February 8, 2016

Dilan Roe
Hazardous Materials Supervisor
Alameda County Environmental Health
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502-6577

Subject: **M&M LLC Property**
2800 Broadway, Oakland, CA
Fuel Leak Case No. RO3201

Dear Ms. Roe:

Enclosed is the *Interim Remedial Action Plan* for the subject volunteer cleanup site. The Voluntary Remedial Action Agreement governing this site was executed on December 17, 2015. In compliance with state and local regulations, electronic submittals of this report have been uploaded to the Geotracker database and the Alameda County ftp website.

I declare under penalty of perjury that the information and/or recommendations contained in the attached report are true and correct to the best of my knowledge.

Please contact Tim Cook at Cook Environmental Services at (925) 478-8390 if you have questions or comments in regard to the technical content of this report.

Very truly yours,

Mike Murphy

cc: Tim Cook, Cook Environmental Services, Inc.

INTERIM REMEDIAL ACTION PLAN

PROJECT SITE:
2800 Broadway
Oakland, California 94612
ACEH Case RO0003201

PREPARED FOR:
M&M, LLC.
2740 Broadway
Oakland, CA 94612

SUBMITTED TO:
Dilan Roe
Alameda County Environmental Health
1311 Harbor Bay Pkwy, Ste 250
Alameda, CA 94502-6577

PREPARED BY:
Cook Environmental Services, Inc.
1485 Treat Blvd, Suite 203A
Walnut Creek, CA 94576

Project No. 1137

February 5, 2016

PROFESSIONAL CERTIFICATION

INTERIM REMEDIAL ACTION PLAN

2800 Broadway
Oakland, California 94612
ACEH Case RO0003201

February 5, 2016

This Work Plan has been prepared by the staff of Cook Environmental Services, Inc. (CES) under the professional supervision of the professional engineer whose seal and signature appears hereon.

The findings, recommendations, specifications or professional opinions are presented within the limits prescribed by the client, after being prepared in accordance with generally accepted professional engineering practice.

There is no other warranty, either expressed or implied. Some of the information presented herein may have been provided by third parties, and verification/certification of third party information is beyond the scope of CES's work on this project. The scope of services for this project is limited, and this report should not be relied upon by parties for whom it was not intended.

Tim Cook, P.E. #C54036

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1.0 INTRODUCTION

This Interim Remedial Action Plan is presented in response to a release of petroleum hydrocarbons and chlorinated hydrocarbons from a former automobile repair and dealership located at 2800 Broadway in Oakland, California. The Site location is shown on **Figure 1**.

The lead regulatory agency for this case is Alameda County Environmental Health (ACEH). The Site is owned by M&M Property LLC. The owner retained Cook Environmental Services, Inc. (CES) to provide regulatory compliance services under the oversight of ACEH. The ACEH case number for the Site is No**.** RO0003201. The ACEH caseworker is Ms. Dilan Roe.

1.1 Site Description

The Site is located at the northeast corner of Broadway and 28th Street and is approximately one mile northeast of downtown Oakland. The area surrounding the site is referred to as Oakland's "Auto Row", an area historically occupied by automobile sales and service facilities. The building to the north of the site, formerly a Nissan dealership, was vacant at the time of the site reconnaissance. Adjacent to the east is a smog check station. To the south of the site are 28th Street and a Volkswagen dealership. Broadway is adjacent to the west, and across Broadway is a vacant building, a parking lot and various small businesses.

Glen Echo Creek is approximately 375 ft east of the site and flows southeasterly towards Lake Merritt. Lake Merritt is approximately 0.4-mile southeast of the site. The elevation of the site is approximately 34 ft above mean sea level and the property slopes to the south-southeast, towards Lake Merritt. According to FEMA maps, the site is not located within a designated flood zone.

The site is a trapezoidal parcel (APN 09-685-68). The area of the lot is approximately 13,207 SF. The site is occupied by a one-story and mezzanine commercial building presently used for automobile storage by Premier Hyundai of Oakland, an automobile dealership.

1.2 Site History

According to Sanborne Fire Maps, the site was occupied by a single dwelling unit in 1903[1], two dwelling units in 1911[2], wholesale electrical supply stores in 1950, 1952 and 1954[3].

[1] Sanborne Fire Insurance Map, 1903
[2] Sanborne Fire Insurance Map, 1911 identifies the property as 1912 and 1916 Broadway
[3] Sanborne Fire Insurance Maps, 1950, 1952 and 1954 identifies the electrical supply stores as 2800, 2810, 2812, and 2814 Broadway

The first listing for the site in the City Directory is Range Lloyd Auto Access (1933), then Auburn Authorized Factory Parts & Service (1938), Used Autos (1943), Motor Car Exchange (1945), Incandescent Supply Company (1950 to 1962), Galaxy Lighting Company (1967 to 1991), and King Covers (1996 to 2008).

Historical City of Oakland Building Department records for the site include various permits for signs, electrical work, and zoning clearances for use as "automobile and other light vehicle sales and rental" and a car dealership. A permit was issued in 1993 for the removal of an interior wall, old plaster ceiling, and wood floor, and the construction of three concrete ramps. A permit was issued in 1993 for the installation of two toilets and two sinks. A permit was issued in 1998 for a mandatory seismic upgrade.

1.3 Previous Site Investigations

Recent Phase II environmental investigations conducted during due diligence surveys discovered petroleum hydrocarbons and chlorinated hydrocarbons in soil and groundwater beneath the Site.[4],[5] A site plan showing boring locations on the site as well as 2820 and 2855 Broadway is included as **Figure 2**.

Total petroleum hydrocarbons as gasoline (TPH-g) was detected in site soils at concentrations up to 89 mg/kg. None of the site soil samples exceeded the ESLs[6] for TPH. Several offsite samples exceeded ESLs. A Site Plan showing TPH concentrations in soil is included as **Figure 3**. Trichloroethylene (TCE) was detected in subsurface soil at concentrations up to 200 milligrams per kilogram (mg/kg). A Site Plan showing TCE concentrations in soil samples is included as **Figure 4**. Laboratory results for organic constituents in soil samples are summarized in **Table 1**.

TPH-g was detected in groundwater at concentrations up to 880,000 µg/L. A Site Plan showing TPH-g concentrations in groundwater is included as **Figure 5**. TCE was detected in groundwater at concentrations up to 14,000 micrograms per liter (µg/L). A Site Plan showing TCE concentrations in groundwater is included as **Figure 6**. Laboratory results for organic constituents in groundwater samples are summarized in **Table 2**.

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[4] Limited Phase II Subsurface Investigation, AEI Consultants, April 27, 2015.
[5] Limited Phase II Environmental Assessment Report, 2800 2820 and 2855 Broadway, Oakland, California, ATC Group Services LLC, December 29, 2015.
[6] Users Guide: Derivation and Application of Environmental Screening Levels, San Francisco Bay Regional Water Quality Control Board, Interim Final, December 2013.

1.4 Regulatory Directive

This Interim Remedial Action Plan (IRAP) was prepared in response to meeting with ACEH on November 19, 2015 at which the owner agreed to be named as the Responsible Party (RP) for corrective action addressing soil and groundwater contamination at the site. A Voluntary Remedial Action Agreement between the owner and ACEH was executed on December 17, 2015. The purpose of this IRAP is to provide details for a proposed remediation system that will reduce concentrations of hydrocarbons and chlorinated solvents at the site to acceptable levels that protect human health and the environment.

1.5 Remediation Approach

This IRAP includes a description of the pilot system design and construction, baseline air and groundwater monitoring, system startup and monitoring, post-startup operation and monitoring, data evaluation and reporting, and project schedule. A three month pilot test is proposed.

The technology chosen to remediate soil and groundwater is in situ air sparging. Air sparging has been shown to be an effective means of treating volatile fuel hydrocarbons and chlorinated hydrocarbons.[7] In some cases, ozone sparging has been shown to be effective in oxidizing fuel hydrocarbons and dissolved chlorinated hydrocarbons.[8] There is supporting evidence for using air sparging on chlorinated solvents to remove the bulk of the contaminant plume and polishing the residual solvents (<100 µg/L) using ozone sparging[6.] We will follow this approach by monitoring groundwater quality at regular intervals during the pilot test. Once TCE concentrations drop to below 100 µg/L, we will switch on the ozone generator until concentrations drop to levels at which they no longer pose minimal risk to human health and the environment.

[7] Insitu Remediation of Chlorinated Solvent Plumes, Ward, C.H.and Stroo, H.F. Editors, Springer, 2010.
[8] Insitu Chemical Oxidation for Groundwater Remediation, Siegrist, R.L.; Crimi, M; Simpkin, Th.J., Editors, Springer, 2011

2.0 PILOT SYSTEM DESIGN

Figures 5 and 6 show the general area of groundwater impacts requiring remediation, with iso-concentration contours from groundwater data collected in April 2015 by AEI Consultants (AEI) and in September and October 2015 by ATC Group Services LLC (ATC).

The principle constituents of concern (COCs) are defined as those chemicals that were detected in groundwater samples above the Environmental Screening Levels (ESLs) established by the San Francisco Bay Regional Water Quality Control Board.[9] Using this definition, COCs at the site are TPH-g, TPH-d and TPH-o (collectively referred to as TPH), benzene, toluene, ethylbenzene and xylenes (collectively referred to as BTEX), TCE, cis-1,2 dichloroethene (DCE) and naphthalene.

Figure 7 shows proposed groundwater monitoring and sparge well locations. The sparge well locations indicate a fifteen foot radius of influence for each sparge point. A total of twelve ozone sparge points are proposed. The equipment system layout is shown on **Figure 8,** which indicates the location of the sparge system compound, above ground ozone conduit and sparge point locations.

2.1 Groundwater Monitoring Wells

Groundwater monitoring wells will be installed within and outside the building. The wells will be located within and around the perimeter of the contaminant plume. The purpose of the wells will be to collect groundwater samples to document the decrease in COC concentrations and to identify the formation of any secondary constituents during the injection of ozone (e.g., hexavalent chromium, bromate) that might pose additional risks to human health or the environment.

Eight monitoring wells will be installed in the uppermost water bearing zone in the locations shown on **Figure 7**. Groundwater was encountered in previous soil borings at the site at approximately 15 ft bgs. We anticipate screening the wells from 12 to 22 fbg. Screened intervals will not exceed 10 feet. Wells will be constructed of 2-inch diameter schedule 40 PVC and screened slots will be 0.010 inches wide. The filter pack will be comprised of #2/12 graded sand and will extend from the bottom of the well to 2 feet above the screened interval. The annular space above the filter pack will be sealed with at least 2 feet of hydrated bentonite chips. Type II

[9] Environmental Screening Levels, Interim Final, San Francisco Bay Regional Water Quality Control Board, December 2013

Portland Cement will be installed above the bentonite seal to within 1 foot of the surface. Surface completion will consist of a flush grade traffic box.

Well permits for monitoring and sparge wells will be obtained from Alameda County Public Works. Prior to drilling buried utilities within the work area will be determined using a private utility locator service and by notifying USA Alert.

Upon completion, monitoring wells will be developed to remove silts and clays from the filter pack. This will be accomplished by surging the wells followed by removal of fines using a bailer and/or submersible trash pump. Development water will be handled and stored as described in **Appendix B**.

A licensed California surveyor will survey the location and elevation of each monitoring well and will provide coordinates to the Geotracker database in accordance with State requirements.

2.2 Sparge Wells

Twelve sparge wells will be constructed by drilling borings with nominal 8-inch diameter hollow-stem augers to a total depth of 23 feet below the ground surface, which will result in groundwater submersion of approximately eight feet during base on historic groundwater levels in this area. The sparge diffuser points will be set at a depth that is below the highest concentration of the plume such that after the micro-bubbles are injected into the subsurface they rise through and oxidize dissolved contaminants. The location of the sparge wells is depicted on **Figure 7**.

Thirty-inch long, 2-inch diameter micro-porous ozone sparge points will be connected to a ¾-inch PVC riser pipe and placed through the auger annulus to the bottom of the boring. Sparge well hardware are shown on **Figure 9**. Each sparge point will be backfilled with graded #2/12 sand, through the augers to a depth of two feet above the top of each sparge point. A two-foot bentonite seal will be placed on top of the sand pack, and the remaining open borehole will be filled with Type II Portland Cement to a depth of one foot below the ground surface. At the surface, the sparege wells will stick up above the concrete slab and will be connected to horizontal ¾-inch PVC pipe that runs on top of the concrete floor to the sparger system.

2.3 Sparger System

The sparger system is the H_2O Engineering OSU10-26 Ozone Sparge Unit, a unit that generates and distributes compressed air or ozone to sparge points. The sparge unit rations air or ozone to each

sparge point by a cyclic valve and timer apparatus. Air or ozone is delivered, under sufficient pressure to each sparge point. The maximum operating pressure is 50 pounds per square inch (PSI) and the maximum operating flow is 3.8 cubic feet per minute (CFM). The system is capable of injecting either air or ozone enriched air in the sparge points. Our approach will be to inject air into the sparge points until TCE concentrations in nearby groundwater wells drop to approximately 200 ug/L. Ozone will be used to polish groundwater and remove TCE and hydrocarbons to acceptable concentrations.

If ozone is injected, the output will be up to 1.4 pounds per day at a concentration of approximately 2,250 ppmv. Ozone is generated from the ionization of concentrated oxygen. An oxygen concentrator within the unit removes nitrogen to produce an oxygen enriched airstream that is fed to the ozone generator. The system is capable of "pulsing" the flow of oxygen or ozone through a number of circuits using a programmable timer.

2.4 Sparge System Compound

The sparge system compound location is shown on **Figure 8**. The system compound will be placed next to the south wall of the building in order to access available electrical circuits.

The sparge unit is a free standing unit that will be anchored into the existing concrete floor. The sparger unit is housed in a cabinet to protect the equipment from weather and to provide sound mitigation.

2.5 Electrical

Electrical work will be performed in accordance with the Alameda County Building Code by a licensed electrical contractor. A dedicated 120 volt, 20 amp circuit will be installed from the main electrical panel in the building to the sparger compound. This circuit will include a 20 amp breaker in the main panel. Inside the sparger enclosure, we will install a GFCI protector and a switched breaker for the redundancy and manual system shutoff. Power for the sparge unit will come from a new installed 120 volt receptacle. A manual shutoff switch will be located next to the sparge system and will be labeled as an emergency shutoff.

2.6 System Operation

The system will be programmed to sequentially run each of the 10 sparge points connected to the sparge system for seven minutes (total of 70 minutes), after which time the sparger will rest for 10 minutes. This cycle will be repeated around the clock for the proposed three month pilot test period. As described in "System Startup and Monitoring", modifications to the system operating schedule may

be implemented to mitigate nuisance issues such as excessive noise. Operation schedule reductions will only occur in the event that other engineering or administrative controls are insufficient to mitigate potential excessive ozone concentrations or noise.

Since the OSU10-26 Ozone Sparge Unit will provide air or ozone to a maximum of ten stations at one time, we will first remediate groundwater in the source area. After COC concentrations have dropped to acceptable levels in nearby monitoring wells, we will manually reconfigure the delivery system to convey oxygen/ozone to the last two sparge wells.

3.0 SCOPE OF WORK

3.1 Project Management

Following approval of this IRAP, bids will be obtained from from C-57 drilling contractors for drilling and construction of the sparge and monitoring wells. Separate bids will be obtained from licensed contractors for construction of the system compound. Bids for installation of electrical components will be obtained from qualified electrical contractors. In addition, an underground utility survey will be conducted, sparge and monitoring wells will be surveyed, and construction derived wastes will be profiled and properly disposal of. CES will operate, monitor and maintain the system for a period of three months.

3.2 Permitting

Permits to construct the sparge and monitoring wells will be obtained from the Alameda County Department of Public Works. A CFR 1910.120 compliant Site Specific *Health and Safety Plan* will be prepared by CES and will include procedures to safety install the wells and sparge system.

3.3 Utility Survey

CES will mark sparge and monitoring well locations in the field and notify Underground Service Alert (USA) a minimum of 72 hours before work begins. USA will mark locations of public utilities. As an additional safety measure, CES will subcontract a private utility locator to perform a private utility survey in the work area. They will perform an electromagnetic scan for metallic objects, track nearby sinks, toilets or cleanouts to locate buried waste water lines, attempt to locate buried phone and gas lines, and perform water line detection. The utility surveyor will provide a utility location sketch while at the site and mark buried private utilities within the building.

3.4 Construction Derived Residuals

Soils that may be potentially impacted with contaminants from sparge and monitoring well drilling will be placed in 55-gallon drums, labeled, sealed, and left at the site pending laboratory analysis, disposal profiling, and appropriate disposal.

4.0 BASELINE MONITORING

4.1 Baseline Groundwater Monitoring

Baseline groundwater monitoring will be performed prior to system startup in order to establish background conditions. Baseline groundwater samples will be collected from each of the eight proposed monitoring well and analyzed for:

- Total petroleum hydrocarbons as gasoline (TPH-g) by EPA method 8015 modified;
- Benzene, toluene, ethylbenzene and xylenes by EPA Method 8021B,
- VOCs (standard list) by EPA Method 8260B

Samples for organic laboratory analysis will be collected in accordance with CES *Standard Operating Procedure for Groundwater Sampling* (fuel hydrocarbons) as described in **Appendix B**. In addition to the above organic analyses, baseline samples will be collected and analyzed for the following parameters:

- Bromide and Bromate by Method 300 (IC) – samples will be collected in unpreserved 1L plastic bottles, samples not field filtered, samples filtered in laboratory (28 day holding time),
- Total Chromium, Vanadium, Selenium and Molybdenum by Method 200.8 (ICP/MS) – samples field filtered into preserved (HNO_3) 1L plastic bottles (14 day holding time),
- Hexavalent Chromium by Method 218.6 - samples field filtered into unpreserved 1L plastic bottles (24 hr holding time).

