APPENDIX 3.3-A, APPENDIX D: BALLAST HAULING MEMORANDUM

Memorandum

To:	Gary Kennerley, HSR Alice Lovegrove, HSR
From:	Laura Yoon, ICF Kim Avila, ICF
Date:	February 23, 2019
Re:	**High-Speed Rail San Jose to Central Valley Wye Project Extent: Estimated Emissions from Hauling Ballast Material**

Introduction

Construction of the San Jose to Central Valley Wye Project Extent (project) would require a substantial amount of railroad sub-ballast and ballast material to serve as the foundation for the track alignment. This memorandum describes the methods used to: (1) determine two possible scenarios of material hauling that could occur during construction of the project, and (2) calculate criteria pollutant and greenhouse gas (GHG) emissions associated with the material hauling activities for each project alternative. The information presented in this memo is intended to be used as an initial estimate of criteria pollutant and GHG emissions associated with truck and rail trips from material hauling that would occur within the San Francisco Bay Area Air Basin (SFBAAB), the North Central Coast Air Basin (NCCAB), and the San Joaquin Valley Air Basin (SJVAB). The actual distances and quantities associated with material hauling activities for the project are not known at this time, but this memo reflects a reasonable estimate of these activities given currently available information.

Table 1 shows total ballast and sub-ballast requirements for the project alternatives based on construction data provided by the project engineering team, AnchorCM (Scholz pers. comm.).

Table 1. Material Quantities by Alternative (cubic yards)

Material Type	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Ballast	273,000	518,000	297,000	647,000
Sub-ballast	447,000	829,000	477,000	1,035,000
Total	720,000	1,347,000	774,000	1,682,000

Source: Scholz pers. comm.

Quarries Evaluated

A list of all active quarries in California was obtained from the California Department of Conservation, Division of Mine Reclamation's interactive Mines Online (MOL) map (California Department of Conservation 2017). Quarries were filtered for those supplying a primary commodity that could potentially be used for ballast material (rock or sand and gravel), and those quarries that are in the air basins nearest to the project (SFBAAB, NCCAB, and SJVAB). Quarries with 200 or more acres of permitted area were considered to be of sufficient size to effectively serve the demand, consistent with the analysis approach taken for the Bakersfield to Palmdale Project Section (URS/HMM/Arup 2012).

Based on these criteria, the list of all active quarries in California was narrowed down to 11 quarries. It was assumed that the fewest possible quarries would be used for efficiency, and that the selection of quarries would differ through the project based on proximity to transportation infrastructure. Four quarries were identified to serve the San Jose Diridon Station Approach and Monterey Corridor Subsections, and two quarries were identified to serve the Morgan Hill and Gilroy Subsection. These two quarries, as well as an additional quarry in the SJVAB, would also serve the Pacheco Pass Subsection. Five quarries were identified to serve the San Joaquin Valley Subsection.

All selected quarries were evaluated using the following criteria:

1. Distance to the project in rail miles.
2. Distance from the quarry to the nearest railhead for transport (via roads).
3. Truck hauling distance (road miles) to project work sites through the SFBAAB, NCCAB, and SJVAB.

Table 2 shows the results of these inquiries. Distances were measured to the centerpoint of each subsection.

Table 2. Quarry Information

Quarry Name (Air Basin)	San Jose Diridon Station Approach		Monterey Corridor		Morgan Hill and Gilroy		Pacheco Pass		San Joaquin Valley	
	Rail Miles[1]	Road Miles[2]	Rail Miles[1]	Road Miles[2]	Rail Miles[1]	Road Miles[2]	Rail Miles[1]	Road Miles[2]	Rail Miles[1]	Road Miles[2]
Sunol SMP 24 (SFBAAB)	N/A	24	N/A	26	–	–	–	–	–	–
Eliot Facility (SFBAAB)	32	35	37	37	–	–	–	–	–	–
Calmat/Pleasanton (SFBAAB)	32	40	37	43	–	–	–	–	–	–
Pilarcitos Quarry (SFBAAB)	N/A	37	N/A	42	–	–	–	–	–	–
A.R. Wilson quarry (SFBAAB)	–	–	–	–	18	23	20	25	–	–
Southside Sand & Gravel (NCCAB)	–	–	–	–	N/A	29	N/A	15	–	–
Los Banos Sand & Gravel (SJVAB)	–	–	–	–	–	–	N/A	39	N/A	15
Woolstenhulme Quarry (SJVAB)	–	–	–	–	–	–	–	–	N/A	57
Kerlinger – Rhodes (SJVAB)	–	–	–	–	–	–	–	–	N/A	88
Waterford Plant (SJVAB)	–	–	–	–	–	–	–	–	N/A	57
Vernalis (SJVAB)	–	–	–	–	–	–	–	–	N/A	49

N/A = values represent quarries with no visible railhead.

