ENVIRONMENTAL MONITORING PLAN

COFFIN BUTTE LANDFILL

BENTON COUNTY, OREGON

Prepared for

Valley Landfills, Inc.

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Environmental Monitoring Plan
Coffin Butte Landfill
Benton County, Oregon

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1.0 INTRODUCTION

Coffin Butte Landfill is located in Benton County, Oregon (Figure 1-1), and is owned and operated by Valley Landfills, Inc. (VLI). VLI's parent company is Republic Services, Inc. Water quality monitoring is required at the Coffin Butte Landfill by solid waste permit 306, issued by the Oregon Department of Environmental Quality (DEQ). The permit was renewed November 24, 2010. A copy can be found in Appendix A.

An earlier version of this environmental monitoring plan (EMP) was originally submitted to the DEQ in December 2005 and followed completion of the Record of Decision (ROD) in October 2005 (DEQ, 2005) and issuance of a Solid Waste Permit Addendum in 2004 (DEQ, 2004). The ROD concluded a focused risk assessment and feasibility study for the west-side cells (Cells 1/1A and Closed Landfill) that included developing remedial action concentration limits (RACLs). That version of the EMP not only consolidated the monitoring and evaluation elements of the ROD and permit addendum, but explained the rationale for establishing concentration limits at the compliance boundary along the east side of the landfill, which at the time had been along the eastern edge of Cell 2B.

Since then, the landfill has continued operations in several phases of Cell 3 with slight adjustments to the monitoring program. More recently, VLI expanded to the east into Cells 4 and 5A, constructed in the summers 2011 and 2013, respectively. The expansion into Cells 4 and 5A required modification to the monitoring network because the primary east-side compliance well MW-22, as well as other detection and observation wells, were within the footprint of the Cells 4 and 5A (TC, 2011b and 2012a). This realignment of the monitoring network also required collecting baseline water quality data at new compliance wells to develop concentration limits for the east-side compliance boundary.

The current plan (Revision 3) updates and supersedes the previous EMPs for this site prepared by EMCON (1997) and TUPPAN CONSULTANTS LLC (2005, 2011a, and 2012b). This EMP serves multiple purposes. First, it captures requirements that are part of the solid waste permit (Appendix A) and embeds them in the monitoring program. Next, it organizes the elements of site monitoring into one document by connecting the objectives of monitoring for the west side and for the east side with the practical steps needed to implement the program. Finally, it explains the conceptual approach to collecting baseline groundwater quality data for the eastside compliance wells and statistically evaluates that data. To accomplish this, different parts of the EMP will:

- Summarize the hydrogeology at the site.

- Describe the different landfill areas and the monitoring network, and discuss the rationale and monitoring objectives for each area.
- Discuss how monitoring results will be evaluated for each area and propose types of actions to be taken for any exceedances.
- Describe sampling and analysis methods.
- Provide quality assurance and quality control goals and requirements for field sampling and for the analytical laboratory.

In addition to water quality monitoring related to the solid waste permit, the last chapter of the EMP provides an overview of other environmental monitoring activities conducted at the facility to satisfy other programs.

2.0 BACKGROUND

This section provides the backdrop for developing the rationale for the water quality monitoring program. It describes areas of existing impacts on the west side where performance monitoring occurs, and discusses baseline water quality conditions for the east side where detection monitoring will be implemented.

2.1 Site Location and History

Coffin Butte Landfill is in the west-central Willamette Valley, 11 miles north of Corvallis, Oregon (see Figure 1-1). Topographic elevations in the area range from 220 to over 740 feet above mean sea level (msl) at the summit of Coffin Butte. The landfill is in a predominantly agricultural area. The land adjacent to the site is zoned exclusive farm use, forest conservation, and rural residential with either a 5- or 10-acre lot minimum.

Landfilling began in 1945 on the southwest flank of Coffin Butte and has continued to the east along the southern flank (Figure 2-1). The first area of landfilling (referred to as the Closed Landfill) was initially quarried for crushed rock; it then received waste from 1945 to 1977. In 1977, the Closed Landfill was capped with soil and closed. Subsequent landfill development progressed eastward across the site. Since 1975, VLI has filled in Cells 1 and 1A, with most waste being placed in Cell 1 beginning in 1977. Cell 1A (approximately 4 acres) primarily handled waste from Teledyne Wah Chang and was not used for disposal after 1988. Cell 1 (approximately 30 acres) has a clay bottom liner and leachate collection system that conveyed the leachate to an adjacent holding pond. Placement of waste in Cell 1 stopped in early 1993, when cell 2B was constructed. Cell 1A has gone through final closure, and Cell 1 has been closed along the southern, central, and western parts. A “piggyback” liner system was constructed over the east side of Cell 1 as part of the development of Cell 3D. The lower half was constructed in 2006, and the upper half constructed in 2008. Final stages of filling Cell 2 ended in 2004 with final cover constructed along its southern flank in summer 2003. Cell 3 has also been filled, and final closure construction has occurred over a portion of the south face of Cell 3. Cell 4 was constructed in summer 2011 with operations moving into the northern half of that cell in fall 2011. In summer 2012, the remaining features of Cell 4 were completed, including moving the primary and secondary leachate sumps to their locations on the southern perimeter of the cell. Cell 5A was excavated north of Cell 4 in summer 2012 with construction completed in 2013; filling is occurring in Cell 5A as of the writing of this plan.

Coffin Butte serves Benton, Linn, Polk, Lincoln, and Tillamook counties. The facility is permitted as a municipal solid waste disposal site and is authorized under Section 5 of its solid waste permit to accept domestic, commercial, industrial, construction, demolition, and agricultural waste, sewage sludge and grit, petroleum contaminated soil, and asbestos.

2.2 Site Hydrogeology

The geology and hydrogeology of the site have been described in a number of documents. One of the most comprehensive was the site characterization report for Cell 3 (EMCON, 1999), which synthesized the regional and site geology and hydrogeology from a number of earlier reports and the scientific literature. Discussions of water quality conditions at the site are summarized in annual reports (since 1992), the remedial investigation and its addendum (EMCON, 1994, 1996b), the preliminary assessment for the area downgradient of the 1977-closed landfill (EMCON, 1996a), previous versions of the EMP (EMCON, 1997; TC, 2005, 2011a, 2012b) and the focused risk assessment and feasibility study (TC, 2003a).

2.2.1 Hydrogeologic Units

The landfill is situated along the south flank of Coffin Butte (Figure 2-1). 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 generally consist of silty clay to clayey silt with variable amounts of thin, interbedded sands and silty to sandy gravels (commonly referred to as Willamette Silt). The lower slopes transition to relatively flat valleys where alluvium is transected by small drainages or creeks. Solid waste in Cells 1/1A and the Closed Landfill is generally inferred to rest on bedrock, which in places was lined with clay (e.g., in Cell 1). Cells 2 through 5 are constructed with composite liners and leak detection systems, with Cells 3 through 5 also designed with underdrains. The vertical relationship of alluvium, bedrock, and waste units in the Cell 2 area (and Cell 4 to the east of Cell 2) is illustrated in Figure 2-2.

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 not separated by a confining layer but are hydraulically interconnected. The two units are monitored separately by groundwater monitoring wells.

2.2.2 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). Seasonal fluctuations vary, depending on the hydrogeologic position of the monitoring point. The average site fluctuation measured in monitoring wells and piezometers is approximately 5.5 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 and southwest part of Cell 3 (Figure 2-3). 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 (Figure 2-4). In areas dissected by surface drainages, groundwater in the upper part of the alluvial aquifer discharges to surface creeks (such as Soap Creek) and during the summer months provides base flow. Near upland areas, groundwater in bedrock also can provide base flow to surface creeks, for instance, in Soap Creek, weathered basalt bedrock is exposed in the stream bed between surface water locations S-2 and S-4. Groundwater contours for the most recent sampling event in April 2014 is shown in Figure 2-5 for the entire site with the most current monitoring network.

Estimates of horizontal groundwater velocity (V_h) are calculated at the Coffin Butte Landfill for two areas: on the east side, beneath Cell 4, and on the west side, downgradient of Cell 1. Beneath Cell 4, V_h is calculated at approximately 6.4 ft/yr, given a hydraulic conductivity of 0.22 ft/day for the alluvium, an estimated effective porosity of 25 percent (literature values in Morris and Johnson, 1967), and a hydraulic gradient of 0.02 ft/ft.

Downgradient of Cell 1, estimates for V_h are 25 to 120 ft/yr in the spring and 30 to 160 ft/yr in the fall. Assumptions include an average hydraulic conductivity of 2.7 ft/day for the bedrock (EMCON, 1994), an estimated effective porosity of between 5 and 25 percent (Morris and Johnson, 1967), and an average hydraulic gradient of 0.006 ft/ft in the spring and 0.008 ft/ft in the fall.

2.3 Water Quality

The discussion of water quality is organized into west and east sides since the objective of monitoring and hence the manner of data evaluation is different for each. For the west side, the primary goal of monitoring is to track performance of the landfill closure (i.e., the presumptive remedies described in the focused feasibility study [TC, 2003a]) in improving groundwater quality. The water quality discussion therefore focuses on characterizing current impacts and contaminant trends. For the east side, monitoring is in the detection mode, therefore, the discussion focuses more on characteristics of natural or baseline water quality and how to recognize impacts from the landfill.

2.3.1 West Side

The presence and trends of landfill-related contaminants in groundwater has been dynamic over the past 20 or so years of monitoring, with more recent trends (i.e., within the last 5 years or so) being more representative of current conditions. For man-made organic chemicals, these trends have mostly been downward, although some excursions have occurred in isolated areas. The following discussion is based on the 2013 annual report (TC, 2014a) and focused risk assessment and feasibility study (TC, 2003a).

2.3.1.1 Cells 1 and 1A

Groundwater quality along the compliance boundary of Cells 1 and 1A has been relatively stable the past few years. Few inorganic indicator parameters exhibit upward trends (e.g., bicarbonate, likely as a result of dissolution of carbonate minerals lining fractures or in pores driven by carbon dioxide produced through the metabolism of microorganisms in breaking down VOCs), and most have peaked or show downward trends.

Trends of VOCs have peaked and are declining in each of the compliance wells (most VOCs are now nondetect), and except for Tetrachloroethene (PCE) at MW-12S, none exceeds its RACL. Concentrations for PCE appear to have stabilized between 4 and 20 micrograms per liter (µg/L) and in April 2014 was at 3.5 µg/L. Trichloroethene (TCE), a likely degradation product of PCE, is also detected in MW-12S at concentrations up to 3.0 µg/L.

Approximately 300 to 400 feet downgradient of the compliance boundary, groundwater quality generally shows an improvement in detection wells MW-17 through MW-19 indicating attenuation between the compliance boundary and the downgradient detection wells.

With respect to inorganic compounds, groundwater along the compliance boundary is characterized by elevated concentrations of dissolved metals, chloride and total dissolved solids (TDS) downgradient of Cell 1A and low concentrations of inorganic compounds downgradient of Cell 1.

Trace metals concentrations are low to nondetect in this area, both along the compliance boundary wells and in the detection wells farther downgradient, indicating little if any landfill-related effect on water quality.

2.3.1.2 Closed Landfill

The Closed Landfill is monitored by two compliance wells: one completed in the alluvium (MW-20), and one completed in bedrock (MW-21). Of 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 in 2006. At MW-20, few isolated detections of VOCs have been found at trace levels since the well was installed in 1994.

For inorganic compounds, the alluvial well typically shows variable water quality associated with seasonal fluctuations of the water table (EMCON, 1996a). Within that variability, water quality for the indicator parameters such as chloride has trended downward the last ten years and is currently stable. The bedrock well does not exhibit seasonal fluctuation.

Trace metals in groundwater downgradient of the Closed Landfill have been low to nondetect throughout the history of monitoring, and do not suggest trends related to landfill-related impacts.

2.3.1.3 Surface Water

Surface water is monitored upstream (S-1) and downstream (S-2) in Soap Creek to test for potential impacts from the west side of the facility. A third sampling point (S-4) is situated to check for residual impacts from past leachate spray irrigation. In Soap Creek, historical results for biological oxygen demand (BOD), total Kjeldahl nitrogen, total phosphorus, and orthophosphate are either nondetect or virtually identical in concentration between the upstream and downstream monitoring points.

Historically, the other inorganic parameters (chloride, calcium [Ca], magnesium [Mg], and sodium [Na]) show seasonal changes in concentration as great as 8 mg/L (e.g., for chloride), with low concentrations in April (high stream flow) and higher concentrations in October (low stream flow). There are no statistically significant differences between upstream and downstream points for those parameters, with most concentration differences less than 1 mg/L. Inorganic water quality between the two monitoring stations is virtually identical and suggests that discharge of groundwater (from both the alluvium and bedrock) to Soap Creek does not affect surface water quality.

2.3.2 East side

2.3.2.1 General Chemistry

Classification of alluvial geochemistry for the east side of the landfill was initially presented in the 1997 EMP (EMCON, 1997). Chemistry plots from that report included plotting major anions and cations on a trilinear plot and in Stiff diagrams. On the trilinear plot, relative anion and cation ratios divided into three distinct groups or hydrochemical facies. Two of the wells, MW-22 and MW-23, reflected a predominantly bicarbonate hydrochemical facies. Slightly higher concentrations of chloride and sulfate relative to the bicarbonate ion shifted the MW-23 groundwater composition away from MW-22 toward the chloride and sulfate end of the Piper plot. Both wells had cation ratios with Ca as the principal cation species, followed by Mg and Na in equal amounts (MW-22) or Mg and Na in progressively lesser amounts (MW-23). The Stiff diagrams showed slightly different shapes for groundwater at MW-22 and MW-23, although the most notable difference between water quality in the two wells was an overall higher ionic concentration in MW-23.

The recent data for MW-26 and MW-27 are plotted with other east-side wells on a Piper Plot in Appendix E (see Memorandum of January 16, 2014, in Attachment B). Water quality in the eastern part of the landfill plots in four different areas. Wells MW-26 and MW-27 are both bicarbonate waters, but with MW-27 having a higher ratio of calcium to sodium than MW-26. Otherwise, the anion ratios are comparable. Both waters are similar to nearby (but now decommissioned) wells P-16 and MW-22. The bedrock (unweathered basalt) is represented by MW-13. Farther east is well MW-9S, which is affected by saline conditions related to connate water of the Siletz River formation. That well has much higher chloride relative to bicarbonate as well as sodium relative to calcium and magnesium. The Piper plots also show the slight seasonal shift in chemistry between spring and fall at MW-26 and MW-27.

The other notable characteristic of water from both wells is that it is highly reduced, with negative oxidation reduction potential. This is caused by the former depositional environment being a marsh or wetland with organic rich clays (e.g., MW-27 from a depth of 22 to 28 feet). The effect on water quality is elevated natural levels of redox-sensitive parameters such as total organic carbon (TOC), chemical oxygen demand (COD), iron, manganese, and arsenic. In the Willamette Valley, arsenic is associated with volcanic glass (e.g., from air fall ash layers), adsorbed to and co-precipitated with metal oxides, particularly iron oxide. Reducing conditions in alluvial sediments dissolve high concentrations of iron oxides with subsequent release of adsorbed or co-precipitated arsenic.

2.3.2.2 Groundwater Quality Trends

Before it was decommissioned in May 2011, trends for each parameter at compliance well MW-22 were stable. Early in its history, nearby detection well MW-23 had shown increases for bicarbonate alkalinity, chloride, hardness, 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, Ca, iron (Fe), Mg, manganese (Mn), Na, 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 demonstrate seasonality with higher concentrations in the fall and lower concentrations in the spring.

For the east-side compliance wells, a preliminary examination of the trends shows relatively lower and stable concentrations at MW-26 compared to MW-27, which typically has a wider range of concentrations. Concentrations for several parameters at MW-27 can be quite variable as illustrated on trend plots in Appendix E (e.g., bicarbonate, sodium, arsenic, and TOC). This is likely caused by two conditions at MW-27. First, the water bearing zone that the well monitors has very low permeability, requiring the well to be purged one day and then sampled the following after it recharges adequately. This does not allow the purge water to stabilize; the result is that water samples can be affected unevenly from sampling event to sampling event. The second condition is the mineral composition of the formation opposite the screened interval, which is composed of clay with up to 10 percent organic material. The presence of the organics is likely from an ancient bog as mapped in the base of the Cell 4 excavation.

3.0 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 water quality monitoring locations are summarized on Table 3-1. A summary of the well construction, survey information, and lithologic completion interval is provided in Table 3-2. Well construction diagrams and boring logs are provided in Appendix B.

3.1 Monitoring Wells

The solid waste permit (§18.2) states that compliance wells will be defined in the most current site-specific monitoring plan. This section of the EMP identifies compliance locations in addition to the other types of wells shown on Table 3-1. All well locations are shown on Figure 2-1.

3.1.1 Compliance Wells

Compliance wells monitor groundwater along the compliance boundary defined in the solid waste permit. These wells are used to assess achievement in meeting RACLs (west side) and the compliance of groundwater quality with concentration limits (east side) under the detection monitoring program. Compliance locations include well pairs immediately downgradient of Cells 1 and 1A along Coffin Butte Road (west side), two wells approximately 200 feet downgradient of the Closed Landfill, and wells MW-26 and MW-27 which are downgradient of Cell 4 and serve as the compliance wells for the multiunit east-side landfill (Figure 3-1).

3.1.2 Detection Wells

Detection wells monitor groundwater near potential sources of contamination and at other critical locations throughout the facility, thereby augmenting the monitoring network. Water quality data from wells next to waste management units (e.g., MW-23 and

MW-24) give an indication of potential contamination before it reaches the compliance boundary. Other wells with this designation provide water quality information for (1) background east of the landfill along Highway 99W (MW-9S), and (2) domestic use (to verify drinking water quality).

3.2 Observation Wells and Piezometers

Groundwater wells and piezometers that are not designated as compliance or detection monitoring wells are used primarily to collect groundwater level data. These assist in evaluating the direction and rate of groundwater flow at the facility. Locations are shown on Figure 2-1.

During comprehensive split sampling events, selected observations wells (e.g., MW-9S) will be sampled to better understand water quality along the perimeter of the landfill. Data have, in the past, been acquired from these monitoring points, but they are not critical for assessing compliance with the permit or for tracking constituent trends near source areas.

3.3 Surface Water and Underdrains

Surface water is monitored upstream (S-1) and downstream (S-2 and S-4) in Soap Creek to test for potential impacts from the landfill or from residual impacts from past leachate spray irrigation on the west side of the facility. Location S-3 was eliminated for Cell 4 construction, and monitoring on this side of the landfill is directed toward the stormwater sampling locations required by the DEQ's General 1200-Z Permit. Five other sites monitor landfill or leachate pond underdrains where groundwater collected from the drainage layer beneath newer cells discharges to surface water. These are identified as S-U3 (Cell 3), S-U4 (LDS-ELP), S-U5 (LDS-WLP), S-U6 (Cell 4), and S-U7 (Cell 5). Locations are shown on Figure 2-1.

3.4 Secondary Leachate Collection System

The secondary leachate collection system (SLCS) underlies each of the landfill cells, beginning with Cell 2B, and the leachate surge ponds. It is designed to collect liquid that enters between the primary and secondary liners of each unit. It was previously referred to as the leak detection system (LDS), and sampling point designations retain the LDS identifier for continuity in the database and on site drawings:

- Landfill Cells 2B, 2C, 2D (LDS-2B)
- Cell 3 (LDS-3)

- Cell 4 (LDS-4)
- Cell 5 (LDS-5)
- East and West Leachate Ponds (LDS-ELP and LDS-WLP)

The presence of liquid is checked routinely either by bubbler (Cell 2B, Cell 3) or transducer (Cell 4, Cell 5) or by recording the liquid volume removed (LDS-ELP and LDS-WLP). When present, liquid is pumped out (to the respective sump or leachate pond) and the volume recorded. A detailed description of the SLCS monitoring points is provided in the SAP (Appendix C).

3.5 Leachate

Samples of leachate from individual sumps in Cell 1 (L-1), Cell 2 (L-2B), Cell 3 (L-3), Cell 4 (L-4), and Cell 5 (L-5) had been historically collected to assess leachate constituents that might be detected in groundwater or in the SLCS beneath possible source areas. Samples were collected from stopcocks connected in-line with the sump discharge pipe. Beginning with this EMP, VLI proposes to collect a composite sample of leachate from the currently active leachate pond (L-Pond) rather than samples from each of the five sumps. A review of historical leachate data collected from each of the sumps shows generally comparable quality (Appendix F) and for the purpose of characterizing the range of possible constituent concentrations, one composite location is sufficient. Additional monitoring and reporting related to leachate management operations are described in Section 4.7.

3.6 Landfill Gas

VLI routinely monitors a total of six landfill gas probes (GP-2 through GP-6) around the perimeter of the landfill (Figure 2-1), in addition to the interior of eight site buildings and structures. Monitored parameters include lower explosive limit (LEL), methane, and oxygen. LFG monitoring points are listed in Table 3-3. LFG probes are monitored to:

- Evaluate the performance of the LFG control measures.
- Provide accurate, representative field measurements of methane and oxygen concentrations away from the landfill.
- Monitor the effectiveness of landfill gas migration control wells.

Additional monitoring to evaluate the efficiency of the landfill gas recovery and control system is performed routinely by operators (Pacific Northwest Generating Cooperative) of the gas-to-electric plant.

4.0 MONITORING PROGRAM

This section describes the rationale behind the water quality monitoring program and lists sampling locations, parameters and frequency. It also discusses LFG probe monitoring.

4.1 Purpose

Conceptually, the purpose of groundwater detection monitoring at new landfill cells is to detect the earliest indication of a release. Ideally, this requires monitoring for a parameter(s) that is characteristic of, or present in, the waste and that migrates rapidly in the subsurface. The sooner a release is recognized through monitoring, the more quickly that proper remedial action can be implemented to mitigate any possible impacts. Furthermore, the approach to monitoring should be (1) hydrogeologically sound by monitoring the aquifer most likely to be affected by impacts and (2) able to recognize what a landfill-related impact to groundwater “looks like.” For landfills with documented impacts that have undergone a process to evaluate acceptable risks and establish cleanup goals, the purpose of monitoring is focused toward evaluating the performance of the remedy in restoring the aquifer and in providing protectiveness.

At Coffin Butte, the monitoring program blends these in a two-sided effort to monitor and assess groundwater quality at the landfill. For the west side, downgradient of Cells 1/1A and the Closed Landfill, VLI will employ RACLs as part of performance monitoring.

Consistent with the remedial action objectives identified in the ROD for this part of the landfill, objectives of performance monitoring for the west side include:

- Document restoration of aquifer using RACLs as quantitative measures, and contaminant removal by assessing declining contaminant concentrations.

- Assess the effectiveness of source control by examining trends in wells along waste unit boundaries and by monitoring for migration of landfill gas.

- Evaluate plume stabilization, based on inorganic or organic water quality.

- Assess protectiveness of remedy between the landfill and potential receptors.

Monitoring downgradient of the east-side cells will follow a straightforward intrawell approach. The objective of monitoring will be to identify any release early so that impacts can be mitigated relatively quickly. VLI will compare water quality results with statistically-derived concentration limits and examine groundwater quality trends in this effort. The purpose will be to determine if engineering controls (e.g., the landfill liner, cover, leachate or landfill gas [LFG] collection and removal systems) and operations are effective in preventing the release of landfill-derived compounds to the environment.

4.2 Monitoring Locations

West-side well locations almost exclusively monitor the downgradient edge of landfill cells because differences in hydrogeology between upgradient and downgradient preclude interwell comparisons. Monitored areas are indicated for each sampling location in Table 3-1. In areas of landfill impacts on the west side, groundwater is monitored with both shallow and deep compliance wells. Detection wells also monitor farther downgradient of these areas to define the extent of landfill effects (e.g., MW-17, MW-18, and MW-19) as well as provide protectiveness monitoring between the landfill and potential receptors (e.g., P-8).

On the east side, groundwater flow paths in the alluvium flow through compliance wells MW-26 and MW-27 (Figure 3-1). These wells are supplemented by closer-in detection, such as MW-23, which is situated along the landfill perimeter, to provide earlier indications of a possible release from the landfill. Other wells near the east-side cells provide information on bedrock water quality, near the southwest corner of Cell 2 (MW-24), or on alluvial water quality across the road from Cell 2 (MW-8S).

4.3 Parameters

Monitoring parameters are focused to a group of indicator parameters for routine annual to semiannual monitoring. This is augmented by comprehensive parameter groups, which are tested every five years in split-sampling events with the DEQ. Monitoring indicator parameters provides site-specific sampling data that are responsive to evaluating changes in groundwater quality as a result of landfill impacts. Desirable attributes of indicator parameters include detectability or presence in leachate and groundwater, concentration contrast between background groundwater and leachate, mobility through porous media, persistence in the subsurface, analytical reliability, and cost-effectiveness. In addition to these attributes, other criteria used to select indicators consider concentrations relative to regulatory criteria, such as drinking water standards.

Indicator parameter selection (also referred to as parameter optimization) was originally based on groundwater characterization in both the west and east sides of the landfill. For the west side, five inorganic indicator parameters (chloride, hardness, Ca, Mg, and Na) and eight VOCs had been identified for routine monitoring downgradient of Cells 1 and 1A (EMCON, 1993). Those parameters were selected through a process that screened for compounds with higher concentrations in leachate-impacted wells relative to background concentrations. Further groundwater characterization as part of remedial investigation (EMCON, 1994 and 1996b) and the preliminary assessment (EMCON, 1996a) identified the same inorganic indicator parameters, but also included bicarbonate.

For the east side, indicator parameters were selected primarily on the basis of characterization monitoring at MW-22 and MW-23 (TC, 2003b). The results of the selection process were the same as for wells downgradient of Cells 1 and 1A, and the Closed Landfill, suggesting that the groundwater geochemistry at the site responds similarly to landfill-derived constituents and can be suitably monitored with the same group of indicator parameters. These indicator parameters were recently reviewed for wells MW-26 and MW-27 after the baseline groundwater collection period was completed. A copy of that review can be found in Appendix E.

Based on those reviews, monitoring parameter groups are designated as follows:

- Indicator parameters: site specific parameters based on existing well impacts and leachate quality.

- Annual metals scan: selected group of metals based on minor groundwater impacts or because concentrations are within an order of magnitude of drinking water standards.

- VOCs: these are important tools for groundwater detection monitoring because they are mobile, do not occur naturally in groundwater, and are common constituents of municipal solid waste leachate and landfill gas. These characteristics make VOCs good indicator compounds of a release at a solid waste facility.

- Comprehensive analytical groups: tested occasionally as a check on a previously uncharacterized release and to provide information on changes in general water chemistry.

- Surface water parameters: similar to groundwater indicators (exclusive of arsenic) but include parameters to assess nutrient loading in surface water. Bacteriological testing is not included because bacteria are ubiquitous in the agricultural area surrounding Coffin Butte and, therefore are not good indicators of landfill impacts.

- Underdrain parameters: these parameters mimic groundwater indicators and are intended to assess whether waste management units affect underlying groundwater and the discharge to surface water.

4.4 Frequency

Water Levels. Water levels will be measured semi-annually in site monitoring wells, piezometers, and domestic wells to document the range of seasonal water level fluctuations.

Routine Water Quality Monitoring. The sampling frequency for each monitoring well group is based on its location and the level of concern from historical analytical results. Compliance wells will be monitored semiannually (twice per year), as will surface water. Detection wells, which are in locations less critical to the assessment of contaminant migration downgradient of the landfill and generally have lower constituent concentrations, will be monitored annually. The SLCS will also be tested semiannually as will the underdrains. For the purpose of characterizing potential chemicals of concern generated in the leachate, annual leachate sampling is sufficient.

In past years, leachate had been tested at each of the sumps. As the landfill has expanded, the number of sumps has risen to five. The goal of monitoring leachate is to provide an idea of the concentration range and types of contaminants being generated by the waste. This goal can be satisfied in several ways: (1) by monitoring each of the sumps separately, (2) by monitoring one of the sumps, presumably from the active operations cell, or (3) collecting a composite sample from the leachate pond. Given the quantity of leachate quality data collected over the years, VLI has an excellent data set of the types of constituents generated at this landfill. A summary of the leachate data and time-series concentration plots are provided in Appendix F. Based on our review of this data and the general consistency and range of leachate quality between sumps, VLI recommends collecting an annual composite sample of leachate from the active leachate pond from this time forward. It will provide the same type of information needed to assess the range of constituents. If more cell-specific information is needed in the future to address a release, then that type of data can also be acquired.

Quinquennial Water Quality Monitoring. Every five years, groundwater in the compliance and detection wells and in selected observation wells will be tested for more comprehensive analytical groups (listed in Table 4-1) to assess site-wide geochemistry and to identify whether any constituents, previously detected below levels of concern, have increased. These sampling events will be coordinated with the DEQ, which will take split samples at selected locations.

Schedule. To provide a range of chemical variability associated with seasonal water level fluctuations, semiannual sampling will be scheduled at the seasonal high and seasonal low groundwater periods. These typically occur in the late winter/early spring and late summer/early fall, respectively. The annual sampling event will be scheduled for the fall, as this quarter shows the higher parameter concentrations in some site wells that have seasonally influenced geochemistry (e.g., inorganic parameters in MW-23).

Consistent with permit-identified periods, sampling events will be planned within the following time frames:

Sampling Event	Time Period
Winter	January 1 to February 28
Spring	April 1 to May 31
Summer	July 1 to August 31
Fall	October 1 to November 30

4.5 Notification for Sampling Event

VLI will notify the DEQ in writing of upcoming sampling events at least ten (10) working days before the scheduled date consistent with §16.1 of the solid waste permit. Should a more immediate sampling event be required (e.g., resampling), then VLI will notify the DEQ as soon as feasible after scheduling. The notification will be made to the program manager of solid waste permits at DEQ's Salem office or alternatively, may be done via email to the program manager or current project manager.

4.6 Water Quality Sampling and Analysis Procedures

Water will be sampled consistent with procedures described in the site sampling and analysis plan (SAP), attached as Appendix C. Procedures are based on standard U.S. Environmental Protection Agency methods and DEQ guidance. The SAP is designed to provide consistent, representative, and reproducible sample results.

Water quality samples will be tested for the parameters and constituents shown in Table 4-1. For samples that exceed 100 mg/L of total suspended solids (TSS), the total trace metals suite for that sample should also be tested as a dissolved trace metals suite to evaluate the effect of the particulates in the water sample on the metal concentration. To reduce the effects of ambient atmospheric conditions on pH, temperature, specific conductance, dissolved oxygen, and redox potential (Eh), measurements for those parameters will be taken in the field at the time of sample collection. Samples will be analyzed by a qualified analytical laboratory certified by ORELAP (Oregon Environmental Laboratory Accreditation Program) and NELAP (National Environmental Laboratory Accreditation Program). VLI, through a contract with its parent company Republic Services, Inc., currently contracts with TestAmerica Laboratories, Inc., of Denver, Colorado, for its analytical services. Analytical procedures and quality assurance and quality control (QA/QC) measures for specific laboratories are available on request.

4.7 Leachate Management Program

VLI reports on its leachate management program annually as part of solid waste permit conditions. Elements of reporting, which have been developed over several years, include the following information:

- Totals by month, on a water year basis, of the leachate volumes that are generated and handled.
- Review of significant leachate management events that occurred during the last water year.
- Review of leachate monitoring and recommendation for improvement, as needed.
- Summary of site conditions and compilation of monitoring and analysis data.
- Summary of daily reports for monitoring irrigation on waste, and spray evaporation, as applicable.
- Proposed plans or changes for upcoming leachate management.

As required in the permit (§19.4 and §19.5), this information will be submitted as part of the AEMR by March 31 of each year covering the previous water year (October 1 to September 30).

4.8 LFG Probe Monitoring

VLI monitors six landfill gas monitoring probes around the perimeter of the landfill (GP-2 through GP-6), in addition to the interior of eight site structures on a monthly basis. Monitored parameters include lower explosive limit (LEL), methane, and oxygen. Procedures for measuring LFG are described in Appendix D. Because of possible effects of LFG migration on safety, results will be evaluated at the time of sampling. Criteria for assessing whether action is required are presented in Section 5.5.

5.0 DATA EVALUATION

The purpose of evaluating groundwater data at a landfill is to determine if engineering controls (e.g., the landfill liner, cover, leachate or landfill gas [LFG] collection and removal systems) and operations are effective in preventing the release of landfill-derived compounds to the environment. In many instances, early identification of a release can result in mitigation of those impacts relatively quickly. Moreover, standard landfill operations and engineered systems can be viewed as presumptive remedial technologies, and, combined with sufficient buffer property, can be highly effective in preventing exposure of potential receptors to landfill impacts. Since current site knowledge about hydrogeology and groundwater quality is substantial, and the landfill engineered systems are state of the art, any leakage that might result in a groundwater impact can be assessed rapidly and an appropriate remedial action fashioned in a streamlined fashion.

For older areas of the landfill that have undergone a focused risk assessment, the purpose of monitoring is to evaluate the performance of the remedy in protecting potential receptors and in restoring groundwater quality. This monitoring information is used to assess Remedial Action Objectives (RAOs) established for the site in the ROD. RAOs, which are media-specific goals for protecting human health and the environment, were developed for the landfill to maintain the current level of protectiveness present at the site and to provide source control, which is the primary goal of the landfill presumptive remedy. For Coffin Butte Landfill, RAOs include:

- Prevent direct contact with landfill contents.
- Reduce contaminant leaching to groundwater.
- Prevent exposure to contaminated groundwater.
- Control surface water runoff and erosion.
- Collect and treat leachate.
- Control and treat landfill gas.

Many of these RAOs are related to source control and will be addressed through routine landfill maintenance of the cover, and ensuring that the leachate treatment and removal system and the landfill gas removal system are operating properly. The monitoring objective for this area is to assess the performance of the remedy in protecting potential receptors and in restoring groundwater quality. Progress in meeting this objective is evaluated by comparing results of groundwater monitoring with RACLs, assessing longer term geochemical trends, and monitoring for the migration of landfill gas as discussed in Section 5.5.

For cells that were constructed under the Subtitle D-era regulations, which include Cells 2, 3, 4, 5, and future cells, monitoring is more properly classified as detection monitoring—in essence, to identify whether the landfill is leaking. Instrumental to this program will be testing for VOCs, assessing the geochemical trends of indicator parameters in compliance wells, and comparing water quality with unique site concentration limits (Site Specific Limits [SSLs] and Permit-Specific Concentration limits [PSCLs]) established for each compliance well.

In addition to groundwater, VLI also monitors the SLCS for indications of leachate that may be released to the environment. The SLCS is a redundant, engineered monitoring system that allows significantly faster leak detection than groundwater monitoring wells. Section 5.4 describes the approach to assessing routine SLCS monitoring results.

The following sections describe the types of specific evaluation that will be performed for groundwater analytical data.

5.1 Site Concentration Limits

Site groundwater quality will be judged on the basis of three types of concentration limits established for the site. For older areas, RACLs which were selected on the basis of evaluating receptor pathways, will be used for assessment. RACLs for west-side wells are listed in Table 5-1.

The east-side multiunit cells will be evaluated primarily with SSLs developed for a suite of eight site-specific indicator parameters. These were calculated as prediction limits consistent with EPA's Unified Guidance (EPA, 2009) and are based on intrawell statistics with the intent of identifying a change from the initial (i.e., historical) sample population for each well. An excursion above the concentration limit does not necessarily mean that groundwater quality is above a risk-based concentration or other water quality criteria since the value is purely statistics based. However, triggering this value brings attention to a potential statistical change and initiates the need to determine whether the change is from the landfill operations or from some other cause unrelated to the landfill.

For wells MW-26 and MW-27, an explanation of the exploratory statistics and copies of statistical plots and calculations can be found in Appendix E. Table 5-2 summarizes the prediction limit statistics. The prediction limits were calculated one of two ways, and are based on assumptions of normality and retesting schemes to meet an annual Site Wide

False Positive Rate (SWFPR) of 10 percent per year, consistent with Unified Guidance. Of the baseline data set, prediction limits were calculated using parametric assumptions of normality with the equation:

$$\mathrm{PL} = x + ks$$

Where x is the sample mean in background, s is the background standard deviation, and k is a multiplier depending on the several variables that include number of compliance wells, number of background samples, number of constituents to be tested, sampling schedule, and retesting strategy. The k multiplier values are shown on the eighth column of Table 5-2 and assume variables taken from Unified Guidance Appendix D, Chapter 19 tables for intrawell estimates. These all include a retesting scheme of 1-of-2 future samples, 7 constituents (i.e., the indicator parameter suite), and number of background samples that depend on the data set ultimately used to calculated the prediction limit. For instance, where n is less than the standard number of background samples, it means that outliers may have been removed (e.g., for MW-22 calculations).

Selected SSLs are shown in bold for each of the parameters under each well in which a normal distribution could be achieved. For several parameters in MW-26, the data were very consistent which resulted in either bimodal or trimodal distribution with little or no variance. Data sets with no variance have no standard deviation and therefore, parametric statistical tests such as prediction limits are not valid (i.e., because there is no standard deviation). Nonparametric tests in these instances are also not practical where only two or three values are present. For these parameters (bicarbonate, TDS and calcium), prediction limits were calculated using the data set for nearby well MW-22 as a surrogate for MW-26. MW-22 was a past compliance well and approximately 300 feet west (upgradient) of MW-26. This resulted in reasonable values that will be used until a larger, more variable, data set is available at MW-26.

It should be noted that while there are eight indicator parameters, SSLs were only calculated for seven for each well. For MW-26, no SSL for iron was calculated because while a normal distribution could be calculated by removing outliers, the resulting prediction limit was not reasonable with regard to the data distribution. For MW-27, after removing an outlier, chloride was consistently detected at only two values (bimodal distribution) and a nonparametric value was not reasonable. As with MW-26, VLI will re-evaluate the statistical distribution after additional data have been collected to determine if a normal distribution can be achieved.

The selected SSLs for indicator parameters are shown in Table 5-3. These values are indicated as horizontal lines in the time-series concentration plots in Appendix E. The proposed limits appear reasonable based on a visual examination of these plots.

5.2 Evaluation of Groundwater Analytical Data

Groundwater monitoring data from compliance wells will be evaluated after each sampling event. Before the data are evaluated, they will be reviewed according to the procedures and quality controls outlined in the sampling and analysis plan (Appendix C). Once the quality of the data has been verified, the data will be assessed as discussed below.

5.2.1 West Side

For the west side, VLI will examine the (1) effect of remedial actions on groundwater quality (i.e., assess progress of cleanup) and (2) protection of potential human health receptors. These are discussed in the annual report as follows:

5.2.1.1 Aquifer Restoration-Contaminant Removal

Areas downgradient of the landfills on the west side rely on containment and control of the source with natural attenuation in groundwater downgradient. Contaminant removal occurs through natural processes and is measured with respect to trends of constituent concentrations with time. Sampling results will also be compared to cleanup levels referred to as RACLs, which are the long term goals of aquifer restoration. No further action will be required as a consequence of monitoring results that exceed RACLs along the compliance boundary.

5.2.1.2 Source Control Effectiveness

Source controls include the final cover at the landfill, leachate removal, and active landfill gas recovery to control the migration of landfill gas that contains methane and VOCs. Effectiveness is measured qualitatively by examining (1) the trends and number of VOCs at downgradient monitoring wells and (2) whether landfill gas is migrating to perimeter gas probes.

5.2.1.3 Plume Stabilization

The stability of the VOC plume is evaluated qualitatively by examining whether concentrations at impacted wells are increasing and whether monitoring wells downgradient of the VOC plume, in downgradient wells MW-17, MW-18, and MW-19, have VOC detections.

5.2.1.4 Protectiveness Evaluation

This is assessed at two locations. The first examines water quality results at the Phillips domestic well. Analytical results are compared with drinking water standards and also reviewed to determine if any water quality trends are present. Second, water quality results at detection monitoring well P-8 are examined for trends or other indications that landfill-derived compounds are migrating from the landfill to the domestic well. Well P-8 is located between the landfill and the Phillips well near the hydrogeologic divide that protects the domestic well from landfill-contaminant migration.

5.2.2 East-Side Detection Monitoring Evaluation

The basic framework for reviewing groundwater monitoring data and the possible consequences related to exceeding a concentration limit are described below. Analytical results at compliance wells will be reviewed at three levels after they are checked for meeting laboratory quality assurance and quality control criteria (Table 5-4):

- Indicator compounds will be compared to their SSLs at each compliance well.
- Hazardous compounds will be compared to their primary drinking water maximum contaminant levels (MCLs). For vinyl chloride, a detection at or above the practical quantitation limit (currently at 0.5 µg/L) will be considered exceeding the PSCL.
- Data will be assessed for indications of significant change.

If groundwater results meet the following conditions at a compliance well, then VLI will resample the well (Section 5.3.1) for the parameter of concern and notify the DEQ of this action. An exceedance should be identified and the DEQ notified within ten (10) working days of receiving results from the laboratory.

- Results exceed three (3) SSLs for a compliance well during any one sampling event.
- Results for vinyl chloride are detected at or above the PSCL which is set at the practical quantitation limit (currently at 0.5 µg/L for TestAmerica) The practical quantitation limit is the lowest concentration that can be reliably measured within specific limits of precision and accuracy under routine laboratory operating conditions.
- Parameter detected at concentration that indicates a significant change in water quality, not considered background or natural water quality. Examples of significant change are listed in Table 5-5.

As part of its review, VLI will also examine time-concentration (trend) plots of indicator parameters for changes indicative of impacts from the landfill. Trends may indicate a source of systematic error, an increase unrelated to landfill operations such as from climatic changes, or an actual release. In addition, trilinear diagrams could also be developed and reviewed to assess perceived changes in basic groundwater quality. VLI will include a discussion of these findings in the annual report.

Table 5-5 identifies triggers that require verification resampling and provides examples of reporting actions that will be taken after each routine detection monitoring event, including actions if the data exceed a statistical limit or indicate a change in groundwater quality.

5.3 Action Requirements

5.3.1 Verification Resampling

If the monitoring results indicate that a groundwater monitoring parameter at the east-side compliance boundary exceeds a concentration limit (three SSLs or a PSCL) or indicate a significant change in groundwater quality, then VLI will notify the DEQ within ten (10) working days of receiving laboratory results and resample the affected well for the parameter(s) in a timely manner. There are no such resampling requirements for west-side compliance boundary wells.

If resampling results confirm that a concentration limit has been exceeded, or indicates significant change, then VLI will notify the DEQ within 10 days of receiving the laboratory results, but in no case longer than 60 days from the date of resampling. If resampling does not confirm the change, no further action will be taken, and the results will be discussed in the next annual report. Otherwise, VLI will undertake further action, as described below, to assess the change in water quality.

5.3.2 Notification Requirements

If, after resampling, VLI determines that the change in groundwater quality cannot be explained after reviewing the original laboratory data and QA/QC reports, then the DEQ will be notified in writing (or by e-mail correspondence) of the change within 10 days of receipt of the laboratory results, but in no case longer than 60 days from the date of resampling. The notification will identify the compliance point and associated parameter(s) and will explain the action being taken by VLI to evaluate the cause of the change. In addition to those actions described in Section 5.3.3, such action may be a demonstration by VLI that (1) a source other than the landfill caused the water quality variation, (2) the detection was an artifact caused by an error in sampling, analysis, or statistical evaluation, or (3) the detection was a natural variation in groundwater quality.

5.3.3 Further Action

Confirmation of an exceedance could trigger follow-up action on the part of VLI. Actions will first be discussed with the DEQ as to purpose and scope within 45 days of notifying the DEQ of the verified change in water quality; documentation will be provided as needed. Further actions could include continued monitoring; measures to abate and prevent further releases; corrective actions to reduce and stabilize the contaminants; measures to define and protect existing beneficial uses, if any; or other actions discussed with the DEQ to adequately accomplish the goals of the action identified by VLI and the DEQ.

Depending on the parameter(s), degree of impact, or duration of an exceedance, these could range from relatively simple to more complex. A matrix of possible actions is shown in Table 5-6.

5.4 SLCS Assessment Criteria

The SLCS will be evaluated against criteria proposed in this section to assess the effectiveness and integrity of the landfill liner system. Data evaluation will consider liquid quantities and chemistry of the liquid in addition to the historical influx of liquids that have occurred during and after construction of the liner systems. Therefore, a variety of data evaluation techniques will be used to account for the variability of historic and current conditions.

The solid waste permit states in §18.5 that VLI must provide for further monitoring or investigation as determined by an evaluation of data collected from the secondary system. Based on the criteria discussed below, VLI will develop a plan that defines the nature of the problem and proposes to evaluate its cause. The objective of the assessment will be to develop actions to mitigate or otherwise manage the release of contaminants to the secondary system and, as needed, to recommend any additional measures to protect or monitor groundwater resources.

Quantity. The quantity of liquid pumped from the SLCS is recorded weekly by the site operator. The quantities will be evaluated quarterly, and converted to a unit of gallons-per-acre-per-day (gpad), based on the lined area containing an SLCS layer. For the SLCSs underlying the landfills, a criterion of 20 gpad is used as the trigger for initiating evaluation of the causes of the quantity of liquids being collected in the SLCS. The value of 20 gpad was selected based on a recommendation by Bonaparte and Gross (1990), who stated that this value is reasonable for landfills that have been constructed using rigorous third-party CQA programs.

For SLCSs underlying the leachate ponds, which have much smaller footprints of slightly over one acre each, the goal will be to keep the secondary system dry, essentially no leakage. Pumps installed in both of the riser pipe sumps are set to automatic mode and pump when there is sufficient liquid in the pipe to trigger pumping. Volumes will be recorded weekly. If persistent recharge is recorded so that the system cannot maintain a dry system (i.e., continuous pumping), then VLI will plan to inspect and repair the primary liner during the subsequent summer when the ponds have been drained.

Levels. Liquid levels in the SLCS for Cell 2 (LDS-2B), Cell 3 (LDS-3), Cell 4 (LDS-4), and Cell 5 (LDS-5) are measured routinely (up to every 6 hours) with a bubbler system or transducer that records the values with a data logger. The SLCS riser pipes for the leachate ponds (LDS-ELP and LDS-WLP) are not instrumented but are evaluated for volume as described above. The measurement of liquid levels in the SLCS will be a valuable diagnostic tool if an assessment is triggered. In the event the SLCS liquid quantity or chemistry criteria are exceeded, SLCS liquid level information will be used to help understand the cause of the problem. Instrumentation is also used to document liquid levels in the secondary system relative to liner design criteria.

Liquid Chemistry. Because leachate constituents have been detected in SLCS sumps the past few years, criteria for assessing the liquid chemistry will be based on trends, rather than numeric threshold values. Based on a past investigation at LDS-2B (Thiel and EMCON, 1997), inorganic indicator parameters similar to groundwater indicators will be selected for trend evaluation. In addition to the inorganic parameters, VOCs that are detected can be included in the trend evaluation

Annual Review of SLCS Criteria. The year's annual report will discuss monitoring results from each SLCS with respect to actual and expected liquid volume, level, and chemistry. The analysis will consider variables that might affect results for these criteria and whether additional monitoring or action is proposed on the basis of findings. Part of this analysis reviews the water quality of the underlying drainage layer (e.g., S-U3 for Cell 3, S-U6 for Cell 4, S-U7 for Cell 5, S-U4 for the east leachate pond, S-U5 for the west leachate pond) for indications of leakage to groundwater.

5.5 Landfill Gas Probe Monitoring Assessment

Gas probes are monitored monthly to determine whether LFG is migrating in the subsurface away from the landfill. Criteria for gas control compliance are defined in OAR 340-94-060(4), in guidelines originally established under the Resource Conservation and Recovery Act (RCRA) of 1976, and in the §18.6 of the solid waste permit. The following criteria apply:

- Methane concentrations at the property boundary shall not exceed 100 percent of methane's lower explosive limit (LEL), or 5 percent methane by volume.

- Methane concentrations inside buildings and structures on landfills shall not exceed 25 percent of methane’s LEL or 1.25 percent methane by volume.

Immediately following each monitoring session, data should be evaluated and the need for corrective action determined according to Section 1.3 of the LFG migration monitoring plan (Appendix D). For methane concentrations above 5 percent, DEQ notification and measures to mitigate any potentially dangerous conditions are required. No action is required if monitoring results are below 5 percent methane.

6.0 REPORTING

The annual report for the Coffin Butte Landfill 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, (3) evaluate detection monitoring data for east side cells, and (4) evaluate performance of the engineered liner systems for the active waste management units. Two copies of the report (one paper copy and one electronic copy) must be submitted to the DEQ by March 31 of each year for the previous calendar year.

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 will be to focus 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 of the VOCs.
- Discuss results of protectiveness monitoring at domestic wells and at early warning detection wells.

For the east side, the report will compare analytical results to site concentration limits and examine the data for indications of a significant increase as described in Section 5.2.2. Results will also be compared to relevant water quality standards.

The annual report will include the following elements:

- 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, box plots, trilinear diagrams) as appropriate, for selected constituents of concern; to be used in assessing data as described in Section 5.2.
  - 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).

- 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.

- Findings from the leachate management program as described and itemized in Section 4.7.

7.0 OTHER MONITORING REQUIREMENTS

In addition to the water quality, leachate management, and LFG monitoring conducted by VLI, other types of monitoring at the landfill include stormwater sampling under the National Pollutant Discharge Elimination System (NPDES) program and air quality monitoring. Results from these programs are reported to the DEQ according to schedules separate from the AEMR. NPDES monitoring for the leachate treatment facility is currently not required because the plant is not operating.

7.1 Stormwater Sampling

Stormwater from the Coffin Butte Landfill is monitored under an NPDES permit, consistent with the stormwater pollution control plan (TC, 2014b). Surface water samples are collected four times a year from two designated locations and tested for the set of parameters listed in the 1200-Z general stormwater permit; the new permit for Coffin Butte was effective May 29, 2013. A discharge monitoring report is submitted to the DEQ water quality division in Eugene by July 31st of each year.

7.2 Air Quality Monitoring

VLI maintains a Title V Air Quality Permit (#02-9502) for the site. Requirements are varied but generally include the following:

- For Fugitive Emissions, a weekly visual survey of the landfill is required using EPA Method 9.

- For Nuisance Conditions, VLI investigates the complaint immediately and then reports to the DEQ within 5 days the following: (1) the reason for the complaint (2) any actions taken to address the complainant’s concerns, and (3) findings from investigating the cause of the odor.

- For NSPS and NESHAP requirements:
  - Startups and shutdowns are recorded; measurements and performance testing are recorded.
  - LFG wellhead pressures and oxygen levels are recorded.
  - Surface Emissions Monitoring is done quarterly and recorded.
  - Disposal of asbestos and cover records are maintained.

In addition to the above requirement, a Source Test is required 6-months before expiration of the permit for renewal purposes. Plant Site Emission Limits are calculated and recorded for continuous gas flow measurements. Records are maintained for 5 years and are available to the DEQ within 4 hours, if requested. Annual and semi-annual reports to document compliance with the above conditions are required. The semi-annual report is due July 30th, and annual report is due February 15th; both are submitted to the DEQ and the EPA.

REFERENCES

Bonaparte, R., and Gross, B. A. Field behaviour of double-liner systems. Waste Containment Systems: Construction, Regulation, and Performance. ASCE Special Geotechnical Publication #26. 1990.

DEQ. 2004. Solid Waste Disposal Site Permit No. 306 Addendum. Issued by the Oregon Department of Environmental Quality, Hazardous and Solid Waste, Permitting and Compliance, Western Region. Signed by Gil Hargreaves, November 4.

DEQ. 2005. Record of Decision for Coffin Butte Landfill, Corvallis, Oregon. Prepared by the Oregon Department of Environmental Quality, Western Region. October.

DEQ. 2010. Solid Waste Disposal Site Permit No. 306. Issued by the Oregon Department of Environmental Quality, Hazardous and Solid Waste, Permitting and Compliance, Western Region. Signed by Brian Fuller, November 24.

EMCON. 1993. Water quality monitoring plan for Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc., by EMCON Northwest, Inc., Portland, Oregon. October 14.

EMCON. 1994. Remedial investigation and additional hydrogeologic investigation report, Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc., by EMCON Northwest, Inc., Portland, Oregon. February 4.

EMCON. 1996a. Preliminary assessment, Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc., by EMCON, Portland, Oregon. February 28.

EMCON. 1996b. Remedial investigation addendum, Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc., by EMCON, Portland, Oregon. February 28.

EMCON. 1997. Environmental monitoring plan, Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc., by EMCON, Portland, Oregon. February 25.

EMCON. 1999. Site characterization – cell 3, Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc., by EMCON, Portland, Oregon. June 11.

EPA. 2009 Statistical analysis of groundwater monitoring data at RCRA facilities, *Unified Guidance*. U.S. Environmental Protection Agency. EPA 530/R-09-007. March.

Morris, D. A., and Johnson, A. I. 1967. Summary of hydrologic and physical properties of rock and soil materials, as analyzed by the hydrologic laboratory of the U.S. Geological Survey, 1948-60. U.S. Geological Survey Water-Supply Paper 1839-D.

TC. 2003a. Focused risk assessment and feasibility study, Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc. Corvallis, by Tuppan Consultants LLC, Lake Oswego, Oregon. September 23.

TC. 2003b. Letter (re: Permit-Specific Concentration Limits for Coffin Butte Landfill, Solid Waste Permit 306, Benton County, Oregon) to G. Hargreaves, Oregon Department of Environmental Quality, Salem, from E. Tuppan, Tuppan Consultants LLC, Lake Oswego, Oregon. November 5.

TC. 2005. Environmental monitoring plan, Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc., by Tuppan Consultants LLC, Lake Oswego, Oregon. December 16.

TC. 2011a. Environmental monitoring plan, Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc., by Tuppan Consultants LLC, Lake Oswego, Oregon. March 23.

TC. 2011b. Letter (re: Cell 4 well siting plan, Coffin Butte Landfill) to B. Mason, Oregon Department of Environmental Quality, Eugene, from E. Tuppan, Tuppan Consultants LLC, Lake Oswego, Oregon. April 5.

TC. 2012a. Letter (re: Cell 5 well siting plan, Coffin Butte Landfill) to B. Mason, Oregon Department of Environmental Quality, Eugene, from E. Tuppan, Tuppan Consultants LLC, Lake Oswego, Oregon. May 21.

TC. 2012b. Environmental monitoring plan, Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc., by Tuppan Consultants LLC, Lake Oswego, Oregon. October 26 (Rev. 2).

TC. 2014a. 2013 annual environmental monitoring report, Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc., by Tuppan Consultants LLC, Lake Oswego, Oregon. March 14.

TC. 2014b. Stormwater pollution control plan, Coffin Butte Landfill, Benton County, Oregon. DEQ No. 104176. Prepared for Valley Landfills, Inc., by Tuppan Consultants LLC, Lake Oswego, Oregon. Revision 1, June 24.

Thiel and EMCON. 1997. Status report: evaluation of liquid in the leak detection system – Cell 2, Coffin Butte Landfill, Benton County, Oregon. Prepared for Valley Landfills, Inc., by Thiel Engineering, Oregon House, California, and EMCON, Portland, Oregon. March 28.

TABLES

Table 3-1
Description of Monitoring Network
Environmental Monitoring Plan
Coffin Butte Landfill

Monitoring Program	Monitored Area	Position
Landfill Water Quality Monitoring Program		
Compliance Wells		
MW-1D, MW-3D, MW-12S, MW-12D	Cell 1	Downgradient
MW-10S, MW-10D, MW-11S, MW-11D	Cell 1A	Downgradient
MW-20, MW-21	Closed Landfill	Downgradient
MW-26, MW-27	Cells 2/3/4/5	Downgradient
Detection Wells		
MW-8S, MW-15	Former Leachate Irrigation Fields A/B	Downgradient
MW-17, MW-18, MW-19	Cells 1/1A	Downgradient
MW-23	Cell 2	Crossgradient
MW-24	Cells 2/3	Crossgradient
P-8	Cell 1	
Phillips	Domestic Water Quality	—
Other Monitoring Well Sites		
MW-9S	East boundary of property	—
Observation Wells/Piezometers		
MW-1S, MW-3S, MW-8D, MW-14S, MW-14D, PW-2, P-9, P-10, P-19, P-20, P-21, Duplex, Merril, Berkland	Various	—
Wetland Piezometers		
WP-1, WP-3, WP-5, WP-6, WP-8, WP-9	Fields South of Coffin Butte Road	Various
Quarry Piezometers		
QP-2S, QP-3S, QP-4S, QP-5N, QP-6N, QP-7N	Knife River Quarry and Coffin Butte	Various
Secondary Leachate Collection System		
LDS-2B	Cells 2B, 2C	Underneath
LDS-3	Cell 3	Underneath
LDS-4	Cell 4	Underneath
LDS-5	Cell 5	Underneath
LDS-WLP (formerly LDS-SP)	West Leachate Pond	Underneath
LDS-ELP	East Leachate Pond	Underneath
Leachate		
L-1	Cell 1	—
L-2B	Cells 2A, 2B, 2C, 2D	—
L-3	Cell 3	—
L-4	Cell 4	—
L-5	Cell 5	—
L-Pond	Composite of All Sumps	—
Surface Water		
S-1	Background (Soap Creek)	Upstream
S-2, S-4	Cell 1, 1A, Closed Landfill	Downstream
Underdrains		
S-U2 (end of pipe not accessible for sampling)	Cell 2C/D & Cell 4 (north half)	Underneath
S-U3	Cell 3	Underneath
S-U4	East Leachate Pond	Underneath
S-U5	West Leachate Pond	Underneath
S-U6	Cell 4 (south half)	Underneath
S-U7 (Manhole east of cell)	Cell 5A	Underneath
Stormwater Monitoring Program (NPDES)		
Outfall 1 (monitored by rock quarry operator)	Quarry/part of Cell 1A & Closed Landfill	Downstream
Outfall 2	Cell 1	Downstream
Outfall 6 (northeast end of bioswale)	Cell 2/3/4/5A	Downstream

Table 3-2
Well Construction Summary
Environmental Monitoring Plan
Coffin Butte Landfill

Location	Status	Northing	Easting	Ground Surface Elevation (ft msl)	Surveyed Reference Elevation (ft msl)	Casing Total Depth (ft bgs)	Screened Interval (ft bgs)	Filter Pack Interval (ft bgs)	Seal (ft bgs)	Well Casing Diameter (Inches)	Drilling Method	Date Well Installed	Lithology Screened
MONITORING/OBSERVATION WELLS													
MW-1S[a]		176.31	394.27	288.50	289.87	23.0	18-23	16-23	0-16	2	Air Rotary	1977	Weathered basalt
MW-1D[a]		176.31	394.27	288.50	289.89[b]	40.0	35-40	34-40	23-34	2	Air Rotary	1977	Weathered/fresh basalt
MW-2S	Decom. 9/18/91	Replaced by	MW-12S		285.26	26.0	21-26	19-26	0-19	2	Air Rotary	1977	Weathered basalt
MW-2D	Decom. 9/18/91	Replaced by	MW-12D		285.26	60.0	55-60	54-60	26-54	2	Air Rotary	1977	Weathered basalt
MW-3S[a]		131.43	-346.95	284.70	285.86	26.0	21-26	20-26	0-20	2	Air Rotary	1977	Weathered basalt
MW-3D[a]		131.43	-346.95	284.70	285.94[b]	54.3	49-54	47-54	26-47	2	Air Rotary	1977	Weathered/fresh basalt
MW-5S	Decom. 5/28/91		Not Available		295.94	4.5	3-4.5	2-5	0-2	2	Hand Auger	01/16/79	Clay
MW-5I	Decom. 5/28/91		Not Available		295.34	30.0	24-29	21-30	0-21	2	Air Rotary	01/16/79	Weathered basalt
MW-5D	Decom. 5/28/91		Not Available		295.36	58.0	53-58	50-58	0-48	2	Air Rotary	01/16/79	Weathered basalt
MW-6	Decom. 5/25/04	466.13	1,174.56	279.50	279.83[b]	50.0	40-50	25-50	0-25	2	Air Rotary	09/18/84	Fresh basalt
MW-7S	Decom. 5/24/04	618.33	1,147.37	282.50	283.73	25.0	15-25	10-25	0-10	2	Air Rotary	09/18/84	Weathered basalt
MW-7D	Decom. 5/24/04	614.23	1,146.62	282.20	283.71	40.0	30-40	23-40	0-23	2	Air Rotary	09/18/84	Weathered basalt
MW-8S		868.45	2,465.16	240.63	244.01[b]	30.8	21-31	16-31	0-16	2	Air Rotary	07/30/85	Weathered basalt
MW-8D		873.29	2,463.49	240.50	244.04	75.0	65-75	60-75	0-60	2	Air Rotary	07/30/85	Fresh basalt
MW-9S		1,721.42	3,790.27	221.50	223.27	35.0	25-35	20-35	0-20	2	Air Rotary	08/02/85	Clay
MW-9D	Decom.	1,721.00	3,795.00	221.00	221.00	125.0	106-115	na	na	2	Air Rotary	08/01/85	Silt, clay, and weath. basalt
MW-10S[c]		364.70	-1,068.43	289.03	291.42[b]	41.1	30.1-40.1	25.8-41.1	0-25.8	2	Air Rotary	08/02/85	Weathered basalt
MW-10D[c]		361.08	-1,069.56	289.02	291.38[b]	82.2	73.0-82.2	60.1-82.2	0-60.1	2	Air Rotary	08/02/85	Fresh basalt
MW-11S		380.77	-1,395.21	274.80	274.71[b]	31.8	22-32	20-32	0-20	2	Air Rotary	08/05/85	Weathered basalt
MW-11D		382.87	-1,399.20	274.80	274.96[b]	75.0	65-75	55-75	0-55	2	Air Rotary	08/05/85	Fresh basalt
MW-12S		83.35	26.27	283.80	285.59[b]	26.1	21-26	18.9-26.2	2-18.9	2	Air Rotary	09/19/91	Weathered and fresh basalt
MW-12D		85.06	36.25	283.80	285.43[b]	60.3	55-60	52.6-61.3	1.5-52.6	2	Air Rotary	09/19/91	Fresh basalt
B-13	Coordinates Est.	1,497.00	343.00	398.00	398.00	43.0	na	na	0-43	na	Corehole	07/21/92	–
MW-13	Decom. 7/18/12	1,497.68	353.63	426.50	430.46	108.8	95-105	92-107	1-92	2	Air Rotary	07/28/92	Fresh basalt
B-14	Coordinates Est.	251.00	654.00	287.00	287.00	70.0	na	na	0-70	na	Corehole	07/23/92	–
MW-14S		251.74	674.78	287.50	289.58	30.1	19.5-29.5	16.5-30	1.5-16.5	4	Air Rotary	07/27/92	Weathered basalt
MW-14D		248.23	664.50	287.80	290.27	70.6	60-70	57.5-71	1-57.5	2	Air Rotary	07/24/92	Fresh basalt
MW-15		684.93	3,100.49	233.45	235.66[b]	28.9	19.0-28.0	16.5-29.0	0-16.5	2	HSA	07/14/93	Silt and gravel
MW-16	Decom. 5/24/04	113.19	2,052.21	281.70	284.03[b]	27.3	17.2-26.6	15.6-27.3	0-15.6	2	HSA	07/19/93	Fresh basalt
MW-17		-205.54	-658.45	277.45	279.67[b]	26.9	16.7-26.2	15.0-27.0	0-15.0	2	HSA	07/15/93	Weathered basalt and silt
MW-18		78.22	-1,276.14	267.70	269.90[b]	20.9	11.2-20.8	9.0-21.4	0-9.0	2	HSA	07/15/93	Weathered basalt
MW-19		174.60	-1,773.34	261.00	263.29[b]	23.0	13.5-23.0	11.7-24.1	0-11.7	2	HSA	07/16/93	Weathered basalt
MW-20		792.44	-2,156.98	256.81	259.22[b]	21.4	11.3-20.7	9.5-22.5	0-9.5	2	HSA	07/15/93	Clay and gravel

Table 3-2
Well Construction Summary
Environmental Monitoring Plan
Coffin Butte Landfill

Location	Status	Northing	Easting	Ground Surface Elevation (ft msl)	Surveyed Reference Elevation (ft msl)	Casing Total Depth (ft bgs)	Screened Interval (ft bgs)	Filter Pack Interval (ft bgs)	Seal (ft bgs)	Well Casing Diameter (Inches)	Drilling Method	Date Well Installed	Lithology Screened
MW-21		1,292.98	-2,438.44	254.25	256.67[b]	16.9	11.0-16.7	9.0-17.0	0-9.0	2	HSA	07/15/93	Fresh basalt
MW-22	Decom. 5/24/11	1,275.42	2,857.32	232.73	235.30[b]	24.2	14.0-23.6	11.0-24.2	0-11.0	2	HSA	07/22/94	Silt
MW-23		885.09	2,213.53	242.81	244.76[b]	22.7	12.4-22.1	9.6-22.7	0-9.6	2	HSA	08/02/94	Silt, clay, and gravel
MW-24		439.97	1,288.27	273.94	276.76[b]	34.9	19.5-34.5	18.0-35.0	0-18.0	2	HSA	08/31/98	Weathered basalt
MW-25	Decom. 5/24/11	1,181.50	2,626.80	240.39	242.79[b]	32.5	13.5-23.5	11.0-24.0	0-11.0	2	HSA	06/04/99	Silt and clayey silt
MW-26		388,531.15	7,493,967.51	235.18	237.91	27.2	17.1-26.9	15.5-28.0	0-15.5	2	Sonic	10/17/11	Silt
MW-27		388,887.59	7,493,881.47	252.12	254.76	35.1	25.0-34.8	23.5-35.5	0-23.5	2	Sonic	10/17/11	Clay with organics
LANDFILL WATER SUPPLY													
PW-1	Decom. 5/26/04	221.43	-650.93	282.50	282.80	125.0	60-125	na	0-58	6	Air Rotary	08/03/77	Sandstone and basalt
PW-2		3,190.41	3,122.43	248.90	250.27	199.0	95-199 OH	none	0-95	8	Air Rotary	07/30/92	Fresh basalt
PRIVATE WATER SUPPLY													
Duplex		156.61	667.42	289.01	289.01	74.0	26-74 OH	none	0-20	6	Rotary	07/17/72	Basalt (?)
Berkland		-749.95	545.36	327.63	327.63	220.0	20-220 OH	none	0-20	6	Rotary	05/01/78	Basalt and sandstone
Phillips		-459.53	165.45	291.00	291.00	—	—	—	—	—	—	—	(?)
Helms	Decom. 9/12/06	1,086.71	-2,646.00	250.72	250.72	50.0	45-50 OH	none	0-30	6	Cable tool	07/07/64	Sand, gravel, and clay
PIEZOMETERS													
P-1	Decom. 5/24/93	1,425.28	2,047.91	265.48	266.10	12.4	9.4-11.4	2.7-12.4	0-2.7	1	SSA	11/26/90	Sandy, silty clay (CL)
P-2	Decom. 5/24/93	1,305.46	2,263.98	245.46	245.81	16.8	14.2-16.2	4-16.8	1-4	1	SSA	11/26/90	Clay (CH)
P-3	Decom. 5/24/93	998.25	2,184.14	244.20	244.83	24.5	22-24	10-24.5	1-10	1	SSA	11/26/90	Clay (MH)
P-4	Decom. 5/24/93	799.54	1,835.40	253.13	253.73	13.0	10-12	8.7-13	1-8.7	1	SSA	11/27/90	Silty clay (CH)
P-5	Decom. 5/24/93	1,237.88	1,684.48	270.31	271.00	16.0	13.5-15.5	10-16	2-16	1	SSA	11/27/90	Sandy silty clay (ML)
P-6	Decom. 5/25/04	460.46	664.50	293.80	294.80	40.8	34-39	31-40.8	1-31	2	HSA	07/24/92	Fresh basalt
P-7	Decom. 5/26/04	710.74	560.99	297.30	298.55	32.0	18.8-28.8	16-32	1-16	2	HSA	07/28/92	Weathered basalt
P-8		-168.31	136.85	282.40	284.02	28.4	18.7-27.6	16.4-29.0	0-16.4	2	HSA	07/13/93	Weathered basalt
P-9		1,146.97	-2,113.73	273.66	276.01	23.3	17.2-23.0	15.0-23.3	0-15.0	2	HSA	07/15/93	Fresh basalt
P-10		1,118.44	-2,617.87	243.00	245.12	18.0	7.7-17.2	5.7-18.5	0-5.7	2	HSA	07/20/93	Weath. basalt, gravel and silt
P-11	Decom. 5/23/11	1,899.30	2,322.21	270.50	271.74	50.9	40.6-50.3	38.4-51.7	1.0-38.4	2	Air Rotary	03/28/94	Weathered basalt
P-12	Decom. 4/24/97	1,880.87	1,648.00	349.36	351.21	61.4	51.1-60.8	48.6-61.4	1.0-48.6	2	Air Rotary	03/31/94	Fresh basalt
P-13	Decom. 6/4/99	1,168.97	1,016.35	312.49	313.81	83.3	73.0-82.7	70.8-83.3	1.0-70.8	2	Air Rotary	03/29/94	Fresh basalt
P-14	Decom. 5/8/95	1,575.52	1,957.41	279.77	281.46	51.8	41.5-51.2	39.4-51.8	1.0-39.4	2	Air Rotary	03/28/94	Weathered to fresh basalt
P-15	Decom. 5/8/95	1,314.68	1,382.48	292.85	294.53	43.6	33.3-43.0	31.3-43.6	1.0-31.3	2	Air Rotary	03/29/94	Fresh basalt
P-16	Decom. 5/23/11	1,486.31	2,541.93	242.98	244.68	18.8	8.6-18.2	6.0-18.8	3.0-6.0	2	HSA	04/18/94	Silty and sandy clay
P-17	Decom. 7/17/12	2,079.11	1,560.54	371.10	372.10	45.5	35.2-45.0	32.7-47.6	2.0-32.7	2	Air Rotary	04/24/97	Fresh basalt
P-18	Decom. 7/17/12	1,886.12	1,089.23	378.21	380.87	45.5	35.0-45.0	32.0-46.0	0-32	2	Air Rotary	09/22/98	Fresh basalt
P-19		389,840.33	7,492,921.45	383.15	385.65	106.5	96.3-106.1	94.2-106.5	0-94.2	2	Air Rotary	08/17/12	Fresh basalt
P-20		389,793.66	7,492,187.47	585.92	588.32	131.5	101.4-131.2	98.5-132.1	0-98.5	2	Air Rotary	08/16/12	Fresh basalt
P-21		389,463.58	7,491,479.07	624.09	626.74	170.1	150.0-169.8	147.0-170.1	0-147.0	2	Air Rotary	08/14/12	Fresh basalt

Table 3-2
Well Construction Summary
Environmental Monitoring Plan
Coffin Butte Landfill

Location	Status	Northing	Easting	Ground Surface Elevation (ft msl)	Surveyed Reference Elevation (ft msl)	Casing Total Depth (ft bgs)	Screened Interval (ft bgs)	Filter Pack Interval (ft bgs)	Seal (ft bgs)	Well Casing Diameter (Inches)	Drilling Method	Date Well Installed	Lithology Screened
QP-1S	Decom. 4/30/10	1,540.19	-1,306.26	426.13	425.55	224.1	93.5-223.5	89.8-224.1	0-89.8	2	Air Rotary	09/03/98	Fresh basalt
QP-2S		976.12	-939.27	355.40	355.66	100.1	79.6-99.6	74.6-100.1	0-74.6	2	Air Rotary	09/02/98	Fresh basalt
QP-3S		1,980.90	-1,117.76	601.70	502.02	354.4	333.4-353.8	330.5-354.4	0-330.5	2	Air Rotary	09/09/98	Fresh basalt
QP-4S	Domestic supply	2,070.90	-232.91	717.15	718.95	403.1	363.1-403.1	NA	0-28.4	5	Air Rotary	09/15/98	Fresh basalt
QP-5N		2,489.07	-29.98	601.48	601.53	230.9	200.3-230.3	197.7-230.9	0-197.7	2	Air Rotary	09/16/98	Fresh basalt
QP-6N		3,003.81	-22.69	445.39	445.82	150.0	119.4-149.4	117.3-150.0	0-117.3	2	Air Rotary	09/18/98	Fresh basalt
QP-7N		2,925.42	-706.21	374.43	374.80	119.6	89.0-119.0	85.2-119.6	0-85.2	2	Air Rotary	09/09/98	Fresh basalt
WP-1		387,199.43	7,488,891.35	257.33	259.83	13.8	8.6-13.1	Prepack	0-1	2	Push probe	01/18/08	Clay
WP-3		386,661.80	7,489,643.80	271.01	273.39	9.8	4.6-9.2	Prepack	0-1	2	Push probe	01/18/08	Clay-sandy silt
WP-5		386,542.49	7,488,194.58	258.94	261.55	12.0	6.8-11.3	Prepack	0-2	2	Push probe	01/18/08	Sandy clay - clay
WP-6		385,925.20	7,487,996.18	262.17	264.85	13.0	7.8-12.3	Prepack	0-1	2	Push probe	01/19/08	Silty clay - clay
WP-8		387,861.89	7,487,856.57	253.15	255.80	10.3	5.1-9.7	Prepack	0-1	2	Push probe	01/19/08	Silty clay
WP-9		387,470.03	7,486,845.01	255.21	257.90	10.1	4.9-9.4	Prepack	0-1	2	Push probe	01/19/08	Clay

Notes: msl = mean sea level; bgs = below ground surface; OH= open hole; na = not available.
Drilling methods: HSA = hollow stem auger; SSA = solid stem auger

[a] Multiple well completion in single borehole.

