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HAZARD CONSEQUENCES ANALYSIS REPORT
FALLBROOK BATTERY ENERGY STORAGE SYSTEM
PDS2019-ZAP-19-001
1405 E. MISSION ROAD
FALLBROOK, CALIFORNIA

by
Haley & Aldrich, Inc.
San Diego, California

for
Fluence
Arlington, Virginia

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SIGNATURE PAGE FOR

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1. Introduction

This Hazard Consequences Analysis Report presents the results of an offsite consequence analysis associated with the operation of the proposed 40-megawatt (MW) battery energy storage system (BESS) initially proposed by AES Energy Storage in the unincorporated community of Fallbrook, in northern San Diego County. Under normal operations, a BESS does not store or generate hazardous materials in quantities that would represent a risk to offsite receptors. This offsite consequence analysis was therefore conducted to determine the impacts resulting from the release of toxics from a credible fire or thermal runaway event at the project site.

For this consequence analysis, offsite means any activity or receptors located beyond the boundaries of the proposed BESS. This report is being conducted in accordance with Section 5.1 of the San Diego County's 2007 "Guidelines for Determining Significance, Hazardous Materials and Existing Contamination," the U.S. Environmental Protection Agency's (EPA) 2009 "Risk Management Program Guidance for Offsite Consequence Analysis" and guidance from the California Accidental Release Prevention Program (CalARP). The project is not subject to 40 Code of Federal Regulations (CFR) Part 68, as there are no regulated substances present above any threshold quantity as defined in the regulation. The Hazard Consequences Analysis Report was prepared at the request of San Diego County in accordance with Section 5.1 of the San Diego County's 2007 "Guidelines for Determining Significance, Hazardous Materials and Existing Contamination," which references EPA guidance related to 40 CFR, Part 68. The offsite consequences analysis was conducted using EPA's and the National Oceanic and Atmospheric Administration's (NOAA's) "Areal Location Hazardous Atmospheres" ([ALOHA]; (Version 5.4.7, September 2016) hazards modeling program to determine distances to the toxic endpoints for release scenarios. The distance to the toxic endpoint is the distance a toxic vapor cloud, heat from a fire, or blast waves from an explosion will travel before dissipating to the point where serious injuries from short-term exposures will no longer occur. The supporting ALOHA hazards modeling program output files for the offsite consequence analysis are provided in Attachment A.

The topic of BESS and air toxic releases during a credible fire event is limited in available data and current hazards analyses. Much of the available information is very recent and subject to ongoing study. As such, this hazard consequences analysis represents the current understanding of the subject matter but is subject to the limitations of available data at the time of this report.

Appropriate preventative measures make a thermal runaway event a very rare event and can reduce the duration and intensity of an event when it may occur. The credible thermal runaway/fire event was determined to involve 1.5 battery racks. Per Consolidated Edison's 2017 "Considerations for ESS Fire Safety," "…the estimations limit of failure of a BESS is 1.5 battery modules [racks], with the presumption that the system should demonstrate adequate separations, cascading protections, and suppression systems to limit failure to a single cell [module] or at least a single module [rack]. The probability of failure for multiple modules [racks] should be very low for systems with these active and passive barriers to catastrophic failure." Use of the term "module" in the study is consistent with use of the term "rack" in this report and use of the term "cell" in the study is consistent use of the term "module" in this report. BESS thermal runaway/fire events may generate hazardous substances such as hydrogen chloride, hydrogen fluoride, hydrogen cyanide, and carbon monoxide, which may be released to the environment. The Consolidated Edison study identified eleven toxic and/or flammable gases during their fire testing events and concluded that the main gases emitted were hydrogen chloride, hydrogen fluoride, hydrogen cyanide, and carbon monoxide, which were also identified in every battery tested.

1.1 PROJECT OVERVIEW

The project site is located within the northeastern portion of the unincorporated community of Fallbrook, in northwestern San Diego County. The project proposes to construct 40 MW of battery energy storage. The proposed BESS would consist of 16, 63-foot long, 12-foot wide, and 13-foot tall (756 square feet each) battery storage containers on individual concrete equipment pads. Each container would store approximately 50 battery racks, and each rack would hold 12 battery modules. Fire suppression systems would be installed in each container (clean agent Novec 1230 in a tank connected to nozzles and designed to flood the entire container during fire event). The fire suppression systems would be equipped with early smoke detection, alarms, and remote monitoring. The battery storage containers would be set back 19 feet from the eastern parcel boundary. The proposed project would be adjacent to rural residential, agricultural, and industrial land uses.

1.2 PURPOSE

As part of the Minor Use Permit Application and California Environmental Quality Act (CEQA) requirements, this hazard consequences analysis evaluates the potential for adverse effects to people or the environment related to hazards and hazardous materials. CEQA requires the analysis of potential adverse effects of a project on the environment. Consistent with Appendix G of the CEQA Guidelines, a proposed project would cause adverse impacts related to hazards and hazardous materials if they would create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment. This consequence analysis considers the potential impacts to the surrounding community and school facilities within 0.25 mile of the project site.

This report is also being conducted in accordance with Section 5.1 of the San Diego County's 2007 "Guidelines for Determining Significance, Hazardous Materials and Existing Contamination," which states that facilities that would handle regulated substances subject to CalARP regulations and are located within 0.25-mile from a school or day care are required to prepare a hazard assessment to determine the effects of the regulated substance on surrounding land uses in the event of a release. According to these guidelines, the requirement for a hazard assessment is typically satisfied by preparing an Offsite Consequence Analysis following EPA's 2009 "Risk Management Program Guidance for Offsite Consequence Analysis," as supplemented by guidance from CalARP.

The office of San Diego's Planning & Development Services has indicated that the St. Stephen Lutheran Church located on parcel APN 1050922200 is proposing to modify their Major Use Permit to be a small school. This property is located approximately 0.25 mile from the project site's boundary. In addition, Lavender Hill School is a small home school located approximately 700 feet east of the project site on parcel APN 1054210100. The nearest residence is located approximately 150 feet north of the battery storage area.

The objectives of this hazard consequences analysis are to:

- Identify and characterize the quantities and locations of hazardous chemicals that could be released during a thermal runaway/fire event from the proposed BESS;
- Determine the distance from the proposed BESS to the nearest residence;

- Conduct plume dispersion modeling using EPA's ALOHA (Version 5.4.7, September 2016) hazards modeling program to determine distances to the toxic endpoints for the release scenario;
- Determine potential impacts and safety risks at the nearest receptors; and
- Identify project safety design measures and fire risk mitigation measures.

1.3 SETTING

The project's general location is within the northeastern portion of the unincorporated community of Fallbrook, in northwestern San Diego County, approximately 19 miles inland from the Pacific Ocean, 6 miles northeast of Camp Pendleton, 3 miles south of Riverside County, and 3 miles west of Interstate 15. Figure 1 shows the general project location.

1.3.1 Project Site

The project site includes three assessor parcels located at 1405 East Mission Road (Table 1). Only one of the parcels (105-410-19) would be developed with the proposed BESS, while the remaining parcels would support off-site components (16-foot wide access driveway, infiltration basins, underground utility easement). The project site's topography is gently sloping with elevations ranging from approximately 780 feet above mean sea level in the northwestern portion of the project site to 806 feet above mean sea level in the southeastern portion. Portions of the project site are used for residential, and previously for agricultural purposes (primarily citrus crops) since 1994 or earlier, the remnants of which are still visible in places (e.g., irrigation pipe, tree stumps, among others). However, no active agricultural uses are currently taking place, and an off-site single-family residence located along the existing access driveway is vacant. The general project site is shown in Figure 2.

Table 1. Project Site Parcels

Assessor's Parcel Number (APN)	Area (acres)	Proposed Use	% Development
105-410-19	4.22	Development of BESS	98%
105-410-10	4.87	Widening existing access driveway/ infiltration basins	8.2%
105-410-44	5.79	Limited use for 30-foot underground utility easement (offsite impact)	8%
TOTAL	**14.88**		

1.3.2 Surrounding Area

The project site is immediately adjacent to rural residential and agricultural land uses. Within the larger context, more than 400 feet from the project site, the land uses surrounding the project site become more intense. The surrounding land uses are described in more detail in Table 2.

