August 2021 | Health Risk and Safety Hazard Assessment

CALEXICO HIGH SCHOOL RENOVATION

Calexico Unified School District

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PLACEWORKS

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1. Introduction

1.1 PURPOSE

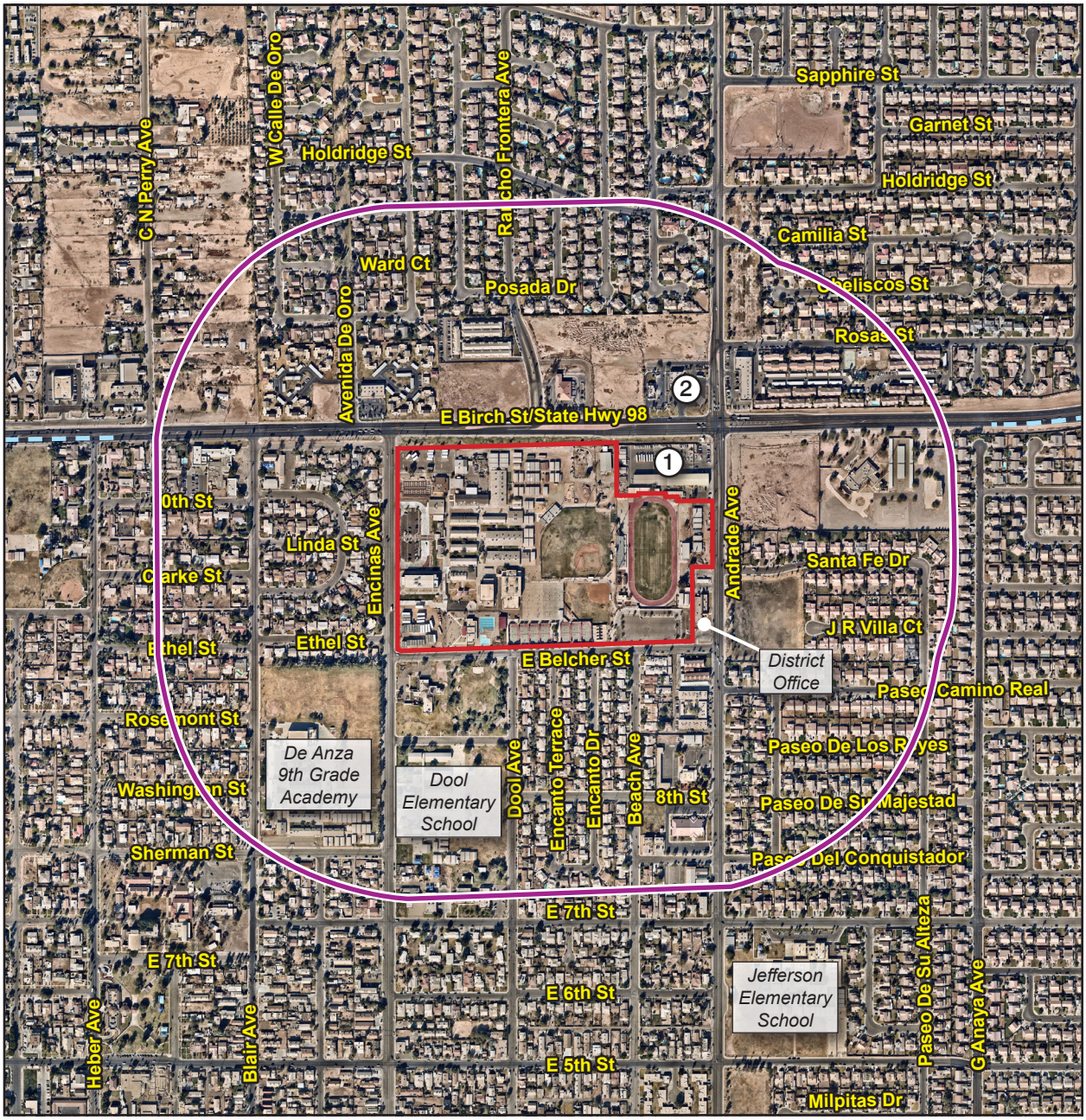
This report presents the results of a health risk assessment (HRA) and safety hazard assessment prepared for the Calexico Unified School District (District). The District is proposing renovations associated with their Master Plan for the existing Calexico High School (project site). Regulations pertaining to the siting of new schools or modernization of existing schools in California require compliance with the California Code of Regulations (CCR) Title 5 standards. For modernization projects, the District must certify that it has reviewed the Title 5 standards and that the project would not create any new significant safety hazards or exacerbate any existing safety hazards. This report evaluates facilities with the potential to emit hazardous air pollutants within a quarter-mile radius of the school site to ensure that any health risks to students and staff are not exacerbated by the proposed project. Also, the potential for accidents to occur at the compressed natural gas (CNG) station at the adjacent District Maintenance, Operations, and Transportation (MOT) Department facility was evaluated.

The HRA was conducted in accordance with relevant and appropriate procedures of the U.S. Environmental Protection Agency (USEPA), California Environmental Protection Agency (CalEPA), and Office of Environmental Health and Hazard Assessment (OEHHA). Although there currently are no California Department of Education (CDE) guidelines for conducting hazard assessments for CNG facilities, procedures developed by USEPA and the American Institute of Chemical Engineers (AIChE) were used in this assessment.

1.2 PROJECT LOCATION

The existing Calexico High School is located at 1030 Encinas Avenue in the City of Calexico, Imperial County, California (site). The approximately 42.56-acre site is bounded by an Imperial Irrigation District easement to the north, Encinas Avenue to the west, and E. Belcher Street to the south. To the east, the site is bound by Andrade Avenue, the District administrative office at 901 Andrade Avenue, and the District Maintenance, Operations, and Transportation (MOT) Department at 1085 Andrade Avenue. The District administrative office and MOT facility are not part of the project. The project site boundary and surrounding area are shown on Figure 1.

Figure 1 - Emission Sources



School Boundary

Quarter-Mile Radius

1 District Maintenance, Operations, and Transportation Facility

2 7-11 Gas Station

0 900
Scale (Feet)

Source: Nearmap, 2021

1.3 REPORT OBJECTIVES

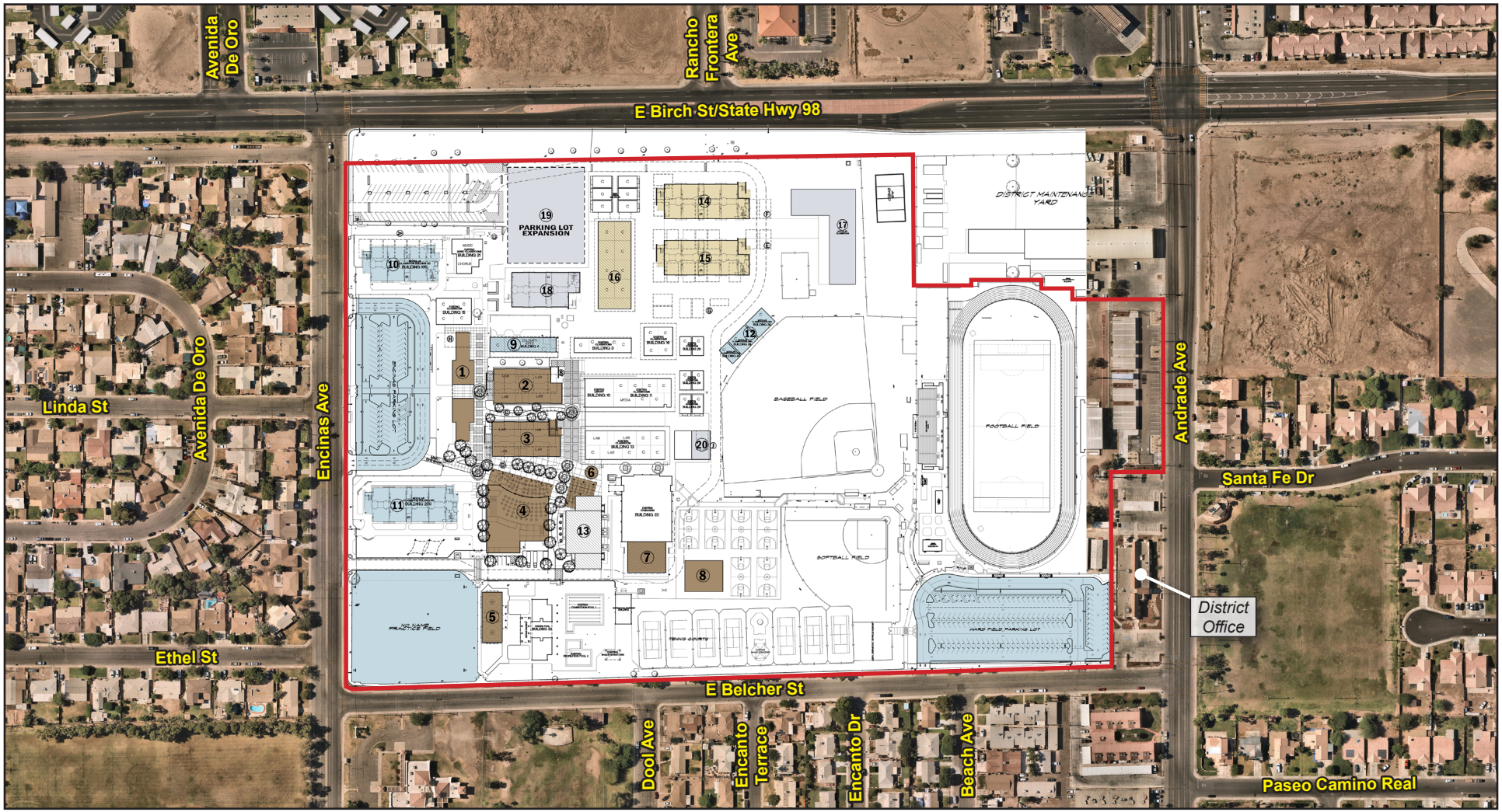
This health risk assessment (HRA) included conducting the following tasks:

- Facilities within a quarter-mile (1,320-foot) radius of the proposed site were identified and evaluated that might reasonably emit hazardous or acutely hazardous air emissions.
- Evaluate the health risks to students at Calexico High School from toxic air contaminants (TACs) emitted from CNG-fueled buses and vehicles at the District MOT facility.
- Air dispersion modeling, using the AERMOD computer model, was conducted to quantify maximum ground-level concentrations for receptors at the project site. Meteorological (met) data from the nearest Imperial County Air Pollution Control District (ICAPCD) met station with similar meteorological conditions were used to represent local weather conditions and prevailing winds.
- Cancer and non-cancer risks to students and staff attending the school site were determined, based on the results of the AERMOD modeling. The assessment considered exposure through the inhalation pathway. Cancer Potency Factors (CPFs) were used to determine carcinogenic risk and Recommended Exposure Limits (RELs) were used to determine non-carcinogenic risk.
- Evaluate potential accident scenarios and identify if hazard footprints associated with MOT facility CNG equipment extend onto the project site.
- Conduct a semi-quantitative risk analysis to predict exposures and safety risks at the school site.
- Where appropriate, identify and develop mitigation measures to reduce risk to an acceptable level.

For districts that are undergoing a modernization project and constructing additional buildings or replacing existing buildings on an existing school site, the CDE requirement is that the project would not create any new significant health and safety hazards or exacerbate any existing health and safety hazards. According to the current modernization plan, new construction on the school site would mostly place new classrooms or student service buildings within areas where there are existing buildings and therefore would not exacerbate any safety hazards. The proposed site plan is shown in Figure 2.

As shown in Figure 2, only new modular classroom building 17 (for vocational arts) would be placed closer to the MOT facility than previous classroom buildings. An existing agricultural shed is the nearest school building to the MOT facility and is 30 feet west from the MOT property line. However, to be conservative, this HRA has been prepared to address all potential risks from emission sources for the entire school site and has been prepared in accordance with CDE requirements as if it were a new school site.

Figure 2 - Proposed Site Plan



Aerial Photo Source: Nearmap, 2021; Site Plan: Sanders, Inc; 2020

1.4 ASSESSMENT METHODOLOGY

A health risk assessment report has been prepared that compares the calculated risks with thresholds established by the Office of Environmental Health Hazard Assessment (OEHHA). The CDE has not established a protocol for evaluating the safety of students and staff at schools near CNG facilities. Therefore, the following references were used to develop accident scenarios and evaluate risk to nearby receptors for the CNG facility:

- *Air Toxics Hot Spots Program Guidance Manual for the Preparation of Health Risk Assessments,* Office of Environmental Health Hazard Assessment (OEHHA), 2015.
- *NFPA 52 – Vehicular Natural Gas Fuel Systems Code,* National Fire Protection Association, 2019.
- Guidelines for Chemical Process Quantitative Risk Analysis, American Institute of Chemical Engineers, 2000.

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2. Air Toxics Health Risks

2.1 EMISSION SOURCES

Information provided to Padre Associates, Inc., by the ICAPCD was reviewed to assist in the identification of potential emission sources within a quarter-mile of the project site (Padre Associates, Inc., 2021). A summary of the emissions sources evaluated during this assessment is provided below in Table 1. The project site and evaluated emission sources are depicted in Figure 2.

Table 1 Emission Sources

Source	Address
District Maintenance, Operation, and Transportation (MOT) Facility	1085 Andrade Avenue, Calexico, CA 92231
7-11 Gas Station	1101 Andrade Avenue, Calexico, CA 92231

Contaminant release information and associated chemical species were identified for each emission source through a review of available documentation. The compounds emitted from each stationary source are listed in Table 2.

Table 2 Compounds Emitted from Emission Sources

Source	Contaminant
District CNG-fueled School Buses (17) District CNG-fueled Maintenance Vehicles (75) Public CNG-fueled buses and other vehicles (58 per day)	Acetaldehyde, Benzene, 1,3-Butadiene, Ethylbenzene, Formaldehyde, Propylene, Styrene, Toluene
7-11 Gas Dispensing	Benzene

The chemicals listed in Table 2 have established cancer potency factors (CPFs) and reference exposure levels (RELs) which can be used to evaluate carcinogenic risks and non-carcinogenic chronic and acute hazards. Appendix A presents the emission rate calculations for each source considered in the assessment.

2.2 RISK CHARACTERIZATION

Air quality modeling using the AERMOD atmospheric dispersion model was performed to assess the impact of emitted compounds on nearby sensitive receptors. The model is a steady state Gaussian plume model and is recommended by OEHHA and ICAPCD for estimating ground-level impacts from point and fugitive sources in simple and complex terrain. Meteorological data provided by the California Air Resources Board (CARB) for the Imperial County Airport meteorological station (2009-2013, -17.7m) were used to represent local weather conditions and prevailing winds. A unit emission rate of 1 gram per second (g/s) was used for all emission sources. The unit emission rates were proportioned throughout the area sources used to characterize

the vehicle running emissions throughout the fueling facility. The maximum AERMOD concentrations from the output files were then multiplied by the emission rates calculated in Appendix A to obtain the maximum ground-level concentrations at the maximum exposed receptor (MER). The AERMOD output is presented in Appendix B.

CARB's Hotspots Analysis and Reporting Program (HARP), Risk Assessment Standalone Tool was used to calculate the health risk values. CARB's HARP tool includes procedures for determining cancer risk and chronic and acute non-cancer hazard indices, using the latest HRA guidance recommended by OEHHA. The calculated health risk values are presented in Appendix C.

The State of California has established a threshold of one in one hundred thousand (1.0×10^{-5} or 10 in a million) as a level posing no significant risk for exposures to carcinogens regulated under the Safe Drinking Water and Toxic Enforcement Act (Proposition 65). The cancer risk is determined by multiplying the dose by the inhalation cancer potency factor. To calculate dose, discrete variates (breathing rate, age sensitivity factor, exposure duration, and averaging time) for residential and school-based receptors are obtained from OEHHA guidance documents.

The hazard index approach is used to quantify chronic and acute non-carcinogenic impacts. The hazard index assumes that chronic, 8-hour and acute sub-threshold exposures adversely affect a specific organ or organ system (toxicological endpoint). To calculate the hazard index, each chemical concentration or dose is divided by the appropriate toxicity value (i.e., REL). This ratio is summed for compounds affecting the same toxicological endpoint. A health hazard is presumed to exist where the total equals or exceeds one.

2.3 AIR TOXICS HEALTH RISK ASSESSMENT RESULTS

The health risk calculations are provided in Appendix C and the summary results of the HRA are provided in Table 3. The excess cancer risk was calculated to be 0.03 per million for students and 0.05 for adult staff at the high school. In comparison to the threshold level of 10 in a million, carcinogenic risks are well below the significance threshold value for students and staff at the project site. For chronic, acute 1-hour, and 8-hour non-carcinogenic effects, the hazard index identified for each toxicological endpoint totaled less than one for all receptors. Therefore, non-carcinogenic hazards are also below the significance threshold.

Table 3 Air Toxics Health Risk Assessment Results

	Cancer Risk - Student (per million)	Cancer Risk - Staff (per million)	Chronic Hazards	Acute (1-hour) Hazards	8-Hour Hazards
All Sources	0.03	0.05	0.005	0.068	0.005
ICAPCD Threshold	10	10	1.0	1.0	1.0
Exceeds Threshold?	No	No	No	No	No

Based on a comparison to the carcinogenic and non-carcinogenic thresholds established by OEHHA and ICAPCD, hazardous air emissions generated from sources within a quarter-mile radius are not anticipated to pose an actual or potential endangerment to students and staff occupying the project site and no mitigation measures are required.

2. Air Toxics Health Risks

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3. Safety Hazards

3.1 CNG EQUIPMENT LOCATION AND OPERATIONAL DATA

The District's MOT facility is a 24-hour publicly accessible CNG station that supports the District's CNG vehicle operations and provides CNG refueling for other existing natural gas users in the Calexico area and Imperial County. There is a fast-fill dispenser in the MOT parking lot adjacent to Andrade Avenue that is accessible with a card reader 24 hours a day, and there is a two-hose time fill dispenser within the MOT facility that serves the Calexico USD CNG buses. The two non-operational CNG compressors were replaced by two new CNG compressors in 2013 as part of a California Energy Commission (CEC) upgrade project. The CNG station makes CNG accessible to multiple fleets, including Calexico USD, El Centro Elementary School District, the City of Holtville, Imperial County Air Pollution Control District, and commercial fleets (Calexico Unified School District, 2020). The compressors units are approximately 1.14 cubic meters in volume and increase the natural gas pressure to a maximum of 3,600 pounds per square inch (psi).

The CNG facility is approximately 215 feet north of the nearest Calexico High School property line (near the athletic fields) and approximately 400 feet east from the high school's eastern property boundary. The nearest existing school building is the agricultural shed, which is 425 feet west of the CNG facility and the nearest new classroom building would be proposed Building 17, which is approximately 550 feet west. The CNG equipment, except for the public CNG dispenser, is within a 20-feet wide by 45-feet long area surrounded by 4-foot high concrete partitions with 4 high chain-link fencing to the north, west and south and 10-foot high chain-link fencing to the east.