– = Quarry not assumed to supply ballast for the subsection.

[1] Measured by Regional Consultant staff from each railhead, following the rail tracks, to the centerpoint of the alignment, using Google Earth imagery.

[2] Measured by Regional Consultant staff from each quarry to the centerpoint of the alignment using Google Earth directions.

Methodology for Developing Ballast Hauling Scenarios

The actual hauling scenarios that would take place during construction are not known at this time. Accordingly, the following two potential total hauling scenarios for ballast and sub-ballast material for the four project alternatives were developed for the quarries listed in Table 2.

- **Scenario 1**—All ballast and sub-ballast materials from quarries would be hauled by truck. This scenario represents the maximum emissions scenario for truck hauling.
- **Scenario 2**—All ballast and sub-ballast materials from quarries without rail or where rail would be infeasible would be hauled by truck. All ballast and sub-ballast materials from quarries with rail would be hauled by rail. Rail was considered infeasible if there was determined to be no direct route of train tracks from the quarry to the project. This scenario represents the maximum emissions scenario for rail hauling.

These scenarios were developed to provide a reasonable range of potential criteria pollutant and GHG emissions that might be generated by material hauling activities. The scenarios characterize a range of supply from the different quarries, representing the maximum amount of haul activity for truck transport to a maximum amount of haul activity for rail transport. Each of the selected quarries in each subsection was assumed to supply an equal amount of ballast (i.e., for the San Jose Diridon Station Approach Subsection, each of the four quarries was assumed to supply one-fourth of the total amount of ballast and sub-ballast material required for the subsection).

Table 3 shows the amount of ballast and sub-ballast hauled by truck and rail under Scenarios 1 and 2 for each project alternative.

Table 3. Amount of Ballast and Sub-Ballast Material Hauled from Each Quarry for Scenarios 1 and 2 (cubic yards per year)

	Alternative 1		Alternative 2		Alternative 3		Alternative 4	
Quarry Name	**Scenario 1**	**Scenario 2**	**Scenario 1**	**Scenario 2**	**Scenario 1**	**Scenario 2**	**Scenario 1**	**Scenario 2**
Sunol SMP 24								
Rail	0	0	0	0	0	0	0	0
Truck	48,000	48,000	60,500	60,500	40,500	40,500	91,750	91,750
Eliot Facility								
Rail	0	48,000	0	60,500	0	40,500	0	91,750
Truck	48,000	0	60,500	0	40,500	0	91,750	0
Calmat/Pleasanton								
Rail	0	48,000	0	60,500	0	40,500	0	91,750
Truck	48,000	0	60,500	0	40,500	0	91,750	0
Pilarcitos Quarry								
Rail	0	0	0	0	0	0	0	0
Truck	48,000	48,000	60,500	60,500	40,500	40,500	91,750	91,750
A.R. Wilson Quarry								
Rail	0	131,167	0	419,667	0	173,167	0	524,667
Truck	131,167	0	419,667	0	173,167	0	524,667	0
Southside Sand & Gravel								
Rail	0	0	0	0	0	0	0	0
Truck	131,167	131,167	419,667	419,667	173,167	173,167	524,667	524,667
Los Banos Sand & Gravel								
Rail	0	0	0	0	0	0	0	0
Truck	87,267	87,267	87,267	87,267	87,267	87,267	87,267	87,267
Woolstenhulme Quarry								
Rail	0	0	0	0	0	0	0	0
Truck	44,600	44,600	44,600	44,600	44,600	44,600	44,600	44,600
Kerlinger–Rhodes								
Rail	0	0	0	0	0	0	0	0
Truck	44,600	44,600	44,600	44,600	44,600	44,600	44,600	44,600
Waterford Plant								
Rail	0	0	0	0	0	0	0	0
Truck	44,600	44,600	44,600	44,600	44,600	44,600	44,600	44,600
Vernalis								
Rail	0	0	0	0	0	0	0	0
Truck	44,600	44,600	44,600	44,600	44,600	44,600	44,600	44,600

