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FIRST QUARTER 2006
BIOVENTING STATUS REPORT

REDWOOD REGIONAL PARK
SERVICE YARD
OAKLAND, CALIFORNIA

Prepared for:

EAST BAY REGIONAL PARK DISTRICT
OAKLAND, CALIFORNIA

April 2006

STELLAR
ENVIRONMENTAL SOLUTIONS, INC.
GEOSCIENCE & ENGINEERING CONSULTING

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April 3, 2006

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 Quarter 2006 Bioventing Progress Report
Redwood Regional Park Service Yard Site, Oakland, California – RO #0000246

Dear Mr. Wickham:

This report discusses activities conducted during the First Quarter of 2006 related to a 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 us directly at (510) 644-3123.

Sincerely,

Bruce M. Rucker, R.G., R.E.A.
Project Manager

Richard S. Makdisi, R.G., R.E.A.
Principal Geochemist

cc: Carl Wilcox (California Department of Fish and Game); Cherie McCalou (Water Board); Neal Fujita (East Bay Regional Park District)

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Prepared for:

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

Prepared by:

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April 3, 2006

Project No. 2005-66

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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 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).

This report documents the activities conducted in the First Quarter of 2006 related to a soil bioventing system at the site. 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. The report summarizing the pilot test recommended the installation and operation of a full-scale bioventing system (Stellar Environmental Solutions, Inc., 2004b), which was approved by Alameda County Health (Alameda County Health, 2005b). The bioventing system was installed and started up in December 2005 and January 2006 (Stellar Environmental Solutions, Inc., 2006). Alameda County 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.

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.

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 545 feet amsl at Redwood Creek, which defines the approximate western edge of the project site with regard to this investigation.

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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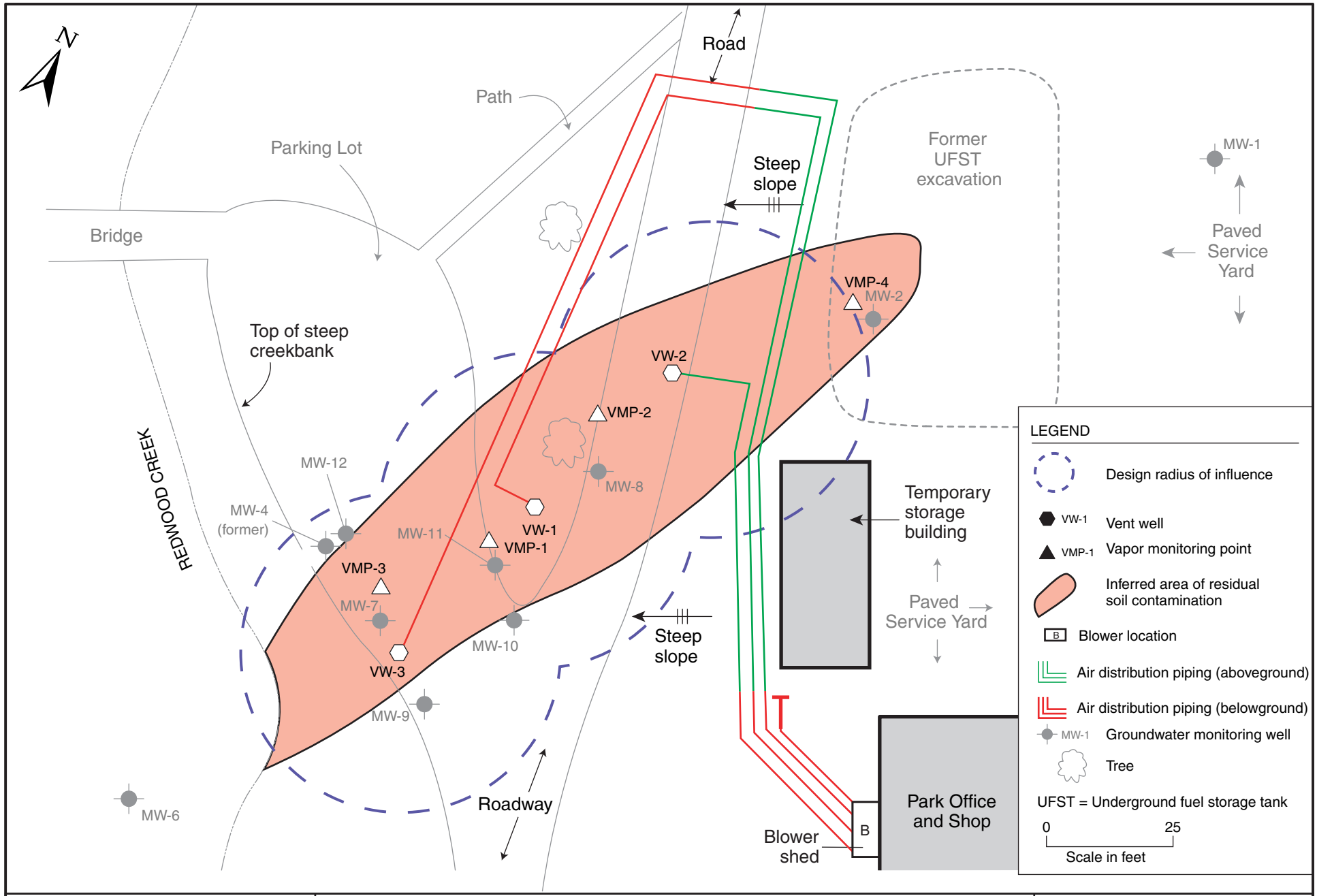
2006-17-01