In addition to samples collected for laboratory analysis, and in addition to standard field parameter measurements for groundwater sampling, field measurements will be performed for dissolved oxygen in order to evaluate changes before and after the introduction of air and/or ozone into the subsurface.

4.2 Baseline Air Monitoring

According to the *2005 Bay Area Ozone Strategy, Final Adopted January 4, 2006*, In April 2005 the California Air Resources Board (CARB) established an eight-hour average ozone standard of 0.070 ppm. Previously EPA adopted a new federal eight-hour standard of 0.08 ppm and after several years of litigation is currently finalizing planning requirements for the new standard including revocation of the federal one-hour ozone standard. The San Francisco Bay Area remains a non-attainment area for both the one-hour and eight-hour state ozone standards. The Bay Area 2010 Clean Air Plan provides a comprehensive plan to improve Bay Area air quality. Among other issues the plan outlines a strategy to meet standards for ground level ozone and it key precursors, ROG and NO_x. The California one-hour ozone standard is set at 0.09 parts per million (ppm). In recent years, the State standard has

been exceeded an average of 16 days per year." The greatest one source of ozone in air in the San Francisco Bay Area is from vehicle exhaust. CARB monitoring stations have provided ozone monitoring data for Alameda County since 1985. There are six monitoring stations for ozone in Alameda County. The most recent ozone compliance data available online is from 2003[10]. There was one exceedance of the 1-hour average and 5 exceedances of the 8-hour average. Data presented in this document represents data collected only at these specific monitoring stations and does not necessarily represent expected conditions at the site. Baseline air ozone concentrations will be measured at the site for ambient outdoor conditions and for conditions inside the building prior to system startup. Although outdoor ozone concentrations are expected to fluctuate with respect to the time of year, time of day, traffic conditions and changing weather conditions, monitoring data will be collected to provide a comparison between ambient outdoor conditions and indoor conditions to evaluate whether after startup, the ozone sparge system is having a detrimental effect on indoor air quality with respect to ozone. During system construction field work, periodic outdoor ozone measurements will be collected inside and outside of the building at approximately 10:00 a.m., noon, 2:00 p.m., and 4:00 p.m. Ozone reading will be measured with an Ozone Solutions Series-200 Ozone Monitor™ (0.001-20.00 ppm range, 1 PPB resolution) or comparable meter.

[10] Goodguide scorecard, pollution information site, http://scorecard.goodguide.com/env-releases/cap/county.tcl?fips_county_code=06001#air_rankings

5.0 SYSTEM STARTUP AND MONITORING

After the system construction is complete the system will be started, and undergo three consecutive days of monitoring. Immediately after startup, accessible PVC pipe connections will be sprayed with soapy water to identify potential leaks. Leaks identified will be repaired immediately.

Once the air sparging porition of the remediation has completed, the ozone generator will be turned on. At that time, an ozone detector (see Section 4.2) will be utilized to monitor ozone levels in the building and at accessible pipe connections. Sparge circuits will be manually run sequentially as readings are performed, and sparge pressures will be recorded on a CES Ozone Log.

Ozone concentration readings will be taken inside and outside the building (ambient upwind of the sparge system), once per hour for a period of four hours, starting at 10:00 a.m.

During the course of the first three days of monitoring, it should become apparent whether the ozone sparge system is causing an increase in ozone levels within the building. No workers will be allowed in the building during the three day startup period.

In the event that indoor ozone concentrations exceed ambient outdoor levels, it may be necessary to implement engineering and/or administrative controls that will address excessive ozone concentrations in the building, related to the ozone sparge system.

Following the initial three day startup and monitoring period, ozone monitoring and system operating parameters will be recorded once per week for two weeks. Ambient outdoor ozone concentration levels will be compared to indoor readings at the time of each ozone measurement.

It is our understanding that the building is used for vehicle storage only and workers do not work in this building. We will restrict access to the building to CES and/or subcontractors responsible for the operation and maintenance of the sparge system.

In the event that indoor ozone concentrations exceed outdoor concentrations such that they pose a threat to human health, due to operation of the ozone generator, the following engineering controls may be implemented:

- Install an ozone sensor and automatic shutoff in the building. The automatic shutoff sensor will be set to the current ozone PEL for workers of OSHA PEL†: TWA 0.1 ppm (0.2 mg/m^3);
- Ensure that adequate ventilation is available (via windows and doors),
- A clearly visible sign restricting access to the building shall be posted at the entrances to the building. The signs will inform workers of the presence of the sparge system, and instructions on how to turn it off if odors are sensed (ozone has excellent warning properties, with a

reported odor threshold of 0.0032 ppmv),

- Personnel will be acquainted with the manual shutdown switch,
- In the event that excessive ozone concentrations in indoor air are persistently detected, an ozone destruction unit may be purchased and operated in the building,
- The sparge system operation schedule may be modified to exclude sparge wells suspected of causing increased ozone concentrations in the building,

The following administrative controls are proposed:

- During the pilot study, all vehicles presently stored in the building will be removed and access to the building will be restricted to technical staff operating and maintaining the sparge system.

After the two week startup and monitoring period, a startup report will be prepared and submitted to ACEH which presents the results of the system startup and monitoring. This report will present groundwater data and recommendations, based on information gathered during the startup period.

6.0 POST STARTUP OPERATION AND MAINTENANCE

After the initial two week startup and monitoring period the system will be operated around the clock as described in Section 2.6, for a period of three months, unless modifications to the sparge schedule are necessary to control ozone concentrations in the conference building. Subsequent to the two week startup period, system operation, maintenance and monitoring will be conducted on a monthly basis (from the initial start date). The system will be checked for leaks, and operating parameters will be documented (including system chronometer). System leaks will be repaired, and potential problems causing system shutdown will be addressed. After the three month pilot test, CES will prepare a report recommending the continued use of air/ozone sparging or the cessation of sparging if the system is determined to be ineffective. Recommendations will be based on an evaluation of the site data as described in Section 8.0, *Data Evaluation and Reporting*.

7.0 POST STARTUP GROUNDWATER MONITORING

Groundwater monitoring wells will be monitored weekly during the first month of the pilot test (4 sampling events). Samples will be analyzed for TPH-g, BTEX and VOCs (standard list) as described in Section 4.1.

Wells will be monitored weekly during the first month of ozone sparging. These samples will be analyzed for TPH-g, BTEX, VOCs (standard list), bromide and bromate, total chromium, vanadium, selenium, molybdenum and hexavalent chromium as described in Section 4.1.

Secondary pollutants, such as hexavalent chromium and bromate, have been formed from ozone sparging at petroleum hydrocarbon impacted sites.[11] If concentrations of secondary pollutants from the oxidation of groundwater, such as hexavalent chromium or bromate, are detected in one or more wells above their respective public health limits and appear to be migrating offsite or downgradient of the established monitoring network, ACEH will be notified and the pilot test will be stopped immediately. The remedial effort will be re-evaluated to ensure secondary pollutants do not degrade water quality..

Quarterly groundwater monitoring will continue after completion of the pilot test. Quarterly groundwater monitoring samples will be analyzed for TPH-g, BTEX and VOCs (standard list) as described in Section 4.1.

[11] In-Situ Chemical Oxidation Ozone Sparging at a Petroleum Hydrocarbon-Impacted Site, J. Leu and R. Domingez, October 2012

8.0 DATA EVALUATION AND REPORTING

After the initial two week system startup monitoring period, a System Startup Report will be submitted to ACEH. The report will include the following elements:

- Borings logs for newly installed monitoring and sparge wells
- Results of baseline groundwater monitoring
- Initial system construction and ozone monitoring data,
- A compilation of ozone detection readings, shutoff dates and times (if applicable),
- Engineering or administrative controls utilized to control indoor ozone concentrations,
- A comparison of indoor and outdoor ozone detector readings as well as ozone air quality objectives and OSHA PELs.
- Disposal documentation for construction derived wastes
- Recommendations for the continued operation of the system, including recommendations for appropriate administrative and/or administrative controls, or it may, depending on monitoring data recommend a system shutdown and alternative remedial measures.

Following the three month pilot test period, the system will be shut down, and a *Quarterly Groundwater Monitoring and Remediation Pilot Test Report* will be prepared and submitted to ACEH. This report will include the following elements:

- A comparison of data from the baseline and quarterly groundwater monitoring events,
- A description of groundwater monitoring methods and procedures
- A description of air/ozone pilot system operation and maintenance, including system operating parameters.
- Field sampling logs,
- Laboratory analytical reports,
- A tabulation of groundwater monitoring data,
- A groundwater contour map,
- Iso-concentration maps for COCs of interest.
- A discussion of results and conclusions, and
- Recommendations as appropriate.

9.0 SCHEDULE

The proposed project schedule is shown on **Figure 10**. Project delays may result in areas beyond CES control such as permitting and approvals from ACEH. CES may take advantage of possibilities to accelerate the project schedule, to reduce the amount of time required to complete the scope of work.

TABLES

TABLE 1
Summary of Soil Laboratory Analytical Data - Organics
2800, 2820, 2855 Broadway
Oakland, CA

Sample ID	Sample Depth (ft bgs)	Sample Date	TPHg	TPHd	TPHo	Benzene	Toluene	Ethyl benzene	Total Xylenes	MTBE	cis-1,2-Dichloroethene	Trichloroethene (TCE)	Naphthalene	Other VOCs
			(mg/kg)	(mg/kg)	(mg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)
Soil Borings - AEI														
SB1-12.0	12	4/8/2015	<1.0	<1.0	<5.0	--	--	--	--	--	--	<0.0050	--	<MRL
SB2-12.0	12	4/8/2015	<1.0	<1.0	<5.0	--	--	--	--	--	--	<0.0050	--	<MRL
SB3-12.0	12	4/8/2015	<1.0	**4.7**	**56**	--	--	--	--	--	--	<0.0050	--	<MRL
SB4-12.0	12	4/8/2015	<1.0	<1.0	<5.0	--	--	--	--	--	--	<0.0050	--	<MRL
SB5-12.0	12	4/8/2015	<1.0	<1.0	<5.0	--	--	--	--	--	--	**0.015**	--	<MRL
SB6-12.0	12	4/8/2015	<1.0	<1.0	<5.0	--	--	--	--	--	--	**0.0069**	--	<MRL
SB7-12.0	12	4/8/2015	<1.0	<1.0	<5.0	--	--	--	--	--	--	<0.0050	--	<MRL
SB8-12.0	12	4/8/2015	<1.0	**1.2**	<5.0	--	--	--	--	--	--	<0.0050	--	<MRL
SB9-4.0	4	4/8/2015	**3.5**	**22**	**180**	--	--	--	--	--	--	<0.0050	--	<MRL
SB10-4.0	4	4/8/2015	**2.4**	**70**	**340**	--	--	--	--	--	--	<0.0050	--	<MRL
SB11-12.0	12	4/8/2015	<1.0	<1.0	<5.0	--	--	--	--	--	--	<0.0050	--	<MRL
Soil Borings - Cardno														
B1-5'	5	09/19/15	<0.230	**3.1**	<49	<4.6	<4.6	<4.6	<9.2	<4.6	<4.6	<4.6	<9.2	ND
B1-10'	10	09/19/15	<0.240	**1.2**	<50	<4.8	<4.8	<4.8	<9.6	<4.8	<4.8	<4.8	<9.6	ND
B1-15'	15	09/19/15	<0.240	**1.3**	<50	<4.9	<4.9	<4.9	<9.8	<4.9	<4.9	<4.9	<9.8	ND
B2-5'	5	09/19/15	<0.220	**2.1**	<50	<4.4	<4.4	<4.4	<8.8	<4.4	<4.4	<4.4	<8.8	ND
B2-10'	10	09/19/15	<0.230	**1.2**	<49	<4.6	<4.6	<4.6	<9.2	<4.6	<4.6	<4.6	<9.2	ND
B2-12'	12	09/19/15	**0.6**	**2.6**	<50	<4.8	<4.8	<4.8	**13**	<4.8	<4.8	<4.8	<9.6	1,2,4-Trimethylbenzene - **8.1**
B2-15'	15	09/19/15	**1.1**	**2.5**	<50	<5.0	<5.0	**17**	**29**	<5.0	<5.0	**20**	**29**	n-Propylbenzene - **6.1** 1,2,4-Trimethylbenzene - **50** 1,3,5-Trimethylbenzene - **12**
B2-16'	16	09/19/15	**89**	**94**	<50	<500	<500	<500	<1,000	<500	<500	<500	**1,200**	n-Butylbenzene - **520** 1,2,4-Trimethylbenzene - **3,300** 1,3,5-Trimethylbenzene - **940**
B3-5'	5	09/19/15	<0.250	**2.8**	<50	<5.0	<5.0	<5.0	<9.8	<5.0	<5.0	<5.0	<9.8	ND
B3-10'	10	09/19/15	<0.250	**4.3**	<50	<4.9	<4.9	<4.9	<9.9	<4.9	<4.9	<4.9	<9.9	ND
B3-15'	15	09/19/15	<0.250	<0.99	<50	<5.0	<5.0	<5.0	<10	<5.0	<5.0	<5.0	<10	ND
B3-20'	20	09/19/15	<0.250	<0.99	<49	<5.0	<5.0	<5.0	<9.9	<5.0	<5.0	<5.0	<9.9	ND
B3-24'	24	09/19/15	<0.250	**1.8**	<50	<5.0	<5.0	<5.0	<9.9	<5.0	<5.0	<5.0	<9.9	ND
B4-5'	5	10/03/15	<0.250	**2.3**	<50	<5.0	<5.0	<5.0	<10	<5.0	<5.0	<5.0	<10	ND
B4-10'	10	10/03/15	<0.250	<0.99	<49	<4.9	<4.9	<4.9	<9.9	<4.9	<4.9	<4.9	<9.9	ND
B4-14'	14	10/03/15	**15**	**40**	<50	<23	<23	<23	<46	<23	<23	**64**	<46	n-Butylbenzene - **40** 4-Isopropyltoluene - **26** N-Propylbenzene - **26** Trichloroethene - **64**
B4-16'	16	10/03/15	**0.53**	<0.98	<49	<5.0	<5.0	<5.0	<9.9	<5.0	**9.2**	**370**	<9.9	ND
B5-5'	5	10/03/15	<0.250	**1.8**	<49	<5.0	<5.0	<5.0	<10	<5.0	<5.0	<5.0	<10	ND
B5-10'	10	10/03/15	<0.250	**1.9**	<50	<5.0	<5.0	<5.0	<9.9	<5.0	<5.0	<5.0	<9.9	ND
B5-15'	15	10/03/15	<0.250	**2.1**	<50	<5.0	<5.0	<5.0	<9.9	<5.0	<5.0	<5.0	<9.9	ND
B6-5'	5	10/03/15	**0.29**	<0.98	<49	<5.0	<5.0	<5.0	<10	<5.0	<5.0	**200**	<10	ND
B6-10'	10	10/03/15	<0.250	**1.1**	<50	<5.0	<5.0	<5.0	<10	<5.0	<5.0	**40**	<10	ND
B6-15'	15	10/03/15	<0.240	**2.9**	<50	<4.7	<4.7	<4.7	<9.5	<4.7	<4.7	<4.7	<9.5	ND
B7-5'	5	10/03/15	<0.250	**1.0**	<49	<5.0	<5.0	<5.0	<9.9	<5.0	<5.0	<5.0	<9.9	ND
B7-10'	10	10/03/15	<0.250	<1.0	<50	<4.9	<4.9	<4.9	<9.9	<4.9	<4.9	**33**	<9.9	ND
B7-15'	15	10/03/15	<0.250	<1.0	<50	<5.0	<5.0	<5.0	<10	<5.0	<5.0	**82**	<10	ND
B8-5'	5	10/03/15	<0.250	**1.2**	<50	<4.9	<4.9	<4.9	<9.9	<4.9	<4.9	<4.9	<9.9	ND
B8-10'	10	10/03/15	<0.250	<1.0	<50	<5.0	<5.0	<5.0	<9.9	<5.0	<5.0	**65**	<9.9	ND
B8-15'	15	10/03/15	<0.230	**1.3**	<50	<4.6	<4.6	<4.6	<9.2	<4.6	<4.6	<4.6	<9.2	ND
B9-10'	10	10/03/15	<0.250	**1.0**	<50	<5.0	<5.0	<5.0	<9.9	<5.0	<5.0	<5.0	<9.9	ND
B9-15'	15	10/03/15	<0.250	**2.2**	<50	<5.0	<5.0	<5.0	<10	<5.0	<5.0	<5.0	<10	ND
B10-5'	5	10/03/15	<0.250	<0.98	<49	<4.9	<4.9	<4.9	<9.8	<4.9	<4.9	<4.9	<9.8	ND
B10-10'	10	10/03/15	<0.250	**1.5**	<50	<5.0	<5.0	<5.0	<10	<5.0	<5.0	<5.0	<10	ND
B10-15'	15	10/03/15	<0.250	<1.0	<50	<5.0	<5.0	<5.0	<10	<5.0	<5.0	<5.0	<10	ND
B11-5'	na	10/03/15	Collected groundwater sample only. No soil samples collected.											
B12-5'	5	10/10/15	<0.969	--	--	<4.8	<4.8	<4.8	<9.7	--	<4.8	<4.8	<4.8	ND
B12-10'	10	10/10/15	<0.982	--	--	<4.9	<4.9	<4.9	<9.8	--	<4.9	<4.9	<4..9	ND
B12-15'	15	10/10/15	<1.0	--	--	<5.0	<5.0	<5.0	<10.0	--	<5.0	<5.0	<5.0	ND
B13-5'	5	10/10/15	<1.0	--	--	<5.0	<5.0	<5.0	<10.0	--	<5.0	<5.0	<5.0	ND
B13-10'	10	10/10/15	<0.971	--	--	<4.9	<4.9	<4.9	<9.7	--	<4.9	<4.9	<4.9	ND
B13-15'	15	10/10/15	<0.990	--	--	<5.0	<5.0	<5.0	<9.9	--	<5.0	**75.1**	<5.0	ND
B13-24'	24	10/10/15	<0.965	--	--	<4.8	<4.8	<4.8	<9.7	--	<4.8	**33.4**	<4.8	ND
B13-28'	28	10/10/15	<0.992	**--**	--	<5.0	<5.0	<5.0	<9.9	--	<5.0	**49.7**	<5.0	ND
B14-5'	5	10/10/15	<0.994	**--**	--	<5.0	<5.0	<5.0	<9.9	--	<5.0	**14.7**	<5.0	ND
B14-12'	12	10/10/15	<0.969	**--**	--	<4.8	<4.8	<4.8	<9.7	--	<4.8	**20.0**	<4.8	ND
B14-15'	15	10/10/15	<0.965	**--**	--	<4.8	<4.8	<4.8	<9.7	--	<4.8	**162**	<4.8	ND
B15-8'	8	11/05/15	**12**	**290**	**590**	<5.0	**6.3**	**9.7**	**76**	<5.0	<5.0	<5.0	**150**	n-Butyl benzene - **30** sec-Butyl benzene - **16** Isopropylbenzene - **11** n-Propyl benzene - **17** 1,2,4-Trimethylbenzene - **120** 1,3,5-Trimethylbenzene - **47**
B15-12'	12	11/05/15	**1.3**	**1.2**	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	**5.6**	ND
B15-16'	16	11/05/15	<0.250	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	ND
B15-20'	20	11/05/15	<0.250	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	ND
B15-24'	24	11/05/15	<0.250	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	ND
B15-28'	28	11/05/15	<0.250	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	ND
B16-8'	8	11/05/15	<0.250	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	ND
B16-12'	12	11/05/15	<0.250	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	ND
B16-16'	16	11/05/15	<0.250	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	Carbon Tetrachloride - 14
B16-20'	20	11/05/15	<0.250	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	Carbon Tetrachloride - 16
B16-24'	24	11/05/15	<0.250	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	Carbon Tetrachloride - 11
B16-28	28	11/05/15	<0.250	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	Carbon Tetrachloride - 10 Chloroform - 7.6
B18-8'	8	11/05/15	<0.250	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	ND
B18-12'	12	11/05/15	<0.250	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	ND
B18-16'	16	11/05/15	<0.250	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	ND
B18-20'	20	11/05/15	<0.250	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	ND
B18-24'	24	11/05/15	<0.250	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	ND
B19-8'	8	11/06/15	<0.250	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	ND
B19-12'	12	11/06/15	<0.250	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	ND
B19-16'	16	11/06/15	<0.250	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	**16**	<5.0	ND
B19-20'	20	11/06/15	<0.250	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	ND
B19-24'	24	11/06/15	<0.250	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	ND
B20-8'	8	11/06/15	<0.250	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	ND
B20-10'	10	11/06/15	**3.3**	**8.6**	**15**	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	sec-Butyl benzene - **9.2**