The CNG facility was designed and constructed in accordance with 2019 National Fire Protection Association's (NFPA's) Code 52 – Vehicular Natural Gas Fuel Systems Code and all applicable State and local fire and building codes. NFPA 52 requires 1) all CNG compression and dispensing equipment to be located a minimum of 10 feet from a building, mobile home, public sidewalk, highway, street, or road; 2) overpressure protection devices to be installed in the fueling transfer system to prevent overpressure of the vehicles; 3) protection of piping and hoses; 4) installation of emergency shutdown equipment at various locations within the CNG equipment area and installation of breakaway protection at the fuel dispensers; and 5) installation of emergency shut-off valves on the inlet side of the compressors that shut off the gas supply in the event that an emergency shutdown device is activated or a power failure occurs.

3.2 CNG ACCIDENT SCENARIOS

Potential hazards associated with the use of CNG include:

- Flammability hazard – fire from ignition of gas leaks or piping rupture. Such accident scenarios can occur from the natural gas distribution pipeline, the CNG fuel dispensing systems, or fuel system damage. High pressure natural gas leaks can ignite from static electricity.
- Confined vapor explosion hazard – occurs with the accumulation of natural gas in enclosed spaces. Since all the fueling equipment and buses at the proposed facility will be located outdoors and in the open, the potential for confined vapor explosion hazards is negligible.
- High pressure hazard – could occur due to a compressor explosion, missile damage from failure or improper installation of fuel system components, or the failing of fuel hoses or fuel lines.

Hazards During Transport

The only "transport" issue associated with the proposed CNG fueling facility involves the connection of the natural gas pipeline to the fueling facility. The Southern California Gas Company did not identify a high-pressure natural gas pipeline within 1,500 feet of the school site (Padre, 2021). Low to medium pressure pipelines (<80 psig) are considered to have minimal impact in the event of an accident or third-party damage that results in a pipeline break at the connection to the compressor station. Previous analyses indicate that the hazard footprints for this accident scenario would not extend beyond 33 feet and would not impact any off-site receptors (PlaceWorks, 2013). In addition, since natural gas is lighter than air, it will rapidly disperse in an open environment. Therefore, the consequence of a pipeline rupture or leak in the incoming natural gas pipeline was not considered further in this evaluation.

Hazards During Operation

This process involves the compression of the natural gas to the desired pressure (approximately 3,600 psi) and transfer to the CNG dispensing system. The CNG equipment pad occupies a 20-foot by 45-foot area at the northeastern portion of the MOT facility. The code requirements for this area are provided in NFPA 52, *Compressed Natural Gas (CNG) Vehicular Fuel Systems*, which specifies electrical, piping, and vessel codes that apply to this equipment as well as the California Fire Code and applicable County ordinances. NFPA 52 specifies the location and level of electrically hazardous areas surrounding the equipment and defines the separation distances between CNG equipment and other buildings, railways, property lines, sources of ignition, and other equipment and obstructions. The minimum distance of CNG equipment from public streets, sidewalks, property lines, ignition sources, and buildings is 10 feet and the minimum distance is 50 feet from the nearest railroad track. The CNG facility is located approximately 215 feet north of the school's athletic fields and 400 feet east from the school's eastern property line. NFPA 52 also requires the area surrounding the equipment and dispenser to be electrically classified as Class 1, Division 2, Group D area (i.e., an area in which flammable gases or vapors may be present in the air in sufficient quantities to be explosive or ignitable). Therefore, the compressors have explosion-proof motors and there is a combustible gas detector at each compressor with automatic shutdown capability.

One potential safety hazard would be a physical explosion of one of the compressors. However, there has only been one reported incident in the United States of an explosion and fire involving a compressor at a CNG fueling facility. In February 2011, an explosion and subsequent fire occurred at the Pierce Transit CNG Bus Fueling Facility in Lakewood, Washington. It appears that the incident occurred within an enclosed maintenance facility and the exact cause of the accident has not yet been determined. However, no injuries were reported from this incident. Although the probability of an explosion occurring at this location is negligible, the explosion scenario was evaluated in the following section.

Another concern is that the rupture of the compressor may lead to missile damage from fragments. The rupture of a compressor usually involves ductile fracture, which does not produce missiles and involves a separation into two parts. The CNG equipment area is enclosed within 4-foot high concrete partitions and 4- to 10-foot high chain-link fencing. In the unlikely event that fragmentation occurred, the fragments would most likely remain within the enclosed area. In addition, the MOT facility maintenance and operations buildings are located south of the CNG refueling units, between the compressor units and the nearest school property line 215 feet to the south. Therefore, the generation of compressor fragments from an explosion was not subject to further evaluation.

The dispensing areas are probably the highest level of inherent risk at the CNG fueling facility. However, there are many safety devices to minimize the risks associated with this part of the fueling process, in accordance with NFPA 52 standards:

- Explosion-proof emergency manual shutdown devices (ESDs) are provided at various locations within the CNG equipment area and ESDs are provided at the fast-fill and slow-fill dispensers. When activated, the ESDs will shut off the power and gas supply to the equipment.
- Breakaway devices are provided at every dispensing point so that in the event of a pull-away, natural gas ceases to flow at the separation.
- The dispensers have a temperature compensation system that is electronically controlled to adjust the fill pressure to account for variations in ambient temperature as well as the heating effect in vehicle cylinders during the fueling process.
- The dispensers shut down automatically if preset flow rates or fill volumes are exceeded or if a sudden loss of pressure occurs. All dispensers are also equipped with breakaway hoses.

Previous analyses conducted by PlaceWorks for other CNG facilities indicate that a rupture of the line that feeds the fuel dispensers would result in a hazard footprint that only extends 39 feet from the rupture location (PlaceWorks, 2013). Therefore, there would be no impact to students or staff at the school site and further evaluation was not conducted.

Hazard During Storage

After fueling, the CNG buses are typically parked outside. No CNG buses will be stored inside buildings, which is necessary in certain climates. This eliminates the concern of a release of natural gas in an enclosed space, which can result in fire or an explosion in the presence of an ignition source. Outdoor parking does not present a significant safety concern, because releases of natural gas, which are lighter than air, will disperse into the

atmosphere. In addition, the CNG buses have been parked at the District MOT facility for several years with no incidents and the school modernization project would not exacerbate existing conditions, which is the threshold for significance by CDE. Nevertheless, potential accident scenarios and consequences involving the cylinders on the CNG buses parked in the open parking lot are discussed qualitatively in the following paragraphs.

A low release event would be a natural gas release from a CNG bus that results from a loose fitting, a valve stem, a crack in a gasket, or similar leak. This type of leak can be expected to dissipate quickly and not pose a significant hazard, either immediately or over an extended period. Because of the odorant in the natural gas, the presence of the leak most likely will be quickly detected and corrective measures can be implemented.

A large leak event would be characterized as a natural gas release from the catastrophic failure in the connection between the storage tank cylinders beneath the CNG bus or a complete discharge by a cylinder's pressure relief device (PRD). This would occur over a duration of only a few minutes. All CNG fuel tanks are protected by pressure relief valves that open and vent the tank's contents outside of the vehicle if tank pressures become dangerously high. This could occur if the compressor overfilled the tank or the tank was heated due to an external fire.

CNG cylinders undergo very stringent testing criteria, in accordance with ANSI/CSA NGV2, *Basic Requirements for Compressed Natural Gas Vehicle Fuel Containers*, and have been shown to be much safer than conventional gasoline or diesel fuel tanks in accidents. With the stringent testing of CNG cylinders and advances in the design of CNG buses, it is highly unlikely that any releases from a CNG cylinder on one of the school buses would occur at the MOT facility and in the unlikely event of an accident, the CNG would be released through the PRD and dissipate quickly into the atmosphere without adverse impacts. Therefore, this accident scenario was not evaluated in further detail.

3.3 CNG RISK ANALYSIS

The accident scenario warranting additional evaluation is catastrophic rupture of one of the compressor units and subsequent explosion. The results of the risk analysis are provided in Appendix D and summarized in Table 4.

Table 4 Distances of Hazard Footprints

Accident Scenario	Type of Hazard	Threshold	Exceed Threshold?	Exceeds Threshold?
Physical explosion of compressor	Blast overpressure	Outdoor 5.0 psi Indoor 1.0 psi	No - 1.79 psi at 215 feet (outdoor)	No – 0.74 psi at 450 feet (indoor)

For the failure of the compressor and subsequent physical explosion, it was determined that missile generation (i.e., shrapnel) would not result because of the nature of the compressor failure (ductile fracture), which does not generate missiles. The compressors are located in an area surrounded by 4-foot-high concrete partitions and 4- to 10-foot-high chain-link fencing. The blast overpressure that would result from compressor failure was estimated using the procedures provided in the AIChE's document *Guidelines for Chemical Process Quantitative Risk Analysis* (2000).

3. Safety Hazards Assessment

The results indicate that there could be a blast overpressure of 1.79 psi at the nearest property boundary (i.e., 215 feet from the center of the nearest compressor). The human body can survive relatively high blast overpressure without experiencing any trauma. A 5-psi blast overpressure will rupture eardrums in about 1 percent of subjects (Zipf and Cashdollar). Lung injury does not occur until a peak overpressure of 20 psi is reached. Therefore, there is a less than significant risk to outdoor receptors from a compressor explosion.

At 450 feet (i.e., the location to the nearest existing building – agricultural shed to the west), the blast overpressure is estimated to be 0.74 psi, which is below the 1.0 psi USEPA significance threshold for window breakage. For the closest proposed new classroom building (i.e., building 17), at 550 feet the blast overpressure is 0.58 psi which is also below the 1.0 psi USEPA significance threshold for window breakage.

In summary, operations at the District's MOT facility regarding CNG refueling would not adversely impact students and staff at Calexico High School from the postulated accident scenarios analyzed in this report nor would the proposed school modernization project exacerbate existing safety hazards.

