COFFIN BUTTE LANDFILL

Annual Report

2010

COFFIN BUTTE LANDFILL

2010 Summary of Operations and Environmental Monitoring

This report provides a summary of the following aspects of Coffin Butte Landfill operational and environmental status for calendar year 2010:

LANDFILL CAPACITY

Coffin Butte Landfill has permitted airspace of 39,594,002 cubic yards (including consumed). During 2010 the landfill accepted 458,590 tons of solid waste. Based on historical aerial fly-over data, the average effective density of the in-place waste at the Coffin Butte Landfill is 0.892 tons/cy (1,784 lbs/cy – 2010 Operational Density).[1] Therefore, an estimated 514,111 cubic yards of airspace was used for the year. A total of 12,211,761 cubic yards has been consumed as of December 31, 2010.

The remaining capacity for the entire permitted landfill footprint as of the end of 2010 was approximately 27,382,241 cubic yards. This information is updated annually with aerial flyovers. Using 0.80 tons/cy, the remaining available landfill space expressed in tons is about 21,905,793 tons. Using the current disposal rate of approximately 600,000 tons per year, there are about 36.51 years of landfill space available. If we use our three year density average of 0.9245 tons/cy, the site life extends to 42.19 years. This illustrates the importance of density on landfill site life.

FUTURE INFRASTRUCTURE DEVELOPMENT

The following projects and estimated timing for construction are anticipated for the upcoming year:

- Cell 4 Construction – Approximately 14 acres with a limited life of 18 months. This is one of the largest construction projects in Coffin Butte History. Cell 4 serves as the buttress for Cell 2 and the tipping elevation for Cell 5 and the East Triangle.
- Storm water Enhancements – A portion of the current storm water silt pond will be consumed by Cell 4. The enhancement will increase the pond capacity from one to two ponds and the addition of a bioswale.
- Landfill Gas infrastructure – Additional horizontal wells and decommissioning of a number of collapsed wells.
- Groundwater Monitoring – Cell 4 requires four monitoring wells to be decommissioned and two new monitoring wells installed.
- Public Recycle Depot – Cell 4 construction will temporarily displace the recycle depot. A permanent location will be developed in the 2012 construction season.
- Leachate Management – Approximately 15 additional acres of exposed membrane will be deployed to better shed storm water.
- Cell 3 South Slope Closure – Project will be finalized in the summer.

[1] Effective density incorporates the effects of daily and intermediate soil cover usage. It is calculated by measuring the amount of airspace occupied between successive aerial flyovers using photogrammetric maps, and dividing that volume into the number of tons of waste received at the gate.

SUMMARY OF ANNUAL ENVIRONMENTAL MONITORING REPORT

This annual report provides a summary of the water quality monitoring activities at Coffin Butte Landfill during 2010. Coffin Butte Landfill, located in Benton County, Oregon, is a municipal solid waste landfill owned and operated by Valley Landfills, Inc. (VLI). Environmental monitoring and associated reporting is required by the landfill's solid waste disposal permit number 306, issued and administered by the Oregon Department of Environmental Quality (DEQ).

During 2010, no significant changes in water quality were measured. Volatile organic compound (VOC) concentrations in wells along the compliance boundary were below primary drinking water standards with the exception of MW-12S, where tetrachloroethene (PCE) was detected above the drinking water standard. Beginning in 2007, the trend in MW-12S declined and is currently fluctuating between 9 and 20 micrograms per liter (µg/L). Other than PCE, four VOCs were detected at low concentrations (below the method reporting limit [MRL] and 2 µg/L) and several inorganic parameters were present above background concentrations. Since the landfill cover was installed on Cells 1/1A in 1996 and landfill gas removal wells were installed in Cell 1 in 1994, the number and concentrations of VOCs have declined in compliance wells. Groundwater conditions at the detection wells (MW-17, MW-18, MW-19, and P-8), 300 to 400 feet downgradient of the compliance boundary, approximate background water quality.

At the compliance boundary for Cell 2, no primary drinking water standards were exceeded and concentrations of monitored parameters are below the permit-specific concentration limits.

Downgradient of the closed landfill, groundwater quality trends are stable as well. Based on the age of the landfill, it is expected that the existing low level impacts will diminish with time.

Leachate production for the water year 2009-2010 was estimated at 33.5 million gallons of leachate. This was generated by Cells 1, 2, and 3 during the water year ending September 30, 2010. VLI continues to monitor the secondary leachate collection system (SLCS) beneath Cells 2 and 3.

The text portion of the AEMR is presented in Appendix A. The Tables, Figures and Appendices stated in the text portion of the report are on file at the Benton County Health Department.

SUMMARY OF ANNUAL LEACHATE MANAGEMENT REPORT

Beginning this year, the Annual Environmental Monitoring Report (AEMR) includes information and data from the leachate management program. Leachate production and management for the water-year October 2009 to October 2010 is discussed in the report. The text portion of the leachate report can be found in section 3.4 of the AEMR.

SUMMARY OF ANNUAL TITLE V AIR MONITORING REPORT

Air emissions generated at the Coffin Butte Landfill in 2010 were summarized in a report on DEQ forms prepared by Valley Landfills. The air emissions generated in 2010 were less than the plant site emission limits (PSELs) allowed under the Title V Operating Permit. There were no deviations from the Title V Operating Permit conditions.

The landfill received, responded to, documented and reported 97 odor complaints to DEQ. During the first quarter of 2010 Coffin Butte Landfill experienced a Landfill Gas header partially collapsed. The header was replaced in April. On April 15th a meeting was held at the Adair Village Community Building to allow public feedback on odor issues. At the meeting Coffin Butte Landfill also discussed the current year plans for Landfill Gas construction.

