Appendix A

Health Risk Assessment

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Health Risk Assessment for Emissions of Diesel Particulate Matter Lindero Pump Station Rehabilitation (Project No. 592)

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Prepared for

Calleguas Municipal Water District
2100 Olsen Road
Thousand Oaks, California 91360

K/J Project No. 2144202*00

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Section 1: Introduction

This Health Risk Assessment for Diesel Particulate Matter Report (Report) presents the results of a Health Risk Assessment (HRA) performed by Kennedy Jenks for the backup generator planned to be installed by Calleguas Municipal Water District (CMWD) as part of its Lindero Pump Station Rehabilitation (Project). Figure 1 identifies the location of the Project in Ventura County within the city limits of Thousand Oaks, California. The emergency diesel-fueled engine-generator (genset) will be located outside, adjacent to an existing structure and is surrounded by a school to the west, residential units to the north, and undeveloped land to the south and east. Included in this Report is a discussion on the purpose and background of the HRA, a summary of the methods used to perform the HRA, and the results obtained for the HRA as it pertains to emissions of Diesel Particulate Matter (DPM) from the diesel-fueled engines that support the genset.

The HRA was performed to support the permitting process for the Project in accordance with the requirements of the Ventura County Air Pollution Control District (VCAPCD). The VCAPCD administers a program that requires new air pollution-emitting facilities to obtain permits to construct and operate those facilities, referred to as Authority to Construct and Permit to Operate, respectively. CMWD is currently working with VCAPCD to obtain an Authority to Construct and, as part of the permitting process, VCAPCD has requested CMWD perform an air toxic review (i.e., HRA) for the Project. The HRA is limited to DPM emissions that may occur from the diesel-fueled engine that supports the genset.

As requested by VCAPCD, the HRA is being performed for DPM emissions that could be released during the testing and maintenance operations performed on the diesel-fueled engine. The genset serves as an emergency power source and will be tested on a routine basis for maintenance and readiness.

VCAPCD has developed an Engineering Division Policy and Procedure (Policy), issued 12 February 1992, for conducting an air toxic review of new potential pollution-emitting facilities. According to the Policy, each Authority to Construct application for new potential pollution-emitting facilities is reviewed by the Air Toxics Section to determine whether an HRA needs to be prepared. The policy has established cancer risk levels and non-cancer chronic and acute hazard indices designed to protect human health and welfare with an acceptable margin of safety.

Cancer risk is expressed as the maximum number of new cases of cancer projected to occur in a population of one million people due to exposure to the cancer-causing substance over a 70-year residential period. Cancer risk is calculated by multiplying the daily inhalation or oral dose, by a cancer potency factor, the age sensitivity factor, the frequency of time spent at home (for residents only), and the exposure duration divided by averaging time, to yield the excess cancer risk.

Non-cancer hazard index and non-cancer acute hazard index are defined on the Emission Inventory and Risk Glossary of the California Air Resources Board (CARB) website (CARB 2013) as follows:

- **Non-Cancer Chronic Hazard Index:** "The potential non-cancer health impacts resulting from exposure to toxic substances usually lasting from 1 year to a lifetime. The total hazard index includes the sum of hazard indices for pollutants with non-cancer health effects that have the same or similar adverse health effects (endpoints). A chronic hazard index is calculated by dividing the annual average concentration of a toxic pollutant by the chronic reference exposure level for that pollutant."

- **Non-Cancer Acute Hazard Index:** "The potential non-cancer health impacts resulting from a 1-hour exposure to toxic substances. The total hazard index includes the sum of hazard indices for pollutants with non-cancer health effects that have the same or similar adverse health effects (endpoints). An acute hazard index is calculated by dividing the 1-hour concentration of a toxic pollutant by the acute reference exposure level for that pollutant."

As shown in this report, the Project will result in local air quality impacts that are below the risk levels and hazard indices defined by the VCAPCD and are not anticipated to cause an impact to human health and welfare at the Point of Maximum Impact, nearby school, or residential units.

