0.66% (elasticity of 0.66) (Figure 67).
- Total trips decreased slightly by 2.1% (Figure 69)
- About 40% of AV VMT was generated by ‘zombie’ AV trips with no passengers; only 2% with 2 or more passengers (Figure 68).
- Mode share changes for San Diego resident models (Figure 69):
    - DA decreased from 45.8% to 45.0%
    - SR2 increased from 23.6% to 24.4%
    - SR3 decreased from 16.6% to 14.8%
    - Transit increased from 2.6% to 3.2%
    - Active modes increased from 9.9% to 10.8%
- Transit boarding increased by over 20% (Figure 71)
- Average trip distance increased from 6.1 miles to 6.2 miles; trip distance of all auto modes increased (Table 14).

The results of the experiment indicated a significant VMT increase as the household AV penetration rate increased. Nearly 40% of AV VMT was from ‘zombie’ AV trips. Zombie AV VMT accounted for 10% and 18% of regional VMT and were the majority of the regional VMT increases in the two tested scenarios (Figure 72). Total trips decreased as AV penetration rate increased, probably because the model was calibrated to factor in 10% and 25% reductions in auto ownership for 20% and 50% AV penetration rates, respectively (Figure 69). Average trip distance increased slightly, indicating AV trips tend to be longer. Drive alone mode share decreased while transit and active (walk, bike, and micromobility) mode shares increased, probably because the reduced auto ownership (Figure 73) shifted some auto trips to transit and non-motorized trips.

Figure 66. VMT Change from Baseline: AV Penetration Rate Tests (Tests 41 & 42)

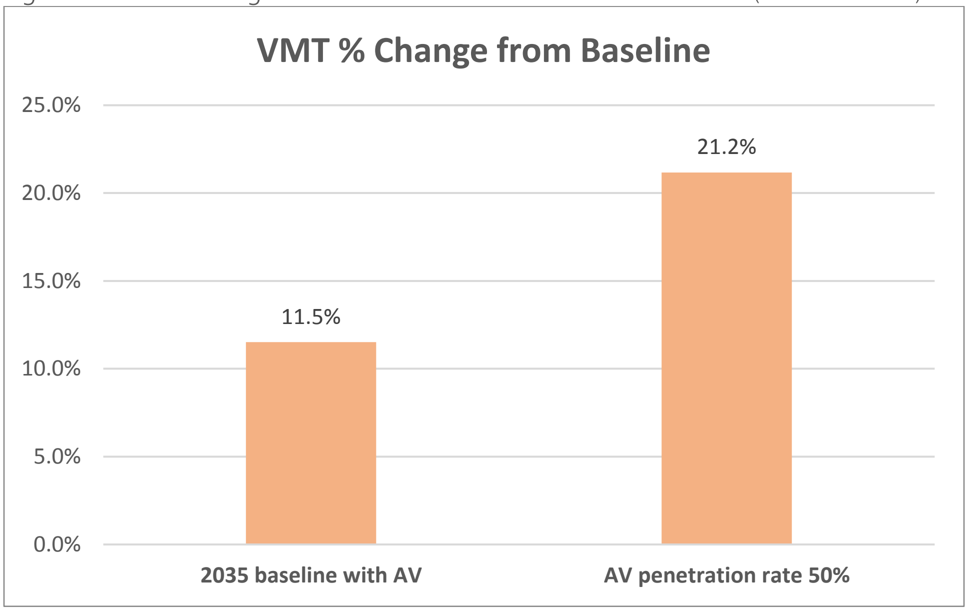


Figure 67. Share of AV Trips and AV VMT of Reginal Total: AV Penetration Rate Tests (Tests 41 & 42)

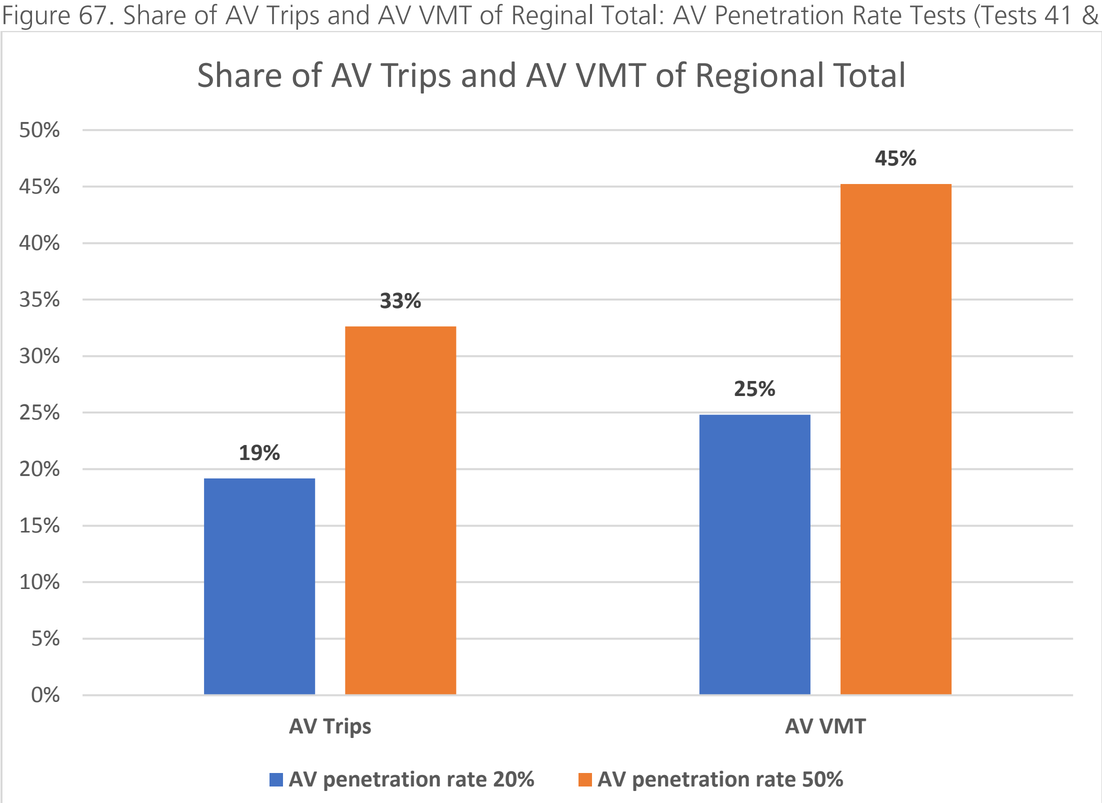


Figure 68. AV VMT by Occupancy: AV Penetration Rate Tests (Tests 41 & 42)

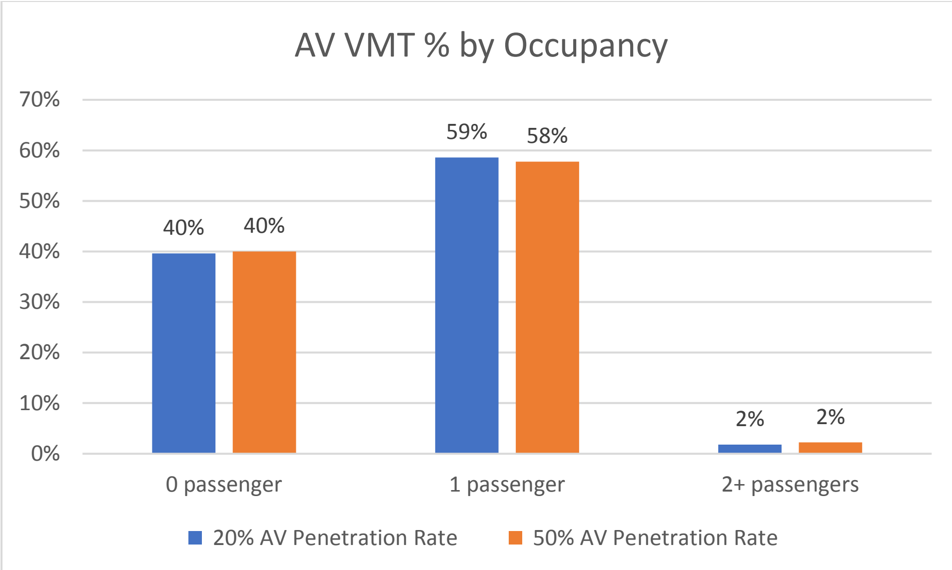


Figure 69. Total Trips Change from Baseline: AV Penetration Rate Tests (Tests 41 & 42)

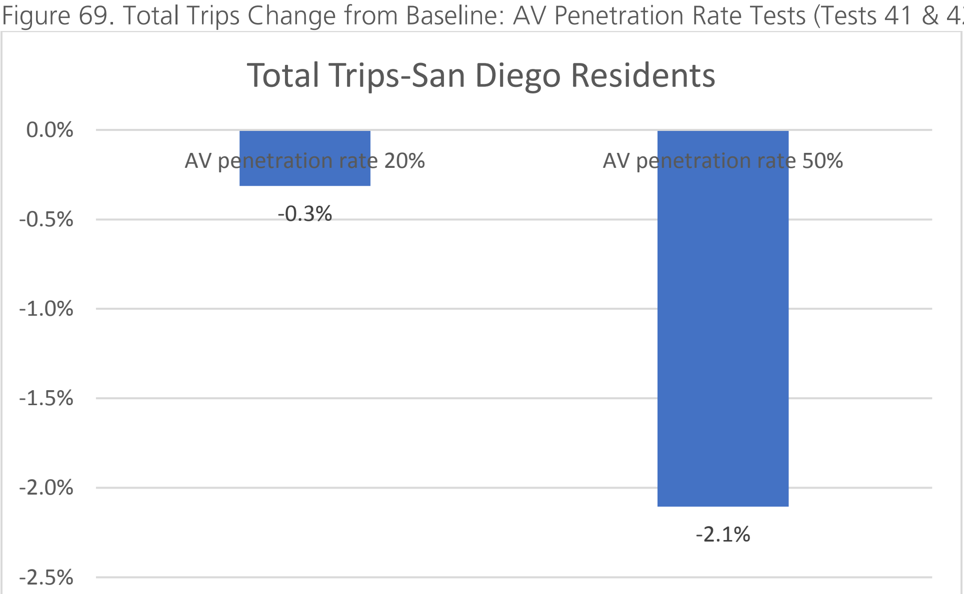


Figure 70. Mode Share of Person Trips: AV Penetration Rate Tests (Tests 41 & 42)

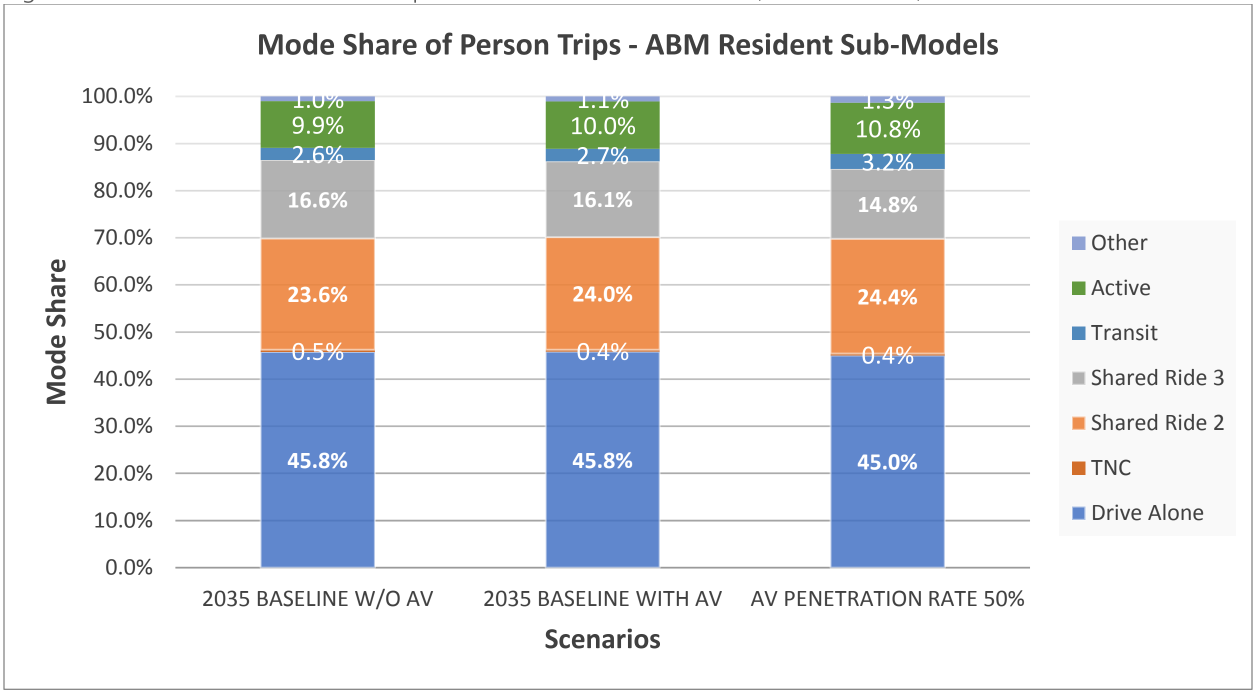


Figure 71. Transit Boarding Change from Baseline: AV Penetration Rate Tests (Tests 41 & 42)

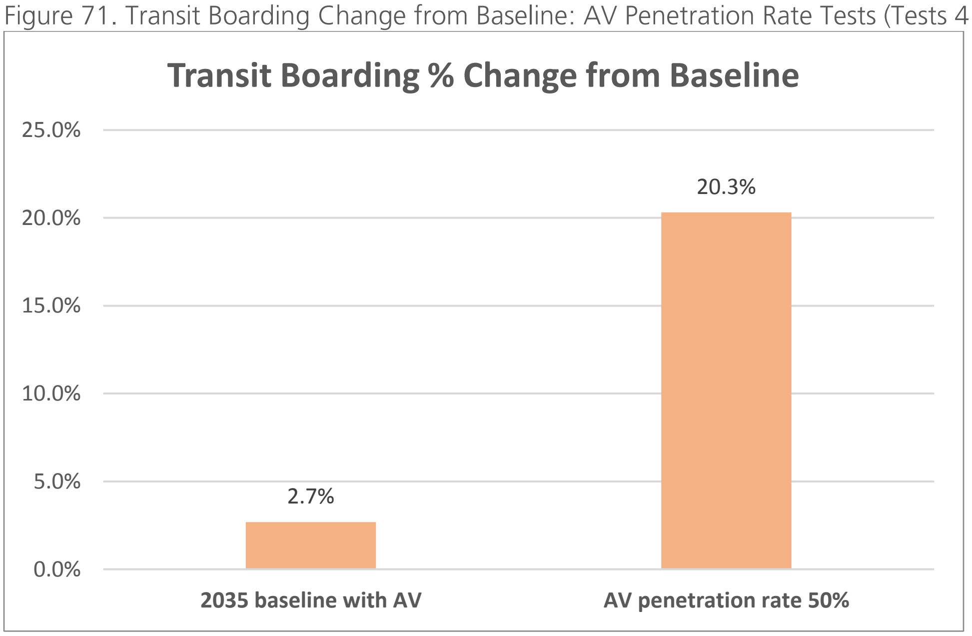


Figure 72. Zombie AV VMT & Regional VMT Increase: AV Penetration Rate Tests (Tests 41 & 42)

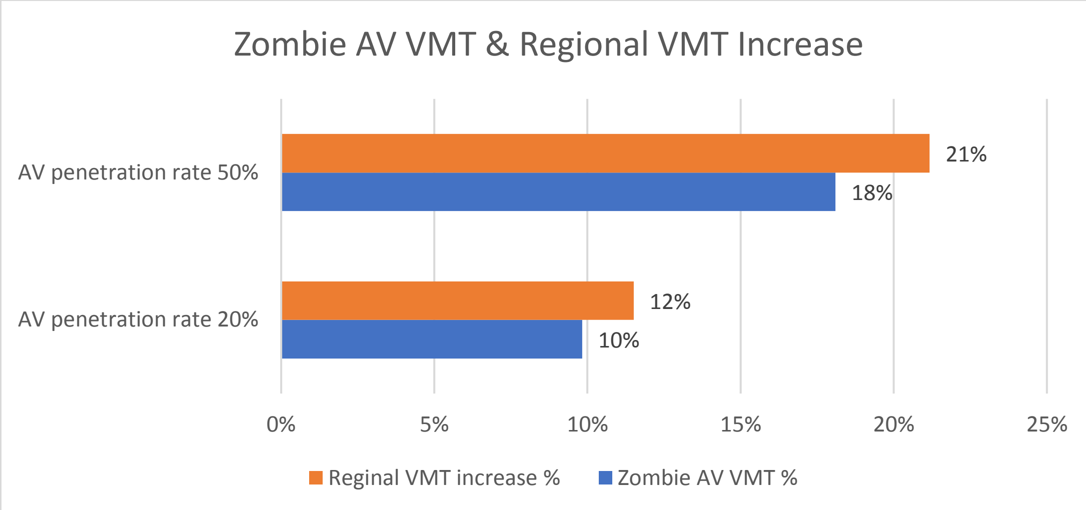


Figure 73. Auto Ownership by Vehicle Type: AV Penetration Rate Tests (Tests 41 & 42)

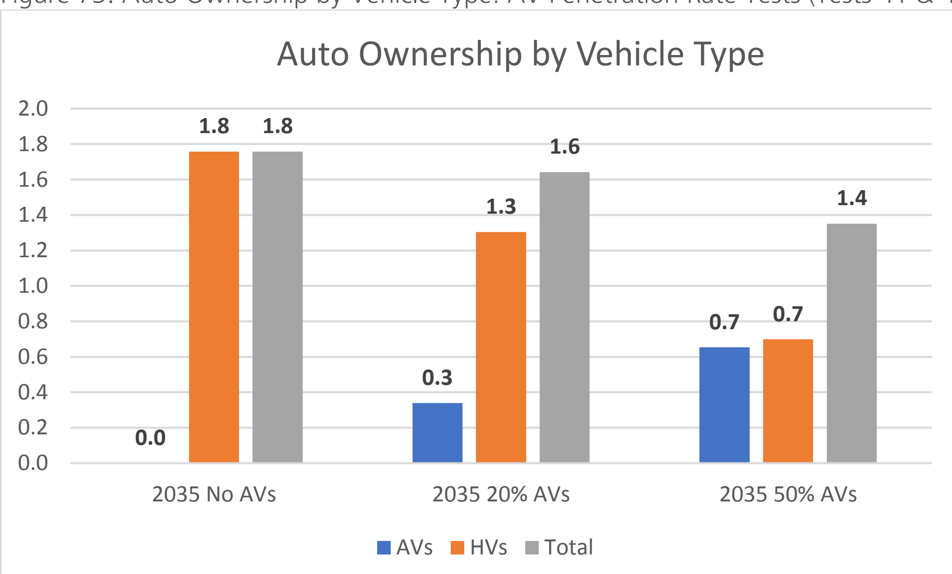


Table 14. Person Trip Distance by Mode: AV Penetration Rate Tests (Tests 41 & 42)

description	DA	SR2	SR3	TNC	Pooled TNC	Walk	Bike	Transit	Total
2035 baseline w/o AV	7.5	5.7	5.9	3.3	3.4	0.8	3.2	8.9	6.1
2035 baseline with AV	7.5	5.7	5.9	3.3	3.2	0.8	3.3	8.7	6.2
AV penetration rate 50%	7.6	5.8	6.1	3.3	3.3	0.8	3.4	8.5	6.2

AV In-Vehicle Time (IVT) Coefficient Tests (Tests 43 & 44)

Compared with the 2035 baseline with a 0.75 AV IVT coefficient, the 0.6 AV IVT coefficient test had the following results:

- Regional VMT increased by 0.5% (Figure 74)
- Insignificant mode share changes (Figure 75)
- Share of AV VMT in regional total increased from 24.8% to 25.1% (Figure 76)

Compared with the 2035 baseline with a 0.75 AV IVT coefficient, 0.9 AV IVT coefficient test had the following results:

- VMT decreased by 0.4% (Figure 74)
- Insignificant mode share changes (Figure 75)
- Share of AV VMT in regional total decreased from 24.8% to 24.6% (Figure 76).

The results suggest that the ABM2+ is sensitive to the AV in-vehicle time coefficient. As AV IVT coefficient decreased, both regional VMT and AV VMT increased slightly. However, the AV IVT coefficient had limited impact on mode shares. When AV IVT coefficient increased, the opposite patterns was observed.

Figure 74. VMT Change from Baseline: AV In-Vehicle Time (IVT) Coefficient Tests (Tests 43 & 44)

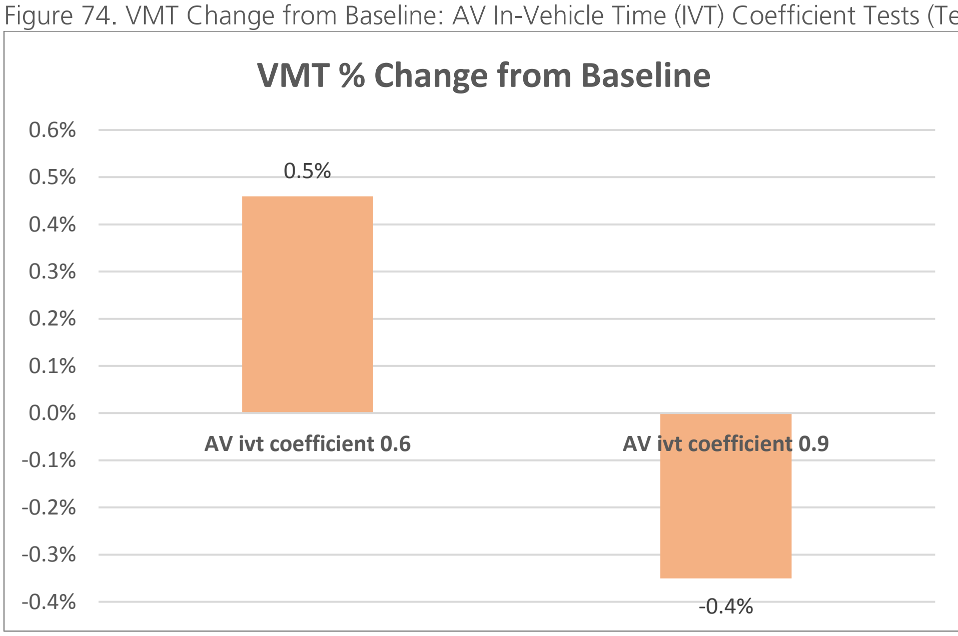


Figure 75. Mode Share of Person Trips: AV In-Vehicle Time (IVT) Coefficient Tests (Tests 43 & 44)

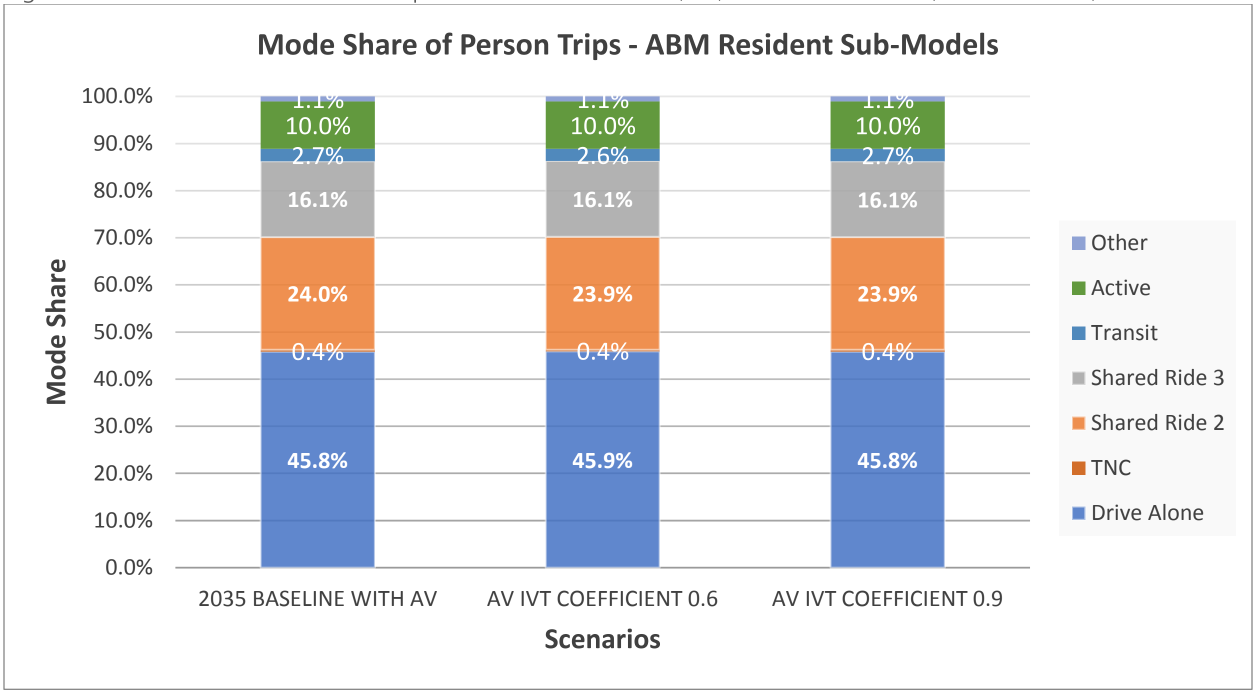
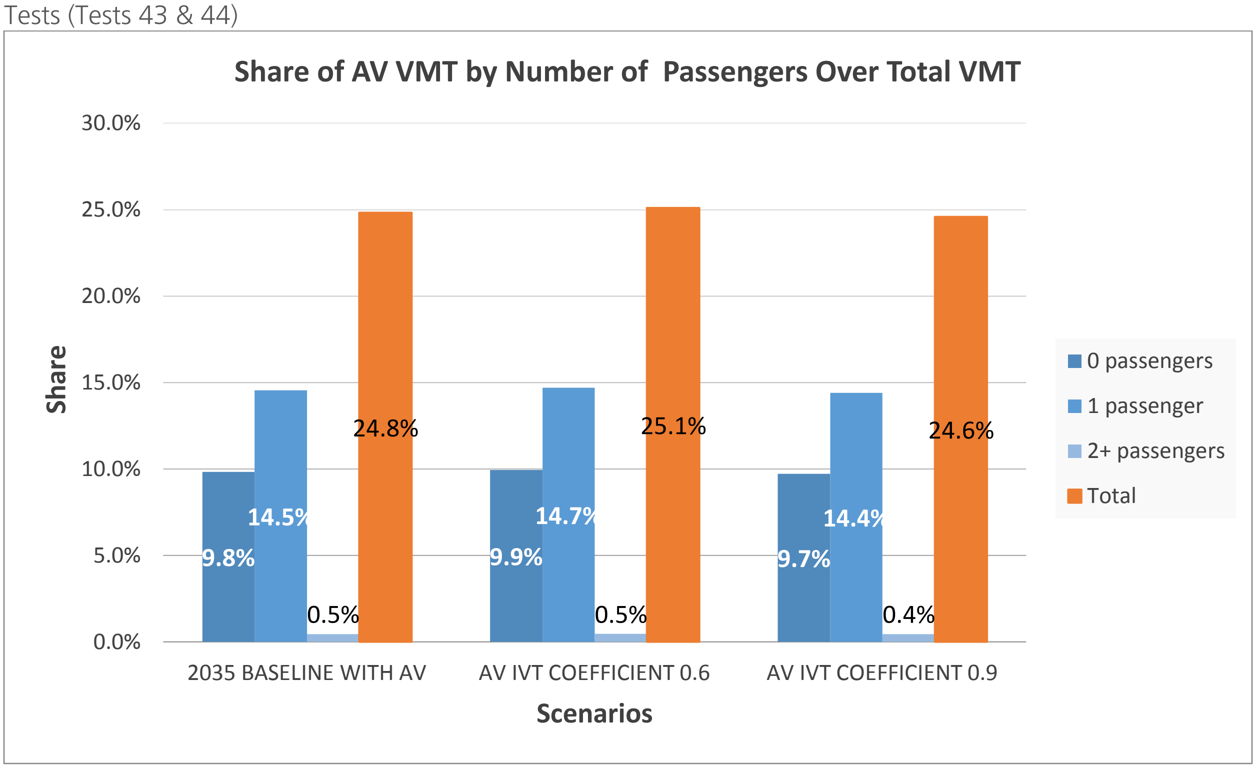


Figure 76. Share of AV VMT by Number of Passengers Over Total VMT: AV In-Vehicle Time (IVT) Coefficient Tests (Tests 43 & 44)



AV Auto Operating Cost Scaler Tests (Tests 45 & 46)

Compared with the 2035 baseline with a 0.7 AV AOC scaler, 0.5 AV AOC scaler test had the following results:

- Regional VMT increased by 0.7% (Figure 77)
- Insignificant mode share changes (Figure 78)
- Share of AV VMT in regional total increased from 24.8% to 25.0% (Figure 79).

Compared with the 2035 baseline with 0.7 AV AOC scaler, 0.9 AV AOC scaler test had the following results:

- VMT decreased by 0.4% (Figure 77)
- Insignificant mode share changes (Figure 78)
- Share of AV VMT in regional total increased from 24.8% to 24.6% (Figure 79).

The results suggest that ABM2+ is sensitive to AV AOC. As the AV AOC scaler decreased, both regional VMT and AV VMT increased slightly. However, the AV AOC scaler had limited impact on mode shares. When the AV AOC scaler increased, the opposite patterns were observed.

Figure 77. VMT Change from Baseline: AV Auto Operating Cost Scaler Tests (Tests 45 & 46)

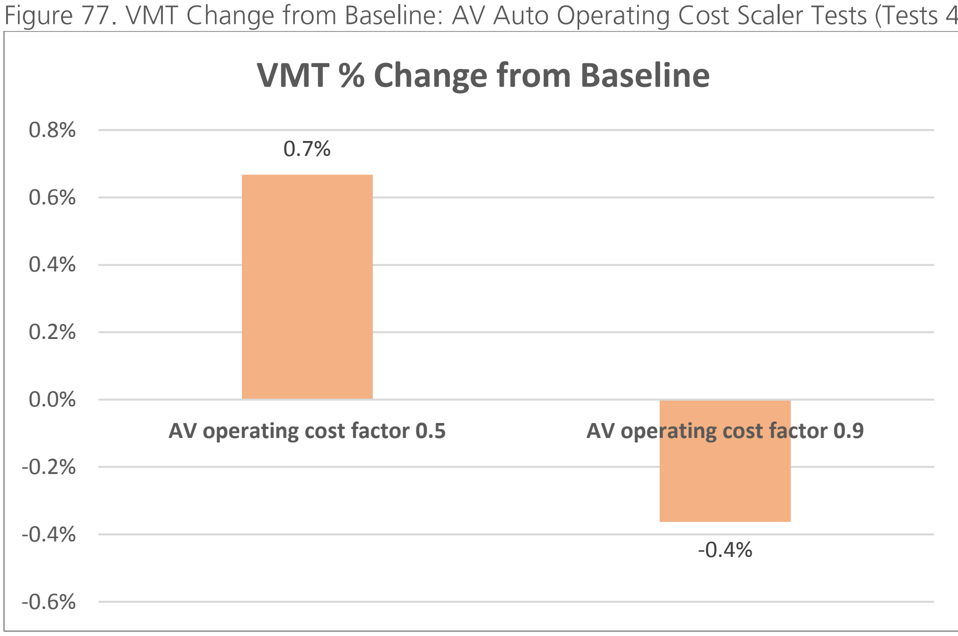


Figure 78. Mode Share of Person Trips: AV Auto Operating Cost Scaler Tests (Tests 45 & 46)

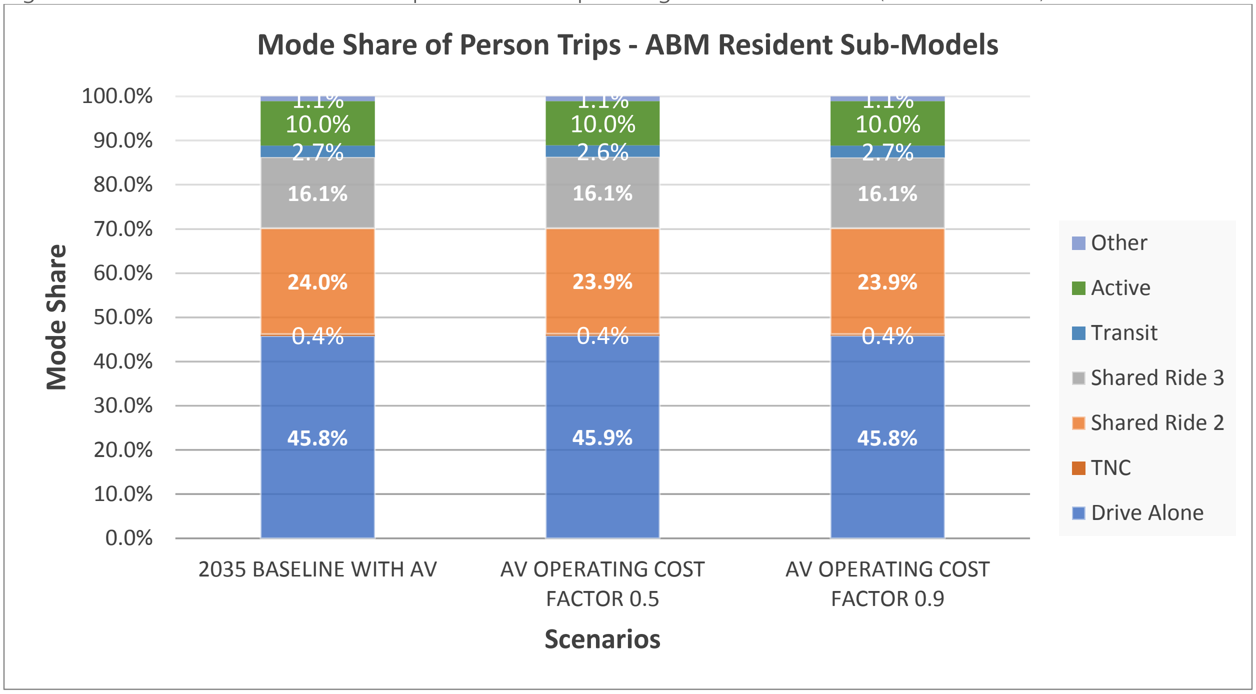
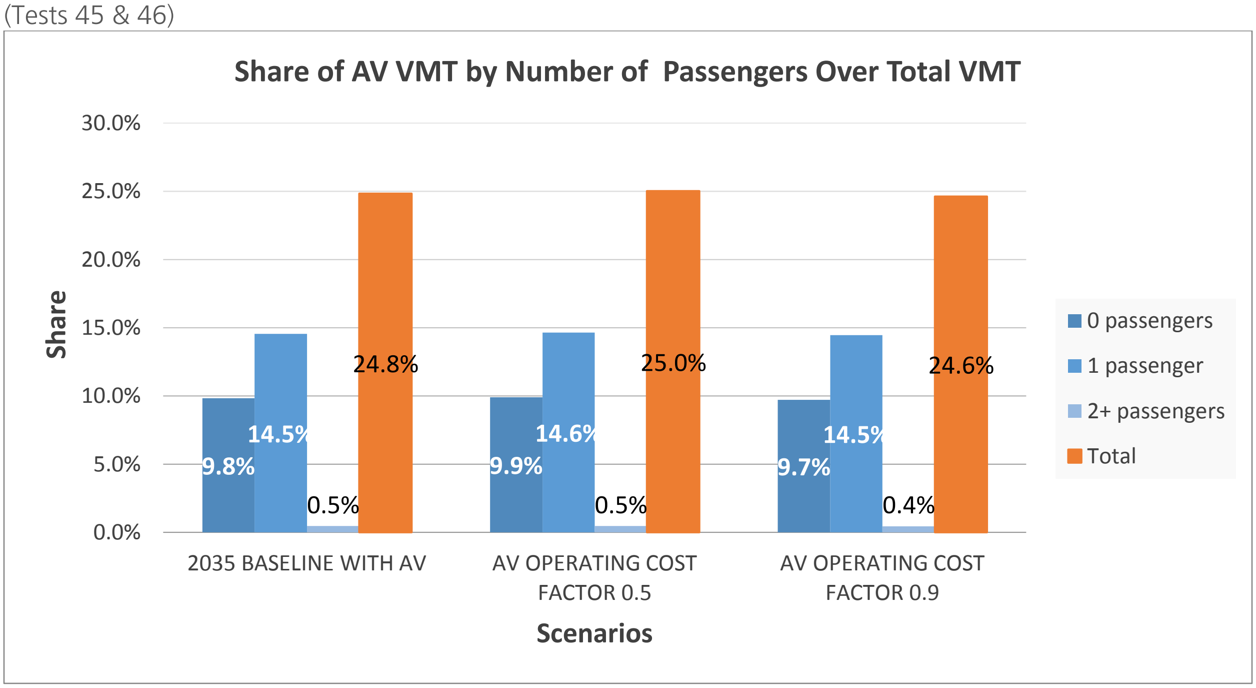


Figure 79. Share of AV VMT by Number of Passengers Over Total VMT: AV Auto Operating Cost Scaler Tests (Tests 45 & 46)



AV Terminal Time Tests (Tests 47 & 48)

In comparison with the 2035 baseline with a default AV terminal time factor of 0.65, a 0.5 AV terminal time factor test had the following results:

- Overall regional VMT increased slightly by 0.1% (Figure 80)
- Insignificant mode share changes (Figure 81)

In comparison with the 2035 baseline with a default AV terminal time factor of 0.65, a larger 0.8 AV terminal time factor test had the following results:

- Insignificant VMT change (Figure 80)
- Insignificant mode share changes (Figure 81)

The results suggest that the model had limited sensitivity to the AV terminal time scaler. When the AV terminal time changed in either direction, VMT and mode share changes were insignificant.

Figure 80. VMT Change from Baseline: AV Terminal Time Tests (Tests 47 & 48)

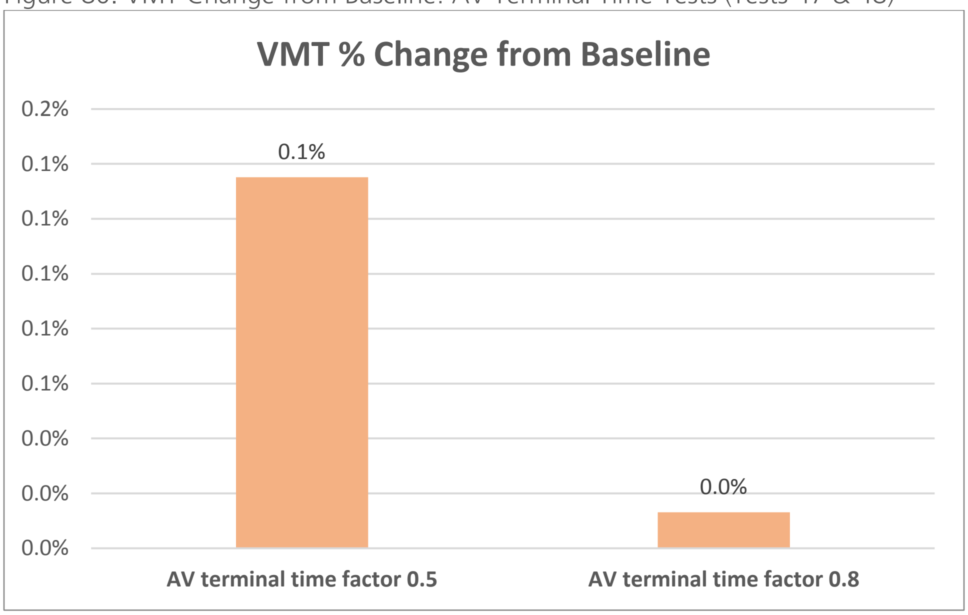
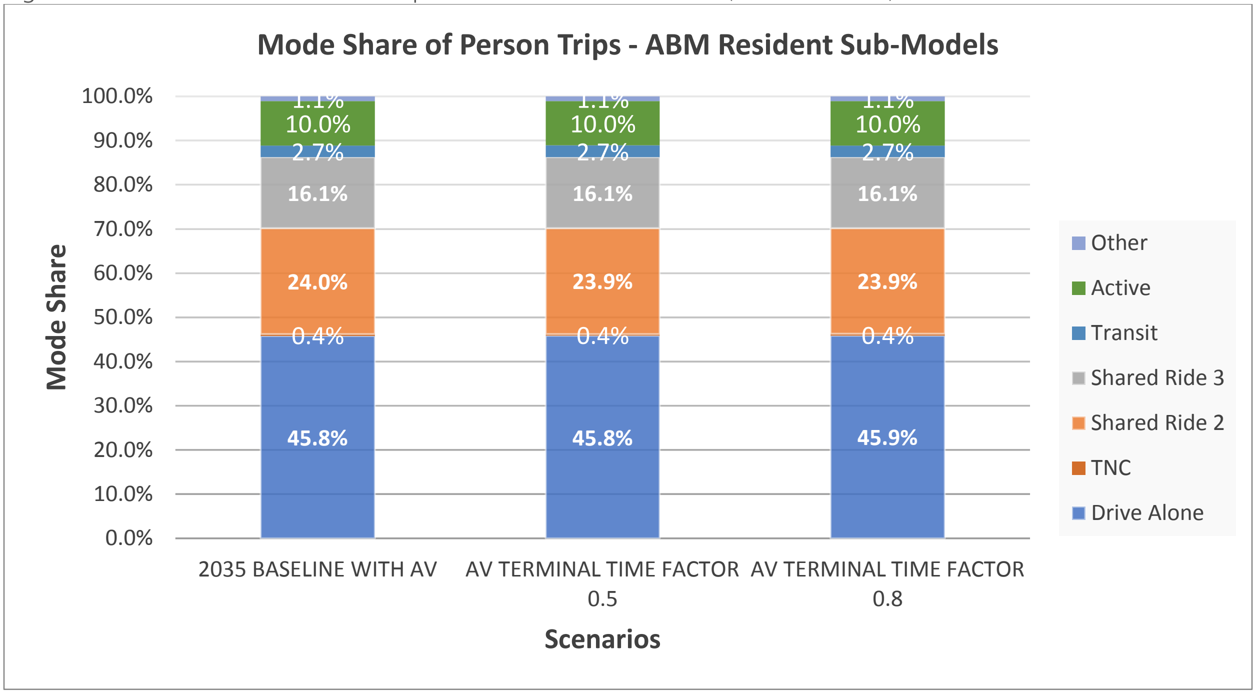


Figure 81. Mode Share of Person Trips: AV Terminal Time Tests (Tests 47 & 48)



TNC Optimization Tests (Tests 49 & 50)

In comparison with the 2035 baseline without AVs, the TNC optimization scenario had the following results:

- VMT increased slightly by 0.3% (Figure 82)
- Mode share for all models (Figure 84):
  - Drive alone decreased from 45.3% to 45.0%.
  - TNC increased from 0.9% to 1.9%.
  - Transit decreased from 2.6% to 2.5%.
  - Active modes (walk, bike, and micromobility) decreased from 9.7% to 9.6%.
- Transit boarding decreased by 2.2% (Figure 83)
- Share of TNC VMT in regional total increased from 1.1% to 1.9% (Figure 85).

In comparison with the 2035 baseline without AVs, the transit TNC optimization scenario had the following results:

- Insignificant VMT change (Figure 82).
- Insignificant mode share changes (Figure 84).
- Transit boarding increased slightly by 0.2% (Figure 83).

The results suggest that the model was sensitive to the TNC optimization scenario when all TNC were given 30-minute benefits. While TNC mode share increased significantly, auto, transit and active mode shares all decreased, indicating competition between TNC and all other modes.

On the other hand, the results suggest that the model had limited sensitivity to the TNC transit optimization scenario when only TNC transit were given 30-minute benefits. The lack of sensitivity could be explained by the very small TNC transit mode share (roughly 0.01%). Regardless of how much benefit was given to TNC transit, with such a small mode share, the impact of TNC transit on model results was insignificant.

Figure 82. VMT Change from Baseline: TNC Optimization Tests (Tests 49 & 50)

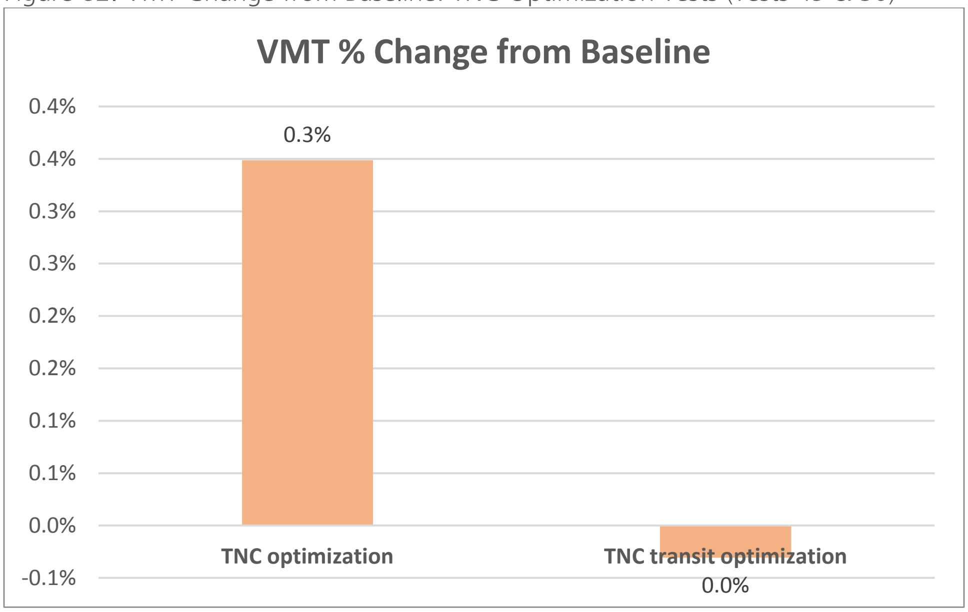


Figure 83. Transit Boarding Change from Baseline: TNC Optimization Tests (Tests 49 & 50)

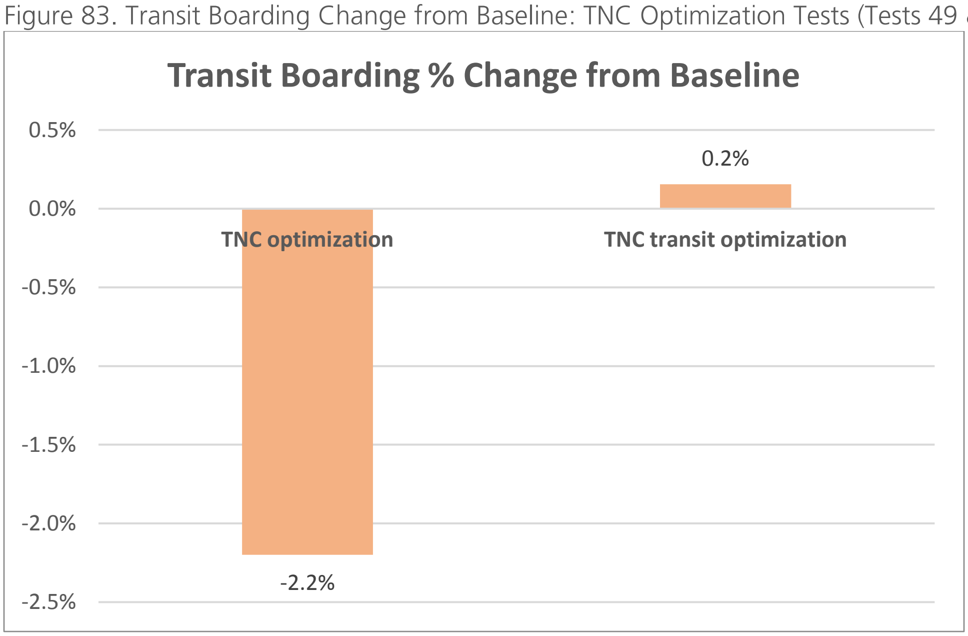


Figure 84. Mode Share of Person Trips: TNC Optimization Tests (Tests 49 & 50)

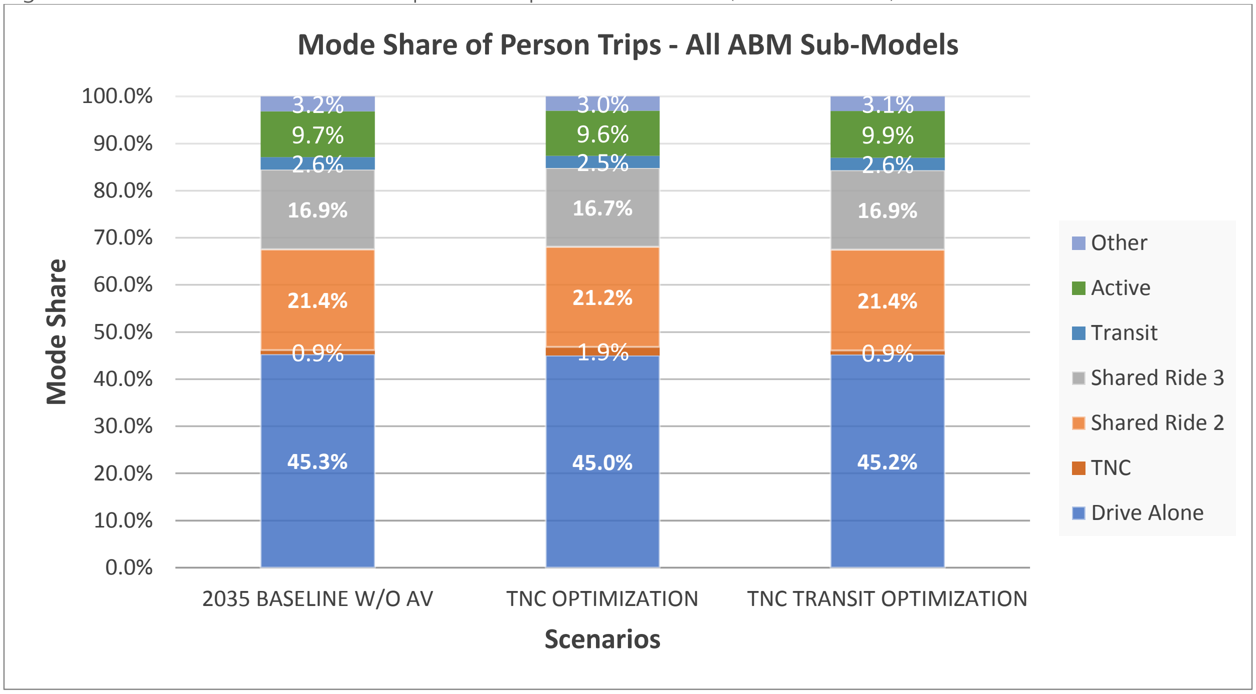
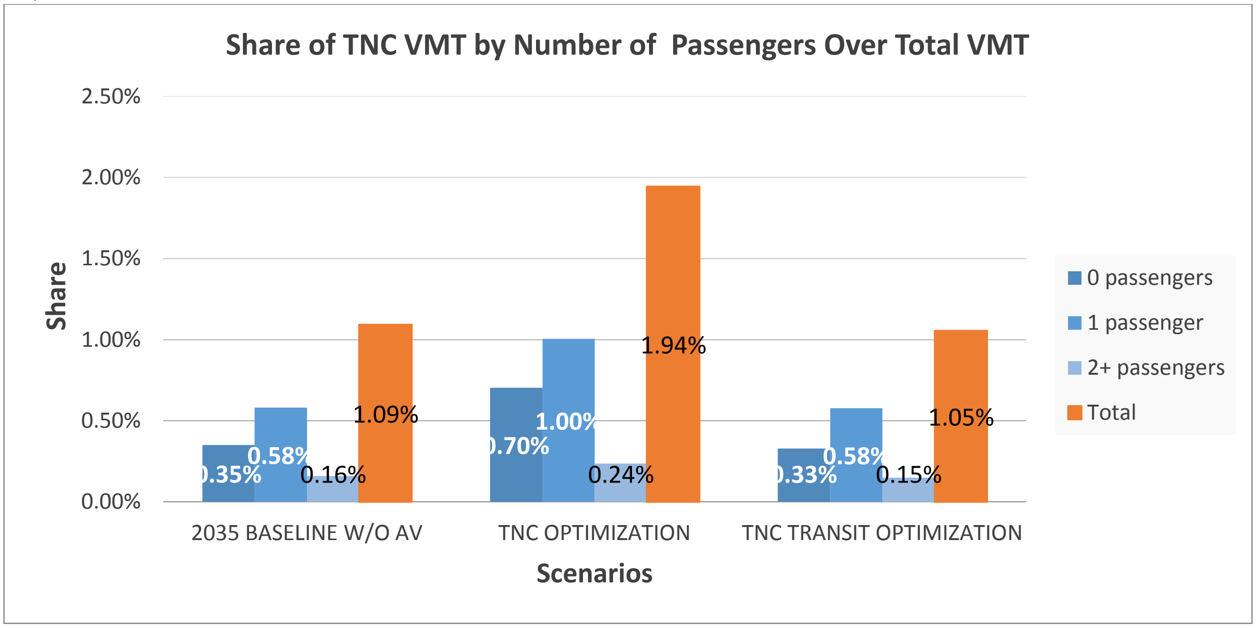


Figure 85. Share of TNC VMT by Number of Passengers Over Total VMT: TNC Optimization Tests (Tests 49 & 50)



AV and TNC Combo Tests (Tests 51-53)

In comparison with the 2035 baseline with 20% AV, the 20% AV with 30 minutes TNC benefit test had the following results:

- VMT increased slightly by 0.1% (Figure 86)
- Mode share of all models (Figure 87):
  - Drive alone decreased from 45.3% to 45.1%.
  - SR3 decreased from 16.7% to 16.4%.
  - TNC increased from 0.8% to 1.7%.
  - Active modes (walk, bike, and micromobility) decreased from 9.7% to 9.6%.
- Share of TNC VMT in regional total increased from 0.9% to 1.6% (Figure 89).
- Overall trip distance change was insignificant; Regular TNC trip distance decreased from 7.7 miles to 6.3 miles; Pooled TNC trips decreased from 6.0 miles to 5.4 miles (Table 15).

In comparison with the 2035 baseline with 20% AV, the 20% AV with 7.5 minutes TNC benefit test had the following results:

- VMT change was insignificant (Figure 86)
- Mode share changes were insignificant, except TNC mode share increased from 0.8% to 1.0% (Figure 87).
- Share of TNC VMT in regional total change was insignificant (Figure 89).
- Overall trip distance change was insignificant; Regular TNC trip distance decreased from 7.7 miles to 7.5 miles; Pooled TNC trips decreased from 6.0 miles to 5.8 miles (Table 15).

In comparison with the 2035 baseline with 20% AV, the 50% AV with 15 minutes TNC benefit test had the following results:

- VMT increased by nearly 9% (Figure 86)
- Mode share of all models (Figure 87):
  - Drive alone decreased from 45.3% to 44.6%.
  - SR2 increased from 21.7% to 21.9%.
  - SR3 decreased from 16.7% to 15.5%.
  - Transit increased from 2.7% to 3.2%.
  - TNC increased from 0.8% to 1.1%.
  - Active modes (walk, bike, and micromobility) increased from 9.7% to 10.3%.
- Transit boarding increased by 17% (Figure 88)
- Share of TNC VMT in regional total increased from 0.9% to 1.0% (Figure 89).
- Overall trip distance change was insignificant; Regular TNC trip distance decreased from 7.7 miles to 7.0 miles; Pooled TNC trips decreased from 6.0 miles to 4.7 miles (Table 15).

The results suggest that the model is sensitive to the combined AV penetration rate and TNC benefit changes. Regional VMT increased significantly in the 50% AV scenario but not in the 7.5

minutes and 30 minutes TNC benefit scenarios (both with 20% AV), indicating that the key driver of VMT is AV penetration rate not TNC benefit. The results also indicate ABM2+ is sensitive to TNC benefits; with 30 minutes TNC benefits, the TNC mode share increased significantly from 0.8% to 1.7%.

Figure 86. VMT Change from Baseline: AV and TNC Combo Tests (Tests 51-53)

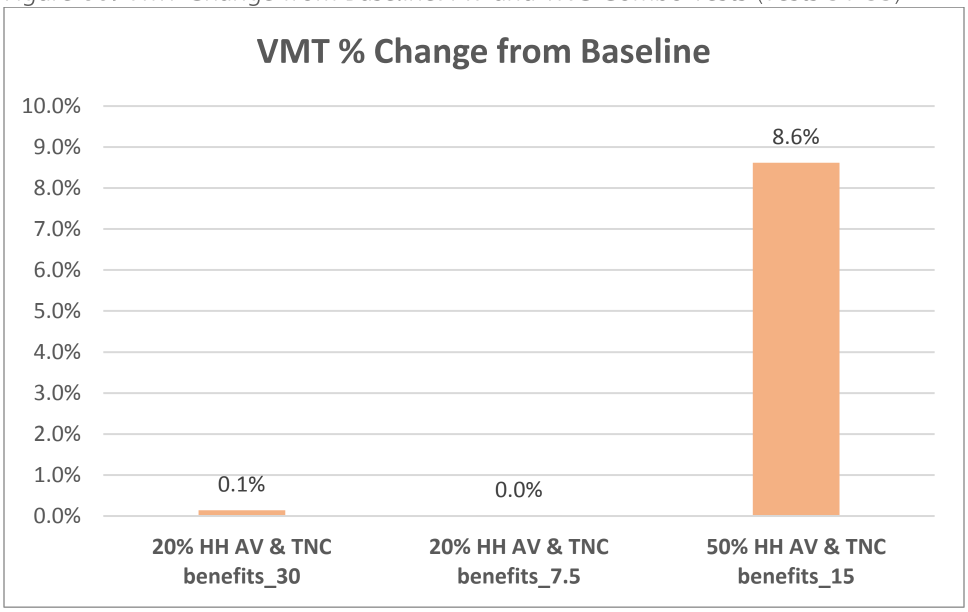


Figure 87. Mode Share of Person Trips: AV and TNC Combo Tests (Tests 51-53)

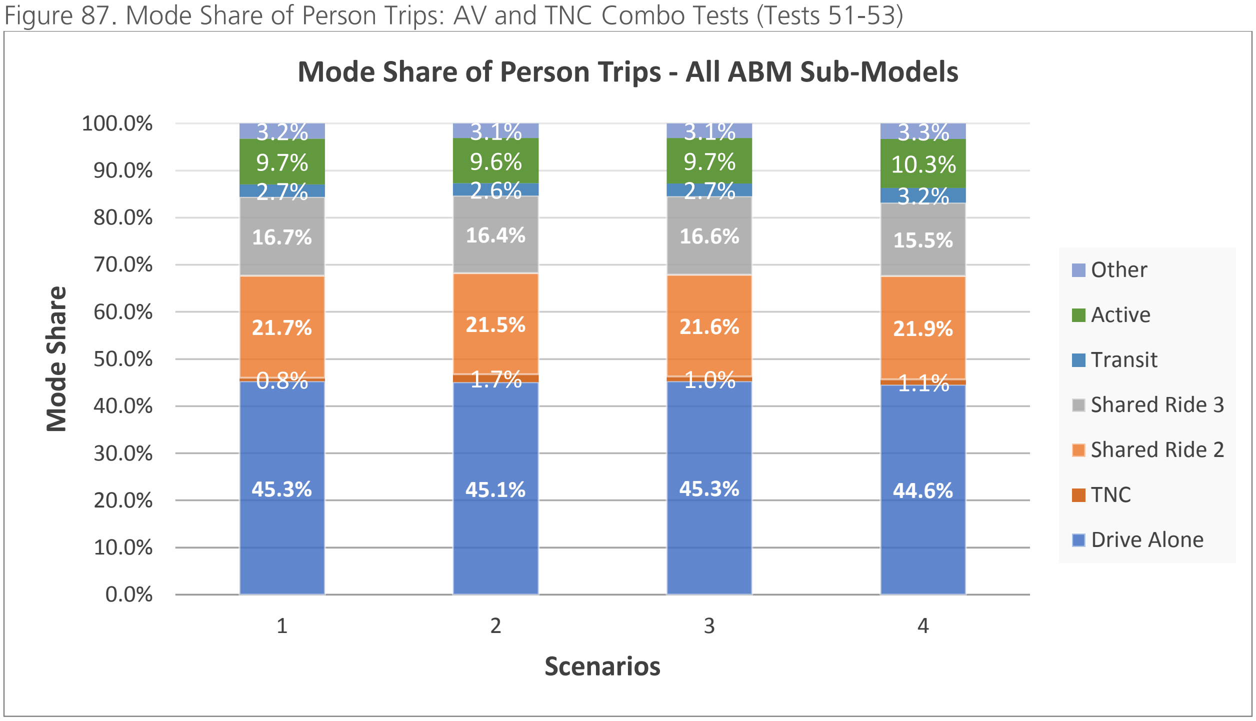


Figure 88. Transit Boarding Change from Baseline: AV and TNC Combo Tests (Tests 51-53)

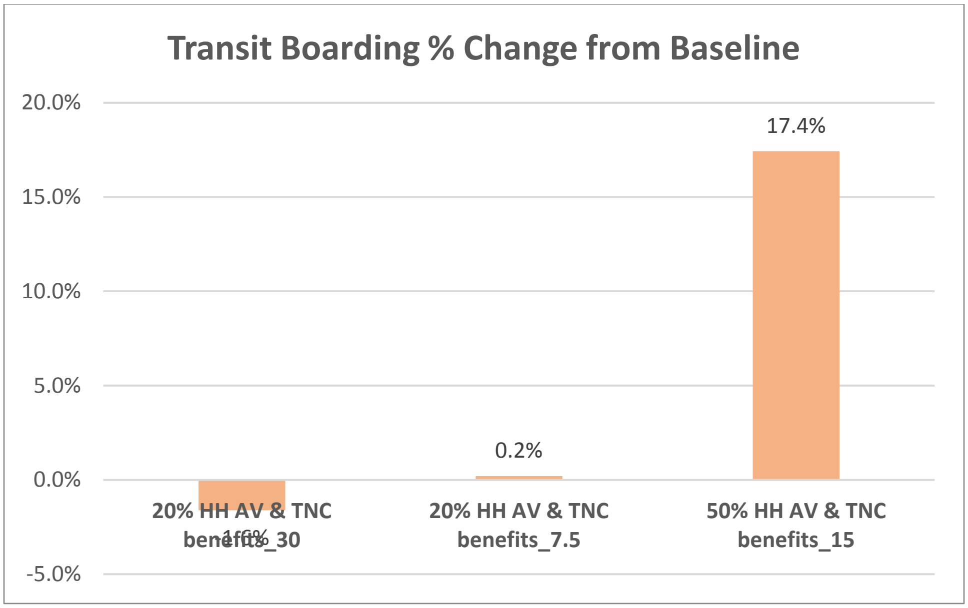


Figure 89. Share of TNC VMT by Number of Passengers Over: AV and TNC Combo Tests (Tests 51-53)

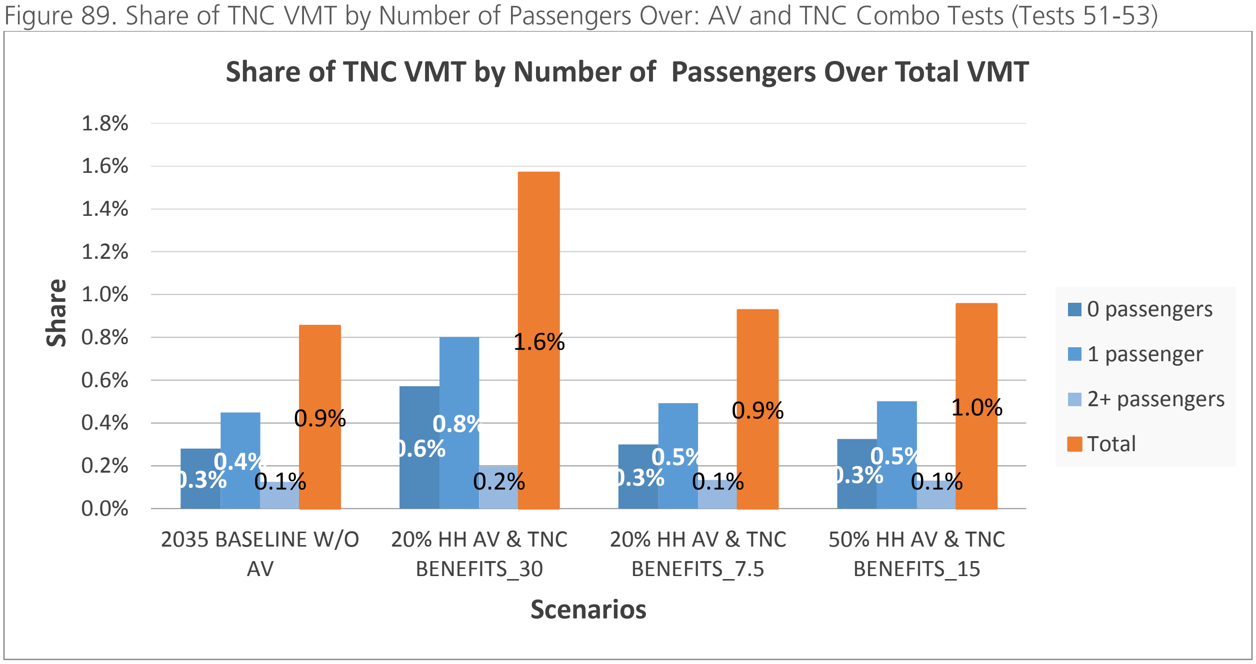


Table 15. Person Trip Distance by Mode: AV Penetration Rate Tests (Tests 41 & 42)

description	DA	SR2	SR3	TNC	Pooled TNC	Walk	Bike	Transit	Total
2035 baseline with AV	8.0	7.2	8.3	7.7	6.0	0.8	3.3	9.1	7.3
20% HH AV & TNC benefits_30	8.0	7.2	8.3	6.3	5.4	0.8	3.3	9.2	7.3
20% HH AV & TNC benefits_7.5	8.0	7.2	8.3	7.5	5.8	0.8	3.3	9.1	7.3
50% HH AV & TNC benefits_15	8.0	7.3	8.6	7.0	4.7	0.8	3.4	8.9	7.3

Telework

Telework Rate (Tests 54, 55 & 56)

In May 2020, amid the COVID19 pandemic, staff conducted telework sensitivity tests to evaluate the responsiveness of ABM2+ to various telework scenarios. In ABM2+, there are two types of telework, permanent and occasional telework. Permanent telework is modeled in the work from home model, while the impact of occasional telework is reflected in daily activity pattern, telework frequency, non-mandatory tour frequency, and non-mandatory tour stop frequency models. Since telework modeling in ABM2+ is based on the 2016/2017 household travel behavior survey, ABM2+ telework results represent the pre-COVID19 'normal' condition. Neither temporary COVID19 shelter in place nor post-COVID19 new 'normal' conditions are reflected in ABM2+ telework modeling.

Staff tested three 2035 telework alternatives (Table 16): existing pattern (business as usual) scenario, moderate growth scenario, and maximum growth scenario.

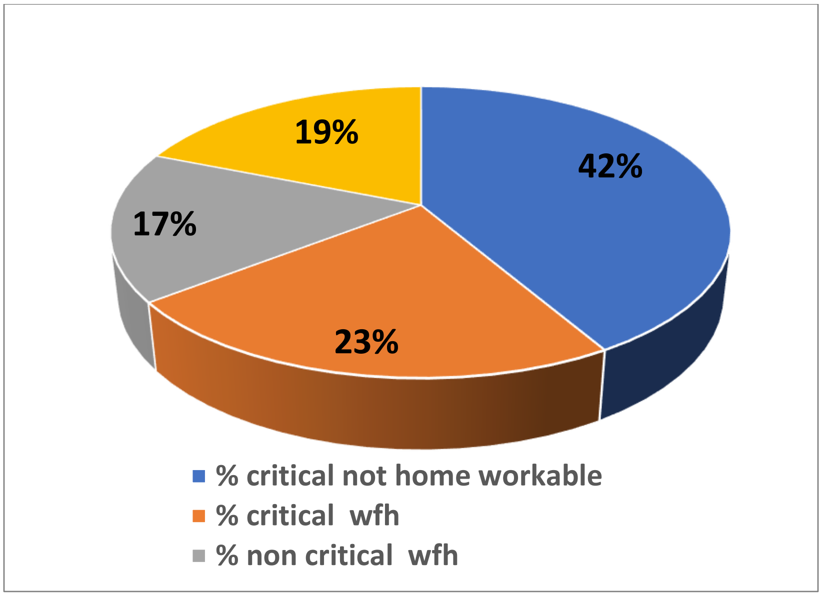
Table 16. 2035 telework alternatives

CARB Category	Description	Test ID	Scenario	Year
Telework	Existing pattern	54	Existing telework rates	2035
	Moderate growth pattern	55	Moderate telework rate growth	2035
	Maximum growth pattern	56	Maximum telework rate growth	2035

In each of the three scenarios, occasional telework is further broken down to 1 day a week, 2-3 days a week, and 4+ days a week categories using the observed proportions from the 2016/2017 household survey.

The maximum telework scenario is constructed using data from an analysis by a SANDAG economist. In the analysis, workers in San Diego are categorized into four categories (below). Combining both critical and non-critical workers who can work from home, roughly 40% of San Diego's workforce are telework-able, while the other 60% are not. In test 56, the combined permanent and occasional telework rate is 38%, roughly representing a maximum possible telework scenario.

- Critical workers but not home workable (42%)
- Critical workers who can work from home (23%)
- Non-critical workers but not home workable (19%)
- Non-critical workers who can work from home (17%)



Telework Sensitivity Testing Results

In comparison with the existing telework pattern, the moderate telework growth scenario had the following results:

- Overall trip rate decreased from 4.51 to 4.49 (Figure 90). All categories except teleworking 2-3 days/week decreased (Figure 91).
- Mode shares (Figures 92 & 93):
  - Drive alone decreased from 45.9% to 45.5%.
  - SR2 increased from 23.5% to 23.6%
  - SR3 increased from 16.6% to 16.7%.
  - Walk mode increased from 8.8% to 9.0%
  - Transit decreased from 2.6% to 2.5%
- Auto trip length decreased from 6.1 to 6.0 (Figure 94). Walk trip length decreased from 3.2 to 3.1 (Figure 95).
- Transit boardings decreased by 1.7% (Figure 96)
- VMT decreased by 1.5% (Figure 97). VMT per capita decreased from 24.3 to 23.9 (Figure 98). All Worker VMT telework types decreased (Figure 99).

In comparison with the existing telework pattern, the maximum telework scenario had the following results:

- Trip rate decreased from 4.51 to 4.47 (Figure 90). All telework categories decreased (Figure 91).
- Mode shares (Figures 92 & 93):
  - Drive alone decreased from 45.9% to 43.6%.

- SR2 increased from 23.5% to 24.7%
- SR3 increased from 16.6% to 17.5%.
- Walk mode increased from 8.8% to 9.2%
- Transit decreased from 2.6% to 2.4%

- Auto trip length decreased from 6.1 to 5.8 (Figure 94). Walk trip length decreased from 3.2 to 2.9 (Figure 95).
- Transit boardings decreased by 5.4% (Figure 96)
- VMT decreased by 4.7% (Figure 97). VMT per capita decreased from 24.3 to 23.1 (Figure 98). All Worker VMT telework types decreased (Figure 99).

The results suggest that the model is sensitive to permanent and occasional telework rate changes. When compared with non-teleworkers, teleworkers generally generate fewer and shorter trips, drive alone less while sharериding and walking more, avoid peak-time travel, and have a smaller VMT per capita. Additionally, those who primarily work from home tend to have a higher trip rate, shorter trip distances, and smaller drive alone mode share, rates of peak-time travel, and VMT per capita when compared to occasional teleworkers. In general, as telework rate increases, the regional VMT, transit ridership, and peak-hour congestion all decrease.

Figure 90. Worker Trip Rate: Telework Rate Tests (Tests 54-56)

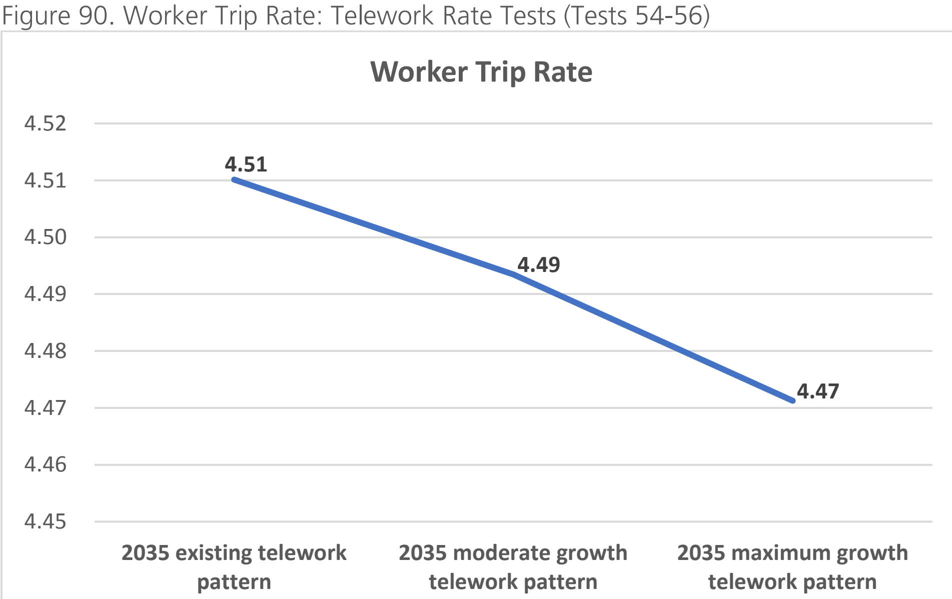


Figure 91. Worker Trip Rate by Telework Type: Telework Rate Tests (Tests 54-56)

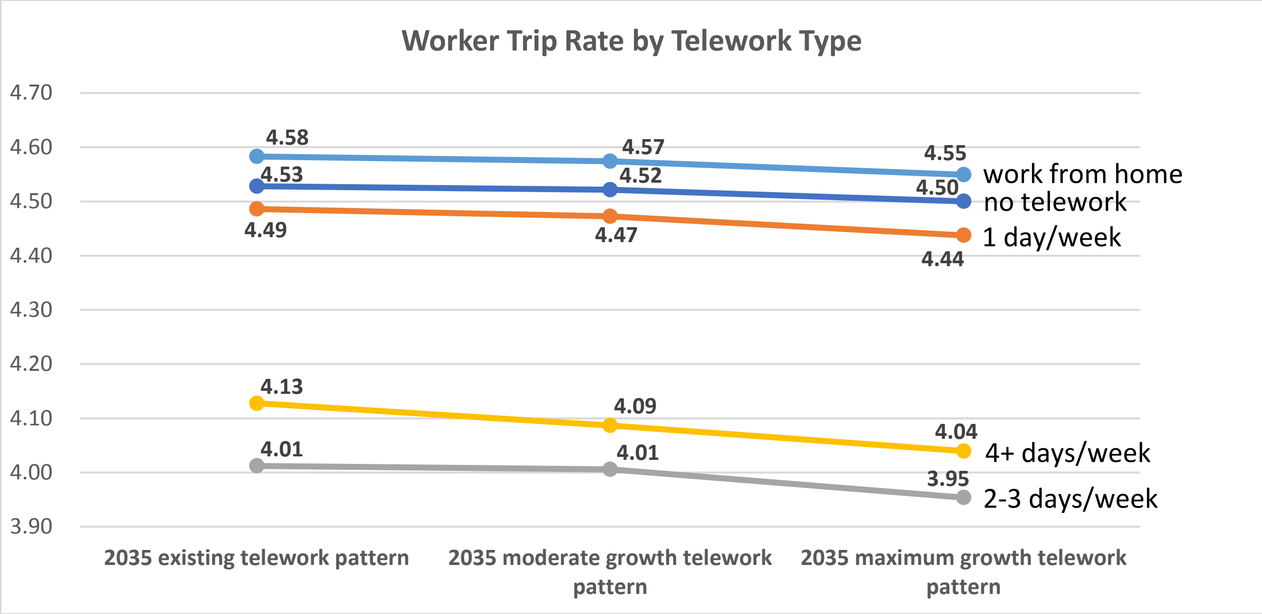


Figure 92. Auto Mode Shares: Telework Rate Tests (Tests 54-56)

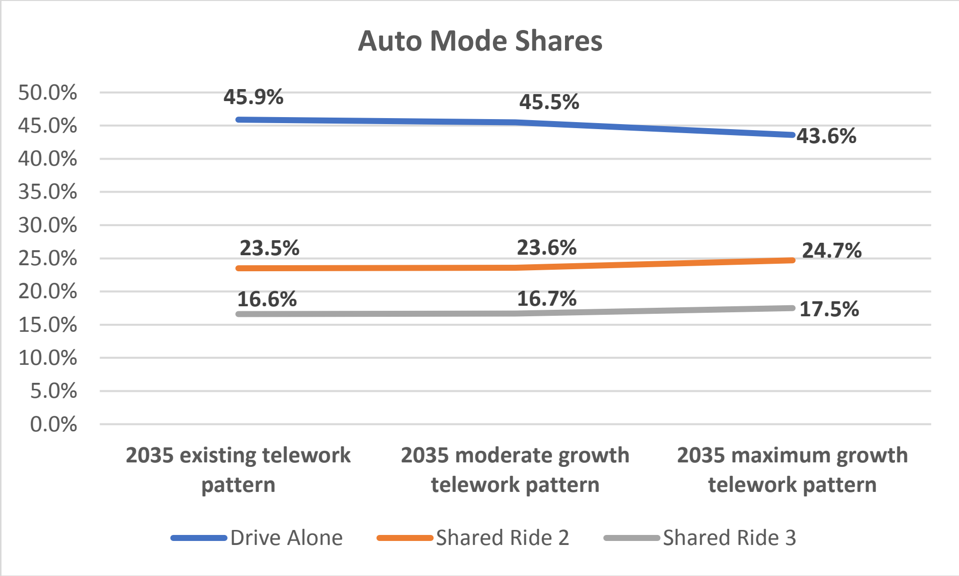


Figure 93. Non-Auto Mode Shares: Telework Rate Tests (Tests 54-56)

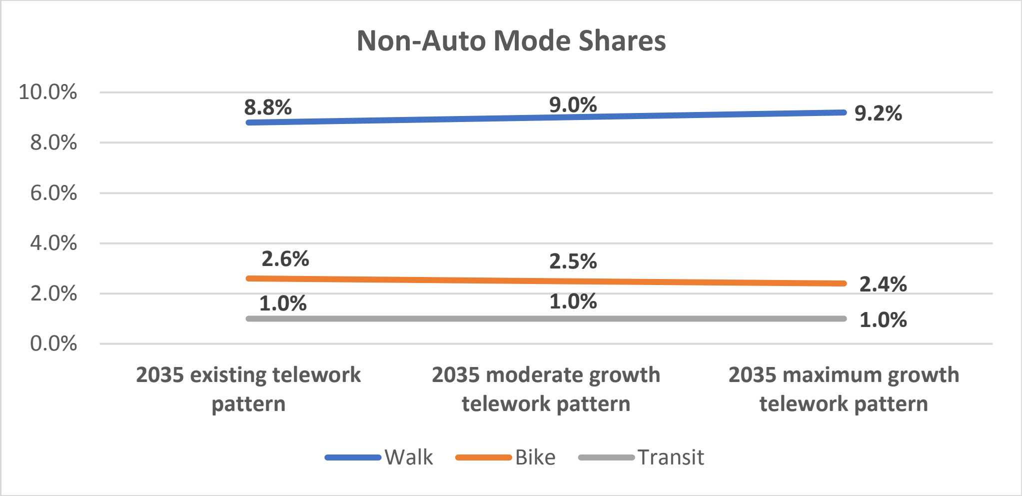


Figure 94. Auto Trip Length: Telework Rate Tests (Tests 54-56)

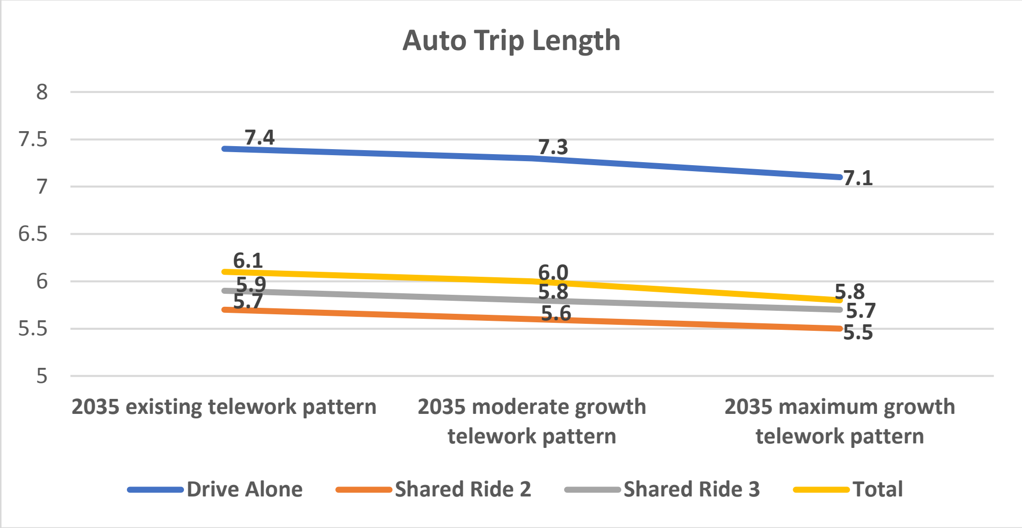


Figure 95. Auto Trip Length: Telework Rate Tests (Tests 54-56)

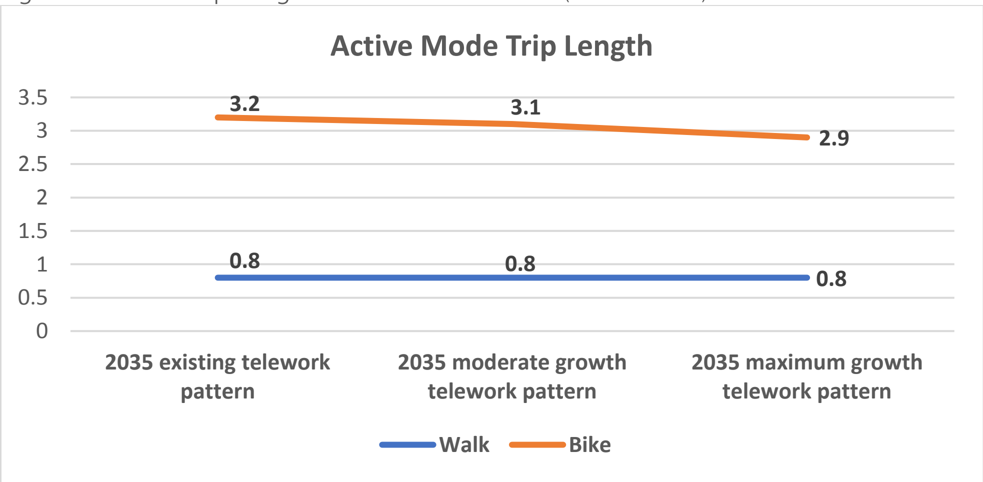


Figure 96. Transit Boarding Change from Baseline: Telework Rate Tests (Tests 54-56)

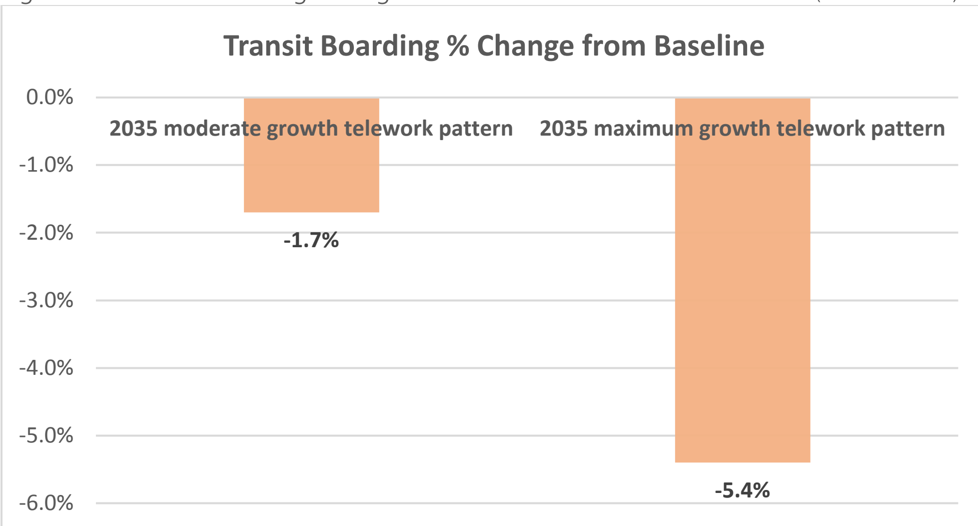


Figure 97. Telework Rate & VMT Reduction: Telework Rate Tests (Tests 54-56)

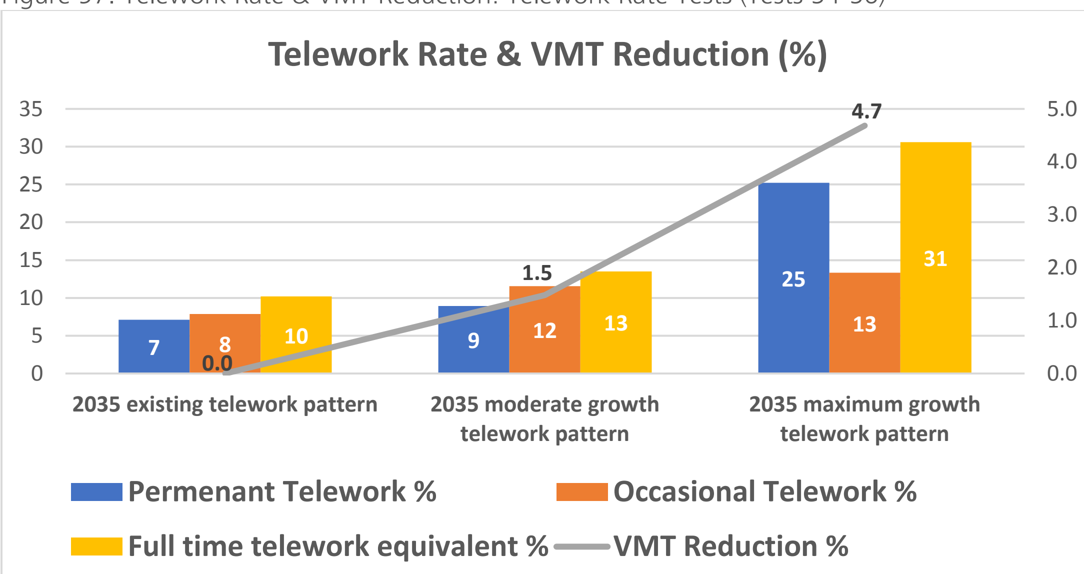


Figure 98. VMT Per Capita: Telework Rate Tests (Tests 54-56)

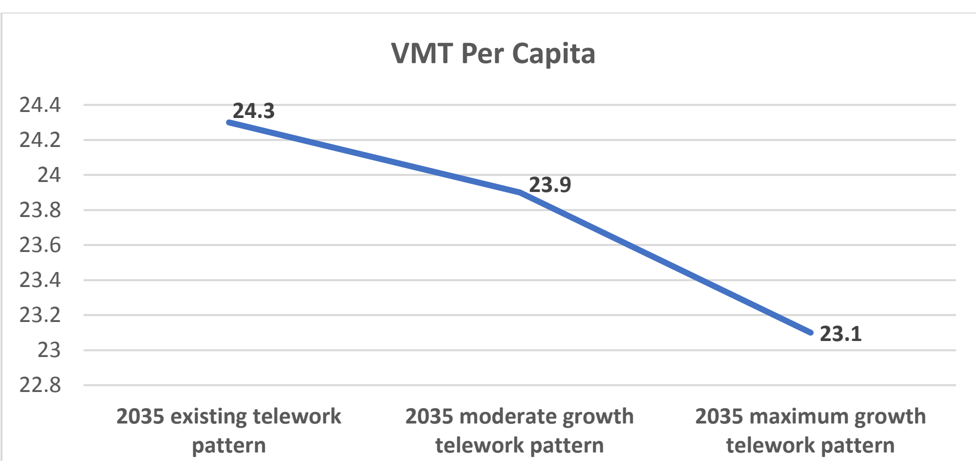
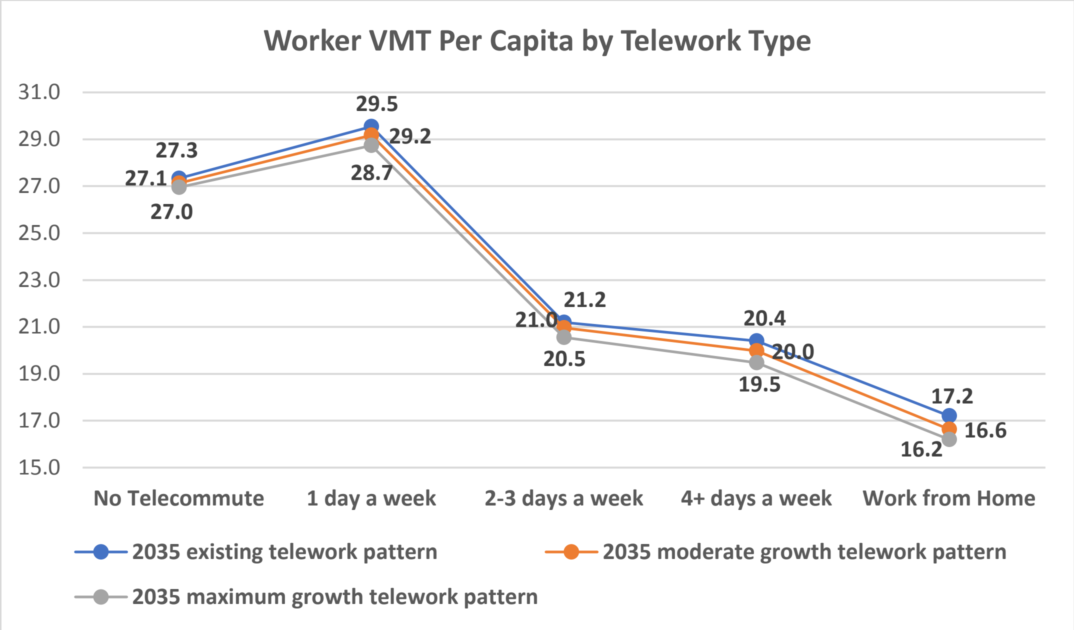


Figure 99. Worker VMT Per Capita by Telework Type: Telework Rate Tests (Tests 54-56)



Appendix C
SANDAG Auto Operating Cost Calculations

Auto Operation Cost Calculator (Draft For Comments Only)

Select MPO	SANDAG
Select Calendar Year	2020

	GASOLINE			DIESEL			ELECTRIC			HYDROGEN			PHEV		
	Data Source	Value		Data Source	Value		Data Source	Value		Data Source	Value		Data Source	Value	
		Default	Custom		Default	Custom		Default	Custom		Default	Custom		Default	Custom
Fuel Cost (dollar/gasoline gallon equivalent)[1]	Custom		3.74	Default	3.34		Default	6.45		Default	14.80			4.95	4.95
Non-fuel Cost (cents per mile)[2]	Custom		7.91	Default	7.91		Default	6.55		Default	7.91			6.99	6.99
VMT	Default	88,715,887		Default	1,020,620		Default	496,651		Default	60,891		Default	913,087	
Fuel Efficiency (mile/gasoline gallon equivlent)	Gasoline	25.79		Diesel	35.71		Electric	113.93		Hydrogen	74.19		PHEV	56.25	
Auto Operating Cost by Fuel Type (Cents/Mile)	Gasoline	22.43		Diesel	17.27		Electric	12.22		Hydrogen	27.86		PHEV	14.68	

Calendar Year	2020
Auto Operating Cost (Cents/Mile)	22.24

CARB Calculator is using 2017 dollars
SANDAG ABM2+ uses 2010 dollars

CPI Adjusted value → ¢19.3 per mile

Steps:
1. Select MPO and Calender Year from the drop-down list.
2. Select "Default" or "Custom" mode for each parameter from the drop-down list
3. Enter custom value(s) after selecting "Custom" mode for fuel cost, non-fuel cost and VMT

Note:
1- Input as 2017 dollars/cents
2- Include maintenace, repair and tire cost

Auto Operation Cost Calculator (Draft For Comments Only)

Select MPO	SANDAG
Select Calendar Year	2025

	GASOLINE			DIESEL			ELECTRIC			HYDROGEN			PHEV		
	Data Source	Value		Data Source	Value		Data Source	Value		Data Source	Value		Data Source	Value	
		Default	Custom		Default	Custom		Default	Custom		Default	Custom		Default	Custom
Fuel Cost (dollar/gasoline gallon equivalent)[1]	Custom		4.17	Default	3.78		Default	6.57		Default	12.56			5.40	5.40
Non-fuel Cost (cents per mile) [2]	Custom		7.91	Default	7.91		Default	6.55		Default	7.91			6.99	6.99
VMT	Default	90,162,637		Default	1,183,323		Default	1,051,622		Default	381,376		Default	2,187,369	
Fuel Efficiency (mile/gasoline gallon equivlent)	Gasoline	29.97		Diesel	40.65		Electric	121.06		Hydrogen	79.32		PHEV	65.44	
Auto Operating Cost by Fuel Type (Cents/Mile)	Gasoline	21.81		Diesel	17.20		Electric	11.98		Hydrogen	23.75		PHEV	14.36	

Calendar Year	2025
Auto Operating Cost (Cents/Mile)	21.48

CARB Calculator is using 2017 dollars
SANDAG ABM2+ uses 2010 dollars

CPI Adjusted value → ¢18.6 per mile

Steps:
1. Select MPO and Calender Year from the drop-down list.
2. Select "Default" or "Custom" mode for each parameter from the drop-down list
3. Enter custom value(s) after selecting "Custom" mode for fuel cost, non-fuel cost and VMT

Note:
1- Input as 2017 dollars/cents
2- Include maintenace, repair and tire cost

Auto Operation Cost Calculator (Draft For Comments Only)

Select MPO	SANDAG
Select Calendar Year	2035

	GASOLINE			DIESEL			ELECTRIC			HYDROGEN			PHEV		
	Data Source	Value		Data Source	Value		Data Source	Value		Data Source	Value		Data Source	Value	
		Default	Custom		Default	Custom		Default	Custom		Default	Custom		Default	Custom
Fuel Cost (dollar/gasoline gallon equivalent)[1]	Custom		4.65	Default	4.16		Default	6.61		Default	10.32			5.75	5.75
Non-fuel Cost (cents per mile) [2]	Custom		7.90	Default	7.91		Default	6.55		Default	7.91			6.99	6.99
VMT	Default	93,031,627		Default	1,312,533		Default	1,788,700		Default	945,473		Default	3,685,158	
Fuel Efficiency (mile/gasoline gallon equivlent)	Gasoline	36.82		Diesel	48.32		Electric	135.64		Hydrogen	88.65		PHEV	76.28	
Auto Operating Cost by Fuel Type (Cents/Mile)	Gasoline	20.53		Diesel	16.51		Electric	11.42		Hydrogen	19.55		PHEV	13.89	

Calendar Year	2035
Auto Operating Cost (Cents/Mile)	20.06

CARB Calculator is using 2017 dollars
SANDAG ABM2+ uses 2010 dollars

CPI Adjusted value → ¢17.4 per mile

Steps:
1. Select MPO and Calender Year from the drop-down list.
2. Select "Default" or "Custom" mode for each parameter from the drop-down list
3. Enter custom value(s) after selecting "Custom" mode for fuel cost, non-fuel cost and VMT

Note:
1- Input as 2017 dollars/cents
2- Include maintenace, repair and tire cost

Auto Operation Cost Calculator (Draft For Comments Only)

Select MPO	SANDAG
Select Calendar Year	2050

	GASOLINE			DIESEL			ELECTRIC			HYDROGEN			PHEV		
	Data Source	Value		Data Source	Value		Data Source	Value		Data Source	Value		Data Source	Value	
		Default	Custom		Default	Custom		Default	Custom		Default	Custom		Default	Custom
Fuel Cost (dollar/gasoline gallon equivalent)[1]	Custom		5.01	Default	4.16		Default	6.61		Default	10.32			5.92	5.92
Non-fuel Cost (cents per mile) [2]	Custom		7.91	Default	7.91		Default	6.55		Default	7.91			6.99	6.99
VMT	Default	98,827,162		Default	1,416,540		Default	2,107,994		Default	1,166,734		Default	4,290,741	
Fuel Efficiency (mile/gasoline gallon equivlent)	Gasoline	39.25		Diesel	50.98		Electric	161.18		Hydrogen	107.94		PHEV	82.50	
Auto Operating Cost by Fuel Type (Cents/Mile)	Gasoline	20.67		Diesel	16.06		Electric	10.65		Hydrogen	17.47		PHEV	13.62	

Calendar Year	2050
Auto Operating Cost (Cents/Mile)	20.10

CARB Calculator is using 2017 dollars
SANDAG ABM2+ uses 2010 dollars

CPI Adjusted value → ¢17.4 per mile

Steps:
1. Select MPO and Calender Year from the drop-down list.
2. Select "Default" or "Custom" mode for each parameter from the drop-down list
3. Enter custom value(s) after selecting "Custom" mode for fuel cost, non-fuel cost and VMT

Note:
1- Input as 2017 dollars/cents
2- Include maintenace, repair and tire cost

CPI Usage in ABM2+

CPI values are used to adjust costs from recent years to a 2010-equivalent year cost as based on the ABM2+ model. BLS CPI is used for San Diego based on the items specified below.

Source:
https://data.bls.gov/pdq/SurveyOutputServlet?data_tool=dropmap&series_id=CUURS49ESA0,CUUSS49ESA0

CPI for All Urban Consumers (CPI-U)
Series Id: CUURS49ESA0,CUUSS49ESA0
Not Seasonally Adjusted
Series Title: All items in San Diego-Carlsbad, CA, all urban consumers, not seasonally adjusted
Area: San Diego-Carlsbad, CA
Item: All items
Base Period: 1982-84=100

CPI Data:

Year	CPI	Factor
2010	245.464	1.00000
2011	252.91	1.03033
2012	256.961	1.04684
2013	260.317	1.06051
2014	265.145	1.08018
2015	269.436	1.09766
2016	274.732	1.11924
2017	283.012	1.15297
2018	292.547	1.19181
2019	299.433	1.21987
2020*	302.589	1.23272

**March 2020*
Data extracted on: June 3, 2020 (1:16:34 PM ET)

How to use:
If you have a 2018-based cost, for example a $2.50 transit fare, divide the $2.50 by the 2018 CPI factor 1.19181 to get a 2010-equivalent year cost of $2.10.

Appendix D
Ascent Environmental
Electric Vehicle Calculations

Memo

600 B Street, Suite 300
San Diego, CA 92101
916.444.7301

Date: February 7, 2019

To: Susan Freedman and Allison Wood, San Diego Association of Governments

From: Brenda Hom and Honey Walters

Subject: **SANDAG Electric Vehicle Off-Model Calculator Methodology for SCS Compliance – 2019 San Diego Forward: The Regional Plan – February 2019 Revision**

The San Diego Association of Governments (SANDAG) tasked Ascent with preparing a carbon dioxide (CO_2) emissions calculator for regional electric vehicle (EV) programs that would be considered "off-model" greenhouse gas (GHG) reduction strategies in San Diego Forward: The 2019-2050 Regional Plan (2019 Regional Plan). The 2019 Regional Plan is SANDAG's third Regional Transportation Plan and Sustainable Communities Strategy (RTP/SCS) pursuant to Senate Bill (SB) 375.

SB 375, signed into law in 2008, aligns regional transportation planning efforts and land use and housing allocation with overall State GHG reduction goals. Assembly Bill (AB) 32 (2006) and Executive Order (EO) S-3-05 (2005) established targets for the State to reduce its GHG emissions to 1990 levels by 2020 and 80 percent below 1990 levels by 2050. SB 32, signed in 2016, set an intermediate target of reducing statewide emissions to 40 percent below 1990 levels by 2030. Given that transportation accounts for nearly 40 percent of the state's emissions, the efforts in SB 375 to reduce regional transportation-related emissions are key to supporting the State's GHG reductions goals. (California Air Resources Board [CARB] 2017, 2018a).

SB 375 requires metropolitan planning organizations (MPOs), such as SANDAG, to adopt an SCS or Alternative Planning Strategy, showing land use allocation in each MPO's Regional Transportation Plan. The California Air Resources Board (CARB), in consultation with the MPOs, provides each affected region with per capita reduction targets for GHGs emitted by passenger cars and light trucks in their respective regions for 2020 and 2035. SANDAG serves as the MPO for San Diego county and adopted San Diego Forward: The 2015 Regional Plan in October 2015. In March 2018, CARB adopted the Target Update for the SB 375 targets tasking SANDAG to achieve a 15 percent and a 19 percent per capita reduction in CO_2 emissions from 2005 levels by 2020 and 2035, respectively (CARB 2018a).

In order to ensure that the emissions reductions are solely attributed to MPO actions, CARB sets a number of stipulations in its recommended SB 375 SCS GHG reduction methodology (CARB 2011). CARB recommends that MPOs use a post-processed set of vehicle emissions factors in CARB's EMissions FACtor (EMFAC) model that prevent MPOs from taking credit from improving State and federal vehicle efficiency standards to achieve the assigned targets. This stipulation generally leads MPOs to reduce emissions by reducing vehicle miles traveled (VMT) through land use and transportation planning strategies. Although planning efforts may account for the majority of CO_2 emission reductions under SB 375, CARB allows for the inclusion of "off-model" strategies where MPOs can take emissions reductions credit for transportation programs and other activities that are not fully captured in the regional transportation model, such as SANDAG's Activity Based Model (CARB 2011). The "off-model" strategy programs may include transportation demand management (TDM) and EV incentive programs, which are not generally correlated with land use planning. The "off-model" quantification of the emissions reductions from SANDAG's EV incentive programs under the 2019 Regional Plan is the subject of this memorandum.

2019 REGIONAL PLAN EV OFF-MODEL APPROACH

Background and Purpose

EVs will play a significant role in meeting California's climate goals to reduce GHG emissions from transportation, which accounted for 41 percent of the state's emissions in 2016 (CARB 2018b). The Midterm Review of Advanced Clean Cars Program report confirmed that existing vehicle programs and vehicle emission standards will add at least 1 million zero emission vehicles (ZEVs) on the state's roads and highways by 2025. In the report, CARB also recommended that California make a major push to develop new post-2025 standards while working with automakers, federal regulators and partner states to further develop the market for electric cars. CARB projects that the ZEV market will see more than 20 new electric and plug-in model introductions with greater driving range at mass-market prices and more choices of body styles, brands, and consumer utility in the next few years (CARB 2017a).

In planning for a cleaner statewide vehicle fleet after 2025, EO B-48-18, signed by Governor Brown in January 2018, directs all State entities to work with the private sector to have at least 5 million ZEVs on the road by 2030, as well as install 200 hydrogen fueling stations and 250,000 electric vehicle charging stations by 2025. It specifies that 10,000 of the electric vehicle charging stations should be direct current (DC) fast chargers. Therefore, the population of ZEVs will likely grow at a faster pace than current adoption rates based on CARB's analysis and the direction in EOs. The state and individual regions within the state can significantly exceed the projected number of ZEVs in EMFAC with the successful blend and implementation of regulations, incentives, infrastructure, public-private partnerships, and education and outreach campaigns (International Council on Clean Transportation 2016). The analysis presented in this memorandum provides the GHG emission reductions from the increased displacement of conventional gasoline vehicles with EVs in the SANDAG region, based on proposed EV incentive programs under the 2019 Regional Plan.

In preparation for development of the EV off-model calculator, Ascent reviewed methods used by other MPOs in California, including the Association of Bay Area Governments (ABAG) and Metropolitan Transportation Commission (MTC), Southern California Association of Governments (SCAG), and Sacramento Area Council of Governments (SACOG). In 2013, MTC was one of the first MPOs to develop an EV off-model methodology that accounted for specific EV incentive programs (CARB 2014). MTC used the same approach again in 2017 for Plan Bay Area 2040 (MTC 2017). SCAG's 2016 RTP/SCS adopted MTC's EV methodology to develop their off-model calculations (SCAG 2015). SACOG used the difference in EV market penetration forecasts between two versions of EMFAC (EMFAC2011 and EMFAC2014) to calculate EV off-model reductions relative to EMFAC2011 (SACOG 2015).

The EV programs considered by SANDAG for the 2019 Regional Plan would be most similar to MTC's approach, which quantified CO_2 reductions from a regional EV charger program and a vehicle incentive program. The regional charger program would increase the percentage of electric vehicle miles travelled (eVMT) in the region by increasing the use of battery electric vehicles (BEV) and extending the electric range of plug-in hybrid electric vehicles (PHEV) through the addition of public, workplace, and Direct Current (DC) Fast chargers. The vehicle incentive program would encourage faster turnover of gasoline passenger vehicles to BEVs and PHEVs through rebates relative to default vehicle populations based on EMFAC PEV growth rates and existing vehicle populations. Similar to MTC, SANDAG is considering a Regional EV Charger Program (RECP) and Vehicle Incentive Program (VIP) as part of 2019 Regional Plan to increase the share of eVMT and plug-in electric vehicle (PEV) population in the region.

In reviewing MTC's approach and recent EV studies released by governmental and non-governmental research groups, Ascent found that a number of assumptions used in prior calculators could be expanded upon and better substantiated. Recent EV research includes new charging infrastructure studies specific to California and the SANDAG region, as listed in the bulleted section below. Thus, Ascent updated MTC's approach to include these studies to allow for further variability and substantiation of the assumptions and data used in the calculations. The resulting calculator replaces the EV off-model methodology used in San Diego Forward: The 2015 Regional Plan.

It should be noted that PHEVs and BEVs are herein referred together as PEVs. PEVs and hydrogen fuel cell electric vehicles are together referred to as ZEVs.