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4. References

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4. References

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Appendix A. Emission Rate Calculations

Source 1a
Department of Maintenance, Operations and Transportation (MOT)
1085 Andrade Avenue, Calexico, CA 92231
District CNG School Buses

Temporal Profile: [1]	hours	days	weeks
	24	5	36
	0	0	0

Truck Activity:

CNG School Buses	17	
Ingress/Egress	24.1	mi
Idling Duration	15	min

Emissions: [2]

	Emission Factor		
HC	29.38	g/mi	Running Emission Rate
	47.64	g/hr	Idling Emission Rate

Speciation: [3]	Wt Fractions	Compound Emissions (g/s)
Acetaldehyde	3.61E-03	5.12E-04
Benzene	4.18E-04	5.93E-05
1,3-Butadiene	2.84E-05	4.04E-06
Ethylbenzene	5.69E-05	8.07E-06
Formaldehyde	1.01E-01	1.44E-02
Propylene	3.58E-03	5.08E-04
Styrene	2.56E-05	3.63E-06
Toluene	3.50E-04	4.96E-05
Total		**1.55E-02 g/s**

(1) 24-hour public access station. School buses operate assumed 180 school days per year (5 days per weeek, approximately 36 weeks per year).

(2) Emission factor from EMFAC2021 for CNG SBUS category, 2021, in Salton Sea Air Basin. For running emissions, assumed 5 mph speed on-site.

(3) CNG buses speciation from *Organic Gas Speciation Profiles for Buses Running on Compressed Natural Gas (CNG),* Wenli Yang, et.al., 2014, used in CARB's current organic gas speciation database. Total hydrocarbon (THC) Profile for CNG steady-state cruise cycle.

Source 1b
Department of Maintenance, Operations and Transportation (MOT)
1085 Andrade Avenue, Calexico, CA 92231
District CNG Maintenance Vehicles

Temporal Profile: [1]	hours	days	weeks
	24	7	52
	0	0	0

Truck Activity:

CNG Vehicles (light/medium duty)	75	
Ingress/Egress	24.1	mi
Idling Duration	15	min

Emissions: [2]

	Emission Factor		
HC	8.93	g/mi	Running Emission Rate
	47.62	g/hr	Idling Emission Rate

Speciation: [3]

	Wt Fractions	Compound Emissions (g/s)
Acetaldehyde	3.61E-03	7.13E-04
Benzene	4.18E-04	8.26E-05
1,3-Butadiene	2.84E-05	5.62E-06
Ethylbenzene	5.69E-05	1.12E-05
Formaldehyde	1.01E-01	2.00E-02
Propylene	3.58E-03	7.08E-04
Styrene	2.56E-05	5.05E-06
Toluene	3.50E-04	6.91E-05
Total		**2.16E-02 g/s**

(1) 24-hour public access station.

(2) Emission factor from EMFAC2021 for CNG NonTruck category, 2021, in Salton Sea Air Basin. For running emissions, assumed 5 mph speed on-site.

(3) CNG buses speciation from *Organic Gas Speciation Profiles for Buses Running on Compressed Natural Gas (CNG),* Wenli Yang, et.al., 2014, used in CARB's current organic gas speciation database. Total hydrocarbon (THC) Profile for CNG steady-state cruise cycle.

Source 1c
Department of Maintenance, Operations and Transportation (MOT)
1085 Andrade Avenue, Calexico, CA 92231
Public CNG Fleets

	hours	days	weeks
Temporal Profile: (1)	24	7	52
	0	0	0

Truck Activity:

CNG Buses/Trucks	58	
Ingress/Egress	7.1	mi
Idling Duration	15	min

Emissions: (2)

	Emission Factor		
HC	4.073	g/mi	Running Emission Rate
	45.96	g/hr	Idling Emission Rate

Speciation: (3)	Wt Fractions	Compound Emissions (g/s)
Acetaldehyde	3.61E-03	9.79E-05
Benzene	4.18E-04	1.13E-05
1,3-Butadiene	2.84E-05	7.71E-07
Ethylbenzene	5.69E-05	1.54E-06
Formaldehyde	1.01E-01	2.75E-03
Propylene	3.58E-03	9.72E-05
Styrene	2.56E-05	6.94E-07
Toluene	3.50E-04	9.49E-06
Total		**2.97E-03 g/s**

(1) 24-hour public access station.

(2) Emission factor from EMFAC2021 for CNG All Other Buses category, 2021, in Salton Sea Air Basin. For running emissions, assumed 5 mph speed on-site.

(3) CNG buses speciation from *Organic Gas Speciation Profiles for Buses Running on Compressed Natural Gas (CNG),* Wenli Yang, et.al., 2014, used in CARB's current organic gas speciation database. Total hydrocarbon (THC) Profile for CNG steady-state cruise cycle.

Source 2
7-11 Gas Station
1101 Andrade Avenue, Calexico, CA 92231
Gasoline Dispensing

	hours	days	weeks
Temporal Profile:	24	7	52
	0	0	0

Materials: (1)

Unleaded Gasoline	15,803	gal/mo

Emission Factor: (2)

Phase II Fueling Non-ORVR	0.42	lbs VOC/1,000 gal
Phase II Fueling ORVR	0.021	lbs VOC/1,000 gal
Phase I Bulk Transfer Losses	0.15	lbs VOC/1,000 gal
Pressure Driven Losses	0.024	lbs VOC/1,000 gal
Phase II Fueling - Spillage	0.24	lbs VOC/1,000 gal
Hose Permeation (2017)	0.009	lbs VOC/1,000 gal

Volume Source Emissions (3)

Refueling (4)	0.13	lbs VOC/1,000 gal
Refueling Emissions	2.90E-03	lbs/hr
	3.66E-04	**g/s**
Spillage (5)	0.24	lbs VOC/1,000 gal
Spillage Emissions	5.21E-03	lbs/hr
	6.56E-04	**g/s**

Point Source Emissions (6)

Transfer and Pressure Losses (7)	0.17	lbs VOC/1,000 gal
Transfer and Pressure Emissions	3.78E-03	lbs/hr
	4.76E-04	**g/s**

(1) Owner and air district did not provide at time of report preparation. Therefore, gasoline throughput amount based on recently evaluated Imperial County gas station (Brawley, La Paloma Middle School HRA by PlaceWorks, dated November 2016; SC Fuels Gas Station; 189,638 gallons dispensed in 2016; ICAPCD permit 2261).

(2) Emission factors is based upon CARB's Revised Emission Factors for Gasoline Marketing Operations at California Gasoline Dispensing Facilities (CARB, 2013). TAC speciation: 0.3% benzene for transfer, pressure losses and refueling emissions; 1% benzene for spillage California Air Pollution Control Officers Assocation (CAPCOA) Gasoline Service Station Industrywide Risk Assessment Guidelines (CAPCOA, 1998).

(3) Volume sources modeled as 4 m high, 13 m long and 13 m wide (CAPCOA, 1998).

(4) Refueling emission include fueling non-ORVR and ORVR vehicles (74% of vehicles; CARB, 2013) and hose permeation (2017 emission rate). Release height 1 m (CAPCOA, 1998).

(5) Release height 0 m for spillage (CAPCOA, 1998).

(6) Point sources modeled as vertical stack with release height 12 feet, diameter 2 inches, temperature 60F, and exit velocity 0.01 m/s (CAPCOA, 1998).

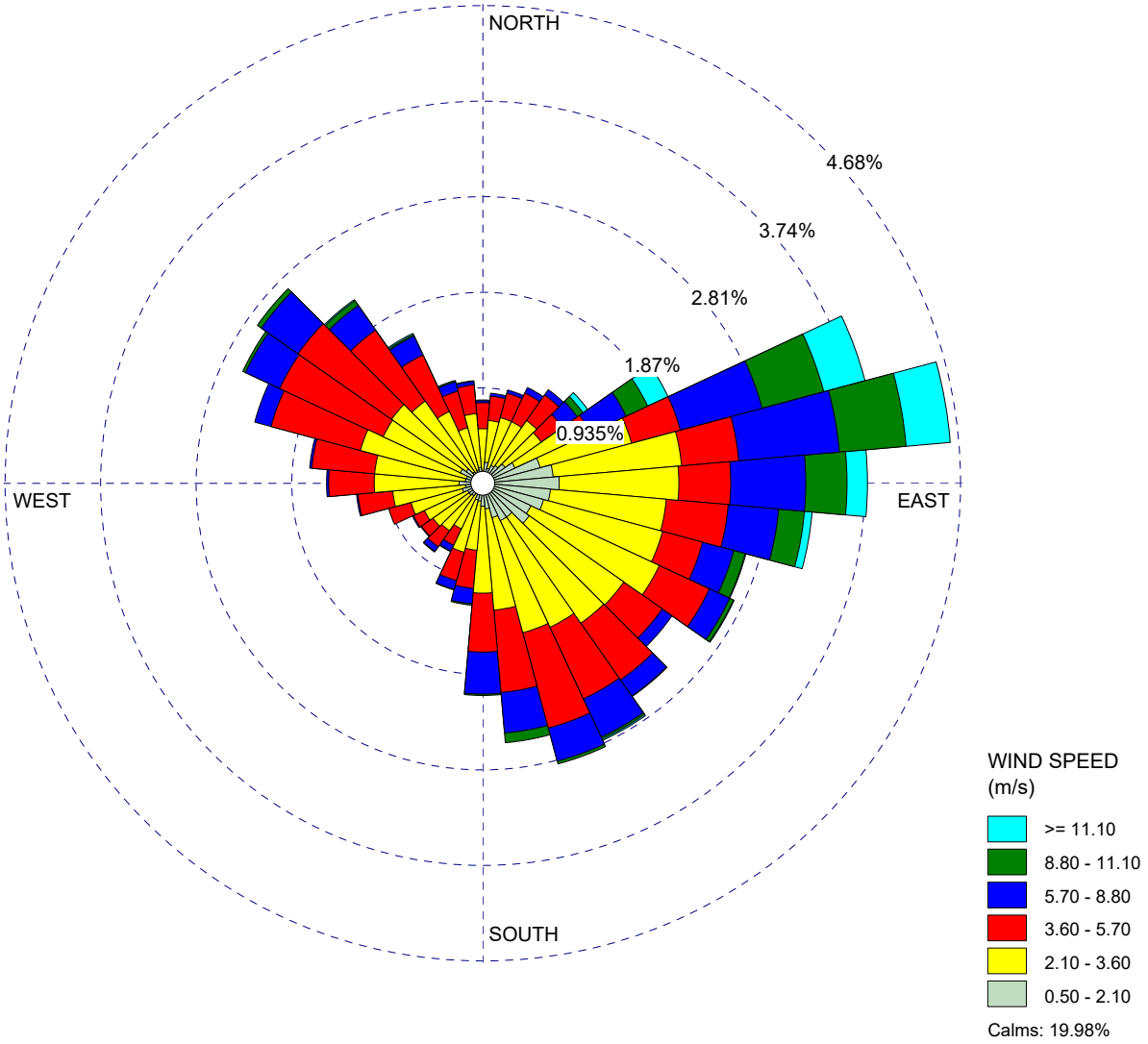
(7) Transfer and pressure driven loss emissions modeling as a single vent pipe (CAPCOA, 1998).