[b] Measuring point is 0.02' higher than surveyed reference elevation shown due to installation of bladder pump enclosure. Groundwater elevations calculated from corrected elevation.

[c] Ground level and casing elevation were raised in June 1996 as part of regrading for truck scale. Wells and ground level elevation were resurveyed by Darryl Harms of Corvallis, OR.

[d] Estimated 20 feet higher than original elevation (added two 10-foot long pieces of 2-inch PVC pipe in 8/12/99 and 10/12/99). Well completion depths relative to original ground surface.

Table 3-3
Landfill Gas Monitoring Locations
Environmental Monitoring Plan
Coffin Butte Landfill

Landfill Perimeter Probes	Buildings/Structures
GP2	Office
GP3	Scale House
GP4	Pump House
GP5	Haz Mat Box
GP5A	Quarry Scale House
GP6	Gas Lock Box
—	Lock-up 1
—	Leachate Treatment Facility

Table 4-1
Monitoring Program
Environmental Monitoring Plan
Coffin Butte Landfill

	Sampling Frequency							
	Compliance Wells	Detection Wells	Other Site	Obsv/Piez	LDS	Leachate	Under-Drain	Surface Water
Parameter Group	MW-1D, MW-3D, MW-12S, MW-12D MW-10S, MW-10D, MW-11S, MW-11D MW-26, MW-27, MW-23[a], P-8[a]	MW-8S, MW-15, MW-17 MW-18, MW-19, MW-20 MW-21, MW-24 Phillips	MW-9S	(Listed on Table 3-1)	LDS-2B, LDS-3 LDS-4, LDS-5 LDS-WLP, LDS-ELP	L-Pond	S-U3, S-U4 S-U5, S-U6 S-U7	S-1, S-2, S-4
Site-Specific Parameters								
Indicator Parameters	2Q, 4Q	4Q	—	—	2Q, 4Q	—	—	—
Cl, HCO_3, TDS, Ca, Fe, Mg, Mn, Na, As								
Annual Scan	4Q	4Q	—	—	—	—	—	—
As, Sb, Ba, Cr, Ni, Se, Pb, Zn								
Field Parameters	2Q, 4Q	4Q	—	—	2Q, 4Q	4Q	—	2Q, 4Q
Water Levels	2Q, 4Q	2Q, 4Q	2Q, 4Q	2Q, 4Q	—	—	—	2Q, 4Q
Comprehensive Analytical Groups								
1b: Laboratory Indicator Parameters	5Y	5Y	5Y	—	5Y	4Q	—	—
TDS, TOC, NH_3, COD, TSS								
2a: Common Anions and Cations	5Y	5Y	5Y	—	5Y	4Q	—	—
Ca, Mg, Fe, Mn, Na, K, Si, NO_3, SO_4, HCO_3, Cl								
2b, 2c: Trace Metals	5Y	5Y	5Y	—	5Y	4Q	—	—
Sb, As, Ba, Be, Cd, Co, Cr, Cu, Pb, Ni, Se, Ag, Tl, V, Zn								
3: VOCs	2Q, 4Q	4Q	5Y	—	2Q, 4Q	4Q	—	—
Surface Water Parameters								
Cl, Ca, Fe, Mg, Mn, Na, BOD TKN, TPhos, PO_4	—	—	—	—	—	—	—	2Q, 4Q
Underdrain Parameters								
Cl, HCO3, TDS, Ca, Fe, Mg, Mn, Na	—	—	—	—	—	—	2Q, 4Q	—

NOTE:
1Q, 2Q, 3Q, 4Q = quarterly sampling events; 5Y = Quinquennial (every 5 years; to be scheduled with the DEQ as split sampling event-tentatively planned for 2019).
a Detection monitoring well that is sampled at frequency listed for compliance wells.

Table 5-1
Remedial Action Concentration Limits
West Side Landfill Units
Environmental Monitoring Plan
Coffin Butte Landfill

Compound	Remedial Action Concentration Limit (RACL)
Inorganic Compounds (mg/L)	
Chloride	250
Total Dissolved Solids (TDS)	500
Dissolved Metals (µg/L)	
Iron	300
Manganese	50
Trace Metals (µg/L)	
Antimony	6
Arsenic	10
Barium	1,000
Beryllium	4
Cadmium	5
Chromium	50
Lead	50
Nickel	100
Selenium	10
Silver	50
Thallium	2
VOCs (µg/L)	
1,4-Dichlorobenzene (1,4-DCB)	75
Chloroethane	—
Tetrachloroethene (PCE)	5
Trichloroethene (TCE)	5
Vinyl chloride	2

Table 5-2
Summary of Prediction Limit Statistics
Environmental Monitoring Plan
Coffin Butte Landfill

MW-26	Units	Data Set	W-calc	W (>)	Distribution	n	k	Mean (x)	s	x + ks	Max	2nd Max	Selected PL
Bicarbonate	mg/L	All	0.390	0.829	N-P	9	2.146	149	3.33	156	150	150	—
Chloride	mg/L	All	0.990	0.829	Normal	9	2.146	5.7	0.18	6.1	6.0	5.9	***6.1***
TDS	mg/L	All	0.780	0.829	N-P	9	2.146	189	6	202	200	190	—
Calcium	mg/L	All	0.750	0.829	N-P	9	2.146	22.722	0.972	25	25.0	24.0	—
Iron	mg/L	All	0.590	0.829	N-P	9	2.146	0.772	0.866	2.6	4.5	1.4	—
Iron (removed >1.5 IQR)	mg/L	Adjusted	0.860	0.788	Normal	6	2.616	0.4142	0.0269	0.48	4.5	1.3	—
Magnesium	mg/L	All	0.960	0.829	Normal	9	2.146	8.767	0.48	9.8	9.80	9.30	***9.8***
Manganese	mg/L	All	0.880	0.829	Normal	9	2.146	0.584	0.072	0.74	0.68	0.640	***0.74***
Sodium	mg/L	All	0.940	0.829	Normal	9	2.146	26.667	1.031	29	28	27.0	***29***
MW-27													
Bicarbonate	mg/L	All	0.940	0.829	Normal	9	2.146	351	61.7	483	430	410	***483***
Chloride	mg/L	All	0.720	0.829	N-P	9	2.146	12.2	1.09	15	13.0	12.0	—
TDS	mg/L	All	0.830	0.829	Normal	9	2.146	433	30.4	498	460	450	***498***
Calcium	mg/L	All	0.920	0.829	Normal	9	2.146	68.444	13.667	98	93.0	86.0	***98***
Iron	mg/L	All	0.900	0.829	Normal	9	2.146	7.833	5.159	18.9	15.0	12.0	***19***
Magnesium	mg/L	All	0.950	0.829	Normal	9	2.146	30.333	6.265	44	40.0	37.0	***44***
Manganese	mg/L	All	0.970	0.829	Normal	9	2.146	5.667	1.114	8.1	7.40	6.90	***8.1***
Sodium	mg/L	All	0.970	0.829	Normal	9	2.146	36.111	4.457	46	44.0	40.0	***46***
MW-22 (surrogate for MW-26)													
Bicarbonate	mg/L	1994-2000	0.930	0.887	Normal	16	1.83	169	3.1	175	150	150	***175***
TDS (removed >3 IQR)	mg/L	1994-2000	0.860	0.859	Normal	12	1.952	213	17	246	200	190	***246***
Calcium	mg/L	1994-2000	0.950	0.887	Normal	16	1.891	29.4	1.4	32	25.0	24.0	***32***

Notes:

[a] total concentration (unfiltered)

All = data set from 11/2011 through 10/2013.

Adjusted = data set adjusted to remove outliers greater than 1.5 IQR.

W(>) = Shapiro-Wilk critical statistic at 0.05.

N-P = non parametric distribution

k values from Unified Guidance Appendix D, Table 19-10: wells(w)=2; number background samples(n)=variable; 7 Constituents(COCs), performed semiannually.

Table 5-3
Site Specific Limits - East Side Wells
Assumes 2 Compliance Wells, 7 COCs, Semiannual Sampling
Environmental Monitoring Plan
Coffin Butte Landfill

		Baseline	Statistical	Prediction Limit		
Indicator Parameters SSLs	Units	Data Set	Distribution	MW-26	MW-27	Retesting
Bicarbonate	mg/L	2011-2013	Normal	175[a]	483	1-of-2
Chloride	mg/L	2011-2013	Normal	6.1	—	1-of-2
TDS	mg/L	2011-2013	Normal	246[a]	498	1-of-2
Calcium	mg/L	2011-2013	Normal	32[a]	98	1-of-2
Iron	mg/L	2011-2013	Normal	—	19	1-of-2
Magnesium	mg/L	2011-2013	Normal	9.8	44	1-of-2
Manganese	mg/L	2011-2013	Normal	0.74	8.1	1-of-2
Sodium	mg/L	2011-2013	Normal	29	46	1-of-2

Notes:

[a] surrogate value calculated from MW-22; to review after 8 sampling events.

Retesting scenario achieves annual site wide false positive rate of 10% per EPA Unified guidance.

Table 5-4
Data Evaluation Methods
East Side Compliance Wells
Environmental Monitoring Plan
Coffin Butte Landfill

Parameter Groups	Units	Drinking Water Standards	Indicator Parameter	Evaluation Method		
				SSL	DWS	Trend
1 Indicator Parameters						
1b Laboratory Indicator Parameters						
Ammonia (NH_3)	mg/L	—				
Chemical oxygen demand (COD)	mg/L	—				
Total dissolved solids (TDS)	mg/L	500 S	√	√	√	√
Total organic carbon (TOC)	mg/L	—				
2 Inorganic Monitoring Parameters						
2a Common Anions and Cations						
Bicarbonate (HCO_3)	mg/L	—	X	√		√
Calcium (Ca)	mg/L	—	X	√		√
Chloride	mg/L	250 S	X	√	√	√
Iron (Fe)	mg/L	0.3 S	X	√	√	√
Magnesium (Mg)	mg/L	—	X	√		√
Manganese (Mn)	mg/L	0.05 S	X	√	√	√
Nitrate (NO_3)	mg/L	10 P			√	
Potassium (K)	mg/L	—				
Silicon (Si)	mg/L	—				
Sodium (Na)	mg/L	—	X	√		√
Sulfate (SO_4)	mg/L	250 S			√	
2b Trace Metals						
Antimony (Sb)	µg/L	6 P	(A)		√	√
Arsenic (As)	µg/L	10 P	X		√	√
Barium (Ba)	µg/L	1,000 P	(A)		√	√
Beryllium (Be)	µg/L	4 P			√	
Cadmium (Cd)	µg/L	5 P			√	
Chromium (Cr)	µg/L	50 P	(A)		√	√
Cobalt (Co)	µg/L	—				
Copper (Cu)	µg/L	1,000 S			√	
Lead (Pb)	µg/L	15 FAL	(A)		√	√
Nickel (Ni)	µg/L	—	(A)		√	√
Selenium (Se)	µg/L	10 P	(A)		√	√
Silver (Ag)	µg/L	50 P			√	
Thallium (Tl)	µg/L	2 P			√	
Vanadium (V)	µg/L	—				
Zinc (Zn)	µg/L	5,000 S	(A)		√	√
3 Volatile Organic Compounds	µg/L	MCLs			√	√
Vinyl Chloride	µg/L	2 P		√ (PSCL)	√	

NOTE: —: no limit established or proposed; P: primary MCL or Oregon Reference Level; S: secondary MCL; FAL: federal action limit for lead (under review); SSL: site specific limit; PSCL: permit-specific concentration limit; DWS: drinking water standard.
(A): annual trace metals scan.

Table 5-5
Resampling Requirements Triggered by Compliance Well Analytical Results
Environmental Monitoring Plan
Coffin Butte Landfill

Result at Compliance Well	Action
Parameter detected at a concentration above three SSLs in one well; or Vinyl chloride detected at PSCL, which is defined as PQL Parameter detected at a concentration that indicates a significant change in water quality, not considered background. Examples of significant change: • Exceedance of a Safe Drinking Water Standard (primary MCL) unless considered background (e.g., arsenic). • Detection of a previously undetected VOC not detected historically or considered field or laboratory contamination.	1. Notify DEQ in writing or by e-mail within 10 working days of receipt of laboratory results. 2. Resample and reanalyze for the parameter(s) at well where exceedance occurred. If the parameter represents a known release previously confirmed to DEQ in writing, resampling is not required.
None of the above	No notification required. Continue monitoring with the next scheduled event.

Table 5-6
Potential Actions in Response to Change in Water Quality
Environmental Monitoring Plan
Coffin Butte Landfill

Trigger	Assessment[a]	Response Action[a]
Non Hazardous Compound		
Indicator—above three SSLs in sampling event	-Resample well for parameters that exceeded SSLs. -Re-evaluate statistical distribution of baseline to determine whether the exceedance is in fact an excursion above natural background quality. -Continue monitoring to assess for developing trend. -Determine whether other compounds (such as hazardous constituents) display similar behavior. -Examine trends in area detection wells for similar behavior.	Review best management practices near area of concern.
Indicator—increasing trend	-Examine historical variability of parameter; correlate with other site indicators or other influences such as rainfall. -Continue to monitor; closely examine other compounds and other wells for associated increase.	
Hazardous Compound		
Vinyl Chloride—above PSCL (PSCL set at PQL for laboratory [e.g., 0.5 µg/L])	-Resample well for vinyl chloride. -Determine whether potential receptors could be exposed.	If receptor identified, develop RBC for hypothetical exposure; review performance of landfill containment system, develop mitigation measures as appropriate.
Trace metal—above primary MCL or state reference level (unless naturally occurring at background level)	-Evaluate as above. -Reanalyze filtered water sample to check for concentration of dissolved compound. -Determine whether potential receptors could be exposed.	If receptor identified, develop RBC for hypothetical exposure; review performance of landfill containment system, develop mitigation measures as appropriate.
Trace metal—increasing trend	Continue to monitor, assess with respect to sustained trends in other compounds present.	
VOC—detected	Evaluate whether landfill gas is potentially migrating in area, or if detection is result of leachate release; continue more frequent monitoring to determine if trend develops, or if it can be correlated with changes in inorganic water quality.	If landfill gas is suspected of affecting groundwater quality, optimize landfill gas collection system to reduce migration.
VOC—detected above primary MCL or state reference level	-Evaluate as above. -Determine whether potential receptors could be exposed.	If receptor identified, develop RBC for hypothetical exposure; review performance of landfill containment system, develop mitigation measures as appropriate.

Notes:

[a] For verified significant increase or exceedance of SSL or PSCL, VLI will notify the DEQ of assessment or response plan.

RBC=risk based concentration

MCL=federal primary maximum contaminant level (drinking water standard); state reference levels from OAR 340-40-020 Table 1 (Inorganics) and Table 2 (Organics).

FIGURES

0 2000 4000

SCALE IN MILES

Tuppan Consultants LLC

460 Second Street, Suite 103
Lake Oswego, Or 97034

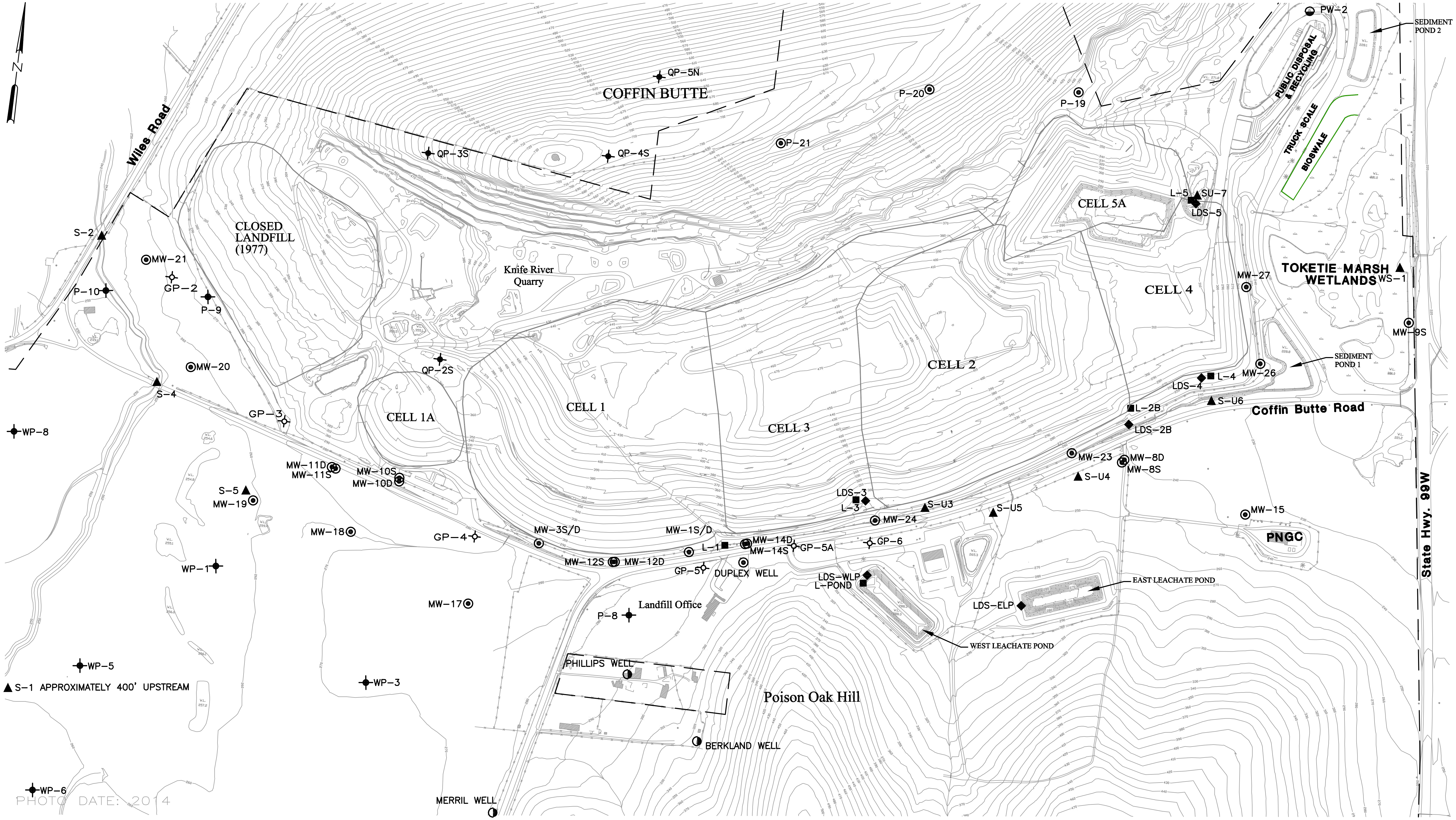
Ph. 503.675.1335

DATE 1-28-09
DWN GRH
APP
REV
PROJECT NO.
VLI-001-002

FIGURE 1-1
COFFIN BUTTE LANDFILL
BENTON COUNTY, OREGON

SITE LOCATION

Jan. 28, 2009
C:\000Projects\00Tuppan\Coffin Butte\Environmental plan 2005\fig1-14.dwg



◎ MONITORING WELL/PIEZOMETER

✛ OBSERVATION WELL/PIEZOMETER

⊖ LANDFILL WATER SUPPLY WELL

⌖ GAS PROBE

◑ PRIVATE WELL

■ LEACHATE SUMP

◆ LEAK DETECTION SYSTEM

▲ SURFACE WATER MONITORING STATION

0 500 1000

SCALE IN FEET

Tuppan Consultants LLC

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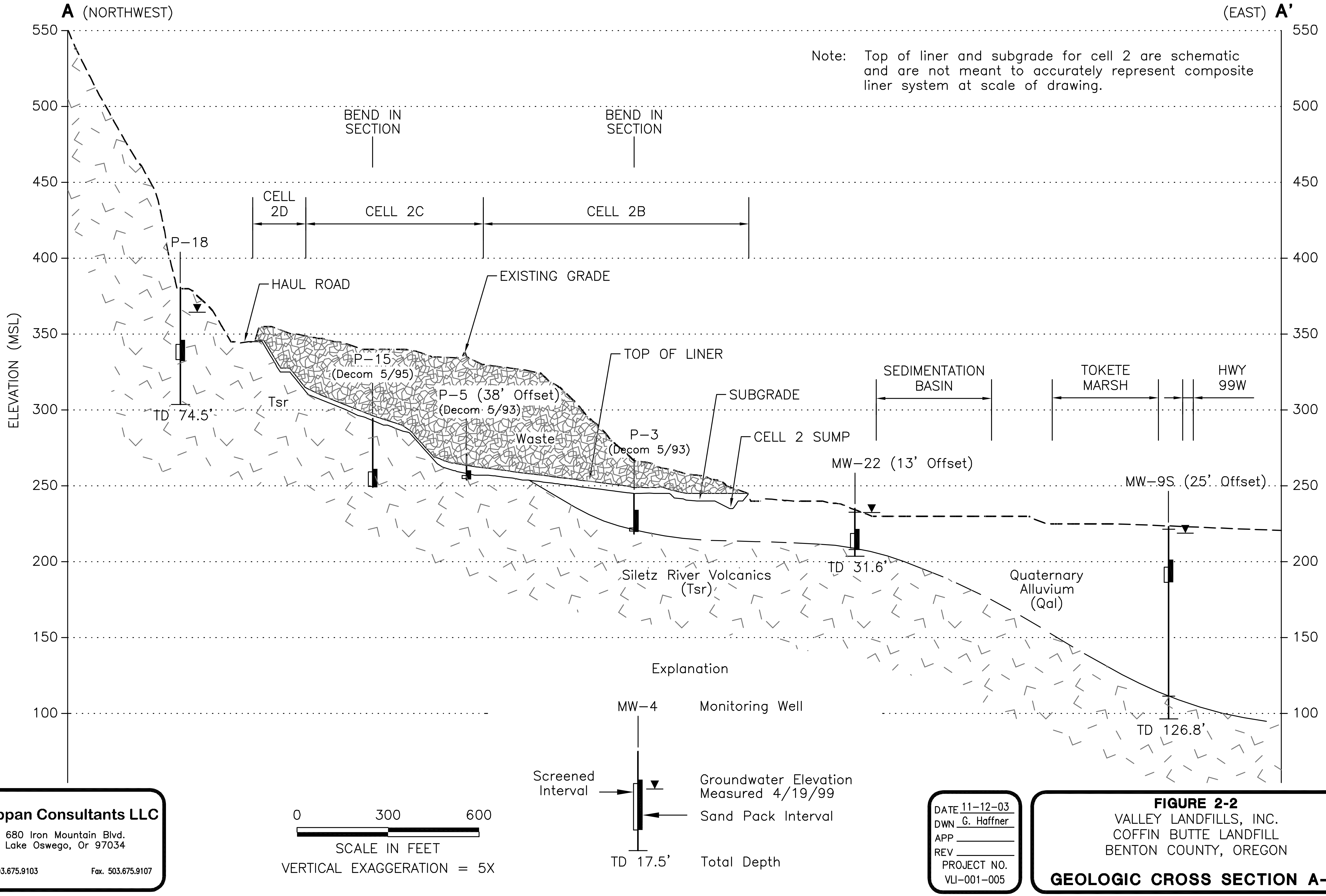
Ph. 503.675.1335

DATE 6–26–14
DWN GRH
APP
REV
PROJECT NO.
VLI–001–005

FIGURE 2-1
COFFIN BUTTE LANDFILL
BENTON COUNTY, OREGON

Site Map and Monitoring Locations

June 26th, 2014
D:\Tuppan\Coffin Butte\Site Map and Monitoring Locations 2014.dwg

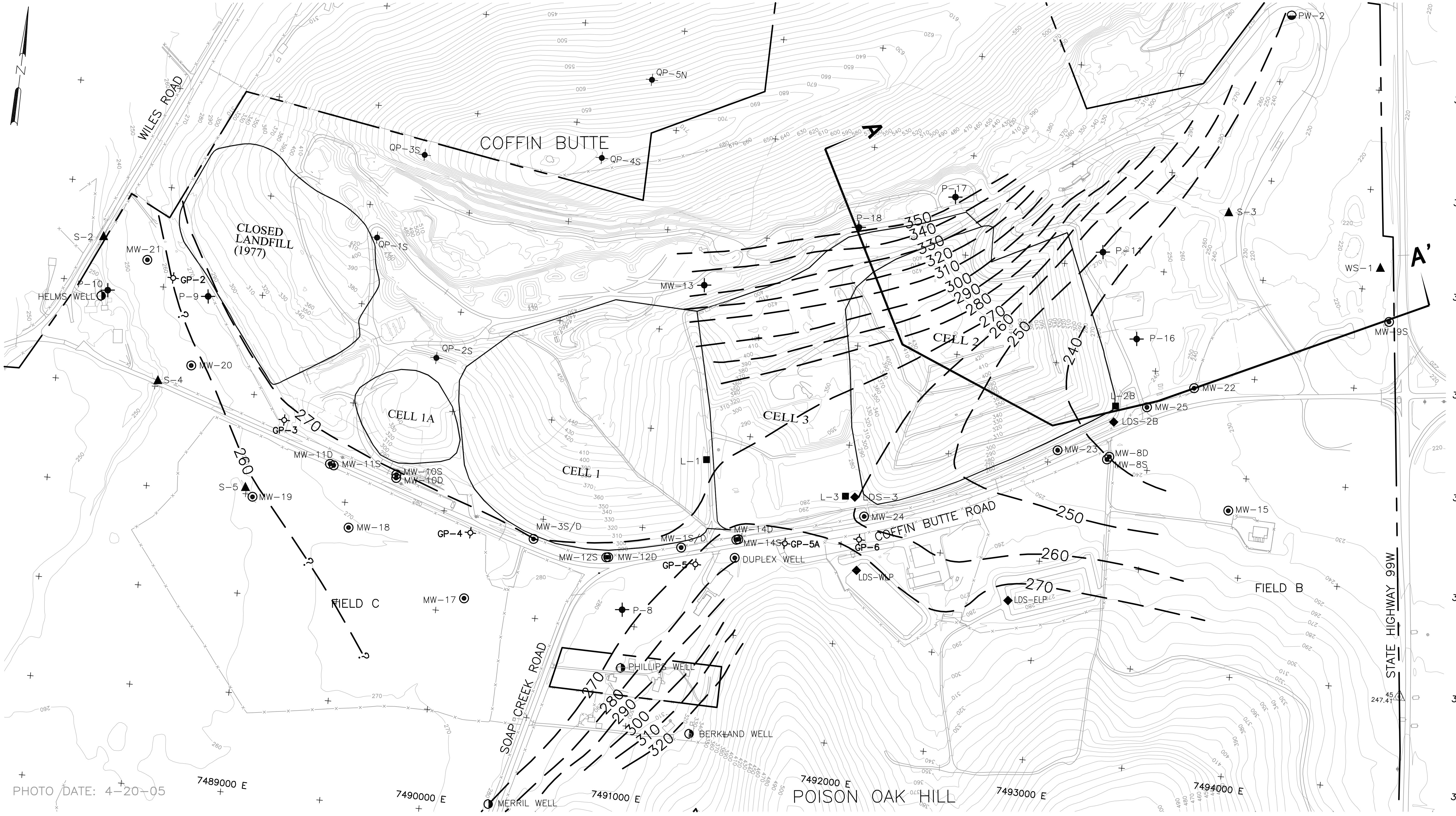


Tuppan Consultants LLC
680 Iron Mountain Blvd.
Lake Oswego, Or 97034
Ph. 503.675.9103 Fax. 503.675.9107

DATE 11-12-03
DWN G. Haffner
APP
REV
PROJECT NO.
VLI-001-005

FIGURE 2-2
VALLEY LANDFILLS, INC.
COFFIN BUTTE LANDFILL
BENTON COUNTY, OREGON

GEOLOGIC CROSS SECTION A-A'



EXPLANATION

◎ MONITORING WELL
◑ PRIVATE WELL
✛ OBSERVATION WELL/PIEZOMETER
◒ LANDFILL WATER SUPPLY WELL
▲ SURFACE WATER MONITORING STATION
⌖ GAS PROBE
■ LEACHATE SUMP
◆ LEAK DETECTION SYSTEM

— — — PROPERTY LINE
— — — GROUNDWATER ELEVATION CONTOUR (FT-MSL) IN BEDROCK (4-19-99)

0 500 1000
SCALE IN FEET

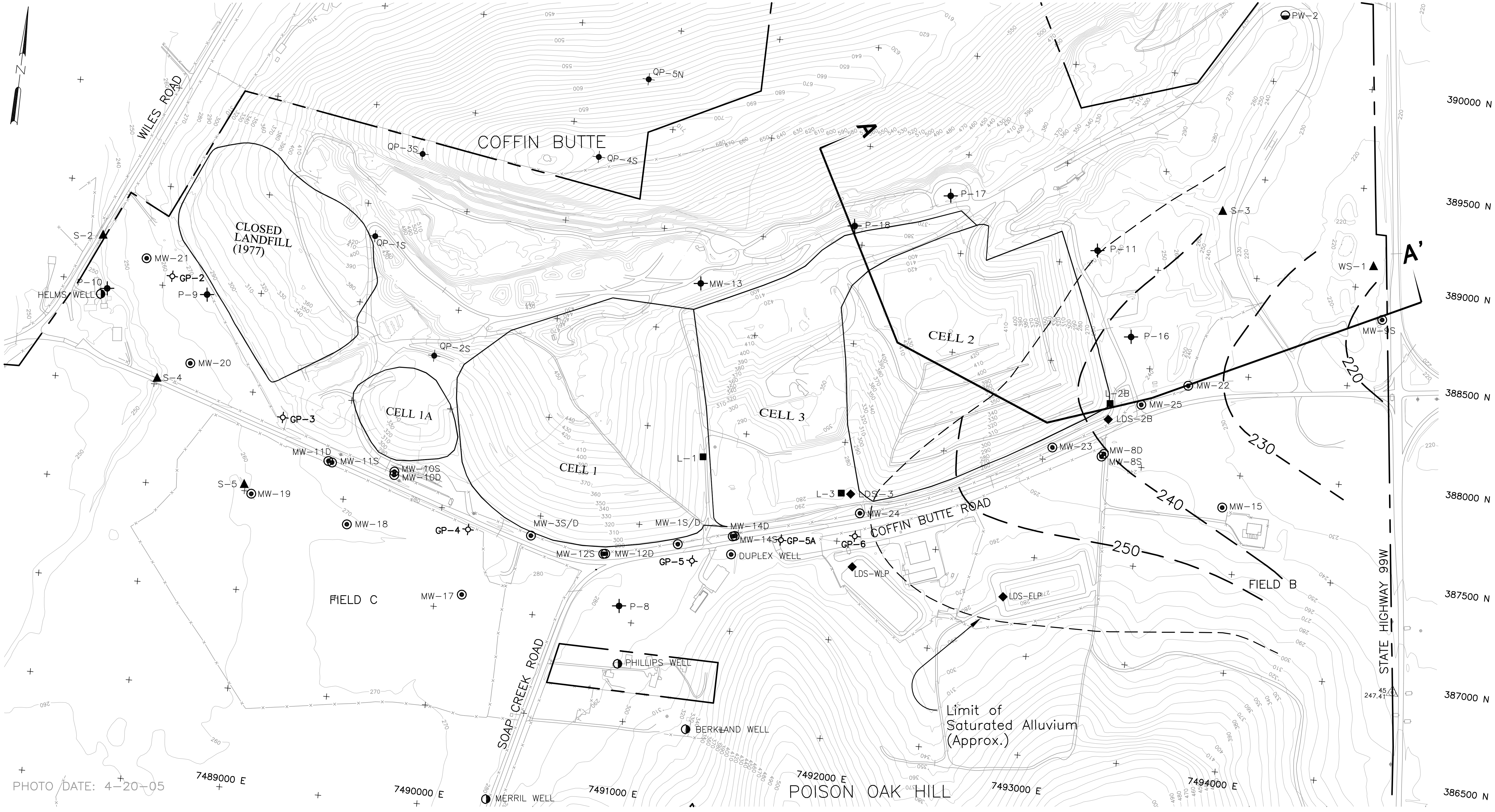
Tuppan Consultants, LLC
460 Second Street, Suite 103
Lake Oswego, Or 97034
Ph. 503.675.1335 Cell 503.866.2551

DATE 12-14-05
DWN GRH
APP
REV
PROJECT NO.
VL1-001-005

FIGURE 2-3
COFFIN BUTTE LANDFILL
BENTON COUNTY, OREGON

BEDROCK
GROUNDWATER CONTOURS

March 17, 2011
C:\000Projects\00Tuppan\Coffin Butte\Envir. mon. plan 2005\fig2-3.dwg



EXPLANATION

◉ MONITORING WELL

◐ PRIVATE WELL

✦ OBSERVATION WELL/PIEZOMETER

⊖ LANDFILL WATER SUPPLY WELL

▲ SURFACE WATER MONITORING STATION

⌖ GAS PROBE

■ LEACHATE SUMP

◆ LEAK DETECTION SYSTEM

— — — PROPERTY LINE

— — — GROUNDWATER ELEVATION CONTOUR (FT-MSL) IN ALLUVIUM (4-19-99)

0 500 1000

SCALE IN FEET

Tuppan Consultants, LLC

460 Second Street, Suite 103
Lake Oswego, Or 97034

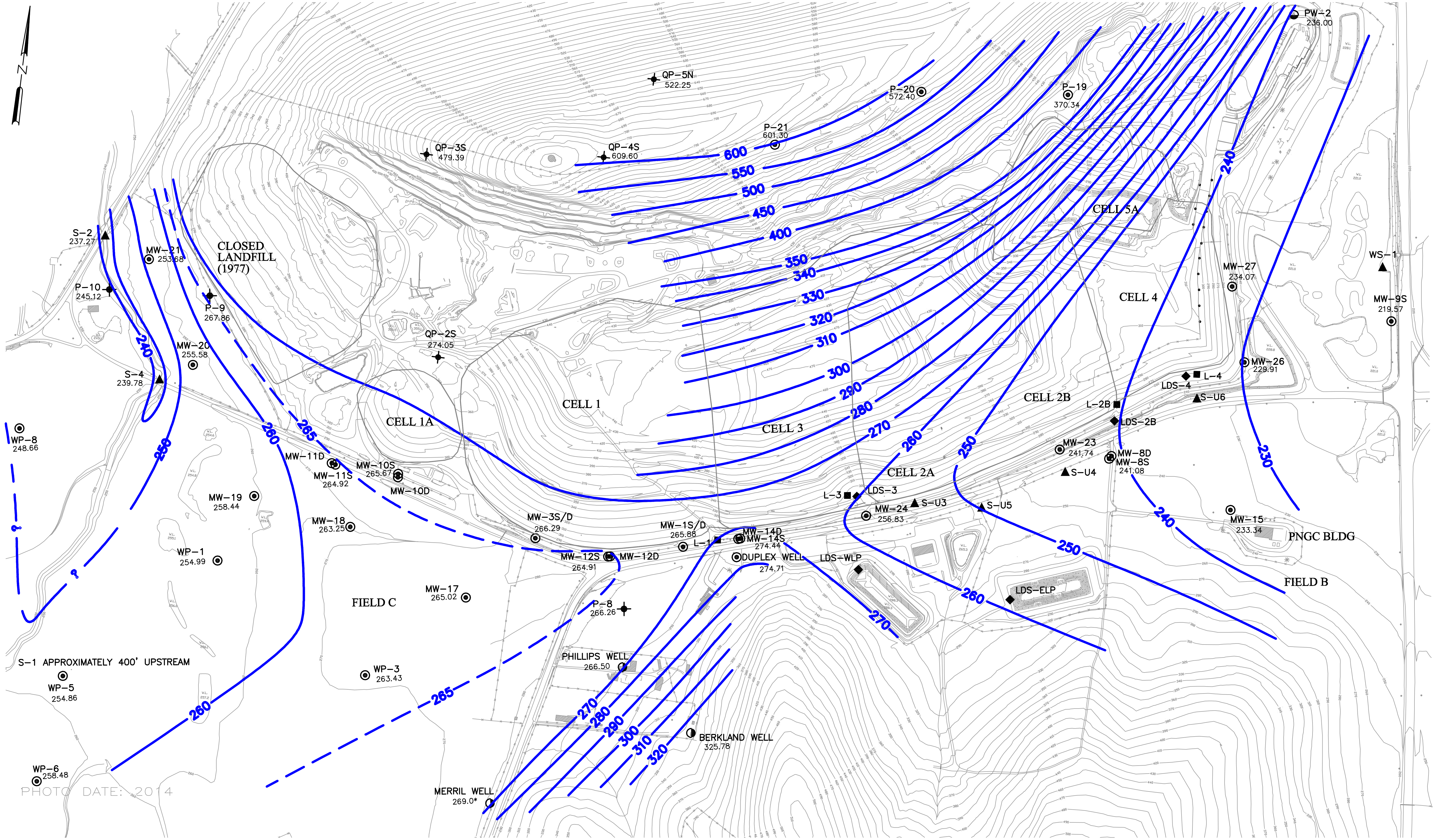
Ph. 503.675.1335 Cell 503.866.2551

DATE 12-14-05
DWN GRH
APP
REV
PROJECT NO.
VL1-001-005

FIGURE 2-4
COFFIN BUTTE LANDFILL
BENTON COUNTY, OREGON

ALLUVIUM
GROUNDWATER CONTOURS

March 17, 2011
C:\000Projects\00Tuppan\Coffin Butte\Envir. mon. plan 2005\fig2-4.dwg



◎ MONITORING WELL

⊕ OBSERVATION WELL/PIEZOMETER

◒ LANDFILL WATER SUPPLY WELL

* PUMPING: APRIL AVERAGE USED FOR CONTOURING

◑ PRIVATE WELL

■ LEACHATE SAMPLING POINT

◆ LEAK DETECTION SYSTEM SAMPLING POINT

▲ SURFACE WATER MONITORING STATION

—?— GROUNDWATER ELEVATION CONTOUR (FT-MSL) QUERIED WHERE PROJECTED

0 500 1000

SCALE IN FEET

Tuppan Consultants LLC

460 Second Street, Suite 103
Lake Oswego, Or 97034

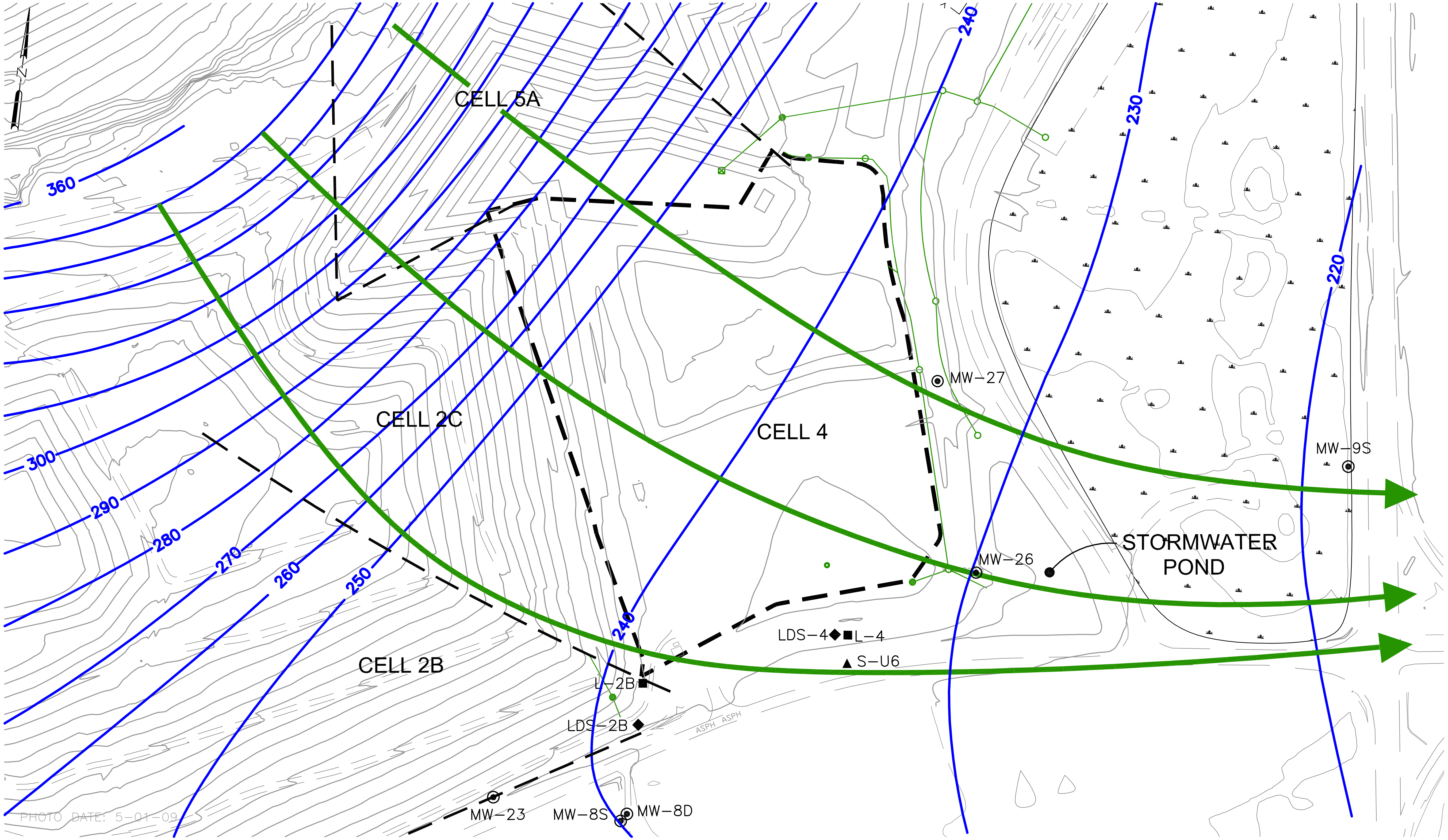
Ph. 503.675.1335

DATE 6-25-14
DWN GRH
APP
REV
PROJECT NO.
VLI-001-002

FIGURE 2-5
COFFIN BUTTE LANDFILL
BENTON COUNTY, OREGON

APRIL 14, 2014
GROUNDWATER CONTOURS

6-25-2014
D:\Tuppan\Coffin Butte\GW April 2014.dwg



◉	MONITORING WELL
✦	PIEZOMETER
■	LEACHATE SAMPLING POINT
◆	LEAK DETECTION SYSTEM SAMPLING POINT
▲	SURFACE WATER MONITORING STATION
—240—	GROUNDWATER ELEVATION CONTOUR (FT–MSL) OCTOBER 2010 (LOW WATER)
←	GROUNDWATER FLOW PATH

0 200 400
SCALE IN FEET

Tuppan Consultants LLC
460 Second Street, Suite 103
Lake Oswego, Or 97034
Ph. 503.675.1335

DATE 9–24–12
DWN GRH
APP
REV
PROJECT NO.
VLI–001–005

FIGURE 3–1
COFFIN BUTTE LANDFILL
BENTON COUNTY, OREGON

EASTSIDE COMPLIANCE WELLS

9–24–12
C:\00Projects\00Tuppan\Coffin Butte\2011 Cell 4\Fig 3–1 Eastside compliance wells.dwg

APPENDIX A

SOLID WASTE PERMIT

DEQ
State of Oregon
Department of
Environmental
Quality

SOLID WASTE DISPOSAL SITE PERMIT:
Municipal Solid Waste Landfill

Oregon Department of Environmental Quality
750 Front Street NE, Suite 120
Salem, OR 97301
Telephone: (503) 378-5047

Issued in accordance with the provisions of ORS Chapter 459 and subject to the land use compatibility statement referenced below.

ISSUED TO:

Valley Landfills, Inc.
28972 Coffin Butte Road
Corvallis, OR 97330

(541) 745-2018

FACILITY NAME AND LOCATION:

Coffin Butte Landfill
29175 Coffin Butte Road
Corvallis, OR 97330

Section 13&18, T10S, R5&4W, Benton County

OWNER:

Valley Landfills, Inc.
28972 Coffin Butte Road
Corvallis, OR 97330

OPERATOR:

Valley Landfills, Inc.
28972 Coffin Butte Road
Corvallis, OR 97330

bmay@republicservices.com

ISSUED IN RESPONSE TO:

- A solid waste permit renewal application received August 8, 2008 ; and
- A Land Use Compatibility Statement from Benton County dated December 20, 2000.

The determination to issue this permit is based on findings and technical information included in the permit record.

ISSUED BY THE OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY

11/24/2010

Brian Fuller, Manager Hazardous and Solid Waste
Permitting and Compliance
Western Region

Date

Permitted Activities

Until this permit expires or is modified or revoked, the permittee is authorized to establish, operate, and maintain a solid waste land disposal site in conformance with the requirements, limitations, and conditions set forth in this document, including all attachments.

TABLE OF CONTENTS

Introduction This document is a solid waste permit issued by the Oregon Department of Environmental Quality (DEQ) in accordance with Oregon Revised Statutes (ORS) 459 and Oregon Administrative Rules (OAR), Chapter 340.

PERMIT ADMINISTRATION

1.0 PERMIT ISSUANCE

1.1 Permittee

This permit is issued to Valley Landfills, Inc.

1.2 Permit number

This permit will be referred to as Solid Waste Permit Number 306.

1.3 Permit term

The permit is issued on the date it is signed.

The permit's expiration date is July 31, 2020.

1.4 Facility type

The facility is permitted as a municipal solid waste landfill.

1.5 Facility owner/ operator

The owner of this facility is:

Valley Landfills, Inc.
28972 Coffin Butte Road
Corvallis, OR 97330

The operator of this facility is:

Valley Landfills, Inc.
28972 Coffin Butte Road
Corvallis, OR 97330

1.6 Basis for permit issuance

This permit is issued based upon the following documents submitted by the permittee:

- Solid waste permit renewal application received August 8, 2008 ;
- Land Use Compatibility Statement from Benton County dated December 20, 2000.

1.7 Definitions

Unless otherwise specified, all terms are as defined in OAR 340-093-0030.

1.8 Legal control of property

The permittee must at all times maintain legal control of the disposal site property; including maintaining a current permit, contract or agreement that allows the operation of the facility if the site is not owned by the permittee.

1.9 Submittal address

All submittals to DEQ, unless otherwise noted, must be sent to:

Oregon Department of Environmental Quality
Manager, Solid Waste Program
750 Front Street NE, Suite 120
Salem, OR 97301

Telephone: (503) 378-5047

2.0 DISCLAIMERS

2.1 Property rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights.

2.2 DEQ liability

DEQ, its officers, agents, or employees do not sustain any liability on account of the issuance of this permit or on account of the construction, maintenance, or operation of facilities pursuant to this permit.

3.0 AUTHORITY

3.1 Ten year permit

This permit is issued for a maximum of 10 years as authorized by Oregon Revised Statutes 459.245 (2).

3.2 Documents superseded

This document is the primary solid waste permit for the facility, superseding all other solid waste permits issued for Coffin Butte Landfill by DEQ.

3.3 Permittee responsibility and liability

Conditions of this permit are binding upon the permittee. The permittee must conduct all facility activities in compliance with the provisions of the permit. The permittee is liable for all acts and omissions of the permittee's contractors and agents in carrying out the operations and other responsibilities pursuant to this permit.

3.4 Other compliance

This permit's issuance does not relieve the permittee from the responsibility to comply with all other applicable federal, state, or local laws or regulations, including the following solid waste requirements, and any future updates or additions to these requirements:

- Solid waste permit application received August 8, 2008;
- Oregon Revised Statutes, Chapters 459 and 459A;
- Oregon Administrative Rules Chapter 340; and
- Any documents submitted by the permittee and approved by DEQ.

3.5 DEQ access to disposal site

The permittee must allow representatives of DEQ access to the disposal facility at all reasonable times for the purpose of making inspections, surveys, collecting samples, obtaining data and carrying out other necessary functions related to this permit. Reference: OAR 340-093-0050(6).

3.6 Penalties

Violation of permit conditions will subject the permittee to civil penalties of up to $10,000 for each day of each violation.

4.0 PERMIT MODIFICATION

4.1 Five year review

In the permit's 4th to 6th year, DEQ will review the permit and amend it if necessary.

DEQ will consider the following factors in making this determination:

- Compliance history of the facility;
- Changes in volume, waste composition, or operations at the facility;
- Changes in state or federal rules which should be incorporated into the permit;
- A significant release of leachate or landfill gas to the environment from the facility;
- Significant changes to a DEQ-approved site development plan, and/or conceptual design; and
- Other significant information or events.

4.2 Permit modification

DEQ or the permittee may propose to change the permit at any time during the permit's term.

Once approved by DEQ, any permit-required plans become part of the permit by reference. DEQ may provide notice and opportunity for review of permit-required plans.

4.3 Modification and revocation by DEQ

The Director may, at any time before the expiration date, modify, suspend, or revoke this permit in whole or in part, in accordance with Oregon Revised Statutes 459.255, for reasons including but not limited to the following:

- Violation of any terms or conditions of this permit or any applicable statute, rule, standard, or order of the Commission;
- Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts;
- A significant change in the quantity or character of solid waste received or in the operation of the disposal site.

4.4 Modification by permittee

The permittee must apply for a modification to this permit if there is a significant change in facility operations or a deviation from permitted activities.

4.5 Public participation

DEQ will issue a public notice to inform the public of any significant changes to the permit.

4.6 Changes in ownership or address

At least 10 days in advance, the permittee must report to DEQ any change in the facility's ownership or the permittee's or operator's name and/or address.

ALLOWABLE ACTIVITIES

5.0 AUTHORIZATIONS

5.1 Wastes authorized for receipt

This permit authorizes the facility to accept: solid wastes as defined in OAR 340-093-0030(85), and

- the following wastes, when special handling and management requirements for their disposal are included in a special waste management plan approved by DEQ:
    - Cleanup Materials Contaminated With Hazardous Substances as defined in OAR 340-093-0030(17), in accordance with OAR 340-093-0170
    - wastes requiring special management as defined in OAR 340-093-0190
    - industrial solid wastes as defined in OAR 340-093-0030(48)

5.2 Authorization of other wastes

DEQ may authorize the permittee to accept other wastes if:

- The permittee develops a Special Waste Management Plan (SWMP) and submits it to DEQ for review and approval;
- DEQ approves the SWMP; and
- The permittee can demonstrate that the materials are not hazardous waste, as defined by state and federal regulations or otherwise a threat to human health or waters of the state.

5.3 Tires for recycling

This permit authorizes the permittee to accept up to 100 whole tires at this facility for storage and removal.

This permit authorizes the permittee to accept up to 2,000 whole tires at this facility for storage and removal if the permittee maintains a continuous contract with a waste tire carrier to remove the tires from the site.

5.4 Salvaging and recycling

This permit authorizes the permittee to conduct salvaging and recycling in a controlled and orderly manner. The permittee must notify DEQ prior to changing salvaging and recycling operations.

5.5 Electronic waste

Electronic waste can be accepted for recycling if conducted in a controlled and orderly manner. Materials must be stored under cover and unexposed to the elements. This authorization is for collection only; this facility is not authorized to dismantle, disassemble or remanufacture e-waste.

Collection must be done according to a DEQ approved facility Operations Plan

6.0 PROHIBITIONS

6.1 Hazardous waste disposal

The permittee must not accept any regulated hazardous wastes.

Reference: 40 CFR 258.20 (b).

In the event discovered wastes are hazardous or suspected to be hazardous, the permittee must, within 24 hours, notify DEQ and initiate procedures to identify and remove the waste. Hazardous wastes must be removed within 90 days, unless DEQ approves otherwise. The permittee's temporary storage and transportation practices must comply with DEQ rules.

6.2 Liquid waste disposal

The permittee must not accept liquid waste for disposal.

Definition: Liquid wastes are wastes that do not pass the paint filter test performed in accordance with EPA Method 9095B.

6.3 Vehicle disposal

The permittee must not accept discarded or abandoned motor vehicles, including trailers or mobile homes, for disposal.

6.4 Used oil disposal

The permittee must not accept used oil for disposal.

6.5 Battery disposal

The permittee must not accept lead-acid batteries for disposal.

6.6 Tire disposal

The permittee must not accept waste tires for disposal.

6.7 Recyclable material disposal

The permittee must not landfill or dispose of any source separated recyclable material brought to the disposal site.

Exception: If the source separated material is unusable or not recyclable it may be landfilled. DEQ must agree to such disposal and pre-approve the identified sources of unusable source separated material prior to its disposal.

6.8 Open burning

The permittee must not conduct any open burning at the site.

6.9 Electronic waste disposal

The permittee must not knowingly accept the following covered electronic devices for disposal:

- Computer monitors having a viewable area greater than four inches diagonally;
- Televisions having a viewable area greater than four inches diagonally;
- Desktop computers; or
- Portable computers.

Reference: Oregon Revised Statutes 459.247 and 459A.300-365.

OPERATIONS AND DESIGN

7.0 OPERATIONS PLAN

7.1 Operations plan submittal Within 360 days of the permit issue date, the permittee must review and submit any necessary updates to the site Operations Plan to DEQ for review and approval. The updated plan must be consistent with the conditions of this permit. A DEQ-approved plan becomes an integral part of the permit.

7.2 Plan content The Operations Plan must describe the methods of operation of the facility in accordance with all regulatory and permit requirements. Among other things, the Operations Plan must describe generally how the facility will be operated to protect human health and the environment.

General Topics	Specific Operating Procedures:
General operations	• Screening procedures for detection of unauthorized wastes; • Handling and removal of unauthorized wastes discovered at the facility; • Management of landfill gas; • Management of landfill leachate; • Designing surface water and erosion control structures; and • Responding to non-compliance events or situations.
Disposal operations	• Placement of daily and intermediate cover; • Detecting and preventing the disposal of regulated hazardous wastes, polychlorinated biphenyl wastes, and any other DEQ-prohibited wastes; • Disposal of putrescible wastes; • Disposal of cleanup materials contaminated with hazardous substances; and • Fill progression and phasing.
Other materials	• Procedures for dealing with cleanup of an oil or hazardous materials spill, or broken cathode ray tube (CRT) televisions or monitors. • A Program for preventing acceptance of covered electronic devices for disposal. • Procedure for reporting spills to the Oregon Emergency Response System (OERS) at 1-800-452-0311. Note: This facility is not authorized to intentionally break, grind or shred CRTs. Procedures for protecting CRTs and other e-waste from breakage must be reflected in the facility operations plan.
Special Waste Management Plan (SWMP)	• Identifying and characterizing special wastes (i.e., wastes that require special management or waste streams not otherwise authorized by the permit); • Identifying the source of all special wastes; • Determining appropriate handling procedures; and • Documenting plan implementation, including waste characterization. References: OAR 340-093-0190, OAR 340-094-0040(11)(b)(J)
Ancillary operations	• Waste unloading and handling; • Handling and removal of waste tires; and • Management of transfer containers.

Inspection and maintenance	• Washing equipment; • Maintaining leachate and gas collection systems; and • Maintaining surface water control structures.
Operating record	• Establishing and maintaining the operating record.
Contingency	• Providing fire protection equipment; and • Notifying DEQ about emergencies and fires.

Reference: OAR 340-094-0040 describes requirements for preparing an Operations Plan.

7.3 **Operations and maintenance manual** Within 60 days of the Operations Plan's approval, the permittee must prepare and submit an updated Operations and Maintenance (O&M) Manual which includes detailed inspection and maintenance procedures and an associated schedule for all facility components that require periodic inspection.

The O&M Manual must include specific procedures for routine preventative maintenance and repairs and for response to emergency situations. The preventative inspection and maintenance program should address the following equipment and facilities: personnel safety equipment, operating equipment, support facilities, environmental control systems, environmental monitoring systems, and the transportation system. The permittee must keep a copy of the Operations and Maintenance Manual with the Operating Record, readily available for DEQ inspection and review.

7.4 **Plan and manual updates** The permittee must update and revise both the Operations Plan and the Operations and Maintenance Manual as necessary to reflect current and future facility conditions and procedures.

The permittee must submit any associated revisions or updates to DEQ for review and approval.

7.5 **Plan and manual compliance** The permittee must operate the facility in accordance with the approved Operations Plan and Operations and Maintenance Manual, and any amendments to these documents.

8.0 RECORDKEEPING AND REPORTING - OPERATIONS

8.1 **Non-compliance reporting** The permittee must take immediate corrective action for any violations of permit conditions or DEQ rules and notify DEQ at:

(503) 378-5047

DEQ response: DEQ may investigate the nature and extent of the compliance problem and evaluate the adequacy of the permittee's corrective action plans.

8.2 **Permit display** The permittee must display this permit where operating personnel can easily refer to it.

8.3 **Access to records** DEQ must have access, when requested, to all records and reports related to the permitted facility

8.4 Procedure

The permittee's record keeping and reporting procedures are as follows:

Step	Action
1	Keep the Operating Record at the facility or at another DEQ-approved location.
2	Place information required by 40 CFR 258.29 in the Operating Record.
3	During facility operations, record the amount of each waste type received. Record zero (0) if the waste is not received. *Identify the following waste types and categorize them as either in-state or out-of-state wastes:* • Municipal solid waste; • Industrial solid waste; • Petroleum-contaminated soil; • Approved alternative daily cover; and • Other.
4	If applicable, every quarter, record the amount of each material recovered for recycling or other beneficial purpose.
5	Submit the information collected in Step 3 above on the Solid Waste Disposal Report/Fee Calculation form provided by DEQ. Pay solid waste fees as required by OAR 340-097. Date due: the last day of the month following the end of the calendar quarter.
6	Submit the information collected in Step 4 above to the Wasteshed Representative on a DEQ provided or approved form. Date due: January 25th of each year.
7	Retain copies of all records and reports for 10 years after their creation.
8	Update all records to reflect current conditions at the facility.

8.5 Submittal address

Send required submittals to:

Oregon Department of Environmental Quality
Land Quality
Solid Waste Program
811 S.W. Sixth Ave.
Portland, OR 97204

(503) 229-5409

9.0 SPECIFIC OPERATING CONDITIONS

9.1 Discovery of prohibited waste

If the permittee discovers prohibited wastes, the permittee must notify DEQ within 24 hours and begin to isolate or remove the waste. In addition the permittee must take digital photos of the prohibited waste to document its quantity, nature, identity and source.

Within 60 days following the discovery, the permittee must transport non-putrescible, non-hazardous prohibited waste to a disposal or recycling facility authorized to accept such waste, unless otherwise approved or restricted by DEQ. The permittee must obtain DEQ's written approval to store putrescible, non-hazardous, prohibited wastes.

9.2 Spills notification

Oregon Revised Statue 466.635 and Oil and Hazardous Materials Emergency Response Requirements, Chapter 340, Division 142 require immediate notification to Oregon Emergency Response System (OERS) after taking any required emergency actions to protect human health and the environment when oil or hazardous materials are spilled. The spill must be immediately reported to OERS at 1-800-452-0311 if the spill is of a reportable quantity. Reportable quantities include:

- *Any* amount of oil spilled to waters of the state;
- Oil spills on land in excess of 42gallons;
- Two hundred pounds (25 gallons) or more of spilled pesticide residue; and
- Spills of hazardous materials that are equal to, or greater than, the quantity listed in the Code of Federal Regulations, 40 CFR Part 302 (List of Hazardous Substances and Reportable Quantities), and amendments adopted before July 1, 2002.

For a complete list of hazardous materials required to be reported, please refer to OAR 340-142-0050.

9.3 Access roads

The permittee must provide all-weather access roads from the landfill property line to the active operational area and the environmental monitoring stations, and maintain them in a manner that prevents traffic hazards, dust and mud.

The permittee must use appropriate means, including truck washing, as needed to prevent haul trucks from tracking mud on external roadways outside the landfill boundaries. Any truck washing activities must be conducted on a hard surface and any disposal of wastewater must be accomplished in a manner approved by DEQ.

9.4 Unloading area

The area(s) for unloading incoming waste must be clearly defined by signs, fences, barriers or other devices.

9.5 Daily cover

At the end of each working day the permittee must cover all solid wastes with a six inch, or thicker, layer of compacted soil or with a DEQ-approved, alternative daily cover.

9.6 Interim cover

As specified in DEQ-approved design and operations plans, the permittee must place and maintain interim cover over fill areas that will not receive additional waste for an extended period of time [i.e., greater than 120 days] and actively revegetate, in a DEQ-approved manner, any interim cover that will remain exposed for more than two years.

9.7 Surface water structures

The permittee must maintain all storm water drainage structures in good functional condition, report to DEQ any significant malfunctions or damage, and complete repairs within 60 days of discovery the problem.

9.8	**Stormwater pollution control plan**	The permittee must update and implement the Storm Water Pollution Control Plan (SWPCP) consistent with site conditions and the stormwater permit requirements. Refer to the National Pollutant Discharge Elimination System (NPDES) Storm Water Discharge Permit No. 1200-Z. In addition, the permittee must keep a current copy of the SWPCP in the facility Operating Record.
9.9	**Asbestos waste management**	The permittee must off load and dispose of friable asbestos-containing solid waste as specified in DEQ-approved Operations Plan, Operations & Maintenance Manual, and in OAR 340-248.
9.10	**Leachate management system**	The permittee must operate the disposal site in a manner that deters leachate production to the maximum extent practicable, and construct, operate and maintain in good functional condition all DEQ-approved leachate containment, collection, detection, removal, storage and treatment systems. The permittee must remove leachate continuously from all landfill leachate collection systems, to minimize fluid build up on the bottom liner and prevent the hydraulic head (fluid depth) from exceeding one foot.
9.11	**Leachate surface impoundment**	The permittee must: 1) completely contain leachate stored within lined surface impoundments; 2) maintain a minimum dike freeboard of two feet above the maximum leachate level in those impoundments unless otherwise approved by DEQ; 3) fence the impoundments to control public access; and 4) lock all gates when no attendant is on duty. In addition, the permittee must post clearly legible, visible signs that describe the surface impoundment's contents and display the words "no trespassing".
9.12	**Leachate irrigation**	Spray irrigation of leachate on the lagoon, waste working face, fields, etc. must be conducted in accordance with plans approved in writing by DEQ.
9.13	**Leachate concentrate management**	The solidification facilities for the concentrate from the leachate treatment plant must be operated in accordance with the approved plans and such that concentrate and its additives do not escape to public waters or air in violation of DEQ's rules. The solidified concentrate may be disposed in the landfill in accordance with the site special waste management plan.
9.14	**Litter control**	The permittee must at all times minimize windblown litter and collect it quickly and effectively to prevent scattering, nuisance conditions and unsightliness.
9.15	**Vector control**	The permittee must minimize vectors in the active disposal area, including insects, rodents, and birds.
9.16	**Air emissions**	The permittee must control air emissions, including dust, malodors, air toxics, etc related to disposal site construction, operation, and other activities, and comply with DEQ air quality standards.
9.17	**Access control**	The permittee must control public access to the landfill as necessary to prevent unauthorized entry and dumping.

9.18 Landfill entrance sign

A prominently displayed sign must indicate the following:

- The name of facility;
- The emergency telephone number;
- The days and hours of operation;
- The authorized and prohibited wastes;
- The Solid Waste Permit number;
- The operator's address;
- The consequences to haulers if they attempt to dispose of prohibited materials; and
- Any other information critical to the safe and efficient operation of the facility.

9.19 Fire protection and reporting

The permittee must provide complete and sufficient protection equipment and facilities in accordance with DEQ-approved Operations Plan.

Arrangements must be made with the local fire control agency to immediately acquire its services when needed. The permittee must implement preventative measures to ensure adequate on-site fire control, as determined by the local fire control agency. Fires must be immediately and thoroughly extinguished.

Fires must be reported to DEQ within 24 hours at: (503) 378-5047

9.20 Water supply

The permittee must provide water in sufficient quantities for fire protection, dust suppression, establishment of vegetation, and other site operations requiring water.

9.21 Landfill gas management

The permittee must control landfill gas (LFG) in accordance with the requirements of 40 CFR Parts 51, 52 and 60 and OAR 340-094-0060(4).

9.22 Landfill gas control system operation and maintenance

The permittee must operate and maintain the landfill gas control and monitoring systems in good working order as required to prevent nuisance odors, air emissions and LFG migration (see methane compliance limits in Section 18).

If critical LFG equipment is significantly damaged or compromised, the permittee must replace or repair that equipment, within 60 days of discovering the problem, and submit a written inspection report to DEQ.

10.0 SITE DEVELOPMENT AND DESIGN

10.1 Site development plan

Within 360 days of the permit issue date, the permittee must submit any necessary update to the long-term Site Development Plan to DEQ for review and approval. Once approved, the plan becomes an integral part of this permit.

Reference: The *Solid Waste Landfill Guidance, September 1996,* describes the basic elements of a Site Development Plan. Organizing the plan in accordance with the Guidance will expedite DEQ's review.

10.2 Baseline design criteria

New MSW landfill disposal units must include the following engineering controls:

- A composite liner system, including a DEQ-approved geomembrane liner (at least 60 mils thick for high density polyethylene, and at least 30 mils thick for approved alternative geomembranes) and at least two feet of compacted soil with an in-place permeability of 1 X 10^{-7} cm/sec or less, or a DEQ-approved alternative liner pursuant to 40 CFR Part 258.40(a)(1);
- A primary leachate collection and removal system (LCRS) which fully covers the liner system and maintains a leachate depth of less than a one foot above the liner, per 40 CFR 258.40(a)(2). All leachate collection pipes must be serviceable by clean outs;
- A secondary leachate collection and removal system(s) designed to effectively monitor the overlying composite-liner system's performance and (1) detect and collect leachate at locations of maximum leak probability; and (2) prevent groundwater intrusion and related monitoring biases;
- A leachate collection sump(s) with a double composite liner system and a leak detection and removal system. Each composite liner must meet the minimum design criteria previously cited in this subsection;
- An operations layer that covers and protects the primary LCRS and liner system from physical damage; and
- A leachate surface impoundment (if applicable) with a double liner and leak detection and removal system. One liner must meet the minimum composite liner criteria described above.

10.3 Design plans

At least six months prior to the anticipated construction date for new disposal units, closure of existing units, or development of other ancillary facilities, the permittee must submit engineering design plans to DEQ for review and approval. The design plans must be prepared and stamped by a qualified Professional Engineer with current Oregon registration and specify and/or provide the following:

- All applicable performance criteria, construction material properties and characteristics, dimensions, and slopes; and
- The design basis and all relevant engineering analyses and calculations.

10.4 Construction requirement

The permittee must construct all improvements in accordance with:

- The approved plans and specifications;
- Any DEQ imposed conditions of approval;
- Any future DEQ approved amendments to the plans and specifications; and
- Construction work must begin within 18 months of plan approval.

10.5 **Construction documents**

Prior to constructing any landfill engineering controls (e.g., final cover, new disposal unit, or other waste containment facilities or improvements), the permittee must submit complete construction documents and receive DEQ's written approval. The construction documents must:

- Define the construction project team;
- Specify material and workmanship requirements to guide the Constructor in executing work and furnishing products; and
- Include a Construction Quality Assurance (CQA) plan that describes how the project team will monitor the quality of materials and the Constructor's work performance and ensure compliance with project specifications and contract requirements.

Reference: Follow the current *Solid Waste Guidance* to expedite DEQ review of the construction documents.

10.6 **Construction inspection**

During construction of a new landfill disposal unit, final cover system, or any other landfill controls or engineered features, the permittee must provide DEQ with a summary and schedule of planned construction activities to facilitate DEQ's inspection and oversight.

10.7 **Construction report submittal**

Within 90 days of completing construction of a new landfill disposal unit, a final cover system, or other engineering controls, the permittee must submit to DEQ a Construction Certification Report prepared by a qualified independent party. The report must document and certify that the construction of all required components and structures complies with this permit and the DEQ-approved design specifications.

10.8 **Construction report content**

The construction report must include:

- An executive summary describing the construction project and any major problems encountered;
- A list of the governing construction documents;
- A summary of all construction and CQA activities;
- The manufacturer's written certifications that all geosynthetic materials conform with with project specifications;
- Test data documenting that soil materials conform with project specifications;
- A summary of all CQA observations, including daily inspection records and test data sheets documenting that materials deployment and installation conform with project specifications;
- A description of the problems encountered and the corrective measures implemented;
- The designer's acceptance reports for errors and inconsistencies;
- A list/description of any deviations from the design and material specifications, including justification for the deviations, copies of change orders and recorded field adjustments, and copies of DEQ's written approvals for deviations and change orders;
- Signed certificates for subgrade acceptance prior to placement of soil liner and for acceptance of the soil liner prior to deployment of geomembrane liner;
- Photographs and as-constructed drawings, including record surveys of the subgrade, soil liner, granular drainage layer and protective soil layer; and
- The certification statement(s) and signatures of the CQA consultant, designer, and facility owner. One of these representatives must be a Professional Engineer with current Oregon registration.

10.9 **Approval to use new disposal units**

The permittee must not dispose of solid waste in newly constructed disposal units until DEQ has accepted the Construction Certification. If DEQ does not respond to the Construction Certification Report within 30 days of its receipt, the permittee may place waste in the unit.