1.1 Purpose of Health Risk Assessment

CMWD is working with VCAPCD to obtain an Authority to Construct and, as part of the permitting process, VCAPCD has requested CMWD perform an HRA for the Project. The HRA is limited to DPM emissions that may occur from the diesel-fueled engine.

The Air Toxics "Hot Spots" Information and Assessment Act (AB2588) was enacted in September 1987. The goal of AB2588 is to collect emissions data, identify facilities having localized impacts, ascertain health risks, notify nearby residents of significant risks, and reduce significant risks. The Air Toxic "Hot Spots" program is managed by CARB. VCAPCD works in conjunction with CARB to ensure source-emitting regulated air pollutants in Ventura County meet the applicable requirements of this program. To ensure the requirements of AB2588 are satisfied, VCAPCD developed their air toxic Policy.

The Policy developed by VCAPCD indicates that any required HRAs shall be prepared in accordance with AB2588's current guidelines, and includes the following thresholds and resulting actions:

- If potential cancer risk of the proposed emissions is less than one in one million and the non-cancer chronic and acute hazard indices are less than 0.5, no further action is required by the applicant to evaluate air toxic emissions.
- If potential cancer risk is greater than one in one million, or the chronic or acute hazard indices are greater than 0.5, then VCAPCD staff will work with the applicant to reduce risk to an acceptable level.
- If potential cancer risk is greater than ten in one million or chronic or acute hazard indices exceed 1.0, then the Authority to Construct permit may be issued with a requirement for the facility to develop and implement a health risk reduction plan (VCAPCD 2002). The health risk reduction plan would target and reduce potential emissions and ultimately lower the cancer risk below the ten in one million threshold or non-cancer risk below the 1.0 threshold.

- If the potential cancer risk is greater than 100 in one million or the chronic or acute hazard indices are greater than 10, the application will be denied based on failure to demonstrate compliance with Rule 51 – Nuisance.

As part of the application for an Authority to Construct for the Project, this HRA was performed to evaluate emissions of DPM from the combustion of diesel fuel in the Project's genset to ensure the emissions of air toxics will not result in a health risk exceeding thresholds for cancer risk, chronic hazard index, or acute hazard index. The Project utilized CARB's Air Toxic Hot Spot program to determine health risk values.

1.2 Evaluation Tools and Methods

This HRA was developed for emissions of DPM for the Project. As shown in this Report, potential emissions of DPM from the diesel-fueled engine, supporting the genset, will not cause an unacceptable cancer or non-cancer health risk. This assessment was performed using tools and procedures developed by U.S. Environmental Protection Agency (EPA) and CARB. The tool used to perform air quality impact evaluations is referred to as an air dispersion model. For purposes of this assessment, the most sophisticated air dispersion model (i.e., AERMOD) developed to date and recommended as the preferred modeling tool for conducting air quality impact evaluations by EPA was utilized. In conjunction with this air dispersion modeling tool, five years of hourly meteorological conditions representative of the Project site were incorporated and evaluated. The concentration results from the dispersion model are entered in the CARB Hotspots Analysis Reporting Program Version 2 (HARP 2) Risk Assessment Standalone Tool (RAST) to calculate cancer and non-cancer risk values.

The AERMOD air dispersion model is a computerized program that requires information about the sources (i.e., air pollutant emission rates and stack release parameters) and meteorological conditions present in the area. The model utilizes the source information and meteorological conditions to simulate the potential impacts on ambient air quality. Potential impacts are expressed in micrograms per cubic meter ($\mu g/m^3$) which corresponds to the standard units in which air quality regulations are established.

Section 2: Air Dispersion Model Used in the Health Risk Assessment

2.1 Description of the Air Dispersion Model

To perform the health risk assessment, the most recent version of AERMOD View (Version 9.9.0), developed by Lakes Environmental Software, was utilized. AERMOD View incorporates the latest available version of EPA regulatory models AERMOD Version 19191, AERMET Version 14134, ISCST3, and ISC-PRIME, developed by The American Meteorological Society/EPA Regulatory Model Improvement Committee, into a single interface. The EPA's approved regulatory AERMOD code, used to predict ambient and ground level concentrations, is unaltered by AERMOD View and accompanying software packages.

