Q1/Q2 2008 BIOVENTING AUGMENTATION AND STATUS REPORT

REDWOOD REGIONAL PARK
SERVICE YARD
OAKLAND, CALIFORNIA

Prepared for:

EAST BAY REGIONAL PARK DISTRICT
OAKLAND, CALIFORNIA

July 2008

STELLAR ENVIRONMENTAL SOLUTIONS, INC.

GEOSCIENCE & ENGINEERING CONSULTING

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Prepared for:

EAST BAY REGIONAL PARK DISTRICT
P.O. BOX 5381
OAKLAND, CALIFORNIA 94605

Prepared by:

STELLAR ENVIRONMENTAL SOLUTIONS
2198 SIXTH STREET, SUITE 201
BERKELEY, CALIFORNIA 94710

July 14, 2008

Project No. 2008-02

STELLAR
ENVIRONMENTAL SOLUTIONS, INC.
2198 SIXTH STREET, SUITE 201·BERKELEY, CA 94710
TEL: (510)644-3123 · FAX: (510)644-3859
GEOSCIENCE & ENGINEERING CONSULTING

July 14, 2008

Mr. Jerry Wickham, P.G.
Hazardous Materials Specialist
Alameda County Department of Environmental Health
1131 Harbor Bay Parkway, Suite 250
Alameda, California 94502

Subject: First and Second Quarters 2008 Bioventing Augmentation and Status Report, Redwood Regional Park Service Yard Site, Oakland, California – RO #0000246

Dear Mr. Wickham:

This report discusses activities conducted during the first and second quarters of 2008, and summarizes activities related to augmentation in March 2008 and monitoring of the bioventing corrective action system at the Redwood Regional Park Service Yard, located at 7867 Redwood Road, Oakland, California. This project is being conducted for the East Bay Regional Park District, and follows previous site investigation and remediation activities (conducted since 1993). The key regulatory agencies for this investigation are the Alameda County Department of Environmental Health, the Regional Water Quality Control Board, and the California Department of Fish and Game. I declare, under penalty of perjury, that the information and/or recommendations contained in the attached document or report is true and correct to the best of my knowledge.

If you have any questions regarding this report, please contact Mr. Neal Fujita of the East Bay Regional Park District, or contact me directly at (510) 644-3123.

Sincerely,

Richard S. Makdisi, R.G., R.E.A.
Principal and Project Manager

cc: Carl Wilcox - California Department of Fish and Game
Neal Fujita - East Bay Regional Park District
State of California GeoTracker system and Alameda County Environmental Health (electronic uploads)

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1.0 PROJECT DESCRIPTION AND SITE HISTORY

PROJECT DESCRIPTION

The subject property is the East Bay Regional Park District (EBRPD) Redwood Regional Park Service Yard, located at 7867 Redwood Road in Oakland, Alameda County, California. The site has undergone site investigations and remediation since 1993 to address subsurface contamination caused by leakage from one or both of two former underground fuel storage tanks (UFSTs) that contained gasoline and diesel fuel. The Alameda County Health Care Services Agency, Department of Environmental Health (Alameda County Environmental Health) has provided regulatory oversight of the investigation since its inception. Other regulatory agencies with historical involvement in site review include the Regional Water Quality Control Board – San Francisco Bay Region (Water Board) and the California Department of Fish and Game (CDFG).

Bioventing was selected as an appropriate corrective action to mitigate residual petroleum contamination, based on site conditions, residual contaminant distribution, and results from a previously conducted bioventing pilot test in 2004 (SES, 2004b). The bioventing system was approved by Alameda County Environmental Health (Alameda County Environmental Health, 2005b), and was installed and started up in December 2005 and January 2006 (SES, 2006a). The First Quarter Bioventing Status Report was issued in April 2006 (SES, 2006b). Alameda County Environmental Health responded to that report (in its letter of March 15, 2006) approving the proposed approach of monthly bioventing operations and maintenance (O&M) and reporting.

This report documents the activities conducted in the First and Second Quarter of 2008, and summarizes the soil bioventing system-related activities and installation of two additional vent wells installed in March 2008.

SITE DESCRIPTION

Figure 1 shows the location of the project site. A site plan showing the full-scale bioventing system is presented on Figure 2.

N

SITE LOCATION ON U.S.G.S. TOPOGRAPHIC MAP

Redwood Reg. Park Service Yard Oakland, CA	By: MJC	MARCH 2006
	Figure 1	

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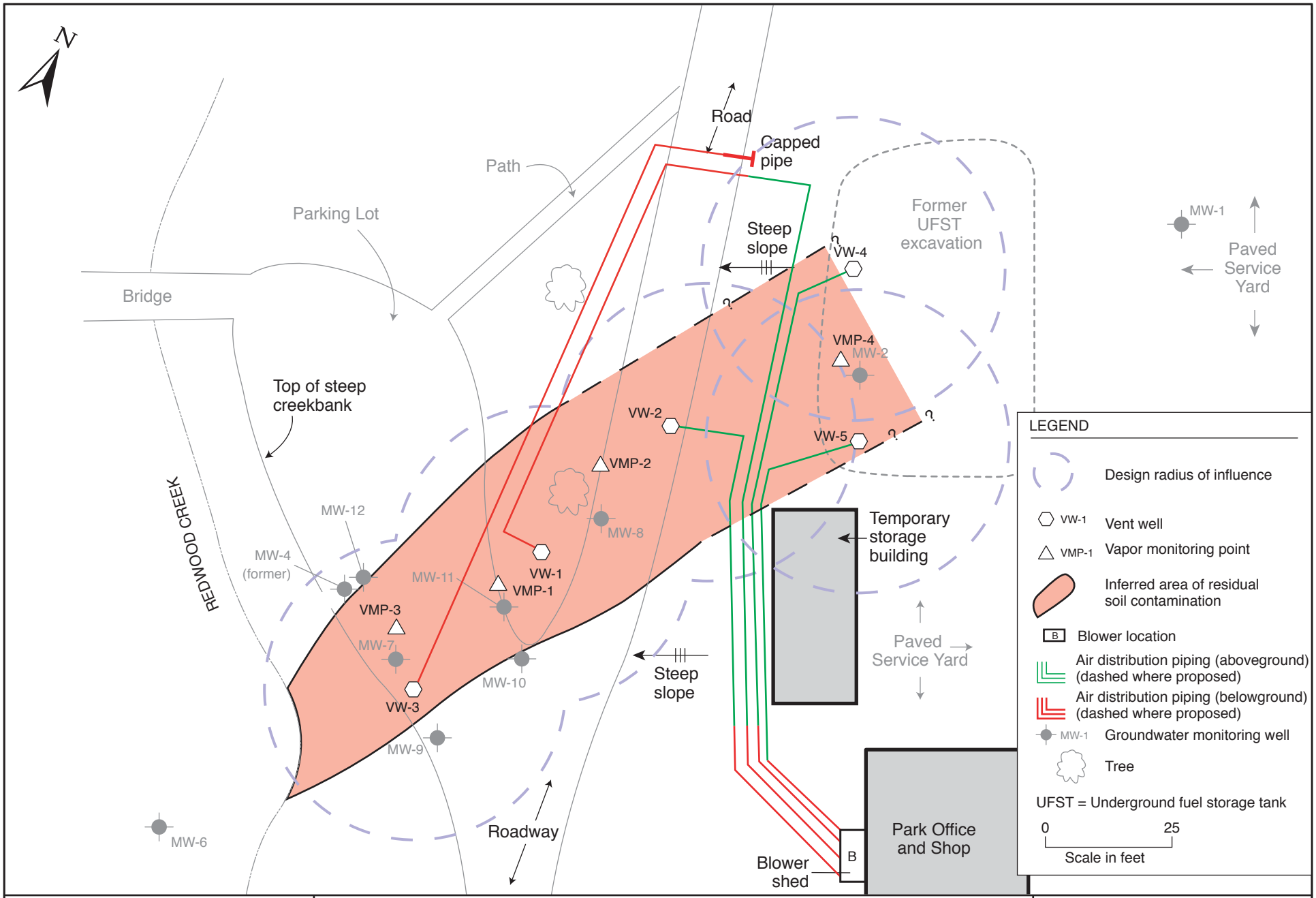
2006-17-01



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BIOVENTING SYSTEM

7867 Redwood Rd, Oakland, CA

Figure 2

by: MJC | **MARCH 2008**

2008-02-06

The site slopes to the west, from an elevation of approximately 564 feet above mean sea level (amsl) at the eastern edge of the service yard to approximately 530 feet amsl at Redwood Creek, which defines the approximate western edge of the project site with regard to this investigation.

From east to west, the study area consists of:

- Flat, paved EBRPD service yard with several permanent and temporary buildings/sheds (former UFST excavation area);
- Steep slope (approximately 45 degrees) between the western edge of the service yard and the park entrance road (immediately west of MW-2);
- Hummocky terrain with low vegetation (between MW-8 and MW-11), including a large EBRPD-designated sycamore tree (adjacent to MW-8 and VMP-2);
- Flat, unpaved parking lot (between MW-11 and MW-7); and
- Steep slope (approximately 45 degrees) to Redwood Creek (immediately west of MW-12, MW-7, and MW-9).

SITE HISTORY AND CONTAMINATION

Contaminant corrective actions and investigations have been conducted at the site since 1993. General phases of work previously conducted include:

- Removal of UFSTs and contaminated soil;
- Installation and quarterly monitoring of groundwater monitoring wells;
- Several phases of remedial investigation-oriented exploratory borehole drilling and sampling;
- A correction action feasibility study;
- Two phases of ORC™ injection;
- An evaluation of bioventing feasibility as a corrective action, which included a bioventing pilot test; and
- Installation and startup of the bioventing system in December 2005 and January 2006. After startup, four weekly monitoring/air flow optimization events were conducted.
- Installation of two additional bioventing vent wells (VW-4 and VW-5) in the source area and disconnection of VW-3.

As detailed in previous SES reports, the available data support the following conclusions:

- The saturated zone overlies laterally extensive bedrock, which limits downward migration of groundwater contamination.
- The unsaturated zone varies in thickness due to seasonal water level fluctuations of several feet.
- Site chemicals of concern include total petroleum hydrocarbons (TPH)—specifically as gasoline (TPHg) and diesel (TPHd); benzene, toluene, ethylbenzene, and xylenes (BTEX); and methyl *tertiary*-butyl ether (MTBE).
- Residual soil contaminant mass in the unsaturated zone is acting as a long-term source of groundwater contamination; the maximum thickness of the residual soil contamination (during lowest water level periods) is approximately 10 feet.
- Previous ORC™ injection programs resulted in apparent permanent reductions at the peripheral plume margins, but were followed by rebound to pre-injection conditions within the central portions of the plume, corroborating the conceptual model that remaining unsaturated zone soil contamination is continuing to impact groundwater.
- Site conditions appear favorable for bioventing as a corrective action to reduce unsaturated zone soil contamination, especially in the near-source area that is inaccessible to other methods due to the hilly topography.

REGULATORY STATUS AND DATA REPORTING

The lead regulatory agency for the site investigation and remediation is Alameda County Environmental Health (ACEH), with oversight provided by the Water Board. The CDFG is also involved with regard to water quality impacts to Redwood Creek. Installation and start up of the full-scale bioventing system was approved in 2005, and implemention of the monthly bioventing O&M program with a yearly in-situ respiration test began in 2006 (ACEH 2005b, 2006). The most recent regulatory agency input was Alameda County Environmental Health's approval to augment the existing bioventing system with two additional vent wells (VW-4 and VW-5) in the source area and the disconnection of VW-3 (ACEH 2008).

The site is in compliance with the State Water Resources Control Board's GeoTracker requirements for uploading of electronic data and reports. In addition, electronic copies of all bioventing-related reports have been uploaded to Alameda County Environmental Health's online file transfer protocol (ftp) system. Per Alameda County Environmental Health's October 31, 2005 "Miscellaneous Administrative Topics and Procedures" directive, effective January 31, 2006, paper copies of reports are no longer required to be provided to Alameda County Environmental Health.

2.0 BIOVENTING SYSTEM AND DESCRIPTION

This section discusses the installation of the full-scale bioventing system, which includes: two additional VWs and air distribution air distribution piping. Photos of the bioventing system installation are included in Appendix A. Figure 2 shows the full-scale bioventing system site plan.

SYSTEM BACKGROUND

Bioventing typically has an effective radius of influence between 10 and 50 feet, depending on soil type. As part of the October 2004 pilot test, a single vent well (VW-1) was installed in the central portion of the contaminated area, and three VMPs (VMP-1, VMP-2, and VMP-3) were installed at distances of approximately 10, 20, and 35 feet from the vent well to allow for an evaluation of the radius of influence due to air injection at VW-1. The pilot test data indicated a likely radius of influence of 30 feet (SES 2004). This data was the basis for installation of all subsequent vent wells, namely VW-2 and VW-3 installed in 2005 and the newly installed VW-4 and VW-5 that are discussed in next section of this report.