TABLE 1
Summary of Soil Laboratory Analytical Data - Organics
2800, 2820, 2855 Broadway
Oakland, CA

Sample ID	Sample Depth (ft bgs)	Sample Date	TPHg	TPHd	TPHo	Benzene	Toluene	Ethyl benzene	Total Xylenes	MTBE	cis-1,2-Dichloroethene	Trichloroethene (TCE)	Naphthalene	Other VOCs
			(mg/kg)	(mg/kg)	(mg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)
B20-12'	12	11/06/15	**3.6**	**9.7**	**19**	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	ND
B20-16'	16	11/06/15	<0.250	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	ND
B20-19'	19	11/06/15	<0.250	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	ND
B20-24'	24	11/06/15	<0.250	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	ND
B21-3'	3	11/06/15	**40**	**680**	**3,100**	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	ND
B22-8'	8	11/06/15	<0.250	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	ND
B22-12'	12	11/06/15	<0.250	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	ND
B22-16'	16	11/06/15	<0.250	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	ND
B22-21'	21	11/06/15	<0.250	<1.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	ND
B23	na	11/-6/15	Collected groundwater sample only. No soil samples collected.											
ESL, Summary Table A (<9.8 feet)			100	100	100	44	2,900	3,300	2,300	23	190	460	1,200	Chloroform - 1,100; Trichloroethene - 460; Carbon tetrachloride - 110; *
ESL, Summary Table C (>9.8 feet)			500	110	500	44	2,900	3,300	2,300	23	190	460	1,200	Chloroform - 1,100; Trichloroethene - 460; Carbon tetrachloride - 110; *

Definitions/Abbreviations:

EPA -- Environmental Protection Agency
TPHg -- Gasoline Range Organics ([GRO] C5-C12) by EPA 8015 Gas chromatograph (GC)
TPHd -- Extractable fuel hydrocarbons ([EFC] C10 - C28) by EPA 8015 GC
TPHo -- Extractable fuel hydrocarbons ([EFC] C24 - C36) by EPA 8015 GC
mg/kg -- Milligrams per kilogram (equivalent to parts per million [ppm])
µg/kg -- Micrograms per kilogram (equivalent to parts per billion [ppb])
Total Xylenes -- Meta-, ortho-, and para-xylenes by EPA Method 8260B
MTBE -- Methyl tertiary-butyl ether by EPA Test Method 8260B
Ethanol -- Analyzed by EPA Test Method by 8260B
bgs -- Below Ground Surface
ft -- feet
< -- Less than the laboratory reporting limit indicated.
ND -- not detected above laboratory method detection limits
J -- Estimated value between method detection limit and reporting limit.
* -- "Other VOCs" ESLs' are not listed in this table because they are not listed in the ESL table
Results reported above the laboratoryreporting limit (RL) are presented in **bold** font.
Results reported above the ESL are highlighted in yellow

Notes:

ESL, Summary Table A (<9.8 feet):
San Francisco Bay, Regional Water quality Control Board, *Environmental Screening Levels (ESL's),* ***Summary Table A***.
Environmental Screening Levels (ESLs), Shallow Soils (<3m bgs), Groundwater is Current or Potential Source of Drinking Water,
Residential Land Use. December 2013.
Source: http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/esl.shtml. Viewed December 9, 2015.

ESL, Summary Table C (>9.8 feet):
San Francisco Bay, Regional Water quality Control Board, *Environmental Screening Levels (ESL's),* ***Summary Table C***.
Environmental Screening Levels (ESLs), Deep Soils (>3m bgs), Groundwater is a Current or Potential Source of Drinking Water,
Residential Land Use. December 2013.
Source: http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/esl.shtml. Viewed December 9, 2015.

TABLE 2
Summary of Groundwater Laboratory Analytical Data - Organics
2800, 2820, 2855 Broadway
Oakland, CA

Sample ID	Sample Date	TPHg	TPHd	TPHo	Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE	cis-1,2-Dichloroethene	Trichloroethene	Naphthalene	Other VOCs
		(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
Soil Borings													
B1-W	09/19/15	<50	<65	<130	<0.50	<0.50	<0.50	<1.0	**1.6**	<0.50	<0.50	<1.0	ND
B2-W	09/19/15	**880,000**	**170,000**	<7,500	**150**	**3,000**	**6,500**	**27,000**	<50	**310**	**14,000**	**4,200**	n-Butylbenzene - **1,900** sec-Butylbenzene - 4**60** Isopropylbenzene - **970** 4-Isopropyltoluene - **530** N-Propylbenzene - **3,000** 1,2,4-Trimethylbenzene - **18,000** 1,3,5-Trimethylbenzene - **5,700** Vinyl acetate - **4,100**
B3-W	09/19/15	<50	**160**	**350**	<0.50	<0.50	<0.50	<1.0	<0.50	**0.79**	**32**	<1.0	ND
B4	10/04/15	**3,800**	**830**	<100	**25**	**0.77**	**40**	**6.5**	<0.50	**180**	**4,400**	**10**	n-Butylbenzene - **14** sec-Butylbenzene - **4.7** 1,2-Dichloroethane - **3.6** 1,1-Dichloroethene - **0.85** trans-1,2-Dichloroethene - **1.0** Isopropylbenzene - **30** 4-Isopropyltoluene - **7.4** N-Propylbenzene - **29** 1,1,2-Trichloroethane - **6.1** 1,2,4-Trimethylbenzene - **25** 1,3,5-Trimethylbenzene - **15**
B5	10/04/15	**14,000**	**710**	<110	**56**	**1.5**	**7.5**	**6.0**	<0.50	**190**	**14,000**	**4.2**	Acetone - **230** n-Butylbenzene - **7.5** sec-Butylbenzene - **7.1** Chloroform - **3.8** Chloromethane - **1.1** 1,2,-Dichloroethane - **1.0** 1,1-Dichloroethene - **6.4** trans-1,2-Dichloroethene - **3.9** Isopropylbenzene - **52** 4-Isopropyltoluene - **1.2** N-Propylbenzene - **5.5** Tetrachloroethene - **5.8** 1,1,2-Trichloroethane - **5.6** 1,2,4-Trimethylbenzene - **0.98** Vinyl acetate - **47**
B6	10/04/15	<500	**140**	<110	<0.50	<0.50	<0.50	<1.0	<0.50	**2.2**	**340**	<1.0	ND
B7	10/04/15	**340**	**270**	<100	<0.50	<0.50	**0.71**	<1.0	**0.90**	**4.8**	**460**	<1.0	Dichlorobromomethane - **4.6** Isopropylbenzene - **0.73** 1,2,4-Trimethylbenzen**e - 0.64**
B8	10/04/15	<50	**170**	<100	<0.50	<0.50	<0.50	<1.0	**1.1**	**12**	**1,900**	<1.0	Chloroform - **1.2** trans-1,2-Dichloroethene - **0.72** Tetrachloroethene - **0.87** 1,1,2-Trichloroethane - **0.70**
B9	10/04/15	<50	**200**	<110	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	**36**	<1.0	ND
B10	10/04/15	**51**	**320**	<100	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	**17**	<1.0	ND
B11	10/04/15	<50	**480**	**460**	<0.50	<0.50	<0.50	<1.0	<0.50	<0.50	<0.50	<1.0	Carbon tetrachloride - **34** Chloroform - **8.3**
B-12	10/10/15	**12,800**	**--**	**--**	**6.9**	**1.6**	**59.9**	**29.5**	--	**9.4**	**121**	**54.3**	n-Butylbenzene - **13.8** sec-Butylbenzene - **9.7** Isopropylbenzene - **40.4** p-Isopropyltoluene - **14.5** n-Propylbenzene - **60.6** 1,2,4-Trimethylbenzene - **240** 1,3,5-Trimethylbenzene - **110**
B-13	10/10/15	**3,550**	**--**	**--**	<12.5	<12.5	<12.5	<25	--	<12.5	**2,800**	<12.5	ND
B-14	10/10/15	**7,800**	**--**	**--**	<25.0	<25.0	<25.0	<50.0	--	**26.1**	**6,160**	<25.0	ND
B-15	11/05/15	<50	**120**	<500	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	ND
B-16	11/05/15	<50	<50	<250	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	Carbon Tetrachloride - **4.8** Chloroform - **9.5**
B-17	11/05/15	<50	**95**	**310**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	Carbon Tetrachloride - **1.9**
B-18	11/05/15	<50	**190**	**1,000**	<0.50	<0.50	<0.50	<0.50	**0.58**	<0.50	<0.50	<0.50	Carbon Tetrachloride - **0.8**
B-19	11/06/15	<50	<150	<750	<0.50	<0.50	<0.50	<0.50	**1.1**	<0.50	**7.9**	<0.50	ND
B-20	11/06/15	<50	**640**	**1,800**	<0.50	<0.50	<0.50	<0.50	<0.50	**0.72**	**14**	<0.50	ND
B-21	11/06/15	**5,500**	**1,100**	**880**	**120**	**42**	**83**	**210**	<5.0	<5.0	**28**	**13**	2-Butanone (MEK) - **64** 2-Hexanone - **10** Isopropylbenzene - **26** n-Propyl benzene - **21** 1,2,4-Trimethylbenzene - **130** 1,3,5-Trimethylbenzene - **39**
B-22	11/06/15	**75**	**420**	**3,400**	<1.2	<1.2	<1.2	<1.2	<1.2	**3.3**	**39**	<1.2	ND
B-23	11/06/15	**800**	**160**	<500	**16**	**3.2**	**3.1**	<2.5	<2.5	**4.7**	**79**	<2.5	Isopropylbenzene - **6.2** n-Propyl benzene - **2.5** 1,3,5-Trimethylbenzene - **6.8**
ESL, Summary Table A (<9.8 feet)		100	100	100	1	40	30	20	5	6	5	6.1	Acetone - 1,500; Carbon tetrachloride - 0.5; Chloroform - 80; Chloromethane - 130; 1,2,-Dichloroethane - 0.5; 1,1-Dichloroethene - 6; trans-1,2-Dichloroethene - 10; 2-Butanone (MEK) - 4,900; Tetrachloroethene - 5; 1,1,2-Trichloroethane - 5 Trichloroethene - 5; *

Definitions/Abbreviations:

EPA	-- Environmental Protection Agency
TPHg	-- Gasoline Range Organics ([GRO] C5-C12) by EPA 8015 Gas chromatograph (GC)
TPHd	-- Extractable fuel hydrocarbons ([EFC] C10 - C28) by EPA 8015 GC
TPHo	-- Extractable fuel hydrocarbons ([EFC] C24 - C36) by EPA 8015 GC
µg/kg	-- Micrograms per kilogram (equivalent to parts per billion [ppb])
Total Xylenes	-- Meta-, ortho-, and para-xylenes by EPA Method 8260B
MTBE	-- Methyl tertiary-butyl ether by EPA Test Method 8260B
Ethanol	-- Analyzed by EPA Test Method by 8260B
bgs	-- Below Ground Surface
ft	-- feet
<	-- Less than the laboratory reporting limit indicated.
ND	-- not detected above laboratory method detection limits
J	-- Estimated value between method detection limit and reporting limit.
*	-- "Other VOCs" ELSs are not listed in this table because they are not listed in the ESL tables.

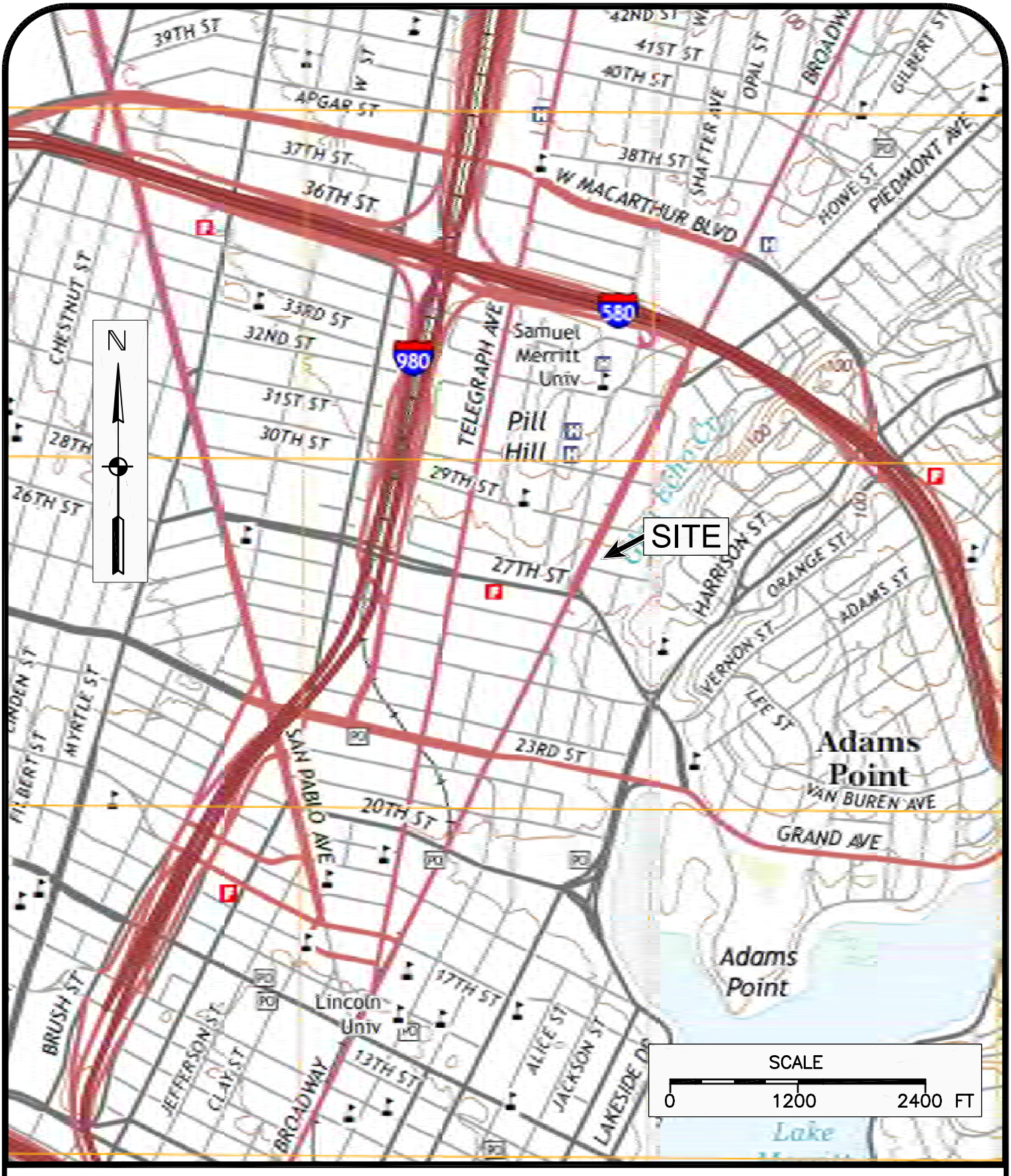
Results reported above the laboratoryreporting limit (RL) are presented in **bold** font.
Results reported above the ESL are highlighted in yellow

Notes:

ESL, Summary Table A (<9.8 feet):
San Francisco Bay, Regional Water quality Control Board, *Environmental Screening Levels (ESL's),* ***Summary Table A*** .
Environmental Screening Levels (ESLs), Shallow Soils (<3m bgs), Groundwater is Current or Potential Source of Drinking Water, Residential Land Use. December 2013.
Source: http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/esl.shtml. Viewed December 9, 2015.