Table 2. Surrounding Zoning and Land Uses

Location	General Plan	Zoning	Adjacent Streets	Description
North	Village Residential (VR-2)	Rural Residential (RR)	East Mission Road	Large-lot estate residential
East	VR-2	Rural Residential	Mercedes Road	Pumpkin Farm and Rural Residential
South	VR-2	Rural Residential	Bryce Lane	Tract housing
West	Limited Impact Industrial (I-1)	Limited Impact Industrial (M52)	Industrial Way	Industrial and Institutional uses (religious)

All the surrounding residential lots are designated for Village Residential (VR-2) under San Diego County's General Plan and are zoned Rural Residential (RR). However, existing development patterns include large lot estate residential-type land uses immediately to the north, while the development to the south, southeast, and southwest is tract housing at a slightly higher density. The industrial complex to the west includes both a Calvary Chapel and the North Coast Church as well as an animal hospital and industrial uses such as welding and sign shops and a fabricator.

The proposed St. Stephan Lutheran Evangelical School is located approximately 0.25 mile northeast of the project site. The Lavender Hill School is a small home school located approximately 700 feet east of the project site on parcel APN 1054210100. The nearest residence is located approximately 150 feet north of the battery storage area.

1.4 DESIGN MEASURES AND FIRE MITIGATION MEASURES

California Fire Code 2018 section 608.5.1.1 requires Stationary Storage Battery Systems to have a fire suppression system.

The batteries proposed for use in the project are either LG Chem or Samsung SDI modules assembled and connected in racks. Each container will have four heating, ventilation, and air conditioning systems to keep battery cores at optimal operating temperature. Fire suppression systems in each container include the clean agent Novec 1230 in a tank connected to nozzles and designed to flood the entire container during a fire event. The systems will be equipped with early smoke detection, alarms, and remote monitoring. Major equipment will also include:

- Low and medium voltage electrical switching equipment;
- Computer and telecommunications equipment;
- Medium-voltage transformers;
- Medium-voltage switchgear;
- Step-up transformer and associated equipment;
- Security lighting and fencing; and
- Signage.

As described above, the credible thermal runaway/fire event was determined to involve 1.5 battery racks per Consolidated Edison's 2017 "Considerations for ESS Fire Safety." This determination is predicated upon the project meeting industry standards for adequate separations, cascading protections, and suppression systems to limit failure to a single cell or at least a single module [rack]. This scenario has also been used in a CEQA hazards analysis for at least one other battery storage project.[1]

Cascading protections assumed in the Consolidated Edison study can be tested by the UL 1973 internal fire test, the IEC 62619 internal propagation test, SAE J2929 propagation test, or similar standards. Both the Samsung SDI and LG Chem batteries considered for this project have been tested to the UL 1973 standard.

The project will be equipped with the state-of-art Battery Management System (BMS), that monitors cell level voltage, state of health, cell temperature, and cell current in and out. If any of the monitored parameters are above or below pre-determined limits, the BMS will shut down and electrically isolate the affected battery rack from the system. This is designed to happen well before a battery cell overheats to the point that it will enter a thermal runaway state.

Air conditioning equipment will be used to maintain safe ambient operating temperature conditions. An effective method for Li-ion battery storage is to use a fire containment and suppression system that would deal with a battery fire event. Such systems contain the fire event and encourage suppression through cooling, isolation, and containment. It is important when using this approach to ensure batteries are housed in environments that feature fire suppression systems that extinguish through cooling. Suppressing a lithium ion (secondary) battery is best accomplished by cooling the burning material. The proposed project would include a gaseous fire suppressant agent (e.g., 3M™ Novec™ 1230 Fire Protection Fluid or similar) and an automatic fire extinguishing system with sound and light alarms. Water has been historically recommended as fire suppression because of its ability to cool and limited side effects. Novec 1230 evaporates 50 times faster than water, rapidly removing heat. The project will also be developed with an onsite fire hydrant for the fire department to use water to provide additional cooling and to prevent fires from spreading. The Consolidated Edison study found that If a fixed suppression agent is installed within an enclosed environment containing the event, it may suppress flammability in the enclosed space and make the use of water unnecessary. The Consolidated Edison study recommended that the first stage of fire suppression should be a gas-based suppression system to extinguish a single rack fire and prevent flashover in a contained environment. In the event that temperatures continue to rise, the study recommended the second stage of fire suppress be forced ventilation or water to cool the system and prevent further propagation of fire. This is consistent with the fire suppression measures proposed by Fluence.

The use of Novec 1230 with an active suppression system is consistent with recommendations of the Consolidated Edison study and supports the determination adequate separations, cascading protections, and suppression systems would to limit failure to a single module or at least a single rack and that the credible thermal runaway/fire event involving a maximum of 1.5 battery racks is a conservative assumption.

[1] Santa Paula Battery Energy Storage System. Hazards Consequences Analysis, prepared by RCH Group for Z Global

2. Air Toxics Evaluated

Based upon testing data in available publications (the Consolidated Edison study, National Fire Protection Association studies), there are four hazardous substances that are potentially released during an accidental event within the BESS that may have an impact on nearby population. The hazardous substances include hydrogen chloride (HCl), hydrogen fluoride (HF), hydrogen cyanide (HCN), and carbon monoxide (CO). These air toxics were analyzed using ALOHA to determine the characteristics of emissions, possible smoke or emissions plume under several weather and wind scenarios, and potential exposure impacts to population and animals within the plume area.

The ALOHA program models dispersion of a release and compares predicted maximum concentrations to a toxic Level of Concern (LOC). The most common public exposure guidelines that are used as LOC's include Acute Exposure Guideline Levels (AEGLs) Emergency Response Planning Guidelines (ERPGs), and Temporary Emergency Exposure Limits (TEELs). All have three tiers of exposure values for each covered chemical. At a general level, the tiers are similar: the first tier is a mild effects threshold, the second tier is an escape-impairment threshold, and the third tier is a life-threatening effects threshold. Any of these three sources may be appropriate for a LOC comparison. For releases with an impact area extending well beyond the site, AEGLs are often preferentially used, but modeling against AEGLs has been shown to predict lower concentrations at a closer distance than ERPG values (Kelsey, 2012). As impacts under the release scenario are close to the project site, ERPG values were selected for the LOC in this analysis. The following describes potential air toxics, potential impacts from acute inhalation exposure and ERPG values. The descriptions of health effects are summarized from the National Institute of Health PubChem database. ERPGs are developed by the Emergency Response Planning committee of the American Industrial Hygiene Association (AIHA). For many substances regulated by 40 CFR Part 68, included those listed above, the toxic endpoints listed in 40 CFR Part 68, Appendix A, are the ERPG-2 values published by AIHA. These are the toxic endpoints, which are airborne concentrations, that would be used if the facility was subject to 40 CFR Part 68 and are considered appropriate for this analysis. The offsite consequences analysis and distance of toxic endpoints used the ERPG-2 value per EPA guidance to assess the hazards impacts on nearby receptors. The ERPG values are defined as follows:

- ERPG-1 is the maximum airborne concentration below which nearly all individuals could be exposed to for up to one hour without experiencing more than mild, transient adverse health effects or without perceiving a clearly defined objectionable odor.
- ERPG-2 is the maximum airborne concentration below which nearly all individuals could be exposed to for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action.
- ERPG-3 is the maximum airborne concentration below which nearly all individuals could be exposed to for up to one hour without experiencing or developing life-threatening health effects.

In ALOHA, you can choose ERPGs as your toxic Levels of Concern when modeling a toxic chemical release if ERPGs have been defined for that chemical. ALOHA allows you to specify up to three toxic Levels of Concern. Modeling was conducted to identify maximum estimated distances to the ERPG-1, ERPG-2, and ERPG-3 values and the ERPG-2 value was used as the toxic endpoint.

2.1 HYDROGEN CHLORIDE

HCl is a colorless, corrosive gas with a pungent, suffocating odor. It is heavier than air and may accumulate in low-lying areas. When exposed to air it forms white fumes due to condensation with atmospheric moisture. These fumes consist of hydrochloric acid which forms when HCL dissolves in water. HCL forms corrosive hydrochloric acid on contact with body tissue. Inhaling the fumes can cause coughing, choking, inflammation of the nose, throat, and upper respiratory tract, and in severe cases, pulmonary edema, circulatory system failure, and death.