Odor Notices

Month	2005	2006	2007	2008	2009	2010
Jan	2	2	33	5	2	19
Feb	0	20	23	15	3	25
Mar	2	7	35	10	7	12
Apr	4	21	16	4	5	6
May	5	22	8	1	7	3
Jun	11	10	1	1	2	6
Jul	2	0	0	1	1	2
Aug	16	1	0	0	6	0
Sep	13	3	1	1	2	9
Oct	5	0	1	0	0	6
Nov	5	2	1	0	0	0
Dec	0	9	1	0	2	9
Total	65	97	120	38	37	97

SUMMARY OF LANDFILL USERS BY COUNTY OF ORGIN

Tables showing the 2009 and 2010 landfill users by vehicle class, tonnage and county of origin are presented in Appendix B.

STATUS OF ENVIRONMENTAL TRUST FUND AND INSURANCE

The value of the Environmental Trust on 12/31/2010 was $6,409,374.

The value of the Environmental Trust on 12/31/2009 was $5,652,977.

The value of the Environmental Trust on 12/31/2008 was $4,496,176.

A copy of the Certificate of Liability Insurance, showing Benton County as an additional insured is presented in Appendix C.

SUMMARY OF ENVIRONMENTAL AND REGULATORY PERMITS

Permit Number	Permit Type	Permit Terms	Renewal Date	Enforcement Actions - 2010	Comments
SWDP # 306	Solid Waste	10 Year	July 31, 2020	None	Permit Renewed
# 1200Z	NPDES Stormwater	5 Year	June 30, 2012	None	Permit Renewed
#101545	NPDES Leachate Treatment	5 Year	September 30, 2008	None	Application Complete – Administratively Extended
#02-9502	Title V Air Quality	5 Year	October 1, 2014	None	Permit Renewed
#5	Industrial Wastewater Discharge	5 Year	May 31, 2013	None	City of Corvallis Leachate Disposal
N/A	Septage Waste Haulers Permit	5 Year	July 7, 2015	None	City of St. Helens Backup Leachate Disposal Facility

SUMMARY OF CUSTOMER COMPLAINTS

The table was compiled from the verbal complaints logged at the Coffin Butte and the Pacific Region Compost scale houses. The Public Tipping Area will be redesigned and constructed in 2012.

Price	Public Tipping Area	Pacific Region Compost
4	15	2

SUMMARY OF PACIFIC REGION COMPOST ACTIVITY 2010

Pacific Region Compost (PRC) operates under a Solid Waste Disposal Site Permit (Composting Facility No. 1418) issued by the Oregon Department of Environmental Quality (DEQ) on April 5, 2010. The permit allows PRC to be the first in the State of Oregon approved to compost Food Waste (Type III Feed Stocks). Below is a list of the Inbound and Outbound materials at PRC in 2009 and 2010.

Summary of Pacific Region Compost Activity 2010								
Recycling							Sales	
	Green Waste		Urban Wood Waste		Food Waste		Hog Fuel	Compost
	Cubic Yards	Tons	Cubic Yards	Tons	Residential (Tons)	Commercial (Tons)	Tons	Cubic Yards
Inbound	11,319.00	42,615.00	1,317.00	2,930.00	14,819.00	4,903.00		
Outbound							1,721.00	20,800.00
Totals	**11,319.00**	**42,615.00**	**1,317.00**	**2,930.00**	**14,819.00**	**4,903.00**	**1,721.00**	**20,800.00**

Summary of Pacific Region Compost Activity 2009								
Recycling							Sales	
	Green Waste		Urban Wood Waste		Food Waste		Hog Fuel	Compost
	Cubic Yards	Tons	Cubic Yards	Tons	Residential (Tons)	Commercial (Tons)	Tons	Cubic Yards
Inbound	5,488.50	39,652.57	3,286.50	3,533.57	0.00	16.58		
Outbound							6,574.29	14,432.00
Totals	**5,488.50**	**39,652.57**	**3,286.50**	**3,533.57**	**0.00**	**16.58**	**6,574.29**	**14,432.00**

Appendix A

Text Portion of Annual Environmental Monitoring Report

2010 ANNUAL ENVIRONMENTAL MONITORING REPORT

COFFIN BUTTE LANDFILL

BENTON COUNTY, OREGON

Prepared for

Valley Landfills, Inc.

March 28, 2011

Prepared by

TUPPAN CONSULTANTS LLC
460 SECOND STREET, SUITE 103
LAKE OSWEGO, OREGON 97034

Project VLI-001-002

2010 Annual Monitoring Report
Coffin Butte Landfill
Benton County, Oregon

The material and data in this report were prepared under the supervision and direction of the undersigned.

TUPPAN CONSULTANTS LLC

Eric J. Tuppan, R.G.

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EXECUTIVE SUMMARY

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Leachate production for the water year 2009-2010 was estimated at 33.5 million gallons of leachate. This was generated by Cells 1, 2, and 3 during the water year ending September 30, 2010. VLI continues to monitor the secondary leachate collection system (SLCS) beneath Cells 2 and 3.

1.0 INTRODUCTION

The Annual Environmental Monitoring Report (AEMR) presents results of water quality and landfill gas probe monitoring during the 2010 calendar year at the Coffin Butte Landfill in Benton County, Oregon (Figure 1-1), operated by Valley Landfills, Inc. (VLI). TUPPAN CONSULTANTS LLC oversaw sampling, managed the water quality data, and prepared this annual report. Annual reporting is required by Section 19.0 of the landfill's solid waste disposal permit number 306, issued by Oregon Department of Environmental Quality (DEQ) on November 24, 2010.

This annual report is the first subsequent to renewal of the solid waste permit and updating of the Environmental Monitoring Plan (EMP) (TC, 2011). As defined in the most recent version of the EMP, the annual report serves as the mechanism to (1) collate and report analytical data for the past year, (2) assess achievement of remedial goals for the west side, and (3) evaluate detection monitoring data for east-side cells which bears on the performance of the engineered liner systems for the active waste management units. The last two items will be discussed in Section 4 of the annual report.

For the west side, the purpose of the report is to assess (1) the effect of remedial actions on groundwater quality (i.e., assess progress of cleanup) and (2) protection of potential human health receptors. Consequently, the intent of the report focuses data evaluation on the following objectives:

- Assess aquifer restoration and contaminant removal rates based on concentration trends.
- Evaluate the effectiveness of source control.
- Evaluate stabilization of the plume based on the extent and concentration of volatile organic compounds (VOCs).
- Discuss results of protectiveness monitoring at domestic wells and at early warning detection wells.