The purpose of this EV off-model calculator is to estimate the CO_2 reductions and costs associated with implementation of SANDAG's proposed RECP and VIP. The estimated reductions would contribute towards meeting SB 375 regional CO_2 reduction targets for 2020 and 2035, updated by CARB in March 2018 (CARB 2018a). This calculator expands upon MTC's EV off-model methodology and applies a similar methodology to calculate emission reductions from SANDAG's proposed version of the RECP and VIP. MTC's approach was first developed as part of Plan Bay Area, MTC's 2013 Metropolitan Transportation Plan and Sustainable Communities Strategy (MTP/SCS). At the time MTC's MTP/SCS was being developed, data and studies related to EV charging, travel, and market behavior were limited because PEVs had only been mass produced for about three years in the U.S., starting with the 2010 Nissan Leaf. SANDAG's EV off-model calculator for 2019 Regional Plan takes advantage of more recent and locally-specific research on the EV market and EV travel and charging behavior. Recent policies, research, studies, and models used to develop the 2019 Regional Plan EV off-model calculator include:

- EO B-16-12 and EO B-48-18, which set a target of 1.5 million ZEVs and 5 million ZEVs in the State by 2025 and 2030, respectively.
- *California Plug-In Electric Vehicle Infrastructure Projections: 2017-2025*, published by the California Energy Commission (CEC) in March 2018, which includes projections of the PEV vehicle fleet mix, charger inventory, and charging demand by county that would achieve the 1.5 million ZEV statewide

target by 2025 established in EO B-16-12 and 250,000 EV chargers statewide, including 10,000 DC Fast Chargers, by 2025 established in EO B-48-18 (CEC 2018);

- *Plug-in Electric Vehicle Market Growth Analysis*, prepared by the Center for Sustainable Energy (CSE) for SANDAG in March 2018, which forecasts PEV sales in the San Diego region based on historical PEV sales trends in the area (CSE 2018);

- Electric Vehicle Infrastructure Projection Tool (EVI-Pro), released in early 2018 by the National Renewable Energy Laboratory's (NREL) and CEC, which estimates the public charging infrastructure needed to support a targeted PEV mix by 2025 for various regions across the state by county. Although this tool is not publicly available at this time, NREL and CEC released a web-based data viewer that summarizes the results of the tool for California, including anticipated charger counts and charger loads. The results of EVI-Pro were used to develop projections in CEC's *California Plug-In Electric Vehicle Infrastructure Projections: 2017-2025* report. (NREL 2018a, NREL 2018b);

- EMFAC2017, released in late 2017 by CARB, which updates the statewide vehicle population, emissions, and VMT forecasts by fuel type, vehicle class, and other factors, accounting for adjusted ZEV forecasts that are generally more conservative than previously assumed in EMFAC 2014 (CARB 2017b). EMFAC2017 also accounts for a minimum regulatory compliance scenario under the ZEV mandate in the State's Advanced Clean Cars Program. This mandate requires vehicle manufacturers to produce an increasing number of ZEVs for model years 2018 through 2025.

With respect to the RECP, SANDAG's EV off-model approach is the first among the MPOs to use CEC's EVI-Pro's region-specific results to account for how changes to the targeted PEV population would affect the recommended number of chargers needed. The EVI-Pro tool, mentioned above, uses real-world travel data from mass market consumers to determine the charging infrastructure needed for residential, workplace, and public areas under a variety of scenarios (Alternative Fuels Data Center [AFDC] 2018). CEC's EVI-Pro runs also accounted for county-level PEV distributions and forecast, charger densities, travel behavior, and land use profiles. Additional higher-level factors included fuel sensitivities and range anxiety. Ascent used EVI-Pro results for San Diego County. EVI-Pro's results are limited to forecast years through 2025, which anticipate a maximum PEV share of 4.3 percent of the light-duty fleet in the SANDAG region. In comparison, under EO B-16-12 and EO B-48-18, the targeted statewide EV population mix is approximately five percent by 2025 and 16 percent by 2030. For modeling purposes, Ascent assumed that the trend in charger-to-PEV ratios and other charging behavior anticipated by EVI-Pro through 2025 for San Diego County would continue through 2050.

Key Methods and Assumptions

SANDAG's EV Off-Model includes the following key methods and assumptions used in the model's calculations. The differences from MTC's approach resulted in a more complex calculator, but also one that accounts for San Diego-specific factors.

- CO_2 reductions from the RECP and VIP were calculated in two key steps. First, the difference was taken between the total eVMT supported by each respective program and the eVMT anticipated in a business-as-usual (BAU) forecast for a given milestone year. In cases where the program's eVMT would result in more eVMT than the BAU forecast, the additional eVMT was attributed to the displacement of the same VMT from equivalent gasoline light-duty vehicles (LDV), which was then translated to CO_2 reductions associated with the reduced gasoline LDV VMT. Second, the resulting CO_2 reductions were scaled to SANDAG-related efforts by applying the ratio of SANDAG incentives to non-SANDAG incentives, on dollar-per-dollar basis. To avoid double counting reductions between the RECP and VIP, Ascent assumed that the reductions from additional PHEVs under VIP would be a subset of any additional PHEV eVMT supported by RECP because the RECP is assumed to extend the electric range of any PHEVs purchased under the VIP.

- The BAU forecast was based on a combination of 2018 vehicle populations from DMV registration data, EMFAC2017 ZEV growth rates, and adjustment of EMFAC's daily VMT per vehicle forecasts to SANDAG travel demand modeling.

- CO_2 reductions from the RECP were based on the difference between the total eVMT supported by a targeted number of all non-residential chargers, including existing and new chargers, in the SANDAG region and the eVMT anticipated in the BAU forecast for the SANDAG region for a given milestone year. The targeted total number of chargers in the SANDAG region was calculated using local PEV-to-charger ratios estimated by CEC's EVI-Pro analysis. EVI-Pro estimates that these ratios would change over time and also vary by PEV type. The targeted total number of chargers would be equal to the sum of all existing chargers as of 2018 and any new chargers added starting from 2018. To estimate the number of chargers needed to be incentivized by SANDAG, the number of existing non-residential chargers was subtracted from the targeted number of all non-residential chargers in the region.

- EV chargers were assumed to charge both BEVs and PHEVs. The eVMT provided to each type of vehicle per charger by non-residential charger type (e.g., public vs. workplace) reflect the findings and assumptions in CEC's 2018 study and EVI-Pro runs.

- CO_2 reductions from the VIP were based the difference between the targeted EV population for a given milestone year and the EV population anticipated in the BAU forecast. Average VMT and eVMT per vehicle per day were based on EMFAC2017 defaults, which varies by calendar year and vehicle type.

- As SB 375 only requires MPOs to address tailpipe emissions, upstream emissions from additional electricity demand from EVs are ignored.

Other assumptions include:

- Chargers have a 90 percent charging efficiency;

- Level 2 and DC Fast Chargers would be rated at 6.6 kilowatt (kW) and 105 kW, respectively, starting in 2025;

- PHEVs would not have the ability to use DC Fast Charging; and

- CEC's EVI-Pro analysis defines a charger as "a connector that can serve a vehicle at the full rated power capacity without any operational limitations" (CEC 2018:4). SANDAG's EV off-model tool adopts this definition.

Regardless, the calculator allows the user to adjust these inputs and assumptions in light of evolving research. Other specific assumptions used in the calculator are detailed in the rest of this memorandum.

Model Inputs

The calculator is set up such that the user can input basic program assumptions for the regional charger and vehicle incentive programs (RECP and VIP) for each milestone year (2020, 2025, 2030, 2035, and 2050). Default assumptions included in the background calculations for RECP and VIP can also be changed by the user, if necessary. For each program, the user can choose a target scenario based on preprogrammed inputs or choose a custom target scenario. SANDAG's chosen scenario should reflect the desired exceedance above BAU EV forecasts in order to appropriately assign GHG reduction credits and incentive costs to SANDAG efforts. All scenarios should be based on daily VMT forecasts from the version of SANDAG's regional transportation model that aligns with the applicable Regional Plan.

<u>Scenarios</u>

The tool allows the user to select a different forecast scenario for either the RECP or VIP to determine the total charger or PEV population that SANDAG hopes to achieve under those programs. The preprogrammed inputs include full and partial iterations of three preset scenarios based on State EV targets under EO B-16-12 (State Targets), CEC's EV forecast in EVI-Pro (CEC forecasts), and EV forecasts anticipated in CSE's market study (CSE forecasts). For example, the user can select the full CEC forecast scenario or a 70 percent CEC forecast scenario, which scales down the PEV and charger targets that would have occurred under the CEC forecast scenario by 70 percent. The following describe the three preprogrammed scenarios and the custom scenario option in the tool.

- State Targets: The State Targets under EO B-16-12 and EO B-48-18 to achieve 1.5 million EVs by 2025 and 5 million EVs by 2030 were apportioned to the SANDAG region based on the ratios between the EV population in SANDAG and the state as a whole, as modeled by EMFAC2017.

- CEC Forecast: The CEC's forecast scenario is based on what the CEC anticipates the PEV population will be like for the SANDAG region in order to meet State Targets for 2025, including the statewide target of having 250,000 EV chargers statewide by 2025. The CEC forecast scenario also accounts for a variety of economic and organizational factors that influence PEV usage. The model assumes that the CEC forecast trends would continue past 2025.

- CSE Forecast: The CSE Forecast scenario is based on either a linear or second-order polynomial trend of the PEV population in SANDAG based on historical sales. The second-order polynomial forecast is currently the preferred CSE Forecast scenario per SANDAG staff, though the user has the option to change the trend assumption in the background calculations.

- Custom Inputs: The model also allows the user to input custom charger or PEV population targets or custom scenarios based on a chosen fraction of either the State Targets or the CEC forecasts.

Regional Electric Vehicle Charger Program

The RECP CO_2 calculations require the user to select a target scenario of the number of PEVs to be supported by the charger program. This calculator utilizes CEC's results from EVI-Pro (average charger counts based on the default scenario) to calculate a PEV-to-charger ratio for each charger destination type (e.g., workplace, public) that is characteristic of the SANDAG region's EV charging behavior. This provides a recommended number of chargers needed to support the targeted PEV population. Alternatively, the model allows the user to decide on the specific number of chargers to be installed under the program based on fiscal or administrative limitations. The number of average active hours of charging per charger specific to each PEV type and charger type was calculated from CEC's EVI-Pro model results.

With respect to program costs, the user can input the average capital and administrative costs associated with each new charger funded or incentivized by the program. The average costs can be varied or remain constant over time depending on how SANDAG designs the program.

Vehicle Incentive Program

Similar to the RECP calculations, the VIP calculations require the user to either select a target PEV scenario or choose a custom targeted number of vehicles that would be incentivized under the program. If a custom target is chosen, the user can input the number of BEVs or PHEVs that would be incentivized by each milestone year starting with 2020. Once the number of PEVs is selected, the calculator utilizes the average VMT per PEV per day and the default PHEV utility factor (UF) used in EMFAC2017 to estimate the total eVMT associated with VIP. The PHEV utility factor (UF) is defined as the percent of PHEV VMT that is electric. To estimate the CO_2 reductions, the total eVMT from the population of EVs under the VIP is subtracted by the eVMT from population of EVs in the BAU forecast. The additional eVMT under the VIP is assumed to offset emissions from equivalent gasoline LDVs.

With respect to program costs, the user can input the average capital and administrative costs associated with each vehicle incentive. The average costs can be varied or remain constant over time depending on how SANDAG designs the program.

Comparison to State Targets

The calculator allows for the user to evaluate how SANDAG's EV program contributes to the region's overall per-capita CO_2 reduction targets under SB 375 and how the resulting PEV populations compares to the San Diego region's share of the State's EV targets under EO B-16-12 and B-48-18. Once finalized, the forecasted population and daily VMT for the San Diego region can be input into the calculator for each milestone year. To calculate the per-capita CO_2 reductions associated with the EV off-model calculations, total daily reductions from both programs are divided by SANDAG's forecasted population. To evaluate how SANDAG's EV programs would help achieve the State's EV targets, SANDAG's total EV population and eVMT under both EV programs are compared to SANDAG's LDV population and VMT, respectively, for each milestone year.

SANDAG EV OFF-MODEL METHODOLOGY

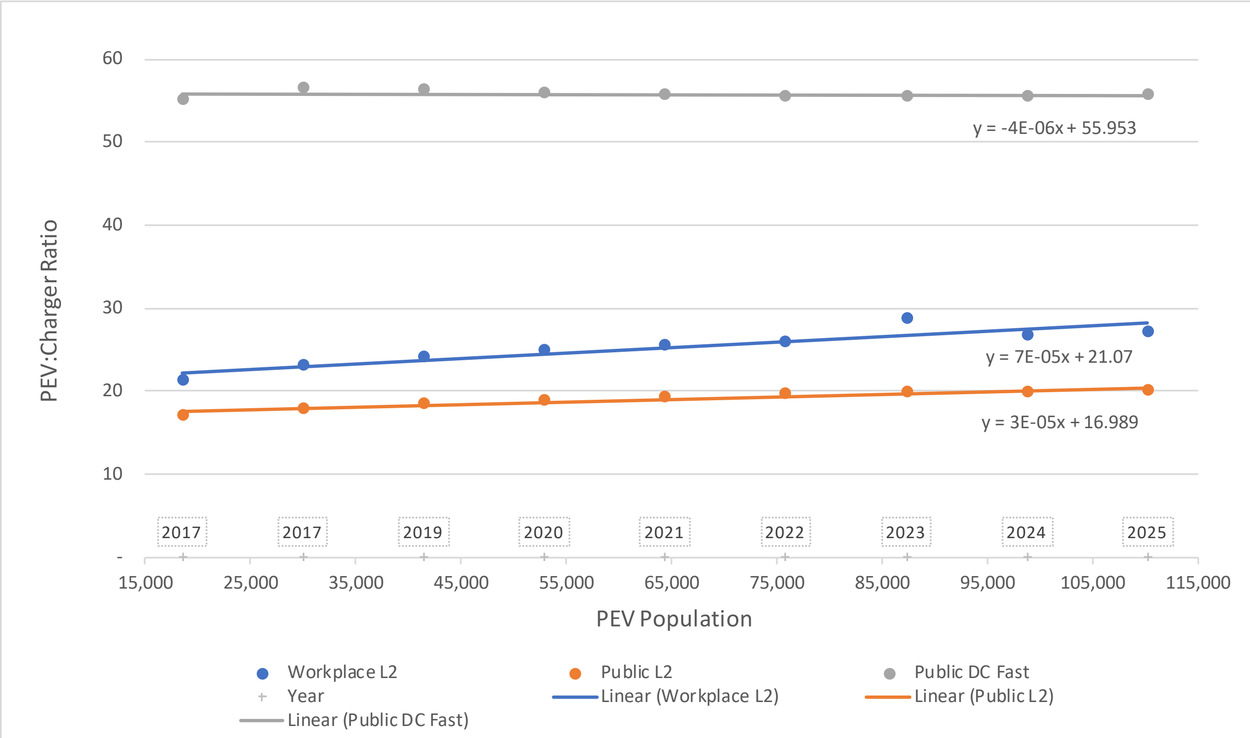
SANDAG's EV off-model calculator quantifies the CO_2 reductions attributable to SANDAG's EV programs that go beyond the reductions that would occur under current State legislation. The calculator quantifies CO_2 reductions associated with implementation of the RECP and VIP for the milestone years 2020, 2025, 2030, 2035, and 2050. These years have been selected primarily to be consistent with the milestone years set in AB 32, SB 32, and SB 375. The tool allows the user to adjust program targets (e.g., number of chargers or vehicles incentivized) and other assumptions to calculate the CO_2 reductions relative to a BAU forecast. The BAU forecast of PEV and eVMT growth is based on historical vehicle sales data and assumed regulatory compliance with the State's ZEV mandate, as modeled in EMFAC2017. Descriptions of how the BAU forecast was calculated for BEVs and PHEVs are shown on pages 11 and 16, respectively. This approach allows CO_2 reductions to be separated out for only SANDAG's programs rather than both State and SANDAG actions.

Both the RECP and VIP calculators use the same assumptions for vehicle emission factors of offset gasoline LDVs and average miles travelled per day per vehicle by vehicle type. For offset gasoline LDVs, emission factors were modeled in EMFAC2017 for the SANDAG region for each milestone year. The EMFAC2017 web database was used to obtain the emission factors, in contrast with the desktop version of EMFAC that includes the post-processed SB 375 analysis option. The SB 375 analysis option in EMFAC is typically used to determine the emissions reductions associated with VMT reductions in future years under a given transportation plan, so that MPOs do not rely on increasing vehicle efficiencies to meet the regional SB 375 CO_2 reduction targets. However, for the purposes of assigning CO_2 reductions to the proposed EV programs, it is more conservative to compare to more efficient gasoline vehicles that have lower emission factors than to compare to gasoline vehicles that have higher emission factors that would have been assumed under the SB 375 analysis option.

Regional Electric Vehicle Charger Program

Under the RECP, SANDAG would continue to expand the public EV charging infrastructure in the San Diego region to support and incentivize the growing PEV population in the region. Chargers alone do not reduce CO_2 emissions. However, the public EV charging infrastructure allows for the PEV population to grow by making it easier and more convenient for PEV drivers to charge their vehicles. The relationship between the charging infrastructure and the PEV population and travel behavior has been a primary study focus for several research groups, including various universities, national laboratories, and state agencies. However, until recently, this research has been limited to the behavior of early PEV adopters.

As the State prepares for greater adoption of PEVs to fulfill its climate goals, SANDAG's RECP calculator utilizes CEC's recent EVI-Pro modeling to account for travel and charging behavior that is more representative of mainstream drivers in the San Diego region (CEC 2018:1). The PEV-to-charger ratios from CEC's EVI-Pro modeling was used to estimate the number of chargers needed to support a given PEV population, accounting for San Diego-specific estimates of the PEV fleet mix, access to home charging, and other factors. The resulting PEV-to-charger ratios characterize the demand for various charger types for a given PEV population and is the basis for both the CO_2 reduction and cost estimates related to the RECP. Based on CEC's results, Ascent calculated a ratio of one charger for approximately every 17 to 56 PEVs, depending on the targeted PEV population and type of charger. Charger types include workplace Level 2, public Level 2, and public DC Fast Chargers. The relationship between PEV population and charger demand by charger type for the San Diego region is shown in Figure 1.



Note: Adapted from CEC's results from EVI-Pro for the San Diego Region, consistent with results in "California Plug-In Electric Vehicle Infrastructure Projections: 2017-2025 Future Infrastructure Needs for Reaching the State's Zero Emission-Vehicle Deployment Goals." (CEC 2018). [1]

Figure 1 PEV-to-Charger Ratio vs. PEV Population for the San Diego Region (2017-2025)

Figure 1 shows the PEV-to-charger ratios between the 2017 and 2025 PEV population in the San Diego region, as assumed in CEC's EVI-Pro modeling. These ratios vary depending on the type of charger and are primarily used to calculate the number of chargers by type needed in the region under the RECP (see Equation 3). This figure also shows that, for 2025, CEC estimates that SANDAG's fair share of PEVs to meet the 2025 goals under EO B-16-12 is 110,227 PEVs. In contrast, EMFAC2017 forecasts that the SANDAG region would have 61,378 PEVs by 2025, almost half of the State's 2025 target. Ascent assumes that the linear trend between 2017 and 2025 would continue past 2025. As such, the equations shown in Figure 1 are used to calculate the number of workplace and public Level 2 and public DC Fast Chargers needed to support a given PEV population, as used in Equation 3. SANDAG's goal under the RECP is to meet the charger demand under a selected PEV population scenario.

CO_2 reductions from implementation of the RECP are based on the effect of the additional chargers on BEV and PHEV travel activity, assumed to offset equivalent gasoline LDV VMT. The RECP affects BEV and PHEV activity differently because charging behavior differs between BEV and PHEV drivers. While BEV drivers may experience range anxiety due to a limited presence of chargers, all miles associated with BEV driving are electric and BEVs are assumed to primarily charge at home (See Figure 2). On the other hand,

[1] EVI-Pro should not be confused with EVI-Pro Lite, a simplified version of EVI-Pro, was not used in this analysis (AFDC 2018). Although EVI-Pro Lite is a publicly available version of EVI-Pro, it does not include many of the assumptions embedded in CEC's California-specific runs. In comparisons between EVI-Pro and EVI-Pro Lite, the latter substantially underestimates the number of DC Fast Chargers in the San Diego region. EVI-Pro Lite also requires the user to input the PEV fleet mix and level of access to home charging, whereas CEC already uses data specific to the San Diego region to support those assumptions.

PHEV drivers have the option of travelling further using gasoline after their electric-only range has been exhausted and a nearby charger is unavailable (It should be noted that no diesel PHEVs are currently on the market). However, the increased availability of chargers could allow PHEV drivers to extend their electric-only range, resulting in a greater percentage of eVMT across all miles driven in a PHEV.

Equations 1 through 3 are used to calculate the CO_2 reductions from BEVs and PHEVs under the RECP for a given milestone year. (Note that SANDAG's EV off-model calculator allows users to adjust all variables, though defaults are provided and explained herein.)

$$E_{RECP} = \left(E_{BEV_{RECP}} + E_{PHEV_{RECP}}\right) * \frac{I_{SANDAG\_RECP}}{I_{SANDAG\_RECP} + I_{Non-SANDAG\_Chargers}} \qquad (Equation\ 1)$$

Where:

E_{RECP} = Emissions reductions associated with implementation of RECP (MT CO_2)

E_{BEV_RECP} = Emissions reductions associated with BEVs under the RECP (MT CO_2)

E_{PHEV_RECP} = Emissions reductions associated with PHEVs under the RECP (MT CO_2)

I_{SANDAG} = Average incentive per chargers under the RECP offered by SANDAG (Dollars)

$I_{Non-SANDAG\_Chargers}$ = Average incentives per charger totaled across all non-SANDAG programs in the SANDAG region (Dollars)

To attribute the reductions to the RECP, specifically, an additional adjustment is made based on the proportion of the RECP incentives to all incentives offered on a per-charger basis.

<u>BEV CO_2 Reductions</u>

CO_2 reductions from BEVs are based on the difference between emissions from charging associated with the eVMT provided to BEVs under the RECP compared to the eVMT from BEVs anticipated by EMFAC. Any additional eVMT from the RECP is assumed to offset equivalent gasoline LDV VMT. Thus, for a given milestone year, BEV emission reductions from the RECP are based on Equation 2.

$$E_{BEV_{RECP}} = \frac{\left(VMT_{BEV_{RECP}} - VMT_{BEV_{BAU}}\right) * (EF_{Gas})}{10^6 \frac{g}{MT}} \qquad (Equation\ 2)$$

Where:

E_{BEV_RECP} = Emissions reductions from additional BEV eVMT from chargers operating under the RECP scenario compared to the BAU forecasts (MT CO_2)

VMT_{BEV_RECP} = eVMT associated with the electricity provided by chargers to BEVs under the RECP (mi/day)

VMT_{BEV_BAU} = eVMT associated with all BEV VMT under the BAU forecast (mi/day)

EF_{Gas} = Emissions factor per mile associated with gasoline LDVs in the SANDAG region, as modeled in EMFAC2017 (g CO_2/mi). Based on the four EMFAC vehicle categories included in the model's SB 375 analysis option (passenger cars [LDA], light duty trucks with an estimated total weight less than 3,750 pounds [LDT1], light duty trucks with an estimated total weight less between 3,751 and 5,750 pounds [LDT2], and medium duty trucks [MDV]).

VMT_{BEV_RECP} is the eVMT provided to BEVs by all chargers in the SANDAG region including those associated with RECP that would have been installed after 2019. VMT_{BEV_BAU} is the product of the BEV population and the average daily VMT per EV, based on EMFAC2017 results that were adjusted by the difference between SANDAG VMT forecasts and EMFAC VMT forecasts. These and other adjustments were made to EMFAC results because EMFAC2017 does not output EV populations by PEV type and because EMFAC VMT forecasts were not developed based on locally-specific data, as SANDAG VMT forecasts are. The following adjustments were made to EMFAC results to estimate the BAU BEV forecasts:

1. Based forecasts on 2018 BEV populations for San Diego County taken from DMV vehicle registration data,

2. Forecasted the 2018 BEV population into the future years by using EMFAC's assumed growth in LDVs and the assumed proportion of new vehicles that must be ZEVs under the state's ZEV mandate, and

3. Applied an adjustment factor based on the ratio between the SANDAG regional VMT forecast with EMFAC2017's VMT forecast to population and daily VMT per vehicle (CARB 2015, Department of Motor Vehicles [DMV] 2018).

These adjustments were made because EMFAC2017 uses historical vehicle populations through calendar year 2016 and regulation-based EV projections for years after 2016. Thus, projections were calibrated based on actual 2018 vehicle populations. The SANDAG regional VMT forecasts are considered a variable in this off-model calculator and are not shown here due to the current development of SANDAG's travel demand model as part of the 2019 RTP/SCS. The assumptions behind EMFAC's growth forecasts for ZEVs are shown in Table 1 for each ZEV type.

VMT_{BEV_RECP} is calculated from the total number of chargers, active charging time for BEVs per charger, and EV fuel economy as shown in Equation 3.

$$VMT_{BEV_{RECP}} = \sum_{i=Charger\ Type}^{n} \frac{C_i * H_{i_{BEV}} * P_i * \eta_{charger}}{FE_{EV}} \qquad (Equation\ 3)$$

Where:

VMT_{BEV_RECP} = eVMT associated with the electricity provided by chargers to BEVs under the RECP

i = charger type (e.g., Level 2 or DC Fast Charger)

C_i = Cumulative number of chargers by type installed under RECP (chargers).

H_{i_BEV} = Active hours charged by charger type, per charger, per day associated with BEVs (hours/charger)

P_i = Power rating of charger type (e.g., 6.6 kW for Level 2 chargers or between 55 and 105 kW for DC Fast Chargers)

$\eta_{charger}$ = Charger efficiency (i.e., electricity delivered by the charger divided by the electricity drawn from the electricity grid by the charger)

FE_{EV} = Fuel economy of electric vehicles (kWh/mi) (e.g., 0.225 kWh/mi)

Table 1 Zero Emission Vehicle Forecast Assumptions

	PHEV	BEV	FCEV
DMV 2018 Population in San Diego County[1]	11,216	14,960	135
Sectors	Required Percent of New LDV Sales that Must be ZEVs in EMFAC2017[2]		
Model Year	PHEV	BEV	FCEV
2019	1.86%	0.54%	5.44%
2020	3.26%	0.98%	8.59%
2021	4.82%	1.52%	11.34%
2022	5.25%	2.54%	11.93%
2023	6.01%	3.05%	13.00%
2024	6.70%	3.56%	13.98%
2025 through 2050	7.32%	4.06%	14.89%
Sectors	Calculated Year-over-Year Percent Growth in ZEV Population in San Diego County assumed in EMFAC2017		
Model Year	PHEV	BEV	FCEV
2019	20%	6%	167%
2020	28%	11%	141%
2021	30%	15%	104%
2022	26%	14%	69%
2023	23%	14%	50%
2024	20%	13%	40%
2025	18%	12%	36%
2026	16%	10%	27%
2027	13%	9%	21%
2028	12%	9%	17%
2029	10%	8%	15%
2030 through 2050	3-9%	2-7%	3-12%

Notes: EMFAC2017 uses the same future ZEV sales requirements as assumed in EMFAC 2014.

EMFAC = EMission FACtor model; ZEV = zero emission vehicle; SANDAG = San Diego Association of Governments; PHEV = plug-in hybrid electric vehicle; BEV = battery electric vehicle; FCEV = fuel cell electric vehicle.

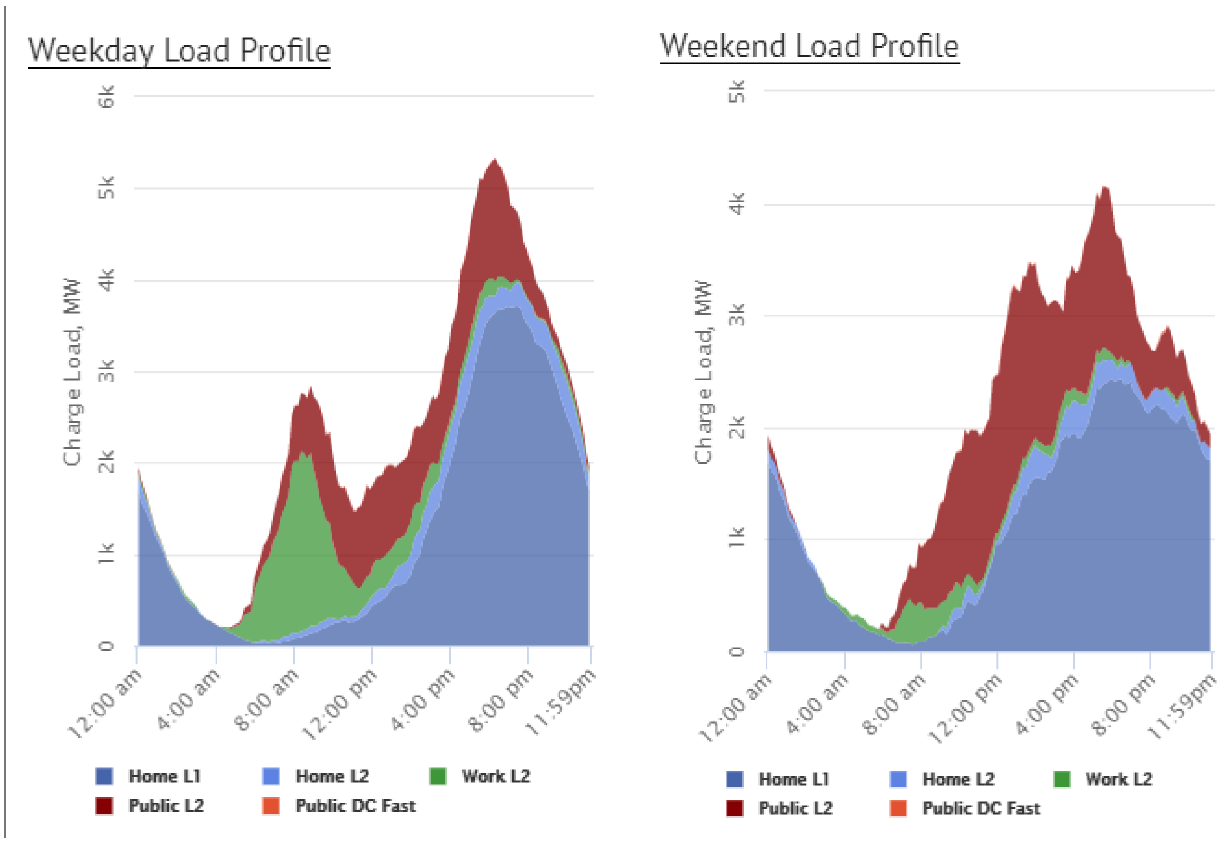
[1] DMV 2018

[2] CARB 2015: Table 3.3-7

Source: CARB 2015: Table 3.3-7, DMV 2018

C_i is calculated from the charger-to-PEV ratio from EVI-Pro (See Figure 1). The active charging referred to in H_i is distinct from charging time, because a car may still be plugged in but not actively charging as the attached car may have completed or stopped charging. For H_i, the default charging activity is shown in at the bottom of Table 3 where workplace chargers are estimated to actively charge BEVs for 0.6 hours and PHEVs for 2.2 hours per charger, across multiple vehicles over the course of an average day. Values in Table 3 were calculated from load profiles by charger type, as shown in Figure 2. These charging times are consistent with the understanding that PHEVs would need to charge more frequently due to their smaller range compared to BEVs. P_i, $\eta_{charger}$, and FE_{EV} assumptions are consistent with those used in CEC's EVI-Pro runs statewide. CEC assumed a charger efficiency of 90 percent in its analysis for all charger types (CEC 2018:25). Charger efficiency is understood here as the electricity delivered by the charger divided by the electricity drawn from the electricity grid by the charger.

The default H_i values given above are calculated from charger load results from CEC's EVI-Pro runs for the SANDAG region (NREL 2018b). The charger load results show how much power, in MW, is drawn from each charger destination type (e.g., public level 2, workplace level 2, and public DC fast charger) over a 24-hour period, as shown in Figure 2. These results varied by the day of the week. Weekday and weekend loads were combined to provide average daily loads.



Source: NREL 2018a. Note that Public DC Fast charger loads are imperceptible in this figure due to very small loads in comparison to other charger types.

Figure 2 Weekend and Weekday Power Load by Charger Destination Type over a 24-hour Period for SANDAG in 2025

The area under the curve by each charger type is equal to the daily electricity demand for all chargers in the SANDAG region in 2025, under CEC's target scenario in their 2018 infrastructure report (CEC 2018). Dividing the total energy delivered (in MWh) by the average charger power rating (in kW) gives the average hours charged by charger type. Ascent further disaggregated the charging hours by PEV type using the charger demand profile by PEV type assumed in CEC's modeling (CEC 2018: Figure 4.5). This methodology to calculate the charging hours was recommended by CEC (Bedir, Pers. Comm., 2018). See Table 3 for the resulting calculated active daily charging hours by PEV type and charger type based on the data shown in Figure 2. It was assumed that the 2025 charging behavior by charger type would stay constant from 2020 through 2050. CEC's EVI-Pro analysis did not have similar data available for years other than 2025.

PHEV CO_2 Reductions

For CO_2 reductions from PHEVs, the approach differs from the BEV calculations because the chargers affect the overall electric UF of PHEVs. Depending on the charger assumptions, the chargers would increase the amount of eVMT provided to PHEVs. Dividing the eVMT provided by the chargers by the PHEV VMT assumed in EMFAC would result in a higher UF relative to EMFAC defaults, potentially beyond the maximum UF for PHEVS. The maximum UF for PHEVs, assuming access to charging is widely available, is 80 percent according to a 2017 NREL study and the San Diego 2025 PEV fleet mix [NREL 2017: Figure 26]. MTC used this approach of comparing UFs to assign CO_2 reductions to the MTC's RECP and estimated a UF of 80 percent with additional chargers.

However, PHEV UF assumed under the RECP is inextricably connected with the assumptions used to estimate reductions from the VIP. This is because the VIP has the potential to increase overall PHEV VMT by increasing the number of PHEVs in the region. This affects the calculation of the PHEV UF under the RECP because the UF is calculated by dividing PHEV eVMT provided under the RECP by the total PHEV VMT. Thus, the calculations are set up to avoid double counting reductions from PHEVs from the two programs. This approach is detailed in Equations 4 through 7.

$$E_{PHEV_{RECP}} = E_{PHEV_{BAU}} - E_{PHEV_{SANDAG}} - E_{PHEV_{VIP}} \qquad (Equation\ 4)$$

Where:

E_{PHEV_RECP} = Emissions reductions associated with PHEVs under the RECP (MT CO_2)

E_{PHEV_BAU} = Emissions from PHEVs and Gasoline LDVs in the BAU forecast (MT CO_2)

E_{PHEV_SANDAG} = Emissions from PHEVs that would occur under the RECP and VIP (MT CO_2)

E_{PHEV_VIP} = Emissions reductions from PHEVs that would occur under the VIP only (MT CO_2)

The overall PHEV daily VMT, regardless of fuel types, is assumed to be equal for both E_{PHEV_BAU} and E_{PHEV_SANDAG}. E_{PHEV_VIP} is calculated in Equation 10. The PHEV-related VMT (VMT_{PHEV_SANDAG}) under both programs is assumed to be equal to the product of 1) the total number of PHEVs anticipated under the VIP (incentivized and existing) and 2) average daily VMT per gasoline LDV assumed in the BAU forecast. The PHEV population target under the VIP needs to be greater than or equal to the BAU forecasts to achieve applicable reductions. The VIP CO_2 reductions from PHEVs are subtracted from the total in Equation 4 to avoid double counting.

Equation 5 describes how E_{PHEV_BAU} is calculated.

$$E_{PHEV_{BAU}} = \frac{\left(VMT_{PHEV_{VIP}} - \left[VMT_{PHEV_{BAU}} * UF_{EMFAC}\right]\right) * EF_{Gas}}{10^6 \frac{g}{MT}} \qquad (Equation\ 5)$$

Where:

E_{PHEV_BAU} = BAU-forecasted emissions from PHEVs and Gasoline LDVs (MT CO_2)

VMT_{PHEV_VIP} = Daily VMT associated with entire PHEVs population under the VIP (mi/day)

VMT_{PHEV_BAU} = BAU-forecasted daily VMT associated with all PHEVs (mi/day)

UF_{EMFAC} = Default PHEV Utility Factor assumed in EMFAC2017 (%).

EF_{Gas} = Emissions factor per mile associated with gasoline LDVs in the SANDAG region, as modeled in EMFAC2017 (g CO_2/mi). Based on EMFAC vehicle categories LDA, LDT1, LDT2, and MDV.

VMT_{PHEV_VIP} is the product of the total PHEV population under VIP and the average daily miles per gasoline LDV, as modeled in EMFAC2017. VMT_{PHEV_BAU} is calculated by multiplying the PHEV population and the average daily gasoline VMT per LDV, based on EMFAC2017 results that were adjusted by the difference between SANDAG VMT forecasts and EMFAC VMT forecasts. As with the approach for BEVs, these and other adjustments were made to EMFAC results because EMFAC2017 does not output EV populations by PEV type and because EMFAC VMT forecasts were not developed based on locally-specific data, as SANDAG VMT forecasts are. The following adjustments were made to EMFAC results to estimate the business-as-usual PHEV forecasts:

1. Based forecasts on 2018 PHEV populations for San Diego County taken from DMV vehicle registration data,
2. Forecasted the 2018 PHEV population into the future years by using EMFAC's assumed growth in LDVs and the assumed proportion of new vehicles that must be ZEVs under the state's ZEV mandate, and
3. Applied an adjustment factor based on the ratio between the SANDAG regional VMT forecast with EMFAC2017's VMT forecast to both the PHEV population and daily VMT per vehicle (CARB 2015, DMV 2018).

As with the approach for BEVs, these adjustments were made because EMFAC2017 uses historical vehicle populations through calendar year 2016 and regulation-based EV projections for years after 2016. Thus, projections were calibrated based on actual 2018 vehicle populations. The SANDAG regional VMT forecasts are considered a variable in this off-model calculator and are not shown here due to the current development of SANDAG's travel demand model as part of the 2019 RTP/SCS. EMFAC's ZEV forecast assumptions are shown in Table 1.

UF_{EMFAC} was based on data obtained directed from CARB. CARB provided PHEV UF assumptions for each model year (MY) starting with MY 2018. Prior to MY 2018, EMFAC assumes all PHEVs have a UF of 40 percent, which was the assumption used in MTC's EV off-model calculator. For EMFAC2017, however, CARB increased the UF assumptions for future model years to account for increasing electric range of available PHEVs (Long, pers. comm., 2018b). EMFAC2017 UF assumptions by model year are summarized in Table 2. These assumptions were applied to the PHEV population mix in EMFAC to calculate a weighted average UF_{EMFAC} that accounts for the different UFs across model years for a given calendar year.

Table 2 EMFAC2017 PHEV Utility Factor Assumptions

Model Year	PHEV UF
Pre-2018	40%
2018	46%
2019	47%
2020	48%
2021	50%
2022	55%
2023	56%
2024	58%
2025 though 2050	59%

Notes: UF assumptions apply statewide. EMFAC = EMission FACtor model; PHEV = plug-in hybrid electric vehicle; UF = utility factor.

Source: Long, pers. comm., 2018b

Equation 6 describes how E_{PHEV_RECP} is calculated.

$$E_{PHEV_{SANDAG}} = \frac{\left(VMT_{PHEV_{VIP}} - [1 - UF_{RECP}]\right) * EF_{Gas} + VMT_{PHEV_{VIP}} * UF_{RECP} * EF_{EV}}{10^6 \frac{g}{MT}} \qquad (Equation\ 6)$$

Where:

E_{PHEV_SANDAG} = Emissions from PHEVs as anticipated under 2019 Regional Plan scenarios with the implementation of the off-model programs (MT CO_2)

VMT_{PHEV_VIP} = Daily VMT associated with PHEVs under the VIP (mi/day)

UF_{RECP} = PHEV utility factor associated with charger scenario under the RECP. Limited to be between UF_{EMFAC} and a maximum of 80 percent. (%)

EF_{Gas} = Emissions factor per mile associated with gasoline LDVs in the SANDAG region, as modeled in EMFAC2017 (g CO_2/mi). Based on EMFAC vehicle categories LDA, LDT1, LDT2, and MDV.

EF_{EV} = FE_{EV} * EF_E (g CO_2/mi) (See Equation 2)

UF_{RECP} is the calculated PHEV UF associated with the charging scenario under the RECP, as shown in Equation 7.

$$UF_{RECP} = \frac{eVMT_{PHEV_{RECP}}}{VMT_{PHEV_{VIP}}} \qquad (Equation\ 7)$$

Where,

$eVMT_{PHEV\_RECP}$ = eVMT associated with the electricity provided by chargers to PHEVs under the RECP

VMT_{PHEV_VIP} = Daily VMT associated with PHEVs under the VIP (mi/day)

$eVMT_{PHEV\_RECP}$ is the eVMT provided to PHEVs by all chargers in the SANDAG region including those associated with RECP. $eVMT_{PHEV\_RECP}$ is calculated identically to Equation 3, with the exception of H_i. In the case of PHEVs, H_{i_PHEV} refers to the active hours charged by charger type per charger per day associated with PHEVs. To simplify model assumptions, the H_i for both BEVs and PHEVs were assumed to be constant for all milestone years based on charger load assumptions used in CEC's EVI-Pro analysis for 2025 for the San Diego region.

Tables 3 and 4 show the assumptions and calculation of the active charging hours (H_i) for BEVs and PHEVs by non-residential charger type based on the CEC's EVI-Pro charger load profile, which is based on data behind Figure 2. Table 3 shows the charger load profile that CEC's EVI-Pro model quantified for the San Diego region in 2025 broken out by PEV and charger type. Table 4 shows the estimated charging behavior (i.e., hours of charge per day per PEV by charger type and day of the week) based on the data in Table 3. The average daily charging patterns by PEV are used as the active charging hours (H_i) applied in Equation 3 to calculate the VMT anticipated from each PEV type under the RECP.

Note that fuel cell electric vehicles (FCEV) were not included in the RECP calculations because FCEVs are assumed to only be fueled via hydrogen fueling stations and are not assumed to have on-board batteries that can be charged separately from the hydrogen fuel cell.

Table 3 CEC EVI-Pro Charging Behavior Results for 2025 in the San Diego Region

Metric	Unit	Workplace L2	Public L2	Public DC Fast	Total
EVI-Pro Charger Load Results[4]	Number of Chargers[1]	4,051	5,485	1,981	11,517
	MWh/weekday[2]	86	79	53	218
	MWh/weekend[2]	21	106	125	252
	BEV kW[3]	6.6	6.6	105	N/A
	PHEV kW[3]	4.9	4.9	-	N/A
Percent of Demand Associated with BEVs by Charger Type	%[5]	27	6	100	N/A
Percent of Demand Associated with PHEVs by Charger Type	%[5]	73	94	0	N/A
BEVs per charger by type	Vehicles[6]	11	8	22	4
PHEVs per charger by type	Vehicles[6]	16	12	33	6

Notes: Values may not sum due to rounding. DC = direct current; CEC = California Energy Commission; MWh = megawatt-hours; BEV = battery electric vehicle; PHEV = plug-in hybrid electric vehicle; L2 = Level 2 charger, kW = kilowatt; PEV = plug-in electric vehicle

[1] NREL 2018b

[2] Bedir, Pers. Comm., 2018

[3] CEC 2018: Table 4.1

[4] CEC assumed a charger efficiency of 90% across all chargers and PEV combinations (CEC 2018: 25)

[5] CEC 2018: Figure 4.5

[6] Calculated by dividing the number of chargers by the 2025 BEV or PHEV population based on a total population of 110,227 and apportioned based on the calibrated EMFAC population forecast for BEVs and PHEVs in 2025.

Table 4 Calculated Active Charger Load and Hours per Charger by PEV in 2025 in the San Diego Region[1]

Metric	Day	Workplace L2	Public L2	Public DC Fast	Total
kWh delivered to ALL BEVs per day per charger	Weekday	5	1	24	30
	Weekend	0	0	6	6
	Average	4	1	19	23
kWh delivered to ALL PHEVs per day per charger	Weekday	14	12	0	26
	Weekend	3	16	0	20
	Average	11	13	0	24
Active Charging Hours for ALL BEVs per day per charger (H_{i_BEV})[2]	Weekday	0.8	0.1	0.2	1
	Weekend	0.0	0.0	0.1	0.1
	Average	0.6	0.1	0.2	1
Active Charging Hours for ALL PHEVs per day per charger (H_{i_PHEV})[3]	Weekday	2.9	2.5	0	5
	Weekend	0.7	3.3	0	4
	Average	2.2	2.7	0	5

Notes: Values may not sum due to rounding. DC = direct current; MWh = megawatt-hours; BEV = battery electric vehicle; PHEV = plug-in hybrid electric vehicle; L2 = Level 2 charger, kWh = kilowatt-hours; PEV = plug-in electric vehicle

[1] For each charger type, active charging hours by PEV equals the product of daily MWh, efficiency, and percent demand by PEV type divided by the number of chargers based on data shown in Table 3.

[2] The average daily results should be used to represent the H_{i_BEV} variable shown in Equation 3.

[3] The average daily results should be used to represent the H_{i_PHEV} variable based on Equation 3.

Vehicle Incentive Program

Under the VIP, SANDAG would offer incentives for drivers to replace older gasoline passenger vehicles with equivalent PEVs. While SANDAG could consider incentivizing fuel-cell electric vehicles (FCEVs) in addition to PEVs, this calculator only accounts for reductions associated with incentives for PEVs due to the relatively small FCEV population forecast and limited amount of existing infrastructure (see Table 1). The VIP would increase the share of PEVs among the LDA fleet in the San Diego region. It is assumed that the VIP would not increase or decrease overall VMT in the San Diego region anticipated under 2019 Regional Plan.

The CO_2 reductions associated with the VIP are essentially a comparison of the new eVMT that would occur from the additional BEVs and PHEVs incentivized under the program beyond the BAU forecast. To account for reductions attributed to non-SANDAG incentives, an additional adjustment is made based on the proportion of the VIP incentives to all incentives offered on a per-vehicle basis. The calculation of CO_2 reductions from VIP are reflected in Equations 8 through 10. Similar to Equation 1, the emissions reductions from VIP are the sum of the emissions reductions from BEVs and PHEVs under the program.

$$E_{VIP} = \left(E_{BEV_{VIP}} + E_{PHEV_{VIP}}\right) * \frac{I_{SANDAG\_VIP}}{I_{SANDAG\_VIP} + I_{Non-SANDAG\_ZEV}} \qquad (Equation\ 8)$$

Where:

E_{VIP} = Emissions reductions associated with implementation of VIP (MT CO_2)

E_{BEV_VIP} = Emissions reductions associated with BEVs under the VIP (MT CO_2)

E_{PHEV_VIP} = Emissions reductions associated with PHEVs under the VIP (MT CO_2)

I_{SANDAG} = Average incentive per ZEV under the VIP offered by SANDAG (Dollars)

$I_{Non\text{-}SANDAG\_Chargers}$ = Average incentive per ZEV totaled across all non-SANDAG programs in the SANDAG region (Dollars)

BEV CO_2 Reductions

CO_2 reductions from BEVs are based on the difference between emissions from charging associated with the eVMT of the BEVs incentivized under the VIP compared to the eVMT from BEV anticipated by EMFAC. Any additional eVMT from the VIP is assumed to offset equivalent gasoline LDV VMT. Similar to Equation 2, BEV emission reductions from the VIP are based on the following equation.

$$E_{BEV_{VBIP}} = \frac{\left(VMT_{BEV_{VIP}} - VMT_{BEV_{BAU}}\right) * EF_{Gas}}{10^6 \frac{g}{MT}} \qquad (Equation\ 9)$$

Where:

E_{BEV_VIP} = Emissions reductions from the BEV population under VIP compared to the BAU forecast (MT CO_2)

VMT_{BEV_VIP} = eVMT associated with all BEVs including those incentivized under the VIP (mi/day)

VMT_{BEV_BAU} = eVMT associated will all BEV VMT under the BAU forecast (mi/day)

EF_{Gas} = Emissions factor per mile associated with gasoline LDVs in the SANDAG region, as modeled in EMFAC2017 (g CO_2/mi). Based on EMFAC vehicle categories LDA, LDT1, LDT2, and MDV.

Because both Equations 2 and 9 calculate reductions relative to EMFAC-forecasted VMT, BEV emissions reductions from VIP (E_{BEV_VIP}) are assumed to be independent of the BEV reductions from RECP (E_{BEV_RECP}). VMT_{BEV_VIP} is the product of the targeted BEV population under VIP and the average daily miles per vehicle for EVs as modeled in EMFAC2017 and adjusted based on the difference between SANDAG and EMFAC VMT forecasts. VMT_{BEV_BAU} and EF_{Gas} are the same values used in Equation 2.

PHEV CO_2 Reductions

For emission reductions from PHEVs, the approach is similar to Equation 6 with an added complication behind the UF assumption.

$$E_{PHEV_{VIP}} = \frac{\left(VMT_{PHEV_{VIP}} * [1 - UF_{VIP}]\right) * EF_{Gas}}{10^6 \frac{g}{MT}} \qquad (Equation\ 10)$$

Where:

E_{PHEV_VIP} = Emissions from PHEVs as anticipated under the VIP (MT CO_2)

VMT_{PHEV_VIP} = Daily VMT associated with PHEVs under the VIP (mi/day)

UF_{VIP} = PHEV utility factor assumed for VIP (%)

EF_{Gas} = Emissions factor per mile associated with gasoline LDVs in the SANDAG region, as modeled in EMFAC2017 (g CO_2/mi). Based on EMFAC vehicle categories LDA, LDT1, LDT2, and MDV.

VMT_{PHEV_VIP} is the product of the targeted PHEV population under VIP and the average daily miles per vehicle for gasoline LDVs as modeled in EMFAC2017 and adjusted based on the difference between SANDAG and EMFAC VMT forecasts. To be conservative and to avoid circular arguments, UF_{VIP} is assumed to be equal to the UF assumed under EMFAC2017 (UF_{EMFAC}).

Incentive Costs

To estimate the cumulative incentive program costs to SANDAG, the user can input SANDAG's incentive costs per charger or vehicle and percent-based administrative costs (e.g., five percent of all vehicle incentives) for each milestone year. For the RECP, the user can choose SANDAG's average incentive cost per workplace charger, public L2 charger, and public DC Fast Charger. For the VIP, the user can choose SANDAG's average incentive cost per BEV and PHEV. The total cost of each program would be based on the per-unit incentives multiplied by the associated new chargers or PEV populations as of 2018, as calculated from the EV off-model calculator for each milestone year. The calculated costs are cumulative, because the tool calculates the cumulative number of new chargers and PEVs as of 2018 associated with the RECP and VIP. Thus, the input costs per unit should reflect the average cost across all new chargers or vehicle incentivized since 2018.

Results

[TO BE ADDED ONCE SANDAG SELECTS SCENARIO]

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Appendix E
WP TDM Off-Model Memo

MEMO

TO: SANDAG TDM and Modeling Staff

FROM: Rosella Picado, WSP

SUBJECT: Draft TDM Off-Model Methodology—March 2019 Revision

DATE: March 20, 2019

Introduction

SANDAG uses the Activity Based Model (ABM) to estimate performance measures and to evaluate the transportation network included in the Regional Plan (SANDAG's Regional Transportation Plan and Sustainable Communities Strategy (RTP/SCS). However, some strategies that contribute towards the reductions of greenhouse gas (GHG) emissions are not fully captured by the SANDAG ABM or the California Air Resources Board (ARB) Emissions Factor model.

The four largest MPOs in California (SANDAG, the Metropolitan Transportation Commission and Association of Bay Area Governments, the Sacramento Area Council of Governments, and the Southern California Association of Governments) have partnered to establish the Future Mobility Research Program. The purpose of the program is to jointly fund research on the potential impacts of transportation technologies, study key policy issues, and identify appropriate roles for the MPOs in relation to emerging transportation technologies. This cooperative effort ensures a consistent approach to evaluating the range of potential changes to travel behavior associated with emerging technologies and will provide recommendations on how to model travel behavior and incorporate technology into each MPO's RTP/SCS. The FMRP partnered in this effort to have a consistent approach in considering strategies whose GHG impacts are not captured through traditional modeling.

For SANDAG's Regional Plan, the off-model analysis included evaluating such strategies as carshare, electric vehicle charging stations, and carpool assumptions. The draft Transportation Demand Management (TDM) off-model strategies which are the focus of this memo, are as follows[1]:

- Vanpool
- Carshare
- Bikeshare
- Microtransit
- Pooled rides
- Community-based travel planning

[1] The Community-Based Travel Planning strategy was prepared by SANDAG staff. All other calculators referenced in this memo were developed in collaboration with WSP.

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Methodology

The inputs and assumptions listed within this methodology are draft and are subject to change, pending the selection of a preferred network scenario and the final regional growth forecast developed to inform the 2019 Regional Plan. Furthermore, the draft model data used in the draft calculators is subject to change, pending the selection of the preferred network scenario.

The draft off-model greenhouse gas emissions reduction strategies included in this off-model methodology memo are Transportation Demand Management (TDM) strategies which includes programs or services that encourage the use of transportation alternatives. Strategies proposed in this methodology includes programs facilitated and administered by SANDAG as well as services operated by third-parties. These programs and services include a vanpool subsidy program; transit solutions; regional support for shared mobility services, like bikeshare and carshare; incentives for pooled rides, and commuter outreach.

This memorandum documents the methodology for estimating vehicle miles traveled (VMT) and GHG emission reductions from vanpool, carshare, bikeshare, microtransit, pooled rides, and community-based travel planning. The methodology for estimating GHG emission reductions is a series of Excel spreadsheet calculators that estimate average VMT reductions for each program or shared mobility service type. The VMT reductions are based on historic data, applicable research, and case study findings, as documented in the "References" section within each strategy. Where possible and if available, local data was used to inform the assumptions used in the methodology. To minimize double counting, the methodology intentionally employs a conservative approach to estimate reasonable program impacts. While the off-model calculators utilize mode-based inputs from the ABM to estimate program impacts, calculator outputs remain off-model and do not interact or feed back into the ABM.

In general, the research is used to estimate the following methodology parameters:

a. Population that has access to the mobility service, or market. The market may be defined in terms of persons or households.

b. Level of supply/geographic extent. The level of supply may be defined as a function of cities or neighborhoods in which the program or service is available.

c. Regional infrastructure improvements. Regional investments in transportation infrastructure may help facilitate use of a mobility service and induce demand.

d. Baseline VMT. An estimate of the average VMT per person or per household, among persons/households that do not participate in the program or mobility service.

e. Project VMT. An estimate of the average VMT per person or per household expected among persons per households that participate in the program or mobility service. This could be estimated directly from average trip lengths, indirectly from mode shifts, changes in car occupancy, and/or reductions in average number of trips.

f. GHG emission factors. Based on total trip and Carbon Dioxide (CO_2) forecasts produced by the SANDAG ABM 14.0.1.

Summary

The six off-model greenhouse gas reduction strategies described in this memo will be considered during the transportation network development process of the 2019 Regional Plan. During the analysis, reductions in daily VMT and corresponding daily CO_2 emissions reductions will be reported using the draft companion calculators appended to this memo. Following this summary are the detailed methodologies of each of the six individual strategies.

VANPOOL PROGRAM

Program Description

Vanpooling is a flexible form of public transportation that provides groups of 5–15 people with a cost-effective and convenient rideshare option for commuting. SANDAG has been operating a regional vanpool program since 1995, and currently comprises of approximately 700 vans. The SANDAG Vanpool Program provides a subsidy of up to $400 per month for eligible vanpoolers to offset the cost of the lease of the vanpool vehicle and works with the vanpool vendors to conduct marketing and outreach through employers in the region to grow participation in the Program. All vanpools in the program are subsidized by SANDAG using Congestion Mitigation Air Quality (CMAQ) funds.

Per the Vanpool Program Guidelines, participating vanpools must have origins or destinations within San Diego County, operate at 80 percent occupancy, and travel a minimum of 20 one-way vehicle miles on San Diego County's highways. Vanpools may have an origin or destination outside of the San Diego County but must demonstrate that they meet the travel distance minimum on the region's highways. While the congestion and environmental benefits of vanpooling expand beyond San Diego County, the travel impacts and GHG emission reduction estimates accounted for in this methodology only account for vanpool travel that occurs within San Diego County. Based on historical program data, participants of the program are those that typically were driving alone to work and travel over 55 miles one-way to work[2].

The SANDAG TDM program, iCommute, has an Employer Services Program that works with major employers throughout the region to develop and implement commuter benefit programs. As part of their work plan, the Employer Services program conducts targeted outreach to host vanpool formation events at employer sites that are suitable candidates for vanpooling. Vanpools in the program represent commuters from diverse employer industries in the region including military, manufacturing, and technology or professional services. Currently one-half of all the vanpools comprise persons that work for the federal government. In addition to the subsidy provided by SANDAG, the federal government subsidizes their commute-related expenses through the federal Transportation Incentive Program (TIP), which is why a substantial number of vanpools in the San Diego region are federal employees. However, any employer contributions, TIP or other, are not tracked or administered by our program. All participants in the SANDAG Vanpool Program receive a monthly subsidy of up to $400 per vanpool and therefore all program impacts are entirely attributed to the SCS.

Assumptions

The following assumptions were incorporated into the off-model calculator for the Vanpool Program. The calculation of VMT reductions was based on the Regional Vanpool Program data specific to the vanpool fleet, as of June 30, 2018. This data included the total number of active vanpools, vehicle type, vanpooler industries, commute trip origin and destination, distance traveled within San Diego County, and vehicle occupancy. Future growth assumptions were based on two growth drivers:

a. Employment growth. Based on existing vanpool program trends, the proportion of vanpoolers relative to the total workers employed in San Diego County will remain approximately constant. Therefore, as the region adds jobs within industries that have historically had higher rates of vanpooling (i.e. military, biotech, federal employers, etc.), it is assumed that enrollment in the Vanpool Program will proportionally grow.

b. Travel time savings. Vanpools in the San Diego region can leverage the exclusive use of managed lanes (High Occupancy Vehicle (HOV), Interstate-15 (I-15) Express Lanes), to shorten their commute time during

[2] Based on FY 2018 Vanpool Program data, the average vanpooled travels a total roundtrip distance of 116 miles. Only vanpool travel that occurs in the San Diego region is accounted for in the off-model calculator. Miles traveled outside of the San Diego County are discounted from the final VMT estimates.

peak travel periods. Nearly half of the participants currently in the Vanpool Program travel in the I-15 Express Lanes. The reliability of the managed lanes makes vanpooling an attractive option. As the region's managed lane network expands, commuters who choose to vanpool, are likely to experience shorter travel times than commuters driving alone. This travel time savings will encourage a shift from driving alone to vanpooling.

Based on historical program participation data, three vanpool markets were defined based on the vanpoolers' employer industry: military vanpools, federal non-military vanpools, and non-federal vanpools. This segmentation was used to calculate employment growth factors that are specific to each of these industries. The travel time savings methodology also varies depending on industry type, since the destinations of the future military vanpools are defined. Other inputs, such as average distance traveled and average vehicle occupancy, also vary by type of industry.

The off-model employed for the Vanpool Program utilize mode-based inputs from the ABM to estimate program impacts, however the calculator outputs remain off-model and do not interact with the ABM. A summary of the principle assumptions underlying the CO2 emission reduction calculation for vanpools is shown in Table 1.

Table 1. Principle Approach to Vanpool CO2 Emissions Calculations

Quantity	Overall Approach	Inputs and Source

Market / Market Growth	• The primary market for vanpooling are commuters with home-to-work trips that are longer than 50 miles one way
	• Vanpool trip origins and destinations are expected to follow the existing trend
	• Vanpool program growth will occur proportionally with employment growth in the region
		• SANDAG Vanpool Program data, aggregated by origin/destination Metropolitan Statistical Area (MSA)
		  o Number of vans in program (FY 2018) by zip code of trip origin and trip destination, and type of employer (federal military, federal non-military, non-federal)
		• SANDAG growth forecast, aggregated by origin/destination MSA
		  o Population and employment by employer industry in each forecast year

Regional Infrastructure Improvements	• Proposed regional managed lane infrastructure investments (HOV lanes and Express Lanes) offer travel time savings to vanpools and are likely to increase demand for vanpooling
	• Change in demand calculated based on elasticity of demand with respect to travel time
		• SANDAG Vanpool Program data
		  o Estimated number of vanpool trips per month
		• SANDAG ABM data
		  o Average one-way weekday travel time (minutes), based on existing vanpool trip origins and destinations
		  o Average travel time savings by trip origin and destination in each forecast year future year, relative to 2016
		  o Marginal disutility of time, in-vehicle time coefficient

Baseline VMT	• Assume that vanpool participants would commute by car in single-occupant vehicles (SOVs), if vanpool is unavailable • Estimate average trip length based on existing program participation	• SANDAG Vanpool Program data o Average trip length
Program VMT	• Estimate Program VMT, based on estimated number of vanpools in forecast year and average vanpool occupancy	• SANDAG Vanpool Program data o Average vanpool occupancy

Quantity	Overall Approach	Inputs and Source
GHG Emission Factors		• SANDAG ABM 14.0.1

GHG Emission Calculator Methodology

CO_2 reductions were calculated following the procedure described below; the principle parameters and data items underlying this method are listed in Table 2.

Vanpool demand due to regional employment growth:

1. To establish the current vanpool demand due to regional employment growth, data was obtained directly from SANDAG's Vanpool Program, reflecting active vanpools as of June 30, 2018. This demand was assumed to be representative of the vanpool fleet during the 2016 baseline year. Over the past five years, the number of active vanpools has fluctuated between 680 and 720 vehicles. The vanpool demand was then tabulated in a trip origin-destination matrix, where the trip origin represented the home location and the trip destination was the work location. Home and work locations were then identified at the level of Metropolitan Statistical Areas (MSA) if they fell within San Diego County, and County, if they fell outside San Diego County.
2. The total number of vanpools were multiplied within the destination MSA by the employment growth rate at the MSA, which was calculated as future year employment divided by 2016 employment. The new vanpools due to employment growth were then distributed to origin MSAs in the proportions observed in 2016.

Vanpool demand due to managed lane infrastructure investments:

3. Compute demand elasticity with respect to travel time. In lieu of observed demand elasticities, elasticity of demand was estimated using a logit mode choice model formulation (see below for details about this formulation).
4. Calculate average MSA to MSA travel time savings, defined as the difference between the travel time experienced when using all available highways, and the travel time experienced using general purpose lanes only (excluding HOV and Express Lanes). For trip origins outside of San Diego County, the travel time savings are computed only over the portion of the trip that occurs within San Diego County. Since the specific location of military bases is known, the travel time savings associated with military vanpools is computed specifically to the zones that comprise the military bases, rather than an average over all of the MSA destinations.
5. Compute the demand induced by travel time savings by applying the demand elasticity formula to the estimate number of vanpools for each scenario year, after accounting for employment growth.

Vanpool VMT and GHG reductions:

6. Calculate VMT reduction, which for each van is equal to the average roundtrip distance within San Diego County, multiplied by the number of passengers (excluding the driver).
7. Calculate the CO_2 reduction corresponding to the VMT reduction and reduction in trip starts using the Emission Factors (EMFAC) 2014 CO_2 emission rates.

Elasticity of Demand Methodology

Elasticity of demand with respect to travel time:

The elasticity of demand for vanpooling with respect to travel time was approximated using the formula for point elasticity derived from a logit model (Train, 1993):

*Elasticity = (coefficient of in-vehicle time) * average travel time * (1 – probability of vanpooling)*

The coefficient of in-vehicle time was obtained from the SANDAG ABM and reflects the value of the mode choice in-vehicle time coefficient for trips on work tours (-0.032 utils/minute).

The *probability of vanpooling* in the region represents the share of daily work trips that are suitable candidates for vanpooling. Based on historical program data and trends, the vanpool program is a suitable and convenient option for commuters that travel a one-way distance of 50 miles or more. Results from SANDAG's 2018 Commute Behavior Survey reveal commuters that exhibit these longer trip characteristics are representative of 2.7 percent of the San Diego employed population (SANDAG, 2018). Given a total employed population in 2016 of approximately 1.6 million workers (Census Bureau, 2016), this resulted in a total of 86,400 work trips that are suitable vanpool candidates. Based on program data, it is assumed that approximately 7,995 vanpool trips occur on an average weekday (699 vans x observed vanpool occupancy of 73% x two trips per day per vanpool participant). The *probability of vanpooling* is then reflected as a share of the actual vanpool trips divided by total work trips that are candidates for vanpooling, or 9.3% (7,995 vanpool trips / 86,400 work trips).

Table 2. Methodology Parameters, Vanpool CO2 Emissions Calculator

Parameter	Source	Details
Current vanpool inventory	Active vanpools as of June 30, 2018, SANDAG Vanpool Program	Inventory of vanpools in operation during base year (2018). Required data for each vanpool includes trip origin, trip destination, employment industry (federal military, federal non-military, non-federal), van capacity, roundtrip mileage. Trip origin and destination aggregated to MSAs if inside San Diego County, and to County if outside San Diego County
Coefficient of in-vehicle travel time	SANDAG ABM 14.0.1 Trip mode choice model, Work tours	SANDAG ABM value (-0.032 utils/minute) used to calculate elasticity of demand with respect to travel time and with respect to trip cost. Input to the demand elasticity formula
Total 2016 San Diego County workers	American Community Survey (2016, 1-Year Release)	Used to calculate vanpool mode market share, an input to the demand elasticity formula (estimated value of 1.6 million workers)
Probability of vanpooling	American Community Survey (2011-2016 5-Year Release); SANDAG Vanpool Program SANDAG 2018 Commute Behavior Survey	Used as an input to calculate elasticity of demand with respect to travel time. Estimated as the proportion total daily work trips that are suitable for vanpooling. Based on vanpool program market trends, it is assumed that daily work trips that are longer than 50 miles (one-way) are suitable for vanpooling .
Average work trips per month		Assumed at 44 work trips per month (22 work days, 2 trips per day). Used to calculate average lease cost per trip (input to demand elasticity calculation)
Average one-way vanpool mileage	SANDAG Vanpool Program Data. Active vanpools as of June 30, 2018. Salesforce report.	Based on SANDAG Vanpool Program data, *excluding distance traveled outside of San Diego County*
Average van capacity (seats)	SANDAG Vanpool Program Data. Active vanpools as of June 30, 2018. Salesforce report.	Based on SANDAG Vanpool Program data
Average van occupancy	SANDAG Vanpool Survey for National Transit Database Reporting, FY 2017/2018	Based on SANDAG Vanpool Program data
Postal zip code centroid coordinates	ESRI USPS zip code area boundary shapefile: https://www.arcgis.com/home/item.html?id=8d2012a2016e484dafaac0451f9aea24	Used to approximate the distance traveled by vanpools outside San Diego County

Parameter	Source	Details
County gateway centroids	US Census Bureau TIGER line file https://www.census.gov/geo/maps-data/data/tiger-line.html	Used to approximate the distance traveled by vanpools outside San Diego County. Gateways are assumed as follows, based on home county: • Los Angeles and Orange counties: Interstate 5 • Riverside and San Bernardino counties: Interstate 15 • Imperial county: Interstate 8

Calculator Inputs

Table 3 summarizes the calculator inputs for each future year scenario.

Table 3. Scenario Inputs, Vanpool CO2 Emissions Calculator

Data Item	Source	Required Input Data
Employment forecast	Draft Series 14: 2050 Regional Growth Forecast/San Diego Forward: The Regional Plan in ABM 14.0.1	For each scenario year and MSA: • Jobs by industry category
Regional Population Forecast	Draft Series 14: 2050 Regional Growth Forecast/San Diego Forward: The Regional Plan in ABM 14.0.1	For each scenario year: • Total employment
Travel times, non-military base destinations	SANDAG ABM 14.0.1	For each scenario year[3]: • TAZ-to-TAZ travel time, general purpose lane (AM_SOVGPM_TIME) • TAZ-to-TAZ travel time, managed lane (AM_HOV2TOLLM_TIME)
Travel times, military base destinations	SANDAG ABM 14.0.1	For each scenario year[4]: • TAZ-to-TAZ travel time, general purpose lanes (AM_SOVGPM_TIME) • TAZ-to-TAZ travel time, managed lanes (AM_HOV2TOLLM_TIME)
Emission factors	EMFAC 2014, SANDAG ABM 14.0.1	For each scenario year: • Trips (cold starts) regional emissions (ton) • Running CO2 regional emissions (ton) • Regional VMT • Regional trips

[3] Vanpool travel times were averaged to the MSA at both the trip origin and destination using an R Script, see traveltimesavings.R

[4] Since military base locations are known, the travel times of military vanpools were averaged to the MSA at the trip origin and base location TAZ(s) using an R Script, see traveltimesavings.R

Results

Table 4 summarizes the vehicle trip results, VMT and CO2 reductions attributed to the Regional Vanpool Program for each future year scenario.

Table 4: Regional Vanpool Program VMT and GHG Emission Reductions

Variable	2025	2035	2050
Total daily vehicle trip reductions	Final results pending selection of the preferred network scenario		
Total daily VMT reductions			
GHG reduction due to cold starts (short tons)			
GHG reduction due to VMT (short tons)			
Total daily GHG reduction (short tons)			
Total population			
Daily per capita GHG reduction (lbs/person)			
Daily per capita GHG reduction, change in percent			

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CARSHARE

Program Description

Carshare is a shared mobility service highlighted in San Diego Forward: The 2019-2050 Regional Plan and an important component of the Regional Mobility Hub Strategy. Mobility hubs are places of connectivity where different modes of travel – walking, biking, transit, and shared mobility – converge and where there is a concentration of employment, housing, shopping, and/or recreation.

Carshare can provide connections to transit or fill gaps in a region's transit services, by providing an efficient transportation alternative that reduces reliance on the private automobile. By providing members with access to a vehicle for short-term use, a carshare service provides some of the benefits of a personal vehicle without the costs associated with owning one. As of January 2019, the San Diego region currently has two carshare service providers, Zipcar and Getaround. Zipcar provides roundtrip carshare service and Getaround operates a peer-peer carsharing service. Shared vehicles are distributed across a network of locations (or specified service area) within communities. Members can access the vehicles at any time with a reservation and are charged by time or by mile. In support of regional mobility hub planning efforts[5], the SANDAG TDM program seeks to promote and encourage the provision of carshare within the region's employment centers, colleges, and military bases.

Assumptions

The carsharing methodology described in this memo only accounts for VMT and GHG emission benefits associated with roundtrip carshare service. The peer-peer carshare service provider, Getaround, has only been operating in San Diego since November 2018 and observed impacts in the region are unknown. Car2go, a free-float carshare service provider in San Diego, ceased operations in the region in 2016 leaving Zipcar as the only carshare service provider in the region at the time. While the off-model calculator is able to account for the VMT reduction impacts of free-floating carshare service, it is assumed that this type of service will not return to the San Diego region due to the rise and popularity of on-demand ride-hailing service providers like Uber, Lyft, and Waze Carpool.

Research indicates that households that participate in carsharing tend to own fewer motor vehicles than non-member households (Martin et al, 2016). With fewer cars, carshare households shift some trips to transit and non-motorized modes, which helps to contribute to overall trip-making reductions. Estimates of the VMT reductions attributed to carshare participation have been reported to be seven fewer miles per day (Cervero, 2007) and up to 1,200 miles per year (Martin and Shaheen, 2010) for roundtrip carshare. A survey of car2go users in five North American cities, including San Diego[6], found that carshare households reported decreases in VMT ranging from 6 to 16 percent, with San Diego users reporting an average 10 percent VMT reduction, or approximately 1.4 miles per day (Martin and Shaheen, 2016). Similar behavior has been reported for participants in London's free-floating carshare service, with carshare members exhibiting a net decrease in VMT of approximately 1.5 miles per day (LeVine et al, 2014).

Based on market trends in the San Diego region, it is expected that carshare will remain a viable transportation option in neighborhoods that exhibit similar supporting land uses as those where carsharing is provided today. In support of regional mobility hub planning efforts, the SANDAG TDM program seeks to promote and encourage the provision of carshare within the region's employment centers, colleges, and military bases (Figure 1). Given the rapid trend towards automation, it is assumed that carsharing will be replaced by a fleet of shared and autonomous vehicles by the year 2050, therefore carshare coverage areas are only defined up until 2035. Within these defined carshare service areas, it is assumed that participation in the carshare program may vary depending on the supporting density characteristics (Transportation Sustainability Center, 2018). The population density thresholds that support carshare

[5] To learn more about SANDAG mobility hub efforts, visit www.sdforward.com/mobilityhubs

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participation in the region are based on the Car2Go service area prior to their exit from the San Diego market. Based on the 2016-2017 San Diego Regional Transportation Study (SANDAG, 2017) and available research on carshare participation rates, it is assumed that areas with a population greater than 17 people/acre will have a 2 percent participation rate. Areas with a population density lower than 17 people/acre will have a 0.5 percent participation rate. These density thresholds are specific to carshare trends exhibited in the San Diego region.

Carshare fleets are typically comprised of vehicles that are more fuel-efficient than the personally-owned vehicles. Some carshare providers offer a fleet at least partially comprised of zero-emission vehicles (ZEVs). The vehicle efficiency gains have been reported at 29 percent for roundtrip carshare (Martin and Shaheen, 2010) and 45 percent for one-way carshare (Martin and Shaheen, 2016). To avoid overestimation and to ensure that GHG emission reductions associated with fleet efficiencies are only captured in the SANDAG Electric Vehicle Programs off-model calculator, the carshare methodology does not account for fuel-efficiency of carshare vehicle fleets.

A summary of the principle assumptions underlying the CO2 emission reduction calculation for carshare is shown in Table 5.

Table 5: Principle Approach to Carshare CO2 Emissions Calculations

Quantity	Overall Approach	Inputs and Source

Market / Market Growth	• Estimate future carshare users based on population living in areas dense enough to support carsharing
	• Estimate carshare demand within three types of markets:
	  ○ Employment centers
	  ○ Colleges and universities
	  ○ Military bases
		• Define carshare coverage areas that are projected to offer carshare services
		  ○ Employment centers
		  ○ Colleges and universities
		  ○ Military bases
		• SANDAG ABM data
		  ○ Driving-age population in each future year by MSA
		• Share of the population that participates in carshare (2 percent in higher density areas and 0.5 percent in lower density areas based on data from the 2016-2017 San Diego Regional Transportation Study (SANDAG, 2017) and Puget Sound Region (Petersen et al, 2016)
		• A density threshold of 17 persons per acre is used to differentiate between participation in higher density and lower density areas based on the car2go service area prior to their exit from the San Diego market

Project VMT	• Estimate carshare VMT reduction based on roundtrip and one-way carshare case studies ○ It is assumed that free-float carshare service like Car2go will not return to the San Diego region due to the rise and popularity of on-demand ride-hailing service providers like Uber, Lyft, and Waze Carpool.	• 7 miles per day, traditional carshare (Cervero et al, 2007) • 1.1 miles per day, one-way (Martin and Shaheen, 2016)[7]
GHG Emission Factors	Note: No efficiency gains assumed relative to the region's carshare vehicle fleet. Emission reductions associated with vehicle fleet types are	SANDAG ABM 14.0.1

[7] Since there is currently no one-way carshare service provider in the region, the off-model calculator does not account for a VMT or GHG reduction from a one-way or free-floating service.

	captured in the Electric Vehicle Programs off-model calculator	

GHG Emission Calculator Methodology

The CO2 reduction attributed to the three carshare markets—general population, colleges, and military bases—is calculated following the procedures described below; the principle parameters and data items underlying these methods are listed in Table 6.

Carshare participation:

1. Identify the carshare service coverage areas. In support of regional mobility hub planning efforts, the SANDAG TDM program seeks to promote and encourage the provision of carshare within neighborhoods that exhibit similar supporting land uses as those where carsharing is provided today such as the region's employment centers, colleges, and military bases (Figure 1):
    a. General Population: These areas are defined as agglomerations of MGRAs and aggregated by MSA. The coverage areas could vary by scenario year, reflecting increasing land use density and a maturing carshare industry.
    b. College Staff and Students: Identify colleges and university areas where carshare services will operate in each scenario year. These areas are defined as agglomerations of MGRAs and aggregated by MSA.
    c. Military: Identify military bases where carshare services will operate in each scenario year. The military bases are defined as agglomerations of MGRAs and aggregated by MSA.
2. Calculate eligible population for carsharing:
    a. General Population: Estimate the eligible population for carsharing, which reside within the defined carshare coverage area boundaries and are persons older than 18 years old and younger than 65 years old.
    b. College Staff and Students: The eligible student population that are potential carshare participants corresponds to the total students enrolled (full-time and part-time) in each college/university campus and total staff employed at each campus.
    c. Military: Estimated carshare participants within the region's military bases corresponds to the employment at each base.
3. Calculate the carshare participation, defined as 2 percent of the eligible population in higher density areas and 0.5 percent of the eligible population in lower density areas. The population density thresholds that support carshare participation in the region are based on the Car2Go service area prior to their exit from the San Diego market.. Colleges and military bases, participation rates are assumed equal to higher density area carshare participation rates or 2 percent of the eligible population.

Carshare VMT and GHG reductions:

4. Calculate the VMT reduction from roundtrip carshare, assuming a daily average reduction of seven miles per day per roundtrip carshare member (Cervero et al, 2007).
5. Calculate the CO2 reduction corresponding to the VMT reduction, using the EMFAC 2014 CO2 emission rates.

Figure 1: Draft 2035 Carshare Coverage Areas

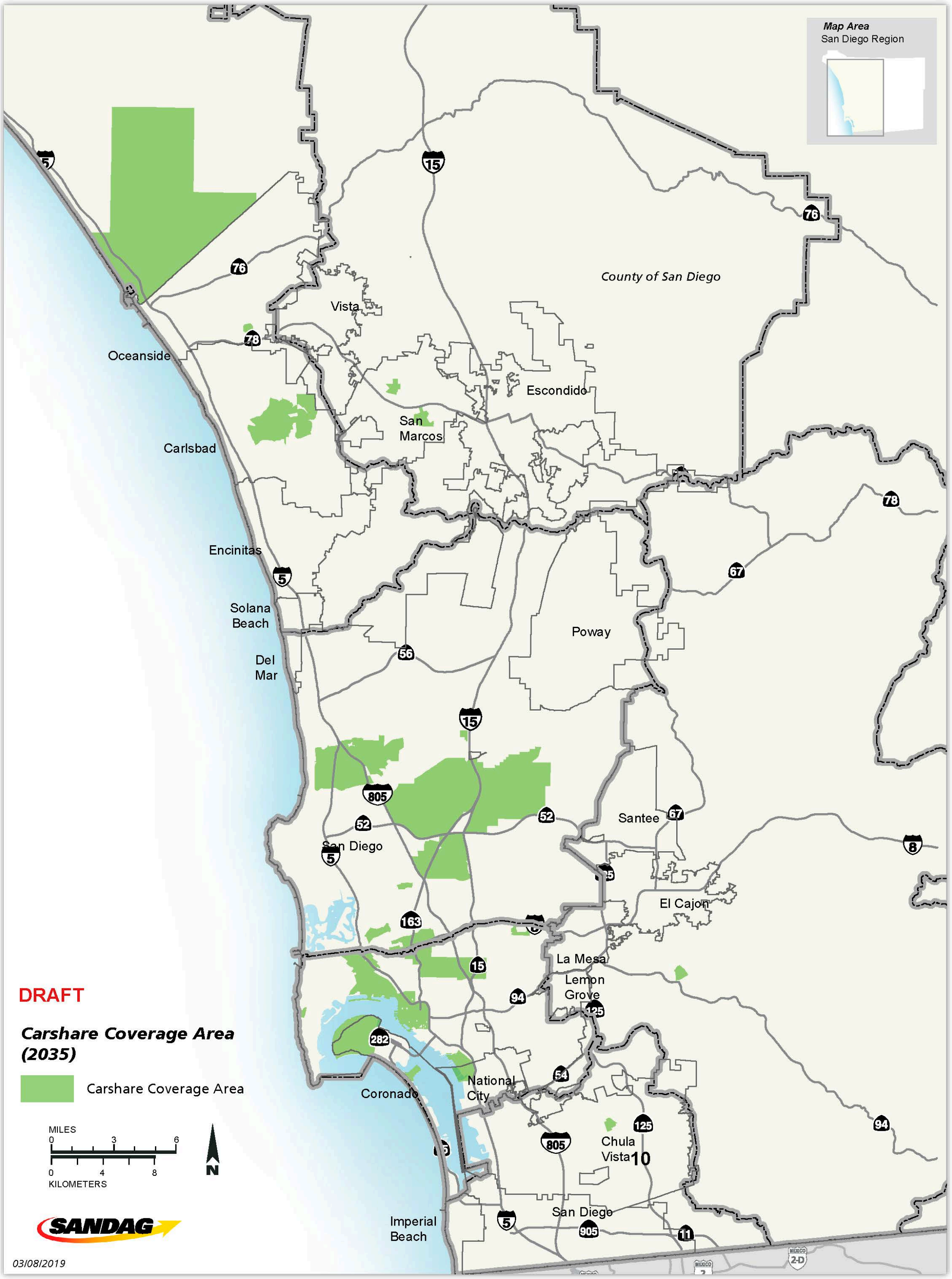

Table 6: Methodology Parameters, Carshare CO2 Emissions Calculator

Parameter	Source	Details
Carshare participation rate, higher density areas	2016-2017 San Diego Regional Transportation Study (SANDAG, 2017)	The 2016-2017 San Diego Regional Transportation Study reports that approximately 2 percent of the San Diego population are carshare participants. In the San Diego region, coverage areas with a population density greater than 17 persons per acre are assumed to reflect these participation rates.
Carshare participation rate, lower density areas	Petersen et al, 2016	Data for the Puget Sound region indicates that carshare participation in the Seattle-Bellevue-Redmond area is 2 percent in urban neighborhoods and 0.5 percent in suburban neighborhoods. In the San Diego region, coverage areas with a population density less than 17 persons per acre are assumed to reflect the participation rates of lower density neighborhoods in the Puget Sound region.
Carshare participation rates, college employees and students		Local data on the carshare participation at colleges is unavailable. Participation rates are assumed equal to higher density area carshare participation rates.
Carshare participation rates, military bases		Local data on the carshare participation at military bases is unavailable. Participation rates are assumed equal to higher density area carshare participation rates.
Daily VMT reduction, roundtrip carshare	Cervero et al, 2007	Estimated based on data for San Francisco's City CarShare service (7.0 miles per day)

Calculator Inputs

Table 7 summarizes the calculator inputs for each future year scenario.

Table 7: Scenario Inputs, Carshare CO2 Emissions Calculator

Data Item	Source	Required Input Data
Population and employment	Draft Series 14: 2050 Regional Growth Forecast/San Diego Forward: The Regional Plan in ABM 14.0.1	For each scenario year and MGRA: • Total population • Adult population (population 18-65 years old) • Total employment • Population density (total population / MGRA area in acres) • College student enrollment
Emission factors	EMFAC 2014, SANDAG ABM 14.0.1	For each scenario year: • Trips (cold starts) regional emissions (ton) • Running CO2 regional emissions (ton) • Regional VMT • Regional trips
Carshare coverage, General population	Draft San Diego Forward: The 2019-2050 Regional Plan	For each scenario year: o Carshare flag (1 if carshare operates in MGRA, 0 otherwise)
Carshare coverage, Colleges and universities	Draft San Diego Forward: The 2019-2050 Regional Plan	For each scenario year: o College/university flag (1 if carshare operates in college/university)
Carshare coverage, Military bases	Draft San Diego Forward: The 2019-2050 Regional Plan	For each scenario year: o Military base flag (1 if carshare operates on military base, 0 otherwise)

Results

Table 8 summarizes the vehicle trip, VMT and CO2 reductions attributed to carshare for each future year scenario.

Table 8: Carshare VMT and GHG Emission Reductions

Variable	2025	2035	2050
Total daily vehicle trip reductions	Final results pending selection of the preferred network scenario		
Total daily VMT reductions			
GHG reduction due to cold starts (short tons)			
GHG reduction due to VMT (short tons)			
Total daily GHG reduction (short tons)			
Total population			
Daily per capita GHG reduction (lbs/person)			
Daily per capita GHG reduction, change in percent			

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BIKESHARE

Program Description

Shared bicycle (bike) systems, also known as bikeshare, provide members of the public access to a fleet of bicycles for short trips in exchange for a fee. Bikeshare initially started out as station-based systems, in which the bicycles were borrowed from, and returned to designated docking stations. More recently, bikeshare providers have deployed bicycles and scooters equipped with payment technology and locks to allow users to pick them up, ride them, and drop them off anywhere within the service area. These systems are known as dockless bikeshare and scootershare systems.

The first bikeshare system in San Diego County, Discover®Bike, started operating in 2014, with plans to operate 1,800 bicycles and have 180 stations (City of San Diego, 2013). In 2017, Lime (formerly known as LimeBike), Mobike and ofo entered the San Diego market, offering traditional and pedal-assist dockless bikeshare and scootershare, expanding the bikeshare supply from a few hundred units to 3,000 to 5,000 units in less than one year of operations[8]. Additionally, several electric scootershare services (Razor, Bird, and others), established dockless operations within the City of San Diego in 2018. As of January 2019, Mobike and ofo ceased their dockless operations within San Diego. In March 2019, the City of San Diego announced that it had terminated its contract with station-based bikeshare provider, Discover®Bike, leaving only two dockless bikeshare providers, Lime and JUMP (Bowen, 2019). Lime offers traditional dockless bikes, electric scooters, and pedal-assist (electric) bikes; JUMP operates an all-electric bikeshare fleet.

SANDAG launched a Regional Micromobility Coordination effort among municipalities, transit agencies, universities, and military to establish best practices for effective micromobility operations. Micromobility refers to services like dockless bikeshare, e-scooters, and neighborhood electric vehicles (NEVs). At the March 7, 2019 Regional Micromobility Coordination meeting, local jurisdictions that partner with Lime announced that Lime is retiring traditional pedal bikes from its fleet and will be transitioning to an all-electric service.

Assumptions

The following assumptions informed the development of the bikeshare off-model calculator. It is assumed that bikeshare reduces GHG emissions by enabling users to take short-distance trips by bicycle instead of by automobile. In some cases, bikeshare can eliminate longer trips by enabling users to connect to transit. The shared service could also displace some walk trips, particularly when electric-assist options are available. The average trip distance of station-based bikeshare deployed for transit integration varies in the 1.3 to 2.4-mile range (Hernandez, 2018). In the 2017 Year End Report, ofo indicated that 80 – 90% of trips are less than 3 miles, which aligns with trip distances reported by bikeshare systems operating in other U.S. metropolitan areas in the 2.0 to 4.5-mile range. In San Diego County, anonymized and aggregated data from bikeshare operations indicated an average distance of 1.2 miles per pedal bike in 2018. Although other bikeshare operators within the U.S. reflect longer bikeshare trip distances, the data provided by local bikeshare operators was used to inform VMT & GHG reduction estimates to ensure bikeshare trip making assumptions conservatively reflect the San Diego market. An average car substitution rate of 20% for non-pedal assist bicycles is based on data from eight bikeshare systems operators in the U.S. (Table 10).

It is also assumed that the increasing availability of pedal-assist e-bikes and scooters will extend the range of bikeshare trip distances, facilitating travel by bike and scooters, opposed to driving alone in an automobile. Research conducted in North America and Europe that has tracked the utilization of pedal-assist bicycles owned or leased by their users, indicates that the average trip distance of e-bike trips is twice the distance traveled with regular bicycles (Cairns et al, 2017). In San Diego County, anonymized and aggregated data from bikeshare operators indicate an average distance

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[8] Based on fleet estimates provided by Transit App in April 2018. Estimates were based on the number bikes that were available and not reserved at 5:00 AM P.T.

of 1.7 miles for e-bikes and e-scooters combined in 2018. Similarly, recent case study research on the JUMP bikeshare system in San Francisco, which also operates in the San Diego region, estimates that the average e-bike trip distance is 1.9 miles per trip. E-bike owners report car substitution rates of 37 percent for non-commute trips and 64 percent for commute trips (MacArthur et al, 2018), which are more than twice the average car substitution rates reported by various station-based traditional bikeshare systems. In its 2018 End of Year Report, Lime reports an average substitution rate of 37 – 40% based on operations in Los Angeles, Austin, Seattle, Atlanta, and Kansas City.

As part of the development of the Regional Plan and Sustainable Communities Strategy (SCS), SANDAG is planning for an expansion of the regional bikeway network. The attractiveness of biking in general, and bikeshare more specifically, will grow as cities build infrastructure that separates bicyclists from moving motor vehicles. The SANDAG ABM accounts for the impact of bikeway investments on personally-owned bike trip generation. However, this only accounts for the impact on personally-owned bike trips and not bikeshare trips resulting from these investments. Recently published research on New York's Citi Bikeshare system indicates that each new lane-mile of dedicated bike infrastructure results in an average of 102 additional bikeshare trips per day (Xu and Chow, 2018).

Based on the success of current bikeshare operations within San Diego County, coverage areas were defined to delineate where bikeshare operations are projected to be available (Figure 2). The bikeshare coverage areas are based on staff knowledge of interest or plans to pursue bikeshare operations within certain jurisdictions, in colleges and universities, military bases and SANDAG Smart Growth Opportunity Areas[9], which reflect a similar mix of land uses and density observed in current bikeshare operations. Staff is currently working with the cities in the North County Coastal region to deploy a bikeshare program and is actively involved in bikeshare deployment via SANDAG's Regional Micromobility Coordination Working Group. Through this working group, SANDAG is in the process of developing a micromobility data sharing clearinghouse to facilitate data collection and analysis of micromobility service operations in the region. This data will support regional planning activities and evaluation of micromobility travel patterns that may be used to augment this methodology in the future.

A summary of the principle assumptions underlying the CO2 emission reduction calculation for bikeshare is shown in Table 9.

Table 9: Principle Approach to Bikeshare CO2 Emissions Calculations

Quantity	Overall Approach	Inputs and Source
Market / Market Growth	• Estimate utilization from experience of bikeshare systems in operation in U.S. cities	• Define coverage areas that are projected to offer bikeshare services • SANDAG ABM data o Population in coverage area for each forecast year by MSA
Supply	• Number of bikes per 1,000 persons in bikeshare coverage area	• Average bike supply for U.S. bikeshare systems (The Bikeshare Planning Guide and other sources) • Higher bike supply density assumed in parts of the county by MSA to reflect providers responding to more demand (The Bikeshare Planning Guide)
Regional Infrastructure Improvements	• Estimate increase in bikeshare trips due to regional bicycle infrastructure investments (new bike lane miles)	• An additional 102 bikeshare trips induced for each additional bike lane mile (Xu and Chow, 2018) • SANDAG ABM data o Miles of bike lanes for each forecast year based on 2016 Active Transportation Networks

[9] SANDAG Smart Growth Opportunity Areas. https://www.sandag.org/uploads/projectid/projectid_296_13994.pdf

Quantity	Overall Approach	Inputs and Source
Program VMT	• VMT reduction estimated based on substitution rate of auto trips, and average bikeshare trip length	• Inputs obtained from reported data for various U.S. bikeshare systems: o Average bikeshare trips per bike (pedal and e-bike) o Percent of trips that would have used a car o Average trip length • Differentiate utilization of traditional bikes and e-bikes, given research that indicates the latter are used for longer trips (Cairns et al, 2017)
GHG Emission Factors		• SANDAG ABM 14.0.1

GHG Emission Calculator Methodology

The CO2 reduction attributed to bikeshare and scootershare was calculated following the procedures described below.

Bikeshare membership within the region:

1. Identify the bikeshare service coverage areas. The bikeshare coverage areas reflect a similar mix of land uses observed in current bikeshare operations including SANDAG Smart Growth Opportunity Areas, colleges and universities, military bases, and ongoing local agency initiatives to deploy bikeshare operations. These areas are defined as agglomerations of MGRAs and aggregated by MSA. The coverage areas could vary by scenario year, reflecting increasing land use density and a maturing bikeshare industry (Figure 2).
2. Calculate the total population in the bikeshare coverage area, including persons living in non-institutional group quarters (e.g., college dormitories).
3. Estimate the projected bicycle supply, given the size of the population in the bikeshare area. The recommended minimum supply of bicycles, based on station-based system data, is 10-30 bicycles per 1,000 persons (ITDP, 2014). A supply of ten bicycles per person was assumed for the most urbanized and well-visited areas of San Diego County (Central and North City MSAs), while a supply of five bicycles per person was assumed for the other less-dense areas.
4. Estimate the total number of daily bikeshare trips. Based on data reported by various U.S. bikeshare systems, the bikeshare daily trip rates for the San Diego region are estimated to be within 1.2 – 2.3 daily trips per bike. The derivation of these trip rates is described below in the *Bikeshare System Trip Rates* section. Recent research conducted on San Francisco's bikeshare services, revealed that the JUMP bikeshare system observed an average of 2.8 average daily trips per bike (Lazarus, J. et al, 2019). Although higher than the trip rates input used in this off-model methodology, this research helps to further validate the conservative approach and inputs employed in this methodology.

Bikeshare demand due to bikeway infrastructure and fleet types:

5. Estimate the induced demand for biking resulting from investments in bicycling infrastructure. An induced demand of 102 daily bikeshare trips per new bike lane-mile was estimated based on data from Citi Bikeshare (Xu and Chow, 2018).
6. Estimate the number of bikeshare trips that are taken in pedal-assist bicycles. Based on e-bike data provided by local operators and shared mobility industry trends that favor more electric-assisted devices in the future, SANDAG staff estimates that 100 percent of all bikeshare trips will be made via an e-bike or e-scooter by 2020. As of March 2019, the San Diego region will have two primary bikeshare operators, Lime and JUMP. As of early in 2019, Lime is transitioning its fleet to all-electric (pedal-assist and e-scooters) while JUMP

operates an all-electric fleet (pedal-assist and e-scooters) in the region. Given the industry trend towards fleet electrification since bikeshare operations initiated in 2014 in the region, staff estimates that 100 percent of the fleet will be electric in 2020.

Bikeshare VMT and GHG reductions:

7. Calculate the proportion of bikeshare trips that replace a car trip. Car substitution rates are assumed to be 20 percent for traditional bikeshare and 37 percent for pedal-assist bikes, following the rates reported in the research cited above.
8. Calculate the VMT reduction resulting from the car trips replaced by bikeshare trips. Based on anonymized and aggregated data from 2018 bikeshare operations in the region, the average trip length for traditional pedal bikes is 1.2 miles and 1.7 miles for pedal-assist bikes and scooters, combined.
9. Calculate the corresponding CO2 reduction corresponding to the VMT reduction, using the EMFAC 2014 CO2 emission rates.

Bikeshare System Trip Rates

Since bikeshare trip generation rates for the San Diego region are unavailable, trip rate estimates are based on information from other U.S. bikeshare systems. Bikeshare operators in the San Diego region did not provide bikeshare trip generation estimates. Table 10 presents the relevant data gathered from multiple sources and is documented in the References section. A regression model was estimated using the following form:

$$\frac{Trips}{bicycle} = \beta \times \frac{Bikes}{1{,}000\ Persons}$$

Bikeshare trip information from operations in the U.S. resulted in a trip rate multiplier (β) of 0.23 applied to the bike supply density (bicycles per 1,000 persons in the coverage area).

The principle parameters and data items underlying the bikeshare CO2 emission calculations are listed in Table 11.

Table 10: Bikeshare System Utilization Data

City	Bikeshare System	Population in bikeshare coverage area	Annual members	Number of bicycles	Average daily bikeshare trips	Bikes per 1000 persons in coverage area	Average daily rides per bicycle
Washington DC	Capital Bikeshare	225,000	18,000	1,800	5,502	8.0	3.1
Minneapolis	Nice Ride Minnesota	190,000	3,500	1,325	735	7.0	0.6
Seattle	Seattle DOT	600,000	n/a	1,200	1,929	2.0	1.6
Portland	Portland BOT	210,000	3,519	464	858	2.2	1.9
New York	Citi Bike	814,000	19,692	9,242	57,897	11.4	6.3
Boston	Blue Bikes	179,904	14,577	1,800	3,600	10.0	2.0
Denver	Denver Bikeshare	190,242	2,111	800	972	4.2	1.2
San Antonio	San Antonio Bikeshare	33,281	11,488	500	179	15.0	0.4

Figure 2: Draft 2035 Bikeshare Coverage Areas

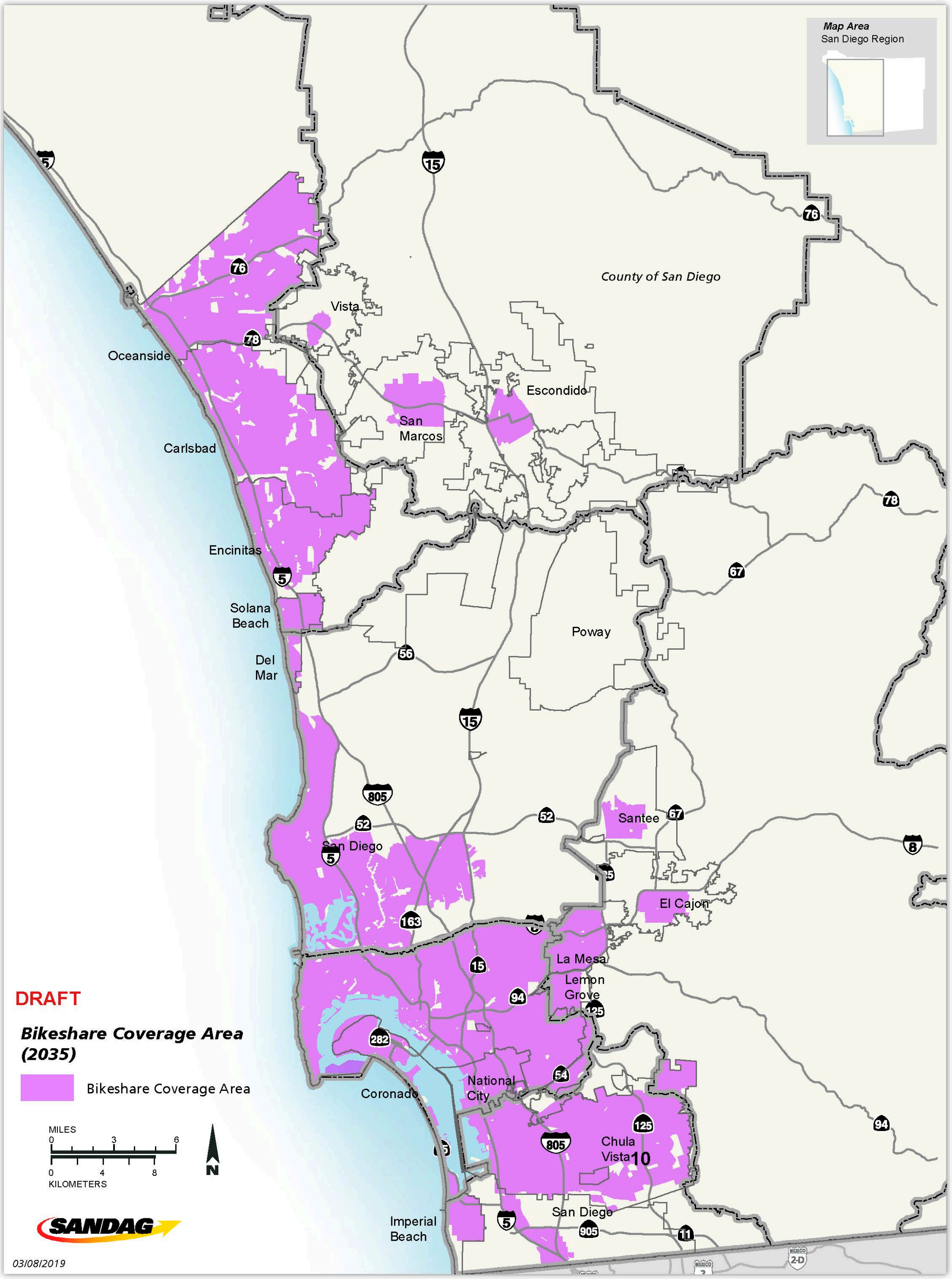

Table 11: Methodology Parameters, Bikeshare CO2 Emissions Calculator

Parameter	Source	Details
Bikeshare trip rate	Capital Bikeshare, 2012 Nice Ride Minnesota, 2010 Seattle DOT, 2018 Portland BOT, 2017 NYC Citi Bike, 2017 Blue Bikes Boston, 2017 Denver Bikeshare, 2016 San Antonio Bikeshare, 2017	Based on the estimated bikeshare fleet size within the respective MSA, the bikeshare trip rate is estimated at 2.3 daily trips per bike for Central and North City MSA, 1.2 daily trips per bike for the rest of MSAs.
Bikeshare bike supply	Bikeshare Planning Guide (ITDP, 2014)	Assumed at 10 bicycles per 1,000 persons in the Central and North City areas, and at 5 bicycles per 1,000 persons elsewhere in San Diego County.
Induced demand due to bike-lane infrastructure	Xu and Chow, 2018	Estimated at 102 additional daily bikeshare trips per bike lane-mile.
Percent of electric-assisted bikes and scooters	Draft San Diego Forward: The 2019-2050 Regional Plan	Based on the market trend towards more electric assisted devices in the future and local operator shift towards operating primarily all-electric bike fleets.
Car substitution rate, traditional bicycles	Capital Bikeshare, 2012 Nice Ride Minnesota, 2010 Seattle DOT, 2018 Portland BOT, 2017 NYC Citi Bike, 2017 Blue Bikes Boston, 2017 Denver Bikeshare, 2016 San Antonio Bikeshare, 2017	Estimated as the average car substitution rate of U.S. bikeshare systems, or 20 percent.
Car substitution rate, pedal-assist bicycles	MacArthur et al, 2018 Lime Year-End Report 2018.	Estimated at 37 percent, based on reported utilization of shared e-bikes across multiple pilot studies. In the 2018 End of Year Report, Lime reports an average substitution rate of 37 – 40% based on its operations in Los Angeles, Austin, Seattle, Atlanta, and Kansas City.
Average trip distance, traditional bicycles	Based on anonymized and aggregated data provided by bikeshare operators in the region	Based on anonymized and aggregated data from 2018 bikeshare operations in the region, the average trip length for traditional pedal bikes is 1.2 miles. Similarly, TCRP 2018 research on average trip distance for station-based bikeshare ranges from 1.3 to 2.4 miles per trip (Hernandez et al, 2018).
Average trip distance, pedal-assist bicycles	Based on anonymized and aggregated data provided by bikeshare operators in the region	Based on anonymized and aggregated data from 2018 bikeshare operations in the region, the average trip length for pedal-assist bikes and scooters 1.7 miles. Similarly, e-bike trip characteristics from JUMP bikeshare in San Francisco, California indicate that the average e-bike trip distance is 1.9 miles per trip (Lazarus, J. et al, 2019).

Calculator Inputs

Table 12 summarizes the calculator inputs for each future year scenario.

Table 12: Scenario Inputs, Bikeshare CO2 Emissions Calculator

Data Item	Source	Required Input Data
Population and employment	Draft Series 14: 2050 Regional Growth Forecast/San Diego Forward: The Regional Plan in ABM 14.0.1	For each scenario year and MGRA: • Total population
Bikeway lane miles	Draft San Diego Forward: The 2019-2050 Regional Plan	For each scenario year and MSA: • Total bikeway lane miles in each MSA (Class I, Class II, and Class III bikeway segments)
Bikeshare coverage	Draft San Diego Forward: The 2019-2050 Regional Plan	For each scenario year: • Bikeshare flag (1 if bikeshare operates in MGRA, 0 otherwise)
Emission factors	EMFAC 2014, SANDAG ABM 14.0.1	For each scenario year: • Trips (cold starts) regional emissions (ton) • Running CO2 regional emissions (ton) • Regional VMT • Regional trips

Results

Table 13 summarizes the vehicle trip, VMT and CO2 reductions attributed to bikeshare.

Table 13: Bikeshare VMT and GHG Emission Reductions

Variable	2025	2035	2050
Total daily vehicle trip reductions	Final results pending selection of the preferred network scenario		
Total daily VMT reductions			
GHG reduction due to cold starts (short tons)			
GHG reduction due to VMT (short tons)			
Total daily GHG reduction (short tons)			
Total population			
Daily per capita GHG reduction (lbs/person)			
Daily per capita GHG reduction, change in percent			

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POOLED RIDES

Program Description

The pooled rides strategy utilizes application (app)-enabled services to facilitate carpooling in the region by matching drivers with passenger who are traveling in the same direction. These app-enabled services have the potential to fill empty seats, increase average vehicle occupancies, and reduce traffic congestion. GHG reductions would be realized whenever travelers shift from driving alone to app-enabled carpooling; without adequate policies in place, pooled ride users may also shift from other modes, like transit, bike, or walking.

There are a few common examples of app-enabled pooling services to date. Transportation Network Companies (TNC) offer the option of pooling rides from independent travel parties that share a similar trip origin and destination. The “pooled” ride options offered by Uber and Lyft (Uber Pool and Lyft Line, respectively) incentivize carpooling by offering a discount on the price of individual rides. Similarly, Waze Carpool provides dynamic ridesharing services by matching drivers with potential carpool partners on a per-ride basis. Passengers reimburse the driver based on the miles traveled and the IRS mileage reimbursement rate.

SANDAG recently launched a carpool incentive program with technology partner, Waze. The carpool incentive program provides a trip subsidy to eligible employees to help encourage carpooling. The SANDAG ABM model accounts for some carpool travel within the model’s shared ride mode categories. However, due to insufficient and limited data, the model is unable to explicitly account for the impact of carpool incentive programs or carpooling activity associated with new app-enabled services. SANDAG plans for the continued implementation of a carpool incentive program based on the Waze Carpool model that will provide a small trip subsidy to passengers, further incentivizing the use of carpooling. It is assumed that participation in the program will be administered by the iCommute Employer Services team, which will determine program eligibility for the carpool trip subsidy. The program will subsidize eligible employees that currently drive alone to work and are not suitable candidates for commuting by vanpool, microtransit, or transit.