Based on the findings of the initial pilot test, two additional VWs (VW-2 and VW-3) and one additional VMP (VMP-4) were installed in November/December 2005 to supplement the existing bioventing well network. As shown on Figure 2, the design radii of the three VWs encompass the entire area of residual unsaturated zone soil contamination. The VWs were screened from 6 to 16 feet bgs (VW-1) and 8 to 18 feet bgs (VW-2 and VW-3) to incorporate the full depth of the residual soil contamination zone. Since installation, VW-2 has functioned 3 to six months per year due to the screen interval being below the water table. VW-3 has never functioned because of assumed lithlogic restraints.

CURRENT AUGMENTED BIOVENTING SYSTEM DESCRIPTION

The installation of vent wells VW-4 and VW-5 are discussed in the next section. The augmented bioventing system consists of the following components:

- Four vent wells (VW-1, VW-2, VW-4, and VW-5), screened across both the saturated and unsaturated zones.

- Four vapor monitoring points (VMPs), each with two nested screened intervals at depths coincident with VW screened intervals.
- A regenerative-type air blower installed in a small shed on the west side of the service yard garage building. The blower is rated at 140 cubic feet per minute (cfm) and exerts a pressure of approximately 1 to 3 pounds per square inch (psi).
- Air distribution piping between the blower and the VW wellheads, including a manifold just downstream of the blower.
- Appurtenant air flow valves, pressure/vacuum gauges, and air sampling ports.

Table 1 summarizes bioventing well construction data. Figure 2 (in the previous chapter) is a site plan showing the layout of the bioventing system. Figures 3 and 4 are as-builts for typical site VWs and VMPs, respectively. Figure 5 is a flow instrumentation diagram for the blower and associated manifold. This blower system was designed and configured based on the pilot test design specifications—i.e., achieving a potential 30-foot radius of influence and a flow rate of 40 standard cubic foot per minute (scfm) to individual VWs under induced pressure conditions.

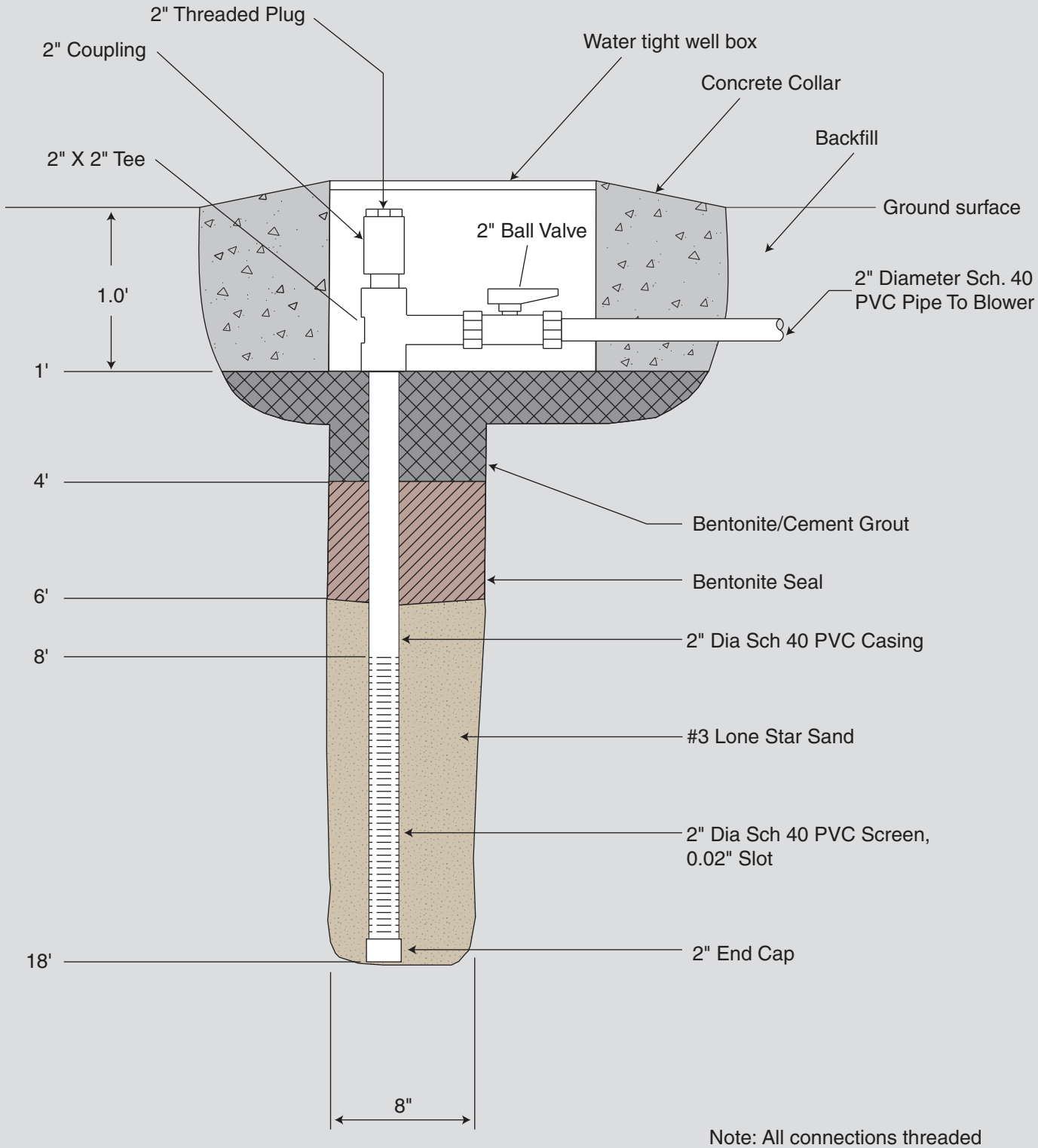
Table 1
Bioventing Well Construction Data
Redwood Regional Park Service Yard, Oakland, California

Well	Screen Interval Depth (feet)	Filter Pack Sand Depth Interval (feet)
VW-1	6 – 16	4 – 16
VW-2	8 – 18	6 – 18
VW-3 (1)	8 – 18	6 – 18
VW-4	15 - 27	14.5 - 27
VW-5	13 - 26	12.5 - 26
VMP-1	10 – 11.5	9.5 – 12
	14 – 15.5	13.5 – 16
VMP-2	10 – 11.5	9.5 – 12
	14 – 15.5	13.5 – 16
VMP-3	10 – 11.5	9.5 – 12
	12.5 – 14	12 – 14.5
VMP-4	15.5 – 17	15 – 17.5
	20.5 – 22	20 – 20.5

Note:

(1) = disconnected

All depths are in feet below top of well box (approximately ground surface).



NOT TO SCALE
(well casing is actually centered in borehole)

Note: All connections threaded with gasket or teflon tape.
No glues used. See Table 1 for exact screened intervals.

AS-BUILT VENT WELL CONSTRUCTION DETAILS

Redwood Regional Park Oakland, CA	By: MJC	MARCH 2008
	Figure 3	

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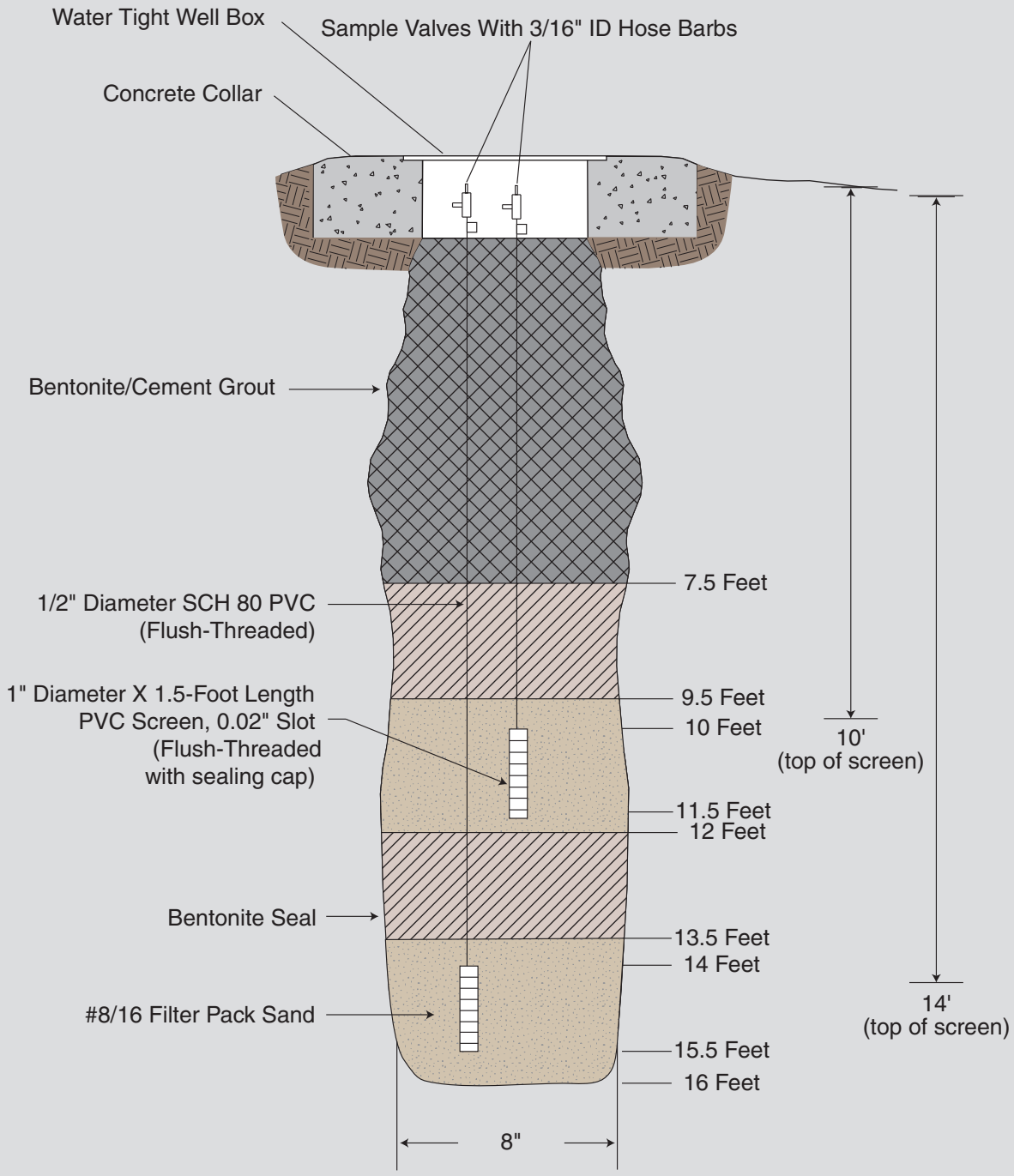
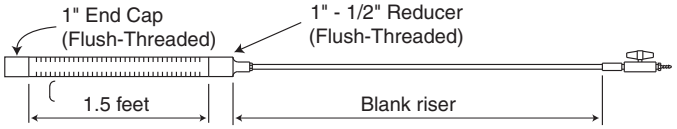
2008-02-01



Not To Scale

Note: Depts shown are applicable to VMP-1 and VMP-2. Deptsh in VMP-3 and VMP-4 vary.