Inhalation is an important exposure route to HCL. Its odor and highly irritating properties generally provide adequate warning for acute, high-level exposures. Concentrated HCL can be corrosive to the skin, eyes, nose, mucous membranes, and respiratory and gastrointestinal tracts. Inhaling HCL can lead to pulmonary edema. Other effects of exposure include shock, circulatory collapse, metabolic acidosis, and respiratory depression. HCL gas is intensely irritating to the mucous membranes of the nose, throat, and respiratory tract. Brief exposure to 35 parts per million (ppm) causes throat irritation and levels of 50 to 100 ppm are barely tolerable for 1 hour. The greatest impact is on the upper respiratory tract; exposure to high concentrations can rapidly lead to swelling and spasm of the throat and suffocation.

Most seriously exposed persons have immediate onset of rapid breathing, blue coloring of the skin, and narrowing of the bronchioles. Patients who have massive exposures may develop an accumulation of fluid in the lungs. Exposure to HCL can lead to Reactive Airway Dysfunction Syndrome, a chemically- or irritant-induced type of asthma. Children may be more vulnerable to corrosive agents than adults because of the relatively smaller diameter of their airways. Children may also be more vulnerable to gas exposure because of increased minute ventilation per kilogram and failure to evacuate an area promptly when exposed. EPA has not classified HCL or hydrochloric acid for carcinogenicity.

The ERPG values for HCl are:

- ERPG-1: 3 ppm;
- ERPG-2: 20 ppm; and
- ERPG-3: 150 ppm.

2.2 HYDROGEN FLURIDE

HF is a colorless, corrosive gas or liquid (it boils at 19.5 degrees Celsius [°C]) that is made up of a hydrogen atom and a fluorine atom. It fumes strongly, readily dissolves in water, and both the liquid and vapor will cause severe burns upon contact. HF is also a very irritating gas, not as dangerous as fluorine, but large amounts of it can also cause death. The dissolved form is called hydrofluoric acid, a colorless fuming mobile aqueous solution with a pungent odor. It is corrosive to metals and tissue and highly toxic by ingestion and inhalation. Exposure to fumes or very short contact with liquid may cause severe painful burns; it penetrates skin to cause deep-seated ulceration that may lead to gangrene.

Hydrofluoric acid is a clear, colorless liquid, miscible with water, with an acrid, irritating odor. It is an extremely corrosive liquid and vapor that can cause severe injury via skin and eye contact, inhalation, or ingestion. Dilute solutions deeply penetrate before dissociating, thus causing delayed injury and symptoms. Skin contact results in painful deep-seated burns that are slow to heal. Burns from dilute (less than 50 percent) hydrogen fluoride solutions do not usually become apparent until several hours after exposure. Hydrofluoric acid and HF vapor can cause severe burns to the eyes, which may lead to permanent damage. At 10 to 15 ppm, HF vapor is irritating to the eyes, skin, and respiratory tract. Exposure to higher concentrations can result in serious damage to the lungs. Hydrofluoric acid has not been reported to be a human carcinogen.

Acute inhalation exposure to gaseous HF can cause severe respiratory damage in humans, including severe irritation and pulmonary edema. Irritation of the eyes, nose, and upper and lower respiratory tract, lacrimation, sore throat, cough, chest tightness, and wheezing have been reported. Damage to the lungs, liver, and kidneys has been observed in animals acutely exposed to HF by inhalation. Acute animal tests in rats, mice, guinea pigs, and monkeys have demonstrated HF to have moderate to high acute toxicity from inhalation exposure. EPA has not classified hydrogen fluoride or hydrofluoric acid for carcinogenicity.

The ERPG values for HF are:

- ERPG-1: 2 ppm;
- ERPG-2: 20 ppm; and
- ERPG-3: 50 ppm.

Water solutions containing regulated substances such as hydrofluoric acid are analyzed differently from pure toxic liquids. The evaporation rate varies with the concentration of the solution. If a concentrated water solution is spilled, the toxic substance will evaporate more quickly than the water from the spilled solution, and the vapor pressure and evaporation rate will decrease as the concentration of the toxic substance in solution decreases.

2.3 HYDROGEN CYANIDE

HCN is a colorless, extremely poisonous gas above temperature at 26° C. It is a chemical asphyxiant as it interferes with the normal use of oxygen by nearly every organ of the body. Exposure to HCN can be rapidly fatal. It has whole-body (systemic) effects, particularly affecting those organ systems most sensitive to low oxygen levels: the central nervous system (brain), the cardiovascular system (heart and blood vessels), and the pulmonary system (lungs). It is used commercially for fumigation, electroplating, mining, chemical synthesis, and for producing synthetic fibers, plastics, dyes, and pesticides. HCN gas has a distinctive bitter almond odor (others describe a musty "old sneakers smell"), but a large proportion of people cannot detect it; the odor does not provide adequate warning of hazardous concentrations.

HCN is extremely toxic to humans. Acute inhalation exposure to 100 milligrams per cubic meter or more of HCN will cause death in humans. Acute exposure to lower concentrations (6 to 49 milligrams per cubic meter) of HCN will cause a variety of effects in humans, such as weakness, headache, nausea, increase rate of respiration, and eye and skin irritation.

Tests involving acute exposure of rats and mice have shown HCN to have extreme acute toxicity from inhalation exposure. EPA has not classified HCN or hydrocyanic acid for carcinogenicity.

The ERPG values for HCN are:

- ERPG-1: Not Appropriate;
- ERPG-2: 10 ppm; and
- ERPG-3: 25 ppm.

2.4 CARBON MONOXIDE

CO is a poisonous, colorless, odorless, and tasteless gas. It is the product of the incomplete combustion of carbon-containing compounds, notably in internal combustion engines. It consists of one carbon atom covalently bonded to one oxygen atom and is a gas at room temperature. CO is a significantly toxic gas and is the most common type of fatal poisoning in many countries. Exposures can lead to significant toxicity of the central nervous system and heart.

When CO is not ventilated, it binds to hemoglobin, which is the principal oxygen-carrying compound in blood; this produces a compound known as carboxyhemoglobin. The traditional belief is that carbon monoxide toxicity arises from the formation of carboxyhemoglobin, which decreases the oxygen-carrying capacity of the blood and inhibits the transport, delivery, and use of oxygen by the body. The affinity between hemoglobin and CO is approximately 230 times stronger than the affinity between hemoglobin and oxygen, so hemoglobin binds to carbon monoxide in preference to oxygen. The resultant oxygen deprivation causes headache, dizziness, decreased pulse and respiratory rates, unconsciousness, and death. EPA has not classified CO for carcinogenicity.

The ERPG values for CO are:

- ERPG-1: 200 ppm;
- ERPG-2: 350 ppm; and
- ERPG-3: 500 ppm.

2.5 ESTIMATED EMISSIONS

The modeled release assumes a constant emission rate in kilograms per second for a thermal runaway event lasting 30 minutes, after which it is assumed that the event would be controlled. For the purpose of evaluating impacts to first responders in a controlled event, the Consolidated Edison report identified a 30-minute release rate as conservative, accounting for an average of emissions rate that is higher than the low-level emissions leading up to peak failure, and lower than the peak emissions. Consolidated Edison's calculated average 30-minute release rate was identified in Table 2 of the Consolidated Edison report.

The Consolidated Edison publication “Considerations for ESS Fire Safety” (as Table 2 within publication), documents the average release rate (in kilograms per second) of the air toxics described above for thermal runaway events and fires involving battery materials over a 30-minute period. The study evaluated several types and manufactures of battery systems, including lithium ion batteries provided by LG Chem and Samsung SDI. These values were used to estimate the toxics release rate of a credible fire event. Consistent with “Considerations for ESS Fire Safety”, it was assumed that the event would involve 1.5 single battery racks, equivalent to 18 individual modules (Table 3).