For the east side, the report compares analytical results to permit specific concentration limits (PSCLs) and examines the data for indications of a significant change as described in Section 4.2.2. Results are also compared to relevant water quality standards.

Consistent with solid waste permit requirements, municipal solid waste guidance (DEQ, 1996), and the updated EMP, the annual report contains the following:

- A cover letter that:
  - Compares the analytical results with relevant monitoring standards.
  - States whether or not federal or state standards were exceeded for the relevant media.
  - States whether or not a significant change in water quality occurred or methane levels were exceeded.

- An executive summary.

- Assessment of the current status of the environmental monitoring network and recommendations for improvements.

- Data analysis and evaluation, based on the following:
  - Updated groundwater elevation information for each sampling event and monitored unit, depicting groundwater flow velocities and direction, and piezometric water contours.
  - Data evaluation tools (e.g., time-series plots) for selected constituents of concern to be used in assessing data.
  - Results of a major ion balance for each groundwater monitoring well that was sampled for major anions and cations (during split sampling events).
  - Summary of results of monitoring for the year, including a table that compares results with relevant water quality standards.

- Description of activities resulting from exceeding a relevant standard or significant change in water quality, such as resampling or additional investigation.

- Results of LFG probe monitoring (monitoring related to operations of the gas-to-electric plant are not reported as part of the environmental monitoring program).

- Findings from the leachate management program.

- Summary of sampling and analysis, field quality assurance and quality control (QA/QC), and laboratory QA/QC techniques implemented during the year.

- Copies of applicable information, including field data, laboratory analytical reports, and chain-of-custody reports; data are cross-referenced and labeled with the designated field sampling location.

New in this year's annual report will be conversion of more lengthy appendix material from paper to PDF in an effort to reduce paperwork, consistent with DEQ policy. This applies to trend plots and data summations in Appendices C and D, as well as field sampling sheets and laboratory reports.

2.0 WATER QUALITY MONITORING

2.1 Monitoring Network

The water quality monitoring network has five components: (1) groundwater monitoring wells, which include compliance and detection wells, (2) water level observation wells and piezometers, (3) the secondary leachate collection system (SLCS), (4) leachate sumps, and (5) surface water monitoring points. In addition to water quality, landfill gas is monitored at probes surrounding the landfill, and in buildings or structures near the landfill. The rationale for the network design and the media monitored was presented in the updated EMP (TC, 2011). The water quality monitoring locations are summarized on Table 2-1. A summary of the well construction, survey information, and lithologic completion intervals is provided in Table 2-2.

As mentioned in last year's report, new transducers and data loggers from Instrumentation Northwest, Inc. (INW) were installed in the primary and secondary leachate sumps for Cell 2B and Cell 3 on February 17, 2010. The probes are PT2X Submersible Pressure/Temperature Smart Sensors with the datalogger integrated into the unit. The system is cabled to the surface with the end of the cable terminating in the control panel located near the primary sumps. Data for each of the sumps/riser pipes are recorded in the sensor and subsequently downloaded through the cable with a laptop computer. VLI plans on recording pressure (in feet of water above the transducer), temperature and time (every 6 hours). Data will be downloaded monthly and converted to hydrographs to evaluate levels relative to design criteria for the primary and secondary sump liners. The placement of the transducers is as follows:

Primary Sumps (L-2B and L-3). Transducers were placed at the bottom of the primary concrete sumps by "tagging" the bottom with the transducer and then marking and securing the cable where it exits a hole on the side of the concrete structure at the surface (Figure 2-1). Data from this placement will reflect feet of water above the concrete bottom of the sump.

Secondary Sumps (LDS-2B and LDS-3). Transducers are placed 2.5 inches above the pumps and then along with the electronic cable, zip-tied to the pump hose. After securing the transducer and cable, each pump and transducer assembly was lowered down the LDS riser pipe (a 3:1 horizontal to vertical rise) to the bottom of the LDS sump. The distance from the bottom of the pump to the riser pipe well cap is 39 feet for LDS-2B and 47 feet for LDS-3. Once in position, the pump and transducer lie at the bottom of the riser pipe where it joins with the secondary piping below the primary sump. Because the transducer is at the bottom of the sump in a nearly horizontal position, water level data approximately represent the base of the LDS layer.

2.2 Sampling and Analysis Program

Water quality monitoring in 2010 was conducted consistent with the previous version of the EMP for Coffin Butte Landfill (TC, 2005b), which presented monitoring rationale, sampling and analysis parameters, locations, and a schedule. The frequency of monitoring, the sampling points, and the analytical parameters tested in 2010 are summarized in Table 2-3.

Water was sampled consistent with procedures described in the site sampling and analysis plan in Appendix C of the EMP. Samples were collected by staff from Delta Consultants, Inc., under contract to TUPPAN CONSULTANTS and submitted to TestAmerica Laboratories, Inc., in Denver, Colorado.

In 2010, samples could not be collected from several locations as follows:

- Second Quarter: S-U2 was not flowing and no sample was collected. S-U4 was submerged so no sample could be collected.
- Fourth Quarter: S-3 and S-U2 were not sampled because the sampling points were not flowing. The LDS-3 system was dry, no sample could be collected.

In addition, a new sampling point, S-U5, was established to test the water quality of the underdrain from LDS-WLP.

Memoranda that document field sampling procedures, copies of field sampling data sheets that record measurements for the sampling events, and laboratory reports are included in Portable Document Format (PDF) on a compact disc (CD) attached to the inside back of the report cover. Memoranda that review TestAmerica's laboratory quality assurance and quality control data and that provide qualifiers for the data can be found in Appendix A.

3.0 FINDINGS

The discussion of hydrogeology is summarized from sections on site characterization in past reports and the EMP (EMCON, 1994, 1996, 2000; TC, 2003a,b, 2011).