Assumptions

The following assumptions were incorporated into the pooled rides off-model calculator. To date, there is very little research information on pooled rides. TNCs that offer pooled services do not share adequate trip data on pooling activity. Uber reports that 20 percent of their rides globally, and 30 percent of the rides in New York and Los Angeles, are on Uber Pool (Tech Crunch, 2016), however, it is not necessarily the case that a ride on Uber Pool is, in fact, a pooled ride. Moreover, the total number of rides served by Uber and Lyft in San Diego is unknown. Therefore, the off-model methodology for pooled rides only accounts for pooled services following the Waze carpool model. To estimate the impacts of app-enabled pooled rides throughout the region, regional survey data of app-enabled ridesharing activity was used as a proxy to estimate pooled ride use. The survey data collected did not differentiate between the different app-enabled rideshare models that were used for travel; such as dynamic carpooling like Waze Carpool or on-demand ride-hailing services like Uber or Lyft.

SANDAG used app-enabled pooled ride utilization data that was gathered through the 2016-2017 San Diego Regional Transportation Study and 2018 Commute Behavior Survey. As shown in Table 14, the app-enabled rideshare mode share decreases with increasing auto ownership. Self-administered internet-based surveys conducted in several U.S. metropolitan areas reported that on-demand ride-hailing use was predominantly for discretionary travel, with few users indicating it was their primary mode for work trips (Clewlow and Mishra, 2017). Contrary to this expectation, the 2016-2017 San Diego Regional Transportation Study reports that app-enabled ride-hailing utilization is higher for work than for non-work trips. A second difference relates to how utilization is reported; the nationwide study reports the frequency of ride-hailing, while the limited availability of San Diego data was used to estimate app-enabled ride-hailing mode shares. Since work trips account for roughly only 20 percent of all person trips, in terms of trip frequency, there are more discretionary trips than work trips, even if the relative mode share of ride-hailing for discretionary trips is lower than for work trips.

The 2016-2017 San Diego Regional Transportation Study did not ask respondents to indicate whether they hailed a shared or pooled app-enabled trip. However, limited information on app-enabled ride-hailing use was available from the 2018 Commute Behavior Survey. As shown in Table 14, the proportion of all app-enabled ride-share trips that were pooled is highest for workers from 0-car households and decreases rapidly with increasing auto ownership. The total number of pooled rides taking place in the San Diego region was calculated by applying the mode shares in Table 14 to estimates of total person trips predicted by the SANDAG ABM.

Table 14: Pooled Ride Mode Shares, San Diego Region

	2018 Commute Behavior Survey	**2016-2017 San Diego Regional Transportation Study**	
Ride-hailing mode	Work trips	Work trips	Non-work trips
All app-enabled ride-hailing trips			
0-car household	5.97%	19.28%	8.10%
1-car household	1.87%	0.87%	0.32%
2+ car household	0.20%	0.36%	0.11%
Proportion of ***pooled*** app-enabled ride-hailing trips			
0-car household	50%		
1-car household	43%	n/a	n/a
2+ car household	14%		

Based on ABM data, a two-step process was applied to predict the number of app-enabled pooled ride trips in future years. First, a simple mode choice model was developed to predict the likelihood of using an app-enabled pooled ride service as opposed to driving alone, assuming no difference in travel times between driving alone and pooling. No difference in travel time is based on the assumption that a pooled trip would occur similar to pooling via the Waze Carpool app, in which the driver & passenger(s) are matched based on their similar origin and destination and meet at a common pick-up location, thereby mitigating route deviations or additional trip links. In this first step, the likelihood of pooling is solely a function of the difference in trip cost between driving alone and pooling and a pooled-ride mode-specific constant that captures the overall preference expressed by the observed pooled-ride mode shares. The second step applied a demand elasticity formula to predict the increase in pooling that would result from investments in managed lanes. As the region's managed lane network expands, commuters who choose to pool will experience shorter travel times than commuters driving alone. This travel time savings will further encourage a shift from driving alone to pooling.

The assumptions underlying the level of service calculations for each modal option are shown in Table 15. Based on the SANDAG ABM, the cost of driving alone is 16.30 cents per mile in 2016 (in 2010 $) and is projected to increase to 26 cents per mile by 2035. Since the cost of a pooled ride is not known with certainty, it is assumed that the cost of pooling will utilize the reimbursement model currently used by Waze Carpool. Waze Carpool reimburses drivers based on the Internal Revenue Service (IRS) standard mileage reimbursement rate for travel in personally-owned automobiles, which was 54 cents per mile in 2016 or 49 cents in 2010 $. The auto operating costs used in the model only account for variable costs (gas, tire, maintenance); whereas the IRS mileage reimbursement rate accounts for both variable and fixed costs (insurance, license, registration, taxes, depreciation). Based on historical data from the

Bureau of Transportation Statistics (BTS), variable costs account for approximately 28% of the total cost per mile. Based on this assumption, variable costs associated with the IRS mileage reimbursement rates in 2016 are estimated to be 15 cents per mile in 2010 $ (49 cents x .28 = 13.72 cents). It is assumed that the cost of pooling in future years will remain the same as the cost ratio of pooling to driving alone in 2016 (16.3 cents/13.7 cents = 1.188). This pooled ride index factor of 1.188 is applied to model-based auto operating costs to estimate the cost of pooling in future years for consistency with ABM auto operating costs assumptions. The SANDAG carpool incentive program will provide a minor trip subsidy that will lower the cost of pooling per trip. Non-work trips will not be subsidized by SANDAG. To calculate travel time savings, the calculator uses the travel times predicted by the SANDAG ABM for each scenario year, for drive-alone and carpool vehicles, respectively.

Table 15: Pooled Ride Level of Service Assumptions

Level of service attribute	Drive alone, 2016—2050	Pooled ride, 2016—2050
Travel time	General purpose lane travel times	HOV and Managed lane travel times
Trip cost (cents/mile)		
Work trips	16.3 – 18.70 [1]	9.72 cents – 11.74 [2]
Non-work trips		13.0 cents – 15.74

[1] Auto operating cost assumed in the SANDAG ABM; varies based on scenario year

[2] Pooled ride costs based on estimated pooled ride costs; indexed with auto operating costs to account for variable costs only (gas, tire, maintenance) in future years. Cost for pooled work trips includes minor trip subsidy from SANDAG.

A summary of the principle assumptions underlying the CO_2 emission reduction calculation for pooled rides is shown in Table 16.

Table 16: Principle Approach to Pooled Rides CO_2 Emissions Calculations

Quantity	Overall Approach	Inputs and Source
Market / Market Growth	• Estimate total number of pooled app-enabled ride-hailing trips as a share of drive alone trips and segmented by household auto ownership	• SANDAG ABM data, for each scenario year o Drive alone trips predicted in each future year auto ownership category o Auto operating cost • 2016-2017 San Diego Regional Transportation Study o Utilization frequency--percentage of users that use a ride-hail service, work and non-work trips • 2018 Commute Behavior Survey o Proportion of ride-hail trips that are pooled
Regional Infrastructure Improvements	• Proposed regional managed lane infrastructure investments (HOV lanes and Express Lanes) offer travel time savings for carpooling and will increase demand for app-enabled pooling • Change in demand calculated based on elasticity of demand with respect to travel time	• SANDAG ABM data, for each scenario year o Average drive alone and carpool travel times o Average value of time o Marginal disutility of time, in-vehicle time coefficient • Internal Revenue Service (IRS) o 2016 mileage reimbursement rate
Program VMT	• Estimate program VMT based on estimated number of pooled rides in	• SANDAG ABM data, for each scenario year o Average drive-alone trip distance, work and non-work trips • Average vehicle occupancy

	forecast year and average vehicle occupancy	
GHG Emission Factors		• SANDAG ABM 14.0.1

GHG Emission Calculator Methodology

The CO2 reduction attributed to pooled rides was calculated following the procedures described below. The principle parameters and data items underlying the pooled rides CO2 emission calculations are listed in Table 17.

Pooled (app-enabled) trips within the region:

1. Based on the SANDAG ABM predictions for each scenario year, sum the number of drive-alone person trips by origin MSA, destination MSA, purpose (work/other), time period, and household auto ownership category
2. Lookup the average travel time for each MSA-to-MSA origin/destination market, based on the travel time skims produced by the SANDAG ABM for drive-alone trips and carpool trips, respectively
3. Lookup the average trip distance for each MSA-to-MSA origin/destination market, based on the distance skims produced by the SANDAG ABM for drive alone trips.
4. Estimate the cost of driving alone by applying the auto operating cost to the average trip distance
5. Estimate the cost of pool-riding by applying the indexed mileage reimbursement rate to the average trip distance and any trip subsidies as proposed in the Regional Plan.
6. Estimate the proportion of pooled rides in each trip market listed above, using the binomial mode choice model described below
7. Estimate the additional pooled ride trips that will be incentivized by managed lane investments, applying the demand elasticity formula

Pooled rides VMT and GHG reductions:

8. Calculate pooled ride VMT based on the average MSA-to-MSA trip distance and pooled ride prediction, assuming an average pool ride auto occupancy of 3 persons per car. The pooled ride occupancy corresponds with the minimum HOV requirements being recommended as part of the Regional Plan's managed lane investments.
9. Calculate the pooled ride VMT reduction. Since the shift is from drive alone to pooled ride, the difference between the total person trips and the vehicle trips used for pooled-riding is equal to the vehicles removed from highways by the availability of ride-pooling.
10. Calculate the corresponding CO2 reduction corresponding to the VMT reduction, using the EMFAC 2014 CO2 emission rates.

Pooled ride mode shifting model

Both the 2016-2017 San Diego Regional Transportation Study and 2018 Commute Behavior Survey provide some information about the current utilization of app-enabled pooled rides. To predict how utilization might change in response to a cost subsidy, a mode choice model was specified and calibrated to the current observed utilization. The model takes the form of a binomial logit mode choice model, with two choices—drive alone and pooled riding. The utility of each mode is a function of trip cost and a mode-specific constant that captures un-included attributes or preferences:

$$Utility = \alpha + \beta \times trip\ cost$$

Given this utility specification and the assumption of logit error terms, the probability of pooled-riding is then given by:

$$Probability\ (pooled\ ride) = \frac{1}{1 + e^{U(drive\ alone) - U(pooled\ ride)}}$$

By convention, the mode-specific constant (α) for the drive alone mode was set as zero. The trip cost coefficient (β) was computed from the definition of value of time, derived from regional median household income, and the in-vehicle time coefficient used in the SANDAG ABM for trips on work tours. The mode-specific constant for the pooled-ride mode was calibrated so that when the model is applied in 2016, assuming no subsidies, it predicts the mode shares observed in the 2016-2017 San Diego Regional Transportation Study and 2018 Commute Behavior Survey. The calibrated constants are shown in Table 17.

Elasticity of demand with respect to travel time savings:

The elasticity of demand for pooled rides with respect to travel time was approximated using the formula for point elasticity derived from a logit model (Train, 1993):

*Elasticity w.r.t. travel time= (coefficient of in-vehicle time) * average travel time * (1 – probability of app-enabled pooling)*

The coefficient of in-vehicle time was obtained from the SANDAG ABM and reflects the value of the mode choice in-vehicle time coefficient for trips on work tours (-0.032 utils/minute). The probability of pooled rides was calculated for each scenario year, using the pooled ride mode choice model while the average travel time was based on the single-occupant vehicle travel time.

The change in demand resulting from travel time savings is then equal to:

*Percent change in app-enabled pooled ride trips = elasticity w.r.t travel time * percent change in travel time*

The percent change in travel time was calculated based on the average weekday travel time savings associated with the use of managed lanes from the ABM.

Table 17: Methodology Parameters, Pooled Ride CO2 Emissions Calculator

Parameter	Source	Details
Observed pooled ride mode shares	SANDAG (2017). 2016-2017 San Diego Regional Transportation Study. SANDAG (2018). 2018 Commute Behavior Survey.	The observed ride-hailing mode share and the share of ride-hail pooled options, were used to estimate the total number of pooled app-enabled trips in the San Diego region for the base year (2016). This trip estimate serves as the calibration target for the pooled ride mode shifting model
Pooled ride average vehicle occupancy		In lieu of observed data, the calculator conservatively assumes the minimum occupancy to qualify as a pooled ride trip (3 persons per car). The pooled ride occupancy corresponds with the minimum HOV requirements being recommended as part of the Regional Plan's managed lane investments.
Coefficient of in-vehicle travel time (utils/minute)	SANDAG ABM 14.0.1 Trip mode choice model, work tours	SANDAG ABM value (-0.032 utils/minute). Used to calculate elasticity of demand with respect to travel time. Input to the demand elasticity formula and mode choice model
Average value of time	Preliminary Series 14 Forecast	Derived value ($9.80/hour), estimated as one-third median household income for San Diego region ($61,400), expressed as an hourly wage rate ($29.52/hour). The value of time is used to calculate an average coefficient of cost, for the pooled ride mode choice model
Pooled ride mode-specific constant		Mode choice model pooled ride constants were calibrated by trip purpose and auto ownership category: • Work trips

Parameter	Source	Details
		○ 0-car household: -2.60 ○ 1-car household: -5.90 ○ 2+ car household: -7.90 • Non-work trips ○ 0-car household: -2.90 ○ 1-car household: -6.30 ○ 2+ car household: -8.40

Calculator Inputs

Table 18 summarizes the calculator inputs for pooled rides for each future year scenario.

Table 18: Scenario Inputs, Pooled Rides CO2 Emissions Calculator

Data Item	Source	Required Input Data
Drive alone person trips	SANDAG ABM 14.0.1	For each scenario year, origin MSA and destination MSA: • Strategy year • Origin MSA • Destination MSA • Time period (AM, Midday, PM) • Trip mode (Drive Alone) • Trip purpose (Work, School, Other) • Household auto ownership (0, 1, 2+) • Person trips
Auto operating cost (cents/mile)	SANDAG ABM 14.0.1	Used to calculate the cost of driving-alone; accounts for fuel and vehicle maintenance. Auto operating cost varies from 16.3 cents/mile (2010 $) in 2016 to 18.7 cents/mile (2010 $) in 2050.
Pooled ride mileage cost (cents/mile)	Internal Revenue Service, 2016 standard mileage reimbursement rate for travel in personally-owned automobile.	IRS mileage reimbursement rate used to calculate the cost of a pooled ride trip based on the Waze Carpool model; equal to 13.72 cents/mile in 2016 (2010 $). The cost of pooling is estimated using the pooled rides index factor in future years.
Pooled rides index factor		Used to estimate the cost of pooling in future years based on ABM auto operating costs, which account for variable costs (gas, tire, maintenance) only. It is assumed that the cost of pooling in future years will remain the same as the rate of pooling to driving alone in 2016 (16.3/13.7 = 1.188)
Travel times and trip distance	SANDAG ABM 14.0.1	For each scenario year, origin MSA and destination MSA: • Strategy year • Origin MSA • Destination MSA • Time period (AM, Midday, PM) • Average one-way weekday travel time, drive-alone, general purpose lanes, (minutes) • Average one-way weekday travel time, drive-alone, managed lanes, (minutes) • Average one-way weekday trip distance, drive alone, general purpose lanes (miles)
Emission factors	EMFAC 2014, SANDAG ABM 14.0.1	For each scenario year: • Trips (cold starts) regional emissions (ton) • Running CO2 regional emissions (ton) • Regional VMT • Regional trips

Results

Table 19 summarizes the vehicle trip, VMT and CO2 reductions attributed to app-based pooled rides.

Table 19: Pooled Ride VMT and GHG Emission Reductions

Variable	2025	2035	2050
Total daily vehicle trip reductions	Final results pending selection of the preferred network scenario		
Total daily VMT reductions			
GHG reduction due to cold starts (short tons)			
GHG reduction due to VMT (short tons)			
Total daily GHG reduction (short tons)			
Total population			
Daily per capita GHG reduction (lbs/person)			
Daily per capita GHG reduction, change in percent			

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MICROTRANSIT

Program Description

Microtransit services utilize real-time ride-hailing, mobile tracking and app-based payment (Faigon et al., 2018) to provide demand-based service to users. Microtransit services are flexible and can operate vehicles that range from small sport utility vehicles (SUV) to large shuttle buses to provide transit-like services. In San Diego County, a type of microtransit service called the Free Ride Everywhere Downtown (FRED) has been operating in downtown San Diego since 2016. The FRED service is managed by Civic San Diego, the City of San Diego's non-profit entity that oversees downtown development. FRED operates a fleet of neighborhood electric vehicles (NEVs) within a defined service area that can be hailed in real-time or via an app-based reservation system and fulfills rides that are typically less than two miles long (Steele, 2017). The service is free to users and is paid for by advertisers, parking meter revenues, and grants. Through conversations with the FRED service provider, it is anticipated that FRED will expand its service to other parts of the region that have similar land uses and visitor destinations as Downtown San Diego. In support of regional mobility hub planning efforts[10], the SANDAG TDM program seeks to promote and encourage the provision of NEV microtransit to provide critical connections to and from mobility hubs.

In addition to the NEV shuttle service, other types of microtransit services operate as a crowd-sourced, route-deviation, demand responsive form of transit, such as Bridj, and Via that operate international microtransit services. These services help to reduce GHG emissions by providing an alternative to automobile travel in areas where traditional fixed-route transit does not operate, where service is relatively infrequent, or where demand for transit exceeds the capacity provided by public transit agencies. SANDAG is proposing to incentivize the deployment of a commuter-oriented microtransit service in areas not currently well-served by fixed-route transit. The provision of an operational subsidy that reduces the cost of a trip would make this a cost-effective alternative for commuters. As with the vanpool program, the SANDAG Employer Services Program will conduct targeted outreach with major employers throughout the region to identify employees that may be suitable candidates for the commuter shuttle service as proposed in this methodology.

With the exception of FRED and a few privately sponsored employer shuttles, the emergence of microtransit is a new concept in the San Diego region. Without sufficient empirical data on microtransit use the SANDAG ABM is unable to consider microtransit as a transportation mode, therefore the GHG emission reductions of NEV and commuter shuttle trips are unaccounted for by the model.

The methodology presented in this memo accounts for two microtransit services:

- Neighborhood electric vehicles (NEVs) that operate within a defined service area and can be hailed in real-time to fulfill rides that are less than two miles long; and
- Commuter shuttle services that provide a feasible alternative to automobile travel in areas where traditional fixed-route transit is poor or does not operate.

This calculator does not address microtransit services that could be designed to interface with other transit services (trunk line or local).

Assumptions

To estimate impacts resulting from the deployment of NEV shuttle service, it is assumed that these shuttle services will operate very similarly to the FRED service in downtown San Diego. The NEV shuttle would be deployed within

[10] To learn more about SANDAG mobility hub efforts, visit www.sdforward.com/mobilityhubs

designated areas to provide critical connections to high-frequency transit stations, corresponding to the regional mobility hub network[11] (Figure 3), and will fulfill short trips that are less than two miles in length. The off-model calculator assumes that the NEV shuttle mode shares will be similar to the FRED mode share observed today, or 0.41 percent. This mode share is estimated based on the number of rides reported by FRED (Van Grove, 2019) and the total person trips in the current FRED service area, as predicted by the SANDAG ABM. It's assumed that NEV microtransit services, like FRED, reduce GHG emissions by offering an emissions-free alternative for short trips that could otherwise be completed by car, bicycle, transit, or walking. As such, it is assumed that one-third of the NEV shuttle trips would have otherwise been automobile trips, should this service not exist. The auto substitution rate is consistent with auto substitution rates reported for e-bike users (37%), a motorized service that also primarily fulfills short trips (less than 2 miles) and deemed comparable to NEVs. Staff is working to establish a micromobility data clearinghouse and hopes to partner with FRED to collect and evaluate trip data that may be used to inform this methodology in the future.

The other type of microtransit service accounted for in this off-model methodology will provide commuters with a viable transportation option to the region's major employment centers (Figure 4) from areas where there is currently no or poorly fixed-route transit available, where traditional transit service is very infrequent, and/or there are long walk-access distances. The commuter shuttle service will use 15-passenger vehicles to fulfill trips that are less than thirty miles one-way to the region's top employment centers and military bases. Commuters with trips that are over thirty miles one-way are not considered microtransit candidates and filtered out of the trip estimates as these types of trips are assumed to be more viable for the SANDAG Vanpool Program[12]. Unlike vanpools, which are typically comprised of employees from the same company, the commuter shuttles will group commuters with similar travel patterns independently of their employer. Additionally, participation in the Vanpool Program is not restricted by a geographical boundary, meaning that a vanpooler's employers could be located anywhere throughout the region. Participation in the commuter shuttle service, however, is constrained by the employer's location, which must be located within the pre-defined coverage areas (see Table 23) including Downtown San Diego, Sorrento Valley, East Carlsbad, Kearny Mesa, Camp Pendleton, and more.

The commuter shuttles will pick up commuters, based on their trip origin and destination, at a common pick up location. It is assumed that shuttle users will travel a maximum of 5-minutes to-and-from the origin and destination either via biking or walking, consistent with SANDAG mobility hub planning efforts. A minimum level of demand is required for the shuttles to operate and was assumed to be 80 percent, consistent with the occupancy threshold for the SANDAG Regional Vanpool Program, or 12 passengers per vehicle per hour, corresponding to 36 trips over the 3-hour AM peak period.

A summary of the principle assumptions underlying the CO2 emission reduction calculation for microtransit is shown in Table 20.

Table 20: Principle Approach to Microtransit CO2 Emissions Reduction Calculations

Quantity	Overall Approach	Inputs and Source
Market / Market Growth	• Estimate potential microtransit users for two microtransit service types within the region: (1) NEV shuttle service that fulfills short trips (~two miles max) within mobility hubs	• Define NEV shuttle coverage areas (based on regional mobility hub network) • Define commuter shuttle coverage areas (dense employment centers) • SANDAG ABM data

[11] More information on the regional mobility hub network methodology is available in Attachment A

[12] Based on FY 2018 Vanpool Program data, the average vanpooled travels a roundtrip distance of 116 miles or 58 miles one-way.

	(2) commuter shuttle service to high density employment centers for commuters with no or poor fixed-route transit available and where trips are less than 30 miles to the employment centers • Estimate microtransit trips within the NEV shuttle and commuter shuttle coverage areas	○ Person and daily auto trips less than two miles long that start and end within the NEV shuttle coverage areas ○ Home to work drive alone person trips to commuter shuttle coverage areas with no or poor fixed-guideway transit service and less than 30 miles • NEV shuttle mode share • Commuter shuttle mode share dependent on time and cost, as compared to driving alone
Supply; Regional Infrastructure Improvements	• Refine microtransit trip estimates based on projected commuter shuttle travel time and fares. Assumes commuter shuttle service can leverage managed lane infrastructure for travel	• Commuter shuttles priced comparatively to the cost of single ride transit fare in the region. • Commuter shuttles travel at prevailing highway speeds
Program VMT	• Program VMT based on predicted microtransit trip and trip lengths in forecast year • Assumes that only some of the demand is shifting from driving alone	• SANDAG ABM data ○ Average trip length of trips that switch to microtransit • Auto substitution rate
GHG Emission Factors		• SANDAG ABM 14.0.1

GHG Emission Calculator Methodology

The CO2 reduction attributed to microtransit was calculated following the procedures described below.

NEV shuttle service:

1. Identify the areas where the NEV shuttles will operate by scenario year (Figure 3) These areas are defined as agglomerations of MGRAs and aggregated by MSA. The coverage areas could vary by scenario year, reflecting increasing land use density that could support NEV shuttle service.
2. Based on the SANDAG ABM, compute the total number of daily person and daily auto trips that start and end within the NEV shuttle coverage areas and are two miles long or shorter. Aggregate totals by MSA and scenario year.
3. Compute the number of NEV shuttle person trips by applying the observed mode share of 0.41 percent to the person trip totals.
4. Compute the proportion of NEV shuttle trips that switched from driving alone by applying the car substitution rate to the total NEV shuttle trips. It is assumed that one-third of the NEV shuttle trips would have been auto trips, should this service not exist. The auto substitution rate is consistent with auto substitution rates reported for e-bike users (37%), a motorized service that also primarily fulfills short trips (less than 2 miles) deemed comparable to NEVs.
5. Based on trip estimates provided by FRED, average trip distances vary between 1 - 1.7 miles per ride. To not overestimate trip distances, an average trip distance of 1 mile per trip is used. It is assumed that trip distances in future years will reflect existing trip trends given that NEV services would be deployed within defined areas and primarily continue to fulfill trips less than 2 miles.

6. Based on the SANDAG ABM, compute the average trip distance of auto trips less than two miles long within the specified coverage areas for each scenario year.

NEV shuttle VMT and GHG reductions:

7. Compute the NEV shuttle VMT by applying the average trip distance to the estimated NEV shuttle trips (trips that replaced autos only).
8. Calculate the corresponding CO2 reduction corresponding to the VMT and trip reduction reductions, using the EMFAC 2014 CO2 emission rates.

Commuter shuttle microtransit:

9. Identify the employment centers that will be served by the commuter shuttle service (Figure 4).
10. Based on the SANDAG ABM predictions for each scenario year, sum the number of drive-alone home-to-work person trips by origin MGRA and destination MGRA.
11. Find the best transit path from each origin MGRA to each destination MGRA in the trip universe.
12. Lookup the in-vehicle and out-of-vehicle transit travel time (including walk access and egress time) for each MGRA-to-MGRA origin/destination trip market, based on the transit skims produced by the SANDAG ABM for premium transit trips.
13. Lookup the average trip distance for each MGRA-to-MGRA origin/destination market, based on the distance skims produced by the SANDAG ABM for drive alone trips.
14. Filter out trips in MGRA-to-MGRA markets with high fixed-route transit productivity. The remaining trips are the market for microtransit trips.
15. Apply the microtransit mode choice model to the pool of trips that makeup the microtransit market. This mode choice model is described below.
16. Summarize the predicted microtransit demand by origin MSA and destination employment center.
17. Refine microtransit estimates, based on minimum demand threshold. Filter out trips in (origin MSA, destination employment center) pairs with fewer than 36 trips, corresponding to 12 one-way passenger trips per hour over the 3-hour AM peak period.

Commuter shuttle VMT and GHG reductions:

18. Estimate microtransit VMT based on the average MSA-to-employment center trip distance and microtransit demand. Since the microtransit mode choice model is applied to drive alone trips only, each microtransit trip represents one less vehicle on the road.
19. Estimate the total microtransit VMT reduction as twice the reduction computed for home-to-work trips, to account for the return trip from work to home.
20. Calculate the corresponding CO2 reduction corresponding to the VMT and trip reduction, using the EMFAC 2014 CO2 emission rates.

Commuter shuttle mode choice model

The commuter shuttle market consists of home to work drive-alone person trips with a destination in one of the identified employment centers. This pool of drive alone trips was obtained from the SANDAG ABM predictions for each scenario year. Since the commuter shuttles will be deployed to augment where transit service is nonexistent or poor, it is necessary to filter out from the pool of drive alone trips those that already have a good fixed-route transit path. Since the SANDAG ABM model does not report the alternative transit option of trips for which the chosen mode is auto, a likely transit path was reconstructed for each drive alone trip. Using a somewhat simplified level of service criteria, yet consistent with the stop-to-stop transit skims and MGRA-to-stop walk paths produced by the SANDAG ABM, the best transit path for each origin/destination MGRA pair was found and associated with each drive alone trip in the microtransit market. The current average speed for fixed-route transit is 9 mph, including stop wait time and walk access/egress time or 0.15 miles per minute. The estimated microtransit trips which held a low average speed, meaning for which the fixed-route transit speed was higher, were filtered out from the microtransit market to account for microtransit trips that may directly compete with transit and may actually be more suitable transit trips.

To predict the commuter shuttle utilization, a simple drive alone versus transit mode choice model was specified and applied to the drive alone trips in the microtransit service markets. The model takes the form of a binomial logit mode choice model, with two choices—drive alone and microtransit. The utility of each mode is a function of trip cost, travel time (including in-vehicle and out-of-vehicle time) and a mode-specific constant that captures un-included attributes or preferences.

$$Utility = \alpha + \beta_c \times trip\ cost + \beta_{ivt} \times in\ vehicle\ time + \beta_{ovt} \times out\ of\ vehicle\ time$$

Given this utility specification and the assumption of logit error terms, the probability of choosing transit is then given by:

$$Probability\ (transit) = \frac{1}{1 + e^{U(drive\ alone) - U(transit)}}$$

By convention, the mode-specific constant (α) for the drive alone mode was set at zero. The value of the SANDAG ABM in-vehicle time coefficient for trips on work tours was used for β_{ivt}, while β_{ovt} was set at 2.5 times the value of β_{ivt}. The trip cost coefficient (β_c) was computed from the definition of value of time ($VOT = \beta_{ivt}/\beta_c$), with value of time estimated from median wage data for the San Diego region. The microtransit alternative specific constant was asserted at a value equivalent to 20 minutes of in-vehicle time (-0.64). For reference, when this model is applied to predict the fixed-route transit mode share, it results in a calibrated transit constant equivalent to 12 minutes of in-vehicle time (-0.40). The more negative constant value asserted for microtransit correlates to a more conservative assumption, essentially indicating that the model assumes that microtransit is perceived less favorably than fixed-route transit, all else equal. The level of service attributes for driving alone and commuter shuttle are shown in Table 21, and the calibrated constants and other calculator parameters are shown in Table 22.

Table 21: Commuter Shuttle Level of Service Attributes

Level of service attribute	Driving alone	CB shuttle
Trip cost	Based on trip distance and auto operating cost for the scenario year (16.3 - 26.0 cents per mile) from SANDAG ABM model	\$3.37 per trip, or 50 percent premium over the San Diego Metropolitan Transit System (MTS) fixed-route bus and light rail full boarding fare of \$2.25 A fare analysis of areas where microtransit service providers Chariot & Bridj operate revealed that the cost per trip for microtransit is on average 50 percent higher than single bus fare within that service area

In-vehicle time	Based on trip distance and average speed of 30 mph	Based on trip distance and average speed of 30 mph, based on the average speed of select MTS *Rapid* bus service routes. *Rapid* provides high-frequency, limited-stop bus service throughout the San Diego region. Routes 235, 280, and 290 leverage managed lane infrastructure to fulfill trips, similar to the proposed commuter shuttle service
Out-of-vehicle time	n/a	7.5 minutes of average wait time and 10 minutes of walk access and egress time (5 minutes at the origin and 5 minutes at the destination)

Figure 3: Draft 2035 NEV Microtransit Coverage Areas

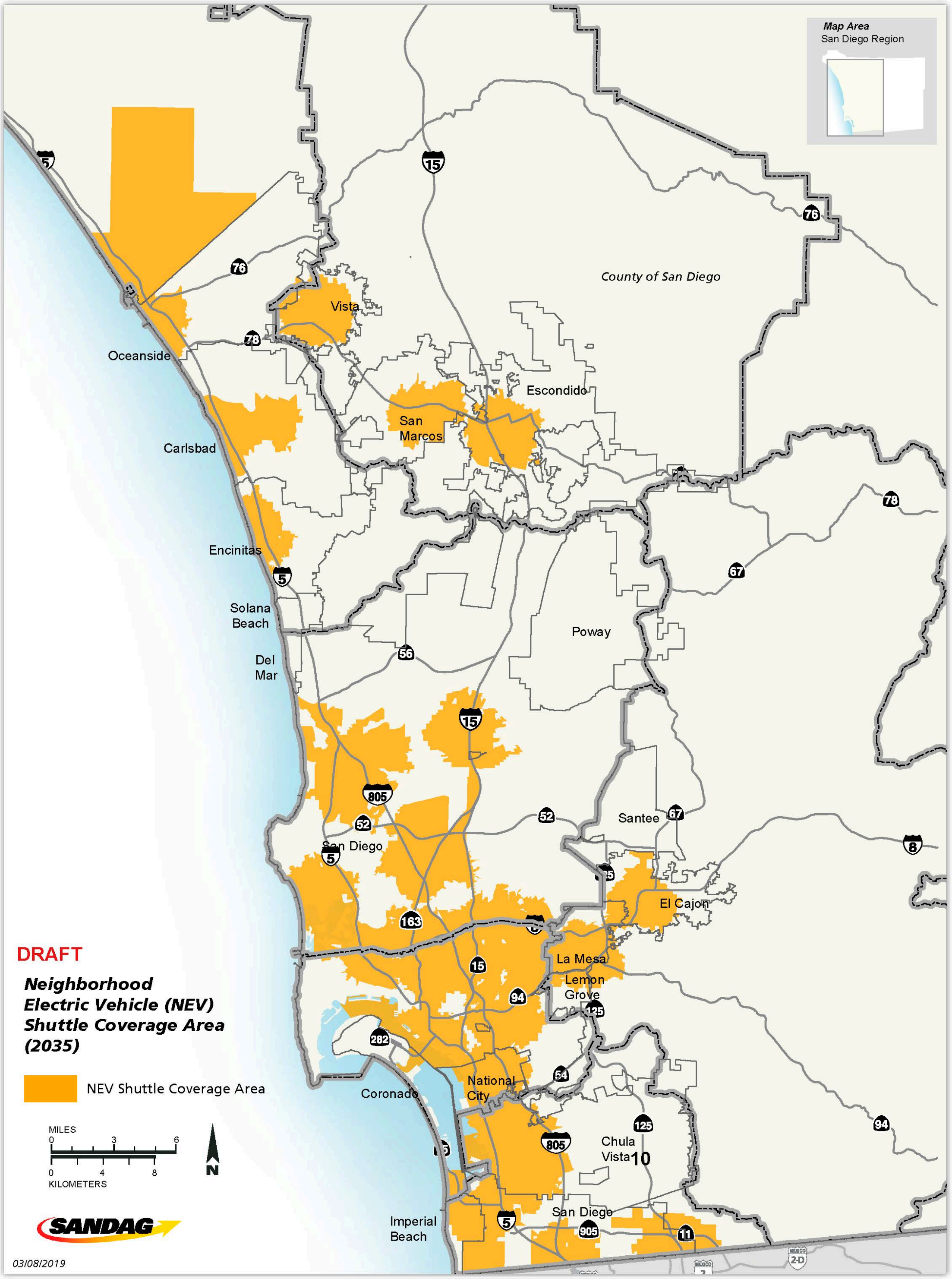

Figure 4: Draft 2035 Commuter Shuttle Microtransit Coverage Area

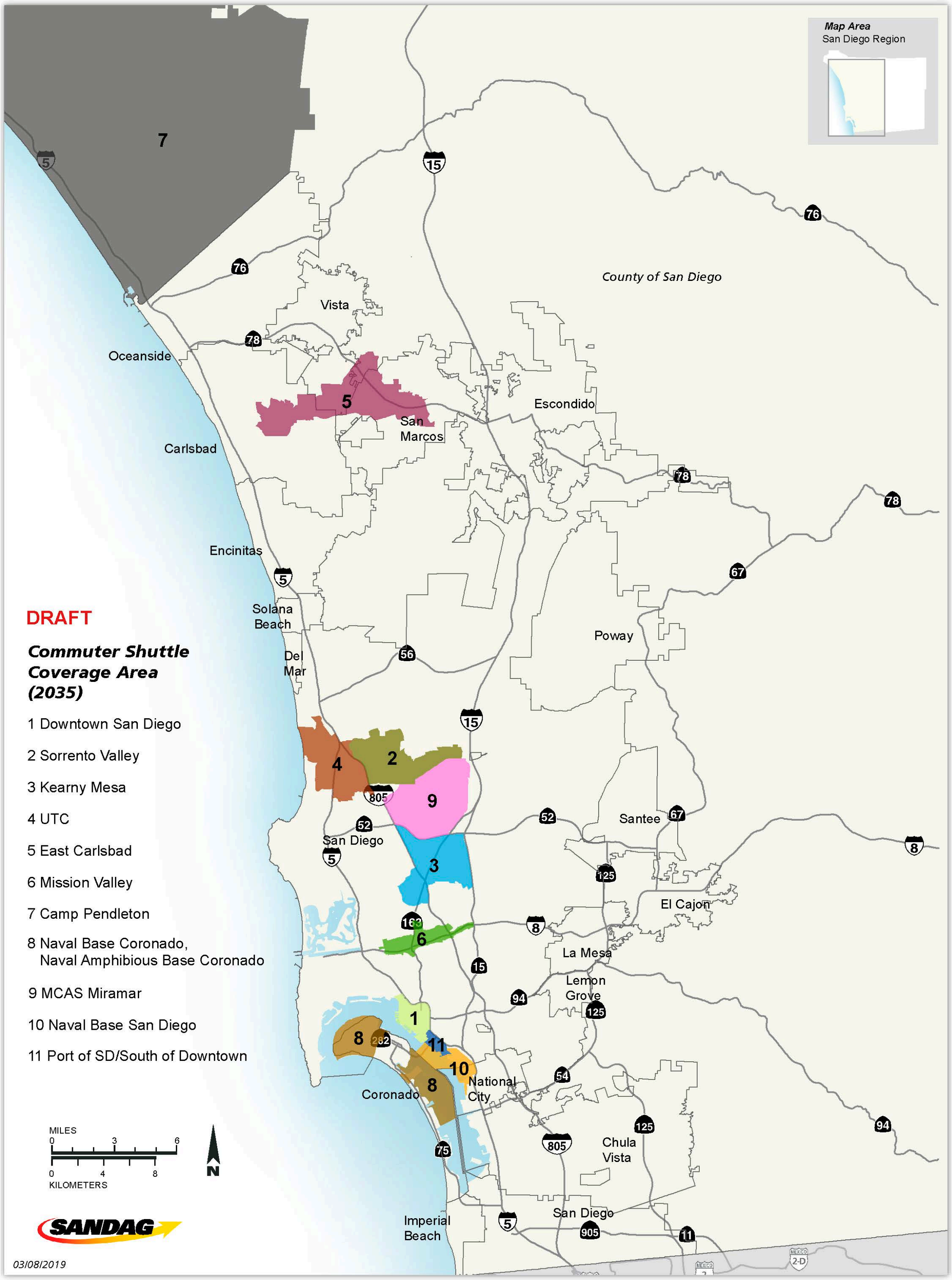

Table 22: Microtransit Commuter Shuttle Mode Choice Parameters, Microtransit CO2 Emissions Calculator

Parameter	Source	Details
Average NEV trip distance		Based on trip estimates provided by FRED, 2/11/19, average trip distances vary between 1 - 1.7 miles per ride. It is assumed that trip distances would reflect current trends given that NEV services would be deployed within defined areas and primarily fulfill trips less than 2 miles
NEV shuttle mode share	Van Grove, 2019 SANDAG ABM 14.0.1	Estimated based on FRED reported utilization of approximately 17,500 monthly rides in 2018 (Van Grove, 2019), person trips that are 2-miles or shorter in the existing NEV shuttle service area, and an average of 30 service days per month
Coefficient of in-vehicle travel time (civt) (utils/minute)	SANDAG ABM 14.0.1 Trip mode choice model, work tours	SANDAG ABM value (-0.032 utils/minute). Used to calculate elasticity of demand with respect to travel time. Input to the demand elasticity formula and mode choice model
Ratio of out of vehicle to in vehicle time coefficient		Ratio (2.5) reflects best practices for travel demand models
Average value of time	Preliminary Series 14 Forecast	Derived value (\$9.80/hour), estimated as one-third median household income for San Diego region (\$61,400), expressed as an hourly wage rate (\$29.52/hour). The value of time is used to calculate an average coefficient of cost, for the commuter shuttle mode choice model
Cost coefficient		Derived value (-0.0020) from the definition of value of time (marginal disutility of time / marginal disutility of cost); 0.6 is a unit conversion factor required because VOT is in \$/hour, civt is in minutes, and cost should be expressed in cents
Microtransit mode-specific constant		The commuter shuttle microtransit alternative specific constant was asserted at a value equivalent to 20 minutes of in-vehicle time (-0.64)

Calculator Inputs

Table 23 summarizes the calculator inputs for each future year scenario.

Table 23: Scenario Inputs, Microtransit CO2 Emissions Calculator

Data Item	Source	Required Input Data

Microtransit coverage area (NEV and Commuter Shuttle services)	Draft San Diego Forward: The 2019-2050 Regional Plan	For each scenario year and Master Geographic Reference Area (MGRA):
		• MSA Id
		• TAZ Id
		• Area (acres)
		• NEVSHUTTLE_FLAG -- NEV shuttle service flag (1 if service operates in MGRA, 0 otherwise)
		• CBSHUTTLE_FLAG – Commuter shuttle service flag:
		  o 1 if Downtown San Diego
		  o 2 if Sorrento Valley
		  o 3 if Kearny Mesa
		  o 4 if UTC
		  o 5 if East Carlsbad
		  o 6 if Mission Valley
		  o 7 if Camp Pendleton
		  o 8 if Naval Base Coronado, Naval Amphibious Base Coronado
		  o 9 if MCAS Miramar
		  o 10 if Naval Base San Diego
		  o 11 if Port of San Diego/South of Downtown
		  o 0 otherwise
		• OP_YEAR_NEVSHUTTLE -- Year that NEV shuttle service becomes operational in this MGRA
		• OP_YEAR_CBSHUTTLE -- Year that commuter shuttle service becomes operational in this MGRA

Population and employment	Draft Series 14: 2050 Regional Growth Forecast/San Diego Forward: The Regional Plan in ABM 14.0.1	For each scenario year and Master Geography Reference Area (MGRA): • Strategy year • NEVSHUTTLE_FLAG -- NEV shuttle service flag (1 if service operates in MGRA, 0 otherwise) • CBSHUTTLE_FLAG -- Commuter shuttle service flag (see Microtransit Coverage input item above) • Total employment • Total population

Regional trips, NEV shuttle	SANDAG ABM 14.0.1	For each scenario year:
		• indivTripData_3.csv (SANDAG ABM 14.0.1 output)
		• TAZ-to-TAZ drive alone distance, general purpose lanes, median VOT, AM Peak (SANDAG ABM 14.0.1 output)
		• Process trip data file with SANDAG_microtransitCalculatorTables.R to produce this summary of trips less than 2 miles long
		  o Origin MSA
		  o Origin MSA NEV shuttle service flag
		  o Destination MSA
		  o Destination MSA NEV shuttle service flag
		  o Sum of person trips less than 2 miles long
		  o Sum of auto trips less than 2 miles long

	SANDAG ABM 14.0.1	For each scenario year:

Data Item	Source	Required Input Data
Regional trips, Commuter shuttle		• indivTripData_3.csv (SANDAG ABM 14.0.1 output) • TAZ-to-TAZ drive alone distance, general purpose lanes, AM Peak (SANDAG ABM 14.0.1 AMF output) • TAP-to-TAP commuter rail walk to transit skim, AM Peak (SANDAG ABM) • walkMGRATAPEquivMinutes.csv • SANDAG_TAP_TAP_to_MAZ_MAZ_IVT_OVT.R generates home to work trips • Process trip data file with [SANDAG ABM Transit Mode Share.xlsx] to produce these summary matrices of home to work trips: o Home MSA to employment center destination, total home-to-work drive alone trips o Home MSA to employment center destination, total home-to-work drive alone trips with origins with no or poor transit service o Home MSA to employment center destination, total home-to-work microtransit trips, full fare o Home MSA to employment center destination, total home-to-work average microtransit trip distance, full fare o Home MSA to employment center destination, total home-to-work microtransit trips, subsidized fare o Home MSA to employment center destination, total home-to-work average microtransit trip distance, subsidized fare
Emission factors	EMFAC 2014, SANDAG ABM 14.0.1	For each scenario year: • Running CO2 regional emissions (short tons) • Regional vehicle-miles traveled (VMT) • Regional vehicle trip starts • Trip start CO2 regional emissions (short tons)
Commuter shuttle service operations	Draft San Diego Forward: The 2019-2050 Regional Plan	These assumptions define the level of service for commuter shuttle service. • Commuter shuttle fare (cents) • Average vehicle travel speed (mph) • Average time waiting for a ride (min) • Average access/egress time, total (min) • Maximum trip distance (miles) • Minimum demand per origin MSA (trips)

Results

Table 24 summarizes the vehicle trip, VMT and CO2 reductions attributed to microtransit.

Table 24: Microtransit VMT and GHG Emission Reductions

Variable	2025	2035	2050
Total daily vehicle trip reductions	Final results pending selection of the preferred network scenario		
Total daily VMT reductions			
GHG reduction due to cold starts (short tons)			
GHG reduction due to VMT (short tons)			
Total daily GHG reduction (short tons)			
Total population			
Daily per capita GHG reduction (lbs/person)			
Daily per capita GHG reduction, change in percent			

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COMMUNITY BASED TDM OUTREACH

The Community-Based Travel Planning strategy was prepared by SANDAG staff.

Program Description

Community-based travel planning (CBTP) is a residential-based approach to TDM outreach and a proven method for encouraging sustained travel behavior change. CBTP provides households with customized information, incentives and support to encourage the use of transportation alternatives. The approach involves a team of trained 'Travel Advisors' engaging residents at-home or in their communities to offer information, incentives, and advice about how members of households can travel in alternative ways that meet their needs. Teams of trained Travel Advisors visit all households within a targeted geographic area, have tailored conversations about residents' travel needs, and educate residents about the various transportation options available to them. Travel Advisors are trained in motivational interviewing techniques that helps to facilitate intrinsic motivation to inspire changed behaviors.

Following the one-on-one conversation with a Travel Advisor, residents receive resources and incentives that are relevant to their transportation needs that can reduce the barriers to trying transportation alternatives. Examples of incentivized packets include:

- A trial transit pass, assistance with transit trip planning and a free bikeshare membership to provide a first and last mile solution to transit
- Regional vanpool program information and ride-matching assistance coupled with a "first month free" vanpool promotion.

Travel Advisors not only provide information, but they also play a key role in educating residents on how to use transportation services by providing step-by-step support with planning a transit trip, accessing and using shared mobility programs, using online trip planning tools, enrolling in the vanpool or carpool program, etc. Within twelve weeks of the initial doorstep conversation and incentive distribution, Travel Advisors follow-up with all participating households with a survey to see how travel behavior has changed, what their experience has been, and if any additional support is needed.

SANDAG partnered with a consulting firm to conduct a small CBTP pilot project in Encinitas, California in March 2014. The project was branded as "Travel Encinitas" and targeted nearly 400 households to encourage residents to try transportation alternatives for commuting purposes or for local trips. The "Travel Encinitas" pilot demonstrated that CBTP has good potential for the San Diego region, with participants indicating that they drove less and walked, biked, and carpooled more frequently as a result of the pilot. Based on the success of the "Travel Encinitas" CBTP pilot, SANDAG is proposing to expand community based TDM outreach to target households that are typically within a 5-minute bike shed around select high-frequency transit stations or major regional bikeway investments within the region in 2025 and 2035 (Figure 5). In a few instances, the CBTP boundary was expanded beyond a 5-minute bike shed due to the transit-oriented nature of the community, which may be more conducive to driving to and parking at a local transit station. Households targeted for CBTP outreach include households near the Mid-Coast Trolley, Barrio Logan Transit Station, City Heights Mid-City Centerline Station, Iris Trolley Station, South Bay Rapid stations, Grantville Trolley Station, 8th Street Station, Costal Rail Trail, and Inland Rail Trail. Surveys before and after CBTP participation will be implemented to track program performance.

The coverage areas listed within this document are subject to change, pending the selection of a preferred network scenario.

Assumptions

In addition to the San Diego data from the "Travel Encinitas" pilot project, data from CBTP initiatives in Portland, Oregon, Pleasanton, California, Mill Creek, Washington, and King County, Washington was used to estimate VMT and GHG reductions associated with a regional Community-based TDM Outreach program. Based on data from nine CBTP cases studies, between 10 and 30 percent of households typically agree to participate and actively engage with a Travel Advisor, which results in an average 12 percent reduction in SOV trips. These program assumptions were applied to model-based outputs of households within the defined CBTP areas (number of daily driving trips and driving trip distance for participating households) to estimate VMT impacts. Evaluations of CBTP programs typically focus on impacts during the year after programs are implemented via short surveys; long-term evaluations that provide information on how long behavior change persists due to PTP programs is limited.

The principle parameters and data items underlying the CBTP CO2 emission calculations are listed in Table 25.

Table 25: Methodology Parameters, CBTP CO2 Emissions Calculator

Quantity	Overall Approach	Inputs and Source
Market / Market Growth	• Target households typically within a 5-minute bike shed around select high-frequency transit stations or regional bikeway investments	• SANDAG ABM data, for each scenario year o Households typically within 5-minute bike shed including Mid-Coast Trolley, Barrio Logan Transit Station, City Heights Mid-City Centerline Station, Iris Trolley Station, South Bay *Rapid* stations, Grantville Trolley Station, 8th Street Station, Costal Rail Trail, and Inland Rail Trail.
Supply	• Based on national CBTP case studies, estimates participation rate, cost, and impact of households that participate in CBTP	• CBTP Case Studies o Decrease in SOV trips for households participating in CBTP o CBTP participation rate o Cost per households targeted for CBTP
Program VMT	• Estimate VMT reduction based on average household trips and trip length	• SANDAG ABM data, for each scenario year o Average daily one-way driving trips per household o Average one-way trip length for driving trips (miles)
GHG Emission Factors		• SANDAG ABM 14.0.1

GHG Emission Calculator Methodology

The CO2 reduction attributed to CBTP was calculated following the procedures described below.

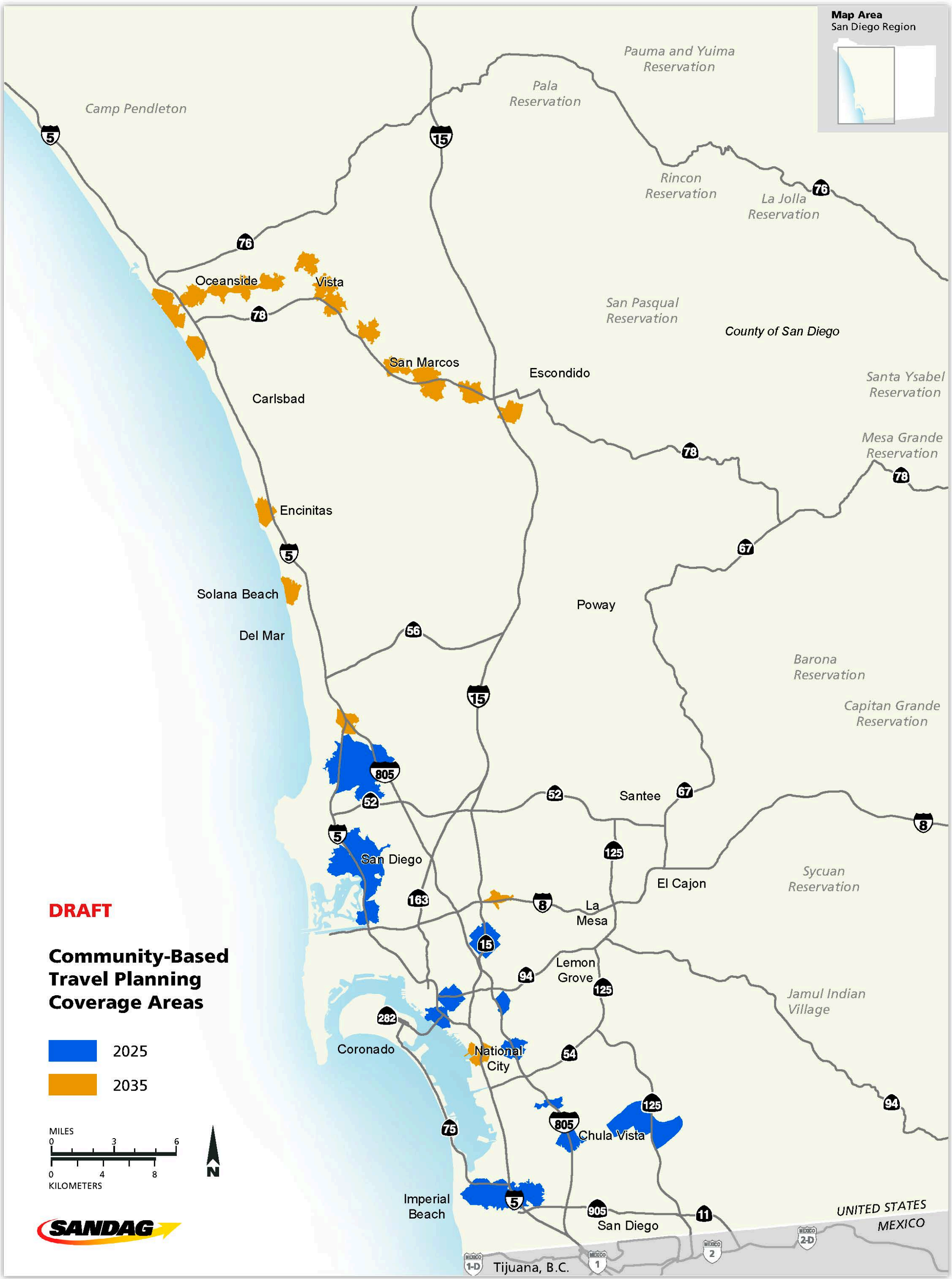
1. The number of households was identified within the designated target areas for CBTP to determine the number of households participating in CBTP. Based on nine CBTP case studies, it was assumed that an average 17 percent of targeted households would participate.

2. The total number of participating households was multiplied by the average reduction in SOV trips among participants. The average daily one-way driving trips affected was used to calculate the average daily number of vehicle trips reduced by participants.

3. The daily vehicle trips reduced was multiplied by the average one-way trip length for driving to calculate average daily VMT reductions.

4. The corresponding CO_2 reduction factor was calculated corresponding to the VMT and trip reduction, using the EMFAC 2014 CO_2 emission rates.

Figure 5: Draft 2035 – 2050 CBTP Coverage Areas



Calculator Inputs

Table 26 summarizes the Carbon Dioxide emissions calculator inputs for each future year scenario. Table 26 summarizes the Carbon Dioxide emissions calculator inputs for each future year scenario.

Table 26: Scenario Inputs, CBTP CO2 Emissions Calculator

Parameter	Source	Details
Average cost per household targeted for CBTP	Portland SmartTrips; Salmon Friendly Trips, 2017; Smart Trips Pleasanton, 2016; Green Lake in Motion, 2015; Renton in Motion, 2014; Burien in Motion, 2014; Curb @ Home, 2017; Travel Encinitas, 2014	The cost per household targeted for CBTP can vary depending on households and level of investment. On average, the cost per household targeted for CBTP costs $20.56. This is used to estimate annual program costs in 2025 and 2035.
Number of households targeted for CBTP	Draft Series 14: 2050 Regional Growth Forecast/San Diego Forward: The Regional Plan in ABM 14.0.1	The total number of households within the defined CBTP coverage areas.
Average participation rate	Portland SmartTrips; Salmon Friendly Trips, 2017; Smart Trips Pleasanton, 2016; Green Lake in Motion, 2015; Renton in Motion, 2014; Burien in Motion, 2014; Curb @ Home, 2017; Travel Encinitas, 2014	On average, 17 percent on households targeted for CBTP participate
Average reduction in SOV trips for participating households	Portland SmartTrips; Salmon Friendly Trips, 2017; Smart Trips Pleasanton, 2016; Green Lake in Motion, 2015; Renton in Motion, 2014; Burien in Motion, 2014; Curb @ Home, 2017; Travel Encinitas, 2014	On average, households that participate in CBTP decrease their SOV trips by 12 percent
Average daily one-way driving trips per household	SANDAG ABM 14.0.1	The average daily one-way trips vary by scenario year: 2016, 2020, and 2025 data is from no-build scenario and 2035 is from Scenario E from ABM 14.0.1
Average one-way trip length for driving trips (miles)	SANDAG ABM 14.0.1	The average one-way trip length for driving trips varies by scenario year: 2016, 2020, and 2025 data is from no-build scenario and 2035 is from Scenario E from ABM 14.0.1
Emission factors	EMFAC 2014, SANDAG ABM 14.0.1	For each scenario year: • Running CO2 regional emissions (short tons) • Regional vehicle-miles traveled (VMT) • Regional vehicle trip starts • Trip start CO2 regional emissions (short tons)

Results

Table 27 summarizes the vehicle trip, VMT and CO2 reductions attributed to CBTP.

Table 27: CBTP VMT and GHG Emission Reductions

Variable	2025	2035	2050
Total daily vehicle trip reductions	Final results pending selection of the preferred network scenario		
Total daily VMT reductions			
GHG reduction due to cold starts (short tons)			
GHG reduction due to VMT (short tons)			
Total daily GHG reduction (short tons)			
Total population			
Daily per capita GHG reduction (lbs/person)			
Daily per capita GHG reduction, change in percent			

Appendix F
SANDAG Vanpool Calculator Review and Comparison

Vanpool Off-Model Methodologies Review

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11/13/2020

Summary

This document provides a review of SANDAG's Vanpool off-model calculator (OMC) that was originally developed by WSP Inc. (WSP, 2019) as compared to CARB's recommended methodology (CARB 2019a, 2019b). The methods were found to be consistent with best practices. In addition to the review the vanpool OMC was updated to reflect the most recent SANDAG Vanpool Program Data (from May 2020) and the most recent ABM 2+ forecasts. There were 590 registered vanpools in May 2020, which reflects decreases in program participation due to both major employers who have withdrawn support and to COVID-19 impacts at the time. Over the past five years, the number of active vanpools has fluctuated between 680 and 720 vehicles. The recent active Vanpool demand dropped to 590 van pools, which is likely to be affected by COVID-19. Current vanpool program requires at least 80% of occupancy for the benefit and at least 20 miles of travel distances within the County. The recent growth of teleworking is likely to affect the decrease in vanpools, though any easing of the COVID-19 pandemic may have the opposite effect in terms of an increased demand for mobility. Since is it too early to know how these potential changes will interact in terms of a trend going forward, it is reasonable to use the May 2020 results as an intermediate point of reference. The results of the updates produce a somewhat lower per capita reduction (0.35% reduction vs the original 0.46% reduction), which is to be expected given the lower vanpool participation rates found in May of 2020. Though this performance is diminished, the calculator's GHG reduction estimates are still significant and may evolve over time.

Please note that the inputs, assumptions, and emission reduction estimates listed within this methodology are draft and are subject to change pending the development of a final network and land use scenario to inform the 2021 Regional Plan.

Review of the SANDAG Vanpool Calculator

ITS-Irvine reviewed models, assumptions, and modeling inputs. Overall, the vanpool OMC follows CARB's (2019b) recommendations from its Final Sustainable Communities Strategy Program and Evaluation Guidelines-Appendices. This includes specific methodological recommendations such as accounting properly for interregional travel and double counting with other calculators. For instance, the vanpool OMC excludes the portion of SCAG's VMT in Internal-External trip (IX) and External-Internal trip (XI), depending on the origin, destination coordinates and gateways for origins and destinations. Furthermore, the vanpool calculator resolves a double-counting issue by considering average occupancy excluding drivers, thus emissions from vans are counted.

The core modeling inputs to the vanpool calculator include:

- EMFAC 2014 emission factors
- EMFAC 2014 VMT
- SANDAG population forecasts
- SANDAG employment forecasts by industry category per SANDAG ABM classification
- SCAG employment forecasts by county
- SANDAG travel time skim data (military/non-military base destinations)
- Average vanpool mileage (as of May 20, 2020, SANDAG Vanpool Program)
- Average van capacity (as of May 20, 2020, SANDAG Vanpool Program)
- Average van occupancy (as of May 20, 2020, SANDAG Vanpool Program)
- Postal zip code centroid coordinates (used to approximate the distance traveled by vanpools outside San Diego County)
- County gateway centroids (Used to approximate the distance traveled by vanpools outside San Diego County)

No methodological changes to these inputs were deemed necessary by our review other than updating the population and travel forecasts (trips, skims, and VMT) from SANDAG's ABM2+ model and the vanpool statistics from the recent program data.

Table 1 shows the additional parameters and assumptions used in the calculator. ITS-Irvine's review of the SANDAG Vanpool calculator assessed whether parameter changes were appropriate based upon any changes to the literature since the calculators were developed by WSP (2019). We found that the assumptions (i.e., the marginal disutility of travel time and the person trips suitable for vanpooling assumptions) are up to date and are consistent with the ABM 2+, though parameter updates to the vanpool inventory using the most recent data available from SANDAG was warranted.

Table 1. Parameters and assumptions of SANDAG Vanpool calculator

Parameter	**Source**	**Details**
Current vanpool inventory	Active vanpools as of May 20, 2020, SANDAG Vanpool Program)	Required data for each vanpool includes trip origin, trip destination, employment industry (federal military, federal non-military, non-federal), van capacity, roundtrip mileage. Trip origin and destination aggregated to MSAs if inside San Diego County, and to County if outside San Diego County.
Marginal disutility of travel time	SANDAG ABM 2+ Trip mode choice model, Work tours	In-vehicle time coefficient of the work trip mode choice model, SANDAG ABM 2+ (the same as ABM14.0.1)

Total person trips that are suitable for vanpooling	U.S. Census Bureau (2016). American Community Survey, 2016 1-Year Release.	Used to calculate vanpool mode market share, an input to the demand elasticity formula (value rounded to 1.6 million workers).

GHG Emission Calculator Methodology

ITS-Irvine also reviewed the core methodology employed by the calculator and found it to be consistent with CARB's (2019) Final Sustainable Communities Strategy Program and Evaluation Guidelines. The calculator computes CO2 reductions following the procedure described below.

Establish the current vanpool demand:

1. The vanpool demand was then tabulated in a trip origin-destination matrix, where the trip origin represented the home location and the trip destination was the work location. Home and work locations were then identified at the level of Metropolitan Statistical Areas (MSA) if they fell within San Diego County, or at the county level if they fell outside San Diego County.

The main assumptions underlying the number of vanpool program participants are based on two factors:

1. Employment growth: it is assumed that the participant rates over employment remain the same in the future, thus the number of vanpoolers is a function of the number of employees.
2. Mode shift from travel time savings. Vanpool incentives include the exclusive use of managed lanes including High Occupancy Vehicle and the Interstate-15 Express Lanes). The shifted demand is measured from the elasticity approach, which is derived from a logit model. Travel time savings from managed lanes attract more vanpoolers, which could reduce VMT by mode shift from drive alone.

Vanpool demand due to regional employment growth:

2. The total number of vanpools were multiplied within the destination MSA by the employment growth rate at the MSA, which was calculated as future year employment divided by 2016 employment. The new vanpools due to employment growth were then distributed to origin MSAs in the proportions observed in 2016.

Vanpool demand due to managed lane infrastructure investments:

3. Compute demand elasticity with respect to travel time. In lieu of observed demand elasticities, elasticity of demand was estimated using a logit mode choice model formulation.

4. Calculate average MSA to MSA travel time savings, defined as the difference between the travel time experienced when using all available highways, and the travel time experienced using general purpose lanes only (excluding HOV and Express Lanes). For trip origins outside of San Diego County, the travel time savings are computed only over the portion of the trip that occurs within San Diego County. Since the specific location of military bases is known, the travel time savings associated with military vanpools is computed specifically to the zones that comprise the military bases, rather than an average over all of the MSA destinations.

5. Compute the demand induced by travel time savings by applying the demand elasticity formula to the estimated number of vanpools for each scenario year, after accounting for employment growth.

Table 2 shows a summary of the calculated vanpool demand both due to regional employment growth and the impact of managed lane investments.

Table 2. Estimated vanpool demand

6.

Vanpool Program Growth Estimates

1. Vanpool demand due to regional employment growth	2020	2035	2050	Notes
	Total vanpools due to regional employment growth			
Vanpool Industry				
Military	228	244	248	Assumes that the number of vanpools changes proportionally with employment at the destination MSA (County if vanpool destination is outside San Diego County).
Federal Non-Military	115	126	135	
Non-Federal	247	281	302	
TOTAL	590	651	685	
2. Vanpool demand due to managed lane investments	**2020**	**2035**	**2050**	**Notes**
	Total vanpools due to managed lane infrastructure			
Vanpool Industry				
Military	-	9	14	Induced demand for vanpools as the region builds managed lanes which result in travel time savings relative to traveling on general purpose lanes. Travel time savings vary by trip origin and destination, and by scenario year.
Federal Non-Military	-	8	11	
Non-Federal	-	15	21	
TOTAL	-	32	45	
TOTAL VANPOOLS	**2020**	**2035**	**2050**	**Notes**
Vanpool Industry				
Military	228	253	262	
Federal Non-Military	115	134	146	
Non-Federal	247	296	323	
TOTAL	**590**	**683**	**730**	

Vanpool VMT and GHG reductions:

7. Calculate VMT reduction, which for each van is equal to the average round trip distance within San Diego County, multiplied by the number of passengers (excluding the driver). It is noteworthy that the calculator only accounts for vanpool travel within San Diego County only. Out-of-county distance approximated based on home zip code coordinates.

8. Calculate the CO_2 reduction corresponding to the VMT reduction and reduction in trip starts using the Emission Factors (EMFAC) 2014 CO_2 emission rates.

Table 3 shows the estimated VMT and GHG reduction results of the updated vanpool OMC. Compared with the estimated results of the original OMC, shown in Table 4, the changes in input data had a notable impact on daily per capita GHG reduction because both active vanpools and the VMT forecasts have decreased since the updates to the regional model. Although the travel time saving of the simulation run from ABM2+ is higher than that of the original OMC, the reduction in vanpool participants of the active vanpool program in 2020 have significantly affected the results, leading to a smaller per capita GHG reduction in all target years versus the original calculator.

Table 3. Estimated VMT and GHG Reduction Results of the updated Vanpool OMC

VMT and GHG Reduction Results			
Variable	2020	2035	2050
Plan CO2 Emissions			
Regional population	3,383,955	3,620,349	3,746,077
Daily CO2 emissions (short tons)	38,881	38,199	38,777
Daily emissions per capita (lbs)	22.98	21.10	20.70
Total daily vehicle trip reduction	6,012	6,967	7,452
Total daily VMT reduction	307,133	355,422	379,780
VMT reduced in San Diego County	259,598	300,336	320,910
GHG reduction due to cold starts (short tons)	0.6	0.6	0.7
GHG reduction due to VMT (short tons)	121.9	137.3	145.5
Daily Total GHG reduction (short tons)	122.5	137.9	146.2
Daily Per capita GHG reduction (lbs/person)	-0.072	-0.076	-0.078
Daily Per capita GHG reduction	-0.31%	-0.36%	-0.38%

Table 4. Estimated VMT and GHG Reduction Results of the original Vanpool OMC

VMT and GHG Reduction Results			
Variable	2020	2035	2050
Plan CO2 Emissions			
Regional population	3,374,125	3,709,575	3,967,090
Daily CO2 emissions (short tons)	38,652	42,139	43,371
Daily emissions per capita (lbs)	22.91	22.72	21.87
Total daily vehicle trip reduction	6,669	8,106	8,547
Total daily VMT reduction	386,286	469,271	493,683
VMT reduced in San Diego County	334,101	405,763	426,853
GHG reduction due to cold starts (short tons)	0.6	0.8	0.8
GHG reduction due to VMT (short tons)	160.8	189.1	194.3
Daily Total GHG reduction (short tons)	161.4	189.8	195.1
Daily Per capita GHG reduction (lbs/person)	-0.096	-0.102	-0.098
Daily Per capita GHG reduction	-0.42%	-0.45%	-0.45%

References

1. WSP (2019). Draft TDM Off-Model Methodology—March 2019 Revision. WSP Inc.
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5. SANDAG (2018). 2018 Commute Behavior Survey.
6. SANDAG (2017). 2017 San Diego Regional Vanpool Participant Survey.
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Appendix G
SANDAG Carshare Calculator Review and Comparison

Carsharing Off-Model Methodologies Review

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Summary

This document provides a review of SANDAG's Carsharing off-model calculator (OMC), originally developed by WSP, Inc. (WSP, 2019), compared to CARB's recommended methodology (CARB 2019a, 2019b). Generally, the calculator follows the quantification methodology steps of CARB's guidelines and is based upon valid assumptions and up-to-date parameters from the literature. The calculator was updated using the most recent ABM 2+ forecasts and reflect significant changes to coverage areas in 2035. The combined impacts of these updates lead to approximately double (0.20% reduction vs 0.10% reduction) the estimates per capita GHG in the updated calculator versus the original calculator.

Please note that the inputs, assumptions, and emission reduction estimates listed within this methodology are draft and are subject to change pending the development of a final network and land use scenario to inform the 2021 Regional Plan.

Review of the SANDAG Carsharing Calculator

Upon initial review, we realized it was important to note that there are several types of carsharing services, including roundtrip, one-way (either a free-float carshare service or station-based model), and peer-to-peer, that are relevant for quantification methodologies in CARB's SCS Evaluation Guidelines. SANDAG's carsharing calculator only considers roundtrip carsharing since other types of carsharing services do not exist in San Diego. Car2go, a free-float carshare service that was previously operating in San Diego, ceased operation in the region in 2016 and left all North American markets in 2020.

Once establishing the submarket that the calculator is targeting, we reviewed the general methodology, which is described in more detail below, and found it consistent with CARB guidelines. We also reviewed the core modeling inputs to the carshare calculator, which include:

- EMFAC 2014 Emission factors
- EMFAC 2014 VMT
- SANDAG employment forecasts
- SANDAG population forecasts
- SANDAG MGRA residential area (acres)
- SANDAG MGRA college student enrollment and employment

- Carshare Mobility Hub coverage (1 if carshare operates in MGRA, 0 otherwise)
- Carshare College/university coverage (1 if carshare operates in college)
- Carshare Military base coverage (1 if carshare operates on base, 0 otherwise)

No methodological changes to these inputs were deemed necessary by our review other than updating the population and travel forecasts (trips, skims, and VMT) from SANDAG's ABM2+ model and reviewing the carshare coverage indicators to confirm their correctness.

Our review also included assessing what parameter changes were appropriate based upon any changes to the literature since the calculators were developed by WSP Inc. (2019). Table 1 indicates the parameters and assumptions of the calculator. Our review found that the assumptions summarized in the table are based upon valid research and data sources that have not been superseded by any literature we could identify.

Table 1. Parameters and assumptions of SANDAG carsharing calculator

Parameter	**Source**	**Details**
Carshare participation rate in higher density areas	SANDAG (2017). 2016-2017 San Diego Regional Transportation Study.	For each scenario year:proportion of urban population that will become carshare members
Carshare participation rate in lower density areas	Petersen, E., Y. Zhang, and A. Darwiche (2016).	For each scenario year: proportion of suburban population that will become carshare members
Membership rate,	Assumed equal to higher density area carshare participation rates or 2 percent of the eligible population	For each scenario year: proportion of college employees that will become carshare members
Daily VMT reduction, roundtrip carshare	Cervero, R. A. Golub, and Nee (2007)	For each scenario year: VMT reduction per roundtrip carshare member

We reviewed models, assumptions, and modeling inputs and found that the carsharing OMC follows CARB's Final Sustainable Communities Strategy Program and Evaluation Guidelines and Appendices in terms of data sources, supporting literature for assumptions, and efforts avoiding double counting. For instance, to avoid overestimation and to ensure that GHG emission reductions associated with fleet efficiencies are only captured in the SANDAG Electric Vehicle Programs off-model calculator, the carshare methodology does not account for fuel-efficiency of carshare vehicle fleets. Furthermore, the carsharing OMC drops the impact of carsharing service in 2050 by assuming that a carsharing service will no longer be available in 2050 as shared, on-demand services (e.g., ridehailing, microtransit) continue to grow in popularity.

GHG Emission Calculator Methodology

The CO2 reduction attributed to the three carshare markets—general population, colleges, and military bases—is calculated following the procedures described below for each of the markets;

Carshare participation:

1. Identify the carshare service coverage areas. In support of regional mobility hub planning efforts, the SANDAG TDM program seeks to promote and encourage the provision of Carshare within neighborhoods that exhibit similar supporting land uses as those where carsharing is provided today such as the region's employment centers, colleges, and military bases:

    a. Mobility hubs (General Population): Define agglomerations of MGRAs and aggregated by MSA. The coverage areas vary by scenario year, reflecting increasing land use density and a maturing carshare industry.

    b. College/Universities (College Staff and Students): Identify colleges and university areas where carshare services will operate in each scenario year. These areas are defined as agglomerations of MGRAs and aggregated by MSA.

    c. Military (Military personnel on base): Identify military bases where carshare services will operate in each scenario year. The military bases are defined as agglomerations of MGRAs and aggregated by MSA.

2. Calculate the eligible population for carsharing:

    a. General Population: Estimate the eligible population for carsharing, which reside within the defined carshare coverage area boundaries and are persons older than 18 years old and younger than 65 years old.

    b. College Staff and Students: The eligible student population that is potential carshare participants corresponds to the total students enrolled (full-time and part-time) in each college/university campus and total staff employed at each campus.

    c. Military: Estimated Carshare participants within the region's military bases correspond to the employment at each base.

3. Calculate the carshare participation, defined as 2 percent of the eligible population in higher density areas and 0.5 percent of the eligible population in lower-density areas. The population density thresholds that support carshare participation in the region are based on the Car2Go service area prior to their exit from the San Diego market. Colleges and military bases, participation rates are assumed equal to higher density area carshare participation rates or 2 percent of the eligible population.

Carshare VMT and GHG reductions:

4. Calculate the VMT reduction from roundtrip carshare, assuming a daily average reduction of seven miles per day per roundtrip carshare member (Cervero et al, 2007).

5. Calculate the CO2 reduction corresponding to the VMT reduction, using the EMFAC 2014 CO2 emission rates.

The main assumptions regarding carsharing membership are based on the population density and the carshare service coverage area. Table 2 and Table 3 show the eligible employment and estimated carshare participation in 2020 and 2035, respectively. The enlarged coverage of carshare services in 2035 increases the estimated Carshare participation. The carshare service coverage substantially increases to 6,743 MGRAs (Master Geographic Reference Areas) from 31 MGRA in 2020. As such, it is expected that in 2035 employment centers will have 15,026 participants. College staff and student participation will increase to 1,735 and 6,607 respectively. Military bases will include 2,256 participants while there are no participants in 2020 given the current carshare market in the San Diego region.

Table 2. Eligible employments and estimated carshare participation in 2020

	Strategy Inputs -- Year 2020																		
	Employment Centers							Colleges - Staff				Colleges - Students				Military Bases			
MSA	MGRAs in employment center coverage area	Eligible adult population within the coverage area (thousands)	Eligible adult population in higher density areas within the coverage area (thousands)	Eligible adult population in lower density areas within the coverage area (thousands)	Carshare participation rate, higher density areas [4]	Carshare participation rate, lower density areas [5]	Estimated carshare participation	MGRAs in college coverage area	College / University employment	Carshare participation rates, college staff [4]	Estimated carshare participation	MGRAs in college coverage area	College / University enrollment	Carshare participation rates, college students [4]	Estimated carshare participation	MGRAs in military base coverage area	Military base employment	Carshare participation rates, military bases [4]	Estimated carshare participation
Central	26	4	3	0	2.0%	0.50%	68	10	13,027	2.0%	261	10	42,732	2.0%	855	-	-	2.0%	-
North City	5	0	0	0	2.0%	0.50%	2	17	30,822	2.0%	616	17	44,222	2.0%	884	-	-	2.0%	-
South Suburban	-	-	-	-	2.0%	0.50%	-	-	-	2.0%	-	-	-	2.0%	-	-	-	2.0%	-
East Suburban	-	-	-	-	2.0%	0.50%	-	-	-	2.0%	-	-	-	2.0%	-	-	-	2.0%	-
North County West	-	-	-	-	2.0%	0.50%	-	-	-	2.0%	-	-	-	2.0%	-	-	-	2.0%	-
North County East	-	-	-	-	2.0%	0.50%	-	3	4,534	2.0%	91	3	16,627	2.0%	333	-	-	2.0%	-
East County	-	-	-	-	2.0%	0.50%	-	-	-	2.0%	-	-	-	2.0%	-	-	-	2.0%	-
Total	31	4	3	0			70	30	48,383		968	30	103,581		2,072	-	-		-

Table 3. Eligible employments and estimated carshare participation in 2035

	Strategy Inputs -- Year 2035																		
	Employment Centers							Colleges - Staff				Colleges - Students				Military Bases			
MSA	MGRAs in employment center coverage area	Eligible adult population within the coverage area (thousands)	Eligible adult population in higher density areas within the coverage area (thousands)	Eligible adult population in lower density areas within the coverage area (thousands)	Carshare participation rate, higher density areas [4]	Carshare participation rate, lower density areas [5]	Estimated carshare participation	MGRAs in college coverage area	College / University employment	Carshare participation rates, college staff [4]	Estimated carshare participation	MGRAs in college coverage area	College / University enrollment	Carshare participation rates, college students [4]	Estimated carshare participation	MGRAs in military base coverage area	Military base employment	Carshare participation rates, military bases [4]	Estimated carshare participation
Central	2,671	336	288	48	2.0%	0.50%	6,004	14	15,709	2.0%	314	14	71,360	2.0%	1,427	9	59,189	2.0%	1,184
North City	1,167	217	179	39	2.0%	0.50%	3,771	21	53,260	2.0%	1,065	21	111,642	2.0%	2,233	11	9,808	2.0%	196
South Suburban	352	72	51	21	2.0%	0.50%	1,132	1	464	2.0%	9	1	24,768	2.0%	495	-	-	2.0%	-
East Suburban	959	108	72	35	2.0%	0.50%	1,623	2	2,507	2.0%	50	2	38,770	2.0%	775	-	-	2.0%	-
North County West	635	45	27	18	2.0%	0.50%	623	2	1,158	2.0%	23	2	21,745	2.0%	435	6	43,788	2.0%	876
North County East	959	127	83	44	2.0%	0.50%	1,873	4	12,665	2.0%	253	4	62,067	2.0%	1,241	-	-	2.0%	-
East County	-	-	-	-	2.0%	0.50%	-	-	-	2.0%	-	-	-	2.0%	-	-	-	2.0%	-
Total	6,743	905	700	205			15,026	44	85,763		1,715	44	330,352		6,607	26	112,785		2,256

Table 4 shows the estimated VMT and GHG reduction results of the updated carshare OMC. We also compared it with the results of the original calculator developed by WSP (2019) that are shown in Table 5. This comparison indicates that the changes in input data had a notable impact on daily per capita GHG reduction. This is because of changes to the carshare service area defined as part of the Regional Mobility Hub network. The number of MGRAs covered by the carshare service in 2035 is 6,743 MGRAs and its estimated carshare participation is 25,604 members. However, the original OMCs estimated 12,068 members from 1,192 MGRAs in the same year.

Table 4. Estimated VMT and GHG Reduction Results of the updated Carshare OMC

VMT and GHG Reduction Results			
Variable	**2020**	**2035**	**2050**
Plan CO2 Emissions			
Daily CO2 emissions (short tons)	38,881	38,199	Given the rapid trend towards automation, it is assumed that a carsharing service will no longer be available in 2050 and will instead be replaced by a fleet of shared and autonomous vehicles by the year 2050.
Daily emissions per capita (lbs)	22.98	21.10	
Daily VMT reduction			
Roundtrip carshare	21,764	179,225	
Total VMT reduction	21,764	179,225	
Total daily GHG reductions (short tons)	10.2	81.9	
Daily per capita GHG reduction (lbs/person)	0.0060	0.0453	
Daily per capita GHG reduction	-0.03%	-0.21%	

Table 5. Estimated VMT and GHG Reduction Results of the original Carshare OMC

VMT and GHG Reduction Results			
Variable	**2020**	**2035**	**2050**
Plan CO2 Emissions			
Daily CO2 emissions (short tons)	38,663	42,139	Given the rapid trend towards automation, it is assumed that a carsharing service will no longer be available in 2050 and will instead be replaced by a fleet of shared and autonomous vehicles by the year 2050.
Daily emissions per capita (lbs)	22.92	22.72	
Daily VMT reduction			
Roundtrip carshare	78,331	88,395	
Total VMT reduction	78,331	88,395	
Total daily GHG reductions (short tons)	37.7	41.2	
Daily per capita GHG reduction (lbs/person)	0.0223	0.0222	
Daily per capita GHG reduction	-0.10%	-0.10%	

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Appendix H
SANDAG Pooled Rides Calculator Review and Comparison

Pooled Rides Off-Model Methodologies Review

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11/13/2020

Summary

This document provides a review of SANDAG's Pooled rides off-model calculator that was originally developed by WSP Inc. (WSP, 2019). The pooled program subsidizes eligible employees that currently drive alone to work and are not suitable candidates for commuting by vanpool, microtransit, or transit. In addition to subsidy, as the region's managed lane network expands, commuters/non-work related travelers who choose to pool will experience shorter travel times than commuters driving alone. This travel time savings will further encourage a shift from driving alone to pooling. We compare the calculator to CARB's recommended methodology (CARB 2019a, 2019b) and use the 2019 Transportation Study commissioned by SANDAG (SANDAG, 2019) for calibrating the off-model calculator. We find that the calculator is methodology consistent with best practices and, with the parameter updates, uses the most recent data available to estimate the anticipated behavior of the population with respect to the pooled ride mode in the presence of incentives and managed lane investments. Updates to the calculator using the 2019 TNC Survey lead to smaller estimated GHG reductions than WSP's (2019) original calculator. Though the results produce nominal reductions to the ABM2+ forecasts, we recommend maintaining the calculator for the 2021 Sustainable Communities Strategy and reassessing the performance of pooled rides during the next cycle as this is still an evolving mode that may gain future acceptance with changes in population attitudes.

Please note that the inputs, assumptions, and emission reduction estimates listed within this methodology are draft and are subject to change pending the development of a final network and land use scenario to inform the 2021 Regional Plan.

Review of the SANDAG Pooled Rides Calculator

ITS-Irvine's review of the SANDAG pooled ride calculator included assessing what parameter changes were appropriate based upon any changes to the literature since the calculators were developed by WSP (2019).

The core modeling inputs to the pooled rides calculator include:

- EMFAC 2014 Emission factors
- EMFAC 2014 VMT

- SANDAG population forecasts
- SANDAG regional trips
- SANDAG travel time skim data

No methodological changes to these inputs were deemed necessary in our review other than updating the population and travel forecasts (trips, skims, and VMT) from SANDAG's ABM2+ model.

Table 1 summarizes the parameters and assumptions used by the calculator. ITS-Irvine's review assessed whether parameter changes were appropriate based upon any changes to the literature since the calculators were developed by WSP (2019). We found that the assumptions and parameters are up to date and defensible based upon the current state of the practice, with the following notes:

- Newer San Diego-specific data on revealed pooled ride mode shares is available from the 2019 Transportation Study (vs the 2018 survey used by WSP), which is reflected in this table and was used to update the calculator as described in following sections.
- The marginal disutility of travel time was updated to be consistent with the most recent ABM 2+ forecasts.
- The remaining assumptions and parameters remaining justifiable either via policy or by being based upon the most recent appropriate data sources.

Table 1. Parameters and assumptions of SANDAG pooled rides calculator

Parameter	**Source**	**Details**
Pooled ride mode shares	2019 Transportation Study	The mode-specific constant is calibrated based on the observed proportions of pooled ride use reported in the 2019 Transportation Study.
Pooled ride average vehicle occupancy		In lieu of observed data, the calculator assumes the minimum occupancy to qualify as a pooled ride trip (3 persons per car)
Marginal disutility of travel time	SANDAG ABM 2+	Used in the calculation of demand elasticity
Median value of time	Preliminary Series 14 Forecast	Derived value ($9.80/hr.), estimated as one-third median household income for San Diego region ($61,400), expressed as an hourly wage rate ($29.52/hr.). The value of time is used to calculate an average coefficient of cost, for the demand elasticity formula.
Pooled ride mode-specific constant	Calibrated from the Transportation Study	Mode-specific constants asserted to reflect the county-wide pooled app-enabled rideshare utilization (mode share) reported by the 2019 Transportation Study

Auto operating cost	SANDAG ABM 2+	Used to calculate the cost of driving-alone; accounts for fuel and vehicle maintenance. Expressed in cents per mile in (2010 $).
Pooled rides cost per mile	Internal Revenue Service, 2016 standard mileage reimbursement rate for travel in personally-owned automobile.	Expected pooled ride service fare, in cents per mile, including subsidies. Separate values for work and non-work trips, to reflect work-trip subsidies.

GHG Emission Calculator Methodology

ITS-Irvine also reviewed the core methodology employed by the calculator and found that it follows CARB's (2019a, 2019b) Final Sustainable Communities Strategy Program and Evaluation Guidelines. The inputs include detailed strategies associated with pooled rides, such land use and transportation (managed lanes, ridematching programs), location (origin and destination and travel times), and subsidy for pooled rides (new mobility). In addition, the calculator avoids double-counting by taking vehicle trips required to serve the trips, which implies that the shift from drive-alone trips to pooled rides is the amount of the total estimated trips excluding the number of pooled ride drivers.

The calculator computes the CO2 reduction attributed to pooled rides using the following procedures.

Computing pooled (app-enabled) trips within the region:

1. Based on the SANDAG ABM2+ predictions for each scenario year, sum the number of drive-alone person trips by origin MSA, destination MSA, purpose (work/other), time period(AM/PM peak, non-peak), and household auto ownership category.
2. Lookup the average travel time for each MSA-to-MSA origin/destination market, based on the travel time skims produced by the SANDAG ABM2+ for drive-alone trips and carpool trips, respectively.
3. Lookup the average trip distance for each MSA-to-MSA origin/destination market, based on the distance skims produced by the SANDAG ABM2+ for drive alone trips.
4. Estimate the cost of driving alone by applying the auto operating cost to the average trip distance.
5. Estimate the cost of pooling by applying the indexed mileage reimbursement rate to the average trip distance and any trip subsidies as proposed in the Regional Plan.
6. Estimate the proportion of pooled rides in each trip market listed above, using the binomial mode choice model (a binomial logit model). This model is solely a function of

the difference in trip cost between driving alone and pooling and a pooled-ride mode-specific constant that captures the overall preference expressed by the observed pooled-ride mode shares.

7. Estimate the additional pooled ride trips that will be incentivized by managed lane investments (travel time savings), applying the demand elasticity formula (Train 1993).

Computing pooled rides VMT and GHG reductions:

8. Calculate pooled ride VMT based on the average MSA-to-MSA trip distance and pooled ride prediction, assuming an average pool ride auto occupancy of 3 persons per car. The pooled ride occupancy corresponds with the minimum HOV requirements being recommended as part of the Regional Plan's managed lane investments.

9. Calculate the pooled ride VMT reduction. Since the shift is from drive alone to pooled ride, the difference between the total person trips and the vehicle trips used for pooled-riding is equal to the vehicles removed from highways by the availability of ride-pooling.

10. Calculate the corresponding CO2 reduction corresponding to the VMT reduction, using the EMFAC 2014 CO2 emission rates.

The behavior of travelers in pooled ride calculator is based on two assumptions:

1. Drive-alone trips will shift to pooled rides if a subsidy is provided. A binary logit model is used to model this behavior. The explanatory variables of this logit model are travel distance, auto operation cost, pooled ride cost that is subsidized, and mode specific constants.

2. Travel time savings of pooled rides from the usage of managed lanes will better attract pooled rides from drive-alone trips. This behavior is modeled by elasticity, originated from a binary logit model.

For the calibration of logit models, SANDAG requested that we utilize data from the recent Transportation Study (2019), which focused on respondents from San Diego County. Table 1 shows the weighted mode share of pooled rides recorded by the survey. It is noteworthy that we also include all types of app-enabled pooled rides such as Uber Pool, Lyft Shared, and Waze Carpool. Although ABM 2+ includes pooled TNCs, the purpose of the off-model calculator is to capture the impacts of the carpool incentive program and managed lane investments in the region where it leads to increasing inter-household pooling. Furthermore, subsidies currently provided in partnership with Waze Carpool may also be extended to on-demand ridehailing solutions such as Uber or Lyft, which ABM2+ does not consider.

Table 2. 2019 Transportation Study pooled modeshare, weighted

Total Pooled	Work-related	Nonwork	total

0	0.076%	0.275%	**0.261%**
1	0.043%	0.198%	**0.164%**
2+	0.010%	0.048%	**0.040%**
Total	**0.019%**	**0.091%**	**0.076%**

The survey results indicate that the mode share of carpool matches is only 0.076% (10,366 trips over a total of 13,614,928 trips). However, the original version of the pooled-ride calculator estimates 8,536 pooled ride trips versus a total of 4,859,394 drive-alone trips (0.176%) in 2020.

ITS-Irvine re-calibrated the mode-specific constants of a binary logit model in the pooled rides calculator using the weighted trip frequencies from the 2019 Transportation Study that show the aggregated mode share for pooled ride matches. To do this, ITS-Irvine developed a mode-specific constant calibrator as an excel spreadsheet that estimates target mode share by scaling down the OMC's mode share from the ratio of the difference between calculator's predicted mode share for 2020 (which acts as a calibration base year) and the 2019 Transportation Study mode share for pooled rides. The implied assumption is that the 2019 Transportation Study data aligns with behavior that would be expected in the 2020 base year. The current version uses the excel solver with ordinary least squares for the calibrations. The constants are calibrated to match shares for household size and vehicle ownership groups from the 2019 TNC survey data.

The constants found from the calibrator, shown in Table 3 in comparison to the constants from the 2018 survey, were then used to update those in the pooled ride calculator. The mode specific constants are lower than the original calculator. Specifically, the constants for zero car households for both work trips and non-work trips are much lower than the original value, which leads to the expectation that the mode share of both categories will be significantly lower than in the original calculator.

Table 3. Updated mode specific constants

Pooled rides alternative-specific		Original (2018 San Diego Commute Behavior Survey)	Updated (2019 TNC-User Travel Survey-San Diego)
work trips	Zero cars	-2.60	-7.29
	One car	-5.90	-7.86
	Two or more cars	-7.90	-9.34

non-work trips	Zero cars	-2.90	-5.93
	One car	-6.30	-6.25
	Two or more cars	-8.40	-7.68

Table 4 shows a summary of pooled ride demand as computed by the calculator. ITS-Irvine also compared the estimated pooled ride demand with the original calculator, as shown in Table 5. Because of decreased mode specific constants, the updated calculator estimates lower pooled ride ridership except for non-work trips associated with households having more than one car. The updated calculator estimates that travel time savings from managed lane investments have insignificant impacts on pooled ride ridership, in part because the travel time savings of managed lanes in ABM 2+ is lower than the previous data, as shown in Table 6.

Table 4. Estimated Pooled ride demand of the updated calculator

Variable	2020	2035	2050	Notes
Pooled ride person trips, base demand				
Work trips (AM and PM Periods), zero car households	19	13	11	The demand for pooled rides is estimated by applying a mode shift model to the base drive alone trips. The mode shift model was calibrated to observed mode shares [1,6]. This model is segmented by household auto ownership, consistent with the differences in aggregate mode shares in the observed data.
Work trips (AM and PM Periods), one car households	158	129	114	
Work trips (AM and PM Periods), two+ car households	132	110	101	
Non-work trips (all time periods), zero car households	165	195	198	
Non-work trips (all time periods), one car households	1,228	1,327	1,293	
Non-work trips (all time periods), two+ car households	1,173	1,267	1,294	
Pooled ride person trips, demand due to managed lane investments				
Work trips (AM and PM Periods), zero car households	0	0	0	Investments in managed lanes that reduce travel time for carpoolers can further incentivize pooled ride transpiration options. The percent change in demand as a function of travel time savings is estimated based on the elasticity of demand for pooled rides with respect to travel time. The elasticity of demand varies by origin-destination market and by time period.
Work trips (AM and PM Periods), one car households	0	0	0	
Work trips (AM and PM Periods), two+ car households	0	0	0	
Non-work trips (all time periods), zero car households	0	0	0	
Non-work trips (all time periods), one car households	0	0	0	
Non-work trips (all time periods), two+ car households	0	0	0	
Pooled ride person trips, base and induced				
Work trips (AM and PM Periods), zero car households	19	13	11	Total pooled ride trips = base trips + trips induced by managed lane time savings
Work trips (AM and PM Periods), one car households	159	129	114	
Work trips (AM and PM Periods), two+ car households	132	110	102	
Non-work trips (all time periods), zero car households	165	195	198	
Non-work trips (all time periods), one car households	1,229	1,327	1,293	
Non-work trips (all time periods), two+ car households	1,174	1,267	1,294	
Total pooled ride trips				
Total person trips	2,877	3,041	3,013	*= sum of all pooled ride trips*
Vehicle trips required to serve the person trips	959	1,014	1,004	*= pooled ride trips / average vehicle occupancy*
Vehicles replaced by pooled ride service	1,918	2,027	2,008	Since the shift is from drive alone to pooled ride, the difference between the total person trips and the vehicle trips used for pooled-riding is equal to the vehicles removed from highways by the availability of ride-pooling.

Table 5. Estimated Pooled ride demand of the original calculator

Variable	2020	2035	2050	Notes
Pooled ride person trips, base demand				
Work trips (AM and PM Periods), zero car households		1,036	1,351	The demand for pooled rides is estimated by applying a mode shift model to the base drive alone trips. The mode shift model was calibrated to observed mode shares [1,6]. This model is segmented by household auto ownership, consistent with the differences in aggregate mode shares in the observed data.
Work trips (AM and PM Periods), one car households		1,062	1,200	
Work trips (AM and PM Periods), two+ car households		320	323	
Non-work trips (all time periods), zero car households		2,545	3,564	
Non-work trips (all time periods), one car households		1,544	1,771	
Non-work trips (all time periods), two+ car households		454	483	
Pooled ride person trips, demand due to managed lane investments				
Work trips (AM and PM Periods), zero car households		20	23	Investments in managed lanes that reduce travel time for carpoolers can further incentivize pooled ride transpiration options. The percent change in demand as a function of travel time savings is estimated based on the elasticity of demand for pooled rides with respect to travel time. The elasticity of demand varies by origin-destination market and by time period.
Work trips (AM and PM Periods), one car households		16	18	
Work trips (AM and PM Periods), two+ car households		6	6	
Non-work trips (all time periods), zero car households		10	11	
Non-work trips (all time periods), one car households		5	5	
Non-work trips (all time periods), two+ car households		2	1	
Pooled ride person trips, base and induced				
Work trips (AM and PM Periods), zero car households		1,056	1,374	Total pooled ride trips = base trips + trips induced by managed lane time savings
Work trips (AM and PM Periods), one car households		1,078	1,218	
Work trips (AM and PM Periods), two+ car households		326	329	
Non-work trips (all time periods), zero car households		2,555	3,575	
Non-work trips (all time periods), one car households		1,550	1,776	
Non-work trips (all time periods), two+ car households		456	485	
Total pooled ride trips				
Total person trips		7,020	8,756	*= sum of all pooled ride trips*
Vehicle trips required to serve the person trips		2,340	2,919	*= pooled ride trips / average vehicle occupancy*
Vehicles replaced by pooled ride service		4,680	5,837	Since the shift is from drive alone to pooled ride, the difference between the total person trips and the vehicle trips used for pooled-riding is equal to the vehicles removed from highways by the availability of ride-pooling.

Table 6.Comparisons of travel times between ABM2+ and ABM14.0 (original calculator)

		Average one-way weekday travel time					
		AM peak		PM peak		Midday peak	
Data	Year	mixed flow lanes	managed lanes	mixed flow lanes	managed lanes	mixed flow lanes	managed lanes
	2035	14.95	14.90	13.47	13.41	9.81	9.80
ABM 2+	2050	15.02	14.96	13.55	13.48	9.81	9.80
	2035	17.78	17.14	15.86	15.42	11.07	10.96
Original	2050	17.65	17.09	15.82	15.39	11.04	10.95

Table 7 shows the estimated VMT and GHG reduction results of the updated pooled ride OMC. Compared with the estimated results of the original OMC, shown in Table 8, the changes in mode specific constant and input data had a notable impact on daily per capita GHG reduction.

The updated calculator estimates a lower impact on GHG reductions due to pooled rides, which is mainly due to the lower mode share of pooled rides measured in the 2019 Transportation Study. Lower managed lane travel time savings estimated from ABM 2+ also affects the GHG reductions, compared to the original calculator. Compared with the updated vanpool OMC, pooled rides are less affected by managed lanes since pooled rides have shorter travel distances than vanpool.

Table 7 Estimated VMT and GHG Reduction Results of the updated pooled ride OMC

Variable	2020	2035	2050	Notes
Plan CO2 Emissions				
Daily CO2 emissions (short tons)	38,881	38,199	38,777	*= Sum of running emissions and trip start emissions trip start emissions*
Daily emissions per capita (lbs.)	22.98	21.10	20.70	*= Daily emissions (short tons) / regional population * 2000 lbs / 1 short ton*
Daily person miles traveled, pooled ride trips				
Work trips, zero car households	153	102	94	
Work trips, one car households	1,221	993	896	*= pooled ride person trips * distance traveled*
Work trips, two+ car households	1,168	956	903	
Non-work trips, zero car households	867	1,039	1,088	calculated over origin-destination Metropolitan Statistical Areas (MSA)
Non-work trips, one car households	6,288	6,714	6,554	
Non-work trips, two+ car households	6,240	6,596	6,707	
Total person miles traveled, pooled ride trips	15,936	16,400	16,242	
Total vehicle miles reduced by pooled rides	10,624	10,933	10,828	*= total person miles * proportion of vehicles eliminated by pooled-riding*
Total vehicle trips reduced by pooled rides	1,918	2,027	2,008	
GHG reductions				
Total daily GHG reductions (short tons)	5.17	5	5	*= vehicle trip reductions * trip start emission factor + VMT reduction * running emission factor*
Daily per capita GHG reductions (lbs./person)	0.00	0.00	0.00	*= per capita GHG emission reductions*
Daily per capita GHG reduction	-0.0133%	-0.0136%	-0.0131%	*= percent change in per capita GHG reduction*

Table 8 Estimated VMT and GHG Reduction Results of the original pooled ride OMC

Variable	2020	2035	2050	Notes
Plan CO2 Emissions				
Daily CO2 emissions (short tons)	38,663	42,139	43,371	*= Sum of running emissions and trip start emissions trip start emissions*
Daily emissions per capita (lbs.)	22.92	22.72	21.87	*= Daily emissions (short tons) / regional population * 2000 lbs / 1 short ton*
Daily person miles traveled, pooled ride trips				
Work trips, zero car households		8,668	11,471	
Work trips, one car households		8,392	9,597	*= pooled ride person trips * distance traveled*
Work trips, two+ car households		2,839	2,911	
Non-work trips, zero car households		14,242	20,251	calculated over origin-destination Metropolitan Statistical Areas (MSA)
Non-work trips, one car households		8,068	9,228	
Non-work trips, two+ car households		2,447	2,609	
Total person miles traveled, pooled ride trips		44,657	56,067	
Total vehicle miles reduced by pooled rides		29,771	37,378	*= total person miles * proportion of vehicles eliminated by pooled-riding*
Total vehicle trips reduced by pooled rides		4,680	5,837	
GHG reductions				
Total daily GHG reductions (short tons)		14	18	*= vehicle trip reductions * trip start emission factor + VMT reduction * running emission factor*
Daily per capita GHG reductions (lbs./person)		0.01	0.01	*= per capita GHG emission reductions*
Daily per capita GHG reduction		-0.03%	-0.04%	*= percent change in per capita GHG reduction*

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Appendix I
SANDAG Regional TDM Ordinance Calculator Review and Comparison

Methodology and Implementation of Transportation Demand Management Ordinance (TDMO) Off-model Calculator

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1 Summary

This document describes the development of a new off-model calculator for the San Diego Association of Governments's (SANDAG) 2021 Regional Transportation Plan. We discuss the motivation for the development of this calculator, describe both its methodological design and specific implementation, and briefly discuss preliminary results produced by the calculator using draft data from the 2021 Regional Plan that estimate per capita greenhouse gas (GHG) reductions to range from about 0.44 % in 2035 to 0.67 % in 2050.

Please note that the inputs, assumptions, and emission reduction estimates listed within this methodology are draft and are subject to change pending the development of a final network and land use scenario to inform the 2021 Regional Plan.

2 Background

As part of its 2021 regional transportation plan, SANDAG is developing Transportation Demand Management Ordinance (TDMO) program. Per SANDAG's definition:

> "Transportation Demand Management (TDM) refers to policies and programs designed to help reduce commute traffic congestion. This is typically accomplished through sharing information, encouragement and incentives to help people know about and use all the efficient and sustainable transportation options available to them. Typical TDM programs promote carpooling, vanpooling, public transportation, biking and walking to work, and other alter-

natives to driving alone. These alternatives, along with parking management, telework, and compressed work schedules, can significantly reduce congestion on our regions roadways. Moreover, TDM ordinances can serve as a tool that governments - cities, counties, regions and states—use to reduce commute trips. They can achieve this through targeting area employers or land use development on new and renovated projects." (SANDAG, 2020)

SANDAG's new Transportation Demand Management Ordinance (TDMO) plan builds upon the the SANDAG iCommute Employer Program that works with over 200 employers on a voluntary basis to implement commuter benefit programs. Since the adoption of the 2015 Regional Plan, the iCommute Employer Program has expanded to a team of seven account executives that work with employers of all sizes throughout the region. Employers survey their employees to track their mode share over time. Employers are rewarded and recognized through the iCommute Diamond Awards for measurably reducing single occupant vehicle trips by employees. On average, the employers that work with iCommute have reduced their drive alone mode share by 10 %. As part of the 2021 Regional Plan, SANDAG is exploring a regional TDMO that would require employers with over 250 employees to implement and monitor a Travel Demand Management (TDM) plan in order to achieve an established average vehicle ridership (AVR). An employer's TDM program could include the following (SANDAG, 2020):

- **Commuter services** Offering programs like secured bike lockers and free rides home in case of an emergency can make it easier for commuters to use transit and other alternatives to driving alone.
- **Financial Subsidies and Incentives** Financial incentives and pre-tax commuter benefits for commuters can lower the out-of-pocket cost for commuters who choose alternatives to driving alone.
- **Marketing, Education, and Outreach** Outreach events, educational campaigns, and marketing strategies help raise awareness of alternative commute options.
- **Parking Management** Employers can offer cash incentives, transit passes in lieu of a parking space, and preferred parking for high-occupancy vehicles can act as an incentive to choosing an alternative commute option. Charging for parking at the workplace can act as a disincentive to drive alone.
- **Telework and Flexible Work Schedules** Employers can develop workplace policies that promote telework, flexible schedules, and/or compressed work schedules in order to reduce peak commute trips.
- **On-Site Amenities** Secured bike lockers and showers can offer convenience for commuters who choose to bike to work.
- **Employer Provided Transit** Can help to serve the first mile/last mile connection

to transit and/or provide direct pooling options for employees traveling from the same direction.

SANDAG proposes to develop and implement the TDMO in phases. In the near term, SANDAG will conduct outreach with employers and stakeholders that will help develop the policy and framework for the Regional TDMO Program. Regional stakeholders include the region's 19 local governments and advisory boards such as the San Diego County Air Pollution Control District. It is anticipated that the later phases would include a pilot period, during which larger employers would initially participate, and a later broader evaluation period with tentative timelines for these phases as follows:

- Near-Term (2020-2025): Outreach and Policy Development
- Mid-Term (2025-2035): "Pilot" approach (800+ employers in the region)
- Long-Term (2035-2050) : Program Evaluation

Since the impact of this type of program cannot be modeled in SANDAG's regional travel demand forecasting model, Activity-Based Model v2+ (ABM2+)[1], due to the varied and qualitative nature of its impacts on commuter mode choice behavior, capturing the impacts of a TDMO program for SANDAG's Sustainable Communities Strategy submission to the California Air Resources Board (CARB) requires the development of an off-model calculator, which we discuss below.

3 Proposed Methodology

The TDMO will be employer-based, meaning that the regulations will require that employers demonstrate that their employees (as a group) are meeting AVR negotiated between the business and SANDAG. SANDAG intends to expand existing iCommute Employer Program offerings to assist employers with implementing and monitoring their TDM programs. Further, it is assumed that the ordinance will only apply to specific employers, namely larger employers with at least some minimum number of employees, currently assumed to be 250 or more with the final threshold dependent on the outcome of the Outreach and Policy Development phase. These employers will be provided with options from a set of TDM strategies, as discussed above, to achieve the target.

The method described below computes how many aggregate reduced drive alone trips and associated vehicle-miles traveled (VMT) will be attributable to large employers (LEs) collectively taking action to meet their AVR individual targets. The approach computes the difference between the estimated drive alone and total commute trips between each

[1] ABM2+ (Resource Systems Group, Inc., 2020) is a state-of-the-art activity-based travel demand model belonging to the Coordinated Travel–Regional Activity Modeling Platform (CT-RAMP) family of models (Davidson et al., 2010).

pair of zones that are associated with LEs in the absence of any TDMO, and compares that to the drive alone totals that would exactly match the AVR target for LEs, which we call a TDMO cap in this discussion. If the estimated difference is greater than the cap, it is assumed that the TDMO program will induce a shift of those excess trips from drive alone to some other mode, thus removing them and their associated VMT from the forecast. To implement this, we assume that we are given the following:

M is the minimum number of employees an employer must have for the TDMO to apply.

α is the maximum drive alone share, which is the fraction of an employer's commute trips that can use the drive alone mode if the TDMO applies to that employer. For instance, $\alpha = 0.65$ means that a maximum of 65 % of the employees can drive alone and still have the employer be compliant with the TDMO. This is a direct proxy for AVR.

B_j is the set of employers in zone j

x_{ijk} is the number of work trips between zones i and j by all modes for employer $k \in B_j$.

x_{ijk}^{DA} is the number of work trips between zones i and j for employer $k \in B_j$ using a drive-alone mode.

Let B_j^L be the subset of LEs in zone j (those with M employees or more). Note that $B_j^L \subseteq B_j$.

Now, if the TDMO was applied and effective, then no more than α of the trips associated with each LE in zone j could be drive alone trips. Specifically:

$$\sum_i x_{ijk}^{DA} \leq \alpha \sum_i x_{ijk} \quad , \forall k \in B_j^L, \forall j \tag{1}$$

Since the trip variables x represent behavior in the absence of TDMO, we can rearrange the inequality to define the difference between the TDMO requirement for drive alone trips and what the model predicts as:

$$\sum_i x_{ijk}^{DA} - \sum_i y_{ijk}^{DA} = \alpha \sum_i x_{ijk} \quad , \forall k \in B_j^L, \forall j \tag{2}$$

and rearranging:

$$\begin{aligned} y_{jk}^{DA} &= \sum_i y_{ijk}^{DA} = \sum_i x_{ijk}^{DA} - \alpha \sum_i x_{ijk} \quad , \forall k \in B_j^L, \forall j \\ &= \sum_i y_{ijk}^{DA} = \sum_i \left(x_{ijk}^{DA} - \alpha x_{ijk} \right) \quad , \forall k \in B_j^L, \forall j \end{aligned} \tag{3}$$

where y_{jk}^{DA} is the excess drive alone trips to zone j associated with employer k beyond the limit set by the TDMO.