Table 3. Emission Release Rates

Materials	30-minute Release Rate (kg/s) for 1 Battery Module	30-minute Release Rate (kg/s) for 1.5 Battery Racks (18 Modules)
HCl	2.36E-07	4.25E-06
HF	1.74E-07	3.13E-06
HCN	1.74E-07	3.13E-06
CO	2.00E-07	3.60E-06

kg/s = kilograms per second

3. Meteorological Data

Air impacts are a function of the rate and release characteristic location of emissions under the influence of meteorological conditions and topographic features affecting pollutant movement and dispersion. Atmospheric conditions such as wind speed, wind direction, atmospheric stability, and air temperature gradients interact with the physical features of the landscape to determine the movement and dispersal of air pollutants and consequently affect air quality. Climate within the San Diego Air Basin area often varies dramatically over short geographical distances with cooler temperatures on the western coast gradually warming to the east as prevailing winds from the west heats up. Most of southern California is dominated by high-pressure systems for much of the year, which keeps San Diego County mostly sunny and warm. Typically, during the winter months, the high-pressure system drops to the south and brings cooler, moister weather from the north. It is common for inversion layers to develop within high-pressure areas, which mostly define pressure patterns over the air basin. These inversions are caused when a thin layer of the atmosphere increases in temperature with height. An inversion acts like a lid preventing vertical mixing of air through convective overturning. This type of inversion is typically thousands of feet above the ground, too high to affect a dispersing gas cloud. While some low-level inversions, which may be indicated by the presence of ground level fog, may occur in the area, it is exceedingly rare to have an inversion height below 1,000 feet, which even at that height would not have an effect on adjacent receptors.

Based on hourly meteorological data from the Marine Corps Air Base at Camp Pendleton from 2009 through 2014[2], the wind is predominantly calm, with wind speeds of less than 0.5 meters per second recorded about 44 percent of the time. When the wind is blowing it is primarily from the southwest (about 22 percent of recorded hours) with a high frequency of low wind conditions (2.1 to 5.7 meters per second [m/s] or 4.7 to 12.7 miles per hour [mph]). The average annual wind speed is 1.7 m/s (3.8 mph).

Figure 3 displays the wind rose during this period, and the frequency distribution is depicted graphically as shown in Figure 4.

Wind directions within Fallbrook are generally similar to conditions at Camp Pendleton's Marine Air Base weather station, which is the nearest representative meteorological station.

[2] Based upon meteorological data processed by the California Air Resources Board (CARB) made available at: https://ww3.arb.ca.gov/toxics/harp/metfiles2.htm

4. Offsite Consequence Analysis

An offsite consequence analysis was conducted using emission rate estimates as described in Section 2.5 and the ALOHA model as described in the sections below.

4.1 METHODOLOGY

The EPA's "Risk Management Program Guidance for Offsite Consequence Analysis" and the CalARP both recommend conducting an offsite consequence analysis to represent release scenarios that are possible (although unlikely) to occur under a variety of weather and wind conditions to determine the distance to a toxic or flammable endpoint. Modeling assumptions and meteorological conditions that were used for conducting the offsite consequence analysis are specified in the California Code of Regulations (CCR), Title 19, Chapter 4.5, Article 2735.1 et seq.

The offsite consequences analysis was conducted based on the following conditions:

- The credible fire event involves the toxic release from 1.5 battery modules over a 30-minute period.
- Nighttime conditions - wind speed of 1.5 m/s (3.4 mph) and atmospheric stability class F (very stable atmospheric conditions).
- Daytime conditions - wind speed of 3.0 m/s (6.8 mph) and atmospheric stability class C (slightly unstable atmospheric conditions). A cloud cover of 50 percent was assumed, and Incoming solar radiation is assumed to be slight.
- Default release temperature of 77 degrees Fahrenheit (°F) for toxic gas releases. According to historical meteorological data from the National Oceanic and Atmospheric Administration, the average monthly high temperature in Fallbrook ranges from 68°F to 90°F; maximum high temperature can reach 101°F.
- No ambient temperature inversion was included in the consequence analysis; although the San Diego County area does periodically experience inversions with mixing heights of less than 3,000 feet.
- Humidity of 50 percent.
- Height of release – ground level.
- Surface roughness – rural; as determined based on the density and height of obstructions.
- Passive mitigation, such as the release inside of the container, was considered. Active mitigation measures, such as fire suppression, were also considered.

ALOHA uses location and elevation information to estimate sun angle using the location's latitude and longitude and the time of day and atmospheric pressure using the location's elevation. Site-specific project location data were used for input into ALOHA.

The offsite consequence analysis was conducted according to EPA's "Risk Management Program Guidance for Offsite Consequence Analysis" and guidance from the CalARP. Plume analysis and exposure impacts were conducted using USEPA's ALOHA hazards modeling program. Based on information about a chemical release, ALOHA estimates how quickly the chemical will escape from containment and form a hazardous gas cloud, and also how that release rate may change over time. ALOHA can then model how that hazardous gas cloud will travel downwind, including both neutrally buoyant and heavy gas dispersion. Additionally, if the chemical is flammable, ALOHA simulates pool fires, boiling liquid expanding vapor explosions, vapor cloud explosions, jet fires, and flammable gas clouds (where flash fires might occur). ALOHA evaluates different types of hazards (depending on the release scenario); toxicity, flammability, thermal radiation, and overpressure. ALOHA produces a threat zone estimate, which shows the area where a particular hazard (such as toxicity or thermal radiation) is predicted to exceed a specified level of concern at some time after the release begins. ALOHA is able to determine a threat zone under different weather and wind scenarios.

4.2 RESULTS

The nighttime release scenario is under more stable meteorological conditions and represents the more conservative release scenario. A daytime release scenario was also evaluated as an alternative release scenario.

A toxic release from 1.5 battery racks was assumed to be triggered by a fire event and result in a release of HCl, HF, HCN, and CO. Using nighttime meteorological conditions, modeling results indicate that the distance to the toxic endpoint at ERPG-2 would be less than 10 meters (33 feet). ALOHA is unable to predict threat zones less than 10 meters because of the effects of near-field patchiness which make dispersion predictions less reliable for short distances.

A toxic release from 1.5 battery racks was assumed to be triggered by a fire event and result in a release of HCl, HF, HCN, and CO. Using daytime meteorological conditions, modeling results indicate that the distance to the toxic endpoint at ERPG-2 would be less than 10 meters (33 feet).

The results of the offsite consequence analysis show that the impacts at the ERPG-2 thresholds may extend to a toxic endpoint distance of approximately 33 feet from the toxic release/credible fire event and may require shelter in place and/or evacuation of receptors within this toxic endpoint distance. The estimated maximum toxic endpoint distance is primarily within the project site’s boundary but does extend to the adjacent undeveloped parcel (APN 1054101100), which is also controlled by Fluence. No schools or residences are located within the estimated maximum toxic endpoint boundary.

References

1. California Accidental Release Prevention Program, Administering Agency Guidance, January 31, 2005, http://www.caloes.ca.gov/FireRescueSite/Documents/CalARP%20Guidance%20Jan2005.pdf