ESL, Summary Table C (>9.8 feet):
San Francisco Bay, Regional Water quality Control Board, *Environmental Screening Levels (ESL's),* ***Summary Table C*** .
Environmental Screening Levels (ESLs), Deep Soils (>3m bgs), Groundwater is a Current or Potential Source of Drinking Water, Residential Land Use. December 2013.
Source: http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/esl.shtml. Viewed December 9, 2015.

FIGURES



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Site Location
2800 Broadway
Oakland, California

Project : 1137	Figure : 1
Date: 2/5/16	
Scale: 1" = 1200 '	

Soil Boring Locations
2800, 2820 & 2855 Broadway
Oakland, California

Figure: 2

Project : 1137
Date: 2/5/16
Scale: 1"= 50'

N

29TH ST.

BROADWAY

VALDEZ ST.

WEBSTER ST.

2855 BROADWAY

2820 BROADWAY

2800 BROADWAY

28TH ST.

VOLKSWAGEN DEALERSHIP
2740 BROADWAY

SB-1
B-15
SB-2
B-16
B-11
SB-3
SB-7
B-17
SB-8
B-1
B-18
B-3
SB-11
B-23
B-21
B-19
SB-10
B-20
B-22
B-10
B-9
SB-6
B-8
B-13
B-7
B-6
B-14
SB-4
B-5
B-2
B-4
SB-5
B-12

LEGEND

- B-1 — SOIL BORINGS - CARDNO
- SB-1 — HISTORICAL SOIL BORINGS - AEI
- WATER UTILITY LINE
- SEWER UTILITY LINE

SCALE
0 50 100 FT

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TPH in Soil > ESL, 0-12' BGS

2800, 2820 & 2855 Broadway
Oakland, California

Figure: 3

Project: 1137
Date: 2/5/16
Scale: 1"= 50'

N

29TH ST.

BROADWAY

VALDEZ ST.

WEBSTER ST.

28TH ST.

2855 BROADWAY

SB-1
B-15
8' 12 / **290**/**590**
12' 1.3/1.2/<5.0
SB-2
B-16
B-11
SB-3

2820 BROADWAY

SB-7
B-17
SB-8
B-18
B-3
SB-9
4' **3.5** / **22** / **180**
SB-11
B-23
B-21
3' **40** / **680** / **3,100**
B-19
B-20
SB-10
4' **2.4** / **70** / **340**
B-22

2800 BROADWAY

B-10
B-9
SB-6
B-8
B-7
B-13
B-14
B-6
SB-4
B-5
B-2
B-4
SB-5
B-12

VOLKSWAGEN DEALERSHIP
2740 BROADWAY

LEGEND

8' **12** / **290** / **590** — DEPTH OF SAMPLE
TPHg / TPHd / TPHo - (mg/kg)

B-1 — SOIL BORINGS - CARDNO

SB-1 — HISTORICAL SOIL BORINGS - AEI

WATER UTILITY LINE

SEWER UTILITY LINE

SCALE
0 50 100 FT

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TCE in Soil

2800, 2820 & 2855 Broadway
Oakland, California

Figure: 4

Project : 1137
Date: 2/5/16
Scale: 1"= 50'

N

WEBSTER ST.

BROADWAY

29TH ST

VALDEZ ST.

28TH ST.

2855 BROADWAY

2820 BROADWAY

2800 BROADWAY

VOLKSWAGEN DEALERSHIP
2740 BROADWAY

SB-1
B-15
SB-2
B-16
B-11
SB-3
SB-7
B-17
SB-8
B-1
B-18
SB-9
B-3
SB-11
B-23
B-21
B-19
B-20
SB-10
B-22
B-10
B-9
SB-6
B-8
B-7
B-6
B-13
B-14
SB-4
B-5
B-2
B-4
SB-5
B-12

5' 200
10' 40
15' <4.7

5' <5.0
10' 33
15' 82

5' <5.0
10' <5.0
15' <5.0

5' <4.9
10' 65
15' <4.6

5' <5.0
10' <4.9
15' 75.1
24' 33.4
28' 49.7

5' <5.0
10' <4.9
14' 64
16' 370

5' 14.7
10' 20.0
15' 162

5' <4.8
10' <4.9
15' <5.0

5' <4.4
10' <4.6
12' <4.8
15' 20
16' <500

LEGEND

8' 200 — DEPTH OF SAMPLE
TCE - (mg/kg)

B-1 — SOIL BORINGS - CARDNO

SB-1 — HISTORICAL SOIL BORINGS - AEI

WATER UTILITY LINE

SEWER UTILITY LINE

SCALE
0 50 100 FT

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N

WEBSTER ST.

BROADWAY

2855 BROADWAY

SB-1
B-15 <50
SB-2
B-16 <50
B-11 <50
SB-3

2820 BROADWAY

SB-7
B-17 <50
SB-8
B-1 <50
B-18 <50
SB-9
B-3 <50
SB-11
B-23 800
1,000
B-21 5,500
SB-10
B-19 <50
B-20 <50
B-22 75

2800 BROADWAY

B-10 51
B-9 <50
B-8 <50
SB-6
B-6 <500
B-7 340
1,000
B-14 7,800
B-13 3,550
SB-4
B-5 14,000
B-4 3,800
B-2 880,000
SB-5
B-12 12,800

28TH ST.

BROADWAY

VOLKSWAGEN DEALERSHIP
2740 BROADWAY

VALDEZ ST.

29TH ST.

28TH ST.

LEGEND

- 11,000 TPHg SAMPLES RESULT - GW (PPB)
- B-1 SOIL BORINGS - CARDNO
- SB-1 HISTORICAL SOIL BORINGS - AEI
- WATER UTILITY LINE
- SEWER UTILITY LINE
- TPHg CONTOUR LINE (PPB)

SCALE
0 50 100 FT

Figure: 5

Project: 1137
Date: 2/5/16
Scale: 1"= 50'

TPH-g in Groundwater

2800, 2820 & 2855 Broadway
Oakland, California

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TCE in Groundwater
2800, 2820 & 2855 Broadway
Oakland, California

Project : 1137	Date: 2/5/16	Scale: 1"= 50'

Figure: 6

2820 BROADWAY

2800 BROADWAY

VOLKSWAGEN DEALERSHIP
2740 BROADWAY

28TH ST.

28TH ST.

VALDEZ ST.

VALDEZ ST.

BROADWAY

BROADWAY

B-16 <50

SB-7 B-17 <50

SB-8 B-1 <0.50

B-18 <50

SB-9 B-3 **32**

SB-11 B-23 **79**

B-21 **28**

B-19 **7.9**

SB-10

B-20 **14**

B-22 **39**

B-10 **17**

B-9 **36**

B-6 **340**

SB-6 B-8 **1,900**

B-7 **460**

B-14 **6,160**

B-13 **2,800**

SB-4 B-5 **14,000** B-2 **14,000** B-4 **4,400**

SB-5 B-12 **121**

MIP-1 18

MW-8

MIP-2 42

MIP-3 270

MIP-4 960

MW-9 13

VW-1

MW-3

VW-2

VW-3

MW-1 52

MIP-5 750

100

1,000

10,000

1,000

100

?

?

?

LEGEND

14,000 TCE SAMPLES RESULT - GW (PPB)

B-1 SOIL BORINGS - CARDNO

SB-1 HISTORICAL SOIL BORINGS - AEI

HISTORICAL MIP BORINGS - ARCADIS

HISTORICAL MONITORING WELLS - ARCADIS

WATER UTILITY LINE

SEWER UTILITY LINE

TCE CONTOUR LINE (PPB)

SCALE
0 50 100 FT

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1485 Treat Blvd. Ste. 203A
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B-1

B-18

2820 BROADWAY

2800 BROADWAY

B-19

B-10

B-9

LEGE

SB-6

B-8

B-13

B-7

B-6

B-14

SB-4

B-4

B-5

B-2

SB-5

B-12

SPARGE SYSTEM

28TH ST.

WAY

N

SCALE

0 20 40 FT

SOIL BORIN

B-1

HISTORICAL

SB-1

PROPOSED

PROPOSED

SPARGE WE

1,000 PPB TP

WATER UTIL

SEWER UTIL

Figure: 7

Project : 1137

Date: 2/5/16

Scale: 1"= 20 '

Proposed Monitoring and Sparge Well Locations

2800 Broadway

Oakland, California

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Walnut Creek, CA 94597
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(925) 787-6869 cell
tcook@cookenvironmental.com

N

2820 BROADWAY

2800 BROADWAY

SPARGE SYSTEM

28TH ST.

LEGEND

PROPOSED MONITORING WELLS

PROPOSED SPARGE WELLS

WATER UTILITY LINE

SEWER UTILITY LINE

SCALE

0 20 40 FT

Figure: 8

Project : 1137

Date: 2/5/16

Scale: 1"= 20 '

Sparge System Layout

2800 Broadway

Oakland, California

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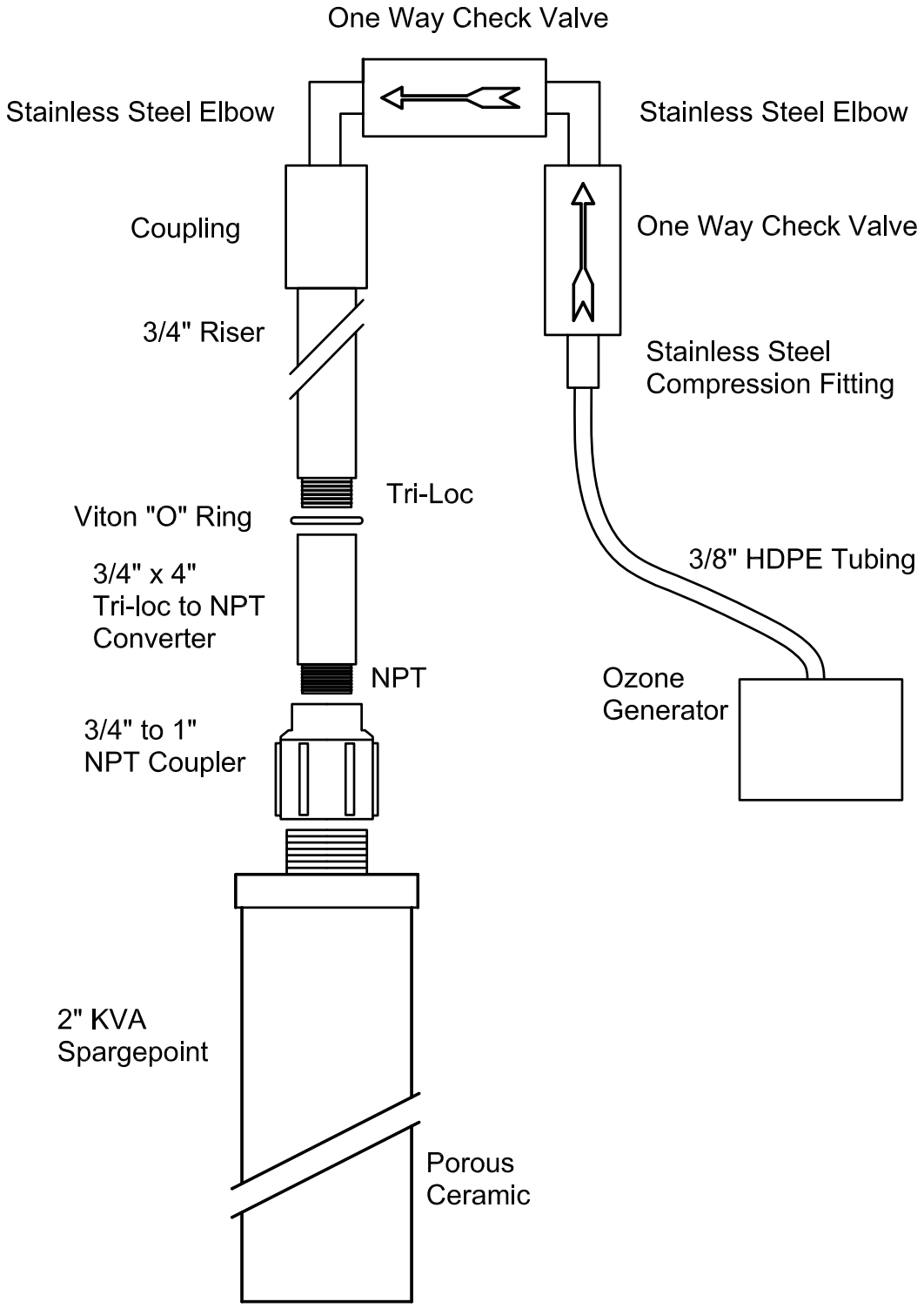

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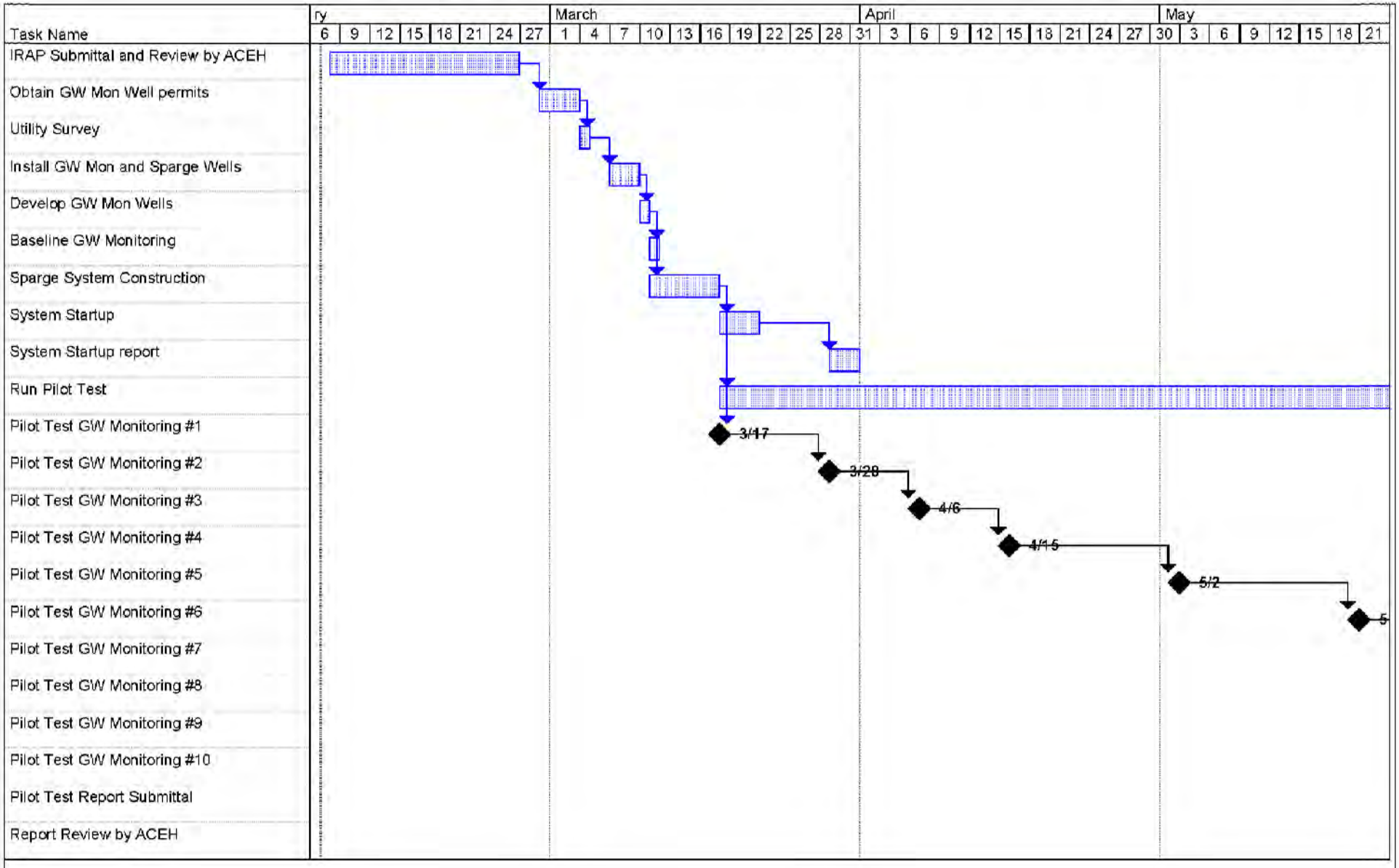
Sparge Point Hardware
Alliance Realty
2800, 2820 & 2855 Broadway
Oakland, California