If y_{jk}^{DA} is positive, that means that the TDMO would require employer k to use TDM programs available to it to reduce its employees' drive alone trips by at least that amount. If it is negative, then employer k's employee work trips to zone j already meet the α threshold and the TDMO would have no impact.

At this point it is worth noting that ABM2+ does not have the resolution to tell us the fraction of work trips between pairs of zones down to the employer level (let alone the drive alone work trips). Instead, ABM2+ will only be able to provide the total number of work and drive alone work trips between each zonal pairing i and j, or x_{ij} and x_{ij}^{DA} respectively. Summing equation 3 over all LEs $k \in B_j^L$ we get:

$$\begin{aligned} y_j^{DA,LE} &= \sum_{k \in B_j^L} \sum_i y_{ijk}^{DA} &&= \sum_{k \in B_j^L} \sum_i \left(x_{ijk}^{DA} - \alpha x_{ijk} \right) \quad, \forall j \\ &= \sum_i y_{ij}^{DA,LE} &&= \sum_i \left(x_{ij}^{DA,LE} - \alpha x_{ij}^{LE} \right) \quad, \forall j \end{aligned} \tag{4}$$

where

$y_j^{DA,LE}$ is the excess number of work trips associated with LEs traveling to zone j, which the TDMO will target if it is a positive value.

x_{ij}^{LE} is the number of work trips associated with LEs traveling from zone i to zone j.

$x_{ij}^{DA,LE}$ is the number of drive alone work trips associated with LEs traveling from zone i to zone j.

ABM2+ does not provide x_{ij}^{LE} or $x_{ij}^{DA,LE}$ directly. Instead, we must estimate the fraction of a zone j's total and drive alone trips that are associated with LEs. The most reasonable proxy we have for that is the total number of employees. Specifically, we have:

E_{jk} is the total number of employees in zone j working for employer k.

Now define the total number of employees in zone j as

$$E_j = \sum_{\forall k \in B_j} E_{jk}$$

and the total number of employees in zone j working for LEs as

$$E_j^L = \sum_{\forall k \in B_j^L} E_{jk}$$

If we assume that the total number of trips associated with LEs in a zone is proportional to the fraction of employment associated with LEs in that zone, we can estimate x_{ij}^{LE} or $x_{ij}^{DA,LE}$. Specifically, define the fraction of employment in zone j associated with LEs as

$$\beta_j = \frac{E_j^L}{E_j} \tag{5}$$

The total number of employees in a given zone for all forecast years can be obtained from SANDAG's I-LUDEM employment forecast. However, data on LEs is only available for the base year, and only for employers that reside within SANDAG-designated *employment centers* that are distributed throughout the region. As such, we conservatively assume that all LEs reside within employment centers and compute the ratio β_j on that basis. Then we can define

$$\begin{aligned} x_{ij}^{LE} &= \beta_j x_{ij} \\ x_{ij}^{LE,DA} &= \beta_j x_{ij}^{DA} \end{aligned} \tag{6}$$

Substituting into equation 4, we have

$$\begin{aligned} y_j^{DA,LE} &= \sum_i \left(\beta_j x_{ij}^{DA} - \alpha \beta_j x_{ij}\right) \quad ,\forall j \\ &= \beta_j \sum_i \left(x_{ij}^{DA} - \alpha x_{ij}\right) \quad ,\forall j \\ &= \frac{E_j^L}{E_j} \sum_i \left(x_{ij}^{DA} - \alpha x_{ij}\right) \quad ,\forall j \end{aligned} \tag{7}$$

Where $y_j^{DA,LE}$ represents the required TDMO reduction in trips for zone j defined in terms of total and large employer zonal employment (E_j and E_j^L) and total and drive alone trips to the zone (x_{ij} and x_{ij}^{DA}), both of which are available from ABM2+.

Note that here we are assuming that the behavior of the population working in that zone is consistent across all employers. For example, the collective employers in a given zone j could be meeting the TDMO threshold, but the drive alone trip reductions might be distributed unequally between them. As a simple example, a zone with two equal sized employers might have a 90 % drive alone fraction, but that could be because employer one has 80 % drive alone and employer two has 100 % drive alone. In this case, the TDMO would reduce the drive alone fraction associated with the zone from $\frac{80\%+100\%}{2} = 90\%$ to $\frac{80\%+90\%}{2} = 85\%$. However, since the ABM2+ model won't be able to provide the employer by employer breakdown, we make the more conservative assumption that the share is equal across all employers in the zone.

Note also that since the drive alone totals in the absence of a TDMO might be smaller than what might be required by a TDMO, it is possible that $y_j^{DA,LE}$ might be a negative number, meaning that there are a surplus of non-drive alone trips relative to the TDMO. Since a

TDMO is unlikely to encourage a shift to *more* drive alone trips, this surplus should be disregarded. As such, let's define the required trip reduction for all LEs k in each zone j as

$$z_j = \max\left(y_j^{DA,LE}, 0\right), \forall j$$

and the total reduction in work trips across all zones due to the TDMO as:

$$z = \sum_j z_j \tag{8}$$

Finally, the impacts of some of the the TDMO options, such as regional vanpool program, are already modeled by other off-model calculators, so care is required to avoid double counting the reductions by TDMO and the regional vanpool operations. The most conservative approach is be to modify equation 8 to remove any trip reductions attributable to explicitly modeled programs that would count against the TDMO caps:

$$z = \sum_j \max\left(\left(z_j - \sum_{l \in OM} z'_{jl}\right), 0\right) \tag{9}$$

where

OM is the set of independent off-model calculators representing TDM strategies

z'_{jl} is the trip reduction estimated for zone j by the calculator for TDM strategy l versus the TDMO phasing year[2].

4 Calculating emissions reductions

The method described above computes the total number of trip reductions that will be attributable to the TDMO.

VMT reductions can be obtained by defining:

d_{ij} is the average distance in miles to travel between zones i and j

and weighting the trip reductions in equation 4:

$$v_j^{DA,LE} = \sum_i v_{ij}^{DA,LE} = \sum_i d_{ij}\left(x_{ij}^{DA,LE} - \alpha x_{ij}^{LE}\right) \quad, \forall j \tag{10}$$

[2]Here we note that since the TDMO targets will be set on the basis of a given phasing year, the trip reductions due to other programs such as vanpool and pooled rides (and computed in those calculators) will be computed as the difference between the reductions attributable to that program for the phasing year and the reductions for that program in the target year, because the phasing year assessments will account for trips already participating in those programs.

where:

$v_j^{DA,LE}$ is the VMT reduction attributable to the TDMO for work trips to zone j.

Given total trip reductions $y_j^{DA,LE}$ and total VMT reductions $v_j^{DA,LE}$, emissions factors from EMission FACtors (EMFAC) can be applied to estimate emissions reductions due to cold starts (per trip) and running emissions (by VMT).

5 Implementation

This off-model calculator is implemented as a spreadsheet model in *Microsoft Excel* that uses SANDAG's employment growth forecasts (SANDAG, 2015) and mode- and purpose-specific regional trip forecasts for each scenario year, which are obtained from ABM2+ v14.2.0 as shown in Table 1. As described above, these forecasts are used to determine the share of commute trips by Metropolitan Statistical Area (MSA) associated with LEs that would therefore be subject to TDMO regulation, which is then used to compute the regulated reduction in drive alone trips. Once these reductions are determined and converted into VMT reductions, the emissions factors from the EMFAC 2014 model is applied to compute the reduction in emissions associated with fewer cold start and running emissions.

The detailed steps of the TDMO off-model GHG spreadsheet are as follows:

1. Estimate the fraction of AM and PM trips associated with LEs (see equation 5).
    (a) Estimate eligible employees impacted by TDMO ordinance program based on employment center major statistical area (MSA) analyses
    (b) The fraction of employees impacted for each MSA is the number of employees working for firms with > 250 employees divided by the number of employees working for all firms.
    (c) The fraction of AM and PM trips impacted for each MSA pair is assumed to be the same as the fraction of employees associated with LEs at the employment end of the trip. The employment end of trips in a period (the fraction of trips going for which work is the origin and the fraction for which work is the destination) is determined from work trip-directionality analysis of the OD and period obtained from the ABM2+ forecast. The LE work trip fraction is computed as a weighted average of the LE fractions for each side of the MSA OD pair.
2. Forecast the number of drive alone (DA) AM/PM trips associated with LEs for each MSA Origin-Destination (OD) pair, computed as the period-specific fraction of LE

Table 1: Principal Inputs to TDMO GHG Emissions Calculations

Data	**Source(s)**	**Notes**
Regional trips	SANDAG ABM 2+	Regional trips for each scenario year by: • Strategy year • O/D MSAs • Time period (AM, PM) • Trip mode (drive alone, carpool, non-motorized, and transit) • Trip purpose (Work) • Household auto ownership (0, 1, 2+)
Travel time and distance	SANDAG ABM 2+	For each scenario year: • TAZ-to-TAZ drive alone distance, general purpose lanes • TAZ-to-TAZ drive alone travel time, general purpose lanes
Work directionality	SANDAG ABM 2+	For each scenario year: • TAZ-to-TAZ share of work trips traveling TO and FROM work for each OD pair and time period
Large Employer Fraction	Share of employment associated with LEs within in each TAZ	Computed from employment center data detailing the total employment and employment center employment associated with LEs.
Emission factors	EMFAC 2014	For each scenario year: • Trips (cold starts) regional emissions (ton) • Running CO_2 regional emissions (ton) • Regional VMT • Regional trips

OD trips times the forecast number of drive alone OD trips during that period (equation 6).

3. Compute target drive-alone trip share (α) for LE work trips in the AM and PM periods between each MSA origin and destination. This is determined by assuming a 15 % reduction in ABM2+ forecast drive alone shares in 2035 and a 25 % reduction in 2050 (equation 7).

4. Establish LE drive alone trips allowance for each MSA OD pair by applying drive alone reduction targets to drive alone trips associated with LEs. This is computed as target drive alone LE work trip splits [step 3] times the forecast total work trips (from ABM2+) times the large employer fraction [step 1] (also see equation 7).

5. Estimate TDMO trip reductions by assuming that ABM2+ forecast trips exceeding the established drive alone allowance in the target year are reduced by the TDMO. TDMO-required reductions in AM/PM drive alone work trips for each MSA OD pair, which are computed as the difference between the forecast [step 3] and the allowance [step 4]. If this value is less than zero, the ABM2+ forecast reductions exceed the TDMO target, so the TDMO will not reduce additional trips and the reductions are set to zero for this period (see equation 9).

6. Estimate baseline VMT reduction as the TDMO trip reductions [step 5] times average MSA to MSA trip distance based on SANDAG ABM2+ (see equation 10).

7. Deduct other calculator drive alone work trip and VMT reductions (vanpool and pooled rides) between TDMO phasing year (assumed to be 2025 by default, and interpolated if necessary) and target year to avoid double counting. These deductions are computed on a TAZ-to-TAZ basis since the TDMO will operate at the employer level. As such, reductions from existing programs such as vanpool associated with employers in one MSA should not be deducted from TDMO impacts associated with employers in another MSA. In addition, if the performance of an existing program degrades between the phasing year and the future year (e.g., fewer commuters are vanpooling in 2035 versus the phasing year), it is assumed that the impacted employers will need make up that difference in the target year via other TDMO programs.

6 Representative Results

Though the results submitted with SANDAG's regional transportation plan and Sustainable Communities Strategy will depend on final forecast numbers from ABM2+ and related models, Figure 1 shows representative results of from the calculator to illustrate the results of the calculator using draft data. As can be seen, the TDMO calculator estimates a total of 44,559 fewer DA trips in 2035 due to the TDMO (after adjusting for the impacts

Variable		2020	2035	2050
TDMO reduction target		0%	15%	25%
Regional population		3383955	3620349	3746077
Average pooled ride vehicle occupancy		3.0	3.0	3.0

TDMO trip reduction targets

Variable		2020	2035	2050
TDMO trip reductions				
Work trips (AM and PM Periods), all households		0	44,605	67,245

VMT and GHG Reduction Results

Variable		2020	2035	2050
Plan CO2 Emissions				
Daily CO2 emissions (short tons)		38,881	38,199	38,777
Daily emissions per capita (lbs.)		22.98	21.10	20.70
Net vehicle trips reduced by vanpool vs 2025 baseline				
Daily DA trips removed by TDMO				
Total vehicle trips reduced by TDMO requirements		0	44,605	67,245
Vehicle trip reductions from existing pooled rides		43	34	31
Net vehicle trips reduced by pooled rides vs 2025 baseline		-	(6)	(10)
Vehicle trip reductions from existing vanpool		691	770	816
Net vehicle trips reduced by vanpool vs 2025 baseline		-	53	98
Net vehicle trips reduced by TDMO requirements		0	44,559	67,156
Daily person miles traveled, for DA trips removed by TDMO				
Total vehicle miles reduced by TDMO requirements		0	364,902	561,486
VMT reductions from existing pooled rides		1,694	1,367	1,262
Net VMT reduced by pooled rides vs 2025 baseline		-	(218)	(324)
VMT reductions from existing vanpool		33,904	37,668	39,828
Net VMT reduced by vanpool vs 2025 baseline		-	2,509	4,669
Net VMT reduced by TDMO requirements		0	362,611	557,140
GHG reductions				
Total daily GHG reductions (short tons)		0.00	169.90	258.84
Daily per capita GHG reductions (lbs./person)		0.00	0.0939	0.1382
Daily per capita GHG reduction		0.00%	-0.44%	-0.67%

Figure 1: Representative TDMO calculator results using draft input data. Final results for the 2021 Regional Transportation Plan are likely to change.

of programs represented by other calculators). These removed DA trips reduce the total commute VMT by 362,611 and ultimately result in a per-capita VMT reduction of 0.44 %. The reductions attributable to TDMO improve to 0.67 % in the 2050 target year.

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Appendix J
SANDAG Electric Vehicle Programs Calculator Review and Comparison

EV Program Off-Model Methodologies Review

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Summary

This document provides a review of SANDAG's EV off-model calculator in comparison to CARB's recommended methodology as well as the methods employed by the other three large MPO's in California.

Please note that the inputs, assumptions, and emission reduction estimates listed within this methodology are draft and are subject to change pending the development of a final network and land use scenario to inform the 2021 Regional Plan.

Changes to date to SANDAG EV Calculators by ITS-Irvine

ITS-Irvine's review of the SANDAG calculators included assessing what parameter changes were appropriate based upon any changes to the literature since the calculators were developed by Ascent Environmental (2019). Since both of these calculators are integrated into a single spreadsheet, we address the changes for both calculators together.

The core modeling inputs to the EV calculator include:

- EMFAC 2017 fleet characteristics
- EMFAC 2017 VMT
- SANDAG population forecasts
- Core EVI-Pro assumptions regarding charging characteristics
- EVI-Pro model results regarding PEV demand for the SANDAG region

We reviewed these modeling inputs and assumptions and determined that we could not recommend any updates to the EMFAC data (there is not an alternative), nor the EVI-Pro assumptions or model results. In the latter case, since the EVI-Pro model has not been updated since Ascent Environmental's original work, there is no need to re-run the scenarios since the data, and associated trend-line projections will remain the same.

We did, however, update the SANDAG population forecasts and VMT totals using data provided by SANDAG staff in August 2020. These changes had a notable impact because the VMT forecasts have decreased since the updates to the regional model. Ascent's original work (shown in Figure 1) shows both higher population and VMT totals for the 2035 and 2050 target years than the most recent forecast (Figure 2). The specific cells modified were G13:H14.

Figure 1. SANDAG Population and VMT forecasts from Ascent Environmental's original work.

	A	B	C	G	H
9	**EV Off-Model Inputs**				
10	**Years**			**2035**	**2050**
11					
12	**2019 RTP/SCS Forecasts**				
13		Population in SANDAG		3,853,698	4,068,759
14		Daily VMT in SANDAG (2019 RTP/SCS)	mi/day	91,312,706	96,050,942
15		*Daily VMT in SANDAG (EMFAC 2017) (for comparison)*	*mi/day*	*100,763,492*	*107,809,171*
16		*EMFAC/SANDAG VMT Adjustment*		*0.91*	*0.89*
17					

Figure 2. SANDAG Population and VMT forecasts updated August, 2020

	A	B	C	G	H
8					
9	**EV Off-Model Inputs**				
10	**Years**			**2035**	**2050**
11					
12	**2020 RTP/SCS Forecasts**				
13		Population in SANDAG		3,620,349	3,746,077
14		Daily VMT in SANDAG (2019 RTP/SCS)	mi/day	86,652,774	89,296,419
15		*Daily VMT in SANDAG (EMFAC 2017) (for comparison)*	*mi/day*	*100,763,492*	*107,809,171*
16		*EMFAC/SANDAG VMT Adjustment*		*0.86*	*0.83*
17					

These reductions lower the EMFAC/SANDAG VMT Adjustment factor, which in turn increases the reductions attributable to SANDAG's EV programs. These updates improve the total per capita GHG reductions due to EV programs from 0.48% to 0.60% in the "90% CEC scenario."

We note that the SANDAG SCS/RTP is based upon EMFAC 2014 while the EV calculator uses EMFAC 2017 data for fleet and VMT information, including the VMT baseline that is important here. However, this adjustment factor is intended to capture the impact of the deviations between the SCS/RTP forecast and EMFAC and those adjustments will compensate for the differences between EMFAC 2014 and 2017.

The scenario inputs to the EV calculator are:

- The selection of the target PEV/ZEV Population Scenario, which determines the demand for PEVs that, in turn, determines the demand and performance for chargers and vehicles (and their incentives)
- Charger and vehicle incentive levels

The specific scenarios available are described in Ascent Environmental's (2019) technical memorandum:

- **State Targets**: The State Targets under EO B-16-12 and EO B-48-18 to achieve 1.5 million EVs by 2025 and 5 million EVs by 2030 were apportioned to the SANDAG region based on the ratios between the EV population in SANDAG and the state as a whole, as modeled by EMFAC2017.

- **CEC Forecast**: The CEC's forecast scenario is based on what the CEC anticipates the PEV population will be like for the SANDAG region in order to meet State Targets for 2025, including the statewide target of having 250,000 EV chargers statewide by 2025. The CEC forecast scenario also accounts for a variety of economic and organizational factors that influence PEV usage. The model assumes that the CEC forecast trends would continue past 2025.

- **CSE Forecast**: The Center for Sustainable Energy (CSE) Forecast scenario is based on either a linear or second-order polynomial trend of the PEV population in SANDAG based on historical sales. The second-order polynomial forecast is currently the preferred CSE Forecast scenario per SANDAG staff, though the user has the option to change the trend assumption in the background calculations

Though all results discussed in this document have used the scenario "90% of CEC forecasts", SANDAG may want to experiment with identifying the most favorable of the scenarios based upon agency priorities, which certainly include maximizing GHG reductions, but may also include wanting to control the resulting cost of the incentive program. Between the three options, both the CEC and CSE forecasts are based upon modeling with trends. The CEC trends are extended from the EVI-Pro forecasts, which only go out to 2025. In the modeled time span (2017-2025), the CEC forecasts are likely the most rigorous method for determining the scenario. Beyond that, the use of trend forecasting makes them less reliable. The CSE forecast, which is based upon sales trends also suffers from this potential weakness. In some respects, the State Targets, should they be backed by state policy via regulatory action, may have the best case for use as the target scenario since they represent the statewide goals that are driving policy.

Determining the appropriate incentive levels for an EV program that is 10 years into the future is challenging at best since it would rely on knowing technology costs at that horizon and beyond. CARB has accepted EV programs with incentive levels ranging from $1,500/vehicle for PHEV incentives (MTC 2017) up to $7,500 for PHEV incentives (CARB 2020). As such, we recommend selecting the scenario that maximizes GHG reductions, while setting the incentive levels that are comparable to other MPOs while still meeting SANDAG's regional objectives, priorities, and budgetary targets.

For instance, if you set a $250M cap on SANDAG vehicle incentives for 2035 and assume a specific ratio between BEV, PHEV, and FCEV incentives that matched assumed external incentive levels as in Table 1.

Table 1. Assumed external vehicle incentive levels in the baseline SANDAG EV calculator

Average Incentive per BEV	$/vehicle	$ 2,500
Average Incentive per PHEV	$/vehicle	$ 1,000
Average Incentive per FCEV	$/vehicle	$ 5,000

Then you can solve for the BEV incentive level under forecast different scenarios (e.g., 100% CEC, 100% state mandate, and CSE forecast) that would result in a total of $250M in cumulative vehicle incentives in 2035. The results in Table 2 show computed vehicle incentive levels along with the associated per capita GHG reductions for the RECP, VIP, and total.

Thus, if you adopt the CSE forecast scenario and set a $250M cap, you can obtain a total 1.78% per capita reduction with BEV incentives of $642, PHEV incentives of $257, and FCEV incentives of $1,285.

Table 2. Computed incentive levels and associated GHG reductions for 3 different demand scenarios in the SANDAG EV calculator assuming a $250M vehicle incentive cap by 2035.

Scenario:	**100% state**	**100% CEC**	**CSE forecast**
BEV incentive	$ 623	$ 3,287	$ 642
PHEV incentive	$ 249	$ 1,315	$ 257
FCEV incentive	$ 1,246	$ 6,574	$ 1,285
RECP GHG red	0.00%	0.09%	0.46%
VIP GHG red	1.21%	0.76%	1.32%
Total GHG red	1.21%	0.85%	1.78%

EV Charging Programs

CARB Recommendations

The CARB Sustainable Communities Strategies Program and Evaluation Guidelines document (SCAG 2020a) offers two methodological approaches for computing the GHG reductions associated with Regional EV Charging Programs.

A. Estimate CO2 emission reductions from PHEV eVMT based on estimated average VMT shift per PHEV from gasoline to electricity (cVMT to eVMT) as a result of increased workplace and public charges

B. Estimate CO2 emission reductions from reduced gasoline consumption based on estimated electricity consumption increase as a result of increased workplace and public charges

SANDAG

SANDAG's Regional EV Charging Program (RECP) calculator uses a version of CARB's method B, focusing on estimating CO2 emission reductions from reduced gasoline consumption based on estimated electricity consumption increase as a result of increased workplace and public chargers. Specifically:

> "CO2 reductions from the RECP were based on the difference between the total eVMT supported by a targeted number of all non-residential chargers, including existing and new chargers, in the SANDAG region and the eVMT anticipated in the BAU forecast for the SANDAG region for a given milestone year. The targeted total number of chargers in the SANDAG region was calculated using local PEV-to-charger ratios estimated by CEC's EVI-Pro analysis. EVI-Pro estimates that these ratios would change over time and also vary by PEV type. The targeted total number of chargers would be equal to the sum of all existing chargers as of 2018 and any new chargers added starting from 2018. To estimate the number of chargers needed to be incentivized by SANDAG, the number of existing non-residential chargers" (Ascent Environmental, 2019).

The use of EVI-Pro to estimate the PEV-to-charger ratios is both unique amongst the California MPOs and consequential, as we'll discuss below. The calculated PEV/charger ratio is used to estimate to the total kWh of charging available to the vehicle population and the target population of PEVs (using both EMFAC 2017 estimates and increases due to the sibling vehicle incentive program), which is distributed between BEV and PHEV based on estimates of relative charging time, and then used to determine the shift from cVMT (gas) to eVMT (electric). This shift is counted as off-model VMT reduction and converted to GHG reduction.

More details and specific critiques of the calculator method are included in the SANDAG section of the vehicle incentive calculator comparison section.

Charging Program Discussion

SCAG's EV charger incentive program accounts for a significant reduction in GHG emissions (1.2% per capita) in SCAG's SCS. As such, we thought it would be useful to investigate the difference between SCAG and SANDAG's calculators. Notably, SCAG and SANDAG apply two different methods, with SCAG opting for CARB's method A that computes the average estimated shift from gasoline-based cVMT to electric eVMT and uses that to determine the reduction. SANDAG's method, like MTC's, adopts CARB's method B, which estimates electricity consumption increase due to increased chargers to estimate the cVMT to eVMT shift.

SANDAG's method is the most methodologically complex of the three methods, but is based upon more rigorous modeling of public EV charging infrastructure needed to meet a given PEV target by using the CEC's Evi-Pro model to estimate region-specific infrastructure requirements. Since Evi-Pro only forecasts out to 2025, the infrastructure requirements are projected using a trend analysis. For the 2035 target year (and assuming the default 90% CEC scenario), 10 chargers per PEV is forecast to meet the PEV charging demand. This results in a per-capita reduction due to the RECP of 0.08%. SCAG's calculator assumes 7 chargers per PEV (though the calculator is actually insensitive to this parameter and it is just used to compute the total number of chargers that would be needed). The resulting per-capita reduction is 1.2%.

However, if we override the Evi-Pro calculation of required chargers per PEV in SANDAG's calculator and manually set this ratio to 7 to match SCAG's assumption, the per-capita reduction improves to 0.47% vs the 0.08% reduction obtained from the 10 PEV/charger ratio (in bold) as shown in Table 5. Thus, we can see that SANDAG's calculator is quite sensitive to the PEV/charger ratio. It's worth noting that this would increase the required number of chargers in SANDAG from 19,398 in the (10 veh/charger) Evi-Pro scenario to 28,914 in the SCAG-equivalent (7 veh/charger) calculation. This would obviously increase the cost of the program to SANDAG. We also applied the assumed ratio of 5 vehicle/charger from the 2017 MTC EV charger program and note that this results in the same improvement as the 7 PEV/charger ratio because the available capacity exceeds the demand. Sensitivity analysis shows that the SANDAG EV charger off-model calculator no longer produces improvements at around 7.84 veh/charger (that is, at levels below the 7.84 ratio, the GHG reduction per capita remains at 0.47%).

Table 5. Sensitivity of SANDAG EV RECP calculator to PEV/charger value

MPO	PEV/ charger	Est. Chargers	EMFAC 2017 regional PHEV	Program PHEV (incl VIP impacts)	Gas VMT reduction	GHG reduction per cap
SANDAG	5	40,479	104,064	131,792	1,520,268	0.47%
SANDAG	7	28,914	104,064	131,792	1,520,268	0.47%
SANDAG	**10**	**19,398**	**104,064**	**131,792**	**678,113**	**0.08%**

Since the SCAG methodology is relatively straightforward, we can also apply that methodology to SANDAG's RECP by simply altering the fraction of statewide eVMT that occur in the region. SCAG's fraction per EMFAC 2014. Table 6 summarizes the EMFAC 2014 VMT splits by MPO and is taken directly from SCAG's EV calculator (2020e), and shows that the fraction of statewide eVMT associated with SANDAG is 0.085 (8.5%)---substantially less than SCAG's 48%. However, applying this fraction in SCAG's calculator produces the results in Table 7, which also varies the PEV/charger ratio to show the variation in required chargers. As you can see, applying SCAG's method to SANDAG results in a per-capita GHG reduction of 0.28%---better than the results obtained using Evi-Pro trends for PEV/charge in the SANDAG calculator, but not as good as if SCAG's 10 PEV/charger parameter is used in the SANDAG calculator in lieu of the Evi-Pro trendline.

Table 6. Fraction of Statewide VMT associated with each MPO (SCAG 2020e and EMFAC 2014).

Area	Fract of State VMT
AMBAG	0.017
BCAG	0.004
COFCG	0.016
KCAG	0.004
KCOG	0.027
MCAG	0.008
MCTC	0.005
MTC	0.187
None	0.033
SACOG	0.063
SanDAG	0.085
SBCAG	0.012
SCAG	0.480
SCRTPA	0.006
SJ COG	0.022
SLOCOG	0.009
StanCOG	0.010
TCAG	0.009
TMPO	0.001

Table 7. Application of SCAG EV charger methodology to SANDAG

MPO	State PHEV 2035	Reg. frac	EMFAC region PHEV	PEV/ charger	Estimated Chargers	mi/ PHEV	Gas VMT reduction	per cap
SCAG	1,000,000	48%	480,000	7	68,571	13	6,240,000	1.20%
SANDAG	1,000,000	8.5%	85,000	7	12,143	13	1,105,000	0.28%
SCAG	1,000,000	48%	480,000	10	48,000	13	6,240,000	1.20%
SANDAG	1,000,000	8.5%	85,000	10	8,500	13	1,105,000	0.28%

EV Vehicle Incentive Programs

CARB Recommendations

CARB's recommendations for EV incentive program off-model calculations are summarized as follows:

> "The overall approach to quantifying GHG emission reductions from the Electric Vehicle Incentive strategy is to first establish the total funding allocated to the subsidy/rebate program established by the MPO, as well as the amount(s) offered for individual subsidies/rebates. Once these two values have been set, the total number of new ZEV's that may be purchased under the incentive program can then be estimated. Based on the number of vehicles purchased under the incentive program and average trip lengths for the region, total VMT associated with the incentive program can be calculated. GHG emission reductions associated with the incentive program can then be estimated using the calculated VMT and emission factors derived from the most recent version of EMFAC" (CARB 2019).

SANDAG

SANDAG's EV incentive calculator deviates from the CARB recommendation in that it does not start with a total amount of incentive funding available. Rather, it uses a PEV population target scenario selected by the user. The default scenario assumes 90% of the CEC forecast obtained from EVI-Pro (discussed above in the SANDAG EV charging section). Once the target PEV population is selected, the EV incentive calculator, the "CO2 reductions associated with the VIP are essentially a comparison of the new eVMT that would occur from the additional BEVs and PHEVs incentivized under the program beyond the BAU forecast" (Ascent Environmental 2019). Essentially, instead of determining the number of incentivized vehicles by assuming a total amount of incentive funding and an incentive level per vehicle, this calculator takes the projected PEV demand from forecasts and uses this to determine the number of incentivized vehicles. From that point forward, the calculator follows the CARB methodology. Given either incentive funding available and/or incentives per vehicle, the reciprocal can be calculated directly.

In that this target population is based upon a best-available forecast of regional EV demand, this methodology has significant advantages to the CARB default if realistic projections are the goal. Possible methodological issues with this calculator are that:

- It is not clear that the EVI-Pro projections are sensitive to incentivization levels. Additional funding for EVs may increase demand and therefore the PEV forecast totals that drive the calculator.

- Because the EVI-Pro projections are limited to the year 2025, a trend-line projection is used to estimate demand for the following years. With the rapidly changing EV market in California, it is risky to rely on prior trends to forecast future demand.

With these potential concerns noted, we still feel that the SANDAG calculator's approach to using demand-based forecasts to determine PEV population totals are more reliable than the default CARB methodology. Further, Ascent Environmental's work includes comparisons to EMFAC forecasts that demonstrate consistency.

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Appendix D Attachment 2: SB 375 2020 Greenhouse Gas Reduction Estimate

Appendix D: SB 375 2020 Greenhouse Gas Reduction Estimate

Executive Summary

A central component of the SANDAG 2021 Regional Plan and Sustainable Communities Strategy (SCS) is measuring the plan's performance under Senate Bill 375 (SB 375). SB 375 essentially seeks to reduce per capita passenger and light truck greenhouse gas (GHG) emissions when compared to a 2005 baseline. The two compliance years that must be evaluated under SB 375 are 2020 and 2035. For these two years, the California Air Resources Board (CARB) established regional per capita GHG reduction targets for SANDAG from the 2005 base year. The 2020 target is defined as a 15% per capita GHG reduction from 2005 levels.

Reporting SB 375 performance for the year 2020 requires the incorporation of observed data, which became a challenging endeavor due to the COVID-19 pandemic. The SANDAG Series 14 SCS land use pattern and activity based transportation model (ABM) treated 2020 as a normal, non-COVID year. Performance results directly from ABM are referred to as "unadjusted." This resulted in vehicle miles traveled (VMT) being over-estimated and required modification of existing research tools and methods to provide an adjusted SB 375 VMT and GHG reduction estimate for 2020.

Specifically, the adjustments are focused on 3 main components: adjusting freeway VMT, adjusting freeway speed distribution, and omitting off-model calculators. The adjustments to freeway VMT and speed, based on observed Caltrans data, were employed to create a new input file for CARB's Emissions Factors (EMFAC) software. EMFAC2014 is used as the platform for SB 375 emissions estimation.

After the adjustment of freeway VMT and freeway speeds for 2020, the 2020 per capita GHG reduction is 17% compared to 2005. The 17% per capita GHG reduction represents a conservative estimate that was limited only to empirically measured changes related to transportation behavior during 2020. While the actual reduction could be greater than 17%, there was insufficient telemetry to accurately quantify additional adjustments.

Introduction

SANDAG's SCS land use pattern and transportation model have been used to evaluate SB 375 performance for the previous two SCS submittals. An ABM can evaluate the performance of many projects, policies, and programs that lead to reductions in per capita VMT. These on-model elements include increased transit service, changes to land use policy, parking policy, freeway managed lanes, active transportation infrastructure, user fees, teleworking, and some technology-based asset management that increases roadway reliability. In addition to the existing regional modeling tools, “off-model” evaluation of GHG reduction programs and policies are used in SB 375 performance analysis. Off-model adjustments are used because not all programs and policies that can reduce SB 375 category VMT can be precisely measured in the SANDAG ABM. The combination of on- and off-model evaluations is used to make the SB 375 per capita GHG reduction estimate.

Because 2020 is now a historic year and transportation behavior was heavily influenced by the COVID-19 pandemic, the standard approach of using the land use pattern, ABM, and off-model calculators was insufficient to accurately estimate 2020 passenger vehicle VMT for evaluation of the 2020 SB 375 per capita GHG reduction target. All components of an unadjusted 2020 SB 375 performance evaluation were inventoried and examined. For each component, a determination was made to assign one of three courses of action; keep component as-is, modify the component, or omit the component.

Once the inventory and determinations were complete, components which required modification went through a two-step process of adjusting based on empirical data, then finding a solution on how those adjustments would be reflected in a new EMFAC input file. Each adjustment was tested individually in EMFAC to ensure that the quantitative results of the test accurately reflected the expected qualitative outcome. After EMFAC testing was complete, the EMFAC input file was run in EMFAC version 2014. The EMFAC results, along with other standard adjustments unrelated to COVID-19, were then combined to make a 2020 SB 375 per capita GHG reduction value.

2020 SB 375 GHG Reduction Estimation Components

SANDAG Activity Based Model

SANDAG is using its updated second-generation Activity Based Model (ABM2+) for the analysis of the 2021 Regional Plan. ABM2+ provides a systematic analytical platform and is intensively data-driven so that different alternatives and inputs can be evaluated in an iterative and controlled environment. For SB 375 evaluation, the two primary outputs are VMT and vehicle speed bins (defined as the percentage of vehicles that fall within speeds in 5 MPH increments, from 5 MPH to 70 MPH). Other outputs from ABM2+ are used as inputs to off-model calculators. The VMT and speed bin output from the year 2020 were used to create a custom EMFAC2014 input file. EMFAC2014 is then run in a special SB 375 mode where only VMT and speed bins from light duty autos are evaluated. Another aspect of EMFAC in SB 375 mode is that a great majority of future fleet vehicle technology is not part of the analysis. This is done for the purposes of minimizing exogenous variables that may interfere with measuring per capita GHG reduction relative to 2005. Because of this, it is important to note that gross GHG output levels from EMFAC2014 output in SB 375 mode are not reflective of all vehicle classes and vehicle technologies. EMFAC2014 SB 375 outputs are only used to evaluate compliance with the regional targets.

Many projects, programs, and policies that seek to reduce light duty VMT under SB 375 are incorporated into ABM2+. Projects could be new or enhanced transit service, new or enhanced transit park & ride locations, addition of dynamically managed lanes on the region's freeway network, additional or enhanced bicycle facilities, and arterial road diets. Programs which can be modeled in ABM2+ include telework and transportation demand management. Policy inputs to ABM2+ can include roadway user fees, transit fares, parking cost, parking locations, congestion pricing, TNC fees, and land use patterns.

These components are applied consistent with the Regional Plan assumptions for each year of analysis and their cumulative effects related to SB 375 are reflected in the VMT and speed output once an ABM2+ model run for a given year is complete.

External Regional Travel

The external travel models predict characteristics of all vehicle trips and selected transit trips crossing the San Diego County border. This includes both trips that travel through the region without stopping and trips that are destined for locations within the region. Trips that travel through the region without stopping, along with any associated VMT, are not required in SB 375 evaluation. The external to external VMT is excluded in the analysis.

Off-Model Calculators

The GHG reduction benefits from the programs evaluates off-model are excluded from this analysis.

EMFAC Software Version Adjustment

SANDAG used EMFAC 2007 to quantify GHG emissions reductions from its first SCS. For the 2021 Regional Plan and SCS, SANDAG is using EMFAC2014 as stipulated by CARB. Using a different EMFAC model version influences estimates and evaluation of SB 375 metrics. CARB staff has developed this methodology to allow SANDAG to adjust the calculation of percent reduction in per capita CO2 emissions used to meet the established targets when using EMFAC2014 for their third RTP/SCS. This method will neutralize the changes in fleet average emission rates between the version used for the first RTP/SCS and the version used for the second RTP/SCS. The methodology adjusts for the small benefit or disbenefits resulting from the use of a different version of EMFAC by accounting for changes in emission rates and applies an adjustment when quantifying the percent reduction in per capita CO2 emissions EMFAC2014.

Component Selection For 2020 Adjustment

The 2020 SB 375 GHG analysis adjustment examined two factors. First, whether each component was materially affected by travel changes associated with COVID-19 and, second, whether enough empirical data existed to quantify those travel changes when compared to a non-COVID state of the component. While there may be anecdotal or broad metrics to the changes to travel that occurred due to COVID-19, only robust data should be considered to properly adjust a specific model output component. If this data were unavailable, the component would be either omitted or unchanged from the analysis. Table 1 shows an itemized list of components that are considered for 2020 adjustment and how those components compare to an unadjusted analysis.

Table 1:

Component	2020 Unadjusted Analysis	2020 Adjusted Analysis
Standard Freeway VMT	✓	--
Freeway VMT Adjustment	--	✓
Standard Arterial VMT	✓	✓
Arterial VMT Adjustment	--	--
External to External VMT	✓	✓
Vanpool	✓	--
Carshare	✓	--
Pooled Rides	✓	--
EMFAC Version Adjustment	✓	✓

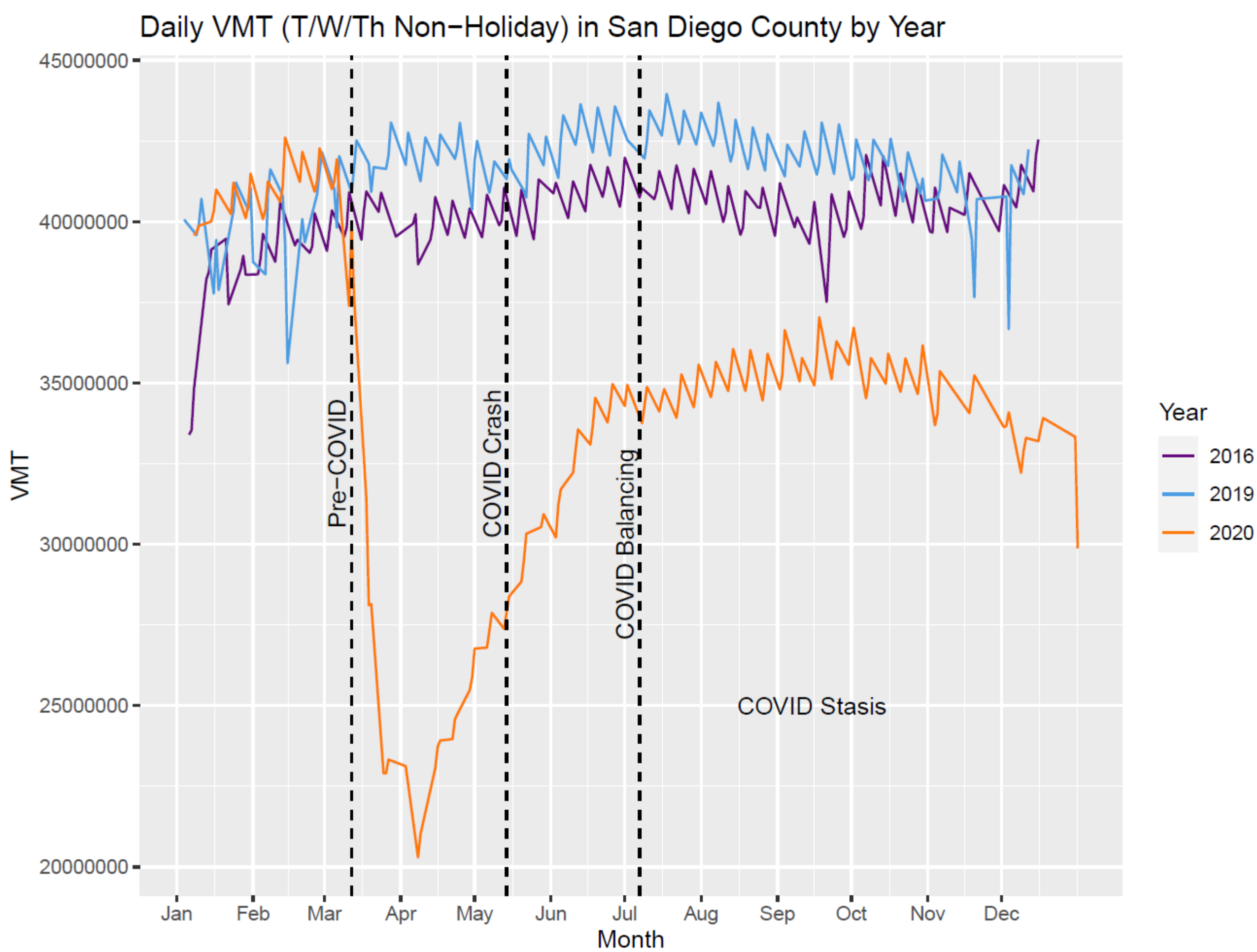
VMT Adjustments

This approach relies on Caltrans Performance Measurement System (PeMS) 2020 freeway VMT data for non-holiday Tuesdays, Wednesdays, and Thursdays to estimate a weighted reduction to pre-COVID 2020 freeway VMT based on post-COVID VMT data. This reduction as a percentage was then applied to ABM2+ VMT results only for freeway facility types. An initial analysis of PeMS freeway data was conducted for 3 years; 2016, 2019, and 2020. 2016 was selected to compare to the calibrated base year of ABM2+. 2019 was evaluated to compare annual trends in 2019 to pre-COVID trends of 2020. Figure 1 shows how the freeway VMT data for 2020 varied substantially. Based on a visual inspection of the data, 2020 was grouped into 4 periods defined by the changes to freeway VMT in San Diego County. The four periods of pre-COVID, COVID crash, COVID balancing, and COVID stasis were statistically evaluated for structural breaks in the VMT data to determine the exact dates of each period.

While the PeMS VMT data was a reliable resource, there were some limitations. Hardware reliability and changes to commercial travel are two of those limitations. PeMS reports detector health for the equipment that measures freeway travel. For 2020, the average fidelity reported by PeMS for the Tuesday through Thursday was 82%. This figure does not assert that VMT was underestimated by 18% on average, rather those missing samples were interpolated to produce an estimated VMT that is reflective on an entire day of travel. All days that had an observed fidelity of less than 70% were investigated to ensure that no outliers existed in the overall dataset. For commercial travel, there was clear anecdotal evidence that deliveries increased because of COVID-19. PeMS does not classify VMT by vehicle type. It is possible that commercial and goods movement VMT increased in 2020 while light duty auto travel decreased. Since there is no method to disaggregate light duty VMT from PeMS data, the conservative approach would be to use the total VMT data to adjust light duty VMT trends.

Arterial VMT was not able to be adjusted due to lack of empirical data and uncertainty over how increased goods movement and commercial travel interacted with the arterial network in 2020. The variety and amount of arterial facilities differ from freeways enough to not reliably ascribe freeway VMT trends to the arterial network. There is a high likelihood that arterial VMT did decrease due to COVID-19, but not enough data existed to reasonably quantify the reduction. The analysis does not adjust arterial VMT, only freeway VMT.

Figure 1



Determining the date ranges above was not an arbitrary task. The *strucchange* package in the R programming language was utilized to mathematically identify the location of multiple breakpoints within the 2020 VMT data. These breakpoints served as the end points for each period of 2020 (pre-COVID, COVID crash, COVID balancing, and COVID stasis). Visually, it was clear that there were three noticeable changes in the time series (i.e. the date partitions that divided each of the four periods) but identifying exactly when those changes occurred could be subject to debate. The *strucchange* package endogenously determines the dates in which these changes occurred. Table 2 shows the exact date ranges of each 2020 period along with other time frame units that were considered for analysis. A more detailed description of the structural break analysis can be found in the Additional Background section of this Attachment.

Table 2

2020 Dates	Description	Average Freeway VMT
1/1 - 12/31	Calendar Year	34,003,689
1/1- 3/31	Q1	38,055,361
4/1 - 6/30	Q2	28,687,235
7/1 - 9/30	Q3	35,171,993
10/1 - 12/31	Q4	34,322,311
1/1 - 3/12	Pre COVID	40,609,642
1/1 - 3/12	Pre COVID (median)	40,772,942
3/17 - 12/31	Post COVID	32,306,747
3/17 - 12/31	Post COVID (median)	34,114,325
3/17 - 5/14	COVID crash	25,374,455
5/19 - 7/7	COVID balancing	32,462,977
5/19 - 7/7	COVID balancing (median)	33,001,344
7/8 - 12/31	COVID stasis	34,818,292
1/1 - 3/12 & 7/8 - 12/31	Pre COVID & COVID stasis	36,561,925

The two time periods considered for analysis of the 2020 freeway VMT adjustment were the pre-COVID and post-COVID median VMT values. Table 3 shows that when comparing these two time periods, a 16.3% decline in overall weekday freeway VMT occurred due to COVID-19.

Table 3

Pre COVID VMT (median)	40,772,942	"Normal 2020"
Post COVID VMT (median)	34,114,325	"Adjusted 2020"
Freeway percent adjustment factor	16.33%	

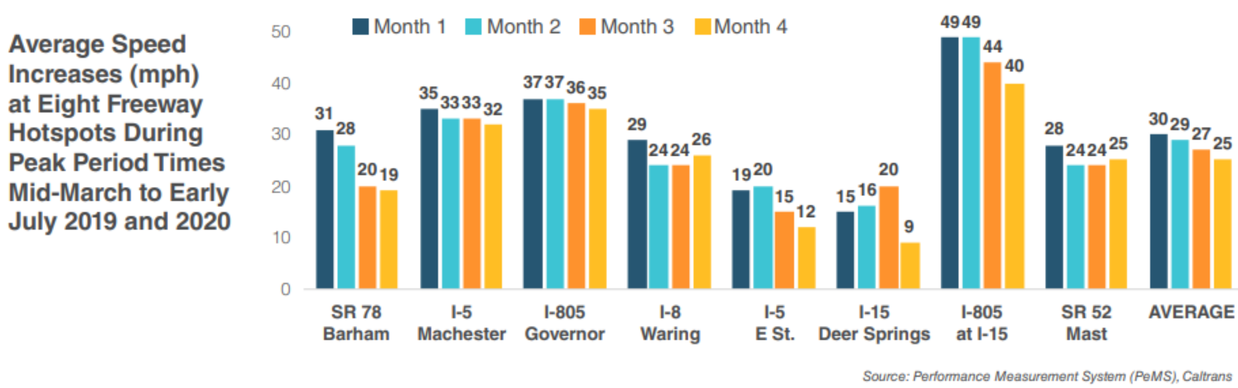
External to External VMT Adjustment

The unadjusted SB 375 ABM2+ analysis calculated that 1.0% of light duty VMT in 2020 should be removed due to that VMT being associated with travel that never stopped inside of San Diego County. While this figure most likely changed during the COVID period in 2020, there was insufficient data to support modifying the analysis from the original value. The most reasonable and prudent course was to leave this 1.0% value unchanged in the adjusted analysis.

Speed Adjustments

Not all travel changes associated with COVID-19 reduced GHG. As freeway VMT was being reduced due to stay at home health orders, those who still chose to make auto trips experienced substantially higher travel speeds on the region's freeways as seen in Figure 2. According to standard EMFAC output, high speeds typically result in more CO2 per mile being emitted from light duty auto classes. Since the increase in travel speed is a reflection of the near total elimination of severe congestion on the freeway network, it was decided to adjust speed bins in the EMFAC input file by "shifting" VMT from the congested speeds of 35 MPH, 40 MPH, and 45 MPH to the non-congested speeds 55 MPH, 60 MPH, and 65 MPH, respectively. It is important to note that in the speed adjustment step, VMT is conserved but GHG slightly increases.

Figure 2



EMFAC Version Adjustment

The EMFAC version adjustment applies only to the differences between versions of software and was agnostic toward the differences between pre and post COVID. The EMFAC version adjustment for 2020 remains at an additional 1.8% of per capita GHG in the analysis.

Omitted Components

The adjusted analysis for 2020 does not consider any GHG reductions from reduced arterial VMT, vanpools, carsharing, or pooled rides. Arterial VMT was not reduced or adjusted down due to insufficient data. PeMS is a robust data source for freeway VMT but has no coverage on arterial streets. While it is anecdotally known that arterial VMT was reduced because of COVID, there was no data to quantify it. Arterial VMT remains unadjusted from a regular, non-COVID, 2020 ABM2+ model run. Vanpool, carshare, and pooled ride GHG reductions were removed altogether because of COVID health and safety restrictions, a substantial increase in telework, and removal of congestion on the freeway network. Had these factors been considered for inclusion, they would have all resulted in a greater GHG reduction for 2020.

EMFAC Input Modification and Testing

Data for freeway VMT and freeway travel speeds was sufficient to use for 2020 adjustment. In order to accurately reflect this, methods had to be created that would take the empirical trends seen for VMT and speed, then apply them to standard 2020 ABM2+ output. These steps were necessary to modify EMFAC2014 input that would reflect the COVID adjustments, but still allow EMFAC2014 to run normally in SB 375 mode.

Freeway VMT adjustment was performed by taking a standard, non-COVID, ABM2+ model run for 2020, and classifying total VMT assigned to the transportation network as either Freeway or non-Freeway (arterial). This is a necessary step so that the 16.3% reduction cited in Table 3 will only be applied to modeled freeway VMT but also allow for the calculation of total VMT reduction. EMFAC2014 does not accept VMT input by facility type, only by vehicle class. The overall VMT percentage reduction is needed so it will only be applied to the VMT from the three relevant SB 375 vehicle classes: Light Duty Auto (LDA), Light Duty Truck 1 (LDT1), and Medium Duty Vehicle (MDV). Table 4 shows that the overall VMT reduction is 9.24%. That percentage is then applied to the SB 375 vehicle classifications and their associated fuel types in Table 5.

Table 4

	ABM2+ VMT	Adjusted VMT
Freeway	47,885,058	40,064,963
Arterial	36,773,360	36,773,360
Total	84,658,418	76,838,323
SB-375 VMT percent reduction:		9.24%

Table 5

Calendar Year	Vehicle Classification	Unadjusted VMT	Adjusted VMT
2020	LDA - Dsl	563,832	511,749
2020	LDA - Gas	50,149,475	45,517,052
2020	LDT1 - Dsl	3,791	3,441
2020	LDT1 - Gas	3,695,378	3,354,027
2020	MDV - Dsl	176,311	160,025
2020	MDV - Gas	9,374,153	8,508,241

Freeway speed adjustments from ABM2+ output assumed that all modeled freeway VMT at a volume to capacity ratio of greater than .99 would have occurred at uncongested speeds. Table 6 shows the amount of VMT to be shifted for both the AM and PM peak periods from slower speed bins to faster speed bins.

Table 6

Period	Total VMT All Roadways	Congested VMT Freeway Only	Volume to Capacity Ratio Threshold	Congested VMT Speed Adjustment Percentage
AM	17,465,463	2,446,022	0.99	14.00%
PM	21,248,772	1,906,341	0.99	8.97%

Speed bins are specified in EMFAC for all vehicle types by one-hour increments of time and 5 mile per hour increments of speed. The AM and PM adjustments from ABM2+ freeway data were applied to calculate new speed bin fractions where more VMT is assigned to faster speeds at the expense of slower speeds. Table 7 shows these new values. It is worth reminding that the speed adjustment step does not add or remove VMT from the analysis. It is exclusively being shifted from slower to faster speeds.

Table 7

		Unadjusted Speed Fractions						
		35mph	40mph	45mph	55mph	60mph	65mph	
	Hour Of Day							
AM Peak	6	0.04	0.03	0.04	0.09	0.41	0.20	
	7	0.09	0.09	0.12	0.11	0.14	0.07	
	8	0.09	0.09	0.12	0.11	0.14	0.07	
PM Peak	16	0.07	0.06	0.07	0.14	0.22	0.10	
	17	0.08	0.08	0.11	0.11	0.16	0.07	
	18	0.08	0.08	0.11	0.11	0.16	0.07	
		Adjusted Speed Fractions						
		35mph	40mph	45mph	55mph	60mph	65mph	
AM Peak	6	0.04	0.03	0.04	0.10	0.42	0.20	14.00%
	7	0.08	0.08	0.10	0.12	0.15	0.09	
	8	0.08	0.08	0.10	0.12	0.15	0.09	
PM Peak	16	0.06	0.05	0.06	0.14	0.22	0.10	8.97%
	17	0.08	0.08	0.10	0.11	0.17	0.08	
	18	0.08	0.08	0.10	0.11	0.17	0.08	

After the VMT and speed input modifications were tabulated, testing occurred of each component before both the VMT reduction and speed increase would be applied in the same input file. The testing process consisted of modifying an EMFAC2014 input file for 2020 with only one component for each test. Qualitative expectations would be that when compared to unadjusted, non-COVID, EMFAC output, the VMT only test would reduce SB 375 CO2 substantially while the speed only test would slightly increase CO2. The results of the tests were as expected, which gave confidence in a EMFAC analysis which placed both components in the same input file. The test and EMFAC results can be seen in Table 8.

Table 8

Scenario	VMT State	Speed State	SB-375 VMT	SB-375 CO2 (tons)	CO2 Difference From Unadjusted
2020 Unadjusted	Non-COVID	Non-COVID	79,862,563	38,861	--
2020 VMT Component	COVID	Non-COVID	73,954,158	36,106	↓ 2755
2020 Speed Component	Non-COVID	COVID	79,862,563	38,882	↑ 21
2020 VMT & Speed Adjusted	COVID	COVID	73,954,158	36,125	↓ 2736

Results

The adjustments resulted in a SB 375 per capita reduction over 2005 levels of 16.9%, which meets the CARB established target for the San Diego region of 15%. The results are shown in Table 9.

Table 9

	2020 Unadjusted	2020 Adjustment
2020 SB-375 Regional Per Capita Reduction Target	15%	15%
Total SB-375 GHG Per Capita Reduction	11.2%	16.9%
Adjusted SB-375 VMT	79,816,845	73,911,822
External to External Trip Adjustment	1.0%	1.0%
SB-375 Emission / Person (lbs)	22.7	21.1
2005 Baseline Emission / Person (lbs)	26.0	26.0
Per Capita Reduction Before EMFAC Version Adjustment	13.0%	18.7%
EMFAC Version Adjustment % per capita	1.8%	1.8%

Additional Background

Structural Breaks Analysis

Recall that 2020 was partitioned into four different periods: pre-COVID, COVID crash, COVID balancing, and COVID stasis. Determining the date ranges for these periods of 2020 was not an arbitrary task. The *strucchange* package in the R programming language[1] was utilized to algorithimically identify the location of multiple breakpoints within the 2020 VMT data[2]. These breakpoints served as the end points for each period of 2020. Visually, it was clear that there were three noticeable changes in the time series (i.e. the date partitions that divided each of the four periods). 2020 VMT for non-holiday Tuesdays, Wednesdays, and Thursdays started off around the same levels as previous years, but crashed during the onset of the Coronavirus pandemic in the United States. After the initial crash, VMT levels steadily increased before stabilizing and leveling off the rest of the year (albeit still below pre-COVID levels). Identifying exactly when those changes occurred could be subject to debate. The "breakpoints" function within the *strucchange* package endogenously and objectively determines the dates in which these changes occurred.

Given the initial assumption of three partitions, the *strucchange* package looks at all possible partition locations to minimize the sum of squared residuals in each partition and across all partitions. Formally, obtaining these dates to find the breakpoints are to find the set of breakpoints $d_1,\dots,d_m$ that minimize the objective function below[3]:

$$(d_{1,\dots,}d_m) = \mathrm{argmin}\, RSS(i_1,\dots,i_m)$$

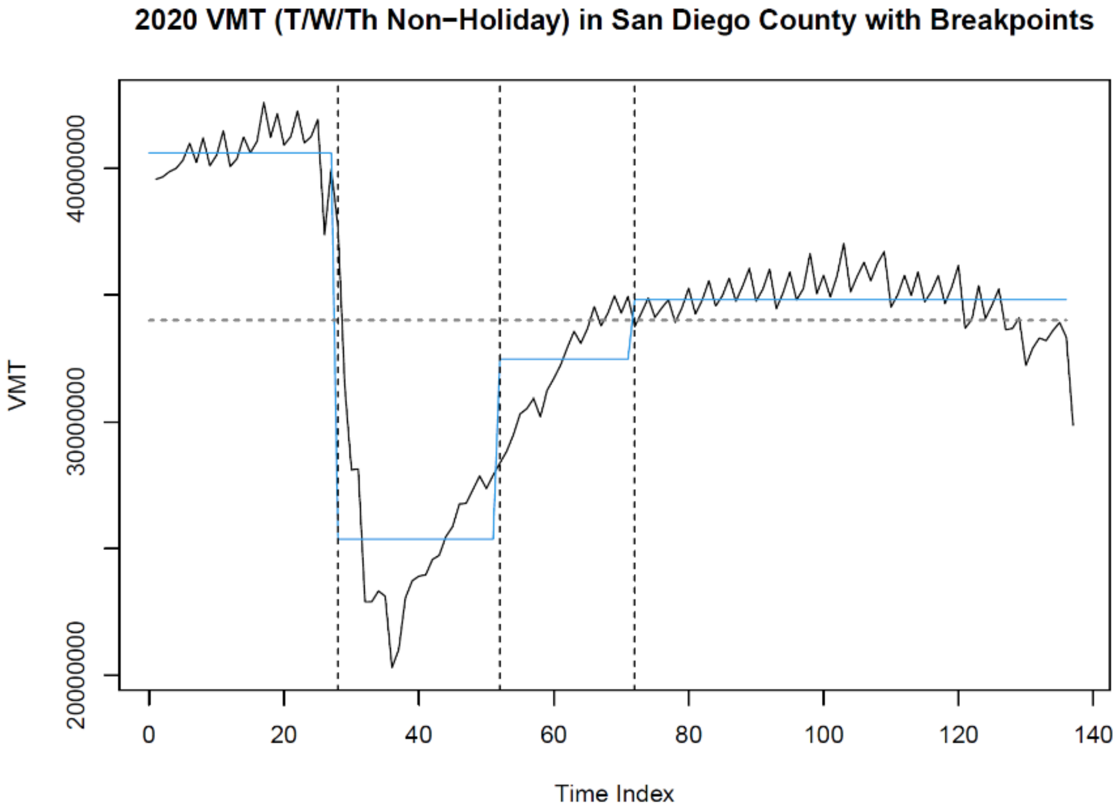
where *RSS* denotes the sum of squared residuals and $i_1,\dots,i_m$ represents the number of partitions. Informally, we can think of the minimized sum of squared residuals as the line in each partition that minimizes the sum of the squared distances between each observation and the line itself.

[1] Zeileis A, Leisch F, Hornik K, Kleiber C (2002). ""strucchange": An R Package for Testing for Structural Change in Linear Regression Models." *Journal of Statistical Software*, **7**(2), 1–38. http://www.jstatsoft.org/v07/i02/.

[2] Zeileis A, Kleiber C, Krämer W, Hornik K (2003). "Testing and Dating of Structural Changes in Practice." *Computational Statistics \& Data Analysis*, **44**, 109–123.

[3] See page 112 of Zeileis A, Kleiber C, Krämer W, Hornik K (2003). "Testing and Dating of Structural Changes in Practice." *Computational Statistics \& Data Analysis*, **44**, 109–123 for more formal details

Figure 3



In Figure 3, it is evident that the three partitions (dotted vertical lines) and the line of best fit that minimizes the sum of squared residuals in each partition (the blue lines). The gray horizontal dotted line is the line of best fit without the partitions. The dates for which the breakpoints occurred were then extracted from the time index by matching the index to the date in the dataset. This time-series analysis was necessary because not only did it give a more accurate picture of what occurred in different points in 2020, but it also mathematically identified when these points occurred.

Alternatives Not Considered

Alternatives A, B, and C were not considered due to a combination of off model and arterial VMT adjustments. However, as shown in Table 10, these alternatives show a range of approaches that could reasonably be taken to evaluate an adjusted 2020 SB 375 GHG reduction. Early attempts were made to account for arterial VMT reduction. The approach ascribed the arterial VMT reduction as 1/3rd or 1/4th of the freeway reduction.

Table 10

	2020 Unadjusted	**Alternative A**	**Alternative B**	**Alternative C**
Total SB-375 GHG Per Capita Reduction	11.2%	18.8%	18.6%	18.2%
SB-375 VMT	79,816,845	72,400,233	72,400,233	72,778,130
Total SB-375 CO2 (tons)	38,861	35,018	35,149	35,580
16.3% Freeway VMT Adjustment	No	Yes	Yes	Yes
Arterial VMT Adjustment (1/3rd of freeway percent)	No	Yes	Yes	No
Arterial VMT Adjustment (1/4th of freeway percent)	No	No	No	Yes
External to External VMT Adjustment	Yes	Yes	Yes	Yes
EMFAC Version Adjustment	Yes	Yes	Yes	Yes
Vanpool Off-Model Adjustment	Yes	Yes	No	No
Carshare Off-Model Adjustment	Yes	Yes	No	No
Pooled Ride/Carpool Off-Model Adjustment	Yes	Yes	No	No

Analysis Worksheet

EMFAC 2014	2020 UNADJUSTED	2020 ADJUSTED	
Database Scenario ID	*155*	*101*	*REMARKS*
Population	3,383,955	3,383,955	
SB 375 VMT	79,862,563	73,954,158	← 9.24% VMT Adjustment
SB 375 VMT / Person	23.6	21.9	
External to External VMT	833,975	756,916	← 9.24% VMT Adjustment
External to External VMT Reduction	1.0%	1.0%	
SB 375 Emissions (tons)	38,861	36,125	← Adjusted CO2 based on VMT& Speed adjustments
SB 375 Emissions / Person (lbs)	22.73	21.13	
2005 Baseline Emissions / Person (lbs)		26.00	
Per Capita Reduction for 2005	**-12.6%**	**-18.7%**	
Off-Model Calculators VMT Reduction			
Vanpool	269,805	-	← Removed From Analysis
Carshare	21,764	-	← Removed From Analysis
Carpool	11,977	-	← Removed From Analysis
TDM Ordiance			
Total VMT reduction	303,546	-	
SB 375 VMT / Person Reduction	0.09	-	
Off-Model Calculators - Daily Total GHG Reduction (tons)			
Vanpool	127.3	0.0	
Carshare	10.2	0.0	
Carpool	5.8	0.0	
TDM Ordiance			
EV Charging Program			
SB 375 Off-Model Emissions Total Reduction (tons)	143.3	0.0	
SB 375 Off-Model Emissions Reduction/ Person (lbs)	(0.080)	-	
Off-Model GHG Reduction per capita	-0.33%	0.00%	
Per Capita Reduction for 2005 with Off-Model Calc	**-12.9%**	**-18.7%**	
ARB Adjustment for EMFAC 2007 - 2014	1.8%	1.8%	
Final Per Capita Reduction for 2005	-11.2%	-16.9%	← Adjusted Per Capita Reduction
	-11%	-17%	
Targets	**-15%**	**-15%**	

Appendix D Attachment 3: SB 375 Greenhouse Gas Adjustment Due to Induced Demand

SB 375 Greenhouse Gas Adjustment Due to Induced Demand

This adjustment to the quantification of greenhouse gas emissions for the SANDAG Sustainable Communities Strategy (SCS) accounts for additional auto travel due to new roadway capacity that may not be fully accounted for in the second generation of SANDAG's Activity Based Model (ABM2+) output. Induced demand occurs when changes in travel demand are a direct or indirect result of the new infrastructure investment. This analysis is focused on how newly constructed highway capacity affects travel.

A vast majority of additional lane mileage[1] in the SANDAG SCS comes from an expansion of the region's managed lane (HOT) system. Existing infrastructure is maximized by repurposing shoulders or existing travel lanes to create managed lanes where shoulders, high-occupancy vehicle travel lanes, or general purpose (GP) travel lanes exist today. Highway projects are limited to existing right-of-way to the extent feasible. The new lane miles include projects completed since 2016, such as SR 76 from Mission Rd. to I-15 and the County of San Diego intersection improvement at SR 67/Highland Valley Rd./Dye Rd. Other projects are programmed in the Regional Transportation Improvement Program for implementation, such as completion of SR 11 connecting to the planned Otay Mesa East port of entry, SR 52 operational improvements (truck climbing lane from Mast Blvd. to Santo Rd. and auxiliary lane from I-15 to Santo Rd.) and the SR 94/SR 125 interchange and arterial operational improvements.

Currently, the SANDAG SCS land use pattern and the ABM2+ modeling system account for a portion, but not all effects from induced demand. A vehicle miles traveled (VMT) based off-model adjustment was used to quantify the estimated unaccounted-for induced demand. The methodology for this adjustment borrowed elements from the existing induced demand calculator developed by the National Center for Sustainable Transportation (NCST) in conjunction with UC Davis. SANDAG's methodology included adjustments to the calculator to develop more robust elasticities applicable to SANDAG's SCS[2]. To calculate the VMT adjustment, the methodology follows the generally accepted principle that the magnitude of the increase of VMT due to induced demand results from a given increase in GP lane miles. Depending on GP facility classification, the elasticities for this increase are 1.0 or 0.75. The results of the adjustment are an additional 210,570 daily SB 375 VMT from 2016 to 2035, a 0.40% per capita VMT increase, and a corresponding 0.38% CO_2 increase. When applied to the 2050 forecast year the estimation methodology results in an additional 365,230 daily SB 375 VMT from 2016 to 2050, a 0.44% per capita VMT increase, and a corresponding 0.43% CO_2 increase.

1 Lane miles are used to measure the total length and lane count of a road. Lane miles are calculated by multiplying the centerline mileage of a road by the number of lanes it has.

2 This methodology differs slightly from what was described in the SANDAG SCS technical methodology because of additional ABM2+ testing, which revealed a better methodology to account for elasticities of all non-GP facility types in addition to the inclusion of VMT reducing policies in the SCS.

The steps in the analysis are illustrated in Figure 1. The facility inventory step disaggregated all additional major highway corridor lane miles in the plan by facility type: GP, Auxiliary, High Occupancy Toll (HOT), and Toll. A full inventory of added lane mileage by facility class and type can be seen in Figure 2. Corridor level tests were conducted using ABM2+ to quantify how induced demand elasticities vary by facility type. These tests allowed for both the development of relative elasticities for each facility type compared to the GP values of 1.0 and 0.75 and assessment of the amount of short-run induced demand accounted for in ABM2+. Further ABM2+ testing was conducted to establish elasticities of VMT reducing policies in the SCS. Major policy components include telework increases, regional road user charge, the SCS land use pattern, reduced transit fares, and parking cost increases. The total elasticity was split between short and long run induced demand so that the level of model accountability for each category (short and long run) could be applied individually. Based on the available project level research[3], a 50/50 split between long-run and short-run was applied for the SCS analysis. Long-run induced demand accounts for increases to population and employment around new infrastructure. The SANDAG SCS land use pattern is based on the California Department of Finance (DOF) population projections series published in January 2020, consistent with AB 1086 (Daly, 2017). While the DOF population forecast accounts for demographic and socioeconomic trends, it is agnostic of the infrastructure changes planned in the region. Additionally, SANDAG's sub-regional allocation of population and employment reflected in the SCS land use pattern uses planning assumptions collected from local jurisdictions rather than model influenced accessibility measures. The NCST induced demand calculator (and research it is based on) accounts for induced demand at the project level, and there is no indication within the tool that regional long-run induced demand occurs at the same elasticity as project-level induced elasticity. Based on the uncertainty within these reasons, accounting for 50% of long-run induced demand is considered appropriate for this analysis.

This analysis is a complete, adequate and good faith effort at quantifying induced demand in the SCS. As recommended by the Technical Advisory on Evaluating Transportation Impacts in CEQA[4], the limitations to both this analysis and the modeling system used to inform it are described in this section. The conversion of existing GP lanes to HOT lanes along with an expanded and enhanced transit system, which are known elements that may mitigate the effects of induced demand, were not considered in the calculations of elasticities. Induced demand effects in ABM2+ have limitations related to both model inputs and model performance. Input limitations in the SCS land use pattern allocation occur at the subregional level. This is mitigated by a Delphi process where feedback from local jurisdiction land use experts help define where and when future growth is likely to occur. The overall SCS land use pattern projection also does not predict

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[3] Handy and Boarnet 2014, "Impact of Highway Capacity and Induced Travel on Passenger Vehicle Use and Greenhouse Gas Emissions, Policy Brief" https://ww2.arb.ca.gov/sites/default/files/2020-06/Impact_of_Highway_Capacity_and_Induced_Travel_on_Passenger_Vehicle_Use_and_Greenhouse_Gas_Emissions_Policy_Brief.pdf

[4] Technical Advisory on Evaluating Transportation Impacts in CEQA, Governor's Office of Planning and Research, December 2018. http://opr.ca.gov/docs/20190122-743_Technical_Advisory.pdf

economic recessions, pandemics, world/state crises, nor large deviations to exogenous variables. While the ABM2+ model structure does provide for the modeling of special markets and cohorts such as military households, sovereign tribal nations, domestic interregional travel, and travel across the international border with Mexico that has at least one stop in the SANDAG region, these capabilities and model components are limited to the fidelity and frequency of efforts to collect travel surveys and travel information. Certain types of commercial, service, and business travel not easily categorized in a traded industry cluster also present challenges to conducting a sensitivity analysis. Finally, nascent technological changes in the transportation sector (and subsequent effects in the supply chain that result from these changes) are difficult to evaluate within ABM2+.

Figure 1: Methodology Flow of Off-Model VMT Adjustment

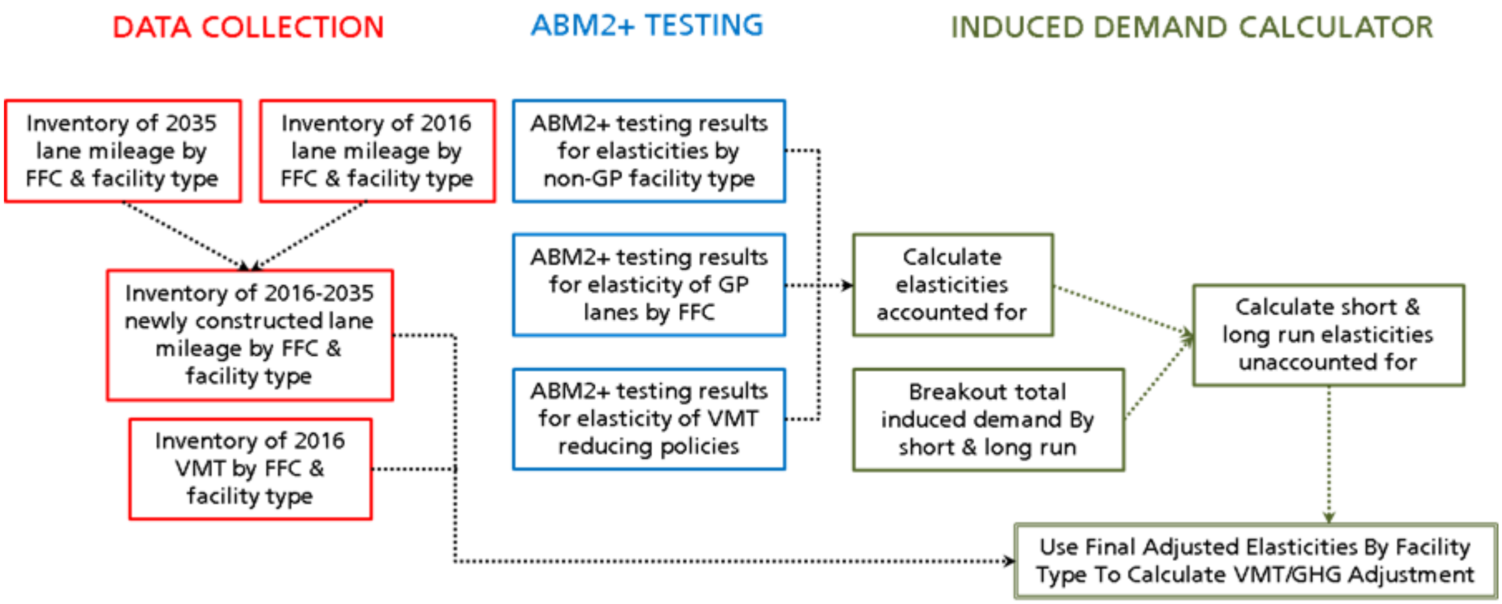

Figure 2: Inventory of added lane miles, 2016-2035 & 2036-2050, by facility class and typ

Federal Functional Class	Facility Type	2016-2035 Added Lane Miles	2036-2050 Added Lane Miles
Class 1	General Purpose	0	0
Class 1	Auxiliary	21	5
Class 1	Managed	140	39
Class 2	General Purpose	13	11
Class 2	Auxiliary	21	6
Class 2	Managed	62	63
Class 2	Toll	10	0
Class 2	Toll to GP Conversion	0	48
Class 3	General Purpose	27	5

Appendix J

Analysis of Potential for Conflicts Between the 2021 Regional Plan and Adopted Local Plans to Reduce Greenhouse Gas Emissions

APPENDIX J
ANALYSIS OF POTENTIAL FOR CONFLICTS BETWEEN THE 2021 REGIONAL PLAN AND ADOPTED LOCAL PLANS TO REDUCE GREENHOUSE GAS EMISSIONS

Table G-1 presents the policies, measures, and implementation actions of each local climate action plan or other local plan adopted for the purpose of reducing greenhouse gas (GHG) emissions. It then analyzes whether the proposed Plan would conflict with or implementation of each plan's policies, measures, or implementation actions. Table G-1 supports the analysis provided in Impact GHG-4 in Draft EIR Section 4.8, Greenhouse Gas Emissions. Table 4.8-5 of the Draft EIR provides a summary of all adopted local plans to reduce GHG emissions in the San Diego region as of June 2021.

Table J-1
Analysis of Potential Conflicts Between the Proposed Plan and Adopted Local Plans to Reduce Greenhouse Gas Emissions

Policy, Measure, or Action	Analysis
City of Carlsbad Climate Action Plan[1]	
<u>Measure A:</u> Install Residential PV Systems	The proposed Plan would not conflict with installation of renewable energy on residential buildings. The proposed Plan would result in GHG reductions from the automobile and light-duty truck sector through a combination of land use planning and transportation improvement projects, many of which would entail similar actions to those identified in a local GHG reduction plan. Although the proposed Plan does not directly call for investments in residential photovoltaics or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
<u>Measure B:</u> Install Commercial and Industrial PV Systems	The proposed Plan would not conflict with installation of renewable energy on commercial and industrial buildings. Although the proposed Plan does not directly call for investments in commercial or industrial photovoltaics or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.

[1] The Carlsbad CAP has GHG reduction targets of 15 percent below 2005 levels by 2020 and 49 percent below 2005 levels by 2035. Because these reductions would be achieved through a combination of federal, state, regional, and local actions for all sources of GHG emissions within the City, the Regional Plan's per capita GHG emissions reductions for passenger vehicles only (15 percent in 2020 and 21 percent in 2035) do not conflict with the City targets. Although the Regional Plan's total regional GHG emissions percentage reductions from all sources would be lower than the City's percentage reductions, there is no conflict because the City's CAP makes different assumptions about federal, state, and, in particular, local GHG reduction measures that would be implemented to achieve the City's target.

Policy, Measure, or Action	Analysis
Measure C: Promote Building Cogeneration for Large Commercial and Industrial Facilities	The proposed Plan would not conflict with the promotion of building cogeneration for large commercial and industrial facilities. Although the proposed Plan does not directly call for investments in cogeneration or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure D: Encourage Single-family Residential Efficiency Retrofits	The proposed Plan would not conflict with the local actions to encourage single-family residential retrofits. Although the proposed Plan does not directly call for investments in residential retrofits or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure E: Encourage Multi-family Residential Efficiency Retrofits	The proposed Plan would not conflict with the local actions to encourage multi-family residential retrofits. Although the proposed Plan does not directly call for investments in residential retrofits or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure F: Encourage Commercial and City Facility Efficiency Retrofits	The proposed Plan would not conflict with the local actions to encourage commercial and municipal residential retrofits. Although the proposed Plan does not directly call for investments in commercial and municipal retrofits or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure G: Promote Commercial and City Facility Commissioning or Improving Building Operations	The proposed Plan would not conflict with local actions to encourage commercial and municipal residential retrofits. Although the proposed Plan does not directly call for investments in commercial and municipal retrofits or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure H: Implementation of Green Building Code	The proposed Plan would not conflict with the local actions to implement a green building code. Although the proposed Plan does not directly call for investments in commercial and municipal retrofits or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.

Policy, Measure, or Action	Analysis
Measure I: Replace Incandescent Bulbs with LED Bulbs	The proposed Plan would not conflict with the local actions to replace incandescent bulbs with LED bulbs. Although the proposed Plan does not directly call for turnover of incandescent bulbs with LED bulbs or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure J: New Construction Residential and Commercial Solar Water Heater/Heat Pump Installation and Retrofit of Existing Residential	The proposed Plan would not conflict with the local actions to implement a residential and commercial solar water heaters. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure K: Promote Transportation Demand Management	The proposed Plan would continue to administer and monitor the iCommute program by providing regional rideshare, employer outreach, and bicycle education and secure parking services to help reduce commute-related traffic congestion and VMT.
Measure L: Increase Zero-Emissions Vehicle Travel	The proposed Plan includes EV charging facilities and funding for infrastructure for low-carbon fuels and would not conflict with Measure L.
Measure M: Develop more Citywide Renewable Energy Projects	The proposed Plan would not conflict with the development of more citywide renewable energy projects. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure N: Reduce the GHG Intensity of Water Supply Conveyance, Treatment, and Delivery	The proposed Plan would not conflict with implementation of strategies to reduce the GHG intensity of water supply, conveyance, treatment, and delivery. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure O: Encourage the Installation of Greywater and Rainwater Systems	The proposed Plan would not conflict with implementation of strategies to encourage installation of greywater and rainwater systems. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.

Policy, Measure, or Action	Analysis
City of Chula Vista Climate Action Plan[2]	
Water Education and Enforcement Strategy 1: Expand Education and Enforcement Targeting Landscape Water Waste	The proposed Plan would not conflict with the water education and enforcement efforts. The proposed Plan's Active Transportation projects promote landscaping of Mobility Hubs.
Water Efficiency Upgrades Strategy 1: Update the City's Landscaping Regulations to Promote more Water-Wise Designs	The proposed Plan would not conflict with the water education and enforcement efforts. The proposed Plan's Active Transportation projects promote landscaping of Mobility Hubs.
Water Efficiency Upgrades Strategy 2: Require Water-Savings Retrofits in Existing Buildings at a Specific Point in Time	The proposed Plan would not conflict with retrofits of existing buildings. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Water Reuse Plan And System Installations Strategy 1: Develop a Water Reuse Framework for Storm Water, Graywater, and Onsite Water Reclamation	The proposed Plan would not conflict with the development of a Water Reuse Framework. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Water Reuse Plan And System Installations Strategy 2: Facilitate Simple Graywater Systems for Laundry-to-Landscape Applications	The proposed Plan would not conflict with the facilitation of graywater systems. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Water Reuse Plan And System Installations Strategy 3: Streamline Complex Graywater Systems Permit Review	The proposed Plan would not conflict with the streamlining of graywater systems permitting. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Zero Waste Plan Strategy 1: Develop a Zero Waste Plan to Supplement Statewide Green Waste, Recycling, and Plastic Bag Ban Efforts	The proposed Plan would not conflict with the implementation of a Zero Waste Plan. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the

[2] The City of Chula Vista's 2017 CAP builds on previous GHG reduction efforts for the city, the most recent being the 2014 City Operations Sustainability Plan, which achieved a 29 percent reduction in 2005 baseline emissions in 2020. The 2017 CAP extends this goal to achieving a 55 percent reduction in 2005 baseline emissions by 2030.

Policy, Measure, or Action	Analysis
	proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Energy Education And Enforcement Strategy 1: Expand Education Targeting Key Community Segments and Facilitate Energy Performance Disclosure	The proposed Plan would not conflict with expanded educational efforts. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Energy Education And Enforcement Strategy 2: Leverage the Building Inspection Process to Deter Unpermitted, Low-performing Energy Improvements	The proposed Plan would not conflict with the City's inspection process. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Clean Energy Sources Strategy 1: Incorporate Solar into all New Buildings to Help Transition to Zero Net Energy Design	The proposed Plan would not conflict with installation of renewable energy on new buildings. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Clean Energy Sources Strategy 2: Provide More Grid-Delivered Clean Energy (Up To 100%) through Community Choice Aggregation or other Mechanism	The proposed Plan would not prevent the distribution of energy from a Community Choice Aggregation or any other mechanism. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Energy Efficiency Upgrades Strategy 1: Reauthorize the City's "Cool Roof" Standards and Expand to Include Re-roofs and Western Areas	The proposed Plan would not preclude the implementation and expansion of cool roof standards. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Energy Efficiency Upgrades Strategy 2: Facilitate more Energy Upgrades in the Community through Incentives, Permit Streamlining (Where Possible), and Education	The proposed Plan would not conflict with the City's implementation of incentives, permit streamlining, or educational programs. Although the proposed Plan does not directly call for these streamlining efforts or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from

Policy, Measure, or Action	Analysis
	implementing GHG reduction measures or actions for these sectors.
Energy Efficiency Upgrades Strategy 3: Require Energy-Savings Retrofits in Existing Buildings at a Specific Point in Time	The proposed Plan would not conflict with the local actions to require energy-savings retrofits. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Energy Efficiency Upgrades Strategy 4: Plant More Shade Trees to Save Energy, Address Heat Island Issues, and Improve Air Quality	The proposed Plan encourages the planting of trees as a climate change adaptation planning policy.
Complete Streets And Neighborhoods Strategy 1: Incorporate "Complete Streets" Principles into Municipal Capital Projects and Plans	The proposed Plan supports the design and use of complete streets as a component of Implementation Actions 1 and 8 (see Appendix B of the proposed Plan).
Complete Streets And Neighborhoods Strategy 2: Encourage Higher Density and Mixed-use Development in Smart Growth Areas, Especially Around Trolley Stations and Other Transit Nodes	The proposed Plan supports higher-density and mixed-use development in Smart Growth areas. The proposed Plan also supports transit-oriented development. Smart Growth policies are supported by SANDAG's Smart Growth Concept Map and Smart Growth Toolbox, Designing for Smart Growth guidelines and scorecards, Smart Growth Incentive Program, and Transit-Oriented Development Strategy, among others.
Transportation Demand Management Strategy 1: Utilize Bike Facilities, Transit Access/Passes, and other Transportation Demand Management and Congestion Management Offerings	The proposed Plan would continue to administer and monitor the iCommute program by providing regional rideshare, employer outreach, and bicycle education and secure parking services to help reduce commute-related traffic congestion and VMT.
Transportation Demand Management Strategy 2: Expand Bike-Sharing, Car-Sharing, and other "Last Mile" Transportation Options	The proposed Plan would continue to administer and monitor the iCommute program by providing regional rideshare, employer outreach, and bicycle education and secure parking services to help reduce commute-related traffic congestion and VMT.
Alternative Fuel Vehicles Strategy 1: Support the Installation of More Local Alternative Fueling Stations	The proposed Plan would not conflict with the deployment of alternative refueling infrastructure. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Alternative Fuel Vehicles Strategy 2: Designate Preferred Parking for Alternative Fuel Vehicles	The proposed Plan supports the use of preferred parking spaces for alternative fuel vehicles. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.

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Alternative Fuel Vehicles Strategy 3: Design all New Residential and Commercial Buildings to Be "Electric Vehicle Ready"	The proposed Plan would not conflict with designed new residential and commercial buildings to be electric-vehicle ready. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
City of Del Mar Climate Action Plan[3]	
Goal 1: Residential Photovoltaics	The proposed Plan would not conflict with installation of renewable energy on residential buildings. Although the proposed Plan does not directly call for investments in residential photovoltaics, or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Goal 2: Non-residential Photovoltaics	The proposed Plan would not conflict with installation of renewable energy on nonresidential buildings. Although the proposed Plan does not directly call for investments in nonresidential photovoltaics or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Goal 3: Residential Efficiency Retrofits – Single-family Homes	The proposed Plan would not conflict with the local actions to retrofit single-family homes. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Goal 4: Residential Efficiency Retrofits – Multi-family Homes	The proposed Plan would not conflict with the local actions to retrofit multi-family homes. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Goal 5: Non-residential Efficiency Retrofits	The proposed Plan would not conflict with the local actions to retrofit nonresidential development. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste,

[3] The City of Del Mar's Climate Action Plan aims to reduce GHG emissions by 15 percent from a baseline year of 2012 by 2020 and 50 percent by 2035. The CAP also includes a renewable energy goal of 50 percent by 2020 and 100 percent by 2035. The CAP estimates that the GHG reduction strategies would achieve a reduction of 7,689 and 17,536 $MTCO_2e$ by 2020 and 2035, respectively.

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	water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Goal 6: Residential Solar Hot Water Heater Installation	The proposed Plan would not conflict with the local actions to install solar water heaters. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Goal 7: Renewable Energy Supply	The proposed Plan would not conflict with the generation or distribution of renewable energy. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Goal 8: Reduce Residential Indoor Water Consumption in Remodeled Single-family Homes	The proposed Plan would not conflict with strategies that reduce residential indoor water consumption in single-family homes. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Goal 9: Reduce Outdoor Water Consumption	The proposed Plan would not conflict with local measures to reduce outdoor water consumption. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Goal 10: Pool Cover Program	The proposed Plan would not conflict with a program to implement pool covers locally. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Goal 11: Divert Waste from Landfills and Capture Emissions	The proposed Plan would not conflict with the implementation of strategies to divert waste from landfills and capture fugitive landfill emissions. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from

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	implementing GHG reduction measures or actions for these sectors.
Goal 12: Capture Emissions from Wastewater Treatment	The proposed Plan would not conflict with the implementation of strategies to capture fugitive emissions from wastewater treatment plants. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Goal 13: Increase Mass Transit Ridership	The proposed Plan would continue to administer and monitor the iCommute program by providing regional rideshare, employer outreach, and bicycle education and secure parking services to help reduce commute-related traffic congestion and VMT.
Goal 14: Adopt a Bicycle Strategy	The proposed Plan would continue to administer and monitor the iCommute program by providing regional rideshare, employer outreach, and bicycle education and secure parking services to help reduce commute-related traffic congestion and VMT. The proposed Plan provides funding for bicycle infrastructure projects and directly supports local measures such as Goal 14.
Goal 15: Pedestrian Mobility Plan	The proposed Plan would continue to administer and monitor the iCommute program by providing regional rideshare, employer outreach, and bicycle education and secure parking services to help reduce commute-related traffic congestion and VMT. The proposed Plan provides funding for pedestrian infrastructure projects and directly supports local measures such as Goal 15.
Goal 16: Increase the Percentage of VMT Being Driven by Electric and Alternative Fuel Vehicles	The proposed Plan supports the use of zero-emission vehicles through expansion of electric vehicle infrastructure. Implementation Action 9 of SANDAG's EV program directs SANDAG to make long-term investments in zero and near-zero emissions infrastructure (see Appendix B of the proposed Plan).
Goal 17: Increase Number of Preferential Parking Spaces for Clean Vehicles	The proposed Plan supports the use of preferred parking spaces for clean-air vehicles through its parking management policies.
Goal 18: Install Roundabouts	The proposed Plan supports the use of roundabouts through investments in TDM programs that support roundabouts.
Goal 19: Increase Percentage of Population with Alternate Work Schedules	The proposed Plan would not conflict with the implementation of programs that encourage alternative work schedules among employees. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.

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Goal 20: Increase Telecommuting	The proposed Plan supports the use of telecommuting. Implementation Action 9 directs SANDAG to invest in TDM programs that support telecommuting (see Appendix B of the proposed Plan).
Goal 21: Increase Van Pooling	The proposed Plan supports the use of van pooling. Implementation Action 9 directs SANDAG to invest in TDM programs that support vanpooling (see Appendix B of the proposed Plan).
Goal 22: Implement Urban Tree Planting Program	The proposed Plan encourages the planting of trees as a climate change adaptation planning policy.
El Cajon Sustainability Initiative: Policies to Reduce Greenhouse Gas Emissions[4]	
Strategy 1: Increase the Use of Zero-Emission/Alternative Fuel Vehicles	The proposed Plan supports the use of zero-emission vehicles through expansion of zero and near-zero emissions infrastructure. Implementation Action 9 of the proposed Plan directs SANDAG to make long-term investments in zero and near-zero emissions infrastructure (see Appendix B of the proposed Plan).
Strategy 2: Reduce Fuel Use	A major objective of the proposed Plan is to decrease emissions of air pollution and GHGs through a combination of transportation improvement projects and land use planning strategies that will result in a decrease in the consumption of fossil fuels from the transportation sector. The proposed Plan supports local efforts to reduce fossil fuel consumption and would not conflict with any measures or strategies that aim to achieve this goal.
Strategy 3: Reduce Vehicle Miles Traveled	A major objective of the proposed Plan is to decrease emissions of air pollution and GHGs through a combination of transportation improvement projects and land use planning strategies that will result in a decrease in VMT. The proposed Plan supports local efforts to reduce VMT and would not conflict with any measures or strategies that aim to achieve this goal.
Strategy 4: Increase Building Energy Efficiency	The proposed Plan would not conflict with local actions to improve building energy efficiency. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy 5: Increase Renewable and Zero-Carbon Energy	The proposed Plan would not conflict with the generation or distribution of renewable or zero-carbon energy sources. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not

[4] The City of El Cajon's Sustainability Initiative aims to reduce GHG emissions by 4 percent from a baseline year of 2012 by 2020 and 42 percent by 2030. The CAP estimates that the GHG reduction strategies would achieve a reduction of 33,000 $MTCO_2e$ by 2030.

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	inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy 6: Increase Water Efficiency	The proposed Plan would not conflict with local actions to improve water efficiency. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy 7: Reduce and Recycle Solid Waste	The proposed Plan would not conflict with the implementation of strategies that reduce waste and increase recycling. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy 8: Carbon Sequestration	The proposed Plan would not conflict with the implementation of programs that improve carbon sequestration. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
City of Encinitas Climate Action Plan[5]	
Strategy 1: Building Efficiency	The proposed Plan would not conflict with the local actions to improve the energy efficiency of buildings. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy 2: Renewable Energy	The proposed Plan would not conflict with the generation or distribution of renewable energy. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy 3: Water Efficiency	The proposed Plan would not conflict with the local actions to improve water efficiency. Although the proposed Plan does

[5] The City of Encinitas updated its Climate Action Plan sets reduction targets of achieving a 13 percent reduction in GHG emissions from a 2012 baseline and a 44 percent reduction from 2012 levels by 2030. The CAP estimates that the GHG Reduction Strategies would achieve a 9,531 and 94,041 $MTCO_2e$ by 2020 and 2030, respectively.

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	not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy 4: Clean and Efficient Transportation	A major objective of the proposed Plan is to decrease emissions of air pollution and GHGs through a combination of transportation improvement projects and land use planning strategies that will result in an efficient transportation system to decrease the consumption of fossil fuels. The proposed Plan supports local efforts to improve the efficiency of the transportation network and would not conflict with any measures or strategies that aim to achieve this goal.
Strategy 5: Reduce Off-road Equipment	The proposed Plan would not conflict with strategies to reduce the use of offroad equipment. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy 6: Zero-waste	The proposed Plan would not conflict with the implementation of zero-waste strategies. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy 7: Carbon Sequestration	The proposed Plan would not conflict with the implementation of programs that improve carbon-sequestration potential. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
City of Escondido Climate Action Plan[6]	
Strategy 1: Increase the Use of Zero-emission or Alternative Fuel Vehicles	The proposed Plan supports the use of zero-emission vehicles through expansion of electric vehicle infrastructure. Implementation Action 9 of SANDAG's EV program directs SANDAG to make long-term investments in zero and near-zero emissions infrastructure (see Appendix B of the proposed Plan).

[6] The City of Escondido adopted its most recent Climate Action Plan in 2021 and established reduction targets of 4 percent below 2012 levels by 2020, 42 percent below 2012 levels by 2030, and 52 percent below 2012 levels by 2035. The CAP estimates that the CAP Measures would achieve a 99,000 and 114,000 $MTCO_2e$ reduction by 2020 and 2035, respectively.

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Strategy 2: Reduce Fossil Fuel Use	A major objective of the proposed Plan is to decrease emissions of air pollution and GHGs through a combination of transportation improvement projects and land use planning strategies that will result in a decrease in the consumption of fossil fuels from the transportation sector. The proposed Plan supports local efforts to reduce fossil fuel consumption and would not conflict with any measures or strategies that aim to achieve this goal.
Strategy 3: Reduce Vehicle Miles Traveled	A major objective of the proposed Plan is to decrease emissions of air pollution and GHGs through a combination of transportation improvement projects and land use planning strategies that will result in a decrease in VMT. The proposed Plan supports local efforts to reduce VMT and would not conflict with any measures or strategies that aim to achieve this goal.
Strategy 4: Increase Building Energy Efficiency	The proposed Plan would not conflict with the local actions to improve building energy efficiency. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy 5: Increase Renewable and Zero-Carbon Energy	The proposed Plan would not conflict with the generation or distribution of renewable energy. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy 6: Increase Water Efficiency	The proposed Plan would not conflict with the local actions to improve water efficiency. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy 7: Diversify Local Water Supply	The proposed Plan would not conflict with any effort by a utility or local agency to diversify local water resources and supply. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy 8: Reduce and Recycle Solid Waste	The proposed Plan would not conflict with the implementation of strategies that reduce waste and increase recycling. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from

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	the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy 9: Carbon Sequestration and Land Conservation	The proposed Plan would not conflict with efforts to sequester carbon or conserve natural or working lands. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
City of Imperial Beach Local Coastal Program Resilient Imperial Beach Climate Action Plan[7]	
Strategy: Clean and Efficient Transportation	A major objective of the proposed Plan is to decrease emissions of air pollution and GHGs through a combination of transportation improvement projects and land use planning strategies that result in an efficient transportation system to decrease the consumption of fossil fuels. The proposed Plan supports local efforts to improve the efficiency of the transportation network and would not conflict with any measures or strategies that aim to achieve this goal.
Strategy: Reduce Vehicle Miles Traveled (VMT)	A major objective of the proposed Plan is to decrease emissions of air pollution and GHGs through a combination of transportation improvement projects and land use planning strategies that will result in a decrease in VMT. The proposed Plan supports local efforts to reduce VMT and would not conflict with any measures or strategies that aim to achieve this goal.
Strategy: Increase Renewable Electricity	The proposed Plan would not conflict with the generation or distribution of renewable energy. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy: Zero Waste	The proposed Plan would not conflict with the implementation of zero waste strategies. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy: Carbon Sequestration	The proposed Plan encourages the planting of trees as a carbon sequestration policy.

[7] The City of Imperial Beach's Climate Action Plan sets targets of reducing GHG emissions by 4 percent below 2012 levels by 2020 and 42 percent below 2012 levels by 2030. The LCP CAP estimates that the GHG Reduction Strategies would achieve a 6,454 $MTCO_2e$ reduction by 2030.

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City of La Mesa Climate Action Plan[8]	
Strategy E-1: Building Retrofit Program	The proposed Plan would not conflict with the local actions to retrofit existing buildings. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy E-2: Shade Tree Program	The proposed Plan encourages the planting of trees as a climate change adaptation planning policy.
Strategy E-3: Municipal Energy Efficiency Goal	The proposed Plan would not conflict with goals to improve energy efficiency in municipal facilities. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy E-4: Public Lighting	The proposed Plan would not interfere with the installation of energy-efficient public lighting. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy E-5: Solar Photovoltaic Program	The proposed Plan would not conflict with installation of renewable energy on residential and nonresidential buildings. Although the proposed Plan does not directly call for investments in photovoltaics or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy E-6: Solar Hot Water Heater Program	The proposed Plan would not conflict with the local actions to promote solar hot-water heaters. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy E-7: Solar-ready Construction	The proposed Plan would not conflict with strategies that promote solar-ready construction. Although the proposed Plan does not directly call for these investments or other similar

[8] The City of Las Mesa's Climate Action Plan establishes a long-term GHG reduction goal of reducing emission by 15 and 53 percent 2010 baseline levels by 2020 and 2035. The CAP estimates that the GHG Reduction Strategies would achieve a 16,871 and 116,470 $MTCO_2e$ reduction by 2020 and 2035, respectively.

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	GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy E-8: Zero Net Energy Construction	The proposed Plan would not conflict with strategies that promote zero net energy during construction. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy E-9: 100% Clean Energy CCA Program	The proposed Plan would not impede the creation or operation of a CCA. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy T-1: Bicycle and Pedestrian Infrastructure Development	The proposed Plan would continue to administer and monitor the iCommute program by providing regional rideshare, employer outreach, and bicycle education and secure parking services to help reduce commute-related traffic congestion and VMT.
Strategy T-2: Bicycle Safety Program	The proposed Plan would continue to administer and monitor the iCommute program by providing regional rideshare, employer outreach, and bicycle education and secure parking services to help reduce commute-related traffic congestion and VMT.
Strategy T-3: Transportation Demand Management Program	The proposed Plan would continue to administer and monitor the iCommute program by providing regional rideshare, employer outreach, and bicycle education and secure parking services to help reduce commute-related traffic congestion and VMT.
Strategy T-4: Mixed-use and Transit-oriented Development	The proposed Plan supports mixed-use and transit-oriented development through SANDAG's Transit-Oriented Development Strategy.
Strategy T-5: Alternative Refueling Infrastructure Development	The proposed Plan would not conflict with the deployment of alternative refueling infrastructure. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy T-6: Municipal Fleet Transition	The proposed Plan would not interfere with municipal fleet turnover. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad,

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	or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy W-1: Urban Water Management Plan Programs	The proposed Plan would not conflict with Urban Water Management Plan programs. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy W-2: Water-sensitive Landscape Design and Irrigation	The proposed Plan would not conflict with the planting of water-sensitive landscaping. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy W-3: Pure Water Program	The proposed Plan would not conflict with the Pure Water Program defined in Strategy W-3. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy SW-1: Food Scrap and Yard Waste Diversion	The proposed Plan would not conflict with the implementation of food scrap and yard waste diversion strategies. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy SW-2: Construction and Demolition Waste Diversion Program	The proposed Plan would not conflict with the implementation of construction and demolition waste diversion programs. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy SW-3: 75% Waste Diversion Goal	The proposed Plan would not conflict with the strategies that achieve a 75% waste diversion goal. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.

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Strategy GI-1: Urban Forest Master Plan	The proposed Plan encourages the planting of trees as a climate change adaptation planning policy.
Strategy GI-2: Expanded Urban Forestry Program	The proposed Plan encourages the planting of trees as a climate change adaptation planning policy.
City of Lemon Grove Climate Action Plan[9]	
Strategy 1: Increase Use of Zero-emission or Alternative Fuel Vehicles	The proposed Plan supports the use of zero-emission vehicles through expansion of zero and near-zero emissions infrastructure. Implementation Action 9 of SANDAG's EV program directs SANDAG to make long-term investments in zero and near-zero emissions infrastructure (see Appendix B of the proposed Plan).
Strategy 2: Reduce Fossil Fuel Use	A major objective of the proposed Plan is to decrease emissions of air pollution and GHGs through a combination of transportation improvement projects and land use planning strategies that will result in a decrease in the consumption of fossil fuels from the transportation sector. The proposed Plan supports local efforts to reduce fossil fuel consumption and would not conflict with any measures or strategies that aim to achieve this goal.
Strategy 3: Reduce Vehicle Miles Traveled	A major objective of the proposed Plan is to decrease emissions of air pollution and GHGs through a combination of transportation improvement projects and land use planning strategies that will result in a decrease in VMT. The proposed Plan supports local efforts to reduce VMT and would not conflict with any measures or strategies that aim to achieve this goal.
Strategy 4: Increase Building Energy Efficiency	The proposed Plan supports would not conflict with the local actions to improve building energy efficiency. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy 5: Increase Renewable and Zero-carbon Energy	The proposed Plan would not conflict with the generation or distribution of renewable energy. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy 6: Increase Water Efficiency	The proposed Plan would not conflict with the local actions to improve water efficiency. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and

[9] The City of Lemon Grove's Climate Action Plan sets reduction targets of reducing GHG emissions by 4 percent below 2012 levels by 2020 and 42 percent below 2012 levels by 2030. The CAP estimates that the CAP Measures would achieve a 13,400 $MTCO_2e$ reduction in 2030.

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	wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy 7: Reduce and Recycle Solid Waste	The proposed Plan would not conflict with the implementation of strategies to reduce solid waste and increase recycling. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy 8: Carbon Sequestration	The proposed Plan would not conflict with efforts to sequester carbon or conserve natural or working lands and supports the planting of trees aa a component of climate adaptation planning.
National City Climate Action Plan[10]	
Energy	The proposed Plan would not conflict with the local actions to improve energy efficiency or promote renewable energy usage/generation. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Transportation and Land Use	The proposed Plan encourages smart growth policies that include mixed uses and access to transit and alternative transportation modes. Smart Growth policies are supported by SANDAG's Smart Growth Concept Map and Smart Growth Toolbox, Designing for Smart Growth guidelines and scorecards, Smart Growth Incentive Program, and Transit-oriented Development Strategy, among others. The proposed Plan encourages low-carbon transportation options. The proposed Plan would include the construction of HOV and managed lanes to reduce traffic congestion.
Solid Waste	The proposed Plan would not conflict with implementation of solid waste reduction strategies. Although the proposed Plan does not directly call for investments in photovoltaics or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Water and Wastewater	The proposed Plan would not conflict with implementation of water conservation strategies and strategies to encourage use

[10] National City's 2011 Climate Action Plan established a reduction target of 15 percent 2005/2006 GHG levels by the year 2020, but does not have an established target for 2030. The CAP estimates that the CAP Measures would achieve a 137,286 and 156,127 $MTCO_2e$ reduction in 2020 and 2030, respectively.

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	of reclaimed water. Although the proposed Plan does not directly call for investments in photovoltaics or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Government Operations	The proposed Plan would not conflict with implementation of programs to reduce GHG emissions from government operations. Although the proposed Plan does not directly call for investments in photovoltaics or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
City of Oceanside Climate Action Plan[11]	
Measure E1: Renewable Energy Procurement	The proposed Plan would not conflict with the generation or distribution of renewable energy. Although the proposed Plan does not directly call for investments in photovoltaics or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure E2: Solar Photovoltaic Promotion Program	The proposed Plan would not conflict with installation of renewable energy on residential and nonresidential buildings. Although the proposed Plan does not directly call for investments in photovoltaics or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure E3: Residential Energy Conservation and Disclosure	The proposed Plan would not conflict with measures to conserve and track energy consumption from residential units. Although the proposed Plan does not directly call for these investments or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure E4: Promotion of Low-income Financing Programs	The proposed plan would not conflict with the promotion of low-income financing programs. Although the proposed Plan does not directly call for these investments, or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the

[11] The City of Oceanside has set linear per capita reduction goals of 5 $MTCO_2e$ per capita by 2020, 4 $MTCO_2e$ per capita by 2030, 3 $MTCO_2e$ per capita by 2040, and 2 $MTCO_2e$ per capita by 2050. The CAP estimates that the GHG Reduction Measures would achieve 22,607, 152,973, 196,930, and 234,768 $MTCO_2e$ by 2020, 2030, 2040, and 2050, respectively.

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	proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure E5: Non-residential Building Energy Benchmarking and Disclosure	The proposed Plan would not conflict with efforts to conserve and track energy consumption from nonresidential land uses. Although the proposed Plan does not directly call for these investments or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure W1: Implementation of the Water Conservation Master Plan	The proposed Plan would not conflict with the implementation of a water conservation master plan. Although the proposed Plan does not directly call for these investments or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure W2: Non-residential Water Use Benchmarking and Disclosure	The proposed Plan would not conflict with measures to conserve and track water consumption. Although the proposed Plan does not directly call for these investments or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure W3: Local Water Supply Development	The proposed Plan would not conflict with efforts to increase or expand water supply. Although the proposed Plan does not directly call for these investments or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure SW1: Implementation of Zero Waste Strategic Resource Plan	The proposed Plan would not conflict with the implementation of zero-waste strategies. Although the proposed Plan does not directly call for these investments or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure SW2: Beyond 2020 – Enhanced Waste Diversion	The proposed Plan would not conflict with the implementation of solid waste diversion strategies. Although the proposed Plan does not directly call for these investments or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure TL1: Smart Growth Policies	The proposed Plan supports Smart Growth Policies, including SANDAG's Smart Growth Concept Map and Smart Growth

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	Toolbox, Designing for Smart Growth guidelines and scorecards, Smart Growth Incentive Program, and Transit-oriented Development Strategy, among others.
Measure TL2: Electric Vehicle Promotion	The proposed Plan supports the use of zero-emission vehicles through expansion of zero and near-zero emissions infrastructure. Implementation Action 9 of SANDAG's EV program directs SANDAG to make long-term investments in zero and near-zero emissions infrastructure (see Appendix B of the proposed Plan).
Measure TL3: Preferential Parking Spaces for Clean Air Vehicles	The proposed Plan supports the use of preferred parking spaces for clean-air vehicles.
Measure TL4: Expand Complete Streets Programs	The proposed Plan supports the design and use of complete streets as a component of Implementation Actions 1 and 8 (see Appendix B of the proposed Plan).
Measure TL5: Transportation Demand Management Programs	The proposed Plan would continue to administer and monitor the iCommute program by providing regional rideshare, employer outreach, and bicycle education and secure parking services to help reduce commute-related traffic congestion and VMT.
Measure AF1: Urban Forestry Program	The proposed Plan encourages the planting of trees as a climate change adaptation planning policy.
Measure AF2: Urban Agriculture and Community Gardens	The proposed Plan would not conflict with the creation of urban agriculture and community gardens. Although the proposed Plan does not directly call for these investments or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure AF3: Agricultural Lands Conservation Program	The proposed Plan would not conflict with the creation or operation of an agricultural lands conservation program. Although the proposed Plan does not directly call for these investments or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure AF4: Carbon Farming Program	The proposed Plan would not conflict with the creation or operation of carbon farming program. Although the proposed Plan does not directly call for these investments or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.