3.1 Hydrogeology

The landfill is situated along the south flank of Coffin Butte. In undeveloped areas, the upper third (approximately) of the butte consists of steep grass-covered slopes, the middle third of exposed bedrock with little vegetation, and the lower third of gentle, soil-covered slopes. Generally, the steeper slopes are underlain by basalt bedrock and the lower, flatter slopes on the flanks of Coffin Butte are underlain by alluvium that consists of silty clay to clayey silt with variable amounts of thin, interbedded sands and silty to sandy gravels (commonly referred to as Willamette Silt).

There are two principal water-bearing units: unconsolidated alluvium, and bedrock volcanics. Groundwater occurs in both units, although the alluvial deposits are absent or unsaturated over much of the site where landfill occurs. Where both units are present, they are hydraulically connected. The two units are monitored separately by groundwater monitoring wells.

3.1.1 Groundwater Occurrence and Flow

Depth to groundwater depends on season and topography. In site wells, the groundwater depths range from over 80 feet below the ground surface midway up the slopes of Coffin Butte (in bedrock) to less than 1 foot in the flat lowland area southeast of the butte (in alluvium). East of Cell 2, potentiometric elevations measured during the wet winter and spring months are near or higher than the ground surface elevation, indicating the potential for groundwater to discharge in this area.

Table 3-1 summarizes the groundwater elevations for 2010. Seasonal fluctuations vary with hydrogeologic position of the monitoring point. The seasonal changes in 2010 ranged from less than 2 feet in MW-22, MW-23, MW-25, and P-16 to almost 30 feet in well MW-13. Figures 3-1 to 3-4 illustrate the range of seasonal fluctuations for typical site wells in similar hydrogeologic positions. The average site-wide fluctuation in monitoring wells and piezometers was approximately 3.6 feet, with the lowest groundwater elevations in late summer to fall and the highest in winter and spring.

The direction of groundwater flow is controlled by the topographic setting of Coffin Butte and Poison Oak Hill and the intervening low areas. Groundwater in the bedrock generally flows downslope from the hills until it reaches a groundwater divide near the southeast corner of Cell 1. At the divide, groundwater flows toward the east and west, generally following the long axes of the valleys. Groundwater flow direction in the saturated portion of the alluvium mimics the underlying bedrock.

Groundwater contours for the site are illustrated on Figures 3-5 and 3-6. The groundwater elevations are from wells screened either in the alluvium or the bedrock. With the relatively large topographic relief between wells, any vertical gradients (generally small) between hydrogeologic units at monitoring locations are insignificant, and therefore do not substantially affect the site's groundwater flow pattern or horizontal gradients.

Factors affecting the groundwater gradients include the topographic slope, hydrogeologic material, and the season. The steepest horizontal gradients measured at the site are on the flanks of Coffin Butte. These range from approximately 0.045 to 0.078 foot per foot (ft/ft) downslope of well MW-13, to 0.14 ft/ft downslope of piezometer P-17. Smaller gradients are an order of magnitude lower, approximately 0.014 ft/ft, downgradient of Cell 2 (in alluvium between MW-23 and MW-9S), and average between 0.009 and 0.01 ft/ft downgradient of Cells 1 and 1A. Downgradient of the Closed Landfill, the gradient is relatively consistent between seasons at approximately 0.066 to 0.078 ft/ft.

3.1.2 Groundwater Velocity

Groundwater velocity depends on hydraulic conductivity,[1] horizontal hydraulic gradient, and effective porosity of the water-bearing medium. The horizontal velocity (V_h) of groundwater is calculated by the following equation:

$$V_h = \frac{Ki}{n_e}$$

where

V_h = horizontal groundwater velocity.
K = hydraulic conductivity.
i = horizontal hydraulic gradient.
n_e = effective porosity.

[1] For this report, the mean hydraulic conductivity for alluvium and bedrock were re-evaluated from pumping and slug test data collected from 1985 to 1993 as reported in the remedial investigation (EMCON, 1994). Geometric means were calculated for each unit after examining boring logs to verify hydrogeologic unit. Revisions to the values used in past annual reports are as follows: Alluvium: 0.22 ft/day (old value 0.062 ft/day); Bedrock: 2.7 ft/day (old value 4 ft/day).

Estimates of V_h were calculated at the Coffin Butte Landfill for three areas: on the east side, downgradient of Cell 2, and on the west side, downgradient of Cell 1 and the Closed Landfill. Near Cell 2, estimates of V_h are fairly consistent between seasons because the gradient does not change significantly (low slopes and an area of groundwater discharging to the marsh). V_h is calculated at approximately 4.1 feet per year (ft/yr), given a hydraulic conductivity of 0.22 feet per day (ft/day) for the alluvium, an estimated effective porosity of 25 percent (literature values in Morris and Johnson, 1967), and a hydraulic gradient of 0.014 ft/ft.

Downgradient of Cells 1/1A, estimates for V_h are 35 to 170 ft/yr in the spring and 40 to 190 ft/yr in the fall. Assumptions include an average hydraulic conductivity of 2.7 ft/day for the bedrock, an estimated effective porosity of between 5 and 25 percent (Morris and Johnson, 1967), and an average hydraulic gradient of 0.0085 ft/ft in the spring and 0.01 ft/ft in the fall.

Downgradient of the Closed Landfill, estimates for V_h are approximately 20 to 30 ft/yr for the alluvium, and 260 to 330 ft/yr in the bedrock. Assumptions include the hydraulic conductivities for alluvium and bedrock noted above, an estimated effective porosity of 25 percent both for alluvium and weathered bedrock (Morris and Johnson, 1967), and a hydraulic gradient of 0.084 ft/ft in the spring and 0.066 in the spring.

3.2 Water Quality

Water quality summary tables for 2010 can be found in Appendix B. The tables organize the monitoring points by wells, surface water stations, underdrains, leachate (Cell 1, Cell 2, or Cell 3), and the SLCS (LDS monitoring points).

