Q1/Q2 2007 BIOVENTING STATUS REPORT

REDWOOD REGIONAL PARK
SERVICE YARD
OAKLAND, CALIFORNIA

Prepared for:

EAST BAY REGIONAL PARK DISTRICT
OAKLAND, CALIFORNIA

July 2007

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:

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July 9, 2007

Project No. 2007-17

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July 9, 2007

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 2007 Bioventing 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 2007, and summarizes activities 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 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 2007, and summarizes the soil bioventing system-related activities conducted at the site throughout 2007.

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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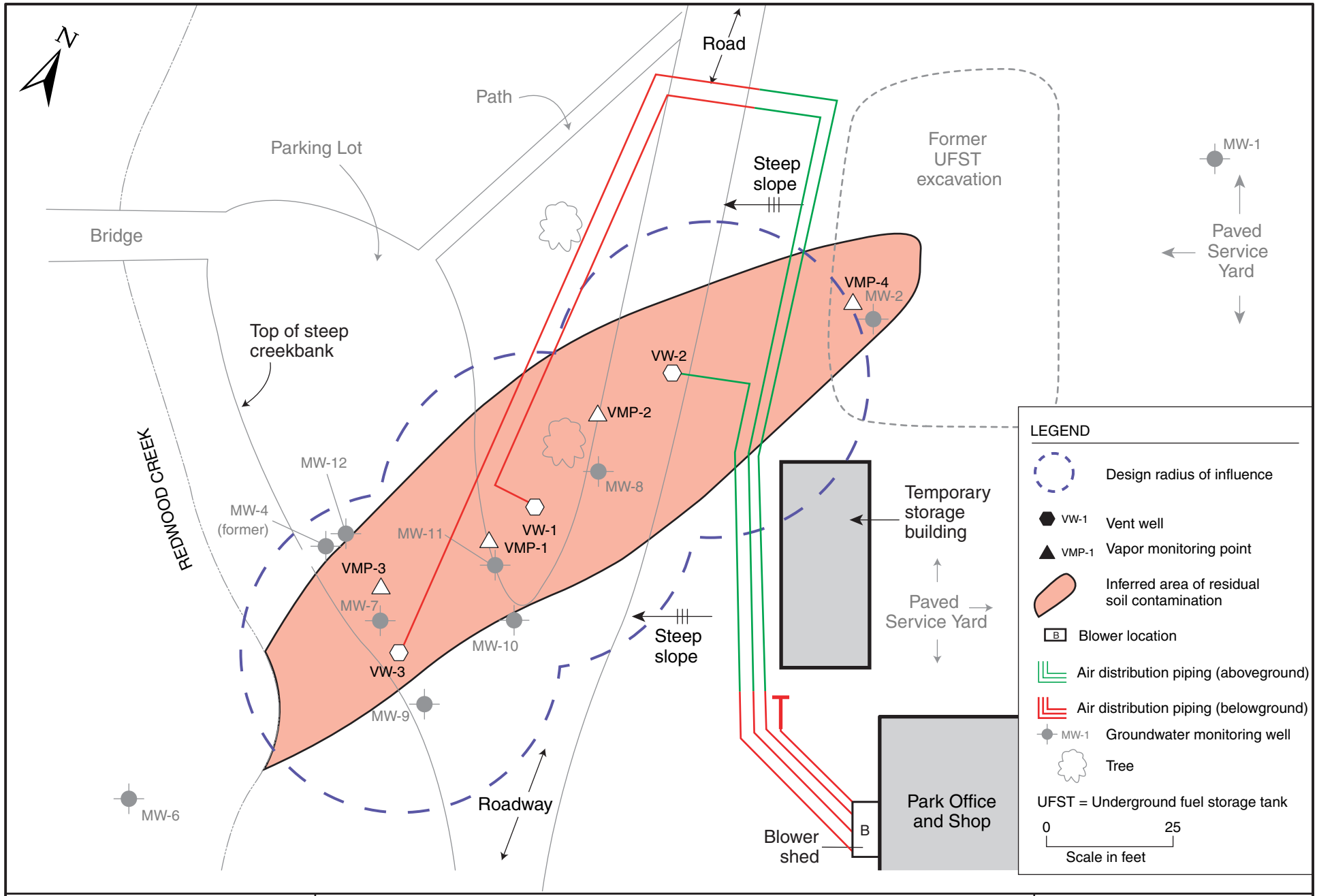
2006-17-01



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FULL-SCALE BIOVENTING SYSTEM

7867 Redwood Rd, Oakland, CA

Figure 2

by: MJC | DECEMBER 2005

2005-66--08

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.