Considerations for the Criteria Pollutant and Greenhouse Gas Emissions Analysis

The material quantities shown in Table 3 were used to determine the pollutant emissions that would be generated within the SFBAAB, NCCAB, and SJVAB from hauling activities for each construction phase that requires ballast and sub-ballast material hauling. The criteria pollutants evaluated were carbon monoxide (CO), nitrogen oxide (NO_X), particulate matter with a diameter of 10 micrometers or less (PM_{10}), particulate matter with a diameter of 2.5 micrometers or less ($PM_{2.5}$), reactive organic gases (ROG), and sulfur dioxide (SO_2). Analysts also evaluated carbon dioxide equivalents (CO_2e)—the contributions of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O). Emissions were calculated by multiplying the mileage associated with each scenario by criteria pollutant and GHG emission factors for rail and truck hauling.

The distances between each quarry and the centerpoint of the alignment were estimated for rail hauling using Google Earth imagery. The distances between each quarry and the centerpoint of the alignments were estimated for truck hauling using Google Earth directions. The truck and rail hauling distances within each air basin were estimated using haul distances from Google Earth directions to the boundary of each air basin.

Total hauling distances associated with each scenario were calculated by multiplying the number of truck trips needed by the hauling trip distances associated with each scenario. The number of truck trips needed was determined by dividing the material quantities for each scenario by an assumed capacity of 20 cubic yards per truck. Material hauled by rail was converted to tons using a conversion factor of 1.3 ton of ballast/sub-ballast per cubic yard. Table 4 shows the emission factors used in the analysis. Rail emission factors are based on *Emission Factors for Locomotives* (USEPA 2009) and are presented in units of grams per ton-mile. Haul truck emission factors are from EMFAC2017 and are presented in units of grams per mile.

Table 4. Rail and Truck Emission Factors

Emission Source	Emission Factors						
	ROG	NO_X	CO	PM_{10}	$PM_{2.5}$	SO_2	CO_2
Rail[1] (all air districts)							
2025	0.01	0.15	0.06	<0.01	<0.01	<0.01	21
2026	0.01	0.14	0.06	<0.01	<0.01	<0.01	21
2027	0.01	0.13	0.06	<0.01	<0.01	<0.01	21
2028	**0.00**	**0.13**	**0.06**	**<0.01**	**<0.01**	**<0.01**	**21**
Trucks[2] (SFBAAB)							
2025	0.03	3.06	0.41	0.11	0.05	0.02	1,673
2026	0.04	3.43	0.43	0.11	0.05	0.02	1,661
2027	0.04	3.40	0.43	0.11	0.05	0.02	1,636
2028	0.04	3.38	0.43	0.11	0.05	0.02	1,614
Trucks[2] (NCCAB)							
2025	0.04	3.48	0.43	0.12	0.05	0.02	1,682
2026	0.04	3.44	0.43	0.11	0.05	0.02	1,661
2027	0.04	3.42	0.43	0.11	0.05	0.02	1,636
2028	0.04	3.40	0.43	0.11	0.05	0.02	1,614
Trucks[2] (SJVAB)							
2025	0.03	3.08	0.41	0.11	0.05	0.02	1,673
2026	0.04	3.44	0.43	0.11	0.05	0.02	1,661
2027	0.04	3.41	0.43	0.11	0.05	0.02	1,636
2028	0.04	3.39	0.43	0.11	0.05	0.02	1,614

Sources: EMFAC2017, USEPA 2009

Emission factors are presented for 2025 through 2028, which are the years in which ballast hauling would occur.

ROG = reactive organic gases

NO_X = nitrogen oxide

CO = carbon monoxide

PM_{10} = particulate matter with a diameter of 10 micrometers or less

$PM_{2.5}$ = particulate matter with a diameter of 2.5 micrometers or less

SO_2 = sulfur dioxide

CO_2 = carbon dioxide

USEPA = U.S. Environmental Protection Agency

[1] Emission units are grams per ton-mile. Based on a conversion factor of 484 ton-miles/gallon from the Association of American Railroads and grams/gallon emission factors from the USEPA's *Emission Factors for Locomotives* (USEPA 2009; American of Railroads 2016).