3.2.1 Data Quality

Results of laboratory quality assurance and quality control data indicate acceptable results as qualified by data review memoranda (Appendix A). TestAmerica's standard laboratory reporting limits (RLs) for several of the trace metals are higher than reporting limit goals devised by the DEQ at 10 percent of the primary drinking water standard. The laboratory can report at lower values to meet these goals, although the laboratory must qualify the data as estimated ("J" qualified) since the resultant values are below the standard laboratory RL, but above the instrument method detection limit. Qualified data are discussed in the memoranda in Appendix A (along with a table comparing the various reporting limits) and listed in the summary tables in Appendix B.

3.2.2 Groundwater

This section evaluates groundwater quality at Coffin Butte Landfill, by geographic area, by examining trends that can be used to predict or assess subtle changes in water quality or which track parameter concentrations used to assess areas with existing impacts. This qualitative examination is complemented by quantitative comparisons in Section 4 that assess remedy performance for the west side and whether water quality meets concentration limits for the east side.

Parameters evaluated for Cell 2 include site-specific indicator parameters that are tested semiannually and a group of site-specific trace metals that are tested annually. For Cells 1 and 1A, parameter evaluation focuses on the suite of indicators and selected VOCs that have been consistently detected over the years. Water quality evaluation downgradient of the Closed Landfill focuses on site indicator compounds and three historically detected VOCs. Time-series concentration plots by parameter can be found in Appendix C in PDF format on the attached CD.

Time-series concentration plots for groundwater wells that monitor the former leachate irrigation Fields B (east side) and C (west side, south of Coffin Butte Road) document recovery of groundwater quality since leachate irrigation was discontinued in 1998. Plots for these wells can also be found in Appendix C.

TUPPAN CONSULTANTS visually examined groundwater quality trends and summarized those findings in Tables 3-2, 3-4, 3-5, and 3-6. These tables show the most recent trend (approximately the last five years) and indicate the general range of parameter concentrations for that period. Trend information from decommissioned wells (e.g., MW-6, MW-7S/7D, and MW-16) can be found in annual reports from 2004 and earlier (e.g., TC, 2005a). Descriptive evaluation terms include:

- Upward: generally upward trend during the last five years; this is indicated by shading in the tables.
- Downward: generally downward trend during the last five years; there may have been earlier periods of water quality variability.
- Stable: indicates that the water quality varies within a range (degree of variability depends on well or parameter) and that no long-term consistently upward or downward trend is apparent.
- Peaked: concentrations have peaked and are now either declining or appear to have stabilized, suggesting that water quality is beginning to improve.

3.2.2.1 West Side

Cells 1 and 1A. Groundwater in this area is characterized by elevated, but declining, concentrations of inorganic compounds downgradient of Cell 1A and low concentrations of inorganic compounds downgradient of Cell 1. Except for MW-12S at Cell 1, VOC concentrations in this area have declined to below 2 micrograms per liter (μg/L) (Table 3-3) and continue to trend downward. Trace metals concentrations are low to nondetect and generally follow stable trends.

Downgradient of Cells 1/1A, inorganic trends are mixed (Table 3-2) but overall, have improved in the past 15 years. This is most apparent for well MW-12S, in which bicarbonate, calcium, magnesium and sodium all appear to have peaked and stabilized since 2005. Overall, the inorganic concentrations downgradient of Cell 1 are considerably lower than in well pairs MW-10 or MW-11 (downgradient of Cell 1A) and the magnitude of any increases is slight. For wells downgradient of Cell 1, chloride concentrations are more than an order of magnitude below the secondary drinking water standard of 250 milligrams per liter (mg/L).

Of the four VOCs historically detected in well pair MW-10S/10D downgradient of Cell 1A (see Tables 3-3 and 3-4), concentrations of 1,1-dichloroethane (1,1-DCA) continue to decline in both wells.[2] Vinyl chloride was not detected in either well in 2010. Only traces of two VOCs below the MRL were detected in MW-11S and MW-11D in 2010. Downgradient of Cell 1, PCE had been routinely detected in well MW-12S, and since 1994 had shown an upward trend. In October 2000, the concentration peaked at 25 µg/L. Beginning in 2008, the concentrations began to decline and currently fluctuate between approximately 9 and 20 µg/L. Trichloroethene (TCE), while still being detected in MW-12S, also fluctuates in concentration below 3 µg/L. In deep well MW-12D, PCE was detected both sampling events from 0.7 µg/L in April to 1.6 µg/L in October.

Closed Landfill. The closed landfill is monitored by two monitoring wells designated as compliance wells in the solid waste permit: one completed in the alluvium (MW-20) and one completed in bedrock (MW-21). The alluvial well has shown stable to downward trends for the site indicator parameters. Trends are summarized in Table 3-5.

In the bedrock well, bicarbonate alkalinity, which had increased in concentration before 2001, appears to have mostly stabilized with some upward variability; the other indicator compounds appear stable the past 5 years. Of the three historically detected VOCs in MW-21, cis-1,2-DCE has not been detected since May 1995, 1,2 dichlorobenzene has been nondetect since 1999, and chlorobenzene was last detected above the MRL at 0.62 µg/L in 2006; in October, a trace was detected at 0.2 µg/L, below the MRL. No other VOCs were detected in these wells in 2010.

3.2.2.2 East Side

Cell 2 - Compliance Well MW-22 and Detection Wells MW-24, MW-25. Wells near Cell 2 include compliance well MW-22 downgradient of Cell 2, detection well MW-24 at the upgradient edge of Cell 2A, and MW-25 which is downgradient of the southeast corner of Cell 2B, but upgradient of MW-22. Both MW-22 and MW-25 are completed in shallow alluvium and MW-24 is completed in shallow weathered bedrock (the alluvium is not saturated in this area). Piezometer P-16, which is sampled once a year, was added to the trend plots to supplement information on natural water quality

[2] Several VOCs were detected below the standard reporting limit of 0.5 µg/L and qualified by the laboratory with a "J."

variability in the alluvium at the downgradient edge of Cell 2, within the footprint of future Cell 4.

Trends for indicator parameters (Table 3-6) at the compliance well MW-22 were stable through 2010, although since approximately 2005, concentrations for sodium and chloride appeared to be marginally higher. This relationship is explored more fully in Section 4.2. Parameters tested in MW-24 and MW-25 are stable, and reflect natural water quality in the area. Of those two wells, MW-25 (completed in alluvium) is more similar in water quality to MW-22. Subtle differences, though, are present, for instance lower concentrations for bicarbonate, calcium, and sodium, and higher natural chloride and arsenic in MW-25 than in MW-22.