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FULL-SCALE BIOVENTING SYSTEM

7867 Redwood Rd, Oakland, CA

Figure 2

by: MJC | DECEMBER 2005

2005-66--08

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; and
- An evaluation of bioventing feasibility as a corrective action, which included a bioventing pilot test.

As discussed in detail 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 Health, with oversight provided by the Water Board. The CDFG is also involved with regard to water quality impacts to Redwood Creek. The most recent regulatory agency input was Alameda County Health's approval to install and startup the full-scale bioventing system (Alameda County Health, 2005b), and to implement the monthly bioventing O&M program and conduct an in situ respiration test (Alameda County Health, 2006).

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 Health's online file transfer protocol (ftp) system. Per Alameda County 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 Health.

2.0 BIOVENTING SYSTEM DESCRIPTION

The bioventing system consists of the following components:

- Three vent wells (VWs), screened across the unsaturated zone.
- 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 minute (cfm) and exerts a pressure of approximately 1 to 3 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.

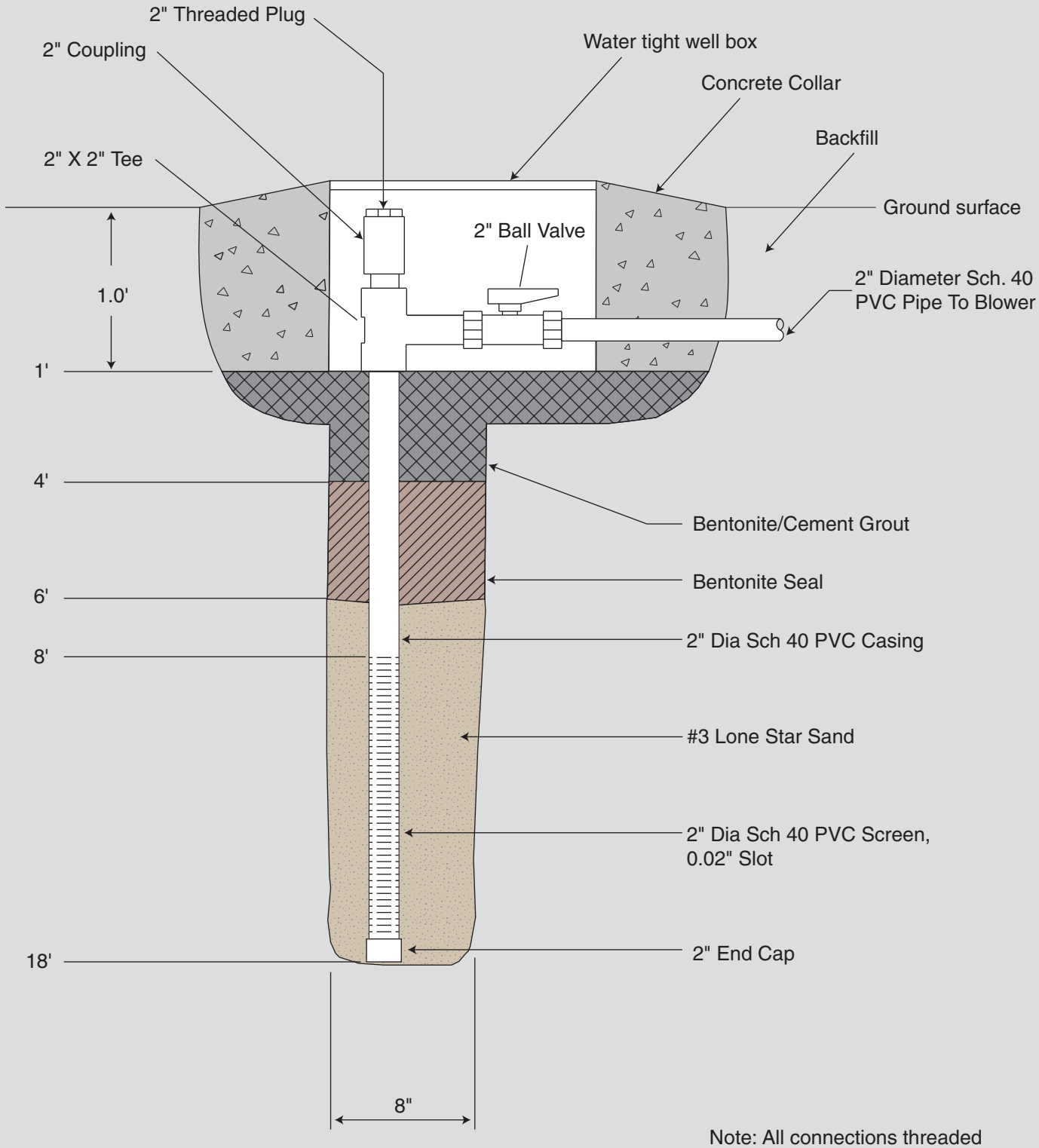
Table 1 summarizes bioventing well construction data. Figure 2 is a site plan showing the layout of the bioventing system. Figures 3 and 4 are as-builts for typical site VMPs and VWs, respectively. Figure 5 is a flow instrumentation diagram for the blower and associated manifold. This blower system was 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	8 – 18	6 – 18
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:

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.