[2] Emission units are grams per mile. Based on EMFAC2017 regional fleet for heavy-heavy duty vehicles.

For this analysis, the significance of the criteria pollutant emissions associated with hauling activities is determined by comparing the emissions to the emissions thresholds relevant to the SFBAAB, NCCAB, and SJVAB, the basins in which all the quarries that were considered in this analysis are located. The applicable air districts in the SFBAAB, the NCCAB, and the SJVAB are the Bay Area Air Quality Management District (BAAQMD), the Monterey Bay Air Resources District (MBARD), and the San Joaquin Valley Air Pollution Control District (SJVAPCD), respectively. The federal and state air quality attainment status of the three air basins—which determines the General

Conformity *de minimis* thresholds that apply to the project—is shown in Table 5. The General Conformity *de minimis* thresholds that are applicable to the project are shown in Table 6, and the applicable air district California Environmental Quality Act (CEQA) thresholds are shown in Table 7. None of the local air districts (BAAQMD, MBARD, or SJVAPCD) has adopted a GHG emission threshold for construction-related emissions.

Table 5. Federal and State Attainment Status of the Study Area within the SFBAAB, NCCAB, and SJVAB

	SFBAAB		NCCAB		SJVAB	
Pollutant	**Federal**	**State**	**Federal**	**State**	**Federal**	**State**
Ozone (O_3)	N (marginal)	N	A/U	N-T	N (extreme)	N
Particulate matter (PM_{10})	A/U	N	A/U	N	M (serious)	N
Particulate matter ($PM_{2.5}$)	N (moderate)	N	A/U	A	N (moderate)	N
Carbon monoxide (CO)	A	A	A	U	A	U
Nitrogen dioxide (NO_2)	A/U	A	A/U	A	A/U	A
Sulfur dioxide (SO_2)	A/U	A	A/U	A	A/U	A

Sources: CARB 2017; USEPA 2018.
A/U = attainment/unclassified
CO = carbon monoxide
M = maintenance
N = nonattainment
N-T = nonattainment-transitional
U = unclassified

Table 6. General Conformity *de minimis* Thresholds for the Resource Study Area

	Annual Air Pollutant Emissions in Tons per Year					
Air Basin	**ROG**	**NO_X**	**CO**	**PM_{10}**	**$PM_{2.5}$**	**SO_2[1]**
San Francisco Bay Area Air Basin	100	100	None	None	100	100
North Central Coast Air Basin[2]	None	None	None	None	None	None
San Joaquin Valley Air Basin	10	10	None	100	100	100

Source: 40 Code of Federal Regulations Section 93.153
CO = carbon monoxide
NO_X = oxides of nitrogen
$PM_{2.5}$ = particulate matter 2.5 microns in diameter or less
PM_{10} = particulate matter 10 microns in diameter or less
ROG = reactive organic gases
SO_2 = sulfur dioxide
RSA = resource study area
[1] Although the RSA is in attainment for SO_2, because SO_2 is a precursor for $PM_{2.5}$, the $PM_{2.5}$ General Conformity *de minimis* thresholds are used.
[2] The NCCAB is considered attainment with respect to federal standards for all criteria pollutants. Accordingly, a general conformity analysis is not required and there are no applicable *de minimis* thresholds.

Table 7. BAAQMD, MBARD, and SJVAPCD Mass Emission Construction CEQA Thresholds

BAAQMD	MBARD	SJVAPCD
ROG: 54 lbs/day	PM_{10}: 82 lbs/day[1]	ROG: 10 tons/year or 100 lbs/day[2]
NO_X: 54 lbs/day		NO_X: 10 tons/year or 100 lbs/day[2]
PM_{10}: 82 lbs/day (exhaust only)		PM_{10}: 15 tons/year or 100 lbs/day[2]
$PM_{2.5}$: 54 lbs/day (exhaust only)		$PM_{2.5}$: 15 tons/year or 100 lbs/day[2]
		CO: 100 tons/year or 100 lbs/day[2]
		SO_X: 27 tons/year or 100 lbs/day[2]