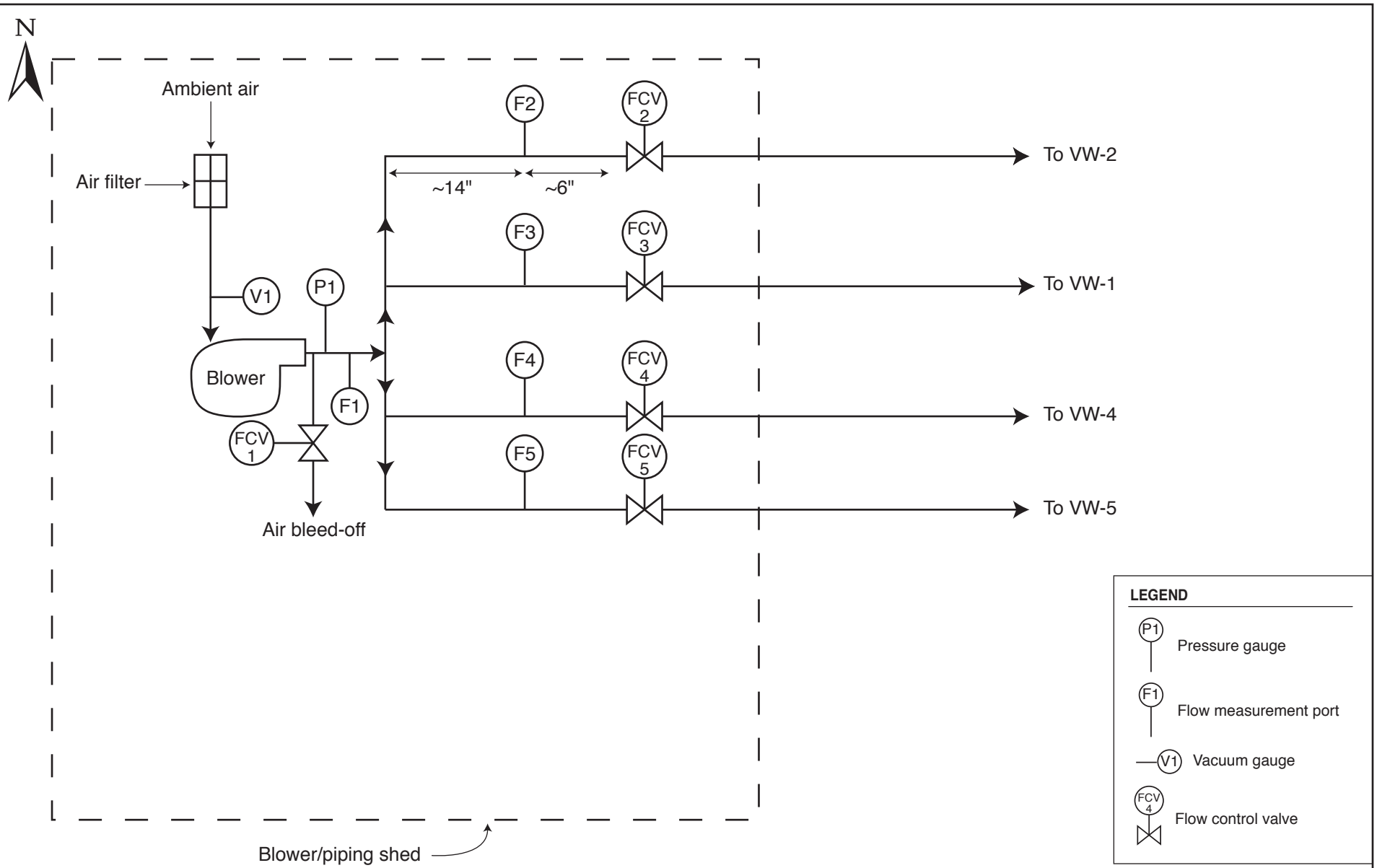


VMP SCREEN DETAIL
Not To Scale

AS-BUILT VAPOR MONITORING POINT CONSTRUCTION DETAILS

Redwood Regional Park **Oakland, CA**	**By: MJC**	**JUNE 2005**	STELLAR ENVIRONMENTAL SOLUTIONS, INC GEOSCIENCE & ENGINEERING CONSULTING
	Figure 4		

2005-66-10



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BIOVENTING PROCESS FLOW AND INSTRUMENTATION DIAGRAM

7867 Redwood Rd, Oakland, CA

Figure 5

by: MJC | **MARCH 2008**

2008-02-07

3.0 BIOVENTING SYSTEM AUGMENTATION

The following section discusses the March 2008 installation of two new vent wells; VW-4 and VW-5. Documentation can be found in Appendix A.

RATIONALE FOR NEW VENT WELL LOCATION AND CONSTRUCTION

A significant increase in total petroleum hydrocarbon concentrations has been observed near the monitoring well MW-2, located in the former source area. This increase has been measured during 3rd and 4th quarter events in 2007 and 1st and 2nd quarter events in 2008 as well as during recently initiated monthly/bimonthly monitoring events beginning in January 2008. The concentrations appear to decrease sharply (from 20,000 ug/L TVHg in March 2008 to 800 ug/L TVHg in April 2008) as a result of relatively minimal (80 gallons) pumping from MW-2. However, the concentrations seem to rebound as observed during the Q2-2008 sampling in June (5,700 ug/L TVHg).

Possible explanations for the increase in concentration include: 1) the contaminant-rich upper layer of groundwater entering the well due to the groundwater elevation dropping to an approximate even level with the top of the MW-2 screened interval; or 2) an isolated hot contaminant feed (although, based on the results of the pumping, this is clearly not a major source of contamination). The new vent wells, VW-4 and VW-5, were each located approximately 20 feet to the north and south of monitoring well MW-2. However, soils in this area of the site can be tight (little to no available pore space), and thus the bioventing wells may not be as effective as VW-1 (located in a sandy soil area). The VW-4 and VW-5 well locations were the only viable place to install them to attempt to remediate the upper (contaminant source) area of site, and so the wells were placed there as the least expensive alternative for additional remedial action.

Previous reports by SES (SES 2004a, 2004b) have detailed site subsurface lithology through a series of constructed cross sections. Shallow soil stratigraphy consists of a surficial 3- to 10-foot-thick clayey silt unit underlain by a 5- to 15-foot-thick silty clay unit. In the majority of boreholes, a 5- to 10-foot-thick clayey coarse-grained sand and clayey gravel unit that laterally graded to a clay or silty clay was encountered. This unit overlies a weathered siltstone at the base of the observed soil profile. The top of this bedrock varies in elevation by several feet in the area of contamination, and likely is a fundamental control on local groundwater flow (on the

order of several feet). The soils beneath Redwood Creek appear to be a thin clayey unit with large cobbles in the creek bed, underlain by sandy and gravelly soils to an unknown depth. Soils in the vicinity of MW-2 are inferred to be landslide debris (loose matrix of poorly-sorted material and a steep groundwater gradient).

MARCH 2008 VENT WELL INSTALLATION ACTIVITIES

Vent wells VW-4 and VW-5 were installed on March 4-5, 2008 by HEW Drilling (East Palo Alto, CA) under the direct supervision of SES geologist Steve Bittman. Prior to installation, well installation permits were obtained from Alameda County Public Works Agency (ACPWA). Well boreholes were drilled with 8-inch-diameter, truck-mounted, hollow-stem augers. Appendix A contains documentation of the well installations and includes; photodocumentation, copies of the ACPWA permits, geologic logs, and DWR Well Completion Reports. Figure 3, in Section 2.0, shows the as-built construction details for VW-4 and VW-5.

Both VWs were constructed of 2.0-inch inner diameter (ID), Schedule 40 PVC casing, and screened from just below the base of the UFST excavation fill; from 15- 27 feet below ground surface (bgs) in VW- 4 and 13 – 26 feet bgs in VW-5 (0.020-inch slot size). Flush-threaded PVC casing and screen was used, with no organic solvents or glues. Annular filter pack material was placed around and 2 feet above the well screen.

Schedule 2-inch-diameter 80 PVC casing was used above and below ground from the wellheads to the blower manifold with glued slip-type couplings. Vent well VW-3 has never functioned, presumably due to lithologic restraints, and was capped. The blower discharge pipe that led to vent well VW-3 was rerouted to the new vent well VW-4. The second new vent well, VW-5, was connected to the blower. Each vent well has a ball-type flow control valve located immediately downstream of the blower manifold piping and at each individual wellhead. This allows for flow adjustment to individual VWs. The current system now consists of four vent wells; VW-1, VW-2, VW-4, and VW-5.

SOIL SAMPLING

One soil sample was collected from each boring, which was subsequently converted into a vent well. Soil sample depth locations were based upon PID measurements that ranged from 0 – 2.4 parts per million by volume (ppmv). PID measurements are shown on the geologic log contained in Appendix A. Soil samples for analysis were collected at a depth of 20 to 20.5 feet bgs in VW-4, and from 16 to 16.5 feet bgs in VW-5.

Soil samples were analyzed using the following methods for:

- Total volatile hydrocarbons (TVH) gasoline range and total extractable hydrocarbons (TEH) diesel range by EPA Method 8015M, and
- BTEX and MTBE by EPA Method 8260.

The samples were submitted to Curtis and Tompkins Laboratory, an ELAP-certified laboratory. Laboratory quality control (QC) samples (e.g., method blanks, matrix spikes, surrogate spikes) were analyzed by the laboratory in accordance with requirements of the analytical method. All laboratory QC sample results and sample holding times were within the acceptance limits of the methods (see Appendix A).

SOIL SAMPLE ANALYTICAL RESULTS

The soil sample results collected from the vent well borings were below laboratory detection limits for all analyzed contaminants, with the exception of soil collected from 20 feet bgs in VW-4. This sample contained 2 milligrams per kilogram (mg/kg) of TEH as diesel, which is well below the Water Board environmental screening limit of 83 mg/kg for a residential site.

Appendix A contains the certified analytical laboratory report and chain-of-custody record.

4.0 EVALUATION OF AUGMENTED BIOVENTING SYSTEM

This section discusses the findings of the augmented bioventing system testing.

BLOWER OPERATION AND AIR FLOW IN DISTRIBUTION PIPING

The blower system is fully functional and operating within design parameters. The blower system has two safety mechanisms for automatic shut-off. For safety reasons, there is no automatic re-start of the blower. The first shut-off mechanism consists of 60-amp fuses in the external circuit breaker box. The second shut-off is an internal, time-delay variable amp shut-off (currently set at 22 amps); the shutdown occurs when the motor operates at unsafe amperage due to increased blower outlet pressure. Testing between the manifold and individual wellheads showed air flow is moving through the air distribution piping and reaching wellheads (when wellheads are open) at expected flow rates. No significant air leaks were observed in the system.

During the initial approximately 2-week period, the blower shut down twice sometime after three hours of operation, after which the system was left on and field personnel had left the site. Both of these shut-downs occurred when the blower outlet pressure was left at 50 psi with VW-1 partly closed and VW-2, VW-4, and VW-5 left fully open. Both shut-downs were due to blower outlet pressure causing an exceedance of the internal shut-off amperage. These events demonstrate that the blower's automatic shut-off mechanisms are working; however, no air is currently moving through vent wells VW-4 or VW-5.

HYDROGEOLOGIC CONDITIONS AFFECTING AIR INJECTION

Water level monitoring has confirmed that water levels fluctuate in wells up to several feet over the year, which will affect both total system flow rate and possibly the ratio of flow into individual VWs. Water level measurements taken during monthly monitoring events in the new vent wells VW-4 and VW-5 show that there is currently 6 to 7 feet of exposed screen (above the saturated zone) in these wells. These wells are located in the higher elevation area of the site and are not subject to groundwater inundation as those wells located at a lower elevation area. However, no air is moving into these new vent wells. It is very unlikely that both well screens were sealed during well installation, therefore appreciable air flow into VW-4 and VW-5 will likely not occur until water levels drop to a level at which a permeable lithologic zone can be exposed (as in the case of VW-2). In our opinion, the silty-clay site lithology is impermeable to

air flow at the current pressure deliverable by the system. The initial system feasibility tests in 2005, measured in vent well VW-1, showed a favorable radius of influence of up to 30 feet. This is most likely due to this well being screened on top of or closer to the gravelly sand noted in the geologic logs. Newly installed vent wells VW-4 and VW-5 are screened across silty clay, which appears relatively impermeable to air flow. As water levels drop in the summer and fall 2008, future monitoring may indicate air flow.

SYSTEM OPERATION AND TESTING

Air Flow Optimization

Initial system tests of the new vent wells were made on March 14, 2008 and then approximately twice a week thereafter. Total, and VW-specific, air injection rates were optimized to ensure both uniform flow rates and proper blower system operation. Total blower airflow was determined to be delivered under a pressure of approximately 60 psi, with all air flow going to VW-1. No air was being injected into either VW-4 or VW-5 (and very minimal air flow to VW-2). SES shut of the air flow to VW-1, and left the blower pressure at 60 cfm at after which it would automatically shut down (stall) after 10 minutes. We tested the system with VW-2, VW-4, and VW-5 concurrently and individually opened; however, the blower overheated. This indicates no flow was being delivered into any of these vent wells under any valve configuration. The blower bleed valve was therefore adjusted to maintain the design outlet pressure of 40 inches of water.

5.0 FIRST AND SECOND QUARTERS ACTIVITIES AND FINDINGS

SYSTEM OPERATION

As discussed in the bioventing system installation and startup report (SES, 2006a), the system was started up in January 2006, and four weekly monitoring/air flow optimization events were conducted. During that time, manifold valves were open to all three VWs; however, no measurable air injection occurred in VW-2 (fully flooded well screen) or VW-3 (partially flooded well screen). Blower outlet pressure during that period was set at 50 inches of water.

Since January 2007, the system has operated continuously with VW-1, VW-2, and VW-3 fully open—except for temporary system shutdowns for monthly O&M activities. However, even after continuous monitoring and well flushing, no noticeable air flow occurred through VW-3. VW-3 was turned off, and vent wells VW-4 and VW-5 were installed in March 2008.

O&M ACTIVITIES

Monthly O&M events were conducted during the first and second quarters (on January 17, February 19, March 14, April 17, May 16, and June 12 of 2008), with the following objectives:

- Confirm that the system was operating within design parameters, with no system problems (e.g., leaks, non-functioning components).
- Conduct preventive maintenance (i.e., clean blower air filter).
- Continue to evaluate air flow through the VW screened intervals.

Monthly O&M activities included:

- Measure water levels in all VMPs and VWs.
- Inspect aboveground portions of the system (i.e., blower, air distribution piping, and wellheads) for leaks or structural problems.
- Record blower outlet pressure and inlet vacuum.
- Qualitatively evaluate if air was flowing across the VW intervals. This was achieved by opening individual VW manifold wells while the blower was operating, and looking for a

drop in blower pressure (a drop in outlet pressure when a valve is opened indicates that air flow is occurring).

- Inspect, clean, or replace the blower inlet filter (filter replaced in the May 2008 O&M event).
- Tighten all aboveground piping clamps (fixed loose clamp in the June 2008 event).
- Complete an O&M checklist.