The AERMOD View software suite consists of several applications supporting pre-processing model input requirements and post-processing model results in addition to those mentioned above. The following list summarizes the versions of AERMOD View software that were used for this air dispersion modeling analysis:

- AERMOD View 9.9.0 (AERMOD 19191)
- AERMAP 18081
- Building Profile Input Program for Prime (BPIPPRM) 04274
- POST View 9.9.0.

2.1.1 Model Parameters

The regulatory default options in AERMOD View were utilized for this air dispersion modeling analysis. The fugitive emission source function of AERMOD (i.e., point source algorithm) in conjunction with the hourly meteorological surface data and upper air data was used to predict short-term (1-hour averaging period) and long-term (annual averaging period) potential ambient air concentrations at discrete receptor locations around the Project site.

Several data elements are required as inputs to support the air dispersion model, including:

- Representative hourly meteorological surface and upper air data
- Locations at which the model will calculate potential predicted concentrations, referred to as discrete receptors
- Terrain elevations for each discrete receptor, building and source
- Emission data specific to each source onsite

Each of these data elements is discussed further below.

2.1.1.1 Meteorological Data

The representative hourly meteorological data used to support the air dispersion modeling analysis is comprised of surface data from the Camarillo Airport Surface Met Station WBAN: 23136, Camarillo, California, and upper air data from Met Station WBAN: 93214, Vandenberg, California. The surface meteorological station is considered representative of the Project site based on distance to the site, proximity to the coast, and similar land use classification and industry in the surrounding area. Pre-processed AERMOD-ready meteorological data was provided by the CARB Website. CARB staff acquired and processed the raw meteorological data using AERMET. The most recent 5 years of meteorological data available (1 January 2009 thru 31 December 2013) were used in the air dispersion modeling analysis.

On 3 August 2016, the VCAPCD approved the above meteorological data set, via email, for use in HRAs to address the potential impacts of DPM emissions from projects in the area.

2.1.1.2 Coordinate System

The air dispersion model uses the 1983 North American Datum (NAD83) with the Universal Transverse Mercator (UTM) Zone 11 North projection. Emission sources, buildings, and discrete receptors were located using this coordinate system.

2.1.1.3 Receptor Network

The receptor network includes a dense array of discrete receptors and is designed to identify the maximum ambient concentration that could occur from potential onsite air pollutant emission sources. Specifically, discrete receptors are spaced at 25 meters along the site boundary and extend outward to 1,000 meters in a fence line grid array with a fence line spacing and tier spacing of 25 meters. Additionally, a multi-tier grid, with two tiers, was established with discrete receptors spaced at 100 meters to a distance of two kilometers in the first tier and spaced at 500 meters to a distance of five kilometers in the second tier. The selection of a 1,000-meter dense fence line array and a 5-kilometer total downwind distance is a conservative estimation for potential maximum ambient air concentrations, as maximum airborne emissions will likely occur within a short distance of the onsite air pollutant emission sources with short release heights, such as the genset exhaust stack (i.e., 20.3 feet above grade). EPA guidance recommends a discrete receptor spacing of 100 meters to capture maximum concentrations in support of analysis performed using the AERMOD dispersion model. The dense array of receptors includes numerous receptors throughout the nearby school property and residences to thoroughly evaluate potential impacts.

The maximum 1-hour and maximum annual model-predicted concentrations occurring on the receptor network were used in the cancer risk and non-cancer chronic and acute hazard indices calculations. More precisely, the maximum cancer risk and maximum chronic and acute hazard indices were estimated by assuming a residence was located at the discrete receptor location of the maximum potential concentration.

A general vicinity map is provided on Figure 1 and shows the nearby school and residential units. A site map is provided on Figure 2 and depicts the proposed exhaust stack location relative to the building and site features. Proposed stack parameters and building dimensions are included on Figure 2. Figure 3 shows an overview of the receptor network and locations relative to the surrounding residential development and open space.