AS-BUILT VENT WELL CONSTRUCTION DETAILS FOR VW-2 & VW-3

Redwood Regional Park **Oakland, CA**	**By: MJC**	**DECEMBER 2005**
	Figure 3	

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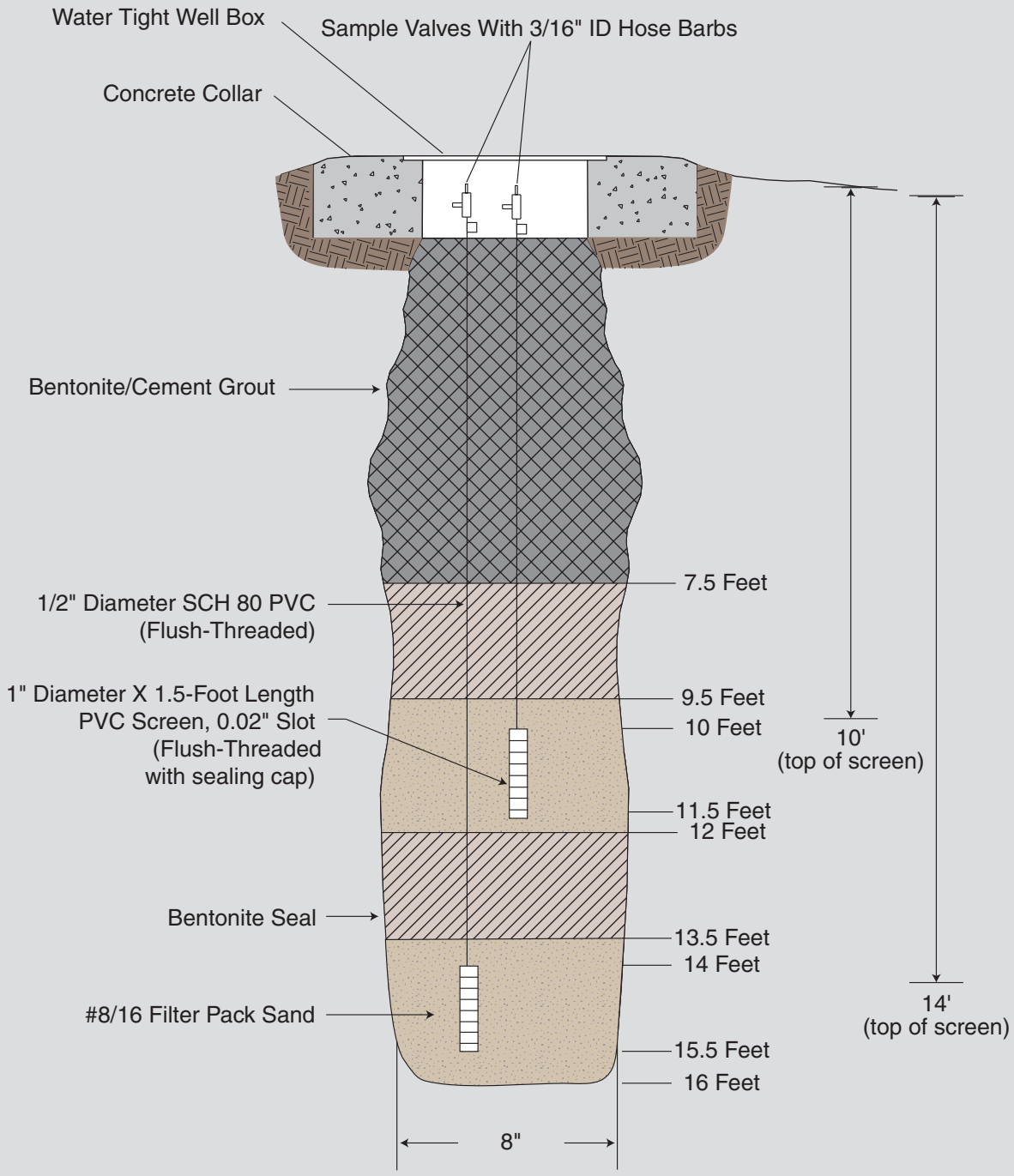
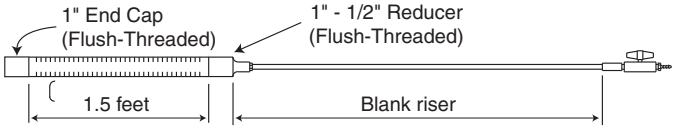
2005-66-09