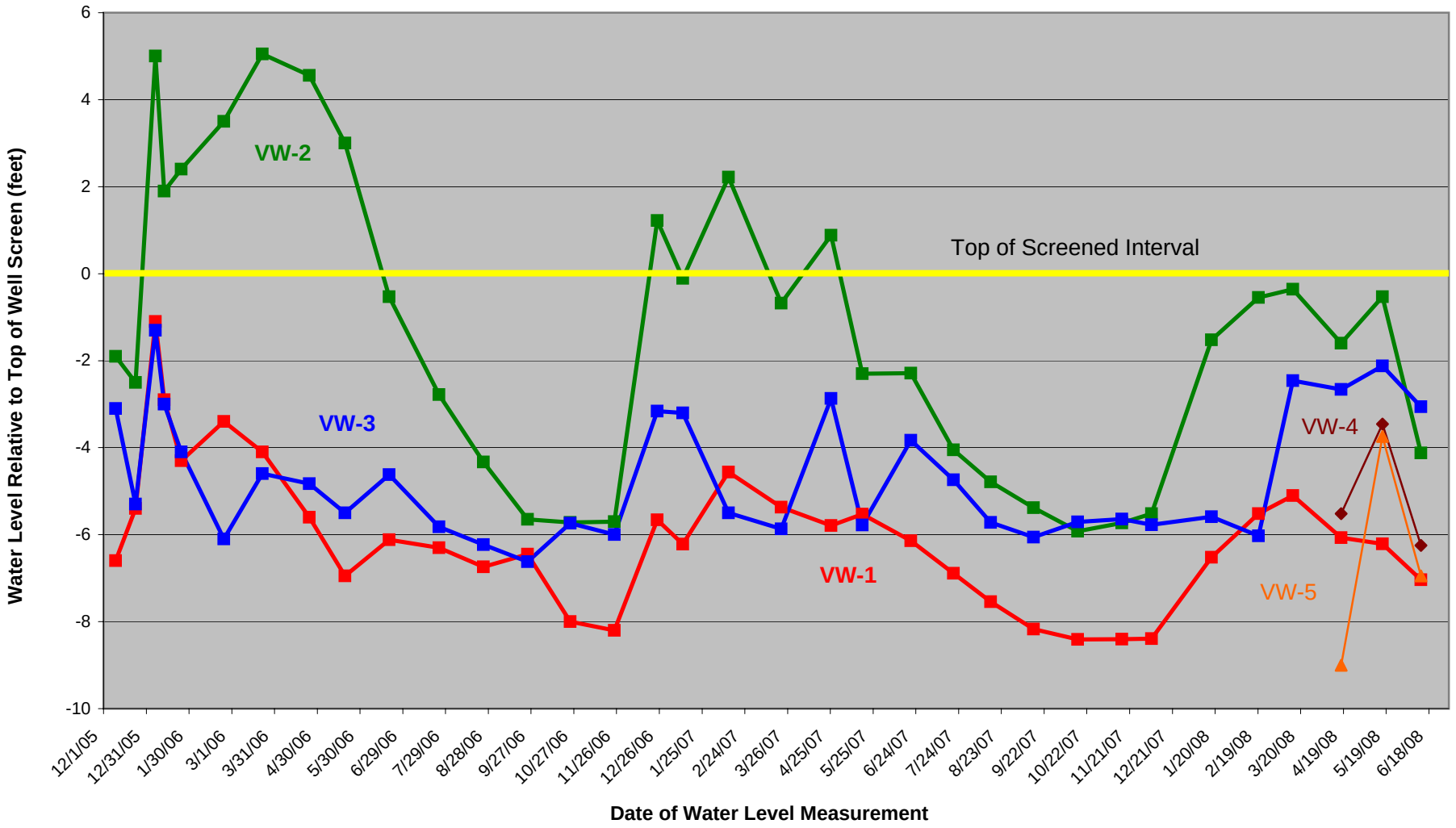
Appendix A contains the completed checklists for the first and second quarters.

O&M FINDINGS

The results of the O&M activities are as follows:

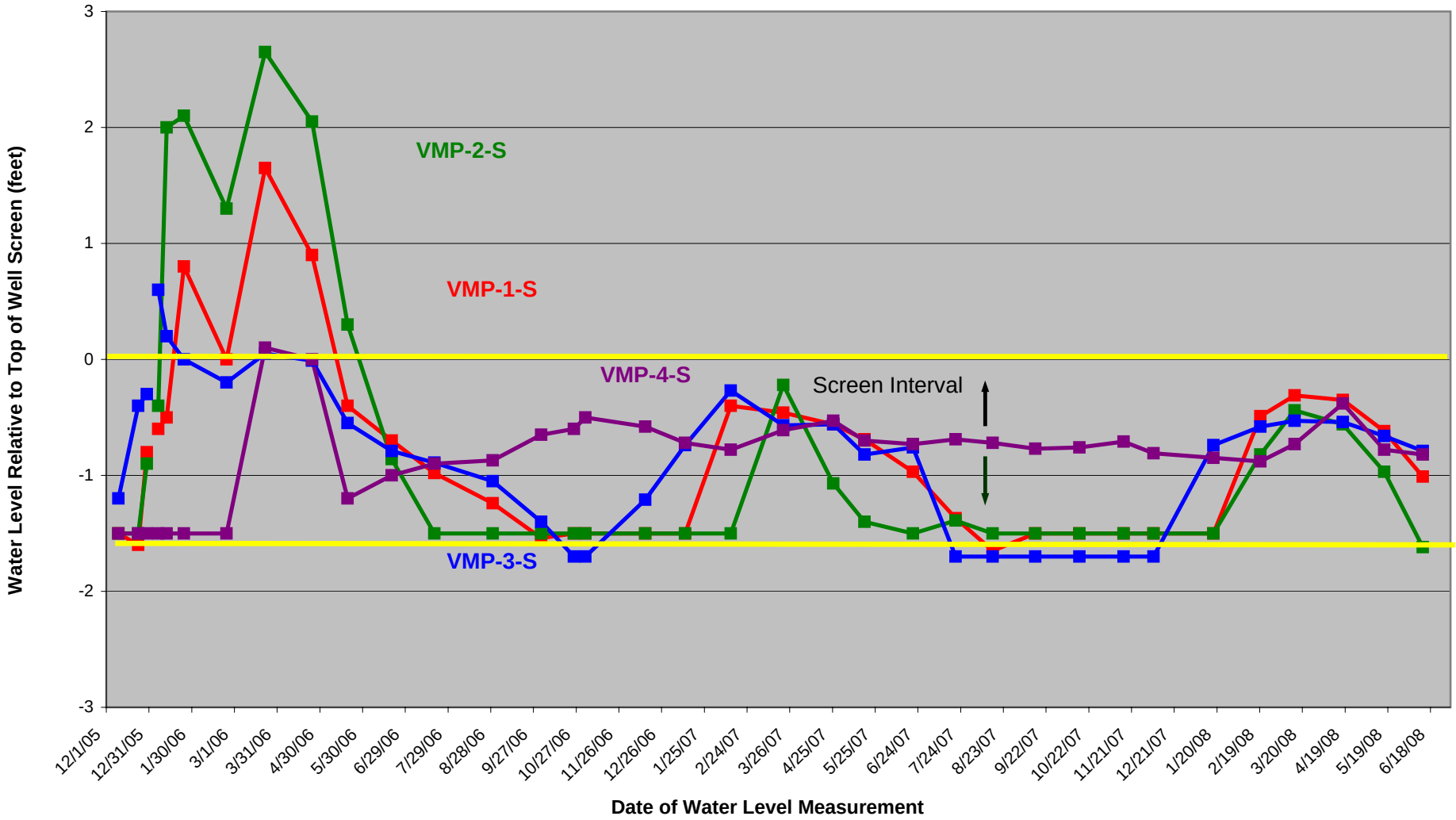
- The blower is functioning properly, there are no significant air leaks in the piping system, and the VMP and VW wellheads and air distribution piping are in good condition.
- Water levels are similar in depth in the shallow VMPs as in the deep VMPs (at each nested well location), suggesting that both the deep and shallow VMP well screens are under similar hydraulic conditions.
- Water levels in the VWs showed a general increase after the wells were installed, resulting in partially or fully flooded well screens in VW-1, VW-2, and VW-3. VW-1 and VW-3 showed a water level decrease through September 2006; the water levels in these VWs have fluctuated since then, but have always been below top of screen. As stated previously, VW-3 was decommissioned in March 2008. Figure 6 shows groundwater levels in VWs relative to the top of the screened interval. The screen in VW-2 was fully flooded as of May 2006, was lower than the screen interval until October 2006, and has fluctuated above and below the screen since then. As of May 2007 the water level has been below the screen interval. Water levels in vent wells VW-4 and VW-5 have been below the screened interval since installation in March 2008.
- As shown on Figure 7, water levels in the shallow VMP wells initially rose until March of 2006 and by May 2006 they lowered to below the top of the screened interval where they have remained to present.

Figure 6 - Historical Groundwater Levels Relative to Top of VW Screened Intervals
Redwood Regional Park Service Yard - Oakland, California



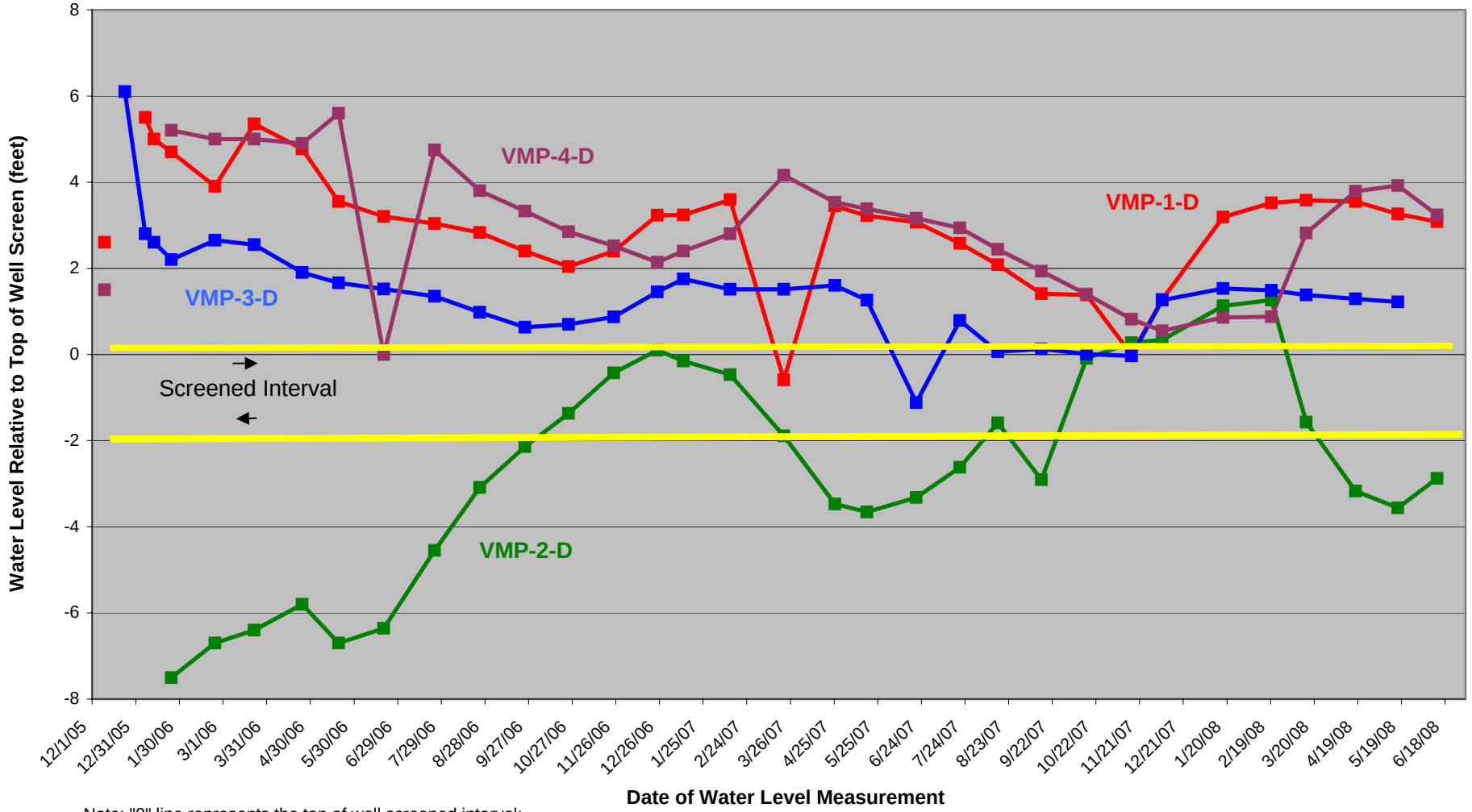
Note: "0" line represents the top of well screened interval;
water levels above that line represent fully flooded screen.