Sources: MBUAPCD 2008; BAAQMD 2017; SJVAPCD 2015
BAAQMD = Bay Area Air Quality Management District
MBARD = Monterey Bay Air Resources District
SJVAPCD = San Joaquin Valley Air Pollution Control District
ROG = reactive organic gases
lbs = pounds
NO_X = nitrogen oxide
PM_{10} = particulate matter that is 10 microns in diameter and smaller
$PM_{2.5}$ = particulate matter that is 2.5 microns in diameter and smaller
CO = carbon monoxide
SO_X = sulfur oxide
CAAQS = California ambient air quality standards
NAAQS = national ambient air quality standards

[1] According to the MBARD CEQA guidelines, construction projects that temporarily emit precursors of ozone (i.e., ROG or NO_X) are accommodated in the emission inventories of state and federally required air plans and would not have a significant impact on the attainment and maintenance of state or federal ozone ambient air quality standard (MBUAPCD 2008). The MBARD guidelines have an exception if a project uses "non-typical equipment, e.g., grinders, and portable equipment"; the project would use standard construction equipment.

[2] The 100-pound-per-day threshold is a screening-level threshold to help determine whether increased emissions from a proposed project would cause or contribute to a violation of CAAQS or NAAQS. Projects with emissions below the threshold would not be in violation of CAAQS or NAAQS. Projects with emissions above the threshold would require an Ambient Air Quality Analysis to confirm this conclusion (SJVAPCD 2015).

Annual Hauling Activity Emissions

Maximum annual criteria pollutant and GHG emissions associated with hauling the ballast and sub-ballast material within the SFBAAB, NCCAB, and SJVAB are shown in Tables 8 through 10, respectively, for the two potential hauling scenarios. Ballast and sub-ballast hauling would occur in 2025, 2027, and 2028. In Tables 8 through 10, annual emissions are assessed against the General Conformity *de minimis* thresholds and annual CEQA thresholds applicable to the resource study area, respectively (see Tables 6 and 7).

As shown in Tables 8 through 10, ballast and sub-ballast hauling under all alternatives would not exceed any annual air basin or General Conformity *de minimis* thresholds. Ballast and sub-ballast hauling emissions have been incorporated into the larger project construction analysis presented in the *San Jose to Merced Project Section Air Quality and Greenhouse Gases Technical Report* (technical report) (Authority and FRA 2019) (see Chapter 7, Air Quality Effects Analysis).

Daily Hauling Activity Emissions

Daily maximum criteria pollutant emissions associated with hauling the ballast and sub-ballast material in the BAAQMD and MBARD are shown in Tables 11 and 12, respectively, for the two potential hauling scenarios. The highest average daily emissions in the SJVAPCD are shown in Table 13. Emission estimates were developed based on the hauling schedule, as provided by the project engineers (Scholz pers. comm.).

As shown in Table 11, ballast and sub-ballast hauling would exceed the BAAQMD's daily NO_X threshold under all project alternatives and both hauling scenarios. None of the project alternatives would exceed MBARD's daily PM_{10} CEQA threshold (see Table 12). All project alternatives under both hauling scenarios would exceed SJVAPCD's AAQA trigger for NO_X (see Table 13).

Ballast and sub-ballast hauling emissions have been incorporated into the larger project construction analysis presented in the technical report (see Chapter 7). Emissions more than BAAQMD's CEQA threshold would be offset to below the air district threshold level through implementation of AQ-MM#1: *Offset Project Construction Emissions in the San Francisco Bay Area Air Basin*.

Greenhouse Gas Emissions

Total GHG emissions (in terms of CO_2e over the entire hauling period) associated with hauling the ballast and sub-ballast material within the SFBAAB, NCCAB, and SJVAB are shown in Tables 8 through 10, respectively. The tables indicate total combined hauling emissions in all air basins would range from 3,449 to 6,877 metric tons CO_2e, depending on the project alternative and hauling scenario. Amortized GHG emissions over a 25-year period ranges from 138 to 275 metric tons CO_2e per year.

Ballast and sub-ballast hauling emissions have been incorporated into the larger project construction analysis presented in the technical report (see Chapter 8, Global Climate Change Effects Analysis). The short-term increase in construction-related emissions would be offset by long-term emissions reductions achieved during project operation.