Not To Scale

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

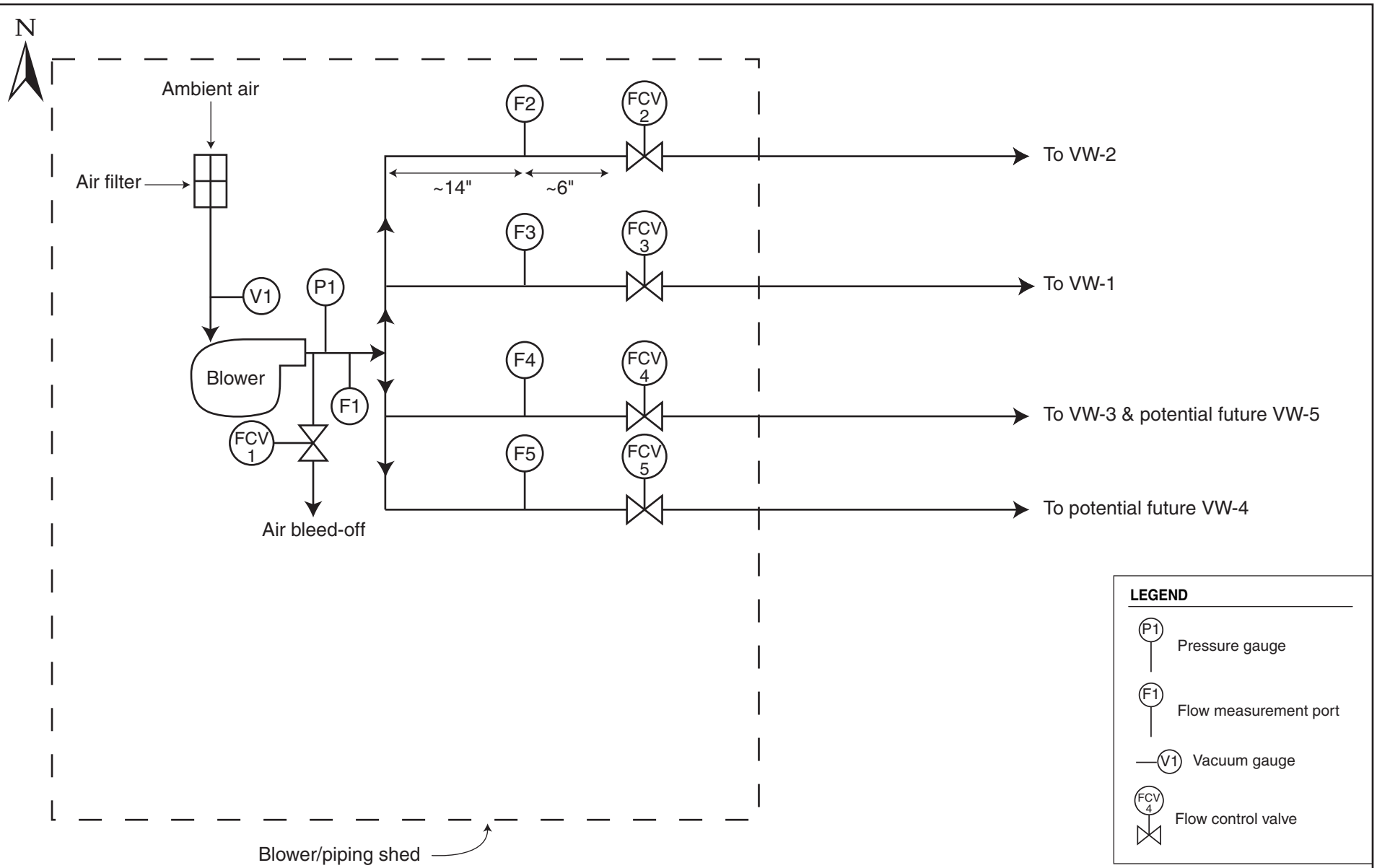


VMP SCREEN DETAIL
Not To Scale

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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GEOSCIENCE & ENGINEERING CONSULTING

BIOVENTING PROCESS FLOW AND INSTRUMENTATION DIAGRAM

7867 Redwood Rd, Oakland, CA

Figure 5

by: MJC | **DECEMBER 2005**

2005-66-07

3.0 CURRENT QUARTER 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.

Following the January 24, 2006 (final) weekly event, all manifold valves were closed except VW-3. The objective of this was to concentrate all air flow into VW-3, in an attempt to facilitate air injection into that well. This attempt was unsuccessful; on February 23, 2006, the manifold valves to all VWs were re-opened. On February 27, 2006, the blower outlet pressure was reset to 40 inches of water.

O&M ACTIVITIES

Two monthly O&M events were conducted in the current quarter, with the following objectives:

- Confirm that the system was operating within design parameters, with no system problems (e.g., leaks, non-functioning components).
- Conducting preventive maintenance (i.e., clean blower air filter).
- Continue to evaluate if air flow was occurring through the screened intervals of VW-2 or VW-3.