Figure 7 - Historical Groundwater Levels Relative to Top of Shallow VMP Screened Intervals
Redwood Regional Park Service Yard - Oakland, California



Note: "0" line represents the top of well screened interval;
water levels above that line represent fully flooded screen.

Figure 8 - Historical Groundwater Levels Relative to Top of Deep VMP Screened Intervals
Redwood Regional Park Service Yard - Oakland, California



Note: "0" line represents the top of well screened interval;
water levels above that line represent fully flooded screen.

- As shown on Figure 8, water levels in deep VMPs have been relatively stable since the VMPs were installed. The exception is VMP-2-D, which showed an increase from March 2006 to February 2008, and then showed a sharp decrease to below the screened interval. A slight rise was observed between May and June 2008, but the water level remains below the screened interval. Since the deep VMPs were installed, water levels in three of the four deep VMPs have been above the top of the well screen; only VMP-2-D has exposed well screen above the water table.
- Air is being injected in the non-flooded portion of the VW-1 screen at an optimum level. Monthly system monitoring has shown a significant increase in air flow as groundwater lowers.
- No measurable air injection occurred in VW-2 from system startup in December 2005 to mid-October 2006. Air flow has since occurred sporadically as demonstrated by a slight change in pressure recorded in January, February, April, May, and June of 2008. No air flow was observed in March 2008.
- No measurable air injection has occurred in VW-3 since system startup, although that well's screen has been at least partially exposed (not flooded) since installation. SES confirmed (by physical probing) that the screened interval of that well is properly installed (from 8 to 18 feet), and that water is infiltrating into the well (confirming that the annular filter pack was not inadvertently cemented in during well installation). The inability to inject air may be due to residual saturation in the well filter pack and/or surrounding soils, or because the native soils in the borehole annulus may have been smeared during installation. The well was disconnected from the system in March 2008.
- No measurable air injection has occurred in VW-4 or VW-5 since their installation in March 2008. Both of the screens in these wells have been partially exposed since installation; however, they are screened across silty clay which appears relatively impermeable to air flow. As groundwater water levels lower in the summer and fall 2008 season, permeable lithologic horizons may become exposed allowing air flow into wells as is the case in VW-2.

6.0 SUMMARY, CONCLUSIONS, AND PROPOSED ACTIONS

This section presents the conclusions and proposed actions with regard to continued operation of the bioventing corrective action system at the Redwood Regional Park Service Yard.

SUMMARY AND CONCLUSIONS

- The blower is operating within design parameters, and there are no physical problems with the blower or air distribution piping.
- In March 2008, two new vent wells, (VW-4 and VW-5) were installed in the UST source area, located in the higher elevation area of the site.
- No air flow has ever occurred through the VW-3 screened interval, therefore this well was disconnected from the bioventing system, and the air supply line was utilized for the new vent well VW-4.
- The initial system feasibility tests in 2005, utilizing vent well VW-1, showed a favorable radius of influence of up to 30 feet. This is most likely due to this well being screened over or closer to gravelly sand as indicated in the geologic logs. Newly installed vent wells VW-4 and VW-5 are screened across silty clay which appears relatively impermeable to air flow. As groundwater water levels lower in the summer and fall 2008 season, permeable lithologic horizons may become exposed, allowing air flow into these as is the case in VW-2.
- High groundwater levels from January to March of 2008 in the bioventing well VW-2 had resulted in a partially or fully saturated screen, thus impeding air flow to the sediments. The groundwater level has been well below the screen since April 2008, which corresponds to the increasing levels of air moving through the well as observed in April and May 2008.
- Air flow is occurring through the VW-1 screened interval at an optimum level.
- Continued monthly O&M (including water level measurements) will determine whether air injection rates at the VWs will improve.

PROPOSED ACTIONS

EBRPD proposes to implement the following actions with regard to the bioventing program:

- Continue to conduct monthly system O&M events, including air flow optimization when water level changes and/or air injection rates warrant.
- Continue to evaluate water levels in VWs and VMPs.
- Conduct an in-situ respiration test in 2008, at such time as water levels drop sufficiently to evaluate response in at least the shallow VMP screens, which should occur in late summer to early fall.
- Continue to report on bioventing system progress/activities in quarterly progress reports, and prepare an annual summary report.

7.0 REFERENCES

Leeson, Andrea and Robert E. Hinchee. Principals of Bioventing, Battelle Memorial Institute, 1996.

Nilsen, et al. 1979. Relative Slope Stability and Land Use Planning in the San Francisco Bay Region, CA USGS Professional Paper 944.

Stellar Environmental Solutions, Inc. (SES), 2003. Letter to Alameda County Health Care Services Agency proposing bioventing as a corrective action remedy at Redwood Regional Park Service Yard, Oakland, California. November 6.

Stellar Environmental Solutions, Inc. (SES), 2004a. Bioventing Feasibility Letter Report – Redwood Regional Park Service Yard, Oakland, California. February 6.

Stellar Environmental Solutions, Inc. (SES), 2004b. Bioventing Pilot Tests Result Report, Redwood Regional Park Service Yard, Oakland, California. October 29.

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Alameda County Health Care Services Agency, Department of Environmental Health (Alameda County Environmental Health), 2006b. Letter approving monthly bioventing O&M and reporting and in-situ respiration test. March 15.

Alameda County Health Care Services Agency, Department of Environmental Health (Alameda County Environmental Health), 2007b. Letter requesting additional remedial investigation. October 11.

Alameda County Health Care Services Agency, Department of Environmental Health (Alameda County Environmental Health), 2008a. Letter and Technical Comments approving installation and implementation of bioventing augmentation. February 22.

Stellar Environmental Solutions, Inc. (SES), 2006a. Bioventing System Installation and Startup Report – Redwood Regional Park Service Yard, Oakland, California. February 21.

Stellar Environmental Solutions, Inc. (SES), 2006b. First Quarter 2006 Bioventing Status Report – Redwood Regional Park Service Yard, Oakland, California. April 3.

Stellar Environmental Solutions, Inc. (SES), 2006c. Second Quarter 2006 Bioventing Status Report – Redwood Regional Park Service Yard, Oakland, California. July 5.

Stellar Environmental Solutions, Inc. (SES), 2006d. Third and Fourth Quarter 2006 Bioventing Status Report – Redwood Regional Park Service Yard, Oakland, California. December 27.

Stellar Environmental Solutions, Inc. (SES), 2007e. First and Second Quarter 2007 Bioventing Status Report – Redwood Regional Park Service Yard, Oakland, California. July 9.

Stellar Environmental Solutions, Inc. (SES), 2008f. Second and Third Quarter 2007 Bioventing Status Report – Redwood Regional Park Service Yard, Oakland, California. January 4.

Stellar Environmental Solutions, Inc. (SES), 2008g. Response to Technical Comments by ACEH and Workplan for Bioventing System Augmentation Redwood Regional Park Service Yard Site – 7867 Redwood Road, Oakland, California. February 7.

APPENDIX A

VW-4 and VW-5 Installation Documentation

Photodocumentation

Subject: View of drilling at location of VW-5	
Site: Redwood Regional Park Service Yard, Oakland, CA	
Date Taken: March 10, 2008	Project No.: SES 2008-2
Photographer: Steve Bittman	Photo No.: 01

Subject: Installation of plumbing at VW-4	
Site: Redwood Regional Park Service Yard, Oakland, CA	
Date Taken: March 13, 2008	Project No.: SES 2008-2
Photographer: Steve Bittman	Photo No.: 02

ACPWA Well Permits

Alameda County Public Works Agency - Water Resources Well Permit

399 Elmhurst Street
Hayward, CA 94544-1395
Telephone: (510)670-6633 Fax:(510)782-1939

Application Approved on: 03/05/2008 By jamesy

Permit Numbers: W2008-0105
Permits Valid from 03/10/2008 to 03/10/2008

Application Id: 1204499943525 **City of Project Site:** Oakland
Site Location: Redwood Regional Park Corporation Yard
7897 Redwood Road
Project Start Date: 03/10/2008 **Completion Date:** 03/10/2008
Requested Inspection:
Scheduled Inspection: 03/10/2008 at 2:00 PM (Contact your inspector, Vicky Hamlin at (510) 670-5443, to confirm.)

Applicant: Stellar environmental Solutions - Henry Pietropaoli
2198 Sixth street, Berkeley, CA 94710 **Phone:** 510-644-3123
Property Owner: East Bay Regional Park District East Bay Regional Park District
P. O. Box 5381, Oakland, CA 94605 **Phone:** 510-482-6024
Client: Neal or Dee Fujita or Rosario
P. O. Box 5381, Oakland, CA 94605 **Phone:** 510-649-3313

Total Due: $200.00
Receipt Number: WR2008-0067 **Total Amount Paid:** $200.00
Payer Name : Henry Pietropaoli Paid By: MC **PAID IN FULL**

Works Requesting Permits:

Remedian Well Construction-Injection - 2 Wells
Driller: HEW Drilling - Lic #: 604987 - Method: hstem **Work Total: $200.00**

Specifications

Permit #	Issued Date	Expire Date	Owner Well Id	Hole Diam.	Casing Diam.	Seal Depth	Max. Depth
W2008-0105	03/05/2008	06/08/2008	VW-4	8.00 in.	2.00 in.	8.00 ft	23.00 ft
W2008-0105	03/05/2008	06/08/2008	VW-5	8.00 in.	2.00 in.	8.00 ft	23.00 ft

Specific Work Permit Conditions

1. Permittee shall assume entire responsibility for all activities and uses under this permit and shall indemnify, defend and save the Alameda County Public Works Agency, its officers, agents, and employees free and harmless from any and all expense, cost, liability in connection with or resulting from the exercise of this Permit including, but not limited to, properly damage, personal injury and wrongful death.

2. Permitte, permittee's contractors, consultants or agents shall be responsible to assure that all material or waters generated during drilling, boring destruction, and/or other activities associated with this Permit will be safely handled, properly managed, and disposed of according to all applicable federal, state, and local statutes regulating such. In no case shall these materials and/or waters be allowed to enter, or potentially enter, on or off-site storm sewers, dry wells, or waterways or be allowed to move off the property where work is being completed.

3. Compliance with the well-sealing specifications shall not exempt the well-sealing contractor from complying with appropriate State reporting-requirements related to well construction or destruction (Sections 13750 through 13755 (Division 7, Chapter 10, Article 3) of the California Water Code). Contractor must complete State DWR Form 188 and mail original to the Alameda County Public Works Agency, Water Resources Section, within 60 days. Including permit number and site map.

4. Applicant shall submit the copies of the approved encroachment permit to this office within 60 days.

5. Applicant shall contact Vicky Hamlin for an inspection time at 510-670-5443 or email to vickyh@acpwa.org at least five (5) working days prior to starting, once the permit has been approved. Confirm the scheduled date(s) at least 24 hours prior to drilling.

6. Minimum seal depth (Neat Cement Seal) is 2 feet below ground surface (BGS).

7. Minimum surface seal thickness is two inches of cement grout placed by tremie

8. Copy of approved drilling permit must be on site at all times. Failure to present or show proof of the approved permit application on site shall result in a fine of $500.00.

9. Prior to any drilling activities onto any public right-of-ways, it shall be the applicants responsibilities to contact and coordinate a Underground Service Alert (USA), obtain encroachment permit(s), excavation permit(s) or any other permits required for that City or to the County and follow all City or County Ordinances. It shall also be the applicants responsibilities to provide to the Cities or to Alameda County a Traffic Safety Plan for any lane closures or detours planned. No work shall begin until all the permits and requirements have been approved or obtained.