WIND ROSE PLOT:

Imperial County Airport (2009-2013)
Meteorological Station

DISPLAY:

Wind Speed
Flow Vector (blowing to)



COMMENTS: School Hours 8AM-4PM	DATA PERIOD: **Start Date: 1/1/2009 - 08:00** **End Date: 1/2/2014 - 15:00**	COMPANY NAME: **PlaceWorks**	
		MODELER: **SB**	
	CALM WINDS: **19.98%**	TOTAL COUNT: **12869 hrs.**	
	AVG. WIND SPEED: **3.15 m/s**	DATE: **6/11/2021**	PROJECT NO.: **CALX-03**

calendar_y	season_mo	sub_area	vehicle_class	fuel	temperatu	relative_hu	process	speed_tim	pollutant	emission_rate
2021	Annual	Imperial (SS)	T6 Public Class 4	NG	71	83	RUNEX	5	HC	3.747611
2021	Annual	Imperial (SS)	T7 Public Class 8	NG	71	83	RUNEX	5	HC	8.578682
2021	Annual	Imperial (SS)	T7 Tractor Class 8	NG	71	83	RUNEX	5	HC	8.975762
2021	Annual	Riverside (SS)	All Other Buses	NG	71	83	RUNEX	5	HC	4.072743
2021	Annual	Riverside (SS)	SBUS	NG	71	83	RUNEX	5	HC	29.38166
2021	Annual	Riverside (SS)	T6 Instate Tractor Class 6	NG	71	83	RUNEX	5	HC	4.095135
2021	Annual	Riverside (SS)	T6 Public Class 4	NG	71	83	RUNEX	5	HC	4.028439
2021	Annual	Riverside (SS)	T6 Utility Class 5	NG	71	83	RUNEX	5	HC	3.968488
2021	Annual	Riverside (SS)	T7 CAIRP Class 8	NG	71	83	RUNEX	5	HC	8.873492
2021	Annual	Riverside (SS)	T7 Public Class 8	NG	71	83	RUNEX	5	HC	8.140665
2021	Annual	Riverside (SS)	T7 Tractor Class 8	NG	71	83	RUNEX	5	HC	8.982308
2021	Annual	Riverside (SS)	UBUS	NG	71	83	RUNEX	5	HC	5.591788

calendar_y	season_mo	sub_area	vehicle_class	fuel	temperatu	relative_hu	process	speed_tim	pollutant	emission_rate
2021	Annual	Imperial (SS)	T6 Public Class 4	NG			IDLEX		HC	35.3636
2021	Annual	Imperial (SS)	T7 Public Class 8	NG			IDLEX		HC	40.30275
2021	Annual	Imperial (SS)	T7 Tractor Class 8	NG			IDLEX		HC	41.87709
2021	Annual	Riverside (SS)	All Other Buses	NG			IDLEX		HC	45.96283
2021	Annual	Riverside (SS)	SBUS	NG			IDLEX		HC	47.64117
2021	Annual	Riverside (SS)	T6 CAIRP Class 7	NG			IDLEX		HC	42.53753
2021	Annual	Riverside (SS)	T6 Public Class 4	NG			IDLEX		HC	45.38764
2021	Annual	Riverside (SS)	T6 Utility Class 5	NG			IDLEX		HC	43.56846
2021	Annual	Riverside (SS)	T7 CAIRP Class 8	NG			IDLEX		HC	41.22996
2021	Annual	Riverside (SS)	T7 Public Class 8	NG			IDLEX		HC	38.25173
2021	Annual	Riverside (SS)	T7 Tractor Class 8	NG			IDLEX		HC	41.88873

calendar_y	season_mo	sub_area	vehicle_class	fuel	temperatu	relative_hu	process	speed_tim	pollutant	emission_rate
2021	Annual	Riverside (SS)	NonTruck	NG	71	83	RUNEX	5	HC	8.932535
2021	Annual	Riverside (SS)	NonTruck	NG			IDLEX		HC	47.62413

Appendix B. Air Dispersion Model Output

Control Pathway

Dispersion Options

Titles

Calexico HS HRA
Calexico, CA

Dispersion Options

☑ Regulatory Default ☐ Non-Default Options

Dispersion Coefficient

Rural

Output Type

☑ Concentration
☐ Total Deposition (Dry & Wet)
☐ Dry Deposition
☐ Wet Deposition

Plume Depletion

☐ Dry Removal
☐ Wet Removal

Output Warnings

☐ No Output Warnings
☐ Non-fatal Warnings for Non-sequential Met Data

Pollutant / Averaging Time / Terrain Options

Pollutant Type

Averaging Time Options

Hours: ☑ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 6 ☐ 8 ☐ 12 ☐ 24

☐ Month ☑ Period ☐ Annual

Exponential Decay

Option not available

Terrain Height Options

☐ Flat ☑ Elevated

SO: Meters
RE: Meters
TG: Meters

Flagpole Receptors

☐ Yes ☑ No

Default Height = 0.00 m

Control Pathway

Optional Files

Re-Start File	Init File	Multi-Year Analyses	Event Input File	Error Listing File
☐	☐	☐	☐	■

Detailed Error Listing File

Filename: CALX03.err

Source Pathway - Source Inputs

Point Sources

Source Type	Source ID	X Coordinate [m]	Y Coordinate [m]	Base Elevation (Optional)	Release Height [m]	Emission Rate [g/s]	Gas Exit Temp. [K]	Gas Exit Velocity [m/s]	Stack Inside Diameter [m]
POINT	2C	642245.27	3616782.05	2.21	3.66	1.00000	288.71	0.01	0.05
		venting							

Volume Sources

Source Type	Source ID	X Coordinate [m]	Y Coordinate [m]	Base Elevation (Optional)	Release Height [m]	Emission Rate [g/s]	Length of Side [m]	Building Height [m]	Initial Lateral Dim. [m]	Initial Vertical Dim. [m]
VOLUME	2A	642229.00	3616799.31	2.19	1.00	1.00000	13.00	Surface-Based	3.02	0.93
		refueling								
VOLUME	2B	642229.00	3616799.31	2.19	0.00	1.00000	13.00	Surface-Based	3.02	1.86
		spillage								

Area Sources

Source Type	Source ID	X Coordinate [m]	Y Coordinate [m]	Base Elevation (Optional)	Release Height [m]	Emission Rate [g/ (s-m^2)]	Length of X Side [m]	Length of Y Side [m]	Orientation Angle from North [deg]	Initial Vertical Dim. [m]
AREA	AREA1	642132.10	3616666.11	2.21	0.60	0.00019	124.27	43.01	-1.59	
		1ab district buses/vehicles								
AREA	AREA2	642256.08	3616668.90	2.21	0.60	0.00073	43.39	31.53	-91.30	
		1c public								

Source Pathway

Building Downwash Information

Option not in use

Emission Rate Units for Output

For Concentration

Unit Factor:	1E6
Emission Unit Label:	GRAMS/SEC
Concentration Unit Label:	MICROGRAMS/M**3

Source Groups

Source Group ID:	List of Sources in Group (Source Range or Single Sources)
2C	2C
2B	2B
2A	2A
1c	AREA2
1a_b	AREA1