2.1.1.4 Terrain Data

Terrain elevation data was assigned to the discrete receptors using the latest version of AERMAP, a utility in AERMOD View. AERMAP obtains national elevation data (NED) files at 1 arc second resolution from the United States Geological Survey data server and can populate elevations for receptors, buildings, and emission sources. The specific terrain data files used in the model are NED GEOTIFF 1 (~USA 30 m). Discrete receptor base, emission stack and building base elevations were provided by AERMAP.

2.1.1.5 Buildings

One existing building with a single tier was included in the model to capture any potential down-washing effects that the building may have on the genset emission source. The existing building has a height of 13 feet.

2.1.1.6 Land Use Dispersion Coefficients

The EPA's Auer Land use method is used to determine whether rural or urban dispersion coefficients should be used in the ambient air quality impact evaluation using air dispersion modeling. The land use method involves circumscribing a 3-kilometer circle about the emission source and classifying the land use within the circle as rural or urban. If more than 50 percent of the land use is classified as urban, then urban dispersion coefficients will be used. Otherwise, rural dispersion coefficients will be used.

Based on visual inspection of aerial photography, it was determined the majority of the land use surrounding the site is comprised of Undeveloped land and Common Residential, which is classified as rural land use, and therefore, rural dispersion coefficients were selected for use within AERMOD View.

2.1.1.7 Emissions Inventory

The inventory of emission sources included in the HRA air dispersion analysis for emissions of DPM is provided in Table 1. As shown in the table, emissions of DPM were evaluated for a single potential DPM emission source. For this Project, a single genset, KOHLER KD3000, is proposed for installation.

To determine the potential 1-hour and annual impacts of DPM from the proposed emission source, emission rates, expressed in grams per horsepower-hour on the manufacturer's equipment specification sheets (Appendix A), were converted to grams per second for direct input in the AERMOD View model. For the annual averaging period, the average annual emission rate was based on 20 operating hours per year. Detailed calculation methodologies are described below.

One-hour impacts were calculated by multiplying the emission rate (grams/horsepower-hour) by the engine power at 100 percent load (brake horsepower) and dividing by 3,600 (seconds/hour) to convert to grams per second. The annual impacts were calculated by multiplying the emission rate by the engine power at 100 percent load and 20 total operating hours (hours/year), then dividing by 8,760 total hours (hours in a year) and 3,600 (seconds/hour) to convert to grams per second.

The model was comprised of one source location with a single source. As shown in the emissions inventory (Table 1), the genset exhaust stack will have a release height of 6.2 meters (20.3 feet) above grade, a diameter of 0.5 meters (20 inches), an exhaust gas temperature of 751.2 Kelvin (892.4 degrees Fahrenheit), and a gas exit velocity of 51.6 meters per second (169.3 feet per second). The exhaust stack discharges vertically through a hinged, counter-weighted, rain cap with no restriction to flow. The location of the emission source is depicted on Figure 2.

2.1.2 Results

The air dispersion modeling results for 1-hour and annual averaging periods are provided in Tables 2 and 3, respectively. The maximum potential and school property 1-hour concentrations from the genset were predicted to be 33.6 $\mu g/m^3$ and 5.78 $\mu g/m^3$ respectively. The maximum potential and school property annual concentrations from the genset were predicted to be 0.00161 $\mu g/m^3$ and 0.00038 $\mu g/m^3$ respectively. These values represent worst case predictions for 1-hour and annual concentration scenarios. Refer to the results provided in Tables 2 and 3 for the predicted concentrations obtained from the genset.

Concentration isopleths for the 1-hour and annual averaging periods are provided on Figures 4 and 5, respectively. Additionally, sections of the 1-hour model output and annual model output files are included in Appendices B and C, respectively.

Section 3: Health Risk Assessment

3.1 Set Up Procedure

This HRA was performed in accordance with the CARB Hot Spots Analysis and Reporting Program (HARP 2). HARP 2 includes an Air Dispersion Modeling and Risk Tool (ADMRT) to perform air dispersion modeling and risk calculations; however, air dispersion modeling was performed using AERMOD View, while the HARP 2 Risk Assessment Standalone Tool (RAST) was utilized to calculate risk values. The following discussion provides a basic overview of how RAST was configured.