11.0 RECYCLING REQUIREMENTS

11.1 Materials

The permittee must provide a place for receiving the following recyclable materials:

☒ ferrous scrap metal
☒ motor oil
☒ newspaper
☒ container glass
☐ hi-grade office paper
☒ non-ferrous scrap metal (including aluminum)
☒ corrugated cardboard and kraft paper (brown paper bags)
☒ tin cans

11.2 Receiving location

The place for receiving recyclable material must be located at the disposal site or at another location more convenient to the population served by the disposal site. The recycling center must be available to every person whose solid waste enters the disposal site.

11.3 Material use

All source separated recyclable materials must be reused or recycled.

11.4 Recycling information

The permittee must provide, to disposal site users, the following recycling information on printed handbills:

- The on-site or off-site location of the recycling center;
- The recycling center's hours of operation;
- A list of acceptable materials for recycling;
- Instructions for preparing source separated recyclable material; and
- Reasons why people should recycle.

11.5 Sign

A prominently displayed sign must indicate the following:

- The availability of recycling at the disposal site or another location;

Note: the sign must indicate the recycling center location, if not at the disposal site

- The materials accepted at the recycling center; and
- The recycling center's hours of operation (if different than disposal site hours).

11.6 Storage

Unless DEQ approves otherwise, all recyclable materials, except car bodies, white goods and other bulky items must be stored in containers.

SITE CLOSURE

12.0 CLOSURE CONSTRUCTION AND MAINTENANCE

12.1 Worst-case closure plan development

The permittee must develop a conceptual "worst-case" closure plan and a conceptual post-closure plan(s), obtain DEQ approval of the plan(s), and maintain up-to-date copies of these plan(s) in the facility file.

Reference: The plans must comply with 40 CFR, Part 258, Subpart F, and OAR 340-094-0110.

12.2 Notification of plan updates

The permittee must notify DEQ and receive DEQ approval when the conceptual "worst-case" closure and conceptual post-closure care plans are updated and placed in the file.

12.3 Closure permit

In accordance with OAR 340-094-0100, the permittee must apply for a closure permit at least five years prior to the landfill's anticipated final closure.

12.4 Closure plan approval

At least six (6) months prior to final closure of any portion of the landfill, the permittee must submit detailed engineering plans, specifications, and a closure schedule to DEQ for review and approval.

The design plans must be prepared and stamped by a qualified Professional Engineer with a current Oregon registration and specify and/or provide the following:

- All applicable performance criteria, construction material properties and characteristics, dimensions and slopes; and
- The design basis and all relevant engineering analyses and calculations.

Reference: The *Solid Waste Landfill Guidance, September 1996,* describes Closure Plan preparation. Following that format will expedite DEQ review of the plan.

12.5 Closure schedule

The permittee must close each landfill area or unit in accordance with the DEQ-approved schedule.

12.6 Final cover

Unless DEQ approves otherwise, the final landfill cover must be:

- At least three feet thick {OAR 340-094-0120(2)(a)};
- Designed to minimize infiltration of precipitation as required by 40 CFR Part 258.60; and
- Graded to compensate for estimated differential settlement and maintain positive drainage. Final (post-settlement) slopes must range between two percent and 30 percent.

12.7 Vegetation

The permittee must establish and maintain a dense, healthy growth of native vegetation over the closed areas of the landfill consistent with the proposed final use.

12.8 Surface contour maintenance

The permittee must maintain the landfill cover's final surface contours as needed to prevent erosion and surface-water ponding and must repair and seed erosion damaged areas (cuts) to ensure that all waste remains covered.

The permittee must repair and maintain all settlement- or erosion-affected areas by adding soil, re-grading, fertilizing or seeding as needed.

12.9 Slope stability

The permittee must maintain the stability of the landfill slopes and the overall structural integrity of the landfill.

12.10 Deed record

Within 30 days after the disposal site's final closure, the permittee must modify the property deed record on file with the county to reflect the presence of the waste and its precise location at the site.

13.0 FINANCIAL ASSURANCE

13.1 Financial assurance plan

Upon request, the permittee must submit an updated financial assurance plan to DEQ for review and approval, and provide financial assurance for the costs of site closure, post-closure care, and potential corrective action. In addition, the permittee must place the plan in the facility file.

Reference: The plan must be prepared in accordance with OAR 340-094-0140. Acceptable mechanisms are described in OAR 340-094-0145.

13.2 Verification of financial assurance

To confirm that the financial assurance is valid and adequate the permittee must submit the following evidence to DEQ:

- A copy of the financial assurance mechanism; and
- A written certification that the financial assurance meets all state requirements.

Note: The permittee must review and update financial assurance annually in accordance with OAR 340-094-0140(6)(e).

13.3 Recertification of financial assurance

Upon request, the permittee must submit to DEQ one copy of the Annual Financial Assurance Recertification Report, signed by:

- A permittee representative who possesses the requisite authority to commit the permittee to the certification; and
- A Professional Engineer, with current Oregon registration (both stamp and signature).

13.4 Use of financial assurance

The permittee must not use the financial assurance for any purpose other than to finance the permitted facility's approved closure, post-closure, and corrective action activities or to guarantee that those activities will be completed.

13.5 Long-term financial responsibility

The permittee must continuously maintain financial assurance for the facility until the permittee or other person owning or controlling the site is no longer required by DEQ to demonstrate financial responsibility for closure, post-closure care, or corrective action.

ENVIRONMENTAL MONITORING

14.0 SITE CHARACTERIZATION

14.1 Workplan

At least 270 days prior to any new landfill construction or expansion beyond the currently characterized and approved footprint defined in the Site Development Plan, the permittee must submit two copies of a detailed workplan to the DEQ for review and approval. The workplan must summarize all site characterization completed to date, describe further site characterization that will be accomplished and include at least the following elements:

- A description of the landfill expansion;
- A proposal for monitoring all relevant media within the expansion area;
- An update to the Environmental Monitoring Plan (EMP) that reflects all approved changes to the facility;
- A detailed description of the planned investigation; and
- A detailed project schedule.

14.2 Site characterization report (SCR)

Within 180 days of the DEQ's approval of the workplan, the permittee must submit at least two copies of the SCR to DEQ for review and approval. This report must be based on the DEQ-approved workplan and any conditions of the approval. The report must be prepared and stamped by a Geologist or a Certified Engineering Geologist, with current Oregon registration. The permittee must submit the SCR and receive DEQ's approval before starting construction or operation of the new landfill area. Once approved, this report and any conditions of approval become an integral part of the permit.

Reference: The *Solid Waste Landfill Guidance, September 1996,* describes the applicable elements of a Site Characterization Report. Organizing the report in that manner will expedite DEQ's review of the plan.

15.0 ENVIRONMENTAL MONITORING PLAN (EMP)

15.1 EMP submittal

When requested by DEQ, at least 120 days prior to any new landfill construction or expansion, the permittee must submit two copies (two paper copy and one electronic copy) of an updated Environmental Monitoring Plan (EMP) to DEQ for approval.

Major changes in updates to the original EMP require that the entire EMP be submitted as a stand-alone document; at a minimum, this must be done at least once every ten years. The EMP, or any updates to the EMP, must be prepared and stamped by an Oregon Registered Geologist or an Oregon Registered Engineering Geologist. Upon approval, this plan is incorporated into this permit by reference.

15.2 EMP contents

The updated EMP must include plans (other than monitoring that is already handled by an NPDES permit) implementing an environmental monitoring program that will characterize potential facility impacts, including leachate collection, containment, treatment, and disposal. The updated plan may incorporate parts of the previous approved EMP with any changes or additions since that time (i.e., approved permit-specific concentration limits, revised parameter lists, revised schedules, and new wells). The updated EMP must include the following contents, as well as applicable elements from the reference document:

- Monitoring Network Design and Construction
- A Sampling and Analysis Plan
- Field QA/QC Procedures
- Lab QA/QC Procedures
- Data Analysis and Evaluation
- Report Format and Executive Summary

Reference: The *Solid Waste Landfill Guidance, September 1996,* provides information on applicable elements of an Environmental Monitoring Plan. Following the organizational format provided in the Guidance will expedite DEQ review of the plan.

15.3 EMP revisions and updates

The permittee must revise the current EMP as necessary to reflect current and future environmental conditions, facility development and regulatory requirements. A Geologist or Certified Engineering Geologist, with current Oregon registration, must prepare and stamp the EMP revisions and submit two copies (one paper copy and one electronic copy) to DEQ for review and approval.

15.4 Long-term monitoring plan

After DEQ approves any Remedial Action Concentration Limits (RACLs), Permit-Specific Concentration Limits (PSCLs), Concentration Limit Variances (CLVs), Action Limits (ALs), or Site-Specific Limits (SSLs), the permittee must update the EMP to reflect the long-term monitoring program and submit the updated plan for DEQ review and approval.

Note: Also see this permit's requirements for establishing PSCLs, ALs, or SSLs and OAR 340-040-0030(4) for procedures to establish CLVs.

15.5 Leak Detection System Any significant increase in flow rate in the leak detection system (or degradation of water quality) that have not been corrected (or significant progress made) within two years, must also require an updated EMP submittal. This EMP update is required if a statistical analysis indicates that normal monitoring of detection and compliance sampling points have shown a degradation of water quality. The analysis should cover the period of time from before the changes to after the increased leakage (or degradation of water quality) occurred. The updated EMP submittal must detail any proposed increases in frequency or parameter monitoring, as well as any additional monitoring points.

15.6 Additional monitoring points The permittee must incorporate any new or replacement monitoring point or device into the Environmental Monitoring Plan (EMP) and submit the updated EMP to DEQ for review and approval.

15.7 EMP compliance The permittee must conduct all environmental monitoring at the facility in accordance with the approved EMP, including any conditions of approval, amendments and updates.

16.0 ENVIRONMENTAL SAMPLING REQUIREMENTS

16.1 Notification The permittee must notify DEQ in writing of all upcoming sampling events at least 10 working days prior to the scheduled date of the sampling event or via email to the program manager or current project manager.

16.2 Split sampling events The permittee must split samples with DEQ at DEQ's request, and schedule split-sampling events with the DEQ's laboratory at least 45 days ahead of time.

Oregon Department of Environmental Quality
Laboratory, Groundwater Monitoring Section
3150 NW 229th, Suite 150
Hillsboro, OR 97124

Phone: (503) 693-5700
Fax: (503) 693-4999

The permittee must conduct split sampling events with DEQ in accordance with the schedule presented in the most recently approved EMP.

16.3 Monitoring schedule The permittee must refer to the approved EMP for environmental monitoring procedures. Quarterly monitoring benchmarks are defined below:

If sampling in the...	Schedule the sampling event	
	On, or after....	But on, or before...
Winter	January 1	February 28
Spring	April 1	May 31
Summer	July 1	August 31
Fall	October 1	November 30

16.4 Monitoring after EMP approval The permittee must monitor the facility in accordance with: 1) the approved EMP; 2) any conditions of DEQ's approval; and 3) any DEQ-approved amendments and updates.

16.5 Changes in sampling or split sampling

The permittee must submit a written request and obtain DEQ's written approval before changing the sampling program, including sampling frequency, parameters, or locations. Approved changes will become an integral part of the EMP.

DEQ reserves the right to add to or delete from the list of scheduled sampling events, sampling locations, and sampling parameters, and to conduct unscheduled sampling or split sampling events.

If the split-sampling schedule changes, DEQ will try to notify the permittee at least 30 days prior to the next scheduled event.

17.0 ESTABLISHING PERMIT-SPECIFIC CONCENTRATION LIMITS (PSCLs), ACTION LIMITS (ALs), CONCENTRATION LIMIT VARIANCES (CLVs), SITE-SPECIFIC LIMITS (SSLs), AND REMEDIAL ACTION CONCENTRATION LIMITS (RACLs)

17.1 Gathering data

The permittee must monitor the designated background wells in accordance with the approved Environmental Monitoring Plan or propose an alternative intrawell approach. Background monitoring must continue until all necessary data sets have been collected, and RACLs, PSCLs, ALs, and/or SSLs are proposed for each parameter of concern. The permittee then must demonstrate to DEQ's satisfaction that the selected background-data set is valid and unaffected by facility releases.

17.2 Future disposal units or cells

For future units, the permittee must collect enough samples to determine background groundwater quality, preferably before using a new landfill unit or cell for waste disposal. Alternatively, the permittee may develop a program to be approved by the DEQ for determining background groundwater quality with wells installed at the time of landfill cell construction.

17.3 Statistical analysis

To establish compliance concentration limits (PSCLs, ALs, and SSLs), the permittee must perform statistical evaluations of the monitoring results for each sampling event.

Use methods outlined in 40 CFR 258.53 or other DEQ accepted statistical methods.

References:

DEQ is in the process of preparing an Internal Management Directive for Statistical Analysis, which will be the applicable reference document.

17.4 Proposing RACLs, PSCLs, ALs, and/or SSLs

The permittee must propose for DEQ's review and approval, a PSCL, AL, SSL, or RACL pursuant to the guidelines specified in OAR 340-040. The proposal must address all parameters DEQ deems necessary. Once a statistically valid data set (at least nine acceptable data points) are established from the appropriate background well(s), the permittee may generate a PSCL, AL, SSL, or RACL for each designated, long-term monitoring parameter.

17.5 Changing RACLs, PSCLs, ALs, and/or SSLs

If the permittee demonstrates to DEQ's satisfaction that background groundwater quality has significantly changed since the PSCL, AL, or SSL was established, and if the change is unrelated to the permitted facility's influence, the permittee can propose, to DEQ, a revised level for the affected PSCL(s), AL(s), or SSL(s)..

17.6 Establishing and changing CLVs

The permittee should refer to DEQ's Groundwater Quality Protection Rules [OAR 340-040-0030(4)] for guidance in establishing and changing Concentration Limit Variances (CLVs).

18.0 ENVIRONMENTAL MONITORING STANDARDS

18.1 Applicable regulatory standard

The permittee must not allow the release of any substance from the landfill into groundwater, surface water, or any other media, which will result in a violation of any applicable federal or state air or water limit, drinking water rules, or regulations, beyond the solid waste boundary of the disposal site or an alternative boundary specified by DEQ. Refer to OAR 340-094-0080.

18.2 Compliance points

Compliance wells are defined in the most current site-specific Environmental Monitoring Plan.

18.3 Review of results

The permittee must review the analytical results after each monitoring event according to the protocols established in the most currently approved site-specific Environmental Monitoring Plan.

18.4 Resampling results

Upon receipt of data from resampling, the permittee must review the analytical results according to the protocols established in the most currently approved site-specific Environmental Monitoring Plan.

18.5 Secondary leachate collection system (SLCS)

If the permittee observes liquids in the leak detection system (LDS), the permittee must respond in accordance with the approved EMP procedures for sampling, analysis and reporting. If testing confirms landfill impacts in the leak detection or SLC system, and that system is compromised as a compliance point, DEQ may require the permittee to install additional detection or compliance wells or conduct further investigations.

The permittee must design each SLCS-equipped landfill cell or sub-unit to allow for discrete sampling of the SLCS without mixing, co-mingling or compositing of samples with other leachate sources.

18.6 Methane limits

The methane concentration must not exceed:

- Twenty-five percent of methane's Lower Explosive Limit in onsite structures (excluding gas control structures or gas recovery system components); or
- Methane's Lower Explosive Limit at the facility property boundary.

Note: Methane's Lower Explosive Limit is equal to a concentration of five percent by volume in air.

18.7 Methane exceedance

If methane levels exceed the specified limits, the permittee must:

1. Take immediate steps to protect human health and safety and notify DEQ within 24 hours;
2. Within seven days of detection, confirm the measures taken to protect human health and safety (unless DEQ approves an alternative schedule), and describe the methane test results and response measures in the facility operating record; and
3. Within 60 days of the methane exceedances, develop and implement a remediation plan, incorporate the plan into the monitoring records, and submit a progress report to DEQ.

18.8 Certified environmental laboratory data

To ensure the best possible data quality, DEQ suggests that the permittee contract with environmental labs certified under the Oregon Laboratory Accredited Program (ORLAP) or the National Volunteer Laboratory Accreditation Program (NVLAP). Use of an ORLAP or NVLAP approved lab will facilitate DEQ's future review of Environmental Monitoring Plan (EMP) updates, Annual Environmental Monitoring Reports (AEMRs), and RI/FS documents.

19.0 RECORDKEEPING AND REPORTING – ENVIRONMENTAL MONITORING

19.1 Annual Environmental Monitoring Report (AEMR)

Prior to March 31 of each year, the permittee must submit to DEQ two copies (one paper copy and one electronic copy) of an annual monitoring report for the previous calendar year's monitoring period. The report must conform to the format detailed in the approved EMP and be prepared and stamped by a Geologist or a Certified Engineering Geologist, with current Oregon registration.

Note: Whenever possible, the permittee must submit two-sided copies of all reports and may submit electronic submittals of reports.

19.2 Statement of compliance

The AEMR must include a brief (approximately one-page) cover letter that:

- Compares the analytical results with the relevant monitoring standards (RACLs, PSCLs, CLVs, ALs, or SSLs);
- Documents any exceedances of or federal or state standards for relevant media; and
- Documents any significant change in water quality, land quality, air quality or methane levels in monitored media.

19.3 AEMR contents

The AEMR must reflect the facility's current conditions, present accurate data that correspond with the original field and lab data, and include the elements presented in the most recently approved EMP.

19.4 Annual leachate treatment report

The permittee must prepare an annual summary report for the leachate treatment program and submit the report to DEQ prior to March 31 of each calendar year.

Note: Whenever possible submit two-sided copies of all reports. Annual leachate treatment report may be included as part of the AEMR submission.

19.5 Annual leachate treatment report contents

This annual report must include the elements presented in the most recently approved EMP.

Reference: The report format should reflect DEQ's guidance: *Solid Waste Landfill Guidance*, September 1996, or the format presented in the most recently approved EMP.

19.6 Split sampling submittal

Within 90 days after any split sampling event, the permittee must submit the following information to DEQ's laboratory:

- A copy of all information pertinent to the sample collection, handling, transport and storage, including field notes;
- Copies of all laboratory analytical reports;
- Copies of all laboratory QA/QC reports;
- Any other data or reports requested by the DEQ.

19.7 Lab address

Report all required split sampling information to:

Oregon Department of Environmental Quality
Laboratory, Groundwater Monitoring Section
3150 NW 229th, Suite 150
Hillsboro, OR 97124

Phone: (503) 693-5700
Fax: (503) 693-4999

19.8 DEQ response to split samples

If the permittee submits all required split sampling data and requests DEQ's results, DEQ's lab may provide, to the permittee, copies of the following information:

- DEQ's analysis of the split sample;
- The QA/QC report;
- The analytical report; and/or
- The field data sheets.

20.0 ENVIRONMENTAL MONITORING NETWORK

20.1 Monitoring device installation

For future disposal units or cells, the permittee must install DEQ-approved background and detection and/or compliance well at least 12 months before refuse disposal occurs in the new cells or according to another schedule approved by DEQ. A Site Characterization Report (SCR) may also be required for any proposed new cell. DEQ may waive or modify this requirement if the permittee provides adequate justification for an alternative approach.

20.2 Monitoring stations and equipment

To ensure that every sample is representative of the site's environmental conditions, the permittee must protect, operate, and maintain all environmental monitoring stations and equipment in accordance with DEQ's requirements.

20.3 Access to monitoring stations and equipment

To facilitate sample collection and/or inspection and maintenance activities, the permittee must maintain reasonable all-weather access to all monitoring stations and associated equipment.

20.4 Reporting equipment damage

Within 14 days of discovering any damaged monitoring equipment or station, the permittee must submit to DEQ a report describing the damage, the proposed repair or replacement measures, and the schedule to complete this work.

Example: a well's impaired function or altered position/location.

20.5 Monitoring well construction

The permittee must complete any monitoring well or gas monitoring probe abandonment (decommissioning), replacement, repair, or installation in a manner that complies with the Water Resources Rules, OAR 690-240.

20.6 Reporting well construction and repairs

The permittee must document all monitoring well or gas probe repair and construction activities, including driller's logs, well location information, and construction information in a report prepared and stamped by a Geologist or Certified Engineering Geologist, with current Oregon registration. The permittee must submit the report to DEQ within 30 days of the action and include this documentation in the next Annual Environmental Monitoring Report (AEMR).

20.7 Well decommissioning or replacement

The permittee must submit a written recommendation to DEQ prior to decommissioning or replacing any well or gas monitoring probe in the monitoring network. After receiving DEQ's approval, the permittee must decommission or replace any well or gas probe that meets the following criteria:

- The well or gas probe was installed in a borehole that hydraulically intersects two saturated strata;
- The permittee lacks supporting documentation demonstrating that the well or gas probe was properly installed and constructed;
- The well or gas probe was damaged beyond repair or destroyed; or
- Other reasons as determined by either the permittee or DEQ.

COMPLIANCE SCHEDULE

21.0 SUMMARY OF DUE DATES –

21.1 Summary The permittee must comply with the event-driven schedule shown below. This compliance schedule does not apply to many of the routine reporting requirements specified in other sections of the permit.

Due Date	Activity	See section...
120 days prior to new landfill construction or expansion	Submit updated Environmental Monitoring Plan (EMP)	15.1 EMP submittal
Within 90 days of permit issuance	Review and submit conceptual "worst-case" closure and post closure plan	12.1 Worst case closure plan development
Within 90 days of permit issuance	If not already submitted for the year, submit financial assurance plan and mechanism	13.1 Financial assurance plan
Within 180 days of permit issuance	Review and submit site development plan update	10.1 Site development plan
Within 180 days of permit issuance	Submit updated Operations Plan	7.1 Operations plan submittal
Within 60 days of Operations Plan approval	Submit updated Operations and Maintenance Manual	7.3 Operations and Maintenance Manual
By March 31st for each year	Submit an Annual Environmental Monitoring Report (AEMR)	19.1 AEMR
By March 31st for each year	Submit an Annual Leachate Treatment Report	19.4 Annual leachate treatment report
By Apr 30th for each year	Submit annual financial assurance recertification report and, if applicable, updated mechanism	13.3 Recertification of financial assurance
SAMPLING:		
At least 10 working days prior to scheduled sampling event	Notify DEQ	16.1 Notification of sampling events
At least 45 days prior to split sampling event	Schedule split sampling event with DEQ laboratory	16.2 Split sampling events
Within 90 days of split sampling event	Submit required data/documents to DEQ laboratory	19.7 Split sampling submittal

EVENTS:		
Within 30 days of Dept notification of need to install monitoring well or probe	Install groundwater monitoring well and/or probe	20.1 Monitoring device Installation
Within 30 days of any well construction	Submit well construction report	20.6 Reporting well construction and repairs
At least 6 months before any new disposal unit and/or closure construction	Submit engineering design plans and, if applicable, closure schedule	10.3 Design plans 12.4 Closure plan approval
At least 270 days prior to new construction or expansion	Submit a Site Characterization Report Workplan	14.2 Workplan
Within 180 days of Dept approval of SCR workplan	Submit a Site Characterization Report (SCR)	14.2 Site characterization report
Within 90 days after completion of any major construction	Submit Construction Certification Report	10.7 Construction report submittal
Within 18 months of plan approval	Begin construction	10.4 Construction requirements

ATTACHMENTS

22.1 **Attachment list**

Attachments to the permit include :

Number	Description
1	Parameter Groups
2	Permit-specific concentration limits

ATTACHMENT 1: PARAMETER GROUPS

Overview

This attachment describes the environmental-monitoring parameter groups and associated requirements

Due to the duration of this permit, suggested analytical methods may change. If that is the case, use the most currently promulgated EPA method or DEQ-approved equivalent.

Note: Method means EPA SW 846 Method [suggested methods are in square brackets].

Group 1a: Field indicators

The field indicators parameter group includes the following parameters:

Elevation of water level
pH
Temperature
Specific Conductance
Dissolved Oxygen
Eh

With instruments calibrated to relevant standards, measure these parameters in the field when collecting samples. Acceptable methods include:

- Down-hole in situ;
- In a flow-through well; or
- Immediately following sample recovery.

Group 1b: Leachate indicators

The laboratory indicators parameter group includes the following parameters:

Total Dissolved Solids (TDS)
Total Suspended Solids (TSS)
Total Organic Carbon (TOC)
Chemical Oxygen Demand (COD)

Proper techniques for sample handling, preservation, and analysis are specific to each individual analyte: Follow appropriate EPA techniques or AWWA Standard Methods.

Group 2a: Common anions and cations

The common anions and cations parameter group includes the following parameters:

Calcium (Ca)
Sulfate (SO_4)
Total Ammonia (NH_3+NH_4)
Sodium (Na)
Nitrate (NO_3)
Silicon (Si)
Iron (Fe)
Manganese (Mn)
Magnesium (Mg)
Chloride (Cl)
Carbonate (CO_3)
Potassium (K)
Bicarbonate (HCO_3)

Dissolved concentrations must be measured. Field-filter and field-preserve samples according to standard DEQ and/or EPA guidelines and analyze by appropriate EPA or AWWA Standard Methods techniques. Report results in mg/L and meq/L.

Group 2b: Trace metals

The trace metals parameter group includes the following parameters:

- Antimony (Sb)
- Arsenic (As)
- Barium (Ba)
- Beryllium (Be)
- Cadmium (Cd)
- Chromium (Cr)
- Cobalt (Co)
- Copper (Cu)
- Lead (Pb)
- Nickel (Ni)
- Selenium (Se)
- Silver (Ag)
- Thallium (Tl)
- Vanadium (V)
- Zinc (Zn)

If the Total Suspended Solids concentration is...	analyze for...
less than or equal to 100.0 mg/L in the sample	total concentrations (unfiltered)
Greater than 100.0 mg/L in the sample	both total (unfiltered) and dissolved (field-filtered)

Field-preserve samples according to standard DEQ and/or EPA guidelines and analyze by EPA Method 6010C or DEQ-approved equivalent.

Group 3: Volatile organic constituents

Analyze for all compounds detectable by EPA Method 8260B (C- other method 8/06) or EPA Method 524.2, include a library search to identify any unknown compounds present. The volatile-organic-compounds parameter group is equivalent to the EPA Method 8260B list.

DEQ must pre-approve alternative methods like EPA Method 8021B

Group 4: Assessment monitoring

The assessment monitoring parameter group includes the following parameters:

- Semi-volatile Organic Constituents, including Phenols, EPA Method 8270D
- Mercury, EPA Method 7470A
- Cyanide, EPA Method 9010C (manual distillation) or 9012B (automated distillation)
- Nitrite

All Method 8270D analyses must include a library search to identify any unknown compounds present.

Group 5: Surface water and leachate

The surface water parameter group includes the following parameters:

- Total Kjeldahl Nitrogen (TKN)
- Total Phosphorus (P)
- Orthophosphate (PO_4)
- Biological Oxygen Demand (BOD)
- Total Coliform Bacteria [EPA Method 9131]
- Fecal Coliform Bacteria [EPA Method 9131]
- E. Coli

ATTACHMENT 2: REMEDIAL ACTION CONCENTRATION LIMITS AND PERMIT SPECIFIC CONCENTRATION LIMITS

In accordance with OAR 340-040-0050(2) and as defined in the site Record of Decision (dated October, 2004); Remedial Action Concentration Limits are established for the "west side" monitoring points specified in Section 18.2 of this permit as follows:

Compound	RACL	Basis	COPC
Volatile Organic Compounds (µg/L)			
1,4-Dichlorobenzene (1,4-DCB)	75	MCL/RL	Yes
Tetrachloroethene (PCE)	5	MCL	Yes
Trichloroethene (TCE)	5	MCL/RL	Yes
Vinyl chloride	2	MCL/RL	Yes
Trace Metals (µg/L)			
Antimony	6	MCL	No
Arsenic	10	MCL	Yes
Barium	1,000	RL	No
Beryllium	4	MCL	No
Cadmium	5	MCL	Yes
Chromium	50	RL	No
Lead	50	RL	No
Nickel	100	MCL	No
Selenium	10	RL	No
Silver	50	RL	No
Thallium	2	MCL	No
Dissolved Metals (µg/L)			
Iron	300	SMCL	Yes
Manganese	50	SMCL	Yes
Inorganic Compounds (mg/L)			
Chloride	250	SMCL	Yes
Total Dissolved Solids (TDS)	500	SMCL	Yes

RACL: Remedial Action Concentration Limit

Basis: The lower of either Federal primary Maximum Contaminant Level (MCL) or State Reference Level (OAR 340-040-0020, Tables 1 through 3).

SMCL: Secondary MCL

COPC: Chemical of Potential Concern

In accordance with Section 17 of this permit, Permit-Specific Concentration Limits are established for the "east side" monitoring points specified in Section 18.2 of this permit as follows:

Site Indicator Parameters	**Concentration Limit (mg/L)**
Bicarbonate (HCO_3)	178
Calcium (Ca)	33.5
Chloride	6.6
Iron (Fe)	1.5
Magnesium (Mg)	15
Manganese (Mn)	0.84
Sodium	27
Arsenic	0.0121

STATE OF OREGON
DEPARTMENT OF ENVIRONMENTAL QUALITY **MEMORANDUM**

To: The File
Coffin Butte MSW Landfill, SW Disposal Permit No. 306

Date: November 9, 2010

From: Hugh Gao, PE, Senior Engineer, Project Manager

Subject: Permit Renewal-Comments

SW Project No. 5390

Facility Location: 29175 Coffin Butte Road, Corvallis, OR 97330
Section 13&18, T10S, R5&4W, Benton County

Subject: **Response to Public Comments for Renewal of DEQ Solid Waste Disposal Permit for Coffin Butte Landfill**

Summary of comments:

Comment from David & Deb Hackleman, October 13, 2010
We are adjoining neighbors to the Coffin Butte Landfill, and have been for the most part, pleased with the stewardship of the landfill by its owners. There are a few minor items which we hope can be addressed and in this light we are submitting commentary.

1. We do not know the height to which the land fill will be permitted to deposit materials; however believe that the prudent concept would be to have the waste material approximate the shape of the hill prior to excavation of the rock. We strongly recommend that any permit issued does specify the maximum size of the landfill operations as this is in part important for soil stability. We also utilize the southern exposure of our property and the height of the hill as it is and has been a site for radio telecommunications since purchase in the 1970's.

DEQ Response: According to the 2000 Site Development Plan for the facility, the estimated landfill's life is about 53 years (from year 2000). The landfill will be closed approximately in 2053 as projected. The peak point of the final cover will be 600~620 feet in elevation, and location of the radio communication is 725 feet in elevation. The top of the landfill's final cover will be 100 feet below the radio communication point/area.

The landfill will be closed in a final cover with an engineer designed cover system. As required in state and federal regulations/standards, the final cover system must be graded to a minimum two percent and a maximum thirty percent slope to ensure stability for the entire structure of landfill and cover system. In applying this standard, DEQ considers the potential for adverse impact from the disposal site on public health, safety or the environment.

2. There are test wells on our property and on other sites in the region. We have never seen information on these wells (yet we have also never asked for such information). Our water wells and our neighbors all have drinking water wells on the north side of this butte. We would like to receive the information offered in the analysis from these test wells. We've never asked for the information before, would prefer to just get the same information that is probably sent to the DEQ as we have no intentions to add a job to the folks at the Landfill. They have been fine neighbors.

DEQ Response: As replied by Bill Mason (DEQ Hydrologist) on October 7, 2010:

I'll start with the bigger picture, and then home in on your well(s).

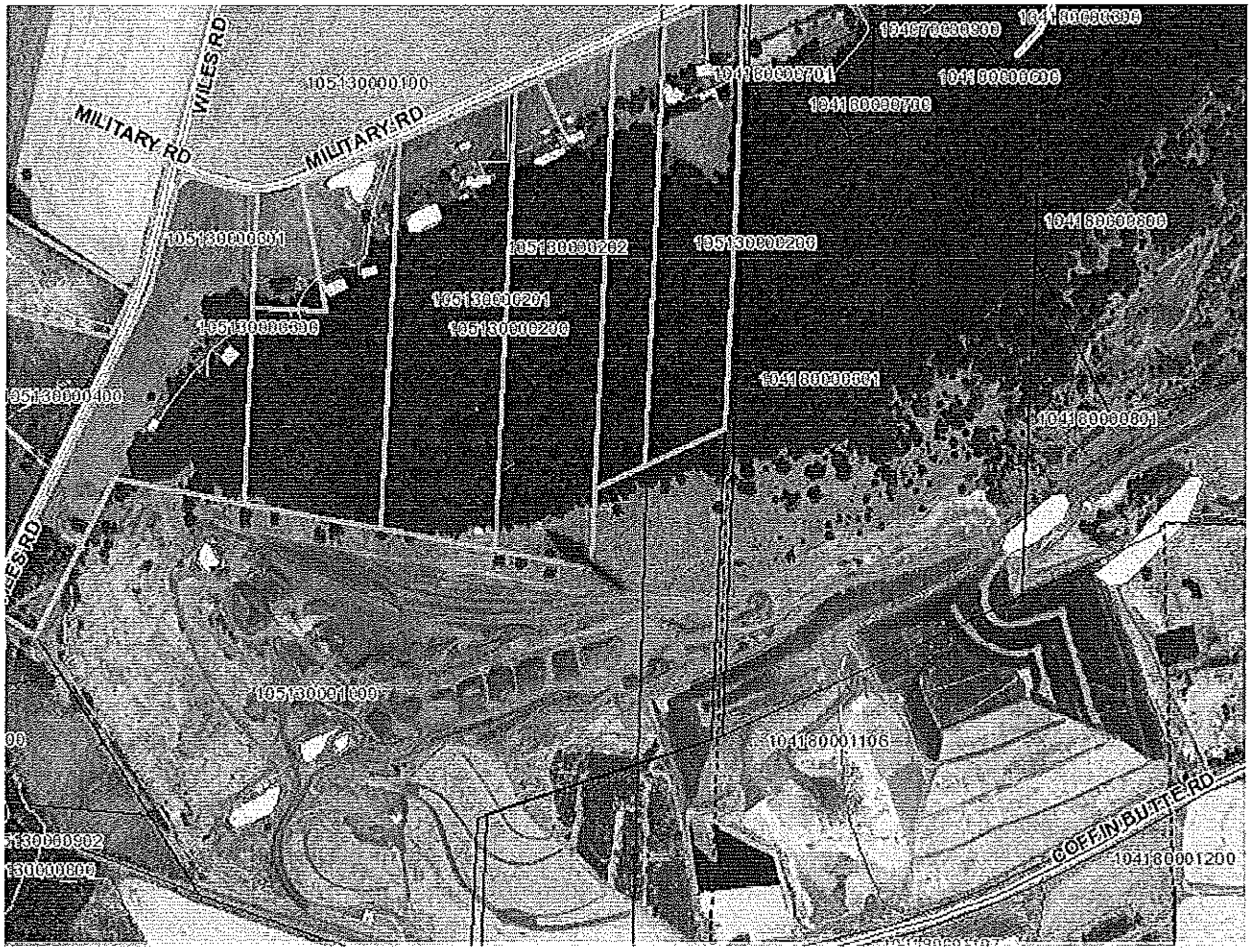
There are some older cells on the west side of landfill property, and newer ones to the east (see attached map). The older ones were unlined, and had caused some localized shallow groundwater contamination. Because the older cells have been capped, groundwater contamination has been steadily disappearing. The newer cells to the east haven't caused groundwater contamination. Shallow groundwater flows to the southwest (on the west side), away from your property, and flows to the east (on the east side).

Coffin Butte is comprised of a rather thick sequence of basalt. Your drinking water well was drilled to 85 feet, and the static water level (section 11 on the attached well log) indicates that the water bearing zone that your well taps is under pressure, meaning that it's overlain by lower permeability materials (basalt in this case) that act to protect your water supply from surfacial contamination.

QP-4S is the one completed as a water well (red arrow). I've attached a map with well locations plotted. I imagine QP-5N is on your property as well?

If you've never tested the water quality in your well, it may be a good idea to do, whether there's a landfill nearby or not. There are some mail order labs that aren't too expensive (~$100 to $180), and test for a wide range of substances. Local labs will set you back $500 to $1000, depending on how many tests you run.

I imagine also that you'd be planting the vines on the south facing side of the hill; looks like a great location for them! The soils are nice and rocky too.



DEQ requires the permittee to perform annual environmental monitoring and produce a report of the results. DEQ reviews the report to ensure environmental quality. The annual environmental monitoring reports are filed in the DEQ Salem Office and they are open to public review.

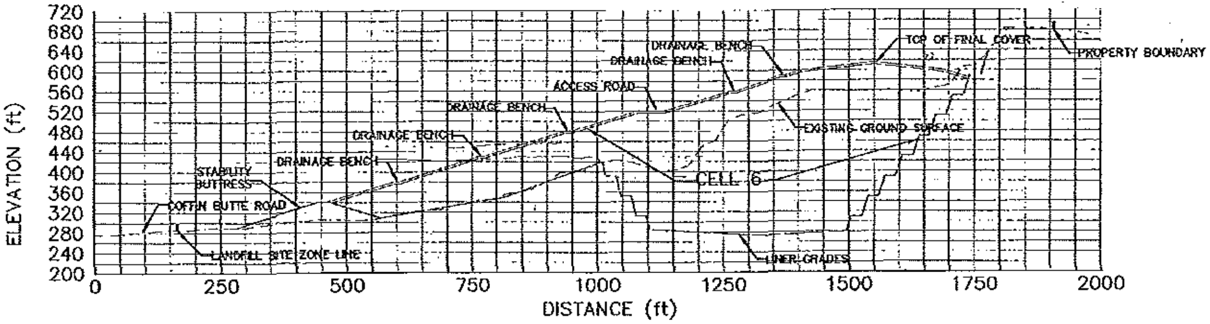
3. We are modestly concerned about the steepness of the rock wall that has formed on the Southern edge of our property – this is a northern boundary for the Landfill. This is a rock wall being formed by the excavation by the rock quarry on the Landfill Property. We do not know if there are any specific minimum allowable slopes, but this wall appears near vertical to us and we do have a building and other items at the top of that vertical cliff. The fence between our property and the landfill property on this border is very old and in need of repair/replacement. We are considering

replacing and repairing the fence in the future, however will be interacting directly with the landfill to ensure that the structure placed will be to our mutual benefit.

DEQ Response: As projected in the 2000 Site Development Plan, the future Cell 5 and 6 will be immediately located at south edge of the Butte. The cell's subgrade would be excavated into the butte by the rock quarrying. The quarrying activities would create near vertical faces and benches (40 feet vertical and 20 feet wide) on the north rock wall of the quarry. The quarrying activities are regulated by the Oregon Department of Geology and Mining Industries (DOGAMI).

The rock wall on the south side of the butte would be 100 feet south from the property boundary line, and down toward south with a slope of 53 degree proximately, as drawing in the plan. The liner system would be installed at the rock wall on the beach anchors.

The quarry reclamation plan is to convert the quarry into additional landfill space for future cells as approved by DOGAMI. The information can be found at the DOGAMI Website: http://www.oregongeology.org/sub/default.htm. Please contact DOGAMI for details.



Comment from William Drabkin, August 24, 2010
I read that Coffin Butte (CB) landfill permit renewal is being requested. I have been in contact with Ms. Jackson of Republic Services.

When one arrives at the CB there is *no information* or *enforcement* of appropriate recycling opportunities. Thusly homeowners or business people will toss EVERYTHING into the huge containers that are then moved to the compacting area. Very efficient for moving a lot of stuff quickly, I have been in contact with Ms. Jackson of Republic Services, as you can see. I am hoping that the DEQ might become involved in order to move things along more quickly. She has said that the large items (refrigerators) are pulled AFTER one dumps them.

I have suggestions that I hope would be included as a condition for renewal. I am not wed to these ideas, but feel that some discussion might ensue to develop appropriate actions to enhance greater recovery of recyclable products:

A FEW IDEAS:
1- Signage telling people where/how to deposit their various items, so that you would not have to pull items out:

A. I. e. Metal in the metal area - at this time I suspect a lot of people do not know that they could travel 50 yards and put the metal in the metal pile.
B. Wood debris- a separate bin for those items that are suitable for the compost site.
C. Yard debris in another area, glass, metal cans, and plastic etc. in their appropriate areas.
D. The attendant informing and after a period of time enforcing the dumping of recyclable items in their appropriate container. Instead of dumping it all into one bin- as is currently being done.

To me, our area is very conscious and wants to recycle, reduce, reuse.
I realize it is a lot of up front work and CHANGE, but once we are educated we could help lower the costs and perhaps increase profits for Allied Waste.

DEQ Response: As specified in the renewal permit, DEQ requires the permittee to update the landfill operations plan. DEQ will review the updated operations plan. The approved plan will become a part of the permit which is enforceable in the landfill's operation and management.

The operations plan addresses material recycling before disposal into the landfill. Section 11 of the permit sets the requirements of material recycling and signage at the landfill, which requires that all source separated recyclable materials must be reused or recycled before the materials are disposed into the landfill.

DEQ will forward your comments and suggestions to the permittee, and request the permittee consider your idea of material recycling and better signage. DEQ will suggest the permittee incorporate these ideas in the updated operations plan.

Comment from Geoff Taylor, August 19, 2010
May I weigh in as a private citizen? I've been a frequent visitor to the CBL, over many years, and have been impressed by the dedication of Valley Landfills Inc. to public safety, access, convenience, and further impressed by the operation of this dump. Call a spade a spade, but CBL has performed a vital public function since 1945, and they've kept apace of these ecological times.

I urge you to renew their solid-waste disposal permit. I have never met, nor have any knowledge of, the individuals who make Coffin Butte possible for me. But I'm grateful that they are so conscientious about taking care of an ugly societal problem, and keeping it from getting worse.

DEQ Response: DEQ concurs - the permittee continues its efforts to remain in compliance with all DEQ's rules and regulations in the operation and maintenance of the landfill.

We thank you for your interest and comments on the renewal of the Coffin Butte Landfill permit. All the above comments made during the Public Notice comment period will be kept in the DEQ file and also forwarded to the permittee.

APPENDIX B

WELL CONSTRUCTION DIAGRAMS AND BORING LOGS

APPENDIX B

WELL CONSTRUCTION DIAGRAMS AND BORING LOGS

COFFIN BUTTE EXPANSION
MONITORING WELLS

M-1 0-2 topsoil
2-8 brown clay (sticky)
8-40 brown weathered basalt (broken)
water: 1/2 gal/min @ 24 ft.
2 gal/min @ 52 ft.

	Perforated	Gravel Pack
piez. 1	23-28	21-28
piez. 2	35-40	34-40

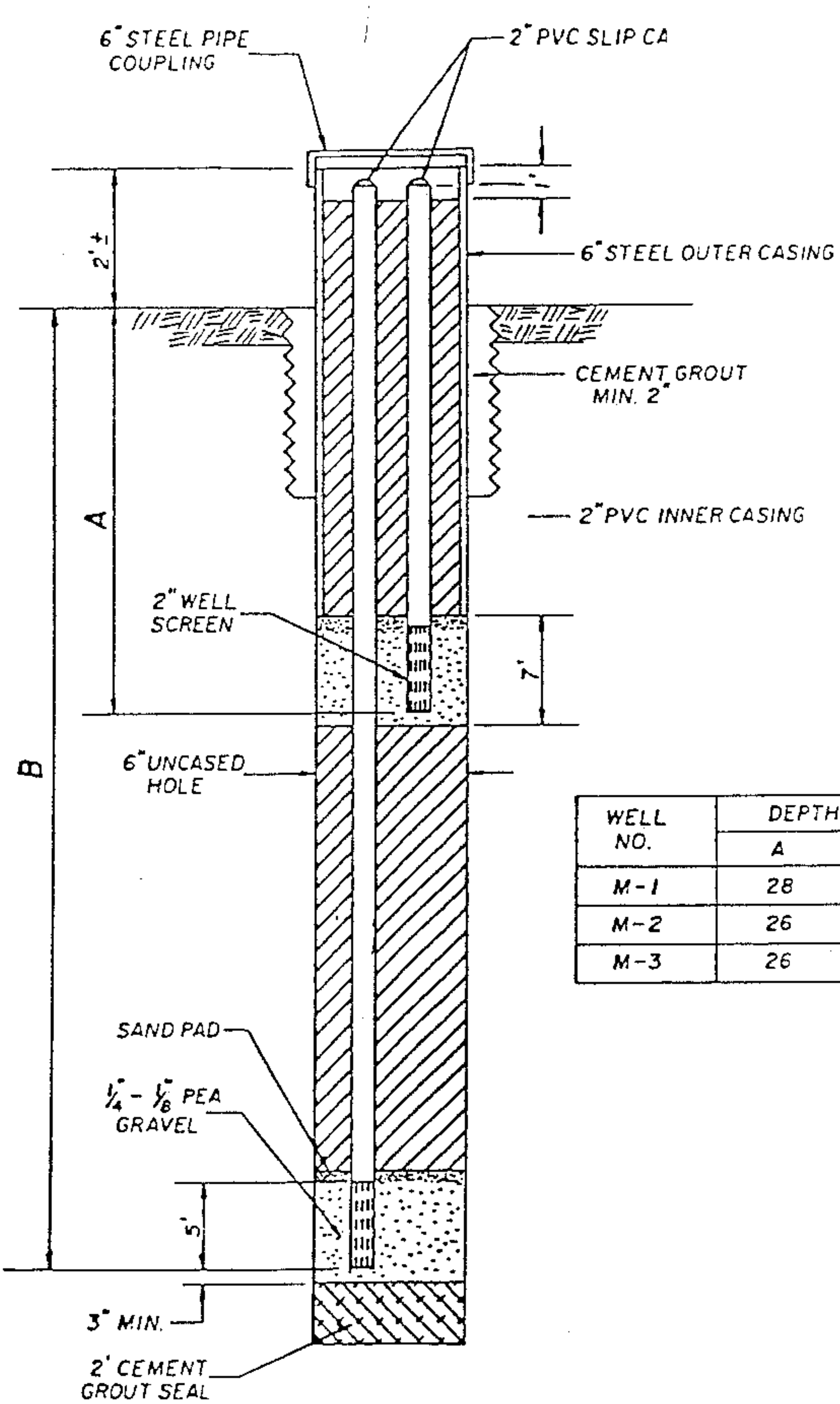
M-2 0-1 topsoil
1-7 brown clay (sticky)
7-60 brown weathered basalt (broken)
water: 1/2 gal/min @ 23 ft.
1/2 gal/min @ 34 ft.
1 gal/min @ 54 ft.

	Perforated	Gravel Pack
piez. 1	21-26	19-26
piez. 2	55-60	54-60

M-3 0-1 topsoil
1-9.5 brown clay (sticky)
9.5-55 brown weathered basalt (broken)
water: 1/2 gal/min @ 24 ft.
2 gal/min @ 52 ft.

	Perforated	Gravel Pack
piez. 1	21-26	20-26
piez. 2	50-55	48-55

M-4 See Bunn Well Log.
Bore hole cleaned for monitoring use.



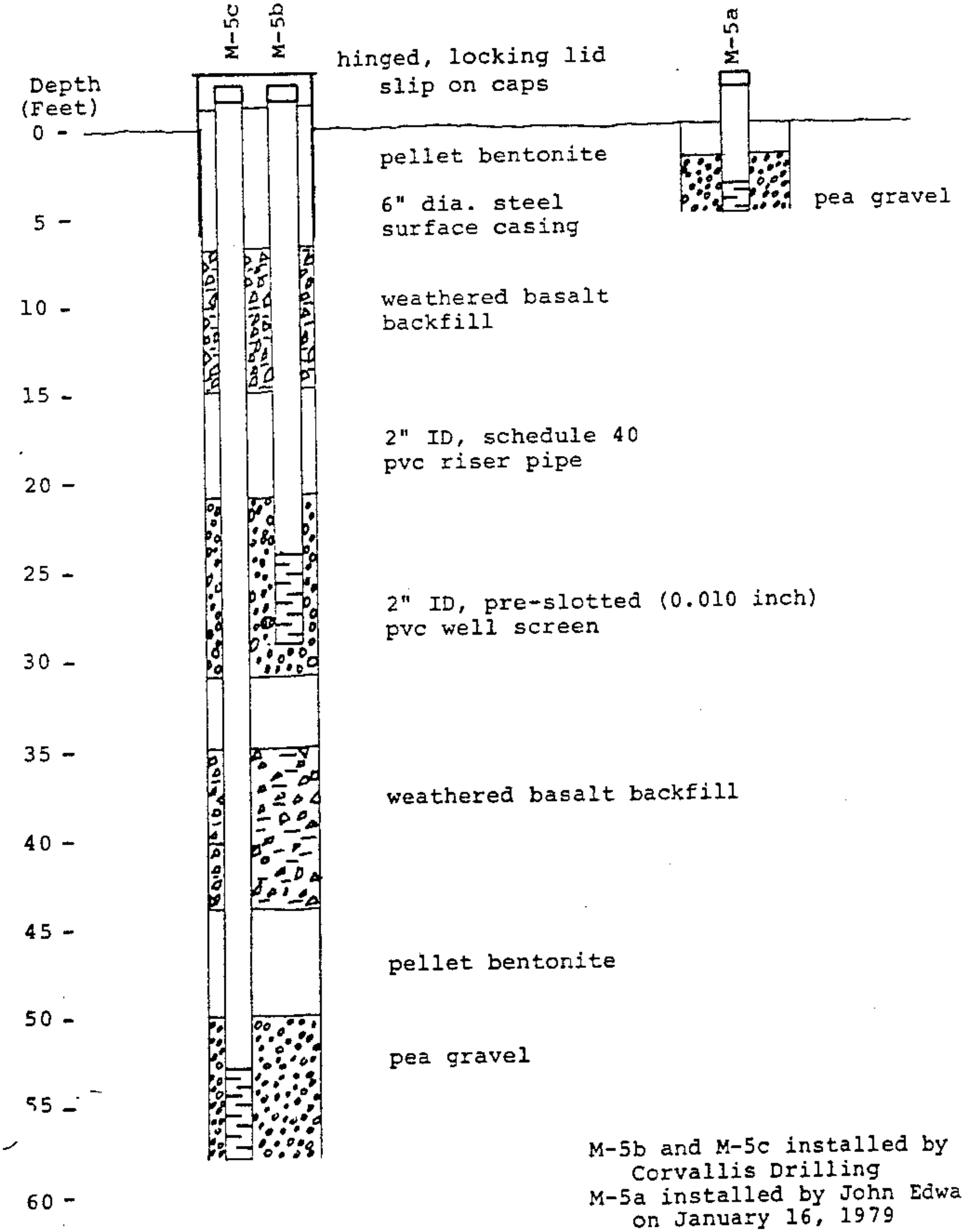
WELL NO.	DEPTH IN FEET	
	A	B
M-1	28	40
M-2	26	60
M-3	26	55

FIGURE 3.1

MULTIPLE COMPLETION MONITORING WELL

VALLEY LANDFILL

Monitoring and Sampling Piezometers M-5a, b, c



M-5b and M-5c installed by
Corvallis Drilling
M-5a installed by John Edwards
on January 16, 1979

CONTRACTOR vallis Drilling Co.
DRILLER Dell Trask HELPER Rod Ayers
INSPECTOR I. Edwards LOGGER ________ (Soil) ________ (Rock)
DATE: HOLE BEGUN 1/16/79 CASING PULLED ________ LOG ________ (Soil) ________ (Rock)

PROJ. NO. ________ BORING NO. MW-5D SH 1 OF 3
PROJ. NAME Coffin Butte
LOCATION as surveyed
SURF. EL. as surveyed ROCK EL. ________ TD 58.0'

Piezometer Record	DEPTH (FT.)	Strata	Soil Sample Record: Sample No.	Blows per 6"	Samp. type	Progress (Date)	Drilling Record: Type Bit	Run No.	No. of Seg.	Recov (Ft.)	% Rec	RQD	Inspector's Remarks (Pocket penetrometer, water loss, artesian cond., caving, void, etc.)	Geologist's Log	
See Attached Sketch for Piezometer Installation	0				BAG SAMPLES	1/16/79	Air Rotary Drill w/6" Tricone Bit						▽ perched on grey clay	0.0' - 2.0'	Dark brown, clay loam (Cl)
														2.0' - 10.0'	Light grey, clay, v. plastic, restrictive, becomes stiff at 5.0' (Note: 0.0' - 5.0' logged during installation of shallow piezometer (M-5,a) with hand auger)
	5		1											10.0' - 35.0'	Colluvium, moderately to highly weathered basalt gravels in light brown sandy-clay matrix
	10		2												
	15		3												Same as above
	20		4												

Show diameter, depth casing(s); depth perforations piezometer. Indicate method advancing hole through soil.

Diameter (s) Sampler (s) 4" dia. drill pipe w/6" dia. surface casing
Weight Sampler Hammer ________ Drilling Fluid Soil ________ Rock ________
Free Drop Sampler Hammer ________

Environmental Geology & Ground Water

GROUND WATER RECORD

Depth to Water	Time	Date	Depth of Casing
2.0		1/16/79	perched
see remarks			

CONTRACTOR ______
DRILLER ______ HELPER ______
INSPECTOR ______ LOGGER ______ (Soil) ______ (Rock)
DATE: HOLE BEGUN ______ CASING PULLED ______ LOG ______ (Soil) ______ (Rock)

PROJ. NO. ______ BORING NO. MW-5D SH 2 OF 3
PROJ. NAME Coffin Butte
LOCATION ______
SURF. EL. ______ ROCK EL. ______ TD 58.0'

Piezometer Record	DEPTH (FT.)	Stratig.	SOIL SAMPLE RECORD			Progress (Date)	DRILLING RECORD						INSPECTOR'S REMARKS Pocket penetrometer, water loss, artesian cond., caving, void, etc.	GEOLOGIST'S LOG
			Sample No.	Blows per 6"	Samp. type		Type Bit	Run No.	No. of Seg.	Recov (Ft.)	% Rec	RQD		
	20				BAG SAMPLES	1/16/79								
	25		5										Driller notes ground water encountered at 26.0"	Same as above
	30		6											
	35		7											35.0' - 50.0' Basalt, black, moderately weathered, gradational contact w/above colluvium
	40		8											

Show diameter, depth casing(s), depth perforations piezometer. Indicate method advancing hole through soil.

iameter (s) Sampler (s) ______
eight Sampler H   er ______ Drilling Fluid Soil ______ Rock ______
ree Drop Sample   mer ______

Environmental Geology
&
Gr d Water

GROUND WATER RECORD

Depth to Water	Time	Date	Depth of Casing
26.0		1/16/79	
see remarks			

CONTRACTOR ___
DRILLER ___ HELPER ___
INSPECTOR ___ LOGGER ___ (Soil) ___ (Rock)
DATE: HOLE BEGUN ___ CASING PULLED ___ LOG ___ (Soil) ___ (Rock)

PROJ. NO. ___ BORING NO. MW-5D SH 3 3
PROJ. NAME Coffin Butte
LOCATION ___
SURF. EL. ___ ROCK EL. ___ TD 58.0'

Piezometer Record	DEPTH (FT.)	Strata	SOIL SAMPLE RECORD Sample No.	Blows per 6"	Samp. type	Progress (Date)	DRILLING RECORD Type Bit	Run No.	No. of Seg.	Recov (Ft.)	% Rec	RQD	INSPECTOR'S REMARKS Pocket penetrometer, water loss, artesian cond., caving, void, etc.	GEOLOGIST'S LOG
	40													Same as above
	45		9											
	50		10										Driller notes slight increase in ground water flow between 45.0' and 55.0'	50.0' - 58.0' Basalt, black, only slightly to moderately weathered
	55		11											Completed at 58.0' 1/16/79 Double completion peizometers installed and developed with compressed air and water Shallow piezometer installed at 5.0' with hand auger to monitor perched ground water
	60													

Show diameter, depth casing(s); depth perforations piezometer. Indicate method advancing hole through soil.

Diameter (s) Sampler (s) ___
Weight Sampler Hammer ___ Drilling Fluid Soil ___ Rock ___
Free Drop Sampler Hammer ___

Environmental Geology & Ground Water

GROUND WATER RECORD

Depth to Water	Time	Date	Depth of Casing
see remarks			

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT Coffin Butte Landfill

Page 1 **of** 1

Location East of Leachate Lagoon

Boring No. 6

Surface Elevation

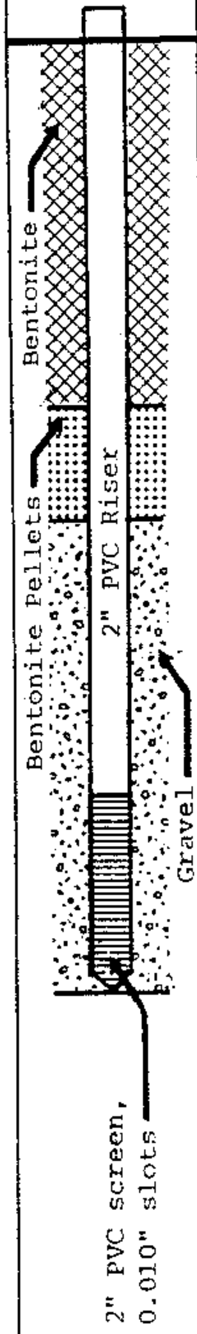
Drilling Method Air Rotary

Total Depth 50 ft.

Drilled By Jones Well Drilling

Date Completed 9/18/84

Logged By D.A. Cordell



WELL DETAILS	PENE-TRATION TIME/RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERME-ABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
							0.0'-8.0' Fill-Brown, silty dry.	
		10					8.0'-18.0' Silty Clay, Brown, moist, plastic. with tuffaceous material.	
		20					18.0'-23.0' Weathered Basaltic Conglomerate, with tuffaceous material.	
		30					23.0'-42.0' Tuffaceous Basaltic Conglomerate, soft to hard, dry to moist, ground water encountered at 37 ft.	Cond.245
		40					42.0'-50.0' Basalt, gray, hard.	Cond.297
		50						
							Boring made ≅ 7gpm below 37 ft.	

SEA-300-02a

Note: PVC has 0.75' stickup above ground level.

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT Coffin Butte Landfill **Page** 1 **of** 1

Location East of Expansion Lagoon

Boring No. 7S

Surface Elevation

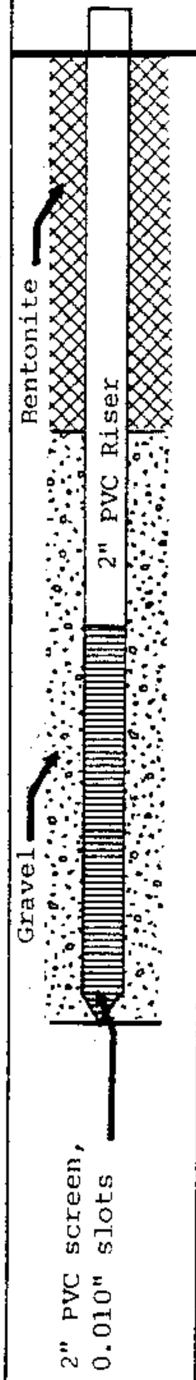
Drilling Method Air Rotary

Total Depth 25 ft.

Drilled By Jones Well Drilling

Date Completed 9/18/84

Logged By D.A. Cordell



WELL DETAILS	PENETRATION TIME/RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
		5					See log for MW-7D for lithologic details	
		10						
		15						
		20						
		25						

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT Coffin Butte Landfill

Page 1 **of** 1

Location East of Leachate Lagoon

Boring No. 7D

Surface Elevation

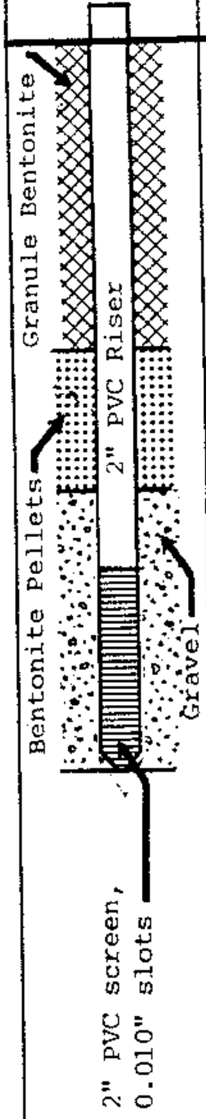
Drilling Method Air Rotary

Total Depth 40 ft.

Drilled By Jones Well Drilling

Date Completed 9/18/84

Logged By D.A. Cordell



WELL DETAILS	PENETRATION TIME/RATE	DEPTH (FEET)	SAMPLE		PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
			NO.	TYPE				
		10					0.0'-17.0' Silty Clay, Clayey Silt, Tan to brown, moist, plastic.	Cond.301
		20 30 40		NONE	NONE		17.0'-40.0' Tuffaceous, Basaltic Conglomerate, Gray to cream, soft to hard, dry above 22 ft., H_2O entered hole below 22 ft.	Cond.297
							Well made ≅ 4gpm below 25 ft.	

SEA-300-02a

Note - PVC has 4.75' stickup above ground level.

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT COFFIN BUTTE LANDFILL

Page 1 **of** 1

Location SE of Landfill

Boring No. MW-8S

Surface Elevation

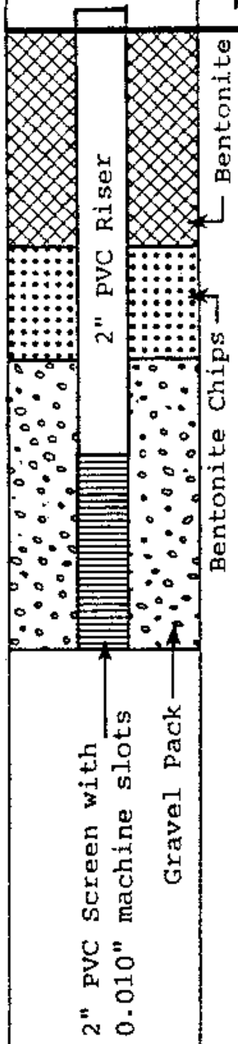
Drilling Method Air Rotary

Total Depth 32 feet

Drilled By Jones Drilling Co.

Date Completed 7/30/85

Logged By S.R. Henshaw



WELL DETAILS	PENE-TRATION TIME/ RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERME-ABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
		0					See boring log MW-8D for lithologic details.	
		10						
		20						
		30						
		40						

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT COFFIN BUTTE LANDFILL

Page 1 **of** 2

Location SE of Landfill

Boring No. MW-8D

Surface Elevation

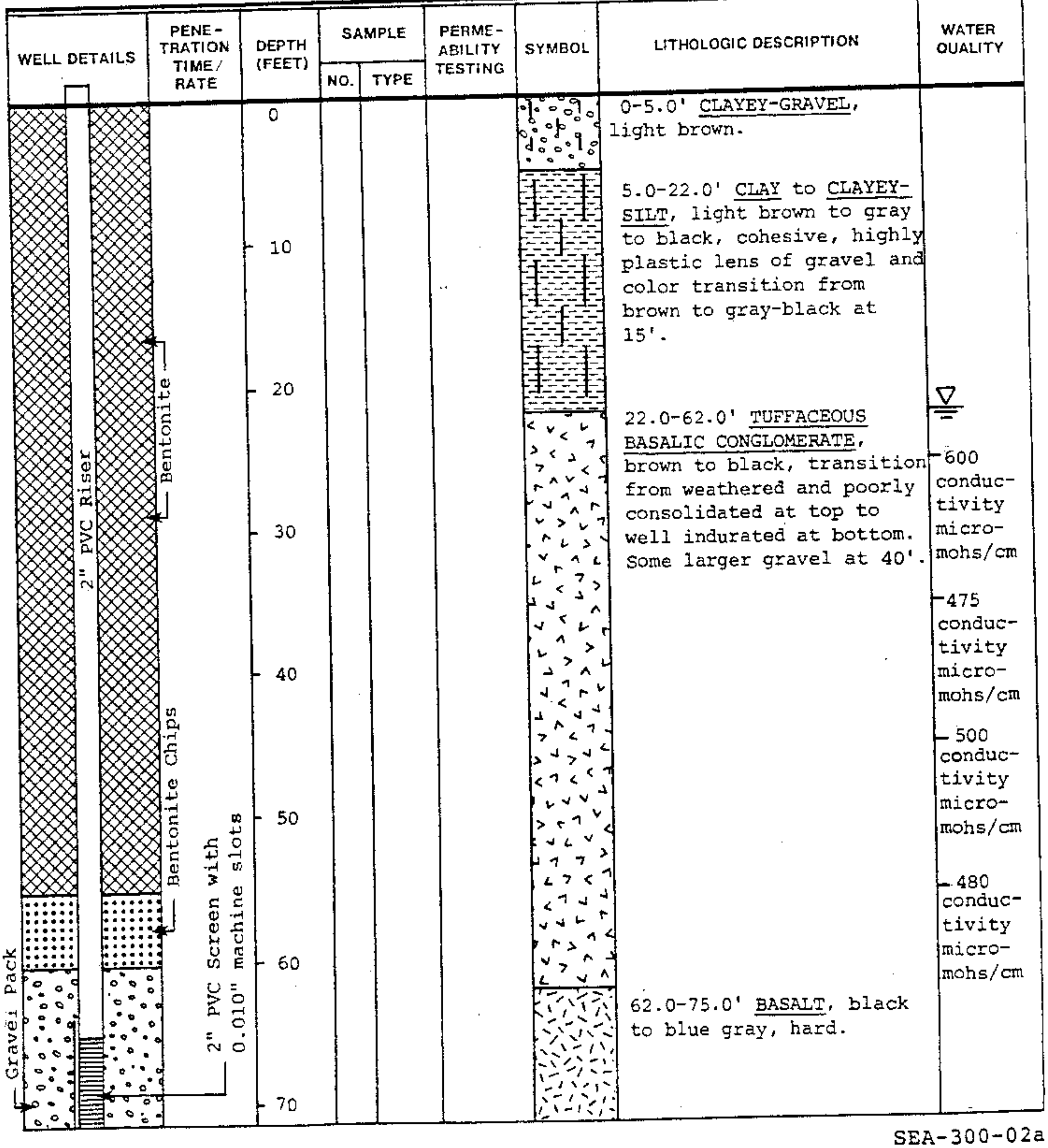
Drilling Method Air Rotary

Total Depth 75 feet

Drilled By Jones Drilling Co.

Date Completed 7/30/85

Logged By S.R. Henshaw



0-5.0' CLAYEY-GRAVEL, light brown.

5.0-22.0' CLAY to CLAYEY-SILT, light brown to gray to black, cohesive, highly plastic lens of gravel and color transition from brown to gray-black at 15'.

22.0-62.0' TUFFACEOUS BASALIC CONGLOMERATE, brown to black, transition from weathered and poorly consolidated at top to well indurated at bottom. Some larger gravel at 40'.

62.0-75.0' BASALT, black to blue gray, hard.

600 conductivity micro-mohs/cm

475 conductivity micro-mohs/cm

500 conductivity micro-mohs/cm

480 conductivity micro-mohs/cm

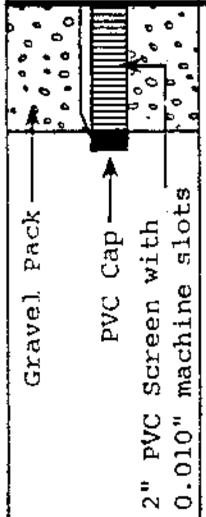
Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT COFFIN BUTTE LANDFILL

Page 2 **of** 2

Boring No. MW-8D

WELL DETAILS	PENETRATION TIME/ RATE	DEPTH (FEET)	SAMPLE		PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
			NO.	TYPE				
 		70				▨	62.0-75.0' See previous page for lithology description.	500 conductivity micro-mohs/cm

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT COFFIN BUTTE LANDFILL

Page 1 **of** 1

Location East of Landfill

Boring No. MW-9S

Surface Elevation

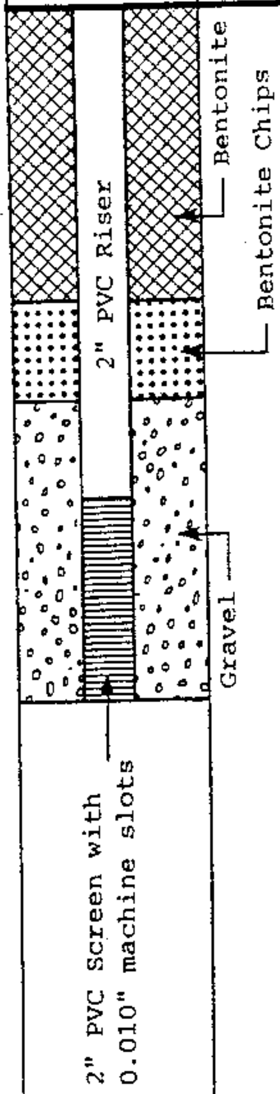
Drilling Method Air Rotary

Total Depth 35 feet

Drilled By Jones Drilling Co.

Date Completed 8/2/85

Logged By S.R. Henshaw

WELL DETAILS	PENETRATION TIME/ RATE	DEPTH (FEET)	SAMPLE		PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
			NO.	TYPE				
		0 10 20 30 40					See boring log MW-9D for lithologic details.	

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BORING LOG

PROJECT COFFIN BUTTE LANDFILL

Page 1 **of** 2

Location East of Landfill

Boring No. MW-9D

Surface Elevation

Drilling Method Air Rotary

Total Depth 125 Feet

Drilled By Jones Drilling Co.

Date Completed 8/1/85

Logged By S.R. Henshaw

WELL DETAILS	PENETRATION TIME/RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
ABANDONED RISER	Cement Slurry backfilled from 115' to 0'. Settled to ___ and backfilled with bentonite chips.	0					0-5.0' FILL, brown, soil and gravel.	
							5.0-19.0' CLAYEY SILT to CLAY, light brown, cohesive, hard, very plastic, sticky, some gravel.	
		10						
		20					19.0-36.0' CLAY, blue gray, hard, very plastic, sticky.	
								1000 conductivity micromohs/cm
		30						
							36.0-110.0' CLAYEY-SILT to SILTY-CLAY, light gray to light brown and red, firm, exhibits shale properties as observed from cuttings, moderately plastic, some small rock fragments 1-2 mm. Little sample recovered due to mixing.	1000 conductivity micromohs/cm
		40						
								1075 conductivity micromohs/cm
		50						
		60						1050 conductivity micromohs/cm
		70						

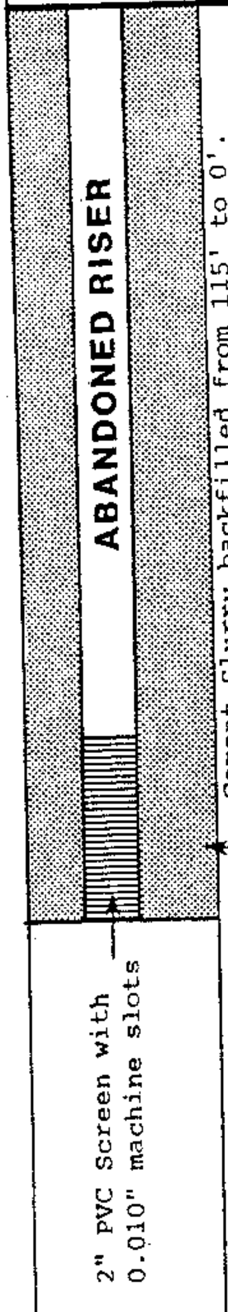
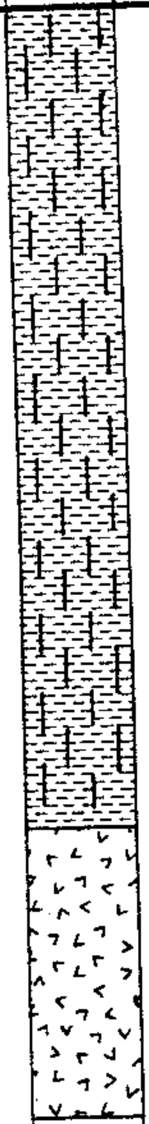
Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT COFFIN BUTTE LANDFILL

Page 2 **of** 2

Boring No. MW-9D

WELL DETAILS	PENETRATION TIME/RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
 ABANDONED RISER Cement Slurry backfilled from 115' to 0'. Settled to ___ and backfilled with bentonite chips. 2" PVC Screen with 0.010" machine slots		70 80 90 100					36.0-110.0' <u>CLAYEY-SILT</u> to <u>SILTY CLAY</u>. See previous page for lithology detail.	
		110 120					110.0-125.0' <u>WEATHERED COLLUVIAL MATERIAL</u>, characterized by angular rock fragments (1-4mm) and clay matrix. Some sand and clay stringers, good water yield, Artesian flow. Conductivity on 8/6/85 = 11,000 micro-mohs/cm.	2500 conductivity micro-mohs/cm 5000 6000 conductivity micro-mohs/cm.