Cell 2 – Detection Well MW-23. Early in its history, detection well MW-23 had shown increases for bicarbonate alkalinity, chloride, hardness, total dissolved solids (TDS), for five of the major dissolved metals, and for arsenic. This had been attributed to localized seepage of leachate from the south side of the landfill. Since 2000 to 2001, the upward trends for bicarbonate, chloride, TDS, calcium, iron, magnesium, manganese, sodium, and arsenic peaked, and in 2008 and April 2009, most of these constituents declined to the range of background concentrations. Of those, the cations, bicarbonate, and chloride continue to demonstrate seasonality with higher concentrations in the fall and lower concentrations in the spring.

3.2.2.3 Former Leachate Irrigation Fields

Field B (East Side). In Field B wells MW-8S and MW-15, concentrations of inorganic indicators continue longer-term trends of past years (see time-series concentration plots in Appendix C). At MW-8S, an earlier increasing trend for chloride peaked in 2001 and is declining gradually, while Na has remained relatively consistent in concentration.

In well MW-15, chloride shows an upward trend and crossed over the concentration in MW-8S in 2009. Other indicators, namely bicarbonate, calcium, magnesium, and sodium, were up in 2008-09 after generally trending downward since 2000. These increases have since arrested with comparable or slightly lower concentrations in 2010. In last year's report, it was thought that the cause of these increased concentrations, for chloride from approximately 10 mg/L in the 1990s to 44 mg/L in 2009, was associated with a release from a condensate sump at the PNGC Power facility located near that well. It appears that PNGC has corrected this problem. Inorganic concentrations in wells MW-8S and MW-15 contrast with those at MW-16, which was screened in fresh bedrock, and had naturally lower concentrations for indicators than the alluvium.

Trace metals in Field B wells were detected at low to trace concentrations, or were not detected in 2010. Neither of the wells shows a trend indicating effects of past leachate irrigation. No VOCs were detected.

Field C (West Side). Past leachate irrigation in Field C appears to have mildly affected the concentrations of some inorganic parameters over the last few years. Since irrigation stopped in 1998, levels appear to be recovering to pre-irrigation conditions, although some variability persists (see time-series concentration plots in Appendix C). It is thought that this minor variability is related to amending the field with fertilizer or lime to improve agricultural production or to disruption of the surface soils in 2008 to create wetlands in the area. This construction occurred near well MW-19, which has seen increased concentrations for chloride, calcium, magnesium, and to a lesser degree, sodium. The increased concentrations for these compounds appear to have leveled off the past year.

As with Field B, trace metals were either not detected in Field C wells, or were detected at low to trace concentrations. Where detected, none of the wells showed a trend indicative of past leachate irrigation. No VOCs were detected in former irrigation field wells this year. We have been monitoring the concentration of dichlorodifluoromethane[3] (Freon 12) in MW-19, which had been detected at 1.5 µg/L in 2008, but has since been nondetect.

3.2.3 Surface Water

Surface water is monitored upstream (S-1) and downstream (S-2 and S-4) in Soap Creek to test for potential impacts from the west side of the facility, and for residual impacts from spray irrigation on Field C. Surface water is also monitored on the east side, where an intermittent creek crosses the landfill access road (S-3). In 2010, water flowed at this point during the April sampling event, but no sample could be collected in October because it was dry.

At the Soap Creek monitoring points, year 2010 results for biological oxygen demand (BOD), total Kjeldahl nitrogen, total phosphorus, and orthophosphate were either nondetect or were virtually identical in concentration between the upstream (S-1) and downstream (S-2) monitoring points. This is similar to past years.

The other inorganic parameters (chloride, calcium, iron, magnesium, manganese, and sodium) showed seasonal changes in concentration, with low concentrations in April (high stream flow) and higher concentrations in October (low stream flow). There were either no significant differences between upstream and downstream points for those parameters, or marginal differences with most concentrations varying by approximately 1 mg/L. Differences in concentration between seasons are typically greater, from 8 to 11 mg/L (e.g., for chloride).

[3] Freon 12 was not identified as a chemical of concern in the remedial investigation and has a preliminary remediation goal (PRG) of 390 µg/L.

3.2.4 Underdrains

Trend plots showing historical results of sampling the underdrains for Cell 3 (S-U3) and from below the East Leachate Pond (S-U4) can be found in Appendix C. The Cell 2C/D subdrain was not sampled because no water flowed at the sampling point. Elevated concentrations for some of the inorganic parameters for Cell 3 in the October 2003 and subsequent sampling events are likely related to construction activities in the area during the summers of 2003 to 2005. Current water quality from this underdrain is comparable to or lower in concentration than samples collected in 1999 and 2000 from upgradient bedrock well MW-13. This suggests that water from the underdrain represents background concentrations unaffected by landfill operations.

Water quality from the East Leachate Pond underdrain (S-U4) represents baseline concentrations. Concentrations for inorganic compounds and dissolved metals from the underdrain are comparable to or lower than concentrations at MW-16, which was a background well that monitored bedrock in the pond location before it was decommissioned in 2004.

The newest underdrain to be sampled, beginning in October 2010, is S-U5 which drains from below the West Leachate Pond. The drain pipe connects with another pipe that drains from below the concrete pad of the non-operational Leachate Treatment Plant. Data from this underdrain will checked in the future for indications of leakage from below the West Leachate Pond.

3.3 Secondary Leachate Collection System (SLCS)

The SLCS was monitored by riser pipes at four locations: beneath the Cell 2 sump in the southeast corner of that cell (LDS-2B), beneath the Cell 3 sump (LDS-3), and beneath the west and east leachate ponds (LDS-WLP and LDS-ELP, respectively). Results for liquid quantity for LDS-2B and LDS-3 are shown graphically in Appendix D. Liquid level data collected for the period after new transducers and dataloggers were installed in February 2010 are also included in Appendix D to illustrate levels for the primary and secondary sumps in Cells 2 and 3.