- **Step 1:** Determine the maximum potential 1-hour DPM concentration for the diesel-fueled engine supporting a genset operating and maximum potential annual average DPM concentration for the diesel-fueled engine supporting the genset operating from the air dispersion model; and

- **Step 2:** Enter the pollutant identification number and modeled maximum 1-hour and average annual concentrations. Select the risk scenario analysis type, receptor type, exposure duration, and intake rate percentile. Select the exposure pathway. Initiate the RAST program to calculate cancer risk and non-cancer chronic and acute hazard index values.

For purposes of this Project, to support the HRA for emissions of DPM from the diesel-fueled engine, the selected risk scenario analysis included cancer, chronic, and acute types for an individual resident, over a 70-year duration using the Office of Environmental Health Hazard Assessment (OEHHA) derived method of intake rate percentile. The assessment focused on the inhalation pathway as the sole exposure pathway. The *Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values* indicates the cancer potency factor should only be used for impacts from the inhalation pathway (CARB 2015). Conservatively, no fraction of time at home was selected, nor was an 8-hour or Tier 2 breathing rate applied to the exposure pathway.

The HRA output files are provided in Appendix D.

3.2 Results

The cancer risk and non-cancer chronic hazard index values account for potential emissions occurring over a 70-year period and are based on the assumptions that the diesel-fueled engine supporting the genset will be exercised monthly and tested annually and will operate in test mode no more than 20 hours a year. The non-cancer acute hazard index is based upon the maximum 1-hour concentration from the diesel-fueled engine operating at any during the day. The HRA analysis, at the maximum point of impact, results in a cancer risk of 1.69E-06 or 1.69 in one million, a respiratory non-cancer chronic hazard index of 3.00E-04, and a non-cancer acute hazard index of 0.0. The HRA analysis, at the school property, results in a cancer risk of 4.0 E-05 or 0.4 in one million, a respiratory non-cancer chronic hazard index of 1.00E-04, and a non-cancer acute hazard index of 0.0. The cancer risk reflects limiting operation of the diesel-fueled engines to operating no more than 20 hours during a given 12-month period.

Results of the HRA analyses are provided in Table 4 and RAST output files are provided in Appendix D. As shown in Table 4, the non-cancer chronic hazard index corresponding to the Point of Maximum Impact and School Property Impact annual predicted concentrations of DPM emissions from the proposed genset is below the non-cancer chronic threshold of 0.5. Similarly, the non-cancer acute hazard index of 0.0, corresponding to the maximum 1-hour predicted concentration, is below the 0.5 threshold as well. As such, the predicted impact meets the health standard for non-cancer risks established by CARB.

The Point of Maximum Impact and the School Property annual concentrations obtained from AERMOD were entered into the RAST and resulted in a potential cancer risk of 1.7 in one million and 0.4 in one million, respectively. The Point of Maximum Impact potential cancer risk is above the non-action threshold of one in one million. However, since the potential cancer risk of 1.7 in one million is less than ten in one million, the VCAPCD Policy suggests no further action is required and the potential risk of less than ten in one million is acceptable. The School Property Impact cancer risk is below one in one million and no further action is required. An Authority to Construct permit can be issued with no requirement to further reduce the air toxic pollutant of concern for the proposed Project.

References

Air Toxics “Hot Spots” Information and Assessment Act (AB2588). 1987. September.

State of California, California Environmental Protection Agency, Air Resources Board, 2013. *Emission Inventory and Risk Glossary* dated 13 March 2013.

State of California, California Environmental Protection Agency, Air Resources Board. 2015. *User Manual for the Hotspots Analysis and Reporting Program Health Risk Assessment Standalone Tool Version 2* dated 17 March 2015.

Ventura County Air Pollution Control District. 2002. Engineering Division, Policies and Procedures, Air Toxics Review of Permit Applications dated 10 July 2002.