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, 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 Environmental Health's approval to install and start up the full-scale bioventing system (Alameda County Environmental Health, 2005b), and to implement the monthly bioventing O&M program and conduct an in-situ respiration test (Alameda County Environmental 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 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 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 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.

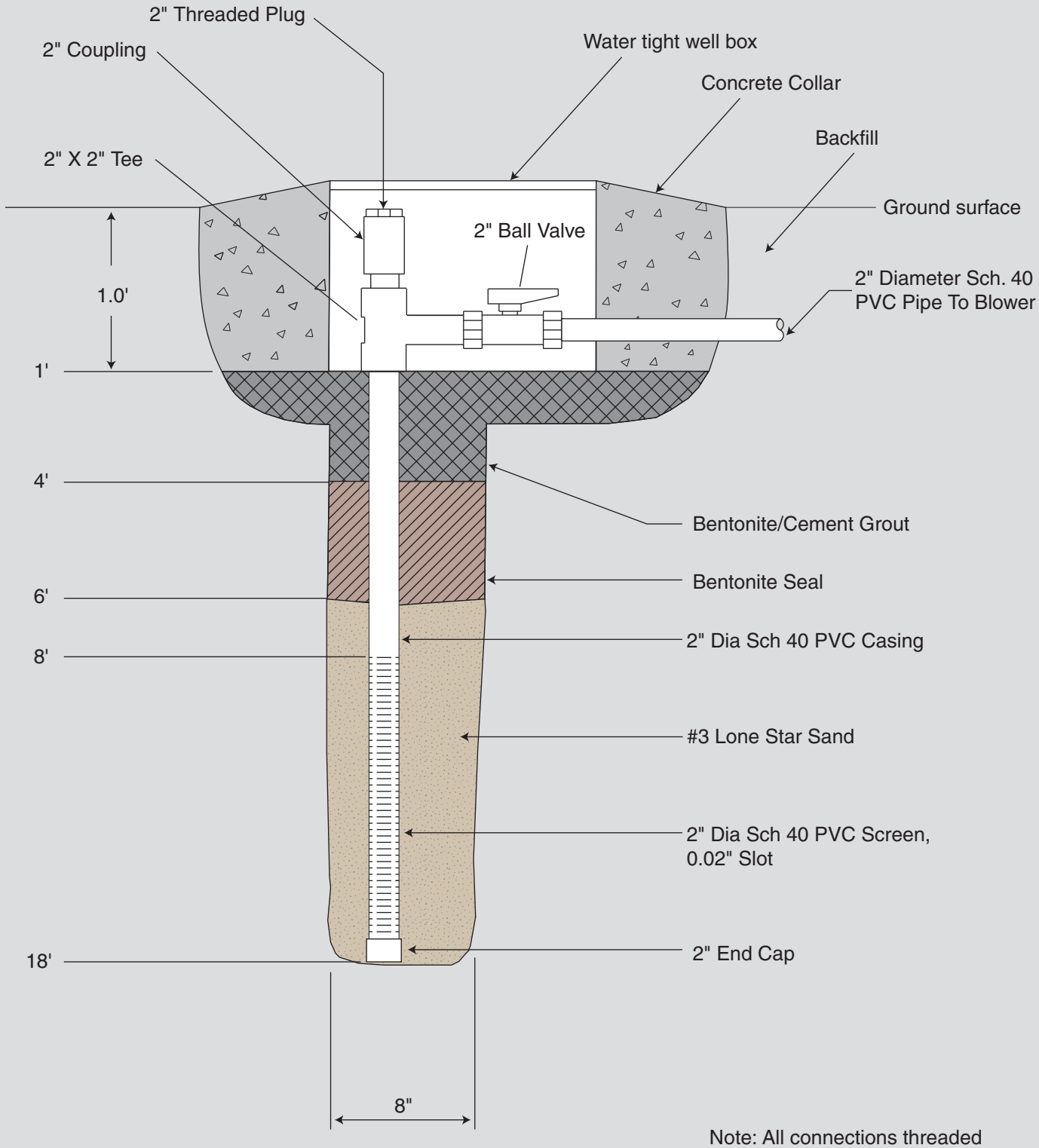
Table 1 summarizes bioventing well construction data. Figure 2 (in the previous chapter) is a site plan showing the layout of the bioventing system. Figures 3 and 4 are as-builts for typical site VMPs and VWs, respectively. Figure 5 is a flow instrumentation diagram for the blower and associated manifold. 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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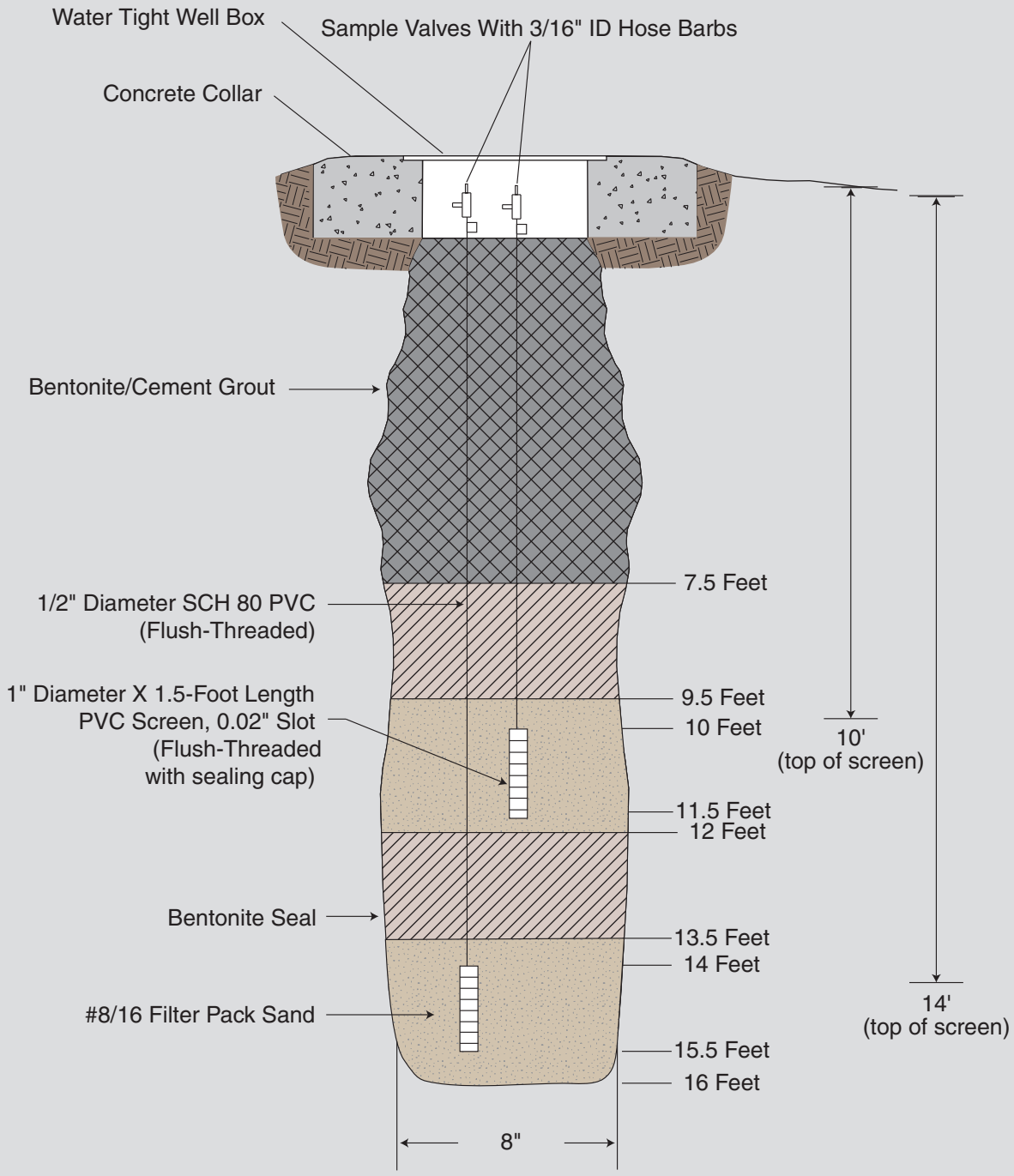
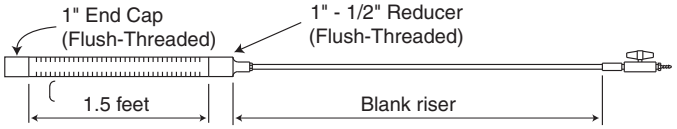
2005-66-09