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BORING LOG

PROJECT COFFIN BUTTE LANDFILL

Page 1 **of** 1

Location West of Entrance Gate

Boring No. MW-10S

Surface Elevation

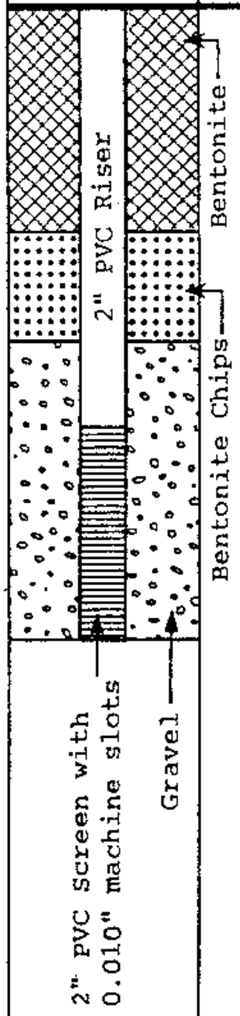
Drilling Method Air Rotary

Total Depth 32 feet

Drilled By Jones Drilling Co.

Date Completed 8/2/85

Logged By S.R. Henshaw

WELL DETAILS	PENE-TRATION TIME/ RATE	DEPTH (FEET)	SAMPLE		PERME-ABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
			NO.	TYPE				
		0 10 20 30 40					See boring log MW-10 D for ligholologic details.	

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT COFFIN BUTTE LANDFILL

Page 1 **of** 2

Location West of Entrance

Boring No. MW-10D

Surface Elevation

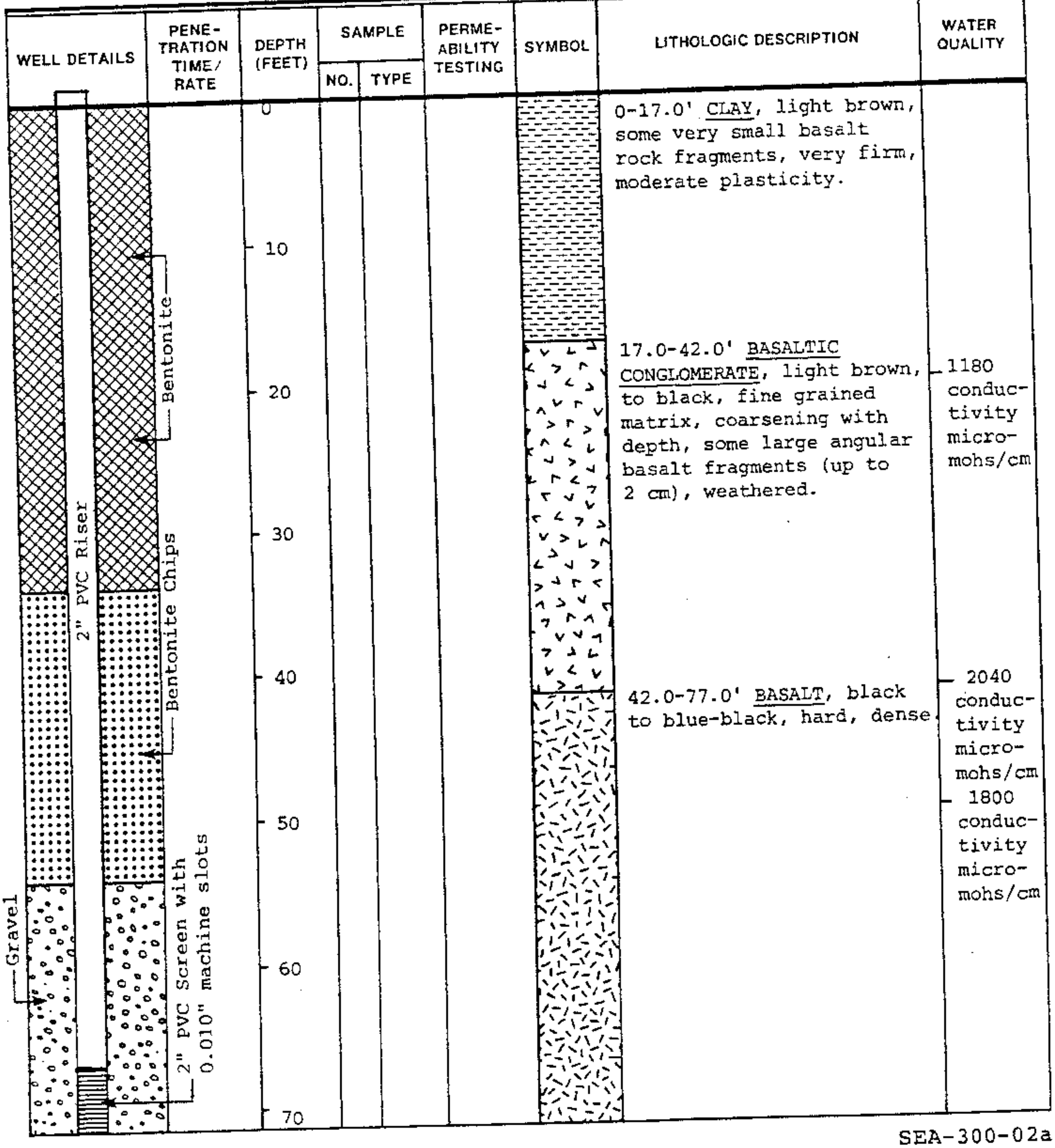
Drilling Method Air Rotary

Total Depth 77 feet

Drilled By Jones Drilling Co.

Date Completed 8/2/85

Logged By S.R. Henshaw



0-17.0' <u>CLAY</u>, light brown, some very small basalt rock fragments, very firm, moderate plasticity.

17.0-42.0' <u>BASALTIC CONGLOMERATE</u>, light brown, to black, fine grained matrix, coarsening with depth, some large angular basalt fragments (up to 2 cm), weathered.

1180 conductivity micromohs/cm

42.0-77.0' <u>BASALT</u>, black to blue-black, hard, dense

2040 conductivity micromohs/cm

1800 conductivity micromohs/cm

SEA-300-02a

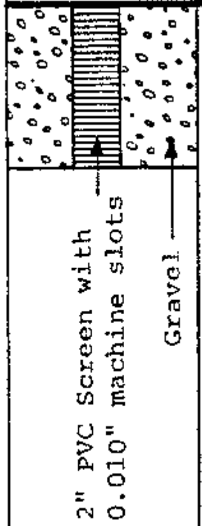
Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT COFFIN BUTTE LANDFILL

Page 2 **of** 2

Boring No. MW-10D

WELL DETAILS	PENETRATION TIME/RATE	DEPTH (FEET)	SAMPLE		PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
			NO.	TYPE				
		70				▨	42.0-77.0' See previous page for lithologic detail.	

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT COFFIN BUTTE LANDFILL

Page 1 **of** 1

Location S.W. of Entrance Gate

Boring No. MW-11S

Surface Elevation

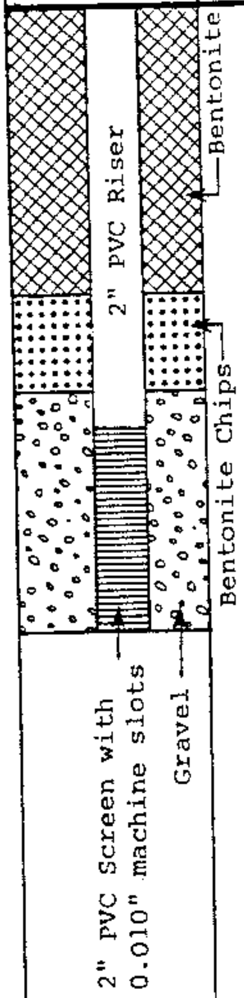
Drilling Method Air Rotary

Total Depth 32 feet

Drilled By Jones Drilling Co.

Date Completed 8/5/85

Logged By S.R. Henshaw

WELL DETAILS	PENETRATION TIME/RATE	DEPTH (FEET)	SAMPLE		PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
			NO.	TYPE				
		0					See boring log MW-11 D for lithologic details.	
		10						
		20						
		30						
		40						

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT COFFIN BUTTE LANDFILL

Page 1 **of** 2

Location S.W. of Entrance Gate

Boring No. MW-11D

Surface Elevation

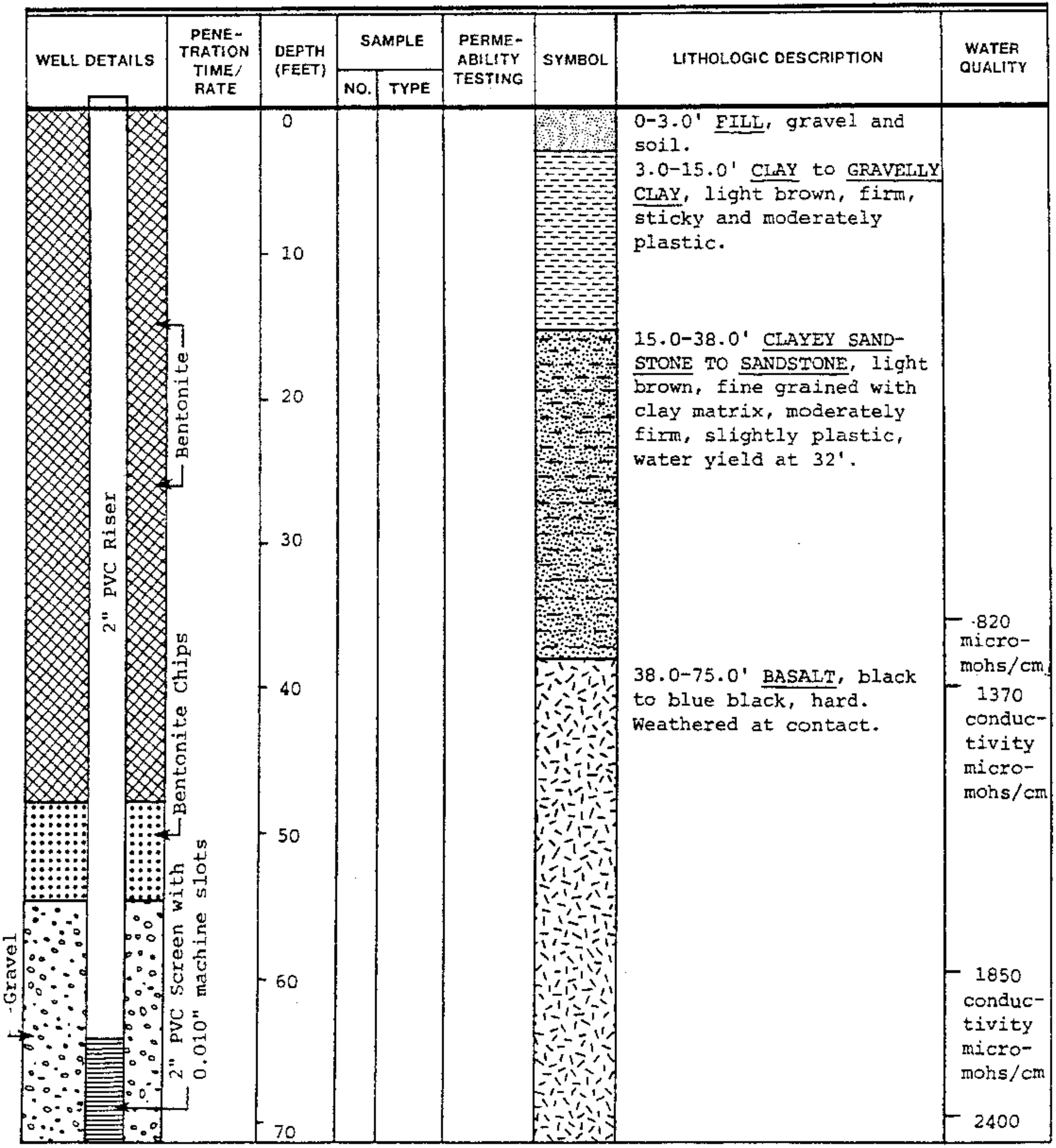
Drilling Method Air Rotary

Total Depth 75 feet

Drilled By Jones Drilling Co.

Date Completed 8/5/85

Logged By S.R. Henshaw



0-3.0' FILL, gravel and soil.

3.0-15.0' CLAY to GRAVELLY CLAY, light brown, firm, sticky and moderately plastic.

15.0-38.0' CLAYEY SANDSTONE TO SANDSTONE, light brown, fine grained with clay matrix, moderately firm, slightly plastic, water yield at 32'.

38.0-75.0' BASALT, black to blue black, hard. Weathered at contact.

820 micro-mohs/cm

1370 conductivity micro-mohs/cm

1850 conductivity micro-mohs/cm

2400

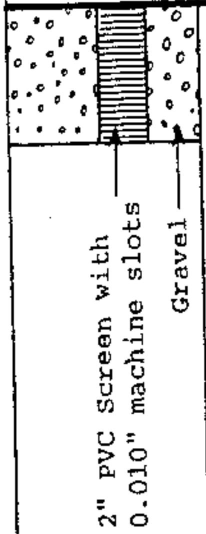
Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT COFFIN BUTTE LANDFILL

Page 2 **of** 2

Boring No. MW-11D

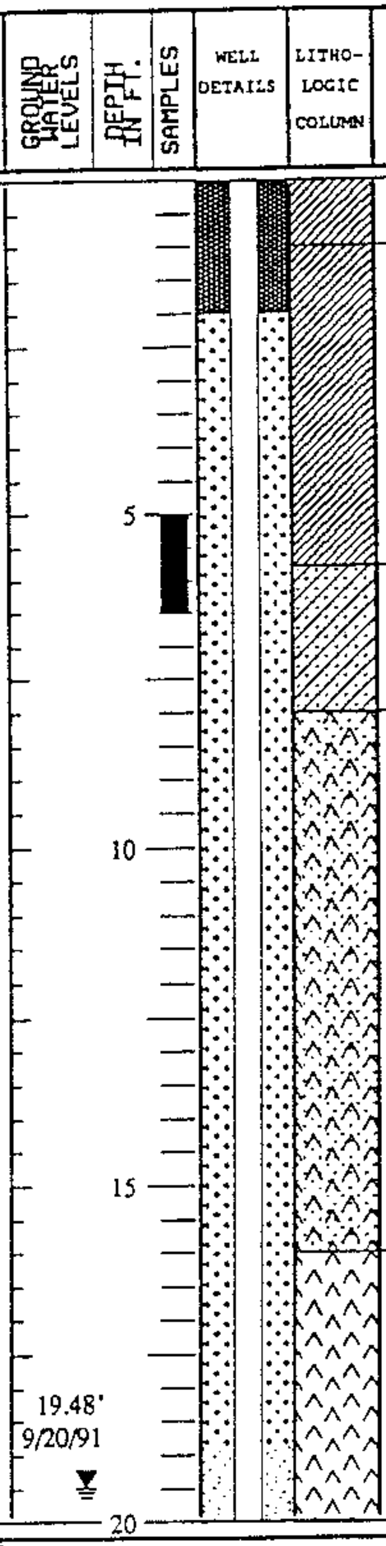
WELL DETAILS	PENETRATION TIME/RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
		70					38.0-75.0' See previous page for lithologic detail.	2400 conductivity micromohs/cm
		80						

LOG OF EXPLORATORY BORING

PROJECT NAME COFFIN BUTTE LANDFILL
LOCATION Benton County, Oregon
DRILLED BY Christenson
DRILL METHOD Air Rotary
LOGGED BY K. Burton

BORING NO. MW-12S
PAGE 1 OF 2
REFERENCE ELEV. ±
TOTAL DEPTH 26.15'
DATE COMPLETED 9/19/91

SAMPLE NUMBER (SAMPLE TYPE)	RECOVERY PERCENT	BLOW COUNTS
S-1 (SS)	100%	11-24-47



LITHOLOGIC DESCRIPTION

0-1 feet: SILTY CLAY (CL), brown, 90% medium to high plastic fines, 10% fine sand, loose, dry, massive. (TOPSOIL)

1-5.8 feet: CLAY (CL), brown to gray brown, 90% medium to high plastic fines, 10% fine sand, stiff, dry to slightly moist with depth, massive. (SAPROLITE)

5.8-8 feet: CLAYEY SAND (SC), brown, 40% medium to high plastic fines, 30% medium, 30% fine, hard, slightly moist, massive, highly weathered, relict lithic fabric is evident and becomes clearer with depth. (PARTLY DECOMPOSED BEDROCK)

8-16 feet: WEATHERED BASALT, gray-brown, broken, stained, moderately hard, slightly moist. (BEDROCK)

16-20 feet: BASALT, dark gray, aphanitic, moderately hard, slightly weathered, slightly moist. (BEDROCK)

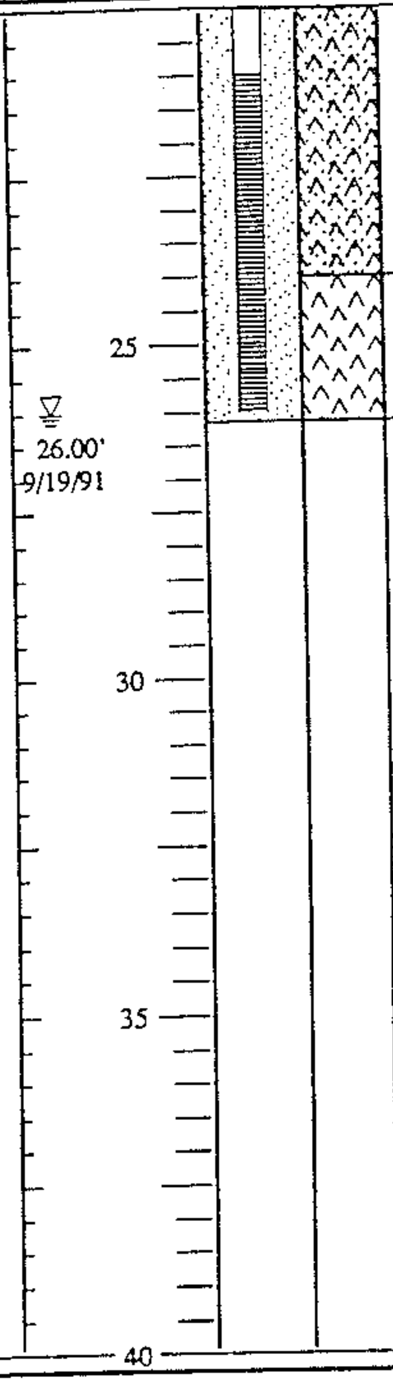
REMARKS
SS=2-inch O.D. split spoon sampler driven with a 140 lb. hammer falling 30-inches.

LOG OF EXPLORATORY BORING

PROJECT NAME COFFIN BUTTE LANDFILL
LOCATION Benton County, Oregon
DRILLED BY Christenson
DRILL METHOD Air Rotary
LOGGED BY K. Burton

BORING NO. MW-12S
PAGE 2 OF 2
REFERENCE ELEV. ±
TOTAL DEPTH 26.15'
DATE COMPLETED 9/19/91

SAMPLE NUMBER (SAMPLE TYPE)	RECOVERY PERCENT	BLOW COUNTS	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION



20-24 feet: WEATHERED BASALT, gray-brown, broken, moderately hard, slightly moist. (BEDROCK)

24-26.15 feet: BASALT, dark gray, aphanitic, moderately hard, trace fine amygdules, slightly moist to wet at bottom. (BEDROCK)

Bottom of boring at 26.15 feet below ground surface.

WELL COMPLETION DETAILS:

2 feet of stick-up, 2-inch diameter schedule 40 pvc blank to 21 feet, 2-inch diameter schedule 40 pvc screen with 0.020-inch slots 21-26 feet, sump 26-26.3 feet. Boring filled with 10x20 silica sand to 18.9 feet, 3/4-inch bentonite chips to 2 feet, concrete to 0.2 feet above ground surface to secure above ground locking security casing.

REMARKS

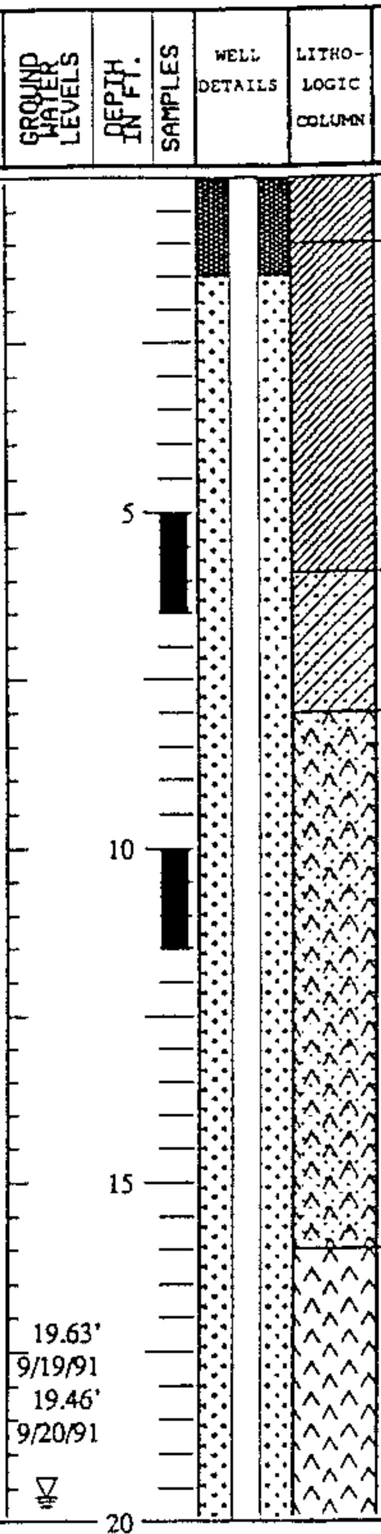
SS=2-inch O.D. split spoon sampler driven with a 140 lb. hammer falling 30-inches.

LOG OF EXPLORATORY BORING

PROJECT NAME COFFIN BUTTE LANDFILL
LOCATION Benton County, Oregon
DRILLED BY Christenson
DRILL METHOD Air Rotary
LOGGED BY K. Burton

BORING NO. MW-12D
PAGE 1 OF 4
REFERENCE ELEV. ±
TOTAL DEPTH 61.25'
DATE COMPLETED 9/19/91

SAMPLE NUMBER (SAMPLE TYPE)	RECOVERY PERCENT	BLOW COUNTS
S-1 (SS)	100%	9-15 -50/5.5
S-2 (SS)	33%	50/6"



LITHOLOGIC DESCRIPTION

0-1 feet: SILTY CLAY (CL), brown, 90% medium to high plastic fines, 10% fine sand, loose, dry, massive. (TOPSOIL)

1-5.9 feet: CLAY (CL), brown to gray brown, 90% medium to high plastic fines, 10% fine sand, stiff, dry to slightly moist with depth, massive. (SAPROLITE)

5.9-8 feet: CLAYEY SAND (SC), brown, 40% medium to high plastic fines, 30% medium, 30% fine, hard, slightly moist, massive, highly weathered relict lithic fabric is evident and becomes clearer with depth. (PARTLY DECOMPOSED BEDROCK)

8-16 feet: WEATHERED BASALT, gray-brown, broken, moderately hard, slightly moist. (BEDROCK)

16-20 feet: BASALT, dark gray, aphanitic, moderately hard, slightly weathered, slightly moist. (BEDROCK)

REMARKS

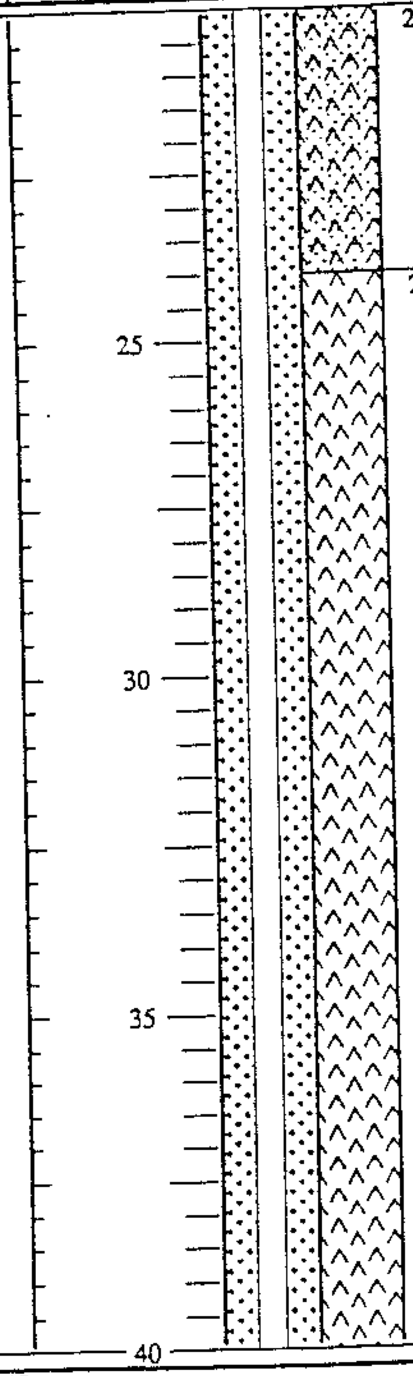
SS=2-inch O.D. split spoon sampler driven with a 140 lb. hammer falling 30-inches.

LOG OF EXPLORATORY BORING

PROJECT NAME COFFIN BUTTE LANDFILL
LOCATION Benton County, Oregon
DRILLED BY Christenson
DRILL METHOD Air Rotary
LOGGED BY K. Burton

BORING NO. MW-12D
PAGE 2 OF 4
REFERENCE ELEV. ±
TOTAL DEPTH 61.25'
DATE COMPLETED 9/19/9

SAMPLE NUMBER (SAMPLE TYPE)	RECOVERY PERCENT	BLOW COUNTS	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION



20-24 feet: **WEATHERED BASALT,** gray-brown, broken, moderately hard, slightly moist. (BEDROCK)

24-61.25 feet: **BASALT,** dark gray, aphanitic, moderately hard, trace fine amygdules, wet. (BEDROCK)

REMARKS

SS=2-inch O.D. split spoon sampler driven with a 140 lb. hammer falling 30-inches.

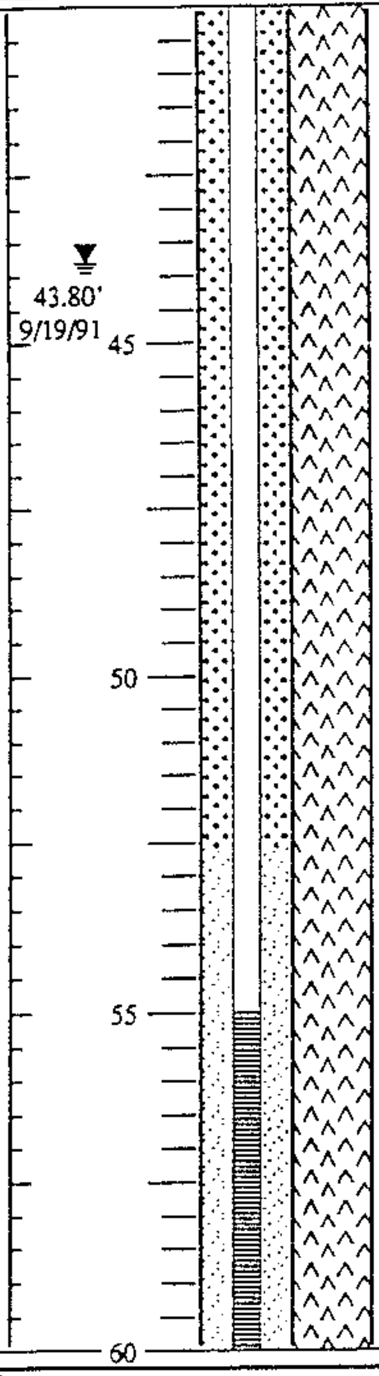
SWEET-EDWARDS/EMCON

LOG OF EXPLORATORY BORING

PROJECT NAME COFFIN BUTTE LANDFILL
LOCATION Benton County, Oregon
DRILLED BY Christenson
DRILL METHOD Air Rotary
LOGGED BY K. Burton

BORING NO. MW-12D
PAGE 3 OF 4
REFERENCE ELEV. ±
TOTAL DEPTH 61.25'
DATE COMPLETED 9/19/91

SAMPLE NUMBER (SAMPLE TYPE)	RECOVERY PERCENT	BLOW COUNTS	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION



24-61.25 feet: BASALT, continued from previous page.

@ 43.8-44.5 feet: fracture zone in basalt.

REMARKS

SS=2-inch O.D. split spoon sampler driven with a 140 lb. hammer falling 30-inches.

LOG OF EXPLORATORY BORING

PROJECT NAME COFFIN BUTTE LANDFILL
LOCATION Benton County, Oregon
DRILLED BY Christenson
DRILL METHOD Air Rotary
LOGGED BY K. Burton

BORING NO. MW-12D
PAGE 4 OF 4
REFERENCE ELEV. ±
TOTAL DEPTH 61.25'
DATE COMPLETED 9/19/9

SAMPLE NUMBER (SAMPLE TYPE)	RECOVERY PERCENT	BLOW COUNTS	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
						░	^^^	24-61.25 feet BASALT, continued from previous page.
				65 70 75 80				Bottom of boring at 61.25 feet below ground surface. WATER: 1.9 gallons/minute at 46.0 feet, 5.5 gallons/minute at 53.0 feet, 13.6 gallons/minute at 60.0 feet. WELL COMPLETION DETAILS: 2 feet of stick-up, 2-inch diameter schedule 40 pvc blank to 55 feet, 2-inch diameter schedule 40 pvc screen with 0.020-inch slots 55-60 feet, sump 60-60.3 feet. Boring filled with 10x20 silica sand to 52.6 feet, 3/4-inch bentonite chips to 1.5 feet, concrete to 0.2 feet above ground surface to secure above ground locking security casing.

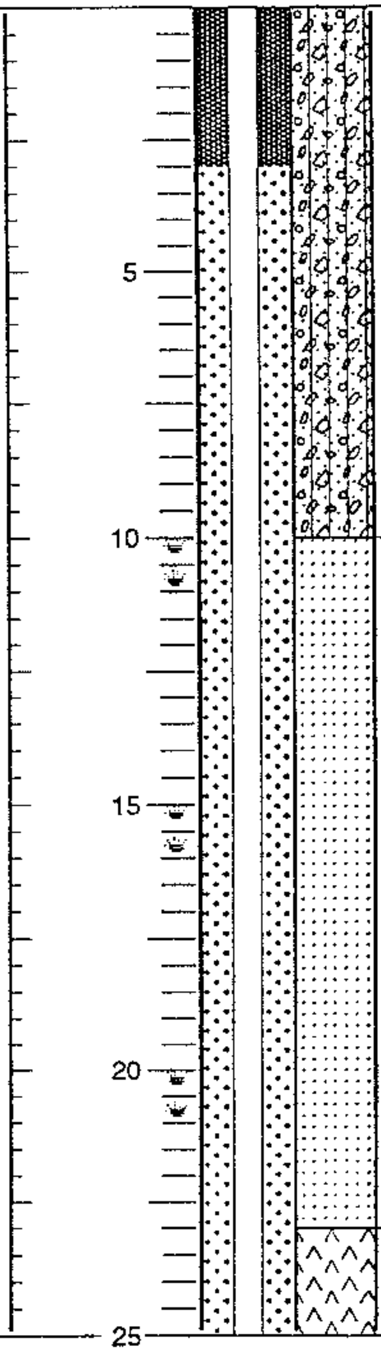
REMARKS

SS=2-inch O.D. split spoon sampler driven with a 140 lb. hammer falling 30-inches.

LOG OF EXPLORATORY BORING

PROJECT NAME COFFIN BUTTE LANDFILL
LOCATION Benton County, Oregon
DRILLED BY Staco Well Services
DRILL METHOD Air Rotary
LOGGED BY Craig Fanshier

BORING NO. MW- 13
PAGE 1 OF 5
REFERENCE ELEV. 398.80'
TOTAL DEPTH 108.80'
DATE COMPLETED 7/21/92



SAMPLE NUMBER SAMPLE TYPE	RECOVERY PERCENT	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
								0-10 feet: WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM), yellowish brown. (FILL)
				5				
S-1 GRAB				10				**10-23 feet:** SANDSTONE (SS), brown, fine to medium grained.
S-2 GRAB				15				
S-3 GRAB				20				
								23-108.8 feet: BASALT, greenish gray, fine grain, massive to locally fractured, propylitic alteration, trace carbonate (quartz) veinlets, trace sideromelane
				25				

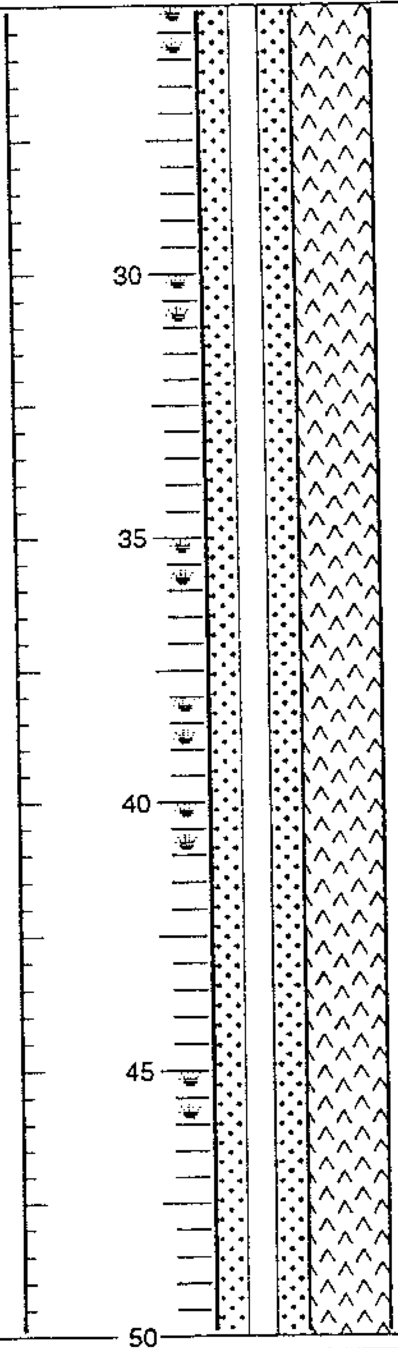
REMARKS

Exploratory boring B-13 drilled by 8-inch diameter hollow stem auger from 0-23 feet; continuously diamond cored from 23-43 feet. Boring backfilled with cement-bentonite grout. Monitoring well boring MW-13 drilled approx. 10 feet east of B-13 by air rotary with 6-inch downhole hammer from surface to 108.8 feet.

LOG OF EXPLORATORY BORING

PROJECT NAME COFFIN BUTTE LANDFILL
LOCATION Benton County, Oregon
DRILLED BY Staco Well Services
DRILL METHOD Air Rotary
LOGGED BY Craig Fanshier

BORING NO. MW- 13
PAGE 2 OF 5
REFERENCE ELEV. 398.80'
TOTAL DEPTH 108.80'
DATE COMPLETED 7/21/92



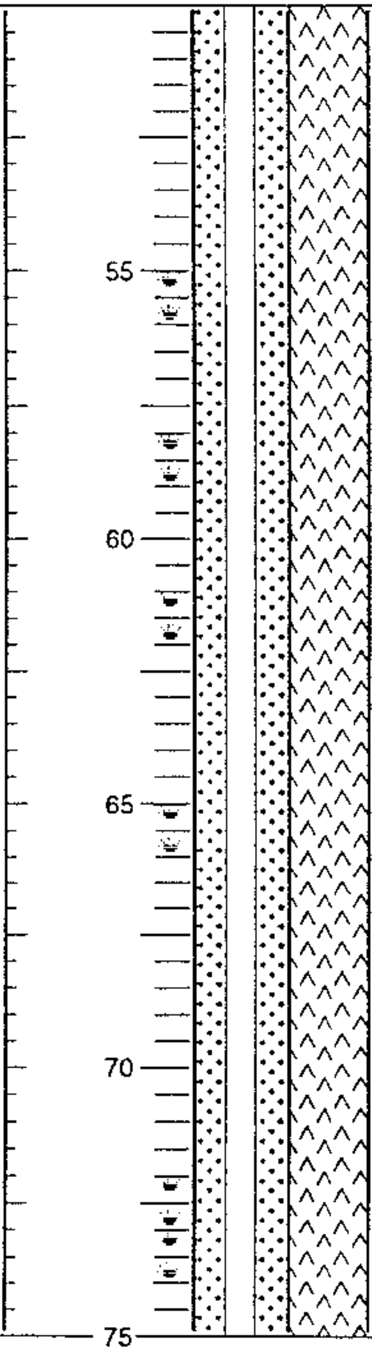
SAMPLE NUMBER SAMPLE TYPE	RECOVERY PERCENT	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
								and zeolites. (Siletz River Volcanics)
S-4 GRAB								@ 23-25 feet: Softer drilling, crushed to intensely fractured.
								@ 27 feet: Basalt, brown.
								@ 29-30 feet: Basalt, brown.
				30				
S-5 GRAB								
				35				@ 35-43 feet: Drilling noticeably harder.
S-6 GRAB								
S-7 GRAB								
				40				
S-8 GRAB								
								@ 43-44 feet: Basalt, brown, crushed to intensely fractured, trace pyrite.
				45				
S-9 GRAB								
								@ 48-49 feet: Basalt, brown.
				50				

REMARKS

Exploratory boring B-13 drilled by 8-inch diameter hollow stem auger from 0-23 feet; continuously diamond cored from 23-43 feet. Boring backfilled with cement-bentonite grout. Monitoring well boring MW-13 drilled approx. 10 feet east of B-13 by air rotary with 6-inch downhole hammer from surface to 108.8 feet.

LOG OF EXPLORATORY BORING

PROJECT NAME	COFFIN BUTTE LANDFILL	BORING NO.	**MW- 13**
LOCATION	Benton County, Oregon	PAGE	**3 OF 5**
DRILLED BY	Staco Well Services	REFERENCE ELEV.	**398.80'**
DRILL METHOD	Air Rotary	TOTAL DEPTH	**108.80'**
LOGGED BY	Craig Fanshier	DATE COMPLETED	**7/21/92**



SAMPLE NUMBER SAMPLE TYPE	RECOVERY PERCENT	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
S-10 GRAB								**23-108.8 feet: BASALT,** greenish gray, fine grain, massive to locally fractured, propylitic alteration, trace carbonate (quartz) veinlets, trace sideromelane and zeolites. (Siletz River Volcanics)
								@ 53-54 feet: Basalt, brown.
				55				
S-11 GRAB								
S-12 GRAB								@ 58-59.5 feet: Basalt, brown, softer drilling.
				60				
S-13 GRAB								
								@ 64.5-66.5 feet: Basalt, brown.
				65				
S-14 GRAB								
				70				@ 69.5-70.5 feet: Basalt, brown.
S-15 GRAB								@ 72-75 feet: Drilling noticeably harder.
S-16 GRAB								
				75				

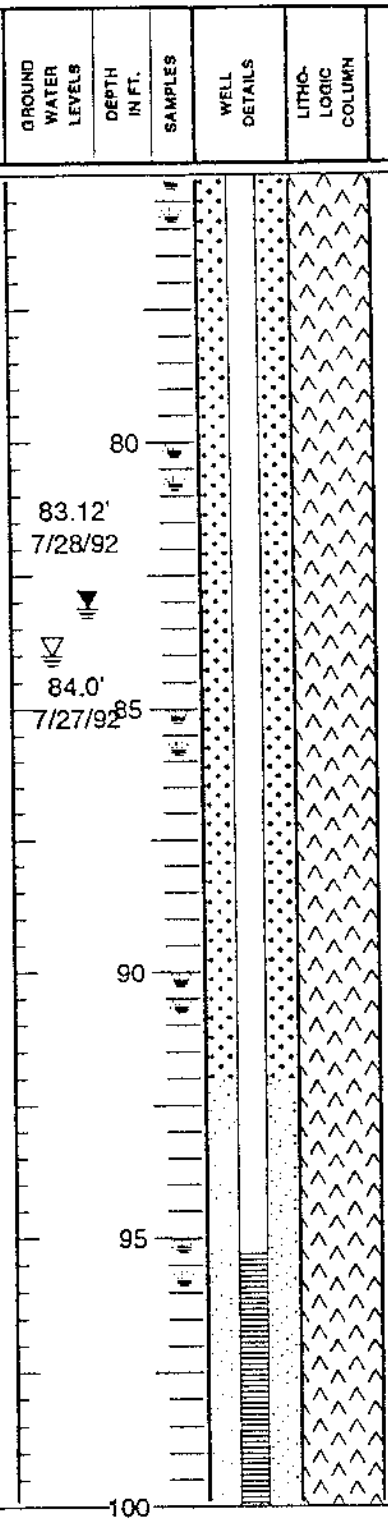
REMARKS

Exploratory boring B-13 drilled by 8-inch diameter hollow stem auger from 0-23 feet; continuously diamond cored from 23-43 feet. Boring backfilled with cement-bentonite grout. Monitoring well boring MW-13 drilled approx. 10 feet east of B-13 by air rotary with 6-inch downhole hammer from surface to 108.8 feet.

LOG OF EXPLORATORY BORING

PROJECT NAME COFFIN BUTTE LANDFILL
LOCATION Benton County, Oregon
DRILLED BY Staco Well Services
DRILL METHOD Air Rotary
LOGGED BY Craig Fanshier

BORING NO. MW- 13
PAGE 4 OF 5
REFERENCE ELEV. 398.80'
TOTAL DEPTH 108.80'
DATE COMPLETED 7/21/92



SAMPLE NUMBER SAMPLE TYPE	RECOVERY PERCENT	BLOW COUNTS (N COMP)	LITHOLOGIC DESCRIPTION
S-17 GRAB			**23-108.8 feet: BASALT**, greenish gray, fine grain, massive to locally fractured, propylitic alteration, trace carbonate (quartz) veinlets, trace sideromelane and zeolites. (Siletz River Volcanics)
S-18 GRAB			@ 80-85 feet: Drilling noticeably harder.
S-19 GRAB			@ 84 feet: Slight moisture in cuttings discharge. (First water determined by tripping drill rod out of hole and measuring depth to water with an electric water sounder).
S-20 GRAB S-21 GRAB			@ 89.5-96.5 feet: Basalt, brown.
S-22 GRAB			@ 96.5-107 feet: Basalt, brown, minor tuffaceous basalt, easier drilling, cuttings discharge slightly damp.

REMARKS

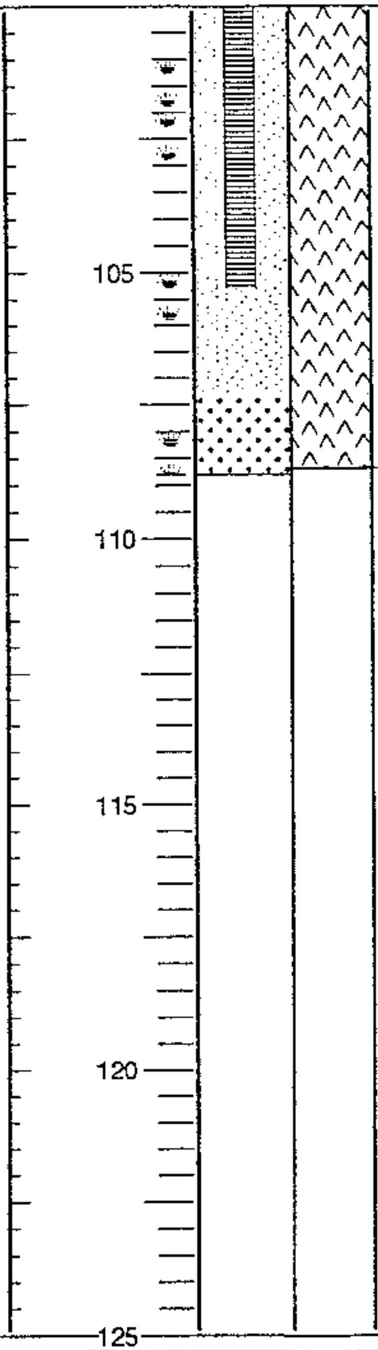
Exploratory boring B-13 drilled by 8-inch diameter hollow stem auger from 0-23 feet; continuously diamond cored from 23-43 feet. Boring backfilled with cement-bentonite grout. Monitoring well boring MW-13 drilled approx. 10 feet east of B-13 by air rotary with 6-inch downhole hammer from surface to 108.8 feet.

LOG OF EXPLORATORY BORING

PROJECT NAME COFFIN BUTTE LANDFILL
LOCATION Benton County, Oregon
DRILLED BY Staco Well Services
DRILL METHOD Air Rotary
LOGGED BY Craig Fanshier

BORING NO. MW- 13
PAGE 5 OF 5
REFERENCE ELEV. 398.80'
TOTAL DEPTH 108.80'
DATE COMPLETED 7/21/92

SAMPLE NUMBER SAMPLE TYPE	RECOVERY PERCENT	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
S-23 GRAB S-24 GRAB S-25 GRAB S-26 GRAB								



23-108.8 feet: BASALT, greenish gray, fine grain, massive to locally fractured, propylitic alteration, trace carbonate (quartz) veinlets, trace sideromelane and zeolites. (Siletz River Volcanics)

@ 107-108 feet: Basalt, greenish gray.

Bottom of boring at 108.8 feet below ground surface.

WELL COMPLETION DETAILS:

+1.9-95 feet: 2-inch dia. schedule 40 PVC flush threaded blank casing with "O" rings.

95.3-105.3 feet: 2-inch dia. schedule 40 PVC screen with 0.020-inch machine slots.

105-105.6 feet: 2-inch dia. schedule 40 PVC end cap.

0-3 feet: Concrete.

3-92 feet: 21.75 - 50 pound bags of 3/4-inch bentonite chips.

92-107 feet: 3 - 100 bags of 8 12 graded silica sand. (FILTER PACK)

107-108.8 feet: 0.5 50 pound bag of 3/4-inch bentonite chips.

SURFACE COMPLETION DETAILS:

6-inch steel locking protective casing, surrounded by 3 - 5-foot long, 3-inch dia. protective posts.

Ground surface elevation: 398.8 feet MSL.

Top of casing elevation: 400.67 feet MSL.

Coffin Butte base map coordinates:
Eastings: 353.63 feet.
Northings: 1497.68 feet.

Notes: Sample depth indicates where a discrete interval sample was collected and archived. Air rotary cuttings were semi-continuously monitored at the discharge pipe during the drilling process.

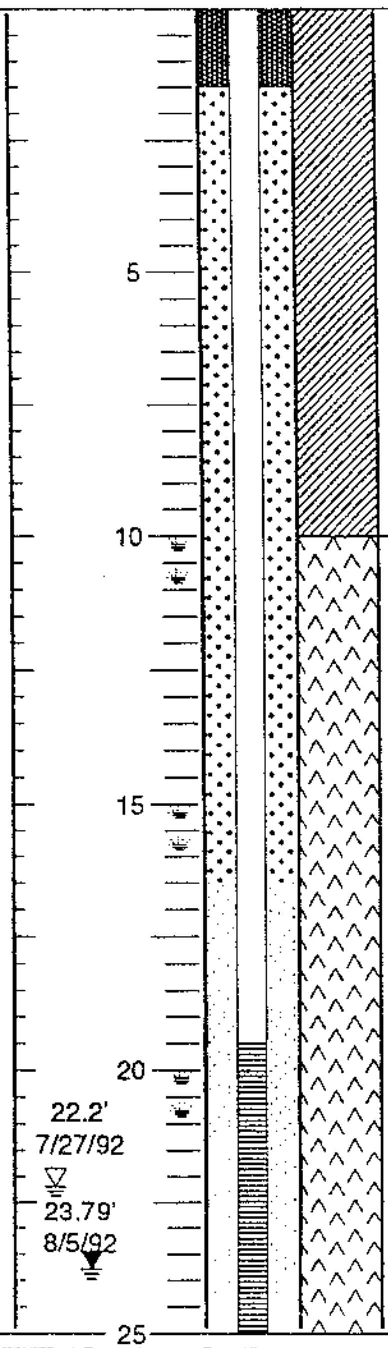
REMARKS

Exploratory boring B-13 drilled by 8-inch diameter hollow stem auger from 0-23 feet; continuously diamond cored from 23-43 feet. Boring backfilled with cement-bentonite grout. Monitoring well boring MW-13 drilled approx. 10 feet east of B-13 by air rotary with 6-inch downhole hammer from surface to 108.8 feet.

LOG OF EXPLORATORY BORING

PROJECT NAME **COFFIN BUTTE LANDFILL**
LOCATION **Benton County, Oregon**
DRILLED BY **Staco Well Services**
DRILL METHOD **Air Rotary**
LOGGED BY **Craig Fanshier**

BORING NO. **MW- 14S**
PAGE **1 OF 3**
REFERENCE ELEV. **287.50'**
TOTAL DEPTH **35.50'**
DATE COMPLETED **7/27/92**



SAMPLE NUMBER SAMPLE TYPE	RECOVERY PERCENT	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
								0-10 feet: SILTY CLAY (CL), yellowish brown, soft, damp, trace (<5%) 3/8-inch angular gravel. (COLLUVIUM)
	– –			5				
S-1 GRAB				10				10-27 feet: BASALT, brown to orange brown, slightly fractured, strongly weathered on fractures, carbona veinlets. (Siletz River Volcanics)
S-2 GRAB				15				
S-3 GRAB			22.2' 7/27/92 ▽ 23.79' 8/5/92 ▼	20				
				25				

REMARKS

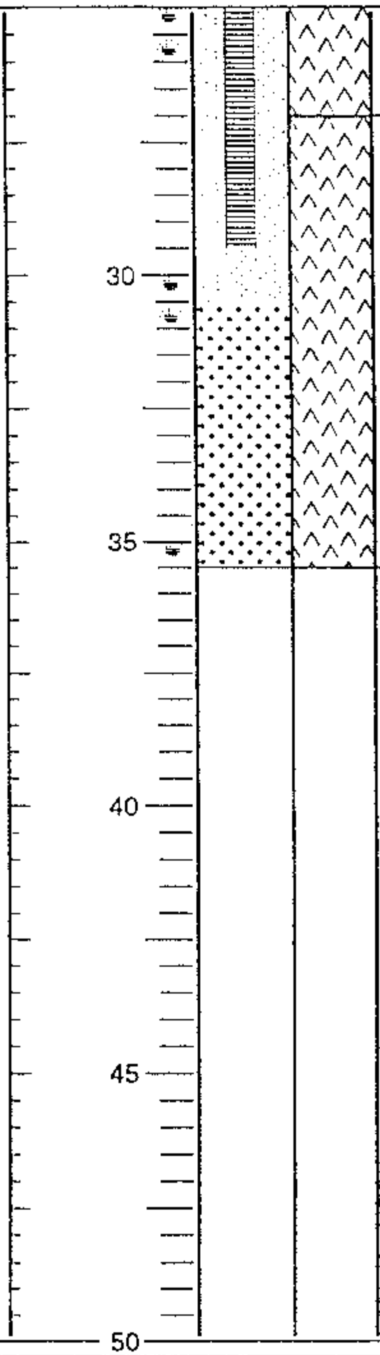
Exploratory boring B-14 drilled by 8-inch dia. hollow stem auger from 0-9.7 feet; continuously diamond cored from 9.7-70 feet. Boring backfilled with cement-bentonite grout. Monitoring well boring MW-14S drilled approx. 20 feet east of B-14 by air rotary with 8-inch downhole hammer from surface to 35.5 feet.

LOG OF EXPLORATORY BORING

PROJECT NAME COFFIN BUTTE LANDFILL
LOCATION Benton County, Oregon
DRILLED BY Staco Well Services
DRILL METHOD Air Rotary
LOGGED BY Craig Fanshier

BORING NO. MW- 14S
PAGE 2 OF 3
REFERENCE ELEV. 287.50'
TOTAL DEPTH 35.50'
DATE COMPLETED 7/27/92

SAMPLE NUMBER SAMPLE TYPE	RECOVERY PERCENT	BLOW COUNTS (N COMP)
S-4 GRAB		
S-5 GRAB	-	
S-6 GRAB		



LITHOLOGIC DESCRIPTION

10-27 feet: BASALT, brown to orange brown, slightly fractured, strongly weathered on fractures, carbonate veinlets. (Siletz River Volcanics)

27-35.5 feet: BASALT, greenish gray to dark green, highly fracture, propylitic alteration, fine carbonates, (quartz) veinlets, trace pyrite.

Bottom of boring at 35.5 feet below ground surface.

WELL COMPLETION DETAILS:

+2.08-19.5 feet: 4-inch dia. schedule 40 PVC flush threaded blank casing with "O" rings.

19.5-29.5 feet: 4-inch dia. schedule 40 PVC screen with 0.020-inch machine slots.

29.5-30.1 feet: 4-inch dia. schedule 40 PVC end cap.

0-1.5 feet: Concrete.

1.5-16.5 feet: 4.5 - 50 pound bags of 3/4-inch bentonite chips.

16.5-30.5 feet: 4.5 - 100 bags of 8x12 graded silica sand. (FILTER PACK)

30.5-35.5 feet: 2.25 - 50 pound bags of 3/4-inch bentonite chips.

SURFACE COMPLETION DETAILS:

6-inch steel locking protective casing, surrounded by 3 - 5-foot long, 3-inch dia. protective posts.

Ground surface elevation: 287.5 feet MSL.

Top of casing elevation: 289.58 feet MSL.

Coffin Butte base map coordinates:
Eastings: 674.78 feet.
Northings: 251.74 feet.

REMARKS

Exploratory boring B-14 drilled by 8-inch dia. hollow stem auger from 0-9.7 feet; continuously diamond cored from 9.7-70 feet. Boring backfilled with cement-bentonite grout. Monitoring well boring MW-14S drilled approx. 20 feet east of B-14 by air rotary with 8-inch downhole hammer from surface to 35.5 feet.

LOG OF EXPLORATORY BORING

PROJECT NAME COFFIN BUTTE LANDFILL
LOCATION Benton County, Oregon
DRILLED BY Staco Well Services
DRILL METHOD Air Rotary
LOGGED BY Craig Fanshier

BORING NO. MW- 14S
PAGE 3 OF 3
REFERENCE ELEV. 287.50'
TOTAL DEPTH 35.50'
DATE COMPLETED 7/27/92

SAMPLE NUMBER SAMPLE TYPE	RECOVERY PERCENT	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
								Sample depth indicates where a discrete interval sample was collected and archived. Air rotary cuttings were semi-continuously monitored at the discharge during the drilling process.
				55				
				60				
				65				
				70				
				75				

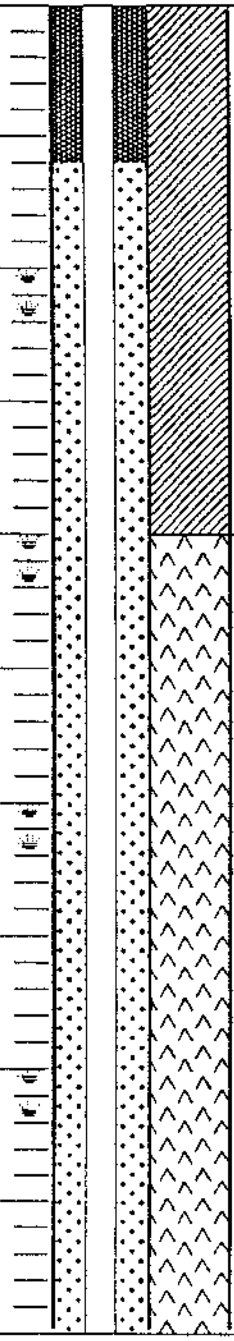
REMARKS

Exploratory boring B-14 drilled by 8-inch dia. hollow stem auger from 0-9.7 feet; continuously diamond cored from 9.7-70 fee Boring backfilled with cement-bentonite grout. Monitoring well boring MW-14S drilled approx. 20 feet east of B-14 by air rotary with 8-inch downhole hammer from surface to 35.5 feet.

LOG OF EXPLORATORY BORING

PROJECT NAME **COFFIN BUTTE LANDFILL**
LOCATION **Benton County, Oregon**
DRILLED BY **Staco Well Services**
DRILL METHOD **Air Rotary**
LOGGED BY **Craig Fanshier**

BORING NO. **MW- 14D**
PAGE **1 OF 4**
REFERENCE ELEV. **287.80'**
TOTAL DEPTH **75.00'**
DATE COMPLETED **7/24/92**



SAMPLE NUMBER SAMPLE TYPE	RECOVERY PERCENT	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	LITHOLOGIC DESCRIPTION
				0	**0-10 feet: SILTY CLAY (CL),** brown, soft, damp, trace (5%) 3/8-inch angular gravel. (COLLUVIUM)
S-1 GRAB	–			5	
S-2 GRAB				10	**10-27 feet: BASALT,** brown to orange brown, slightly fractured, strongly weathered on fractures, carbonate veinlets. (Siletz River Volcanics)
S-3 GRAB				15	
S-4 GRAB				20	
			▼ 23.27' 7/29/92	25	

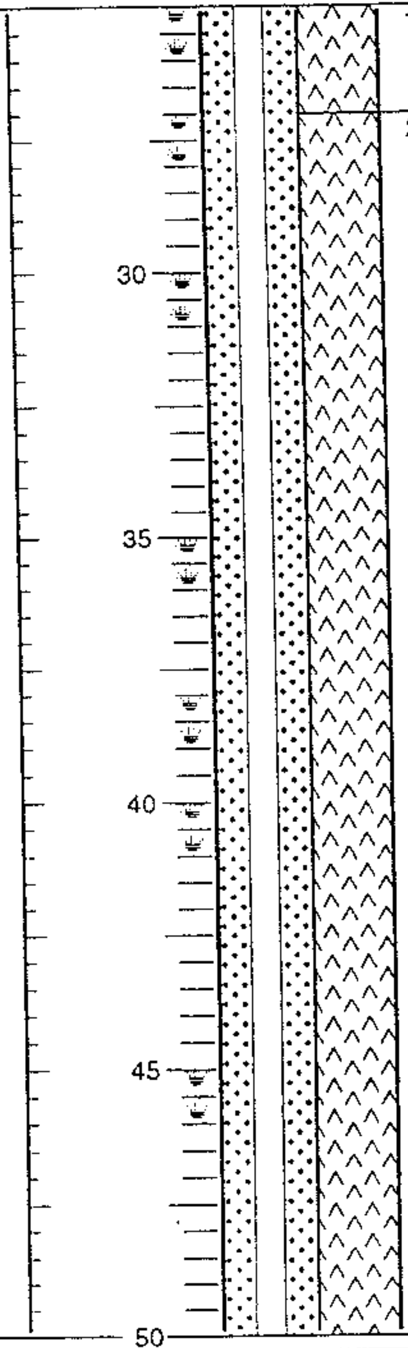
REMARKS

Exploratory boring B-14 drilled by 8-inch dia. hollow stem auger from 0-9.7 feet; continuously diamond cored from 9.7-70 feet. Boring backfilled with cement-bentonite grout. Monitoring well boring MW-14D drilled approx. 10 feet east of B-14 by air rotary with 6-inch downhole hammer from surface to 75 feet.

LOG OF EXPLORATORY BORING

PROJECT NAME COFFIN BUTTE LANDFILL
LOCATION Benton County, Oregon
DRILLED BY Staco Well Services
DRILL METHOD Air Rotary
LOGGED BY Craig Fanshier

BORING NO. MW- 14D
PAGE 2 OF 4
REFERENCE ELEV. 287.80'
TOTAL DEPTH 75.00'
DATE COMPLETED 7/24/92



SAMPLE NUMBER SAMPLE TYPE	RECOVERY PERCENT	BLOW COUNTS (N COMP)	DEPTH IN FT.	LITHOLOGIC DESCRIPTION
S-5 GRAB				**10-27 feet:** BASALT, brown to orange brown, slightly fractured, strongly weathered on fractures, carbonate veinlets. (Siletz River Volcanics)
S-6 GRAB				**27-71 feet:** BASALT, greenish gray to dark green, intensely fractured, propylitic alteration, fine-grained carbonates, (quartz) veinlets, trace pyrite.
S-7 GRAB	-	-	30	
			35	
S-8 GRAB				@ 36 feet: 5% gray ash, tuff.
				@ 37 feet: 5% gray ash, tuff.
S-9 GRAB				
S-10 GRAB			40	
			45	
S-11 GRAB				
			50	

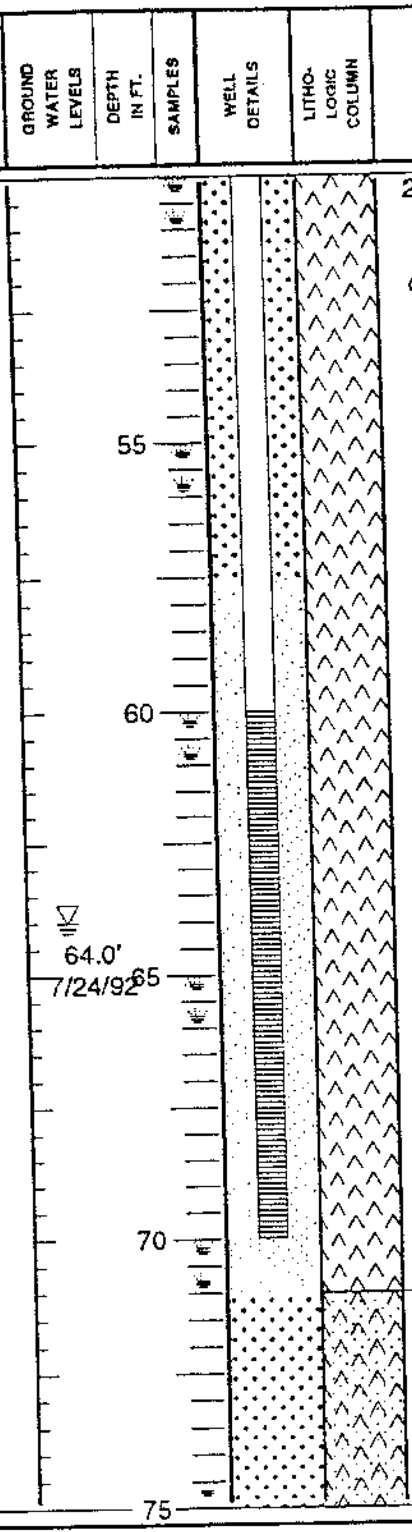
REMARKS

Exploratory boring B-14 drilled by 8-inch dia. hollow stem auger from 0-9.7 feet; continuously diamond cored from 9.7-70 feet. Boring backfilled with cement-bentonite grout. Monitoring well boring MW-14D drilled approx. 10 feet east of B-14 by air rotary with 6-inch downhole hammer from surface to 75 feet.

LOG OF EXPLORATORY BORING

PROJECT NAME COFFIN BUTTE LANDFILL
LOCATION **Benton County, Oregon**
DRILLED BY **Staco Well Services**
DRILL METHOD **Air Rotary**
LOGGED BY **Craig Fanshier**

BORING NO. **MW- 14D**
PAGE **3 OF 4**
REFERENCE ELEV. **287.80'**
TOTAL DEPTH **75.00'**
DATE COMPLETED **7/24/92**



SAMPLE NUMBER SAMPLE TYPE	RECOVERY PERCENT	BLOW COUNTS (N COMP)	LITHOLOGIC DESCRIPTION
S-12 GRAB			27-71 feet: BASALT, greenish gray to dark green, intensely fractured, propylitic alteration, fine-grained carbonates, (quartz) veinlets, trace pyrite. @ 51-60 feet: Harder drilling.
S-13 GRAB			@ 56-71 feet: Trace (5%) white calcite filling small fractures.
S-14 GRAB			@ 60-64 feet: Easier drilling.
			@ 64 feet: Minor water produced at surface cuttings discharge pipe.
S-15 GRAB			
			@ 69-71 feet: Easier drilling, produces approx. 0.2 gpm.
S-16 GRAB			71-75 feet: TUFFACEOUS BASALT, fine grain, greenish gray, 20% light gray ash-tuff, discharge water turns gray.

REMARKS

Exploratory boring B-14 drilled by 8-inch dia. hollow stem auger from 0-9.7 feet; continuously diamond cored from 9.7-70 feet. Boring backfilled with cement-bentonite grout. Monitoring well boring MW-14D drilled approx. 10 feet east of B-14 by air rotary with 6-inch downhole hammer from surface to 75 feet.

LOG OF EXPLORATORY BORING

PROJECT NAME	COFFIN BUTTE LANDFILL	BORING NO.	MW- 14D
LOCATION	Benton County, Oregon	PAGE	4 OF 4
DRILLED BY	Staco Well Services	REFERENCE ELEV.	287.80'
DRILL METHOD	Air Rotary	TOTAL DEPTH	75.00'
LOGGED BY	Craig Fanshier	DATE COMPLETED	7/24/92

SAMPLE NUMBER SAMPLE TYPE	RECOVERY PERCENT	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
S-17 GRAB				80 85 90 95 100				Bottom of boring at 75.0 feet below ground surface.

WELL COMPLETION DETAILS:

+2.47-60 feet: 2-inch dia. schedule 40 PVC flush threaded blank casing with "O" rings.

60-70 feet: 2-inch dia. schedule 40 PVC screen with 0.020-inch machine slots.

70-70.6 feet: 2-inch dia. schedule 40 PVC end cap.

0-3 feet: Concrete.

3-57.5 feet: 13.5 - 50 pound bags of 3/4-inch bentonite chips.

57.5-71 feet: 2.6 - 100 bags of 8x12 graded silica sand. (FILTER PACK)

71-75 feet: 0.8 50 pound bag of 3/4-inch bentonite chips.

SURFACE COMPLETION DETAILS:

6-inch steel locking protective casing, surrounded by 3 - 5-foot long, 3-inch dia. protective posts.

Ground surface elevation: 287.8 feet MSL.

Top of casing elevation: 290.27 feet MSL.

Coffin Butte base map coordinates:

Eastings: 664.50 feet.

Northings: 248.23 feet.

Notes:

Sample depth indicates where a discrete interval sample was collected and archived. Air rotary cuttings were semi-continuously monitored at the discharge during the drilling process.

REMARKS

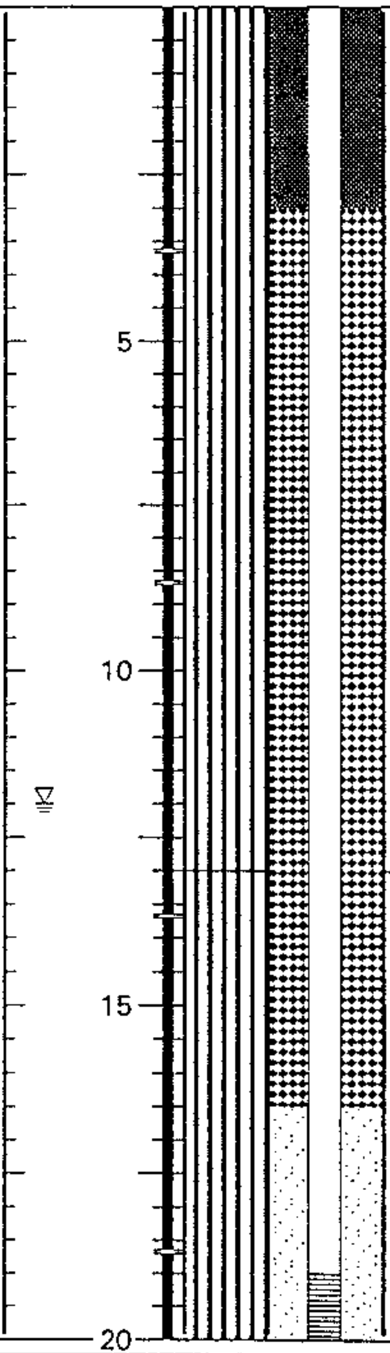
Exploratory boring B-14 drilled by 8-inch dia. hollow stem auger from 0-9.7 feet; continuously diamond cored from 9.7-70 feet. Boring backfilled with cement-bentonite grout. Monitoring well boring MW-14D drilled approx. 10 feet east of B-14 by air rotary with 6-inch downhole hammer from surface to 75 feet.