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City of San Diego Climate Action Plan[12]	
Strategy 1: Energy and Water Efficient Buildings	The proposed Plan supports green building practices and would not conflict with local measures to improve energy or water efficiency. Although the proposed Plan does not directly call for these investments or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy 2: Clean and Renewable Energy	The proposed Plan would not conflict with the generation or distribution of renewable energy. Although the proposed Plan does not directly call for these investments or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy 3: Bicycling, Walking, Transit, and Land Use	The proposed Plan would continue to administer and monitor the iCommute program by providing regional rideshare, employer outreach, and bicycle education and secure parking services to help reduce commute-related traffic congestion and VMT.
Strategy 4: Zero Waste (Gas and Waste Management)	The proposed Plan would not conflict with the implementation of zero-waste strategies. Although the proposed Plan does not directly call for these investments or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy 5: Climate Resiliency	The proposed Plan would fund projects that improve climate resiliency in the San Diego region.

[12] The City of San Diego is currently updating its 2015 Climate Action Plan, which established targets of reducing GHG emissions by 15 percent of the 2010 baseline by 2020, 40 percent by 2030, and 50 percent by 2035. The CAP estimates that local GHG Reduction Strategies would achieve a 423,116, 1,261,745, and 2,525,027 $MTCO_2e$ by 2020, 2030, and 2035, respectively.

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Port of San Diego Climate Action Plan[13]	
TA + TE: Alternative Powered Vehicles and Vessels and Advanced Technologies	The proposed Plan would not conflict with the Port's efforts to use alternative-powered vehicles and ocean-going vessels. Although the proposed Plan does not directly call for these investments or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
TR: Roadway System Management	The proposed Plan would continue to administer and monitor the iCommute program by providing regional rideshare, employer outreach, and bicycle education and secure parking services to help reduce commute-related traffic congestion and VMT.
TL + TT: Land Use/Community Design and Transit	The proposed Plan supports measures that promote sustainable community design and TOD. Smart Growth policies are supported by SANDAG's Smart Growth Concept Map and Smart Growth Toolbox, Designing for Smart Growth guidelines and scorecards, Smart Growth Incentive Program, and Transit-oriented Development Strategy, among others.
TP + TV: Parking Policy/Pricing and Trip and Vehicle Miles Reduction	A major objective of the proposed Plan is to decrease emissions of air pollution and GHGs through a combination of transportation improvement projects and land use planning strategies that will result in an efficient transportation system to decrease VMT. The proposed Plan supports local efforts to improve the efficiency of the transportation network and promote limited parking through its parking management policies, and would not conflict with any measures or strategies that aim to achieve this goal.
EB: Building Energy Use	The proposed Plan would not conflict with local efforts to improve energy efficiency. Although the proposed Plan does not directly call for these investments or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
EH: Heat Gain and Shading	The proposed Plan would not conflict with local efforts to promote shading. Although the proposed Plan does not directly call for these investments or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
EL: Lighting	The proposed Plan would not conflict with local efforts to promote energy-efficiency lighting. Although the proposed Plan does not directly call for these investments or other GHG

[13] The Port of San Diego prepared its Climate Action Plan in 2013. It set a reduction goal of 10 percent less than the 2006 baseline by 2020. The CAP estimates that the GHG reduction measures have the potential to reduce GHG emissions from the projected 2020 scenario total of 855,489 to 745,695 $MTCO_2e$ by 2020.

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	reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
<u>WR:</u> Water Recycling	The proposed Plan would not conflict with local efforts to promote water recycling. Although the proposed Plan does not directly call for these investments or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
<u>WC:</u> Water Conservation	The proposed Plan would not conflict with local efforts to promote water conservation. Although the proposed Plan does not directly call for these investments or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
<u>EA:</u> Alternative Energy Generation	The proposed Plan would not conflict with local efforts to promote alternative-energy generation. Although the proposed Plan does not directly call for these investments or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
<u>ME:</u> Smart Grid	The proposed Plan would not conflict with local efforts to use smart grids. Although the proposed Plan does not directly call for these investments or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
<u>SW:</u> Waste Reduction and Recycling	The proposed Plan would not conflict with local efforts to reduce solid-waste generation and promote recycling. Although the proposed Plan does not directly call for these investments or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
<u>MP:</u> Programs and Outreach	The proposed Plan would not conflict with local outreach and educational efforts. Although the proposed Plan does not directly call for these investments or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
<u>MC:</u> Carbon Capture and Sequestration	The proposed Plan encourages the planting of trees as a climate change adaptation planning policy.

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San Diego County Regional Airport Authority Sustainability Management Program[14]	
Clean Transportation Plan	A major objective of the proposed Plan is to decrease emissions of air pollution and GHGs through a combination of transportation improvement projects and land use planning strategies that will result in a decrease in the consumption of fossil fuels from the transportation sector. The proposed Plan supports local efforts to reduce fossil fuel consumption and would not conflict with any measures or strategies that aim to achieve this goal.
Climate Resiliency Plan	The proposed Plan's Climate Adaptation and Resiliency Program will work jointly with other local efforts to promote climate adaptation policy planning. SANDAG's Climate Adaptation Program complements these efforts and would not impede the implementation of climate resiliency policies.
Carbon Neutrality Plan	The proposed Plan would not conflict with the local actions to achieve carbon neutrality. Through a combination of land use strategies and transportation investments, the proposed Plan will reduce the consumption of gasoline and diesel fuel, thus promoting a more carbon-neutral future in the San Diego region.
Zero-waste Plan	The proposed Plan would not conflict with the local actions to reduce solid waste generation. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Biodiversity Plan	The proposed Plan would not conflict with the local actions to enhance and protect biodiversity. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Water Stewardship Plan	The proposed Plan would not conflict with the local actions to improve water conservation. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategic Energy Plan	The proposed Plan would not conflict with the local actions to improve energy efficiency. Although the proposed Plan does

[14] The San Diego County Regional Airport Authority adopted its Sustainability Management Program in 2020. The plan includes seven plans that address GHG emissions from various sectors. Each plan includes incremental reduction targets.

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	not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
City of San Marcos Climate Action Plan[15]	
Strategy 1: Increase Use of Zero-emission or Alternative Fuel Vehicles	The proposed Plan supports the use of zero-emission vehicles through expansion of zero and near-zero emissions infrastructure. Implementation Action 9 of SANDAG's EV program directs SANDAG to make long-term investments in zero and near-zero emissions infrastructure (see Appendix B of the proposed Plan).
Strategy 2: Reduce Fossil Fuel Use	A major objective of the proposed Plan is to decrease emissions of air pollution and GHGs through a combination of transportation improvement projects and land use planning strategies that will result in a decrease in the consumption of fossil fuels from the transportation sector. The proposed Plan supports local efforts to reduce fossil fuel consumption and would not conflict with any measures or strategies that aim to achieve this goal.
Strategy 3: Reduce Vehicle Miles Traveled	A major objective of the proposed Plan is to decrease emissions of air pollution and GHGs through a combination of transportation improvement projects and land use planning strategies that will result in a decrease in VMT. The proposed Plan supports local efforts to reduce VMT and would not conflict with any measures or strategies that aim to achieve this goal.
Strategy 4: Increase Building Energy Efficiency	The proposed Plan would not conflict with the local actions to improve energy efficiency. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy 5: Increase Renewable and Zero Carbon Energy	The proposed Plan would not conflict with the generation or distribution of renewable energy. Although the proposed Plan does not directly call for investments in commercial photovoltaics or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy 6: Reduce Water Use	The proposed Plan would not conflict with the local actions to reduce water usage. Although the proposed Plan does not

[15] The City of San Marcos updated its Climate Action Plan in 2020. It sets a long-term reduction target of reducing GHG emissions by 42 percent below 2012 baseline emissions by 2030. The CAP estimates that the GHG Reduction Strategies would achieve an 82,000 $MTCO_2e$ reduction by 2030.

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	directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy 7: Reduce and Recycle Solid Waste	The proposed Plan would not conflict with the implementation of strategies to reduce solid waste and increase recycling. Although the proposed Plan does not directly call for investments in commercial photovoltaics or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy 8: Increase Urban Tree Cover	The proposed Plan encourages the planting of trees as a climate change adaptation planning policy.
City of Santee's Sustainable Santee Plan[16]	
Goal 1: Increase Energy Efficiency in Existing Residential Units	The proposed Plan would not conflict with the local actions to improve energy efficiency. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Goal 2: Increase Energy Efficiency in New Residential Units	The proposed Plan would not conflict with the local actions to improve energy efficiency. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Goal 3: Increase Energy Efficiency in Existing Commercial Units	The proposed Plan would not conflict with the local actions to improve energy efficiency. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Goal 4: Increase Energy Efficiency in New Commercial Units	The proposed Plan would not conflict with the local actions to improve energy efficiency. Although the proposed Plan does not directly call for these investments or other similar GHG

[16] The City of Santee's Sustainable Santee Plan sets goals of reducing emissions by 15 percent from 2005 by 2020, 40 percent by 2030, and 49 percent by 2035. The Plan estimates that the GHG Reduction Measures would achieve a 72,615 and 107,723 $MTCO_2e$ reduction in 2030 and 2035, respectively, excluding emissions reductions from the CCA. Including these CCA-related reductions, the GHG Reduction Measures are estimated to reduce emissions by 118,937 and 164,655 $MTCO_2$ in 2030 and 2035, respectively.

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	reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Goal 5: Decrease Energy Demand through Reducing Urban Heat Island Effect	The proposed Plan would not conflict with local efforts to reduce the UHIE, which would alleviate energy demand. Although the proposed Plan does not directly call for investments in commercial photovoltaics or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Goal 6: Decrease Greenhouse Gas Emissions through Reducing Vehicle Miles Traveled	A major objective of the proposed Plan is to decrease emissions of air pollution and GHGs through a combination of transportation improvement projects and land use planning strategies that will result in a decrease in VMT. The proposed Plan supports local efforts to reduce VMT and would not conflict with any measures or strategies that aim to achieve this goal.
Goal 7: Increase Use of Electric Vehicles	The proposed Plan supports the use of zero-emission vehicles through expansion of zero and near-zero emissions infrastructure. Implementation Action 9 of SANDAG's EV program directs SANDAG to make long-term investments in zero and near-zero emissions infrastructure (see Appendix B of the proposed Plan).
Goal 8: Improve Traffic Flow	The proposed Plan provides funding to transportation projects that would improve traffic flow in the San Diego region.
Goal 9: Decrease Greenhouse Gas Emissions through Reducing Solid Waste Generation	The proposed Plan would not conflict with the implementation of strategies to reduce the generation of solid waste. Although the proposed Plan does not directly call for investments in commercial photovoltaics or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Goal 10: Decrease Greenhouse Gas Emissions through Increasing Clean Energy Use	The proposed Plan would not conflict with the development or distribution of clean energy resources that would decrease GHG emissions. Although the proposed Plan does not directly call for investments in commercial photovoltaics or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
City of Solana Beach Climate Action Plan[17]	

[17] The City of Solana Beach has set reduction targets of achieving emissions 15 percent below 2010 levels by 2020 and 50 percent below 2010 levels by 2035. The CAP estimates that the GHG Reduction Strategies would achieve a 73,047 $MTCO_2e$ reduction by 2035.

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Measure T-1: Increase EVs and AFVs VMT to 30% of Total VMT	The proposed Plan supports the use of zero-emission vehicles through expansion of zero and near-zero emissions infrastructure. Implementation Action 9 of SANDAG's EV program directs SANDAG to make long-term investments in zero and near-zero emissions infrastructure (see Appendix B of the proposed Plan).
Measure T-2: Increase Commuting by Vanpools to 20% of Labor Force	The proposed Plan would continue to administer and monitor the iCommute program by providing regional rideshare, employer outreach, and bicycle education and secure parking services to help reduce commute-related traffic congestion and VMT. The proposed Plan would support the use of commuter vanpools.
Measure T-3: Reduce Average Commuter Trip Distance by 1 Mile	The proposed Plan would continue to administer and monitor the iCommute program by providing regional rideshare, employer outreach, and bicycle education and secure parking services to help reduce commute-related traffic congestion and VMT. The proposed Plan would support reducing commuter trip length.
Measure T-4: Increase Commuting By Mass Transit to 10% of Labor Force	The proposed Plan would continue to administer and monitor the iCommute program by providing regional rideshare, employer outreach, and bicycle education and secure parking services to help reduce commute-related traffic congestion and VMT. The proposed Plan would support the use of transit for commuting.
Measure T-5: Increase Preferred Parking for EVs and AFVs to 20% of Eligible Parking Spots	The proposed Plan would continue to administer and monitor the iCommute program by providing regional rideshare, employer outreach, and bicycle education and secure parking services to help reduce commute-related traffic congestion and VMT. The proposed Plan would support preferred parking for EVs and AFVs.
Measure T-6: Retime Four Traffic Signals	The proposed Plan would continue to administer and monitor the iCommute program by providing regional rideshare, employer outreach, and bicycle education and secure parking services to help reduce commute-related traffic congestion and VMT. The proposed Plan would support retiming of traffic signals to improve roadway efficiency.
Measure T-7: Promote Telecommuting to Achieve 10% Participation	The proposed Plan would continue to administer and monitor the iCommute program by providing regional rideshare, employer outreach, and bicycle education and secure parking services to help reduce commute-related traffic congestion and VMT. The proposed Plan would support telecommuting opportunities.
Measure T-8: Convert Municipal Gasoline Fueled Vehicle Fleet to EVs to Achieve 50% Gasoline Reduction	The proposed Plan would not conflict with municipal fleet turnover. Although the proposed Plan does not directly call for investments in commercial photovoltaics or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.

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Measure T-9: Increase Commuting by Walking to 5% of Labor Force	The proposed Plan would continue to administer and monitor the iCommute program by providing regional rideshare, employer outreach, and bicycle education and secure parking services to help reduce commute-related traffic congestion and VMT. The proposed Plan supports commute by walking.
Measure T-10: Increase Commuting by Bicycling by Achieving Approximately 17 Bicycle Lane Miles	The proposed Plan would continue to administer and monitor the iCommute program by providing regional rideshare, employer outreach, and bicycle education and secure parking services to help reduce commute-related traffic congestion and VMT. The proposed Plan supports bicycling commuting.
Measure T-11: Promote Alternative Work Schedule to Achieve Participation from 1% of Labor Force	The proposed Plan would continue to administer and monitor the iCommute program by providing regional rideshare, employer outreach, and bicycle education and secure parking services to help reduce commute-related traffic congestion and VMT. The proposed Plan supports alternative work schedules.
Measure E-1: Implement a Community Choice Aggregation Program, Subject to City Council Approval	The proposed Plan would not impede the creation or operation of a CCA. Although the proposed Plan does not directly call for investments in commercial photovoltaics or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure E-2: Achieve 108 MW Residential Rooftop Solar Photovoltaic Systems	The proposed Plan would not conflict with installation of renewable energy on residential buildings. Although the proposed Plan does not directly call for investments in residential photovoltaics, or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure E-3: Achieve 2 MW Commercial Rooftop Solar Photovoltaic Systems	The proposed Plan would not conflict with installation of renewable energy on commercial buildings. Although the proposed Plan does not directly call for investments in commercial photovoltaics, or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure E-4: Solar Hot Water Heating at 20% of Existing Commercial Spaces	The proposed Plan would not conflict with the local actions to promote the use of solar hot-water heaters. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure E-5: Solar Hot Water Heating at 25% of New Homes and Home Retrofits	The proposed Plan would not conflict with local actions to promote the use of solar hot-water heaters. Although the proposed Plan does not directly call for these investments or

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	other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure E-6: Reduction in Non-space/water Heating Residential Natural Gas use by 15%	The proposed Plan would not conflict with the local actions to reduce onsite natural gas usage. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure E-7: Residential Energy Efficiency Retrofits to Achieve 15% reduction	The proposed Plan would not conflict with the local actions to improve energy efficiency. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure E-8: Commercial Energy Efficiency Retrofits to Achieve 15% Reduction	The proposed Plan would not conflict with the local actions to improve energy efficiency. Although the proposed Plan does not directly call for these investments or other similar GHG reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure W-1: Divert 90% of Waste from Landfills and Capture 85% of Landfill Gas Emissions	The proposed Plan would not conflict with the implementation of strategies to meet 90% solid waste diversion or 85% landfill gas-capture goals. Although the proposed Plan does not directly call for investments in commercial photovoltaics or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure W-2: Implementation of Existing Water Rate and Billing Structure	The proposed Plan would not conflict with implementation of a new water rate and billing structure. Although the proposed Plan does not directly call for investments in commercial photovoltaics or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure W-3: Expand Recycled Water Program Expansion to Reduce Potable Water Consumption by 10%	The proposed Plan would not conflict with the expansion of a recycled water program. Although the proposed Plan does not directly call for investments in commercial photovoltaics or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the

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	proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure W-4: Capture 100% of Emissions from Wastewater Treatment	The proposed Plan would not conflict with the implementation of emissions capture at wastewater treatment plants. Although the proposed Plan does not directly call for investments in commercial photovoltaics or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure W-5: Water Conservation	The proposed Plan would not conflict with strategies to improve water conservation. Although the proposed Plan does not directly call for investments in commercial photovoltaics or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Measure U-1: Carbon Sequestration (Urban Tree Planting Program)	The proposed Plan encourages the planting of trees as a carbon sequestration and climate change adaptation policy.
City of Vista Climate Action Plan[18]	
Strategy 1: Increase Use of Zero-emission/Alternative Fuel Vehicles	The proposed Plan supports the use of zero-emission vehicles through expansion of zero and near-zero emissions infrastructure. Implementation Action 9 of SANDAG's EV program directs SANDAG to make long-term investments in zero and near-zero emissions infrastructure (see Appendix B of the proposed Plan).
Strategy 2: Reduce Vehicle Miles Traveled	A major objective of the proposed Plan is to decrease emissions of air pollution and GHGs through a combination of transportation improvement projects and land use planning strategies that will result in a decrease in VMT. The proposed Plan supports local efforts to reduce VMT and would not conflict with any measures or strategies that aim to achieve this goal.
Strategy 3: Reduce Fossil Fuel Use	A major objective of the proposed Plan is to decrease emissions of air pollution and GHGs through a combination of transportation improvement projects and land use planning strategies that will result in a decrease in the consumption of fossil fuels from the transportation sector. The proposed Plan supports local efforts to reduce fossil fuel consumption and would not conflict with any measures or strategies that aim to achieve this goal.
Strategy 4: Increase Building Energy Efficiency	The proposed Plan would not conflict with the local actions to improve energy efficiency. Although the proposed Plan does not directly call for these investments or other similar GHG

[18] The City of Vista last updated its CAP in 2019, and another update is currently underway. The 2019 CAP established targets of achieving a 4 percent reduction from 2012 emissions by 2020 and 42 percent by 2030. The CAP estimates that the GHG Reduction Strategies would achieve a 51,000 $MTCO_2e$ reduction by 2030.

Policy, Measure, or Action	Analysis
	reduction measures from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy 5: Increase Renewable and Zero-carbon Energy	The proposed Plan would not conflict with the generation or distribution of renewable energy. Although the proposed Plan does not directly call for investments in commercial photovoltaics or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy 6: Reduce and Recycle Solid Waste	The proposed Plan would not conflict with the implementation of strategies to reduce solid waste and increase recycling. Although the proposed Plan does not directly call for investments in commercial photovoltaics or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.
Strategy 7: Carbon Sequestration	The proposed Plan would not conflict with efforts to sequester carbon or conserve natural or working lands. The proposed Plan encourages the planting of trees as a carbon sequestration and climate change adaptation policy. Although the proposed Plan does not directly call for investments in commercial photovoltaics or other GHG reductions from the energy, solid waste, water and wastewater, offroad, or carbon sequestration sectors, the proposed Plan would not inhibit the local jurisdiction from implementing GHG reduction measures or actions for these sectors.

Notes:

AFVs	Alternative Fuel Vehicles	LCP	Local Coastal Program
CAP	Climate Action Plan	LED	Light-Emitted Diode
CCA	Community Choice Aggregation	PV	Photovoltaic
EVs	Electric Vehicles	$MTCO_2e$	Metric Tons of Carbon Dioxide Equivalent
GHG	Greenhouse Gas Emissions	VMT	Vehicle Miles Traveled

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Appendix K

Appendix B of the proposed Plan; Implementation Actions

Appendix B: Implementation Actions

This appendix provides detail on the commitments or key actions that implement the strategies described in the 2021 Regional Plan. While SANDAG can directly implement many of the projects and policies included in the 2021 Regional Plan, there are several strategies that require partnership with local jurisdictions or other agencies. The three core strategies described in Chapter 2 are:

- **Invest in a reimagined transportation system:** Build a network and fund services that include multimodal roadways; an expanded network of fast, frequent, and low-cost transit; 21st century technology that manages the entire transportation system and connects people to on-demand services; and zero-emission options for vehicles and micromobility.
- **Incentivize sustainable growth and development:** Collaborate with local jurisdictions and fund programs that accelerate housing production while also addressing the intertwined issues of equity, climate resilience, and mobility.
- **Implement innovative demand and system management:** Reduce solo driving and congestion through increased remote work, carsharing, vanpooling, value pricing and user fee strategies, and parking-management programs that leverage partnerships and technology.

This appendix includes additional information on the near-term actions SANDAG will take to implement the 2021 Regional Plan in the next four years as well as the long-term/ongoing actions that SANDAG intends to take to continue implementation of the 2021 Regional Plan beyond 2025 through 2050.

Priority Implementation Actions for the 2021 Regional Plan

The following are ten priority actions for implementing the 2021 Regional Plan. Table B.1 describes the near-term and continuing actions associated with each priority implementation action. Many of these actions are cross-cutting and contribute to implementation of the three core strategies of the 2021 Regional Plan.

1. **Apply the Social Equity Planning Framework** and ensure that equity is considered throughout 2021 Regional Plan implementation.
2. **Develop Comprehensive Multimodal Corridor Plans (CMCPs)** to refine 2021 Regional Plan projects at the corridor level and qualify the region for future funding opportunities.
3. **Update SANDAG policies** to reflect 2021 Regional Plan projects and priorities.
4. **Develop a Value Pricing and User Fee Implementation Strategy.**

5. **Seek new local funding** in addition to pursuing state and federal funding opportunities.
6. **Advance the Next Operating System (Next OS)** by preparing technical and planning studies and initiating pilot opportunities.
7. **Implement the Regional Transportation Improvement Program (RTIP)** and near-term projects.
8. **Partner with local jurisdictions, tribal governments, agencies in Mexico, the military, and other agencies** on collaborative efforts to implement the 2021 Regional Plan.
9. **Expand regional programs** on low-carbon transportation options, roadway safety and maintenance, and nature-based climate solutions.
10. **Advance a data science program** to better understand travel behavior and issues in the region, update travel demand modeling tools, and improve transparency and reporting on program effectiveness and project delivery.

Table B.1: Implementation Actions

Implementation Actions
Near-term and Continuing Actions
1. Apply the Social Equity Planning Framework and ensure that equity is considered throughout 2021 Regional Plan implementation
Near-term Actions: a) Develop criteria for project prioritization that advances equitable and safe transportation planning, spending, and implementation b) Partner with and provide funding for community-based organizations through the SANDAG Social Equity Working Group for the implementation of the 2021 Regional Plan c) Complete the following studies, plans, strategies: o Regionwide Displacement Study o Digital Equity Strategy and Digital Equity Action Plan o Adaptation Equity Guidance Document o Regional Equity Baseline Conditions Study **Continuing Actions:** d) Apply the social equity planning framework through Regional Plan implementation e) Evaluate and monitor implementation of social equity planning framework
2. Develop CMCPs to refine 2021 Regional Plan projects at the corridor level and qualify the region for future funding opportunities
Near-term Actions: a) Partner with Caltrans, agency partners, and local governments to develop five initial CMCPs: o Central Mobility Hub and Connections o Coast, Canyons, and Trails – State Route 52 o North County – SPRINTER/Palomar Airport Road/State Route 78/State Route 76 o San Vicente – State Route 67 o South Bay to Sorrento – Purple Line/Interstate 805/Blue Line/Interstate 5 South b) Study additional seven corridors to inform the next Regional Plan

Implementation Actions

Near-term and Continuing Actions

Continuing Actions:

c) Pursue funding opportunities for projects, programs, and services identified in completed CMCPs

3. Update SANDAG policies to reflect 2021 Regional Plan projects and priorities

Near-term Actions:

a) Update *TransNet* ordinance and associated Board policies to reflect projects and priorities included in the 2021 Regional Plan
b) Update evaluation and monitoring of projects using *TransNet* local streets and roads funds, including prioritization of safety for vulnerable road users in the development of complete streets
c) Develop Regional Active Transportation Plan, including update of the San Diego Regional Bike Plan
d) Develop Regional Vision Zero Action Plan, including Regional Safety Policy

4. Develop a Value Pricing and User Fee Implementation Strategy

Near-term Actions:

a) Complete the following studies, plans, strategies:
   - Value Pricing and User Fee Implementation Strategy, guided by an advisory working group
   - Regional Transit Fare Impact Study, including evaluation of fare subsidies for people with low incomes, students, and youth
   - Interstate 15 Operational Study
b) Pursue legislation or another mechanism to administer a regional road user charge
c) Partner with state agencies and other metropolitan planning organizations to design and implement a comprehensive road user charge pilot, assess equity impacts, and test mitigation strategies
d) Pursue a ballot measure or another mechanism to assess a fee on the fares charged for rides provided by ridehailing service companies that encourages ridesharing

5. Seek new local funding in addition to pursuing state and federal funding opportunities

Near-term Actions:

a) Secure additional local funding for 2021 Regional Plan investments through a ballot initiative
b) Assist in securing funding through California Senate Bill 1 (Beall, 2017), Federal Transit Administration Maintenance Programs, and additional future funding sources to help fund transportation rehabilitation projects

Implementation Actions

Near-term and Continuing Actions

Continuing Action:

c) Pursue funding opportunities that align with the goals of the 2021 Regional Plan

6. Advance the Next OS by preparing technical and planning studies and initiating pilot opportunities

Near-term Actions:

a) Establish a Mobility Transportation System Management and Operations (TSMO) Advisory Working Group to guide the implementation of Next OS, identify enabling operational and technological policies for data sharing, develop cross-agency procedural guidelines for multimodal operations, and provide a forum for mutual technology innovation research

b) Implement the Next OS Regional Border-Management System to support the delivery of Otay Mesa East Port of Entry and pilot project implementation of Smart Intersections, Curb Management, and Mobility Hub technology amenities

c) Develop and implement a Digital Equity Strategy and Action Plan that will close gaps in high-quality broadband access essential to the future of transportation and advancing equity in the region

d) Develop and begin implementation of the following studies, plans, and strategies:
- TSMO Plan
- Concept of Operations for Regional Smart Intersection and Curb Management Systems
- Chula Vista Mobility Hub Concept of Operations
- Concept of Operations for Mobility Data Clearinghouse
- Mobility Data Clearinghouse System Requirements
- Regional Intelligent Transportation Systems Architecture Update
- Harbor Drive 2.0 Concept of Operations
- 511 Traveler Information System Concept of Operations

Continuing Actions:

e) Partner with local jurisdictions to develop and maintain the TSMO Plan to advance the development of the Next OS future functionalities and coordinate with the private sector on joint opportunities for Next OS implementation

f) Continue to work with local jurisdictions to maintain common standards for data sharing and data accessibility while protecting security and privacy and examine overall maintenance and operations of Next OS system applications

Implementation Actions
Near-term and Continuing Actions
g) Continue to work with regional and local stakeholders to ensure that TSMO initiatives are considered as a core component of local and regional transportation plans, programs, and investment strategies to help advance the planning, development, and implementation of the Next OS

Implementation Actions

Near-term and Continuing Actions

7. Implement the RTIP and near-term projects

Near-term Actions:

a) Implement the 2021 Regional Transportation Improvement Program (RTIP) and build near-term projects: bike early action program, Los Angeles – San Diego – San Luis Obispo Rail Corridor projects, and State Route 11/Otay Mesa East Port of Entry
b) Pursue applications with the California Transportation Commission and/or pursue legislation to implement managed lanes by repurposing existing shoulders and general-purpose lanes in areas of the highway network with constrained right-of-way
c) Complete the following studies, plans, strategies:
   - San Ysidro Mobility Hub Study
   - Innovative Transit Priority Solutions Study
   - Next-Generation *Rapid* Routes Advanced Planning
   - Advanced planning for commuter rail and light rail improvements
   - Flexible Fleet Implementation Strategic Plan
   - Fix It First Implementation Assessment
   - San Diego and Imperial Counties Sustainable Freight Implementation Strategy

Continuing Actions:

d) Build projects with an emphasis on safety for all road users to implement Vision Zero
e) Continue to implement performance-based planning for federal performance measures relate to safety; infrastructure condition; and system performance, freight, and Congestion Mitigation and Air Quality

8. Partner with local jurisdictions, tribal governments, agencies in Mexico, the military, and other agencies on collaborative efforts to implement the 2021 Regional Plan

Near-term Actions:

a) Jointly procure Flexible Fleet technology vendors and partner with member agencies, transit agencies, and community-based organizations to design, launch, and operate Flexible Fleet pilots
b) Update evaluation criteria and provisions of SANDAG grant programs to:
   - Encourage planning and capital projects that allow for higher-density and mixed-use development within Mobility Hub areas and/or transit priority areas
   - Improve social equity

Implementation Actions

Near-term and Continuing Actions

- Incentivize development of parking- and curb-management plans and pilots
- Advance roadway design with an emphasis on safety for vulnerable road users
- Implement climate action plans
- Provide a process and structure for SANDAG design and review support for agencies regarding projects seeking grant funds to ensure new criteria and standards are met during the application process and project implementation

c) Launch a regional housing incentive grant program to fund local plan updates in Mobility Hub areas that can lead to more housing in transit-rich areas with infrastructure, services, and jobs

d) Provide design and review support for projects utilizing local streets and roads funds to ensure new criteria are met

e) Incentivize implementation of complete streets projects that complement regional investments within Mobility Hubs, along Complete Corridors, and supporting Flexible Fleets

- Formalize a Quick Build implementation program that includes guidance, resources, and partnerships with local jurisdictions to develop complete streets solutions
- Provide resources and funding to implement complete streets features and supporting technology, including secure micromobility parking, e-charging for micromobility and other Flexible Fleets, flexible curb-management solutions, support for e-commerce and urban delivery, and other mobility hub amenities

Continuing Actions:

f) Continue to coordinate with agencies in Imperial County, Riverside County, and Orange County on interregional planning efforts and collaborate with partner agencies in Mexico to improve border infrastructure

g) Continue to coordinate with the region's tribal nations on shared issues, including transportation infrastructure, energy, and conservation planning, forecasting, interoperability, and data collection

h) Utilize the intergovernmental review process to evaluate consistency of development projects with the Sustainable Communities Strategy

i) Update and expand the housing incentive program to fund activities that accelerate construction of housing

j) Continue to provide technical resources and guidance to local jurisdictions to:

- Integrate 2021 Regional Plan projects, policies, and programs into local Climate Action Plans (CAPs) and coordinate use of consistent data to align planning efforts
- Monitor greenhouse gas emissions and CAP implementation through Regional Climate Action Planning Framework (ReCAP) Snapshots, maintenance of the ReCAP Framework, and Climate Action Data Portal

k) Advance adoption of progressive curb and parking policies and strategies and Mobility Hub development

Implementation Actions

Near-term and Continuing Actions

9. Expand regional programs on low-carbon transportation options, roadway safety and maintenance, and nature-based climate solutions

Near-term Actions:

a) Complete the following studies, plans, strategies:
   - Electric Vehicle Charger Management Strategy
   - Medium/Heavy-Duty Zero-Emissions Vehicle Blueprint
   - Regional Carbon-Reduction Program Feasibility Study
   - Regional Resilience Framework
   - Regional Transportation Demand Management Ordinance Policy Analysis

b) Regional electric vehicle incentive program

c) A needs-based maintenance program that identifies and prioritizes infrastructure projects following best practices, cost-effectiveness, and those most essential to transit operations

d) Resilient Capital Grants and Innovative Solutions program

e) Nature-based climate solutions program that:
   - Expands upon the Environmental Mitigation Program to continue regional management and monitoring, restoration, and habitat conservation activities
   - Addresses regional stormwater needs
   - Offers carbon-sequestration benefits

f) Updated and expanded Regional Telework Assistance Program

g) Transportation demand management grant and incentive programs, including e-bike, carpool, and vanpool incentives

Continuing Actions:

h) Partner across agencies, sectors, and organizations to pilot projects that reduce or eliminate vulnerabilities to climate impacts

i) Continue to co-fund and promote the CALeVIP San Diego County incentive project to provide rebates for public, workplace, and multifamily electric vehicle charging stations

j) Continue to administer and monitor the iCommute program by providing regional rideshare, employer outreach, and bike education and secure parking services to reduce commute-related traffic congestion and vehicle miles traveled

Implementation Actions

Near-term and Continuing Actions

10. Advance a data science program to better understand travel behavior and issues in the region, update travel demand modeling tools, and improve transparency and reporting on program effectiveness and project delivery

Near-term Actions:

a) Utilize best available data and analytical tools to understand travel behavior and issues in the region
b) Update travel demand modeling tools
c) Improve transparency and reporting on SANDAG program effectiveness and project delivery
d) Prepare updated Regional Parking Inventory
e) Develop Regional Crash Data Collection, Verification, and Analysis Program

Continuing Actions:

f) Continue to monitor implementation of the Regional Plan on a four-year cycle and make data accessible through online tools
g) Continue to monitor implementation of the Sustainable Communities Strategy on a two-year cycle pursuant to California Assembly Bill 1730 (Gonzalez, 2019)

Policies, Planning and Programs

Eleven policy and program areas were identified for the 2021 Regional Plan. An overview of each policy and program area and detailed information on the implementation actions, program costs, and social equity considerations for each are included in this appendix.

1. Land Use and Regional Growth
2. Housing
3. Climate Action Planning
4. Climate Adaptation and Resilience
5. Electric Vehicles
6. Parking and Curb Management
7. Transportation Demand Management
8. Vision Zero
9. Fix It First
10. Transportation System Management and Operations
11. Value Pricing and User Fees

San Diego FORWARD

SANDAG

2021 Regional Plan
Programs and Policies

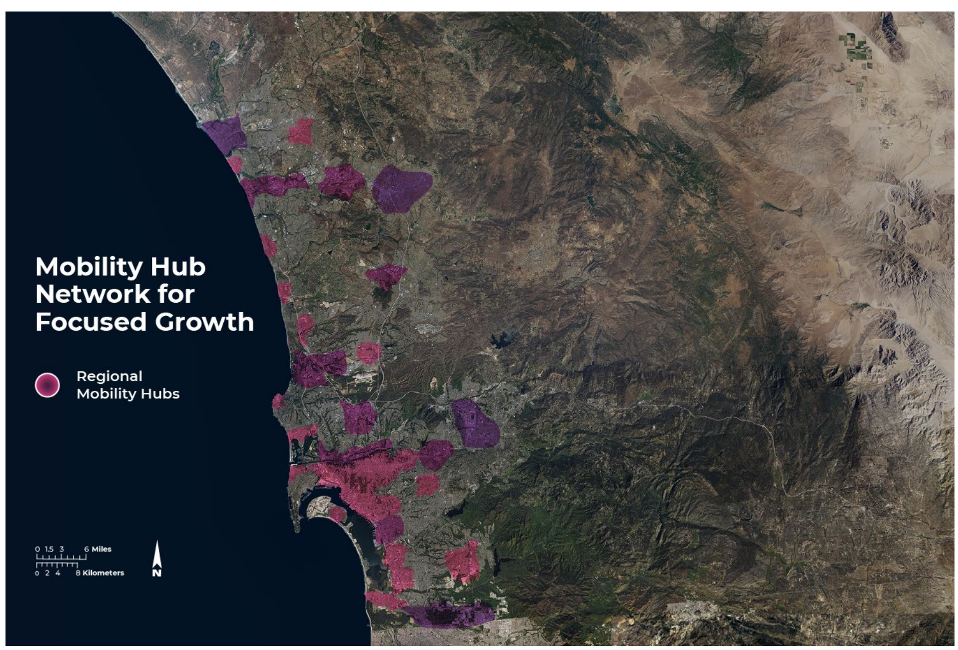
LAND USE AND REGIONAL GROWTH

One of the San Diego region's greatest assets is its wealth of open space, which is used for preservation and recreation alike. However, our region's population is growing, and with it, development and traffic are increasing. To address these changes while preserving San Diego's open space, the 2021 Regional Plan will place a special emphasis on connecting our land use to our transportation system through transit-orientated development. Aimed at reducing the number of miles driven by single-occupant cars and creating mixed-use communities, transit-oriented development offers housing, commercial, and recreational options to an area while reducing greenhouse gas emissions and sprawl.

Land use and development patterns are at the foundation of many issues our region faces around affordable housing options, greenhouse gas emissions, equity, and mobility throughout our communities.
The 2021 Regional Plan's Sustainable Communities Strategy brings land use development, transportation, policy, and programs together to achieve our region's goals of equitable, safe, and healthy communities for all.

The 5 Big Moves reimagine how we use land to accommodate population growth and address climate change and equity in the San Diego region. Mobility Hubs encourage a diversity of housing options, mixed-use development, and travel options within a centralized area. They connect people with their local communities and increase access to employment and educational opportunities throughout the region.

Mobility Hubs will be supported by Flexible Fleets and Complete Corridors to offer a well-connected network of transit and active transportation options, such as walking and biking. The map below demonstrates the proposed Mobility Hub network where future development will be focused, preserving the vast amount of open space and natural resources most valuable to the region.



What should I know about land use and regional growth?

Land use and regional growth policies outlined through the 2021 Regional Plan will build on the smart growth planning tools and projects that SANDAG and the region's cities and other local jurisdictions have put in place. These include the Smart Growth Concept Map and Smart Growth Toolbox, Designing for Smart Growth guidelines and scorecard, Smart Growth Incentive Program, and Transit-Oriented Development Strategy, among others.

Resources

TransNet Smart Growth Incentive Program and Active Transportation Grant Program
sandag.org/grants

Regional Transit Oriented Development Strategy
sandag.org/TOD

SANDAG Smart Growth Concept Map
sandag.org/smartgrowth

California Strategic Growth Council — Affordable Housing and Sustainable Communities Program
sgc.ca.gov/programs/ahsc

Land Use and Regional Growth

Implementation Actions

The 2021 Regional Plan vision for land use focuses on development and growth in Mobility Hub areas to preserve San Diego's open space and support transportation investments by reducing vehicle miles traveled (VMT). Mobility Hubs are the opportunity areas to provide housing to address the Regional Housing Needs Assessment. Because land use authority is reserved to local jurisdictions, SANDAG will leverage partnerships with cities and the County through the Smart Growth Incentive Program and other grants to provide funds for transportation-related improvements and planning efforts that support smart growth in Mobility Hubs to realize this vision. SANDAG will continue its existing grant programs, partner with member agencies on state funding opportunities, and provide data and technical support to assist local jurisdictions with land use planning efforts in line with the 2021 Regional Plan.

Near-Term Implementation Actions

As a first step to realizing the 2021 Regional Plan land use vision, SANDAG will update the requirements of existing *TransNet* grant programs to align with the 2021 Regional Plan and encourage planning and capital projects that allow for higher-density, mixed-use development within Mobility Hub areas and/or transit priority areas. SANDAG will utilize the intergovernmental review process to evaluate consistency of development projects with the Sustainable Communities Strategy.

Long-Term and Ongoing Implementation Actions

SANDAG will continuously support local land use planning efforts by providing data and technical resources as needed (reference Appendix F for data and information regarding the land use forecast). SANDAG will also support plans and land use decisions that are consistent with the Sustainable Communities Strategy through funding, letters of support, and assistance in taking advantage of available streamlining of the environmental review process (reference Appendix D for more information regarding the Sustainable Communities Strategy).

Partners

SANDAG has strengthened relationships with local jurisdictions, community-based organizations, and tribal nations throughout the region. SANDAG will seek to significantly expand partnership to include nonprofit organizations, developers, and other stakeholders. SANDAG will continue to work with its partners to provide data, information, and recommendations that lead to informed land-use planning decisions in line with the 2021 Regional Plan.

Program Costs

Land Use Program Costs (in millions)				
Program	**2025**	**2035**	**2050**	**Total**
Planning and Capital Mobility Hub/ Smart Growth/VMT-Reduction Grants	$75	$262	$500	$837
Member Agency Resources to enhance development review/ processes/policies	$25	$100	$208	$333
			Grand Total	**$1,170**

Social Equity Considerations

Land use is the foundation in determining what is built where and how transportation systems connect work, home, and recreation. Ensuring equitable development starts with considering equity in land use decisions and patterns. By coordinating equity, land use, and transportation, we can better understand where historically marginalized communities are located and how to better connect them with opportunities throughout the region. SANDAG will consider how land use programs, projects, and policies it supports address social equity in relation to regional access to affordable housing, proximity to jobs and transit, opportunities for residents to live where they work and play, convenient access to multimodal transportation options, and other opportunities for work, commerce, and recreation.

San Diego FORWARD

SANDAG

2021 Regional Plan
Programs and Policies

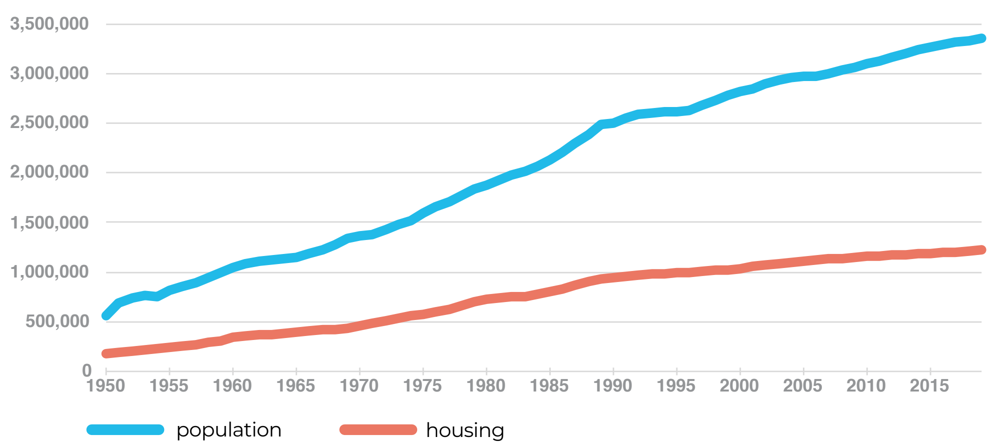
HOUSING

The State of California faces a persistent housing crisis, and San Diego County is no exception. More than 70% of San Diegans say housing affordability is a big problem across the region, especially for low-income families and younger residents.

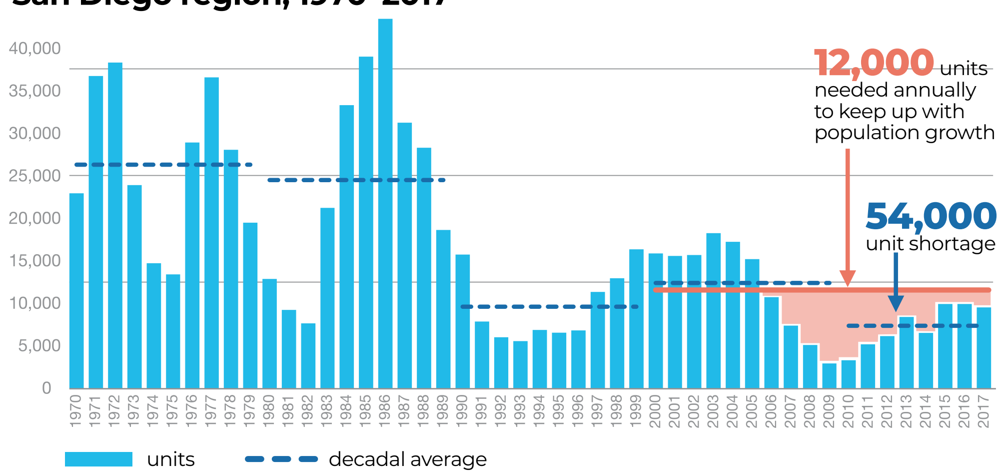
Addressing housing availability and affordability requires action at the local, regional, and state levels. For example, cities in the San Diego region have taken steps to increase affordable housing by making the development process faster and easier. The State of California offers grants to accelerate the production of housing and approves legislation that allows for more types of homes, like accessory dwelling units (see below), to be built statewide. Regionally, government agencies are considering how to better align housing policies with transportation initiatives because both contribute substantially to the region's cost of living.

Through implementation of the 5 Big Moves, the transportation system envisioned for the 2021 Regional Plan will bring more mobility options to where people live. The 2021 Regional Plan will also include policies to encourage new housing in Mobility Hubs, which are places of connectivity where a variety of transit and Flexible Fleet options come together.

San Diego region's growth in population and homes, 1950–2019



Number of new building permits issued in the San Diego region, 1970–2017



SDForward.com

#SDForward #5BigMoves

What are some strategies to increase housing availability and affordability?

Minimum zoning near transit: Zoning requirements dictate the types of structures that can be built on a parcel of land and establish development standards such as height limit, unit size, and density. Cities and counties can establish minimum zoning requirements near high-quality transit services that result in an increase in housing near transit. This locates residents near non-car transportation options, which can help reduce the number of miles that San Diegans drive. To encourage more transit use, cities and counties can also waive or lower parking requirements for housing near transit.

Permit process streamlining: Clear guidelines and permit processes for housing developers can reduce the cost and time it takes to build housing. Cities and counties can streamline the process by providing faster review for affordable housing, development that is consistent with the zoning code, and development that meets the design standards for the area.

Fee-waiver program: Cities and counties charge developers fees to cover the cost of providing water, sewer, street maintenance, and other services associated with new housing. Cities and counties can establish a program to waive some or all of these fees if developers build additional affordable units in their housing projects.

Accessory Dwelling Units (ADUs): ADUs—also known as granny flats, in-law units, or backyard cottages—are housing units on the property of a primary house. California Assembly Bill 881 (Bloom) and California Assembly Bill 671 (Friedman), both passed in 2019, require cities and counties to adopt an ADU policy that makes it easier for families to build these units.

Leveraging public land for affordable housing: Surplus and underused land owned by the federal, state, and local governments (as well as other public agencies, such as transit operators) can be leveraged to support affordable housing development. Government agencies can allow residential units to be built on surplus land or use the revenue from selling surplus land to fund affordable housing elsewhere. California Assembly Bill 1255 (Rivas) and California Senate Bill 6 (Beall), both passed in 2019, require state and local government entities to publish an inventory of surplus land in local and statewide databases. Local governments can adopt policies that make it a priority to use these lands for affordable housing.

What should I know about regional housing needs?

The Regional Housing Needs Assessment (RHNA) is mandated by state law. The RHNA process identifies how much housing the region needs—currently and in the future—to meet projected increases in population and the size of individual households. SANDAG is overseeing the sixth RHNA cycle. On November 22, 2019, the SANDAG Board of Directors approved the final methodology for allocating housing units to each city and county in the region based on the transit and jobs in each jurisdiction. Jurisdictions have until April 2021 to update their general plans to show how and where their city can accommodate the housing units allocated through the RHNA process.

Resources

Affordable Housing Regulations and Expedite Program
sandiego.gov/development-services/news-programs/ahrep

Accessory Dwelling Units
hcd.ca.gov/policy-research/AccessoryDwellingUnits.shtml

Regional Housing Needs Assessment 6th Cycle
sandag.org/RHNA

Local Early Action Planning (LEAP) Grants
hcd.ca.gov/grants-funding/active-funding/leap.shtml

Senate Bill 2 Planning Grants
hcd.ca.gov/grants-funding/active-funding/planning-grants.shtml

San Diego Housing Commission
sdhc.org

San Diego Housing Federation
housingsandiego.org

Housing

Implementation Actions

California is experiencing a housing crisis, with housing demand far outstripping supply. The 2021 Regional Plan addresses the housing crisis through Mobility Hubs, bringing locations where people live and work closer together and providing more housing options for more San Diegans through increased density. SANDAG will rely on building stronger partnerships with local jurisdictions to increase housing in the region, especially housing available to low-income residents. Through grant programs and technical support, SANDAG will serve as a funding partner and resource to assist local jurisdictions in reaching the region's housing production goals.

Near-Term Implementation Actions

As a first step to increase housing production, SANDAG has hired a consultant team to help develop a regional housing incentive grant program to fund local plan updates in Mobility Hubs that can lead to more housing in transit-rich areas with infrastructure, services, and jobs. Development of the regional housing incentive grant program is underway and anticipated to be available to local jurisdictions in early 2022.

Long-Term and Ongoing Implementation Actions

SANDAG will continuously work with local jurisdictions and stakeholders to update and expand the housing incentive program to fund other activities that can accelerate the construction of housing. SANDAG will coordinate with member agencies to implement strategies to support housing availability and affordability throughout the region.

Partners

SANDAG has strengthened relationships with local jurisdictions and community-based organizations throughout the region. SANDAG will seek to significantly expand partnership to include housing advocacy groups and affordable and market-rate housing developers. Together, we can work to ensure the development of housing, especially affordable housing, in the San Diego region.

Program Costs

Housing Program Costs (in millions)				
Program	**2025**	**2035**	**2050**	**Total**
Affordable Housing Grant Program	$730	$1,400	$500	$2,630
			Grand Total	**$2,630**

Social Equity Considerations

SANDAG will increase equity in the region by furthering fair housing in resource-rich areas to provide low-income residents with greater access to jobs, educational opportunities, and other resources. SANDAG will also ensure its housing efforts do not lead to the displacement of current low-income residents in communities where housing growth occurs.

San Diego FORWARD

SANDAG

2021 Regional Plan
Programs and Policies

CLIMATE ACTION PLANNING

A climate action plan (CAP) is a comprehensive policy document that outlines the actions a local jurisdiction is taking or will take to reduce community-wide greenhouse gas (GHG) emissions. By offering technical assistance to local cities, SANDAG has been instrumental in advancing climate action planning in San Diego County. Nearly all of the region's 19 local governments have adopted or are currently developing a CAP.

Transportation is the largest source of GHG emissions in the state of California, accounting for 41% of emissions statewide in 2017. Reducing transportation emissions requires state, regional, and local actions. The 5 Big Moves are the initiatives that SANDAG is pursuing to create a more efficient and low-emission transportation system. This bold new vision for the region's transportation system will help cities and other public agencies achieve their CAP goals.

How can we reduce GHG emissions and achieve carbon neutrality?

The California legislature has set aggressive targets to reduce GHG emissions, and Executive Order B-55-18 set an overall goal of achieving "carbon neutrality" by 2045. Carbon neutrality occurs when the GHG emissions emitted into the atmosphere statewide are completely offset by an equivalent amount of carbon dioxide (CO_2) that is removed from the atmosphere. Removal can occur when forests, other natural landscapes, and agricultural crops take up carbon dioxide as they grow. California, SANDAG, individual cities, and other local jurisdictions all have roles to play in implementing the strategies needed to achieve these goals.

What should I know about climate action planning?

Climate action planning includes efforts to both reduce GHG emissions and prepare communities for the impacts of climate change. CAPs typically focus on reducing GHG emissions. Climate adaptation planning is equally important and includes strategies to prepare for sea level rise, extreme heat, prolonged drought, and more destructive wildfires. Since 2010, SANDAG has provided resources to advance climate action planning in the region.

2010

SANDAG launches Roadmap Program with no-cost energy-management assistance for member agencies

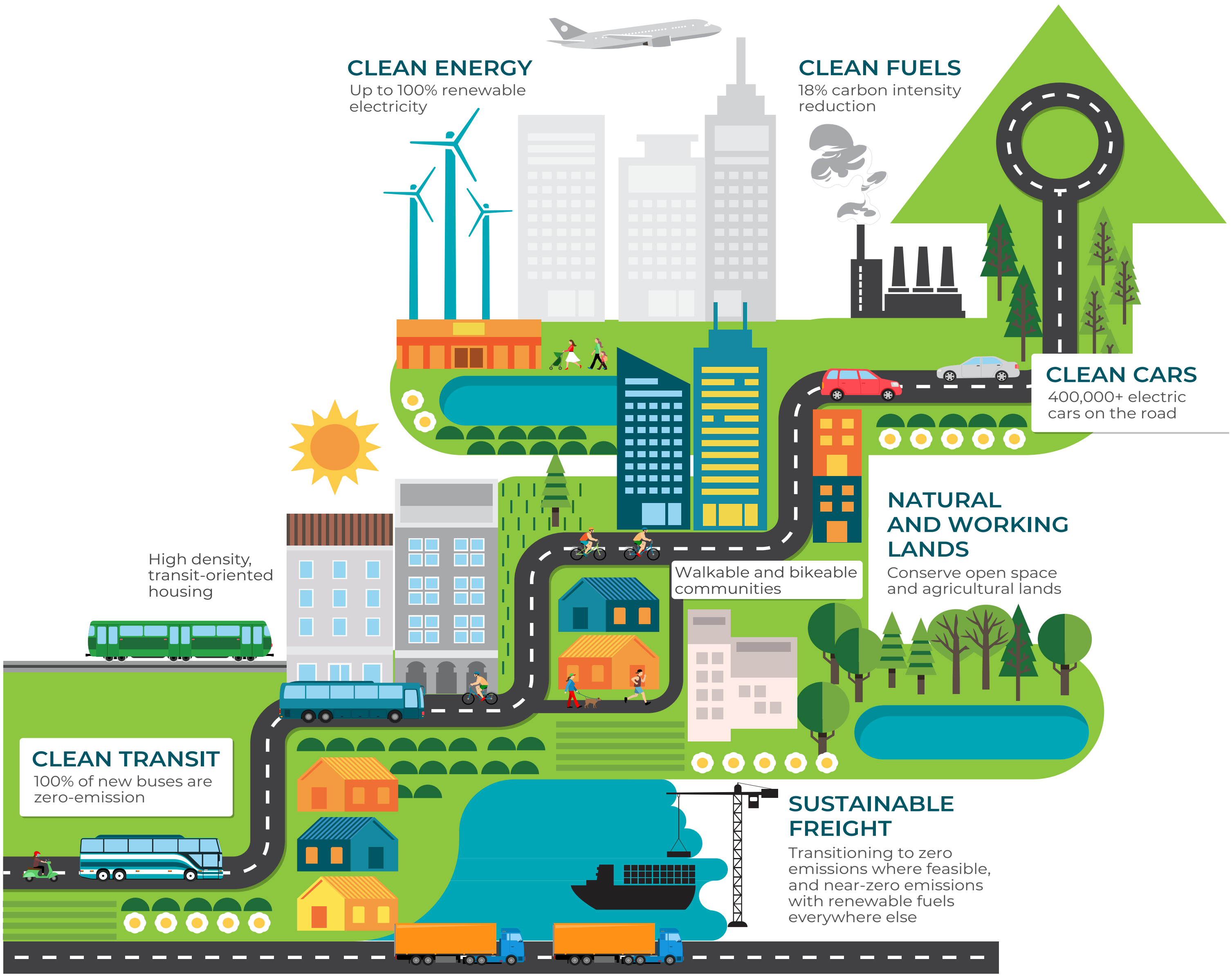
2016

Roadmap Program expands with support for CAP development, monitoring, and implementation

2020+

SANDAG will refine the program to support CAP monitoring and implementation of regional GHG-reduction and climate adaptation programs

2035 State Goals for the San Diego Region



Resources

Regional Climate Action Planning (ReCAP) Framework
sandag.org/climate

California Air Resources Board Scoping Plan
arb.ca.gov/cc/scopingplan/scopingplan.htm

Climate Action Planning

Implementation Actions

To help reach regional and state greenhouse gas (GHG) emissions–reduction targets, the 2021 Regional Plan focuses heavily on the conversion to clean transportation and a shift from personal vehicle dependency through the 5 Big Moves. To help local jurisdictions make this transition and achieve broader reductions in GHG emissions, SANDAG will provide technical assistance, guidance resources, templates, and grant funding to incorporate the 5 Big Moves and Sustainable Communities Strategy actions into their climate action plans (CAP) and plan for more well-connected, sustainable, healthy communities that are accessible to all.

Near-Term Implementation Actions

SANDAG will support local and regional efforts to implement and monitor CAPs by providing grant funding, guidance resources, and templates for CAP implementation. To enhance CAP monitoring, SANDAG will prepare Regional Climate Action Planning Framework (ReCAP) Snapshots to monitor GHG emissions and CAP implementation.

SANDAG will study potential program design options for the development, management, and maintenance of a Regional Carbon Reduction Program.

Long-Term and Ongoing Implementation Actions

SANDAG will continue to maintain the ReCAP Framework and Climate Action Data Portal providing consistent and reliable data and offer technical assistance to local jurisdictions as needed to assist with CAP implementation.

SANDAG will, if the Regional Carbon Reduction Program design study identifies a feasible option, continue to work with partners to manage and implement a regionally relevant Program.

Partners

SANDAG has strengthened relationships with our member agencies and advisory representatives, other public agencies, and utility providers throughout the region. Together, we can work to prepare, update, implement, and monitor climate action planning efforts. SANDAG will further expand and enhance its partnerships to include environmental stewards and land managers.

Program Costs

Climate Action Planning Program Costs (in millions)				
Program	**2025**	**2035**	**2050**	**Total**
CAP Monitoring Program	$4	$20	$12	$37
CAP Implementation Grants	$20	$100	$150	$270
Regional Carbon Reduction Program Management	$6	$150	$150	$306
			Grand Total	**$612**

Social Equity Considerations

SANDAG recognizes that all residents, regardless of age, race, or income, deserve to live in safe and healthy communities and that climate impacts disproportionately affect low-income populations and populations of color. SANDAG will consider climate impacts and the equitable distribution of funding and program assistance for all communities across the region.

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2021 Regional Plan
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CLIMATE ADAPTATION AND RESILIENCE

Despite efforts to reduce greenhouse gas emissions, the consequences of global climate change continue to affect people around the world, public health, national and local economies, and the planet's natural environment. Communities and people across our region will have to adjust how they respond to the impacts of climate change today and become more resilient as they face future impacts.

Adaptation is the way communities and people change how they respond to the impacts of climate change. Becoming more resilient means that the communities, local and regional economies, and natural resources and recreational spaces that make our region special can endure, recover, and thrive in response to impacts of ongoing climate change. Anticipated impacts for the San Diego region include hotter and more frequent heat waves, prolonged droughts, more destructive wildfires and degraded air quality, more extreme precipitation and flooding, and rising sea levels and destructive storm surges. To advance the region's climate adaptation and resilience efforts, SANDAG works with partners to advance regional projects, offers resources to member agencies, and analyzes vulnerabilities of the transportation system, including which areas are prone to flooding and what we need to keep critical infrastructure available during an emergency.

The transportation system envisioned through the 5 Big Moves will incorporate strategies (summarized below) to improve regional resilience and better adapt to climate change impacts. For example, the transportation system must consider travel patterns and rapid mobility for evacuations and emergency response. Also, coastal infrastructure must be designed to withstand rising seas and storm surge.

How will ongoing climate change impact the San Diego region?

TEMPERATURE	WATER	SEA-LEVEL RISE	WILDFIRES	HABITAT
Increase of 5–10˚F in annual average temperature by 2100; increased frequency, intensity, and duration of heat waves	Supplies of water will be highly variable, with wetter winters, drier springs, and more frequent and severe droughts that end with periods of intense rainfall	2.5 feet by 2050 and 6.6 feet by 2100	Longer and less predictable fire seasons, larger and more catastrophic fires, and a higher number of poor air quality days as a result	All of these will threaten the health of coastlines and beaches, wetlands, and plants and animals

How can the region become more resilient to the impacts of climate change?

- Consider climate change in all functions of government and across public and private sectors.
- Partner with vulnerable populations to increase equity and resilience through investments, planning, research, and education.
- Support continued climate research and data tools.
- Identify significant and sustainable funding sources to reduce climate risks, minimize harm to people, and increase spending for disaster relief.
- Maximize the use of natural lands, such as wetlands at the coast and agricultural and conservation lands, to help absorb the impacts of climate change. Wetlands can be natural buffers against rising seas and destructive storm surges. Agricultural and conservation lands, often in more rural communities, can serve as natural fire breaks against increased wildfires. Protected natural lands can also help absorb greenhouse gas emissions while providing many other societal benefits.
- Promote collaboration among federal, local, tribal, and regional government partners and across sectors to help communities better adapt to the impacts of climate change.
- Assess the vulnerability of critical infrastructure to the impacts of climate change.

What should I know about environmental planning work in San Diego?

Past and current environmental planning work at SANDAG has contributed to the region's climate resilience. Since the 1990s, SANDAG has helped coordinate adaptation efforts to preserve shorelines in the region, including two regional beach sand replenishment projects in 2001 and 2012. The San Diego region has about 1.3 million acres of conserved land, and about 8,700 acres of that land has been preserved, with a co-benefit of absorbing greenhouse gas emissions, through the SANDAG Environmental Mitigation Program.

Climate impacts facing California

- Acceleration of warming across the state
- More intense and frequent heat waves
- More intense and frequent droughts
- More severe and frequent wildfires
- More severe storms and extreme weather
- Shrinking snowpack and less precipitation
- Accelerating sea level rise
- Greater riverine flow
- Ocean acidification, hypoxia, and warming

Resources

Fourth Climate Change Assessment, San Diego Region Report
climateassessment.ca.gov/regions/

Safeguarding California Plan: 2018 Update
resources.ca.gov/CNRALegacyFiles/docs/climate/safeguarding/update2018/safeguarding-california-plan-2018-update.pdf

SANDAG Climate Resilience Program
sandag.org/climateresilience

SANDAG Shoreline Management Program
sandag.org/shoreline

Climate Adaptation and Resilience

Implementation Actions

The San Diego region is anticipated to feel the effects of climate change through hotter and more frequent heat waves, prolonged droughts, increased wildfires, rising sea levels, and destructive storm surges. The 2021 Regional Plan aims to better prepare San Diego communities and habitats for these climate change impacts by considering evacuation and rapid mobility needs in our transit corridors, evaluating and considering climate vulnerabilities to the region's transportation infrastructure, and utilizing natural lands and conservation to absorb and protect against climate change impacts. SANDAG will establish a coordinated effort across agencies and local jurisdictions for a more holistic, comprehensive, equitable, sustainable, and resilient region.

Near-Term Implementation Actions

SANDAG will establish a regional vision and coordination to enhance and sustain our existing planning and implementation obligations across agencies, sectors, and organizations through the development of a Regional Resilience Framework (a component of the Climate Adaptation and Resilience Program) and seek Board action elevating the SANDAG commitment to regional resilience.

A recently completed project, the Regional Transportation Infrastructure Sea Level Rise Assessment and Adaptation Guidance, is being leveraged to help inform the Office of Local Defense Community Cooperation Military Resilience Grant currently underway. The Regional Adaptation Needs Assessment, completed in 2020, is being used as the foundation for holistic implementation of adaptation and transportation resilience strategies, studies identifying measures that both mitigate and adapt to climate change, and a decision-making toolkit to help inform local government action integrating economic and equity considerations.

In addition, SANDAG will establish a Nature-Based Climate Solutions Program that will promote natural infrastructure that uses or mimics natural processes to benefit people and wildlife. This will be achieved by: (1) conserving and restoring native habitats, which promotes regional biodiversity, provides carbon sequestration, and improves water quality; (2) use of "soft solutions" for new infrastructure to reduce vulnerability to the impacts of climate change for regional habitats and nature-based engineered systems; and (3) projects that promote the reduction of greenhouse gases through the sequestration of carbon and provide ecosystem functions and values.

Long-Term and Ongoing Implementation Actions

SANDAG will prioritize resilience and innovative solutions in transportation infrastructure, Comprehensive Multimodal Corridor Plans, and consistent regional planning and implementation of the Sustainable Communities Strategy actions, emphasizing nature-based and technological climate solutions. SANDAG will promote climate resilience projects through the Resilient Capital Grants and Innovative Solutions program, prioritizing communities most vulnerable to climate change.

SANDAG will pilot projects that reduce or eliminate vulnerabilities to climate impacts at the intersection of equity, technology, planning, design, construction, education, and collaboration for innovative solutions to regional resilience.

Partners

SANDAG has strengthened relationships with local, state, and federal agencies, tribal nations, community-based organizations, and utility providers to identify regional climate vulnerabilities, impacts, and opportunities to collaboratively plan for, respond and adapt to, and recover from now and into the future. SANDAG will seek to significantly expand partnerships to include land managers, emergency services, and clean technology and innovations partners to more comprehensively, efficiently, and effectively increase the region's capacity to grow from climate-related disruptions. Together, we can work to make the transportation system, critical assets, resources, and communities in our region safe and resilient to the impacts of climate change.

Program Costs

Climate Adaptation and Resilience Program Costs (in millions)

Program	2025	2035	2050	Total
Climate Adaptation and Resilience Program	$8	$75	$75	$158
Nature-Based Climate Solutions Program	$40	$325	$200	$565
Resilient Capital Grants and Innovative Solutions	$20	$215	$100	$335
			Grand Total	**$1058**

Social Equity Considerations

SANDAG recognizes that climate change affects everyone, with low-income and communities of color disproportionately feeling those effects. Regional resilience is only possible if all communities and populations are prepared. The 2021 Regional Plan seeks to equitably prioritize climate resilience projects and increase public awareness of climate change across San Diego County.

San Diego FORWARD

SANDAG

2021 Regional Plan
Programs and Policies

ELECTRIC VEHICLES

Electric Vehicles (EVs) use clean sources of power such as electricity and hydrogen. Unlike vehicles that use internal combustion engines to burn fossil fuels EVs do not produce harmful exhaust gases such as CO_2 and ozone. EV technologies are becoming more popular and affordable, and new EVs are appearing on the roads all the time. EVs include battery electric vehicles and hydrogen fuel cell vehicles, and they come in the form of passenger vehicles, light- and medium-duty vehicles (e.g., pickup trucks and delivery vehicles), and heavy-duty vehicles (e.g., semi-trucks and buses).

This wide range of EVs allows them to play a role in each of the 5 Big Moves. For example, Mobility Hubs and Complete Corridors will integrate EV charging and hydrogen stations into community activity centers and along key corridors. Transit Leap and Flexible Fleets services can adopt EVs for transit, passenger, and goods movement vehicles. The Next OS can help manage charging infrastructure, providing people with different payment options and monitoring activity.

Market forces

45,000
Plug-in EVs
in the San Diego region as of July 2019

61%
increase in EV sales
in CA from 2017–2019

48
EV models available
and more arriving each year

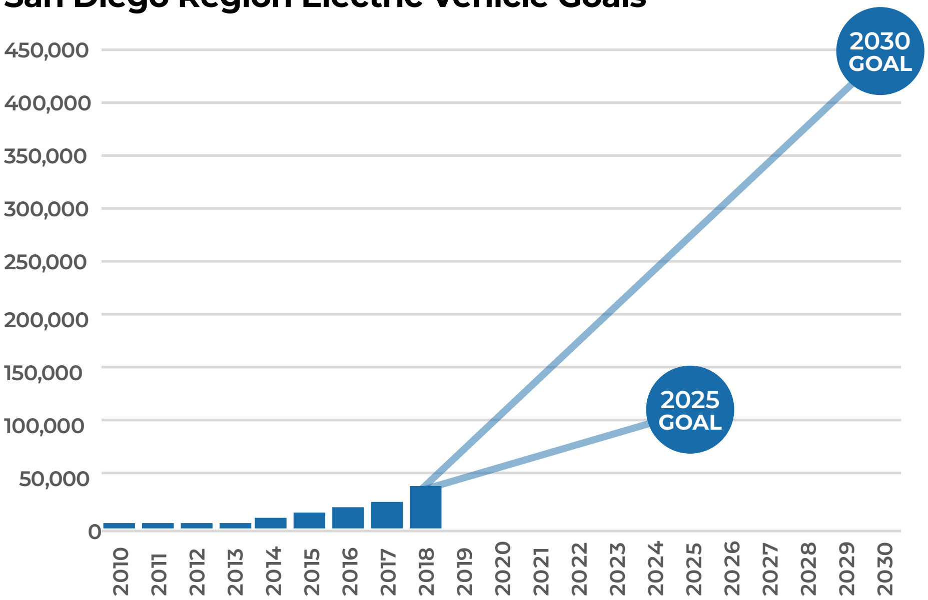
What EV goals have the state and the region made?

With 1.5 million EVs projected to be on California roads by 2025 and 5 million by 2030, SANDAG is planning for about 450,000 EVs in our region by 2030. Meeting vehicle and charger goals requires a quick adoption of EVs and a rapid installation of charging infrastructure.

What should I know about EVs?

SANDAG has been planning for EVs for more than a decade. Industry, government, the local utility, individuals, and businesses are all making investments in EVs and EV infrastructure. SANDAG, the County of San Diego, SDG&E, and other regional entities are working together to make the San Diego region the national leader in electric vehicle adoption and clean transportation. As a sign of progress, transit operators are now piloting electric and hydrogen zero emission buses.

San Diego Region Electric Vehicle Goals



Resources

EV Infobit
sandag.org/uploads/publicationid/publicationid_2027_20605.pdf

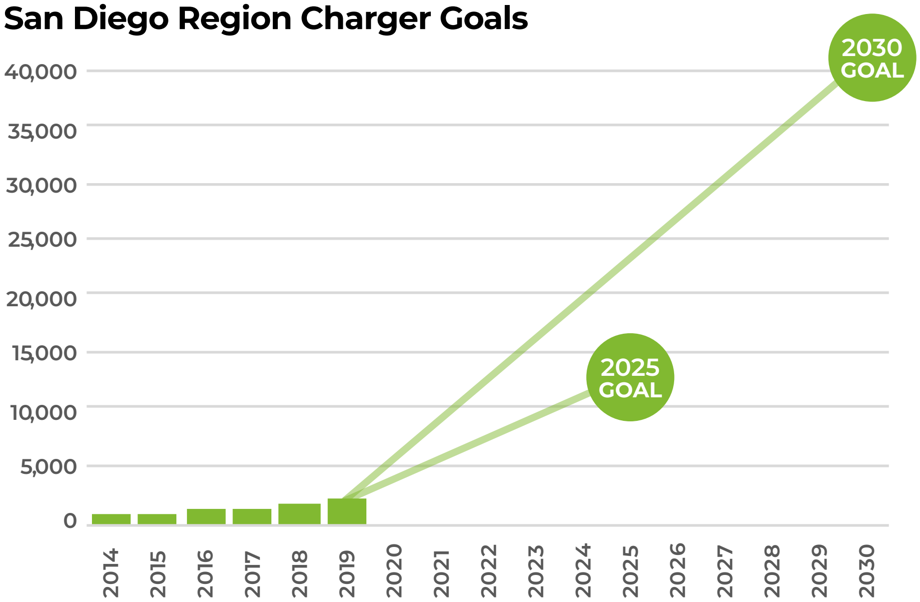
SANDAG Plug-in SD Program
sandag.org/pluginsd

MTS Zero Emissions Bus Pilot Program
sdmts.com/inside-mts-current-projects/zero-emissions-bus-pilot-program

CALeVIP
calevip.org

SDG&E Electrification Projects
sdge.com/electrification-projects

San Diego Region Charger Goals



Electric Vehicles

Implementation Actions

The electrification of cars, trucks, and buses is a key initiative in the 5 Big Moves and the 2021 Regional Plan. Electrification is included in the 2021 Regional Plan as a way to reach regional greenhouse gas (GHG) emission–reduction targets. Electric vehicles (EVs) are zero-emission vehicles that include plug-in battery EVs and hydrogen fuel cell EVs. SANDAG aims to incentivize and encourage the incorporation of all types of EVs into Flexible Fleets, Transit Leap, and goods movement and to support funding programs that increase the number of EVs and charging stations throughout the region and within Mobility Hubs and as part of the Complete Corridor strategy.

Near-Term Implementation Actions

SANDAG will continue to co-fund and promote the CALeVIP San Diego County incentive project to provide rebates for public, workplace, and multifamily EV charging stations. SANDAG will design and fund an EV incentive program for local residents.

SANDAG will also support the inclusion of EV policies in local climate action plans (CAPs) and develop an EV charger management strategy to streamline and increase charging at public agency parking lots. SANDAG, through the Accelerate to Zero Emissions Collaboration with regional partners, will establish a vision and strategy for transportation electrification of passenger vehicles, transit, and goods movement.

Long-Term and Ongoing Implementation Actions

SANDAG will integrate transportation electrification into Comprehensive Multimodal Corridor Plans, Mobility Hubs and Flexible Fleets (including micromobility). SANDAG will continue to coordinate with state and regional stakeholders to identify policies and funding opportunities for hydrogen fueling stations, charging infrastructure, and EV incentive programs. SANDAG will explore feasibility studies and pilots to showcase proof of concept for next-generation EV technologies such as wireless in-road charging. SANDAG will also continuously offer expert technical support to local jurisdictions and workforce development needs to accelerate the adoption of EV infrastructure.

Partners

SANDAG has a long history of working with our local and state partners, including the County Air Pollution Control District, San Diego Gas & Electric, Caltrans, and the Center for Sustainable Energy to develop regional EV plans and projects. SANDAG will also work with community-based organizations (CBOs), local governments, and other stakeholders to conduct outreach and education efforts. We plan to continue these partnerships to make the transportation system in our region equitable, accessible, and better for the environment.

Program Costs

The program costs summarized below would incentivize an estimated 110,000 zero-emission vehicles by 2035, approximately 33,000 Level 2 chargers by 2035, and an additional 29,000 Level 2 chargers by 2050. Incentives for zero-emission vehicles do not extend beyond 2035 since the state is planning for all new vehicles sold in California to be zero emission beginning in 2035. Additional details on how these programs contribute to the region's California Senate Bill 375 (Steinberg, 2008) GHG-reduction target are included in Appendix S. In addition to the program costs below, EV considerations are integrated into other costs of the 2021 Regional Plan, including investments in EV charging at Mobility Hubs, incentives for e-bikes, and implementation of zero-emission Flexible Fleets.

Electric Vehicle Program Costs (in millions)

Program	2025	2035	2050	Total
Incentives for Zero-Emission Vehicles	\$52	\$552	—	\$604
EV Charging Stations	\$45	\$134	\$91	\$270
Hydrogen Fueling Stations	—	\$100	\$150	\$250
Zero Emission Buses and Infrastructure	\$75	\$250	\$332	\$657
Goods Movement Vehicles/ Infrastructure	\$25	\$100	\$104	\$229
			Grand Total	**\$2,010**

Social Equity Considerations

Regionwide adoption of EVs requires affordable and convenient access to zero-emission options for all residents and businesses. The charger incentive program currently offers higher incentives for projects in disadvantaged communities and reserves a minimum of 25% of rebate funds for these installations. Future program updates will explore increases to this budget allocation. Greater technical assistance services are offered for applicants in communities of concern. The proposed vehicle incentive program seeks to prioritize rebate funds for low- and moderate-income households and explore incentivizing used vehicles. SANDAG will engage with CBOs in the design of its incentive programs and consider equitable distribution of funds and resources to communities across the region when considering EV infrastructure projects.

The new regional EV strategy that will be developed through the Accelerate to Zero Emissions Collaboration with regional partners will include engagement with CBOs and address social equity considerations in its purpose, policies, and recommendations. The Collaboration's steering committee also includes representatives from two equity-focused organizations. SANDAG is also committed to coordinating with regional stakeholders to accelerate the transition to zero-emission buses and trucks to meet state climate and environmental goals. As SANDAG develops clean transportation pilot projects, benefits accrued to disadvantaged communities will be a factor in determining pilot locations.

2021 Regional Plan
Programs and Policies

PARKING MANAGEMENT

Parking management aims to make the right amount of parking available when it is needed and price it so that alternative commutes are encouraged; construction costs are lowered; affordable housing is developed; and accessibility, equity, and economic development are promoted.

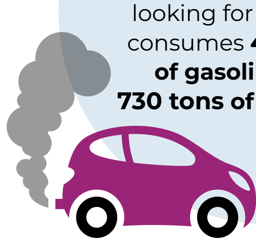
Abundant free parking encourages people to drive alone, and high-traffic areas can become more congested as drivers search for parking.

Existing parking policies often result in parking spaces that are underused and expensive to build.

The expense of building parking in many neighborhoods is absorbed by the people who live or do business there—even if they do not have a car, the cost is passed on to them through rent and the price of goods they purchase. The result is that free parking increases the overall cost of living.

As the region implements the 5 Big Moves, parking policies should evolve so we can use land more efficiently and encourage people to consider switching from driving alone to walking, biking, taking transit, carpooling, and using shared mobility. Parking policies should also adapt to the anticipated decline in parking demand as initiatives such as Transit Leap and Flexible Fleets make alternatives to driving alone more attractive.

A study in Los Angeles revealed that within one 15-block area, cars travel about **950,000 miles** annually looking for parking, which consumes **47,000 gallons of gasoline** and emits **730 tons of carbon dioxide**.

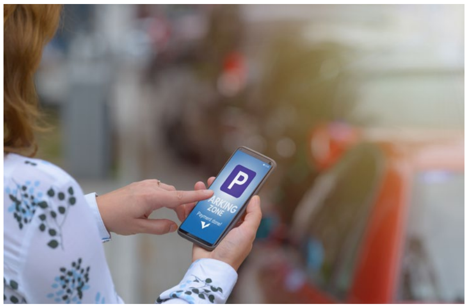


Building one parking space per housing unit increases total project costs by about **12.5%**. Building two parking spaces per housing unit can increase total project costs up to **25%**.

How would it work?

Reduced parking requirements: Many cities require new developments to include a minimum number of parking spaces per housing unit or per square footage of commercial space built. However, if parking requirements were reduced or eliminated, developers would have greater flexibility to consider transit availability, walkability, cost, and other factors in their parking design. Additionally, having fewer parking spaces near transit may reduce demand for driving or owning a personal vehicle.

Unbundled parking and parking cash-out: The expense of building parking is usually passed on to renters or included in the purchase price of a home whether or not residents own a car. "Unbundled parking" refers to renting or selling parking spaces separately, a practice that promotes choice and equity. Parking spaces can also be leased temporarily at workplaces, allowing employees to either pay for parking or receive a cash reimbursement if they commute to work in another way.



Parking pricing: Charging for parking spaces encourages turnover, which may help boost economic activity. Parking revenues can help recover the cost of building parking infrastructure, fund other local improvements, and provide enhanced mobility options.

Real-time parking information: The Next OS will make it possible for signs and apps to display parking information in real time, making it easier to find a space.

What should I know about parking management policies in the San Diego region?

In the San Diego region, each jurisdiction is responsible for implementing its own parking policies. Several cities have implemented parking pricing, including the cities of Oceanside, Del Mar, La Mesa, Coronado, and San Diego. The City of San Diego was one of the first in the region to set limits on the number of parking spaces that developers can build for new residential developments. It also eliminated parking requirements in Transit Priority Areas (areas near high-quality transit). To further reduce the need to own or drive a car, the City uses parking revenues to help fund more travel choices like Neighborhood Electric Vehicle shuttles.

Resources

SANDAG Regional Parking Management Toolbox
SDForward.com/parkingtoolbox

City of San Diego Transit Priority Areas Parking Reform
sandiego.gov/planning/programs/transportation/mobility/tpa

Victoria Transport Policy Institute–Parking Management Comprehensive Implementation Guide
vtpi.org/park_man_comp.pdf

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San Diego FORWARD

SANDAG

2021 Regional Plan
Programs and Policies

CURB MANAGEMENT

A lot happens near the curb: people walk, dine outdoors, pick up and drop off passengers, park vehicles, deliver packages, and more. How we use curbs throughout the day can be managed through well-considered policies that integrate a variety of strategies and emerging technologies. The goal is to create flexible curb space that balances competing and changing needs. Demand for curb access continues to increase in urban areas, in part because of new mobility services and the continued rise of e-commerce.

- Ridehailing services increased 39% between 2009 and 2018
- Online retail sales now account for 10% of U.S. retail sales; just in 2019, e-commerce sales grew by approximately 15%
- Food delivery services represent between 5 and 10% of restaurant business

The 5 Big Moves will offer people more alternatives to driving alone, particularly within Mobility Hubs, where a variety of Flexible Fleets and Transit Leap services will come together. These services will make it easier for people to access transit and other community destinations. However, they may also result in curbside conflicts if curbs are not well-managed, causing frustration, unsafe roads, and more traffic congestion. Strategically managing curbs will bring harmony to this space and promote safety and efficiency.

Who uses curbs?

- Drivers
- People walking
- Sidewalk infrastructure
- Food trucks and mobile retailers
- Police, fire, and emergency medical services
- Parked vehicles and electric vehicle charging
- Couriers and delivery vehicles
- Transit, microtransit, and supporting infrastructure
- Rideshare and carshare
- Bikes, e-bikes, scooters, and supporting infrastructure
- Local businesses
- Accommodations for mobility-impaired people
- Parklets, trees, and other streetscape elements

How would it work?

Flexible use based on time of day

Flexible curbs can accommodate different uses throughout the day using the same infrastructure, thereby optimizing space and balancing competing demands. For example, in the mornings, curb space near a local restaurant might be best suited for delivery loading zones, but during the evening, the same curb space could convert to passenger loading zones.

Curb pricing

Charging for the amount of time you use the curb, whether it is for on-street parking or short-term passenger loading, can free up space and promote passenger loading, which also reduces congestion and boosts economic activity.

Real-time curb information

Next OS technologies will enable real-time curb management and allow people to locate, reserve, and pay for curb space, which can reduce traffic and double-parking.

What would it look like?

Curbside uses benefit more than just nearby businesses.

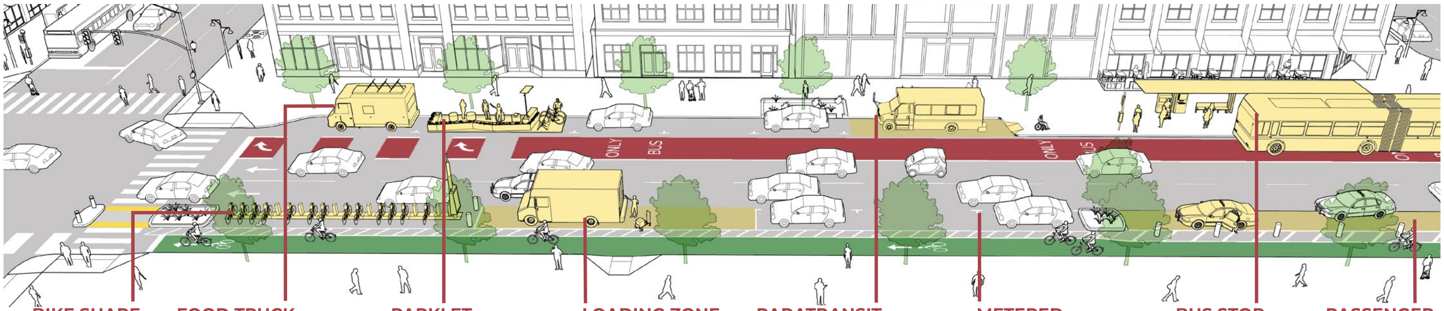

Image Source: National Association of Transportation Officials (NACTO)

What should I know about curb management?

In the San Diego region, cities are responsible for adopting policies to manage curbs. Urban communities, such as the City of San Diego, are using innovative strategies to manage curb space and reduce traffic congestion. For example, on weekend evenings, parking spaces on Fifth Avenue are converted to passenger loading zones. SANDAG can support the region's cities as they begin to plan and implement similar innovative curb policies and pilots.

Resources

Curb Management Practitioners Guide
ite.org/technical-resources/topics/complete-streets/curbside-management-resources/

Curb Appeal
nacto.org/tsdg/curb-appeal-whitepaper/

Shared-Use City: Managing the Curb
itf-oecd.org/shared-use-city-managing-curb-0

Parking and Curb Management

Implementation Actions

Proactively managing parking and curb space enables more people to access places within our communities using alternatives to driving. Effective parking-management policies contribute to the region's ability to meet the California Senate Bill 375 (Steinberg, 2008) greenhouse gas emission–reduction target by applying parking pricing and reduced parking supply assumptions, which are included in the travel demand model (reference Appendix D, Sustainable Communities Strategy documentation). In addition, the 2021 Regional Plan addresses curb management by proposing strategies to help balance competing and changing travel needs at the curb while remaining flexible to resident, employee, business, and visitor needs. While the authority to implement parking and curb policies remains with local jurisdictions, SANDAG plays a unique role of informing these policies by sharing resources and best practices and serving as the regional Mobility Data Clearinghouse.

Near-Term Implementation Actions

SANDAG just completed a concept of operations (ConOps) for curbside management implementation in the San Diego region. The ConOps provides a high-level description of the digital system and how it will function and outlines roles and responsibilities in operating and maintaining the system. A ConOps is a critical step in the Systems Engineering process that informs the steps that follow, which eventually lead to project implementation.

Currently, SANDAG is also developing a regional parking inventory that will collect data needed to inform parking and curb management pilots envisioned in the 2021 Regional Plan. SANDAG is partnering with the City of San Diego to plan and pilot a priced parking district in the Pacific Beach Mobility Hub in conjunction with an on-demand neighborhood electric vehicle shuttle service. The pilot intends to improve parking availability, provide more connections to the Mid-Coast Trolley, and reduce drive-alone trips while serving as a model that SANDAG and potential partners can replicate to expand parking and curb management in the region. SANDAG will also offer new and updated technical resources that local jurisdictions can leverage for implementation, such as an updated Regional Parking Management Toolbox. SANDAG will integrate flexible curb management strategies into Mobility Hubs and Complete Corridor planning while pursuing pilots to test smart parking and flexible curb space technology throughout the region.

Long-Term and Ongoing Implementation Actions

SANDAG will continuously work with local jurisdictions to develop technical resources needed to implement progressive parking and curb management policies, such as a Regional Curb Management Strategy, while supporting the development of local parking and curb management plans and pilot deployment.

Partners

SANDAG has worked with several local jurisdictions in the region to implement effective parking management solutions. SANDAG will seek to expand partnerships with parking districts, local developers, employers, mobility service providers, and the California Coastal Commission to implement more progressive parking policies while integrating more curb management strategies that complement projects in the 2021 Regional Plan.

Program Costs

Parking and curb management elements are vital to the success of the 5 Big Moves, and, in addition to program costs displayed below, investments in technologies and infrastructure that support these policies are embedded into the cost of the network (detailed in Appendix A), including passenger loading zones and carshare parking at Mobility Hubs and curb access and parking technologies for the Next OS.

Parking Management Program Costs (in millions)

Program	2025	2035	2050	Total
Member agency resource/coordination	$8	$100	$40	$148
			Grand Total	**$148**

Social Equity Considerations

SANDAG considers how parking and curb management can address social equity and how all residents in the San Diego region can benefit from its potential impacts. Such policies can enable affordable housing development and create equitable curb space for all travelers, including those who depend on modes like transit, biking, or other Flexible Fleets. SANDAG will ensure that pricing strategies are implemented in coordination with more convenient and accessible travel choices and mobility incentive programs as they become available.

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2021 Regional Plan
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TRANSPORTATION DEMAND MANAGEMENT

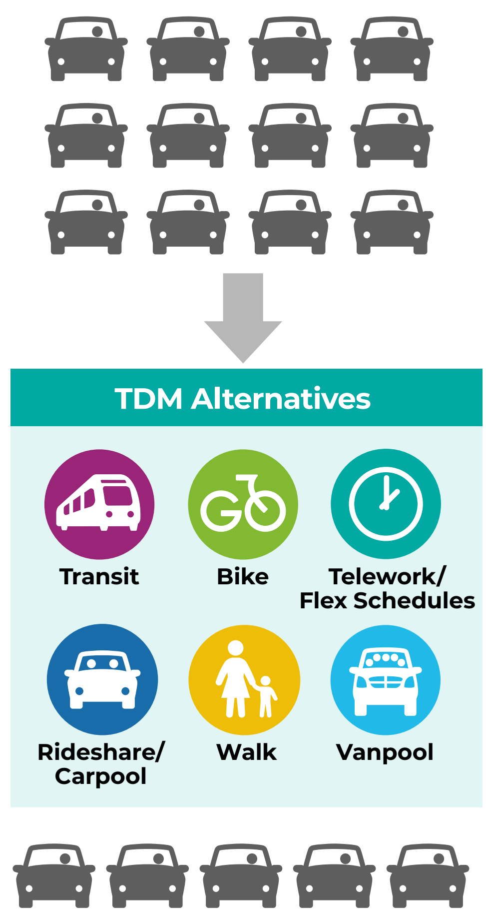
Transportation Demand Management (TDM) refers to policies and programs that help reduce commute-related traffic congestion. Typical TDM programs promote carpooling, vanpooling, taking transit, biking, and walking to work. When used widely, these alternatives—along with telework and compressed work schedules—can significantly reduce congestion on our region's roadways.

As recently as 2019, 80% of commuters in the San Diego region drive alone to work, while only 12% carpool and 4% take transit. iCommute, SANDAG's TDM program, offers several programs that promote alternatives to driving alone. In 2019, their programs made significant impacts on changing travel behavior:

- More than 4,800 vanpool participants saved more than 5 million gallons of gas
- 183 employees from 15 different employers signed up to try transit for the first time
- During Rideshare Week, employees who usually drive alone took 1,636 rideshare carpooling trips

Major highway and transit investments cannot eliminate traffic congestion alone; commuter behavior also will have to change. TDM strategies will succeed when people have a range of attractive travel choices. Existing commute patterns provided a starting point for SANDAG to reimagine the transportation system and develop the 5 Big Moves – Transit Leap, Complete Corridors, Mobility Hubs, Flexible Fleets, and Next OS. Implementing enhanced TDM strategies is vital to shaping travel behavior that supports the vision.

How would it work?



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Who implements TDM and how?

SANDAG, cities and other local jurisdictions, and employers can implement TDM strategies.

Commuter Benefits

Programs and amenities such as secured bike lockers and free emergency rides home can make it easier for commuters to use transit and other alternatives to driving alone. **(SANDAG, jurisdictions, employers)**

Financial Subsidies

TDM programs can include financial incentives and pre-tax benefits that lower out-of-pocket costs for those who do not own a car or choose alternatives to driving alone. **(SANDAG, employers)**

Marketing, Education, and Outreach

Outreach events, educational campaigns, and marketing strategies help raise awareness of commute choices. **(SANDAG, jurisdictions, employers)**

Parking Management

Employers can offer cash incentives or transit passes instead of a parking space to encourage employees to choose alternatives to commuting alone in a car. **(Employers)**

TDM Policy

A TDM ordinance requires employers or developers to provide transportation benefits and amenities that encourage sustainable transportation choices. **(SANDAG, Air Pollution Control District, jurisdictions)**

Flexible Work Schedules

Employers can develop workplace policies that promote telework, flexible schedules, and/or compressed work schedules with the aim of reducing traffic congestion. **(Employers)**

What should I know about TDM in San Diego?

SANDAG operates a TDM program called iCommute for the San Diego region. iCommute manages the regional vanpool program, Guaranteed Ride Home services, bike encouragement programs, and various incentive and marketing programs, mostly through its work with more than 200 employers. On average, employers that work with iCommute have reduced the number of employees who drive alone to work by 10%.

Resources

SANDAG iCommute program
iCommuteSD.org

Victoria Transport Policy Institute TDM Encyclopedia
vtpi.org/tdm/

Transportation Demand Management

Implementation Actions

Transportation Demand Management (TDM) innovations have the potential to transform the way people travel within and between communities. Managing demands on the existing transportation system is a vital strategy for making the overall system more effective in reducing drive-alone commute trips. SANDAG will continue to administer and monitor the iCommute program by providing regional rideshare, employer outreach, and bike education and secure parking services to help reduce commute-related traffic congestion and vehicle miles traveled. Beyond commute trips, TDM programs are expanded to include grants and incentives that make it easier and safer to use active modes for short trips.

Near-Term Implementation Actions

SANDAG will continue to provide various programs, services, and financial subsidies that support sustainable transportation options. Given the impacts of COVID-19, SANDAG will update and expand the Regional Telework Assistance Program and will continue to monitor and study the transportation-related effects. SANDAG will also begin conducting outreach and policy analysis to inform development of a regional TDM ordinance. SANDAG will also develop a framework for new TDM grant and incentive programs that shift travel behavior to more sustainable modes. Local pilot projects and incentives that encourage use of new options like e-bikes would be included.

Long-Term Implementation Actions

SANDAG will refine a framework for a regional TDM ordinance by 2035 that could apply to businesses with more than 250 employees, incentivizing the preparation and implementation of TDM plans that address how employees will reduce drive-alone trips. The framework will include policy development and simultaneously conducting outreach to local jurisdictions, employers, and employees, in addition to seeking potential partners such as the County Air Pollution Control District.

Partners

SANDAG has forged strong relationships with local jurisdictions and large employers throughout the region to implement effective TDM solutions. SANDAG will seek to significantly expand partnerships to include the County Air Pollution Control District and additional jurisdictions, employers, professional business associations, mobility service providers, transportation advocacy groups, schools, and universities

Program Costs

Transportation Demand Management Program Costs (in millions)

Program	2025	2035	2050	Total
GO by BIKE	$0.2	$0.5	$1	$1
TDM Innovation and Shared Streets Grants	$1	$50	$4	$55
E-bike Incentive	$5	$15	$15	$35
Program Administration	$19	$59	$89	$167
Commuter Services (Vanpool, Bike Parking, Guaranteed Ride Home)	$18	$35	$56	$109
Rideshare Incentive Program	$1	$1	$2	$4
Marketing, Outreach, and Education	$11	$23	$35	$69
TDM Ordinance (NEW)	$8	$40	$60	$108
			Grand Total	**$548**

Social Equity Considerations

SANDAG recognizes that all residents throughout the region deserve convenient, safe, and affordable commute options and will ensure equitable distribution of funding and incentive program assistance. SANDAG will ensure that all marketing, outreach, and education efforts reach underrepresented populations in the region. Additionally, SANDAG will continue to offer commuter programs and promote local mobility services that provide options for low-income or unbanked residents, such as providing access to secure bike parking with cash payment or other options not requiring a bank account or promoting shared mobility services that offer discounts to low-income individuals.

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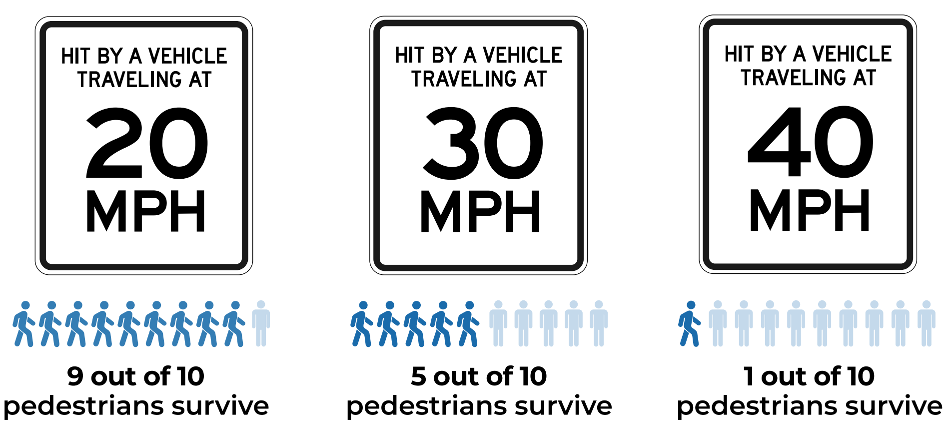
VISION ZERO

California is among the U.S. states with the highest number of fatalities involving people walking and biking, and traffic collisions are one of the top causes of injury and death in Southern California. The aim of a regional Vision Zero policy is to protect everyone who uses the roads, especially the most vulnerable—children, individuals with disabilities, and all people who walk, bike, and ride micromobility.

Vision Zero is a national campaign that uses a variety of strategies to work toward eliminating deaths and severe injuries on our streets. Human error is a reason for these crashes, but poorly designed roads also contribute to crashes being fatal. Speed can also have a significant impact on the severity of crashes and is another important factor in transportation-related deaths. Statistics show that low-income communities and communities of color are disproportionately affected by traffic-related injuries and fatalities, which indicates that establishing an equitable and inclusive transportation system is a critical component of achieving Vision Zero.

The 5 Big Moves will result in people having more travel options. By implementing safe street designs, slow speeds, and policies that promote safe movement, more people will feel comfortable choosing to walk, bike, and ride micromobility to get around their communities.



How would it work?

- Protect vulnerable users of our roads through road design and engineering
- Prioritize safety in local project funding decisions
- Educate drivers and other road users on traffic safety
- Engage communities to uplift local voices and proactively identify local issues
- Use data to understand inequities, including disproportionate impacts on communities of color and low-income populations, and actively work to address them

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What would it look like?

Streets that work for everyone

Street design that prioritizes the creation of safe and comfortable space for people who walk, bike, ride micromobility, and take transit prevents conflicts between people and vehicles traveling at different speeds. Lowering speed limits and designing streets in ways that reduce the speed of moving vehicles can help make crashes, when they do occur, less likely to be fatal. Using data and actively engaging communities helps to identify issues and supports the development of policies, programs, and infrastructure that reflect the unique needs of each community.

What should I know about Vision Zero?

Vision Zero strategies have been implemented in cities throughout the country, including a handful of cities in the San Diego region. Vision Zero aims to move beyond traditionally siloed approaches to traffic safety by implementing an integrated Safe Systems approach. Vision Zero is primarily focused on policies and roadway designs that affect people's choices, rather than individual educational and enforcement activities as in the past. By implementing street designs proven to encourage safe behavior, the need to correct for individual issues through strategies like traffic stops, ticketing, and fines can be reduced.

Many safety-related projects on our roads will be the responsibility of local jurisdictions, but a regional Vision Zero campaign can be a source of technical resources and funding to help keep people safe as they travel through the San Diego region.

Resources

City of San Diego Vision Zero
sandiego.gov/vision-zero

Vision Zero Network
visionzeronetwork.org

9 Components of a Strong Vision Zero Commitment
slideshare.net/CarolynSzczepanski/9-components-of-a-strong-vision-zero-commitment

CalSTA Zero Traffic Fatalities Task Force
calsta.ca.gov/-/media/calsta-media/documents/calsta-report-of-findings-ab-2363-zero-traffic-fatalities-task-force-a11y.pdf

Vision Zero Equity Strategies For Practitioners
visionzeronetwork.org/centering-equity-in-vision-zero/

Vision Zero

Implementation Actions

Traffic-related fatalities and serious injuries are a critical and preventable public health and equity issue in the region. Vision Zero is a national campaign to eliminate all traffic-related deaths and serious injuries by focusing on policies and the redesign of streets to create a transportation system that is safe for everyone. In adopting Vision Zero, SANDAG will work toward Zero by collecting and analyzing crash data to identify safety issues and recommend solutions; developing a regional safety policy; continuing to construct the Regional Bike Network; working with local jurisdictions to conduct outreach for and build out their complete streets networks; and funding educational programs, including opportunities to collaborate with tribal nations.

Near-Term Implementation Actions

SANDAG will develop and implement a regional safety policy. To develop this, SANDAG will study regional traffic safety data and engage communities in needs identification and policy development. SANDAG will also consider recommendations from the Zero Traffic Fatalities Task Force (California Assembly Bill 2363 [Friedman, 2018]) to implement the goals outlined in Vision Zero.

Long-Term Implementation Actions

SANDAG will continuously work with local jurisdictions to provide technical resources and assistance on roadway design and continue to build our projects from the Regional Bike Network with an emphasis on safety for all road users to implement Vision Zero. In the past, SANDAG has worked directly with local jurisdictions to provide training in bikeway design and planning practices, and we intend to expand these efforts in a comprehensive manner. This may include training, design review, project coordination, planning and project management support, and other identified needs as we work with our members.

Partners

SANDAG has a long history of working with our local jurisdictions, state agencies, and tribal nations to develop active transportation projects, including providing training, funding, and resources for planning and construction. SANDAG also constructs active transportation projects on behalf of our partners, as laid out in their planning efforts. We also work with community-based organizations, schools, and elected officials to conduct outreach and education efforts. We plan to continue to partner with these agencies and groups to make the transportation system in our region safe and comfortable for every person who uses it.

Program Costs

Vision Zero Program Costs (in millions)				
Program	**2025**	**2035**	**2050**	**Total**
Member agency project resource/coordination	$6	$25	$15	$46
Community-Based Education	$4	$25	$25	$54
Capital and Planning Grant	$25	$150	$150	$325
			Grand Total	**$425**

Social Equity Considerations

Statistics show that low-income communities and communities of color are disproportionately affected by traffic-related injuries and fatalities, which indicates that establishing an equitable and inclusive transportation system is a critical component of achieving Vision Zero. As described in the SANDAG Equity Framework for the 2021 Regional Plan, SANDAG will prioritize consideration of and outreach with marginalized communities to make transportation safe and convenient for every person in the region.

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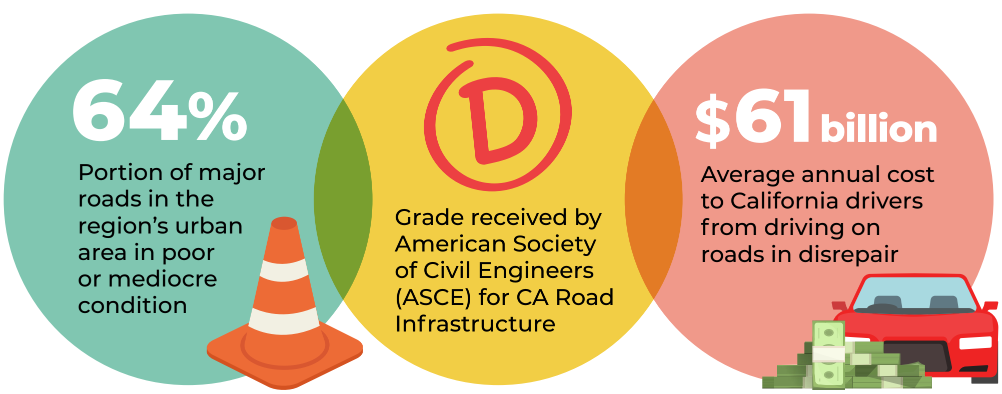
2021 Regional Plan
Programs and Policies

FIX IT FIRST

The safety and maintenance of roads and infrastructure are major concerns for San Diegans. Wear and tear on the region's roads, transit vehicles, and other infrastructure can cause safety concerns and economic losses. Enhancing the existing transportation system with new projects and investing in maintenance of existing infrastructure can make it possible for the San Diego region to have a world-class transportation system.

The 5 Big Moves will build on our existing transportation network and add new connections around the region. By making improvements to maximize use of existing infrastructure, we can make sure our investments are optimized.



How would it work?

- Using technology to monitor infrastructure and assess maintenance needs
- Bringing transit and road infrastructure back to optimal performance
- Prioritizing high impact projects and strategically managing infrastructure life-cycles

What would it look like?

- Up-to-date regional infrastructure that is resilient to natural disasters and other stressors
- A transportation system that is cared for, safe for all users, and efficient
- Infrastructure that will support the 5 Big Moves investments in services and technology

What should I know about the condition of local infrastructure?

California received a “D” in Roads and a “C–“ in Transit from ASCE 2019 Infrastructure Report Card. Cities monitor and address their own infrastructure needs. Providing technology and funding support at the regional level allows cities and other local jurisdictions to prioritize the improvement of aging infrastructure. SANDAG currently allocates a portion of its revenue to projects that maintain our transportation network. Dedicated funding for the operation, maintenance, and rehabilitation of transit, highways, local streets, and roads makes up slightly more than a third of SANDAG’s total expenditures.

SANDAG also supports high-priority maintenance and repair projects, such as stabilization of the Del Mar Bluffs. This project is working to stabilize portions of the 1.6 miles of coastal bluffs between Coast Boulevard and Torrey Pines State Beach in the City of Del Mar, which is an integral segment of the rail corridor that facilitates passenger and freight movements between San Diego County, Los Angeles, and points beyond.

Resources

ACSE report card on California’s infrastructure (Region 9)
ascecareportcard.org

San Diego Transportation by the Numbers
tripnet.org/wp-content/uploads/2018/08/CA_San_Diego_Transportation_by_the_Numbers_TRIP_Report_Aug_2018.pdf

Del Mar Bluffs stabilization

San Diego FORWARD

SANDAG

Fix It First

Implementation Actions

The 2021 Regional Plan envisions many improvements to the San Diego transportation system and network to set the region up for success as a world-class transportation system. To optimize investments in the region's transportation infrastructure, the Regional Plan and the 5 Big Moves focus on improving upon existing roads, rails, and sidewalks. The Fix It First strategy aims to repair existing roads and create a system for sustained maintenance in the future, creating a safe and efficient transportation network for all users.

Near-Term Implementation Actions

SANDAG will create a framework to identify and address preservation needs for the region's transportation system. Framework development will begin with evaluating current maintenance and preservation practices, data availability, and data needs. Life-cycle cost strategies and other best practices from national leaders in asset management and preservation will inform the framework. Treatment selection guidance, project prioritization, and phasing processes will be evaluated for inclusion. The framework will balance the needs of current and future preservation and responsible public spending.