Table 8. Ballast and Sub-Ballast Hauling Emissions within the SFBAAB (max tons/year)

Scenario	ROG	NO_X	CO	PM_{10}			$PM_{2.5}$			SO_2	CO_2e (Total)[1]
				Dust	Exhaust	Total	Dust	Exhaust	Total		
Alternative 1											
Scenario 1	<1	2	<1	1	<1	1	<1	<1	<1	<1	1,392
Scenario 2	<1	3	1	<1	<1	<1	<1	<1	<1	<1	870
Alternative 2											
Scenario 1	<1	3	<1	1	<1	1	<1	<1	<1	<1	2,314
Scenario 2	<1	3	1	<1	<1	<1	<1	<1	<1	<1	1,509
Alternative 3											
Scenario 1	<1	2	<1	1	<1	1	<1	<1	<1	<1	1,299
Scenario 2	<1	2	1	<1	<1	<1	<1	<1	<1	<1	827
Alternative 4											
Scenario 1	<1	5	1	1	<1	1	<1	<1	<1	<1	3,302
Scenario 2	<1	5	1	1	<1	1	<1	<1	<1	<1	2,132
General Conformity Threshold for SFBAAB	100	100	-	-	-	-	-	-	100	100	-
Exceed the General Conformity Threshold	No	No	-	-	-	-	-	-	No	No	-

Source: Scholz pers. comm.; USEPA 2009; EMFAC2017
SFBAAB = San Francisco Bay Area Air Basin
ROG = reactive organic gases
NO_X = nitrogen oxide
PM_{10} = particulate matter that is 10 microns in diameter and smaller
$PM_{2.5}$ = particulate matter that is 2.5 microns in diameter and smaller
CO = carbon monoxide
SO_2 = sulfur dioxide
CO_2e = carbon dioxide equivalent
[1] The units for CO_2e are metric tons, not short tons. Values also represent total GHG over the hauling period, not max annual.

Table 9. Ballast and Sub-Ballast Hauling Emissions within the NCCAB (max tons/year)

Scenario	ROG	NO_X	CO	PM_{10}			$PM_{2.5}$			SO_2	CO_2e (Total)[1]
				Dust	Exhaust	Total	Dust	Exhaust	Total		
Alternative 1											
Scenario 1	<1	1	<1	<1	<1	<1	<1	<1	<1	<1	366
Scenario 2	<1	1	<1	<1	<1	<1	<1	<1	<1	<1	306
Alternative 2											
Scenario 1	<1	2	<1	1	<1	1	<1	<1	<1	<1	1,052
Scenario 2	<1	2	<1	<1	<1	<1	<1	<1	<1	<1	798
Alternative 3											
Scenario 1	<1	1	<1	<1	<1	<1	<1	<1	<1	<1	466
Scenario 2	<1	1	<1	<1	<1	<1	<1	<1	<1	<1	377
Alternative 4											
Scenario 1	<1	3	<1	1	<1	1	<1	<1	<1	<1	1,302
Scenario 2	<1	2	<1	1	<1	1	<1	<1	<1	<1	978
General Conformity Threshold for NCCAB[2]	-	-	-	-	-	-	-	-	-	-	-
Exceed the General Conformity Threshold	-	-	-	-	-	-	-	-	-	-	-

Source: Scholz pers. comm.; USEPA 2009; EMFAC2017
NCCAB = North Central Coast Air Basin
ROG = reactive organic gases
NO_X = nitrogen oxide
PM_{10} = particulate matter that is 10 microns in diameter and smaller
$PM_{2.5}$ = particulate matter that is 2.5 microns in diameter and smaller
CO = carbon monoxide
SO_2 = sulfur dioxide
CO_2e = carbon dioxide equivalent
[1] The units for CO_2e are metric tons, not short tons. Values also represent total GHG over the hauling period, not max annual.
[2] The NCCAB is considered attainment for all criteria pollutants. As such, a general conformity analysis is not required and there are no applicable *de minimis* thresholds.