Monthly O&M activities included:

- Measuring water levels in all VMPs and VWs.
- Inspecting aboveground portions of the system (i.e., blower, air distribution piping, and wellheads) for leaks or structural problems.
- Recording blower outlet pressure and inlet vacuum.
- Qualitatively evaluating if air flow was occurring across the VW intervals. This was conducted 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).

- Inspecting and cleaning the blower inlet filter.
- Conducting an air injection test into well VW-3.

In each event, an O&M checklist was completed. Appendix A contains the completed checklists for the current quarter.

VW-3 AIR INJECTION TEST

On March 22, 2006, an air injection test was conducted at VW-3 using an air compressor (12 cubic feet per minute [cfm] and 120 psi capacity) and a constructed PVC wellhead test assembly consisting of a ball valve, downstream pressure gauge and appropriate fittings. The objective of this test was to inject air at a rate (pressure) greater than the blower capacity, in an attempt to establish flow paths through the screen, filter pack and surrounding lithology.

Prior to the test, it was confirmed that the air distribution piping had no blockage between the blower and the VW-3 wellhead. Air flow from the blower was greater than 100 cfm, and airflow was obvious at the wellhead when the valves and the well top were open.

The compressor was set at 40 psi (on the compressor's pressure gauge), which is approximately 20 times the blower discharge capacity. SES confirmed that the compressor held this pressure steadily when the discharge hose was blanked off. We then closed the ball valve on the wellhead test assembly, confirmed that it was airtight, then reopened the ball valve, exposing the well interior to 40 psi. The compressor gauge dropped (within 30 seconds) to 25 psi, indicating that the excess pressure (above 25 psi) was leaking from the well interior. Pressure held steady at 25 psi while the compressor was running. During this time, the pressure gauge on the wellhead assembly held steady at approximately 10 psi. The cause of the difference between the compressor gauge reading (25 psi) and the wellhead assembly gauge (10 psi) is not known, and may be due either to pressure loss in the system or variations between the two pressure gauges.

SES then closed the wellhead assembly ball valve, isolating the pressure (10 psi as shown on the wellhead assembly gauge) inside the well. The pressure dropped to 0 psi within approximately 1 minute, indicating the presence of a leak inside the well. Based on the pressure integrity demonstrated on the ball valve (and the fact that the compressor continued to exert 25 psi against the closed ball valve), it appears unlikely that the observed pressure loss occurred through the ball valves. In a previous air injection test (a "dry run" to set up the system), SES observed air bubbles emanating through the water in the bottom of the wellbox during air injection. This

suggests that air is being forced out of the well below grade, possibly at a casing union near the surface.

SES continued injecting air (at 25 psi as shown on the compressor gauge and 10 psi as shown on the wellhead assembly gauge) for 4.5 hours. Following the test, we observed the following:

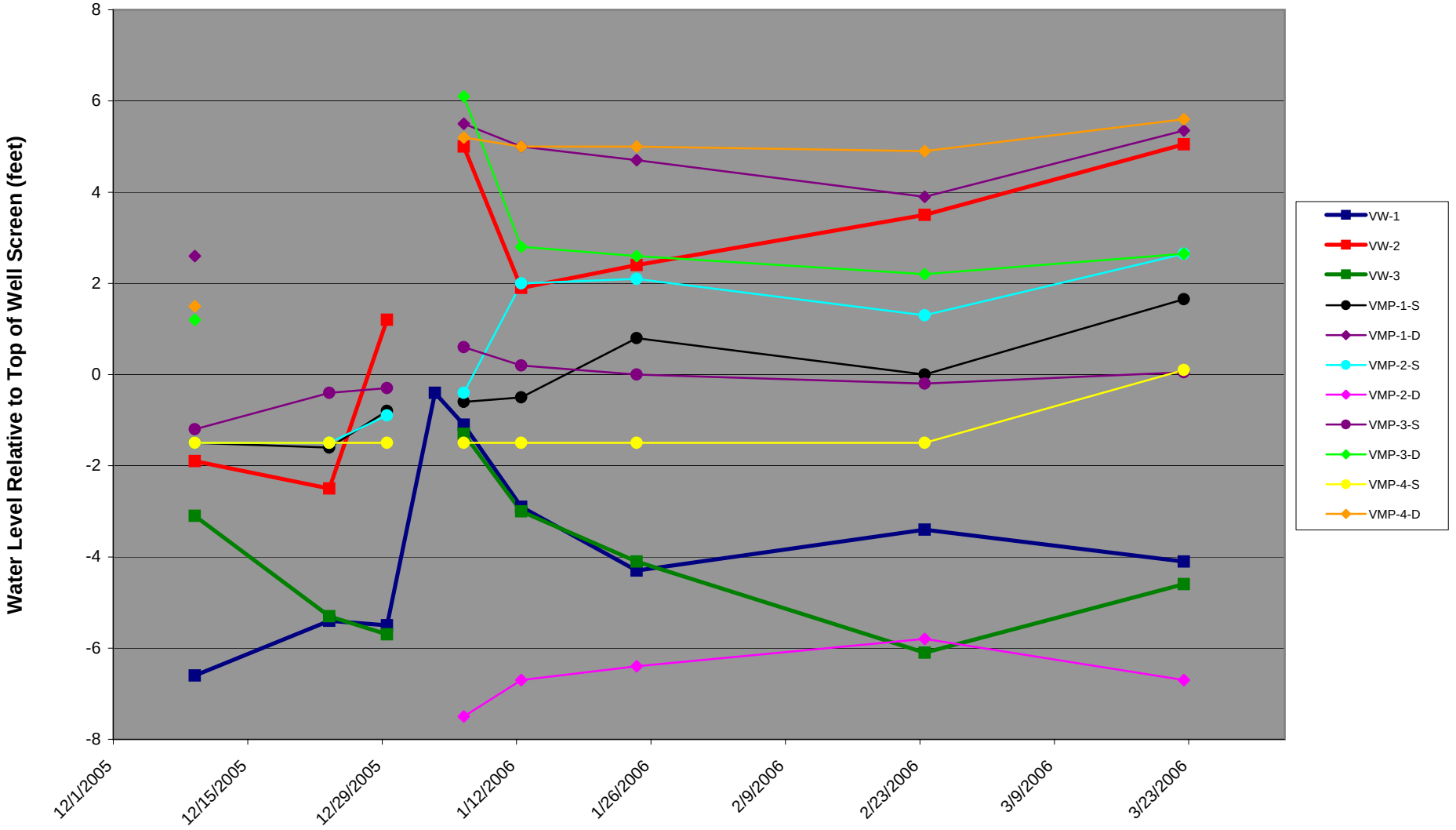
- Water level in the well dropped 2.0 feet (from 13.5 feet to 15.5 feet) due to the exerted pressure.
- A slight pressure decrease (1 to 2 inches of water) was observed at the blower outlet pressure gauge when the VW-3 manifold valve was opened, suggesting that some air flow might be occurring. Actual air flow into VW-3 will be measured in a future O&M event using a thermal anemometer.

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 have shown a general increase in most of the VMPs and VWs since the wells were installed, resulting in partially or fully flooded well screens in some wells. Figure 6 shows groundwater levels in VWs and VMPs relative to the top of the well screened interval. The screen in VW-2 has been fully flooded since installation. Wells VW-1 and VW-3 have had partially exposed screens since installation.
- Air is being injected (since system startup) in the non-flooded portion of the VW-1 screen, but at flow rates less than optimum due to the partially flooded screen.
- No measurable air injection has occurred in VW-2 since system startup, due to the fully flooded screen.
- 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). It is possible that the inability to inject air may be due to residual saturation in the well filter pack and/or surrounding soils, or that the borehole annulus may have been smeared during installation.

Figure 6 - Historical Groundwater Levels Relative to Top of Bioventing Well 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.