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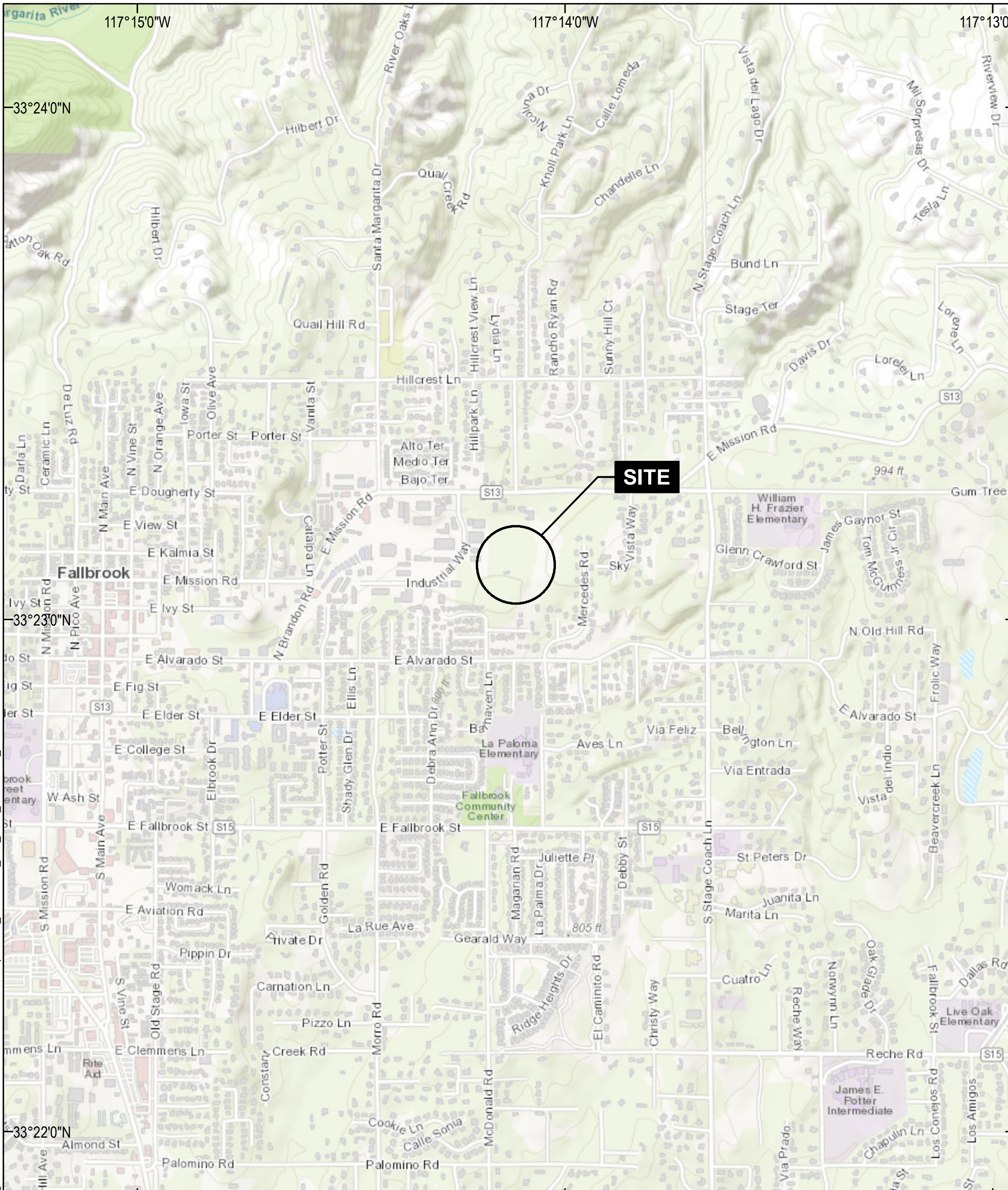
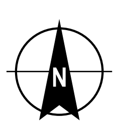
\\haleyaldrich.com\share\sdg_common\130081 AES Fallbrook\006\Response to Stantec\2019_1122_HAI_Hazards Analysis_Fallbrook_F3.docx

FIGURES





MAP SOURCE: ESRI
SITE COORDINATES:
33°23'4.00"N, 117°14'7.62"W

HALEY ALDRICH

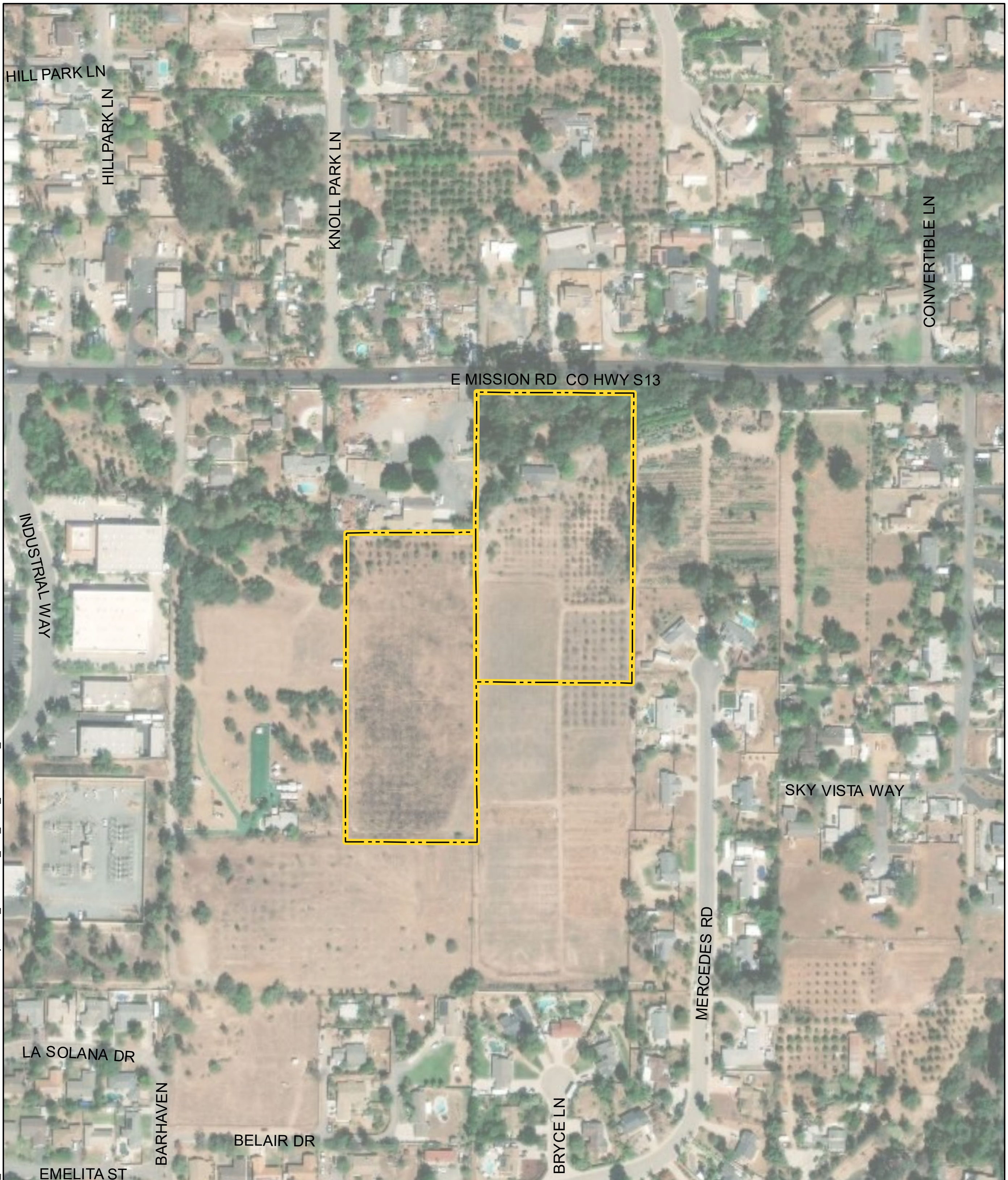
HAZARD CONSEQUENCES ANALYSIS
1405 E. MISSION ROAD
FALLBROOK, CALIFORNIA

PROJECT LOCATION

APPROXIMATE SCALE: 1 IN = 2000 FT
NOVEMBER 2019

FIGURE 1

GIS FILE PATH: \\haleyaldrich.com\share\sdg_common\130081 AES Fallbrook\Global\GIS\Maps\2019_09\130081_002_0001_PROJECT_LOCATION.mxd — USER: anichols — LAST SAVED: 9/6/2019 9:45:20 AM