Table 10. Ballast and Sub-Ballast Hauling Emissions within the SJVAB (max tons/year)

Scenario	ROG	NO_X	CO	PM_{10}			$PM_{2.5}$			SO_2	CO_2e (Total)[1]
				Dust	Exhaust	Total	Dust	Exhaust	Total		
Alternative 1											
Scenario 1	<1	5	1	1	<1	1	<1	<1	<1	<1	2,273
Scenario 2	<1	5	1	1	<1	1	<1	<1	<1	<1	2,273
Alternative 2											
Scenario 1	<1	5	1	1	<1	1	<1	<1	<1	<1	2,273
Scenario 2	<1	5	1	1	<1	1	<1	<1	<1	<1	2,273
Alternative 3											
Scenario 1	<1	5	1	1	<1	1	<1	<1	<1	<1	2,273
Scenario 2	<1	5	1	1	<1	1	<1	<1	<1	<1	2,273
Alternative 4											
Scenario 1	<1	5	1	1	<1	1	<1	<1	<1	<1	2,273
Scenario 2	<1	5	1	1	<1	1	<1	<1	<1	<1	2,273
General Conformity Threshold for SJVAB	10	10	-	-	-	100	-	-	100	100	-
SJVAPCD Yearly Construction Threshold	10	10	100	-	-	15	-	-	15	27	-
Exceed the General Conformity Threshold	No	No	-	-	-	No	-	-	No	No	-
Exceed SJVAPCD Threshold	No	No	No	-	-	No	-	-	No	No	-

Source: Scholz pers. comm.; USEPA 2009; EMFAC2017
SJVAB = San Joaquin Valley Air Basin
SJVAPCD = San Joaquin Valley Air Pollution Control District
ROG = reactive organic gases
NO_X = nitrogen oxide
PM_{10} = particulate matter that is 10 microns in diameter and smaller
$PM_{2.5}$ = particulate matter that is 2.5 microns in diameter and smaller
CO = carbon monoxide
SO_2 = sulfur dioxide
CO_2e = carbon dioxide equivalent
[1] The units for CO_2e are metric tons, not short tons. Values also represent total GHG over the hauling period, not max annual.

Table 11. Maximum Daily Ballast and Sub-Ballast Hauling Emissions within the BAAQMD (pounds/day)[1]

Scenario	ROG	NO_X	CO	PM_{10}			$PM_{2.5}$			SO_2
				Exhaust	Dust	Total	Exhaust	Dust	Total	
Alternative 1										
Scenario 1	3	359	48	2	109	110	2	28	30	2
Scenario 2	10	390	104	6	50	56	5	13	18	1
Alternative 2										
Scenario 1	3	279	38	1	84	86	1	22	23	1
Scenario 2	9	345	92	5	44	49	5	11	16	1
Alternative 3										
Scenario 1	3	297	40	1	90	91	1	23	24	2
Scenario 2	9	348	93	5	45	50	5	12	16	1
Alternative 4										
Scenario 1	5	480	65	2	145	148	2	37	40	2
Scenario 2	13	515	137	7	66	74	7	17	24	2
BAAQMD daily construction threshold	54	54	-	82	-	-	54	-	-	-
Exceedances of the BAAQMD threshold	No	Yes	-	No	-	-	No	-	-	-

Source: Scholz pers. comm.; USEPA 2009; EMFAC2017
BAAQMD = Bay Area Air Quality Management District
ROG = reactive organic gases
NO_X = nitrogen oxide
PM_{10} = particulate matter that is 10 microns in diameter and smaller
$PM_{2.5}$ = particulate matter that is 2.5 microns in diameter and smaller
CO = carbon monoxide
SO_2 = sulfur dioxide
CO_2e = carbon dioxide equivalent
[1] Table presents the highest daily emissions that would be incurred over the hauling period.

Table 12. Maximum Daily Ballast and Sub-Ballast Hauling Emissions within the MBARD (pounds/day)[1]

Scenario	ROG	NO_X	CO	PM_{10}			$PM_{2.5}$			SO_2
				Exhaust	Dust	Total	Exhaust	Dust	Total	
Alternative 1										
Scenario 1	1	48	6	<1	13	13	<1	3	4	<1
Scenario 2	1	42	6	<1	11	11	<1	3	3	<1
Alternative 2										
Scenario 1	1	98	12	<1	27	27	<1	7	7	<1
Scenario 2	1	80	11	<1	21	21	<1	5	6	<1
Alternative 3										
Scenario 1	1	85	11	<1	23	24	<1	6	6	<1
Scenario 2	1	70	10	<1	18	19	<1	5	5	<1
Alternative 4										
Scenario 1	1	95	12	<1	26	26	<1	7	7	<1
Scenario 2	1	78	11	<1	20	21	<1	5	6	<1
MBARD Daily Construction Threshold	-	-	-	-	-	82[2]	-	-	-	-
Exceed MBARD Threshold	-	-	-	-	-	No	-	-	-	-

Source: Scholz pers. comm.; USEPA 2009; EMFAC2017
MBARD = Monterey Bay Air Resources District
ROG = reactive organic gases
NO_X = nitrogen oxide
PM_{10} = particulate matter that is 10 microns in diameter and smaller
$PM_{2.5}$ = particulate matter that is 2.5 microns in diameter and smaller
CO = carbon monoxide
SO_2 = sulfur dioxide
CO_2e = carbon dioxide equivalent

[1] Table presents the highest daily emissions that would be incurred over the hauling period.