Geologic Logs

STELLAR
ENVIRONMENTAL SOLUTIONS, INC
GEOSCIENCE & ENGINEERING CONSULTING

Soil Boring and Well Construction Log

BORING NUMBER VW-4 Page 1 of 1

PROJECT Redwood Park Corporation Yard
OWNER East Bay Regional Park District
LOCATION Oakland, CA
PROJECT NUMBER 2008-02
TOTAL DEPTH 30 feet (bgs)
BOREHOLE DIA. 8-inch
SURFACE ELEV. 564 feet (amsl)
WATER FIRST ENCOUNTERED none
DRILLING COMPANY HEW
DRILLING METHOD HSA with 5-foot sampler
DRILLER Perfecto & Miguel
GEOLOGIST S. Bittman
DATE DRILLED 3/10/08

DEPTH (feet)	PID	DESCRIPTION/SOIL CLASSIFICATION	REMARKS
0	0.0	GC, Clayey gravel fill, base rock, reddish brown, moist	18" recovery (0-5')
5			30" recovery (5-10')
10	0.7	GC, Gravelly clay, grey brown,damp, low plastificy, stiff, slight odor, mixed with clayey gravel fill. Piece of asphalt @ 10'	24" recovery (10-15')
15	2.4	Bottom of fill @ 14'	24" recovery (15-20')
20	1.5	CL/ML, Silty clay to clayey silt, grey brown, moist, medium plasticity, soft becomes reddish brown and increasing silt 20-25', low plasticity	5' recovery (20-25')
25			5' recovery (25-30')
30		GC, Clayey gravel, reddish brown, mottled black, moist to wet below~27', sub-rounded cobbles ≤ 3" from 26-28'	VW-4-20-20.5 Sample submitted for analysis
35		Bottom of boring = 30 feet	Notes: PID = photoionization detector "readings" are in parts per million per volume air (ppmV)
40			

VW-4-20-20.5

VW-4

Bottom of well

2008-02-04

▼ Groundwater encountered

Well Construction Legend:
2" PVC screen (0.020-in. slots)
Hydrated bentonite pellets
Flush mounted well box
No. 3 Monterey Sand
Portland cement & water grout

STELLAR
ENVIRONMENTAL SOLUTIONS, INC
GEOSCIENCE & ENGINEERING CONSULTING

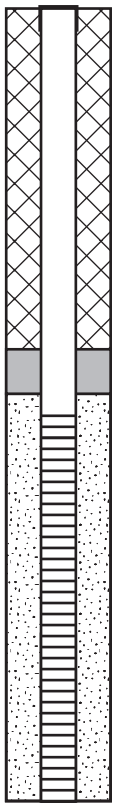
Soil Boring and Well Construction Log

BORING NUMBER VW-5 Page 1 of 1

PROJECT Redwood Park Corporation Yard
OWNER East Bay Regional Park District
LOCATION Oakland, CA
PROJECT NUMBER 2008-02
TOTAL DEPTH 26 feet (bgs)
BOREHOLE DIA. 8-inch
SURFACE ELEV. 564 feet (amsl)
WATER FIRST ENCOUNTERED none
DRILLING COMPANY HEW
DRILLING METHOD HSA with 5-foot sampler
DRILLER Perfecto & Miguel
GEOLOGIST S. Bittman
DATE DRILLED 3/10/08

DEPTH (feet)	GRAPHIC LOG	PID	DESCRIPTION/SOIL CLASSIFICATION	REMARKS
0				
		0.0	GC, Clayey gravel fill, reddish brown, moist, occasional subangular rock fragments to 4"	12" recovery (0-5')
5		0.0		18" recovery (5-10')
10			Bottom of fill	
		0.0	CL, Silty clay, dark grey, damp, medium plasticity, stiff	30" recovery (10-15')
15	VW-5-16	1.5		5' recovery (15-20')
20		0.0	CL/ML, Silty clay to clayey silt, slightly sandy, reddish brown, moist, medium plasticity	5' recovery (20-25')
25		0.0		
			Bottom of boring = 26 feet	
30				VW-5-16 Sample submitted for analysis
35				Notes: PID = photoionization detector "readings" are in parts per million per volume air (ppmV)
40				

VW-5



Bottom of well

2008-02-03

▼ Groundwater encountered

Well Construction Legend:
2" PVC screen (0.020-in. slots)
Hydrated bentonite pellets
Flush mounted well box
No. 3 Monterey Sand
Portland cement & water grout

DWR Well Completion Reports

CONFIDENTIAL

STATE OF CALIFORNIA DWR
WELL COMPLETION REPORT
(WELL LOGS)

REMOVED

CONFIDENTIAL

STATE OF CALIFORNIA DWR
WELL COMPLETION REPORT
(WELL LOGS)

REMOVED

Chain of Custody Documentation and Certified Analytical Results

Chain of Custody Record

Lab job no. 201803

Date

Page 1 of 1

Laboratory Curtis and Tompkins, Ltd.
Address 2323 Fifth Street
Berkeley, California 94710
510-486-0900

Project Owner East Bay Regional Park District
Site Address 7867 Redwood Road
Oakland, California

Project Name Redwood Regional Park
Project Number 2006-16

Method of Shipment Hand Delivery
Shipment No.
Airbill No.
Cooler No.
Project Manager Richard Makdisi
Telephone No. (510) 644-3123
Fax No. (510) 644-3859
Samplers: (Signature) Steve Bittman

	Field Sample Number	Location/ Depth	Date	Time	Sample Type	Type/Size of Container	Preservation: Cooler	Preservation: Chemical	Filtered	No. of Containers	Analysis Required: TPH-diesel	Analysis Required: TVHg/BTEX	Remarks
1	VW4-20		3/10/08	1030	S	4 = Brass	✓			1	X	X	
2	VW5-16		3/10/08	1330	S	4 = Brass	✓			1	X	X	

Relinquished by	Date	Received by	Date	Relinquished by	Date	Received by	Date
Signature Steve Bittman	3-10-08	Signature Teal Bluss	3 10 08	Signature Teal Bluss	3-10 08	Signature	3/10/08
Printed Steve Bittman	Time 13:45	Printed Teal Bluss	Time BUS	Printed Teal Bluss	Time 14:15	Printed Ling Wu	Time 14:15
Company Stellar Environmental		Company SES		Company SES		Company C&T	

Turnaround Time: 5 Day TAT
Comments: on ice, intact

Relinquished by	Date	Received by	Date
Signature		Signature	
Printed	Time	Printed	Time
Company		Company	

2000-00-01

★ Stellar Environmental Solutions

2198 Sixth Street #201, Berkeley, CA 94710

Curtis & Tompkins, Ltd., Analytical Laboratories, Since 1878
2323 Fifth Street, Berkeley, CA 94710, Phone (510) 486-0900

Laboratory Job Number 201803
ANALYTICAL REPORT

Stellar Environmental Solutions	Project : 2006-16
2198 6th Street	Location : Redwood Regional Park
Berkeley, CA 94710	Level : II

Sample ID	Lab ID
VW4-20	201803-001
VW5-16	201803-002

This data package has been reviewed for technical correctness and completeness. Release of this data has been authorized by the Laboratory Manager or the Manager's designee, as verified by the following signatures. The results contained in this report meet all requirements of NELAC and pertain only to those samples which were submitted for analysis. This report may be reproduced only in its entirety.

Signature: _____ Date: 03/21/2008
Project Manager

Signature: _____ Date: 03/24/2008
Operations Manager

Curtis & Tompkins, Ltd.

CASE NARRATIVE

Laboratory number:	**201803**
Client:	**Stellar Environmental Solutions**
Project:	**2006-16**
Location:	**Redwood Regional Park**
Request Date:	**03/10/08**
Samples Received:	**03/10/08**

This hardcopy data package contains sample and QC results for two soil samples, requested for the above referenced project on 03/10/08. The samples were received cold and intact.

TPH-Purgeables and/or BTXE by GC (EPA 8015B and EPA 8021B):
High responses were observed for ethylbenzene, m,p-xylenes, and o-xylene in the CCV analyzed 03/18/08 21:07 and the CCV analyzed 03/19/08 07:08; affected data was qualified with "b". No other analytical problems were encountered.

TPH-Extractables by GC (EPA 8015B):
No analytical problems were encountered.

Curtis & Tompkins, Ltd.

Curtis & Tompkins Laboratories Analytical Report

Lab #:	201803	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	EPA 5030B
Project#:	2006-16		
Matrix:	Soil	Batch#:	136113
Basis:	as received	Sampled:	03/10/08
Diln Fac:	1.000	Received:	03/10/08

Field ID: VW4-20 Lab ID: 201803-001
Type: SAMPLE Analyzed: 03/19/08

Analyte	Result	RL	Units	Analysis
Gasoline C7-C12	ND	1.0	mg/Kg	EPA 8015B
MTBE	ND	21	ug/Kg	EPA 8021B
Benzene	ND	5.2	ug/Kg	EPA 8021B
Toluene	ND	5.2	ug/Kg	EPA 8021B
Ethylbenzene	ND	5.2	ug/Kg	EPA 8021B
m,p-Xylenes	ND	5.2	ug/Kg	EPA 8021B
o-Xylene	ND	5.2	ug/Kg	EPA 8021B

Surrogate	%REC	Limits	Analysis
Trifluorotoluene (FID)	105	66-139	EPA 8015B
Bromofluorobenzene (FID)	125	67-149	EPA 8015B
Trifluorotoluene (PID)	89	53-157	EPA 8021B
Bromofluorobenzene (PID)	107	57-155	EPA 8021B

Field ID: VW5-16 Lab ID: 201803-002
Type: SAMPLE Analyzed: 03/19/08

Analyte	Result	RL	Units	Analysis
Gasoline C7-C12	ND	1.0	mg/Kg	EPA 8015B
MTBE	ND	20	ug/Kg	EPA 8021B
Benzene	ND	5.1	ug/Kg	EPA 8021B
Toluene	ND	5.1	ug/Kg	EPA 8021B
Ethylbenzene	ND	5.1	ug/Kg	EPA 8021B
m,p-Xylenes	ND	5.1	ug/Kg	EPA 8021B
o-Xylene	ND	5.1	ug/Kg	EPA 8021B

Surrogate	%REC	Limits	Analysis
Trifluorotoluene (FID)	109	66-139	EPA 8015B
Bromofluorobenzene (FID)	140	67-149	EPA 8015B
Trifluorotoluene (PID)	94	53-157	EPA 8021B
Bromofluorobenzene (PID)	114	57-155	EPA 8021B

ND= Not Detected
RL= Reporting Limit

Curtis & Tompkins, Ltd.

Curtis & Tompkins Laboratories Analytical Report

Lab #:	201803	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	EPA 5030B
Project#:	2006-16		
Matrix:	Soil	Batch#:	136113
Basis:	as received	Sampled:	03/10/08
Diln Fac:	1.000	Received:	03/10/08

Type: BLANK Lab ID: QC433443

Analyte	Result	RL	Units	Analyzed	Analysis
Gasoline C7-C12	ND	1.0	mg/Kg	03/18/08	EPA 8015B
MTBE	ND	20	ug/Kg	03/19/08	EPA 8021B
Benzene	ND	5.0	ug/Kg	03/19/08	EPA 8021B
Toluene	ND	5.0	ug/Kg	03/19/08	EPA 8021B
Ethylbenzene	ND	5.0	ug/Kg	03/19/08	EPA 8021B
m,p-Xylenes	ND	5.0	ug/Kg	03/19/08	EPA 8021B
o-Xylene	ND	5.0	ug/Kg	03/19/08	EPA 8021B

Surrogate	%REC	Limits	Analyzed	Analysis
Trifluorotoluene (FID)	109	66-139	03/18/08	EPA 8015B
Bromofluorobenzene (FID)	127	67-149	03/18/08	EPA 8015B
Trifluorotoluene (PID)	79	53-157	03/19/08	EPA 8021B
Bromofluorobenzene (PID)	95	57-155	03/19/08	EPA 8021B

ND= Not Detected
RL= Reporting Limit

Curtis & Tompkins, Ltd.

Batch QC Report

Curtis & Tompkins Laboratories Analytical Report

Lab #:	201803	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	EPA 5030B
Project#:	2006-16	Analysis:	EPA 8015B
Matrix:	Soil	Diln Fac:	1.000
Units:	mg/Kg	Batch#:	136113
Basis:	as received		

Type: BS Analyzed: 03/18/08
Lab ID: QC433444

Analyte	Spiked	Result	%REC	Limits
Gasoline C7-C12	5.000	5.158	103	80-120

Surrogate	%REC	Limits
Trifluorotoluene (FID)	110	66-139
Bromofluorobenzene (FID)	124	67-149

Type: BSD Analyzed: 03/19/08
Lab ID: QC433445

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Gasoline C7-C12	5.000	5.370	107	80-120	4	20

Surrogate	%REC	Limits
Trifluorotoluene (FID)	122	66-139
Bromofluorobenzene (FID)	131	67-149

RPD= Relative Percent Difference

Curtis & Tompkins, Ltd.

Batch QC Report

Curtis & Tompkins Laboratories Analytical Report

Lab #:	201803	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	EPA 5030B
Project#:	2006-16	Analysis:	EPA 8021B
Matrix:	Soil	Diln Fac:	1.000
Units:	ug/Kg	Batch#:	136113
Basis:	as received		

Type: BS Analyzed: 03/18/08
Lab ID: QC433446

Analyte	Spiked	Result	%REC	Limits
MTBE	50.00	42.54	85	69-129
Benzene	50.00	52.04	104	80-120
Toluene	50.00	53.83	108	80-120
Ethylbenzene	50.00	59.19 b	118	80-120
m,p-Xylenes	50.00	59.03 b	118	80-122
o-Xylene	50.00	59.93 b	120	80-120

Surrogate	%REC	Limits
Trifluorotoluene (PID)	90	53-157
Bromofluorobenzene (PID)	106	57-155

Type: BSD Analyzed: 03/19/08
Lab ID: QC433447

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
MTBE	30.00	27.47	92	69-129	7	22
Benzene	30.00	29.12	97	80-120	7	20
Toluene	30.00	29.55	98	80-120	9	20
Ethylbenzene	30.00	31.02 b	103	80-120	13	20
m,p-Xylenes	30.00	31.03 b	103	80-122	13	20
o-Xylene	30.00	31.93 b	106	80-120	12	20

Surrogate	%REC	Limits
Trifluorotoluene (PID)	89	53-157
Bromofluorobenzene (PID)	109	57-155

b= See narrative
RPD= Relative Percent Difference

Curtis & Tompkins, Ltd.