Long-Term and Ongoing Implementation Actions

Asset preservation is a long-term and ongoing commitment. SANDAG will continue to manage and implement the transportation system preservation framework though the horizon year of the 2021 Regional Plan. Framework priorities and structures will be managed and updated to match changes in real-world conditions. Quantitative facility condition data will feed back into the framework to provide information needed to update framework components.

Partners

SANDAG has developed strong relationships with local jurisdictions, Caltrans, and federal agencies to provide funding and resources for planning, construction improvements, and maintenance needs. SANDAG will continue to partner with these agencies to make the transportation system in our region safe and efficient for all users.

Program Costs

The 2021 Regional Plan does not include specific program investments for Fix It First strategies. Costs associated with maintenance and rehabilitation of the transportation system are incorporated into the capital investments defined in Appendix A and will be updated for future Regional Plans using the framework identified as a near-term action.

Social Equity Considerations

Special attention will be paid to the location of transportation maintenance investments relative to the location of social equity focus populations to ensure these groups are not disadvantaged by investments or disproportionally burdened by transportation system maintenance. Along with maintenance project location, the frequency, treatment type, and quality will be monitored.

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Programs and Policies

TRANSPORTATION SYSTEM MANAGEMENT AND OPERATIONS

A variety of tools and strategies are necessary to effectively operate and manage transportation infrastructure as a coordinated regional system, including the roadway network, transit system, and active transportation facilities.

In this coordinated multimodal approach, the entire system will be connected by technology that will help people decide which routes to take and what forms of transportation to use. This technology will also help operators manage demands on different parts of the transportation system, including bus and train lines, major transit centers, and roads and highways. This management system is a part of the Next Operating System (Next OS), the electronic nervous system of the region's transportation network. Policies governing Next OS and data and institutional governance structures will ensure that the transportation system can support the technology the region needs.

The policies governing the use of technology within the transportation system can be designed to work in tandem with infrastructure improvements for Complete Corridors and Next OS. The ultimate goal is to make sure that people have the information they need to travel seamlessly through the region's entire transportation system.

What system management and operations efforts are already underway?

Five local, regional, and state agencies collaborated on system performance for freeway, local roads, and transit for the Interstate 15 Integrated Corridor Management project. One result of this collaboration is that local roadway signal timing is coordinated with freeway ramp meters to better manage traffic entering and exiting the freeway during major incidents. The focus remains on the users of the freeway and major roadway networks regardless of who owns or operates the individual systems. This is an example of an operational governance process change agreed upon by local and state agencies in an effort to improve management and operations across networks and across agencies.

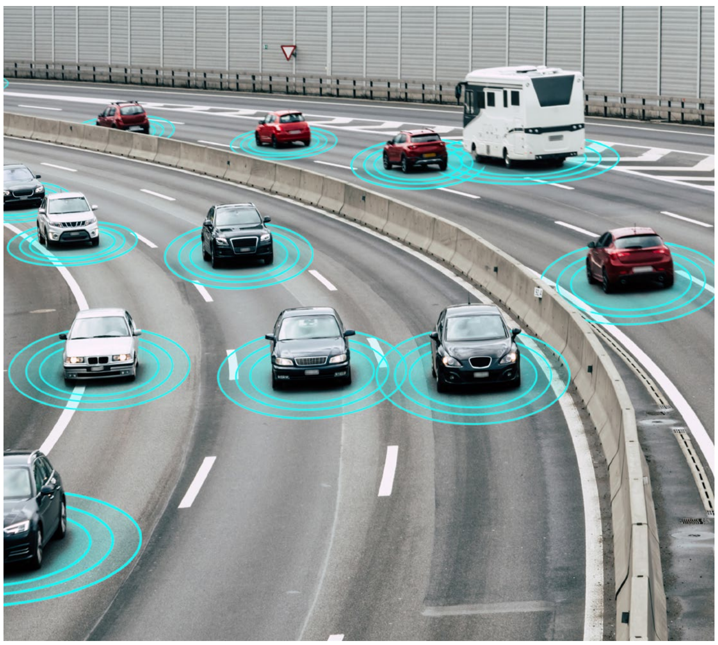
What does it look like?

Transportation systems management and operations encourages agencies to combine tools, resources, and solutions to achieve greater performance of the entire system. Integration can happen with:

- Systemwide investments to integrate corridors into one managed network
- Support for information sharing between technology providers and fleet operators
- Coordination of operational strategies so that corridor, regional, or system objectives are achieved
- Embedding transportation systems management and operations policies, governance, and processes into an agency's normal way of doing business, including planning, program management, and infrastructure improvements:

Who will be responsible for integrated management?

SANDAG, Caltrans, local agencies and jurisdictions, and transit providers will be responsible for developing the policies that will allow the region to integrate systems for coordinated management of transportation.



Resources

U.S. Department of Transportation, Transportation Systems Management and Operations (TSMO) Plans
ops.fhwa.dot.gov/plan4ops/tsmo_plans.htm

Transportation Systems Management and Operations (TSMO) Resource Connect
transportationops.org

U.S. Department of Transportation, Integrated Corridor Management
youtube.com/watch?v=xWPyzgFlf7w

System Management and Operations

Implementation Actions

Transportation System Management and Operations (TSMO) employs a series of intelligent transportation system strategies designed to maximize the capacity and efficiency of the existing and future transportation system. Historically, existing transportation systems are operated and managed as independent systems, resulting in inefficiencies and/or ad hoc planning and implementation of projects that only address project-specific needs and not the particular needs of transportation customers.

TSMO includes the establishment of institutional and governance actions to help advance and facilitate cross-agency collaboration to ensure existing and proposed transportation systems are not operated or managed as independent systems but as a multimodal transportation system. TSMO activities focus on determining how people, processes, and tools can facilitate increased cross-agency collaboration during the planning, development, and operations of intelligent transportation system strategies like the Next Operating System (Next OS), Active Transportation and Demand Management (ATDM), and Smart Intersection Systems (SIS). These strategies will help SANDAG coordinate the management of the complete corridor system across jurisdictions and operators that include capital and technology investments.

Near-Term Implementation Actions

SANDAG will partner with local jurisdictions to develop and maintain the TSMO Plan and will coordinate with the private sector on joint opportunities to improve transportation infrastructure.

SANDAG will establish a Mobility TSMO Advisory Group. This body can include multiple-discipline mobility representatives, technology industry experts, and local and regional transportation system operators. This body will help guide the implementation of the TSMO Plan and can serve as a regional advisory body to help advance the implementation of the Next OS, help identify and establish enabling operational and technological policies for data sharing, establish cross-agency procedural guidelines for multimodal operations, help provide a forum for mutual technology innovation research, and deploy pilot projects.

Additionally, SANDAG will develop and implement a Digital Equity Strategy and Action Plan that will close gaps in high-quality broadband access essential to the future of transportation and advancing equity in the region.

Long-Term Implementation Actions

SANDAG will continuously work with local jurisdictions to maintain common standards for data sharing while protecting security and privacy.

SANDAG will ensure that TSMO initiatives are considered as a core component of local and regional transportation plans, programs, and investment strategies.

Additionally, SANDAG aims to promote and advance the TSMO Plan in daily operations, long-term regional and local transportation-planning initiatives, and project development and implementation processes. Embedding TSMO Plan initiatives into these processes can ensure compliance with regional, state, and federal regulations and maintain consistency with local agency initiatives. This effort will support the implementation of the Next OS and technology components of the Complete Corridors, Transit Leap, Mobility Hubs, and Flexible Fleets.

Partners

SANDAG has developed strong relationships with local jurisdictions, as well as Caltrans, transit operators, and regional stakeholders to provide cross-agency collaboration for planning and infrastructure improvements. SANDAG will continue to partner with these agencies to make the transportation system in our region safe and efficient for all users.

Program Costs

System Management and Operation Program Costs (in millions)				
Program	**2025**	**2035**	**2050**	**Total**
ATDM and SIS	$681	$2,855	$1,223	$4,759
Next OS	$66	$62	$100	$228
			Grand Total	**$4,988**

Social Equity Considerations

SANDAG recognizes the importance of designing and identifying technological tools used in TSMO that respond to the needs of the entire community (e.g., voice-activated multilingual applications, traveler information kiosks, and mobile apps) to ensure the transportation system works for everyone throughout the region.

SANDAG recognizes that communications infrastructure plays a pivotal role in the implementation of the Next OS. Developing a regional communications digital strategy to address the digital divide will set forth a regional roadmap to focus on identifying communications infrastructure improvements to bring affordable, reliable, and high-speed broadband internet access to underserved and rural populations.

The advancement and consideration of TSMO will also be consistent with the SANDAG Equity Framework for the 2021 Regional Plan to ensure that regional project priorities serve all communities across the region.

San Diego FORWARD

SANDAG

2021 Regional Plan
Programs and Policies

VALUE PRICING AND USER FEES

Currently, funding to preserve and improve transportation infrastructure in the San Diego region comes from a variety of federal, state, and local sources that primarily rely on fuel taxes. However, in recent years as vehicles fuel efficiencies have increased, state and federal transportation funding has declined. The practice of charging fees for using transportation infrastructure is becoming more commonplace nationwide. This is one way to optimize performance of the transportation system, manage congestion, and minimize the effect of somewhat unpredictable state and federal funding.

User fees apply a "market-based" approach to achieving environmental, equity, and economic goals and can put a hand on the scale to redress decades of unbalanced investment in roads by making funds available for other types of transportation, including transit. Funds raised from user fees can help the region build a complete transportation system that provides people with more alternatives to driving alone, wherever and whenever they need them. Additionally, providing more transportation alternatives will free up roadway space for people who still need to drive.

Once it is built, the convenience of the new system could, in effect, sustain changes in travel behavior for decades. The result for everyone would be improved mobility and transportation equity, and reductions in congestion, air pollution, and greenhouse gas emissions. These fees can also generate sustainable funding in the long-term to preserve and improve the network and promote a balanced transportation system moving forward.

What should I know about value pricing and user fees?

Transportation user fee structures must be carefully developed to ensure there is no disproportionate burden on people with limited incomes, people of color, and seniors. Revenue from value pricing can be reinvested to fund safe, convenient, and affordable multimodal transportation options. In addition, SANDAG can provide incentives and subsidies to ensure there are viable alternatives to driving alone. Creating more transportation choices while ensuring affordability and accessibility is critical for accomplishing climate and equity goals.

The I-15 Express Lanes in San Diego are an example of Managed Lanes (Source: Union Tribune)

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What would it look like?

User fee systems can feature distance-based (per mile) or segment-based (per toll zone) pricing with rates that are either flat, adjusted in response to congestion levels, or vary according to a known schedule. The 2021 Regional Plan considers a suite of user fees aimed at encouraging travelers to consider more sustainable travel choices and manage congestion. Further analysis and extensive community outreach will be needed to prioritize the objectives and design the operating strategies of each user fee system.

The pricing strategies under consideration in the 2021 Regional Plan are:

- **Managed Lanes:** Lanes or roadways that charge variable tolls, providing a faster trip to solo drivers if they choose to pay a fee, while providing free access to emergency vehicles, transit vehicles, carpoolers, and others. Rates could adjust based on congestion levels or other factors to encourage sustainable travel choices and help keep traffic flowing. The first two managed lanes in the U.S. were deployed in Southern California: The SR 91 Express Lanes in Orange County and I-15 Express Lanes in San Diego County.
- **Road Usage Charge:** A direct user fee where drivers pay to use the roadway network, whether the vehicle is powered by gas or electricity or hydrogen, based on distance traveled or other factors. As personal electric vehicles become more affordable and revenues from fuel taxes continue to decline, road usage charging can be an equitable way to generate revenue. Road usage charging is an emerging strategy for rapidly growing metropolitan areas, including those in California where Caltrans has a Road User Charge pilot program underway.
- **Ridehailing company service fees:** Per-trip fee for Transportation Network Companies, including on-demand passenger and ridehailing services such as Uber and Lyft. Rates could vary by distance traveled, number of riders, or other factors. Ridehailing company service fees have become common in many metropolitan areas, including San Francisco, Chicago, Seattle, Portland, New York, and The District of Columbia.
- **Incentives:** Transit fare subsidies can encourage more transit ridership and travel shifts during both peak and non-peak periods to manage congestion. Other incentives, such as priority parking for shared rides, can be tailored to encourage more sustainable transportation choices.

Resources

SANDAG I-15 FasTrak Study
sandag.org/services/fastrak/pubsarchive.asp?classid=29&fuseaction=home.classhome

Congestion Pricing in the U.S.
virginiadot.org/info/resources/congestion_pricing/cp_in_us.pdf

U.S. Department of Transportation Congestion Pricing
ops.fhwa.dot.gov/congestionpricing/

Value Pricing and User Fees

Implementation Actions

The 2021 Regional Plan incorporates a variety of value pricing and user strategies as tools to improve mobility by encouraging changes in travel behaviors while generating revenue to address our aging infrastructure and expand travel options. Specifically, the 2021 Regional Plan explores a network of Managed Lanes, a mileage-based road usage charge, a fee on the fares charged for rides provided by Transportation Network Companies, and further subsidization of transit fares. Strategies such as these are in different phases of planning, design, pilot, and deployment in different regions and are also being explored at the state and federal level. SANDAG will rely on coordination with the other Metropolitan Planning Organizations (MPOs) in California along with the State Department of Transportation to integrate the selection of technology, collection methods, and account management to ensure a consistent experience for travelers. Meanwhile, the design of these strategies, such as the fee structure and distribution of revenue, should be specifically designed for the San Diego region's unique environment and priorities.

Near-Term Implementation Actions

SANDAG will launch a study in FY 2022 to evaluate different transportation funding sources, including usage-based fees, to understand their relative capabilities in addressing equity and other goals, such as greenhouse gas (GHG) emissions reductions. As part of this study, a working group would oversee the development of a comprehensive value pricing and user fee implementation strategy that supports the goals of the 2021 Regional Plan.

SANDAG also partnered with Sacramento Area Council of Governments and Southern California Association of Governments on a Caltrans Planning Grant proposal to develop a research design framework for pilot projects to test the effectiveness of road pricing strategies combined with demand management approaches (incentives) to advance equity, reduce vehicle miles traveled and GHG emissions, manage roadway congestion, and provide sustainable revenues for system maintenance and operation. If Caltrans does not select that proposal for funding, a new funding source would need to be identified. This study will put California MPOs in a position to complement the efforts of Caltrans through its Road Charge Pilots Program. Caltrans was recently awarded $2.15 million from the Federal Highway Administration to continue pilot testing user acceptance and the technological feasibility of implementing road user charges. Meanwhile, SANDAG will partner with other California MPOs while collaborating with the Caltrans Road Charge

Pilots Program to test a policy-driven approach to leverage road user charges to achieve desirable environmental and equity outcomes.

Both studies would include a robust public-engagement process and would lay the foundation for prioritizing different goals and understanding the potential of these tools in advancing these goals. SANDAG will leverage existing coordination efforts with the other major MPOs in California to ensure an integrated approach when possible.

SANDAG is currently analyzing the existing Interstate 15 (I-15) Managed Lane corridor to understand the potential of operational strategies to improve identified deficiencies and help achieve the vision, goals, and objectives for the I-15 corridor. These strategies will aim to manage demand, incentivize carpooling, and ensure reliable travel times. They are expected to be further considered in FY 2022 as traffic and corridor congestion returns to pre-pandemic levels.

SANDAG will pursue planning work toward implementing the other tools included in the implementation strategy, including a ridehailing service fee, reduced transit fares, and priced parking. SANDAG has an existing partnership with researchers at UC Berkeley to analyze data collected by SANDAG to better understand the time and price tradeoffs of ridehailing service users, exploring opportunities, challenges, and social equity considerations for policies to promote pooled ridehailing trips. This analysis will be completed by FY 2023 and will help inform the development of a potential fee on ridehailing trips. SANDAG will develop updated technical resources and provide targeted support for local jurisdictions to leverage for implementing parking pricing through the updated Regional Parking Management Toolbox and will support local parking-management plans and pilots.

SANDAG will also complete a Regional Fare Impact Study to evaluate how different subgroups could benefit from fare subsidies by FY 2024.

SANDAG will develop an Outreach and Engagement Plan to guide all aspects of the implementation of new pricing strategies by FY 2023.

Long-Term Implementation Actions

Once these initial studies are complete, SANDAG will begin deploying pilot testing by FY 2024 to inform the detailed design of new pricing mechanisms and understand how they influence travel behaviors, how they impact different populations, and how well they support regional and state goals. Ultimately, SANDAG will rely on legislative action, ballot measures, or other mechanisms that would grant authority to administer any new value pricing and user fee strategy. Therefore, it is critical to develop broad community and political support through the initial study and pilot testing phases.

Recent technological advancements have improved fee collection. SANDAG will coordinate with the State and other MPOs to develop a consistent approach to fee collection.

Partners

SANDAG will work with local jurisdictions to align priorities for the pricing strategies and incorporate supporting technology into the Regional ITS Architecture. SANDAG will partner with the other MPOs in California along with the State Department of Transportation and California State Transportation Agency to integrate the selection of technology, collection methods, and account management to ensure a consistent experience for travelers. SANDAG will also continue to work with community-based organizations to conduct education and outreach and solicit feedback from underserved community members to inform the design of the fee structures and collection methods.

Program Costs

The 2021 Regional Plan does not include specific program investments for these strategies. Costs associated with implementing the various pricing strategies are incorporated into the capital investments for Complete Corridors (managed lane pricing), Transit Leap (transit fares), Mobility Hubs (parking pricing), and Next OS (systems to support pricing programs).

Social Equity Considerations

For all different pricing mechanisms included in the Regional Plan, SANDAG will develop the fee structure and distribution of revenue strategy to ensure equitable outcomes. The Next OS has the capability to provide discounts to low-income, youth, and other vulnerable populations. Meanwhile, revenues can be prioritized to fund improved transportation options for low-income and historically underserved neighborhoods. Additionally, shifting away from regressive taxes and fees traditionally used to fund transportation can improve equity outcomes.

Appendix L

Subregional Plan Consistency Analysis

APPENDIX L
SUBREGIONAL PLAN CONSISTENCY ANALYSIS

Table L-1
Carlsbad

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
La Costa Master Plan (Revised)	MP 149 • 1/14/1974 for original MP. • La Costa Town Square approved in 2009. Last amended 8/16/2006	• Large master planned community including residential and commercial. • La Costa Town Square: ○ 63 medium density residential units ○ 32 single-family residences (SFRs) ○ 258,417-square foot (sf) (total) commercial ○ 55,000-sf office Amendment approved to delete a 0.5 acre vacant city owned site (Assessor Parcel 223-617-24) at 7201 Rancho Santa Fe Road approximately a half mile south of San Elijo Road in Local Facilities Management Zone 11. Subject site is proposed Fire Station No. 6.	Largely built out.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Carrillo Rancho	MP 139 10/16/1972 & 7/6/1993 Last amended (minor) 10/27/1998, (PC RESO NO. 4384), MP139(G)	Large residential master planned community that is nearly built out.	Largely built out.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.
Bressi Ranch	MP 178 7/22/2002 Last amended: December 2016	Residential, commercial, and industrial master planned community that is largely built out. Mostly vacant graded industrial lots remain.	Residential built out. Industrial remaining – estimate 939,323 sf expected by 2033.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
La Costa Resort & Spa Master Plan	MP 03-02 9/27/2004 Amended 2017–0026 and final approval by Carlsbad Planning Commission on 01/16/2019	La Costa hotel and 137 commercial dwelling units (DUs). Project planned in phases. October 2011 Minor Master Plan Amendment MP 03-02C: A minor amendment to address Section 4 Sign Program updates, including deletion of obsolete sign elements and the addition of one campus facilities sign at the entrance to La Costa on El Camino Real.	Remaining – 116 commercial DUs comprising 206,366 sf expected by 2030.	N/A	This land use plan contemplates future commercial DUs, which are not included in the SCS land use pattern. Therefore, the SCS land use pattern would not preclude the primary intent of the land use plan.
Villages of La Costa	MP 98-01 11/5/2001	Large master planned community. Residential neighborhoods are built out. Minor amendment to change the permitted use of Planned Industrial to Office in planning area 1.1, approved 9/16/2006.	Non-residential remaining – 5,000-sf church; 15,412-sf day care expected by FY 24-25.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Robertson Ranch	MP 02-03 11/20/2006 Amended May 17, 2016	Master planned community separated into two villages: • East Village (485 total DUs): ○ 78 multi-family units ○ 87 attached SFRs ○ 320 SFRs ○ 66,000-sf office (PA 22) • West Village (672 total DUs): ○ 364 multi-family units ○ 308 SFRs ○ 140,000-sf commercial ○ 16,500-sf daycare An amendment to the Master Plan to change the Master Plan Land Use designation of Planning Area 22 from Office (O) to the R-23 (Residential 15-23 DU/acre) designation, to change the Master Plan Zoning on Planning Area 22 from Office (O) to Residential Density-Multiple (RD-M), and to the update the Planning Area 22 development standards to accommodate this revised land use.	• East Village – largely built out 66,000-sf office expected by FY 29-30. • West Village: ○ 364 multi-family units; construction began in 2016. ○ SFR construction expected from FY 18-19 through FY 29-30. ○ Commercial: – 16,500-sf day care expected by FY 23-24, – 140,000-sf commercial construction expected from FY 19-20 through FY 21-22.	N/A	This land use plan is consistent with the SCS land use pattern.

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Poinsettia Properties	SP 210(A) 1998	Largely built out.	Largely built out.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.
Poinsettia Shores	MP 175 1993 1996 - Poinsettia Shores Master Plan minor amendment to adopt Coastal Commission suggested modifications	Built out with the exception of two vacant parcels in the Ponto area.	Residential largely built out; commercial/ hotel remaining – 144,635 sf expected by 2021.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Aviara Master Plan	MP 177 12/21/1987 Latest amendment 8/6/2002	Aviara Master Plan largely built out.	Remaining units expected by 2027.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.
Arroyo La Costa	MP 88-01 6/5/1990	Built out with the exception of a church expansion and a 28-acre school site.	Remaining 30,000-sf church by 2027.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
La Costa Downs	SP 201 6/24/1991	40-lot single family subdivision.	Largely built out. Remaining five units expected by 2029.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.
Carlsbad Airport Business (Park) Center	SP 200 10/27/1986 Amended 3/6/2001 Amended 10/15/2002	38-lot industrial park, mostly built out.	Two vacant industrial lots remaining (4.9 acres and 2 acres); 59,851 sf expected by 2025.	N/A	This land use plan contemplates future industrial lots, which are not included in the SCS land use pattern. Therefore, the SCS land use pattern would not preclude the primary intent of the land use plan.

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Zone 20 Specific Plan	SP 203 12/13/1993	Largely built out.	Remaining residential expected by 2032. Remaining non-residential—133,067 sf of church uses—expected by 2032. (Two existing churches have planned expansions.)	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.
Carlsbad Ranch Specific Plan	SP 207 3/8/1993 Amended 3/19/1996	Non-residential specific plan.	Remaining development: • PA 1 (GIA): up to 200,000 sf exp./ projected for FY 22-23 through FY 30-31 • PA 5 (Carlsbad Ranch Resort): future hotel expansion: 96 rooms (estimate 53,178 sf) and 188 additional timeshare units (estimate 200,991 sf) from FY 14-15 through FY 32-33 • PA 8a: Floral Trade Center site (4 phases totaling 108,000 sf)	N/A	This land use plan contemplates future retail and resort uses, which are not included in the SCS land use pattern. Therefore, the SCS land use pattern would not preclude the primary intent of the land use plan.

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Carlsbad Oaks North	SP 211 10/14/2002 Amended 8/2016	Industrial Park 23 total industrial lots.	Remaining: 1,611,403 sf of development expected by 2032.	N/A	This land use plan contemplates future industrial lots, which are not included in the SCS land use pattern. Therefore, the SCS land use pattern would not preclude the primary intent of the land use plan.
Carlsbad Airport Centre	SP 181 8/4/81	Industrial park specific plan, mostly built out; two vacant industrial lots remaining.	Remaining: 87,000 sf expected by 2025.	N/A	This land use plan contemplates future industrial lots, which are not included in the SCS land use pattern. Therefore, the SCS land use pattern would not preclude the primary intent of the land use plan.
Carlsbad Research Center	SP 180 8/3/82 Last revised 2/3/16	Industrial park specific plan, mostly built out.	Estimate 200,300 sf by FY 22-32.	N/A	This land use plan contemplates future industrial lots, which are not included in the SCS land use pattern. Therefore, the SCS land use pattern would not preclude the primary intent of the land use plan.

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Fenton Carlsbad Center Specific Plan	SP 07-02 10/07/08	Non-residential Specific Plan for office uses. Built out except one lot.	Remaining – 80,000-sf office expected by 2025.	N/A	This land use plan contemplates future commercial use, which is not a component of the SCS land use pattern. Therefore, the SCS land use pattern would not preclude the primary intent of the land use plan.
Sunny Creek Specific Plan	SP 191 10/24/1984 4/5/1985	• Holly Springs: 127 multi-family residences (MFRs) and 43 SFRs • Cantarini Ranch: 105 SFRs • Rancho Milagro: 19 SFRs • Other: 165 SFRs (no discretionary approvals yet)	This development is identified in the City's Housing Element Update as a site for upzoning.	N/A	Revisions to this land use plan by the City of Carlsbad to implement its Housing Element Update are anticipated.
Quarry Creek Master Plan	MP 10-01 4/4/2013 Last revised 10/10/2017	• 636 DUs • 3,000-sf daycare • 1,500-sf recreation bldg. Master plan amendment to clarify several standards and to allow single family detached products on fee simple lots on Planning Area R-4 West.	Project is in progress.	N/A	This land use plan is consistent with the SCS land use pattern.

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Westfield Carlsbad	SP 09-01 7/9/2013 Last amended by City Council Ordinance No. CS-263 on September 23, 2014	Built out, but remodeling mall.	Demo 148,159 sf and reconstruct 150,495 sf (11,336 sf net increase).	N/A	This land use plan contemplates future commercial use, which is not a component of the SCS land use pattern. Therefore, the SCS land use pattern would not preclude the primary intent of the land use plan.
Village and Barrio Master Plan	10/16/2019	350-acre area surrounding the Carlsbad Village transit station. Master plan supports a variety of mixed use developments.	Project is in progress.	N/A	This land use plan is consistent with the SCS land use pattern.

Table L-2
Chula Vista

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
San Miguel Ranch Sectional Planning Area (SPA) Plan	12/17/96 Reso. 18532 10/19/99 Reso. 19631	• 889 SFRs • 563 MFRs • 14.3 acres commercial use • 13.7 acres school • 4.6 community purpose facility • 21.6 community park • 3.5 neighborhood park	Largely built out.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.
Rolling Hills Ranch SPA Plan	3/24/92 Reso. 16555 6/3/2018	• 2112 SFRs • 283 MFRs • 20 acres school • 7 acres religion • 1 acre fire station • 27 acres neighborhood park	Largely built out.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
					result in a new physical change to the environment not analyzed in other resource chapters of this EIR.
Eastlake Woods SPA Plan	6/20/06 Reso. 2006-190	• 661 SFRs • 14.3 acres for elementary school • 24.8 acres for middle school • 1.1 acres for fire station	Largely built out.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.
Eastlake Vistas SPA Plan	6/20/06 Reso. 2006-190	• 777 SFRs • 938 MFRs • 12.1 acres commercial • 10.8 acres CPF • 13.5 acres neighborhood park	Largely built out.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
					preclude the primary intent of the land use plan and would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.
Otay Ranch Village 7 SPA Plan	10/12/04 Reso. 2004-330 7/10/2018	• 804 SFRs • 316 MFRs • 3.7 acres commercial • 23.4 acres for high school • 11.1 acres for elementary school • 2.8 acres CPF • 7.0 acres park	Largely built out.	N/A	This land use plan is consistent with the SCS land use pattern.
Otay Ranch Village 11 SPA Plan	10/23/01 Reso. 2001-364	• 1101 SFRs • 1203 MFRs • 10.0 acres commercial • 11.0 acres elementary school • 25.0 acres middle school • 6.0 acres CPF • 17.0 acres parks	Largely built out.	N/A	This land use plan is consistent with the SCS land use pattern.
Otay Ranch Village 2 SPA Plan	5/23/06 Reso. 2006-155 11/4/2014 Reso. 2014-209-12	• 857 SFRs • 1834 MFRs • 14.0 acres commercial (130,000 sf) • 91.5 acres industrial • 68.4 acres parks • 14.1 acres CPF	Project is in progress.	N/A	This land use plan is consistent with the SCS land use pattern.

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
	Amended September 28, 2016 by Resolution No. PCS16-0006.	• 19.8 elementary school			
Bella Lago SPA Plan	4/8/03 Reso. 2003-143	• 50 SFRs	Largely built out.	N/A	This land use plan is consistent with the SCS land use pattern.
Otay Ranch Village 3 SPA Plan Part of University Villages SPA	Project approved 12/4 2014. Last amended: 12/6/2016	• 1002 SFRs • 596 MFRs • 4.0 acres CPF • 86.5 acres industrial	Residential is largely built out.	N/A	This land use plan is consistent with the SCS land use pattern.
Otay Ranch Village 4 SPA Plan	Adopted May 15, 2018	• 73 SFRs • 227 MFRs	Project is in progress.	N/A	This land use plan is consistent with the SCS land use pattern.
Otay Ranch Village 8 West SPA Plan	12/17/13 Reso. 2013-270 Amended: February 2020	• 621 SFRs • 1429 MFRs • 300,000 sf commercial • 28.0 acres park • 5.8 acres CPF • 32.4 acres school	Project is in progress.	N/A	This land use plan is consistent with the SCS land use pattern.
Otay Ranch Village 8 East SPA Plan	Project approved 12/4 2014.	• 943 SFRs • 2617 MFRs • 41.0 acres active recreation/community park • 4.0 acres CPF • Designate a portion of	Project is in progress.	N/A	This land use plan is consistent with the SCS land use pattern.

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
		Active Recreation Area (AR-11) as a 51.5-acre community park (a portion of the park may function as a staging area within the OVRP).			
Otay Ranch Village 9 SPA Plan	6/13/2014 Reso. 2014-091	• 266 SFRs • 3734 MFRs • 1.5 million sf commercial • 25.1 acres park • 5.0 acres CPF • 22.0 acres school	Project is in progress.	N/A	This land use plan is consistent with the SCS land use pattern.
Otay Ranch Plan Area 10 (Village 10) SPA Plan	Project approved 12/4/2014.	• 695 SFRs • 1045 MFRs • 4.0 acres CPF	Project is in progress.	N/A	This land use plan is consistent with the SCS land use pattern.
Eastern Urban Center (EUC) SPA Plan	9/15/09 Reso. 2009-224	• 2983 MFRs • 3,487,000 sf non-residential	Project is in progress.	https://www.chulavistaca.gov/departments/development-services/planning/planning-digital-library/spa-plan	This land use plan is consistent with the SCS land use pattern.
Urban Core Specific Plan	04/26/2007 Amended February 2011 City Council Ordinance No. 3184 Amended July	• 7762 MFRs • 3,700,000 sf office • 4,000,000 sf retail	Project is in progress.	N/A	This land use plan is consistent with the SCS land use pattern.

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
	2011 (Minor); April 2015; July 2017 (Minor) Per PCZ16-0001				
Palomar Gateway Specific Plan	08/13/2013	• 1,700 DUs • 50,000-sf office • 300,000-sf retail	Project is in progress.	N/A	This land use plan is consistent with the SCS land use pattern.

Table L-3
Coronado

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Hotel Del Coronado Master Plan & Development Agreement	Adopted in 2002/ Amended 10/2008	Additional 144 condo hotel rooms, additional 19,000 square feet of conference center, and a new spa and fitness center.	78 condo hotel rooms, and new spa and fitness center constructed. The term of the Development Agreement ends in 2025. By the end of 2021, the majority of the improvements will be complete. Anticipating full completion in late 2022	N/A	This land use plan contemplates expanded hotel use, which is not a component of the SCS land use pattern. Therefore, the SCS land use pattern would not preclude the primary intent of the land use plan.

Table L-4
Del Mar

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
941 Camino Del Mar Specific Plan	Adopted 7/2018	25,524 sf site for flexible mixed-use development with a combination of residential hospitality, commercial, professional office, retail, and restaurants.	The Garden Del Mar Specific Plan was adopted by the Del Mar City Council and ratified by citywide vote. The envisioned project has not been implemented.	https://www.delmar.ca.us/DocumentCenter/View/3600/Final-941-CDM-Specific-Plan	The SCS land use pattern does not contemplate future residential growth in this plan area. However, inconsistency with the SCS land use pattern would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.

Table L-5
El Cajon

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Specific Plan No. 438	3/1991	Expands the range of commercial and residential uses on East Main Street near Pepper Drive	Detached single family dwellings have been constructed.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, inconsistency with the SCS land use pattern would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.
Downtown Master Plan, Specific Plan No. 182	6/2005	Mixed Use Urban Village	Various infill development.	N/A	This land use plan is consistent with the SCS land use pattern.
Transit District Specific Plan	5/2018	259 acres surrounding the El Cajon transit center with a mix of residential, commercial, and industrial uses.	Various infill development 20+ year buildout.	N/A	This land use plan is consistent with the SCS land use pattern.

Table L-6
Encinitas

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Downtown Encinitas SP	Feb. 9, 1994 (subsequently amended) Current through Ordinance 2019-28 and the October 2020 code supplement.	• 56.5 acres of residential only zoning • 37.1 acres of commercial and/or mixed use • 1.3 acres of office professional • 3.05 acres of P/SP • 14.1 acres of park/beach park • 18.6 acres of transportation corridor (railroad right-of-way [ROW])	Various infill development Buildout in 2050.	N/A	This land use plan is consistent with the SCS land use pattern.
North 101 Corridor SP	May 21, 1997 (subsequently amended) Current through Ordinance 2019-16 and the April 2020 code supplement.	• 83.1 acres of residential only zoning • 53.3 acres of commercial and/or mixed use • 7.5 acres of P/SP • 0.2 acres of park • 32.7 acres of transportation corridor (railroad ROW)	Various infill development Buildout in 2050.	N/A	This land use plan is consistent with the SCS land use pattern.

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Home Depot SP	September 8, 1993 Current through Ordinance No. 93-17 and the November 2017 code republication.	• 10 acres of home improvement center • 17 single family homes • 5.1 acres of commercial • 37.2 acres of open space	Home improvement center 2.5 acres of commercial; buildout in 2050.	N/A	This land use plan is consistent with the SCS land use pattern.
Encinitas Ranch SP	September 28, 1994 (subsequently amended) Current through Ordinance 2019-16 and the April 2020 code supplement	• 446 low single-family homes • 81 medium single-family homes • 612 multi-family homes • 179 acres of open space • 171.8 acres of golf course • 750,000 sf of regional commercial • 22.8 acres of school/community use Amends 6.5 Single Family Residential Zones ("ER-SFR3," "ER-SFR3V" & "ER-SFR5" Zones). Amends 6.7 Mixed Use Zone ("ER-MU1" Zone). Amends 6.8 Mixed-Use Zone ("ER-MU2" Zone).	Residential component built out. Commercial is largely built out.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Cardiff SP	Effective Date May 8, 2013 Current through Ordinance 2019-16 and the April 2020 code supplement.	• 3.35 acres of residential zoning (C-R- 11) @ up to 11 du/acre equating to 37 DUs • 13.21 acres of general commercial • 0.53 acre of office professional	The CSP area is largely built out.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.

Table L-7
Escondido

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Palos Vista Specific Plan	July 1989 Amended 1/25/2012 Council Resolution No. 2012-08 (cell phone tower amendment)	• 980 acres • 692 single family units	Largely built out.	https://www.escondido.org/Data/Sites/1/media/pdfs/Planning/PalosVistaSpecificPlan.pdf	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.
Northeast Gateway Specific Plan	March 10, 2004 Revised 5/23/2007	• 418 acres • 517 single family units	Largely built out.	https://www.escondido.org/Data/Sites/1/media/pdfs/Planning/NortheastGatewaySpecificPlan.pdf	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not result in a new physical change to

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
					the environment not analyzed in other resource chapters of this EIR.
Escondido Research Technology Center Specific Plan	September 2002 Amended February 2006	• 186 acres • Concentration of a variety of office, research and development, industrial uses, hospital, and uses associated with a medical campus	Largely built out.	https://www.escondido.org/Data/Sites/1/media/pdfs/Planning/ERTCSpecificPlan.pdf	This land use plan contemplates commercial, industrial and hospital uses, which are not components of the SCS land use pattern. Therefore, the SCS land use pattern would not preclude the primary intent of the land use plan.
Downtown Specific Plan	June 1986 Updated August 2013	• 475 acres • 5,275 multi-family units	Largely built out.	https://www.escondido.org/specific-plans	This land use plan is consistent with the SCS land use pattern.
East Grove Specific Plan	Adopted December 1997 Updated February 1998	• 500 acres • 297 single family units	Largely built out.	https://www.escondido.org/Data/Sites/1/media/PDFs/Planning/EastGroveSpecificPlan.pdf	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not result in a new physical change to the environment not analyzed in other

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
					resource chapters of this EIR.
Villages Specific Plan	October 2017	• 109 acres	In progress.	https://www.escondido.org/Data/Sites/1/media/PDFs/Planning/ECC/finalEIR/VillagesSpecificPlan10-13-171.pdf	This land use plan is consistent with the SCS land use pattern.

Table L-8
La Mesa

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Downtown Village Specific Plan	April 1990	• Type of development allowed: ○ Mixed use commercial/retail ○ Single-family residential ○ Multi-family residential ○ Civic center • Buildout assumptions: ○ 4 specific development sites identified, comprising 10.3 acres. ○ Buildout assumptions not quantified.	No development on the four specific development sites. Other new development: • 18 mixed-use units • Police Station (83,000 sf) • County Library (17,000 sf) • Mini-storage facility (46,000 sf) Reinvestment in this area is ongoing. No buildout date identified, although the plan assumes a 20 year timeframe.	https://www.cityoflamesa.us/DocumentCenter/View/1172/Downtown-Village-Specific-Plan?bidId=	This land use plan is consistent with the SCS land use pattern.
Grossmont Specific Plan	April 1985 Amended 1994	• Type of development allowed: ○ Commercial/retail ○ Medical center campus ○ Multi-family residential • Buildout assumptions: ○ 260 multi-family homes ○ Includes, but is not limited to 1,600,000 square feet of new commercial retail	Residential built out (911 multi-family units built). Medical center campus largely built out. Commercial retail/office in progress.	https://www.cityoflamesa.us/DocumentCenter/View/2192/Grossmont-Specific-Plan?bidId=	This land use plan is consistent with the SCS land use pattern.

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
		and office space			

Table L-9
Lemon Grove

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Downtown Village Specific Plan	June 2005; Amended January 2009 Ordinance 380 April 2012 Ordinance 409	• Mixed use; transit oriented development ○ 546–819 residential units (25–45 DU/acre min.) ○ 789,449-sf commercial ○ 579,846-sf office ○ 169,111-sf civic • The Downtown Village Specific Plan area covers approximately 58.3 gross acres	In progress.	N/A	This land use plan is consistent with the SCS land use pattern.

Table L-10
Oceanside

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Rancho del Oro	10/1985 Rancho del Oro Village XII Planned residential development master plan amended 9/2011	Residential (largely detached single- family); commercial; light industrial; open space	Largely built out.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.
Mission Cove	2/2014	288 units of income-restricted housing for families and seniors with approximately 10,000 sf of commercial space	In progress.	N/A	This land use plan is consistent with the SCS land use pattern.

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
El Corazon Specific Plan	8/2011 Amended 12/2019	April 19, 2021, the Planning Commission approved the development plan of a three-story mixed use project consisting of apartments and commercial space in the "Village Commercial" area of El Corazon, on the northeast corner of Senior Center Drive and Village Commercial Drive. The El Corazon Specific Plan Area is within the original boundaries of the Rancho del Oro Specific Plan Area. This El Corazon Specific Plan is intended to supersede the Rancho del Oro Specific Plan in areas where overlap occurs.	Project is in progress; expected completion in 2023.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, inconsistency with the SCS land use pattern would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.

Table L-11
Poway

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Hidden Valley Ranch Specific Plan	November 2003	The Hidden Valley Ranch (HVR) specific plan project approved 41 single-family lots on approximately 420-acre site located in the Old Coach area	Project is in progress.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, inconsistency with the SCS land use pattern would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.
South Poway Specific Plan	December 2002 Last updated February 2016	650 acres of light industrial/industrial park, 28 acres of commercial, and 231 single family homes. 10 million sf of buildings expected at buildout.	Largely built out.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Poway Road Corridor Specific Plan	December 2017	Approximately 237 acres along Poway Road Land Use Districts include town center, mixed-use, commercial/office, commercial general, and automotive/commercial general.	Project is in progress.	https://poway.org/DocumentCenter/View/5245/-Poway-Road-Specific-Plan-?bidId=	This land use plan is consistent with the SCS land use pattern.

Table L-12
City of San Diego

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Balboa Avenue Station Area Specific Plan	September 2019	210 acres in the Pacific Beach and Clairmont Mesa communities; includes residential, light industrial, community village (mixed use), and open space.	Project is in progress.	https://www.sandiego.gov/sites/default/files/balboa_station_area_specific_plan_september_2019.pdf	This land use plan is consistent with the SCS land use pattern.
Morena Corridor Specific Plan	September 2019	280 acres along Morena Boulevard and West Morena Boulevard; buildout includes 18 single family homes, 6,898 multifamily homes, and 2,685,000 square feet of non-residential.	Project is in progress.	https://www.sandiego.gov/sites/default/files/morena_corridor_specific_plan_1.pdf	This land use plan is consistent with the SCS land use pattern.
Carmel Valley (NCW) Employment Center 2 Precise Plan	Sept 1987 One Paseo Amendment (July 2016)	Approximately 100-acre employment center: commercial office, light industrial, approximately 12-acre visitor commercial One Paseo: 23.6 acres mixed use community village	Largely built out.	http://www.sandiego.gov/planning/community/profiles/carmelvalley/plan.shtml	This land use plan is consistent with the SCS land use pattern.
Carmel Valley (NCW) Neighborhood 8	October 2021	926 DUs; 4.5-acre neighborhood commercial	Residential largely built out.	http://www.sandiego.gov/planning/community/profiles/carmelvalley/plan.shtml	This land use plan is consistent with the SCS land use pattern.
(North City West) Neighborhood 9 Town Center Precise Plan	Sept 1986	2277 DUs*, 528,800 sf commercial retail, 200,000 sf commercial office, park, school, library, transit center/park-and-ride	Approximately 150,000 sf retail; approximately 50,000 office transit facility.	N/A	This land use plan is consistent with the SCS land use pattern.
Carmel Valley	June 1997	1551 DUs, 4-acre	4-acre neighborhood	N/A	This land use plan is

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Neighborhood 10 Precise Plan		neighborhood commercial, school, park	commercial to go.		consistent with the SCS land use pattern.
NTC Precise Plan	July 17, 2001	365 DUs on 37 acres, 22-acre educational use, 23-acre office use, 107-acre mixed use, 46-acre park/open space, 54-acre, boat channel, 21-acre visitor hotel, 16-acre business hotel, 9-acre metropolitan wastewater department, 26-acre regional public safety training use	Largely built out.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.
Quarry Falls Specific Plan	October 21, 2008	When fully implemented, Quarry Falls will provide almost 60 acres of public parks, open space, and trails; a maximum of 4,780 residential units; a target of 480,000 sf of retail space; and a target of 420,000 sf of office/business park uses.	Largely built out.	http://www.sandiego.gov/planning/community/profiles/missionvalley/pdf/plans/quarryfallsspecificplan.pdf	This land use plan is consistent with the SCS land use pattern.
Levi-Cushman Specific Plan	August 11, 1987 Riverwalk Amendment (November 2020)	Riverwalk includes 4,300 homes; 152,000 sf of neighborhood-serving retail; and one million sf of office space.	Project is in progress.	N/A	This land use plan is consistent with the SCS land use pattern.

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Atlas Specific Plan	December 13, 1988 Town and Country Master Plan (May 2017)	840 unit residential development; renovated 700 hotel rooms and 177,000 sf of conference and meeting spaces.	Project is in progress.	N/A	This land use plan is consistent with the SCS land use pattern.
First San Diego River Improvement Project Specific Plan	November 16, 1982	1,274,000 sf of office space, 815,500 sf of retail space, 875 hotel rooms, and 2,535 residential units.	Largely built out.	N/A	This land use plan is consistent with the SCS land use pattern.

Table L-13
County of San Diego

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Campus Park / Horse Creek Ridge (Residential)	05/11/11	416-acre project site consisting of 751 total DUs divided as follows: • 521 single-family dwellings • 230 attached multi-family dwellings • 157,000 sf of professional office space • 61,200 sf of town center commercial • 8.5-acre public park • 3.8-acre HOA private parkland • 197-acre biological open space	Project in progress; estimated completion date: 2030.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, inconsistency with the SCS land use pattern would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.
Campus Park West	6/18/14	119-acre project site consisting of: • 513,000 sf of general • commercial space • 283 attached multi-family DUs • 120,000 sf of industrial space • 31 acres of biological open space	0% complete; estimated completion date: 2030.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, inconsistency with the SCS land use pattern would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.
Cielo Del Norte	12/03/03	482 acre SP. Proposes 154 units plus 46 from the Rancho Cielo transfer. 147	0% complete; estimated completion date: 2030.	N/A	The SCS land use pattern does not contemplate future

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
		acres (46 units) transferred from Rancho Cielo to Cielo del Norte.			residential growth in this plan area. However, inconsistency with the SCS land use pattern would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.
East Otay Mesa	7/27/94 & 9/15/10 7/25/2018: introduced two mixed-use designations: Mixed-Use Residential Emphasis and Mixed-Use Employment Emphasis. 3/17/2021: increased the acreage of heavy and mixed industrial zones, decreasing acreage for technology	3,012.7 acre project site consisting of: • 28-acre Activity Node Overlay • 28.8-acre Commercial Center Overlay • 11-acre District Commercial • 501.8-acre Heavy Industrial • 530.8-acre Mixed Industrial • 255.7-acre Light Industrial • 385.5-acre Technology Business Park • 311.3-acre Rural Residential • 241-acre Conservation/Limited Use • 606.3-acre Circulation Corridor	Roughly 10% of the project has been constructed (300 acres of the 3012.7); estimated completion date: 2050.	N/A	This land use plan is consistent with the SCS land use pattern.

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
	business park and light industrial zones.				
Greenhills Ranch	6/23/04	SP 98-004; TM 5140RPL7; R 98-006; ER 98-14-020: Phase I on 51.9 acres proposes 31 single-family residential units on 12.17 acres. Phase 2 consists of 44.2 acres and has no development proposed.	Largely built out.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.
Harmony Grove Village	2/7/07	468-acre project site consisting of: • 189-acre Open Space/Recreation • 177-acre Residential Units (742 DU) • 66-acre Streets • 22-acre Equestrian Ranch • 12-acre Institutional • 2-acre Commercial Development	Largely built out.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
					plan and would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.
Harmony Grove Village South	July 2018	111 acres total: • 453 single-family and multi-family units • 5,000 sf of commercial/civic uses • 4 acres of private and public parks • 35 acres biological open space	0% complete.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, inconsistency with the SCS land use pattern would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.
Hidden Meadows	9/17/03	675-acre project site consisting of: • 931 Residential Units: – 84.5 acres of Estate (35 units) – 299.4 acres of Single Family (716 units) – 21.7 acres of Townhomes (120 units) – 2.8 acres of Condominiums (60 units) • 97.2 acres of Natural Open Space • 148.1 acres of Improved	Largely built out.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not result in a new

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
		Open Space			physical change to the environment not analyzed in other resource chapters of this EIR.
Meadowood	1/11/2012	389-acre site consisting of: • 844 total DUs divided into: – 355 detached single family dwellings – 489 attached multi-family dwellings • 8-acre public park site • 122 acres of biological open space • 49 acres of agricultural open space • 12 acres for an elementary school • 5-acre wastewater treatment plant No commercial uses are proposed.	In progress; estimated completion date: 2030.	N/A	This land use plan is consistent with the SCS land use pattern.
Mesquite Trails Ranch	9/24/08	• 117.9 acre project site consisting of: – 25.4 acres for recreational vehicles (480 lots) – 18.5 acres of roadways – 4.8 acres for a community center – 0.9 acre for a secondary center – 3.2 acres for maintenance and storage	0% complete; estimated completion date: 2030.	N/A	This land use plan contemplates recreational vehicle uses, which are not a component of the SCS land use pattern. Therefore, the SCS land use pattern would not preclude the primary intent of the land use plan.

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
		– 65.1 acres of general use open space • 191.6 acres of natural open space			
Orchard Run	6/22/05 9/14/18 extension	118.3-acre project site consisting of: • 300 residential units: – 77 acres of SFR (248 units) – 4 acres of townhomes (52 units) • 1.4 acres for community recreation • 18.9 acres for floodplain open space • 9.1 acres of greenbelt open space • 5.8 acres of wastewater treatment plant • 1.6 acres of circulation	In progress; estimated completion date: 2030.	N/A	This land use plan is consistent with the SCS land use pattern.
Otay Ranch Village 13	Approved: November 2020	1,869 acres consisting of: • 1,881 SFRs • 14-acre mixed use site with 57 MFRs and 20,000 square feet of commercial use • 28 acres of park land, • 200 guest rooms • 20,000 square feet of commercial office uses • fire station • elementary school • 1,089 acres of preserve open space	0% complete.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, inconsistency with the SCS land use pattern would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Otay Ranch Village 14 and Planning Areas 16/19	Approved: June 2019 Last Amended: June 2020	• 579 acres consisting of 1,266 residential units, school, and fire station • 21.8 acres of public and private parks	0% complete.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, inconsistency with the SCS land use pattern would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.
Pala Mesa	1/24/74	403.75-acre project site consisting of: • 534 residential units: – 154.20 acres of PRD residential (521 units) – 47.15 acres of residential estates (13 units) – 57.90 acres of lodge suites (100 suites/83 lodge rooms) • 137 acres of open space and recreation • 4 acres of commercial • 3.5 acres for maintenance facility/public services	Largely built out.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Peppertree Park	8/14/91	162.9-acre project consisting of 267 single family DUs and 11 acres of office/ professional space.	Largely built out.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.

The Pointe Specific Plan	8/1/90
	
	Last amended: 6/26/2003
		• Changes to design/layout of plan consolidated facilities that allowed for an increase of multi-family DUs
		• Modifications to phasing of the project
		• 653-acre site consisting of:
		  ○ 572 single family DUs
		  ○ 283 multi-family units
		  ○ Destination resort golf course
		  ○ Commercial office/professional
			Residential largely built out.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not result in a new physical change to the environment not analyzed in other

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
					resource chapters of this EIR.
Rams Hill Country Club	12/10/86	• 560 acres consisting of 1,360 DUs • 25 acres for hotel and tennis complex • 13 acres for clinic • 346 acres for a golf course • 8-acre country club and golf pavilion • 30-acre commercial use • 313-acre future planning area • 1832 acres for permanent open space	50% complete; estimated completion date: 2030.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, inconsistency with the SCS land use pattern would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.
Rancho Cielo	3/4/84 Last Amended: January 2004	The original specific plan (SP 81-04) covered an area of 3,525 acres in size and included residential, commercial, and recreational land uses. Transfer 46 Country Estate Lots to the Cielo Del Norte Specific Plan Area (about 147 ac). Reduced total acreage is 2,668.	In progress; estimated completion date: 2050.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, inconsistency with the SCS land use pattern would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.
Santa Fe Creek	10/20/93 Last revised: 5/5/2003	The original specific plan (92-001, R91-032, TM5013, Log 92-08-010) approved estate residential for 56 lots on 194 acres. The	Largely built out.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area.

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
		development would be clustered into three planning areas.			However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.
Santa Fe Valley	12/13/95 Last amended 8/14/2017	• 3,160-acre project site consisting of: ○ 1,314.6 acres of residential (1,200 units) ○ 1,799.4 acres of open space ○ 14.3 acres of commercial uses ○ 31.7 acres of community facilities • In 2003 deleted Resort/Hotel land use designation that was redistributed to open space and residential. Minor changes in subarea location of dwelling units (did not change DU #). • In 2017 allowed for religious assembly in planning subarea.	Largely built out.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
USDRIP To be known as "Riverway"	8/9/00 Last amended: 2/3/2016	592-acre project site consisting of: • 569 SFR Units (78.08 ac) • 14.6-acre commercial • 248.5-acre industrial • 154-acre flood control/ open space • 7-acre elementary school • 20-acre middle school/fire station	70% complete; Estimated completion date: 2030 Partially developed	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, inconsistency with the SCS land use pattern would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.
Viejas Hills Estates	8/2/06 4/13/2018 submitted time extension	181.7 acre project site consisting of: • 41.6 acres of single family residential (27 lots) • 140.08 acres of open space	0% complete	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, inconsistency with the SCS land use pattern would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.
Warner Springs Ranch	11/5/83 3/22/2018 – Warner Spring Ranch Resort Specific Plan Amendment	2,885-acre project site consisting of: • 69-acre resort with 250 cottages • 152-acre 18-hole golf course • 35-acre private airport • 10-acre village commercial	90% of 1983 approved SP built out; estimated completion date, including amendments: 2060.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, inconsistency with the

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
		community school • 1.5-acre wastewater treatment plant • Approx. 2,400-acre future planning area Warner Spring Ranch Resort Specific Plan Amendment: • 2,452 acres of Warner Springs Ranch Specific Plan • 9-hole addition to 18-hole golf course • 120-space recreational vehicle park and restaurant • 685 residential units			SCS land use pattern would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.

Table L-14
San Marcos

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
San Marcos Creek SP	August 2007 Update in progress	Mixed Use (commercial, industrial, residential, and institutional) • 1,265,000 sf of commercial • 589,000 sf of office space • 2,300 multi-family units • 214-acre area along the San Marcos Creek in Central SM. • 94 acres preserved or created for parks and open space, 72 of which will be preserved or naturalized open space	Project is in progress.	N/A	This land use plan is consistent with the SCS land use pattern.
University District SP	November 2009 Administra-tively Amended March 2014, November 2016, August 2017, February 2018, and September 2019	Mixed Use • 1,000,000 sf of commercial • 938,000 sf of office • 30,000 sf civic/community • 2600 multi-family units • 800 student housing • 652,000 sf of general office • 300,000 sf of medical office • 700,000 sf of mixed use retail/commercial	Project is in progress.	N/A	This land use plan is consistent with the SCS land use pattern.

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Heart of the City SP	January 1988 Last amended January 2018	• 13-acre business park • 66-acre town center • 48 acres of commercial • 16 acres of neighborhood commercial • 12 acres of office professional • 5 acres of mixed use (108 apartments and approx. 12,000 sf of commercial) • 9 acres of commercial manufacturing • 36 acres of hospital complex • 2,127 multi-family units • 1,335 single-family units Project site is 248 acres	Largely built out.	N/A	This land use plan is consistent with the SCS land use pattern.
University Commons SP aka: Old Creek Ranch	August 2003	• 10.3 acres of industrial • 401 single-family units • 1123 multi-family units	Largely built out.	N/A	This land use plan is consistent with the SCS land use pattern.
San Elijo Hills SP	November 1990 Formerly amended June 2011 Administra-tively amended August 2018	• 12.5 acres of commercial • 2496 single-family units • 972 multi-family units	Largely built out.	N/A	This land use plan is consistent with the SCS land use pattern.

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Davia Village	November 2013	416 multi-family units 15,000 sf of mixed-use commercial/retail	In progress.	https://www.san-marcos.net/Home/ShowDocument?id=8384	This land use plan is consistent with the SCS land use pattern.
Mulberry Specific Plan	June 2014	Residential development • 55 single-family units • 71 multi-family units • 10.01 gross acres	Largely built out.	https://www.san-marcos.net/home/showpublisheddocument/9351/636565241201030000	This land use plan is consistent with the SCS land use pattern.
El Dorado II	April 2014	Mixed use community development. • 120 multi-family affordable units • 7,000 sf of mixed-use commercial/retail	In progress.	N/A	This land use plan is consistent with the SCS land use pattern.

Table L-15
Santee

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Fanita Ranch Specific Plan	May 2020	2,650 acres consisting of: • 2,000 acres protected as open space, parks, and agriculture • 2,950 homes • K-8 school • Fire station • Community-serving retail	0% complete; 15–20 year build out.	N/A	The SCS land use pattern does not contemplate future residential growth in this plan area. However, inconsistency with the SCS land use pattern would not result in a new physical change to the environment not analyzed in other resource chapters of this EIR.
Town Center Specific Plan	October 1986 Last amended 2019	Mixed use development	Largely built out.	N/A	This land use plan is consistent with the SCS land use pattern.

Table L-16
Vista

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
Downtown Vista Specific Plan	March 2010 Amended 9/2015 Amended 10/2018	352-acre area with a variety of uses: • Area 1: mix of residential (up to 838 DUs) and commercial, office, and retail (1,064,689 sf) • Area 2: limited residential (122 DUs), primarily commercial (shopping and entertainment) (400,069 sf) • Area 3: future pedestrian-oriented mixed-use and retail (270 DUs; 587,944 sf); • Area 4: residential (450 DUs) and retail and restaurants (572,152 sf)	In progress.	https://www.cityofvista.com/city-services/city-departments/community-development/building-planning-permits-applications/vista-general-plan-2030/specific-plan	This land use plan is consistent with the SCS land use pattern.
Hacienda Specific Plan	October 2000	• 51-acre site • 195 single-family detached homes • Recreation and park areas and associated infrastructure	Largely built out.	https://www.cityofvista.com/city-services/city-departments/community-development/building-planning-permits-applications/vista-general-plan-2030/specific-plan	The SCS land use pattern does not contemplate future residential growth in this plan area. However, this land use plan is largely built out. Inconsistency with the SCS land use pattern would not preclude the primary intent of the land use plan and would not result in a new physical change to the environment not analyzed in other

Plan Name	Date Adopted (Month/Year)	Type of Development Allowed/Buildout Assumptions	Development Occurred To Date/Buildout Expected	Link to Document	Consistency with SCS Land Use Pattern
					resource chapters of this EIR.
Enclave at Delpy's Corner Specific Plan (formerly Vineyards Specific Plan)	November 2016	124 townhomes on 16.1 acres	In progress.	https://www.cityofvista.com/city-services/city-departments/community-development/building-planning-permits-applications/vista-general-plan-2030/specific-plan	This land use plan is consistent with the SCS land use pattern.

Appendix M

Mineral Resources Appendix

APPENDIX M
MINERAL RESOURCES APPENDIX

Table M-1
Conversion of Undeveloped MRZ-2 Lands under the Proposed Plan: Regional Growth and Land Use Change and Transportation Network Improvement, Relative to 2016

Converted MRZ-2 Lands (acres)	2016–2025	2016–2035	2016–2050
Regional Growth and Land Use Change	789	803	817
Transportation Network Improvements	11	23	36
Total	800	826	853

Table M-2
Conversion of Undeveloped MRZ-2 Lands: Transportation Network Improvements, 2016 to 2025

Transportation Network Improvement	Converted MRZ-2 Lands (acres)
Active Transportation	
San Diego River Trail - Carlton Oaks Segment	2.3
Ops/Maintenance – Highway Bridge Program	
Heritage Road Bridge	0.4
Existing or Permitted Separately	
Project not in RTP	8.0
TOTAL, 2016 to 2025	**10.7**

Table M-3
Conversion of Undeveloped MRZ-2 Lands: Transportation Network Improvements, 2026 to 2035

Transportation Network Improvement	Converted MRZ-2 Lands (acres)
Active Transportation	
San Diego River Trail – Mast Park to Lakeside Baseball Park	3.9
Santee – El Cajon Corridor	0.8
Subtotal	*4.7*
Complete Corridor: ML	
SR 52 (I-15 to Mast Boulevard)	0.1
SR 52 (Mast Boulevard to SR 125)	0.1
Subtotal	*0.2*
Transit Leap	
Commuter Rail 582	2.2
Subtotal	*2.2*
Existing/Not in RTP	
Project Not in RTP	5.3

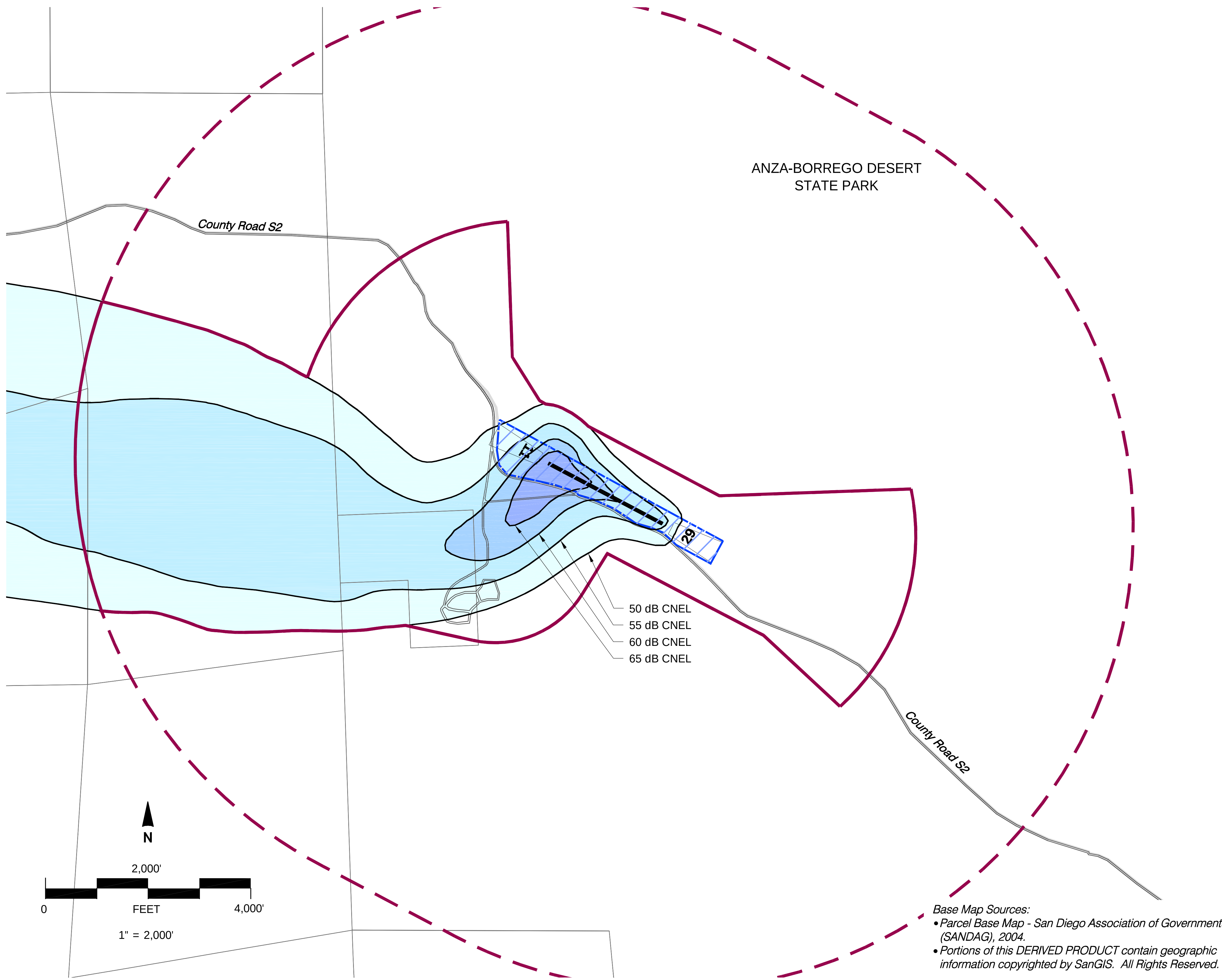
Transportation Network Improvement	Converted MRZ-2 Lands (acres)
Subtotal	*5.3*
Subtotal, 2026 to 2035	*12.4*
Subtotal, 2016 to 2025	*10.7*
TOTAL, 2016 to 2025	**23.1**

Table M-4
Conversion of Undeveloped MRZ-2 Lands: Transportation Network Improvements, 2036 to 2050

Transportation Network Improvement	Converted MRZ-2 Lands (acres)
Active Transportation	
San Diego River Trail – Mast Park to Lakeside Baseball Park	0.1
SR 52 Bikeway – I-5 to Santo Road	1.2
San Luis Rey River Trail	8.2
SR 125 Connector – Bonita Road to U.S.-Mexico Border	0.1
Encinitas to San Marcos Corridor – Double Peak Drive to San Marcos Boulevard	0.1
Subtotal	*9.6*
Transit Leap	
Commuter Rail 582	1.1
Commuter Rail 583	1.1
Subtotal	*2.3*
Existing/Not in RTP	
Project Not in RTP	0.7
Subtotal	*0.7*
Subtotal, 2036 to 2050	*12.6*
Subtotal, 2026 to 2035	*12.4*
Subtotal, 2016 to 2025	*10.7*
TOTAL, 2016 to 2025	**35.7**

Appendix N

Noise Contour Maps



Base Map Sources:

- Parcel Base Map - San Diego Association of Governments (SANDAG), 2004.
- Portions of this DERIVED PRODUCT contain geographic information copyrighted by SanGIS. All Rights Reserved.

Legend

Boundary Lines

- Airport Property Line
- Parcel Line

Noise Impact Zones*

- 50 - 55 dB CNEL
- 55 - 60 dB CNEL
- 60 - 65 dB CNEL
- 65 + dB CNEL

Future Average Annual Day (10 Operations)

Airport Influence Area

- Review Area 1
- Review Area 2

Notes

* Source: Harris Miller Miller & Hanson, Inc. (November 2004).

See Table AGU-1 for criteria applicable within each zone.

50 dB CNEL contour continues westward, not closing within study area because of low altitudes of helicopters along flight track.

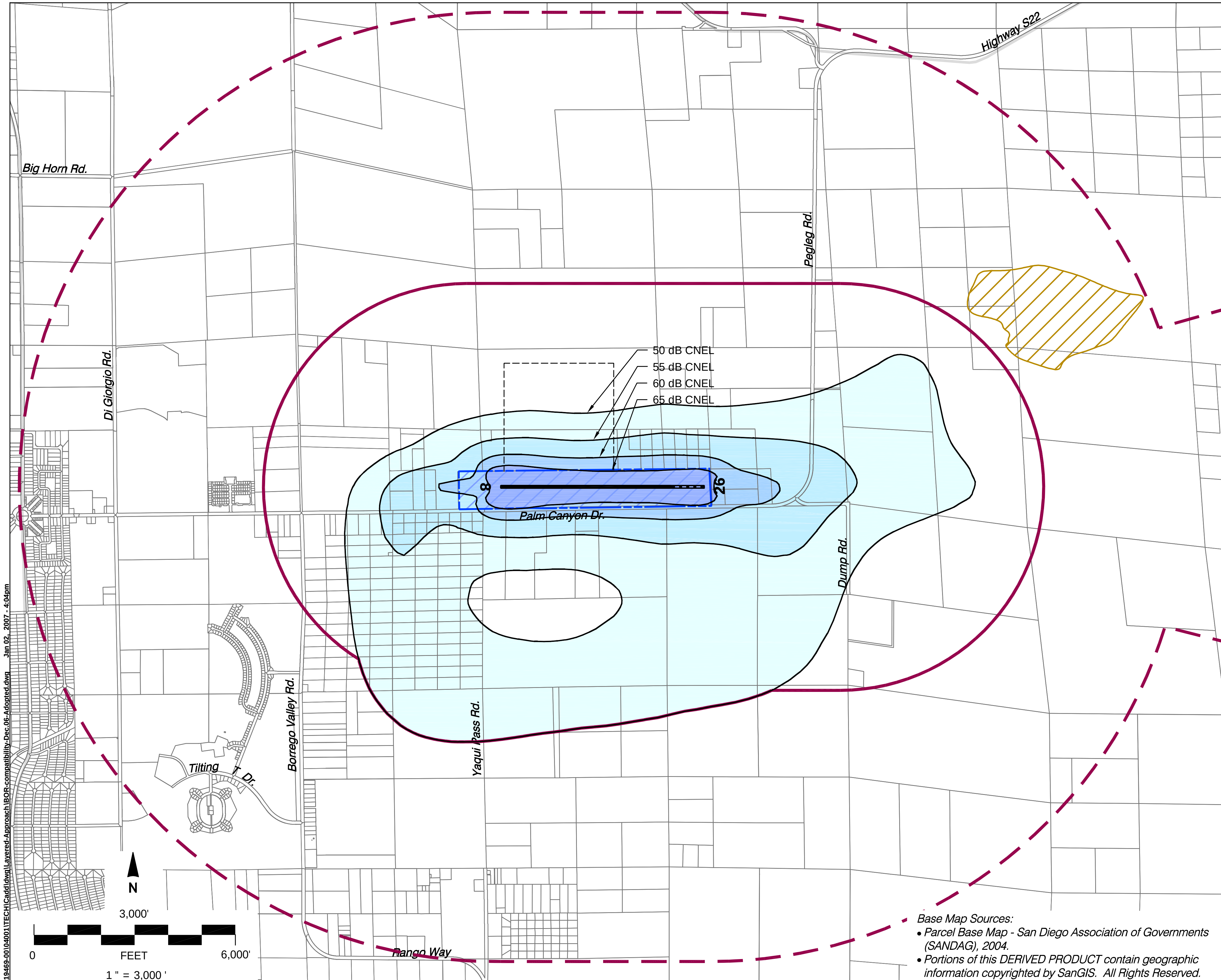
AIRPORT LAND USE COMMISSION
SAN DIEGO COUNTY

Agua Caliente Airport
Land Use Compatibility Plan

(Adopted December 2006)

Map AGU-1

Compatibility Policy Map: Noise



Legend

Boundary Lines

- Airport Property Line
- Parcel Line

Noise Impact Zones*

- 50 - 55 dB CNEL
- 55 - 60 dB CNEL
- 60 - 65 dB CNEL
- 65 + dB CNEL

Future Average Annual Day (137 Operations)

Airport Influence Area

- Review Area 1
- Review Area 2

Notes

* Source: Harris Miller Miller & Hanson, Inc. (November 2004).

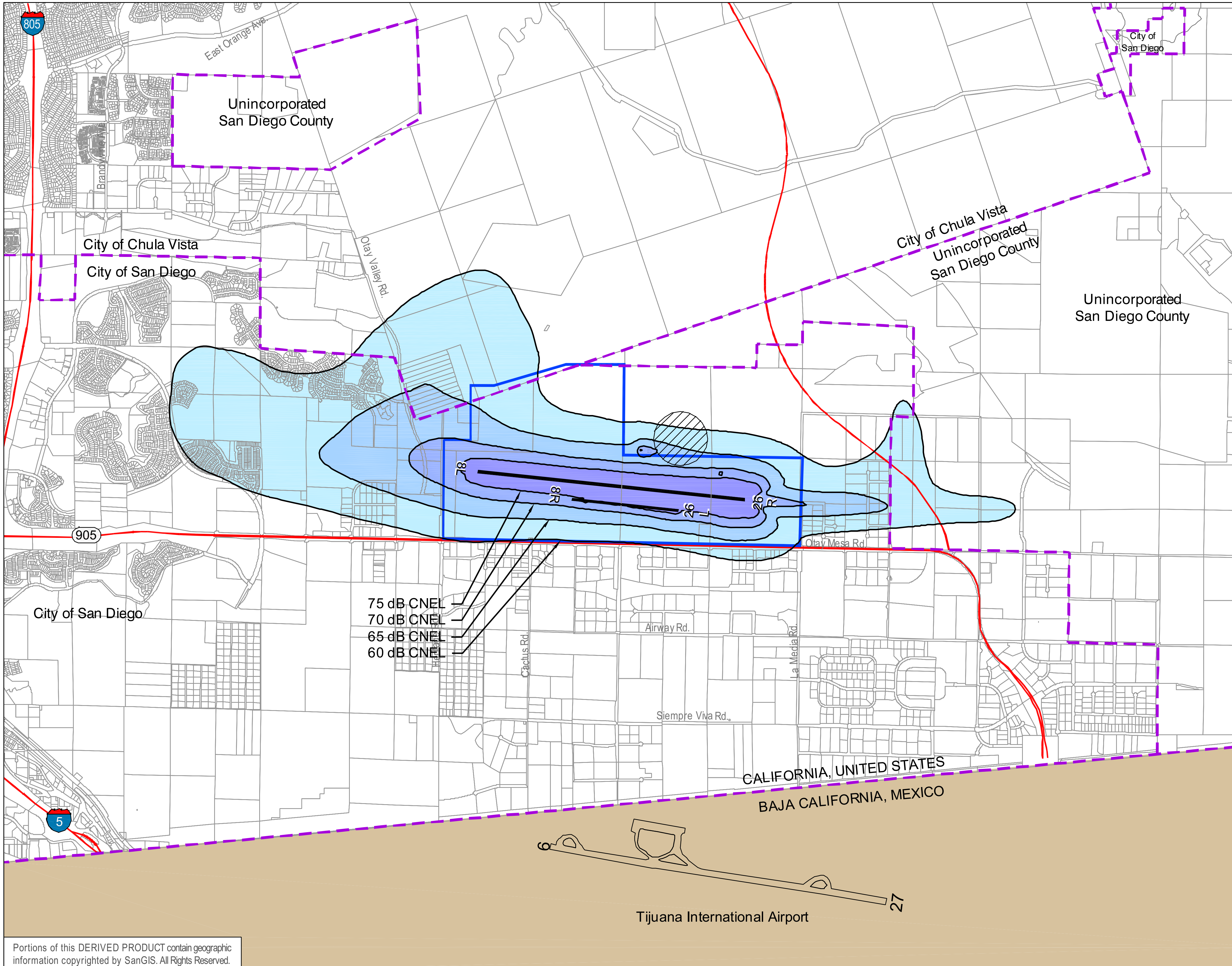
See Table BOR-1 for criteria applicable within each zone.

AIRPORT LAND USE COMMISSION
SAN DIEGO COUNTY

Borrego Valley Airport
Land Use Compatibility Plan
(Adopted December 2006)

Map BOR-1

Compatibility Policy Map: Noise



AIRPORT LAND USE COMMISSION
SAN DIEGO COUNTY

LEGEND

- Airport Property Boundary
- Parcel Line
- Highways
- Municipal Boundary
- No Overflights Below 1,500' MSL

Noise Exposure Range:

- 60 - 65 dB CNEL
- 65 - 70 dB CNEL
- 70 - 75 dB CNEL
- 75 + dB CNEL

Future Average Annual Day (658 operations)

north

0 3,000 ft.

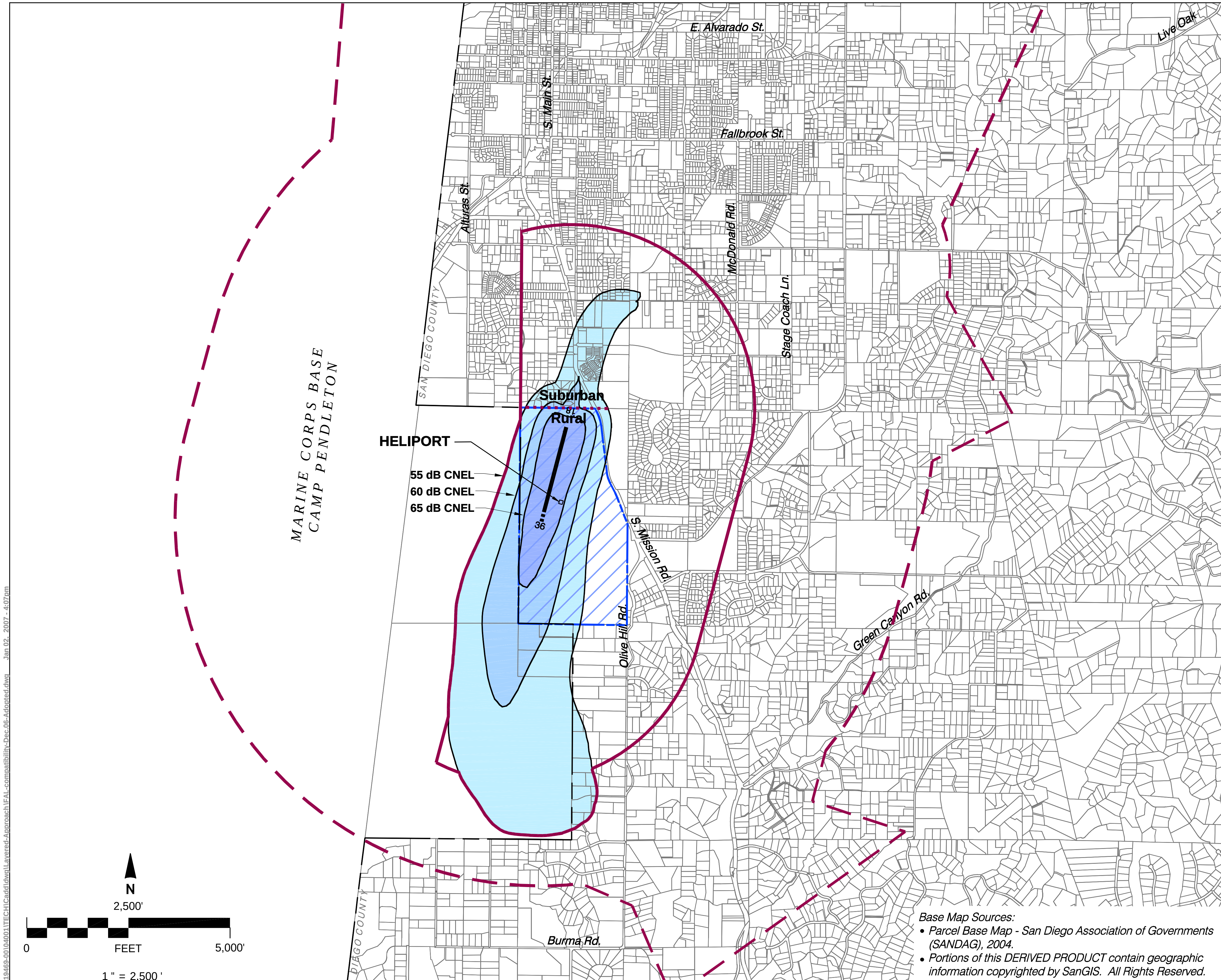
Notes: 1. See Table III-1 for criteria applicable within each noise exposure area.
2. CNEL = Community Noise Equivalent Level
3. MSL = Mean Sea Level

Sources: Parcels - San Diego Geographic Information Source (SanGIS), 2008;
Noise Contours - Harris, Miller, Miller & Hanson, January 2007.

Prepared by: Ricondo & Associates, Inc., October 2009.

Exhibit III-1

Compatibility Policy Map: Noise



Legend

Boundary Lines

- Airport Property Line
- Parcel Line
- MCB Camp Pendleton

Noise Impact Zones*

- 55 - 60 dB CNEL
- 60 - 65 dB CNEL
- 65 + dB CNEL

Future Average Annual Day (142 Operations)

Airport Influence Area

- Review Area 1
- Review Area 2

Notes

* Source: Harris Miller Miller & Hanson, Inc. (November 2004).

See Table FAL-1 for criteria applicable within each zone.

Suburban criteria apply to zones at the North end of the runway; rural criteria apply to the remainder of the Airport Influence Area.

Mapped noise contours are a blending of two sets of future noise contours reflecting:
1) Future aircraft activity on existing runway alignment
2) Future aircraft activity on future runway alignment

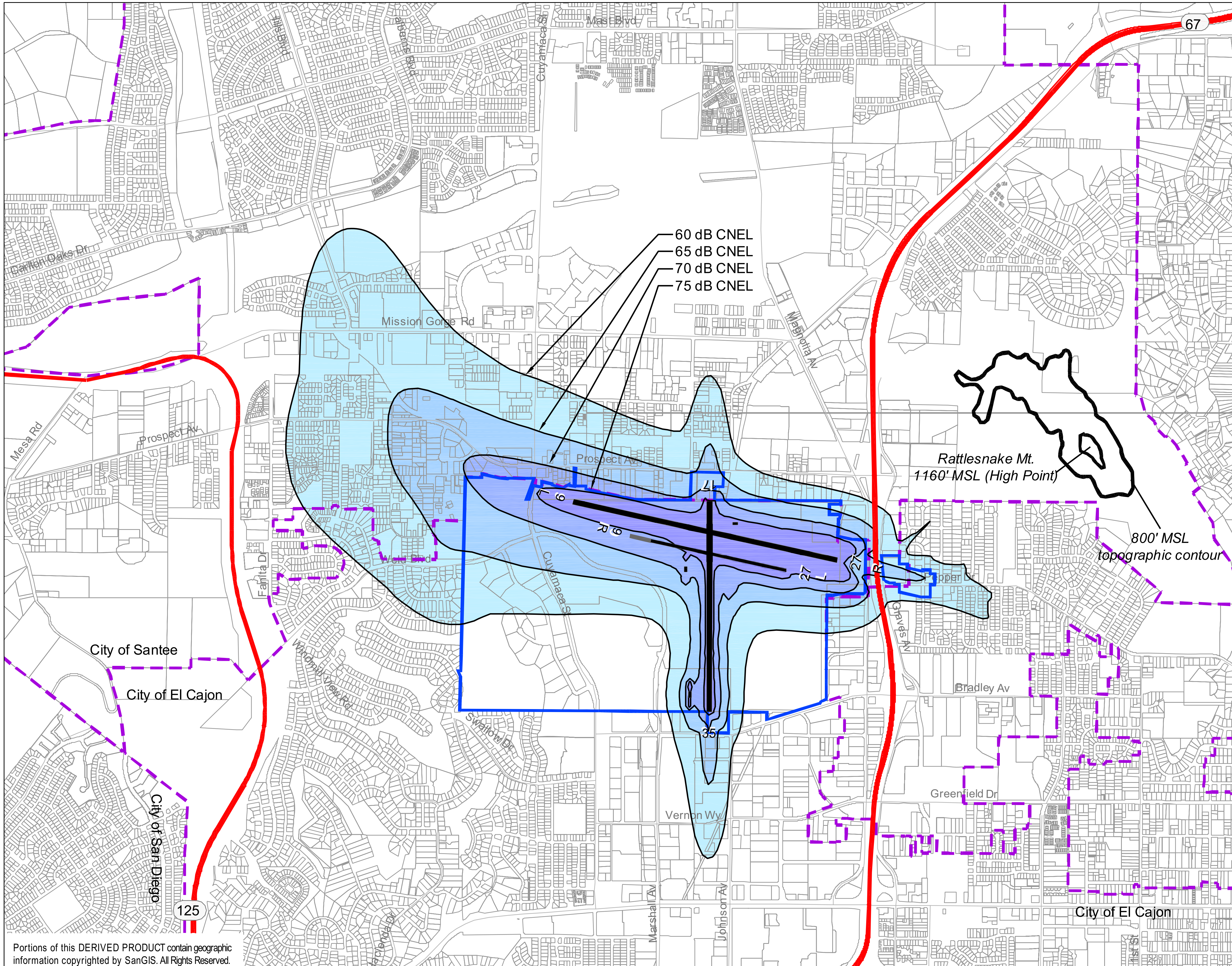
AIRPORT LAND USE COMMISSION
SAN DIEGO COUNTY

Fallbrook Community Airpark
Land Use Compatibility Plan

(Adopted December 2006)

Map FAL-1

Compatibility Policy Map: Noise



AIRPORT LAND USE COMMISSION
SAN DIEGO COUNTY

LEGEND

- Airport Property Boundary
- Parcel Line
- Highways
- Municipal Boundary
- Future Runway 9R/27L extension

Noise Exposure Range

- 60 - 65 dB CNEL
- 65 - 70 dB CNEL
- 70 - 75 dB CNEL
- 75 + dB CNEL

Existing and Future Average Annual Day (776 and 973 operations respectively)

north

0 2,000 ft.

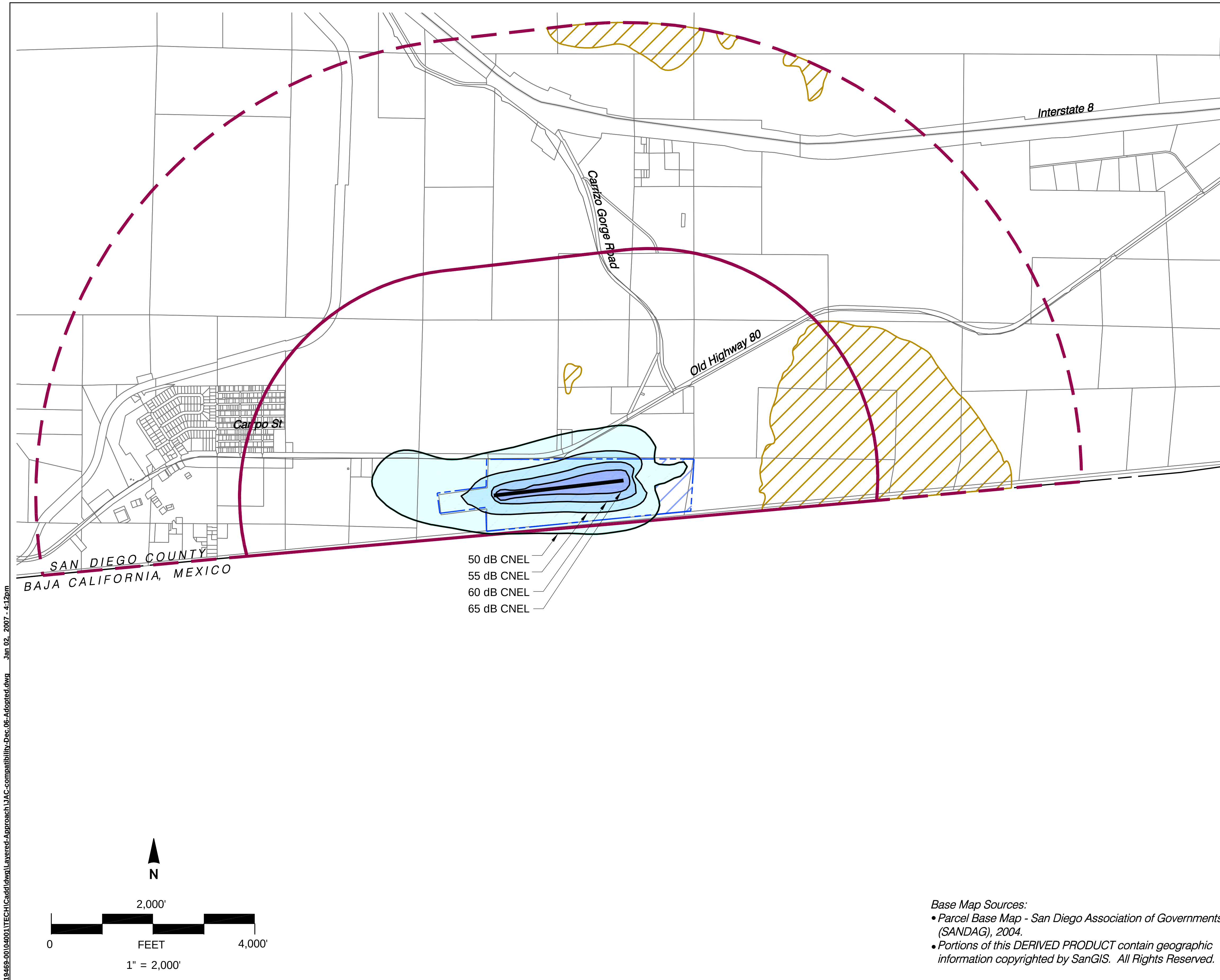
Notes:
1. See Table III-1 for criteria applicable within each noise exposure range.
2. Airport elevation is 387 feet above mean sea level (MSL).
3. The depicted contours are a combination of existing and future contours and represent the highest noise level of either scenario.
4. CNEL = Community Noise Equivalent Level.
5. MSL = Mean Sea Level.

Sources: Parcels - San Diego Geographic Information System (SanGIS), 2008; Noise Contours - Harris, Miller, Miller & Hanson, April 2007.

Prepared by: Ricondo & Associates, Inc., October 2009.

Exhibit III-1

Compatibility Policy Map: Noise



Legend

Boundary Lines
- Airport Property Line
- Parcel Line

Noise Impace Zones*
- 50 - 55 dB CNEL
- 55 - 60 dB CNEL
- 60 - 65 dB CNEL
- 65 + dB CNEL

Future Average Annual Day (9 Operations)

Airport Influence Area
- Review Area 1
- Review Area 2

Notes
* Source: Harris Miller Miller & Hanson, Inc. (November 2004).

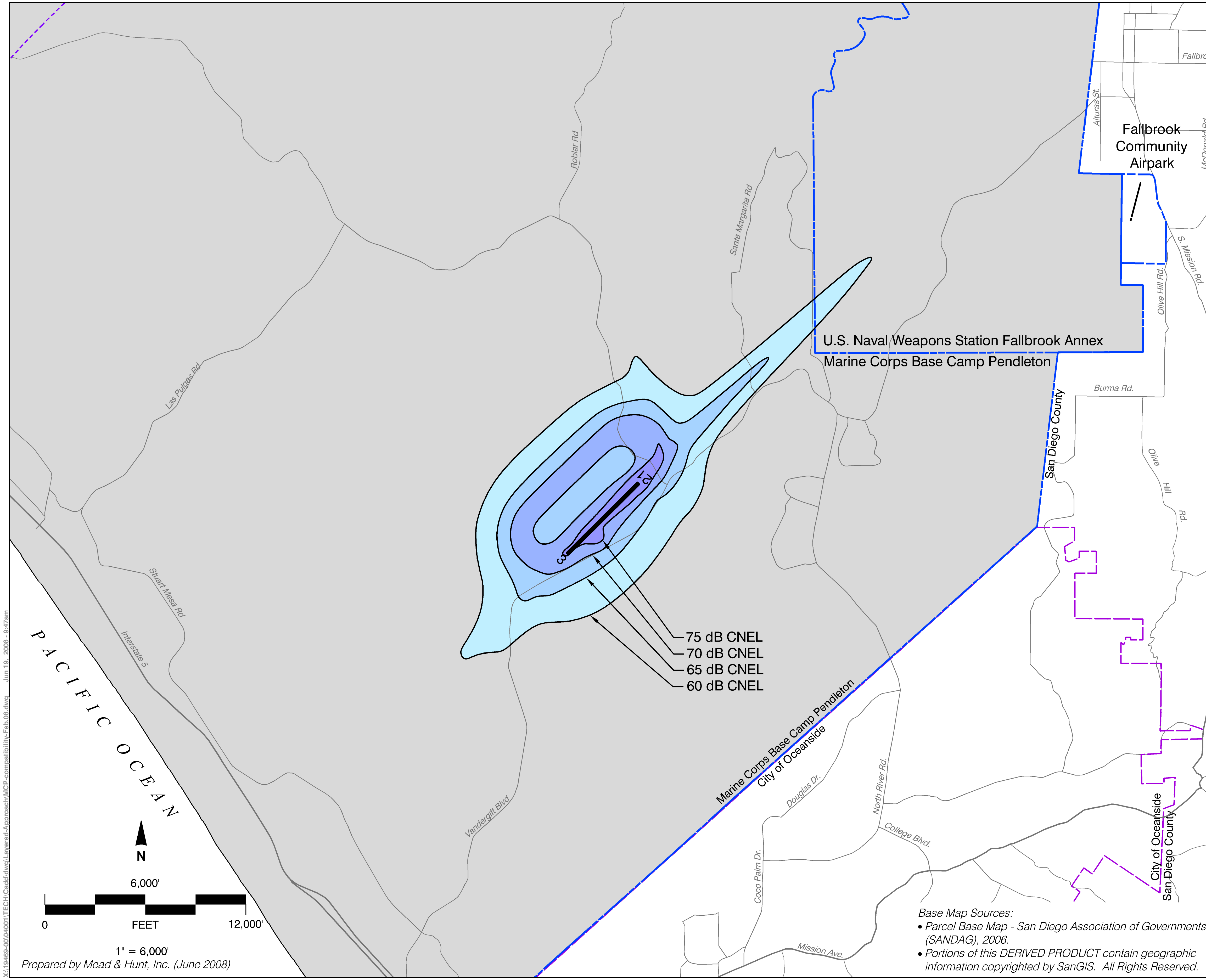
See Table JAC-1 for criteria applicable within each zone.

AIRPORT LAND USE COMMISSION
SAN DIEGO COUNTY

Jacumba Airport
Land Use Compatibility Plan
(Adopted December 2006)

Map JAC-1

Compatibility Policy Map: Noise



Legend

Boundary Lines

- Airport Property Line
- Roads
- City Limits

Noise Exposure Contours[1]

- 60 - 65 dB CNEL
- 65 - 70 dB CNEL
- 70 - 75 dB CNEL
- 75 + dB CNEL

Future Average[2] Annual Day (483 Operations)

Notes

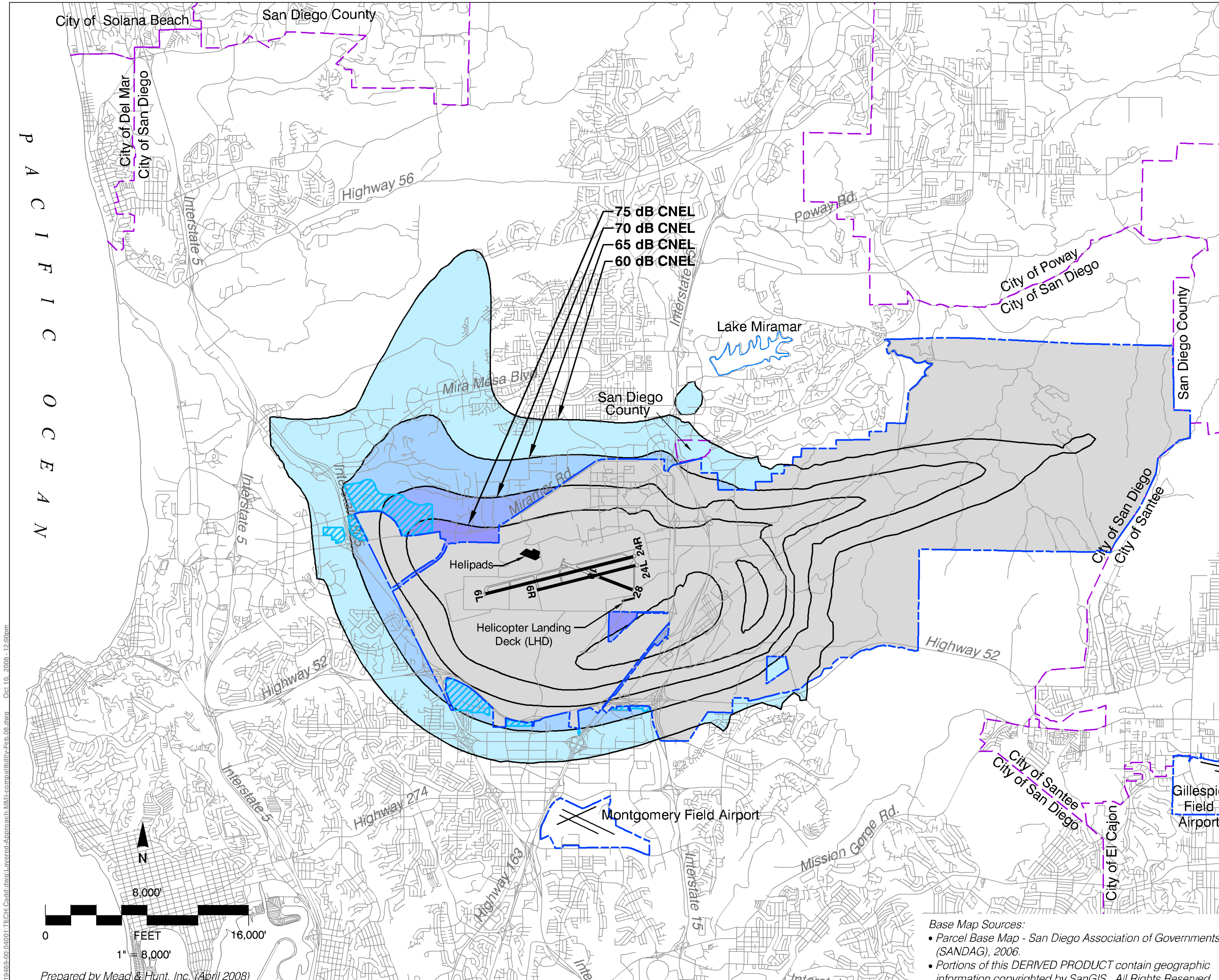
1. See Table MCP-1 for criteria applicable within each noise exposure contour.
2. Noise Contour source: MCAS Camp Pendleton AICUZ Update (December 1995).

AIRPORT LAND USE COMMISSION
SAN DIEGO COUNTY

MCAS Camp Pendleton
Airport Land Use Compatibility Plan
(Adopted June 2008)

Map MCP-1

Compatibility Policy Map: Noise



Legend

Boundary Lines

- Airport Property
- Restrictive Use Easement
- Roads
- City Limits

Noise Exposure Contours[1]

- 60 - 65 dB CNEL
- 65 - 70 dB CNEL
- 70 - 75 dB CNEL
- 75 + dB CNEL

Future Average[2] Annual Day (308 Operations)

Notes

1. See Table MIR-1 for criteria applicable within each noise exposure contour.
2. Noise Contour source: MCAS Miramar AICUZ (March 2005).

AIRPORT LAND USE COMMISSION
SAN DIEGO COUNTY

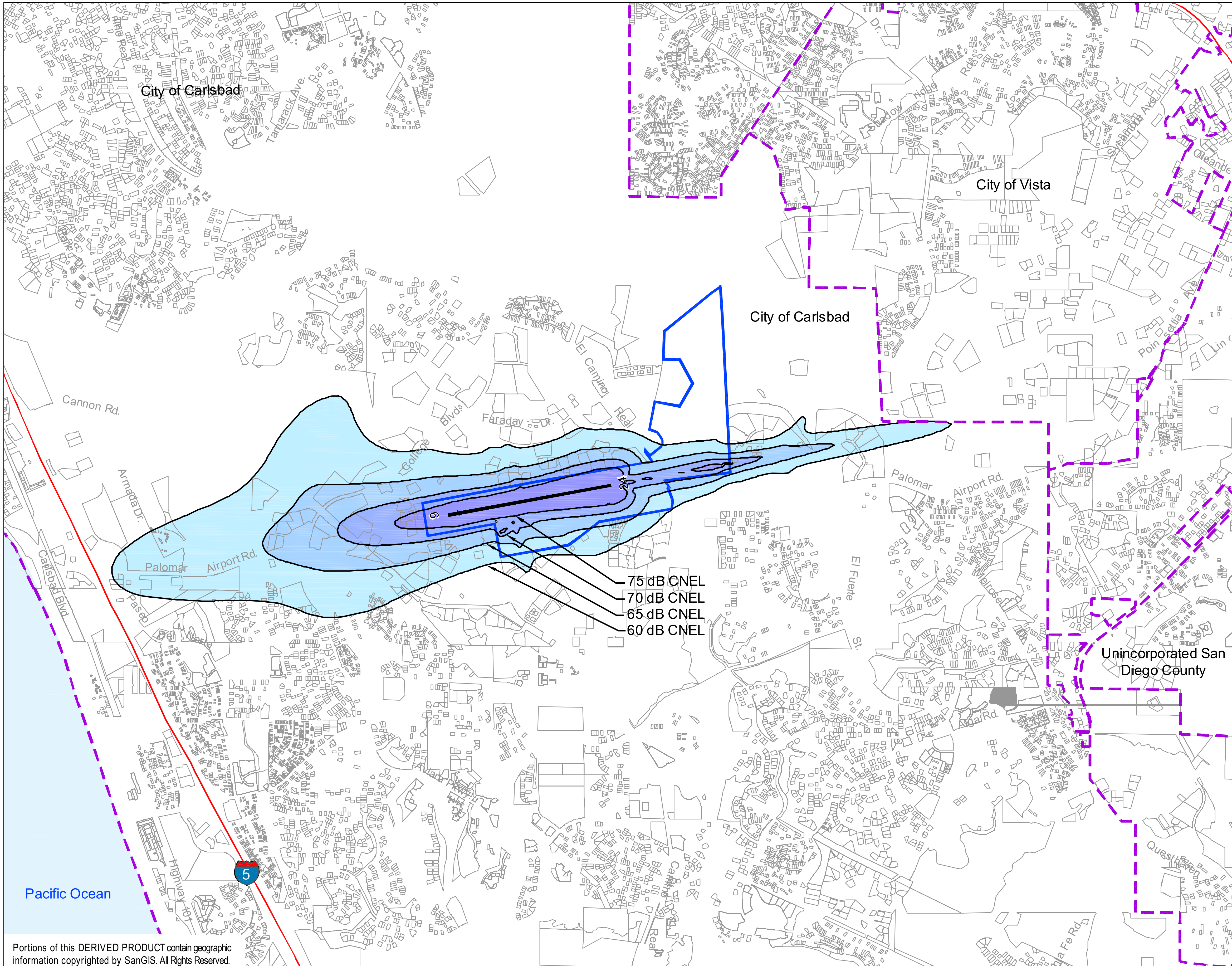
MCAS Miramar

Airport Land Use Compatibility Plan

(Adopted October 2008)

Map MIR-1

Compatibility Policy Map: Noise



AIRPORT LAND USE COMMISSION
SAN DIEGO COUNTY

LEGEND

- Airport Property Boundary
- Parcel Line
- Highways
- Municipal Boundary

Noise Exposure Range

- 60 - 65 dB CNEL
- 65 - 70 dB CNEL
- 70 - 75 dB CNEL
- 75 + dB CNEL

Future Average Annual Day (792 Operations)

north

0 3,000 ft.

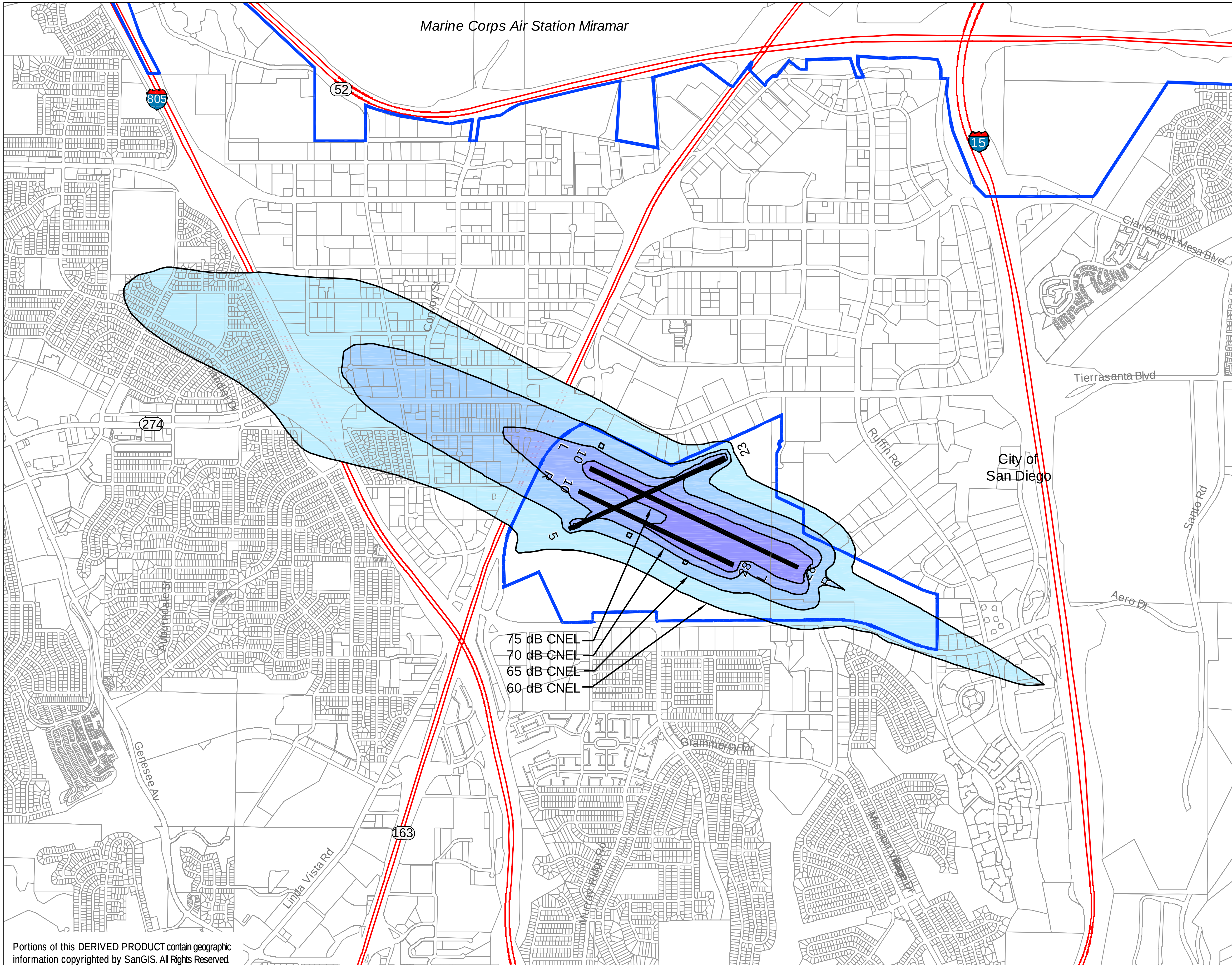
Notes: 1. See Table III-1 for criteria applicable within each noise exposure range.
2. CNEL = Community Noise Equivalent Level.

Sources: Parcels - San Diego Geographic Information Source (SanGIS), 2008; Noise Contours - Harris, Miller, Miller & Hanson, December 2006.

Prepared by: Ricondo & Associates, Inc., October 2009.

Exhibit III-1

Compatibility Policy Map: Noise



AIRPORT LAND USE COMMISSION
SAN DIEGO COUNTY

LEGEND

- Airport Property Boundary
- Parcel Line
- Highways

Noise Exposure Range

- 60 - 65 dB CNEL
- 65 - 70 dB CNEL
- 70 - 75 dB CNEL
- 75 + dB CNEL

Future Average
Annual Day
(1,014 Operations)

north

0 2,000 ft.