[2] According to the MBARD CEQA guidelines, construction projects that temporarily emit precursors of ozone (i.e., ROG or NO_X) are accommodated in the emission inventories of state- and federally required air plans and would not have a significant impact on the attainment and maintenance of state or federal ozone ambient air quality standards (MBUAPCD 2008). The MBARD guidelines have an exception if a project uses "non-typical equipment, e.g., grinders, and portable equipment." The project would use standard construction equipment.

Table 13. Highest Average Daily[1] Ballast and Sub-Ballast Hauling Emissions within the SJVAPCD (pounds/day)[1]

Scenario	ROG	NO_X	CO	PM_{10}			$PM_{2.5}$			SO_2
				Dust	Exhaust	Total	Dust	Exhaust	Total	
Alternative 1										
Scenario 1	2	210	26	57	1	58	15	1	16	1
Scenario 2	2	210	26	57	1	58	15	1	16	1
Alternative 2										
Scenario 1	2	210	26	57	1	58	15	1	16	1
Scenario 2	2	210	26	57	1	58	15	1	16	1
Alternative 3										
Scenario 1	2	210	26	57	1	58	15	1	16	1
Scenario 2	2	210	26	57	1	58	15	1	16	1
Alternative 4										
Scenario 1	2	210	26	57	1	58	15	1	16	1
Scenario 2	2	210	26	57	1	58	15	1	16	1
SJVAPCD Daily Construction Threshold	100[2]	100[2]	100[2]	-	-	100[2]	-	-	100[2]	100[2]
Exceed SJVAPCD Threshold	No	Yes	No	-	-	Yes	-	-	No	No

Source: Scholz pers. comm.; USEPA 2009; EMFAC2017
SJVAPCD = San Joaquin Valley Air Pollution Control District
ROG = reactive organic gases
NO_X = nitrogen oxide
PM_{10} = particulate matter that is 10 microns in diameter and smaller
$PM_{2.5}$ = particulate matter that is 2.5 microns in diameter and smaller
CO = carbon monoxide
SO_2 = sulfur dioxide
CO_2e = carbon dioxide equivalent
AAQA = ambient air quality analysis
CAAQS = California ambient air quality standards
NAAQS = national ambient air quality standards

[1] Presents the average emissions estimate during a single day of construction in the highest emissions year. Average emissions are presented in SJVAPCD (rather than maximum), consistent with SJVAPCD (2015) guidance for correct application of their 100-pound-per-day AAQA screening criteria.

[2] The 100-pound-per-day threshold is a screening-level threshold to help determine whether increased emissions from a project would cause or contribute to a violation of CAAQS or NAAQS. Projects with emissions below the threshold would not be in violation of CAAQS or NAAQS. Projects with emissions above the threshold would require an AAQA to confirm this conclusion (SJVAPCD 2015).

Conclusion

The material hauling scenarios discussed in this memorandum represent possible ballast and sub-ballast material hauling activities for the project. While it is currently unknown which quarries and transport methods would be used, this memorandum provides a reasonable estimation of potential hauling scenarios and the corresponding criteria pollutant and CO_2e emissions.

Ballast and sub-ballast hauling would not independently exceed the General Conformity *de minimis* thresholds in the SFBAAB but would exceed the BAAQMD's NO_X CEQA threshold. Combined GHG emissions in all air basins would range from 3,449 to 6,877 metric tons CO_2e or 138 to 275 metric tons CO_2e per year over a 25-year project life.

Ballast and sub-ballast hauling emissions have been incorporated into the larger project construction analysis presented in the technical report. Emissions more than BAAQMD's CEQA threshold would be offset to below the air district threshold level through implementation of AQ-MM#1. GHG emissions would be offset by long-term emissions reductions achieved during project operation.

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