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY GeoTech Explorations
DRILL METHOD H.S.A. with C.C.B.
LOGGED BY Mike Free

BORING NO. MW-15
PAGE 1 OF 2
GROUND ELEV.
TOTAL DEPTH 29.00'
DATE COMPLETED 07/14/93

SAMPLE TYPE	RECOVERY PERCENT	POCKET PENE-TROMETER (T/ft)
CCB	100	
		1
		0.8
		2
CCB	102	
		1.3
		1.5
		2
		1.3
		1.2
CCB	102	
		0.8
		1.6
		1.8
		1.5
		1.8
CCB	98	
		2
		2.5
		3.8
CCB	102	
		3



LITHOLOGIC DESCRIPTION

0 to 13.0 feet: CLAYEY SILT (MH), very dark gray to black (0 to 1.5 feet), dark grayish brown (1.5 to 2.6 feet), mottled brown and orange (2.6 to 13.0 feet), 75 percent silt, 25 percent clay, trace fine sand, soft to firm, moist, roots to 3.0 feet, micaceous, pore wetness at 13.0 feet. (ALLUVIUM)

13.0 to 20.4 feet: CLAYEY SILT (MH), dark grayish brown (13.0 to 15.9 feet), gray to dark reddish brown (15.9 to 18.0 feet), strong brown (18,0 to 20.4 feet), 75 percent silt, 20 percent clay, 5 percent fine to coarse gravel, soft to firm (overall somewhat crumbly), moist to wet. (ALLUVIUM)

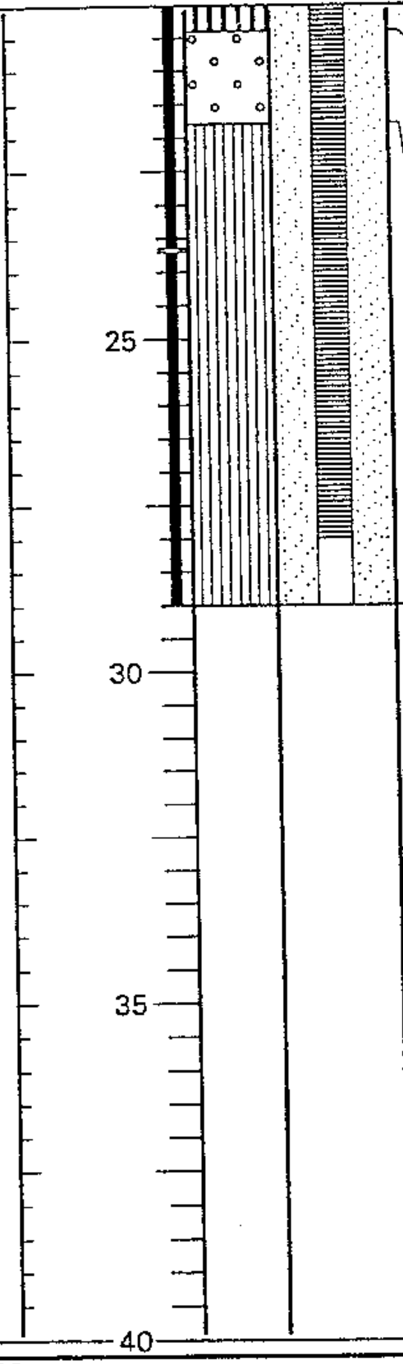
REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY GeoTech Explorations
DRILL METHOD H.S.A. with C.C.B.
LOGGED BY Mike Free

BORING NO. MW-15
PAGE 2 OF 2
GROUND ELEV.
TOTAL DEPTH 29.00'
DATE COMPLETED 07/14/93

SAMPLE TYPE	RECOVERY PERCENT	POCKET PENE-TROMETER (T/ft)	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	LITHOLOGIC COLUMN	WELL DETAILS
		2					
CCB	94	1					
		2					



LITHOLOGIC DESCRIPTION

13.0 to 20.4 feet: CLAYEY SILT (MH), continued.

20.4 to 21.8 feet: SANDY GRAVEL (GP), strong brown, 60 percent fine to coarse decomposed well-rounded gravel, occasional cobbles, 30 percent fine to coarse sand, 10 percent clay and silt. (ALLUVIUM)

21.8 to 29.0 feet: SANDY GRAVELLY SILT (ML), reddish brown to brown, 50 percent silt, 30 percent decomposed fine to medium gravel, 20 percent fine to coarse sand, mostly crumbly, soft to firm, moist. (ALLUVIUM)

Total depth drilled = 29.0 feet.
Total depth sampled = 29.0 feet.

WELL COMPLETION DETAILS:
0 to 19.0 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC blank riser pipe.
19.0 to 28.0 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC well screen with 0.010-inch machined slots.
28.0 to 29.0 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC blank sump pipe.

0 to 3.0 feet: Concrete.
3.0 to 16.5 feet: Bentonite chips hydrated with potable water.
16.5 to 29.0 feet: 20 - 40 Colorado Silica Sand.

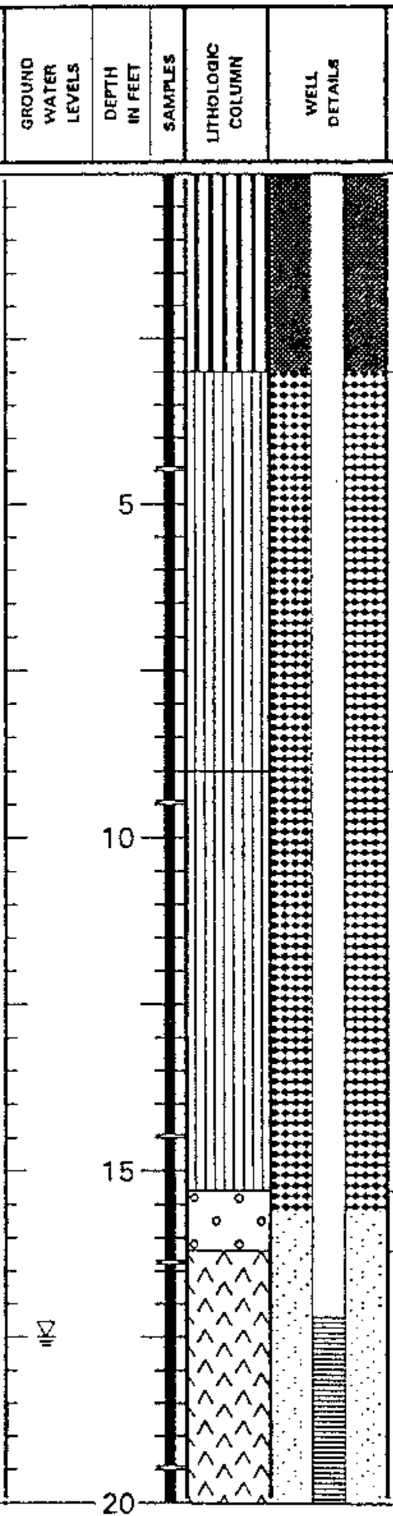
REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY GeoTech Explorations
DRILL METHOD H.S.A. with C.C.B.
LOGGED BY Mike Free

BORING NO. MW-16
PAGE 1 OF 2
GROUND ELEV.
TOTAL DEPTH 27.30'
DATE COMPLETED 07/19/93

SAMPLE TYPE	RECOVERY PERCENT	POCKET PENE-TROMETER (T/ft)
CCB	98	
CCB	104	
CCB	50	
CCB	100	
CCB	68	
CCB	100	



LITHOLOGIC DESCRIPTION

0 to 3.0 feet: CLAYEY SILT (MH), very dark grayish brown, 70 percent silt, 30 percent clay, trace fine sand, stiff to very stiff, dry to damp, crumbly dry from 0 to 1.0 foot. (ALLUVIUM)

3.0 to 9.0 feet: CLAYEY SILT (ML), dark yellowish brown, 60 percent silt, 25 percent clay, 10 percent fine to medium gravel, 5 percent fine to coarse sand, stiff (crumbly from 7.0 to 9.0 feet), moist. (COLLUVIUM)

9.0 to 15.2 feet: CLAYEY GRAVELLY SILT (ML), dark yellowish brown, 50 percent silt, 30 percent fine to coarse, fresh to slightly weathered, subangular basalt gravel, 20 percent clay, stiff, moist. (COLLUVIUM)

15.2 to 16.2 feet: SANDY SILTY GRAVEL (GP), orangy brown, 60 percent fine to coarse angular weathered basalt gravel, 20 percent basalt sand, 20 percent silt and clay. (COLLUVIUM)

16.2 to 27.3 feet: BASALT, black to very dark bluish gray, aphanitic, equigranular, crushed to intensely fractured, hard, fresh. (BEDROCK)

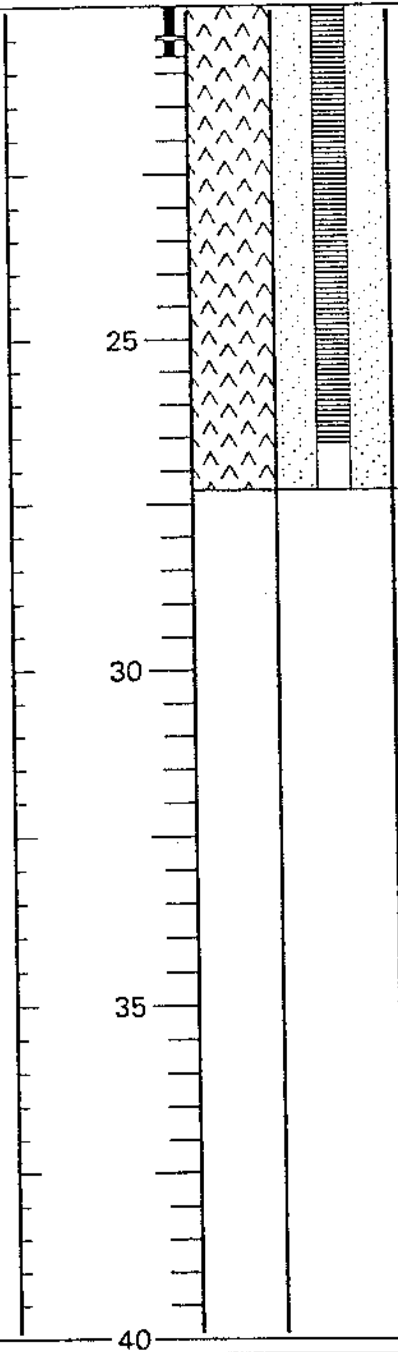
REMARKS

Augered with center bit from 20.8 to 27.3 feet; hard drilling.

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY GeoTech Explorations
DRILL METHOD H.S.A. with C.C.B.
LOGGED BY Mike Free

BORING NO. MW-16
PAGE 2 OF 2
GROUND ELEV.
TOTAL DEPTH 27.30'
DATE COMPLETED 07/19/93

SAMPLE TYPE	RECOVERY PERCENT	POCKET PENE-TROMETER (T/ft)	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	LITHOLOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
CCB	100							16.2 to 27.3 feet: BASALT, continued. Total depth drilled = 27.3 feet. Total depth sampled = 27.3 feet. **WELL COMPLETION DETAILS:** 0 to 17.2 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC blank riser pipe. 17.2 to 26.6 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC well screen with 0.020-inch machined slots. 26.6 to 27.3 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC blank sump pipe. 0 to 3.0 feet: Concrete. 3.0 to 15.6 feet: Bentonite chips hydrated with potable water. 15.6 to 27.3 feet: 10 - 20 Colorado Silica Sand.

REMARKS

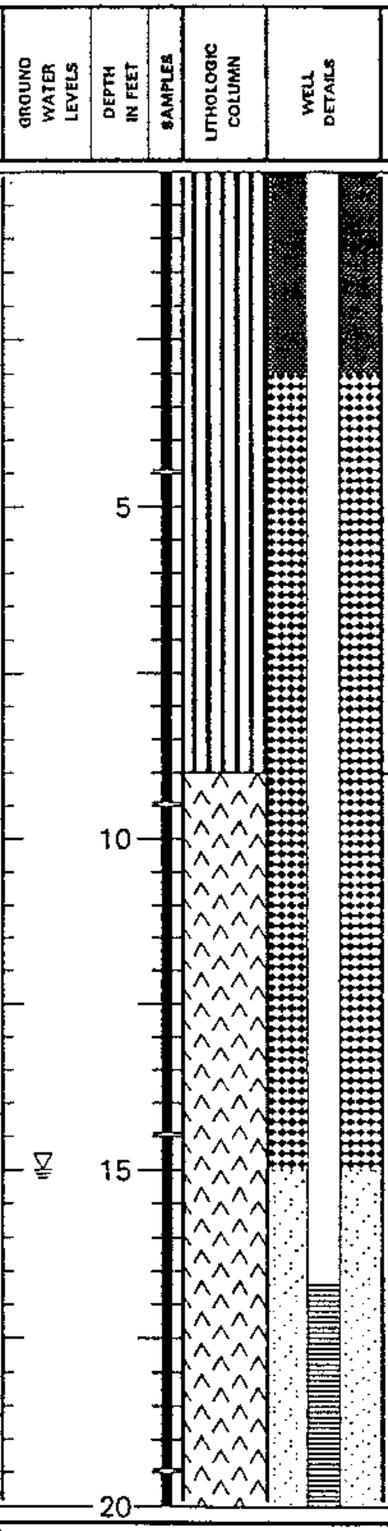
Augered with center bit from 20.8 to 27.3 feet; hard drilling.

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY GeoTech Explorations
DRILL METHOD H.S.A. with C.C.B.
LOGGED BY Mike Free

BORING NO. MW-17
PAGE 1 OF 2
GROUND ELEV.
TOTAL DEPTH 27.00'
DATE COMPLETED 07/15/93

SAMPLE TYPE	RECOVERY PERCENT	POCKET PENE-TROMETER (T/ft)
CCB	93	
		1.7
		1.8
		1.5
CCB	104	
		1.3
		2
		2
CCB	102	
		0.7
		0.5
		3
		4.5
CCB	66	
CCB	78	



LITHOLOGIC DESCRIPTION

0 to 9.0 feet: CLAYEY SILT (MH), very dark grayish brown to brown, 70 percent silt, 25 percent clay, 5 percent fine sand, firm to stiff, moist. (ALLUVIUM)

9.0 to 25.0 feet: BASALT, dark olive brown to orangy brown, intensely fractured to crushed, friable (9.0 to 12.3 feet) to low to moderate hardness, deeply weathered (9.0 to 12.3 feet) to moderately weathered, pillow structures, white fracture fillings. (BEDROCK)

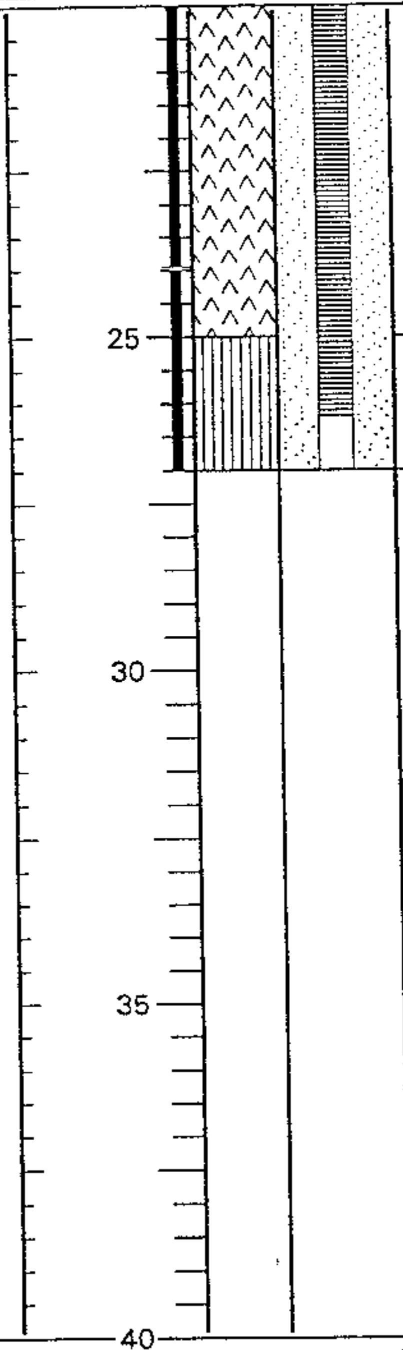
REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY GeoTech Explorations
DRILL METHOD H.S.A. with C.C.B.
LOGGED BY Mike Free

BORING NO. MW-17
PAGE 2 OF 2
GROUND ELEV.
TOTAL DEPTH 27.00'
DATE COMPLETED 07/15/93

SAMPLE TYPE	RECOVERY PERCENT	POCKET PENE-TROMETER (T/ft)	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	LITHOLOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
CCB								



9.0 to 25.0 feet: BASALT, continued.

@ 22.0 to 25.0 feet: dark greenish gray, intensely fractured, moderately hard to hard, weakly moderatly weathered. (BEDROCK)

25.0 to 27.0 feet: GRAVELLY SILT (ML), very dark grayish brown, 40 percent silt, 40 percent fine to coarse basalt gravel, 15 percent fine to coarse sand, 5 percent clay.

Total depth drilled = 27.0 feet.
Total depth sampled = 27.0 feet.

WELL COMPLETION DETAILS:

0 to 16.7 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC blank riser pipe.
16.7 to 26.2 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC well screen with 0.020-inch machined slots.
26.2 to 27.0 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC blank sump pipe.

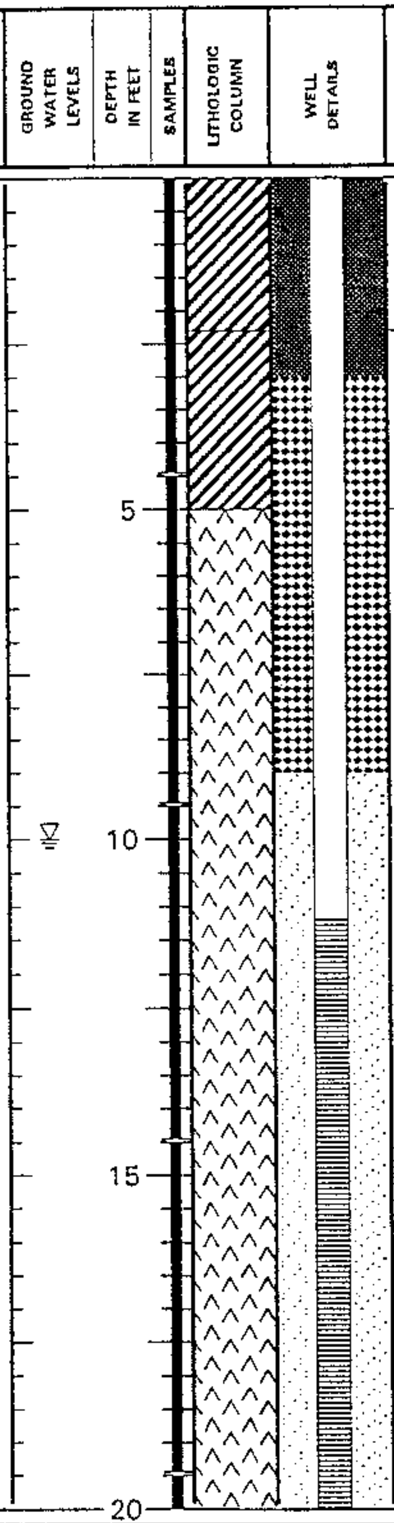
0 to 3.0 feet: Concrete.
3.0 to 15.0 feet: Bentonite chips hydrated with potable water.
15.0 to 27.0 feet: 10 - 20 Colorado Silica Sand.

REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	Coffin Butte Landfill	BORING NO.	MW-18
LOCATION	Coffin Butte, Benton County, Oregon	PAGE	1 OF 2
DRILLED BY	GeoTech Explorations	GROUND ELEV.	
DRILL METHOD	H.S.A. with C.C.B.	TOTAL DEPTH	21.40'
LOGGED BY	Mike Free	DATE COMPLETED	07/15/93

SAMPLE TYPE	RECOVERY PERCENT	POCKET PENE-TROMETER (T/ft)
CCB	89	
		2.5
		0.5
CCB	104	
		3-4.5
CCB	90	
		0.5-2.5
CCB	86	0.5-2.5
		0.5-2.5
CCB	86	



LITHOLOGIC DESCRIPTION

0 to 2.3 feet: SILTY CLAY (CH), very dark brown, 50 percent clay, 50 percent silt, trace fine sand, stiff, moist (top 0.5 foot damp). (ALLUVIUM)

2.3 to 5.0 feet: SILTY CLAY (CH), brown, 50 percent clay, 45 percent silt, 5 percent fine to medium sand, soft, moist. (ALLUVIUM)

5.0 to 21.4 feet: BASALT, orangy brown, equigranular, locally feldspar phenocrysts in fine grained groundmass, 50 percent mafics, 50 percent feldspars, intensely fractured, friable, deeply weathered, iron oxides in most fractures, mineral grains weather to medium size. (BEDROCK)

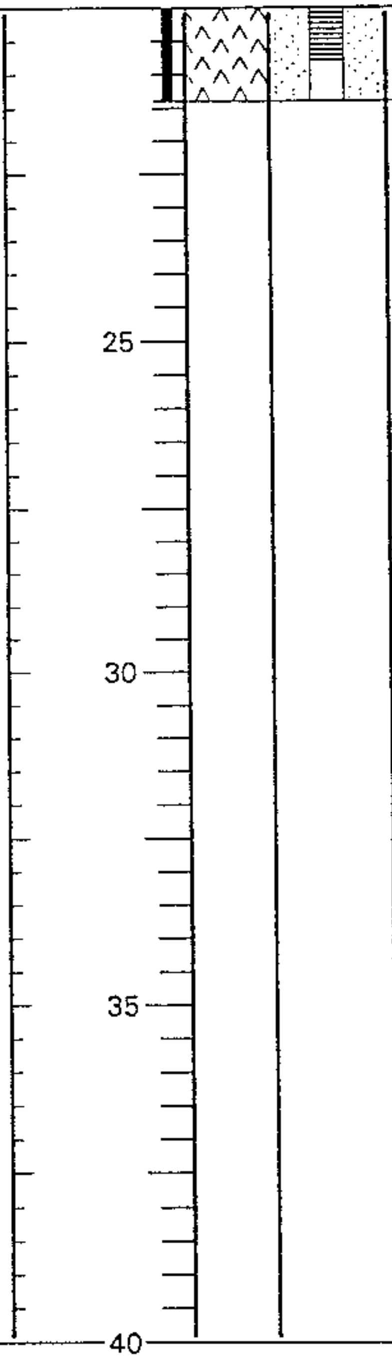
REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY GeoTech Explorations
DRILL METHOD H.S.A. with C.C.B.
LOGGED BY Mike Free

BORING NO. MW-18
PAGE 2 OF 2
GROUND ELEV.
TOTAL DEPTH 21.40'
DATE COMPLETED 07/15/93

SAMPLE TYPE	RECOVERY PERCENT	POCKET PENE-TROMETER (T/ft)	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	LITHOLOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
	111	0.5-2.5						**5.0 to 21.4 feet:** BASALT, continued.



Total depth drilled = 21.4 feet.
Total depth sampled = 21.4 feet.

WELL COMPLETION DETAILS:
0 to 11.2 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC blank riser pipe.
11.2 to 20.8 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC well screen with 0.020-inch machined slots.
20.8 to 21.4 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC blank sump pipe.

0 to 3.0 feet: Concrete.
3.0 to 9.0 feet: Bentonite chips hydrated with potable water.
9.0 to 21.4 feet: 10 - 20 Colorado Silica Sand.

REMARKS

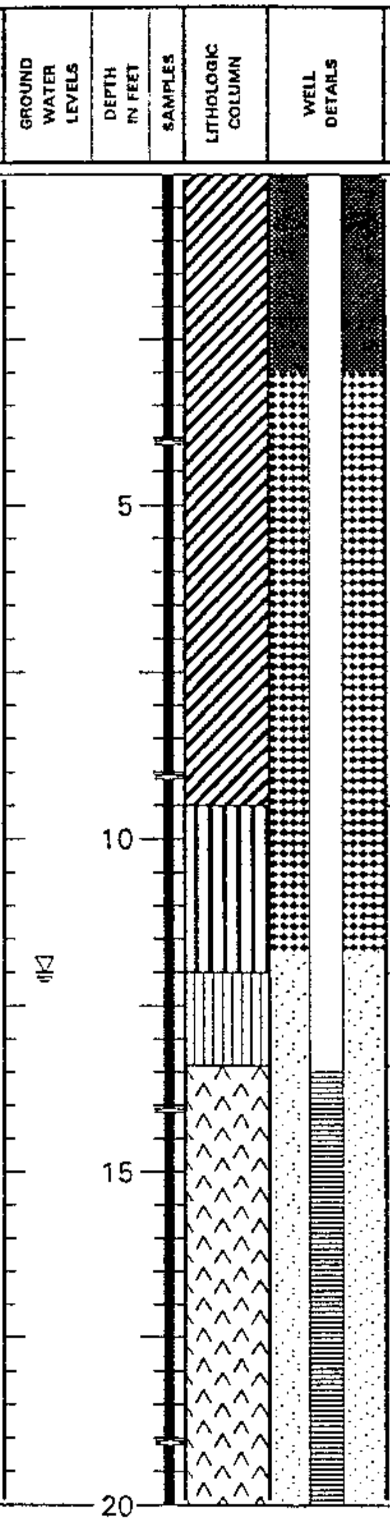
EMCON Northwest, Inc.

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY GeoTech Explorations
DRILL METHOD H.S.A. with C.C.B.
LOGGED BY Mike Free

BORING NO. MW-19
PAGE 1 OF 2
GROUND ELEV.
TOTAL DEPTH 24.10'
DATE COMPLETED 07/16/93

SAMPLE TYPE	RECOVERY PERCENT	POCKET PENE-TROMETER (T/ft)
CCB	102	2
CCB	104	1.3
CCB	102	1.5
CCB	88	
CCB	104	



LITHOLOGIC DESCRIPTION

0 to 3.5 feet: SILTY CLAY (CH), very dark brown (0 to 3.0 feet), mottled gray and brown (3.0 to 6.5 feet) to dark gray (6.5 to 9.5 feet), 50 to 60 percent clay, 40 to 50 percent silt, trace fine sand, stiff, damp (0 to 3.0 feet), moist 3.0 to 9.5 feet, roots common to 3.0 feet. (ALLUVIUM)

9.5 to 12.0 feet: CLAYEY SILT (MH), dark grayish brown, 50 percent silt, 45 percent clay, 5 percent fine to coarse sand, trace fine gravel, stiff, moist. (ALLUVIUM)

12.0 to 13.4 feet: GRAVELLY CLAYEY SILT (ML), light olive brown, 40 percent silt, 30 percent clay, 20 percent fine to medium well rounded gravel, 10 percent fine to coarse sand, firm, moist to wet. (ALLUVIUM)

13.4 to 24.1 feet: BASALT, fine grained, light yellowish brown to yellow, moderately to intensely fractured, friable to low hardness, deeply weathered, wet, dark orangy brown undulating bands 1-inch-thick; pillow structure(?). (BEDROCK)

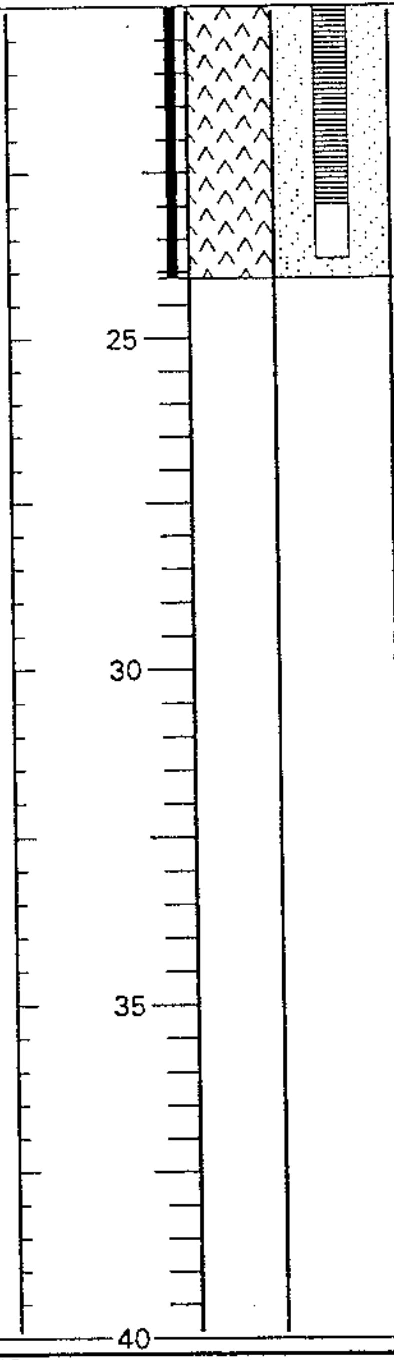
REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY GeoTech Explorations
DRILL METHOD H.S.A. with C.C.B.
LOGGED BY Mike Free

BORING NO. MW-19
PAGE 2 OF 2
GROUND ELEV.
TOTAL DEPTH 24.10'
DATE COMPLETED 07/16/93

SAMPLE TYPE	RECOVERY PERCENT	POCKET PENE-TROMETER (T/ft)	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	LITHOLOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION



13.4 to 24.1 feet: BASALT, continued.

Total depth drilled = 24.1 feet.
Total depth sampled = 24.1 feet.

WELL COMPLETION DETAILS:
0 to 13.5 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC blank riser pipe.
13.5 to 23.0 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC well screen with 0.020-inch machined slots.
23.0 to 23.8 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC blank sump pipe.

0 to 3.0 feet: Concrete.
3.0 to 11.7 feet: Bentonite chips hydrated with potable water.
11.7 to 24.1 feet: 10 - 20 Colorado Silica Sand.

REMARKS

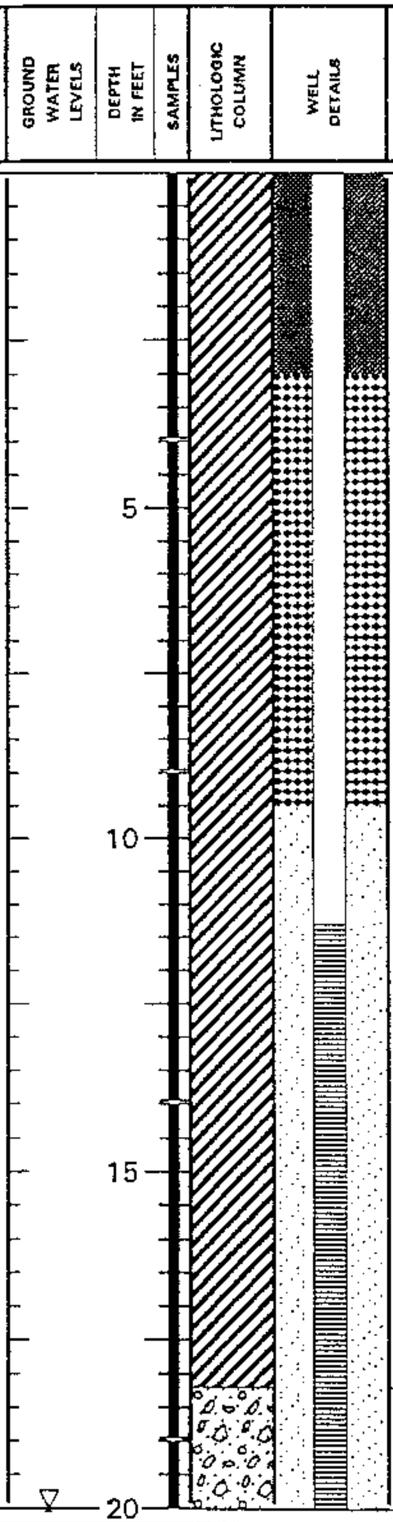
EMCON Northwest, Inc.

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY GeoTech Explorations
DRILL METHOD HSA w/CCB
LOGGED BY Mike Free

BORING NO. MW-20
PAGE 1 OF 3
GROUND ELEV.
TOTAL DEPTH 39.00'
DATE COMPLETED 09/15/93

SAMPLE TYPE	RECOVERY PERCENT
Core	78
Core	106
Core	104
Core	106
Core	104



LITHOLOGIC DESCRIPTION

0 to 18.2 feet: SILTY CLAY (CH), 0 to 4.0 feet very dark gray, 4 to 13.0 feet light olive brown, 13 to 18.2 feet very dark gray to dark olive gray, 90% weakly mottled, silty clay, 5 percent fine to coarse sand, 5 percent fine to medium, angular to sub-angular gravel, stiff, moist, limonite blebs, roots to 6.0 feet. (ALLUVIUM)

18.2 to 21.1 feet: SANDY SILTY GRAVEL (GW), dark brown to very dark grayish brown, 50 percent subangular to well rounded, fine to

REMARKS

Sensidyne at 24.0, 20-30 ppm.

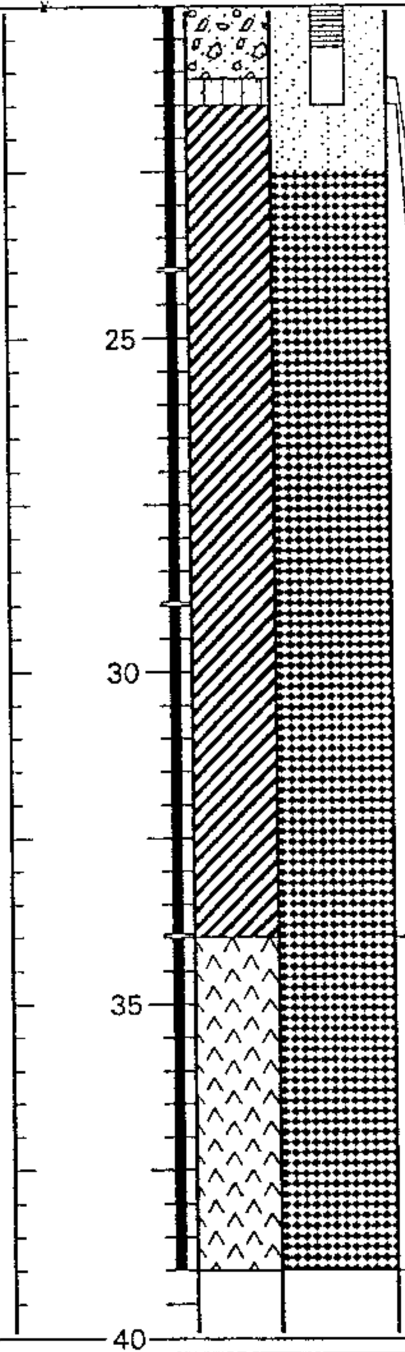
EMCON Northwest, Inc.

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY GeoTech Explorations
DRILL METHOD HSA w/CCB
LOGGED BY Mike Free

BORING NO. MW-20
PAGE 2 OF 3
GROUND ELEV.
TOTAL DEPTH 39.00'
DATE COMPLETED 09/15/93

SAMPLE TYPE	RECOVERY PERCENT	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	LITHOLOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
Core	104		25				
Core	104		30				
Core	102		35				
			40				



coarse gravel, 30 percent clay and silt, 20 percent fine to coarse sand, nearly loose, moist to wet (20 to 21.5 feet), fine gravel is well rounded, coarse gravel is sub-angular basalt. (ALLUVIUM)

21.1 to 21.5 feet: SAND (SP-SM), dark grayish brown, 85percent fine sand, 15 percent silt and clay, soft, moist. (ALLUVIUM)

21.5 to 34.0 feet: GRAVELLY CLAY (CH), dark reddish brown, 65 percent silty clay, 20 percent medium to coarse gravel, 15 percent cobbles, subangular to subrounded, fresh, moderately hard basalt with 1 mm weathering rind to low hardness, moderately weathered basalt, very stiff, moist. (ALLUVIUM AND COLLUVIUM)

34.0 to 39.0 feet: BASALT, pillow lavas, dark gray (fresher pieces) to grayish brown cores in matrix (rind) of tan to orangey brown to dark brown, moderately to intensely fractured, low hardness to friable, deeply weathered, locally moderately weathered, wet. (BEDROCK)

See Page 3 for Well Completion Details.

Total depth drilled = 39.0 feet.
Total depth sampled = 39.0 feet.

REMARKS

Sensidyne at 24.0, 20-30 ppm.

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY GeoTech Explorations
DRILL METHOD HSA w/CCB
LOGGED BY Mike Free

BORING NO. MW-20
PAGE 3 OF 3
GROUND ELEV.
TOTAL DEPTH 39.00'
DATE COMPLETED 09/15/93

	SAMPLE TYPE	RECOVERY PERCENT	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	LITHOLOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
								WELL COMPLETION DETAILS: 0 to 11.3 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC blank riser pipe. 11.3 to 20.7 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC well screen with 0.010-inch machined slots. 20.7 to 21.5 feet: 2-inch-diameter threaded end cap. 0 to 3.0 feet: Concrete. 3.0 to 9.5 feet: Bentonite chips hydrated with potable water. 9.5 to 22.5 feet: 20 - 40 Colorado Silica Sand. 22.5 to 39.0 feet: Bentonite chips hydrated with groundwater.
				45				
				50				
				55				
				60				

REMARKS

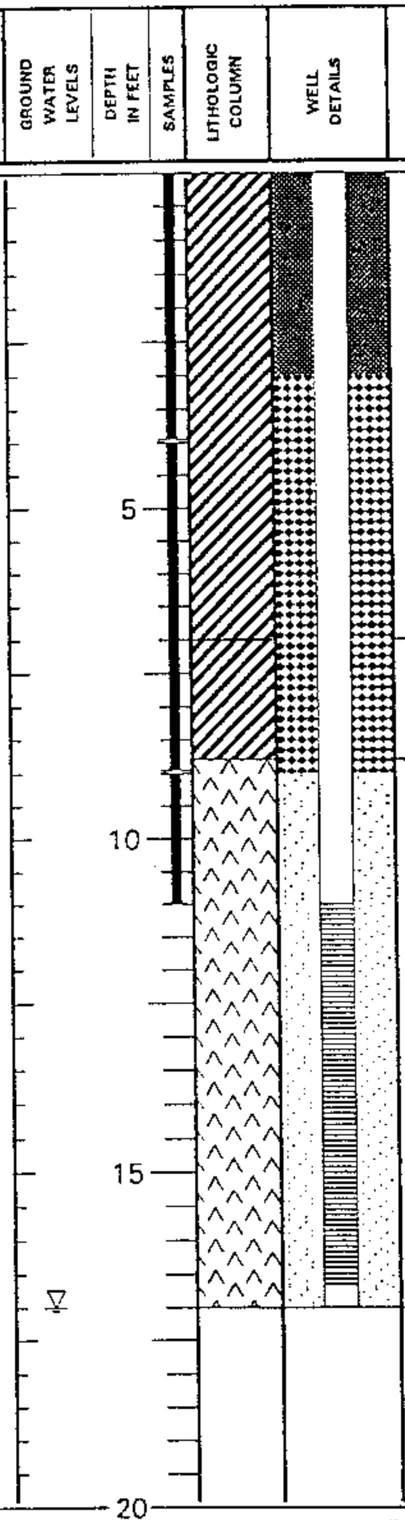
Sensidyne at 24.0, 20-30 ppm.

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY GeoTech Explorations
DRILL METHOD HSA w/CCB
LOGGED BY Mike Free

BORING NO. MW-21
PAGE 1 OF 2
GROUND ELEV.
TOTAL DEPTH 17.00'
DATE COMPLETED 09/15/93

SAMPLE TYPE	RECOVERY PERCENT
Core	100
Core	104
Core	100



LITHOLOGIC DESCRIPTION

0 to 7.0 feet: SILTY CLAY (CH), 0 to 2.0 feet very dark brown, 2.0 to 7.0 feet dark brown to light olive brown, weakly mottled, 90 percent silty clay, 10 percent subangular to angular fine to medium gravel, some decomposed, stiff, damp to moist, roots to 5.0 feet. (ALLUVIUM)

7.0 to 8.8 feet: SILTY CLAY (CH), very dark grayish brown, 80 percent silty clay, 10 percent fine to coarse sand, 10 percent fine to medium angular to subangular basalt gravel, stiff, moist. (ALLUVIUM)

8.8 to 17.0 feet: BASALT, dark gray, intensely to moderately fractured, hard, fresh. (BEDROCK)

Total depth drilled = 17.0 feet.
Total depth sampled = 17.0 feet.
See Page 2 for Well Completion Details.

REMARKS

Slip cap attached with three stainless steel screws. No core from 11.0 to 17.0 feet; drilled with center bit.

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY GeoTech Explorations
DRILL METHOD HSA w/CCB
LOGGED BY Mike Free

BORING NO. MW-21
PAGE 2 OF 2
GROUND ELEV.
TOTAL DEPTH 17.00'
DATE COMPLETED 09/15/93

	SAMPLE TYPE	RECOVERY PERCENT	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	LITHOLOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
								WELL COMPLETION DETAILS: 0 to 11.0 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC blank riser pipe. 11.0 to 16.7 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC well screen with 0.010-inch machined slots. 16.7 to 17.0 feet: 2-inch-diameter threaded end cap.
				25				0 to 3.0 feet: Concrete. 3.0 to 9.0 feet: Bentonite chips hydrated with potable water. 9.0 to 17.0 feet: 10 - 20 Colorado Silica Sand.
				30				
				35				
				40				

REMARKS

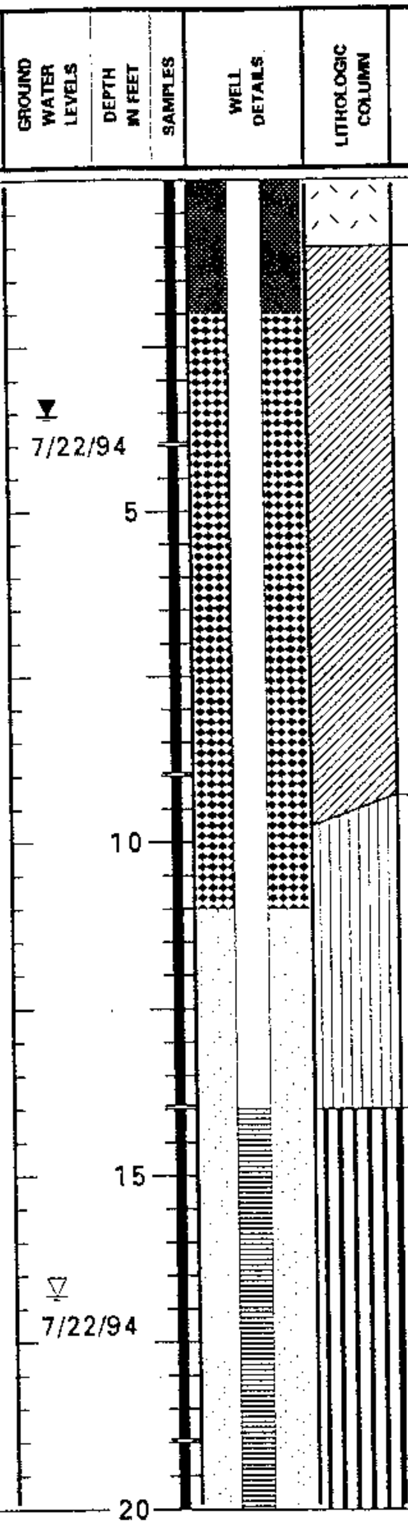
Slip cap attached with three stainless steel screws. No core from 11.0 to 17.0 feet; drilled with center bit.

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Benton County, Oregon
DRILLED BY Geo-Tech Explorations, Inc.
DRILL METHOD Hollow Stem Auger
LOGGED BY Eric Tuppan

BORING NO. MW-22
PAGE 1 OF 2
GROUND ELEV. 232.73'
TOTAL DEPTH 29.00'
DATE COMPLETED 07/22/94

SAMPLE TYPE	RECOVERY PERCENT	POCKET PENETRO-METER
CCB	75%	
		3.3
		1.75
CCB	100%	
CCB	100%	
		2.5
CCB	100%	
		0.75
		3.25
CCB	100%	



LITHOLOGIC DESCRIPTION

0 to 1.0 foot: GRAVEL FILL, grass at surface.

1.0 to 9.3 feet: SILTY CLAY (CL), very dark grayish brown (10YR 3/2), some mottling with dark gray brown (10YR 2/6); medium plasticity fines; silty, minor fine to medium sand; root hairs; very stiff to stiff; damp. (ALLUVIUM)

@ 5.5 feet: dark brown (10YR 3/3) with oxidized medium sand grains.

@ 6.0 feet: root holes; moist to wet.

@ 9 to 9.3 feet: basal layer of sandy clay.

9.3 to 14.0 feet: CLAYEY SILT (ML), dark olive gray (5Y 3/2); very clayey; medium plasticity; trace fine to medium sand; very stiff; root hairs and root holes are wet to moist; crumbly texture. (ALLUVIUM)

14.0 to 24.7 feet: SILT (MH), dark olive gray (5Y 3/2); minor clay; high plasticity; roots and organic matter common; root holes are wet. (ALLUVIUM)

@ 17.0 feet: zones of very dark grayish brown (2.5Y 3/2); twigs horizontal to core axis; roots and root holes abundant; firm to very stiff; wet in root holes.

REMARKS

Boring drilled with 3.75-inch I.D. hollow-stem augers to 29 feet and sampled with continuous core barrel. Backfilled hole from 24 to 29 feet with bentonite chips and pulled augers. Reamed out hole with 6.25-inch hollow-stem auger to 24.2 feet and installed well.

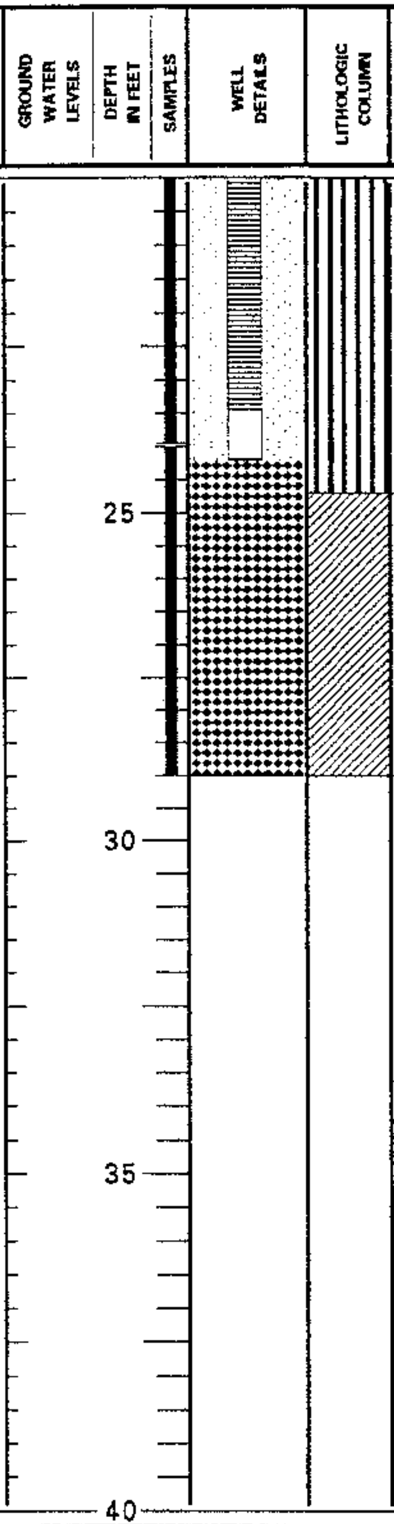
EMCON

LOG OF EXPLORATORY BORING

PROJECT NAME **Coffin Butte Landfill**
LOCATION **Benton County, Oregon**
DRILLED BY **Geo-Tech Explorations, Inc.**
DRILL METHOD **Hollow Stem Auger**
LOGGED BY **Eric Tuppan**

BORING NO. **MW-22**
PAGE **2 OF 2**
GROUND ELEV. **232.73'**
TOTAL DEPTH **29.00'**
DATE COMPLETED **07/22/94**

SAMPLE TYPE	RECOVERY PERCENT	POCKET PENETRO-METER	LITHOLOGIC DESCRIPTION
			14.0 to 24.7 feet: SILT (MH), continued. @ 20.0 feet: dark gray (5Y 4/1); uniform silt with abundant roots; very stiff; damp to moist.
		3.0	
CCB	100%		
			24.7 to 29.0 feet: CLAY (CL), dark olive gray (5Y 3/2); low plasticity clay with minor silt; trace fine to medium sand; relict intergranular basalt texture; few roots; crumbly and breaks apart along what appear to be relict fractures(?); very stiff; moist. (WEATHERED BEDROCK)
		2.0	
			Boring terminated at 29.0 feet; sufficient data.



REMARKS
Boring drilled with 3.75-inch I.D. hollow-stem augers to 29 feet and sampled with continuous core barrel. Backfilled hole from 24 to 29 feet with bentonite chips and pulled augers. Reamed out hole with 6.25-inch hollow-stem auger to 24.2 feet and installed well.

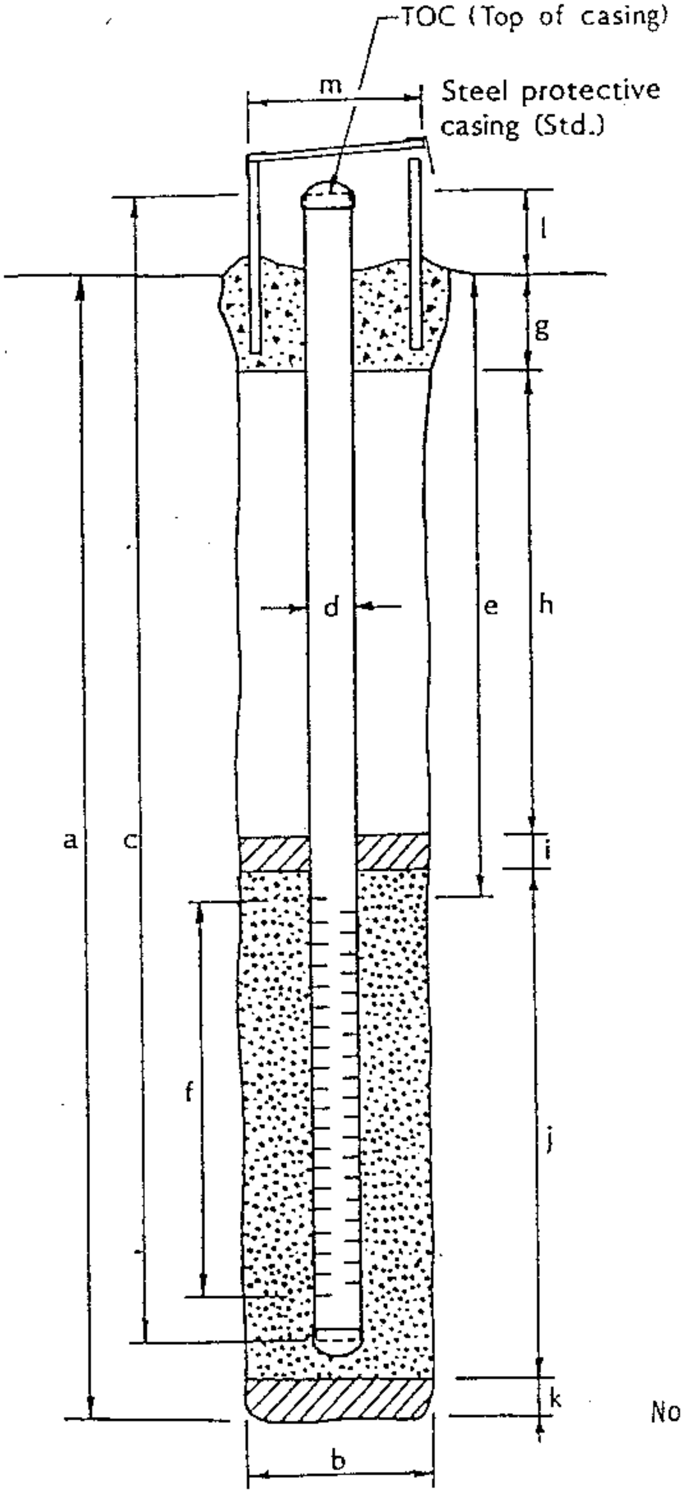
EMCON

WELL DETAILS

EMCON ASSOCIATES

PROJECT NUMBER 0139-001.47
PROJECT NAME Coffin Butte Landfill
LOCATION Benton County , Or
WELL PERMIT NO. 67395

BORING / WELL NO. MW-22
TOP OF CASING ELEV. 235.30
GROUND SURFACE ELEV. 232.73
DATUM Mean Sea level
INSTALLATION DATE 7-22-94



EXPLORATORY BORING

a. Total depth 29.0 ft.
b. Diameter 10 1/4 in.
Drilling method Hollow-stem auger

WELL CONSTRUCTION

c. Total casing length 26.7 ft.
Material Sch. 40 PVC
d. Diameter 2 in.
e. Depth to top perforations 14.0 ft.
f. Perforated length 9.6 ft.
Perforated interval from 14.0 to 23.6 ft.
Perforation type Machine Slotted
Perforation size 0.010 inch
g. Surface seal (0-2.0) 2.0 ft.
Seal material Concrete
h. Backfill ft.
Backfill material NA
i. Seal (2.0 - 11.0) 9.0 ft.
Seal material Bentonite Chips
j. Gravel pack (11.0-24.2) 13.2 ft.
Pack material 20X40 Silica Sand
k. Bottom seal (24.2 - 29.0) 4.8 ft.
Seal material Bentonite Chips
l. Casing stickup 2.46 ft.
m. Protective casing diameter 6.5 in.

Note: SS Centralizers at 8.7' and 24.0'

Prepared by: Eric Tuppan

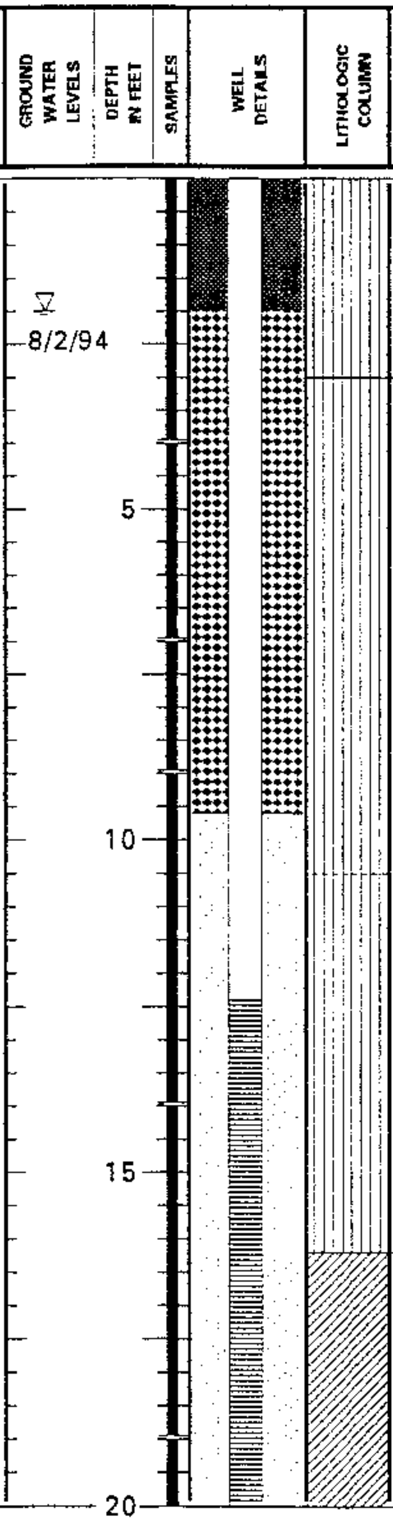
Reviewed by: Date: 8/12/94

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY Geo-Tech Explorations, Inc.
DRILL METHOD Hollow Stem Auger
LOGGED BY Mike Free

BORING NO. MW-23
PAGE 1 OF 2
GROUND ELEV. 242.81'
TOTAL DEPTH 24.30'
DATE COMPLETED 08/02/94

SAMPLE TYPE	RECOVERY PERCENT
CCB	45
CCB	100
CCB	90
CCB	100
CCB	100
CCB	100



LITHOLOGIC DESCRIPTION

0 to 3.0 feet: CLAYEY SILT (ML), very dark grayish brown, some black; medium plasticity fines; 10 percent fine to coarse sand; 10 percent medium gravel; firm, moist, few roots. (FILL)

@ 1.0 foot: soft.

@ 2.0 feet: wet.

3.0 to 10.5 feet: SANDY CLAYEY SILT (ML), very dark grayish brown; medium plasticity fines; 15 percent fine to coarse sand, mostly medium; few roots; firm, wet (root holes wet). (ALLUVIUM)

@ 4.8 feet: grayish brown and orange mottling.

@ 7.0 to 8.0 feet: crumbly, low plasticity.

10.5 to 16.2 feet: CLAYEY SILT (ML), dark gray to dark greenish gray; breaks with massive, fine grained texture; trace fine rootlets; micaceous; stiff to firm; wet. (ALLUVIUM)

@ 12.0 feet: core barrel wet on outside.

@ 15.5 to 16.5 feet: few fine rootlets.

16.2 to 20.4 feet: SANDY SILTY CLAY (CL), very dark greenish gray; medium plasticity fines; 20 percent fine to coarse sand; trace fine gravel; breaks with massive, textured surface; trace fine rootlets; stiff; wet. (ALLUVIUM)

@ 17.0 feet: low plasticity.

REMARKS

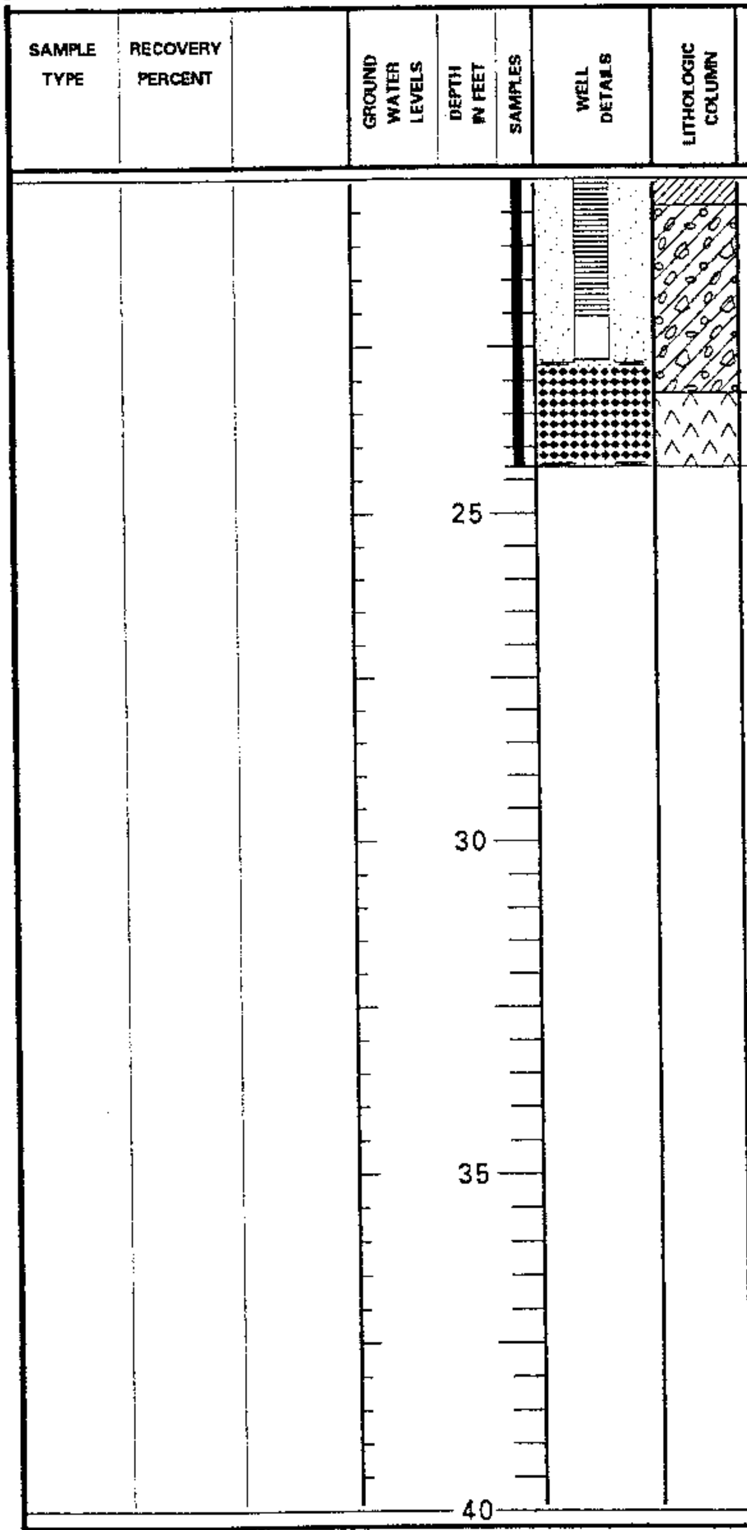
Drilled to 24.3 feet with 3 3/4-inch I.D. augers and sampled with continuous core barrel. Backfilled with bentonite chips from 21.0 to 24.3 feet. Reamed with 6 1/4-inch I.D. auger with PVC plug to 22.8 feet and installed well. Added 30 gallons of potable water during well installation.

EMCON

LOG OF EXPLORATORY BORING

PROJECT NAME **Coffin Butte Landfill**
LOCATION **Coffin Butte, Benton County, Oregon**
DRILLED BY **Geo-Tech Explorations, Inc.**
DRILL METHOD **Hollow Stem Auger**
LOGGED BY **Mike Free**

BORING NO. **MW-23**
PAGE **2 OF 2**
GROUND ELEV. **242.81'**
TOTAL DEPTH **24.30'**
DATE COMPLETED **08/02/94**



LITHOLOGIC DESCRIPTION

16.2 to 20.4 feet: SANDY SILTY CLAY (CL), continued.

20.4 to 23.2 feet: CLAYEY SANDY GRAVEL (GC), dark greenish gray; 30 percent fines; 10 percent fine to coarse sand; 60 percent well graded fine to coarse gravel; sand and gravel subangular to well rounded; loose; wet. (ALLUVIUM)

23.2 to 24.3 feet: BASALT, light to very dark brown, some yellow; crushed; 50 percent friable, 50 percent low to moderate hardness; weakly to deeply weathered; wet. (BEDROCK)

Boring terminated at 24.3 feet; sufficient data.

WELL COMPLETION DETAILS:

0 to 12.4 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC blank riser pipe.
12.4 to 22.1 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC well screen with 0.010-inch machined slots.
22.1 to 22.7 feet: 2-inch-diameter flush-threaded end cap.

0 to 2.0 feet: Concrete.
2.0 to 9.6 feet: Bentonite chips hydrated with potable water.
9.6 to 22.7 feet: 20 - 40 Colorado Silica Sand.
22.7 to 22.8 feet: Slough
22.8 to 24.2 feet: Bentonite chips.
24.2 to 24.3 feet: Slough.

REMARKS

Drilled to 24.3 feet with 3 3/4-inch I.D. augers and sampled with continuous core barrel. Backfilled with bentonite chips from 21.0 to 24.3 feet. Reamed with 6 1/4-inch I.D. auger with PVC plug to 22.8 feet and installed well. Added 30 gallons of potable water during well installation.

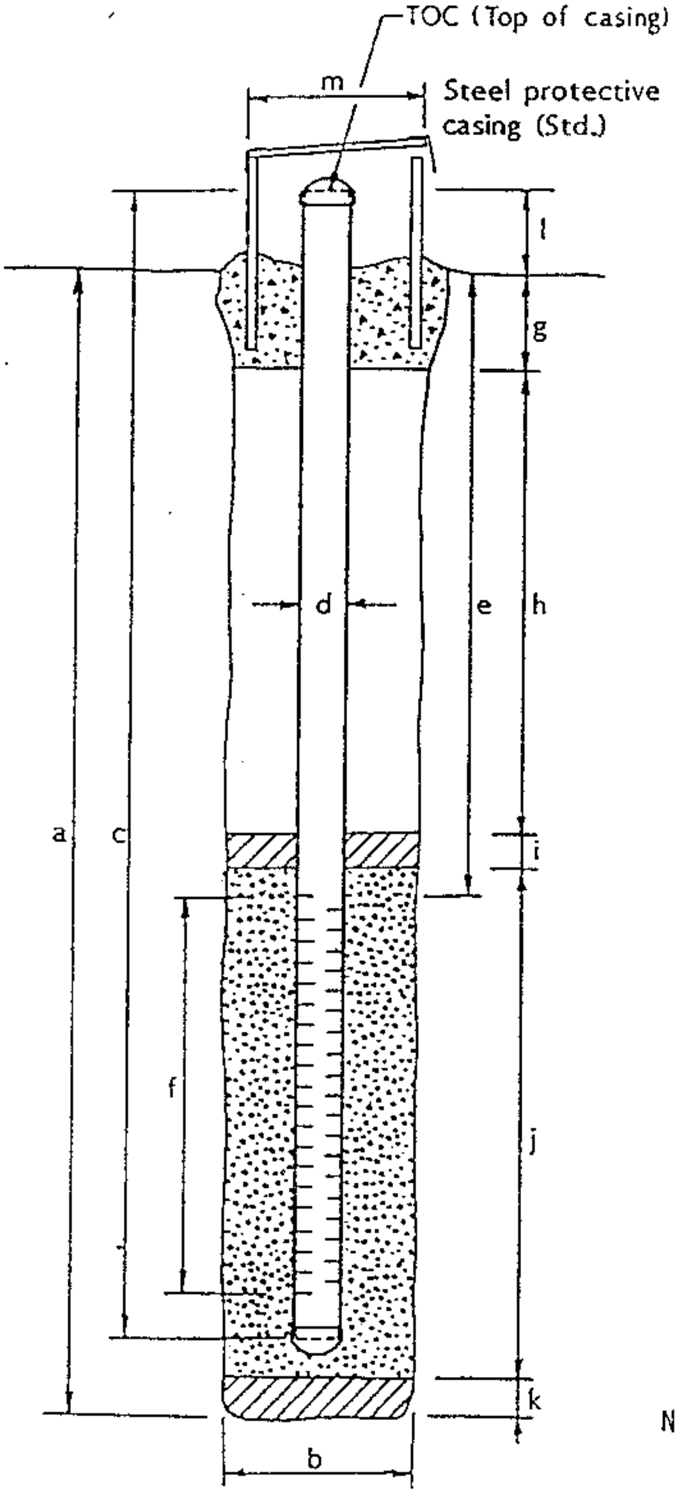
EMCON

WELL DETAILS

EMCON
ASSOCIATES

PROJECT NUMBER 0139-001.47
PROJECT NAME Coffin Butte Landfill
LOCATION Benton County, Or
WELL PERMIT NO. 67396

BORING / WELL NO. MW 23
TOP OF CASING ELEV. 244.71
GROUND SURFACE ELEV. 242.81
DATUM Mean Sea Level
INSTALLATION DATE 8-2-94



EXPLORATORY BORING

a. Total depth 24.3 ft.
b. Diameter 10 1/4 in.
Drilling method Hollow Stem Auger

WELL CONSTRUCTION

c. Total casing length 24.7 ft.
Material Sch 40 PVC
d. Diameter 2 in.
e. Depth to top perforations 12.4 ft.
f. Perforated length 9.7 ft.
Perforated interval from 12.4 to 22.1 ft.
Perforation type Machine Slotted
Perforation size 0.010 inch
g. Surface seal (0-2.0) 2.0 ft.
Seal material Concrete
h. Backfill ft.
Backfill material NA
i. Seal (2.0- 9.6) 7.6 ft.
Seal material Bentonite Chips
j. Gravel pack (9.6-22.7) 13.1 ft.
Pack material 20-40 Silica Sand
k. Bottom seal 1.5 ft.
Seal material Bentonite Chips
l. Casing stickup 2.0 ft.
m. Protective casing diameter 6.5 in.

Note: SS Centralizers at 7.2' and 21.2'.

Prepared by: Mike Free

Reviewed by:

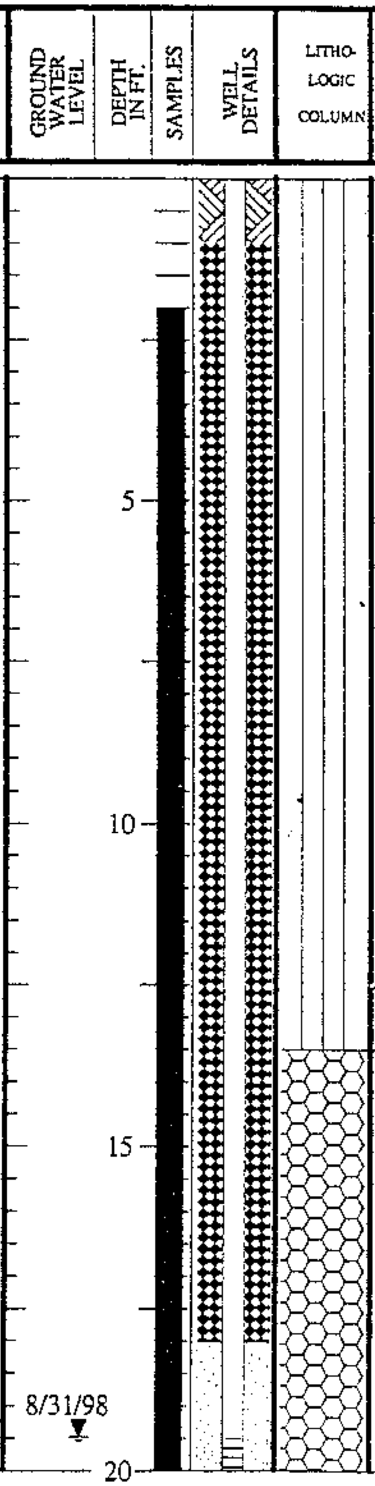
Date: 8/12/94

Form F-11 Rev. 12/90

LOG OF EXPLORATORY BORING

PROJECT NAME	Coffin Butte/Valley Landfills		
LOCATION	Benton County, Oregon	PAGE	1 OF 2
DRILLED BY	GeoTech Explorations, Inc.	BORING NO.	MW-24
DRILL METHOD	Hollow Stem Auger	TOTAL DEPTH	35'
LOGGED BY	John Renda	DATE COMPLETED	8/31/98

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS/6"
1 SS	67	6-11-16
2 SS	33	10-7-5
3 SS	100	3-6-8
4 SS	20	3-3-6
5 SS	100	3-5-8
6 SS	100	3-3-7
7 SS	100	3-8-11
8 SS	100	3-9-24
9 SS	100	24-23-17
10 SS	33	16-24- 50/0.4'
11 SS	100	8-25-36
12 SS	100	19-22-44



LITHOLOGIC DESCRIPTION

0.0 to 13.5 feet: SILTY CLAY (CL); yellowish-brown (10 YR, 6/6); 95% medium to high plasticity fines, trace coarse sand; 5% organics (roots); very stiff; dry. (ALLUVIUM)

@ 12.0 feet: sand content increases to 5%.

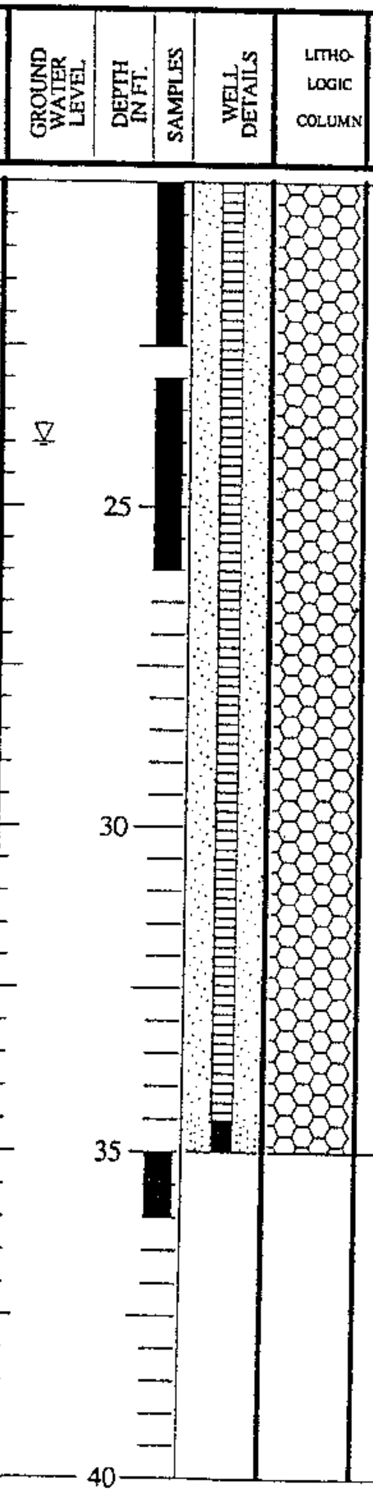
13.5 to 35.0 feet: BASALT WEATHERED TO SILTY CLAY (CL) WITH SAND (SW) AND GRAVEL (GC); brown (7.5 YR, 4/6); 50% medium to high plasticity fines, 40% deeply weathered basaltic gravel; friable; 10% fine to medium sand; dense. (WEATHERED BASALT)

@ 18.0 feet: moist.

REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	Coffin Butte/Valley Landfills	PAGE	2 OF 2
LOCATION	Benton County, Oregon	BORING NO.	MW-24
DRILLED BY	GeoTech Explorations, Inc.	TOTAL DEPTH	35'
DRILL METHOD	Hollow Stem Auger	DATE COMPLETED	8/31/98
LOGGED BY	John Renda		



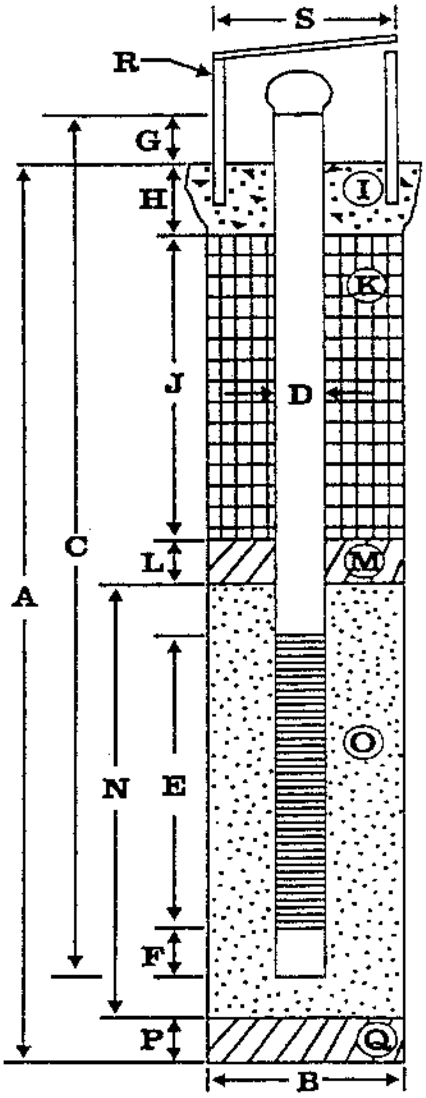
SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS/6"	LITHOLOGIC DESCRIPTION
13 SS	100	12- 50/0.4'	
14 SS	67	21-24- 50/0.4'	
15 SS	100	19- 50/0.4'	
16 SS	40	50/0.4'	@ 24.0 feet: wet.
17 SS	40	50/0.4'	@ 25.0 feet: split spoon refusal.
18 SS	100	50/0.4'	@ 35.0 feet: fractured basalt; auger refusal. @ 35.0 feet: boring terminated.

REMARKS

EMCON®

WELL DETAILS

Project Number:	40139-001.065	Boring/Well No.:	MW-24
Client Name:	Valley Landfills, Inc	Top of Casing Elev.:	276.76
Project Name:	Coffin Butte Landfill	Ground Surface Elev.:	273.94
Location:	Benton County, Oregon	Installation Date:	8/31/98
Driller:	Geo-Tech Explorations, Inc.	Permit/Start Card No.:	112462



Depth (feet)	Elev. (ft, msl)
3.0	276.94
2.8	276.76
0.0	273.94
1.0	272.94
1.0	272.94
18.0	255.94
19.5	254.44
34.5	239.44
35.0	238.94
35.0	238.94

EXPLORATORY BORING

A. Total depth: 35.0 ft.

B. Diameter 10 in.

Drilling method: Hollow Stem Auger

WELL CONSTRUCTION

C. Well casing length: 37.7 ft.

Well casing material: Sched 40 PVC

D. Well casing diameter: 2.0 in.

E. Well screen length: 15.0 ft.

Well screen type: Machine Slotted

Well screen slot size: 0.020 in.

F. Well sump/end cap length: 0.5 ft.

G. Well casing height (stickup): 2.7 ft.

H. Surface seal thickness: 1.0 ft.

I. Surface seal material: Concrete

J. Annular seal thickness: NA ft.

K. Annular seal material: NA

L. Filter pack seal thickness: 18.0 ft.

M. Filter pack seal material: Bentonite Chips

N. Sand pack thickness: 17.0 ft.

O. Sand pack material: 8X12 Silica Sand

P. Bottom material thickness: NA ft.

Q. Bottom material: NA

R. Protective casing material: Steel

Well centralizer depths: 20 and 34 ft.

S. Protective casing diameter: 6.5 in.

NOTES:

Installed by: John J. Renda

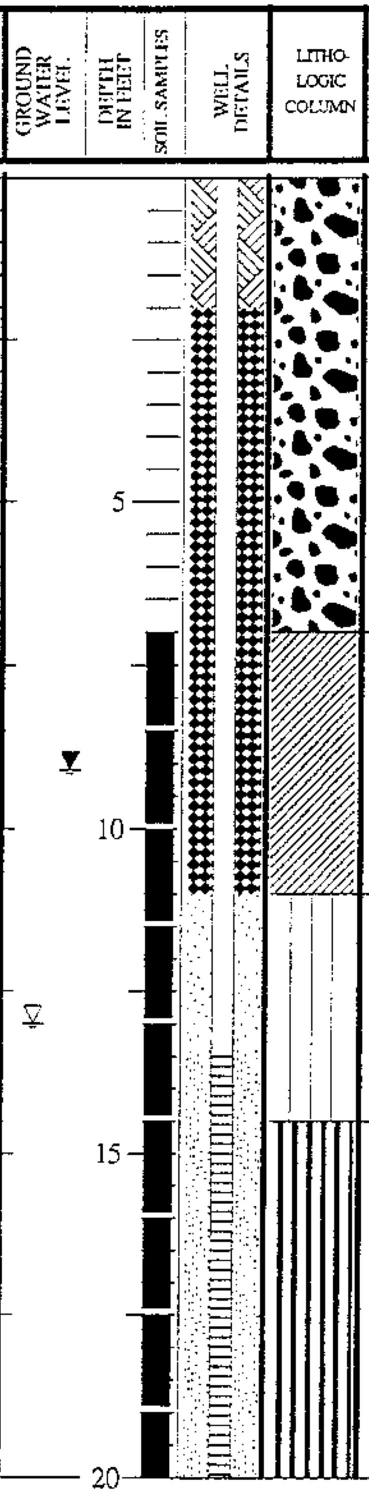
Reviewed by:

Date: 2/8/98

LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte Landfill**	BORING NO.	MW-25
LOCATION	**Benton County, Oregon**	PAGE	1 OF 2
DRILLED BY	**Geo-Tech Explorations, Inc.**	REFERENCE ELEV.	242.79
DRILL METHOD	**Hollow Stem Auger**	TOTAL DEPTH	32.5 feet
LOGGED BY	**John Renda**	DATE COMPLETED	6/4/99

SAMPLE NUMBER	BLOWS PER FOOT
SS-1	3-4-6 (10)
SS-2	2-3-4 (7)
SS-3	1-2-3 (5)
SS-4	4-6-10 (16)
SS-5	4-6-8 (14)
SS-6	4-7-10 (17)
SS-7	3-5-5 (10)
SS-8	5-11-11 (22)
SS-9	3-4-6



LITHOLOGIC DESCRIPTION

0.0 to 7.0 feet: GRAVEL FILL.

7.0 to 11.0 feet: SILTY CLAY (CL); very dark grayish brown (2.5YR 3/2); medium plasticity fines; silty; trace fine to medium sand; root hairs; firm to stiff; damp. (ALLUVIUM)

11.0 to 14.5 feet: CLAYEY SILT (ML); dark gray (2.5YR 4/1); medium plasticity fines; trace fine to medium sand; root hairs; stiff, crumbly texture. (ALLUVIUM)

@ 13.0 feet: wet.

14.5 to 24.0 feet: SILT (MH); dark greenish gray (10GY 4/1); medium to high plasticity fines; root hairs; moist. (ALLUVIUM)

REMARKS

SS = samples collected with a split-spoon stainless steel sampler.

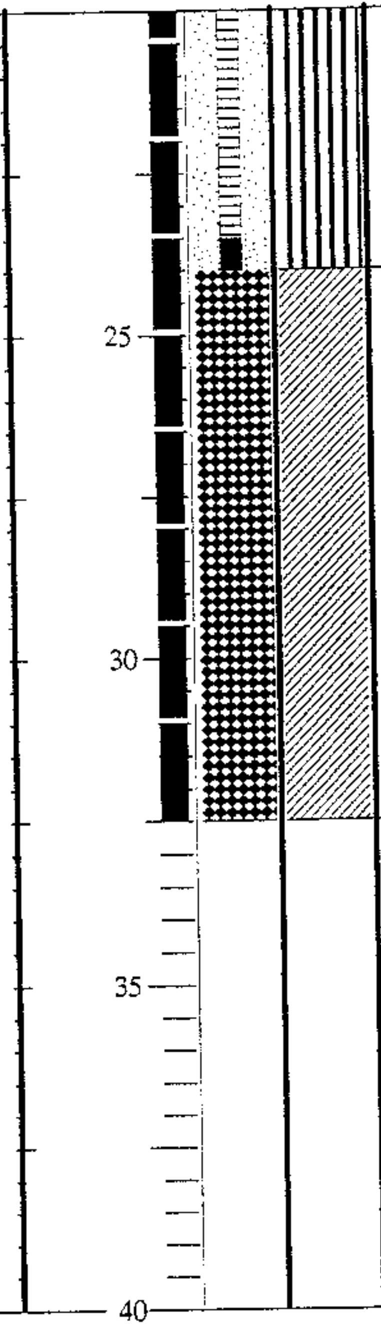
EMCON®

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Benton County, Oregon
DRILLED BY Geo-Tech Explorations, Inc.
DRILL METHOD Hollow Stem Auger
LOGGED BY John Renda

BORING NO. MW-25
PAGE 2 OF 2
REFERENCE ELEV. 242.79
TOTAL DEPTH 32.5 feet
DATE COMPLETED 6/4/99

SAMPLE NUMBER	BLOWS PER FOOT
	(10)
SS-10	3-6-8 (14)
SS-11	4-8-7 (15)
SS-12	2-3-5 (8)
SS-13	3-4-6 (10)
SS-14	4-8-12 (20)
SS-15	5-10-13 (23)
SS-16	8-13-15 (28)
SS-17	4-6-7 (13)



LITHOLOGIC DESCRIPTION

14.5 to 24.0 feet: SILT (MH); continued.

24.0 to 32.5 feet: CLAY (CL); dark greenish gray (10Y 3/1); medium to high plasticity clay; trace fine to coarse, subrounded to well-rounded sand; relict basalt texture visible; root hairs; stiff; moist. (WEATHERED BASALT)

Boring terminated at 29.5 feet.
Split-spoon sampler advanced to 32.5 feet.

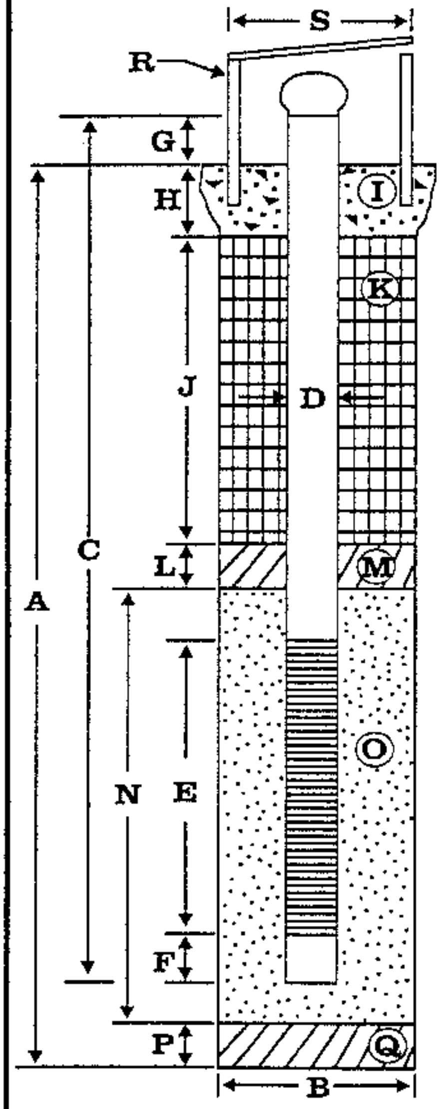
REMARKS

SS = samples collected with a split-spoon stainless steel sampler.

WELL DETAILS

Project Number: 40139-001.071
Client Name: Valley Landfills, Inc.
Project Name: Coffin Butte Landfill
Location: Benton County, Oregon
Driller: Geo-Tech Explorations

Boring/Well No.: MW-25
Top of Casing Elev.: 242.79
Ground Surface Elev.: 240.39
Installation Date: 6/4/99
Permit/Start Card No.: 122965



Depth (feet)	Elev. (ft, msl)
2.6	243.0
2.4	242.8
0.0	240.4
2.0	238.4
11.0	229.4
13.5	226.9
23.5	216.9
24.0	216.4
24.0	216.4
32.5	207.9

EXPLORATORY BORING

A. Total depth: 32.5 ft.
B. Diameter 10 in.
Drilling method: Hollow Stem Auger

WELL CONSTRUCTION

C. Well casing length: 26.7 ft.
Well casing material: Schedule 40 PVC
D. Well casing diameter: 2 in.
E. Well screen length: 10 ft.
Well screen type: Machine Slotted
Well screen slot size: 0.020 in.
F. Well sump/end cap length: 0.5 ft.
G. Well casing height (stickup): 1.5 ft.
H. Surface seal thickness: 2.0 ft.
I. Surface seal material: Cement
J. Annular seal thickness: 9 ft.
K. Annular seal material: Bentonite Chips
L. Filter pack seal thickness: NA ft.
M. Filter pack seal material: NA
N. Sand pack thickness: 13 ft.
O. Sand pack material: 10 x 20 Silica Sand
P. Bottom material thickness: 8.5 ft.
Q. Bottom material: Bentonite Chips
R. Protective casing material: Steel
Well centralizer depths: 13.0 ft.
23.5 ft.
S. Protective casing diameter: 6.5 in.

NOTES:

Well coordinates: Northing: 1181.5 Easting: 2626.8

Installed by: J. Renda

Reviewed by: ET

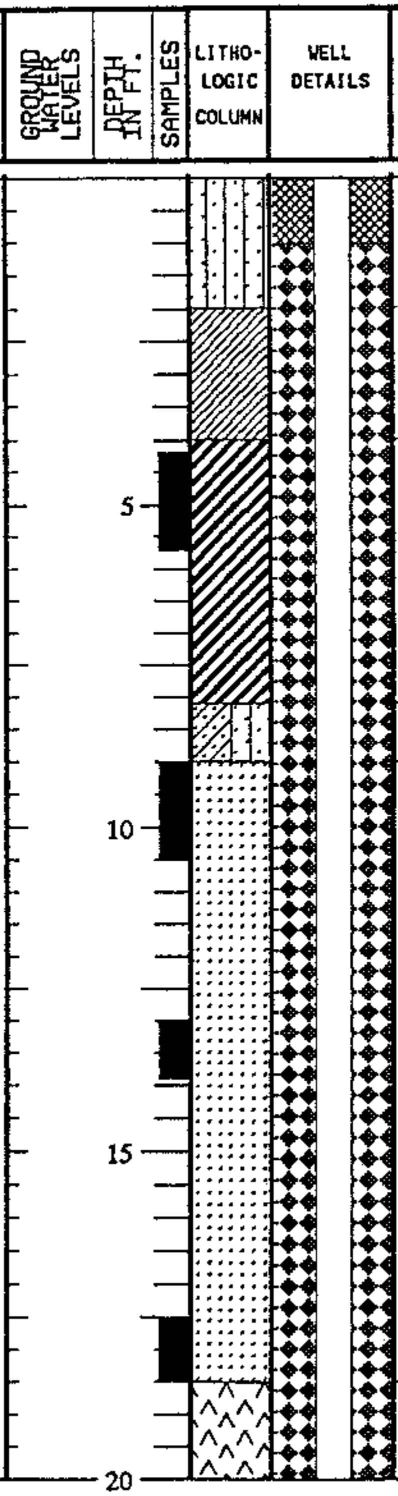
Date: 7/20/99

PJ:\Geology\COFFIN-B\MW24-P18\MW25DET.DOC-99\jrenda:1

LOG OF EXPLORATORY BORING

PROJECT NAME	COFFIN BUTTE LANDFILL	BORING NO.	P- 6
LOCATION	Benton County, Oregon	PAGE	1 OF 3
DRILLED BY	GeoTech Explorations	REFERENCE ELEV.	293.80'
DRILL METHOD	HSA & Diamond Coring	TOTAL DEPTH	40.00'
LOGGED BY	Mike Free	DATE COMPLETED	07/24/92

RECOVERY PERCENT	POCKET PENETRO-METER (TSF)	BLOW COUNTS (N COMP)
	3.3	
100		1-3-3 (6)
	1.7	
	1.3	
	1.5	
	3.2	
100		20-18-17 (35)
	3.2	
100		32-50/5 (>50)
100		23-50/6 (>50)



LITHOLOGIC DESCRIPTION

0-2 feet: SILTY SAND (SM), dark yellowish brown, 50% fine sand, 20% medium to coarse sand, 15% fines, 5% fine to medium gravel, loose, dry to damp, few roots. (COLLUVIUM)

2-4 feet: SANDY CLAY (CL-CH), dusky yellowish brown, 70% high plastic fines, 30% fine to coarse sand, stiff, damp. Transition layer. Few roots. (COLLUVIUM)

4-8.1 feet: CLAY (CH), olive gray, 95% high plastic fines, 5% fine to coarse sand, stiff to very stiff, moist, trace roots.

8.1-9 feet: CLAYEY SILTY SAND (SC-SM), light olive brown, 60% medium to coarse sand, 20% fine sand, 20% plastic to nonplastic fines, trace fine gravel, dense, damp. Grades to sandstone. (COLLUVIUM)

9-18.5 feet: SANDSTONE, light brown, 60% fine to medium sand, 30% coarse sand with basalt fragments, highly fractured, moderately weathered with white quartz-carbonate (?) veinlets, very friable, slightly damp, iron and manganese oxides common.

@ 15-17.6 feet: Basalt boulder, very friable, moderately weathered, iron and manganese oxides.

18.5-40 feet: FINE GRAINED BASALT.

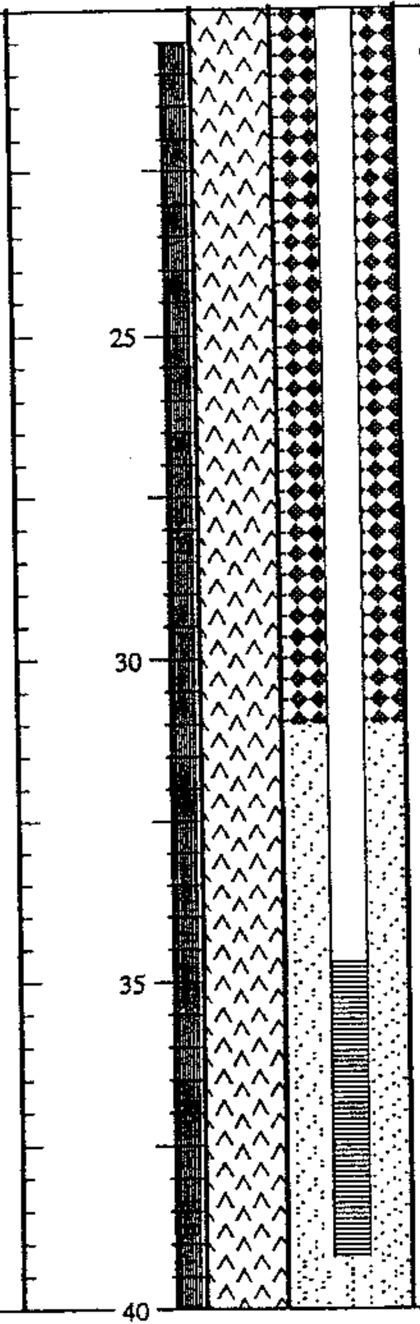
REMARKS

Standard split spoon, 2" O.D., 1 3/8" I.D., 140-lb. slide hammer, NWJ rods, 30" drop, 2 turns of rope on cap stem, metal keeper in spoon, hole dry. 0-18.5 ft. HSA with CB; 18.5-20.5 ft. HSA; 20.5-40 ft. diamond core.

LOG OF EXPLORATORY BORING

PROJECT NAME COFFIN BUTTE LANDFILL
LOCATION Benton County, Oregon
DRILLED BY GeoTech Explorations
DRILL METHOD HSA & Diamond Coring
LOGGED BY Mike Free

BORING NO. P- 6
PAGE 2 OF 3
REFERENCE ELEV. 293.80'
TOTAL DEPTH 40.00'
DATE COMPLETED 07/24/92

RECOVERY PERCENT	POCKET PENETRO-METER (TSF)	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
								@ 20.5-27.9 feet: Basalt, brown to greenish-gray, weathered, highly fractured with sandstone interbeds (?). @ 27.9-40 feet: Basalt, greenish gray, massive, fine grained, fractured (3 frac/foot), carbonate-zeolite (quartz) veins to 1/4"-pervasive propylitic alteration, trace fine grained pyrite, carbonate vugs at 34.8-35.9 feet and 40.2-40.8 feet.

REMARKS
Standard split spoon, 2" O.D., 1 3/8" I.D., 140-lb. slide hammer, NWJ rods, 30" drop, 2 turns of rope on cap stem, metal keeper in spoon, hole dry. 0-18.5 ft. HSA with CB; 18.5-20.5 ft. HSA; 20.5-40 ft. diamond core.

LOG OF EXPLORATORY BORING

PROJECT NAME	COFFIN BUTTE LANDFILL	BORING NO.	P- 6
LOCATION	Benton County, Oregon	PAGE	3 OF 3
DRILLED BY	GeoTech Explorations	REFERENCE ELEV.	293.80'
DRILL METHOD	HSA & Diamond Coring	TOTAL DEPTH	40.00'
LOGGED BY	Mike Free	DATE COMPLETED	07/24/92

RECOVERY PERCENT	POCKET PENETRO-METER (TSF)	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-LOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
				45 50 55 60				Bottom of boring at 40.0 feet below ground surface. PIEZOMETER CONSTRUCTION DETAILS: +1.0-34.7 feet: 2-inch dia. schedule 40 PVC blank casing. 34.7-39.2 feet: 2-inch dia. schedule 40 PVC screen with 0.010-inch machine slots. 39.2-39.4 feet: 2-inch dia. schedule 40 PVC end cap. 0-1 foot: Concrete. 1-31 feet: Hydrated bentonite chips. 31-40 feet: 10x20 gradation Colorado silica sand pack. PVC casing and screen couplings were flush threaded with "O"-rings. The surface completion consisted of a protective cover constructed of a 6-inch dia. by 5-foot long steel pipe positioned over the piezometer, through the concrete and set into the bentonite seal. An expansion well cap was used to cap the piezometer. A steel cover was locked on the protective casing. Three 2-inch dia. by 5-foot long steel pipes anchored 2 feet into the ground with concrete were installed in a triangle pattern around the piezometer.

REMARKS

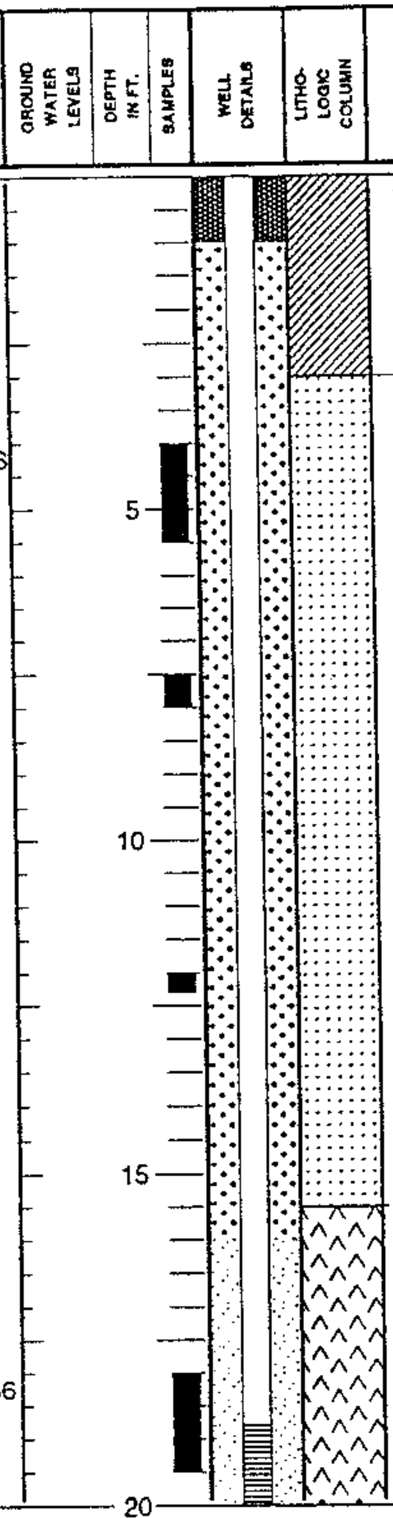
Standard split spoon, 2" O.D., 1 3/8" I.D., 140-lb. slide hammer, NWJ rods, 30" drop, 2 turns of rope on cap stem, metal keeper in spoon, hole dry. 0-18.5 ft. HSA with CB; 18.5-20.5 ft. HSA; 20.5-40 ft. diamond core.

LOG OF EXPLORATORY BORING

PROJECT NAME COFFIN BUTTE LANDFILL
LOCATION Benton County, Oregon
DRILLED BY GeoTech Explorations
DRILL METHOD HSA & Diamond Coring
LOGGED BY Mike Free

BORING NO. P- 7
PAGE 1 OF 3
REFERENCE ELEV. 297.30'
TOTAL DEPTH 32.00'
DATE COMPLETED 7/28/92

RECOVERY PERCENT	POCKET PENETROMETER (TSF)	BLOW COUNTS (N COMP)
	2.5	
	4.5	
100		9-19-50/6 (>50)
100		50/5.5 (>50)
	4.0	
	4.5	
	4.5+	
100		50/4 (>50)
100		15-28-36 (>50)



LITHOLOGIC DESCRIPTION

0-3 feet: CLAY (CL-CH), dusky yellowish brown to moderate yellowish brown, 70% plastic fines, 30% fine to coarse sand, trace fine gravel, stiff, damp. Few roots. (COLLUVIUM)

3-15.5 feet: SANDSTONE (SS), light brown, 50% fine sand, 30% medium to coarse sand, 10% nonplastic fines, 10% gravel, very friable, highly fractured, moderately weathered, damp. Mafic minerals altered to limonite, feldspars to clay. Grades into basalt at 15 ft.

15.5-32 feet: BASALT, light brown to orange brown, compact to friable, weathered.

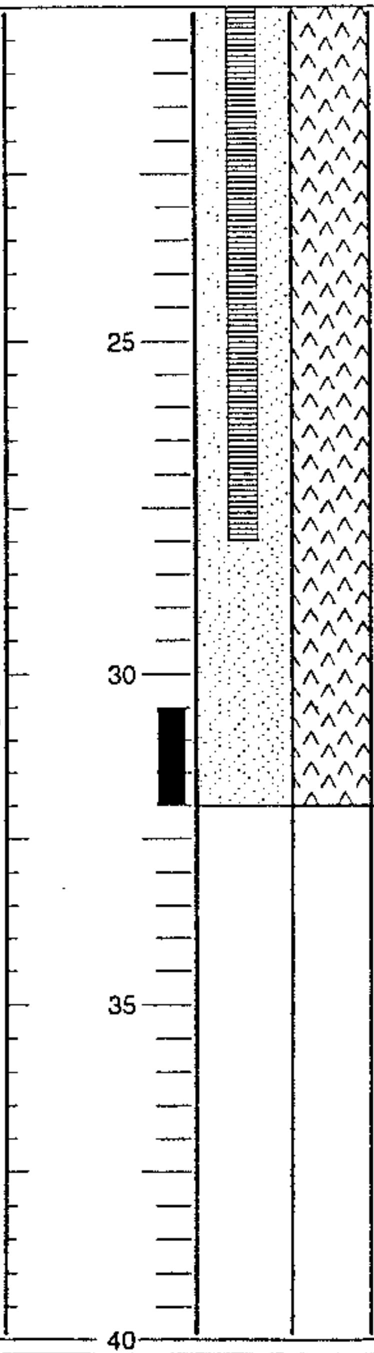
REMARKS

Standard split spoon, 2" O.D., 1 3/8" I.D., 140-lb. slide hammer, NWJ rods, 30" drop, 2 turns of rope on cap stem, metal keepe in spoon, hole dry. 0-12.7 ft. HSA with CB; 12.7-32 ft. HSA.

LOG OF EXPLORATORY BORING

PROJECT NAME COFFIN BUTTE LANDFILL
LOCATION Benton County, Oregon
DRILLED BY GeoTech Explorations
DRILL METHOD HSA & Diamond Coring
LOGGED BY Mike Free

BORING NO. P- 7
PAGE 2 OF 3
REFERENCE ELEV. 297.30'
TOTAL DEPTH 32.00'
DATE COMPLETED 7/28/92



RECOVERY PERCENT	POCKET PENETRO-METER (TSF)	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
								@ 21.5 feet: Hard pieces of basalt.
				25				
				30				
100		20-30-30 (>50)			■			@ 31-32 feet: Moderately fresh basalt fragments.
				35				
				40				

Bottom of boring at 32.0 feet below ground surface.

PIEZOMETER CONSTRUCTION DETAILS:

+1.25-18.8 feet: 2-inch dia. schedule 40 PVC blank casing.
18.8-28.8 feet: 2-inch dia. schedule 40 PVC screen with 0.010-inch machine slots.
28.8-29.3 feet: 2-inch dia. schedule 40 PVC end cap.
0-1 foot: Concrete.
1-16 feet: Hydrated bentonite chips.
16-30 feet: 10x20 gradation Colorado silica sand pack.
PVC casing and screen couplings were flush threaded with "O"-rings.
The surface completion consisted of a protective cover constructed of a 6-inch dia. by 5-foot long steel pipe positioned over the piezometer, through the concrete and set into the bentonite seal. An expansion well

REMARKS

Standard split spoon, 2" O.D., 1 3/8" I.D., 140-lb. slide hammer, NWJ rods, 30" drop, 2 turns of rope on cap stem, metal keeper in spoon, hole dry. 0-12.7 ft. HSA with CB; 12.7-32 ft. HSA.

EMCON Northwest, Inc.

LOG OF EXPLORATORY BORING

PROJECT NAME **COFFIN BUTTE LANDFILL**
LOCATION **Benton County, Oregon**
DRILLED BY **GeoTech Explorations**
DRILL METHOD **HSA & Diamond Coring**
LOGGED BY **Mike Free**

BORING NO. **P- 7**
PAGE **3 OF 3**
REFERENCE ELEV. **297.30'**
TOTAL DEPTH **32.00'**
DATE COMPLETED **7/28/92**

RECOVERY PERCENT	POCKET PENETRO-METER (TSF)	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
								cap was used to cap the piezometer. A steel cover was locked on the protective casing. Three 2-inch dia. by 5-foot long steel pipes anchored 2 feet into the ground with concrete were installed in a triangle pattern around the piezometer.
				45				
				50				
				55				
				60				

REMARKS

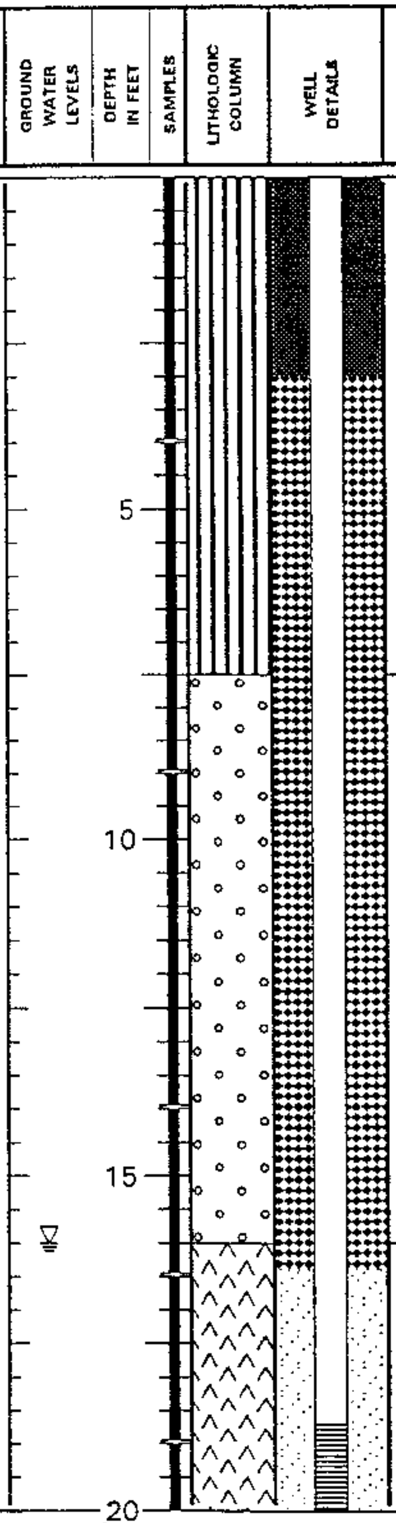
Standard split spoon, 2" O.D., 1 3/8" I.D., 140-lb. slide hammer, NWJ rods, 30" drop, 2 turns of rope on cap stem, metal keepe in spoon, hole dry. 0-12.7 ft. HSA with CB; 12.7-32 ft. HSA.

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY GeoTech Explorations
DRILL METHOD HSA w/CCB
LOGGED BY Mike Free

BORING NO. P- 8
PAGE 1 OF 2
GROUND ELEV.
TOTAL DEPTH 29.00'
DATE COMPLETED 07/13/93

SAMPLE TYPE	RECOVERY PERCENT	POCKET PENETRO-METER (T/ft)
CCB	75	
		3
		2.5
		2
CCB	102	2.5
		3.5
		4
		4.5
CCB	40	
CCB	80	
CCB	100	
CCB	100	



LITHOLOGIC DESCRIPTION

0 to 7.5 feet: CLAYEY SILT (MH), brown, 75 percent silt, 25 percent clay, trace fine sand, 2.0 to 3.0 feet soft, moist, 7.5 feet very stiff, damp. Roots common to 3.0 feet, occasional to 7.5 feet. (ALLUVIUM)

7.5 to 16.0 feet: SILTY GRAVEL (GP), brown, 60 percent decomposed basalt gravel, 40 percent silt, basalt is crushed, low to moderate hardness, moderately weathered. (COLLUVIUM)

16.0 to 29.0 feet: BASALT, brown, crushed, low to moderate hardness, moderately weathered. (BEDROCK)

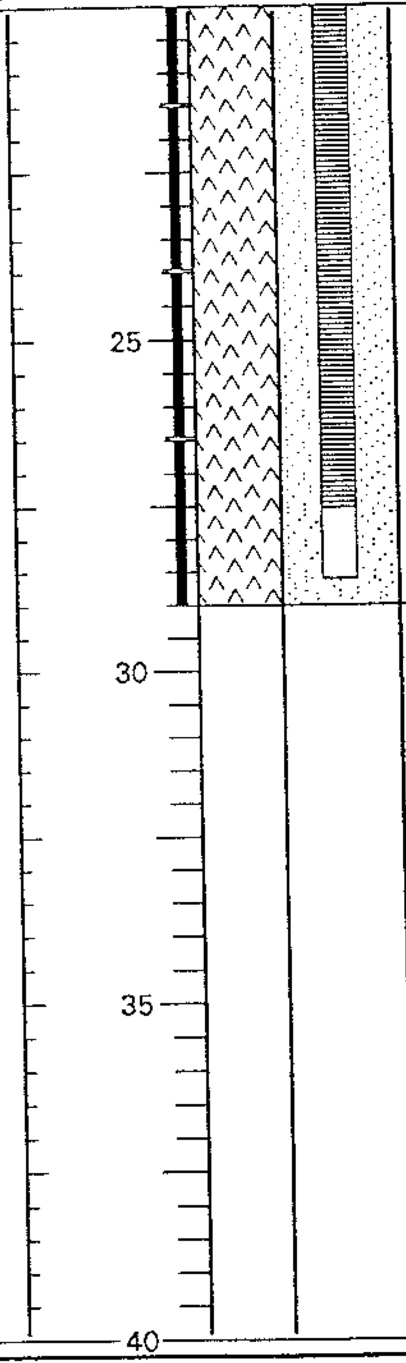
REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY GeoTech Explorations
DRILL METHOD HSA w/CCB
LOGGED BY Mike Free

BORING NO. P- 8
PAGE 2 OF 2
GROUND ELEV.
TOTAL DEPTH 29.00'
DATE COMPLETED 07/13/93

SAMPLE TYPE	RECOVERY PERCENT	POCKET PENETRO-METER (T/ft)
CCB	84	
CCB	104	
CCB	100	



LITHOLOGIC DESCRIPTION

16.0 to 29.0 feet: BASALT, continued.

Total depth drilled = 29.0 feet.
Total depth sampled = 29.0 feet.

WELL COMPLETION DETAILS:
0 to 18.7 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC blank riser pipe.
18.7 to 27.6 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC well screen with 0.010-inch machined slots and a 2-inch-diameter threaded end cap.
27.6 to 28.6 feet: 2-inch-diameter PVC blank sump pipe.

0 to 3.0 feet: Concrete.
3.0 to 16.4 feet: Bentonite chips hydrated with potable water.
16.4 to 29.0 feet: 10 - 20 Colorado Silica Sand.

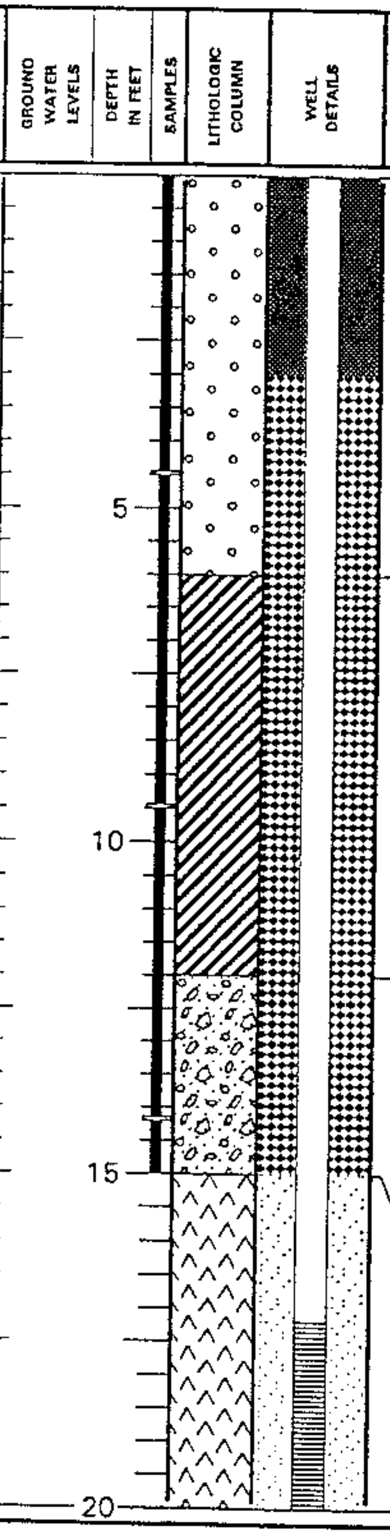
REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY GeoTech Explorations
DRILL METHOD HSA w/CCB
LOGGED BY Mike Free

BORING NO. P- 9
PAGE 1 OF 2
GROUND ELEV.
TOTAL DEPTH 23.30'
DATE COMPLETED 09/15/93

SAMPLE TYPE	RECOVERY PERCENT
Core	91
Core	104
Core	111
Core	100



LITHOLOGIC DESCRIPTION

0 to 6.0 feet: SILTY CLAYEY GRAVEL (GP), 0 to 1.2 feet black, 1.2 to 6.0 feet dark grayish brown to very dark grayish brown, 50 percent fine to coarse, subangular to subrounded gravel, 40 percent fines, 10 percent basalt cobbles, stiff, moist. (COLLUVIUM)

6.0 to 12.0 feet: SILTY CLAY (CH), brown, 80 percent silty clay, 10 percent fine to medium, subangular, basalt gravel, 10 percent fine to coarse (subangular to well rounded) sand, stiff, moist. (COLLUVIUM)

12.0 to 15.0 feet: SANDY CLAYEY GRAVEL (GW), very dark grayish brown, 50 percent fine to coarse, subrounded to subangular gravel, 30 percent fines, 20 percent fine to coarse sand (some coarse grains deeply weathered), stiff, moist, basalt gravel moderately hard to hard, weakly weathered. (COLLUVIUM)

15.0 to 23.3 feet: BASALT, hard, fresh (hard drilling at 19.0 feet). (BEDROCK)

REMARKS

No coring from 15.0 to 23.0 feet; used center bit basalt, hard, fresh, hard drilling at 19.0 feet. Bedrock.

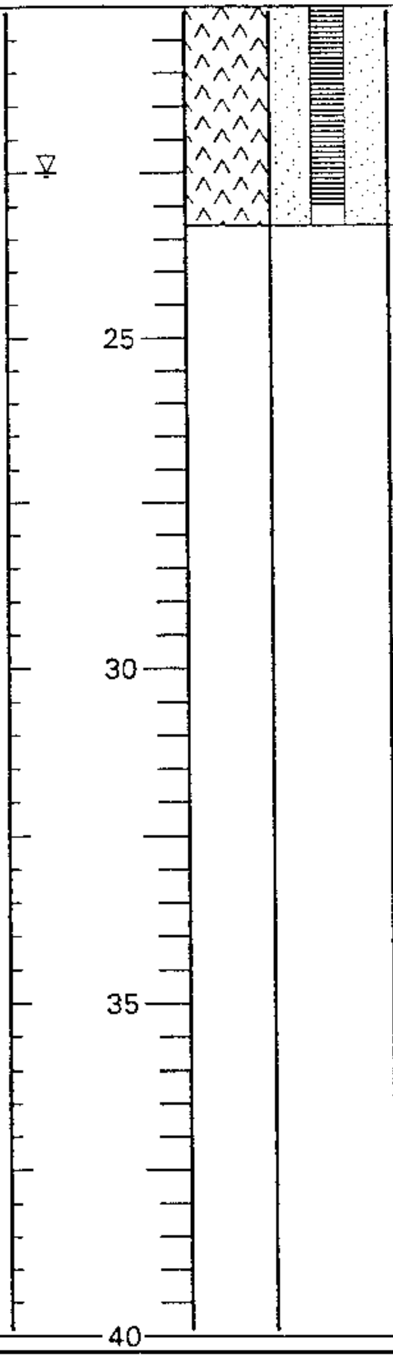
EMCON Northwest, Inc.

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY GeoTech Explorations
DRILL METHOD HSA w/CCB
LOGGED BY Mike Free

BORING NO. P- 9
PAGE 2 OF 2
GROUND ELEV.
TOTAL DEPTH 23.30'
DATE COMPLETED 09/15/93

SAMPLE TYPE	RECOVERY PERCENT	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	LITHOLOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION



15.0 to 23.3 feet: BASALT, continued.

Total depth drilled = 23.3 feet.
Total depth sampled = 15.0 feet.

WELL COMPLETION DETAILS:

0 to 17.2 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC blank riser pipe.
17.2 to 23.0 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC well screen with 0.010-inch machined slots.
23.0 to 23.3 feet: 2-inch-diameter threaded end cap.

0 to 3.0 feet: Concrete.
3.0 to 15.0 feet: Bentonite chips hydrated with potable water.
15.0 to 23.3 feet: 10 - 20 Colorado Silica Sand.

REMARKS

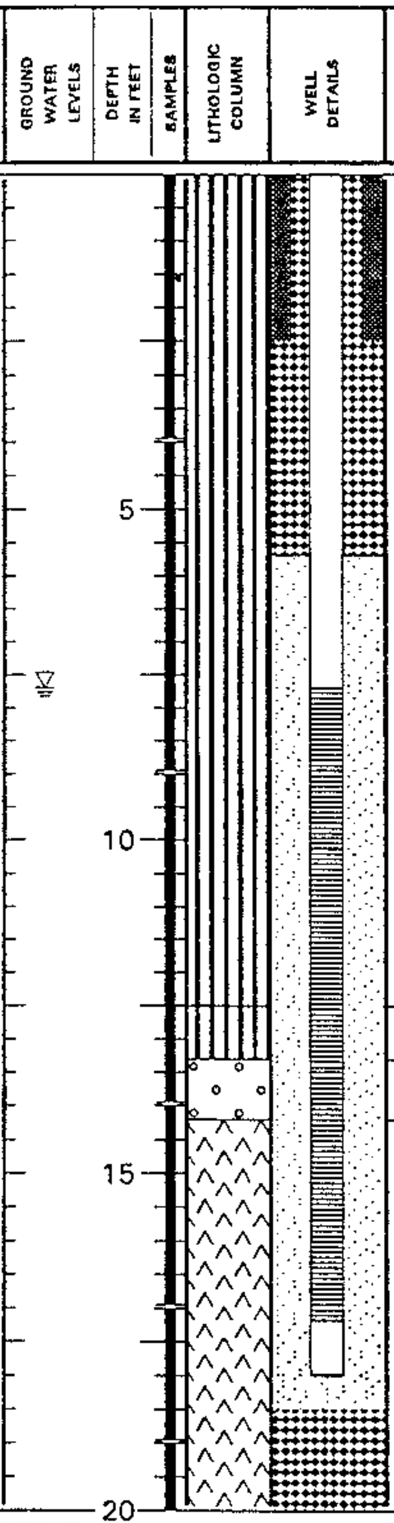
No coring from 15.0 to 23.0 feet; used center bit basalt, hard, fresh, hard drilling at 19.0 feet. Bedrock.

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY GeoTech Explorations
DRILL METHOD HSA w/CCB
LOGGED BY Mike Free

BORING NO. P-10
PAGE 1 OF 2
GROUND ELEV.
TOTAL DEPTH 26.50'
DATE COMPLETED 07/20/93

SAMPLE TYPE	RECOVERY PERCENT	POCKET PENETRO-METER (T/ft)
CCB	100	
		1.5
CCB	100	2.2
		2.1
		1.7
		1
CCB	104	
		0.8
		0.8
CCB	83	
CCB	90	
CCB	113	



LITHOLOGIC DESCRIPTION

0 to 12.5 feet: CLAYEY SILT (MH), very dark grayish brown 0 to 1.5 feet, very dark gray 1.5 to 8.0 feet, dark greenish gray 8.0 to 13.3 feet, 60 percent silt, 35 percent clay, 5 percent fine to medium sand, firm to stiff, damp 0 to 1.0 feet, moist 1.0 to 8.0 feet, wet 8.0 to 12.5 feet, roots to 11.0 feet, micaceous. (ALLUVIUM)

12.5 to 13.3 feet: GRAVELLY SILT (MH), dark greenish gray, 60 percent silt, 25 percent well rounded, fine to medium gravel, 10 percent clay, 5 percent fine to coarse sand, soft to firm, wet. (ALLUVIUM)

13.3 to 14.2 feet: SILTY SANDY GRAVEL (GP), very dark grayish brown, 40 percent fine to medium (coarse) gravel, 25 percent coarse sand, 25 percent silt, 10 percent fine to medium sand, trace clay, loose, wet. (ALLUVIUM)

14.2 to 20.5 feet: BASALT, dark brown to reddish brown, locally black, intensely fractured to crushed, friable to hard generally low hardness, deeply to moderately weathered, occasional hard fresh basalt zone. (COLLUVIUM?)

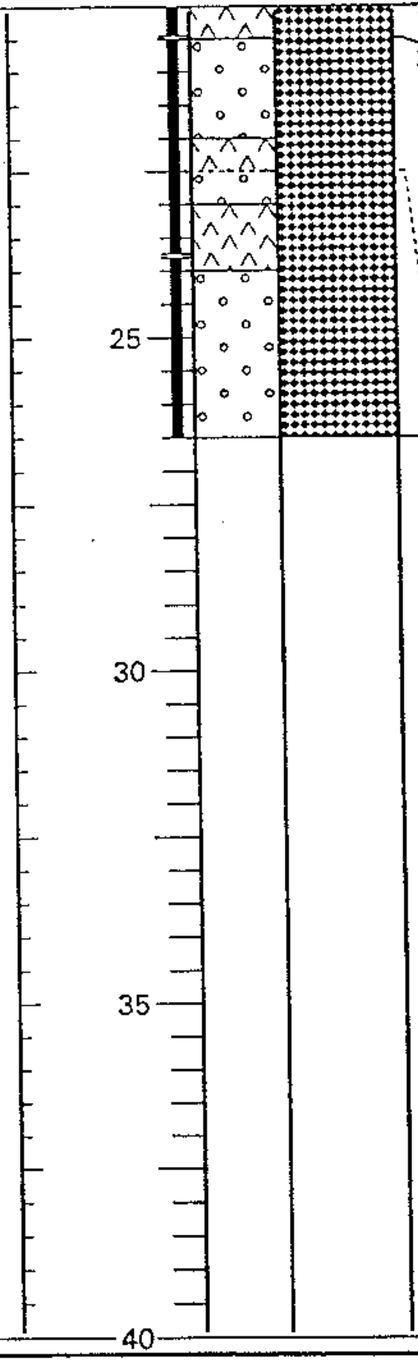
REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY GeoTech Explorations
DRILL METHOD HSA w/CCB
LOGGED BY Mike Free

BORING NO. P-10
PAGE 2 OF 2
GROUND ELEV.
TOTAL DEPTH 26.50'
DATE COMPLETED 07/20/93

SAMPLE TYPE	RECOVERY PERCENT	POCKET PENETRO-METER (T/ft)	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	LITHOLOGIC COLUMN	WELL DETAILS	LITHOLOGIC DESCRIPTION
CCB	79							
CCB	119							



14.2 to 20.5 feet: BASALT, continued.

20.5 to 26.5 feet: SANDY SILTY GRAVEL (GP), very dark grayish brown to dark brown, 50 percent subangular, fine to coarse gravel, occasional cobble (two basalt boulders from 22.0 to 22.5 feet and 23.0 to 24.0 feet), 30 percent silt and clay, 20 percent fine to coarse sand, firm, wet. (COLLUVIUM)

Total depth drilled = 26.5 feet.
Total depth sampled = 26.5 feet.

WELL COMPLETION DETAILS:
0 to 7.7 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC blank riser pipe.
7.7 to 17.2 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC well screen with 0.010-inch machined slots.
17.2 to 18.0 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC blank sump pipe.

0 to 2.5 feet: Concrete (outside protective casing).
0 to 5.7 feet: Bentonite chips hydrated with potable water.
5.7 to 17.5 feet: 20 - 40 Colorado Silica Sand.
17.5 to 18.5 feet: 10 - 20 Colorado Silica Sand.
18.5 to 26.5 feet: Bentonite chips hydrated with potable water.

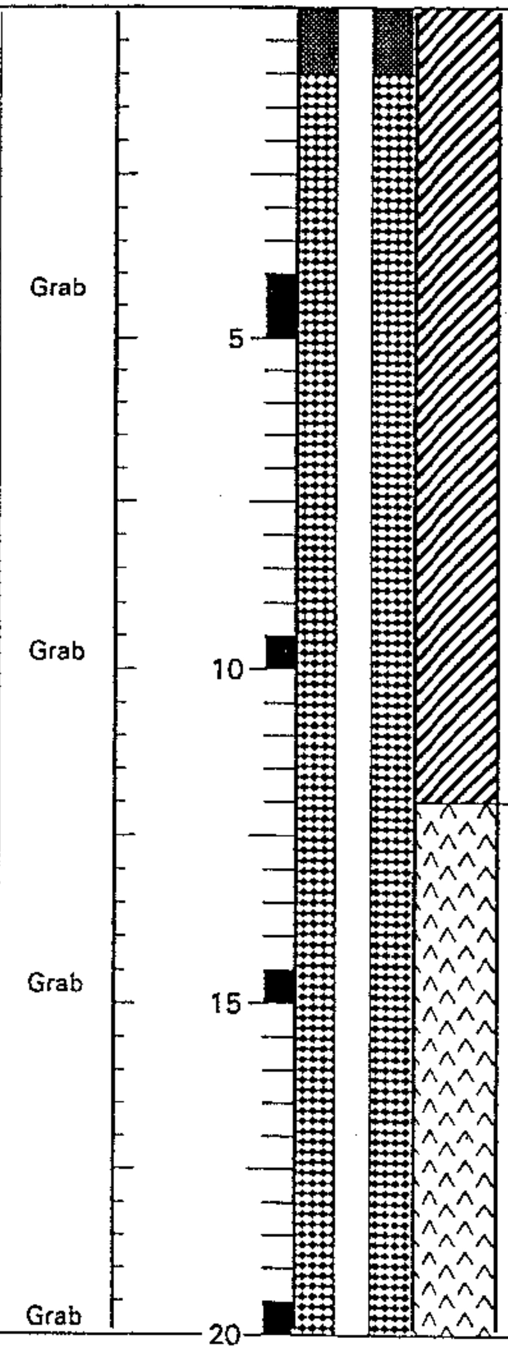
REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME **Coffin Butte Landfill**
LOCATION **Coffin Butte, Benton County, Oregon**
DRILLED BY **Staco Well Services**
DRILL METHOD **Air Rotary**
LOGGED BY **Mike Free**

BORING NO. P-11
PAGE 1 OF 4
GROUND ELEV. 270.20'
TOTAL DEPTH 52.00'
DATE COMPLETED 03/28/94

SAMPLE TYPE | GROUND WATER LEVELS | DEPTH IN FEET | SAMPLES | WELL DETAILS | LITHOLOGIC COLUMN | LITHOLOGIC DESCRIPTION



0 to 12.0 feet: SANDY SILTY CLAY (CH), dark brown to black, 80 percent high plasticity fines, 20 percent fine to coarse sand, stiff, moist. (ALLUVIUM)

12.0 to 52.0 feet: BASALT, dark gray, tan and orangy brown, crushed to intensely fractured, hard to moderately hard, moderately weathered.

@ 19.5 feet: driller notes formation harder than above.

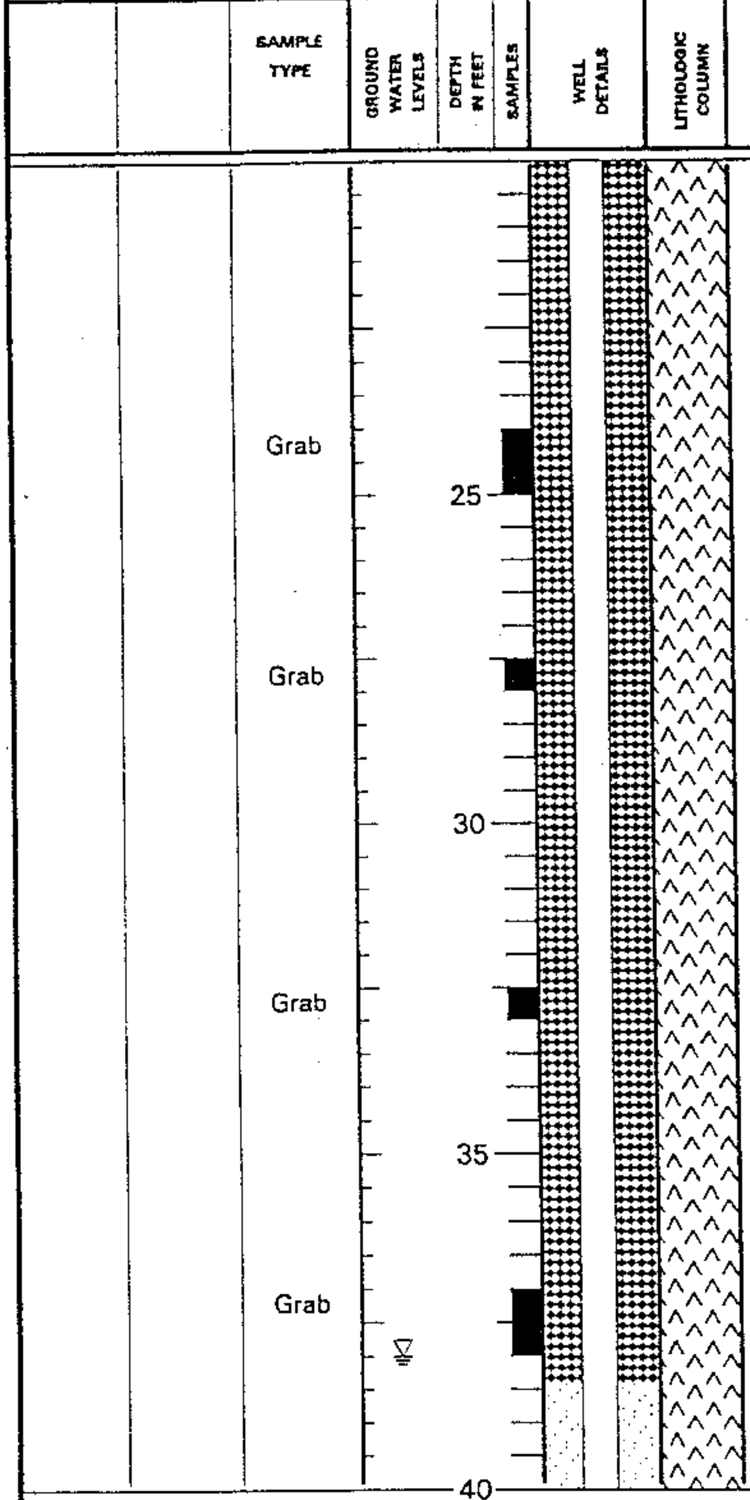
REMARKS

Boring drilled with a tri-cone bit.

EMCON Northwest, Inc.

LOG OF EXPLORATORY BORING

PROJECT NAME	Coffin Butte Landfill	BORING NO.	P-11
LOCATION	Coffin Butte, Benton County, Oregon	PAGE	2 OF 4
DRILLED BY	Staco Well Services	GROUND ELEV.	270.20'
DRILL METHOD	Air Rotary	TOTAL DEPTH	52.00'
LOGGED BY	Mike Free	DATE COMPLETED	03/28/94



LITHOLOGIC DESCRIPTION

12.0 to 52.0 feet: BASALT, continued.

@ 22.0 to 35.0 feet: mostly fine to medium sand; friable, deeply weathered.

@ 32.0 to 35.0 feet: cuttings dry.

@ 35.0 to 52.0 feet: dark brown with minor tan and reddish brown, crushed to intensely fractured, hard to moderately hard, moderately weathered.

@ 35.0 feet: driller added water to keep hole open.

@ 36.5 feet: driller shut off water.

@ 38.0 feet: cuttings wet.

REMARKS

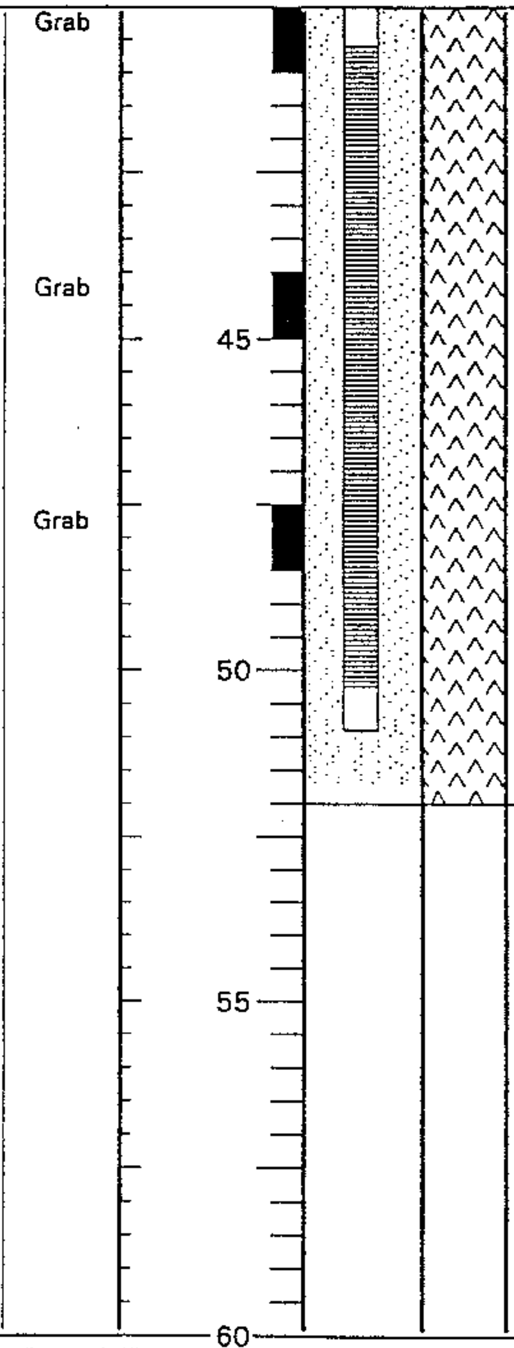
Boring drilled with a tri-cone bit.

LOG OF EXPLORATORY BORING

PROJECT NAME **Coffin Butte Landfill**
LOCATION **Coffin Butte, Benton County, Oregon**
DRILLED BY **Staco Well Services**
DRILL METHOD **Air Rotary**
LOGGED BY **Mike Free**

BORING NO. **P-11**
PAGE **3 OF 4**
GROUND ELEV. **270.20'**
TOTAL DEPTH **52.00'**
DATE COMPLETED **03/28/94**

SAMPLE TYPE | GROUND WATER LEVELS | DEPTH IN FEET | SAMPLES | WELL DETAILS | LITHOLOGIC COLUMN | LITHOLOGIC DESCRIPTION



12.0 to 52.0 feet: BASALT, continued.

@ 41.0 feet: driller notes increased hardness of formation.

@ 45.0 feet: waited for 10 minutes, then flushed approximately 10 gallons of groundwater out of the hole.

Total depth drilled = 52.0 feet.
Total depth sampled = 48.5 feet.

See Page 4 for Well Completion Details.

REMARKS

Boring drilled with a tri-cone bit.

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY Staco Well Services
DRILL METHOD Air Rotary
LOGGED BY Mike Free

BORING NO. P-11
PAGE 4 OF 4
GROUND ELEV. 270.20'
TOTAL DEPTH 52.00'
DATE COMPLETED 03/28/94

		SAMPLE TYPE	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
				65 70 75 80				WELL COMPLETION DETAILS: 0 to 40.6 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC blank riser pipe. 40.6 to 50.3 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC well screen with 0.020-inch machine-cut slots. 50.3 to 50.9 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC end cap. 0 to 1.0 foot: Concrete. 1.0 to 38.4 feet: Medium bentonite chips hydrated with potable water. 38.4 to 50.9 feet: 10 - 20 Colorado Silica Sand. 50.9 to 51.7 feet: Slough. Stainless steel centralizers at 25.0 and 45.0 feet.

REMARKS

Boring drilled with a tri-cone bit.

EMCON Northwest, Inc.

WELL DETAILS

EMCON ASSOCIATES

PROJECT NUMBER 0139-001.38

PROJECT NAME Coffin Butte Landfill

LOCATION Coffin Butte, Benton County, Oregon

WELL PERMIT NO.

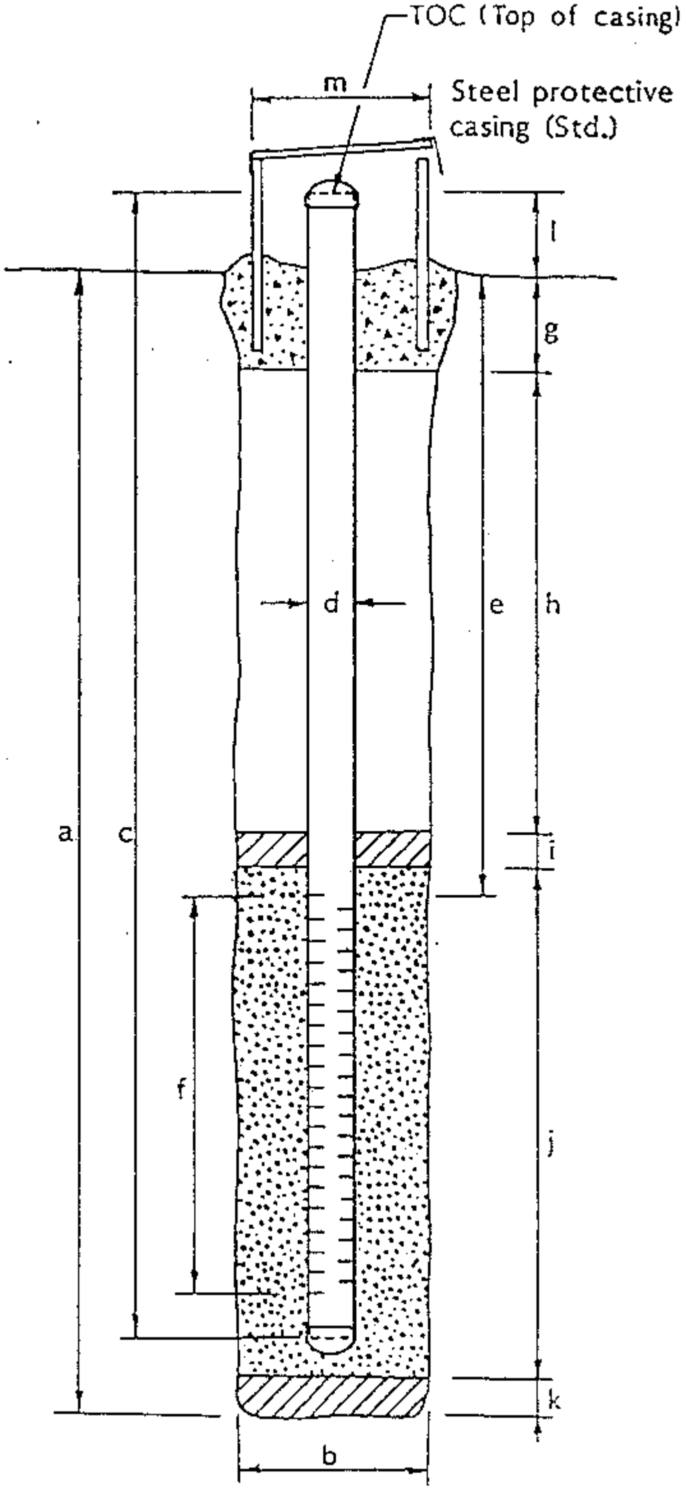
BORING / WELL NO. P-11

TOP OF CASING ELEV. 271.74

GROUND SURFACE ELEV. 270.20

DATUM Mean Sea Level

INSTALLATION DATE 3-28-94



EXPLORATORY BORING

a. Total depth 52.0 ft.

b. Diameter 6 in.

Drilling method Air Rotary

WELL CONSTRUCTION

c. Total casing length (50.9 + 1.5) 52.4 ft.

Material Schedule 40 PVC

d. Diameter 2 in.

e. Depth to top perforations 40.6 ft.

f. Perforated length 9.7 ft.

Perforated interval from 40.6 to 50.3 ft.

Perforation type Machine-Cut Slots

Perforation size 0.020 Inch

g. Surface seal (0-1.0) 1.0 ft.

Seal material Concrete

h. Backfill NA ft.

Backfill material NA

i. Seal (1.0-38.4) 37.4 ft.

Seal material Bentonite Chips

j. Gravel pack (38.4-51.7) 13.3 ft.

Pack material 10x20 Graded Colorado Silica Sand

k. Bottom seal None ft.

Seal material None

l. Casing stickup 1.54 ft.

m. Protective casing diameter 6 in.