Variable Emissions

Hour-of-Day / Day-of-Week Emission Rate Variation

Scenario: schoolhours

Source ID:	**AREA1**							
Weekdays								
	Hour	1 - 6	0.00	0.00	0.00	0.00	0.00	0.00
	of	7 - 12	0.00	0.00	1.00	1.00	1.00	1.00
	Day	13 - 18	1.00	1.00	1.00	1.00	0.00	0.00
		19 - 24	0.00	0.00	0.00	0.00	0.00	0.00
Saturday								
	Hour	1 - 6	0.00	0.00	0.00	0.00	0.00	0.00
	of	7 - 12	0.00	0.00	0.00	0.00	0.00	0.00
	Day	13 - 18	0.00	0.00	0.00	0.00	0.00	0.00
		19 - 24	0.00	0.00	0.00	0.00	0.00	0.00
Sunday								
	Hour	1 - 6	0.00	0.00	0.00	0.00	0.00	0.00
	of	7 - 12	0.00	0.00	0.00	0.00	0.00	0.00
	Day	13 - 18	0.00	0.00	0.00	0.00	0.00	0.00
		19 - 24	0.00	0.00	0.00	0.00	0.00	0.00
Source ID:	**2A**							
Weekdays								
	Hour	1 - 6	0.00	0.00	0.00	0.00	0.00	0.00
	of	7 - 12	0.00	0.00	1.00	1.00	1.00	1.00
	Day	13 - 18	1.00	1.00	1.00	1.00	0.00	0.00
		19 - 24	0.00	0.00	0.00	0.00	0.00	0.00
Saturday								
	Hour	1 - 6	0.00	0.00	0.00	0.00	0.00	0.00
	of	7 - 12	0.00	0.00	0.00	0.00	0.00	0.00
	Day	13 - 18	0.00	0.00	0.00	0.00	0.00	0.00
		19 - 24	0.00	0.00	0.00	0.00	0.00	0.00
Sunday								
	Hour	1 - 6	0.00	0.00	0.00	0.00	0.00	0.00
	of	7 - 12	0.00	0.00	0.00	0.00	0.00	0.00
	Day	13 - 18	0.00	0.00	0.00	0.00	0.00	0.00
		19 - 24	0.00	0.00	0.00	0.00	0.00	0.00
Source ID:	**2B**							
Weekdays								
	Hour	1 - 6	0.00	0.00	0.00	0.00	0.00	0.00
	of	7 - 12	0.00	0.00	1.00	1.00	1.00	1.00
	Day	13 - 18	1.00	1.00	1.00	1.00	0.00	0.00
		19 - 24	0.00	0.00	0.00	0.00	0.00	0.00
Saturday								
	Hour	1 - 6	0.00	0.00	0.00	0.00	0.00	0.00
	of	7 - 12	0.00	0.00	0.00	0.00	0.00	0.00
	Day	13 - 18	0.00	0.00	0.00	0.00	0.00	0.00
		19 - 24	0.00	0.00	0.00	0.00	0.00	0.00
Sunday								
	Hour	1 - 6	0.00	0.00	0.00	0.00	0.00	0.00
	of	7 - 12	0.00	0.00	0.00	0.00	0.00	0.00
	Day	13 - 18	0.00	0.00	0.00	0.00	0.00	0.00
		19 - 24	0.00	0.00	0.00	0.00	0.00	0.00
Source ID:	**AREA2**							
Weekdays								
	Hour	1 - 6	0.00	0.00	0.00	0.00	0.00	0.00
	of	7 - 12	0.00	0.00	1.00	1.00	1.00	1.00
	Day	13 - 18	1.00	1.00	1.00	1.00	0.00	0.00

Source Pathway

Scenario: schoolhours

Source ID:		**AREA2**						
		19 - 24	0.00	0.00	0.00	0.00	0.00	0.00
Saturday								
	Hour	1 - 6	0.00	0.00	0.00	0.00	0.00	0.00
	of	7 - 12	0.00	0.00	0.00	0.00	0.00	0.00
	Day	13 - 18	0.00	0.00	0.00	0.00	0.00	0.00
		19 - 24	0.00	0.00	0.00	0.00	0.00	0.00
Sunday								
	Hour	1 - 6	0.00	0.00	0.00	0.00	0.00	0.00
	of	7 - 12	0.00	0.00	0.00	0.00	0.00	0.00
	Day	13 - 18	0.00	0.00	0.00	0.00	0.00	0.00
		19 - 24	0.00	0.00	0.00	0.00	0.00	0.00
Source ID:		**2C**						
Weekdays								
	Hour	1 - 6	0.00	0.00	0.00	0.00	0.00	0.00
	of	7 - 12	0.00	0.00	1.00	1.00	1.00	1.00
	Day	13 - 18	1.00	1.00	1.00	1.00	0.00	0.00
		19 - 24	0.00	0.00	0.00	0.00	0.00	0.00
Saturday								
	Hour	1 - 6	0.00	0.00	0.00	0.00	0.00	0.00
	of	7 - 12	0.00	0.00	0.00	0.00	0.00	0.00
	Day	13 - 18	0.00	0.00	0.00	0.00	0.00	0.00
		19 - 24	0.00	0.00	0.00	0.00	0.00	0.00
Sunday								
	Hour	1 - 6	0.00	0.00	0.00	0.00	0.00	0.00
	of	7 - 12	0.00	0.00	0.00	0.00	0.00	0.00
	Day	13 - 18	0.00	0.00	0.00	0.00	0.00	0.00
		19 - 24	0.00	0.00	0.00	0.00	0.00	0.00

Meteorology Pathway

Met Input Data

Surface Met Data

Filename: ..\met\747185\747185.SFC

Format Type: Default AERMET format

Profile Met Data

Filename: ..\met\747185\747185.PFL

Format Type: Default AERMET format

Wind Speed

☐ Wind Speeds are Vector Mean (Not Scalar Means)

Wind Direction

Rotation Adjustment [deg]:

Potential Temperature Profile

Base Elevation above MSL (for Primary Met Tower): -17.70 [m]

Meteorological Station Data

Stations	Station No.	Year	X Coordinate [m]	Y Coordinate [m]	Station Name
Surface		2009			
Upper Air		2009			

Data Period

Data Period to Process

Start Date: 1/1/2009 Start Hour: 1 End Date: 1/2/2014 End Hour: 24

Wind Speed Categories

Stability Category	Wind Speed [m/s]	Stability Category	Wind Speed [m/s]
A	1.54	D	8.23
B	3.09	E	10.8
C	5.14	F	No Upper Bound

Results Summary

Calexico HS HRA
Calexico, CA

Concentration - Source Group: 1A_B

Averaging Period	Rank	Peak	Units	X (m)	Y (m)	ZELEV (m)	ZFLAG (m)	ZHILL (m)	Peak Date, Start Hour
1-HR	1ST	935.24931	ug/m^3	642094.72	3616685.44	2.21	0.00	2.21	12/21/2009, 16
PERIOD		10.83483	ug/m^3	642094.72	3616710.44	2.21	0.00	2.21	

Concentration - Source Group: 1C

Averaging Period	Rank	Peak	Units	X (m)	Y (m)	ZELEV (m)	ZFLAG (m)	ZHILL (m)	Peak Date, Start Hour
1-HR	1ST	655.31096	ug/m^3	642224.60	3616608.55	2.21	0.00	2.21	1/24/2013, 10
PERIOD		10.30585	ug/m^3	642249.60	3616608.55	2.21	0.00	2.21	

Concentration - Source Group: 2A

Averaging Period	Rank	Peak	Units	X (m)	Y (m)	ZELEV (m)	ZFLAG (m)	ZHILL (m)	Peak Date, Start Hour
1-HR	1ST	260.67006	ug/m^3	642094.72	3616710.44	2.21	0.00	2.21	12/10/2009, 16
PERIOD		1.45968	ug/m^3	642249.60	3616608.55	2.21	0.00	2.21	

Results Summary

Calexico HS HRA
Calexico, CA

Concentration - Source Group: 2B

Averaging Period	Rank	Peak	Units	X (m)	Y (m)	ZELEV (m)	ZFLAG (m)	ZHILL (m)	Peak Date, Start Hour
1-HR	1ST	289.09838	ug/m^3	642094.72	3616710.44	2.21	0.00	2.21	12/10/2009, 16
PERIOD		1.45098	ug/m^3	642249.60	3616608.55	2.21	0.00	2.21	

Concentration - Source Group: 2C

Averaging Period	Rank	Peak	Units	X (m)	Y (m)	ZELEV (m)	ZFLAG (m)	ZHILL (m)	Peak Date, Start Hour
1-HR	1ST	225.37008	ug/m^3	642094.72	3616710.44	2.21	0.00	2.21	12/10/2009, 16
PERIOD		1.71123	ug/m^3	642249.60	3616608.55	2.21	0.00	2.21	

Appendix C. Risk Calculations

Table C1
MER Concentration Worksheet
Toxic Air Contaminants
For HARP2 Input

Source No.	Source	Contaminant	Weight Fraction	Emission Rates[1] **Annual Avg** (g/s)	AERMOD Output[2] **Annual Avg** ($\mu g/m^3$)	Annual Average MER Concentration ($\mu g/m^3$)	AERMOD Output[2] **1-Hour** ($\mu g/m^3$)	Acute (1-Hour) MER Concentration ($\mu g/m^3$)
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
Calexico High School MER								
1a	District Buses	Acetaldehyde	3.61E-03	1.55E-02	10.835	6.08E-04	935.249	5.25E-02
		Benzene	4.18E-04			7.04E-05		6.08E-03
		1,3-Butadiene	2.84E-05			4.79E-06		4.13E-04
		Ethylbenzene	5.69E-05			9.58E-06		8.27E-04
		Formaldehyde	1.01E-01			1.71E-02		1.48E+00
		Propylene	3.58E-03			6.03E-04		5.21E-02
		Styrene	2.56E-05			4.31E-06		3.72E-04
		Toluene	3.50E-04			5.89E-05		5.08E-03
1b	District Vehicles	Acetaldehyde	3.61E-03	2.16E-02	10.835	8.47E-04	935.249	7.31E-02
		Benzene	4.18E-04			9.80E-05		8.46E-03
		1,3-Butadiene	2.84E-05			6.67E-06		5.76E-04
		Ethylbenzene	5.69E-05			1.33E-05		1.15E-03
		Formaldehyde	1.01E-01			2.38E-02		2.05E+00
		Propylene	3.58E-03			8.40E-04		7.25E-02
		Styrene	2.56E-05			6.00E-06		5.18E-04
		Toluene	3.50E-04			8.20E-05		7.08E-03
1c	Public Vehicles	Acetaldehyde	3.61E-03	2.97E-03	10.306	1.11E-04	655.311	7.03E-03
		Benzene	4.18E-04			1.28E-05		8.14E-04
		1,3-Butadiene	2.84E-05			8.71E-07		5.54E-05
		Ethylbenzene	5.69E-05			1.74E-06		1.11E-04
		Formaldehyde	1.01E-01			3.11E-03		1.98E-01
		Propylene	3.58E-03			1.10E-04		6.98E-03
		Styrene	2.56E-05			7.84E-07		4.98E-05
		Toluene	3.50E-04			1.07E-05		6.81E-04
2	7-11 refueling	Benzene	3.00E-03	3.66E-04	1.46	1.60E-06	260.7	2.86E-04
	Gasoline spillage	Benzene	1.00E-02	6.56E-04	1.45	9.52E-06	289.1	1.90E-03
	Gasoline venting	Benzene	3.00E-03	4.76E-04	1.71	2.44E-06	225.4	3.22E-04
Note: Maximum Exposed Receptor (MER)						For Cancer/Chronic Calculation		For Acute Calculation

[1] Emission Rates, per source, from Source Emissions Inventories (Appendix A).