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LEGEND

APPROXIMATE SITE BOUNDARY

N

NOTES
1. PARCEL DATA SOURCE: SAN DIEGO COUNTY
2. AERIAL IMAGERY SOURCE: ESRI

0 150 300
SCALE IN FEET

HALEY ALDRICH

HAZARDS CONSEQUENCES ANALYSIS
1405 E. MISSION ROAD
FALLBROOK, CALIFORNIA

PROJECT SITE

NOVEMBER 2019

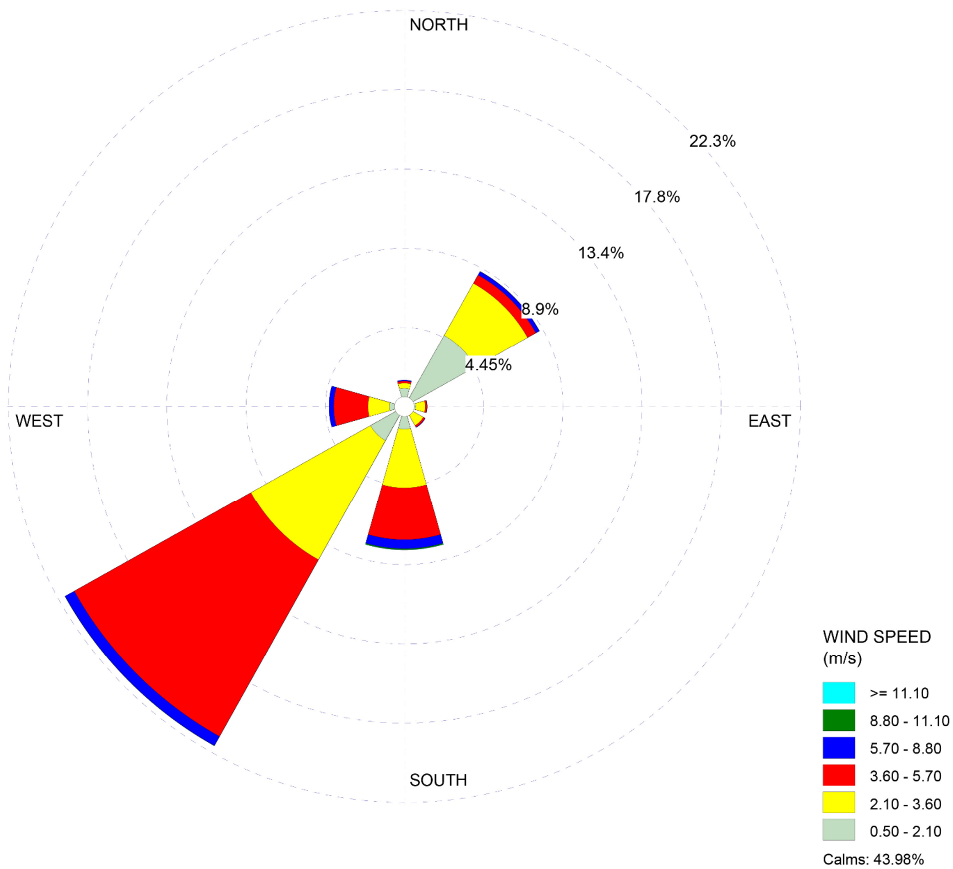
FIGURE 2

WIND ROSE PLOT:

Windrose for Marine Air Base - Camp Pendleton 2009-2014

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD:		
	Start Date: 1/1/2009 - 00:00 **End Date: 1/2/2014 - 23:59**		HALEY ALDRICH
	CALM WINDS: **43.98%**	TOTAL COUNT: **40120 hrs.**	
	AVG. WIND SPEED: **1.70 m/s**	DATE: **8/27/2019**	PROJECT NO.:

WRPLOT View - Lakes Environmental Software

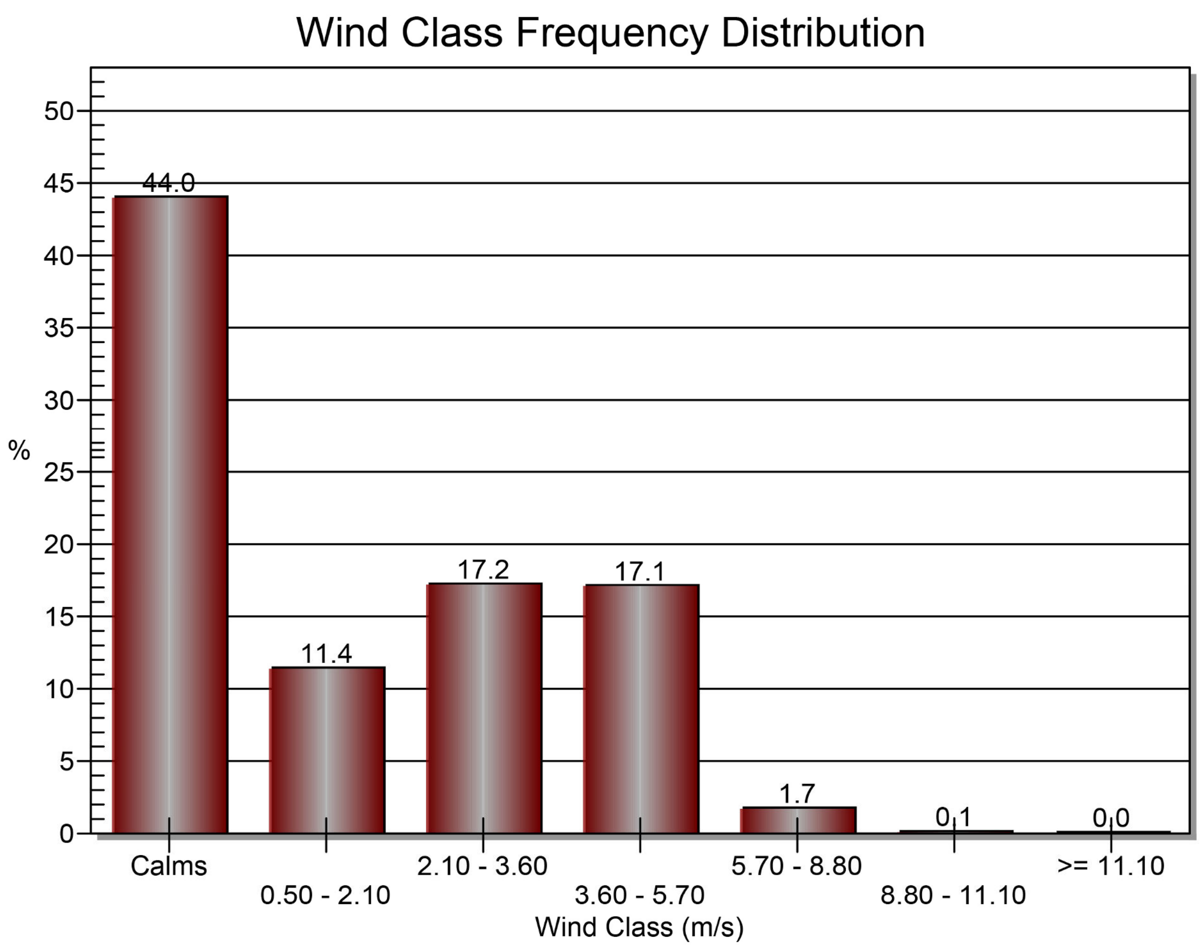
HALEY ALDRICH

HAZARDS CONSEQUENCES ANALYSIS
1405 E. MISSION ROAD
FALLBROOK, CALIFORNIA

WIND ROSE

NOVEMBER 2019

FIGURE 3



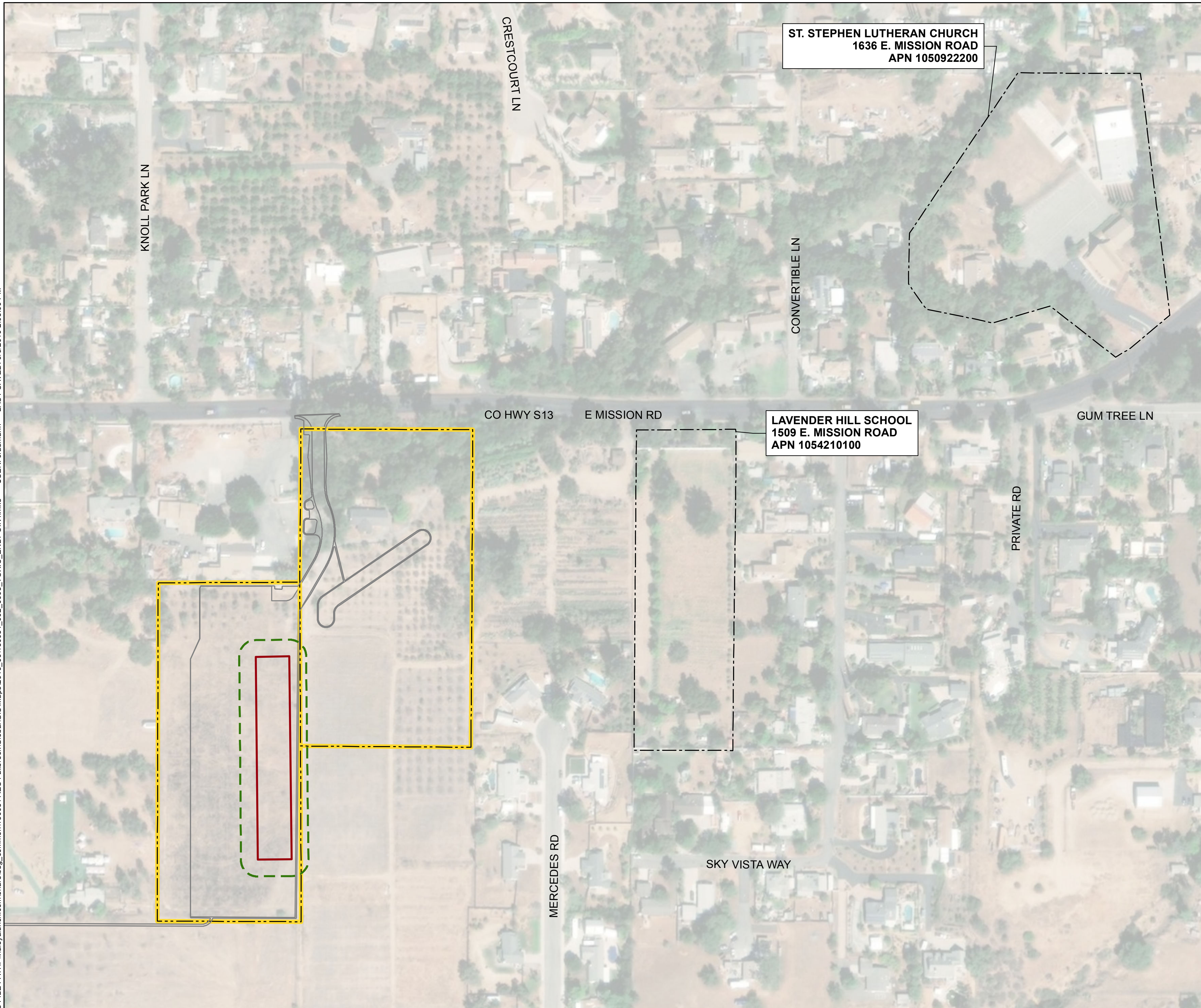
HALEY ALDRICH

HAZARDS CONSEQUENCES ANALYSIS
1405 E. MISSION ROAD
FALLBROOK, CALIFORNIA

FREQUENCY DISTRIBUTION

NOVEMBER 2019

FIGURE 4



LEGEND

- APPROXIMATE SITE BOUNDARY
- PROPOSED BATTERY STRUCTURES
- 10-METER ESTIMATED MAXIMUM TOXIC ENDPOINT BASED ON ERPG-2 THRESHOLDS FOR A FIRE/THERMAL RUNAWAY EVENT INVOLVING 1.5 BATTERY RACKS (18 BATTERY MODULES)
- SCHOOL PROPERTY BOUNDARY
- PROPOSED PROJECT SITE

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. BATTERY STRUCTURE LOCATION DIGITIZED FROM "SITE PLAN", PREPARED BY CORGAN, DATED 28 AUGUST 2019.
3. PARCEL BOUNDARY DATA SOURCE: SAN DIEGO COUNTY
4. AERIAL IMAGERY SOURCE: ESRI