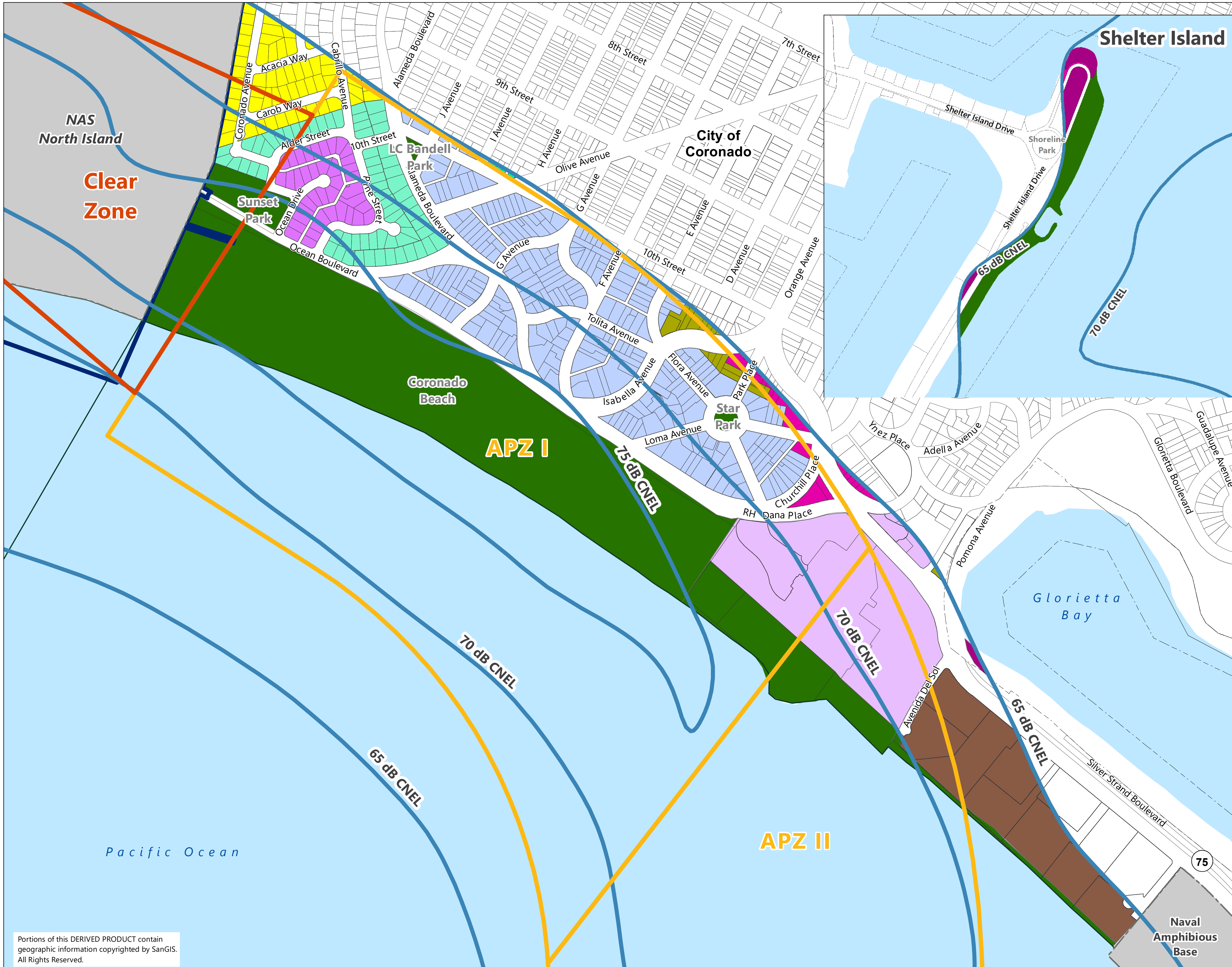
Notes: 1. See Table III-1 for criteria applicable within each noise exposure range.
2. CNEL = Community Noise Equivalent Level.

Sources: Parcels - San Diego Geographic Information Source (SanGIS), 2008;
Noise Contours - City of San Diego, *Montgomery Field Airport Master Plan Update*, August 2004.

Prepared by: Ricondo & Associates, Inc., October 2009.

Exhibit III-1

Compatibility Policy Map: Noise



SAN DIEGO COUNTY REGIONAL AIRPORT AUTHORITY

AIRPORT LAND USE COMMISSION

LEGEND

- Naval Air Station Property Boundary
- Federal Lands
- San Diego Unified Port District
- Municipal Boundaries
- Water
- Clear Zone Boundary
- Accident Potential Zone (APZ) I & II Boundaries
- Prospective Noise Contours

Existing Zoning and Minimum Residential Lot Size or Maximum Density

- R-1A(CC-1) - Single-Family Residential (7,500 sq ft)
- R-1A(CC-2) - Single-Family Residential (6,600 sq ft)
- R-1A(CC-3) - Single-Family Residential (6,000 sq ft)
- R-1A - Single-Family Residential (5,500 sq ft)
- R-1A(E) - Single-Family Residential (5,250 sq ft)
- R-1B - Single-Family Residential (3,500 sq ft)
- R-3 - Multiple-Family Residential (28 du/ac)
- R-5 - Multiple-Family Residential (47 du/ac)
- C - Commercial
- C-R - Commercial Recreation
- H-M - Hotel-Motel
- OS - Open Space
- MZ - Military Zone

north

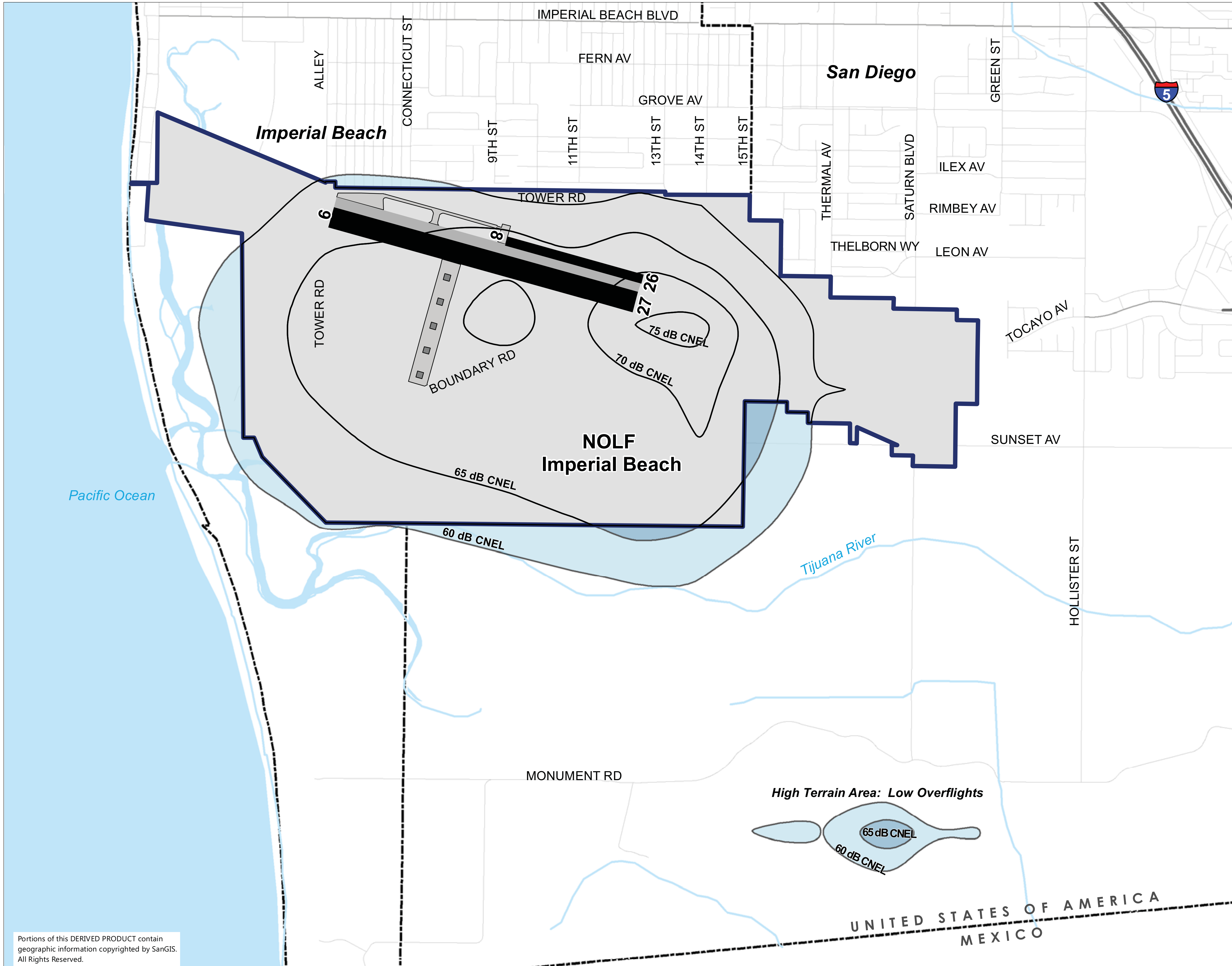
0 700 ft.

Sources: SanGIS, County of San Diego, 2019 (roads); California Department of Water Resources, 2019 (federal lands); Unified Port of San Diego, 2015 (port district boundary); County Assessor, SanGIS, San Diego Local Agency Formation Commission, 2019 (municipal boundaries); SanGIS, County of San Diego, 2015 (hydrology); The Onyx Group, *Air Installation Compatibile Use Zones (AICUZ) Update for Naval Air Station North Island and Naval Outlying Landing Field Imperial Beach, California*, Naval Facilities Engineering Command Southwest, 2011, Figure 2-2 on page 2-3 (airport property line), Figure 3-1 on page 3-2 (airfield and runways), Figure 4-8 on page 4-12 (prospective noise contours), Figure 5-3 on page 5-7 (safety zones); City of Coronado, Community Development Department, 2004, https://www.coronado.ca.us/cms/one.aspx?pageId=1619276, accessed June 28, 2019, (zoning).

Prepared By: Ricondo & Associates, Inc., September 2019.

Exhibit 4

Safety Zones and Noise Contours



LEGEND

- Major Roads
- Highways
- Municipal Boundaries
- Airport Property Boundary
- Water

Forecast Noise Exposure Ranges:

- 60 - 65 dB CNEL
- 65 - 70 dB CNEL
- 70 - 75 dB CNEL
- 75 + dB CNEL

north

0 1,600 ft.

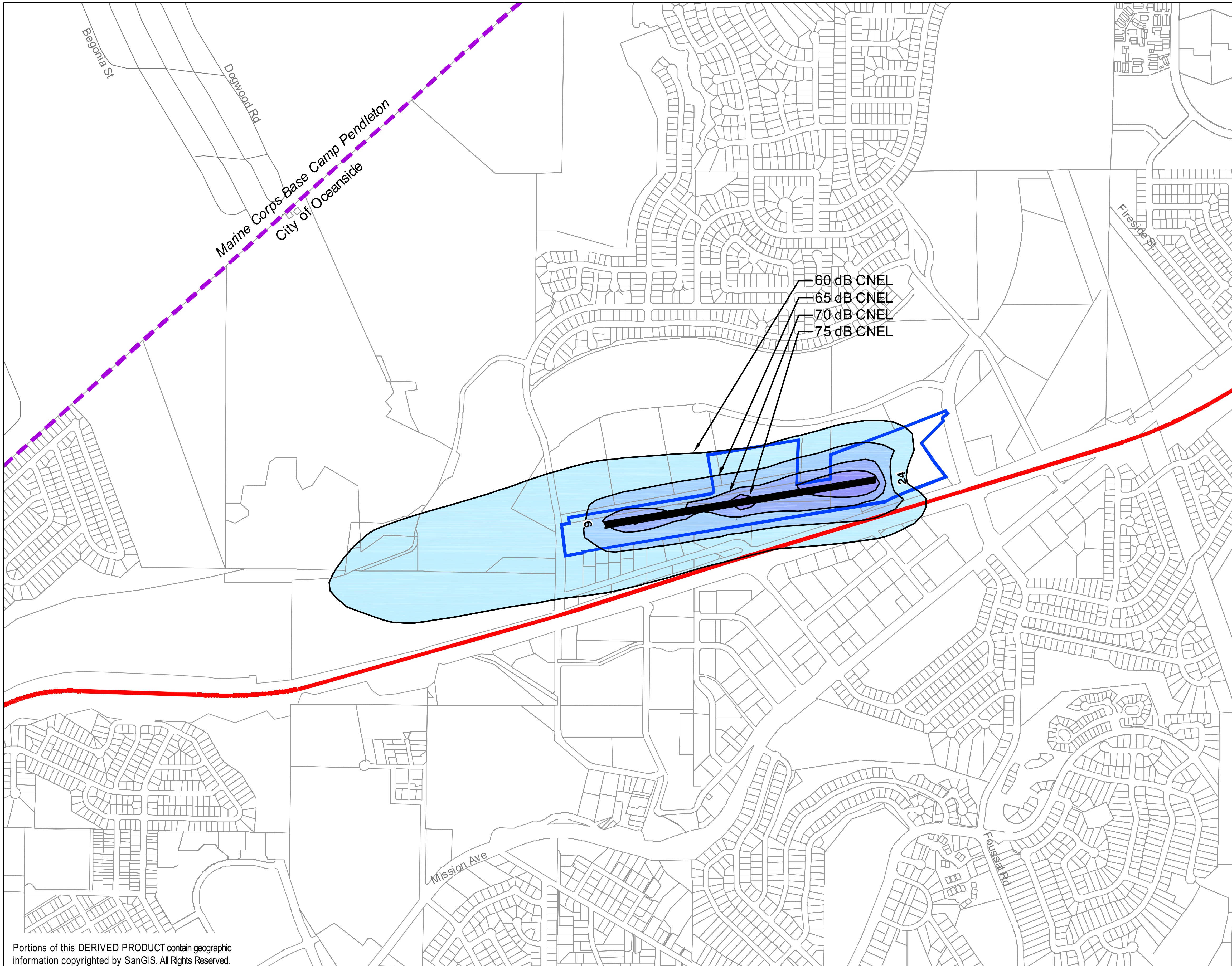
Note: Airfield elevation is 24 feet above mean sea level (MSL)

Sources: San Diego Geographic Information Source (SanGIS), 2008 and 2011 (municipal boundaries, roads, rivers and highways); Naval Facilities Engineering Command, Air Installation Compatible Use Zones (AICUZ) Update for Naval Air Station North Island and Naval Outlying Field Imperial Beach, California, 2011, (airport property boundary, runways, airfield, noise contours).

Prepared by: Ricondo & Associates, Inc., October 2015.

Exhibit 2-1

Noise Contour Map



AIRPORT LAND USE COMMISSION
SAN DIEGO COUNTY

LEGEND

- Airport Property Boundary
- Parcel Line
- Roads (on Marine Corps Base Camp Pendleton)
- Highways
- Municipal Boundary

Noise Exposure Range

- 60 - 65 dB CNEL
- 65 - 70 dB CNEL
- 70 - 75 dB CNEL
- 75 + dB CNEL

Future Average Annual Day (115 Operations)

north

0 1,000 ft.

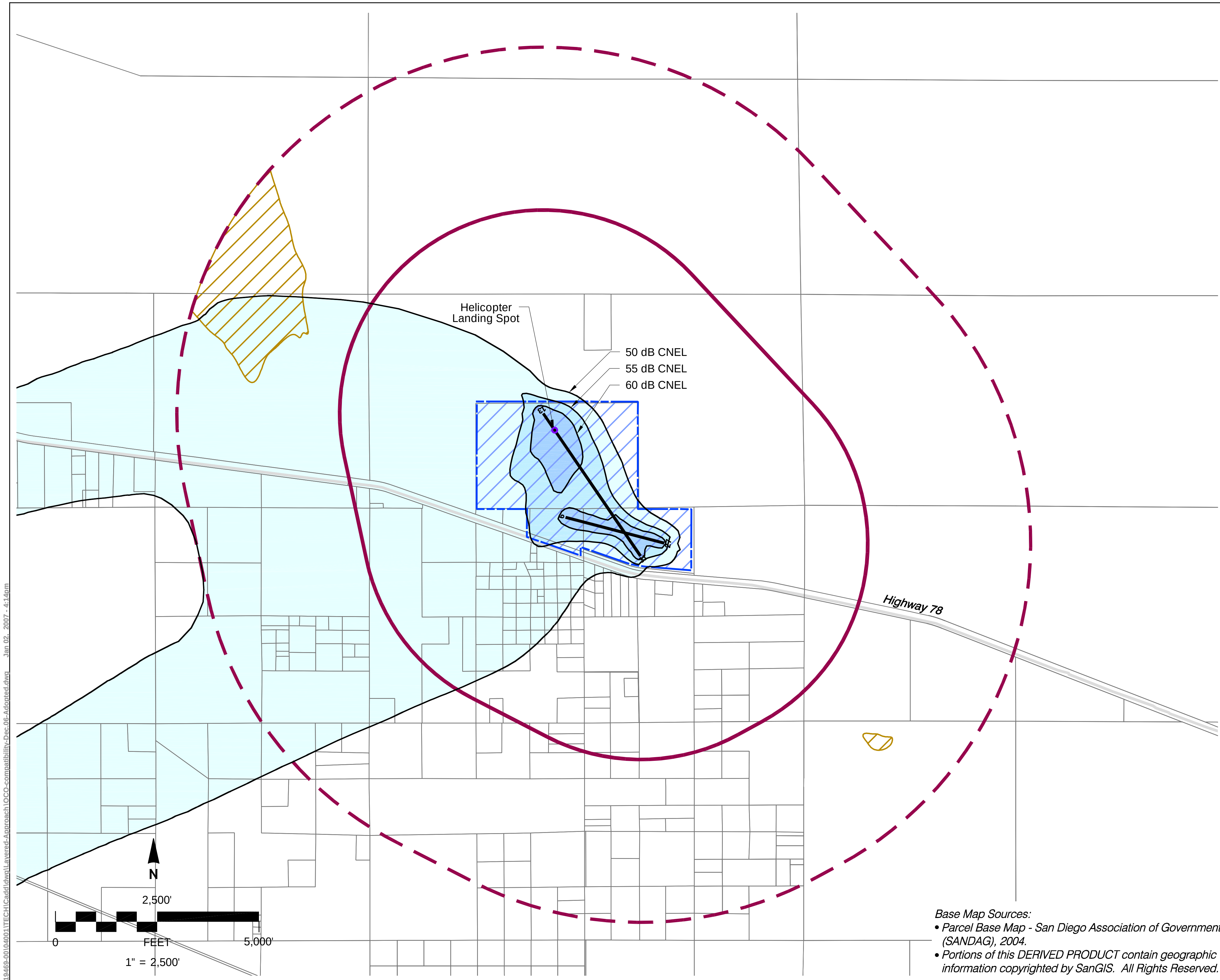
Notes: 1. See Table III-1 for criteria applicable within each noise exposure range.
2. CNEL = Community Noise Equivalent Level.

Sources: Parcels - San Diego Geographic Information Source (SanGIS), 2008;
Noise Contours - Harris, Miller, Miller & Hanson, April 2008.

Prepared by: Ricondo & Associates, Inc., October 2009.

Exhibit III-1

Compatibility Policy Map: Noise



Legend

Boundary Lines

- Airport Property Line
- Parcel Line

Noise Impact Zones

- 50 - 55 dB CNEL
- 55 - 60 dB CNEL
- 60 - 65 dB CNEL

Future Average Annual Day (8 Operations)

Airport Influence Area

- Review Area 1
- Review Area 2

Notes

* Source: Harris Miller Miller & Hanson, Inc. (November 2004).

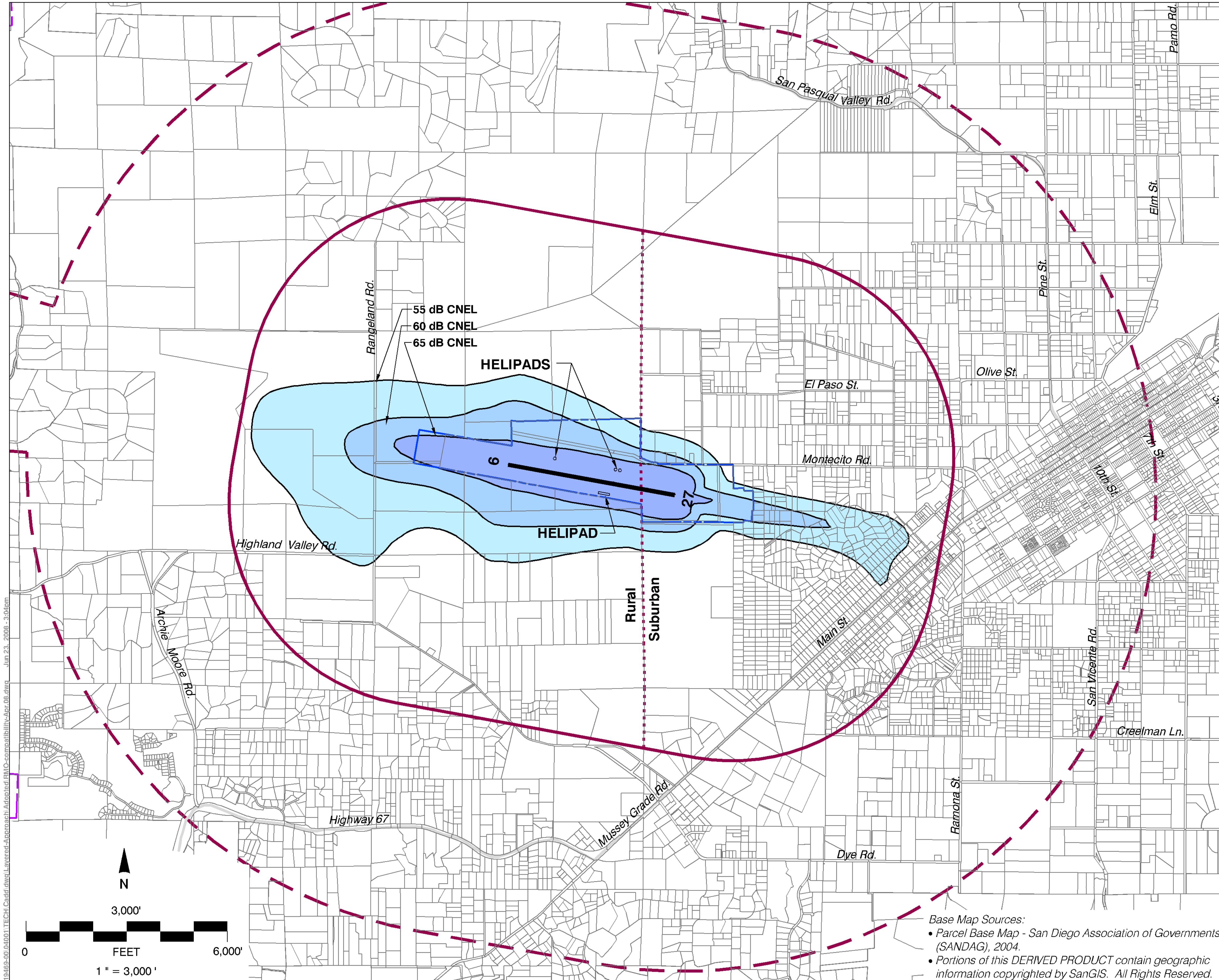
See Table OCO-1 for criteria applicable within each zone.

AIRPORT LAND USE COMMISSION
SAN DIEGO COUNTY

Ocotillo Airport
Land Use Compatibility Plan
(Adopted December 2006)

Map OCO-1

Compatibility Policy Map: Noise



Legend

Boundary Lines

- Airport Property Line
- Parcel Line

Noise Impact Zones*

- 55 - 60 dB CNEL
- 60 - 65 dB CNEL
- 65 + dB CNEL

Future Average Annual Day (540 Operations)

Airport Influence Area

- Review Area 1
- Review Area 2

Notes

* Source: Harris Miller Miller & Hanson, Inc. (November 2004).

1. See Table RMO-1 for criteria applicable within each zone.
2. Suburban criteria apply to zones at the East end of the runway; rural criteria apply to the remainder of the Airport Influence Area.

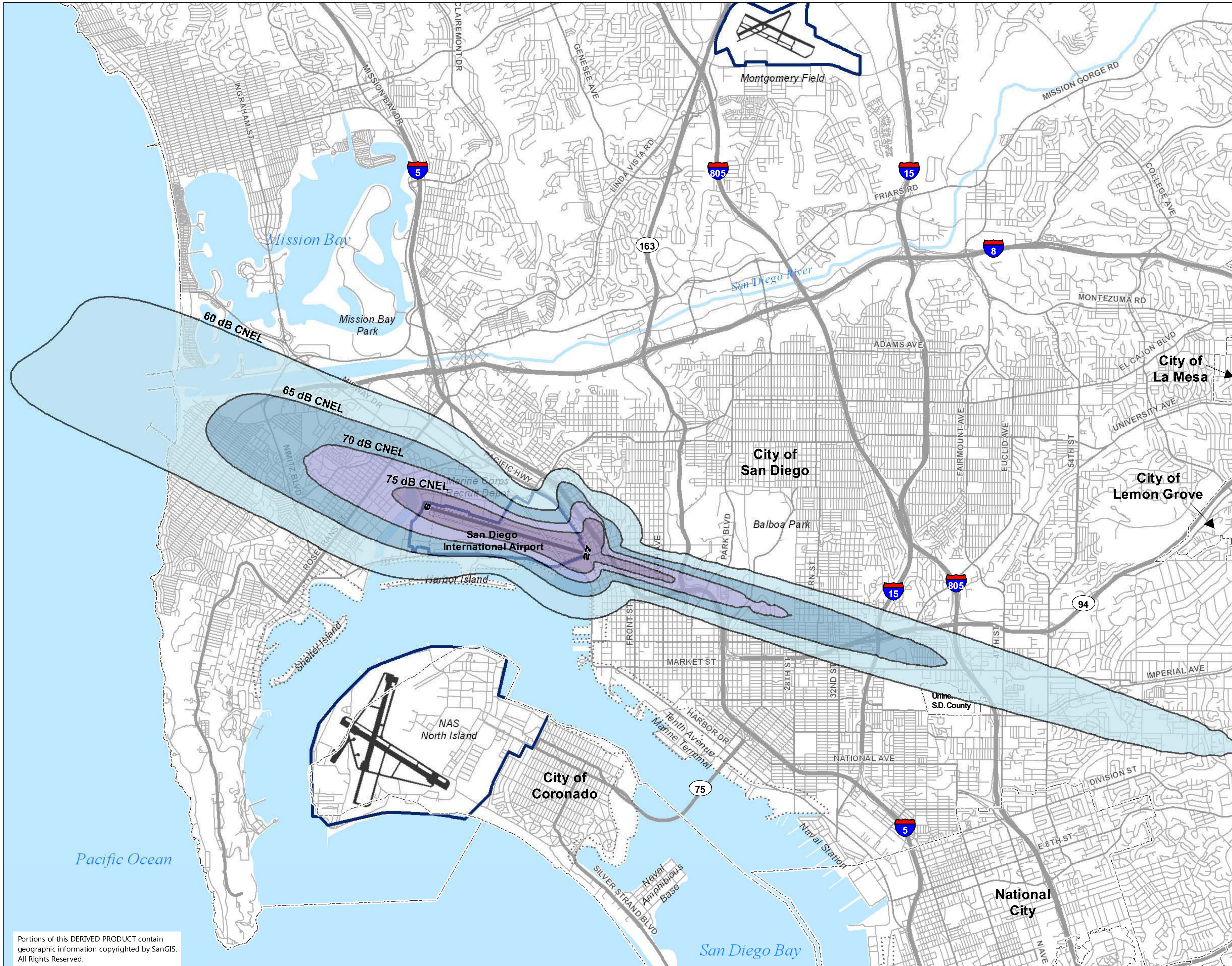
AIRPORT LAND USE COMMISSION
SAN DIEGO COUNTY

Ramona Airport
Land Use Compatibility Plan

(Amended June 2008)

Map RMO-1

Compatibility Policy Map: Noise



LEGEND

- Major Roads
- Highways
- Municipal Boundaries
- Airport Property Boundary
- San Diego Unified Port District Planning Jurisdiction Boundary

Forecast Noise Exposure Ranges:

- 60 - 65 dB CNEL
- 65 - 70 dB CNEL
- 70 - 75 dB CNEL
- 75 + dB CNEL

north

0 6,000 ft.

Notes: 1. CNEL = Community Noise Equivalent Level
2. Based on 2030 Forecast Noise Exposure.

Sources: San Diego Geographic Information Source (SanGIS), 2008 and 2011 (municipal boundaries, roads and highways); Harris Miller Miller & Hanson Inc., 2010 (forecast noise exposure ranges).

Prepared by: Ricondo & Associates, Inc., July 2012.

Exhibit 2-1

Noise Contour Map

Appendix O
Alternatives Data

No-Build Projects

No-Build projects are projects that would be built in the region in absence of the 2021 Regional Plan because they are in progress or recently completed and are assumed under Alternative 1 No Project of the alternatives analysis. The No-Build projects for the 2021 Regional Plan are shown in Table O-1. After the 2019 Federal RTP expires in 2023, it is assumed that no state or federal funding would be available for future projects.

Table O-1: No-Build Projects

No-Build Projects			
Category	**Project**	**Description/Jurisdiction**	**Note**
Active Transportation	Bayshore Bikeway: Segments 4B and 5	San Diego, 32nd Street Naval Station, National City	Completed
Active Transportation	Inland Rail Trail: Phase 1	San Marcos, Palomar College	Completed
Active Transportation	SR 15 Commuter Bike Facility	Mission Valley, Kensington	Completed
Active Transportation	Coastal Rail Trail Encinitas: E St to Chesterfield Drive (Chesterfield–Santa Fe)	Cardiff	Completed
Active Transportation	Inland Rail Trail: Phase 2	San Marcos, Palomar College	Completed
Active Transportation	Coastal Rail Trail San Diego: Rose Creek	Pacific Beach, Bay Ho, University City	Completed
Active Transportation	North Park/Mid-City Bikeways: Georgia–Meade Bikeway	Hillcrest, North Park, University Heights, Normal Heights	Under Construction
Active Transportation	North Park/Mid-City Bikeways: Landis Bikeway	North Park, City Heights	Under Construction
Active Transportation	Uptown Bikeways: Fourth and Fifth Avenue Bikeways	Downtown, Bankers Hill, Hillcrest	Under Construction
Active Transportation	Bayshore Bikeway: Barrio Logan	Barrio Logan, Downtown, 32nd Street Naval Station	Final Design
Active Transportation	Border to Bayshore Bikeway	Imperial Beach, San Ysidro	Final Design
Active Transportation	Coastal Rail Trail: Santa Fe Undercrossing to E Street	Encinitas	Final Design
Active Transportation	Imperial Avenue Bikeway	East Village, Sherman Heights, Grant Hill, Mountain View	Final Design

No-Build Projects			
Category	**Project**	**Description/Jurisdiction**	**Note**
Active Transportation	Inland Rail Trail: Phase 3	Vista	Final Design
Active Transportation	North Park/Mid-City Bikeways: University Bikeway	City Heights, Rolando, La Mesa	Final Design
Active Transportation	Uptown Bikeways: Eastern Hillcrest Bikeways	Hillcrest	Final Design
Active Transportation	San Diego River Trail: Stadium Segment	Mission Valley, SDSU West	Under Construction
Complete Corridors	I-5 NCC (I-5/I-805 Merge to SR 78)	1 HOV lane in each direction	CAL09 – Sept 2022
Complete Corridors	SR 94/SR 125	South to East Freeway Connector	CAL68 – Feb 2025
Complete Corridors	SR 52 Operational Improvements (I-805 to SR 125)	WB Mast to Santo Road Truck Climbing, Santo to I-15 EB Aux Lanes	CAL536 – Dec 2023
Complete Corridors	SR 11 (SR 125 to Mexico) + POE	New Roadway Between SR 125 and Mexico, plus Port of Entry (POE) Facility	
Complete Corridors	SR 11/SR 905	Freeway Connectors	CAL325A/38C
Transit	Mid-Coast Trolley	Old Town to University City	SAN25 SAN23 – Sep 2021
Transit	South Bay *Rapid*	Otay Mesa to Downtown San Diego	SAN47 – Jan 2019
Transit	LOSSAN Double Tracking	San Diego to Oceanside	SAN29, 64, 66, 73, 114, 119, 132

Table O-2: Performance Measures for Alternatives Considered in Detail in this EIR

				Proposed Plan			Alternative 1 No Project			Alternative 2 2019 Transportation Network with New Value Pricing and User Fee Policies			Alternative 3 All Growth Focused in Mobility Hubs and More Progressive Value Pricing and User Fee Policies		
PM ID	Performance Measure		2016	2025	2035	2050	2025	2035	2050	2025	2035	2050	2025	2035	2050
	Total Households		1,134,848	1,219,745	1,327,588	1,374,841	1,219,745	1,327,588	1,374,841	1,219,745	1,327,588	1,374,841	1,219,745	1,327,588	1,374,841
	Total Households within Mobility Hubs		506,081	584,052	689,581	732,086	570,267	653,202	689,956	570,267	653,202	689,956	581,457	687,146	732,992
	% Households within Mobility Hubs		45%	48%	52%	53%	47%	49%	50%	47%	49%	50%	48%	52%	53%
	Total Population		3,265,489	3,424,145	3,573,645	3,699,373	3,424,145	3,573,645	3,699,373	3,424,145	3,573,645	3,699,373	3,424,145	3,573,645	3,699,373
	Total Population within Mobility Hubs		1,793,114	1,650,282	1,898,306	1,994,412	1,613,140	1,793,114	1,886,966	1,613,140	1,793,114	1,886,966	1,644,206	1,890,914	1,944,052
	% Population within Mobility Hubs		42%	48%	53%	54%	47%	50%	51%	47%	50%	51%	48%	53%	53%
	Total Employment		1,646,419	1,762,747	1,922,475	2,087,318	1,789,965	1,936,818	2,095,301	1,789,965	1,936,818	2,095,301	1,762,479	1,921,480	2,086,342
	Total Employment within Mobility Hubs		1,113,109	1,213,064	1,347,193	1,484,038	1,213,630	1,311,281	1,417,136	1,213,630	1,311,281	1,417,136	1,211,964	1,344,897	1,481,997
	% Employment within Mobility Hubs		68%	69%	70%	71%	68%	68%	68%	68%	68%	68%	69%	70%	71%
1	**Mode Share**														
	Work Trips (peak period)	Bike & walk	3.3%	5.5%	6.6%	8.0%	4.0%	4.4%	4.4%	3.8%	4.4%	4.8%	5.8%	6.2%	7.6%
		Carpool	13.4%	15.9%	15.5%	16.5%	13.0%	12.7%	12.8%	12.8%	12.6%	12.5%	16.6%	15.4%	16.4%
		Drive alone	79.7%	72.4%	66.5%	62.4%	79.1%	78.6%	78.4%	78.6%	76.8%	75.5%	71.2%	64.7%	60.2%
		Other (TNC, MicroMobility, Taxi, School bus)	0.2%	0.4%	0.4%	0.5%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.4%	0.4%	0.5%
		Transit	3.3%	5.8%	11.1%	12.6%	3.6%	4.0%	4.1%	4.5%	5.9%	6.8%	6.0%	13.4%	15.3%
	Work Trips (all day)	Bike & walk	3.6%	6.1%	7.2%	8.7%	4.4%	4.7%	4.8%	4.2%	4.8%	5.2%	6.4%	6.7%	8.2%
		Carpool	13.1%	15.5%	15.1%	16.2%	12.6%	12.2%	12.4%	12.5%	12.2%	12.2%	16.1%	15.0%	16.0%
		Drive alone	79.6%	72.2%	66.0%	61.9%	79.1%	78.7%	78.4%	78.5%	76.7%	75.3%	71.0%	64.3%	59.7%
		Other (TNC, MicroMobility, Taxi, School bus)	0.2%	0.4%	0.4%	0.5%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.4%	0.4%	0.5%
		Transit	3.4%	5.9%	11.3%	12.8%	3.7%	4.0%	4.1%	4.6%	6.0%	7.0%	6.1%	13.6%	15.6%
	All Trips	Bike & walk	7.7%	9.7%	11.7%	13.3%	8.7%	9.7%	10.0%	8.8%	10.0%	10.5%	10.0%	11.7%	13.6%
		Carpool	44.3%	43.6%	40.6%	40.5%	42.3%	39.7%	39.1%	42.4%	39.8%	39.2%	44.0%	40.8%	40.4%
		Drive alone	44.8%	42.3%	41.0%	39.0%	45.6%	47.0%	47.3%	45.0%	45.8%	45.6%	41.4%	39.7%	37.3%
		Other (TNC, MicroMobility, Taxi, School bus)	1.6%	2.0%	2.1%	2.2%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	2.1%	2.2%	2.4%
		Transit	1.6%	2.4%	4.5%	5.0%	1.7%	1.9%	1.8%	2.1%	2.7%	3.0%	2.5%	5.7%	6.3%
2	**Number/percent of people within 0.5 miles of a commuter rail, light rail, or next gen**														
	Commuter Rail (Tier 1)	Number	15,196	29,448	117,048	257,823	20,720	27,063	28,636	20,720	43,879	46,388	32,920	110,105	255,192
		Percent	0.5%	0.9%	3.3%	7.0%	0.6%	0.8%	0.8%	0.6%	1.2%	1.3%	1.0%	3.1%	6.9%
	Light Rail (Tier 2)	Number	141,814	228,088	312,424	452,087	215,729	282,200	294,864	261,805	465,549	644,034	225,095	302,344	453,196
		Percent	4.3%	6.7%	8.7%	12.2%	6.3%	7.9%	8.0%	7.6%	13.0%	17.4%	6.6%	8.5%	12.3%
	Next Gen Rapid (Tier 3)	Number	188,077	481,562	1,086,765	1,190,092	253,168	288,853	324,426	524,780	825,629	1,059,375	479,468	1,076,444	1,201,194
		Percent	5.8%	14.1%	30.4%	32.2%	7.4%	8.1%	8.8%	15.3%	23.1%	28.6%	14.0%	30.1%	32.5%
	access to any of the tiers (1-3)	Number	297,954	593,389	1,170,037	1,284,782	401,626	487,442	532,047	650,888	960,013	1,205,058	585,599	1,160,281	1,300,484
		Percent	9.1%	17.3%	32.7%	34.7%	11.7%	13.6%	14.4%	19.0%	26.9%	32.6%	17.1%	32.5%	35.2%
3	**Number/percent of jobs within 0.5 miles of a commuter rail, light rail, or next gen Rapid**														
	Commuter Rail (Tier 1)	Number	33,315	55,669	119,095	217,383	36,922	43,749	46,177	36,922	73,248	77,141	55,907	118,623	216,051
		Percent	2.0%	3.2%	6.2%	10.4%	2.1%	2.3%	2.2%	2.1%	3.8%	3.7%	3.2%	6.2%	10.4%
	Light Rail (Tier 2)	Number	193,149	243,539	285,229	369,667	235,518	262,924	284,813	272,276	379,984	511,694	242,827	282,719	367,480
		Percent	11.7%	13.8%	14.8%	17.7%	13.2%	13.6%	13.6%	15.2%	19.6%	24.4%	13.8%	14.7%	17.6%
	Next Gen Rapid (Tier 3)	Number	209,879	392,856	806,790	913,431	233,976	258,850	278,577	404,681	635,018	845,535	393,085	804,465	910,351
		Percent	12.7%	22.3%	42.0%	43.8%	13.1%	13.4%	13.3%	22.6%	32.8%	40.4%	22.3%	41.9%	43.6%
	access to any of the tiers (1-3)	Number	349,992	515,234	877,947	996,012	394,437	431,024	465,534	536,126	747,189	962,807	515,068	876,065	994,154
		Percent	21.3%	29.2%	45.7%	47.7%	22.0%	22.3%	22.2%	30.0%	38.6%	46.0%	29.2%	45.6%	47.7%
4	**Number/percent of people within 0.25 miles of a bike facility (class I and II, cycletrack or bike boulevard)**														
		Number	2,111,208	2,417,827	2,636,703	2,807,068	2,394,606	2,519,237	2,586,079	2,265,687	2,480,102	2,616,654	2,417,529	2,620,445	2,810,999
		Percent	64.7%	70.6%	73.8%	75.9%	69.9%	70.5%	69.9%	66.2%	69.4%	70.7%	70.6%	73.3%	76.0%
5	**Daily transit boardings**														
	Region	Commuter Rail (Tier 1)	3,473	8,144	49,563	180,153	4,615	4,966	5,273	7,365	9,103	8,984	8,495	82,475	289,004
		Light Rail (Tier 2)	126,031	200,037	336,375	358,361	164,957	192,350	191,377	182,954	264,227	351,705	207,471	401,196	418,937
		Next Gen Rapid (Tier 3)	30,307	107,490	390,123	426,205	45,530	51,713	52,796	109,314	184,033	214,984	111,569	488,009	520,912
		Local Bus	216,822	300,092	416,726	430,511	224,186	244,125	245,805	252,204	278,765	283,653	311,953	526,078	543,753
		All transit boardings	376,632	615,763	1,192,786	1,395,230	439,288	493,153	495,251	551,837	736,128	859,327	639,489	1,497,757	1,772,606
	Mohub	Commuter Rail (Tier 1)	3,015	7,038	45,480	178,819	4,157	4,456	4,747	6,367	8,959	8,836	7,271	75,795	286,724
		Light Rail (Tier 2)	122,186	196,469	329,168	347,848	161,459	188,798	187,778	178,690	257,939	339,016	203,751	391,838	405,388
		Next Gen Rapid (Tier 3)	28,936	101,931	338,484	365,858	43,889	49,886	51,088	101,960	164,218	183,750	105,769	422,232	445,393
		Local Bus	172,354	238,922	325,669	420,207	179,494	197,335	200,113	195,399	212,176	214,049	247,218	406,592	420,207
		All transit boardings	326,491	544,359	1,038,802	1,228,662	388,999	440,476	443,727	482,417	643,291	745,651	564,009	1,296,457	1,557,712
6	**Physical activity**														
		Total time engaged in transportation related physical activity per capita	7.33	9.34	11.65	12.95	8.14	8.93	9.13	8.34	9.38	9.89	9.61	12.24	13.81
		Percent of the population engaged in 20 min or more of transportation related physical activity	11.3%	14.4%	18.4%	20.3%	12.5%	13.7%	14.0%	13.0%	14.7%	15.6%	14.8%	19.5%	21.8%
7	**Average truck/commercial vehicle travel times to and around regional gateways and distribution hubs (minutes)**														
			15.76	15.65	15.99	16.30	16.20	16.75	17.28	16.19	16.67	17.13	15.57	15.95	16.25
8	**Average Particulate Matter (PM2.5)**														
		Exposure per person	5.16	5.12	5.38	5.56	5.13	5.66	5.89	5.03	5.50	5.67	4.98	5.21	5.44
9-a	**Truck travel time index**														
		Highway (SHS)	1.08	1.06	1.11	1.14	1.07	1.09	1.12	1.07	1.07	1.08	1.06	1.10	1.13
		Arterial	1.28	1.22	1.20	1.20	1.29	1.30	1.31	1.28	1.28	1.27	1.21	1.20	1.20
		Highway (SHS) + Arterial	1.15	1.12	1.14	1.16	1.15	1.16	1.18	1.14	1.14	1.14	1.11	1.13	1.15
9-b	**Heavy Duty Truck delay by facility type (average daily)**														
	All day - Heavy Heavy Duty	Highway (SHS)	1,215	1,154	2,385	3,847	1,361	2,186	3,189	1,353	1,693	2,093	1,058	2,215	3,618
		Arterial	6,063	5,268	5,612	5,831	6,898	8,052	8,653	6,708	7,477	7,843	5,175	5,533	5,899
	AM and PM peak - Heavy Heavy Duty	Highway (SHS)	805	749	1,218	1,937	888	1,343	1,919	893	927	1,092	666	1,085	1,763
		Arterial	2,845	2,454	2,554	2,618	3,206	3,683	4,006	3,080	3,350	3,514	2,361	2,452	2,591
	All day - Medium Heavy Duty	Highway (SHS)	501	446	919	1,410	528	824	1,156	529	640	753	405	860	1,314
		Arterial	3,479	2,877	2,915	3,066	3,780	4,330	4,509	3,709	4,031	4,053	2,825	2,906	3,040
	AM and PM peak - Medium Heavy Duty	Highway (SHS)	308	272	430	662	322	474	654	328	331	369	239	389	597
		Arterial	1,451	1,204	1,180	1,234	1,565	1,785	1,881	1,533	1,639	1,627	1,165	1,165	1,197
	All day - Light Heavy Duty	Highway (SHS)	1,120	997	2,121	3,166	1,188	1,847	2,577	1,181	1,442	1,687	906	1,979	2,944
		Arterial	8,071	6,746	6,926	7,317	8,859	10,199	10,719	8,709	9,525	9,690	6,607	6,864	7,211
	AM and PM peak - Light Heavy Duty	Highway (SHS)	648	572	911	1,382	681	996	1,370	691	697	774	501	821	1,242
		Arterial	3,105	2,592	2,559	2,679	3,373	3,854	4,071	3,305	3,543	3,542	2,505	2,515	2,597
	All day - All Heavy Duty (HHD + MHD + LHD)	Highway (SHS)	2,836	2,596	5,426	8,423	3,077	4,857	6,922	3,064	3,776	4,532	2,370	5,054	7,875
		Arterial	17,613	14,891	15,453	16,214	19,538	22,582	23,881	19,127	21,032	21,587	14,607	15,303	16,150
	AM and PM peak - All Heavy Duty (HHD + MHD + LHD)	Highway (SHS)	1,761	1,593	2,559	3,981	1,891	2,813	3,943	1,913	1,955	2,235	1,405	2,295	3,603
		Arterial	7,401	6,250	6,292	6,530	8,144	9,321	9,958	7,918	8,532	8,683	6,031	6,133	6,386
10	**Transportation system use costs**														
		Percent of Income Consumed by Out-of-Pocket Transportation Costs	7.8%	10.2%	10.1%	10.5%	8.4%	7.7%	7.4%	8.3%	7.6%	7.3%	10.8%	9.7%	10.0%
	Vehicle Miles Traveled (VMT) (SB 743)														
		All vehicle classes regionwide	84,488,451	84,965,647	87,009,311	90,100,203	89,034,167	95,518,173	100,851,250	87,450,159	93,134,308	97,883,869	84,250,846	85,456,912	87,967,724
	Regionwide VMT per capita (all vehicle classes)		19.5	18.1	17.3	16.8	19.3	19.4	19.6	18.8	18.8	18.6	18.0	16.9	16.3

Table O-3 SB 375 GHG Reducations for Alternatives Considered in Detail in this EIR

	Proposed Plan		Alternative 1 No Project		Alternative 2 2019 Transportation Network with New Value Pricing and User Fee Policies		Alternative 3 All Growth Focused in Mobility Hubs and More Progressive Value Pricing and User Fee Policies	
Database	**2035**	**2050**	**2035**	**2050**	**2035**	**2050**	**2035**	**2050**
SB 375 VMT	81,212,119.8	83,653,097	89,730,891	94,493,749	87,233,002	91,366,752	79,664,589	81,486,491
SB 375 VMT / Person	22.4	22.3	24.8	25.2	24.1	24.4	22.0	21.8
External to External VMT	984,563	1,101,363	984,561	1,101,638	984,674	1,101,421	984,561	1,101,255
External to External VMT Reduction	1.2%	1.3%	1.1%	1.2%	1.1%	1.2%	1.2%	1.4%
SB 375 Emissions (tons)	38,574.1	39,636.2	43,277.4	45,628.6	41,966.8	43,923.8	37,781.7	38,509.8
SB 375 Emissions (tons) without E-E	38,106.5	39,114.3	42,802.5	45,096.7	41,493.0	43,394.3	37,314.8	37,989.4
SB 375 Emissions / Person (lbs)	21.05	20.88	23.65	24.08	22.92	23.17	20.61	20.28
Per Capita Reduction for 2005**	**-19.03%**	**-19.7%**	**-9.06%**	**-7.4%**	**-11.8%**	**-10.9%**	**-20.7%**	**-22.0%**
Off-Model Calculators VMT Reduction								
Vanpool	308,108	329,435	-	-	309,561	334,100	308,171	329,513
Carshare	176,896	N/A*	-	-	170,006	N/A	176,896	N/A
Carpool	12,244	12,151	-	-	14,168	14,928	11,656	11,382
TDM Ordiance	393,851	632,789	-	-	453,163	755,370	367,004	573,912
Total VMT reduction	891,099	974,375	-	-	946,898	1,104,397	863,728	914,807
SB 375 VMT / Person Reduction	0.25	0.26	-	-	0.26	0.29	0.24	0.24
Off-Model Calculators - Daily Total GHG Reduction (tons)								
Vanpool	141.07	150.06	-	-	143.6	154.5	140.9	149.7
Carshare	80.60	N/A	-	-	78.5	N/A	80.5	N/A
Carpool	5.78	5.71	-	-	6.77	7.12	5.50	5.33
TDM Ordiance	183.93	293.89	-	-	214.45	356.21	171.17	265.98
EV Charging Program	1024.0	825.0	-	-	1,021.0	777.0	1030.0	836.0
SB 375 Emissions Total Reduction (tons)	1435.4	1274.7	-	-	1464.4	1294.8	1428.0	1257.0
SB 375 Emissions Reduction/ Person (lbs)	(0.79)	(0.68)	-	-	(0.81)	(0.69)	(0.79)	(0.67)
Off-Model GHG Reduction per capita	-3.05%	-2.62%	-	-	-3.11%	-2.66%	-3.03%	-2.58%
Per Capita Reduction for 2005 with Off-Model Calc	-22.1%	-22.3%	-	-	-14.9%	-13.6%	-23.7%	-24.6%
ARB Adjustment for EMFAC 2007 - 2014	1.7%	1.6%	-	-	1.7%	1.6%	1.7%	1.6%
Final Per Capita Reduction for 2005**	**-20.38%**	**-20.7%**	**-9.06%**	**-7.4%**	**-13.2%**	**-12.0%**	**-22.0%**	**-23.0%**

*The carshare program off-model GHG-reduction methodology estimates that carsharing in the region will grow to include over 25,000 members by 2035. Given the popularity of on-demand ridehailing and mobility-as-a-service, it is assumed that carsharing services may sunset before 2050.

**Baseline 2005 per capita GHG emissions are 26 lbs/person.

Table O-4 EMFAC 2017 Onroad Output Summary for Alternatives Considered in Detail in this EIR

Alternative	Annual CO2 Total	Annual PM 2.5 Total	Annual PM10 Total	Annual Gasoline	Annual Diesel	Summer ROG Total	Summer NOx Total	Winter CO Total
	tons/day	tons/day	tons/day	thousand gallons/day	thousand gallons/day	tons/day	tons/day	tons/day
2016	38,740	2.44	5.2	3,671.72	418.75	22.37	37.82	188.11
Proposed Plan-2025	30,172	2.03	4.8	2,743.56	423.94	11.94	15.4	99.75
Proposed Plan-2035	25,383	2.02	4.87	2,226.71	433.31	8.17	11.96	83.33
Proposed Plan-2050	24,789	2.08	5.06	2,149.62	444.74	6.66	11.88	79.99
Alternative 1-2025	31,589	2.12	5.01	2,899.94	416.65	12.6	15.84	102.28
Alternative 1-2035	27,543	2.2	5.3	2,473.58	411.35	9.06	12.55	83.95
Alternative 1-2050	27,345	2.3	5.59	2,441.82	420.24	7.57	12.5	81.98
Alternative 2-2025	31,196	2.09	4.93	2,850.45	425.81	12.38	15.72	102.86
Alternative 2-2035	27,140	2.15	5.19	2,411.06	434.87	8.81	12.33	87.36
Alternative 2-2050	26,899	2.24	5.45	2,367.60	451	7.31	12.26	85.73
Alternative 3-2025	29,933	2.01	4.76	2,719.16	422.88	11.82	15.31	98.82
Alternative 3-2035	24,993	1.99	4.79	2,185.14	433.15	8.01	11.88	81.95
Alternative 3-2050	24,317	2.04	4.96	2,094.27	448.94	6.49	11.9	78.29

*This table only includes onroad vehicles emissions.

Appendix O-5

2019 Federal Regional Transportation Plan; Appendix A: Transportation Projects, Costs, and Phasing

Appendix A

Transportation Projects, Costs, and Phasing

Appendix Contents

Transportation Projects, Costs, and Phasing

This appendix includes information for both the 2019 Federal Regional Transportation Plan Revenue Constrained Plan and Unconstrained (i.e., illustrative) list of projects. Detailed transit, managed lanes and highway, goods movement, and active transportation project listings, cost estimates, and phasing are included for the Revenue Constrained Plan. For the Unconstrained Transportation scenario, detailed descriptions and cost estimates are provided for the same types of projects.

Revenue Constrained Projects

Table A.1 lists the capital improvements in the 2050 Revenue Constrained Plan in 2019 and year of expenditure (YOE) dollars. Table A.2 lists these revenue constrained projects by phase and Table A.3 includes the phased Revenue Constrained arterial projects. Table A.4 shows Revenue Constrained Freight and Goods Movement projects. Figures A.1 through A.9 depict the Revenue Constrained 2025, 2035, and 2050 transit, highway, and active transportation improvements (Regional Bike Network), respectively. Figure A.10 shows the Planned California High-Speed Train Overview. Figure A.11 shows the high frequency local bus routes by 2025 and 2035. Figures A.12, A.13, and A.14 show the 2016 Transit System, Managed Lanes and Highway Network, and Bike Network, respectively. Figure A.15 shows the Regional Arterial System. The California Coastal Trail and County of San Diego Community Trails are shown in Figure A.16. The regionally significant projects and the timing for when they are expected to be open to traffic in each conformity analysis year are documented in Appendix B in Tables B.11 through B.13.

Unconstrained Projects

Table A.5 lists the major capital improvements included in the Revenue Constrained and the Unconstrained Network which also are shown in Figures A.17, A.18, and A.19. Additionally, Figure A.20 illustrates the Unconstrained Goods Movement Strategy and Figure A.21 depicts the National Highway Freight Network (California South), which was established by the Federal Highway Administration.

No-Build Projects

Table A.6 lists the projects included in the No-Build Scenario.

Table A.1

Revenue Constrained Projects

Transit Facilities

TransNet	Service	Route	Description	Cost ($2019); millions	Cost ($YOE); millions
TransNet	COASTER	398	Double tracking (includes grade separations at Leucadia Blvd and two other locations, stations/platforms at Convention Center/Gaslamp Quarter and Del Mar Fairgrounds, Del Mar Tunnel, and extensions to the Convention Center and Camp Pendleton)	$5,754	$10,439
TransNet	SPRINTER	399	SPRINTER efficiency improvements and double tracking (Oceanside to Escondido and six rail grade separations at El Camino Real, Melrose Dr, Vista Village Dr/Main St, North Dr, Civic Center, Auto Parkway and Mission Ave)	$1,287	$1,564
	SPRINTER	399	Branch Extension to Westfield North County	$239	$479
	SPRINTER	588	SPRINTER Express	$332	$545
TransNet	Trolley	510	Mid-Coast Trolley Extension	$919	$919
	Trolley	510	Blue Line/Mid-Coast Frequency Enhancements and rail grade separations at 28th St, 32nd St, E St, H St, Palomar St, at Taylor St and Ash St, and Blue/ Orange Track Connection at 12th/Imperial	$586	$844
	Trolley	520	Orange Line Frequency Enhancements and four rail grade separations at Euclid Ave, Broadway/ Lemon Grove Ave, Allison Ave/University Ave, Severin Dr	$363	$453
	Trolley	530	Green Line Frequency Enhancements	$0	$0
	Trolley	560	SDSU to Downtown San Diego via El Cajon Blvd/ Mid-City (transition of Mid-City *Rapid* to Trolley)	$3,251	$6,676
	Trolley	561	UTC to COASTER Connection (extension of Route 510)	$467	$581
	Trolley	562	San Ysidro to Carmel Valley via National City/ Chula Vista via Highland Ave/ 4th Ave, Southeast San Diego, Mid-City, Mission Valley, and Kearny Mesa	$6,766	$10,679
	Trolley	563	Pacific Beach to El Cajon Transit Center via Balboa and Kearny Mesa	$1,579	$3,024
	Rapid	2	North Park to Downtown San Diego via 30th St, Golden Hill	$54	$62
	Rapid	10	La Mesa to Ocean Beach via Mid-City, Hillcrest, Old Town	$57	$65
	Rapid	11	Spring Valley to SDSU via Southeast San Diego, Downtown, Hillcrest, Mid-City	$154	$199
	Rapid	28	Point Loma to Kearny Mesa via Old Town, Linda Vista	$67	$80
	Rapid	30	Old Town to Sorrento Mesa via Pacific Beach, La Jolla, UTC	$143	$172

Table A.1 (continued)

Revenue Constrained Projects

Transit Facilities (continued)

TransNet	Service	Route	Description	Cost ($2019); millions	Cost ($YOE); millions
	Rapid	41	Fashion Valley to UTC/UC San Diego via Linda Vista and Clairemont	$75	$90
	Rapid	90	El Cajon Transit Center to San Diego International Airport ITC via SR 94, City College (peak only)	$27	$32
	Rapid	103	Solana Beach to Sabre Springs Rapid station via Carmel Valley	$91	$152
	Rapid	120	Kearny Mesa to Downtown San Diego via Mission Valley	$127	$145
	Rapid	235	Temecula (peak only) Extension of Escondido to Downtown San Diego *Rapid* (formerly Route 610)	$133	$222
	Rapid	440	Carlsbad to Escondido Transit Center via Palomar Airport Rd	$140	$234
	Rapid	471	Downtown Escondido to East Escondido	$46	$94
	Rapid	473	UTC/UC San Diego to Oceanside via Hwy 101 Coastal Communities, Carmel Valley	$176	$267
	Rapid	474	Oceanside to Vista via Mission Ave/Santa Fe Rd Corridor	$99	$202
	Rapid	477	Camp Pendleton to Carlsbad Village via College Blvd, Plaza Camino Real	$109	$181
	Rapid	550	SDSU to Palomar Station via East San Diego, Southeast San Diego, National City	$112	$126
	Rapid	635	Eastlake to Palomar Trolley via Main St Corridor	$105	$126
	Rapid	636	SDSU to Spring Valley via East San Diego, Lemon Grove, Skyline	$53	$88
	Rapid	637	North Park to 32nd St Trolley via Golden Hill	$60	$101
	Rapid	638	Iris Trolley to Otay Mesa via Otay, Airway Dr, SR 905 Corridor	$52	$67
	Rapid	640A/640B	Route 640A: I-5 - San Ysidro to Old Town Transit Center via City College Route 640B: I-5 Iris Trolley/Palomar to Kearny Mesa via City College	$208	$229
	Rapid	650	Chula Vista to Palomar Airport Rd Business Park via I-805/I-5 (peak only)	$112	$186
	Rapid	653	Mid-City to Palomar Airport Rd via Kearny Mesa/ I-805/I-5	$14	$22
TransNet	*Rapid*	688/689/690	Route 688: San Ysidro to Sorrento Mesa via I-805/ I-15/SR 52 Corridors (peak only); Route 689: Otay Mesa Port of Entry (POE) to UTC/Torrey Pines via Otay Ranch/ Millennia, I-805 Corridor (Peak Only); Route 690: Mid-City to Sorrento Mesa via I-805 Corridor (Peak Only)	$623	$757

Table A.1 (continued)

Revenue Constrained Projects

Transit Facilities (continued)

TransNet	Service	Route	Description	Cost ($2019); millions	Cost ($YOE); millions
	Rapid	709	H St Trolley to Millennia via H St Corridor, Southwestern College	$89	$101
	Rapid	870	El Cajon to UTC via Santee, SR 52, I-805	$100	$190
	Rapid	890	El Cajon to Sorrento Mesa via SR 52, Kearny Mesa	$16	$31
	Rapid	950 (formerly 905)	Extension of Iris Trolley Station to Otay Mesa Port of Entry (POE) route with new service to Imperial Beach	$3	$3
	Rapid	910	Coronado to Downtown via Coronado Bridge	$54	$65
	Rapid	SR163 DARs	Kearny Mesa to Downtown San Diego via SR 163. Stations at Sharp/ Children's Hospital, University Ave, and Fashion Valley Transit Center	$204	$215
	Shuttle	448/449	San Marcos Shuttle[1]	$0	$0
	Streetcar	553	Downtown San Diego: Little Italy to East Village[2]	$15	$20
	Streetcar	554	Hillcrest/Balboa Park/Downtown San Diego Loop[2]	$39	$45
	Streetcar	555	30th St to Downtown San Diego via North Park/ Golden Hill[2]	$23	$29
	Streetcar	565	Mission Beach to La Jolla via Pacific Beach[2]	$34	$57
	Airport Express	--	Airport Express Routes[3]	$71	$82
	Intermodal Transit Center	--	San Diego International Airport Intermodal Transit Center and I-5 Direct Connector Ramps	$231	$258
	Intermodal Transit Center	--	San Ysidro Intermodal Transit Center	$160	$209
	Other	--	Vehicles	$2,740	$4,553
	Other	--	Transit System Rehabilitation	$2,065	$3,777
	Other	--	Maintenance Facilities, Park and Ride, Transit Center Expansions	$2,016	$2,476
	Other	--	ITS, Regulatory Compliance	$496	$674
			Subtotal	**$32,736**	**$52,887**

Table A.1 (continued)

Revenue Constrained Projects

Managed Lanes/Toll Lanes Projects

TransNet	Freeway	From	To	Existing	With Improvements	Transit Route	Cost ($2019); millions	Cost ($YOE); millions
TransNet	I-5	SR 905	SR 54	8F	8F+2ML	640	$542	$627
TransNet	I-5	SR 54	SR 15	8F	10F+2ML	640	$467	$540
TransNet	I-5	I-8	La Jolla Village Dr	8F/10F	8F/10F+2ML		$978	$2,067
TransNet	I-5	La Jolla Village Dr I-5/I-805 Merge	I-5/805 Merge SR 56	8F/14F 8F/14F+ 2ML	8F/14F+2ML 8F/14F+4ML	650, 653	$422	$513
TransNet	I-5	SR 56 Manchester Ave	Manchester Ave Vandegrift Blvd	8F+2ML 8F	8F+4ML 8F+4ML	650, 653	$2,881	$4,537
	I-5	Vandegrift Blvd	Orange County	8F	8F+4T		$3,165	$6,687
	SR 11/ Otay Mesa East POE	SR 125	Mexico	--	4T+POE	905	$472	$472
	SR 15	I-5	SR 94	6F	8F+2ML		$185	$391
TransNet	SR 15	SR 94	I-805	6F	6F+2ML	235, 610	$41	$59
TransNet	I-15	Viaduct	--	8F	8F+2ML	235, 610, 653, 690	$1,040	$2,197
TransNet	I-15	I-8	SR 163	8F	8F+2ML	235, 610, 653, 690	$64	$72
	I-15	SR 78	Riverside County	8F	8F+4T	610	$1,744	$3,684
TransNet	SR 52	I-805	I-15	6F	6F+2ML	653, 870, 890	$238	$503
TransNet	SR 52	I-15	SR 125	4F/6F	4F/6F+2ML(R)	870, 890	$405	$856
TransNet	SR 54	I-5	SR 125	6F	6F+2ML		$151	$319
TransNet	SR 78	I-5	I-15	6F	6F+2ML		$1,621	$2,127
TransNet	SR 94	I-5	SR 125	8F	8F+2ML	90, 225, 235, 610,	$1,229	$2,012
TransNet	SR 125	SR 54 SR 94	SR 94 I-8	6F 8F	6F+2ML 10F+2ML	90	$690	$1,457
TransNet	I-805	SR 905	Palomar St	8F	8F+2ML	688	$235	$316
TransNet	I-805	SR 54	SR 94	8F+2ML	8F+4ML	225, 650, 688, 689	$742	$998
TransNet	I-805	SR 94	Carroll Canyon Rd	8F	8F+4ML	30, 225, 650, 653, 688, 689, 690, 870, 890	$3,295	$5,939
						Subtotal	**$20,607**	**$36,373**

Table A.1 (continued)

Revenue Constrained Projects

Highway Projects

TransNet	Freeway	From	To	Existing	With Improvements	Cost ($2019); millions	Cost ($YOE); millions
TransNet	I-8	2nd St	Los Coches	4F/6F	6F	$44	$94
	SR 52	I-5	I-805	4F	6F	$151	$319
TransNet	SR 52	Mast Blvd	SR 125	4F	6F	$103	$147
TransNet	SR 56	I-5	I-15	4F	6F	$192	$405
TransNet	SR 67	Mapleview St	Dye Rd	2C/4C	4C	$673	$1,340
TransNet	SR 94	SR 125	Avocado Blvd	4F	6F	$190	$401
TransNet	SR 94	Avocado Blvd	Jamacha	4C	6C	$124	$261
TransNet	SR 94	Jamacha	Steele Canyon Rd	2C/4C	4C	$54	$115
	SR 125	SR 905	San Miguel Rd	4T	8F	$439	$741
	SR 125	San Miguel Rd	SR 54	4F	8F	$241	$509
					Subtotal	**$2,211**	**$4,332**

Operational Improvements

TransNet	Freeway	From	To	Existing	With Improvements	Cost ($2019); millions	Cost ($YOE); millions
TransNet	I-5	SR 15	I-8	8F	8F+Operational	$1,985	$4,194
	I-8	I-5	SR 125	8F/10F	8F/10F+Operational	$907	$1,917
	I-8	SR 125	2nd St	6F/8F	6F/8F+Operational	$227	$480
	SR 76	I-15	Couser Canyon	2C/4C	4C/6C+Operational	$178	$376
					Subtotal	**$3,297**	**$6,967**

Table A.1 (continued)

Revenue Constrained Projects

Managed Lanes Connectors

TransNet	Freeway	Intersecting Freeway	Movement		Cost ($2019); millions	Cost ($YOE); millions
TransNet	I-5	I-805	North to North and South to South		*	*
	I-5	SR 78	South to East and West to North, North to East and West to South		$344	$451
TransNet	SR 15	SR 94	South to West and East to North		$97	$127
	SR 15	I-805	North to North and South to South		$110	$124
	I-15	SR 52	West to North and South to East		$177	$374
TransNet	I-15	SR 78	East to South and North to West		$144	$171
	I-805	SR 94	North to West and East to South		$137	$180
	I-805	SR 52	West to North and South to East		*	*
* Project Cost included in associated Managed Lane Project				**Subtotal**	**$1,009**	**$1,427**

Freeway Connectors

TransNet	Freeway	Intersecting Freeway	Movement		Cost ($2019); millions	Cost ($YOE); millions
TransNet	I-5	SR 56	West to North and South to East		$371	$487
TransNet	I-5	SR 78	South to East and West to South		$371	$487
	I-15	SR 56	North to West		$104	$219
TransNet	SR 94	SR 125	South to East		$94	$106
TransNet	SR 94	SR 125	West to North		$110	$134
				Subtotal	**$1,050**	**$1,433**
				TOTAL	**$28,174**	**$50,532**

Table A.1 (continued)

Revenue Constrained Projects

Active Transportation Projects

Project	Jurisdiction(s)	Cost ($2019) millions	Cost ($YOE) millions
Uptown - Fashion Valley to Downtown San Diego	San Diego	$13.0	$13.0
Uptown - Old Town to Hillcrest	San Diego	$1.0	$1.0
Uptown - Hillcrest to Balboa Park	San Diego	$2.0	$2.0
North Park - Mid-City - City Heights	San Diego	$7.0	$8.0
North Park - Mid-City - Hillcrest to City Heights (City Heights – Old Town Corridor)	San Diego	$5.0	$6.0
North Park - Mid-City - City Heights to Rolando	San Diego	$3.0	$3.0
San Diego River Trail - Qualcomm Stadium	San Diego	$1.0	$1.0
Bayshore Bikeway - Main St to Palomar	Chula Vista/ Imperial Beach	$1.0	$1.0
Inland Rail Trail (Combination of four projects)	San Marcos/ Vista/ Co. of San Diego	$35.0	$35.0
Coastal Rail Trail Encinitas - Chesterfield to Solana Beach	Encinitas	$0.5	$1.0
Pershing and El Prado - North Park to Downtown San Diego	San Diego	$7.0	$8.0
Pershing and El Prado - Cross-Park	San Diego	$1.0	$1.0
San Ysidro to Imperial Beach - Bayshore Bikeway Connection	Imperial Beach/ San Diego	$8.0	$9.0
Terrace Dr/Central Ave - Adams to Wightman	San Diego	$4.0	$5.0
San Diego River Trail – I-805 to Fenton	San Diego	$3.0	$3.0
San Diego River Trail - Short gap connections	San Diego	$2.0	$2.0
Coastal Rail Trail Encinitas - Leucadia to G St	Encinitas	$7.0	$8.0
Bayshore Bikeway - Barrio Logan	San Diego	$25.8	$39.0
San Diego River Trail - Father Junipero Serra Trail to Santee	Santee	$9.5	$14.0
Downtown to Southeast connections	San Diego	$8.8	$14.0
Coastal Rail Trail San Diego - UTC	San Diego	$0.8	$1.0
Coastal Rail Trail San Diego - Rose Canyon	San Diego	$8.7	$13.0
Coastal Rail Trail San Diego - Pac Hwy (W Washington St to Laurel St)	San Diego	$7.0	$11.0
Coastal Rail Trail San Diego - Pac Hwy (Laurel St to Santa Fe Depot)	San Diego	$13.9	$21.0
Coastal Rail Trail San Diego – Pac Hwy (Taylor St to W Washington St)	San Diego	$7.0	$11.0
Coastal Rail Trail San Diego- Pac Hwy (Fiesta Island Rd to Taylor St)	San Diego	$12.2	$18.0
City Heights /Encanto/Lemon Grove	Lemon Grove/ San Diego	$12.2	$18.0
City Heights/Fairmount Corridor	San Diego	$20.9	$28.0

Table A.1 (continued)

Revenue Constrained Projects

Active Transportation Projects (continued)

Project	Jurisdiction(s)	Cost ($2019) millions	Cost ($YOE) millions
Rolando to Grossmont/La Mesa	La Mesa/El Cajon/ San Diego	$3.5	$5.0
La Mesa/Lemon Grove/El Cajon connections	Lemon Grove/ La Mesa	$10.4	$16.0
San Diego River Trail - Qualcomm Stadium to Ward Rd	San Diego	$3.5	$5.0
San Diego River Trail - Rancho Mission Rd to Camino Del Rio North	San Diego	$0.5	$1.0
Coastal Rail Trail San Diego - Rose Creek Mission Bay Connection	San Diego	$7.0	$11.0
Coastal Rail Trail Carlsbad - Reach 4 Cannon to Palomar Airport Rd	Carlsbad	$8.7	$13.0
Coastal Rail Trail Carlsbad - Reach 5 Palomar Airport Rd to Poinsettia Station	Carlsbad	$5.2	$8.0
Coastal Rail Trail Encinitas - Carlsbad to Leucadia	Encinitas	$12.2	$18.0
Coastal Rail Trail Del Mar	Del Mar	$0.7	$1.0
Coastal Rail Trail San Diego - Del Mar to Sorrento via Carmel Valley	Del Mar/ San Diego	$0.7	$1.0
Coastal Rail Trail San Diego - Carmel Valley to Roselle via Sorrento	San Diego	$1.6	$2.0
Coastal Rail Trail San Diego - Roselle Canyon	San Diego	$8.7	$13.0
Chula Vista/National City connections	Chula Vista/ National City	$19.1	$25.0
Pacific Beach to Mission Beach	San Diego	$17.4	$23.0
Ocean Beach to Mission Bay	San Diego	$41.8	$51.0
San Diego River Trail - Bridge connection (Sefton Field to Mission Valley YMCA)	San Diego	$12.2	$18.0
San Diego River Trail - Mast Park to Lakeside baseball park	Santee	$17.4	$23.0
I-8 Flyover - Camino del Rio S to Camino del Rio N	San Diego	$17.4	$23.0
Coastal Rail Trail Oceanside - Broadway to Eaton	Oceanside	$0.7	$1.0
El Cajon - Santee connections	El Cajon/La Mesa/ Santee	$20.9	$28.0
San Diego River Trail - Father JS Trail to West Hills Pkwy	San Diego	$5.2	$8.0
Inland Rail Trail Oceanside	Oceanside	$33.1	$40.0
Coastal Rail Trail Carlsbad - Reach 3 Tamarack to Cannon	Carlsbad	$8.7	$13.0
Clairemont Dr (Mission Bay to Burgener)	San Diego	$13.9	$21.0
Harbor Dr (Downtown to Ocean Beach)	San Diego	$12.2	$18.0
Mira Mesa Bike Blvd	San Diego	$7.0	$11.0
Sweetwater River Bikeway Ramps	National City	$15.7	$24.0
Coastal Rail Trail Oceanside - Alta Loma Marsh bridge	Oceanside	$8.7	$13.0
Coastal Rail Trail San Diego - Mission Bay (Clairemont to Tecolote)	San Diego	$5.2	$8.0
Bayshore Bikeway Coronado - Golf course adjacent	Coronado	$5.2	$8.0

Table A.1 (continued)
Revenue Constrained Projects

Active Transportation Projects (continued)

Project	Jurisdiction(s)	Cost ($2019) millions	Cost ($YOE) millions
San Luis Rey River Trail	Oceanside, Unincorporated	$64.4	$122.0
Encinitas-San Marcos Corridor – Double Peak Dr to San Marcos Blvd	San Marcos	$20.9	$48.0
Escondido Creek Bikeway – Quince St to Broadway	Escondido	$3.5	$8.0
Escondido Creek Bikeway – Escondido Creek to Washington Ave	Escondido	$1.7	$4.0
Escondido Creek Bikeway – 9th Ave to Escondido Creek	Escondido	$1.7	$4.0
Escondido Creek Bikeway – El Norte Pkwy to northern bikeway terminus	Escondido	$10.4	$24.0
Encinitas to San Marcos Corridor – Leucadia Blvd to El Camino Real	Carlsbad, Encinitas	$3.5	$8.0
I-15 Bikeway – Via Rancho Pkwy to Lost Oak Ln	Escondido	$7.0	$16.0
I-15 Bikeway – Rancho Bernardo Community Park to Lake Hodges Bridge	San Diego	$5.2	$12.0
I-15 Bikeway – Camino del Norte to Aguamiel Rd	San Diego	$22.6	$40.0
I-15 Bikeway – Poway Rd interchange to Carmel Mountain Rd	San Diego	$29.6	$52.0
SR 56 Bikeway – Azuaga St to Rancho Penasquitos Blvd	San Diego	$3.5	$8.0
I-15 Bikeway – Murphy Canyon Rd to Affinity Ct	San Diego	$69.6	$115.0
SR 56 Bikeway – El Camino Real to Caminito Pointe	San Diego	$3.5	$8.0
SR 52 Bikeway – I-5 to Santo Rd	San Diego	$52.2	$104.0
SR 52 Bikeway – SR 52/Mast Dr to San Diego River Trail	San Diego	$3.5	$8.0
I-8 Corridor – San Diego River Trail to Riverside Dr	Unincorporated	$3.5	$8.0
I-805 Connector – Bonita Rd to Floyd Ave	Chula Vista, Unincorporated	$10.5	$24.0
SR 125 Connector – Bonita Rd to U.S.-Mexico Border	Chula Vista, San Diego	$67.9	$118.0
SR 905 Connector – E Beyer Blvd to U.S.-Mexico Border	San Diego, Unincorporated	$59.2	$103.0
El Camino Real Bike Lanes – Douglas Dr to Mesa Dr	Oceanside	$1.7	$4.0
Vista Way Connector from Arcadia	Vista, Unincorporated	$3.7	$8.0
I-15 Bikeway – W Country Club Ln to Nutmeg St	Escondido	$7.0	$16.0
El Camino Real Bike Lanes – Marron Rd to SR 78 offramp	Carlsbad	$0.5	$1.0
Carlsbad to San Marcos Corridor – Paseo del Norte to Avenida Encinas	Carlsbad	$0.7	$2.0
Encinitas to San Marcos Corridor – Kristen Ct to Ecke Ranch Rd	Encinitas	$0.7	$2.0
Encinitas to San Marcos Corridor – Encinitas Blvd/I-5 Interchange	Encinitas	$0.3	$1.0
Mira Mesa Corridor – Reagan Rd to Parkdale Ave	San Diego	$0.7	$2.0
Mira Mesa Corridor – Scranton Rd to I-805	San Diego	$0.7	$2.0

Table A.1 (continued)
Revenue Constrained Projects

Active Transportation Projects (continued)

Project	Jurisdiction(s)	Cost ($2019) millions	Cost ($YOE) millions
Mira Mesa Corridor – Sorrento Valley Rd to Sorrento Valley Blvd	San Diego	$1.4	$3.0
Mid-County Bikeway – I-5/Via de la Valle Interchange	San Diego	$0.5	$1.0
Mid-County Bikeway – Rancho Santa Fe segment	San Diego, Unincorporated	$5.2	$12.0
El Camino Real Bike Lanes – Manchester Ave to Tennis Club Dr	Encinitas	$0.9	$2.0
Mid-County Bikeway – Manchester Ave/I-5 Interchange to San Elijo Ave	Encinitas	$1.4	$3.0
Central Coast Corridor – Van Nuys St to San Rafael Pl	San Diego	$1.0	$4.0
Clairemont – Centre-City Corridor – Coastal Rail Trail to Genesee Ave	San Diego	$3.5	$8.0
SR 125 Corridor – Mission Gorge Rd to Glen Vista Way	Santee	$0.5	$1.0
SR 125 Corridor – Prospect Ave to Weld Blvd	Santee, El Cajon	$1.4	$3.0
I-8 Corridor – Lakeside Ave to SR 67	Unincorporated	$0.9	$2.0
I-8 Corridor – Willows Rd to SR 79	Unincorporated	$8.7	$19.0
E County Northern Loop – N. Marshall Ave to El Cajon Blvd	El Cajon	$0.5	$1.0
E County Northern Loop – Washington Ave to Dewitt Ct	El Cajon	$1.7	$4.0
E County Northern Loop – SR 94 onramp to Del Rio Rd	Unincorporated	$0.3	$1.0
E County Southern Loop – Pointe Pkwy to Omega St	Unincorporated	$1.4	$3.0
SR 125 Corridor – SR 94 to S of Avocado St	Unincorporated	$1.9	$4.0
Centre City – La Mesa Corridor – Gateside Rd to Campo Rd	La Mesa, Unincorporated	$0.7	$2.0
Bay to Ranch Bikeway – River Ash Dr to Paseo Ranchero	Chula Vista	$0.9	$2.0
Mid-County Bikeway – San Elijo Ave to 101 Terminus	Encinitas	$1.7	$4.0
Central Coast Corridor – Van Nuys St	San Diego	$0.3	$1.0
E County Northern Loop – El Cajon Blvd to Washington Ave	El Cajon	$1.7	$4.0
E County Northern Loop – Calavo Dr to Sweetwater Springs Blvd	Unincorporated	$1.2	$3.0
Central Coast Corridor – Torrey Pines Rd to Nautilus St	San Diego	$10.4	$23.0
Central Coast Corridor – Via Del Norte to Van Nuys St	San Diego	$8.7	$19.0
Kearny Mesa to Beaches Corridor – Ingraham St from Garnet Ave to Pacific Beach Dr	San Diego	$3.5	$8.0
Kearny Mesa to Beaches Corridor – Clairemont Dr to Genesee Ave	San Diego	$17.4	$31.0
Kearny Mesa to Beaches Corridor – Genesee Ave to Linda Vista Dr	San Diego	$10.4	$23.0
Bay to Ranch Bikeway – E J St from 2nd Ave to Paseo Del Rey	Chula Vista	$20.9	$36.0
Chula Vista Greenbelt – Bay Blvd to Oleander Ave	Chula Vista	$29.6	$51.0
Safe Routes to Transit at new transit stations	Various	$1,230	$1,943
Local Bike and Pedestrian Projects	Various	$1,399	$2,211

Table A.1 (continued)

Revenue Constrained Projects

Active Transportation Projects (continued)

Project	Jurisdiction(s)	Cost ($2019) millions	Cost ($YOE) millions
Regional Bicycle and Pedestrian Programs	Various	$34	$54
Regional Safe Routes to School Implementation	Various	$78	$123
	Subtotal	**$3,892**	**$6,226**
	TOTAL	**$64,803**	**$109,645**

1 Capital cost to be funded by the City of San Marcos

2 Streetcar cost is representative of 10% of the total capital cost

3 Capital cost to be funded by aviation and other private funds

Table A.2

Phased Revenue Constrained Projects

Transit Facilities

Year Built By	Service	Route	Description	Cost ($2019); millions	Cost ($YOE); millions
2025	COASTER	398	Double tracking (20-minute peak frequencies and 120-minute off-peak frequencies)	$609	$693
2025	Trolley	510	Mid-Coast Trolley Extension	$919	$919
2025	*Rapid*	2	North Park to Downtown San Diego via 30th St, Golden Hill	$54	$62
2025	*Rapid*	10	La Mesa to Ocean Beach via Mid-City, Hillcrest, Old Town	$57	$65
2025	*Rapid*	120	Kearny Mesa to Downtown via Mission Valley	$127	$145
2025	*Rapid*	550	SDSU to Palomar Station via East San Diego, Southeast San Diego, National City	$112	$126
2025	*Rapid*	709	H St Trolley Station to Millennia via H St Corridor, Southwestern College	$89	$101
2025	*Rapid*	950 (formerly 905)	Extension of Iris Trolley Station to Otay Mesa Port of Entry (POE) route with new service to Imperial Beach	$3	$3
2025	*Rapid*	SR 163 DARs	Kearny Mesa to Downtown via SR 163. Stations at Sharp/Children's Hospital, University Ave, and Fashion Valley Transit Center	$204	$215
2025	Streetcar	554	Hillcrest/Balboa Park/Downtown San Diego Loop[3]	$39	$45
2025	Shuttle	448/449	San Marcos Shuttle[1]	$0	$0
2025	Airport Express	--	Airport Express Routes[2]	$71	$82
2025	Intermodal Transit Center	--	San Diego International Airport Intermodal Transit Center and I-5 Direct Connector Ramps	$231	$258
2025	Other	--	Other Improvements (Vehicles, transit system rehabilitation, maintenance facilities, ITS, regulatory compliance, Park and Ride, transit center expansions)	$721	$798
2025	--	--	Local Bus Routes - 15 minutes in key corridors	--	--
2035	COASTER	398	Double tracking (20-minute peak frequencies and 60-minute off-peak frequencies, grade separations at Leucadia Blvd, stations/platforms at Convention Center/Gaslamp Quarter and Del Mar Fairgrounds, and extension to Camp Pendleton)	$1,224	$1,488
2035	SPRINTER	399	SPRINTER efficiency improvements (20-minute frequencies by 2025); double tracking Oceanside to Escondido for 10-minute frequencies and six rail grade separations at El Camino Real, Melrose Dr, Vista Village Dr/Main St, North Dr, Civic Center, Auto Pkwy and Mission Ave	$1,287	$1,564

Table A.2 (continued)

Phased Revenue Constrained Projects

Transit Facilities (continued)

Year Built By	Service	Route	Description	Cost ($2019); millions	Cost ($YOE); millions
2035	Trolley	510	Phase I - Blue Line Frequency Enhancements and rail grade separations at 28th St, 32nd St, E St, H St, Palomar St, and Blue/Orange Track Connection at 12th/Imperial	$279	$339
2035	Trolley	520	Orange Line Frequency Enhancements and four rail grade separations at Euclid Ave, Broadway/Lemon Grove Ave, Allison Ave/University Ave, Severin Dr	$363	$453
2035	Trolley	561	UTC to COASTER Connection (extension of Route 510)	$467	$581
2035	Trolley	562	Phase I - San Ysidro to Kearny Mesa via Chula Vista via Highland Ave/4th Ave, National City, Southeast San Diego, Mid-City, and Mission Valley	$4,575	$6,290
2035	*Rapid*	11	Spring Valley to SDSU via Southeast San Diego, Downtown, Hillcrest, Mid-City	$154	$199
2035	*Rapid*	28	Point Loma to Kearny Mesa via Old Town, Linda Vista	$67	$80
2035	*Rapid*	30	Old Town to Sorrento Mesa via Pacific Beach, La Jolla, UTC	$143	$172
2035	*Rapid*	41	Fashion Valley to UTC/UC San Diego via Linda Vista and Clairemont	$75	$90
2035	*Rapid*	90	El Cajon Transit Center to San Diego International Airport ITC via SR 94, City College (peak only)	$27	$32
2035	*Rapid*	473	Phase I - Solana Beach to UTC/UC San Diego via Hwy 101 Coastal Communities, Carmel Valley	$58	$70
2035	*Rapid*	635	Eastlake to Palomar Trolley via Main St Corridor	$105	$126
2035	*Rapid*	638	Iris Trolley Station to Otay Mesa via Otay, Airway Dr, SR 905 Corridor	$52	$67
2035	*Rapid*	640A/ 640B	Route 640A: I-5 - San Ysidro to Old Town Transit Center via City College; 640B: I-5 Iris Trolley/Palomar to Kearny Mesa via City College	$208	$229
2035	*Rapid*	688/ 689/ 690	Route 688: San Ysidro to Sorrento Mesa via I-805/I-15/ SR 52 Corridors (Peak Only); Route 689: Otay Mesa Port of Entry (POE) to UTC/Torrey Pines via Otay Ranch/ Millennia, I-805 Corridor (Peak Only); Route 690: Mid-City to Sorrento Mesa via I-805 Corridor (Peak Only)	$623	$757
2035	*Rapid*	910	Coronado to Downtown via Coronado Bridge	$54	$65
2035	Streetcar	553	Downtown San Diego: Little Italy to East Village[3]	$15	$20
2035	Streetcar	555	30th St to Downtown San Diego via North Park/ Golden Hill[3]	$23	$29
2035	Intermodal Transit Center	--	Phase I - San Ysidro Intermodal Transit Center	$129	$158
2035	Other	--	Other Improvements (Vehicles, transit system rehabilitation, maintenance facilities, ITS, regulatory compliance, Park and Ride, transit center expansions)	$2,872	$3,843

Table A.2 (continued)
Phased Revenue Constrained Projects

Transit Facilities (continued)

Year Built By	Service	Route	Description	Cost ($2019); millions	Cost ($YOE); millions
2035	--	--	Local Bus Routes - 10 minutes in key corridors	--	--
2050	COASTER	398	Double tracking (completes double tracking; includes Del Mar Tunnel) plus 2 grade separations	$3,921	$8,258
2050	SPRINTER	399	Branch Extension to Westfield North County	$239	$479
2050	SPRINTER	588	SPRINTER Express	$332	$545
2050	Trolley	510	Phase II - Blue Line rail grade separations at Taylor St and Ash St	$307	$505
2050	Trolley	520	Orange Line Frequency Enhancements	$0	$0
2050	Trolley	530	Green Line Frequency Enhancements	$0	$0
2050	Trolley	560	SDSU to Downtown via El Cajon Blvd/Mid-City (transition of Mid-City *Rapid* to Trolley)	$3,251	$6,676
2050	Trolley	562	Phase II - Kearny Mesa to Carmel Valley	$2,191	$4,389
2050	Trolley	563	Pacific Beach to El Cajon Transit Center	$1,579	$3,024
2050	*Rapid*	103	Solana Beach to Sabre Springs *Rapid* station via Carmel Valley	$91	$152
2050	*Rapid*	440	Carlsbad to Escondido Transit Center via Palomar Airport Rd	$140	$234
2050	*Rapid*	471	Downtown Escondido to East Escondido	$46	$94
2050	*Rapid*	473	Phase II - Oceanside to Solana Beach via Hwy 101 Coastal Communities	$118	$197
2050	*Rapid*	474	Oceanside to Vista via Mission Ave/Santa Fe Rd Corridor	$99	$202
2050	*Rapid*	477	Camp Pendleton to Carlsbad Village via College Blvd, Plaza Camino Real	$109	$181
2050	*Rapid*	235	Temecula (peak only) Extension of Escondido to Downtown *Rapid* (formerly Route 610)	$133	$222
2050	*Rapid*	636	SDSU to Spring Valley via East San Diego, Lemon Grove, Skyline	$53	$88
2050	*Rapid*	637	North Park to 32nd St Trolley Station via Golden Hill	$60	$101
2050	*Rapid*	650	Chula Vista to Palomar Airport Rd Business Park via I-805/I-5 (peak only)	$112	$186
2050	*Rapid*	653	Mid-City to Palomar Airport Rd via Kearny Mesa/I-805/I-5	$14	$23
2050	*Rapid*	870	El Cajon to UTC via Santee, SR 52, I-805	$100	$190
2050	*Rapid*	890	El Cajon to Sorrento Mesa via SR 52, Kearny Mesa	$16	$31
2050	Streetcar	565	Mission Beach to La Jolla via Pacific Beach[3]	$34	$57
2050	Intermodal Transit Center	--	Phase II - San Ysidro Intermodal Transit Center	$31	$51

Table A.2 (continued)

Phased Revenue Constrained Projects

Transit Facilities (continued)

Year Built By	Service	Route	Description	Cost ($2019); millions	Cost ($YOE); millions
2050	Other	--	Other Improvements (Vehicles, transit system rehabilitation, maintenance facilities, ITS, regulatory compliance, Park and Ride, transit center expansions)	$3,724	$6,839
			Subtotal	**$32,736**	**$52,887**

Table A.2 (continued)

Phased Revenue Constrained Projects

Managed Lanes/Toll Lanes

Year Built By	Freeway	From	To	Existing*	With Improvements	Transit Route	Cost ($2019); millions	Cost ($YOE); millions
2025	I-5	Manchester Ave	SR 78	8F	8F+2ML	650, 653	$51	$51
2025	I-5	SR 78	Vandegrift Blvd	8F	8F+2ML		$116	$131
2025	SR 11/Otay Mesa East Port of Entry (POE)	SR 125	Mexico	--	4T+POE	905	$472	$472
2025	I-15	I-8	SR 163	8F	8F+2ML	235, 610, 653, 690	$64	$72
2025	I-805	SR 94	SR 15	8F	8F+2ML	225, 650, 688, 689	$234	$264
2035	I-5	SR 905	SR 54	8F	8F+2ML	640	$542	$627
2035	I-5	SR 54	SR 15	8F	10F+2ML	640	$467	$540
2035	I-5	La Jolla Village Dr I-5/I-805 Merge	I-5/805 Merge SR 56	8F/14F 8F/14F+2ML	8F/14F+2ML 8F/14F+4ML	650, 653	$422	$513
2035	I-5	SR 56	SR 78	8F+2ML	8F+4ML	650, 653	$2,082	$3,019
2035	SR 15	SR 94	I-805	6F	6F+2ML	235, 610	$41	$59
2035	SR 78	I-5	I-15	6F	6F+2ML		$1,621	$2,127
2035	SR 94	I-5	I-805	8F	8F+2ML	90, 225, 235, 610	$728	$955
2035	I-805	SR 905	Palomar St	8F	8F+2ML	688	$235	$316
2035	I-805	SR 54	SR 94	8F+2ML	8F+4ML	225, 650, 688, 689	$742	$998
2035	I-805	SR 163	SR 52	8F	8F+2ML	650, 688, 689, 690	$195	$269
2035	I-805	SR 52	Carroll Canyon Rd	8F+2ML	8F+4ML	30, 650, 653, 688, 689, 690, 870, 890	$778	$996
2050	I-5	I-8	La Jolla Village Dr	8F/10F	8F/10F+2ML		$978	$2,067
2050	I-5	SR 78	Vandegrift Blvd	8F+2ML	8F+4ML		$632	$1,336
2050	I-5	Vandegrift Blvd	Orange County	8F	8F+4T		$3,165	$6,687
2050	SR 15	I-5	SR 94	6F	8F+2ML		$185	$391

Table A.2 (continued)

Phased Revenue Constrained Projects

Managed Lanes/Toll Lanes (continued)

Year Built By	Freeway	From	To	Existing*	With Improvements	Transit Route	Cost ($2019); millions	Cost ($YOE); millions
2050	I-15	Viaduct	--	8F	8F+2ML	235, 610, 653, 690	$1,040	$2,197
2050	I-15	SR 78	Riverside County	8F	8F+4T	610	$1,744	$3,684
2050	SR 52	I-805	I-15	6F	6F+2ML	653, 870, 890	$238	$503
2050	SR 52	I-15	SR 125	4F/6F	4F/6F+2ML(R)	870, 890	$405	$856
2050	SR 54	I-5	SR 125	6F	6F+2ML		$151	$319
2050	SR 94	I-805	SR 125	8F	8F+2ML	90	$501	$1,057
2050	SR 125	SR 54 SR 94	SR 94 I-8	6F 8F	6F+2ML 10F+2ML	90	$690	$1,457
2050	I-805	SR 94	SR 15	8F+2ML	8F+4ML	225, 650, 688, 690	$83	$175
2050	I-805	SR 15	SR 163	8F/10F	8F/10F+4ML	650, 688, 689, 690	$1,567	$3,310
2050	I-805	SR 163	SR 52	8F+2ML	8F+4ML	650, 688, 689, 690	$438	$925
						Subtotal	**$20,607**	**$36,373**

Table A.2 (continued)

Phased Revenue Constrained Projects

Highway Projects

Year Built By	Freeway	From	To	Existing*	With Improvements	Cost ($2019); millions	Cost ($YOE); millions
2025	SR 67	Mapleview St	Gold Bar Ln	2C	4C	$82	$92
2035	SR 52	Mast Blvd	SR 125	4F	6F	$103	$147
2050	I-8	2nd St	Los Coches	4F/6F	6F	$44	$94
2050	SR 52	I-5	I-805	4F	6F	$151	$319
2050	SR 56	I-5	I-15	4F	6F	$192	$405
2050	SR 67	Gold Bar Ln	Dye Rd	2C/4C	4C	$591	$1,248
2050	SR 94	SR 125	Avocado Blvd	4F	6F	$190	$401
2050	SR 94	Avocado Blvd	Jamacha	4C	6C	$124	$261
2050	SR 94	Jamacha	Steele Canyon Rd	2C/4C	4C	$54	$115
2050	SR 125	SR 905	San Miguel Rd	4T	8F	$439	$741
2050	SR 125	San Miguel Rd	SR 54	4F	8F	$241	$509
					Subtotal	**$2,211**	**$4,332**

Operational Improvements

Year Built By	Freeway	From	To	Existing*	With Improvements	Cost ($2019); millions	Cost ($YOE); millions
2050	I-5	SR 15	I-8	8F	8F+Operational	$1,985	$4,194
2050	I-8	I-5	SR 125	8F/10F	8F/10F+Operational	$907	$1,917
2050	I-8	SR 125	2nd St	6F/8F	6F/8F+Operational	$227	$480
2050	SR 76	I-15	Couser Canyon	2C/4C	4C/6C+Operational	$178	$376
					Subtotal	**$3,297**	**$6,967**

Table A.2 (continued)

Phased Revenue Constrained Projects

Managed Lanes Connectors

Year Built By	Freeway	Intersecting Freeway	Movement	Cost ($2019); millions	Cost ($YOE); millions
2025	SR 15	I-805	North to North and South to South	$110	$124
2035	I-5	SR 78	South to East and West to North, North to East and West to South	$344	$451
2035	I-5	I-805	North to North and South to South	*	*
2035	I-15	SR 78	East to South and North to West	$144	$171
2035	SR 15	SR 94	South to West and East to North	$97	$127
2035	I-805	SR 94	North to West and East to South	$137	$180
2050	I-15	SR 52	West to North and South to East	$177	$374
2050	I-805	SR 52	West to North and South to East	*	*
			Subtotal	**$1,009**	**$1,427**

* Project Cost included in associated Managed Lane Project

Freeway Connectors

Year Built By	Freeway	Intersecting Freeway	Movement	Cost ($2019); millions	Cost ($YOE); millions
2025	SR 94	SR 125	South to East	$94	$106
2035	I-5	SR 56	West to North and South to East	$371	$487
2035	I-5	SR 78	South to East and West to South	$371	$487
2035	SR 94	SR 125	West to North	$110	$134
2050	I-15	SR 56	North to West	$104	$219
			Subtotal	**$1,050**	**$1,433**

Table A.2 (continued)

Phased Revenue Constrained Projects

Active Transportation Projects

Year Built By	Project	Jurisdiction(s)	Project Phase	Cost ($2019); millions	Cost ($YOE); millions
2025	Uptown - Fashion Valley to Downtown San Diego	San Diego	Const.	$13.0	$13.0
2025	Uptown - Old Town to Hillcrest	San Diego	Const.	$1.0	$1.0
2025	Uptown - Hillcrest to Balboa Park	San Diego	Const.	$2.0	$2.0
2025	North Park - Mid-City - City Heights	San Diego	Const.	$7.0	$8.0
2025	North Park - Mid-City - Hillcrest to City Heights (City Heights - Old Town Corridor)	San Diego	Const.	$5.0	$6.0
2025	North Park - Mid-City - City Heights to Rolando	San Diego	Const.	$3.0	$3.0
2025	San Diego River Trail - Qualcomm Stadium	San Diego	Const.	$1.0	$1.0
2025	Bayshore Bikeway - Main St to Palomar	Chula Vista/ Imperial Beach	Const.	$1.0	$1.0
2025	Inland Rail Trail (combination of four projects)	San Marcos, Vista, Co. of San Diego	Const.	$35.0	$35.0
2025	Pershing and El Prado - North Park to Downtown San Diego	San Diego	Const.	$7.0	$8.0
2025	Pershing and El Prado - Cross-Park	San Diego	Const.	$1.0	$1.0
2025	Terrace Dr/Central Ave - Adams to Wightman	San Diego	Const.	$4.0	$5.0
2025	San Diego River Trail – I-805 to Fenton	San Diego	Const.	$3.0	$3.0
2025	San Diego River Trail - Short gap connections	San Diego	Const.	$2.0	$2.0
2025	Coastal Rail Trail Encinitas - Leucadia to G St	Encinitas	Const.	$7.0	$8.0
2025	San Ysidro to Imperial Beach - Bayshore Bikeway Connection	Imperial Beach/ San Diego	Const.	$8.0	$9.0
2025	Bayshore Bikeway – Barrio Logan	San Diego	Const.	$25.8	$39.0
2025	Coastal Rail Trail San Diego – Rose Creek Mission Bay Connection	San Diego	Const.	$7.0	$11.0
2025	Other Active Transportation Programs and Projects[4]	Various	Various	$600	$654.0
2035	Downtown to Southeast connections - East Village	San Diego	ROW	$1.1	$2.0
2035	Downtown to Southeast connections – Downtown San Diego to Encanto	San Diego	ROW	$4.1	$6.0
2035	Downtown to Southeast connections – Downtown San Diego to Golden Hill	San Diego	Const.	$3.6	$6.0
2035	Coastal Rail Trail San Diego - UTC	San Diego	Const.	$0.8	$1.0
2035	Coastal Rail Trail San Diego - Rose Canyon	San Diego	Const.	$8.7	$13.0
2035	Coastal Rail Trail San Diego - Pac Hwy (W Washington St to Laurel St)	San Diego	Const.	$7.0	$11.0
2035	Coastal Rail Trail San Diego - Pac Hwy (Laurel St to Santa Fe Depot)	San Diego	Const.	$13.9	$21.0
2035	Coastal Rail Trail San Diego - Encinitas Chesterfield to Solana Beach	Encinitas	Const.	$0.5	$1.0

Table A.2 (continued)

Phased Revenue Constrained Projects

Active Transportation Projects (continued)

Year Built By	Project	Jurisdiction(s)	Project Phase	Cost ($2019); millions	Cost ($YOE); millions
2035	Coastal Rail Trail San Diego – Pac Hwy (Taylor St to W Washington St)	San Diego	Const.	$7.0	$11.0
2035	Coastal Rail Trail San Diego- Pac Hwy (Fiesta Island Rd to Taylor St)	San Diego	Const.	$12.2	$18.0
2035	San Diego River Trail - Father Junipero Serra Trail to Santee	Santee	Const.	$9.5	$14.0
2035	City Heights /Encanto/Lemon Grove	Lemon Grove/ San Diego	Const.	$12.2	$18.0
2035	City Heights/Fairmount Corridor	San Diego	Const.	$20.9	$28.0
2035	Rolando to Grossmont/La Mesa	La Mesa/ El Cajon/ San Diego	Const.	$3.5	$5.0
2035	La Mesa/Lemon Grove/El Cajon connections	Lemon Grove/ La Mesa	Const.	$10.4	$16.0
2035	San Diego River Trail - Qualcomm Stadium to Ward Rd	San Diego	Const.	$3.5	$5.0
2035	San Diego River Trail - Rancho Mission Rd to Camino Del Rio North	San Diego	Const.	$0.5	$1.0
2035	Coastal Rail Trail Carlsbad - Reach 4 Cannon to Palomar Airport Rd	Carlsbad	Const.	$8.7	$13.0
2035	Coastal Rail Trail Carlsbad - Reach 5 Palomar Airport Rd to Poinsettia Station	Carlsbad	Const.	$5.2	$8.0
2035	Coastal Rail Trail Encinitas - Carlsbad to Leucadia	Encinitas	Const.	$12.2	$18.0
2035	Coastal Rail Trail Del Mar	Del Mar	Const.	$0.7	$1.0
2035	Coastal Rail Trail San Diego - Del Mar to Sorrento via Carmel Valley	Del Mar/ San Diego	Const.	$0.7	$1.0
2035	Coastal Rail Trail San Diego - Carmel Valley to Roselle via Sorrento	San Diego	Const.	$1.6	$2.0
2035	Coastal Rail Trail San Diego - Roselle Canyon	San Diego	Const.	$8.7	$13.0
2035	Chula Vista/National City connections	Chula Vista/ National City	Const.	$19.1	$25.0
2035	Pacific Beach to Mission Beach	San Diego	Const.	$17.4	$23.0
2035	Ocean Beach to Mission Bay	San Diego	Const.	$41.8	$51.0
2035	San Diego River Trail - Bridge connection (Sefton Field to Mission Valley YMCA)	San Diego	Const.	$12.2	$18.0
2035	San Diego River Trail - Mast Park to Lakeside baseball park	Santee	Const.	$17.4	$23.0
2035	I-8 Flyover - Camino del Rio S to Camino del Rio N	San Diego	Const.	$17.4	$23.0
2035	Coastal Rail Trail Oceanside - Broadway to Eaton	Oceanside	Const.	$0.7	$1.0
2035	El Cajon - Santee connections	El Cajon/ La Mesa/ Santee	Const.	$20.9	$28.0
2035	San Diego River Trail - Father JS Trail to West Hills Pkwy	San Diego	Const.	$5.2	$8.0
2035	Inland Rail Trail Oceanside	Oceanside	Const.	$33.1	$40.0

Table A.2 (continued)

Phased Revenue Constrained Projects

Active Transportation Projects (continued)

Year Built By	Project	Jurisdiction(s)	Project Phase	Cost ($2019); millions	Cost ($YOE); millions
2035	Coastal Rail Trail Carlsbad - Reach 3 Tamarack to Cannon	Carlsbad	Const.	$8.7	$13.0
2035	Clairemont Dr (Mission Bay to Burgener)	San Diego	Const.	$13.9	$21.0
2035	Harbor Dr (Downtown to Ocean Beach)	San Diego	Const.	$12.2	$18.0
2035	Mira Mesa Bike Blvd	San Diego	Const.	$7.0	$11.0
2035	Sweetwater River Bikeway Ramps	National City	Const.	$15.7	$24.0
2035	Coastal Rail Trail Oceanside - Alta Loma Marsh bridge	Oceanside	Const.	$8.7	$13.0
2035	Coastal Rail Trail San Diego - Mission Bay (Clairemont to Tecolote)	San Diego	Const.	$5.2	$8.0
2035	Bayshore Bikeway Coronado - Golf course adjacent	Coronado	Const.	$5.2	$8.0
2035	Other Active Transportation Programs and Projects[4]	Various	Various	$857.0	$1,179
2050	San Luis Rey River Trail	Oceanside, Unincorporated	Const.	$64.4	$122.0
2050	Encinitas-San Marcos Corridor – Double Peak Dr to San Marcos Blvd	San Marcos	Const.	$20.9	$48.0
2050	Escondido Creek Bikeway – Quince St to Broadway	Escondido	Const.	$3.5	$8.0
2050	Escondido Creek Bikeway – Escondido Creek to Washington Ave	Escondido	Const.	$1.7	$4.0
2050	Escondido Creek Bikeway – 9th Ave to Escondido Creek	Escondido	Const.	$1.7	$4.0
2050	Escondido Creek Bikeway – El Norte Pkwy to northern bikeway terminus	Escondido	Const.	$10.4	$24.0
2050	Encinitas to San Marcos Corridor – Leucadia Blvd to El Camino Real	Carlsbad, Encinitas	Const.	$3.5	$8.0
2050	I-15 Bikeway – Via Rancho Pkwy to Lost Oak Ln	Escondido	Const.	$7.0	$16.0
2050	I-15 Bikeway – Rancho Bernardo Community Park to Lake Hodges Bridge	San Diego	Const.	$5.2	$12.0
2050	I-15 Bikeway – Camino del Norte to Aguamiel Rd	San Diego	Const.	$22.6	$40.0
2050	I-15 Bikeway – Poway Rd interchange to Carmel Mountain Rd	San Diego	Const.	$29.6	$52.0
2050	SR 56 Bikeway – Azuaga St to Rancho Peñasquitos Blvd	San Diego	Const.	$3.5	$8.0
2050	I-15 Bikeway – Murphy Canyon Rd to Affinity Ct	San Diego	Const.	$69.6	$115.0
2050	SR 56 Bikeway – El Camino Real to Caminito Pointe	San Diego	Const.	$3.5	$8.0
2050	SR 52 Bikeway – I-5 to Santo Rd	San Diego	Const.	$52.2	$104.0
2050	SR 52 Bikeway – SR 52/Mast Dr to San Diego River Trail	San Diego	Const.	$3.5	$8.0
2050	I-8 Corridor – San Diego River Trail to Riverside Dr	Unincorporated	Const.	$3.5	$8.0

Table A.2 (continued)

Phased Revenue Constrained Projects

Active Transportation Projects (continued)

Year Built By	Project	Jurisdiction(s)	Project Phase	Cost ($2019); millions	Cost ($YOE); millions
2050	I-805 Connector – Bonita Rd to Floyd Ave	Chula Vista, Unincorporated	Const.	$10.5	$24.0
2050	SR 125 Connector – Bonita Rd to U.S.-Mexico Border	Chula Vista, San Diego	Const.	$67.9	$118.0
2050	SR 905 Connector – E Beyer Blvd to U.S.-Mexico Border	San Diego, Unincorporated	Const.	$59.2	$103.0
2050	El Camino Real Bike Lanes – Douglas Dr. to Mesa Dr.	Oceanside	Const.	$1.7	$4.0
2050	Vista Way Connector from Arcadia	Vista Unincorporated	Const.	$3.7	$8.0
2050	I-15 Bikeway – W Country Club Ln to Nutmeg St	Escondido	Const.	$7.0	$16.0
2050	El Camino Real Bike Lanes – Marron Rd to SR 78 off ramp	Carlsbad	Const.	$0.5	$1.0
2050	Carlsbad to San Marcos Corridor – Paseo del Norte to Avenida Encinas	Carlsbad	Const.	$0.7	$2.0
2050	Encinitas to San Marcos Corridor – Kristen Ct to Ecke Ranch Rd	Encinitas	Const.	$0.7	$2.0
2050	Encinitas to San Marcos Corridor – Encinitas Blvd/ I-5 Interchange	Encinitas	Const.	$0.3	$1.0
2050	Mira Mesa Corridor – Reagan Rd to Parkdale Ave	San Diego	Const.	$0.7	$2.0
2050	Mira Mesa Corridor – Scranton Rd to I-805	San Diego	Const.	$0.7	$2.0
2050	Mira Mesa Corridor – Sorrento Valley Rd to Sorrento Valley Blvd	San Diego	Const.	$1.4	$3.0
2050	Mid-County Bikeway – I-5/Via de la Valle Interchange	San Diego	Const.	$0.5	$1.0
2050	Mid-County Bikeway – Rancho Santa Fe segment	San Diego, Unincorporated	Const.	$5.2	$12.0
2050	El Camino Real Bike Lanes – Manchester Ave to Tennis Club Dr	Encinitas	Const.	$0.9	$2.0
2050	Mid-County Bikeway – Manchester Ave/ I-5 Interchange to San Elijo Ave	Encinitas	Const.	$1.4	$3.0
2050	Central Coast Corridor – Van Nuys St to San Rafael Pl	San Diego	Const.	$1.0	$4.0
2050	Clairemont – Centre-City Corridor – Coastal Rail Trail to Genesee Ave	San Diego	Const.	$3.5	$8.0
2050	SR 125 Corridor – Mission Gorge Rd to Glen Vista Way	Santee	Const.	$0.5	$1.0
2050	SR 125 Corridor – Prospect Ave to Weld Blvd	Santee, El Cajon	Const.	$1.4	$3.0
2050	I-8 Corridor – Lakeside Ave to SR 67	Unincorporated	Const.	$0.9	$2.0
2050	I-8 Corridor – Willows Rd to SR 79	Unincorporated	Const.	$8.7	$19.0
2050	E County Northern Loop – N Marshall Ave to El Cajon Blvd	El Cajon	Const.	$0.5	$1.0
2050	E County Northern Loop – Washington Ave to Dewitt Ct	El Cajon	Const.	$1.7	$4.0

Table A.2 (continued)

Phased Revenue Constrained Projects

Active Transportation Projects (continued)

Year Built By	Project	Jurisdiction(s)	Project Phase	Cost ($2019); millions	Cost ($YOE); millions
2050	E County Northern Loop – SR 94 onramp to Del Rio Rd	Unincorporated	Const.	$0.3	$1.0
2050	E County Southern Loop – Pointe Pkwy to Omega St	Unincorporated	Const.	$1.4	$3.0
2050	SR 125 Corridor – SR 94 to S of Avocado St	Unincorporated	Const.	$1.9	$4.0
2050	Centre City – La Mesa Corridor – Gateside Rd to Campo Rd	La Mesa, Unincorporated	Const.	$0.7	$2.0
2050	Bay to Ranch Bikeway – River Ash Dr to Paseo Ranchero	Chula Vista	Const.	$0.9	$2.0
2050	Mid-County Bikeway – San Elijo Ave to 101 Terminus	Encinitas	Const.	$1.7	$4.0
2050	Central Coast Corridor – Van Nuys St	San Diego	Const.	$0.3	$1.0
2050	E County Northern Loop – El Cajon Blvd to Washington Ave	El Cajon	Const.	$1.7	$4.0
2050	E County Northern Loop – Calavo Dr to Sweetwater Springs Blvd	Unincorporated	Const.	$1.2	$3.0
2050	Central Coast Corridor – Torrey Pines Rd to Nautilus St	San Diego	Const.	$10.4	$23.0
2050	Central Coast Corridor – Via Del Norte to Van Nuys St	San Diego	Const.	$8.7	$19.0
2050	Kearny Mesa to Beaches Corridor – Ingraham St from Garnet Ave to Pacific Beach Dr	San Diego	Const.	$3.5	$8.0
2050	Kearny Mesa to Beaches Corridor – Clairemont Dr to Genesee Ave	San Diego	Const.	$17.4	$31.0
2050	Kearny Mesa to Beaches Corridor – Genesee Ave to Linda Vista Dr	San Diego	Const.	$10.4	$23.0
2050	Bay to Ranch Bikeway – E J St from 2nd Ave to Paseo Del Rey	Chula Vista	Const.	$20.9	$36.0
2050	Chula Vista Greenbelt – Bay Blvd to Oleander Ave	Chula Vista	Const.	$29.6	$51.0
2050	Other Active Transportation Programs and Projects[4]	Various	Various	$1,285	$2,498
			Subtotal	**$3,892**	**$6,226**
			TOTAL	**$64,802**	**$109,645**

* Based on facility configuration at time of project construction.