Not To Scale

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

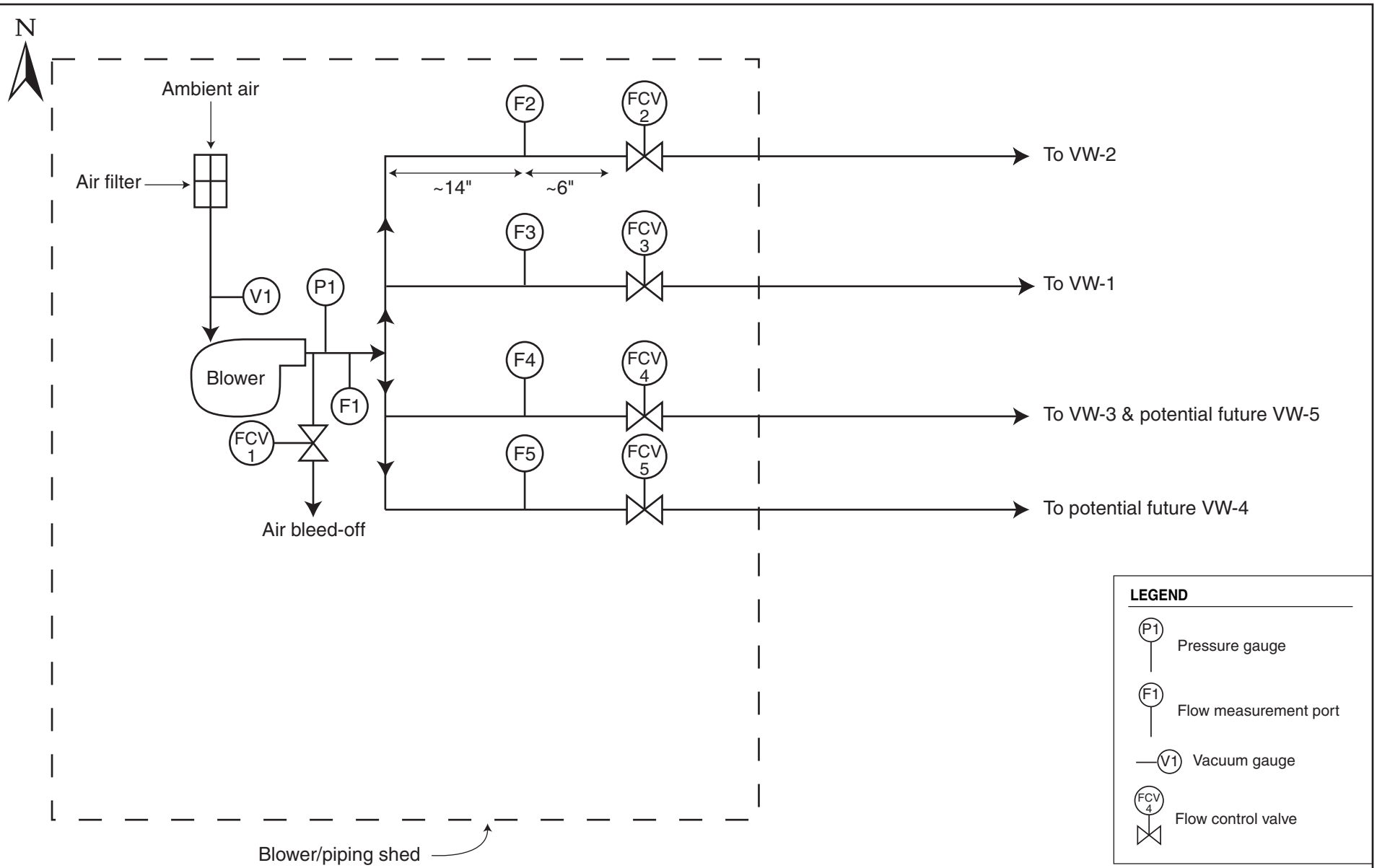


VMP SCREEN DETAIL
Not To Scale

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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BIOVENTING PROCESS FLOW AND INSTRUMENTATION DIAGRAM

7867 Redwood Rd, Oakland, CA

Figure 5

by: MJC | **DECEMBER 2005**

2005-66-07

3.0 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.

O&M ACTIVITIES

Monthly O&M events were conducted during the first and second quarters (on January 11, February 12, March 21, April 25, May 17, and June 20 2007), 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 April 2007 O&M event).
- Tighten all aboveground piping clamps (in the March 2007 O&M event).
- Complete an O&M checklist.