Project : 1137	Figure : 9
Date: 2/5/16	
Scale: NTS	



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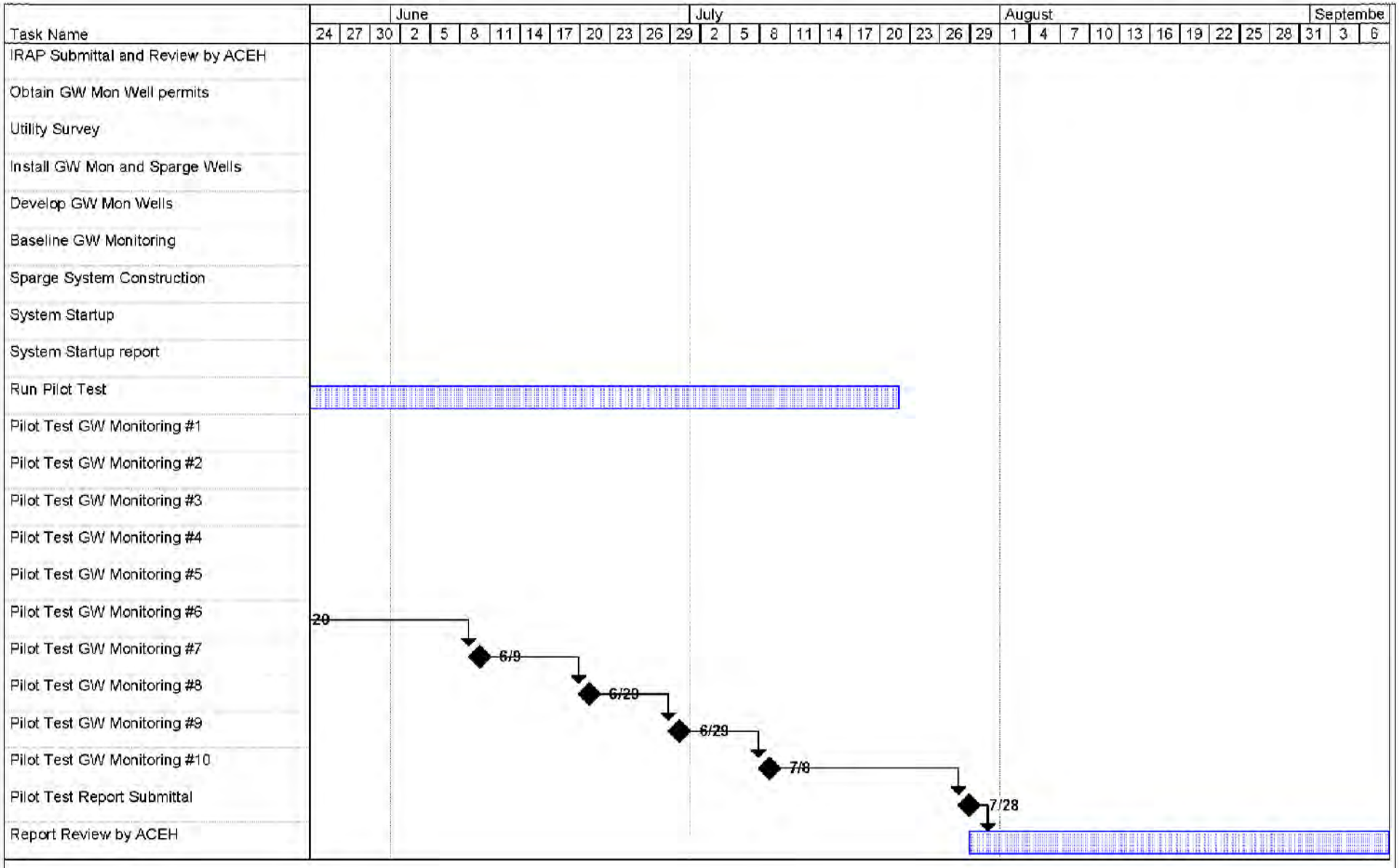
Project Schedule

2800 Broadway
Oakland, California

Project : 1137	Figure: 10
Date: 2/8/16	
Scale: N/A	Page 1



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Project Schedule (continued)

2800 Broadway
Oakland, California

Project : 1137	Figure: 10
Date: 2/8/16	
Scale: N/A	Page 2

APPENDIX A
Sparger Operating Manual and Specifications

Ozone Remediation

H2O Engineering's ozone sparge technology delivers the highest concentration of ozone gas directly to the contaminated subsurface. Ozone is released in controlled time duration sequences via in-situoxidation points. This feature can be programmed and recorded by the logic controller.

Effective for short-term "hot spot" remediation or full scale site cleanups, H2O Engineering's ozone sparge units are completely self-contained and are available in trailer and cabinet enclosures. While we have designed our standard units to handle most field conditions, we also offer custom systems to meet extraordinary site demands. Our systems are successfully oxidizing petroleum hydrocarbons and chlorinated solvents such as TPHg, TPHd, BTEX, TCE, and PCE in both groundwater and soil applications.

STANDARD FEATURES

- Featuring Intelo-zone® Control Technology
- Ozone Generator Output: 1.3 to 43.8 lbs/day, up to 6% concentration by weight
- PSA oxygen concentrator delivers 90% purity
- Ozone delivery pump features all ozone-resistant components
- Maximum ozone sparge pressure of 50 PSI
- Maximum air / breakthrough sparge pressure of 90 PSI
- Automatic regression from ozone to air / breakthrough mode upon high pressure detection
- Programmable Logic Controller (PLC) with Human Machine Interface (HMI)
- Selectable mode for ozone, ozone/air, oxygen, oxygen/air or air per sparge port
- Independent time duration control for each sparge port (programmable from 1 to 120 minutes)
- Independent time accumulators for tracking ozone vs. oxygen vs. air / breakthrough time per valve
- User confi gurable valve sparge sequence ordering
- Variable ozone output can be individually configured for each valve
- Lag time between sparge cycles (programmable from 1 to 480 minutes)
- Suspend mode for planned nonoperational periods
- Delivery fl ow and pressure displayed and logged via PLC, viewable from HMI
- Automated maintenance notifi cations
- Ozone sparge port manifold includes ozone compatible solenoid valves, 1/2" Kynar® compression fi ttings and analog pressure transmitter
- 10, 20, 30 or 40 port manifolds available
- Distinctive built-in safety features:
  - Ambient ozone alarm/shutdown sensor
  - High pressure alarm/shutdown
  - Built-in thermal protection, high / low temperature alarms
  - Sensor failure alarm
- Remote shutdown interface signal
- Remote ozone sensor connections
- PLC controlled air conditioning and heating in trailer version
- H2O Telemetry Packages (optional)
- Full one-year warranty includes materials and workmanship
- Service contracts and start-up assistance available
- Start-up Service Kit included

189 Granada Drive, San Luis Obispo, CA 93401 | 866.987.0303
www.h2oengineering.com

H2O Engineering Inc.
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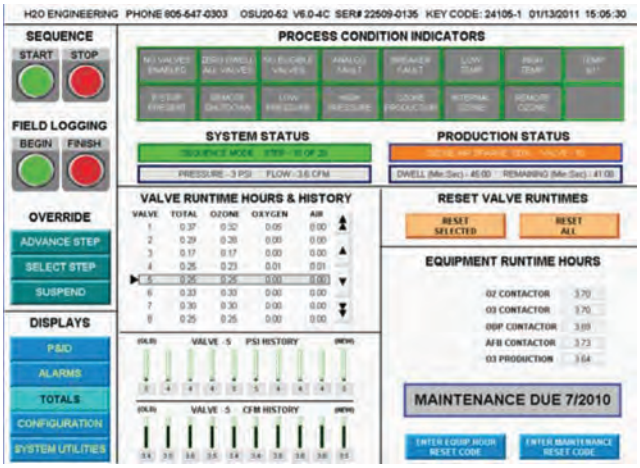
Ozone Remediation



TELEMETRY SOFTWARE PACKAGE (OPTIONAL)

SELF-CONTAINED

- 2-50 pounds/day ozone output
- Skid, trailer, or cabinet mounted systems available
- PSA oxygen generation with 90% or higher oxygen purity
- PLC automated system controls
- Online monitoring options available PH, ORP, DO, DO3, etc.
- Custom systems available for unique project needs
- Telemetry available for remote monitoring and controls

LARGE-SCALE

- 50+ pounds/day ozone output
- Systems can be container mounted or permanently installed
- PSA or VSA oxygen generation with 90% or higher oxygen purity
- PLC automated system controls
- Online monitoring options available PH, ORP, DO, DO3, etc.
- Custom systems available for unique project needs
- Telemetry available for remote monitoring and controls

MODEL[1]	DELIVERED OZONE OUTPUT (lbs/day)	OZONE GAS CONCENTRATION (ppmv)	ENCLOSURE	ELECTRICAL REQUIREMENT[2] (VAC)	POWER CONSUMPTION[3] (kW)	MAXIMUM OPERATING FLOW (CFM)	MAXIMUM OPERATING PRESSURE[4] (PSI)
OSUXX-26	1.4	2250	Cabinet	240	2.31	3.8	50
OSUXX-52	2.7	3570	Cabinet	240	2.82	3.8	50
OSUXX-104	5.5	4160	Cabinet	240	4.81	4.2	50
MOSUXX-26	1.4	2250	Cabinet	240	2.31	3.8	50
MOSUXX-52	2.7	3570	Trailer	240	2.82	3.8	50
MOSUXX-104	5.5	4160	Trailer	240	4.81	4.2	50
MOSUXX-209	11.0	11900	Trailer	240	9.12	4.7	50
MOSUXX-520	27.4	22180	Trailer	208/3Ø	25.56	7.3	50

Notes:
1. XX in model number denotes the amount of sparge valves.
2. Electrical requirement: 60 Hz, Single Phase (unless otherwise noted); All 240 VAC systems require a true neutral.
3. Air conditioning unit in mobile products consumes 1.69 kW during operation.
4. Maximum well breakthrough pressure = 90 PSI.

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www.h2oengineering.com

H2O Engineering Inc.
PURE WATER. CLEAN WORLD.®

User Guide

H_2O ENGINEERING, INC.

Ozone Sparge Unit – OSUXX-26

Rev. 5.9-5B Series A.6

OSUXX-26 OZONE SPARGE UNIT

User Guide

'XX' IN MODEL CODE DENOTES MODELS

OSU10-26

OSU20-26

OSU30-26

OSU40-26

H2O Engineering, Inc.
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San Luis Obispo • CA 93401
Phone 805.547.0303 • Fax 805.547.0113

www.h2oengineering.com

1-16-09

Table of Contents

Chapter 1

Safety Warnings

This section describes some of the safety concerns you should be aware of before proceeding with operation of this unit.

Ozone Gas

High concentrations of ozone gas can be dangerous to humans. Low concentrations can cause irritations to eyes, throat and respiratory system. The OSUXX-26 has an ambient ozone alarm and other safety interlocks.

Electrical

Proper care must be used by a qualified electrician when making any internal adjustments or performing any maintenance procedures. The electrical supply to this system must be rated at 120VAC/60Hz, 30amps.

Safety Instructions

- Before applying power to the system, be sure the main power switch located on the door is in the "Off" position.
- The electrical supply to this system must be rated at 120VAC/60Hz, 30amps.
- Be sure the power source is grounded and conforming with all electrical codes.
- Before operating this system be sure that the cabinet enclosure is securely located on-site.

Equipment Enclosure Requirement

- The OSU Cabinet should be protected from direct weather. For example a four sided enclosure should be placed around the OSU cabinet (Top, Left, Back, and Right side).
- If the OSU cabinet is placed inside a secondary equipment enclosure; shed, trailer, etc., then there should be properly sized forced air ventilation provided in the secondary enclosure. **If forced air ventilation is not provided to the secondary enclosure then the equipment warranty will be voided.**

Chapter 2

System Description

This section briefly explains the primary components of the Ozone Sparge Unit and their basic functionality.

Oxygen Concentrator

The majority of ozone generators require a source of clean, dry, oxygen-enriched air for effective ozone production. To meet that need, the air preparation system used employs pressure swing absorption (PSA) technology to increase the concentration of oxygen and reduce the moisture content in the feed gas. This greatly improves the output capability of the ozone generator and prevents premature failure of critical internal components. The air preparation system delivers 90% +/- 3% oxygen purity at -100°F dew point.

Ozone Generator

The feed gas from the oxygen generator system is supplied to the ozone generator. A back pressure regulator valve is supplied on the ozone generator outlet to control the internal flow and pressure. The ozone generators supply a total of 26 grams/hour with concentrations up to 6% by weight under 10 to 12 PSI to the ozone delivery pump (ODP).

Control System

The control system utilizes a programmable logic controller to control the ozone sparge system. A Panel View 300 provides a human machine interface for the operator.

Panel View 300

The Panel View 300 is a touch pad control interface device for the ozone sparge system.

**Please see the Panel View Screen Diagram in Appendix A.

Ozone Gas and Airflow Delivery

Oxygen Compressor (O2)
The oxygen compressor delivers air to the oxygen concentrator. The flow is regulated using the flow meter in line after the oxygen concentrator. The oxygen compressor is an oil-less dual head piston compressor.

Ozone Delivery Pump (ODP)
The ozone delivery pump is used to pull ozone gas from the ozone generator and deliver the ozone gas to the sparge port manifold. The ozone delivery pump is ozone gas resistant and is a single speed pump.

Air Flow Booster Compressor (AFB)
The air flow booster compressor blends between 0.3 to 3.4 CFM of air with the ozone gas that is delivered to the sparge port manifold. The air flow booster compressor includes an after cooler, auto drain valve with timer, and adjustable air flow meter (.6 to 6.6 CFM). The air flow boost compressor flow rate will be dependent upon the back pressure on the active sparge port. The maximum air flow rate is 3.4 CFM at 0 PSI back pressure.

Manifold
The ozone gas is delivered to the sparge wells through a 10, 20, 30 or 40 port manifold, depending on the model type. The manifold utilizes solenoid valves to direct the delivered gas to the appropriate sparge well. The manifold includes two check valves to prevent backflow, a 100 PSI delivery pressure gauge, a high pressure transmitter (High Pressure Set Point 50 PSI), and a 100 PSI pressure relief valve.

Required Maintenance

The OSUXX-26 system requires maintenance at regular intervals, as with all industrial equipment. Please refer to the Appendix for the various service kits needed including start-up and at 6 and 12 month intervals. H2O Engineering can assist in regular maintenance both in one-time service visits as well as scheduled service contracts. Depending on various site conditions, individual inlet air filters may require replacement at intervals sooner than every 6 months. Please contact H2O Engineering's Service Department with any questions at (805) 547-0303.

Chapter 3

Start-up and Calibration

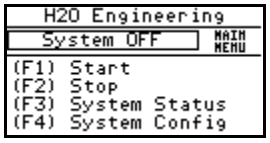
This section describes basic unit operation and instructions for calibration.

Turning on the Ozone Sparge Unit

TO TURN ON THE OZONE SPARGE SYSTEM:

1. Before applying power to the system be sure the main power switch located on the door is in the "Off" position.

2. The power cord should be interfaced to the power on-site (120V, 60Hz, 30Amp). Next, turn the main power switch to the "ON" position. The "Main Menu" on the panel view will be activated.

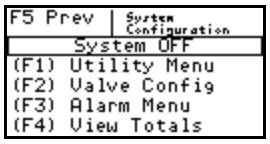


Valve Configuration

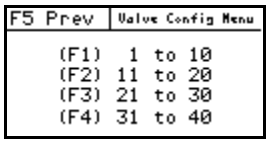
TO SET THE VALVE CONFIGURATION:

NOTE: When the OSUXX-26 is shipped from the factory, all the valves are disabled and set to sparge ozone as a default. Also, the default dwell time for each valve is set to 30 minutes from the factory. These settings can be changed by performing the following steps:

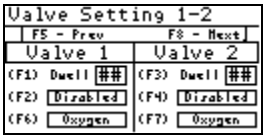
1. From the Main Menu, press **(F4) System Config.** This will take you to the System Configuration screen.



2. From the Valve Configuration Screen you can select **(F2) Valve Config.** This will take you to the Valve Config Menu.