[2] AERMOD Output (Appendix B) at the maximum exposed receptor (MER) are based on unit emission rates for emission sources (1 g/s per source).

*HARP - HRACalc v21081 6/23/2021 7:44:22 AM - Cancer Risk - Input File: C:\!HarpOutput\CALX\HS

INDEX	GRP1	GRP2	POLID	POLABBRE	CONC	RISK_SUM	SCENARIO	DETAILS
1			75070	Acetaldehy	0.000608	2.11E-10	4YrCancerl	*
2			71432	Benzene	7.04E-05	2.44E-10	4YrCancerl	*
3			106990	1,3-Butadi	4.79E-06	9.96E-11	4YrCancerl	*
4			100414	Ethyl Benz	9.58E-06	2.89E-12	4YrCancerl	*
5			50000	Formaldeh	0.017098	1.24E-08	4YrCancerl	*
6			115071	Propylene	0.000603	0.00E+00	4YrCancerl	*
7			100425	Styrene	4.31E-06	0.00E+00	4YrCancerl	*
8			108883	Toluene	5.89E-05	0.00E+00	4YrCancerl	*
9			75070	Acetaldehy	0.000847	2.93E-10	4YrCancerl	*
10			71432	Benzene	9.80E-05	3.40E-10	4YrCancerl	*
11			106990	1,3-Butadi	6.67E-06	1.39E-10	4YrCancerl	*
12			100414	Ethyl Benz	1.33E-05	4.02E-12	4YrCancerl	*
13			50000	Formaldeh	0.023798	1.73E-08	4YrCancerl	*
14			115071	Propylene	0.00084	0.00E+00	4YrCancerl	*
15			100425	Styrene	6.00E-06	0.00E+00	4YrCancerl	*
16			108883	Toluene	8.20E-05	0.00E+00	4YrCancerl	*
17			75070	Acetaldehy	0.000111	3.83E-11	4YrCancerl	*
18			71432	Benzene	1.28E-05	4.44E-11	4YrCancerl	*
19			106990	1,3-Butadi	8.71E-07	1.81E-11	4YrCancerl	*
20			100414	Ethyl Benz	1.74E-06	5.25E-13	4YrCancerl	*
21			50000	Formaldeh	0.003108	2.26E-09	4YrCancerl	*
22			115071	Propylene	0.00011	0.00E+00	4YrCancerl	*
23			100425	Styrene	7.84E-07	0.00E+00	4YrCancerl	*
24			108883	Toluene	1.07E-05	0.00E+00	4YrCancerl	*
25			71432	Benzene	1.60E-06	5.55E-12	4YrCancerl	*
26			71432	Benzene	9.52E-06	3.30E-11	4YrCancerl	*
27			71432	Benzene	2.44E-06	8.47E-12	4YrCancerl	*
				TOTAL		3.35E-08		

*HARP - HRACalc v21081 6/23/2021 7:38:59 AM - Cancer Risk - Input File: C:\!HarpOutput\CALX\Sta

INDEX	GRP1	GRP2	POLID	POLABBRE	CONC	RISK_SUM	SCENARIO	DETAILS
1			75070	Acetaldehy	0.000608	3.42E-10	25YrCance	*
2			71432	Benzene	7.04E-05	3.96E-10	25YrCance	*
3			106990	1,3-Butadi	4.79E-06	1.62E-10	25YrCance	*
4			100414	Ethyl Benz	9.58E-06	4.69E-12	25YrCance	*
5			50000	Formaldeh	0.017098	2.02E-08	25YrCance	*
6			115071	Propylene	0.000603	0.00E+00	25YrCance	*
7			100425	Styrene	4.31E-06	0.00E+00	25YrCance	*
8			108883	Toluene	5.89E-05	0.00E+00	25YrCance	*
9			75070	Acetaldehy	0.000847	4.76E-10	25YrCance	*
10			71432	Benzene	9.80E-05	5.51E-10	25YrCance	*
11			106990	1,3-Butadi	6.67E-06	2.25E-10	25YrCance	*
12			100414	Ethyl Benz	1.33E-05	6.53E-12	25YrCance	*
13			50000	Formaldeh	0.023798	2.81E-08	25YrCance	*
14			115071	Propylene	0.00084	0.00E+00	25YrCance	*
15			100425	Styrene	6.00E-06	0.00E+00	25YrCance	*
16			108883	Toluene	8.20E-05	0.00E+00	25YrCance	*
17			75070	Acetaldehy	0.000111	6.22E-11	25YrCance	*
18			71432	Benzene	1.28E-05	7.20E-11	25YrCance	*
19			106990	1,3-Butadi	8.71E-07	2.94E-11	25YrCance	*
20			100414	Ethyl Benz	1.74E-06	8.52E-13	25YrCance	*
21			50000	Formaldeh	0.003108	3.67E-09	25YrCance	*
22			115071	Propylene	0.00011	0.00E+00	25YrCance	*
23			100425	Styrene	7.84E-07	0.00E+00	25YrCance	*
24			108883	Toluene	1.07E-05	0.00E+00	25YrCance	*
25			71432	Benzene	1.60E-06	9.01E-12	25YrCance	*
26			71432	Benzene	9.52E-06	5.36E-11	25YrCance	*
27			71432	Benzene	2.44E-06	1.37E-11	25YrCance	*
				TOTAL		5.44E-08		

*HARP - HRACalc v21081 6/23/2021 7:38:59 AM - Chronic Risk - Input File: C:\!HarpOutput\CALX\StaffHRAInput.hra

INDEX	POLID	POLABBRE	CONC	SCENARIO	CV	CNS	IMMUN	KIDNEY	GILV	REPRO/DE	RESP	SKIN	EYE	BONE/TEE	ENDO	BLOOD
1	75070	Acetaldeh	0.000608	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.34E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	71432	Benzene	7.04E-05	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.35E-05
3	106990	1,3-Butadi	4.79E-06	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.40E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4	100414	Ethyl Benz	9.58E-06	NonCancer	0.00E+00	0.00E+00	0.00E+00	4.79E-09	4.79E-09	4.79E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.79E-09	0.00E+00
5	50000	Formaldeh	0.017098	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.90E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
6	115071	Propylene	0.000603	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.01E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7	100425	Styrene	4.31E-06	NonCancer	0.00E+00	4.79E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
8	108883	Toluene	5.89E-05	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.40E-07	0.00E+00	0.00E+00	0.00E+00
9	75070	Acetaldeh	0.000847	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.05E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10	71432	Benzene	9.80E-05	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.27E-05
11	106990	1,3-Butadi	6.67E-06	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.33E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
12	100414	Ethyl Benz	1.33E-05	NonCancer	0.00E+00	0.00E+00	0.00E+00	6.67E-09	6.67E-09	6.67E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.67E-09	0.00E+00
13	50000	Formaldeh	0.023798	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.64E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
14	115071	Propylene	0.00084	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.80E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
15	100425	Styrene	6.00E-06	NonCancer	0.00E+00	6.67E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
16	108883	Toluene	8.20E-05	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.95E-07	0.00E+00	0.00E+00	0.00E+00
17	75070	Acetaldeh	0.000111	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.90E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
18	71432	Benzene	1.28E-05	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.27E-06
19	106990	1,3-Butadi	8.71E-07	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.35E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
20	100414	Ethyl Benz	1.74E-06	NonCancer	0.00E+00	0.00E+00	0.00E+00	8.71E-10	8.71E-10	8.71E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.71E-10	0.00E+00
21	50000	Formaldeh	0.003108	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.45E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
22	115071	Propylene	0.00011	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.66E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
23	100425	Styrene	7.84E-07	NonCancer	0.00E+00	8.71E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
24	108883	Toluene	1.07E-05	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.55E-08	0.00E+00	0.00E+00	0.00E+00
25	71432	Benzene	1.60E-06	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.34E-07
26	71432	Benzene	9.52E-06	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.17E-06
27	71432	Benzene	2.44E-06	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.14E-07
		TOTAL			0.00E+00	1.23E-08	0.00E+00	1.23E-08	1.23E-08	6.18E-06	4.90E-03	0.00E+00	3.61E-07	0.00E+00	1.23E-08	6.49E-05
		MAX			4.90E-03											

*HARP - HRACalc v21081 6/23/2021 7:38:59 AM - Acute Risk - Input File: C:\!HarpOutput\CALX\StaffHRAInput.hra