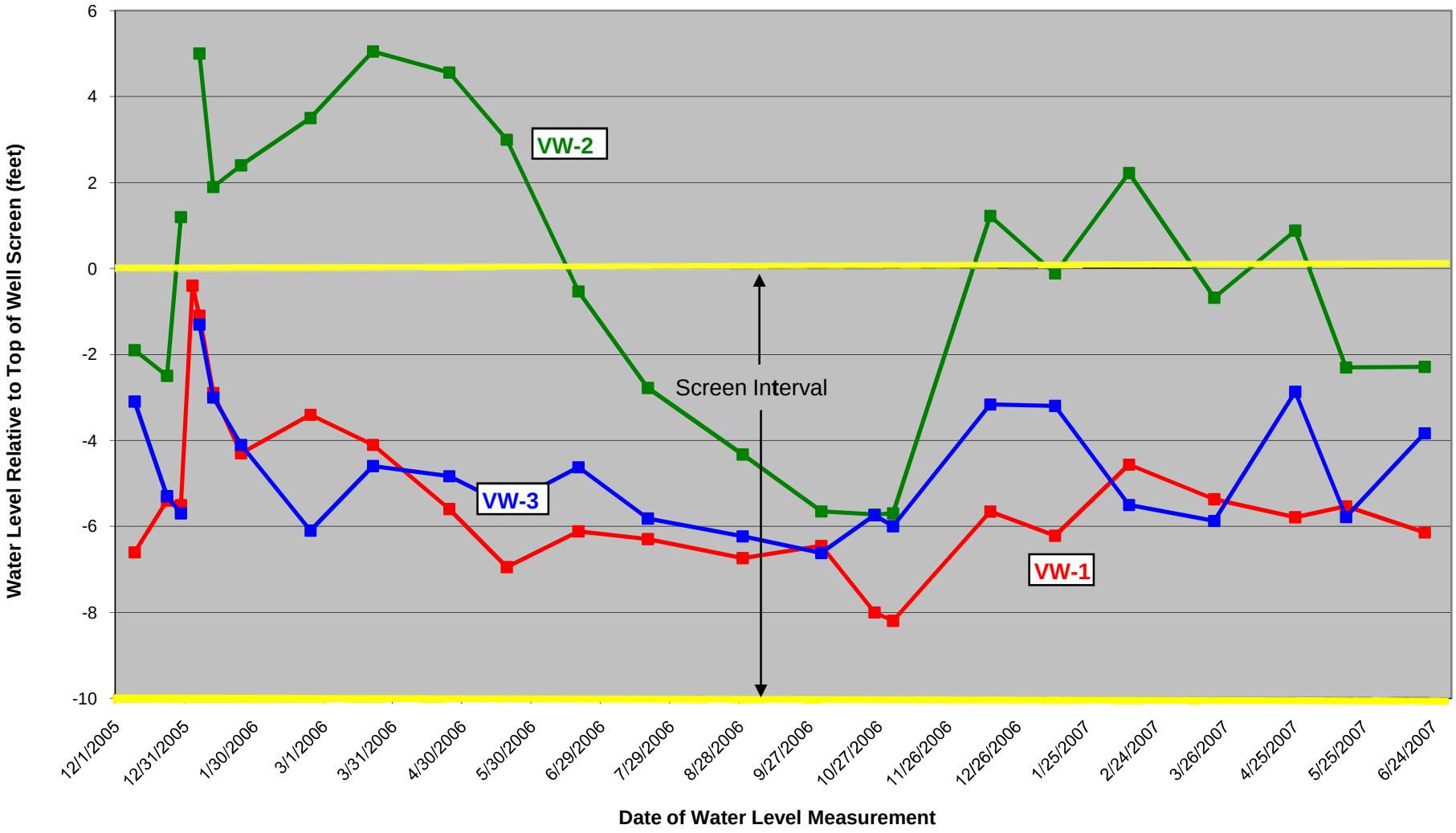
Appendix A contains the completed checklists for the first and second quarters.

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 VWs showed a general increase after the wells were installed, resulting in partially or fully flooded well screens in all VWs. 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. 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.
- 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.
- As shown on Figure 8, water levels in deep VMPs have been relatively stable since the VMPs were installed, with the exception of VMP-2-D, which has shown an increase since March 2006. 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.