3.3.1 Cell 2

Historical variations in the concentrations of indicator parameters measured for LDS-2B reflect changes to the volume and liquid chemistry from different sources. These had varied (1) seasonally as the amount of leachate generated changed, surface water runoff changed, and groundwater levels fluctuated, and (2) from year to year as sources had been eliminated through reconstruction. Increased concentrations were generally attributed to a greater volume of leachate-dominated sources, while decreases reflected a greater ratio of surface water or groundwater to leachate. Trend plots of indicator parameters for both the SLCS and Cell 2 leachate can be found in Appendix D.

The volume of liquid that infiltrated into the SLCS for the water years since 1995 is shown in Table 3-7. Cumulative water purged from the system is illustrated in Figure D-1. For the 2009-2010 water year, an infiltration performance value of 34.6 gallons per acre per day (gpad) was calculated. This is above the 20 gpad action level generally suggested in the literature, and used by the USEPA and several states (Thiel, 2001). This amount correlates to over 7,000 gallons per inch of rainfall, the highest recorded at the site, and suggests that water is likely infiltrating via a stormwater pathway. In past years, VLI has found that stormwater had breached perimeter liner completions. VLI will evaluate this possibility along the east side of Cell 2 this coming summer construction season.

Liquid levels in the primary and secondary leachate collections systems are illustrated beginning in mid-February 2010 through January 2011. Periods in late 2010, where the Cell 2B SLCS level is above the 4.5-foot design criterion, are indicated and were caused by a pump that was not performing adequately because of clogging and problems with impellers. In the primary sump, the float controls were adjusted in early April to lower the average liquid level to approximately 4-foot above the bottom of the sump.

3.3.2 Cell 3

Liquid quality in Cell 3 LDS initially indicated impacts, likely from leachate that drained into the system during cell expansion in 2005, but these have dissipated. Before that time (2004 and earlier), visual inspection of the LDS-3 riser pipe showed the system to be dry. Water quality plots for the system show that indicator parameter concentrations declined significantly in 2006, and for some parameters approach the water quality of the underdrain, S-U3, which represents natural conditions of the underlying bedrock (see plots in Appendix D). Subsequently, the water quality appears to indicate a mixture of some leachate (leakage from the primary system) and clean water, likely stormwater as discussed below.

More recently, the system was pumped out (121,111 gallons on March 1, 2010) and the liquid level returned to near zero, however the hydrograph indicates some leakage into the system. Since March 2010, these increases appear to correlate closely with rainfall as shown on the hydrographs in Appendix D. Total volume infiltrating to the Cell 3 LDS for the 2009-2010 water year was 142,670 (the system was outfitted with a controller that automatically purges the system in February 2010). On a daily basis, from June 1 to December 27, 2010, which is a period where weekly pumping volumes were recorded, the infiltration rate was 7.5 gpad (calculated over the Cell 3 area of 33.8 acres). This infiltration rate is significantly below the criteria noted above, which is applicable to leakage through a primary liner. Moreover, it appears that the main water source is stormwater runoff rather than leakage through the primary liner or infiltration from groundwater (the entire system is built above the groundwater table and groundwater intrusion to the SLCS is unlikely). In the past year to address leakage to the secondary system, VLI has focused on repairing perimeter berms and drainages to shed stormwater and installed interim cover over 10 acres of Cell 3.

3.3.3 Leachate Ponds

Both leachate ponds were used to store leachate this past year. For most of the year, liquid was not pumped from the secondary system. In January and February 2011, pumps were automated in the SLCS sumps below the ponds, to keep the head off of the secondary liner system. Records of volume pumped will be reported in next year's report.

Liquid was purged from the secondary systems before pond maintenance. For the east leachate pond, approximately 9,200 gallons were purged in August before repairing the pond cover. For the west pond, approximately 340 gallons were removed in September before pond maintenance. At that time, VLI washed and removed all leachate and sludge from the pond using Vac trucks. Subsequently, the primary liner of the pond was examined for holes and several were repaired. A floating cover was then installed to prevent rainwater from mixing with the leachate.

Sample quality results are listed on the water quality summaries in Appendix B. For the leachate pond SLCSs, the liquid is generally high in inorganic indicators such as chloride, bicarbonate, dissolved calcium, magnesium, and sodium with detections of several VOCs, such as benzene, toluene, ethylbenzene, xylenes, and acetone. This indicates leakage from through the primary liner. Monitoring of the underdrain (S-U4) for the East Leachate Pond indicates no difference between underdrain water and background groundwater quality previously tested at MW-16. VLI instituted monitoring for the West Leachate Pond, and will report on trends in next year's annual report.

3.4 Leachate Production

Beginning this year, the AEMR includes information and data from the leachate management program as required by Sections 19.4 and 19.5 of the Solid Waste Permit. That information was formerly reported separately to the DEQ. The data is from the previous water year (October 2009 to September 2010) and presented in a format consistent with elements described in Section 4.7 of the updated EMP. Information contained in this report is a summary of data provided by VLI to TUPPAN CONSULTANTS. Tabular and graphical weekly leachate production data from totalizing flowmeters are used to illustrate overall seasonal trends in the data (Appendix D).

3.4.1 Overview of Leachate Management for the 2009-10 Water Year

During the 2009-10 water year, leachate was generated from Cells 1, 2, and 3 and pumped into one of two leachate surge ponds south of Coffin Butte Road. Leachate was treated by the following methods:

- Most of the leachate was trucked to the waste-water treatment plant in the City of Corvallis, with lesser quantities trucked to other facilities, including: St. Helens, WC-FB, Vigor, and PPV. Details of volumes trucked to other facilities can be found in Appendix D.

- A small fraction (approximately 0.5%) of the leachate volume was irrigated back onto the waste fill.