N

0 200 400
SCALE IN FEET

HALEY ALDRICH

HAZARDS CONSEQUENCES ANALYSIS
1405 E. MISSION ROAD
FALLBROOK, CALIFORNIA

ESTIMATED MAXIMUM
TOXIC ENDPOINT

NOVEMBER 2019

FIGURE 5

APPENDIX A

ALOHA Modeling Files

```
SITE DATA:
  Location: FLUENCE FALLBROOK, CALIFORNIA
  Building Air Exchanges Per Hour: 0.38 (unsheltered single storied)
  Time: September 5, 2019  0000 hours PDT (user specified)

CHEMICAL DATA:
  Warning: HYDROGEN CHLORIDE can react with water and/or water vapor.  This
  can affect the evaporation rate and downwind dispersion.  ALOHA cannot
  accurately predict the air hazard if this substance comes in contact with
  water.
  Chemical Name: HYDROGEN CHLORIDE
  CAS Number: 7647-1-0                   Molecular Weight: 36.46 g/mol
  AEGL-1 (60 min): 1.8 ppm   AEGL-2 (60 min): 22 ppm   AEGL-3 (60 min): 100 ppm
  IDLH: 50 ppm
  Ambient Boiling Point: -122.1° F
  Vapor Pressure at Ambient Temperature: greater than 1 atm
  Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
  Wind: 1.5 meters/second from SW at 3 meters
  Ground Roughness: open country         Cloud Cover: 5 tenths
  Air Temperature: 77° F                 Stability Class: F
  No Inversion Height                    Relative Humidity: 50%

SOURCE STRENGTH:
  Direct Source: 0.0000042 kilograms/sec
  Source Height: 0
  Release Duration: 30 minutes
  Release Rate: 5.56e-04 pounds/min
  Total Amount Released: 0.017 pounds
  Note: This chemical may flash boil and/or result in two phase flow.

THREAT ZONE:
  Model Run: Gaussian
  Red   : less than 10 meters(10.9 yards) --- (150 ppm = ERPG-3)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.
  Orange: less than 10 meters(10.9 yards) --- (20 ppm = ERPG-2)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.
  Yellow: 20 yards --- (3 ppm = ERPG-1)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.
```

```
SITE DATA:
  Location: FLUENCE FALLBROOK, CALIFORNIA
  Building Air Exchanges Per Hour: 0.38 (unsheltered single storied)
  Time: September 5, 2019  0000 hours PDT (user specified)

CHEMICAL DATA:
  Warning: HYDROGEN FLUORIDE can react with water and/or water vapor.  This
  can affect the evaporation rate and downwind dispersion.  ALOHA cannot
  accurately predict the air hazard if this substance comes in contact with
  water.
  Chemical Name: HYDROGEN FLUORIDE
  CAS Number: 7664-39-3                   Molecular Weight: 20.01 g/mol
  AEGL-1 (60 min): 1 ppm   AEGL-2 (60 min): 24 ppm   AEGL-3 (60 min): 44 ppm
  IDLH: 30 ppm
  Ambient Boiling Point: 65.8° F
  Vapor Pressure at Ambient Temperature: greater than 1 atm
  Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
  Wind: 1.5 meters/second from SW at 3 meters
  Ground Roughness: open country          Cloud Cover: 5 tenths
  Air Temperature: 77° F                  Stability Class: F
  No Inversion Height                     Relative Humidity: 50%

SOURCE STRENGTH:
  Direct Source: 0.0000031 kilograms/sec
  Source Height: 0
  Release Duration: 30 minutes
  Release Rate: 4.1e-04 pounds/min
  Total Amount Released: 0.012 pounds
  Note: This chemical may flash boil and/or result in two phase flow.
     Use both dispersion modules to investigate its potential behavior.

THREAT ZONE:
  Model Run: Gaussian
  Red   : less than 10 meters(10.9 yards) --- (50 ppm = ERPG-3)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.
  Orange: less than 10 meters(10.9 yards) --- (20 ppm = ERPG-2)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.
  Yellow: 28 yards --- (2 ppm = ERPG-1)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.
```

```
SITE DATA:
  Location: FLUENCE FALLBROOK, CALIFORNIA
  Building Air Exchanges Per Hour: 0.38 (unsheltered single storied)
  Time: September 5, 2019  0000 hours PDT (user specified)

CHEMICAL DATA:
  Chemical Name: HYDROGEN CYANIDE
  CAS Number: 74-90-8                    Molecular Weight: 27.03 g/mol
  AEGL-1 (60 min): 2 ppm   AEGL-2 (60 min): 7.1 ppm   AEGL-3 (60 min): 15 ppm
  IDLH: 50 ppm       LEL: 56000 ppm      UEL: 400000 ppm
  Ambient Boiling Point: 76.8° F
  Vapor Pressure at Ambient Temperature: greater than 1 atm
  Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
  Wind: 1.5 meters/second from SW at 3 meters
  Ground Roughness: open country         Cloud Cover: 5 tenths
  Air Temperature: 77° F                 Stability Class: F
  No Inversion Height                    Relative Humidity: 50%

SOURCE STRENGTH:
  Direct Source: 0.0000031 kilograms/sec
  Source Height: 0
  Release Duration: 30 minutes
  Release Rate: 4.1e-04 pounds/min
  Total Amount Released: 0.012 pounds

THREAT ZONE:
  Model Run: Gaussian
  Red   : less than 10 meters(10.9 yards) --- (25 ppm = ERPG-3)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.
  Orange: less than 10 meters(10.9 yards) --- (10 ppm = ERPG-2)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.
  Yellow: no recommended LOC value --- (N/A = ERPG-1)
```

```
SITE DATA:
  Location: FLUENCE FALLBROOK, CALIFORNIA
  Building Air Exchanges Per Hour: 0.38 (unsheltered single storied)
  Time: September 5, 2019  0000 hours PDT (user specified)

CHEMICAL DATA:
  Chemical Name: CARBON MONOXIDE
  CAS Number: 630-8-0                    Molecular Weight: 28.01 g/mol
  AEGL-1 (60 min): N/A   AEGL-2 (60 min): 83 ppm   AEGL-3 (60 min): 330 ppm
  IDLH: 1200 ppm     LEL: 125000 ppm     UEL: 742000 ppm
  Ambient Boiling Point: -313.2° F
  Vapor Pressure at Ambient Temperature: greater than 1 atm
  Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
  Wind: 1.5 meters/second from SW at 3 meters
  Ground Roughness: open country         Cloud Cover: 5 tenths
  Air Temperature: 77° F                 Stability Class: F
  No Inversion Height                    Relative Humidity: 50%

SOURCE STRENGTH:
  Direct Source: 0.0000036 kilograms/sec
  Source Height: 0
  Release Duration: 30 minutes
  Release Rate: 4.76e-04 pounds/min
  Total Amount Released: 0.014 pounds
  Note: This chemical may flash boil and/or result in two phase flow.
     Use both dispersion modules to investigate its potential behavior.

THREAT ZONE:
  Model Run: Gaussian
  Red   : less than 10 meters(10.9 yards) --- (500 ppm = ERPG-3)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.
  Orange: less than 10 meters(10.9 yards) --- (350 ppm = ERPG-2)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.
  Yellow: less than 10 meters(10.9 yards) --- (200 ppm = ERPG-1)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.
```

```
SITE DATA:
  Location: FLUENCE FALLBROOK, CALIFORNIA
  Building Air Exchanges Per Hour: 0.67 (unsheltered single storied)
  Time: September 5, 2019  1200 hours PDT (user specified)

CHEMICAL DATA:
  Warning: HYDROGEN CHLORIDE can react with water and/or water vapor.  This
  can affect the evaporation rate and downwind dispersion.  ALOHA cannot
  accurately predict the air hazard if this substance comes in contact with
  water.
  Chemical Name: HYDROGEN CHLORIDE
  CAS Number: 7647-1-0                   Molecular Weight: 36.46 g/mol
  AEGL-1 (60 min): 1.8 ppm   AEGL-2 (60 min): 22 ppm   AEGL-3 (60 min): 100 ppm
  IDLH: 50 ppm
  Ambient Boiling Point: -122.1° F
  Vapor Pressure at Ambient Temperature: greater than 1 atm
  Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
  Wind: 3 meters/second from SW at 3 meters
  Ground Roughness: open country         Cloud Cover: 5 tenths
  Air Temperature: 77° F                 Stability Class: C
  No Inversion Height                    Relative Humidity: 50%

SOURCE STRENGTH:
  Direct Source: 0.0000042 kilograms/sec
  Source Height: 0
  Release Duration: 30 minutes
  Release Rate: 5.56e-04 pounds/min
  Total Amount Released: 0.017 pounds
  Note: This chemical may flash boil and/or result in two phase flow.

THREAT ZONE:
  Model Run: Gaussian
  Red   : less than 10 meters(10.9 yards) --- (150 ppm = ERPG-3)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.
  Orange: less than 10 meters(10.9 yards) --- (20 ppm = ERPG-2)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.
  Yellow: less than 10 meters(10.9 yards) --- (3 ppm = ERPG-1)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.
```

```
SITE DATA:
  Location: FLUENCE FALLBROOK, CALIFORNIA
  Building Air Exchanges Per Hour: 0.67 (unsheltered single storied)
  Time: September 5, 2019  1200 hours PDT (user specified)

CHEMICAL DATA:
  Warning: HYDROGEN FLUORIDE can react with water and/or water vapor.  This
  can affect the evaporation rate and downwind dispersion.  ALOHA cannot
  accurately predict the air hazard if this substance comes in contact with
  water.
  Chemical Name: HYDROGEN FLUORIDE
  CAS Number: 7664-39-3                  Molecular Weight: 20.01 g/mol
  AEGL-1 (60 min): 1 ppm   AEGL-2 (60 min): 24 ppm   AEGL-3 (60 min): 44 ppm
  IDLH: 30 ppm
  Ambient Boiling Point: 65.8° F
  Vapor Pressure at Ambient Temperature: greater than 1 atm
  Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
  Wind: 3 meters/second from SW at 3 meters
  Ground Roughness: open country         Cloud Cover: 5 tenths
  Air Temperature: 77° F                 Stability Class: C
  No Inversion Height                    Relative Humidity: 50%

SOURCE STRENGTH:
  Direct Source: 0.0000031 kilograms/sec
  Source Height: 0
  Release Duration: 30 minutes
  Release Rate: 4.1e-04 pounds/min
  Total Amount Released: 0.012 pounds
  Note: This chemical may flash boil and/or result in two phase flow.
     Use both dispersion modules to investigate its potential behavior.

THREAT ZONE:
  Model Run: Gaussian
  Red   : less than 10 meters(10.9 yards) --- (50 ppm = ERPG-3)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.
  Orange: less than 10 meters(10.9 yards) --- (20 ppm = ERPG-2)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.
  Yellow: less than 10 meters(10.9 yards) --- (2 ppm = ERPG-1)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.
```

```
SITE DATA:
  Location: FLUENCE FALLBROOK, CALIFORNIA
  Building Air Exchanges Per Hour: 0.67 (unsheltered single storied)
  Time: September 5, 2019  1200 hours PDT (user specified)

CHEMICAL DATA:
  Chemical Name: HYDROGEN CYANIDE
  CAS Number: 74-90-8                    Molecular Weight: 27.03 g/mol
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  IDLH: 50 ppm       LEL: 56000 ppm      UEL: 400000 ppm
  Ambient Boiling Point: 76.8° F
  Vapor Pressure at Ambient Temperature: greater than 1 atm
  Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
  Wind: 3 meters/second from SW at 3 meters
  Ground Roughness: open country         Cloud Cover: 5 tenths
  Air Temperature: 77° F                 Stability Class: C
  No Inversion Height                    Relative Humidity: 50%

SOURCE STRENGTH:
  Direct Source: 0.0000031 kilograms/sec
  Source Height: 0
  Release Duration: 30 minutes
  Release Rate: 4.1e-04 pounds/min
  Total Amount Released: 0.012 pounds

THREAT ZONE:
  Model Run: Gaussian
  Red   : less than 10 meters(10.9 yards) --- (25 ppm = ERPG-3)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.
  Orange: less than 10 meters(10.9 yards) --- (10 ppm = ERPG-2)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.
  Yellow: no recommended LOC value --- (N/A = ERPG-1)
```

```
SITE DATA:
  Location: FLUENCE FALLBROOK, CALIFORNIA
  Building Air Exchanges Per Hour: 0.67 (unsheltered single storied)
  Time: September 5, 2019  1200 hours PDT (user specified)

CHEMICAL DATA:
  Chemical Name: CARBON MONOXIDE
  CAS Number: 630-8-0                    Molecular Weight: 28.01 g/mol
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  IDLH: 1200 ppm     LEL: 125000 ppm     UEL: 742000 ppm
  Ambient Boiling Point: -313.2° F
  Vapor Pressure at Ambient Temperature: greater than 1 atm
  Ambient Saturation Concentration: 1,000,000 ppm or 100.0%

ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
  Wind: 3 meters/second from SW at 3 meters
  Ground Roughness: open country         Cloud Cover: 5 tenths
  Air Temperature: 77° F                 Stability Class: C
  No Inversion Height                    Relative Humidity: 50%

SOURCE STRENGTH:
  Direct Source: 0.0000036 kilograms/sec
  Source Height: 0
  Release Duration: 30 minutes
  Release Rate: 4.76e-04 pounds/min
  Total Amount Released: 0.014 pounds
  Note: This chemical may flash boil and/or result in two phase flow.
     Use both dispersion modules to investigate its potential behavior.

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  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.
  Orange: less than 10 meters(10.9 yards) --- (350 ppm = ERPG-2)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.
  Yellow: less than 10 meters(10.9 yards) --- (200 ppm = ERPG-1)
  Note: Threat zone was not drawn because effects of near-field patchiness
     make dispersion predictions less reliable for short distances.
```