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

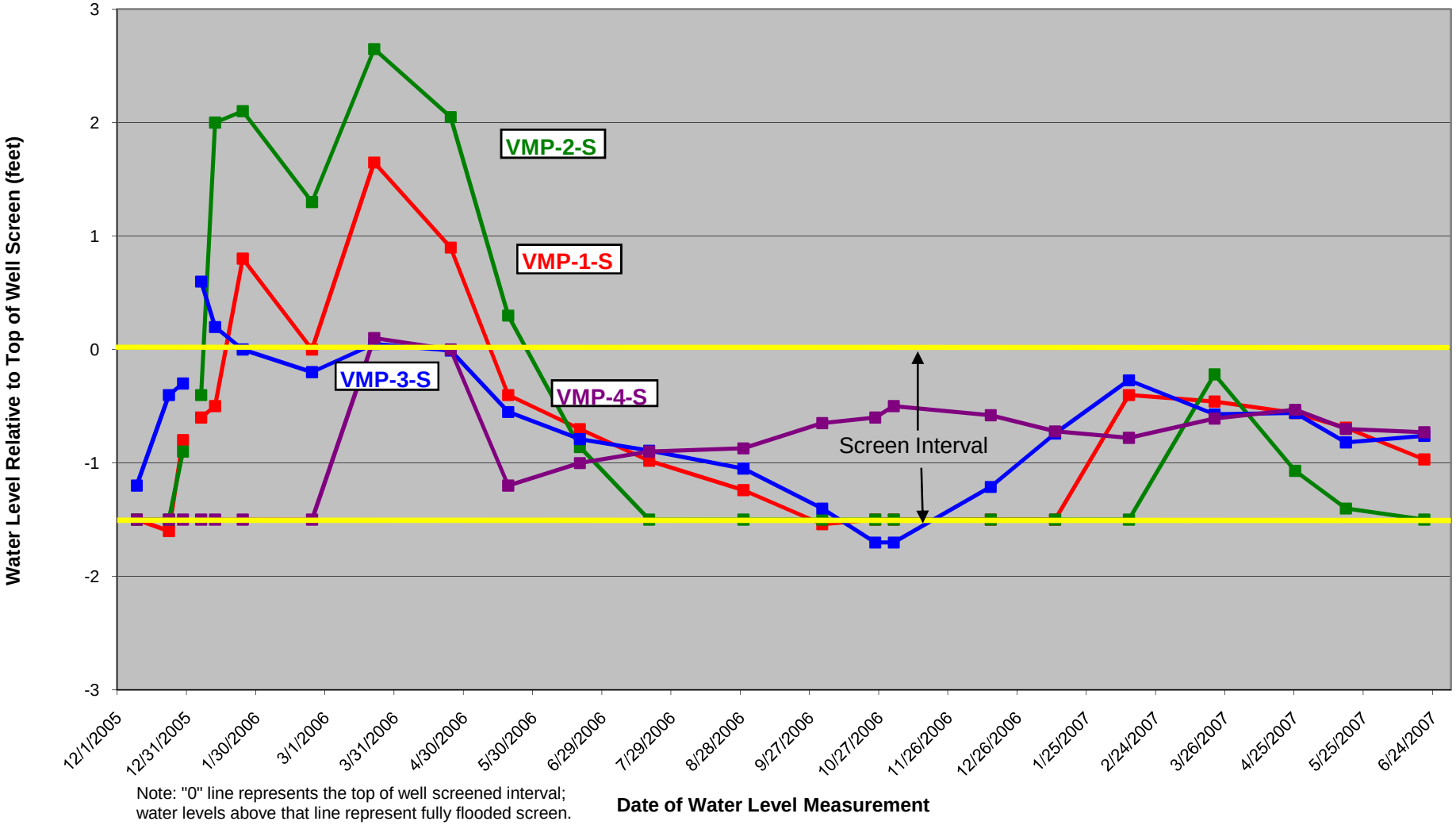
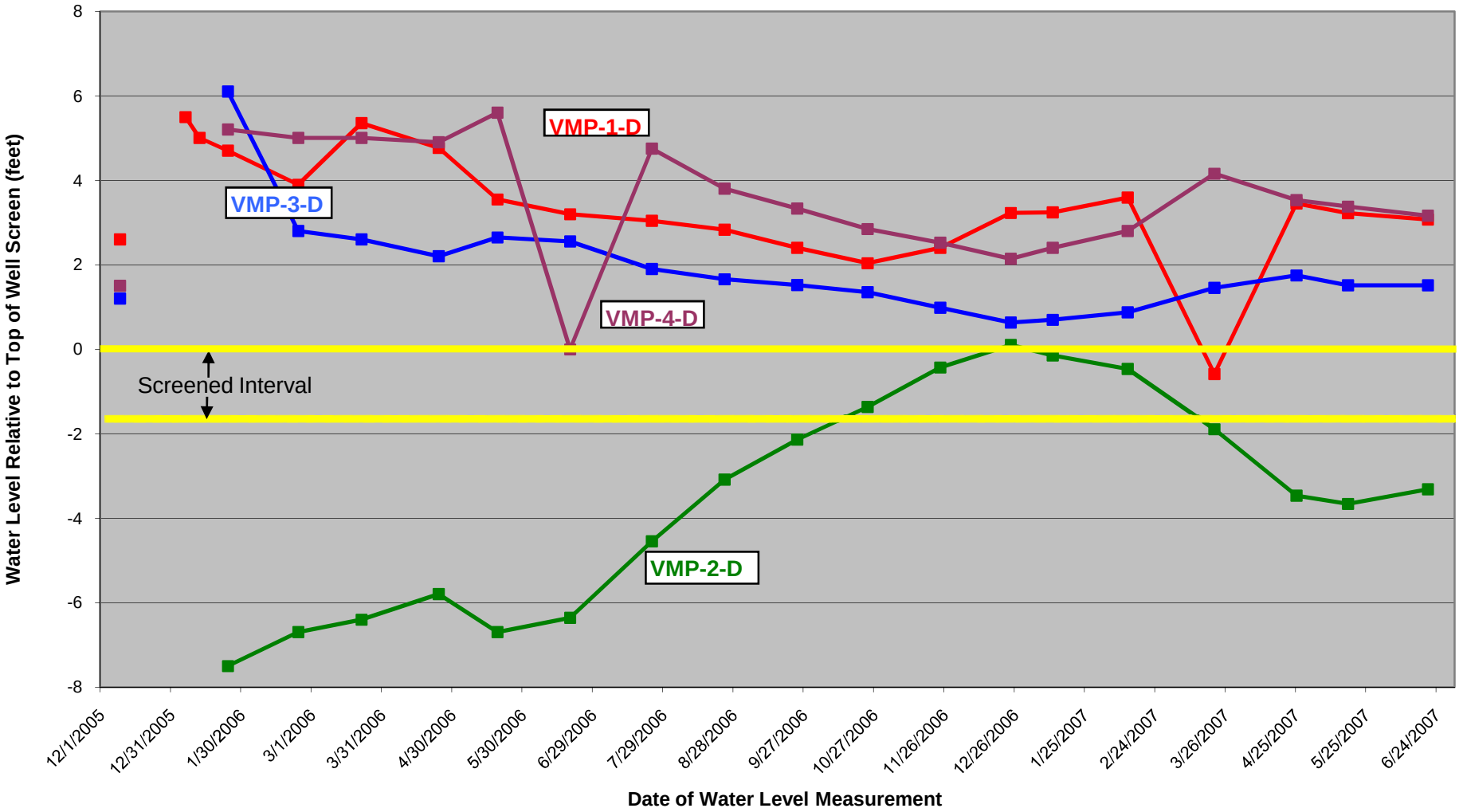