3. From the Valve Config Menu, you must now choose which group of valves to configure as listed in the screen above. To access valves 1 to 10 press **(F1)**, to access valves 11 to 20 press **(F2)**, etc. The Valve Setting 1-2 or Valve Setting 11-12 screen will now be seen as shown below:



4. At each valve setting, the valve must be "Enabled" or "Disabled", the "Ozone" or "Oxygen" selection must be made, and a Dwell time value (1 – 99 minutes) must be set. To enable or disable a valve, press **(F2)** for the valve shown on the left side of the screen, or **(F4)** for the valve shown on the right side of the screen. The "Enabled/Disabled" state will toggle as you press the key multiple times. The same method applies when choosing to sparge either "Oxygen" or "Ozone" for each valve. Press **(F6)** to toggle between oxygen/ozone sparging for the valve shown to the left side of the screen, and press **(F7)** for the valve shown to the right side of the screen. To set the Dwell time for each valve, press **(F1)** for the valve shown to the left of the screen, or **(F3)** for the valve shown to the right of the screen. A numeric keypad entry screen will now be seen.

5. Enter the desired Dwell time for the particular valve and press the **Enter** key ↵ in order for the valve to save the time entered.

6. Once all of the properties have been set for the two valves shown on the screen, proceed to the next set of valves by depressing the **(F8) - Next** key. You may also go back to the previous set of valves by pressing **(F5) - Prev**.

7. **Important: "Disable" the valve if the valve will not be used!!**

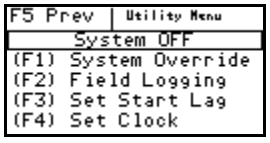
8. Once the valve settings have all been entered and you are back to the Valve Config Menu, you may go back to the Main Menu by pressing **(F5) - Prev** three times.

Setting the Sequence Lag Time

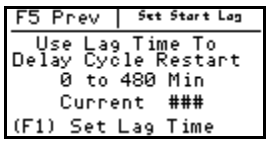
The Start Lag Time allows the OSU equipment to cool down between sequences. The Start Lag will commence at the end of each sequence. During the Start Lag, the unit will remain on with only the control system and fans in operation. A sequence consists of the unit sparging oxygen or ozone to each of the enabled valves, 1 through 40 in order, through one cycle, depending on the model code (10, 20, 30 or 40 valves total).

TO SET THE SEQUENCE LAG TIME:

1. From the Main Menu, press (**F4) System Config** and then press (**F1) Utility Menu.**



2. Press (**F3) Set Start Lag**.



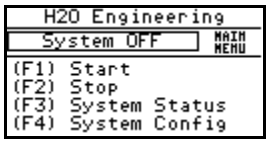
3. From the **Set Start Lag** screen, press (**F1) Set Lag Time**. This will allow the operator to numerically input a lag time (0 to 480 minutes). Press the **Enter** key ↵ when done inputting the lag time.

4. To return to the Main Menu, press **(F5) – Prev** three times.

Starting the Ozone Sparge System

TO START THE OZONE SPARGE SYSTEM:

1. From the **Main Menu**, press **(F1) Start**, or press **(F2) Stop** to start or stop the OSU.



NOTE: Place the threaded plugs into the outlet of the solenoid valve(s) that are not being used.

- When sparging to a valve enabled and set to ozone, the ozone generators should indicate a green LED light in the middle of the circuit board. This means that ozone gas is being produced. The oxygen concentrator flow gauges will read 9 SCFH, and the pressure gauge should read 9 to 12 PSI.

- To obtain the correct pneumatic parameters within the ozone generator(s), adjust the O2 flow meter(s) to 9 SCFH. Adjust the stainless steel backpressure regulator located downstream of the ozone generator(s) to attain the correct operating pressure of 10 psi. Opening the regulator (turning it counter-clockwise) lowers reaction cell pressure while increasing oxygen flow. Conversely, closing the valve (turning it clockwise) raises the pressure while decreasing oxygen flow. Adjust the O2 flowmeter(s) and backpressure regulator together until the proper flow and pressure are reached.

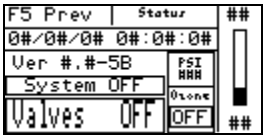
- The air flow booster compressor flow gauge reading will be dependent upon the back pressure on the sparge port. The delivery pressure gauge reading will be dependent upon the back pressure on the sparge port. The air flow meter maximum reading is 3.4 CFM at 0 PSI back pressure.

- The ozone sensor will shut down the ozone gas production when ozone gas concentrations have exceeded the high set point (1 PPM) within the interior of the OSU enclosure. Ozone gas will ONLY be produced when the ozone sensor is below the set point.

Determining the OSU System Status

TO DETERMINE THE OSU SYSTEM STATUS:

- From the main menu, press **(F3) System Status**.



The **Status** screen will show:

a. H2O Eng V.#.# - 2A (System Revision Level)

b. the date and time

c. which valve is currently running

d. the current settings (ozone or oxygen) for the valve in operation

e. initial dwell time for the active valve (user defined setpoint, see Valve Configuration)

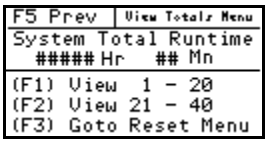
f. remaining dwell time for the active valve

g. system delivery pressure, in psig

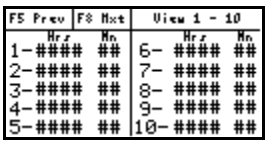
Viewing Valve Run Time and System Total Run Time

TO VIEW THE VALVE RUN TIMES AND TOTAL SYSTEM RUN TIME:

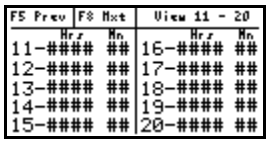
1. From the Main Menu, press (**F4) System Config.** From the System Config Menu, press (**F4) View Totals.** The OSU System Total Runtime will appear in hours and minutes at the top of the View Totals Menu screen.



2. Press (**F1) View 1 - 20** to view valve run times on valves 1 -20, or **(F2)** to view valves 21-40. You will see the valve total run times for valves 1 to 10.



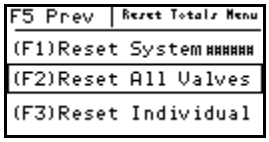
3. Press **(F8) Nxt** to view valves 11-20.



4. Press **(F5) Prev** two times to go back to the View Totals Menu.

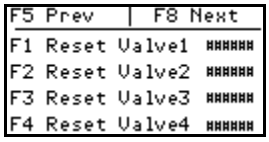
Resetting Valve Run Time and System Total Run Time

1. From the View Totals Menu, press **(F3) Goto Reset Menu**. The system will ask for a password, enter "H2O".



2. From the Reset Totals Menu screen, press **(F2) Reset All Valves** to reset all valve run times.

3. Press **(F3) Reset Individual** to reset individual valve run times.



4. Press **(F1) Reset System** to reset all valves and total system run time. **NOTE: Only reset the total system run time when absolutely necessary. The total system run time can assist H2O Engineering's Service Department in supporting proactive maintenance on the unit.**

5. To return to the Main Menu, press **(F5) Prev** three times.

Chapter 4

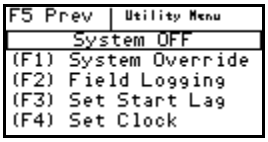
Utility Mode

This section describes the utility mode operation.

Using the Utility Mode

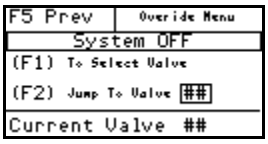
TO USE THE UTILITY MODE:

1. From the Main Menu press **(F4) System Config**, then press **(F1) Utility Menu.**



TO USE THE SYSTEM OVERRIDE

1. In the Utility Menu press **(F1) System Override.**



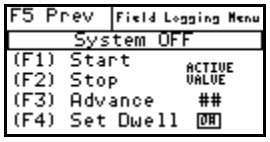
2. To select a valve press **(F1) To Select Valve,** using the keypad to enter the desired valve. Press the **Enter** key ↵ when done inputting the desired valve. Press **(F2) Jump to Valve.** This will allow the operator to move to the selected valve without interrupting or waiting for the sequence to cycle to the desired valve. After moving to the desired valve, the sequence will continue from that valve, through the rest of the enabled valves in the sequence. To return to the Main Menu, press **(F5) Prev** three times.

TO USE THE FIELD LOGGING FUNCTION

1. From the Utility Menu press **(F2) Field Logging.** This function will allow the operator to log flow and pressure measurements for each valve without having to interrupt the current sparge sequence settings.

2. First, the dwell time will need to be set by pressing **(F4) Set Dwell.** The dwell time will operate each active valve for the dwell time value during the field logging mode operation. This time allows the operator to log flow and pressure for each well, and observe each wellhead during operation if desired.

3. Next, the Field Logging Mode can be started by pressing **(F1) Start.** The field logging mode will run the system for one field logging cycle only. Press **(F2) Stop** to stop the field logging cycle. NOTE: The unit will need to be started again in Sequence Mode if stopped in Field Logging Mode, following the steps on page 6 of this manual.



4. The Field Logging cycle can be manually advanced to the next valve by pressing **(F3) Advance.**

**** The Field Logging Mode will automatically transition into the Sequence Mode after it completes, if not stopped by the operator.**

TO SET THE SYSTEM TIME AND DATE

1. From the Utility Menu press **(F4) Set Clock.** From here, the user can set both the time and date to correspond to the local time zone. The system uses the clock to time stamp alarm events. This can be helpful in troubleshooting any possible future issues.

Chapter 5

Alarms

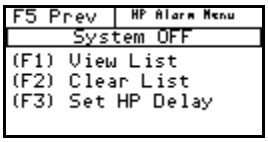
High Pressure Alarm

TO CLEAR A HIGH PRESSURE ALARM

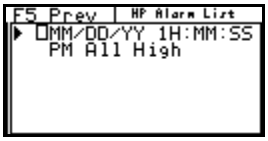
The OSUXX-26 employs a pressure transmitter to monitor the output pressure during operation. If the system output pressure ever exceeds 50psi for longer than the HP Alarm Delay Setpoint (explained on the next page), the unit will disable the active valve, skip to the next enabled valve, and activate the High Pressure Alarm. If the High Pressure Alarm is activated, a HP alarm screen will be shown, indicating which valve(s) has seen a high pressure.

1. From this screen, **(F1) Acknowledge** will clear the alarm and allow the corresponding valve back into operation during the next sequence. If multiple valves initiate high pressure alarms, the user will have to acknowledge each of those valves to allow them back into operation during the next sequence. If all of the enabled valves initiate High Pressure Alarms in a single cycle, the All High Alarm will be shown. This alarm will need to be acknowledged to allow the unit back into sequence mode operation.

2. To view the HP alarm history log, from the Main Menu press **(F4) System Config**, press **(F3) Alarm Menu**, then **(F1) HP Alarm Menu.**



3. Press **(F1) View List**



4. Press **(F5)** Prev to return to the HP Alarm Menu. In order to clear the HP alarm history log, press **(F2) Clear List**

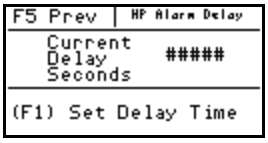
5. Press **(F5) Prev** three times to return to the Main Menu.

Setting the High Pressure Alarm Delay

TO SET THE HP ALARM DELAY TIME:

The HP Alarm Delay Time is the time interval from which the system exceeds 50psi output pressure, to when the HP Alarm is activated. To change the HP Alarm Delay, follow the steps below:

1. From the Main Menu, press **(F4) System Config**. Press **(F3) Alarm Menu.** Next, press **(F1) HP Alarm Menu**, press **(F3) Set HP Delay.**



2. Press **(F1) Set Delay Time.** The delay time can be set from 0 to 600 seconds. After setting the value, press the **Enter Key** ↵. The value is factory set at 180 seconds.

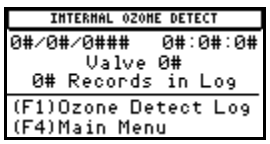
**** Alarm delay time may need to be reset per job site sparge conditions.**

Internal Ozone Alarm

TO ACKNOWLEDGE AN INTERNAL OZONE ALARM:

1. An internal ozone sensor is capable of detecting very low concentrations of ozone gas. When ozone is detected the PLC will disable ozone production on the active sparge port and create a record in its Internal Ozone Detect log. The same valve will continue operating through its current sequence time; however, it will switch to sparging oxygen. An internal ozone alarm screen will be displayed indicating "Internal Ozone Present", along with the date, time, and valve # corresponding to when the alarm took place. A record will also be logged in the Ozone Alarm Log, explained below.

   Once the ozone level drops below the internal ozone alarm set point (1.0 PPM), the internal ozone alarm screen will display "Internal Ozone Detect", along with the date, time, and valve # corresponding to when the alarm took place.



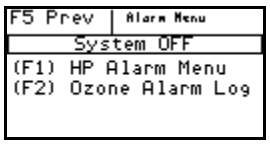
2. From this screen you can press **(F1) Ozone Detect** Log to view the ozone alarm log as explained in the next section, or press **(F4) Main Menu** to return to the Main Menu.

   The valve that was active while the alarm condition occurred will automatically be toggled from ozone to oxygen until it is manually set back to ozone in the Valve Configuration Menu.

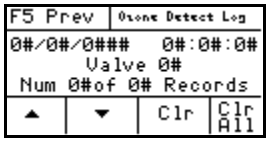
   To do this, return to the Valve Configuration Menu as shown on page 4. The alarm state must no longer be present to reset any valve back to ozone production.

TO VIEW THE OZONE ALARM LOG

1. From the Main Menu, press **(F4) System Config,** press **(F3) Alarm Menu**,



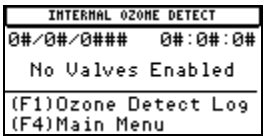
2. Press **(F2) Ozone Alarm Log**.



3. The most recent logged alarm will be shown on the screen. To view previously logged alarms, press **(F2).** To return to the more recent alarms, press **(F1)** to scroll through the log. Individual alarms can be cleared by pressing **(F3) Clr.** To clear all of the logged ozone alarms, press **(F4) Clr All.**

4. To return to the Main Menu, press **(F5) Prev** three times.

**** If the internal ozone sensor detects ozone present when no valves are active, an internal ozone alarm screen will be displayed indicating "Internal Ozone Present", along with the date, time and a message stating No Valves Enabled . No record will be logged in the Ozone Alarm Log in this situation.**

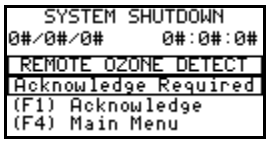


Remote Ozone Alarm

****This function is only used when an ambient ozone sensor has been connected to the OSUXX-26 control system. Please refer to the Appendix for a subpanel wiring diagram with information regarding termination points for an ambient ozone sensor (sold separately).**

TO CLEAR A REMOTE OZONE ALARM:

1. The ozone sparge unit panel view will display a flashing "System Shutdown / Remote Ozone Present" screen when the ambient ozone sensor senses ozone above the high limit detection set point. When the ambient ozone level is below the high limit detection set point, the panel view will display a "System Shutdown / Remote Ozone Detected" screen. First, the ozone alarm must be acknowledged by pressing **(F1) Acknowledge.** Then, the ozone sparge unit can be restarted by pressing **(F4) Main Menu** which displays the Main Menu screen, and then depress **(F1) Start.**



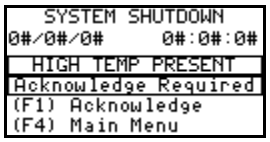
High Temperature Alarm

TO CLEAR A HIGH TEMP ALARM:

1. If the High Temp Alarm is activated, a High Temp Screen will be shown, indicating that the internal system temperature is above the alarm condition set point or has previously reached the high set point.

2. If the internal temperature is above the set point, the system will not allow the alarm to be acknowledged. This will be indicated by flashing text reading "High Temp Present".

   Once the temperature has dropped below the set point the text will change to "High Temp Detect"



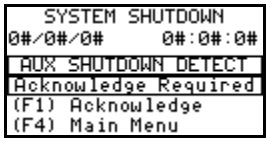
3. At this point press **(F1) Acknowledge** to allow the system back into normal operation mode. Then press **(F4) Main Menu** to return to the Main Menu.

Remote Auxiliary Alarm:

**** Function is only used when a REMOTE AUXILIARY SIGNAL has been connected to the OSUXX-26 control system. Please refer to the Appendix for a subpanel wiring diagram with information regarding termination points for an auxiliary shutdown signal.**

TO CLEAR AN AUXILIARY ALARM:

1. When a 120VAC signal is applied to this input terminal, the ozone sparge unit will shut down and an "Auxiliary Shutdown Detect" screen will be displayed on the panel view. The ozone sparge unit must manually be restarted on-site by the service technician.

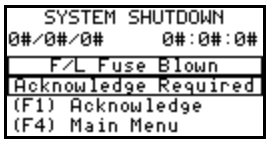


2. To acknowledge the auxiliary shutdown alarm, press **(F1) Acknowledge**, then press **(F4) Main Menu** to return to the Main Menu. From there, you may restart the unit by pressing **(F1) Start.**

Fuse Alarms:

TO CLEAR A FAN/LIGHT FUSE BLOWN ALARM:

1. When the fan/light fuse is blown the "F/L Fuse Blown" screen will be displayed on the panel view. The fan/light fuse must be replaced before pressing **(F1) Acknowledge,** then **(F4) Main Menu** to return to the main menu.