Prepared by: M. Free

Reviewed by: EJT

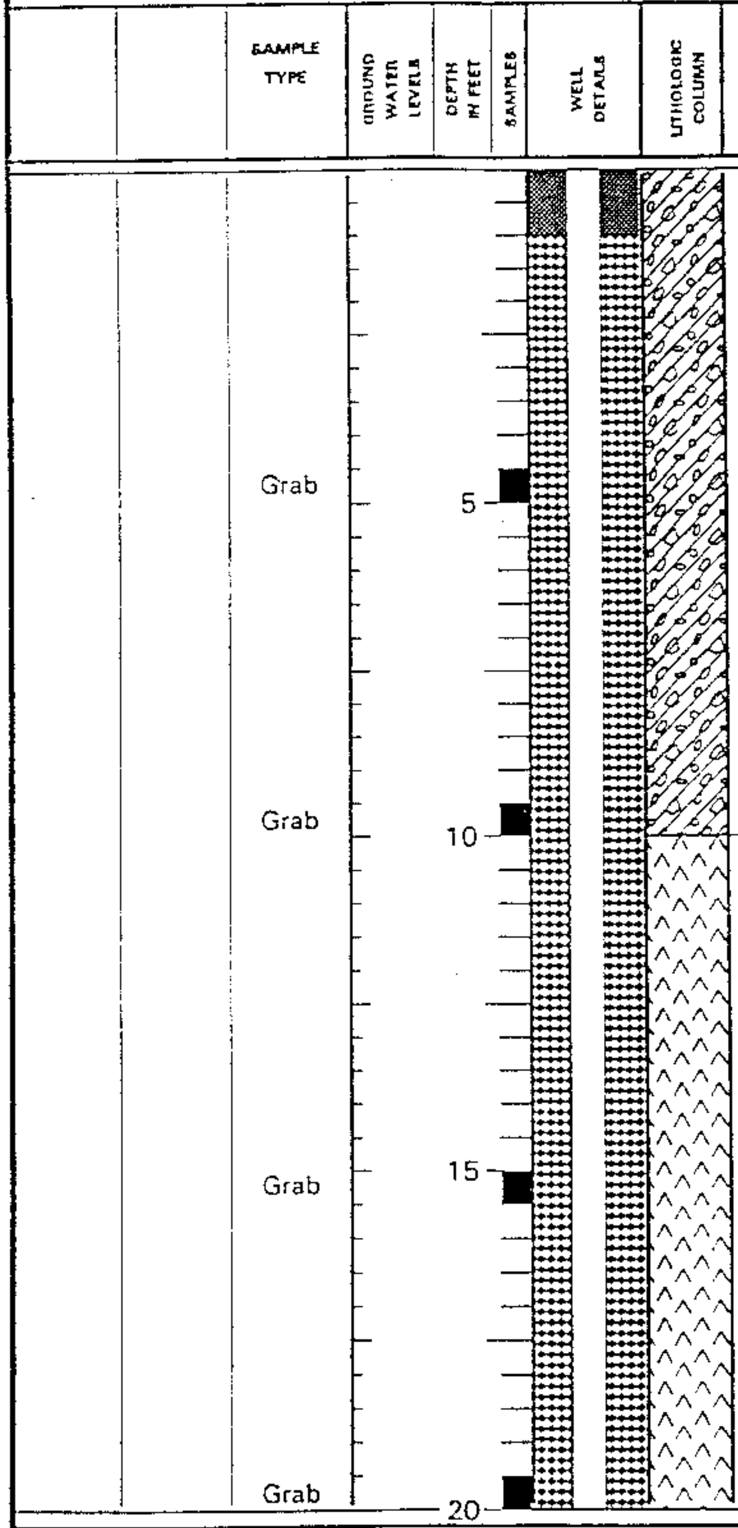
Date: 4/21/94

Form F-11 Rev. 12/90

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY Staco Well Services
DRILL METHOD Air Rotary
LOGGED BY Mike Free

BORING NO. P-12
PAGE 1 OF 4
GROUND ELEV. 349.06
TOTAL DEPTH 61.40'
DATE COMPLETED 03/31/94



LITHOLOGIC DESCRIPTION

0 to 10.0 feet: CLAYEY GRAVEL (GC), dark brown, 60 percent fine to coarse gravel and cobbles, 30 percent fines, 10 percent fine to coarse sand, slightly compact, moist. (FILL AND COLLUVIUM)

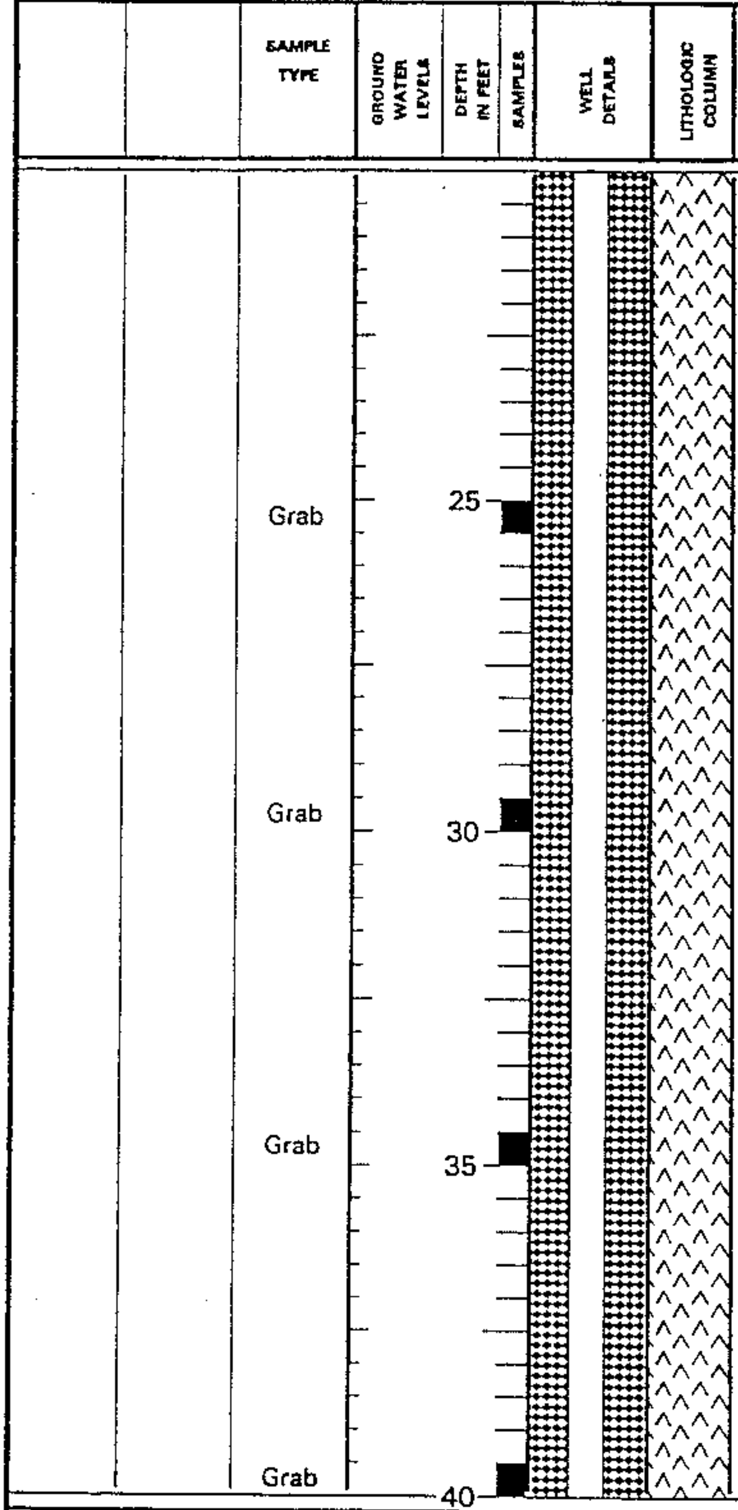
10.0 to 61.4 feet: BASALT, black, moderately fractured, hard, fresh. (BEDROCK)

REMARKS

Boring drilled with a down-hole hammer.

LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte Landfill**	BORING NO.	P-12
LOCATION	**Coffin Butte, Benton County, Oregon**	PAGE	2 OF 4
DRILLED BY	**Staco Well Services**	GROUND ELEV.	349.06'
DRILL METHOD	**Air Rotary**	TOTAL DEPTH	61.40'
LOGGED BY	**Mike Free**	DATE COMPLETED	03/31/94



LITHOLOGIC DESCRIPTION

10.0 to 61.4 feet: BASALT, continued.

@ 39.5 to 40.0 feet grab: 5 percent of cuttings are dark greenish gray with a trace of pyrite.

REMARKS

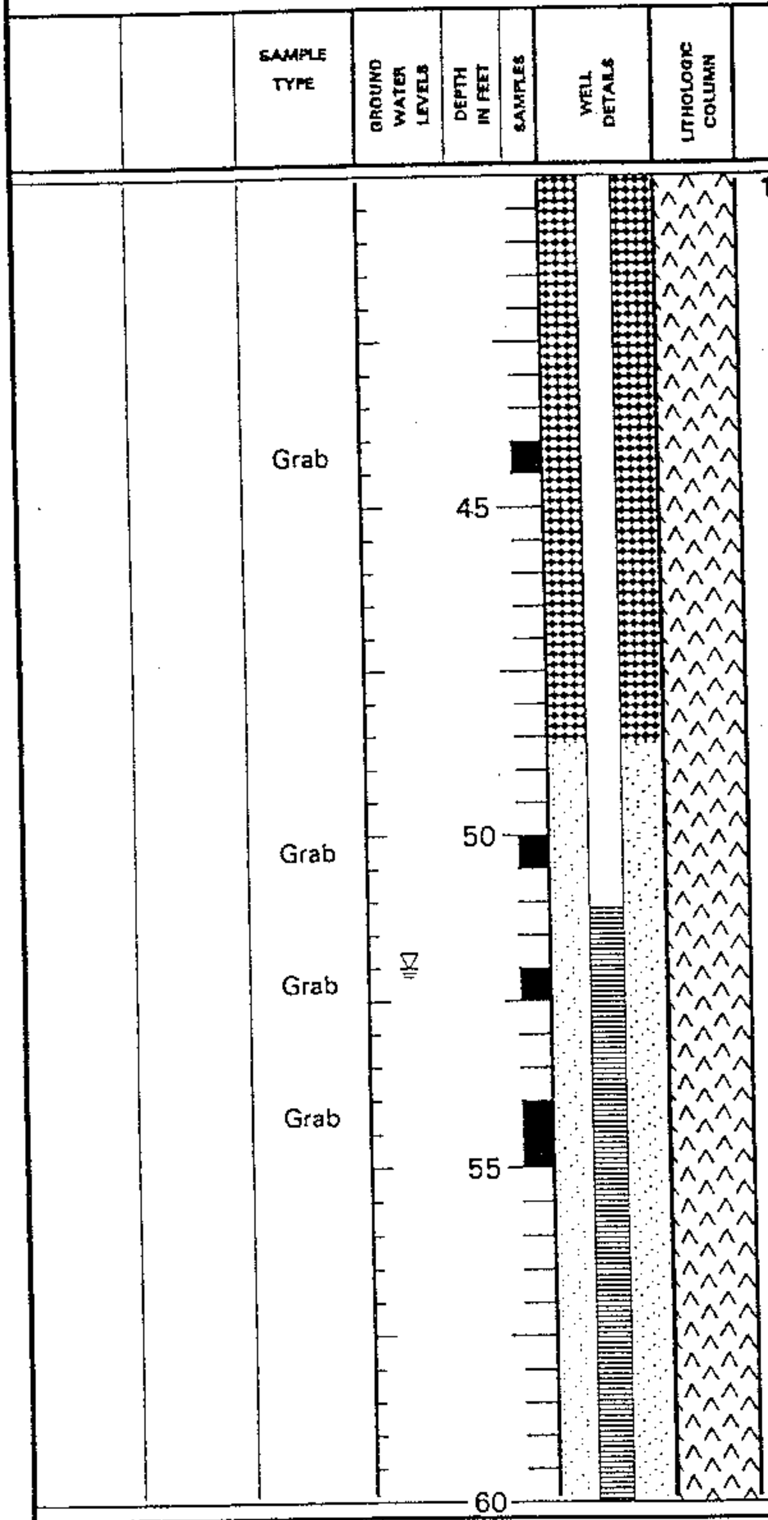
Boring drilled with a down-hole hammer.

EMCON Northwest, Inc.

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY Staco Well Services
DRILL METHOD Air Rotary
LOGGED BY Mike Free

BORING NO. P-12
PAGE 3 OF 4
GROUND ELEV. 349.06'
TOTAL DEPTH 61.40'
DATE COMPLETED 03/31/94



LITHOLOGIC DESCRIPTION

10.0 to 61.4 feet: BASALT, continued.

@ 52.0 feet: cuttings wet.
@ 52.0 to 54.0 feet: basalt, black, intensely fractured, hard, weakly weathered (manganese oxide coatings on surfaces) hole caved during drilling, possible fracture zone.
@ 53.0 feet: boring making approximately 2 gallons per minute.

REMARKS

Boring drilled with a down-hole hammer.

EMCON Northwest, Inc.

LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte Landfill**	BORING NO.	P-12
LOCATION	**Coffin Butte, Benton County, Oregon**	PAGE	4 OF 4
DRILLED BY	**Staco Well Services**	GROUND ELEV.	349.06'
DRILL METHOD	**Air Rotary**	TOTAL DEPTH	61.40'
LOGGED BY	**Mike Free**	DATE COMPLETED	03/31/94

		SAMPLE TYPE	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
		Grab			■			**10.0 to 61.4 feet:** BASALT, continued.
				65				
				70				
				75				
				80				

Total depth drilled = 61.4 feet.
Total depth sampled = 60.5 feet.

WELL COMPLETION DETAILS:

0 to 51.1 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC blank riser pipe.
51.1 to 60.8 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC well screen with 0.020-inch machine-cut slots.
60.8 to 61.4 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC end cap.

0 to 1.0 foot: Concrete.
1.0 to 48.6 feet: Medium bentonite chips hydrated with potable water.
48.6 to 61.4 feet: 10 - 20 Colorado Silica Sand.
Stainless steel centralizers at 36.3 and 56.3 feet.

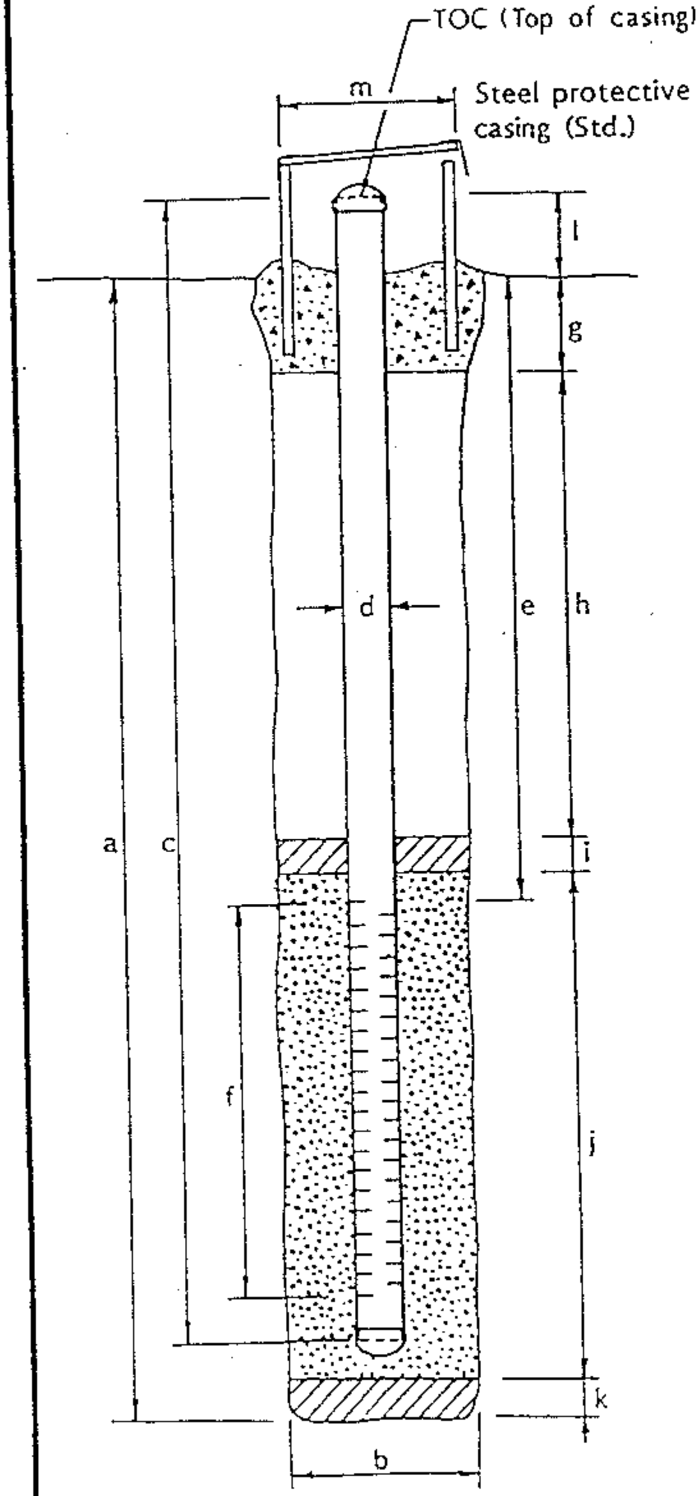
REMARKS

Boring drilled with a down-hole hammer.

WELL DETAILS

PROJECT NUMBER 0139-001.38
PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
WELL PERMIT NO. Start Card No. 41629

BORING / WELL NO. P-12
TOP OF CASING ELEV. 351.21
GROUND SURFACE ELEV. 349.06
DATUM Mean Sea Level
INSTALLATION DATE 3-31-94



EXPLORATORY BORING

a. Total depth 61.4 ft.
b. Diameter 6 in.
Drilling method Air Rotary

WELL CONSTRUCTION

c. Total casing length 63.3 ft.
Material Schedule 40 PVC
d. Diameter 2 in.
e. Depth to top perforations 51.1 ft.
f. Perforated length 9.7 ft.
Perforated interval from 51.1 to 60.8 ft.
Perforation type Machine-Cut Slots
Perforation size 0.020 Inch
g. Surface seal (0-1.0) 1.0 ft.
Seal material Concrete
h. Backfill NA ft.
Backfill material NA
i. Seal (1.0-48.6) 47.6 ft.
Seal material Bentonite Chips
j. Gravel pack (48.6-61.4) 12.8 ft.
Pack material 10x20 Graded Colorado Silica Sand
k. Bottom seal None ft.
Seal material None
l. Casing stickup 2.15 ft.
m. Protective casing diameter 6 in.

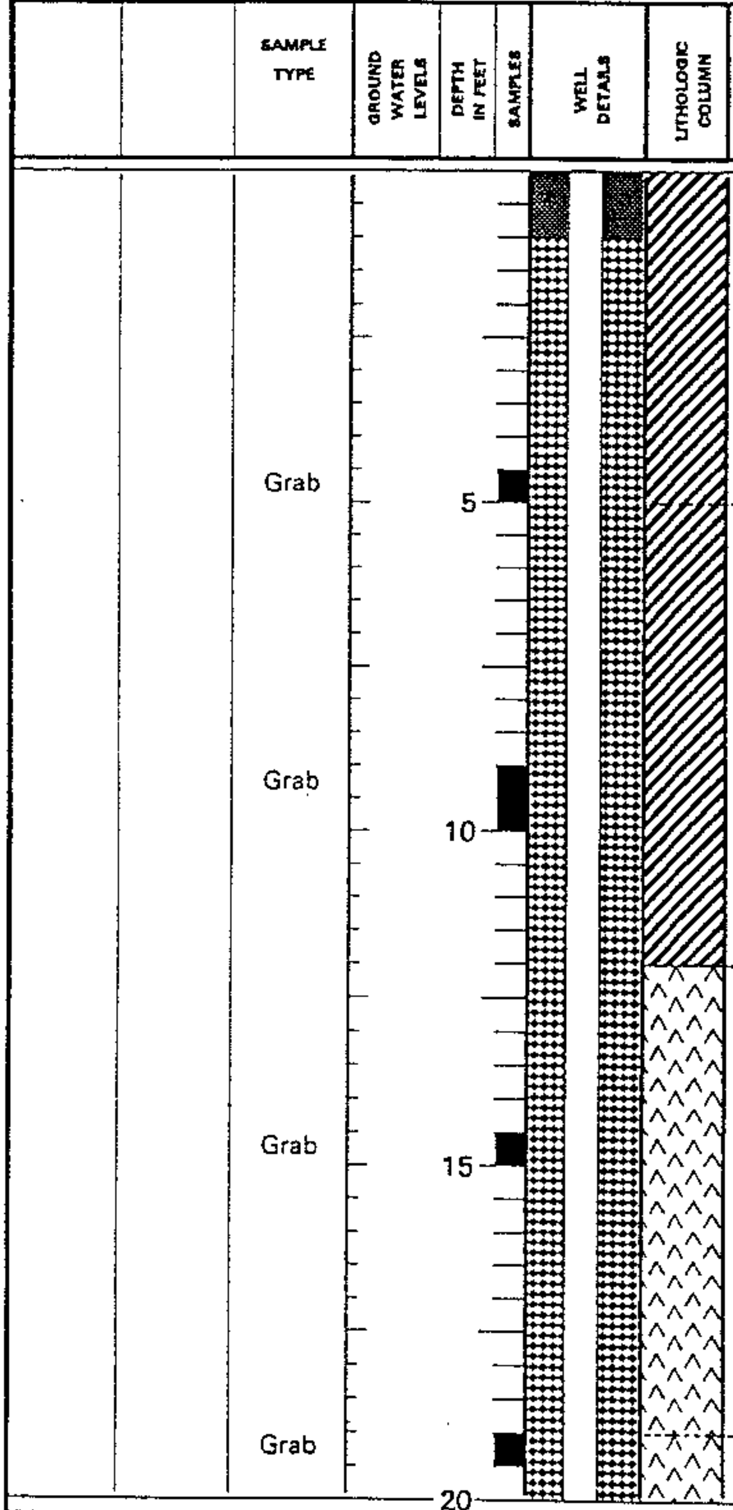
Prepared by M. Free

Reviewed by Date 4/29/94

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY Staco Well Services
DRILL METHOD Air Rotary
LOGGED BY Mike Free

BORING NO. P-13
PAGE 1 OF 5
GROUND ELEV. 312.19'
TOTAL DEPTH 83.30'
DATE COMPLETED 03/29/94



LITHOLOGIC DESCRIPTION

0 to 5.0 feet: GRAVELLY CLAY (CH), dark brown, 60 percent high plastic fines, 40 percent fine to medium gravel (crushed basalt), stiff, moist. (FILL AND ALLUVIUM)

5.0 to 12.0 feet: SANDY SILTY CLAY (CH), brown, 80 percent high plasticity fines, 20 percent fine to coarse sand, firm, moist. (ALLUVIUM)

12.0 to 19.0 feet: BASALT, dark brown to black, intensely fractured to crushed, moderately hard, moderately weathered. (BEDROCK)

19.0 to 83.0 feet: BASALT, black (minor brown), moderately fractured, hard; continued next page.

REMARKS

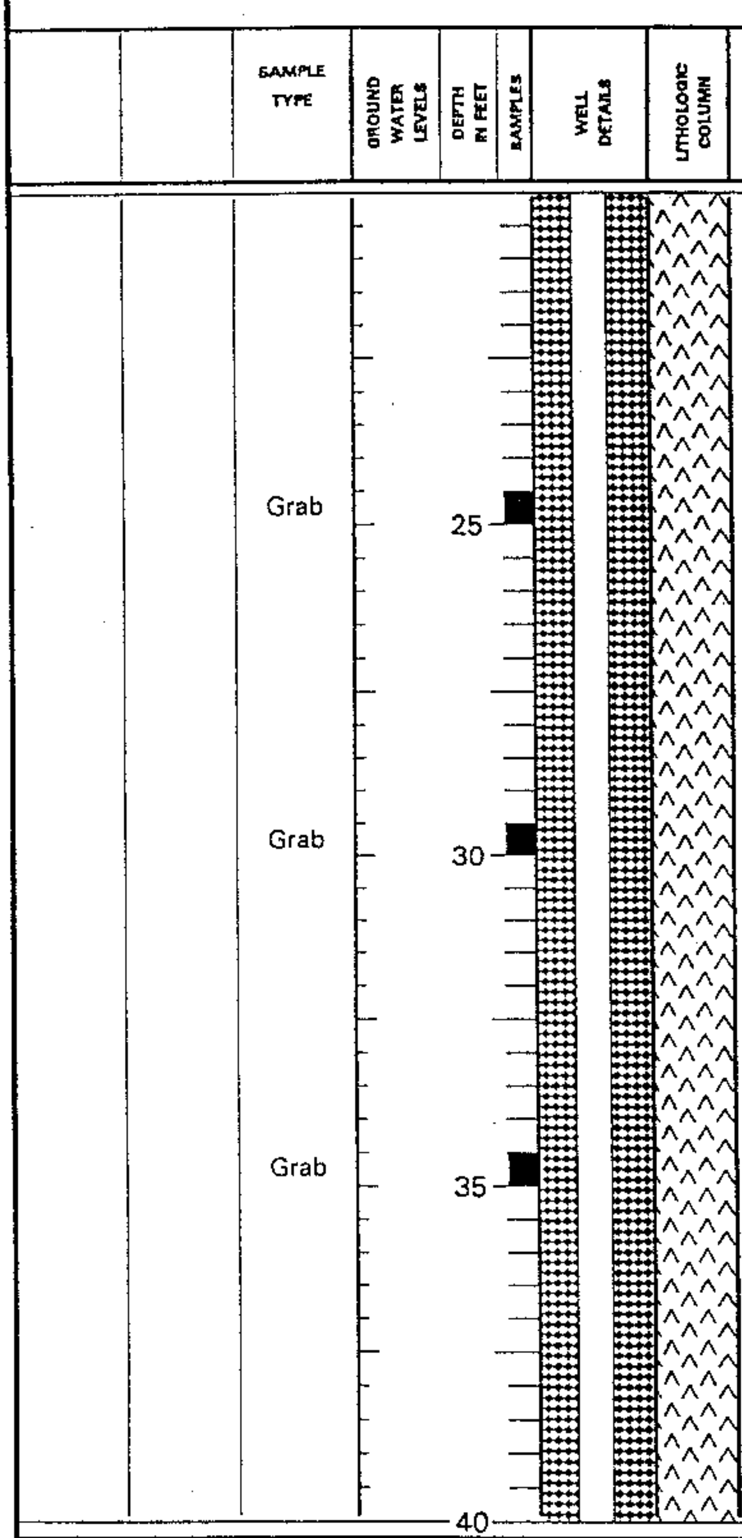
Boring drilled with a tri-cone bit from 0 to 35.0 feet and with a down-hole hammer from 35.0 to 83.0 feet.

EMCON Northwest, Inc.

LOG OF EXPLORATORY BORING

PROJECT NAME **Coffin Butte Landfill**
LOCATION **Coffin Butte, Benton County, Oregon**
DRILLED BY **Staco Well Services**
DRILL METHOD **Air Rotary**
LOGGED BY **Mike Free**

BORING NO. P-13
PAGE 2 OF 5
GROUND ELEV. 312.19'
TOTAL DEPTH 83.30'
DATE COMPLETED 03/29/94



LITHOLOGIC DESCRIPTION

19.0 to 83.3 feet: BASALT, continued: fresh to weakly weathered. (BEDROCK)

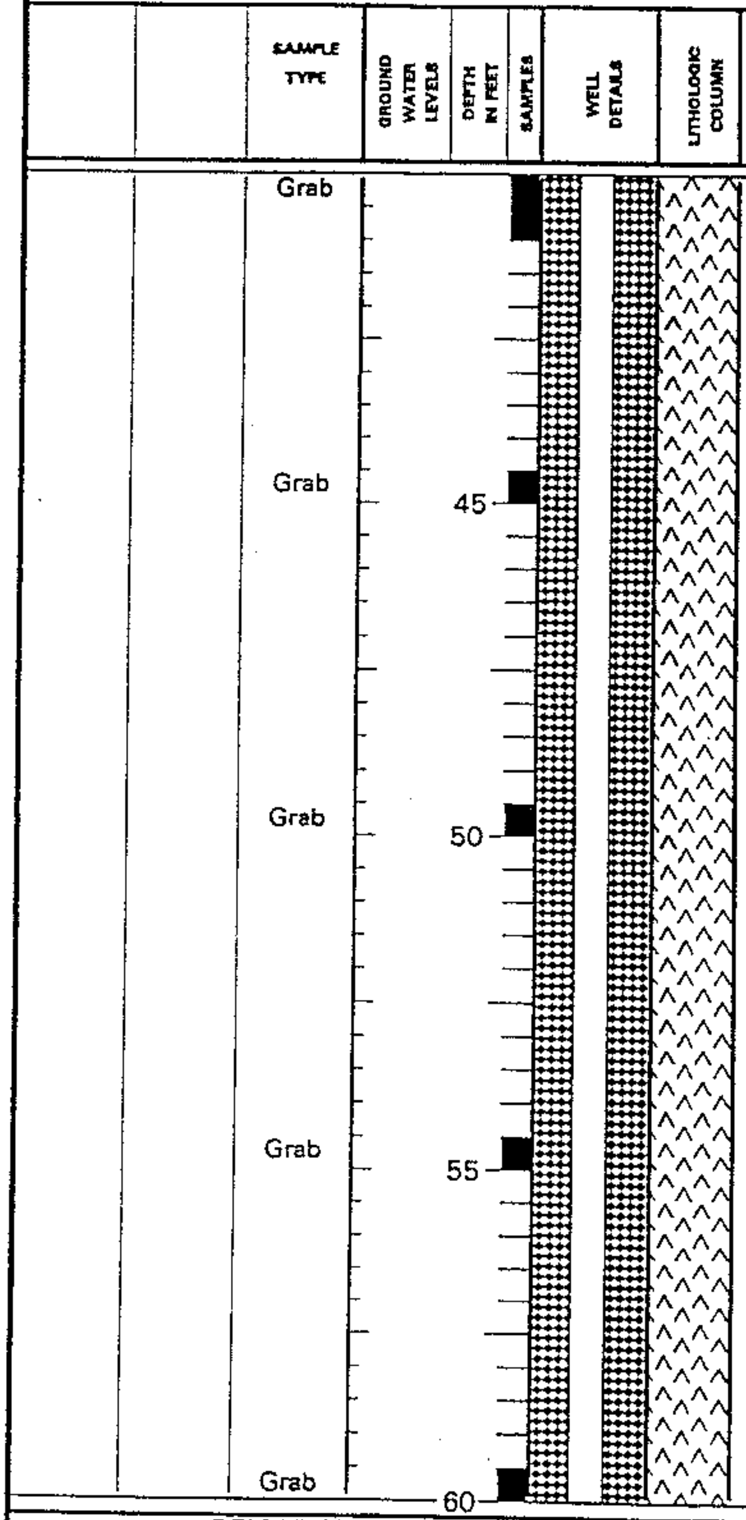
REMARKS

Boring drilled with a tri-cone bit from 0 to 35.0 feet and with a down-hole hammer from 35.0 to 83.0 feet.

LOG OF EXPLORATORY BORING

PROJECT NAME **Coffin Butte Landfill**
LOCATION **Coffin Butte, Benton County, Oregon**
DRILLED BY **Staco Well Services**
DRILL METHOD **Air Rotary**
LOGGED BY **Mike Free**

BORING NO. P-13
PAGE 3 OF 5
GROUND ELEV. 312.19'
TOTAL DEPTH 83.30'
DATE COMPLETED 03/29/94



LITHOLOGIC DESCRIPTION

19.0 to 83.3 feet: BASALT, continued.

@ 48.0 feet: cuttings damp.

REMARKS

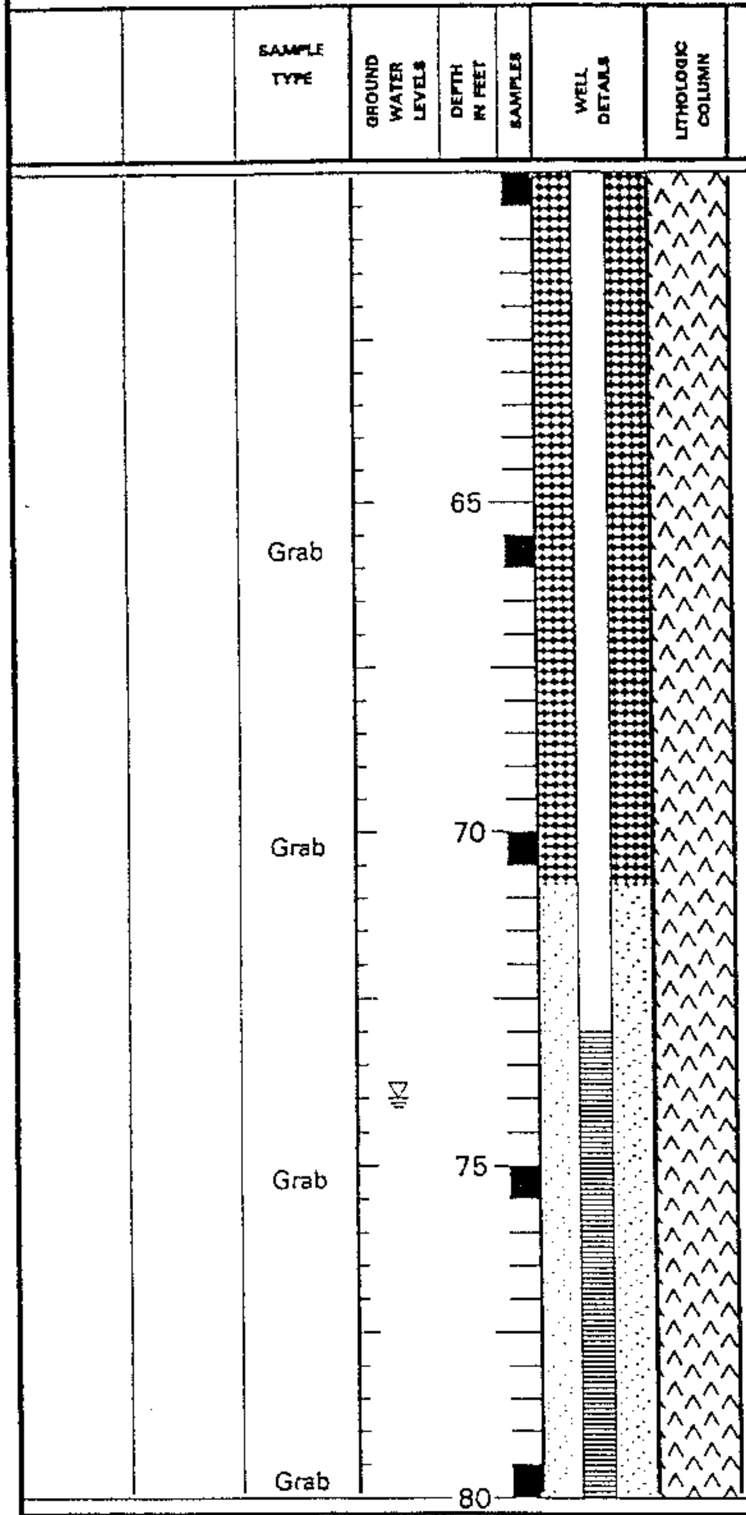
Boring drilled with a tri-cone bit from 0 to 35.0 feet and with a down-hole hammer from 35.0 to 83.0 feet.

EMCON Northwest, Inc.

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY Staco Well Services
DRILL METHOD Air Rotary
LOGGED BY Mike Free

BORING NO. P-13
PAGE 4 OF 5
GROUND ELEV. 312.19'
TOTAL DEPTH 83.30'
DATE COMPLETED 03/29/94



LITHOLOGIC DESCRIPTION

19.0 to 83.3 feet: BASALT, continued.

@ 74.0 feet: cuttings wet.

REMARKS

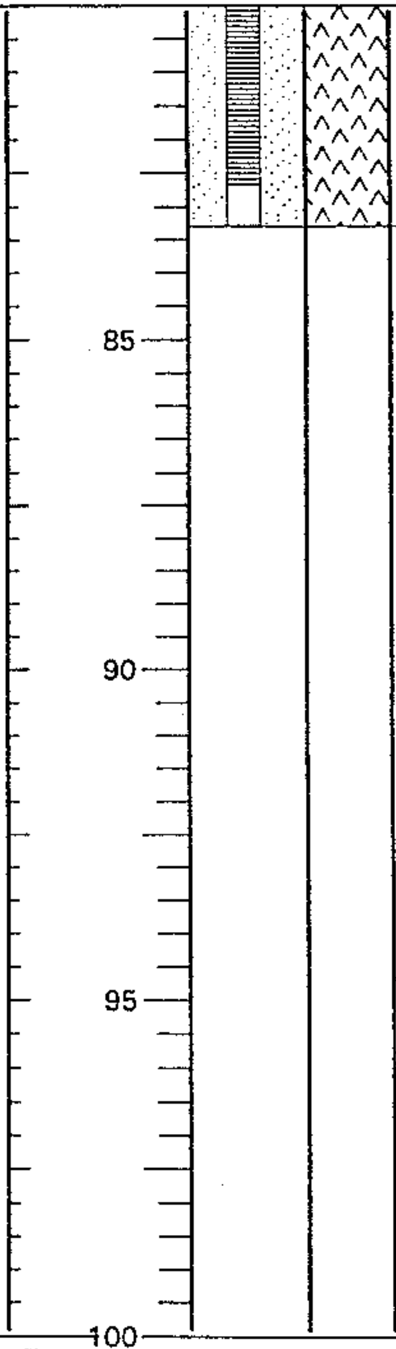
Boring drilled with a tri-cone bit from 0 to 35.0 feet and with a down-hole hammer from 35.0 to 83.0 feet.

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY Staco Well Services
DRILL METHOD Air Rotary
LOGGED BY Mike Free

BORING NO. P-13
PAGE 5 OF 5
GROUND ELEV. 312.19'
TOTAL DEPTH 83.30'
DATE COMPLETED 03/29/94

SAMPLE TYPE | GROUND WATER LEVELS | DEPTH IN FEET | SAMPLES | WELL DETAILS | LITHOLOGIC COLUMN | LITHOLOGIC DESCRIPTION



19.0 to 83.3 feet: BASALT, continued.

Total depth drilled = 83.3 feet.
Total depth sampled = 80.0 feet.

WELL COMPLETION DETAILS:

0 to 73.0 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC blank riser pipe.
73.0 to 82.7 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC well screen with 0.020-inch machine-cut slots.
82.7 to 83.3 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC end cap.

0 to 1.0 foot: Concrete.
1.0 to 70.8 feet: Medium bentonite chips hydrated with potable water.
70.8 to 83.3 feet: 10 - 20 Colorado Silica Sand.
Stainless steel centralizers at 58.0 and 78.0 feet.

REMARKS

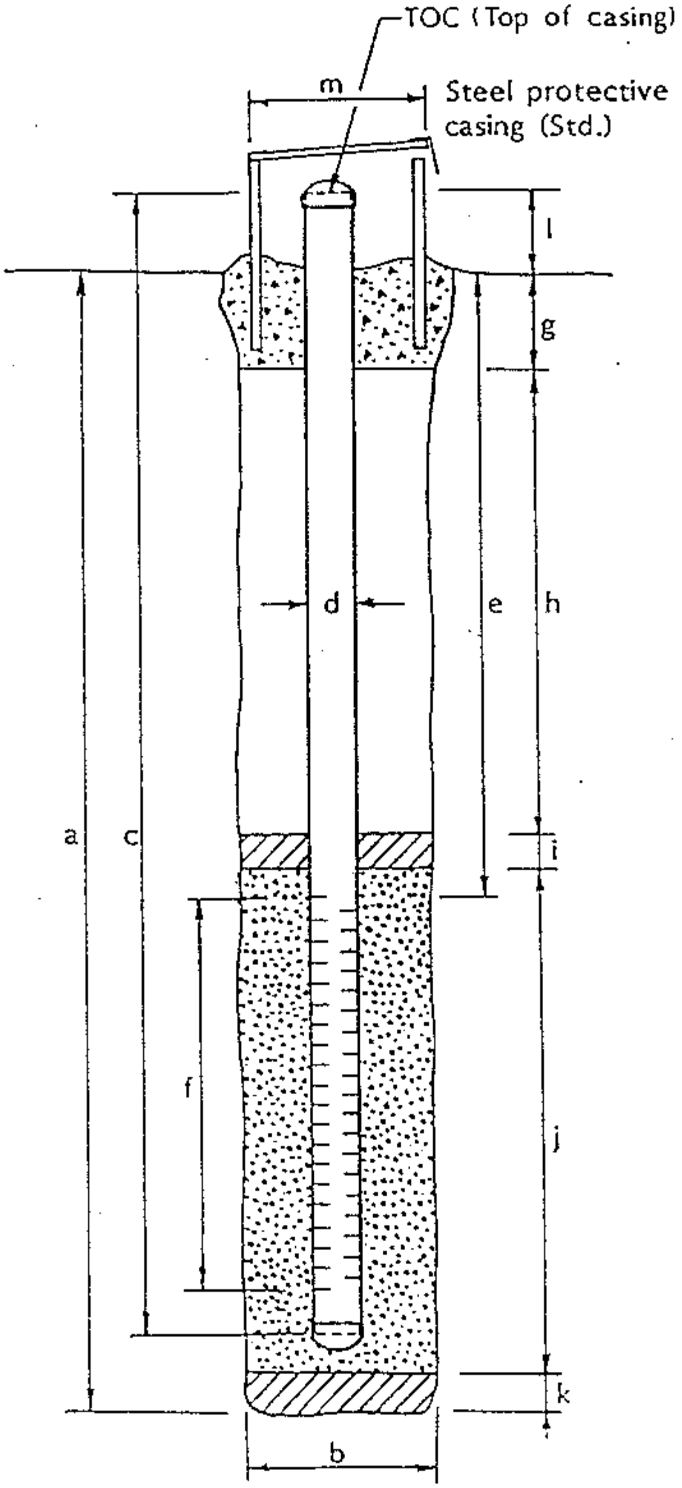
Boring drilled with a tri-cone bit from 0 to 35.0 feet and with a down-hole hammer from 35.0 to 83.0 feet.

WELL DETAILS

EMCON ASSOCIATES

PROJECT NUMBER 0139-001.38
PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
WELL PERMIT NO.

BORING / WELL NO. P-13
TOP OF CASING ELEV. 313.81
GROUND SURFACE ELEV. 312.19
DATUM Mean Sea Level
INSTALLATION DATE 3-29-94



EXPLORATORY BORING

a. Total depth 83.3 ft.
b. Diameter 6 in.
Drilling method Air Rotary

WELL CONSTRUCTION

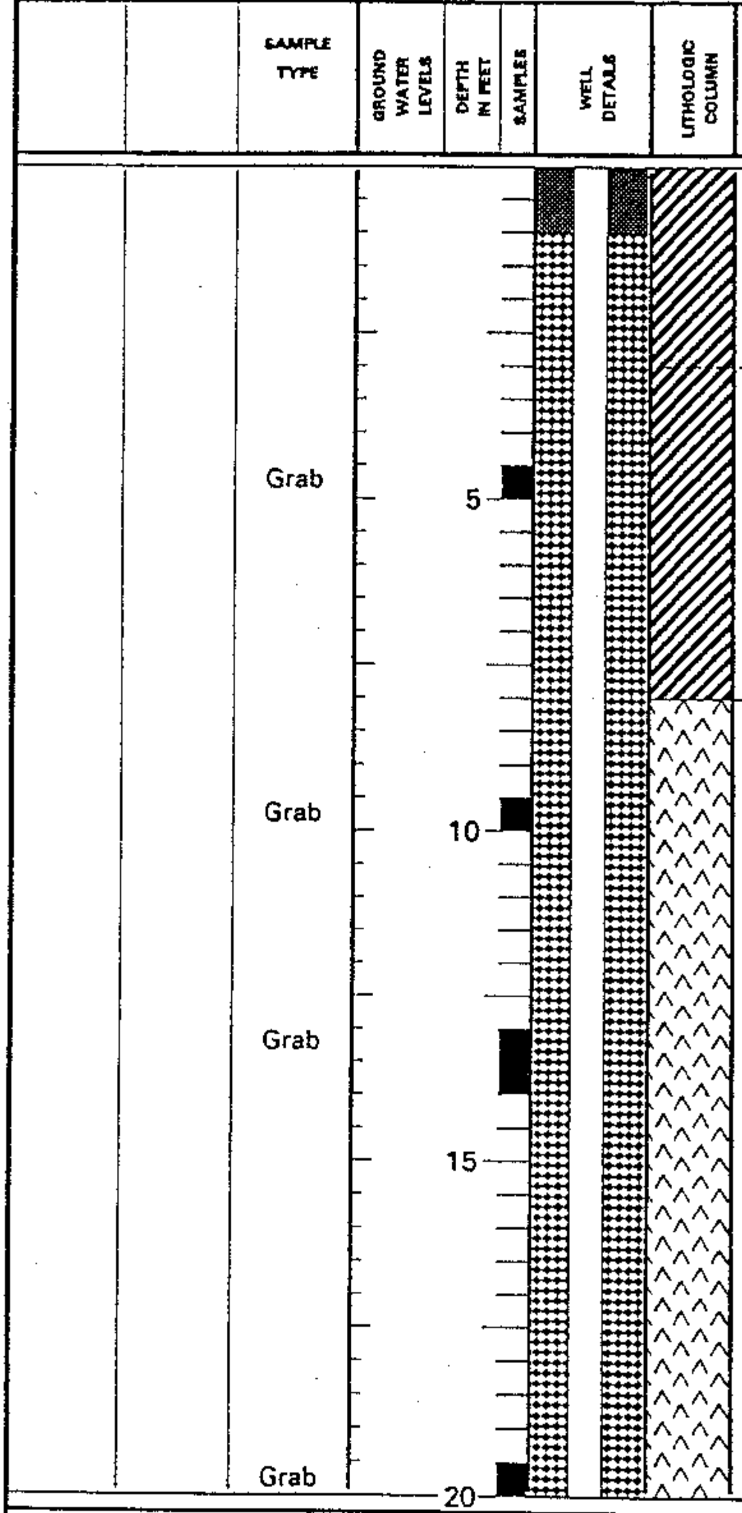
c. Total casing length 84.9 ft.
Material Schedule 40 PVC
d. Diameter 2 in.
e. Depth to top perforations 73.0 ft.
f. Perforated length 9.7 ft.
Perforated interval from 73.0 to 82.7 ft.
Perforation type Machine-Cut Slots
Perforation size 0.020 Inch
g. Surface seal (0-1.0) 1.0 ft.
Seal material Concrete
h. Backfill NA ft.
Backfill material NA
i. Seal (1.0-70.8) 69.8 ft.
Seal material Bentonite Chips
j. Gravel pack (70.8-83.3) 12.5 ft.
Pack material 10x20 Graded Colorado Silica Sand
k. Bottom seal None ft.
Seal material None
l. Casing stickup 1.62 ft.
m. Protective casing diameter 6 in.

Prepared by: M. Free

Reviewed by: EJT
Date: 4/29/94

LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte Landfill**	BORING NO.	P-14
LOCATION	**Coffin Butte, Benton County, Oregon**	PAGE	1 OF 4
DRILLED BY	**Staco Well Services**	GROUND ELEV.	279.47'
DRILL METHOD	**Air Rotary**	TOTAL DEPTH	51.80'
LOGGED BY	**Mike Free**	DATE COMPLETED	03/28/94



LITHOLOGIC DESCRIPTION

0 to 3.0 feet: GRAVELLY SILTY CLAY (CH), black, 80 percent fines, 20 percent fine to coarse gravel (crushed basalt), firm, moist. (FILL AND ALLUVIUM)

3.0 to 8.0 feet: SILTY CLAY (CH), very dark brown, 100 percent high plasticity fines, firm, moist. (ALLUVIUM)

8.0 to 42.0 feet: BASALT, dark brown (some black), alternating sequence (1- to 2-foot-thick zones) of intensely fractured, hard to moderately hard, weakly to moderately weathered, to intensely fractured, friable, intensely weathered, fines (some palagonite) and medium sand; possible pillow lava sequence. (BEDROCK)

REMARKS

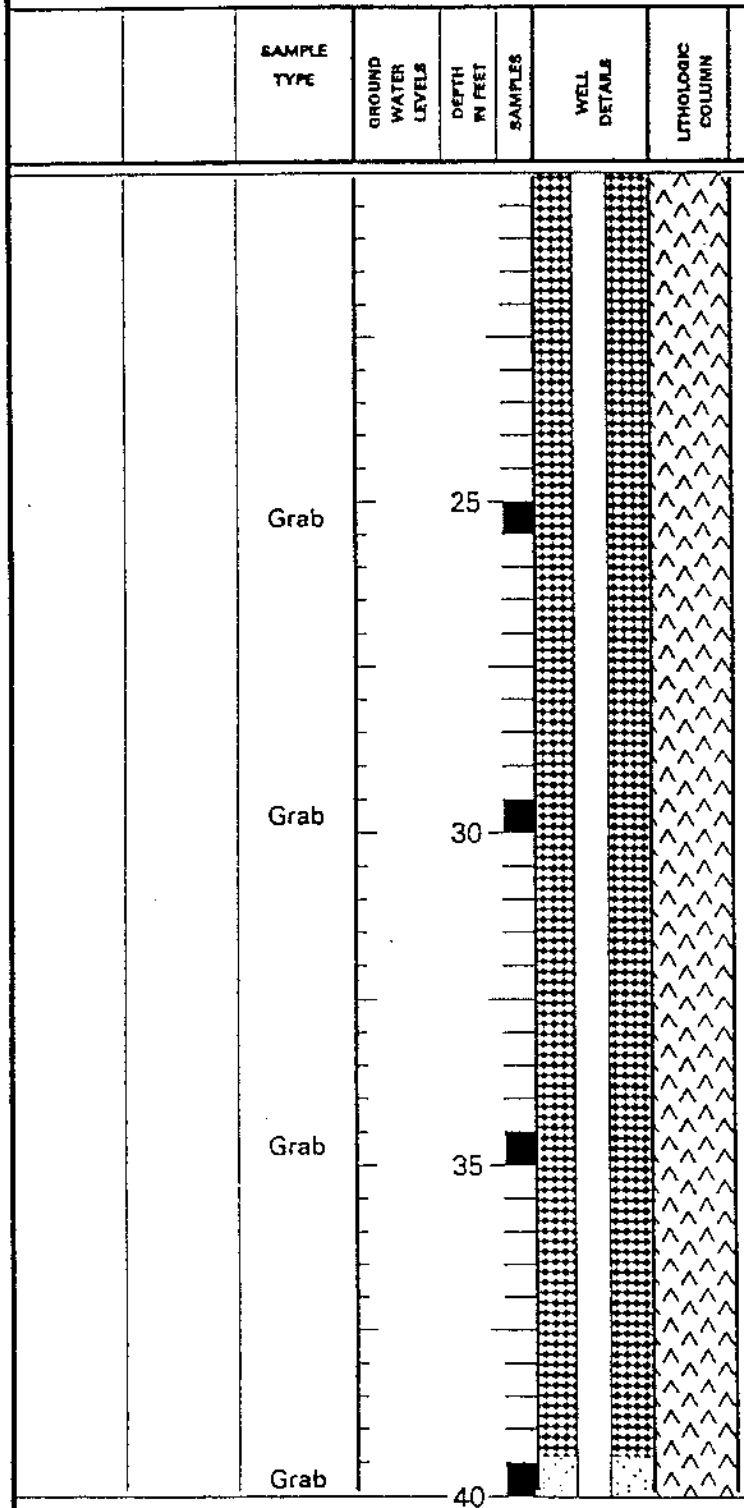
Boring drilled with a tri-cone bit.

EMCON Northwest, Inc.

LOG OF EXPLORATORY BORING

PROJECT NAME **Coffin Butte Landfill**
LOCATION **Coffin Butte, Benton County, Oregon**
DRILLED BY **Staco Well Services**
DRILL METHOD **Air Rotary**
LOGGED BY **Mike Free**

BORING NO. P-14
PAGE 2 OF 4
GROUND ELEV. 279.47'
TOTAL DEPTH 51.80'
DATE COMPLETED 03/28/94



LITHOLOGIC DESCRIPTION

8.0 to 42.0 feet: BASALT, continued.

@ 26.0 feet: cuttings moist.

@ 30.0 feet: cuttings damp.

REMARKS

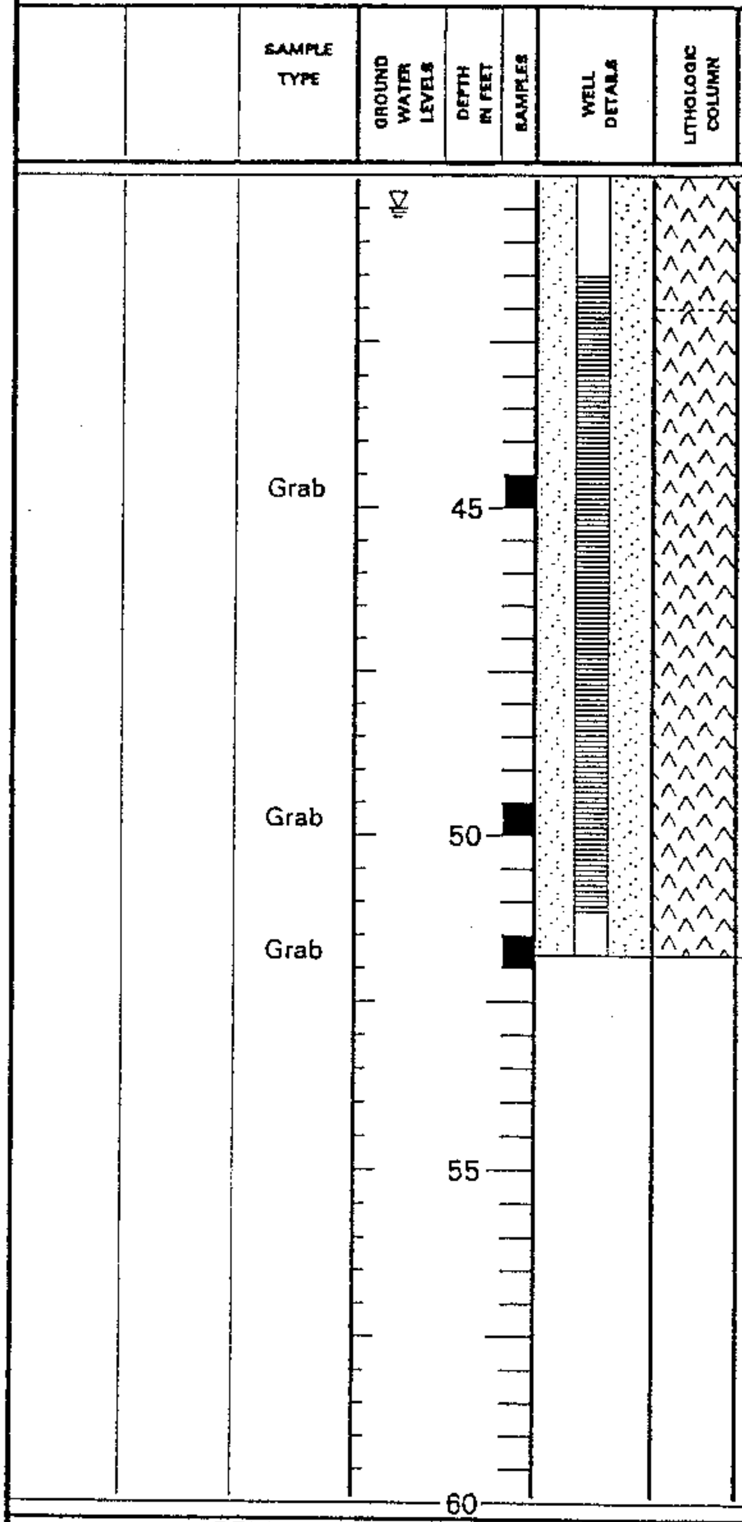
Boring drilled with a tri-cone bit.

EMCON Northwest, Inc.

LOG OF EXPLORATORY BORING

PROJECT NAME **Coffin Butte Landfill**
LOCATION **Coffin Butte, Benton County, Oregon**
DRILLED BY **Staco Well Services**
DRILL METHOD **Air Rotary**
LOGGED BY **Mike Free**

BORING NO. P-14
PAGE 3 OF 4
GROUND ELEV. 279.47'
TOTAL DEPTH 51.80'
DATE COMPLETED 03/28/94



LITHOLOGIC DESCRIPTION

8.0 to 42.0 feet: BASALT, continued.
@ 40.5 feet: cuttings wet.

42.0 to 51.8 feet: BASALT, dark brown (some black), intensely fractured, hard to moderately hard, weakly weathered. (BEDROCK)

@ 51.8 feet: boring making approximately 2 gallons per minute.

Total depth drilled = 51.8 feet.
Total depth sampled = 52.0 feet.

See Page 4 for Well Completion Details.

REMARKS
Boring drilled with a tri-cone bit.

LOG OF EXPLORATORY BORING

PROJECT NAME **Coffin Butte Landfill**
LOCATION **Coffin Butte, Benton County, Oregon**
DRILLED BY **Staco Well Services**
DRILL METHOD **Air Rotary**
LOGGED BY **Mike Free**

BORING NO. P-14
PAGE 4 OF 4
GROUND ELEV. 279.47'
TOTAL DEPTH 51.80'
DATE COMPLETED 03/28/94

		SAMPLE TYPE	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
				65 70 75 80				WELL COMPLETION DETAILS: 0 to 41.5 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC blank riser pipe. 41.5 to 51.2 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC well screen with 0.020-inch machine-cut slots. 51.2 to 51.8 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC end cap. 0 to 1.0 foot: Concrete. 1.0 to 39.4 feet: Medium bentonite chips hydrated with potable water. 39.4 to 51.8 feet: 10 - 20 Colorado Silica Sand. Stainless steel centralizers at 25.0 and 45.0 feet.

REMARKS

Boring drilled with a tri-cone bit.

WELL DETAILS

EMCON ASSOCIATES

PROJECT NUMBER 0139-001.38

PROJECT NAME Coffin Butte Landfill

LOCATION Coffin Butte, Benton County, Oregon

WELL PERMIT NO.

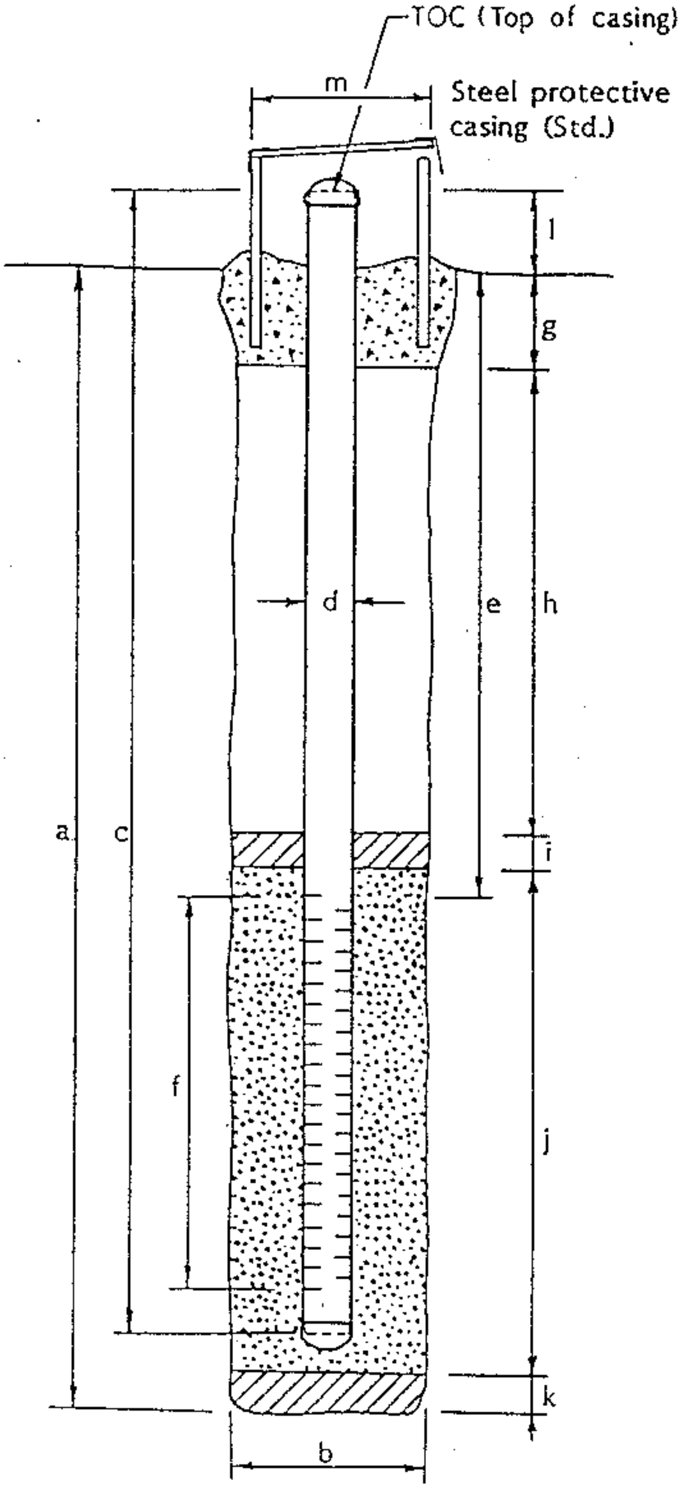
BORING / WELL NO. P-14

TOP OF CASING ELEV. 281.46

GROUND SURFACE ELEV. 279.47

DATUM Mean Sea Level

INSTALLATION DATE 3-28-94



EXPLORATORY BORING

a. Total depth 51.8 ft.

b. Diameter 6 in.

Drilling method Air Rotary

WELL CONSTRUCTION

c. Total casing length 53.8 ft.

Material Schedule 40 PVC

d. Diameter 2 in.

e. Depth to top perforations 41.5 ft.

f. Perforated length 9.7 ft.

Perforated interval from 41.5 to 51.2 ft.

Perforation type Machine-Cut Slots

Perforation size 0.020 Inch

g. Surface seal (0-1.0) 1.0 ft.

Seal material Concrete

h. Backfill NA ft.

Backfill material NA

i. Seal (1.0-39.4) 38.4 ft.

Seal material Bentonite Chips

j. Gravel pack (39.4-51.8) 12.4 ft.

Pack material 10x20 Graded Colorado Silica Sand

k. Bottom seal NA ft.

Seal material NA

l. Casing stickup 1.99 ft.

m. Protective casing diameter 6 in.

Prepared by: M. Free

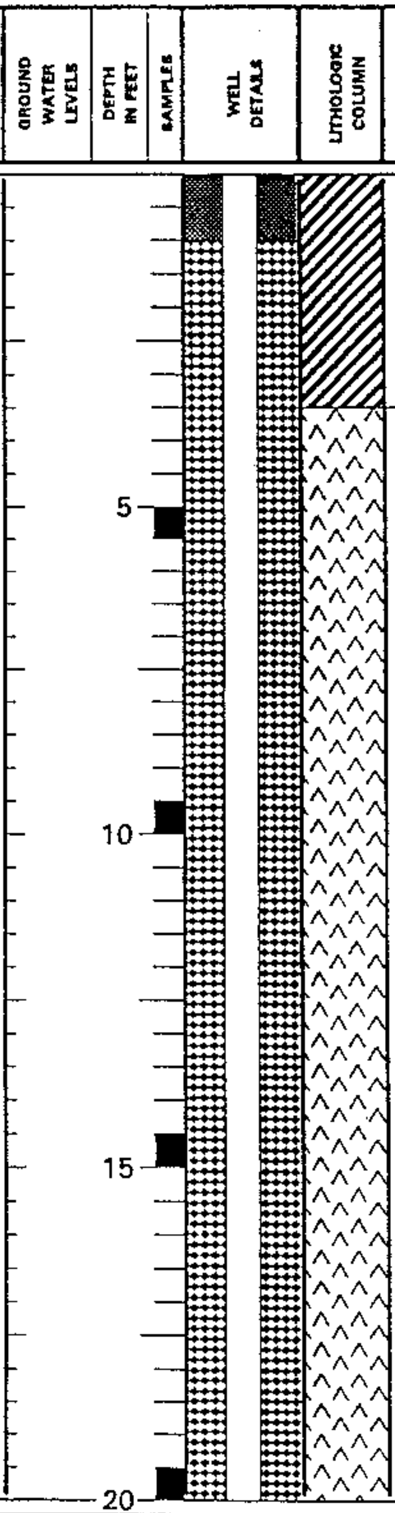
Reviewed by: EJT Date: 4/29/94

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY Staco Well Services
DRILL METHOD Air Rotary
LOGGED BY Mike Free

BORING NO. P-15
PAGE 1 OF 3
GROUND ELEV. 292.55'
TOTAL DEPTH 43.60'
DATE COMPLETED 03/29/94

SAMPLE TYPE	DEPTH IN FEET
Grab	5
Grab	10
Grab	15
Grab	20



LITHOLOGIC DESCRIPTION

0 to 3.5 feet: GRAVELLY SILTY CLAY (CH), very dark brown, 80 percent fines, 20 percent fine to coarse gravel, trace cobbles. (ALLUVIUM)

3.5 to 43.6 feet: BASALT, very dark greenish gray to black, intensely fractured, hard, fresh. (BEDROCK)

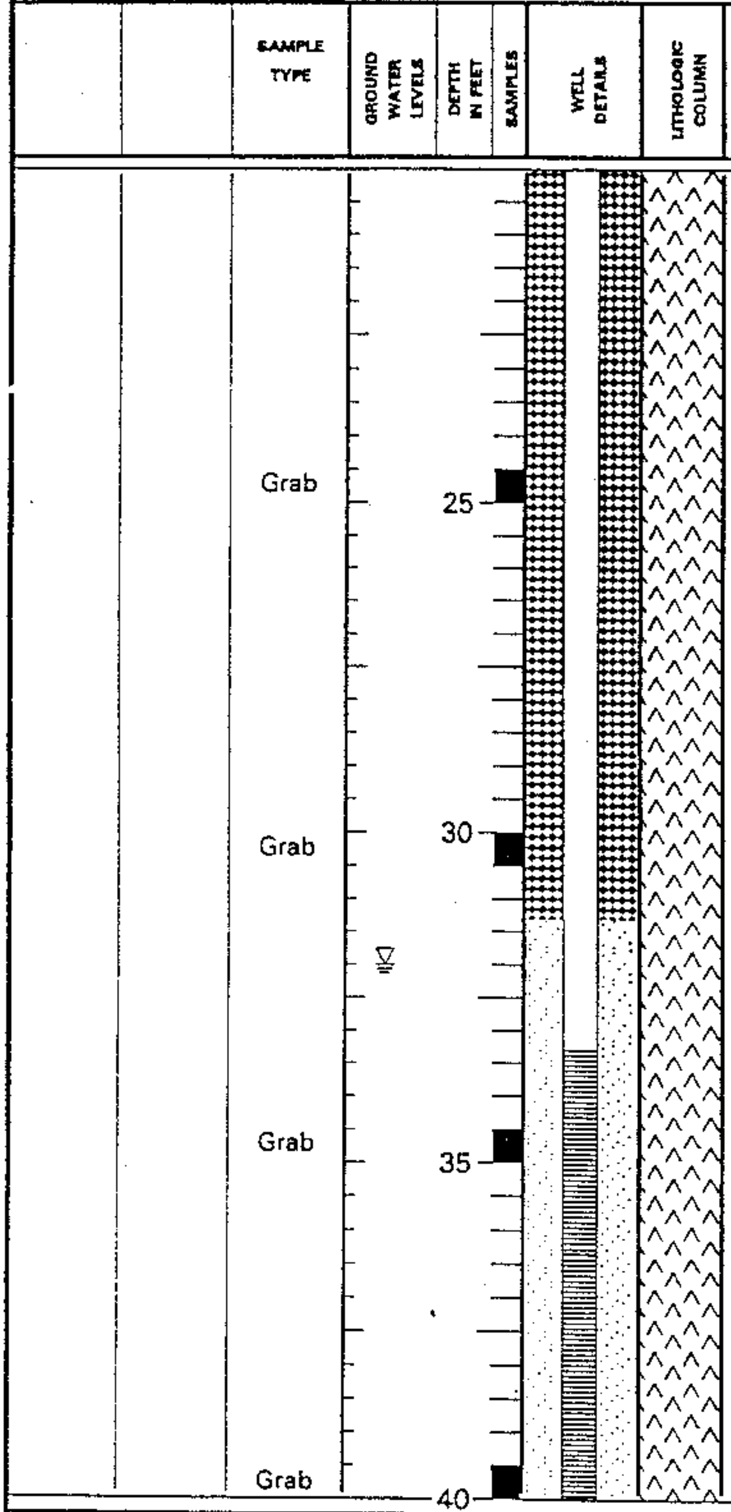
REMARKS

Boring drilled with a down-hole hammer.

EMCON Northwest, Inc.

LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte Landfill**	BORING NO.	P-15
LOCATION	**Coffin Butte, Benton County, Oregon**	PAGE	2 OF 3
DRILLED BY	**Staco Well Services**	GROUND ELEV.	292.55'
DRILL METHOD	**Air Rotary**	TOTAL DEPTH	43.60'
LOGGED BY	**Mike Free**	DATE COMPLETED	03/29/94



LITHOLOGIC DESCRIPTION

3.5 to 43.6 feet: BASALT, continued.

@ 32.0 feet: cuttings wet.

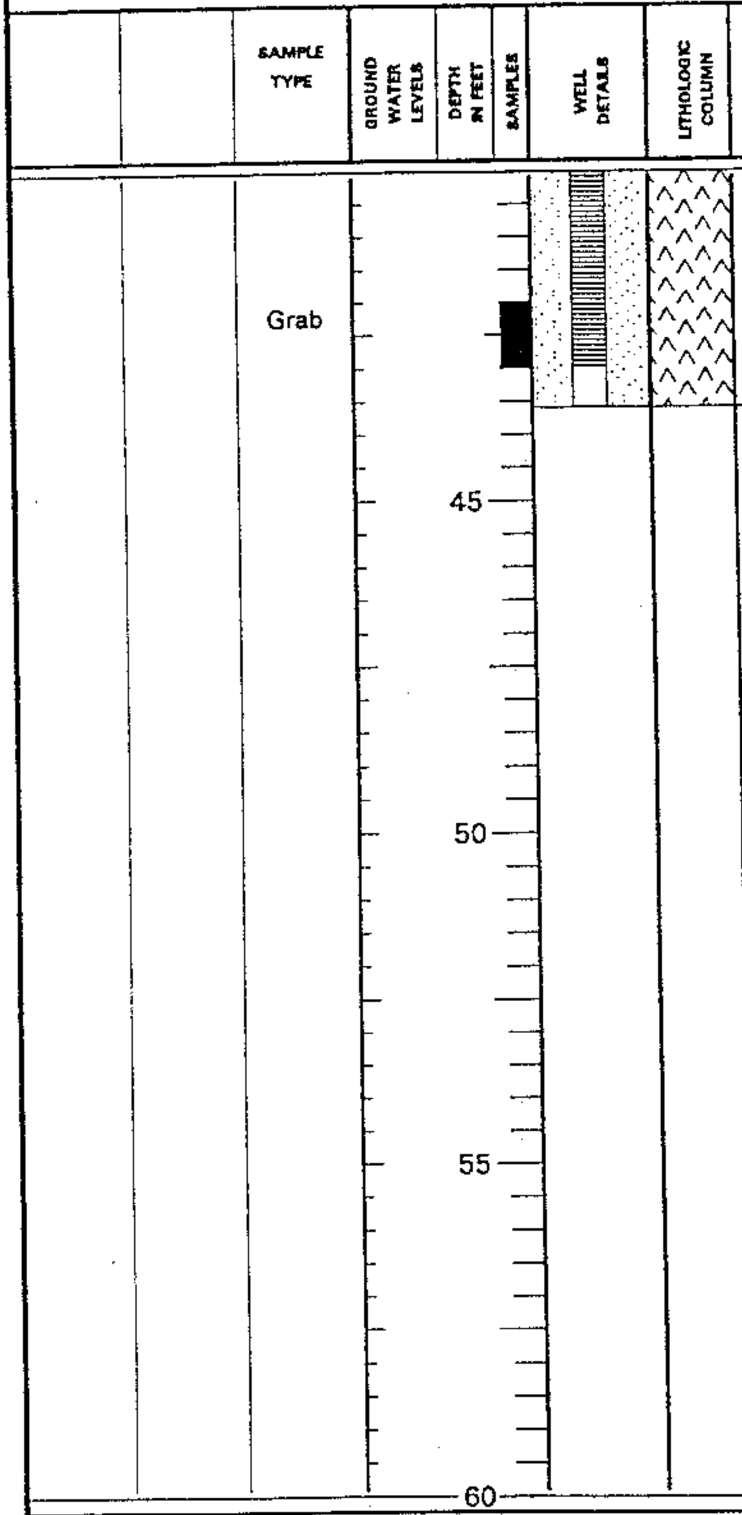
REMARKS

Boring drilled with a down-hole hammer.

LOG OF EXPLORATORY BORING

PROJECT NAME **Coffin Butte Landfill**
LOCATION **Coffin Butte, Benton County, Oregon**
DRILLED BY **Staco Well Services**
DRILL METHOD **Air Rotary**
LOGGED BY **Mike Free**

BORING NO. P-15
PAGE 3 OF 3
GROUND ELEV. 292.55'
TOTAL DEPTH 43.60'
DATE COMPLETED 03/29/94



LITHOLOGIC DESCRIPTION

3.5 to 43.6 feet: BASALT, continued.

Total depth drilled = 43.6 feet.
Total depth sampled = 43.0 feet.

WELL COMPLETION DETAILS:

0 to feet: 33.3 2-inch-diameter, flush-threaded, Schedule 40 PVC blank riser pipe.

33.2 to 43.0 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC well screen with 0.020-inch machine-cut slots.

43.0 to 43.6 feet: 2-inch-diameter, flush-threaded, Schedule 40 PVC end cap.

0 to 1.0 foot: Concrete.

1.0 to 31.3 feet: Medium bentonite chips hydrated with potable water.

31.3 to 43.6 feet: 10 - 20 Colorado Silica Sand.

Stainless steel centralizers at 37.5 and 17.5 feet.

REMARKS

Boring drilled with a down-hole hammer.