INDEX	POLID	POLABBRE	CONC	SCENARIO	CV	CNS	IMMUN	KIDNEY	GILV	REPRO/DE	RESP	SKIN	EYE	BONE/TEE	ENDO	BLOOD
1	75070	Acetaldeh	0.052501	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.12E-04	0.00E+00	1.12E-04	0.00E+00	0.00E+00	0.00E+00
2	71432	Benzene	0.006077	NonCancer	0.00E+00	0.00E+00	2.25E-04	0.00E+00	0.00E+00	2.25E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.25E-04
3	106990	1,3-Butadi	0.000413	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.26E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4	100414	Ethyl Benz	0.000827	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	50000	Formaldeh	1.475836	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.68E-02	0.00E+00	0.00E+00	0.00E+00
6	115071	Propylene	0.052089	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7	100425	Styrene	0.000372	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.77E-08	1.77E-08	0.00E+00	1.77E-08	0.00E+00	0.00E+00	0.00E+00
8	108883	Toluene	0.005085	NonCancer	0.00E+00	1.02E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.02E-06	0.00E+00	1.02E-06	0.00E+00	0.00E+00	0.00E+00
9	75070	Acetaldeh	0.073077	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.55E-04	0.00E+00	1.55E-04	0.00E+00	0.00E+00	0.00E+00
10	71432	Benzene	0.008459	NonCancer	0.00E+00	0.00E+00	3.13E-04	0.00E+00	0.00E+00	3.13E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.13E-04
11	106990	1,3-Butadi	0.000576	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.72E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
12	100414	Ethyl Benz	0.001151	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
13	50000	Formaldeh	2.054246	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.74E-02	0.00E+00	0.00E+00	0.00E+00
14	115071	Propylene	0.072504	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
15	100425	Styrene	0.000518	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.47E-08	2.47E-08	0.00E+00	2.47E-08	0.00E+00	0.00E+00	0.00E+00
16	108883	Toluene	0.007078	NonCancer	0.00E+00	1.42E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.42E-06	0.00E+00	1.42E-06	0.00E+00	0.00E+00	0.00E+00
17	75070	Acetaldeh	0.007031	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.50E-05	0.00E+00	1.50E-05	0.00E+00	0.00E+00	0.00E+00
18	71432	Benzene	0.000814	NonCancer	0.00E+00	0.00E+00	3.01E-05	0.00E+00	0.00E+00	3.01E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.01E-05
19	106990	1,3-Butadi	5.54E-05	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.39E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
20	100414	Ethyl Benz	0.000111	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
21	50000	Formaldeh	0.197657	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.59E-03	0.00E+00	0.00E+00	0.00E+00
22	115071	Propylene	0.006976	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
23	100425	Styrene	4.98E-05	NonCancer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.37E-09	2.37E-09	0.00E+00	2.37E-09	0.00E+00	0.00E+00	0.00E+00
24	108883	Toluene	0.000681	NonCancer	0.00E+00	1.36E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.36E-07	0.00E+00	1.36E-07	0.00E+00	0.00E+00	0.00E+00
25	71432	Benzene	0.000286	NonCancer	0.00E+00	0.00E+00	1.06E-05	0.00E+00	0.00E+00	1.06E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.06E-05
26	71432	Benzene	0.001898	NonCancer	0.00E+00	0.00E+00	7.03E-05	0.00E+00	0.00E+00	7.03E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.03E-05
27	71432	Benzene	0.000322	NonCancer	0.00E+00	0.00E+00	1.19E-05	0.00E+00	0.00E+00	1.19E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.19E-05
		TOTAL			0.00E+00	2.57E-06	6.61E-04	0.00E+00	0.00E+00	6.63E-04	2.85E-04	0.00E+00	6.81E-02	0.00E+00	0.00E+00	6.61E-04
		MAX			6.81E-02											

*HARP - HRACalc v21081 6/23/2021 7:40:24 AM - 8-Hour Chronic Risk - Input File: C:\!HarpOutput\CALX\StaffHRAInput.hra

INDEX	POLID	POLABBRE	CONC	SCENARIO	CV	CNS	IMMUN	KIDNEY	GILV	REPRO/DE	RESP	SKIN	EYE	BONE/TEE	ENDO	BLOOD
1	75070	Acetaldeh	0.000608	NonCance	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.03E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	71432	Benzene	7.04E-05	NonCance	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.35E-05
3	106990	1,3-Butadi	4.79E-06	NonCance	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.32E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4	100414	Ethyl Benz	9.58E-06	NonCance	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5	50000	Formaldeh	0.017098	NonCance	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.90E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
6	115071	Propylene	0.000603	NonCance	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7	100425	Styrene	4.31E-06	NonCance	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
8	108883	Toluene	5.89E-05	NonCance	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.10E-08	0.00E+00	0.00E+00	0.00E+00
9	75070	Acetaldeh	0.000847	NonCance	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.82E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
10	71432	Benzene	9.80E-05	NonCance	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.27E-05
11	106990	1,3-Butadi	6.67E-06	NonCance	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.41E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
12	100414	Ethyl Benz	1.33E-05	NonCance	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
13	50000	Formaldeh	0.023798	NonCance	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.64E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
14	115071	Propylene	0.00084	NonCance	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
15	100425	Styrene	6.00E-06	NonCance	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
16	108883	Toluene	8.20E-05	NonCance	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.88E-08	0.00E+00	0.00E+00	0.00E+00
17	75070	Acetaldeh	0.000111	NonCance	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.69E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
18	71432	Benzene	1.28E-05	NonCance	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.27E-06
19	106990	1,3-Butadi	8.71E-07	NonCance	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.68E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
20	100414	Ethyl Benz	1.74E-06	NonCance	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
21	50000	Formaldeh	0.003108	NonCance	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.45E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
22	115071	Propylene	0.00011	NonCance	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
23	100425	Styrene	7.84E-07	NonCance	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
24	108883	Toluene	1.07E-05	NonCance	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.29E-08	0.00E+00	0.00E+00	0.00E+00
25	71432	Benzene	1.60E-06	NonCance	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.34E-07
26	71432	Benzene	9.52E-06	NonCance	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.17E-06
27	71432	Benzene	2.44E-06	NonCance	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.14E-07
		TOTAL			0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.37E-06	4.89E-03	0.00E+00	1.83E-07	0.00E+00	0.00E+00	6.49E-05
		MAX			4.89E-03											

Appendix D. CNG Calculations

Blast Overpressure from a Ruptured Vessel

Input Data:

Vessel burst pressure:	248.22	bar abs	3600	psi	Distance to property line (outdoor scenario)
Distance from vessel center:	65.532	m	215	ft	
Vessel volume:	1.14	m**3	40.2	ft3	
Final pressure:	1.01325	bar abs			
Heat capacity ratio:	1.32				
Molecular weight of gas:	16.74				
Gas temperature:	298	K			
Speed of sound in ambient gas:	450	m/s	1458.5	ft/sec @ 120F	

Calculated Results:

Energy of explosion using Brode's equation for constant volume expansion:

Energy of explosion:	87.95	MJ
TNT equivalent:	18.75	kg TNT

Effective energy of explosion (x 2):	175.90	MJ
Scaled distance:	5.45	
Interpolated scaled overpressure:	0.034756	
Interpolated scaled impulse:	0.009465	

Vessel shape:	Spherical		Cylindrical	
Overpressure multiplier for vessel shape:	1.1		3.5	
Corrected scaled overpressure:	0.0382		0.1216	
Actual overpressure:	0.0387	bar	0.1233	bar
	0.56	psi	1.79	psi
Impulse multiplier for vessel shape:	1		1	
Corrected scaled impulse:	0.0095		0.0095	
Actual impulse:	20.33	kPa - ms	20.33	kPa - ms

Blast Overpressure from a Ruptured Vessel

Input Data:

Vessel burst pressure:	248.22	bar abs	3600	psi	Distance to existing building (indoor scenario)
Distance from vessel center:	137.16	m	450	ft	
Vessel volume:	1.14	m**3	40.2	ft3	
Final pressure:	1.01325	bar abs			
Heat capacity ratio:	1.32				
Molecular weight of gas:	16.74				
Gas temperature:	298	K			
Speed of sound in ambient gas:	450	m/s	1458.5	ft/sec @ 120F	

Calculated Results:

Energy of explosion using Brode's equation for constant volume expansion:

Energy of explosion:	87.95	MJ
TNT equivalent:	18.75	kg TNT

Effective energy of explosion (x 2):	175.90	MJ
Scaled distance:	11.41	
Interpolated scaled overpressure:	0.014334	
Interpolated scaled impulse:	0.004497	

Vessel shape:	Spherical		Cylindrical	
Overpressure multiplier for vessel shape:	1.1		3.5	
Corrected scaled overpressure:	0.0158		0.0502	
Actual overpressure:	0.0160	bar	0.0508	bar
	0.23	psi	0.74	psi
Impulse multiplier for vessel shape:	1		1	
Corrected scaled impulse:	0.0045		0.0045	
Actual impulse:	9.66	kPa - ms	9.66	kPa - ms

Blast Overpressure from a Ruptured Vessel

Input Data:

Vessel burst pressure:	248.22	bar abs	3600	psi	Distance to new building (indoor scenario)
Distance from vessel center:	167.64	m	550	ft	
Vessel volume:	1.14	m**3	40.2	ft3	
Final pressure:	1.01325	bar abs			
Heat capacity ratio:	1.32				
Molecular weight of gas:	16.74				
Gas temperature:	298	K			
Speed of sound in ambient gas:	450	m/s	1458.5	ft/sec @ 120F	

Calculated Results:

Energy of explosion using Brode's equation for constant volume expansion:

Energy of explosion:	87.95	MJ
TNT equivalent:	18.75	kg TNT

Effective energy of explosion (x 2):	175.90	MJ
Scaled distance:	13.95	
Interpolated scaled overpressure:	0.011316	
Interpolated scaled impulse:	0.003703	

Vessel shape:	Spherical		Cylindrical	
Overpressure multiplier for vessel shape:	1.1		3.5	
Corrected scaled overpressure:	0.0124		0.0396	
Actual overpressure:	0.0126	bar	0.0401	bar
	0.18	psi	0.58	psi
Impulse multiplier for vessel shape:	1		1	
Corrected scaled impulse:	0.0037		0.0037	
Actual impulse:	7.95	kPa - ms	7.95	kPa - ms