TO CLEAR AN O2 FUSE BLOWN ALARM:

1. When the O2 fuse is blown the "O2 Fuse Blown" screen will be displayed on the panel view. The particular fuse must be replaced before pressing **(F1) Acknowledge,** then **(F4) Main Menu** to return to the main menu.

Alarm Auto-dialer Interface:

The OSUXX-26 system is auto-dialer capable. The following alarm conditions are pre-wired for auto-dialer contacts in the control panel. Please see the Appendix for subpanel wiring details.

- External Ambient Ozone Alarm
- Auxiliary Shutdown Alarm
- Internal Ozone Alarm
- High Temperature Alarm
- Individual Valve High Pressure Alarm
- All Valves High Pressure Alarm

Chapter 6

Trouble Shooting

Air Preparation

Problem/Symptom	Possible Cause	Solution
Unit not operating	~ No power to system ~ Power switch in off position ~ Incorrect wiring	~ Check main power to system ~ Turn switch to "On" position ~ See "Installation Procedures - Electrical"
Low air flow or no air flow	~ Flow meter out of adjustment ~ Fouled compressor inlet filter ~ Compressor not functioning	~ Adjust flow meter See "Start up and Calibration" starting the oxygen sparge system ~ Replace the inlet filter ~ Rebuild/replace as required
Compressor pressure relief valve making noise	~ Pressure relief valve not operating correctly ~ Excessive backpressure in system ~ Pinched tubing ~ Compressor not functioning ~ ATF not operating	~ Replace pressure relief valve ~ Check the check valve for proper operation, replace as required ~ Replace tubing ~ Rebuild/replace as required ~ Repair/replace ATF as required
Moisture indicator changed from blue to pink	~ Moisture has entered the air prep system	~ Check and tighten fittings ~ Rebuild/replace compressor or ATF module as required ~ Replace moisture indicator
Unit is making excessive noise	~ Unit not properly secured to floor ~ Shipping damage has occurred ~ Fan is blocked	~ Place unit on a flat, level surface ~ Locate damage, repair/replace parts ~ Clear obstructions

Ozone Sparge Unit

Problem/Symptom	Possible Cause	Solution
Unit not operating	~ No power to system ~ Power switch in off position ~ Incorrect wiring	~ Check main power to system ~ Turn switch to "On" position ~ See "Installation Procedures - Electrical"
Low air flow or no air flow	~ Flow meter out of adjustment ~ Fouled compressor inlet filter ~ Compressor not functioning	~ Adjust flow meter See "Start up and Calibration" starting the oxygen sparge system ~ Replace the inlet filter ~ Rebuild/replace as required
Compressor pressure relief valve making noise	~ Pressure relief valve not operating correctly ~ Excessive backpressure in system ~ Pinched tubing ~ Compressor not functioning ~ ATF not operating	~ Replace pressure relief valve ~ Check the check valve for proper operation, replace as required ~ Replace tubing ~ Rebuild/replace as required ~ Repair/replace ATF as required
Unit is making excessive noise	~ Unit not properly secured to floor ~ Shipping damage has occurred ~ Fan is blocked	~ Place unit on a flat, level surface ~ Locate damage, repair/replace parts ~ Clear obstructions

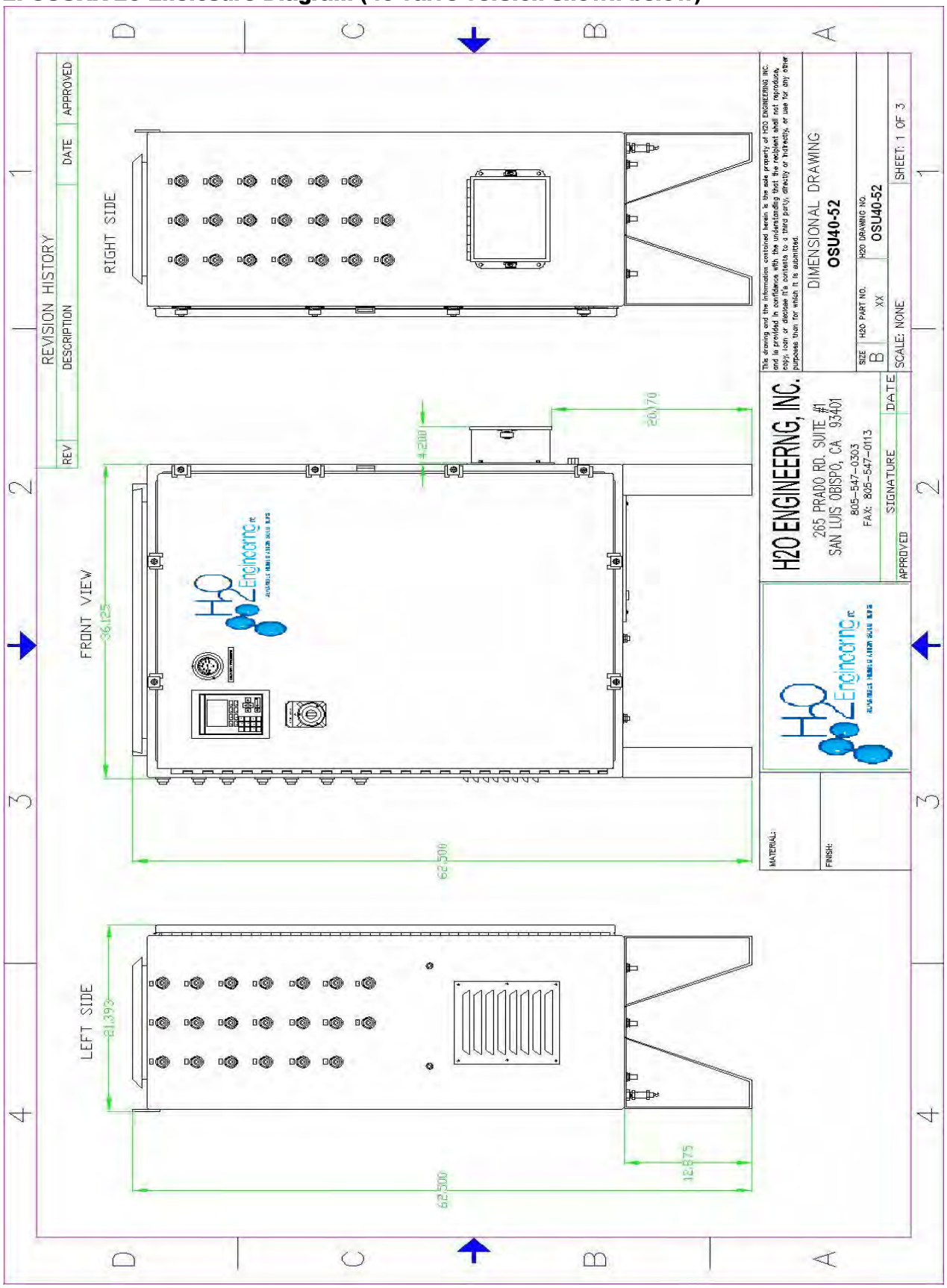
Problem/Symptom	Possible Cause	Solution
No Power to unit	Main On/Off Switch is in the "Off" Position Main fuse blown in electrical junction box Tripped breaker	Turn Switch to the "On" position Replace fuse Reset breaker at main sub panel
No ozone production	Valve set for oxygen internal ozone sensor tripped low pressure switch tripped Ozone relay is bad Ozone fuse is blown	Set valve for ozone exhaust system checked adjust ozone generator needle valve check continuity through relay and replace if necessary Replace fuse
Air Flow Boost - Low flow	clogged intake filter Blown Fuse Hose3/connection integrity	replace filter Replace Fuse Check Valve connection

Appendix

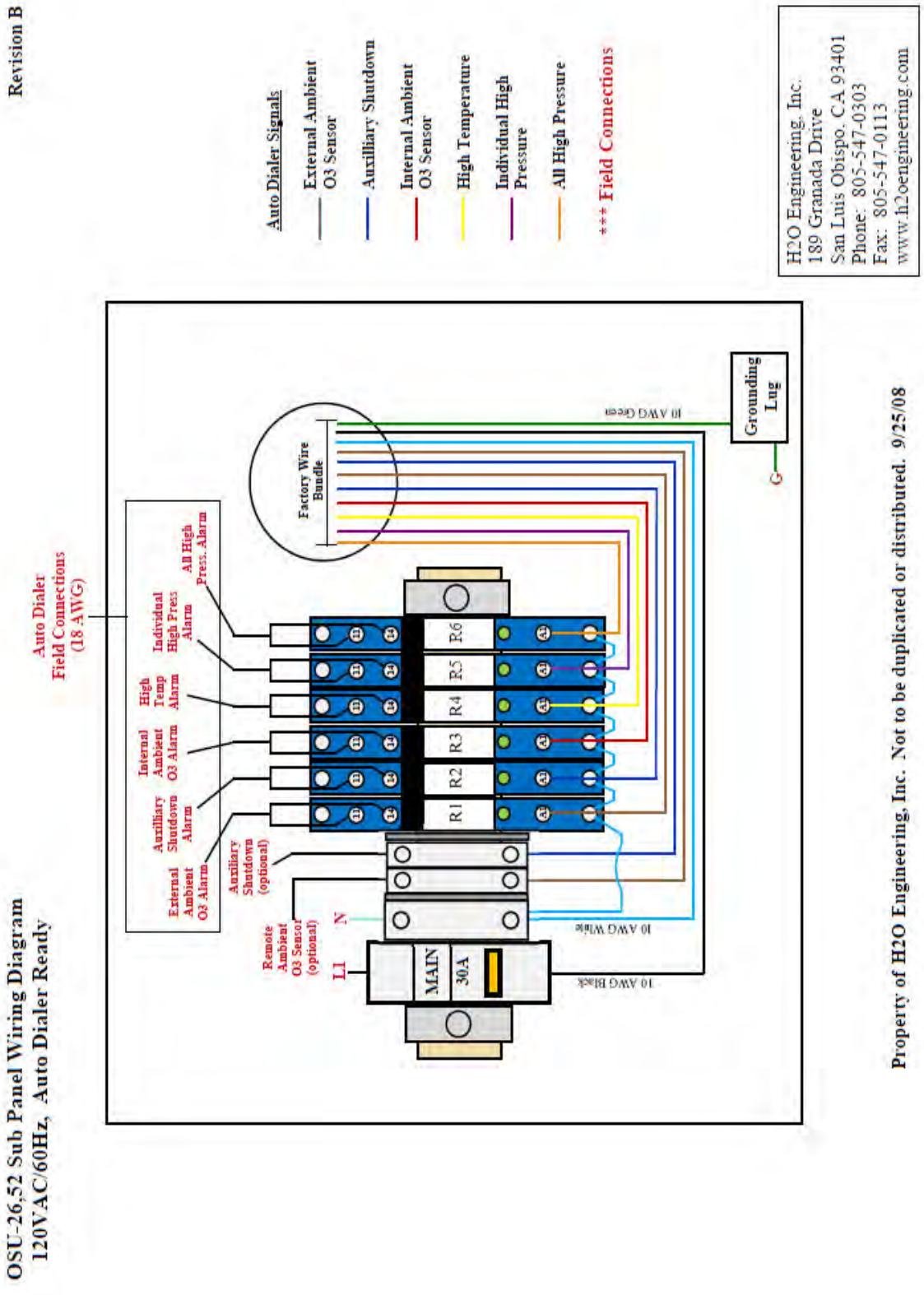
1. Panel View Screen Diagram
2. OSUXX-26 Enclosure Diagram
3. OSUXX-26 Sub-panel Wiring Diagram
4. OSUXX-26 Service Schedule & Replacement Parts List
5. Operation and Maintenance Log
6. MSDS: Ozone Gas

1. Panel View Screen Diagram

2. OSUXX-26 Enclosure Diagram (40-valve version shown below)



3. OSUXX-26 Sub-panel Wiring Diagram



4. OSUXX-26 Service Schedule & Replacement Parts List

OSUXX-26 Service Schedule and Replacement Parts List

No.	Item	Service Schedule	Quantity
1	10" Cooling Fan Filter	*	1
2	Ozone Delivery Pump	**	1
3	Ozone Delivery Pump Rebuild Kit	***	1
4	1313 Oxygen Compressor	**	1
5	Oxygen Moisture Indicator (Blue to Pink)	*	1
6	1313 Oxygen Compressor Rebuild Kit	***	2
7	Oxygen Compressor Inlet Filter	*	1
8	1/4" Oxygen Compressor PRV, 40 PSI	**	1
9	3586 ATF Module	**	1
10	3586 ATF Gear Motor	**	1
11	After Cooler	**	2
12	After Cooler Fan	**	2
13	Air Flow Booster Compressor	**	1
14	Air Flow Booster Rebuild Kit	***	1
15	Air Flow Booster Compressor Inlet Particulate Filter	*	1
16	¼" MPT Stainless Steel Check Valve	**	3
17	Water Separator Filter & O-Ring	*	1
18	Ambient Ozone Sensor Head	**	1
19	Solenoid Valve(s)	**	10-40
20	Solenoid Valve Rebuild Kit(s)	**	10-40
21	High Voltage Lead Tester	n/a	1

* **Inspect Monthly / Rebuild or Replace as needed**

** **Inspect Annually / Rebuild or Replace as needed**

*** **Replace / Rebuild Annually**

OSUXX-26 Service Kits

OSUXX-26 Startup Service Kit

Catalog # SKC26-00

Part No.	Item	Quantity
S-ELH-FN-102-F	10" Cooling Fan Filter	1
S-IFS-100-F	Filter Element for 1/4" Bowl	2
S-FB-100-F	Water Separator Filter & O-Ring	1
ELH-FU-5	Fuse, Time Delay, 5A, Class CC	1
ELH-FU-10	Fuse, Time Delay, 10A, Class CC	1
ELH-FU-15	Fuse, Time Delay, 15A, Class CC	1
ELH-FU-30	Fuse, Time Delay, 30A, Class CC	1

OSUXX-26 Six Month Service Kit

Catalog # SKC26-06

Part No.	Item	Quantity
S-ELH-FN-102-F	10" Cooling Fan Filter	1
V-C-104	1/4" MPT 316SS Check Valve	3
S-IFS-100-F	Filter Element for 1/4" Bowl	2
S-FB-100-F	Water Separator Filter & O-Ring	1

OSUXX-26 Twelve Month Service Kit

Catalog # SKC26-12

Part No.	Item	Quantity
S-ELH-FN-102-F	10" Cooling Fan Filter	1
V-C-104	1/4" MPT 316SS Check Valve	3
MI-100	Oxygen Moisture Indicator	1
S-ECH-O3S-100-SH	Ambient Ozone Sensor Head	1
S-IFS-100-F	Filter Element for 1/4" Bowl	2
S-FB-100-F	Water Separator Filter & O-Ring	1
V-PR-207	Oxygen Pressure Relief Valve, 45psi	1
S-V-S-103-SK	Solenoid Valve Rebuild Kit	1
V-PR-101	Valve, Pressure Relief, 100 psi, 1/4" npt, SS	1
S-CMP-O3-100-SK	ODP Compressor Rebuild Kit	1
S-CMP-O2-101-SK	Oxygen Compressor Rebuild Kit (1313)	1
S-CMP-AFB-100-SK	Air Flow Booster Compressor Rebuild Kit	1

H2O Engineering Inc.
ADVANCED REMEDIATION SOLUTIONS

Site Name/Location:	
O&M Contractor:	
System Startup Date:	
H2O Model Number:	
H2O Serial Number:	

Operation and Maintenance Log

"All Manufacturers recommendations for maintenance are to be followed"
Item to inspect, maintain, or replace.

Maintenance and Inspection Items

Inspect integrity of all hoses, fittings, piping, valves and check valves.	Inspect inlet filter elements on Oxygen Compressor and AFB Compressor and replace as needed.	Inspect 10" fan filter and replace as needed.	Inspect water separator filter(s) & O-ring(s).	Confirm O2 air flow meter (cfh) & O3 reactor pressure gauge (psi) readings.	Inspect O2 moisture indicator.[1]
Frequency					
Monthly	Monthly	Monthly	Monthly	As-Needed	As-Needed
Item Replaced and Date Completed					
6 month kit					
12 month kit					

Comments:

Note[1]: O2 Moisture Indicator- Indicates whether or not moisture is present in ATF Module. Blue indicates that no moisture is present, while pink or white indicates that moisture is present. If moisture indicator is pink or white please contact factory for further instructions, (805) 547-0303.

Note[2] colored bars indicate time for 6 or 12 month maintenance kit. Available for purchase from H2O Engineering, Inc.

6. MSDS: Ozone Gas

OZONE — **Material Safety Data Sheet**

SECTION I: MATERIAL IDENTIFICATION

IDENTITY: OZONE (Gaseous)	**ISSUED: February, 1992**
FORMULA: O_3	**REVISED: September, 2001**

Description (origin/uses): Occurs in atmosphere from UV light action on oxygen at high altitude. Commercially obtained by passing air between electrodes carrying a high voltage alternating current. Also found as a by-product in welding areas, high voltage equipment, or UV radiation.

Ozone is used as an oxidizing agent in air and water disinfection: for bleaching textiles, oils, and waxes; organic synthesis as in processing certain perfumes, vanillin, camphor; for mold and bacteria control in cold storage.