Total Extractable Hydrocarbons

Lab #:	201803	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	EPA 3550B
Project#:	2006-16	Analysis:	EPA 8015B
Matrix:	Soil	Sampled:	03/10/08
Units:	mg/Kg	Received:	03/10/08
Basis:	as received	Prepared:	03/11/08
Diln Fac:	1.000	Analyzed:	03/12/08
Batch#:	135852		

Field ID: VW4-20 Lab ID: 201803-001
Type: SAMPLE

Analyte	Result	RL
Diesel C10-C24	2.0 Y	1.0

Surrogate	%REC	Limits
Hexacosane	93	48-128

Field ID: VW5-16 Lab ID: 201803-002
Type: SAMPLE

Analyte	Result	RL
Diesel C10-C24	ND	0.99

Surrogate	%REC	Limits
Hexacosane	83	48-128

Type: BLANK Lab ID: QC432365

Analyte	Result	RL
Diesel C10-C24	ND	1.0

Surrogate	%REC	Limits
Hexacosane	73	48-128

Y= Sample exhibits chromatographic pattern which does not resemble standard
ND= Not Detected
RL= Reporting Limit

Curtis & Tompkins, Ltd.

Batch QC Report

Total Extractable Hydrocarbons

Lab #:	201803	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	EPA 3550B
Project#:	2006-16	Analysis:	EPA 8015B
Type:	LCS	Diln Fac:	1.000
Lab ID:	QC432366	Batch#:	135852
Matrix:	Soil	Prepared:	03/11/08
Units:	mg/Kg	Analyzed:	03/12/08
Basis:	as received		

Analyte	Spiked	Result	%REC	Limits
Diesel C10-C24	49.79	47.32	95	54-126

Surrogate	%REC	Limits
Hexacosane	77	48-128

Curtis & Tompkins, Ltd.

Batch QC Report

Total Extractable Hydrocarbons

Lab #:	201803	Location:	Redwood Regional Park
Client:	Stellar Environmental Solutions	Prep:	EPA 3550B
Project#:	2006-16	Analysis:	EPA 8015B
Field ID:	ZZZZZZZZZZ	Batch#:	135852
MSS Lab ID:	201740-004	Sampled:	03/05/08
Matrix:	Soil	Received:	03/05/08
Units:	mg/Kg	Prepared:	03/11/08
Basis:	as received	Analyzed:	03/12/08
Diln Fac:	1.000		

Type: MS Lab ID: QC432367

Analyte	MSS Result	Spiked	Result	%REC	Limits
Diesel C10-C24	3.259	49.73	49.23	92	34-144

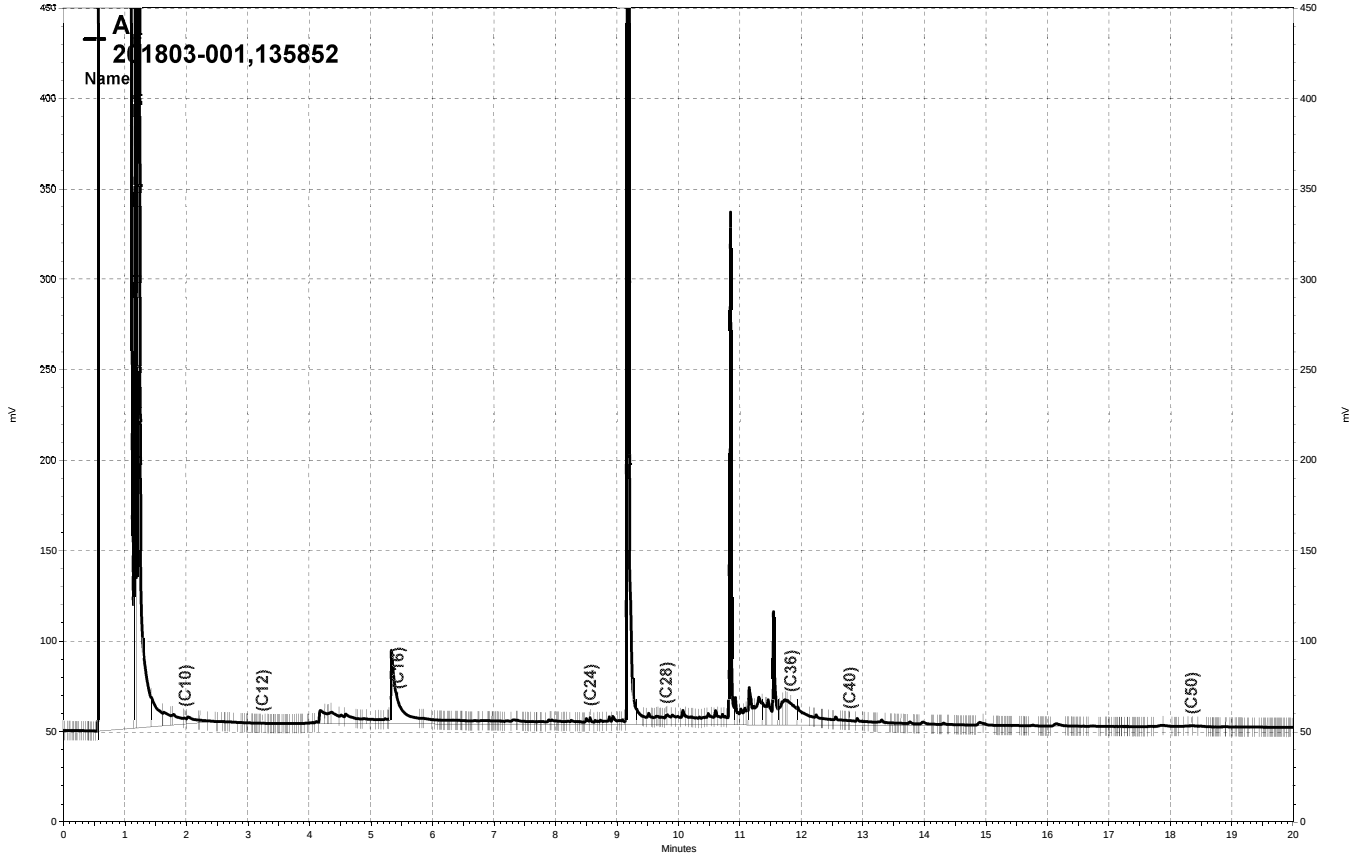
Surrogate	%REC	Limits
Hexacosane	75	48-128

Type: MSD Lab ID: QC432368

Analyte	Spiked	Result	%REC	Limits	RPD	Lim
Diesel C10-C24	50.36	45.09	83	34-144	10	47

Surrogate	%REC	Limits
Hexacosane	66	48-128

RPD= Relative Percent Difference



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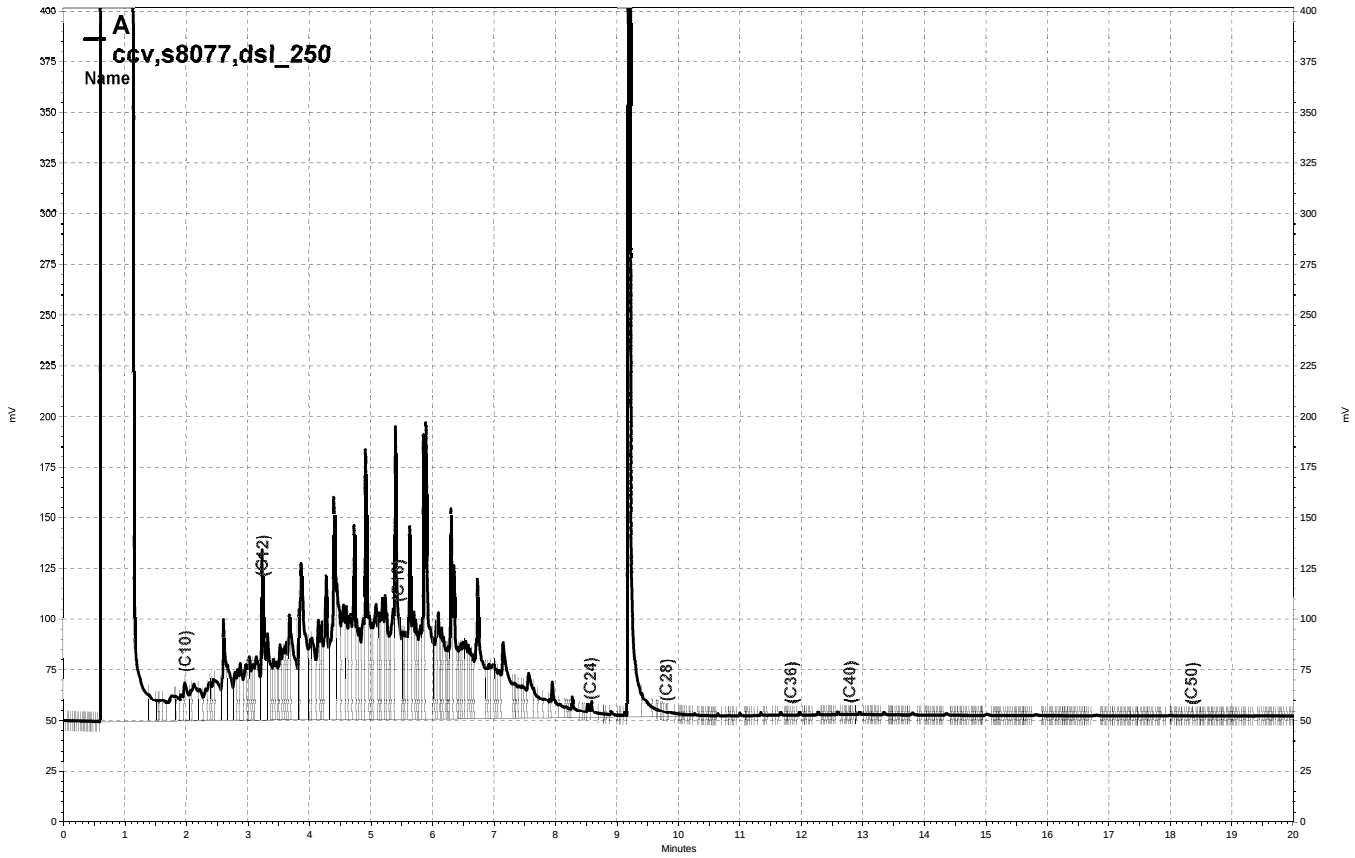

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APPENDIX B

Monthly System O&M Checklists

Redwood Regional Park Service Yard
Bioventing Operations & Maintenance Checklist
Vapor Monitoring Points

Date: **1/17/2008**

	Depth to Top of Screen (ft below TOC)	Water Level (ft below TOC)	Well Head in Good Condition?
VMP-1-Shallow	9.3	Dry	Yes
VMP-1-Deep	13.4	10.21	Yes
VMP-2-Shallow	9.5	Dry	Yes
VMP-2-Deep	13.9	12.33	Yes
VMP-3-Shallow	9.8	10.54	Yes
VMP-3-Deep	12.0	10.74	Yes
VMP-4-Shallow	15.1	15.95	Yes
VMP-4-Deep	20.8	17.98	Yes

TOC= Top of well Casing

Redwood Regional Park Service Yard
Bioventing Operation & Maintenance Checklist
Blower and Vent Wells

Date: 1/17/2008

	Air Flow (scfm)		Blower Inlet Vaccum (inches H_20)		Blower Outlet Pressure (inches H_20)		Depth to Top of Screen	Water Level	Well Head in
	Before adjustment	After adjustment	Before adjustment	After adjustment	Before adjustment	After adjustment	(ft below TOC)	(ft below TOC)	Good Condition?
Blower [a]	NM	NM	20	20	34	40			
VW-1 [b]	NM	NM					5.6	12.12	yes
VW-2 [b]	NM	NM					8.4	9.92	yes
VW-3 [b]	NM	NM					8.8	14.39	yes

Wells on-line (valve open) at arrival 1,2, and 3 Wells on-line at departure 1, 2, and 3

Notes:

[a] Air flow measured at sampling port between blower discharge and manifold.

[b] Air flow measured at blower manifold sampling port

TOC - Top of Casing of well NM = Not Measured

Checklist Items

Is any airflow evident through VW-1? (Close all other manifold valves and look for drop in blower outlet pressure) **20** psi drop

Is any airflow evident through VW-2? (Close all other manifold valves and look for drop in blower outlet pressure) **2** psi drop (no drop increase)

Is any airflow evident through VW-3? (Close all other manifold valves and look for drop in blower outlet pressure) **0** psi drop

Any audible air leaks in air distribution piping or VW wellheads? **No**

Blower filter removed and brushed off? **Yes** Blower filter replaced? **No**

Redwood Regional Park Service Yard
Bioventing Operations & Maintenance Checklist
Vapor Monitoring Points

Date: **2/19/2008**

	Depth to Top of Screen (ft below TOC)	Water Level (ft below TOC)	Well Head in Good Condition?
VMP-1-Shallow	9.3	9.79	Yes
VMP-1-Deep	13.4	9.88	Yes
VMP-2-Shallow	9.5	10.32	Yes
VMP-2-Deep	13.9	10.73	Yes
VMP-3-Shallow	9.8	10.38	Yes
VMP-3-Deep	12.0	10.47	Yes
VMP-4-Shallow	15.1	15.98	Yes
VMP-4-Deep	20.8	17.01	Yes

TOC= Top of well Casing

Redwood Regional Park Service Yard
Bioventing Operation & Maintenance Checklist
Blower and Vent Wells

Date: 2/19/2008

	Air Flow (scfm)		Blower Inlet Vaccum (inches H_20)		Blower Outlet Pressure (inches H_20)		Depth to Top of Screen	Water Level	Well Head in
	Before adjustment	After adjustment	Before adjustment	After adjustment	Before adjustment	After adjustment	(ft below TOC)	(ft below TOC)	Good Condition?
Blower [a]	NM	NM	19	19	46	40			
VW-1 [b]	NM	NM					5.6	11.12	Yes
VW-2 [b]	NM	NM					8.4	8.95	Yes
VW-3 [b]	NM	NM					8.8	14.83	Yes

Wells on-line (valve open) at arrival **1,2,3** Wells on-line at departure **1,2,3**

Notes:

[a] Air flow measured at sampling port between blower discharge and manifold.