4.0 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.
- Air flow is occurring through a portion of the VW-1 screened interval, but at a less-than-optimum rate due to high water level conditions.
- No air flow is occurring through the VW-2 screened interval due to saturated well screen interval.
- No air flow is occurring through the VW-3 screened interval, although a portion of the well screen is unsaturated. The reason for no air flow in this VW is still under investigation, and several (previously discussed) possible causes have been eliminated. The problem may be due to either residual saturation in the filter pack and/or native soil, or possibly borehole smearing during well installation. An air injection test (conducted at 1 order of magnitude greater pressure than that delivered by the blower) indicated that air is leaking from the well, likely through fittings below grade and near the surface.
- Current conditions (little to no air injection) likely will continue through the rainy season. Falling water levels should improve air injection rates and response at the VMPs.

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 (ISR test), including air permeability and system radius of influence, at such time as water levels drop sufficiently to evaluate response in at least the shallow VMP screens.

- Continue to report on bioventing system progress/activities in quarterly progress reports, and prepare an annual summary report (approximately 1 year after the system began operation).
- If future O&M events demonstrate continued absence of air flow through the VW-2 well screen, additional troubleshooting and/or corrective action will be evaluated. This might include redeveloping of the well (by surging and swabbing) to facilitate flushing of the annular pack. If the issue cannot be resolved, replacement of well VW-2 will be considered.

5.0 REFERENCES

Alameda County Health, 2006. Letter approving monthly bioventing O&M and reporting and in-situ respiration test. March 15.

Alameda County Health, 2005a. Letter regarding Alameda County Health's review of SES Bioventing Pilot Test Report. May 25.

Alameda County Health, 2005b. Letter approving installation and implementation of bioventing full-scale system. June 24.

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

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.

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.

APPENDIX A

Monthly System O&M Checklists

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

Date: 2/23/2006

	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	14	14	48	50 [c]			
VW-1 [b]	NM	NM					5.6	8.95	Yes
VW-2 [b]	NM	NM					8.4	4.90	Yes
VW-3 [b]	NM	NM					8.8	14.90	Yes

Notes:
[a] Air flow measured at sampling port between blower discharge and manifold.
[b] Air flow measured at blower manifold sampling port
[c] Blower outlet pressure re-set to 40 inches H_20 on 2/27/06.
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) **8** psi drop

Is any airflow evident through VW-2? (Close all other manifold valves and look for drop in blower outlet pressure) **0** psi drop

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: **2/23/2006**

	Depth to Top of Screen (ft below TOC)	Water Level (ft below TOC)	Well Head in Good Condition?
VMP-1-Shallow	9.3	9.25	Yes
VMP-1-Deep	13.4	9.45	Yes
VMP-2-Shallow	9.5	8.15	Yes
VMP-2-Deep	13.9	8.1	Yes
VMP-3-Shallow	9.8	9.95	Yes
VMP-3-Deep	12.0	9.75	Yes
VMP-4-Shallow	15.1	dry	Yes
VMP-4-Deep	20.8	15.85	Yes

TOC= Top of well Casing

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

Date: **3/22/2006**

	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	40	40 [c]			
VW-1 [b]	NM	NM					5.6	9.7	Yes
VW-2 [b]	NM	NM					8.4	3.35	Yes
VW-3 [b]	NM	NM					8.8	13.4	Yes

Notes:
[a] Air flow measured at sampling port between blower discharge and manifold.
[b] Air flow measured at blower manifold sampling port
[c] Blower outlet pressure re-set to 40 inches H_20 on 2/27/06.
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) **8** psi drop

Is any airflow evident through VW-2? (Close all other manifold valves and look for drop in blower outlet pressure) **0** psi drop

Is any airflow evident through VW-3? (Close all other manifold valves and look for drop in blower outlet pressure) **~ 0.5** 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: **3/22/2006**

	Depth to Top of Screen (ft below TOC)	Water Level (ft below TOC)	Well Head in Good Condition?
VMP-1-Shallow	9.3	7.65	Yes
VMP-1-Deep	13.4	8.05	Yes
VMP-2-Shallow	9.5	6.85	Yes
VMP-2-Deep	13.9	7.20	Yes
VMP-3-Shallow	9.8	9.75	Yes
VMP-3-Deep	12.0	9.35	Yes
VMP-4-Shallow	15.1	15.00	Yes
VMP-4-Deep	20.8	15.20	Yes

TOC= Top of well Casing