Cautions: A powerful oxidizing agent, ozone generally exists as a gas and is highly chemically reactive. Inhalation produces various degrees of respiratory effects from irritation to pulmonary edema (fluid in lungs) as well as affecting the eyes, blood, and central nervous system.

Manufacturer/Supplier: H2O Engineering, Inc.
265 Prado Road #1
San Luis Obispo, CA 93401
Phone: (805) 547-0303
Fax: (805) 547-0113
www.h2oengineering.com

SECTION II: INGREDIENTS AND HAZARDS

Ozone, CAS No. 10028-15-6: NIOSH *RTECS* No. RS8225000

1991 OSHA PELs
8-hr TWA: 0.1 ppm vol. (0.2 mg/m^3)
15-min STEL: 0.3 ppm vol (0.6 mg/m^3)

1996 IDLH
5 ppm

1990 NIOSH REL
Ceiling: 0.1 ppm vol. (0.2 mg/m^3)

1991-1992 ACGIH TLV
Ceiling: 0.1 ppm (0.2 mg/m^3)

1990 DFG (Germany) MAK
TWA: 0.1 ppm (0.2 mg/m^3)
Category 1: Local Irritant
Peak Exposure Limit: 0.2 ppm
5 min momentary value, 8 per shift

Other Designations: Triatomic oxygen: CAS No. 10028-15-6, NIOSH *RTECS* No. RS8225000

SECTION III: PHYSICAL DATA

Boiling Point:	-169° F	**Melting Point:**	-315.4° F (-193° C)
Vapor Pressure:	>1 ATM	**% Volatile by Volume:**	100%
Vapor Density (AIR = 1):	1.6	**Molecular Weight:**	48 Grams/Mole
Solubility in Water:	0.49 ml @ 32° F (0° C), 30 ppm @ 68° (20 ° C)	**pH:**	Not Listed
		Critical Temperature:	10.22° F (-12.1° C)

Appearance and Odor: Colorless to blue gas (greater than -169° F): characteristic odor often associated with electrical sparks or lightning in concentrations of less than 2 ppm and becomes disagreeable above 1-2 ppm. CAUTION: Olfactory fatigue develops rapidly, so do not use odor as a preventative warning device.

SECTION IV: FIRE AND EXPLOSION HAZARD DATA

Flash Point: Nonflammable
Extinguishing Media: Use large amounts of water spray or fog to put out fires involving ozone. Use appropriate fire-fighting techniques to deal with surrounding material.

Special Fire Fighting Procedures: Wear a self contained breathing apparatus with full facepieces operated in a pressure-demand or other positive-pressure mode.

Unusual Fire/Explosion Hazards: Decomposition of ozone into oxygen gas, (O_2), can increase strength of fire.

SECTION V: REACTIVITY DATA

Stability: Ozone is not stable. Hazardous polymerization cannot occur.

Chemical Incompatibilities: Ozone is chemically incompatible with all oxidizable materials, both organic and inorganic.

Conditions to Avoid: Ozone is unstable at room temperatures and spontaneously decomposes to oxygen gas. Avoid ignition sources such as heat, sparks, and open flame. Keep away from strong reducing agents and combustible materials such as grease, oils, and fats.

Products of Hazardous Decomposition: Ozone spontaneously decomposes to oxygen gas, even at room temperatures.

SECTION VI: HEALTH HAZARD DATA

Carcinogenicity: Ozone is not listed as a carcinogen by the NTP, IARC, or OSHA.

Primary Entry: Inhalation

Target Organs: Respiratory system, eyes, blood.

Summary of Risks: There is no true threshold limit and so no exposure (regardless of how small) is theoretically without effect from ozone's strong oxidative ability. Ozone passes straight to the smallest bronchioles and alveoli and is not absorbed by mucous membranes along the way. Initial small exposure may reduce cell sensitivity and/or increase mucous thickness producing a resistance to low ozone levels. Short exposure to 1-2 ppm concentrations causes headache as well as irritation to the respiratory tract, but symptoms subside when exposure ends. High concentrations of ozone produce severe irritation of the eyes and respiratory tract. Exposure above the ACGIH/OSHA limits produce nausea, chest pain, coughing, fatigue, reduced visual acuity, and pulmonary edema. Symptoms of edema from excessive exposure can be delayed one or more hours. Inhalation of >20 ppm for an hour or more (>50 ppm for 1/2 hour) can be fatal.

Acute Effects: Acute damage from ozone appears to be mainly from its oxidizing effect on contact with tissue.

Chronic Effects: Respiratory disease. Deleterious effects on lungs and acceleration of tumors have been reported.

Medical Conditions Generally Aggravated by Long-Term Exposure: History of respiratory or heart disorders.

First Aid: Remove from ozone containing air, get prompt medical help*, administer oxygen if necessary.

Eye Contact - Gently lift eyelids and flush eyes continuously with flooding amounts of water for 15 minutes or until transported to a medical facility*.

Inhalation - Remove exposed person to fresh air, support breathing, administer humidified oxygen as needed, get medical help*.

Ingestion - Highly unlikely since ozone is a gas until -169° F,

* **GET MEDICAL ASSISTANCE = APPROPRIATE IN-PLANT, PARAMEDIC, or COMMUNITY.** Get prompt medical assistance for further treatment, observation, and support after first aid.

SECTION VII: PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be Taken in Case of Spill/Leak:

1. Discontinue production
2. Isolate and vent area
3. Immediately notify personnel
4. Deny entry
5. Follow applicable OSHA regulations

Disposal: Provide ventilation to dilute and disperse small amounts of ozone (below OSHA PELs) to outside atmosphere. Follow federal, state, and local regulations.

Handling/Storage Precautions: Ensure proper personnel training and establish emergency procedures.

SECTION VIII: CONTROL MEASURES

Respiratory Protection: High Level (>10ppm) - Self Contained Breathing Apparatus: MISH/NIOSH approved.
Low Level (0.3 - 10 ppm) - Canister Type (carbon) respirator may be used.

Eye Protection: Wear chemical safety goggles if necessary to work in high ozone (>10 ppm).

Skin Gloves: Effects of ozone on skin are minimal to non-existent.

Ventilation: Provide general and local exhaust ventilation to dilute and disperse small amounts of ozone into the outside atmosphere.

SECTION IX: SPECIAL PRECAUTIONS AND COMMENTS

Storage Segregation: Prevent ozone from coming into direct physical contact with strong acids or bases or with strong oxidizing/reducing agents.

Engineering Controls: Install ventilation systems capable of maintaining ozone to concentrations below the ACGIH/OSHA exposure limits (see sect. II). Install ambient ozone monitor(s) configured to shut down ozone equipment and turn high speed ventilation on.

Warranty

Where parts or equipment are supplied, H2O Engineering warrants these parts to be free from defects in material or workmanship for a period of 12 months commencing on the date of original shipment from H2O Engineering, with the following exception: 1) The warranty period shall begin on the installation date if the installation is performed within 60 days of the original shipment from H2O Engineering.

To validate the warranty, a warranty card, accompanied by a copy of the invoice, must be returned to H2O and must include the following information:

- End user name
- Complete address, including telephone number
- Date installed
- Complete model and serial number information
- Name of company from which the unit was purchased

Repairs and replacement parts provided under this warranty shall carry only the unexpired portion of this warranty or 90 days, whichever is longer. Implied warranties, including but not limited to warranties of fitness for particular purpose, use or application, and all other obligations or liabilities on the part of H2O Engineering, unless such warranties, obligations or liabilities are expressly agreed to in writing by H2O Engineering, are null and void.

Obtaining Service Under Warranty

Purchased Equipment
The Customer undertakes to give immediate written (email) notice to H2O Engineering if parts appear defective and to provide H2O Engineering with reasonable opportunity to make inspections and tests. H2O Engineering's obligations under this warranty are limited to the repair or replacement at its factory, of any part which proves to be defective. If the Customer asks H2O Engineering to replace defective parts at the Customer's premises, the Customer agrees to pay for any traveling time and expenses. H2O Engineering's labor costs to complete the repair/replacement will be covered by H2O Engineering. Goods shall not be returned to H2O Engineering without H2O Engineering's permission. H2O Engineering will provide the Customer with an RGA number (Return Goods Authorization) to use for returned goods to be shipped to H2O Engineering, FOB San Luis Obispo, CA. The RGA number must appear prominently on the exterior of the shipped box(es). The product and/or part must be packaged either in its original packing material or in comparable and suitable packing material, if the original is not available. You are responsible for paying shipping charges to H2O and for any damages to the product and/or part that may occur during shipment. It is recommended that you insure the shipment for the amount you originally paid for the product and/or part. Repaired or replaced items will be shipped back to the Customer by H2O Engineering, FOB San Luis Obispo, CA. If upon inspection, it is determined that there is no defect or that the damage to the product and/or part resulted from causes not within the scope of this limited warranty, then the Customer must bear the cost of repair or replacement of damaged product and/or part and all return freight charges. Any unauthorized attempt by the end user to repair H2O Engineering manufactured products without prior permission shall void any and all warranties. For service, contact H2O Engineering Service direct at (805) 547-0303.

Rental Equipment
H2O Engineering should be notified shall any product and/or part not be performing satisfactorily. H2O Engineering will coordinate with Customer's technician to troubleshoot system malfunctions while the technician is on site, or during the technician's next visit to the site. If by the end of the second visit, normal operation of the rented equipment has not been restored, the rental period will be suspended until such time as normal operation has resumed. Customer may, as a courtesy, ship identified malfunctioning items to H2O Engineering, for more expedient service. A Return Goods Authorization (RGA) number must first be obtained by either calling or writing H2O Engineering direct, prior to shipping the product. The RGA number must appear prominently on the exterior of the shipped box(es). The product and/or part must be packaged either in its original packing material or in comparable and suitable packing material, if the original is not available. You are responsible for paying shipping charges to H2O and for any damages to the product and/or part that may occur during shipment. It is recommended that you insure the shipment for the amount you originally paid for the product and/or part. H2O Engineering and Customer agree to make a reasonable effort to identify and claim shipping damage at the time a package is received. An attempt to trouble shoot the system malfunction will be made as a cooperative effort between H2O Engineering

and Customer's project technician. However, if a malfunction cannot be resolved through trouble shooting with Customer's project technician, timely on-site repair of any malfunctioning equipment will be the responsibility of H2O Engineering. Once on-site, if H2O Engineering determines that the malfunction of the equipment is the result of misuse or improper operation, the Customer is responsible for all costs incurred by H2O Engineering to correct the malfunctions including: parts, labor, travel, and accommodations.

Items Excluded from the Warranty

This warranty does not apply to normally consumable parts or components such as filter cartridges, pump seals, fan filters, etc. This warranty does not extend to any product and/or part from which the factory assigned serial number has been removed or which has been damaged or rendered defective as a result of:

- an accident, misuse, alteration or abuse
- an act of God such as flood, earthquake, hurricane, lightning or other disaster resulting only from the forces of nature
- normal wear and tear
- operation outside the usage parameters stated in the product user's manual
- use of parts not sold by H2O Engineering
- damage which may occur during shipping
- service or unit modification not authorized by H2O Engineering
- failure to meet service requirements as outlined in the Product Manual/User Guide

Claims and Returns

Buyer must inspect shipment for damage in the presence of the carrier at the time of delivery. Failure to bring any damages (obvious or concealed) to the attention of the carrier and noting such damages on the bill of lading will void any claim made against the carrier. Buyer should save all packaging materials and immediately notify the Seller of the damages. On all products shipped F.O.B. shipping point, it is the responsibility of the Seller to file a damage claim with the carrier. Therefore, the Buyer must furnish Seller with complete damage information immediately. Verify contents of all shipments against the packing slip. Carefully check all packaging materials for merchandise before discarding. Claims for shortages or inaccurate filling of orders must be made to Seller within ten (10) days of receiving the shipment. If any goods were shipped in error, the Seller shall provide Buyer with a Returned Goods Authorization (RGA) number. If Seller, in good faith, determines that any error was not the Seller's, the Buyer shall be charged a 20% restocking fee for any products returned for credit or exchange.

Exclusive Warranty

There is no other expressed warranty on H2O products and/or parts. Neither this warranty nor any other warranty, expressed or implied, including any implied warranties or merchantability of fitness, shall extend beyond the warranty period. Some states do not allow limitations on how long an implied warranty lasts, so that the above limitation or exclusion may not apply to you.

THIS STATEMENT OF WARRANTY SUPERSEDES ALL OTHERS PROVIDED TO THE CUSTOMER AT ANY PRIOR TIME.

APPENDIX B
Standard Operating Procedure for Water Sampling

Appendix B

Standard Operating Procedures for Groundwater Sampling

This Standard Operating Procedure (SOP) describes methods and protocols for sampling groundwater from monitoring wells. The following steps are taken in order to obtain representative groundwater samples.

Water Level Measurements

Obtain a "snapshot" measurement of groundwater levels in wells by opening each well vault, removing the well casing cap, and allow adequate time for water levels to equilibrate with atmospheric pressure. After each well cap is removed, the vault lid is replaced to prevent accidents. Water levels are measured from a surveyed mark on the well casing using a conductivity based electric sounder. Water levels are then measured in a sequence of "cleanest to dirtiest" to minimize the potential for cross-contamination between wells. Water levels are measured and recorded to the nearest 100^{th} of a foot. After sounding each well for depth to water, the sounding tape is reeled in and the sounding probe is decontaminated by rinsing with clean tap water and wiped clean with a paper towel. In the event that pure phase chemicals are present in the well, more rigorous methods will be used to decontaminate the sounding probe.

Well Purging

Purging is performed in order to obtain a representative sample of formation water by removi9ng stagnant water from the well casing. Wells are purged and sampled in order of "cleanest to dirtiest". After water levels measurements are completed, the height of the water column in each well is determined by subtracting the depth to water measurement from the total depth of the well. The water column height is then multiplied by a constant determined by the diameter of the well (0.17 gallons per foot for a 2-inch diameter well). This value is equivalent to the volume of the well. This value is then multiplied by 3 to determine the proper purge volume from each well.

The well is purged of three well volumes using either a disposable polyethylene bailer (if the purge volume is relatively small) or a submersible pump and tubing (if the purge volume is relatively large). If the well is pumped, the purge volume is extracted relatively slowly to prevent formation water from cascading down the well screen to the bottom of the well, which could volatilize light end contaminants.

The conductivity, pH and dissolved oxygen concentration are measured for each well volume removed. Field instruments will be calibrated at the beginning of each sampling day. These results will be recorded on a sampling log along with the depth to water and purge volume calculations. Prior to sample collection, indicator parameters are compared to the previous measurements. When three well volumes have been removed and indicator parameters are within ten percent of one another, a sample is collected. Purge water is stored in 55-gallon

drums that are labeled by sample date. The contents of these drums will be appropriately disposed of at a later date.

In the event a well yields less than three well volumes due to low permeability soils or poor well yield, the well will be evacuated and allowed to recover to 80 percent of the original water column height after which water samples may be collected.

Sampling for Fuel or Solvent Parameters

Samples will be collected with disposable polyethylene bailers attached to clean string or cord. Samples are collected in appropriate containers for the analyses to be performed. Sample preservatives will be added to each sample container by the laboratory in accordance with EPA protocols. Samples will be decanted into sample containers taking care not to spill or contaminate the sample. Samples for volatile organic analysis (VOAs) are slowly and carefully decanted from the bailer into replicate 40 ml vials to form a meniscus on the top of the sample with no bubbles present. The lids are affixed and sampled are checked to ensure there are no bubbles in the sealed VOA vials. VOA vials will be pre-preserved with concentrated hydrochloric acid. Samples for TPH-d and TPH-mo will be collected in one liter amber glass bottles.

Samples containers will be labeled with a unique sample identification number and immediately placed in a sample cooler chilled to 4 degrees Celsius. A Chain of Custody form will be completed in the field and will accompany the samples at all times. The Chain of Custody will record the sample identification number, date collected, container type, preservative used, media type (e.g., soil, groundwater, surface water), requested analysis and turnaround time. Chain of Custody forms will be signed and dated by the sampler and the authorized personnel at the receiving laboratory.

Equipment Decontamination

Some sampling equipment, such as submersible pumps, may be cleaned and reused. As mentioned previously, the wells will be sampled in order of “cleanest to dirtiest” to prevent cross contamination. The following decontamination procedures will be used on reused sampling equipment.

1. The equipment is sprayed with tap water upon removal from the well
2. The equipment is submerged in a drum containing approximately 30 gallons of tap water and a non-phosphate detergent. If a pump is being decontaminated the pump will be turned on to allow the soapy water to circulated through the pump and tubing.
3. The equipment is placed in a drum containing approximately 30 gallons of tap water with no detergent to rinse the equipment.
4. Wash and rinse solutions are stored in drums for appropriate disposal.

Investigation Derived Residuals

Purge and rinse water will be placed in 55-gallon drums and stored onsite pending characterization, treatment or disposal. The generation and disposal of investigation derived residuals is the responsibility of responsible party. Although CES may assist the responsible party with the characterization, transportation and disposal of the investigation derived residuals, under no circumstances shall CES be considered the generator, transporter, storage facility or disposal facility for any waste whatsoever.

Use of this SOP

This SOP is intended to be strictly followed on all CES projects wherein groundwater samples are collected. Occasionally, compliance with one or more of these protocols may not be possible. Any field procedures that deviate from this SOP and the rationale will be described in the report of field activities.