3.4.2 Primary Leachate Management

Leachate management reporting has developed over several years and includes the following six elements:

3.4.2.1 Yearly Totals by Month

Monthly totals are reported for (a) leachate volume generated from the landfill sumps and (b) leachate volume treated. These two values would be expected to be similar taking into account the difference in pond volume at the beginning and end of the water year, and any rain that falls into an active leachate pond. Currently, no rain is included in the calculation because both ponds are covered.

There are two ways to estimate the volume of leachate generated. One is to use flow meters on the discharge lines from the leachate sumps. The other is use the volume treated (volumetrics). Both methods were used and are presented in the data provided by the Coffin Butte landfill in Table 3-8. Raw data on volumes of leachate treated, flow-meter data, and rainfall records are provided in Appendix D.

The flow meters resulted in a total of 33.8 million gallons (MG) and the volumetrics approximately 33.5 MG, a difference of approximately 1 percent. This compares with 23.5 MG last year.

The volume of leachate from the SLCSs in Cells 2 and 3 is not itemized separately on Table 3-8 because this liquid was pumped directly into the primary sumps. From the point of view of leachate management, the total volume of leachate managed from the primary Cells 2 and 3 sumps are inclusive of the SLCS volume. The volume that was extracted from the SLCS was discussed in Section 3.3 of the AEMR.

3.4.2.2 Review of Significant Leachate Management Events That Occurred During the Last Water Year

Significant events for the 2009-10 water year are noted below.

- Rainfall of 48.4 inches was recorded, which is significantly above normal average precipitation (normal at Hyslop in Corvallis is approximately 41 inches).

- Leachate volumes generated were more than the previous five years (36.7 MG was produced for 2003-04 water year).

- No new cell construction was performed in 2010, however over 10 acres of 40 mil HDPE exposed geomembrane cap (EGC) was installed on Cell 3 in November 2010. VLI also completed an approximately 6-acre-closure on the south slope of Cell 3, with the soil drainage and vegetative cover to be completed in summer 2011.

- A new floating pond cover was installed in the West Leachate Pond along with repairs made to the primary liner. At the East Leachate Pond, the existing floating pond cover was repaired.

- Minimal leachate irrigation was performed on the landfill in the last water year.

3.4.2.3 Review of Leachate Monitoring Procedures

Leachate monitoring includes the following elements:

- Volume is estimated for each of the treatment methods using a range of techniques such as flow meters or truck counts.

- Monitoring effluent quality of the on-site treatment plant is performed in accordance with the site's NPDES permit; none was performed in 2010 since the plan it currently not operating.

- Leachate quality is monitored for the waste water treatment plants; it is also tested as part of environmental monitoring and reported in Appendix B.

- Head liquid levels are monitored in the landfill primary and secondary sumps (for Cells 2 and 3) using transducers and dataloggers as described in Section 2.1. This was done beginning in February 2010 and plots of the data are included in Appendix D. The head levels in the sumps generally met permit requirements as shown in the graphs with some short term increased levels due to problems with pumps.

- Pond levels (volumes) are recorded regularly using manual dip-sticks in the West Pond, while the East pond volume is estimated from the flow meters. The inventory of both ponds combined is included in Table 3-8.

- Maintenance of the leachate sumps (pumping sediment well, pump, check valves, and flowmeters) was performed quarterly.

3.4.2.4 Summary of Site Conditions and Compilation of Monitoring and Analysis Data

The following matrix summarizes the monitoring and analysis data references. Site conditions relative to leachate management in the 2009-10 water year were efficient and well-managed.

Monitoring and Analysis Summary Data References

Monitoring or Analysis Item	Reference
Flow meters from landfill sumps	Significant amounts of useful data over the reporting period, raw data sheets in Appendix D
Volumes handled by various methods	Table 3-8
Gas production changes, waste saturation, and side- slope seeps in waste irrigation areas	Minimal leachate irrigation was performed and no effects were noted.
Effluent quality from treatment plant	Monthly monitoring reports sent to DEQ (Water Quality Dept) for NPDES compliance (reported "No Discharge" each month this year)
Leachate quality	Provided in Appendix B of AEMR
Head levels in Cell 2 and Cell 3 primary and secondary leachate sumps	New equipment was installed February 2010.
Rainfall	Recorded automatically by site weather station
Pond levels (volumes)	Table 3-8 for beginning and ending volumes. monitored weekly

3.4.2.5 Summary of Reports for Monitoring Irrigation on Waste

Only a minor amount of leachate irrigation was performed in the past water year: in October 2009 (133,060 gallons) and in September 2010 (65,000 gallons). For October, the method of leachate irrigation was via a remote-controlled spray bar attached to the tipper. The leachate was applied evenly to incoming fresh waste at a rate of 5 to 10 gallons per ton during this first part of that month. In September 2010, leachate was vacuumed out of the west pond while it was being cleaned in preparation for installation of the new floating cover. The leachate was then applied by a Vac truck (3,000-gallon capacity) to a pit that the operations staff dug near the active area. The leachate slowly infiltrated down into the waste mass. This occurred over approximately two days, 8 hours per day, with the leachate fully infiltrated after approximately 3 days.

3.4.2.6 Proposed Plans/Changes for Upcoming Leachate Management

The strategy for future leachate management is as follows:

- Continue with landfill operations and cover procedures to reduce leachate generation from precipitation to the extent possible.

- Continue with installation of EGC membrane on the top of Cells 2 and 3.
- Perform pilot testing at the Corvallis WWTP for leachate pre-treatment.
- Develop a long term disposal agreement with the City of Corvallis for leachate disposal.
- Conduct a feasibility study to examine alternate transportation mechanisms for delivery to the Corvallis WWTP.
- Continue to maintain all management options for treating leachate.

3.5 Landfill Gas Monitoring

VLI routinely monitors a total of six landfill gas monitoring probes around the perimeter of the landfill (GP-2 through GP-6), in addition to the interior of twelve site structures. Monitored parameters include lower explosive limit (LEL), methane, and oxygen. Levels of percent LEL were zero for all monitoring events. For several months, trace levels of methane (0.1 to 0.4 percent methane) were recorded in most of the gas probes. This systematic measurement suggests calibration issues rather than actual detection of methane. Results of 2010 gas monitoring are shown in Table 3-9.