Figure 8 - Historical Groundwater Levels Relative to Top of Deep VMP Screened Intervals
Redwood Regional Park Service Yard - Oakland, California



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

- No measurable air injection occurred in VW-2 from system startup in December 2005 to mid-October 2006. Air flow occurred from mid-October through November 2006 (until the first significant rains in late November/early December), presumably due to the raised groundwater level and the corresponding saturation of the well screen interval. Air flow has since occurred sporadically as demonstrated by a slight change in pressure recorded in March, May, and June of 2007.
- 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.

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.
- High groundwater levels from November 2006 through April of 2007 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 below the screen since May 2007.
- Air flow is occurring through the VW-1 screened interval at an optimum level.
- No air flow has occurred through the VW-3 screened interval. The groundwater level is below the screen interval indicating that water saturation is not impeding air flow.
- 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 2007, 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.
- Due to the continued absence of air flow through the VW-3 well screen, additional troubleshooting and/or development should be performed.

5.0 REFERENCES

Alameda County Health Care Services Agency, Department of Environmental Health (Alameda County Environmental Health), 2006. 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), 2005a. Letter regarding Alameda County Health's review of SES Bioventing Pilot Test Report. May 25.

Alameda County Health Care Services Agency, Department of Environmental Health (Alameda County Environmental Health), 2005b. Letter approving installation and implementation of bioventing full-scale system. June 24.

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

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), 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 Operations & Maintenance Checklist
Vapor Monitoring Points

Date: **1/11/2007**

	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	10.16	Yes
VMP-2-Shallow	9.5	Dry	Yes
VMP-2-Deep	13.9	12.01	Yes
VMP-3-Shallow	9.8	10.54	Yes
VMP-3-Deep	12.0	10.55	Yes
VMP-4-Shallow	15.1	15.82	Yes
VMP-4-Deep	20.8	16.64	Yes

TOC= Top of well Casing

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

Date: 1/11/2007

	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	41	40			
VW-1 [b]	NM	NM					5.6	11.82	Yes
VW-2 [b]	NM	NM					8.4	8.51	Yes
VW-3 [b]	NM	NM					8.8	12.00	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? (Close all other manifold valves and look for drop in blower outlet pressure) **40** 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 (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: **2/12/2007**

	Depth to Top of Screen (ft below TOC)	Water Level (ft below TOC)	Well Head in Good Condition?
VMP-1-Shallow	9.3	9.69	Yes
VMP-1-Deep	13.4	9.81	Yes
VMP-2-Shallow	9.5	dry	Yes
VMP-2-Deep	13.9	10.43	Yes
VMP-3-Shallow	9.8	10.07	Yes
VMP-3-Deep	12.0	10.25	Yes
VMP-4-Shallow	15.1	15.88	Yes
VMP-4-Deep	20.8	17.27	Yes