[b] Air flow measured at blower manifold sampling port

TOC - Top of Casing of well NM = Not Measured

Checklist Items

Is any airflow evident through VW-1? **20** inches H_2O drop
(Close all VW valves, set outlet pressure at 40 inches H_20, then open VW-1 valve only)

Is any airflow evident through VW-2? **2** inches H_2O drop
(Close all VW valves, set outlet pressure at 40 inches H_20, then open VW-2 valve only)

Is any airflow evident through VW-3? **0** inches H_2O drop
(Close all VW valves, set outlet pressure at 40 inches H_20, then open VW-3 valve only)

Any audible air leaks in air distribution piping or VW wellheads? **No**

Blower filter removed and brushed off? **Yes** Blower filter replaced? **No**

Redwood Regional Park Service Yard
Bioventing Operations & Maintenance Checklist
Vapor Monitoring Points

Date: **3/14/2008**

	Depth to Top of Screen (ft below TOC)	Water Level (ft below TOC)	Well Head in Good Condition?
VMP-1-Shallow	9.3	9.61	Yes
VMP-1-Deep	13.4	9.82	Yes
VMP-2-Shallow	9.5	9.94	Yes
VMP-2-Deep	13.9	10.34	Yes
VMP-3-Shallow	9.8	10.33	Yes
VMP-3-Deep	12.0	10.51	Yes
VMP-4-Shallow	15.1	15.83	Yes
VMP-4-Deep	20.8	16.88	Yes

TOC= Top of well Casing

Redwood Regional Park Service Yard
Bioventing Operation & Maintenance Checklist
Blower and Vent Wells

Date: 3/14/2008

	Air Flow (scfm)		Blower Inlet Vaccum (inches H_20)		Blower Outlet Pressure (inches H_20)		Depth to Top of Screen	Water Level	Well Head in
	Before adjustment	After adjustment	Before adjustment	After adjustment	Before adjustment	After adjustment	(ft below TOC)	(ft below TOC)	Good Condition?
Blower [a]	NM	NM	22	22	40	40			
VW-1 [b]	NM	NM					5.6	10.70	Yes
VW-2 [b]	NM	NM					8.4	8.76	Yes
VW-3 [b]	NM	NM					8.8	11.26	Yes
VW-4 [b]	NM	NM					15	18.46	Yes
VW-5 [b]	NM	NM					13	17.73	Yes

Wells on-line (valve open) at arrival 1 and 2 Wells on-line at departure 1,2,4, and 5

Notes:

[a] Air flow measured at sampling port between blower discharge and manifold.

[b] Air flow measured at blower manifold sampling port

TOC - Top of Casing of well NM = Not Measured

Checklist Items

Is any airflow evident through VW-1? **18** inches H_2O drop
(Close all VW valves, set outlet pressure at 40 inches H_20, then open VW-1 valve only)

Is any airflow evident through VW-2? **0** inches H_2O drop
(Close all VW valves, set outlet pressure at 40 inches H_20, then open VW-2 valve only)

Is any airflow evident through VW-3? **Not operating** inches H_2O drop
(Close all VW valves, set outlet pressure at 40 inches H_20, then open VW-3 valve only)

Is any airflow evident through VW-4? **0** inches H2O drop
(Close all VW valves, set outlet pressure at 40 inches H20, then open VW-4 valve only)

Is any airflow evident through VW-5? **0** inches H2O drop
(Close all VW valves, set outlet pressure at 40 inches H20, then open VW-5 valve only)

Any audible air leaks in air distribution piping or VW wellheads? **No**

Blower filter removed and brushed off? **Yes** Blower filter replaced? **No**

Redwood Regional Park Service Yard
Bioventing Operations & Maintenance Checklist
Vapor Monitoring Points

Date: **4/17/2008**

	Depth to Top of Screen (ft below TOC)	Water Level (ft below TOC)	Well Head in Good Condition?
VMP-1-Shallow	9.3	9.65	Yes
VMP-1-Deep	13.4	9.85	Yes
VMP-2-Shallow	9.5	10.06	Yes
VMP-2-Deep	13.9	11.02	Yes
VMP-3-Shallow	9.8	10.34	Yes
VMP-3-Deep	12.0	10.62	Yes
VMP-4-Shallow	15.1	15.48	Yes
VMP-4-Deep	20.8	17.56	Yes

TOC= Top of well Casing

Redwood Regional Park Service Yard
Bioventing Operation & Maintenance Checklist
Blower and Vent Wells

Date: 4/17/2008

	Air Flow (scfm)		Blower Inlet Vaccum (inches H_20)		Blower Outlet Pressure (inches H_20)		Depth to Top of Screen	Water Level	Well Head in
	Before adjustment	After adjustment	Before adjustment	After adjustment	Before adjustment	After adjustment	(ft below TOC)	(ft below TOC)	Good Condition?
Blower [a]	NM	NM	18	18	45	60			
VW-1 [b]	NM	NM					5.6	11.67	Yes
VW-2 [b]	NM	NM					8.4	10.00	tightened
VW-3 [b]	NM	NM					8.8	11.46	Yes
VW-4 [b]	NM	NM					15	20.52	Yes
VW-5 [b]	NM	NM					13	22.00	Yes

Wells on-line (valve open) at arrival 1, 2, 4, and 5 Wells on-line at departure 1,2,4, and 5

Notes:

[a] Air flow measured at sampling port between blower discharge and manifold.

[b] Air flow measured at blower manifold sampling port

TOC - Top of Casing of well NM = Not Measured

Checklist Items

Is any airflow evident through VW-1? **20** inches H_2O drop
(Close all VW valves, set outlet pressure at 40 inches H_20, then open VW-1 valve only)

Is any airflow evident through VW-2? **6** inches H_2O drop
(Close all VW valves, set outlet pressure at 40 inches H_20, then open VW-2 valve only)

Is any airflow evident through VW-3? **Not operating** inches H_2O drop
(Close all VW valves, set outlet pressure at 40 inches H_20, then open VW-3 valve only)

Is any airflow evident through VW-4? **0** inches H2O drop
(Close all VW valves, set outlet pressure at 40 inches H20, then open VW-4 valve only)

Is any airflow evident through VW-5? **0** inches H2O drop
(Close all VW valves, set outlet pressure at 40 inches H20, then open VW-5 valve only)

Any audible air leaks in air distribution piping or VW wellheads? **No**

Blower filter removed and brushed off? **Yes** Blower filter replaced? **No**

Redwood Regional Park Service Yard
Bioventing Operations & Maintenance Checklist
Vapor Monitoring Points

Date: **5/16/2008**

	Depth to Top of Screen (ft below TOC)	Water Level (ft below TOC)	Well Head in Good Condition?
VMP-1-Shallow	9.3	9.92	Yes
VMP-1-Deep	13.4	10.14	Yes
VMP-2-Shallow	9.5	10.47	Yes
VMP-2-Deep	13.9	13.89	Yes
VMP-3-Shallow	9.8	10.46	Yes
VMP-3-Deep	12.0	10.71	Yes
VMP-4-Shallow	15.1	15.88	Yes
VMP-4-Deep	20.8	17.87	Yes

TOC= Top of well Casing

Redwood Regional Park Service Yard
Bioventing Operation & Maintenance Checklist
Blower and Vent Wells

Date: 5/16/2008

	Air Flow (scfm)		Blower Inlet Vaccum (inches H_20)		Blower Outlet Pressure (inches H_20)		Depth to Top of Screen	Water Level	Well Head in
	Before adjustment	After adjustment	Before adjustment	After adjustment	Before adjustment	After adjustment	(ft below TOC)	(ft below TOC)	Good Condition?
Blower [a]	NM	NM	Off	20	Off	40			
VW-1 [b]	NM	NM					5.6	11.81	Yes
VW-2 [b]	NM	NM					8.4	8.93	Yes
VW-3 [b]	NM	NM					8.8	10.92	Yes
VW-4 [b]	NM	NM					15	18.46	Yes
VW-5 [b]	NM	NM					13	18.74	Yes

Wells on-line (valve open) at arrival 1,2,4, and 5 but system off Wells on-line at departure 1,2,4, and 5

Notes:

[a] Air flow measured at sampling port between blower discharge and manifold.

[b] Air flow measured at blower manifold sampling port

TOC - Top of Casing of well NM = Not Measured

Checklist Items

Is any airflow evident through VW-1? **20** inches H_2O drop
(Close all VW valves, set outlet pressure at 40 inches H_20, then open VW-1 valve only)

Is any airflow evident through VW-2? **4** inches H_2O drop
(Close all VW valves, set outlet pressure at 40 inches H_20, then open VW-2 valve only)

Is any airflow evident through VW-3? **Not operating** inches H_2O drop
(Close all VW valves, set outlet pressure at 40 inches H_20, then open VW-3 valve only)

Is any airflow evident through VW-4? **0** inches H2O drop
(Close all VW valves, set outlet pressure at 40 inches H20, then open VW-4 valve only)

Is any airflow evident through VW-5? **0** inches H2O drop
(Close all VW valves, set outlet pressure at 40 inches H20, then open VW-5 valve only)

Any audible air leaks in air distribution piping or VW wellheads? **No**

Blower filter removed and brushed off? **Yes** Blower filter replaced? **Yes**

Redwood Regional Park Service Yard
Bioventing Operations & Maintenance Checklist
Vapor Monitoring Points

Date: **6/12/2008**

	Depth to Top of Screen (ft below TOC)	Water Level (ft below TOC)	Well Head in Good Condition?
VMP-1-Shallow	9.3	10.31	Yes
VMP-1-Deep	13.4	10.32	Yes
VMP-2-Shallow	9.5	11.12	Yes
VMP-2-Deep	13.9	11.52	Yes
VMP-3-Shallow	9.8	10.59	Yes
VMP-3-Deep	12.0	10.78	Yes
VMP-4-Shallow	15.1	15.92	Yes
VMP-4-Deep	20.8	18.18	Yes

TOC= Top of well Casing

Redwood Regional Park Service Yard
Bioventing Operation & Maintenance Checklist
Blower and Vent Wells

Date: 6/12/2008

	Air Flow (scfm)		Blower Inlet Vaccum (inches H_20)		Blower Outlet Pressure (inches H_20)		Depth to Top of Screen	Water Level	Well Head in
	Before adjustment	After adjustment	Before adjustment	After adjustment	Before adjustment	After adjustment	(ft below TOC)	(ft below TOC)	Good Condition?
Blower [a]	NM	NM	20	20	36	40			
VW-1 [b]	NM	NM					5.6	12.64	Yes
VW-2 [b]	NM	NM					8.4	12.52	Yes
VW-3 [b]	NM	NM					8.8	11.86	Yes
VW-4 [b]	NM	NM					15	21.25	Yes
VW-5 [b]	NM	NM					13	21.95	Yes

Wells on-line (valve open) at arrival 1, 2, 4, and 5 Wells on-line at departure 1, 2, 4, and 5

Notes:

[a] Air flow measured at sampling port between blower discharge and manifold.

[b] Air flow measured at blower manifold sampling port

TOC - Top of Casing of well NM = Not Measured

Checklist Items

Is any airflow evident through VW-1? **20** inches H_2O drop
(Close all VW valves, set outlet pressure at 40 inches H_20, then open VW-1 valve only)

Is any airflow evident through VW-2? **8** inches H_2O drop
(Close all VW valves, set outlet pressure at 40 inches H_20, then open VW-2 valve only)

Is any airflow evident through VW-3? **unconnected** inches H_2O drop
(Close all VW valves, set outlet pressure at 40 inches H_20, then open VW-3 valve only)

Is any airflow evident through VW-4? **0** inches H2O drop
(Close all VW valves, set outlet pressure at 40 inches H20, then open VW-4 valve only)

Is any airflow evident through VW-5? **0** inches H2O drop
(Close all VW valves, set outlet pressure at 40 inches H20, then open VW-5 valve only)

Any audible air leaks in air distribution piping or VW wellheads? **Yes - leak in VW-1 line, fixed**

Blower filter removed and brushed off? **Yes** Blower filter replaced? **No**