1 Capital cost to be funded by the City of San Marcos

2 Capital cost to be funded by aviation and other private funds

3 Streetcar cost is representative of 10 percent of the total capital cost

4 Includes Safe Routes to Transit projects at new transit station areas, local bike projects, local pedestrian/safety/traffic calming projects, regional bicycle and pedestrian programs and Regional Safe Routes to School implementation.

Table A.3

Phased Revenue Constrained Arterial Projects[1]

Year Built By	SANDAG ID	Lead Agency	Project Title	Project Description
2025	CB04B	Carlsbad	El Camino Real and Cannon Rd	Along the eastside of El Camino Real just south of Cannon Rd, widen to prime arterial standards with three through lanes, a right turn lane, and a sidewalk approaching the intersection
2025	CB12	Carlsbad	College Blvd Reach A - Badger Ln to Cannon Rd	From Badger Ln to Cannon Rd, construct a new segment of College Blvd to provide 4-lane roadway with raised median, bike lanes, and sidewalks/trails in accordance with major arterial standards
2025	CB13	Carlsbad	Poinsettia Ln Reach E - Cassia Dr to Skimmer Ct	From Cassia Dr to Skimmer Ct, construct a new 4-lane roadway with median, bike lanes, and sidewalks/trails to major arterial standards
2025	CB22	Carlsbad	Avenida Encinas, widen from Palomar Airport Rd to Encinas Water Pollution Control Facility	Avenida Encinas from Palomar Airport Rd southerly to existing improvements adjacent to the Embarcadero Lane, roadway widening to secondary arterial standards
2025	CB31	Carlsbad	El Camino Real – La Costa Ave to Arenal Rd	Along El Camino Real from 700 feet north of La Costa Ave to Arenal Rd, widening along the southbound side of the roadway to provide three travel lanes and a bike lane in accordance with prime arterial standards
2025	CB32	Carlsbad	El Camino Real Widening - Cassia to Camino Vida Roble	Widen El Camino Real from 900 feet north of Cassia Rd to Camino Vida Roble, along the northbound side of the roadway to provide three travel lanes and a bike lane in accordance with prime arterial standards
2025	CB35	Carlsbad	Palomar Airport Rd - Palomar Airport Rd to Paseo Del Norte	Lengthen the left turn pocket along eastbound Palomar Airport Rd to northbound Paseo Del Norte
2025	CHV08	Chula Vista	Willow St Bridge Project - Bonita Rd to Sweetwater Rd	Replace 2-lane bridge with 4-lane bridge (Phase II)
2025	CHV69	Chula Vista	Heritage Rd Bridge	Heritage Rd from Main St/Nirvana Ave to Entertainment Circle, widen and lengthen bridge over Otay River from 4-lane to 6-lane bridge that accommodates shoulders, sidewalk, and medial; project is on Heritage Rd from the intersection of Main St and Nirvana Ave to Entertainment Circle
2025	CNTY14A	San Diego County	South Santa Fe Ave South	South Santa Fe from 700 feet south of Woodland Dr to Smilax Rd, widening of South Santa Fe Ave to a 5-lane major road with a center left turn lane, curb, gutter, sidewalk, bike lanes, and drainage improvements.
2025	CNTY21	San Diego County	Bradley Ave Overpass at SR 67	Widen Bradley Ave from Magnolia Ave to Mollison Ave; widen from 2 lanes to 4 lanes plus sidewalks. Replace 2-lane bridge over SR 67 with a 6-lane bridge, which accommodates turn pockets.

Table A.3 (continued)

Phased Revenue Constrained Arterial Projects

Year Built By	SANDAG ID	Lead Agency	Project Title	Project Description
2025	CNTY24	San Diego County	Cole Grade Rd	Cole Grade Rd from north of Horse Creek Trail to south of Pauma Heights Rd, widen to accommodate 14-foot traffic lane in both directions, 12-foot center 2-way left turn, 6-foot bike lane and 10-foot pathway
2025	ESC02A	Escondido	East Valley/ Valley Center	Widen roadway from 4 to 6 lanes with raised medians and left turn pockets; modify signal at Lake Wohlford and Valley Center Rd; widen bridge over Escondido Creek
2025	ESC04	Escondido	Citracado Parkway II	West Valley to Harmony Grove, widen from 2 to 4 lanes with raised medians; construct bridge over Escondido Creek
2025	ESC06	Escondido	El Norte Pkwy Bridge at Escondido Creek - Kaile Ln to Key Lime Way	Construct missing 2-lane bridge at Escondido Creek
2025	ESC08	Escondido	Felicita Ave/Juniper St - from Escondido Blvd to Juniper St and from Juniper St to Chestnut St	Widen from 2 to 4 lanes with left turn pockets, raised medians on Felicita; new traffic signals at Juniper and Chestnut, Juniper and 13th Ave, Juniper and 15th Ave; modify traffic signal at Juniper and Felicita
2025	ESC24	Escondido	Centre City Pkwy	Mission Rd to SR 78, widen 4 lanes to 6 lanes with intersection improvements
2025	NC01	National City	Plaza Blvd Widening	Plaza Blvd from Highland Ave to Euclid Ave, widen from 2 to 3 lanes including a new traffic lane in each direction, new sidewalks, sidewalk widening, traffic signal upgrades, and interconnection at Plaza Blvd
2025	O22	Oceanside	College Blvd - Avenida de la Plate to Waring Road	Widen from the existing 4 lanes to 6 lanes with bike lanes and raised median
2025	SD34	San Diego	El Camino Real	In San Diego on El Camino Real from San Dieguito Rd to Via de la Valle, reconstruct and widen from 2 to 4 lanes and extend transition lane and additional grading to avoid biological impacts (CIP 52-479.0)
2025	SD70	San Diego	West Mission Bay Dr Bridge	In San Diego, replace bridge and increase from 4- to 6-lane bridge including Class II bike lane (CIP 52-643.0/S00871)
2025	SD83	San Diego	SR 163/Friars Rd. Interchange Modification	Widen and improve Friars Road and overcrossing; reconstruct interchange including improvements to ramp intersections (Phase 1); construct new connector roadways and structures (Phase 2); construct auxiliary lanes along northbound and southbound SR163 (Phase 3) (CIP Legacy#52-455.0,WBS# S-00851)
2025	SD102A	San Diego	Otay Truck Route Widening	On Otay Truck Route in San Diego from Drucker Ln to La Media, add one lane (total 3 lanes) for trucks; from Britannia to La Media, add one lane for trucks and one lane for emergency vehicles (border patrol/fire department access); along Britannia from Britannia Court to the Otay Truck Route - add one lane for trucks

Table A.3 (continued)

Phased Revenue Constrained Arterial Projects

Year Built By	SANDAG ID	Lead Agency	Project Title	Project Description
2025	SD190	San Diego	Palm Ave/I-805 Interchange	Improvements to the Palm Avenue Bridge over I-805; repairs to the bridge approaches; a new Project Study Report (PSR) and Preliminary Environmental Assessment Report (PEAR). Phase II will include widening of the bridge, realignment of existing ramps, possible addition of northbound looping entrance ramp, restriping of traffic lanes, and signal modifications.
2025	SD247	San Diego	Camino del Sur and Carmel Mountain Road	On Camino del Sur from Carmel Mountain Road to Dormouse Road, and on Camino del Sur from Torrey Santa Fe to Carmel Mountain Rd, construction of Camino del Sur as a two-lane interim roadway (S00872 and RD15000). Project also includes construction of Carmel Mountain Road, from Sundance Avenue to Camino del Sur as a four-lane major street with Class II bicycle lanes.
2025	SM19	San Marcos	Grand Ave Bridge and Street Improvements	From Discovery St to San Marcos Blvd, construct 4-lane arterial bridge and a 6-lane arterial street from Craven to Grand Ave
2025	SM22	San Marcos	South Santa Fe - Bosstick to Smilax	From Bosstick to Smilax, realign and signalize the South Santa Fe/Smilax intersection (Phase I)
2025	SM24	San Marcos	Woodland Pkwy Interchange Improvements	From La Moree Rd to Rancheros Dr, modify existing ramps at Woodland Pkwy and Barham Dr; widen and realign SR 78 undercrossing and associated work
2025	SM31	San Marcos	Discovery St Improvements	From Via Vera Cruz to Bent Ave/Craven Rd, widen roadway to 4-lane secondary arterial
2025	SM32	San Marcos	Via Vera Cruz Bridge and Street Improvements	From San Marcos Blvd to Discovery St, widen to 4-lane secondary arterial and construct a bridge at San Marcos Creek
2025	SM42	San Marcos	Street Improvements: Discovery St - Craven Rd to West of Twin Oaks Valley Rd	In the City of San Marcos, on Discovery St from Craven Rd to west of Twin Oaks Valley Rd, construct approximately 5,100 lineal feet of a new 6-lane roadway
2025	SM48	San Marcos	Creekside Dr	Construct approximately 3,000 feet of a 2-lane collector road from Via Vera Cruz to Grand Ave in the City of San Marcos. The road will include two 12-foot lanes, diagonal parking on the north side, and parallel parking on the south side. In addition, the project also will include a 10-foot bike trail meandering along the south side.
2025	CB34	Carlsbad	Palomar Airport Rd - Palomar Airport Rd to Paseo Del Norte	Widening along eastbound Palomar Airport Rd to provide a dedicated right turn lane to southbound Paseo Del Norte
2025	CNTY34	San Diego County	Dye Rd Extension	Dye Rd to San Vicente Rd - in Ramona, study, design, and construct a 2-lane community collector road with intermittent turn lanes, bike lanes, curb, gutter, and pathway/walkway

Table A.3 (continued)

Phased Revenue Constrained Arterial Projects

Year Built By	SANDAG ID	Lead Agency	Project Title	Project Description
2025	CNTY35	San Diego County	Ramona St Extension	From Boundary Ave to Warnock Dr - in the community of Ramona, construct new road extension, 2 lanes with intermittent turn lanes, bike lanes, and walkway/pathway
2025	CNTY88	San Diego County	Ashwood Street Corridor Improvements – Mapleview to Willow	Ashwood Street/Wildcat Canyon Road from Mapleview Street to 1100 feet north of Willow Road in Lakeside- traffic signal improvements at Mapleview and Ashwood; traffic signal installation at Willow and Ashwood/Wildcat Canyon; and the addition of turn lanes, addition of a passing lane in a non-urbanized area, bike lanes, and pedestrian facilities.
2025	V15	Various Agencies	I-5/Gilman Dr. Bridge	In San Diego, construct new overcrossing over I-5 between Gilman Drive and Medical Center Drive
2025	V18	Various Agencies	I-5/Voigt Drive Improvements	Between La Jolla Village Drive and Genesee Avenue - in San Diego, on Interstate 5, construction of the realignment of both Campus Point and Voigt Drive between I-5 and Genesee Avenue
2035	SD81	San Diego	Genesee Ave – Nobel Dr to SR 52	In San Diego, future widening to 6-lane major street north of Decoro St and to a 6-lane primary arterial south of Decoro St and included Class II bicycle lanes (CIP 52-458.0)
2035	SD190	San Diego	Palm Avenue/I-805 Interchange	Phase III will provide the ultimate build-out of the project which will incorporate improvements of Phase II plus the northbound and southbound entrance ramps (CIP 52-640.0)
2035	SM10	San Marcos	SR 78/Smilax	Construct new interchange at Smilax Rd interchange and SR 78 improvements

[1] The arterials listed in this table reflect locally initiated projects that were submitted by local jurisdictions in the 2018 Regional Transportation Improvement Program.

Table A.4

Revenue Constrained Freight and Goods Movement Projects

Rail Facilities (Shared Use Freight and Passengers)

Service	Route	Description	Cost ($2019); millions	Cost ($YOE); millions
COASTER/ BNSF	398	Double tracking (includes grade separations at Leucadia Blvd and two other locations, stations/platforms at Convention Center/Gaslamp Quarter and Del Mar Fairgrounds, Del Mar Tunnel, and extensions to the Convention Center and Camp Pendleton)	$5,754	$10,439
SPRINTER/ BNSF	399	SPRINTER efficiency improvements and double tracking (Oceanside to Escondido and six rail grade separations at El Camino Real, Melrose Dr, Vista Village Dr/Main St, North Dr, Civic Center, Auto Parkway and Mission Ave)	$1,287	$1,564
SPRINTER/ BNSF	588	SPRINTER Express	$322	$545
Trolley/ BNSF	510	Blue Line/Mid-Coast Frequency Enhancements and rail grade separations at 28th St, 32nd St, E St, H St, Palomar St, at Taylor St and Ash St, and Blue/Orange Track Connection at 12th/Imperial	$586	$844
Trolley/ BNSF	520	Orange Line Frequency Enhancements and four rail grade separations at Euclid Ave, Broadway/Lemon Grove Ave, Allison Ave/University Ave, Severin Dr	$363	$453
		Subtotal	**$8,312**	**$13,845**

Managed Lanes / Toll Lanes

Freeway	From	To	Existing	With Improvements	Transit Route	Cost ($2019); millions	Cost ($YOE); millions
I-5	SR 905	SR 54	8F	8F+2ML	640	$542	$627
I-5	SR 54	SR 15	8F	10F+2ML	640	$467	$540
I-5	I-8	La Jolla Village Dr	8F/10F	8F/10F+2ML		$978	$2,067
I-5	La Jolla Village Dr I-5/I-805 Merge	I-5/I-805 Merge SR 56	8F/14F 8F/14F+2ML	8F/14F+2ML 8F/14F+4ML	650, 653	$422	$513
I-5	SR 56 Manchester Ave	Manchester Ave Vandegrift Blvd	8F+2ML 8F	8F+4ML 8F+4ML	650, 653 650, 653	$2,881	$4,537
I-5	Vandegrift Blvd	Orange County	8F	8F+4T		$3,165	$6,687
SR 11/ Otay Mesa East POE	SR 125	Mexico	--	4T+POE	905	$472	$472
SR 15	I-5	SR 94	6F	8F+2ML		$185	$391
SR 15	SR 94	I-805	6F	6F+2ML	235, 610	$41	$59
I-15	Viaduct		8F	8F+2ML	235, 610, 653, 690	$1,040	$2,197
I-15	I-8	SR 163	8F	8F+2ML	235, 610, 653, 690	$64	$72

Table A.4 (continued)

Revenue Constrained Freight and Goods Movement Projects

Managed Lanes / Toll Lanes (continued)

Freeway	From	To	Existing	With Improvements	Transit Route	Cost ($2019); millions	Cost ($YOE); millions
I-15	SR 78	Riverside County	8F	8F+4T	610	$1,744	$3,684
SR 52	I-805	I-15	6F	6F+2ML	653, 870, 890	$238	$503
SR 52	I-15	SR 125	4F/6F	4F/6F+2ML(R)	870, 890	$405	$856
SR 54	I-5	SR 125	6F	6F+2ML		$151	$319
SR 78	I-5	I-15	6F	6F+2ML		$1,621	$2,127
SR 94	I-5	SR 125	8F	8F+2ML	90, 225, 235, 610,	$1,229	$2,012
SR 125	SR 54 SR 94	SR 94 I-8	6F 8F	6F+2ML 10F+2ML	90	$690	$1,457
I-805	SR 905	Palomar St	8F	8F+2ML	688	$235	$316
I-805	SR 54	SR 94	8F+2ML	8F+4ML	225, 650, 688, 689	$742	$998
I-805	SR 94	Carroll Canyon Rd	8F	8F+4ML	30, 225, 650, 653, 688, 689, 690, 870, 890	$3,295	$5,939
					Subtotal	**$20,607**	**$36,373**

Highway Projects

Freeway	From	To	Existing	With Improvements	Cost ($2019); millions	Cost ($YOE); millions
I-8	2nd St	Los Coches	4F/6F	6F	$44	$94
SR 52	Mast Blvd	SR 125	4F	6F	$103	$147
SR 56	I-5	I-15	4F	6F	$192	$405
SR 94	SR 125	Avocado Blvd	4F	6F	$190	$401
SR 94	Avocado Blvd	Jamacha	4C	6C	$124	$261
SR 94	Jamacha	Steele Canyon Rd	2C/4C	4C	$54	$115
SR 125	SR 905	San Miguel Rd	4T	8F	$439	$741
SR 125	San Miguel Rd	SR 54	4F	8F	$241	$509
				Subtotal	**$1,387**	**$2,673**

Table A.4 (continued)

Revenue Constrained Freight and Goods Movement Projects

Operational Improvements

Freeway	From	To	Existing	With Improvements	Cost ($2019); millions	Cost ($YOE); millions
I-5	SR 15	I-8	8F	8F+Operational	$1,985	$4,194
I-8	I-5	SR 125	8F/10F	8F/10F+Operational	$907	$1,917
I-8	SR 125	2nd St	6F/8F	6F/8F+Operational	$227	$480
				Subtotal	**$3,119**	**$6,591**

Freeway Connectors

Freeway	Intersecting Freeway	Movement	Cost ($2019); millions	Cost ($YOE); millions
I-5	SR 56	West to North and South to East	$371	$487
I-5	SR 78	South to East and West to South	$371	$487
I-15	SR 56	North to West	$104	$219
SR 94	SR 125	South to East	$94	$106
SR 94	SR 125	West to North	$110	$134
		Subtotal	**$1,050**	**$1,433**

Goods Movement

Year Built By	Air Cargo System Improvement	Cost ($2019) millions	Cost ($YOE) millions
2020	SDIA Interior Northside Roadway	$5	$5
2020	SDIA Air Cargo Facility Improvements for cargo storage and handling	$27	$27
	Subtotal	**$32**	**$32**
	TOTAL	**$34,507**	**$60,947**

Table A.5

Revenue Constrained and Unconstrained Projects[1] [A]

Transit Facilities

Service	Route	Description	Revenue Constrained Peak/Off-Peak (minutes)	Unconstrained Peak/Off-Peak (minutes)	Unconstrained Cost ($2019); millions
HSR	598	Commuter Rail Overlay (Temecula to Airport ITC)	NA	15/15	$462
HSR	--	Extension from Airport ITC to San Ysidro/ Otay Mesa	NA	15/60	$3,719
COASTER	398	Double tracking, grade separation at Leucadia Blvd and two other locations, stations/platforms at Convention Center/ Petco Park and Del Mar Fairgrounds, and extension to Gaslamp and Camp Pendleton	20/60	15/15	$8,204
COASTER	398	COASTER extension to National City	NA	15/15	$1,224
SPRINTER	399	SPRINTER efficiency improvements; double tracking Oceanside to Escondido; includes six rail grade separations at El Camino Real, Melrose Dr, Vista Village Dr/Main St, North Dr, Civic Center, Auto Pkwy and Mission Ave and a Branch Extension to Westfield North County[1]	10/10	7.5/7.5	$1,287
SPRINTER	588	SPRINTER Express	10/15	10/15	$332
Trolley	510	Mid-Coast Trolley Extension	7.5/7.5	7.5/7.5	$919
Trolley	510	Blue Line/Mid-Coast Frequency Enhancements and rail grade separations at 28th St, 32nd St, E St, H St, Palomar St, Taylor and Ash St, and Blue/Orange Track Connection at 12th/Imperial	7.5/7.5	7.5/7.5	$586
Trolley	520	Orange Line Frequency Enhancements and four rail grade separations at Euclid Ave, Broadway/Lemon Grove Ave, Allison Ave/University Ave, Severin Dr	7.5/7.5	7.5/7.5	$363
Trolley	522	Orange Line Express - El Cajon to San Diego International Airport Intermodal Transit Center (ITC)	NA	10/10	$269
Trolley	540	Blue Line Express - Santa Fe Depot to San Ysidro via Downtown	NA	10/10	$532
Trolley	550	SDSU to Palomar Station via East San Diego, Southeast San Diego, National City	NA	7.5/7.5	$2,152
Trolley	560	SDSU to Downtown San Diego via El Cajon Blvd/Mid-City (transition of Mid-City *Rapid* to Trolley)	7.5/7.5	7.5/7.5	$3251
Trolley	561	UTC COASTER Connection	7.5/7.5	7.5/7.5	$467
Trolley	561	COASTER Connection to Sorrento Mesa/Carroll Canyon (extension of Route 510)	NA	7.5/7.5	$1,121
Trolley	562	San Ysidro to Carmel Valley via Chula Vista, National City, Southeast San Diego, Mid-City, Mission Valley, and Kearny Mesa	7.5/10	7.5/7.5	$4,575

Table A.5 (continued)

Revenue Constrained and Unconstrained Projects

Transit Facilities (continued)

Service	Route	Description	Revenue Constrained Peak/Off-Peak (minutes)	Unconstrained Peak/Off-Peak (minutes)	Unconstrained Cost ($2019); millions
Trolley	562	San Ysidro to Carmel Valley via Chula Vista, National City, Southeast San Diego, Mid-City, Mission Valley, and Kearny Mesa	7.5/10	7.5/7.5	$4,575
Trolley	563	Pacific Beach to El Cajon Transit Center via Balboa and Kearny Mesa	7.5/10	7.5/7.5	$1,579
Trolley	564	Otay Mesa Border Crossing to Western Chula Vista via Otay Ranch/Millennia	NA	7.5/7.5	$1,362
Trolley	566	Palomar St Trolley Station to Carmel Valley via Mid-City, Kearny Mesa (Route 562 Express)	NA	10/10	$456
Trolley	510, 520, 540, 522 and 560	Downtown Trolley Tunnel	NA	7.5/7.5	$3,626
Rapid	2	North Park to Downtown San Diego via 30th St, Golden Hill	10/10	10/10	$54
Rapid	10	La Mesa to Ocean Beach via Mid-City, Hillcrest, Old Town	10/10	10/10	$57
Rapid	11	Spring Valley to SDSU via Southeast San Diego, Downtown, Hillcrest, Mid-City	10/10	10/10	$154
Rapid	28	Point Loma to Kearny Mesa via Old Town, Linda Vista	10/10	10/10	$67
Rapid	30	Old Town to Sorrento Mesa via Pacific Beach, La Jolla, UTC	10/10	10/10	$143
Rapid	41	Fashion Valley to UTC/UC San Diego via Linda Vista and Clairemont	10/10	10/10	$75
Rapid	90	El Cajon Transit Center to San Diego International Airport ITC via SR 94, City College (peak only)	15/NA	10/10	$27
Rapid	103	Solana Beach to Sabre Springs *Rapid* station via Carmel Valley	15/15	15/15	$91
Rapid	120	Kearny Mesa to Downtown via Mission Valley	10/10	10/10	$127
Rapid	235	Temecula (peak only) Extension of Escondido to Downtown *Rapid* (formerly Route 610)	10/NA	10/NA	$133
Rapid	430	Oceanside to Escondido (peak only)	NA	10/10	$326
Rapid	440	Carlsbad to Escondido Transit Center via Palomar Airport Rd	10/10	10/10	$140
Rapid	471	Downtown Escondido to East Escondido	10/10	10/10	$46
Rapid	473	UTC/UC San Diego to Oceanside via Hwy 101 Coastal Communities, Carmel Valley	10/10	10/10	$58
Rapid	474	Oceanside to Vista via Mission Ave/ Santa Fe Road Corridor	10/10	10/10	$99
Rapid	477	Camp Pendleton to Carlsbad Village via College Blvd, Plaza Camino Real	10/10	10/10	$109

Table A.5 (continued)

Revenue Constrained and Unconstrained Projects

Transit Facilities (continued)

Service	Route	Description	Revenue Constrained Peak/Off-Peak (minutes)	Unconstrained Peak/Off-Peak (minutes)	Unconstrained Cost ($2019); millions
Rapid	550	SDSU to Palomar Station via East San Diego, Southeast San Diego, National City[2]	10/10	NA	$112
Rapid	635	Eastlake to Palomar Trolley via Main St Corridor	10/10	10/10	$105
Rapid	636	SDSU to Spring Valley via East San Diego, Lemon Grove, Skyline	10/10	10/10	$53
Rapid	637	North Park to 32nd St Trolley via Golden Hill	10/10	10/10	$60
Rapid	638	Iris Trolley to Otay Mesa via Otay, Airway Dr, SR 905 Corridor	10/10	10/10	$52
Rapid	639	Iris Trolley Station to North Island via Imperial Beach and Silver Strand, Coronado	NA	10/10	$73
Rapid	640A/ 640B	Route 640A: I-5 - San Ysidro to Old Town Transit Center via City College Route 640B: I-5 Iris Trolley/Palomar to Kearny Mesa via City College	640A = 10/15 640B=15/NA	640A = 10/15 640B=15/NA	$208
Rapid	650	Chula Vista to Palomar Airport Rd Business Park via I-805/I-5 (peak only)	15/NA	15/NA	$112
Rapid	652	Downtown to UTC via Kearny Mesa Guideway/I-805	NA	10/10	$4
Rapid	653	Mid-City to Palomar Airport Rd via Kearny Mesa/I-805/I-5	15/NA	15/NA	$14
Rapid	688/ 689/ 690	San Ysidro to Sorrento Mesa via I-805/I-15/SR 52 Corridors; Otay Mesa Port of Entry (POE) to UTC/Torrey Pines via Otay Ranch/Millennia, I-805 Corridor; Mid City to Sorrento Mesa via I-805 Corridor. All Peak Only	15/NA	15/NA (no Rt 690)	$623
Rapid	692	Grossmont Center to Otay Town Center/Millennia via Southwest College, SR125, Spring Valley	NA	10/10	$7
Rapid	709	H St Trolley to Millennia via H St Corridor, Southwestern College	10/10	10/10	$89
Rapid	870	El Cajon to UTC via Santee, SR 52, I-805	10/NA	10/15	$10
Rapid	890	El Cajon to Sorrento Mesa via SR 52, Kearny Mesa	10/NA	10/NA	$16
Rapid	950 (formerly 905)	Extension of Iris Trolley Station to Otay Mesa Port of Entry (POE) with new service to Imperial Beach	10/10	10/10	$3
Rapid	910	Coronado to Downtown via Coronado Bridge	10/10	10/10	$54
Rapid	940	Oceanside to Sorrento Mesa via I-5, Carlsbad, Encinitas (peak only)	NA	10/0	$53

Table A.5 (continued)

Revenue Constrained and Unconstrained Projects

Transit Facilities (continued)

Service	Route	Description	Revenue Constrained Peak/Off-Peak (minutes)	Unconstrained Peak/Off-Peak (minutes)	Unconstrained Cost ($2019); millions
Rapid	SR 163 DARs	Kearny Mesa to Downtown via SR 163. Stations at Sharp/Children's Hospital, University Ave, and Fashion Valley Transit Center	✓	✓	204
Shuttle	448/449	San Marcos Shuttle[3]	10/10	10/10	$0
Streetcar	551	Chula Vista Downtown[4]	NA	10/10	$19
Streetcar	552	National City Downtown[4]	NA	10/10	$56
Streetcar	553	Downtown San Diego: Little Italy to East Village[4]	10/10	10/10	$15
Streetcar	554	Hillcrest/Balboa Park/Downtown San Diego Loop[4]	10/10	10/10	$39
Streetcar	555	30th St to Downtown San Diego via North Park/Golden Hill[4]	10/10	10/10	$23
Streetcar	557	El Cajon Downtown[4]	NA	10/10	$22
Streetcar	558	Escondido Downtown[4]	NA	10/10	$69
Streetcar	559	Oceanside Downtown[4]	NA	10/10	$63
Streetcar	565	Mission Beach to La Jolla via Pacific Beach[4]	10/10	10/10	$34
Airport Express	-	Airport Express Routes[5]	30/30	30/30	$71
Local	-	Local Bus Routes - 15 minutes in key corridors	15/15	15/15	NA
Local	-	Local Bus Routes - 10 minutes in key corridors	10/10	10/10	NA
Intermodal Transit Center	-	San Diego International Airport Intermodal Transit Center	✓	✓	$231
Intermodal Transit Center	-	San Ysidro Intermodal Transit Center	✓	✓	$161
Intermodal Transit Center	-	Otay Mesa East Intermodal Transit Center	NA	✓	$0
Other	-	Other Improvements (Vehicles, transit system rehabilitation, maintenance facilities, ITS, regulatory compliance, park and ride, and transit center expansions)	✓	✓	$7,317
				Subtotal	**$48,164**

Table A.5 (continued)

Revenue Constrained and Unconstrained Projects

Managed Lanes / Toll Lanes / Highway Projects / Operational Improvements

Freeway	From	To	Existing or Planned Phase	Revenue Constrained	Unconstrained	Unconstrained Cost ($2019) millions
I-5	SR 905	SR 54	8F	8F+2ML	8F+2ML	$542
I-5	SR 54	SR 15	8F	10F+2ML	10F+2ML	$467
I-5	I-15	I-8	8F	8F+Operational	8F+Operational	$1985
I-5	I-8	La Jolla Village Dr	8F/10F	8F/10F+2ML	8F/10F+2ML	$978
I-5	La Jolla Village Dr	I-5/805 Merge	8F/14F	8F/14F+2ML+conn	8F/14F+2ML+conn	$422
I-5	I-5/I-805 Merge	SR 56	8F/14F +2ML	8F/14F+4ML	8F/14F+4ML	
I-5	SR 56	Manchester Ave	8F+2ML	8F+4ML	8F+4ML	$2881
I-5	Manchester Ave	Vandegrift Blvd	8F	8F+4ML	8F+4ML	
I-5	Vandegrift Blvd	Orange County	8F	8F+4T	8F+4T	$3,165
I-8	I-5	SR 125	8F/10F	8F/10F+ Operational	8F/10F+ Operational	$907
I-8	SR 125	2nd St	6F/8F	6F/8F+ Operational	6F/8F+Operational	$227
I-8	2nd St	Los Coches	4F/6F	6F	6F	$44
I-8	Los Coches	Dunbar Rd[6]	4F/6F	4F/6F	6F	$178
SR 11/ Otay Mesa East POE	SR 125	Mexico	--	4T + POE	4T + POE	$472
SR 15	I-5	SR 94	6F	8F+2ML	8F+2ML	$185
SR 15	SR 94	I-805	6F	6F+2ML	6F+2ML	$41
I-15	Viaduct		8F	8F+2ML	8F+2ML	$1040
I-15	I-8	SR 163	8F	8F+2ML	8F+2ML	$64
I-15	Centre City Pkwy	SR 78	8F/10F+4ML	8F/10F+4ML	10F+4ML	$316
I-15	SR 78	Riverside County	8F	8F+4T	8F+4T	$1,744
SR 52	I-5	I-805	4F	6F	6F	$151
SR 52	I-805	I-15	6F	6F+2ML+Conn.	6F+2ML+Conn.	$238
SR 52	I-15	SR 125[6]	6F	6F+2ML(R)	6F+3ML(R)	$516
SR 52	Mast Blvd	SR 125	4F	6F	6F	$103
SR 52	SR 125	SR 67[6]	4F	4F	6F	$344
SR 54	I-5	SR 125[6]	6F	6F+2ML	6F/8F+2ML	$313
SR 56	I-5	I-15	4F	6F	6F +2ML	$1,084
SR 67	I-8	Mapleview St[6]	4F/6F	4F/6F	6F/8F	$192

Table A.5 (continued)

Revenue Constrained and Unconstrained Projects

Managed Lanes / Toll Lanes / Highway Projects / Operational Improvements (continued)

Freeway	From	To	Existing or Planned Phase	Revenue Constrained	Unconstrained	Unconstrained Cost ($2019) millions
SR 67	Mapleview St	Dye Rd	2C/4C	4C	4C	$673
SR 76	I-5	Melrose	4E	4E	6E	$316
SR 76	I-15	Couser Canyon	2C/4C	4C/6C+ Operational	4C/6C+ Operational	$178
SR 76	Couser Canyon	SR 79	2C	2C	2C+Operational	$861
SR 78	I-5	I-15	6F	6F+2ML+ Operational	6F+2ML+ Operational	$1,621
SR 94	I-5	I-805	8F	8F+2ML	8F+2ML	$728
SR 94	I-805	College Ave[6]	8F	8F+2ML	8F/10F+2ML	$673
SR 94	College Ave	SR 125	8F	8F+2ML	8F+2ML	$234
SR 94	SR 125	Avocado Blvd	4F	6F	6F	$190
SR 94	Avocado Blvd	Jamacha	4C	6C	6C	$124
SR 94	Jamacha	Steele Canyon Rd	2C/4C	4C	6C	$54
SR 125	SR 905	San Miguel Rd	4T	8F	8F	$439
SR 125	San Miguel Rd	SR 54	4F	8F	8F	$241
SR 125	SR 54	SR 94[6]	6F	6F+2ML	8F+2ML	$199
SR 125	SR 94	I-8	8F	10F+2ML	10F+2ML	$399
SR 125	I-8	SR 52[6]	6F	6F	6F+2ML	$358
SR 163	I-805	I-15	8F	8F	8F+2ML	$453
SR 241	Orange County	I-5	--	--	6T	$652
I-805	SR 905	Palomar St	8F	8F+2ML	8F+2ML	$235
I-805	SR 54	SR 94	8F +2ML	8F+4ML	8F+4ML	$742
I-805	SR 94	Carroll Canyon Rd	8F	8F+4ML	8F+4ML	$3,295
SR 905	I-5	I-805[6]	4F	4F	8F	$214
SR 905	I-805	Mexico[6]	6F	6F	8F	$275
					Subtotal	**$31,753**

Managed Lanes Connectors

Freeway	Intersecting Freeway	Movement	Revenue Constrained	Unconstrained	Unconstrained Cost ($2019) millions
I-5	SR 15	North to North and South to South		✓	$268
I-5	SR 54	West to South and North to East		✓	$165
I-5	SR 54	South to East and West to North		✓	$165
I-5	SR 56	South to East and West to North		✓	$241
I-5	SR 56	North to East and West to South		✓	$207

Table A.5 (continued)

Revenue Constrained and Unconstrained Projects

Managed Lanes Connectors (continued)

Freeway	Intersecting Freeway	Movement	Revenue Constrained	Unconstrained	Unconstrained Cost ($2019) millions
I-5	SR 78	South to East and West to North, North to East and West to South	✓	✓	$344
I-5	I-805	North to North and South to South	✓	✓	*
I-15	SR 52	West to North and South to East	✓	✓	$177
I-15	SR 52	West to South and North to East		✓	$192
I-15	SR 56	East to North and South to West		✓	$234
I-15	SR 78	East to South and North to West	✓	✓	$144
I-15	SR 163	North to North and South to South		✓	$220
SR 15	SR 94	South to West and East to North	✓	✓	$97
SR 15	I-805	North to North and South to South	✓	✓	$110
SR 52	SR 125	North to West and East to South		✓	$151
SR 94	SR 125	East to North and South to West		✓	$199
I-805	SR 52	West to North and South to East	✓	✓	*
I-805	SR 54	North to West and East to South		✓	$214
I-805	SR 94	North to West and East to South	✓	✓	$137
I-805	SR 94	West to South and North to East		✓	$295
I-805	SR 94	East to North and South to East		✓	$288
I-805	SR 163	North to North and South to South		✓	$261
				Subtotal	**$4,109**

Freeway Connectors

Freeway	Intersecting Freeway	Movement	Revenue Constrained	Unconstrained	Unconstrained Costs ($2019) millions
I-5	I-8	East to North and South to West[7]		✓	$439
I-5	SR 56	West to North and South to East	✓	✓	$371
I-5	SR 78	South to East and West to South	✓	✓	$371
I-5	SR 94	North to East[7]		✓	$178
I-15	SR 56	North to West	✓	✓	$104
SR 94	SR 125	South to East and West to North	✓	✓	$204
SR 11/ SR 905	SR 125	EB SR 11 and WB SR 11 to NB SR 125, NB SR 905 to NB SR 125	✓	✓	$35
SR 11/ SR 905	SR 125	SB 125 to WB SR 905, SB SR 125 to EB SR 11, SB SR 125 to SB SR 905	✓	✓	$101
				Subtotal	**$1,803**

Table A.5 (continued)

Revenue Constrained and Unconstrained Projects

Goods Movement

Maritime System Improvements	Revenue Constrained	Unconstrained	Unconstrained Costs ($2019) millions
Tenth Ave Marine Terminal (TAMT) Marine Cargo Staging and Handling Projects, including but not limited to: enhanced open storage, shed demolition, cargo handling infrastructure improvements, wharf reinforcements, additional crane, on-dock shorepower, improvements to facilitate "marine highway" cargo, and front gate technology enhancements.[8]		✓	$120
TAMT Freight Rail Improvements, including but not limited to: track upgrades and increased staging area for rail cargo and loading[8]		✓	$38
National City Marine Terminal (NCMT) Marine Cargo Staging and Handling Projects, including but not limited to: construct garages for additional roll-on/roll-off cargo storage, wharf extension to create two new berths, and improvements to facilitate "marine highway" cargo.[8]		✓	$129
NCMT Freight Rail Improvements, including but not limited to: additional rail storage facilities in the vicinity of the balloon track.[8]		✓	$4
Harbor Dr Multimodal Corridor Improvements, including but not limited to: improvements at 32nd St and Vesta St; pedestrian crossings and bridges; various truck improvements; bikeway accommodations; streetscape, safety, and parking improvements.[8]		✓	$371
Rail Mainline Capacity			
Desert Line Basic Service, Rehabilitation[9]		✓	$248
Rail Intermodal System Improvements			
Logistics Center Mid County[8]		✓	$2,897
Logistics Center North County[8]		✓	$226
Rail Safety, Tunnels			
LOSSAN Grade Separations (locations TBD)		✓	$354
Pipeline			
I-15 Access to Kinder Morgan (KM) MV Terminal[8]		✓	NA
KM, New Miramar Junction/Terminal/Tanks[9]		✓	NA
KM Expand to 16 Pipe/Extend to Mexico[9]		✓	NA
Border System Improvements			
Otay Mesa Southbound Truck Route Improvements[9]		✓	$48
Jacumba Port of Entry (POE)[9]		✓	NA
Otay Mesa Port of Entry Modernization Project[9]		✓	$86
Truck Rest Stop			
Truck parking at SR 76/I-15[8]		✓	$19
Truck staging at border[8]		✓	$41
Truck rest stop with restrooms, location TBD[8]		✓	NA

Table A.5 (continued)

Revenue Constrained and Unconstrained Projects

Goods Movement (continued)

Maritime System Improvements	Revenue Constrained	Unconstrained	Unconstrained Costs ($2019) millions
Mexican Freight Projects			
Mesa de Otay II Port of Entry and Related Roads[8]		✓	NA
Tijuana Intermodal Terminal/Distribution Center[9]		✓	NA
Ensenada Port Expansion[9]		✓	NA
Mexican Rail Yard Bicentennial Multi-modal Center in Tijuana[9]		✓	NA
Jacumé Port of Entry (POE)[9]		✓	NA
Expansion of Tecate Port of Entry Cargo Inspection Facility[9]		✓	NA
Tijuana-Tecate Rail Line Improvements[9]		✓	$27
		Subtotal	**$4,608**

Table A.5 (continued)

Revenue Constrained and Unconstrained Projects

Active Transportation Projects

Project	Jurisdiction(s)	Revenue Constrained	Unconstrained	Unconstrained Cost ($2019) millions
Uptown - Fashion Valley to Downtown San Diego	San Diego	✓	✓	$13.0
Uptown - Old Town to Hillcrest	San Diego	✓	✓	$1.0
Uptown - Hillcrest to Balboa Park	San Diego	✓	✓	$2.0
North Park - Mid-City - City Heights	San Diego	✓	✓	$7.0
North Park - Mid-City - Hillcrest to City Heights (City Heights - Old Town Corridor)	San Diego	✓	✓	$5.0
North Park - Mid-City - City Heights to Rolando	San Diego	✓	✓	$3.0
Bayshore Bikeway - Main St to Palomar	Chula Vista/ Imperial Beach	✓	✓	$1.0
Coastal Rail Trail Encinitas - Chesterfield to Solana Beach	Encinitas	✓	✓	$4.8
Pershing and El Prado - Cross-Park	San Diego	✓	✓	$1.0
San Ysidro to Imperial Beach - Bayshore Bikeway Connection	Imperial Beach/ San Diego	✓	✓	$8.0
Terrace Dr/Central Ave - Adams to Wightman	San Diego	✓	✓	$4.0
San Diego River Trail – I-805 to Fenton	San Diego	✓	✓	$3.0
San Diego River Trail - Short gap connections	San Diego	✓	✓	$2.0
Coastal Rail Trail Encinitas - Leucadia to G St	Encinitas	✓	✓	$7.0
San Diego River Trail - Father Junipero Serra Trail to Santee	Santee	✓	✓	$9.5
Downtown to Southeast connections	San Diego	✓	✓	$8.8
Coastal Rail Trail San Diego - UTC	San Diego	✓	✓	$0.8
Coastal Rail Trail San Diego - Rose Canyon	San Diego	✓	✓	$8.7
Coastal Rail Trail San Diego - Pac Hwy (W Washington St to Laurel St)	San Diego	✓	✓	$7.0
Coastal Rail Trail San Diego - Pac Hwy (Laurel St to Santa Fe Depot)	San Diego	✓	✓	$13.9
Coastal Rail Trail San Diego – Pac Hwy (Taylor St to W Washington St)	San Diego	✓	✓	$7.0
Coastal Rail Trail San Diego- Pac Hwy (Fiesta Island Rd to Taylor St)	San Diego	✓	✓	$12.2
City Heights /Encanto/Lemon Grove	Lemon Grove/ San Diego	✓	✓	$12.2
City Heights/Fairmount Corridor	San Diego	✓	✓	$20.9
Rolando to Grossmont/La Mesa	La Mesa/El Cajon/ San Diego	✓	✓	$3.5
La Mesa/Lemon Grove/El Cajon connections	Lemon Grove/ La Mesa	✓	✓	$10.4

Table A.5 (continued)

Revenue Constrained and Unconstrained Projects

Active Transportation Projects (continued)

Project	Jurisdiction(s)	Revenue Constrained	Unconstrained	Unconstrained Cost ($2019) millions
San Diego River Trail - Qualcomm Stadium to Ward Rd	San Diego	✓	✓	$3.5
San Diego River Trail - Rancho Mission Rd to Camino Del Rio North	San Diego	✓	✓	$0.5
Coastal Rail Trail Carlsbad - Reach 4 Cannon to Palomar Airport Rd	Carlsbad	✓	✓	$8.7
Coastal Rail Trail Carlsbad - Reach 5 Palomar Airport Rd to Poinsettia Station	Carlsbad	✓	✓	$5.2
Coastal Rail Trail Encinitas - Carlsbad to Leucadia	Encinitas	✓	✓	$12.2
Coastal Rail Trail Del Mar	Del Mar	✓	✓	$0.7
Coastal Rail Trail San Diego - Del Mar to Sorrento via Carmel Valley	Del Mar/ San Diego	✓	✓	$0.7
Coastal Rail Trail San Diego - Carmel Valley to Roselle via Sorrento	San Diego	✓	✓	$1.6
Coastal Rail Trail San Diego - Roselle Canyon	San Diego	✓	✓	$8.7
Chula Vista National City connections	Chula Vista/ National City	✓	✓	$19.1
Pacific Beach to Mission Beach	San Diego	✓	✓	$17.4
Ocean Beach to Mission Bay	San Diego	✓	✓	$41.8
San Diego River Trail - Bridge connection (Sefton Field to Mission Valley YMCA)	San Diego	✓	✓	$12.2
San Diego River Trail - Mast Park to Lakeside baseball park	Santee	✓	✓	$17.4
I-8 Flyover - Camino del Rio S to Camino del Rio N	San Diego	✓	✓	$17.4
Coastal Rail Trail Oceanside - Broadway to Eaton	Oceanside	✓	✓	$0.7
El Cajon - Santee connections	El Cajon/ La Mesa/Santee	✓	✓	$20.9
San Diego River Trail - Father JS Trail to West Hills Parkway	San Diego	✓	✓	$5.2
Inland Rail Trail Oceanside	Oceanside	✓	✓	$33.1
Coastal Rail Trail Carlsbad - Reach 3 Tamarack to Cannon	Carlsbad	✓	✓	$8.7
Clairemont Dr (Mission Bay to Burgener)	San Diego	✓	✓	$13.9
Harbor Dr (Downtown to Ocean Beach)	San Diego	✓	✓	$12.2
Mira Mesa Bike Blvd	San Diego	✓	✓	$7.0
Sweetwater River Bikeway Ramps	National City	✓	✓	$15.7
Coastal Rail Trail Oceanside - Alta Loma Marsh bridge	Oceanside	✓	✓	$8.7
Coastal Rail Trail San Diego - Mission Bay (Clairemont to Tecolote)	San Diego	✓	✓	$5.2
Bayshore Bikeway Coronado - Golf course adjacent	Coronado	✓	✓	$5.2

Table A.5 (continued)
Revenue Constrained and Unconstrained Projects

Active Transportation Projects (continued)

Project	Jurisdiction(s)	Revenue Constrained	Unconstrained	Unconstrained Cost ($2019) millions
San Luis Rey River Trail	Oceanside, Unincorporated	✓	✓	$64.4
Encinitas-San Marcos Corridor – Double Peak Dr to San Marcos Blvd	San Marcos	✓	✓	$20.9
Escondido Creek Bikeway – Quince St to Broadway	Escondido	✓	✓	$3.5
Escondido Creek Bikeway – Escondido Creek to Washington Ave	Escondido	✓	✓	$1.7
Escondido Creek Bikeway – 9th Ave to Escondido Creek	Escondido	✓	✓	$1.7
Escondido Creek Bikeway – El Norte Pkwy to northern bikeway terminus	Escondido	✓	✓	$10.4
Encinitas to San Marcos Corridor – Leucadia Blvd to El Camino Real	Carlsbad, Encinitas	✓	✓	$3.5
I-15 Bikeway – Via Rancho Pkwy to Lost Oak Ln	Escondido	✓	✓	$7.0
I-15 Bikeway – Rancho Bernardo Community Park to Lake Hodges Bridge	San Diego	✓	✓	$5.2
I-15 Bikeway – Camino del Norte to Aguamiel Rd	San Diego	✓	✓	$22.6
I-15 Bikeway – Poway Rd interchange to Carmel Mountain Rd	San Diego	✓	✓	$29.6
SR 56 Bikeway – Azuaga St to Rancho Penasquitos Blvd	San Diego	✓	✓	$3.5
I-15 Bikeway – Murphy Canyon Rd to Affinity Ct	San Diego	✓	✓	$69.6
SR 56 Bikeway – El Camino Real to Caminito Pointe	San Diego	✓	✓	$3.5
SR 52 Bikeway – I-5 to Santo Rd	San Diego	✓	✓	$52.2
SR 52 Bikeway – SR 52/Mast Dr to San Diego River Trail	San Diego	✓	✓	$3.5
I-8 Corridor – San Diego River Trail to Riverside Dr	Unincorporated	✓	✓	$3.5
I-805 Connector – Bonita Rd to Floyd Ave	Chula Vista, Unincorporated	✓	✓	$10.5
SR 125 Connector – Bonita Rd to U.S.-Mexico Border	Chula Vista, San Diego	✓	✓	$67.9
SR 905 Connector – E Beyer Blvd to U.S.-Mexico Border	San Diego, Unincorporated	✓	✓	$59.2
El Camino Real Bike Lanes – Douglas Dr to Mesa Dr	Oceanside	✓	✓	$1.7
Vista Way Connector from Arcadia	Vista, Unincorporated	✓	✓	$3.7
I-15 Bikeway – W. Country Club Ln to Nutmeg St	Escondido	✓	✓	$7.0
El Camino Real Bike Lanes – Marron Rd to SR 78 offramp	Carlsbad	✓	✓	$0.5
Carlsbad to San Marcos Corridor – Paseo del Norte to Avenida Encinas	Carlsbad	✓	✓	$0.7

Table A.5 (continued)

Revenue Constrained and Unconstrained Projects

Active Transportation Projects (continued)

Project	Jurisdiction(s)	Revenue Constrained	Unconstrained	Unconstrained Cost ($2019) millions
Encinitas to San Marcos Corridor – Kristen Ct to Ecke Ranch Rd	Encinitas	✓	✓	$0.7
Encinitas to San Marcos Corridor – Encinitas Blvd/ I-5 Interchange	Encinitas	✓	✓	$0.3
Mira Mesa Corridor – Reagan Rd to Parkdale Ave	San Diego	✓	✓	$0.7
Mira Mesa Corridor – Scranton Rd to I-805	San Diego	✓	✓	$0.7
Mira Mesa Corridor – Sorrento Valley Rd to Sorrento Valley Blvd	San Diego	✓	✓	$1.4
Mid-County Bikeway – I-5/Via de la Valle Interchange	San Diego	✓	✓	$0.5
Mid-County Bikeway – Rancho Santa Fe segment	San Diego, Unincorporated	✓	✓	$5.2
El Camino Real Bike Lanes – Manchester Ave to Tennis Club Dr	Encinitas	✓	✓	$0.9
Mid-County Bikeway – Manchester Ave/ I-5 Interchange to San Elijo Ave	Encinitas	✓	✓	$1.4
Central Coast Corridor – Van Nuys St to San Rafael Pl	San Diego	✓	✓	$1.7
Clairemont – Centre-City Corridor – Coastal Rail Trail to Genesee Ave	San Diego	✓	✓	$3.5
SR 125 Corridor – Mission Gorge Rd to Glen Vista Way	Santee	✓	✓	$0.5
SR 125 Corridor – Prospect Ave to Weld Blvd	Santee, El Cajon	✓	✓	$1.4
I-8 Corridor – Lakeside Ave to SR 67	Unincorporated	✓	✓	$0.9
I-8 Corridor – Willows Rd to SR 79	Unincorporated	✓	✓	$8.7
E County Northern Loop – N Marshall Ave to El Cajon Blvd	El Cajon	✓	✓	$0.5
E County Northern Loop – Washington Ave to Dewitt Ct	El Cajon	✓	✓	$1.7
E County Northern Loop – SR 94 onramp to Del Rio Rd	Unincorporated	✓	✓	$0.3
E County Southern Loop – Pointe Pkwy to Omega St	Unincorporated	✓	✓	$1.4
SR 125 Corridor – SR 94 to S of Avocado St	Unincorporated	✓	✓	$1.9
Centre City – La Mesa Corridor – Gateside Rd to Campo Rd	La Mesa, Unincorporated	✓	✓	$0.7
Bay to Ranch Bikeway – River Ash Dr to Paseo Ranchero	Chula Vista	✓	✓	$0.9
Mid-County Bikeway – San Elijo Ave to 101 Terminus	Encinitas	✓	✓	$1.7
Central Coast Corridor – Van Nuys St	San Diego	✓	✓	$0.3
E County Northern Loop – El Cajon Blvd to Washington Ave	El Cajon	✓	✓	$1.7

Table A.5 (continued)

Revenue Constrained and Unconstrained Projects

Active Transportation Projects (continued)

Project	Jurisdiction(s)	Revenue Constrained	Unconstrained	Unconstrained Cost ($2019) millions
E County Northern Loop – Calavo Dr to Sweetwater Springs Blvd	Unincorporated	✓	✓	$1.2
Central Coast Corridor – Torrey Pines Rd to Nautilus St	San Diego	✓	✓	$10.4
Central Coast Corridor – Via Del Norte to Van Nuys St	San Diego	✓	✓	$8.7
Kearny Mesa to Beaches Corridor – Ingraham St from Garnet Ave to Pacific Beach Dr	San Diego	✓	✓	$3.5
Kearny Mesa to Beaches Corridor – Clairemont Dr to Genesee Ave	San Diego	✓	✓	$17.4
Kearny Mesa to Beaches Corridor – Genesee Ave to Linda Vista Dr	San Diego	✓	✓	$10.4
Bay to Ranch Bikeway – E J St from 2nd Ave to Paseo Del Rey	Chula Vista	✓	✓	$20.9
Chula Vista Greenbelt – Bay Blvd to Oleander Ave	Chula Vista	✓	✓	$29.6
Safe Routes to Transit	Various	✓	✓	$1,230.1
Local Bike Projects/Local Pedestrian/Safety/Traffic Calming	Various	✓	✓	$1,399.4
Regional Bicycle and Pedestrian Programs	Various	✓	✓	$34.3
Safe Routes to School	Various	✓	✓	$77.7
			Subtotal	**$3,821**

Active Transportation Retrofits - Safe Routes to Transit at Existing Stations

Project	Jurisdiction(s)	Revenue Constrained	Unconstrained	Unconstrained Cost ($2019) millions
Plaza Camino Real Transit Center	Carlsbad		✓	
El Camino Real at Cannon/College	Carlsbad		✓	
Carlsbad Poinsettia COASTER Station	Carlsbad		✓	
Carlsbad Village COASTER Station	Carlsbad		✓	
E St Trolley Station	Chula Vista		✓	
Old Highway 80 between El Cajon and Alpine	County - Fallbrook		✓	

Table A.5 (continued)

Revenue Constrained and Unconstrained Projects

Active Transportation Retrofits - Safe Routes to Transit at Existing Stations (continued)

Project	Jurisdiction(s)	Revenue Constrained	Unconstrained	Unconstrained Cost ($2019) millions
Fallbrook High School	County - Fallbrook		✓	
WB Jamacha Blvd at Sweetwater Springs Blvd	County - Spring Valley		✓	
Jamacha Blvd at Lamplighter Village Dr	County - Spring Valley		✓	
SB Sweetwater Rd at Troy St	County - Spring Valley		✓	
Sweetwater Rd between Jamacha Blvd and Broadway	County - Spring Valley		✓	
Buena Creek SPRINTER Station	County of San Diego		✓	
Encinitas COASTER Station	Encinitas		✓	
Encinitas pedestrian undercrossing connections	Encinitas		✓	
Escondido Transit Center	Escondido		✓	
Del Lago Transit Station	Escondido		✓	
Amaya Trolley Station	La Mesa		✓	
70th St Trolley Station	La Mesa		✓	
National City Blvd and E 32nd St/W 33rd St	National City		✓	
Oceanside Transit Center	Oceanside		✓	
Coast Highway SPRINTER Station	Oceanside		✓	
Crouch St SPRINTER Station	Oceanside		✓	
El Camino Real SPRINTER Station	Oceanside		✓	
Rancho Del Oro SPRINTER Station	Oceanside		✓	
College Blvd SPRINTER Station	Oceanside		✓	
Oceanside High School	Oceanside		✓	
San Luis Rey Transit Center	Oceanside		✓	
Tri-City Medical Center	Oceanside		✓	
32nd and Commercial Trolley Station	San Diego - Barrio Logan		✓	
Euclid Ave between Home Ave and Roselawn Ave	San Diego - City Heights		✓	
Alvarado Trolley Station	San Diego - College Area		✓	
70th St between El Cajon Blvd and Alvarado Rd	San Diego - College Area		✓	
12th and Imperial Transit Center	San Diego - Downtown		✓	

Table A.5 (continued)

Revenue Constrained and Unconstrained Projects

Active Transportation Retrofits - Safe Routes to Transit at Existing Stations (continued)

Project	Jurisdiction(s)	Revenue Constrained	Unconstrained	Unconstrained Cost ($2019) millions
Harbor Dr Pedestrian Bridge	San Diego - Downtown		✓	
Harborside Trolley Station	San Diego - Harborside		✓	
Pacific Fleet Trolley Station	San Diego - Harborside		✓	
Washington St at Hancock St/I-5 Overcrossing	San Diego - Mission Hills		✓	
WB Hotel Circle S. at Bachman Pl	San Diego - Mission Valley		✓	
Fenton Parkway Trolley Station	San Diego - Mission Valley		✓	
Grantville Trolley Station	San Diego - Mission Valley		✓	
Morena/Linda Vista Trolley Station	San Diego - Mission Valley		✓	
54th St between Euclid Ave and Chollas Pkwy	San Diego - Oak Park		✓	
EB Airway Rd at Dublin Dr	San Diego - Otay Mesa		✓	
EB Airway Rd at Excellante St (Southwestern College)	San Diego - Otay Mesa		✓	
La Media Rd at Airway Rd	San Diego - Otay Mesa		✓	
WB Siempre Vida Rd at La Media Rd	San Diego - Otay Mesa		✓	
SB Hollister St at Conifer Ave (Palm St Trolley Station)	San Diego - Palm City		✓	
NB S. Vista Ave at Beyer Blvd Trolley Station	San Diego - San Ysidro		✓	
Calle Primera between Willow Rd and Via de San Ysidro	San Diego - San Ysidro		✓	
Sorrento Valley COASTER Station	San Diego - Sorrento Valley		✓	
SB Gilman Dr at Villa La Jolla Dr	San Diego - University City		✓	
EB Eastgate Mall between I-805 and Miramar Rd	San Diego - University City		✓	
Palomar College SPRINTER Station	San Marcos		✓	
San Marcos Civic Center SPRINTER Station	San Marcos		✓	
Cal State San Marcos SPRINTER Station	San Marcos		✓	
Nordahl Rd SPRINTER Station	San Marcos		✓	

Table A.5 (continued)

Revenue Constrained and Unconstrained Projects

Active Transportation Retrofits - Safe Routes to Transit at Existing Stations (continued)

Project	Jurisdiction(s)	Revenue Constrained	Unconstrained	Unconstrained Cost ($2019) millions
Rancheros Dr/State Department of Rehabilitation	San Marcos		✓	
Solana Beach COASTER Station	Solana Beach		✓	
Melrose Dr SPRINTER Station	Vista		✓	
Vista Transit Center	Vista		✓	
Civic Center-Vista SPRINTER Station	Vista		✓	
Sweetwater Rd between Jamacha Blvd and Broadway	County - Spring Valley		✓	
			Subtotal	**$558**[10]

Active Transportation Retrofits - Bicycle/Pedestrian Improvements at Freeway Interchanges

Project	Jurisdiction(s)	Revenue Constrained	Unconstrained	Unconstrained Cost ($2019) millions
Navajo Rd at SR 125	El Cajon		✓	
Fletcher Parkway/Graves Rd at SR 67	El Cajon		✓	
West Bernardo / Pomerado Rd at I-15	San Diego		✓	
Rancho Bernardo Rd at I-15	San Diego		✓	
Bernardo Center Dr at I-15	San Diego		✓	
Balboa Ave at SR 163	San Diego		✓	
Friars Rd at SR 163	San Diego		✓	
Quince St at SR 163	San Diego		✓	
6th St / University Ave at SR 163	San Diego		✓	
Washington St at SR 163	San Diego		✓	
Richmond St at SR 163	San Diego		✓	
SR 905 / Tocayo Ave at I-5	San Diego		✓	
Dairy Mart Rd / San Ysidro Rd at I-5	San Diego		✓	
Via De San Ysidro at I-5	San Diego		✓	
Camino De La Plaza at I-5, I-805	San Diego		✓	
West Mission Bay Dr at I-8	San Diego		✓	
E San Ysidro Blvd at I-805	San Diego		✓	
SR 905 at I-805	San Diego		✓	
Picador Blvd/ Smythe Ave at SR 905	San Diego		✓	
Camino Del Rio West at I-5 NB/I-8 EB	San Diego		✓	
Camino Del Rio West at I-5 SB	San Diego		✓	
Winter Gardens Blvd at SR 67	San Diego County		✓	

Table A.5 (continued)

Revenue Constrained and Unconstrained Projects

Active Transportation Retrofits - Bicycle/Pedestrian Improvements at Freeway Interchanges (continued)

Project	Jurisdiction(s)	Revenue Constrained	Unconstrained	Unconstrained Cost ($2019) millions
Riverford Rd at SR 67	San Diego County		✓	
Bradley Ave at SR 67	San Diego County		✓	
Tavern Rd at I-8	San Diego County		✓	
Willows Rd at I-8	San Diego County		✓	
Japatul Valley Rd at I-8	San Diego County		✓	
Sunrise Highway at I-8	San Diego County		✓	
Pine Valley Rd at I-8	San Diego County		✓	
Buckman Springs Rd at I-8	San Diego County		✓	
Kitchen Creek Rd at I-8	San Diego County		✓	
Crestwood Rd at I-8	San Diego County		✓	
Campo Blvd at I-8	San Diego County		✓	
Jacumba at I-8	San Diego County		✓	
In-Ko-Pah Park Rd at I-8	San Diego County		✓	
Magnolia Ave at SR 52	Santee		✓	
Prospect Ave at SR 67	Santee		✓	
			Subtotal	**$62**[11]
			Subtotal Active Transportation	**$4,441**
			TOTAL	**$94,878**

1 Unconstrained rail facilities (shared use freight and passengers)

2 *Rapid* Route 550 appeared only as a Trolley route in the Unconstrained Network

3 Capital cost to be funded by the City of San Marcos

4 Streetcar cost is representative of 10 percent of the total capital cost

5 Capital cost to be funded by aviation and other private funds

6 Unconstrained Managed Lanes/Highway (shared use freight and passengers)

7 Unconstrained Freeway Connectors (shared use freight and passengers)

8 Projects that require innovative financing strategies which require development with multiple parties

9 Projects of interest to SANDAG; to be financed by other parties

10 The subtotal reflects estimated Safe Routes to Transit Retrofit project costs ranging from $186,000 to $7.5 million per stop area or station area

11 The subtotal reflects estimated Freeway Interchange Retrofit project costs ranging from $500,000 to $3 million per interchange

A Projects included in the Unconstrained transportation network show a check mark in the Unconstrained column. Projects which are included in the Revenue Constrained network show check marks in both the Revenue Constrained and Unconstrained columns.
Between both networks, for Transit Facilities, some projects show different service frequencies. For Managed Lanes/ Toll Lanes/Highway Projects/Operational Improvements, some projects show different number of lanes between the Constrained and Unconstrained networks.

Table A.6
No-Build Projects

Transit Services

Route #	Description	Note
225	South Bay *Rapid* Otay Mesa to Downtown	In Service
398	LOSSAN Double Tracking (selected segments)	Under Construction
510	Mid-Coast LRT Old Town to University Towne Center	Under Construction

Managed Lanes / Highway Projects

Segment	From	To	Improvement	Note
I-5	Manchester	SR 78	+2ML	Design/Construction
SR 11 (Phase I)	SR 125	Enrico Fermi Dr	+4T	In Service
SR 11/Otay Mesa East POE	Enrico Fermi Dr	Mexico	+4T+POE	Under Construction
SR 11/ SR 905	SR 11/ SR 905	SR 125	SB 125 to SB SR 905, SB SR 125 to EB SR 11, SB SR 125 to SB SR 905	Design/Construction
SR 11/ SR 905	SR 11/ SR 905	SR 125	EB SR 905 and WB SR 11 to NB SR 125, NB SR 905 to NB SR 125	In Service
SR 15	I-805	I-8	+2TL	In Service
SR 76	Mission Rd	I-15	+2C	In Service
I-805	SR 52	Carroll Canyon Rd	+2ML	In Service

NOTE: "No-Build Projects" are projects that were either open to traffic or in service since the adoption of the 2015 Regional Plan in October 2015 or are projects that are substantially underway.

Tables A.1 - A.6 Legend

BNSF: Burlington Northern Santa Fe Railway

Const: Construction

C: Conventional Highway

DAR: Direct Access Ramp

Eng: Engineering

F: Freeway Lanes

ML: Managed Lanes

POE: Port of Entry

R: Reversible

ROW: Right-of-Way

SDIA: San Diego International Airport

SDIV: San Diego and Imperial Valley Railroad

T: Toll Lanes

TL: Transit Lanes

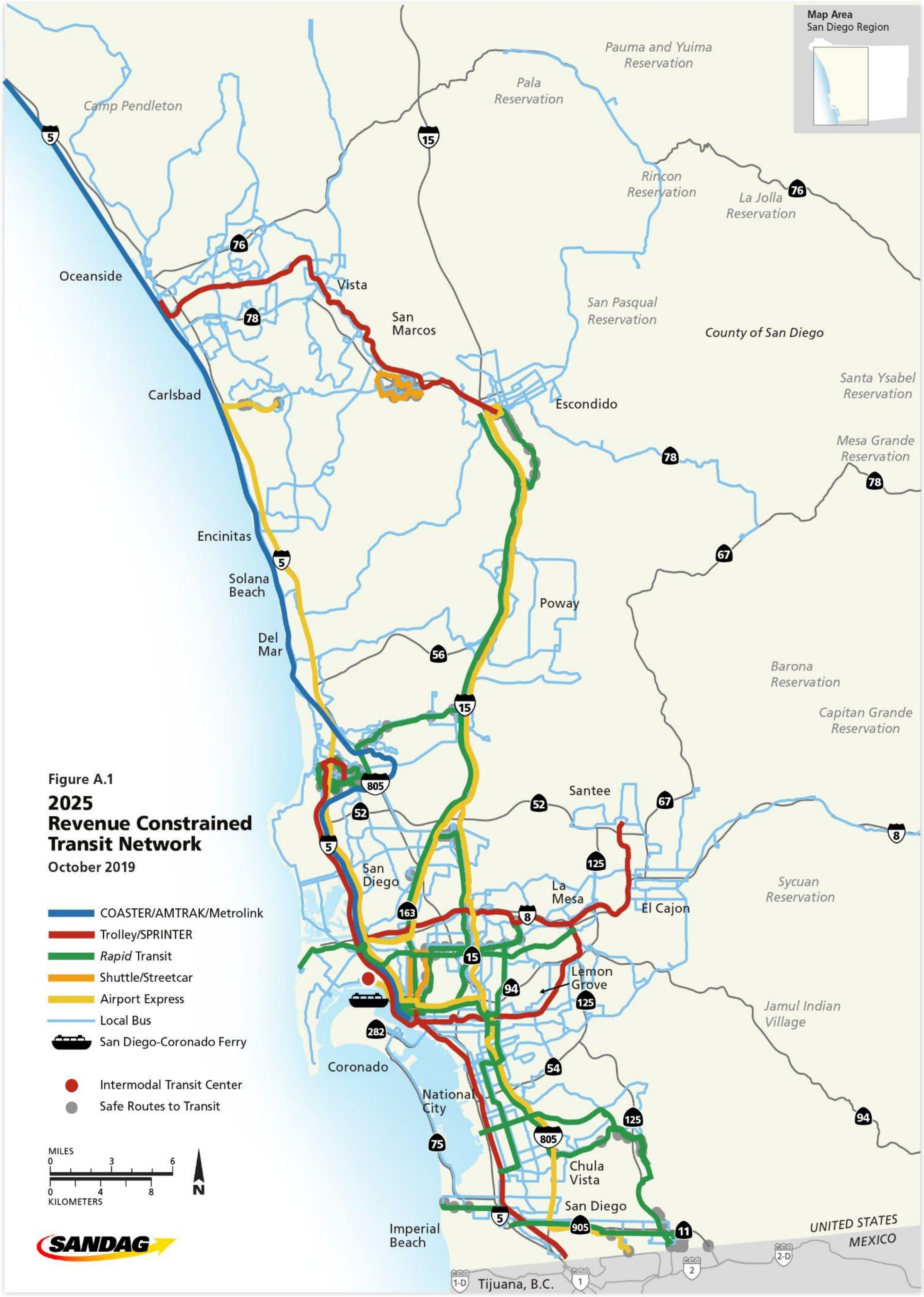
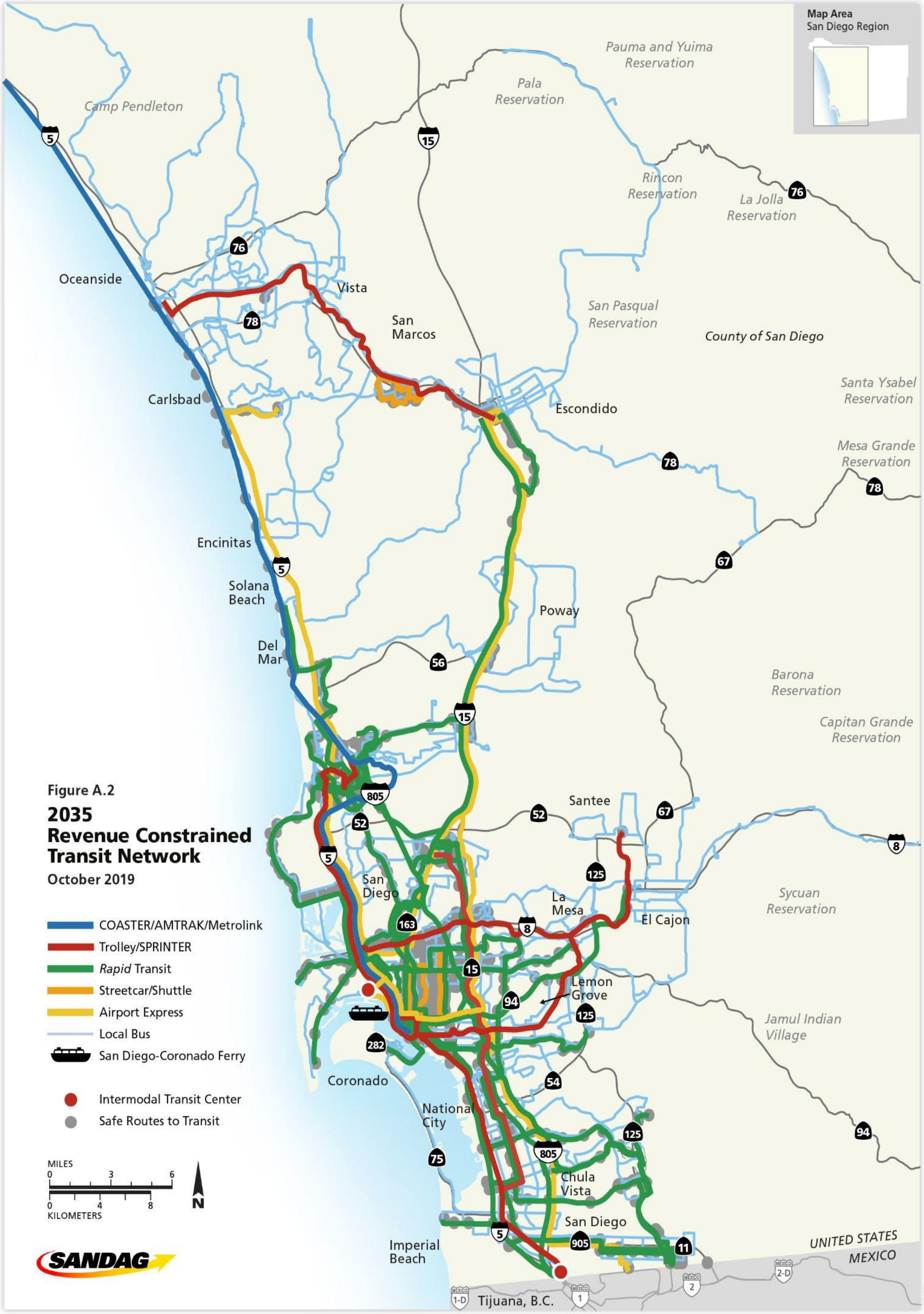


Figure A.1
2025
Revenue Constrained
Transit Network
October 2019
COASTER/AMTRAK/Metrolink
Trolley/SPRINTER
Rapid Transit
Shuttle/Streetcar
Airport Express
Local Bus
San Diego-Coronado Ferry
Intermodal Transit Center
Safe Routes to Transit
MILES
0
3
6
0
4
8
KILOMETERS
N
SANDAG
Map Area
San Diego Region
Camp Pendleton
Pala
Reservation
Pauma and Yuima
Reservation
Rincon
Reservation
La Jolla
Reservation
Oceanside
Vista
San
Marcos
San Pasqual
Reservation
County of San Diego
Santa Ysabel
Reservation
Carlsbad
Escondido
Mesa Grande
Reservation
Encinitas
Solana
Beach
Poway
Del
Mar
Barona
Reservation
Capitan Grande
Reservation
Santee
San
Diego
La
Mesa
El Cajon
Sycuan
Reservation
Lemon
Grove
Jamul Indian
Village
Coronado
National
City
Chula
Vista
San Diego
Imperial
Beach
UNITED STATES
MEXICO
Tijuana, B.C.


Map Area
San Diego Region
Camp Pendleton
Pala Reservation
Pauma and Yuima Reservation
Rincon Reservation
La Jolla Reservation
Oceanside
Vista
San Marcos
San Pasqual Reservation
County of San Diego
Carlsbad
Escondido
Santa Ysabel Reservation
Mesa Grande Reservation
Encinitas
Solana Beach
Poway
Del Mar
Barona Reservation
Capitan Grande Reservation
Santee
San Diego
La Mesa
El Cajon
Sycuan Reservation
Lemon Grove
Jamul Indian Village
Coronado
National City
Chula Vista
San Diego
Imperial Beach
UNITED STATES
MEXICO
Tijuana, B.C.
Figure A.2
2035
Revenue Constrained
Transit Network
October 2019
COASTER/AMTRAK/Metrolink
Trolley/SPRINTER
Rapid Transit
Streetcar/Shuttle
Airport Express
Local Bus
San Diego-Coronado Ferry
Intermodal Transit Center
Safe Routes to Transit
MILES
0
3
6
0
4
8
KILOMETERS
N
SANDAG

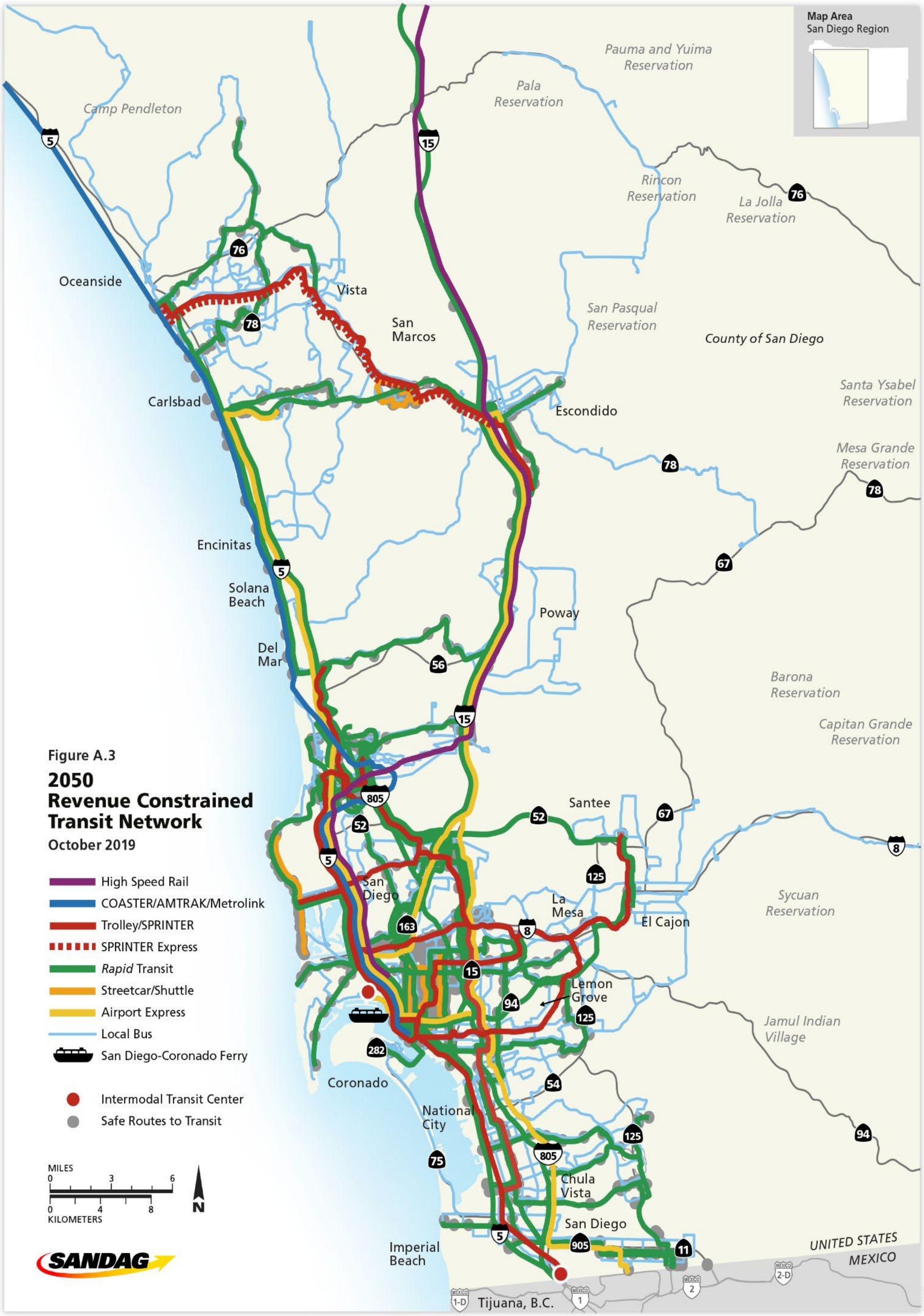


Figure A.3
2050
Revenue Constrained
Transit Network
October 2019
High Speed Rail
COASTER/AMTRAK/Metrolink
Trolley/SPRINTER
SPRINTER Express
Rapid Transit
Streetcar/Shuttle
Airport Express
Local Bus
San Diego-Coronado Ferry
Intermodal Transit Center
Safe Routes to Transit
MILES
0
3
6
0
4
8
KILOMETERS
N
SANDAG
Map Area
San Diego Region
Camp Pendleton
Pauma and Yuima
Reservation
Pala
Reservation
Rincon
Reservation
La Jolla
Reservation
Oceanside
Vista
San
Marcos
San Pasqual
Reservation
County of San Diego
Carlsbad
Escondido
Santa Ysabel
Reservation
Mesa Grande
Reservation
Encinitas
Solana
Beach
Del
Mar
Poway
Barona
Reservation
Capitan Grande
Reservation
Santee
San
Diego
La
Mesa
El Cajon
Sycuan
Reservation
Lemon
Grove
Jamul Indian
Village
Coronado
National
City
Chula
Vista
San Diego
Imperial
Beach
UNITED STATES
MEXICO
Tijuana, B.C.


Map Area
San Diego Region
Camp Pendleton
Pala Reservation
Pauma and Yuima Reservation
Rincon Reservation
La Jolla Reservation
San Pasqual Reservation
County of San Diego
Santa Ysabel Reservation
Mesa Grande Reservation
Barona Reservation
Capitan Grande Reservation
Sycuan Reservation
Jamul Indian Village
Oceanside
Vista
San Marcos
Carlsbad
Escondido
Encinitas
Solana Beach
Del Mar
Poway
Santee
San Diego
La Mesa
El Cajon
Lemon Grove
Coronado
National City
Chula Vista
San Diego
Imperial Beach
Tijuana, B.C.
UNITED STATES
MEXICO
8F
4C
2C
8F+2ML
6F
8F+4ML
10F+4ML
4F
10F+4ML
8F+2ML
8F/10F
8F+2TL
8F+2ML
6F
4F
4C
8F
6F
4T
4F
4T
Figure A.4
2025
Revenue Constrained Managed Lanes and Highway Network
October 2019
Existing Managed Lanes
Managed Lanes
General Purpose Lanes
Toll Lanes
Existing Facility
Bicycle/Pedestrian Improvements at Freeway Interchanges
Freeway Connectors
Managed Lanes Connectors
C = Conventional Highway
F= Freeway
ML = Managed Lanes
T = Toll Lanes
TL = Transit Lanes
MILES
0 3 6
0 4 8
KILOMETERS
N
SANDAG

Figure A.5
2035 Revenue Constrained Managed Lanes and Highway Network
October 2019

Figure A.6
2050 Revenue Constrained Managed Lanes and Highway Network
October 2019


Figure A.7
2025
Revenue Constrained
Regional Bike
Network
October 2019
Class I - Bike Path
Cycle Track
Bike Boulevard
Enhanced Class II - Bike Lane
Enhanced Class III - Bike Route
Freeways and Highways
Regional Arterials
MILES
0
3
6
0
4
8
KILOMETERS
N
SANDAG
Map Area
San Diego Region
Camp Pendleton
Pauma and Yuima Reservation
Pala Reservation
Rincon Reservation
La Jolla Reservation
Oceanside
Vista
San Marcos
San Pasqual Reservation
County of San Diego
Carlsbad
Escondido
Santa Ysabel Reservation
Mesa Grande Reservation
Encinitas
Solana Beach
Poway
Del Mar
Barona Reservation
Capitan Grande Reservation
Santee
San Diego
La Mesa
El Cajon
Sycuan Reservation
Lemon Grove
Jamul Indian Village
Coronado
National City
Chula Vista
San Diego
Imperial Beach
UNITED STATES
MEXICO
Tijuana, B.C.
5
15
76
78
56
805
52
67
8
125
163
94
282
54
75
905
11
1-D
1
2
2-D

Map Area
San Diego Region
Camp Pendleton
Pala
Reservation
Pauma and Yuima
Reservation
Rincon
Reservation
La Jolla
Reservation
Oceanside
Vista
San
Marcos
San Pasqual
Reservation
County of San Diego
Carlsbad
Escondido
Santa Ysabel
Reservation
Mesa Grande
Reservation
Encinitas
Solana
Beach
Poway
Del
Mar
Barona
Reservation
Capitan Grande
Reservation
Santee
San
Diego
La
Mesa
El Cajon
Sycuan
Reservation
Lemon
Grove
Jamul Indian
Village
Coronado
National
City
Chula
Vista
San Diego
Imperial
Beach
UNITED STATES
MEXICO
Tijuana, B.C.
Figure A.8
2035
Revenue Constrained
Regional Bike
Network
October 2019
Class I - Bike Path
Cycle Track
Bike Boulevard
Enhanced Class II - Bike Lane
Enhanced Class III - Bike Route
Freeways and Highways
Regional Arterials
MILES
0
3
6
0
4
8
KILOMETERS
N
SANDAG


Map Area
San Diego Region
Camp Pendleton
Pauma and Yuima Reservation
Pala Reservation
Rincon Reservation
La Jolla Reservation
Oceanside
Vista
San Marcos
San Pasqual Reservation
County of San Diego
Carlsbad
Escondido
Santa Ysabel Reservation
Mesa Grande Reservation
Encinitas
Solana Beach
Poway
Del Mar
Barona Reservation
Capitan Grande Reservation
Santee
San Diego
La Mesa
El Cajon
Sycuan Reservation
Lemon Grove
Jamul Indian Village
Coronado
National City
Chula Vista
San Diego
Imperial Beach
UNITED STATES
MEXICO
Tijuana, B.C.
Figure A.9
2050 Revenue Constrained Regional Bike Network
October 2019
Class I - Bike Path
Cycle Track
Bike Boulevard
Enhanced Class II - Bike Lane
Enhanced Class III - Bike Route
Freeways and Highways
Regional Arterials
MILES
0 3 6
0 4 8
KILOMETERS
N
SANDAG

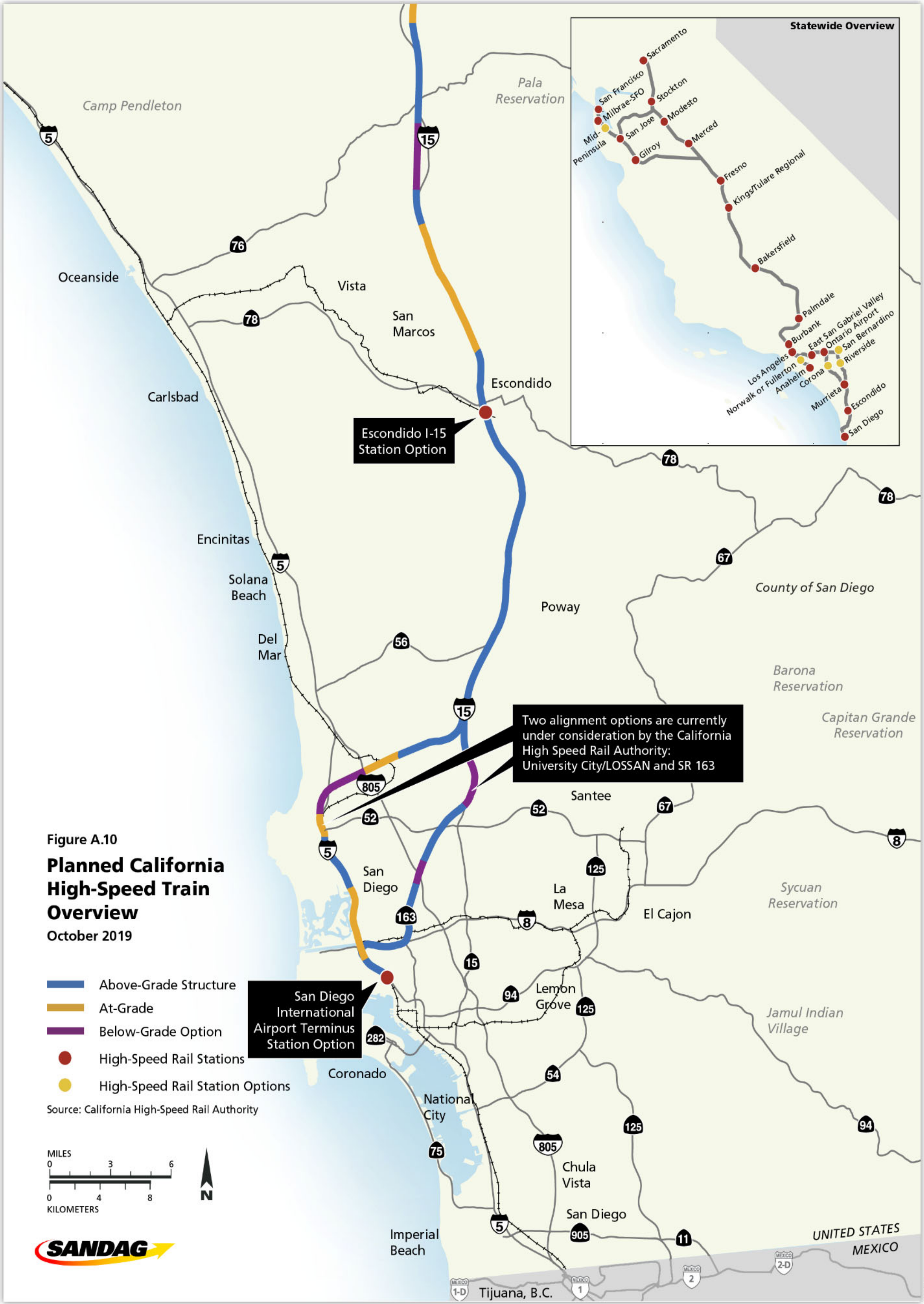


Figure A.10

Planned California High-Speed Train Overview

October 2019

Figure A.11

2025 and 2035 High Frequency Local Bus Routes

October 2019

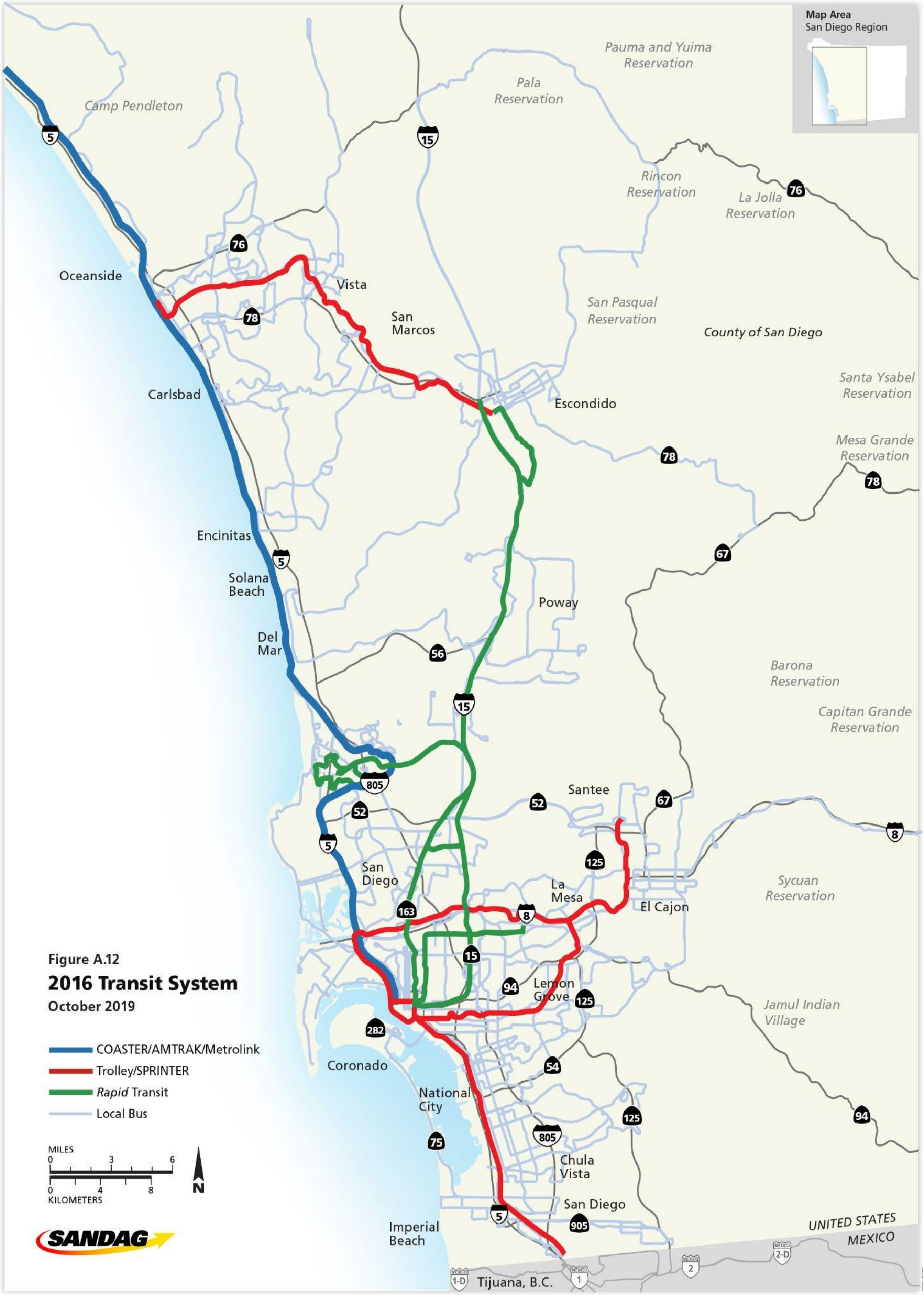


Figure A.12

2016 Transit System

October 2019

Figure A.13

2016
Managed Lanes and Highway Network

October 2019

Figure A.14

2016 Regional Bike Network

October 2019

Figure A.15

Regional Arterial System

October 2019

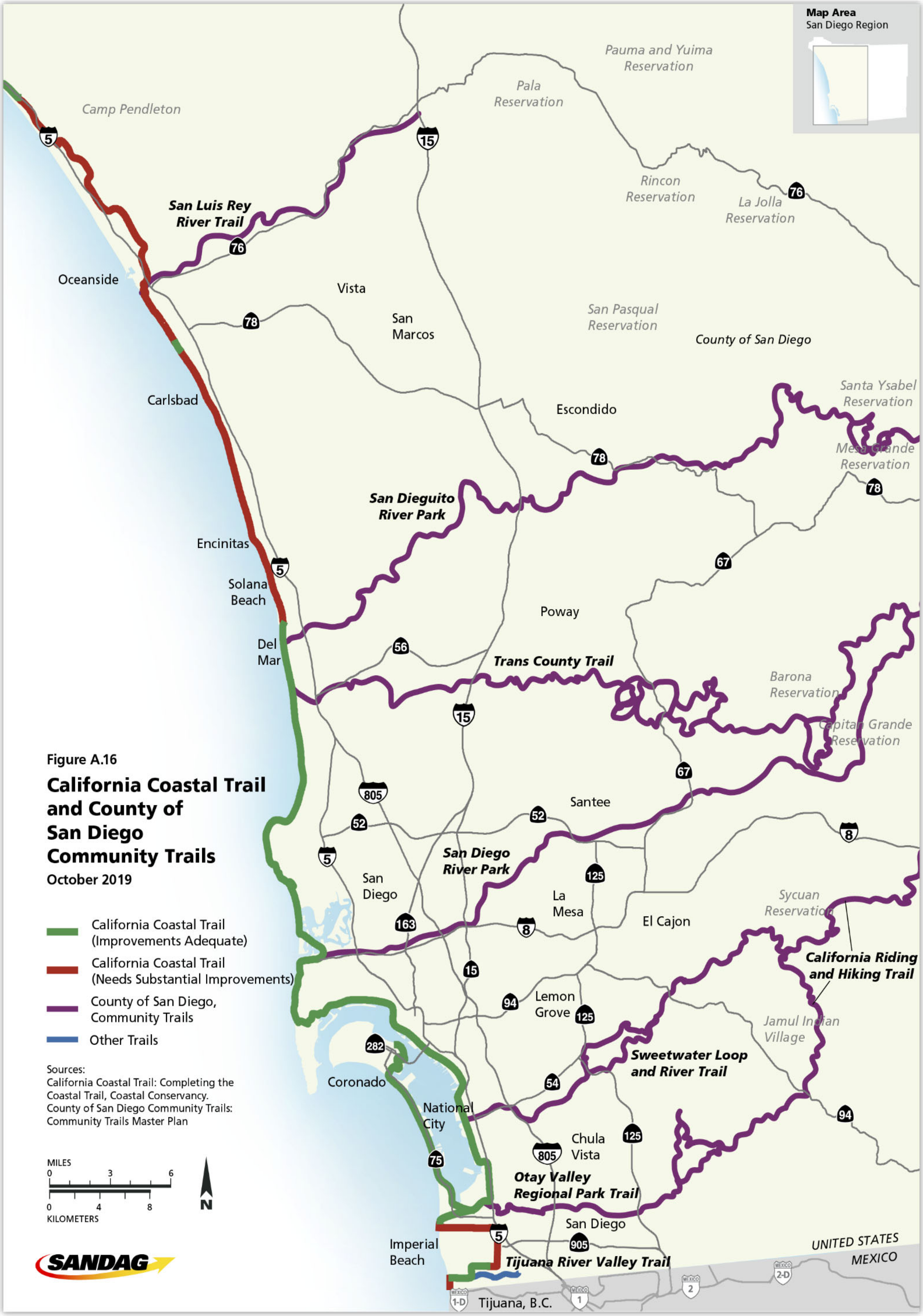


Figure A.16

California Coastal Trail and County of San Diego Community Trails

October 2019

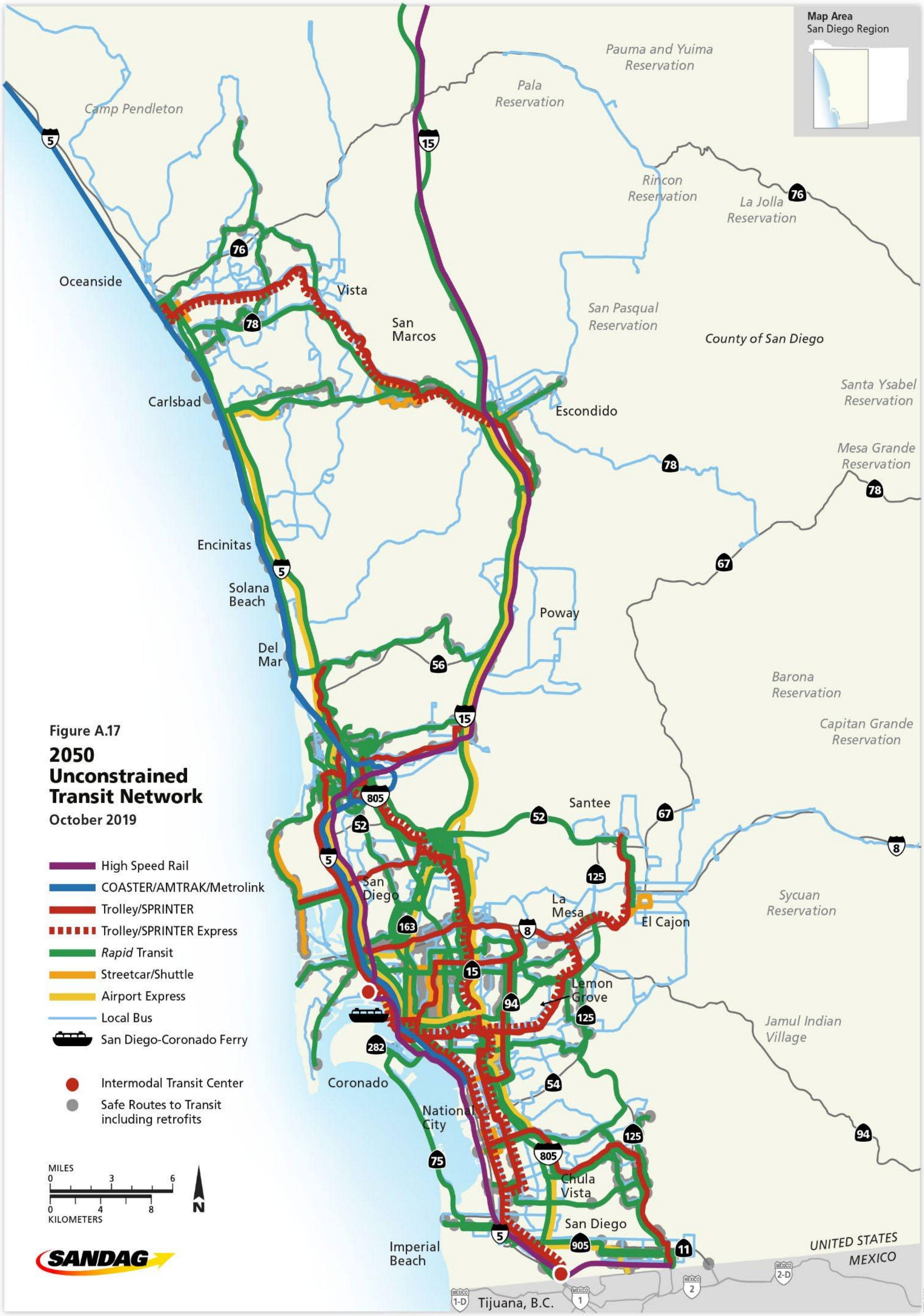


Figure A.17
2050 Unconstrained Transit Network
October 2019
High Speed Rail
COASTER/AMTRAK/Metrolink
Trolley/SPRINTER
Trolley/SPRINTER Express
Rapid Transit
Streetcar/Shuttle
Airport Express
Local Bus
San Diego-Coronado Ferry
Intermodal Transit Center
Safe Routes to Transit including retrofits
MILES
0 3 6
0 4 8
KILOMETERS
N
SANDAG
Map Area
San Diego Region
Camp Pendleton
Pauma and Yuima Reservation
Pala Reservation
Rincon Reservation
La Jolla Reservation
Oceanside
Vista
San Marcos
San Pasqual Reservation
County of San Diego
Santa Ysabel Reservation
Carlsbad
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Encinitas
Solana Beach
Poway
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Capitan Grande Reservation
Santee
San Diego
La Mesa
El Cajon
Sycuan Reservation
Lemon Grove
Jamul Indian Village
Coronado
National City
Chula Vista
San Diego
Imperial Beach
UNITED STATES
MEXICO
Tijuana, B.C.

Figure A.18
2050 Unconstrained Managed Lanes and Highway Network
October 2019


Map Area
San Diego Region
Pauma and Yuima Reservation
Pala Reservation
Camp Pendleton
Rincon Reservation
La Jolla Reservation
Oceanside
Vista
San Marcos
San Pasqual Reservation
County of San Diego
Carlsbad
Escondido
Santa Ysabel Reservation
Mesa Grande Reservation
Encinitas
Solana Beach
Poway
Del Mar
Barona Reservation
Capitan Grande Reservation
Santee
San Diego
La Mesa
El Cajon
Sycuan Reservation
Lemon Grove
Jamul Indian Village
Coronado
National City
Chula Vista
San Diego
Imperial Beach
Tijuana, B.C.
UNITED STATES
MEXICO
Figure A.19
2050 Unconstrained Regional Bike Network
October 2019
Class I - Bike Path
Cycle Track
Bike Boulevard
Enhanced Class II - Bike Lane
Enhanced Class III - Bike Route
Freeways and Highways
Regional Arterials
MILES
0 3 6
0 4 8
KILOMETERS
N
SANDAG

Figure A.20
Unconstrained Goods Movement Strategy
October 2019

Figure A.21

National Highway Freight Network: California (South)

December 2015

LEGEND

NHFN Features

- Primary Highway Freight System (PHFS)
- Remainder of the Interstate System (not part of PHFS)
- Border Crossings
- Cities
- State Capital
- Airport
- Port Terminal
- Truck/Pipeline Terminal
- Truck/Rail Facility
- Water
- Census Urbanized Areas

0 25 50 Miles

0 50 100 Kilometers

U.S. Department of Transportation,
Federal Highway Administration,
Office of Freight Management and Operations