TOC= Top of well Casing

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

Date: 2/12/2007

	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	40	40			
VW-1 [b]	NM	NM					5.6	10.16	Yes
VW-2 [b]	NM	NM					8.4	6.18	Yes
VW-3 [b]	NM	NM					8.8	14.30	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? **40** 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? **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: **3/21/2007**

	Depth to Top of Screen (ft below TOC)	Water Level (ft below TOC)	Well Head in Good Condition?
VMP-1-Shallow	9.3	9.76	yes
VMP-1-Deep	13.4	13.99	yes
VMP-2-Shallow	9.5	9.72	yes
VMP-2-Deep	13.9	10.24	yes
VMP-3-Shallow	9.8	10.37	yes
VMP-3-Deep	12.0	10.49	yes
VMP-4-Shallow	15.1	15.71	yes
VMP-4-Deep	20.8	17.42	yes

TOC= Top of well Casing

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

Date: 3/21/2007

	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	39	40			
VW-1 [b]	NM	NM					5.6	10.97	yes
VW-2 [b]	NM	NM					8.4	9.08	yes
VW-3 [b]	NM	NM					8.8	14.67	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? **1** 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? **yes-outlet feed pipe refastened**

Blower filter removed and brushed off? yes Blower filter replaced? **No-but needs to be www.ametekblowers.cor**

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

Date: **4/25/2007**

	Depth to Top of Screen (ft below TOC)	Water Level (ft below TOC)	Well Head in Good Condition?
VMP-1-Shallow	9.3	9.86	Yes
VMP-1-Deep	13.4	9.95	Yes
VMP-2-Shallow	9.5	10.57	Yes
VMP-2-Deep	13.9	10.58	Yes
VMP-3-Shallow	9.8	10.36	Yes
VMP-3-Deep	12.0	10.49	Yes
VMP-4-Shallow	15.1	15.63	Yes
VMP-4-Deep	20.8	17.64	Yes

TOC= Top of well Casing

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

Date: **4/25/2007**

	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	40	40			
VW-1 [b]	NM	NM					5.6	11.39	Needs new cap
VW-2 [b]	NM	NM					8.4	7.52	yes
VW-3 [b]	NM	NM					8.8	11.67	yes

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

Notes:

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

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? **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? **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? **No** Blower filter replaced? **Yes**

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

Date: **5/17/2007**

	Depth to Top of Screen (ft below TOC)	Water Level (ft below TOC)	Well Head in Good Condition?
VMP-1-Shallow	9.3	9.99	Yes
VMP-1-Deep	13.4	10.18	Yes
VMP-2-Shallow	9.5	10.90	Yes
VMP-2-Deep	13.9	11.28	Yes
VMP-3-Shallow	9.8	10.62	Yes
VMP-3-Deep	12.0	10.40	Yes
VMP-4-Shallow	15.1	15.80	Yes
VMP-4-Deep	20.8	17.86	Yes

TOC= Top of well Casing

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

Date: **5/17/2007**

	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	16.9	20	18	35	40			
VW-1 [b]	NM	16					5.6	11.13	yes
VW-2 [b]	NM	< 1					8.4	10.70	yes
VW-3 [b]	NM	< 1					8.8	14.58	yes

Wells on-line (valve open) at arrival **VW 1,2,3** Wells on-line at departure **VW 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: **6/20/2007**

	Depth to Top of Screen (ft below TOC)	Water Level (ft below TOC)	Well Head in Good Condition?
VMP-1-Shallow	9.3	10.27	yes
VMP-1-Deep	13.4	10.33	yes
VMP-2-Shallow	9.5	Dry	yes
VMP-2-Deep	13.9	12.31	yes
VMP-3-Shallow	9.8	10.56	yes
VMP-3-Deep	12.0	10.74	yes
VMP-4-Shallow	15.1	15.83	yes
VMP-4-Deep	20.8	18.36	yes

TOC= Top of well Casing

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

Date: **6/27/2007**

	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	24	22	2	40			
VW-1 [(b)]	NM	NM					5.6	11.74	yes
VW-2 [(b)]	NM	NM					8.4	10.69	yes
VW-3 [(b)]	NM	NM					8.8	12.63	yes

Wells on-line (valve open) at arrival **1,3** 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 - Note: caps replaced on VW 1 and 3.**
Power outage on 6/20/07. System was not back on until 6/27/07

Blower filter removed and brushed off? **yes** Blower filter replaced? **no**