WELL DETAILS

EMCON ASSOCIATES

PROJECT NUMBER 0139-001.38

PROJECT NAME Coffin Butte Landfill

LOCATION Coffin Butte, Benton County, Oregon

WELL PERMIT NO.

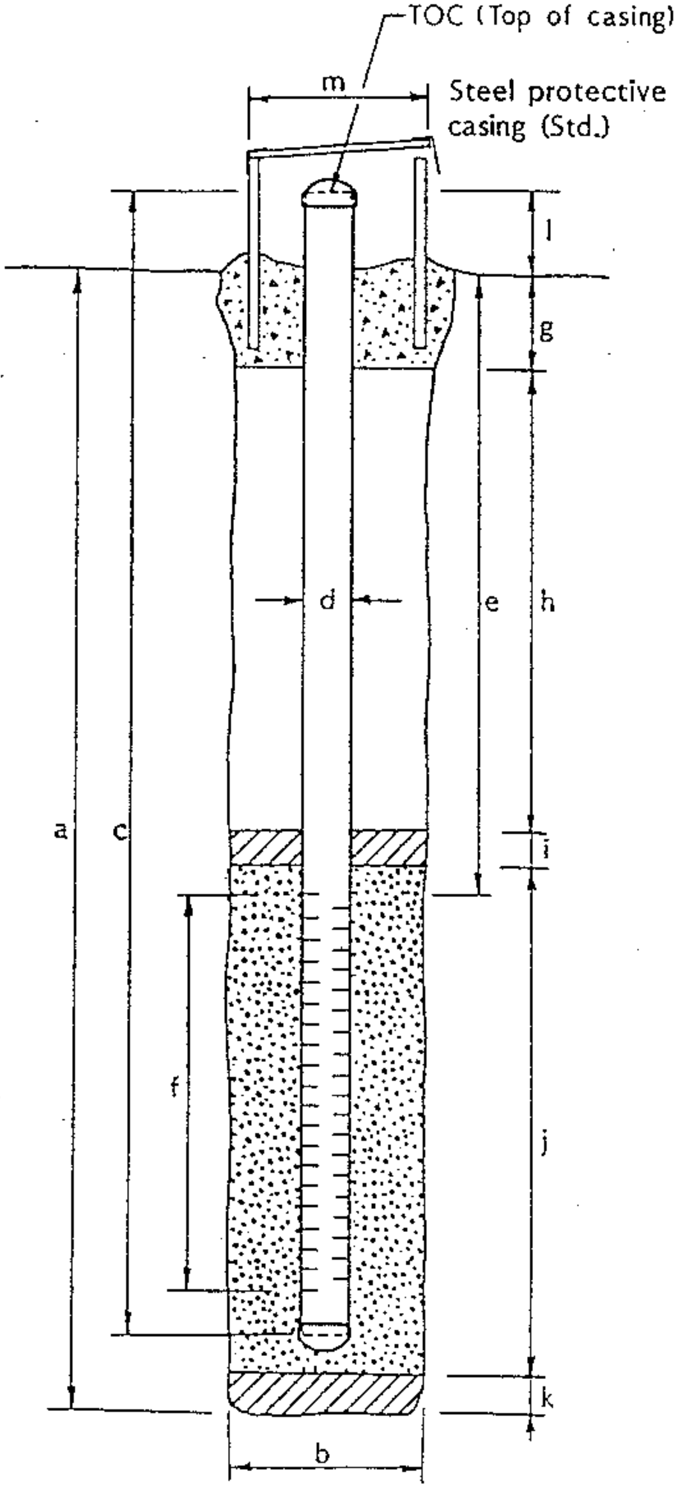
BORING / WELL NO. P-15

TOP OF CASING ELEV. 294.53

GROUND SURFACE ELEV. 292.55

DATUM Mean Sea Level

INSTALLATION DATE 3-29-94



EXPLORATORY BORING

a. Total depth 43.6 ft.

b. Diameter 6 in.

Drilling method Air Rotary

WELL CONSTRUCTION

c. Total casing length 45.6 ft.

Material Schedule 40 PVC

d. Diameter 2 in.

e. Depth to top perforations 33.3 ft.

f. Perforated length 9.7 ft.

Perforated interval from 33.3 to 43.0 ft.

Perforation type Machine-Cut Slots

Perforation size 0.020

g. Surface seal (0-1.0) 1.0 ft.

Seal material Concrete

h. Backfill NA ft.

Backfill material NA

i. Seal (1.0-31.3) 30.3 ft.

Seal material Bentonite Chips

j. Gravel pack (31.3-43.6) 12.3 ft.

Pack material 10x20 Graded Colorado Silica Sand

k. Bottom seal NA ft.

Seal material NA

l. Casing stickup 1.98 ft.

m. Protective casing diameter 6 in.

Prepared by: M. Free

Reviewed by: EH Date: 4/29/94

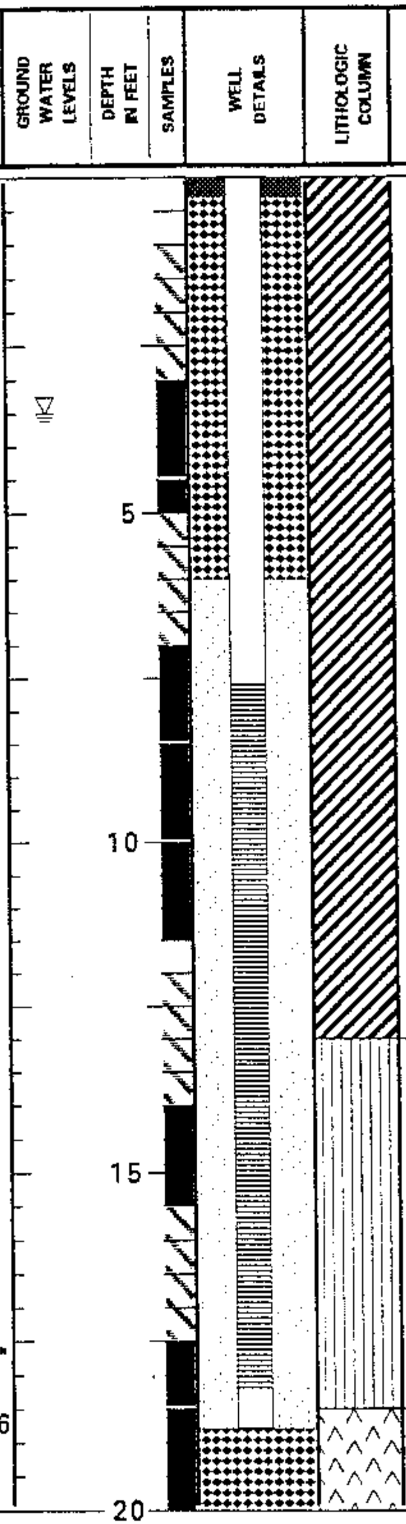
Form F-11 Rev. 12/90

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte
LOCATION Coffin Butte, Benton County, Oregon
DRILLED BY Geo-Tech Explorations, Inc.
DRILL METHOD Hollow Stem Auger
LOGGED BY Mike Free

BORING NO. P-16
PAGE 1 OF 2
GROUND ELEV. 239.48'
TOTAL DEPTH 22.50'
DATE COMPLETED 04/18/94

SAMPLE NUMBER SAMPLE TYPE	RECOVERY PERCENT	BLOW COUNTS (IN COMP)
P-16- 1'-3' Shelby Tube		175 psi
SS	67	3-5-6 (11)
SS		3/6" (3/6")
P-16- 5'-7' Shelby Tube		225 psi
SS	56	2-4-7 (11)
SS	83	3-4-5 (9)
SS	100	2-3-5 (8)
P-16- 12'-14' Shelby Tube		350 psi
SS	100	3-6-7 (13)
P-16- 15.5' 17.5 Shelby Tube		500 psi
SS	0	6-13/12" (19)
SS	94	15-20-26 (46)



LITHOLOGIC DESCRIPTION

0 to 13.0 feet: SILTY CLAY (CH), dark brown, high plasticity fines, trace fine to medium sand, trace fine gravel, soft to firm, moist, trace fine roots to 8.0 feet. (ALLUVIUM)

@ 4.5 feet: black.
@ 5.0 feet: light brown.

13.0 to 18.5 feet: SANDY CLAYEY SILT (ML), dark grayish green, 75 percent medium plasticity fines, 25 percent fine to coarse sand (sand grains friable) iron oxide stained zones, stiff, moist. (ALLUVIUM)

18.5 to 22.5 feet: BASALT, orangy, brown, intensely fractured, mostly friable; some low hardness, deeply weathered. (BEDROCK)

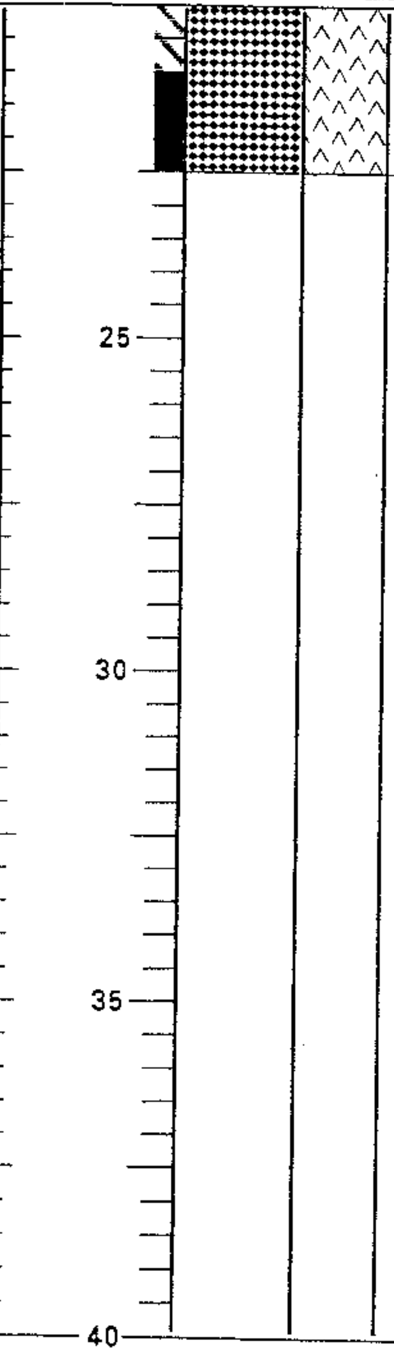
REMARKS

EMCON

LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte**	BORING NO.	**P-16**
LOCATION	**Coffin Butte, Benton County, Oregon**	PAGE	**2 OF 2**
DRILLED BY	**Geo-Tech Explorations, Inc.**	GROUND ELEV.	**239.48'**
DRILL METHOD	**Hollow Stem Auger**	TOTAL DEPTH	**22.50'**
LOGGED BY	**Mike Free**	DATE COMPLETED	**04/18/94**

SAMPLE NUMBER SAMPLE TYPE	RECOVERY PERCENT	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
P-16- 20'-21' Shelby Tube SS	72	1200 psi refusal 19-23-24 (47)						



Total depth drilled = 22.5 feet.
Total depth sampled = 22.5 feet.

WELL COMPLETION DETAILS:

0 to 7.6 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC blank riser pipe.

7.6 to 18.2 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC well screen with 0.020-inch machine-cut slots.

18.2 to 18.8 feet: 2-inch-diameter, flush-threaded, schedule 40 PVC end cap.

0 to 3.0 feet: Concrete.

3.0 to 6.0 feet: Bentonite chips hydrated with potable water.

6.0 to 18.8 feet: 10 - 20 Colorado Silica Sand.

18.8 to 22.5 feet: Bentonite chips hydrated with groundwater.

REMARKS

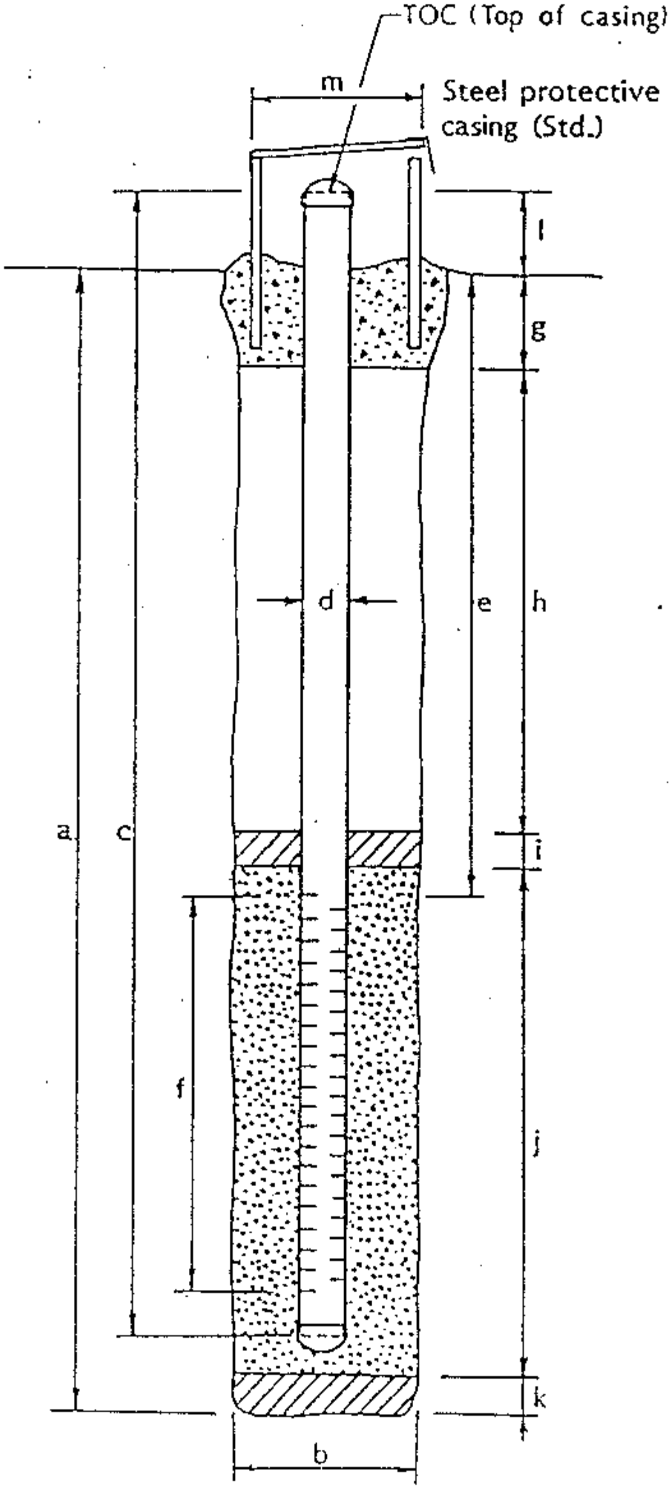
EMCON

WELL DETAILS

EMCON
ASSOCIATES

PROJECT NUMBER 0139-001.47
PROJECT NAME Coffin Butte Landfill
LOCATION Coffin Butte, Benton County, Oregon
WELL PERMIT NO.

BORING / WELL NO. P-16
TOP OF CASING ELEV. 240.88
GROUND SURFACE ELEV. 239.48
DATUM Mean Sea Level
INSTALLATION DATE 4-18-94



EXPLORATORY BORING

a. Total depth 22.5 ft.
b. Diameter 10 in.
Drilling method Hollow Stem Auger

WELL CONSTRUCTION

c. Total casing length 20.3 ft.
Material Schedule 40 PVC
d. Diameter 2 in.
e. Depth to top perforations 8.6 ft.
f. Perforated length 9.6 ft.
Perforated interval from 8.6 to 18.2 ft.
Perforation type Machine-Cut Slots
Perforation size 0.010 Inch
g. Surface seal (0-3.0) 3.0 ft.
Seal material Concrete
h. Backfill NA ft.
Backfill material NA
i. Seal (3.0-6.0) 3.0 ft.
Seal material Bentonite Chips
j. Gravel pack (6.0-18.8) 12.8 ft.
Pack material 20x40 Graded Colorado Silica Sand
k. Bottom seal (18.8-22.5) 3.7 ft.
Seal material Bentonite Chips
l. Casing stickup ft.
m. Protective casing diameter 6 in.

Prepared by: M. Free

Reviewed by: EJS
Date: 4/28/94

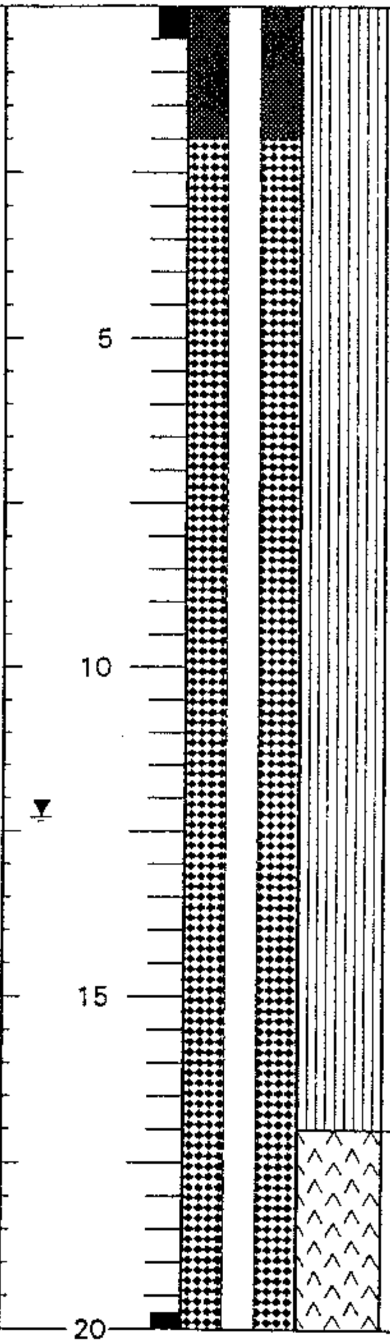
Form F-11 Rev. 12/90

LOG OF EXPLORATORY BORING

PROJECT NAME Piezometer P-17 Installation
LOCATION Coffin Butte Landfill
DRILLED BY Staco Well Services, Inc.
DRILL METHOD Air with downhole hammer
LOGGED BY Anna Coates

BORING NO. P-17
PAGE 1 OF 3
GROUND ELEV. ~ 371
TOTAL DEPTH 47.60'
DATE COMPLETED 04/24/97

SAMPLE METHOD	SAMPLE NUMBER	LITHOLOGIC DESCRIPTION
Grab	1	**0 to 17.0 feet: CLAYEY SILT WITH SAND AND GRAVEL (ML)**, reddish brown (5YR 4/3), 50 percent fines, medium plasticity, 30 percent fine to coarse subangular sand, 20 percent fine to coarse subangular gravel, trace organics, moist. (FILL AND SURFICIAL DEPOSIT)
		@ 15.0 to 17.0 feet: dark gray (5YR 4/1).
		17.0 to 47.6 feet: BASALT, gray, moderately fractured, hard, fresh. (BEDROCK)
Grab	2	



REMARKS

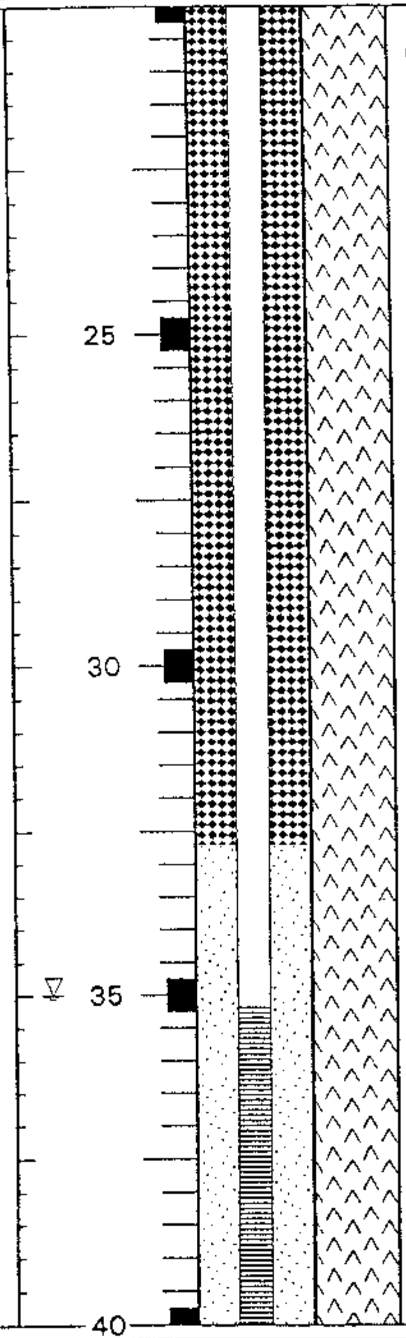
A 6-inch casing was installed to 19 feet below ground surface (bgs). Boring was drilled "open hole" below 19 feet bgs with a 6-inch-diameter down hole hammer. Cuttings were collected every 5 feet for lithologic description. See well detail for well installation information.

EMCON

LOG OF EXPLORATORY BORING

PROJECT NAME Piezometer P-17 Installation
LOCATION Coffin Butte Landfill
DRILLED BY Staco Well Services, Inc.
DRILL METHOD Air with downhole hammer
LOGGED BY Anna Coates

BORING NO. P-17
PAGE 2 OF 3
GROUND ELEV. ~ 371
TOTAL DEPTH 47.60'
DATE COMPLETED 04/24/9



SAMPLE METHOD	SAMPLE NUMBER	GROUND WATER LEVELS	DEPTH IN FEET	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
Grab	2						**17.0 to 47.6 feet:** BASALT, continued. @ 20.0 feet: intensely fractured.
Grab	3		25				@ 25.0 feet: moderately fractured.
Grab	4		30				
Grab	5	∇	35				@ 35.0 feet: intensely fractured; first encountered groundwater, 2 gpm.
Grab	6		40				

REMARKS

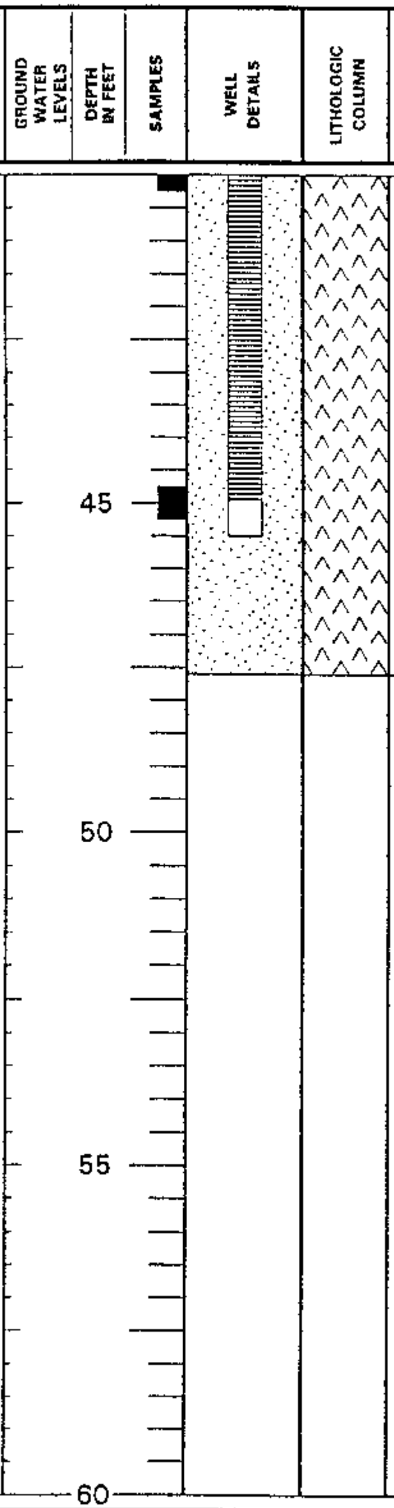
A 6-inch casing was installed to 19 feet below ground surface (bgs). Boring was drilled "open hole" below 19 feet bgs with a 6-inch-diameter down hole hammer. Cuttings were collected every 5 feet for lithologic description. See well detail for well installation information.

EMCON

LOG OF EXPLORATORY BORING

PROJECT NAME Piezometer P-17 Installation
LOCATION Coffin Butte Landfill
DRILLED BY Staco Well Services, Inc.
DRILL METHOD Air with downhole hammer
LOGGED BY Anna Coates

BORING NO. P-17
PAGE 3 OF 3
GROUND ELEV. ~371
TOTAL DEPTH 47.60'
DATE COMPLETED 04/24/97



SAMPLE METHOD	SAMPLE NUMBER	LITHOLOGIC DESCRIPTION
Grab	6	17.0 to 47.6 feet: BASALT, continued.
Grab	7	@ 45.0 feet: 3 gpm.
		Total depth drilled = 47.6 feet. Total depth sampled = 45.2 feet.

REMARKS

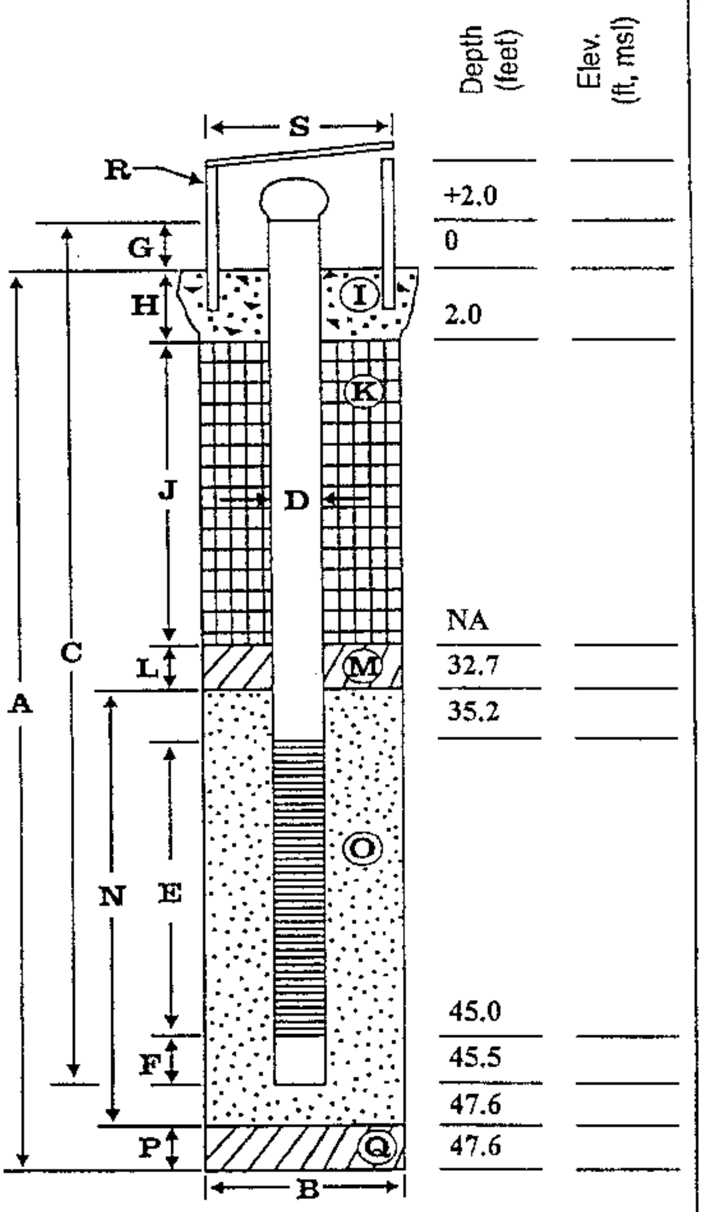
A 6-inch casing was installed to 19 feet below ground surface (bgs). Boring was drilled "open hole" below 19 feet bgs with a 6-inch-diameter down hole hammer. Cuttings were collected every 5 feet for lithologic description. See well detail for well installation information.

EMCON

WELL DETAILS

Project Number: 40139-001.064
Client Name: Valley Landfills, Inc.
Project Name: Piezometer Installation
Location: Coffin Butte Landfill
Driller: Staco Well Services, Inc.

Boring/Well No.: P-17
Top of Casing Elev.: Approx. 373
Ground Surface Elev.: Approx. 371
Installation Date: 4/24/97
Permit/Start Card No.: 95663



EXPLORATORY BORING

A. Total depth: 47.6 ft.
B. Diameter 6 in.
Drilling method: Air/hammer

WELL CONSTRUCTION

C. Well casing length: 47.5 ft.
Well casing material: Flush-threaded Schedule 40 PVC
D. Well casing diameter: 2 in.
E. Well screen length: 9.8 ft.
Well screen type: Machine-cut slots
Well screen slot size: 0.020 in.
F. Well sump/end cap length: 0.5 ft.
G. Well casing height (stickup): 2.0 ft.
H. Surface seal thickness: 2.0 ft.
I. Surface seal material: Concrete
J. Annular seal thickness: 30.7 ft.
K. Annular seal material: Bentonite
L. Filter pack seal thickness: NA ft.
M. Filter pack seal material: NA
N. Sand pack thickness: 14.9 ft.
O. Sand pack material: 10-20 Colorado silica sand
P. Bottom material thickness: NA ft.
Q. Bottom material: NA
R. Protective casing material: Steel
Well centralizer depths: NA ft.
S. Protective casing diameter: 6 in.

NOTES:

Installed by: Anna Coates

Reviewed by: Mike Free

Date: 5/21/97

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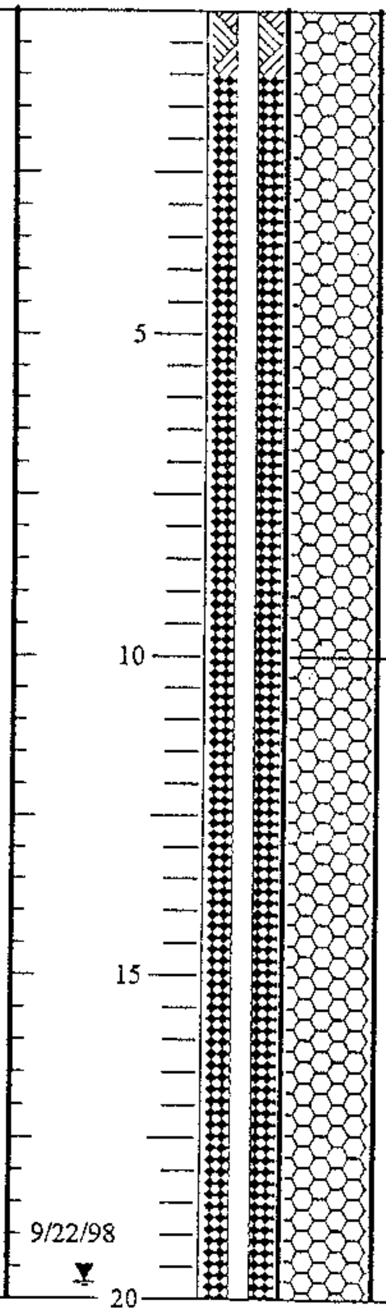
LOG OF EXPLORATORY BORING

PROJECT NAME	Coffin Butte/Valley Landfill	PAGE	1 OF 4
LOCATION	Benton County, Oregon	BORING NO.	P-18
DRILLED BY	GeoTech Explorations, Inc.	TOTAL DEPTH	74.5'
DRILL METHOD	Air Rotary	DATE COMPLETED	9/22/98
LOGGED BY	John Renda		

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER 6 INCHES	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION



0.0 to 10.0 feet: WEATHERED BASALT (SC) AND SILTY CLAY (CL); yellowish-red (5 YR, 4/6); 70% weathered basalt, 30% silty clay; basalt is deeply weathered and easily broken up by hand with minerals altered to silt and clay; silty clay is of medium to high plasticity fines. (BASALT WEATHERED TO SOIL)

@ 8.0 feet: moist.

10.0 to 74.5 feet: BASALT; variable altered from fresh to weakly weathered; 70% basalt, 30% silty clay. (WEATHERED BASALT)

REMARKS

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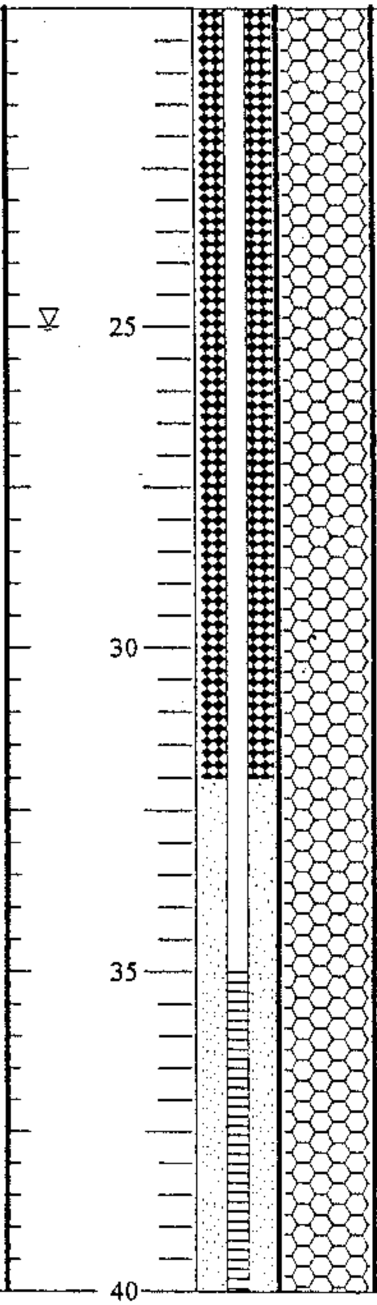
LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte/Valley Landfill**		
LOCATION	**Benton County, Oregon**	PAGE	**2 OF 4**
DRILLED BY	**GeoTech Explorations, Inc.**	BORING NO.	**P-18**
DRILL METHOD	**Air Rotary**	TOTAL DEPTH	**74.5'**
LOGGED BY	**John Renda**	DATE COMPLETED	**9/22/98**

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER 6 INCHES	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
								@ 23.0 to 40.0 feet: fractured; dark gray (N, 4/); hard; blue-green mineral (soft, oxidizes to black) noted along fractures. @ 25.0 feet: wet; water bearing fracture.

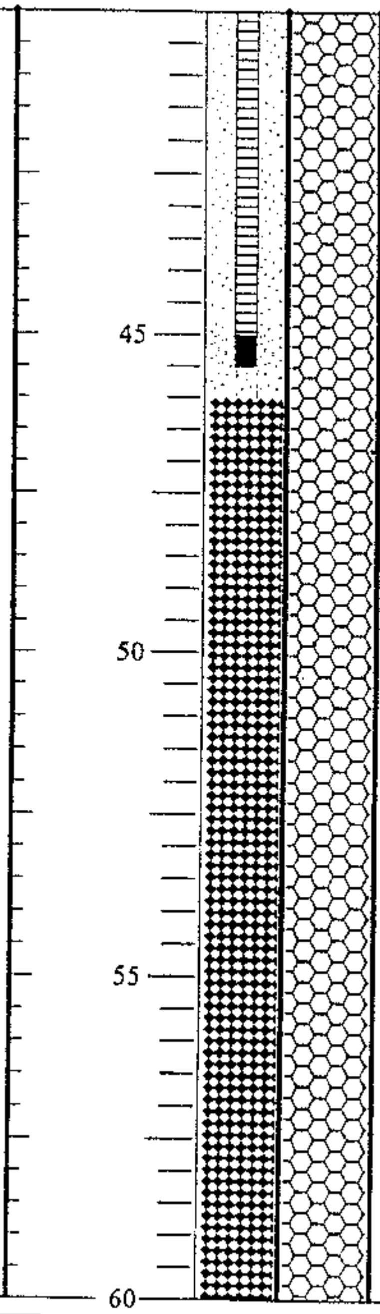
REMARKS

EMCON®

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte/Valley Landfill
LOCATION Benton County, Oregon
DRILLED BY GeoTech Explorations, Inc.
DRILL METHOD Air Rotary
LOGGED BY John Renda

PAGE **3 OF 4**
BORING NO. **P-18**
TOTAL DEPTH **74.5'**
DATE COMPLETED **9/22/98**



SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER 6 INCHES	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
								@ 40.0 to 50.0 feet: chloritic alteration; blue to greenish gray (5G, 5/2); soft, easily scratched with fingernail; oxidizes to black. @ 50.0 to 74.5 feet: fractured; dark gray (N, 4/); weakly weathered; hard; trace pyrite, calcite, quartz; blue to green mineralization noted along basalt fractures.

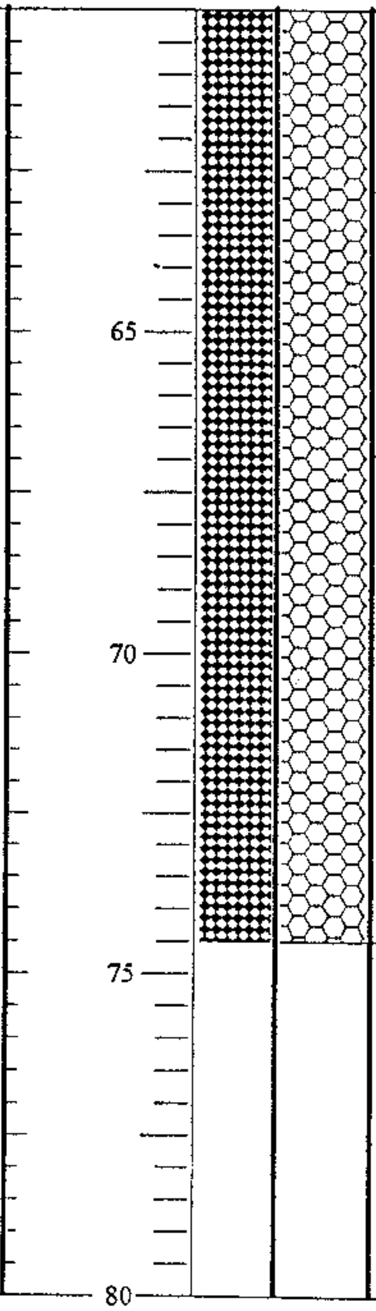
REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte/Valley Landfill
LOCATION Benton County, Oregon
DRILLED BY GeoTech Explorations, Inc.
DRILL METHOD Air Rotary
LOGGED BY John Renda

PAGE 4 OF 4
BORING NO. P-18
TOTAL DEPTH 74.5'
DATE COMPLETED 9/22/98

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER 6 INCHES	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
								Boring terminated at 74.5 feet. Boring backfilled with bentonite chips to 46 feet. Well set at 45 feet.



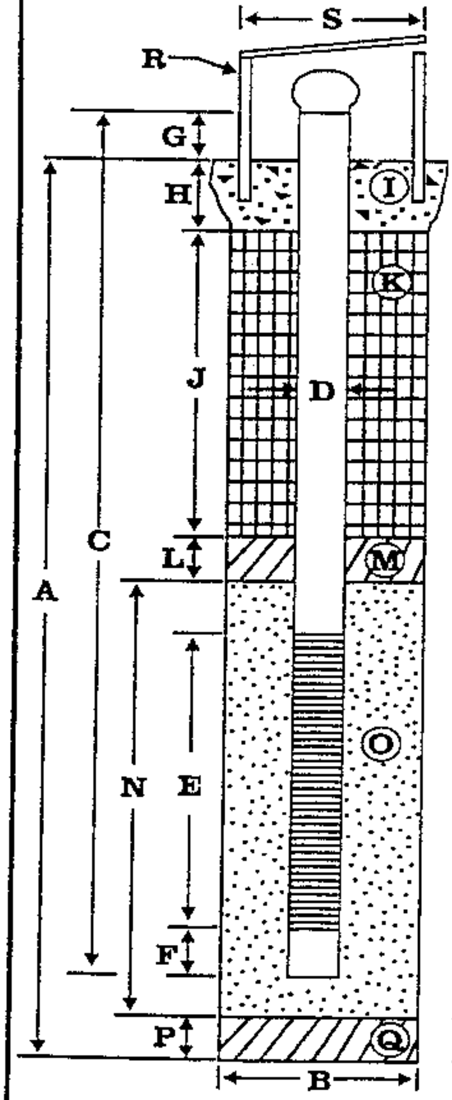
REMARKS

40139-001.065\p-p18jr.gpj...

WELL DETAILS

Project Number: 40139-001.065
Client Name: Valley Landfills, Inc
Project Name: Coffin Butte Landfill
Location: Benton County, Oregon
Driller: Geo-Tech Explorations, Inc.

Boring/Well No.: P-18
Top of Casing Elev.: 380.87
Ground Surface Elev.: 378.21
Installation Date: 9/22/98
Permit/Start Card No.: 112474



Depth (feet)	Elev. (ft, msl)
3.0	381.21
2.66	380.87
0.0	378.21
1.0	377.21
1.0	377.21
32.0	346.21
35.0	343.21
45.0	333.21
45.5	332.71
46.0	332.21
74.5	303.71

EXPLORATORY BORING

A. Total depth: 74.5 ft.
B. Diameter 6 in.
Drilling method: Air Rotary

WELL CONSTRUCTION

C. Well casing length: 47.7 ft.
Well casing material: Sched 40 PVC
D. Well casing diameter: 2.0 in.
E. Well screen length: 10.0 ft.
Well screen type: Machine Slotted
Well screen slot size: 0.020 in.
F. Well sump/end cap length: 0.5 ft.
G. Well casing height (stickup): 2.7 ft.
H. Surface seal thickness: 1.0 ft.
I. Surface seal material: Concrete
J. Annular seal thickness: NA ft.
K. Annular seal material: NA
L. Filter pack seal thickness: 31.0 ft.
M. Filter pack seal material: Bentonite Chips
N. Sand pack thickness: 14.0 ft.
O. Sand pack material: 8X12 Silica Sand
P. Bottom material thickness: 29.0 ft.
Q. Bottom material: Bentonite Chips
R. Protective casing material: Steel
Well centralizer depths: 5.0, 34, and 44 ft.
S. Protective casing diameter: 6.5 in.

NOTES:

Installed by: John J. Renda
Reviewed by:
Date: 2/8/99

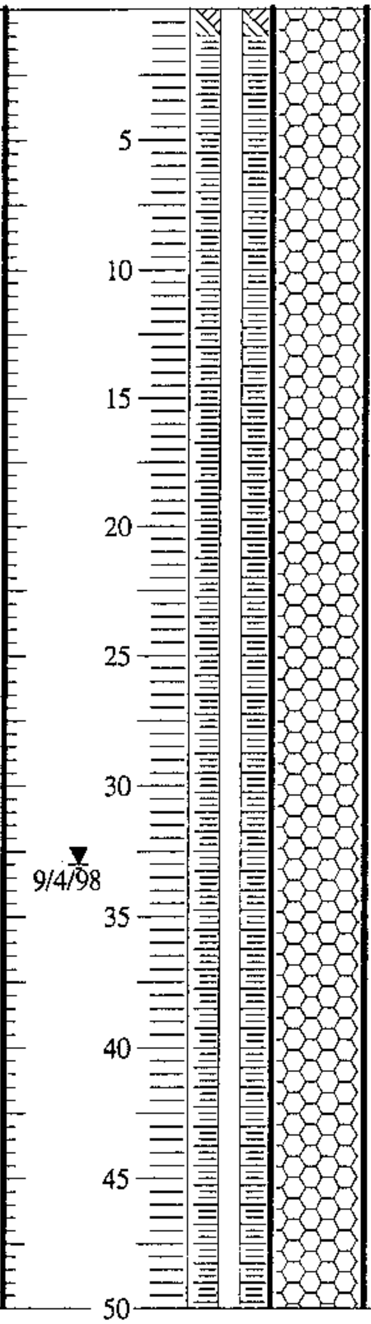
PJ:\GEOLOGY\COFFIN-B\MW24-P18\P-18DET.DOC-98\jrenda:1

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte/Valley Landfill
LOCATION Benton County, Oregon
DRILLED BY GeoTech Explorations, Inc.
DRILL METHOD Air Rotary
LOGGED BY John Renda

PAGE 1 OF 5
BORING NO. QP-1S
TOTAL DEPTH 224.1'
DATE COMPLETED 9/3/98

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
								0.0 to 224.1 feet: BASALT; dark gray (N,4/); up to 30% blue-green crystals; trace quartz, pyrite, and calcite; hard; fresh to weakly weathered.

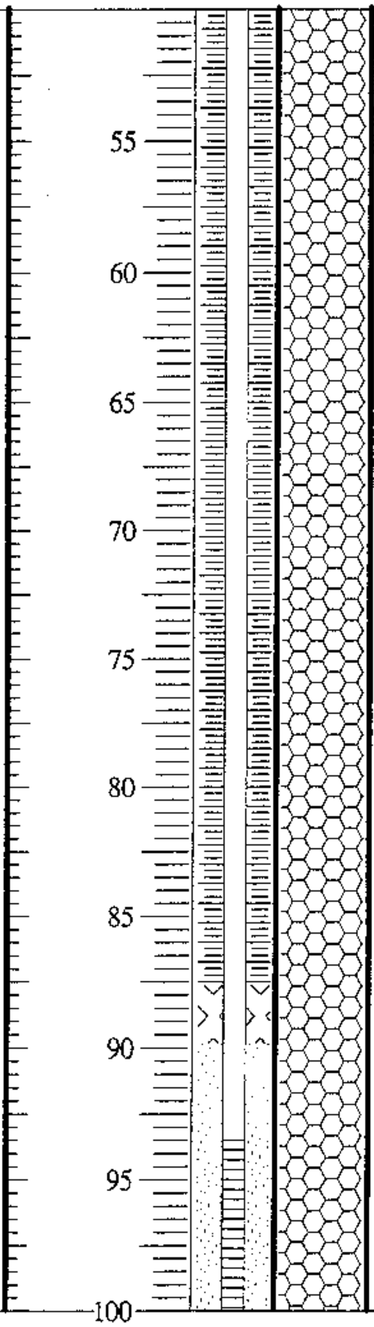


REMARKS

EMCON®

LOG OF EXPLORATORY BORING

PROJECT NAME	Coffin Butte/Valley Landfill
LOCATION	Benton County, Oregon
DRILLED BY	GeoTech Explorations, Inc.
DRILL METHOD	Air Rotary
LOGGED BY	John Renda
PAGE	2 OF 5
BORING NO.	QP-1S
TOTAL DEPTH	224.1'
DATE COMPLETED	9/3/98



SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	LITHOLOGIC DESCRIPTION
			0.0 to 224.1 feet: BASALT; continued.
			@ 70.0 feet: iron oxide staining along fractures.

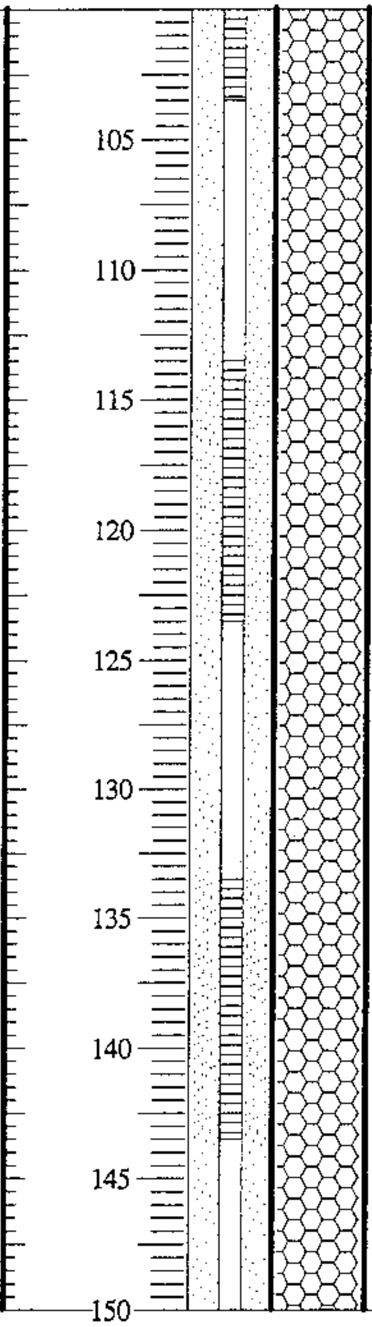
REMARKS

EMCON®

LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte/Valley Landfill**		
LOCATION	**Benton County, Oregon**	PAGE	**3 OF 5**
DRILLED BY	**GeoTech Explorations, Inc.**	BORING NO.	**QP-1S**
DRILL METHOD	**Air Rotary**	TOTAL DEPTH	**224.1'**
LOGGED BY	**John Renda**	DATE COMPLETED	**9/3/98**

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
								0.0 to 224.1 feet: BASALT; continued. @ 110.0 to 120.0 feet: reduction in blue-green minerals. @ 120.0 to 125.0 feet: increase in blue-green crystals (50 to 60%).



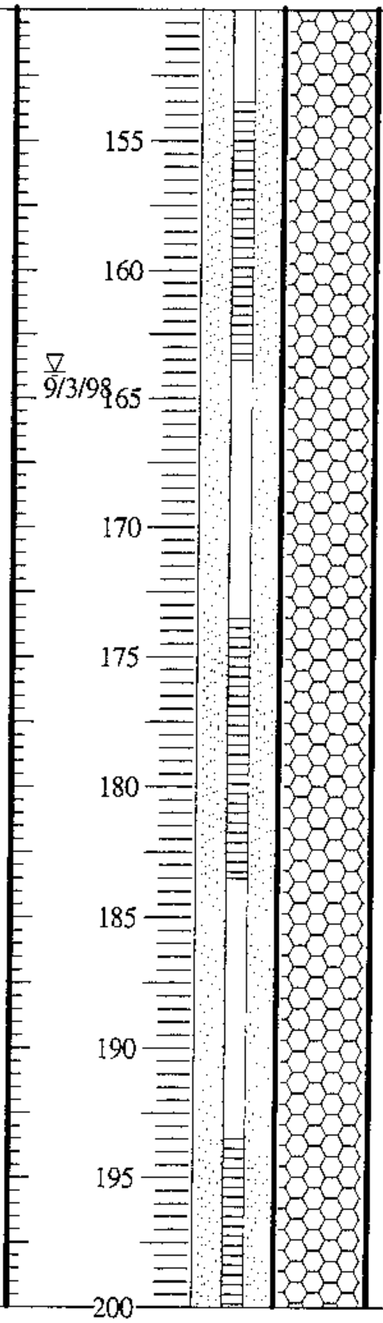
REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte/Valley Landfill
LOCATION Benton County, Oregon
DRILLED BY GeoTech Explorations, Inc.
DRILL METHOD Air Rotary
LOGGED BY John Renda

PAGE 4 OF 5
BORING NO. QP-1S
TOTAL DEPTH 224.1'
DATE COMPLETED 9/3/98

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION



0.0 to 224.1 feet: BASALT; continued.

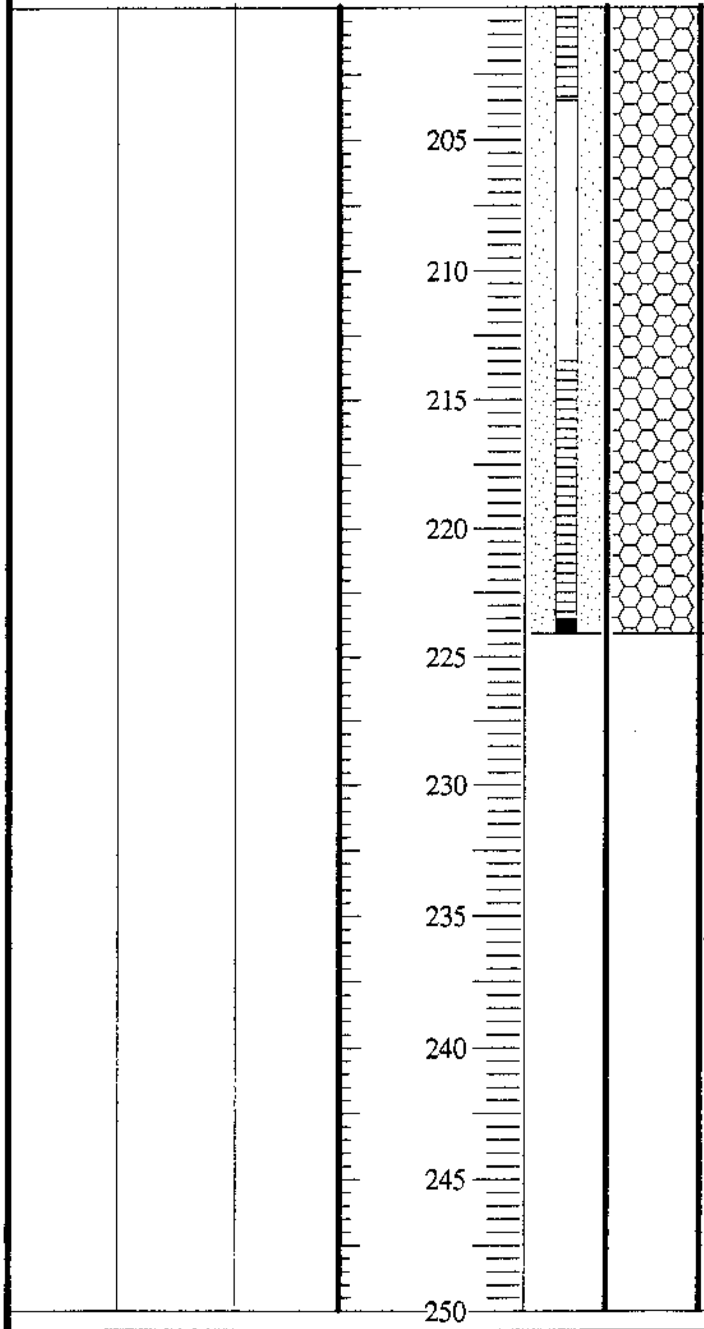
REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME **Coffin Butte/Valley Landfill**
LOCATION **Benton County, Oregon**
DRILLED BY **GeoTech Explorations, Inc.**
DRILL METHOD **Air Rotary**
LOGGED BY **John Renda**

PAGE **5 OF 5**
BORING NO. **QP-1S**
TOTAL DEPTH **224.1'**
DATE COMPLETED **9/3/98**

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION



0.0 to 224.1 feet: BASALT; continued.

@ 224.1 feet: boring terminated.

WELL CONSTRUCTION DETALS:

0.3 to 93.5 feet: 2-inch-diameter schedule 80 PVC blank riser pipe.

93.5 to 223.5 feet: well screen (2-inch-diameter screen with 0.020-inch machine-cut slots) constructed of seven 10-foot screen sections alternating with 10-foot riser pipe.

223.5 to 224.1 feet: schedule 80 PVC end cap.

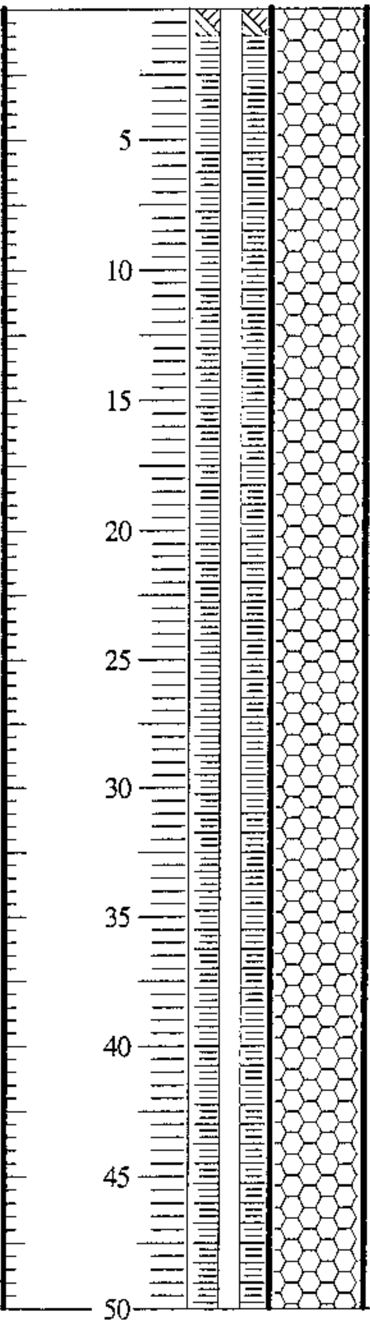
0.0 to 1.0 feet: Concrete.
1.0 to 87.6 feet: Bentonite grout.
87.6 to 89.8 feet: Bentonite chips.
89.8 to 93.5 feet: 20-40 Colorado silica sand.
93.5 to 224.1 feet: 8-12 Colorado silica sand.

REMARKS

EMCON®

LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte/Valley Landfills**
LOCATION	**Benton County, Oregon**
DRILLED BY	**GeoTech Explorations, Inc.**
DRILL METHOD	**Air Rotary**
LOGGED BY	**John Renda**
PAGE	**1 OF 3**
BORING NO.	**QP-2S**
TOTAL DEPTH	**100.1'**
DATE COMPLETED	**9/2/98**

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
								**0.0 to 100.1 feet: BASALT;** very dark gray (N, 3/); hard; fresh to weakly weathered; intermittent zones of low to moderate hardness.

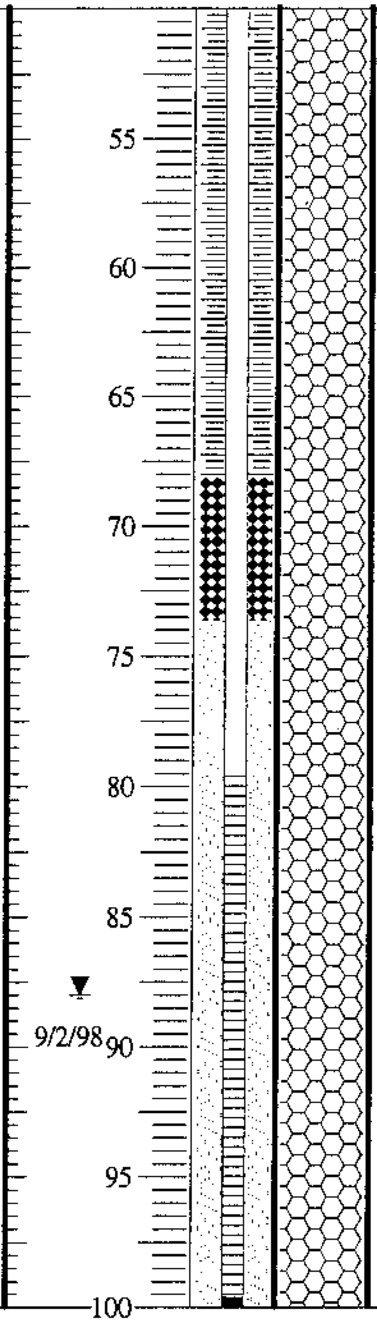
REMARKS

EMCON®

LOG OF EXPLORATORY BORING

PROJECT NAME	Coffin Butte/Valley Landfills	PAGE	2 OF 3
LOCATION	Benton County, Oregon	BORING NO.	QP-2S
DRILLED BY	GeoTech Explorations, Inc.	TOTAL DEPTH	100.1'
DRILL METHOD	Air Rotary	DATE COMPLETED	9/2/98
LOGGED BY	John Renda		

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
								0.0 to 100.1 feet: BASALT; continued. @ 51.0 feet: slower drilling; harder material.
								@ 80.0 feet: increase in fines in cuttings.



REMARKS

EMCON®

LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte/Valley Landfills**		
LOCATION	**Benton County, Oregon**	PAGE	**3 OF 3**
DRILLED BY	**GeoTech Explorations, Inc.**	BORING NO.	**QP-2S**
DRILL METHOD	**Air Rotary**	TOTAL DEPTH	**100.1'**
LOGGED BY	**John Renda**	DATE COMPLETED	**9/2/98**

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
				105 110 115 120 125 130 135 140 145 150				@ 100.1 feet: boring terminated. **WELL CONSTRUCTION DETAILS:** 0.3 to 79.6 feet: 2-inch-diameter schedule 40 PVC blank riser pipe. 79.6 to 99.6 feet: 2-inch-diameter, 0.020-inch machine-cut slot well screen. 99.6 to 100.1 feet: schedule 40 PVC end cap. 0.0 to 1.0 feet: Concrete. 1.0 to 68.1 feet: Bentonite grout. 68.1 to 73.6 feet: Bentonite chips. 73.6 to 74.6 feet: 20-40 Colorado silica sand. 74.6 to 100.1 feet: 8-12 Colorado silica sand.

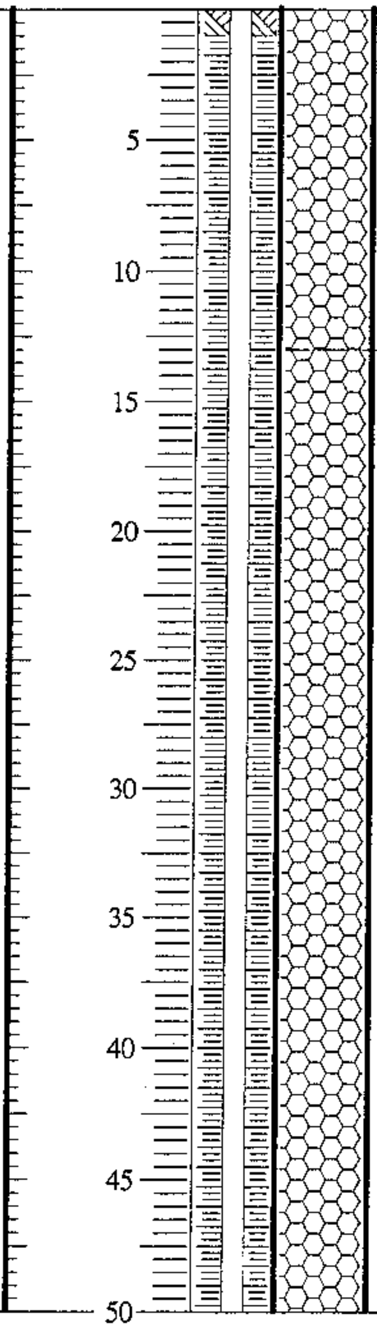
REMARKS

EMCON®

LOG OF EXPLORATORY BORING

PROJECT NAME **Coffin Butte/Valley Landfills**
LOCATION **Benton County, Oregon**
DRILLED BY **GeoTech Explorations, Inc.**
DRILL METHOD **Air Rotary**
LOGGED BY **John Renda**

PAGE **1 OF 8**
BORING NO. **QP-3S**
TOTAL DEPTH **354.4'**
DATE COMPLETED **9/9/98**



SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
								0.0 to 13.0 feet: BASALT; yellowish-red (5 YR, 5/6); moderate hardness; deeply weathered, 30% weathered to clay and silt particles; hardness increasing toward contact; dry.
								13.0 to 354.4 feet: BASALT; dark greenish-gray (10 YR, 3/1); hard; fresh to weakly weathered; 20 to 30% blue-green soft mineral; trace pyrite and quartz.

EMCON

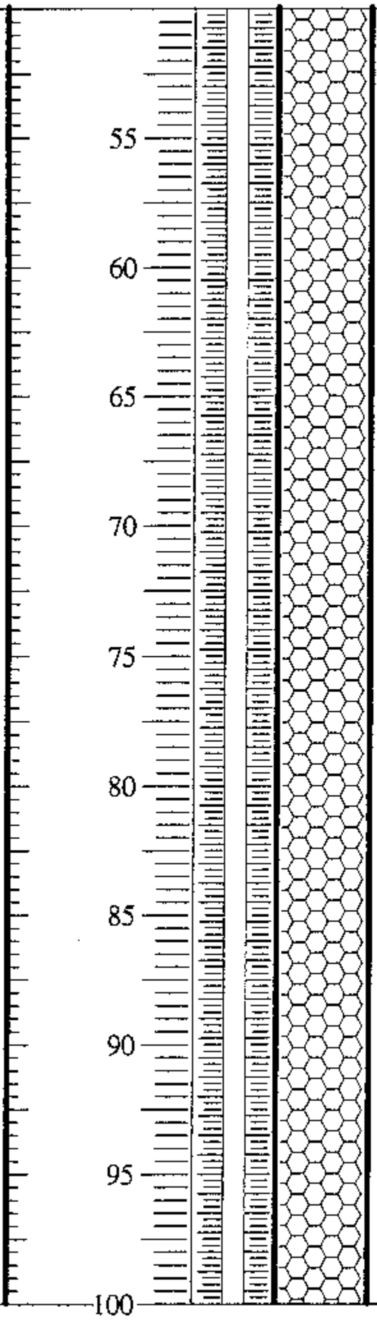
REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte/Valley Landfills**
LOCATION	**Benton County, Oregon**
DRILLED BY	**GeoTech Explorations, Inc.**
DRILL METHOD	**Air Rotary**
LOGGED BY	**John Renda**

PAGE	**2 OF 8**
BORING NO.	**QP-3S**
TOTAL DEPTH	**354.4'**
DATE COMPLETED	**9/9/98**

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION



13.0 to 354.4 feet: BASALT; continued.

@ 96.0 to 110.0 feet: heavily fractured; difficult drilling - drill bit hanging up in fractures.

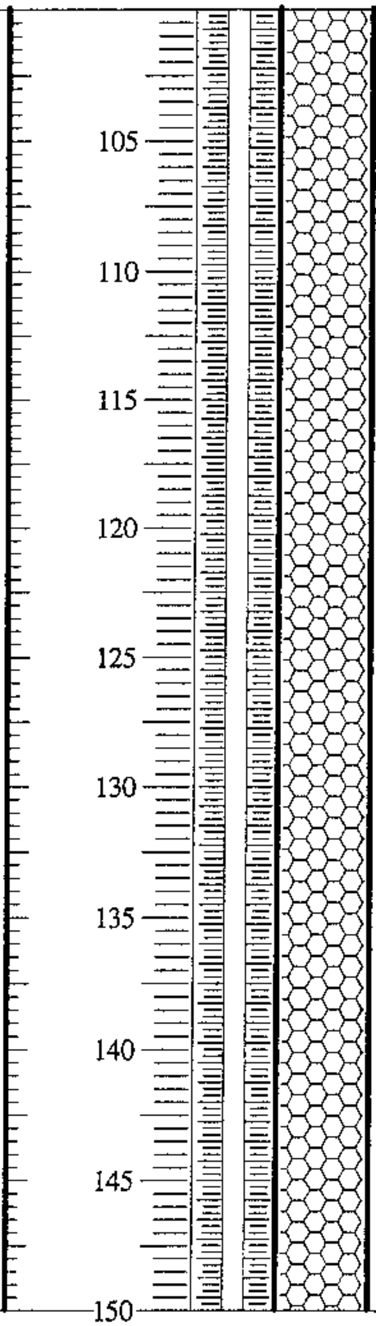
REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME **Coffin Butte/Valley Landfills**
LOCATION **Benton County, Oregon**
DRILLED BY **GeoTech Explorations, Inc.**
DRILL METHOD **Air Rotary**
LOGGED BY **John Renda**

PAGE **3 OF 8**
BORING NO. **QP-3S**
TOTAL DEPTH **354.4'**
DATE COMPLETED **9/9/98**

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
								13.0 to 354.4 feet: BASALT; continued.



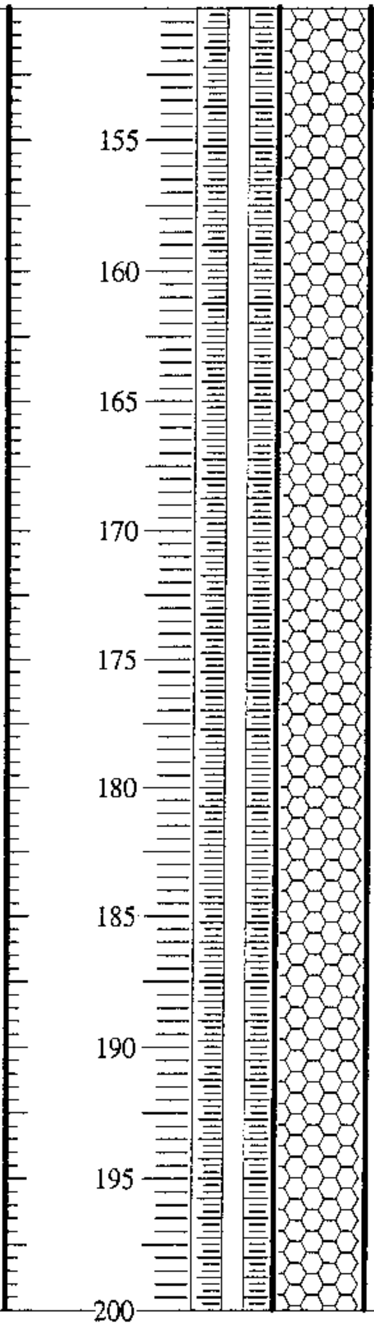
REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte/Valley Landfills
LOCATION Benton County, Oregon
DRILLED BY GeoTech Explorations, Inc.
DRILL METHOD Air Rotary
LOGGED BY John Renda

PAGE 4 OF 8
BORING NO. QP-3S
TOTAL DEPTH 354.4'
DATE COMPLETED 9/9/98

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION



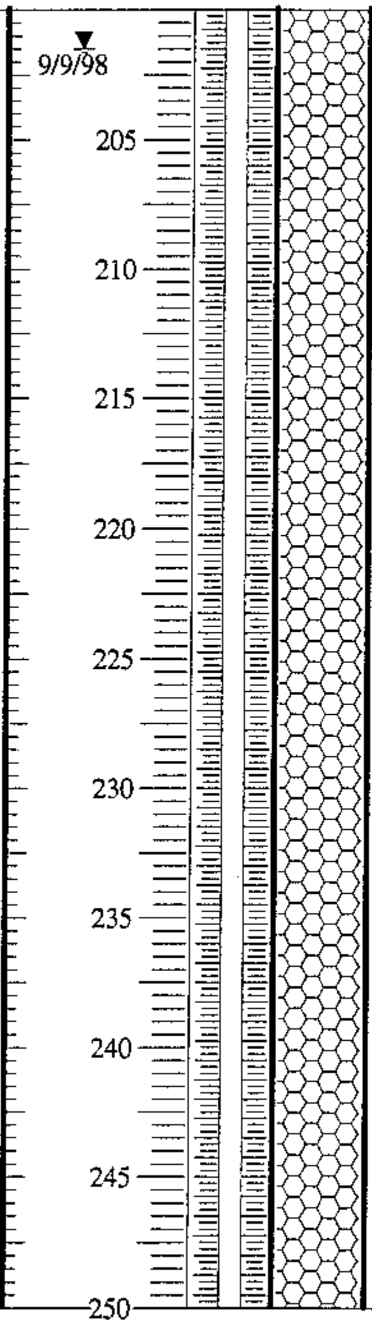
13.0 to 354.4 feet: BASALT; continued.

@ 170.0 to 180.0 feet: drilling slows; fractured zone; blue-green mineral absent, replaced with brown soft mineral.

REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte/Valley Landfills**		
LOCATION	**Benton County, Oregon**	PAGE	**5 OF 8**
DRILLED BY	**GeoTech Explorations, Inc.**	BORING NO.	**QP-3S**
DRILL METHOD	**Air Rotary**	TOTAL DEPTH	**354.4'**
LOGGED BY	**John Renda**	DATE COMPLETED	**9/9/98**

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
								**13.0 to 354.4 feet: BASALT**; continued. @ 215.0 feet: hole making water.

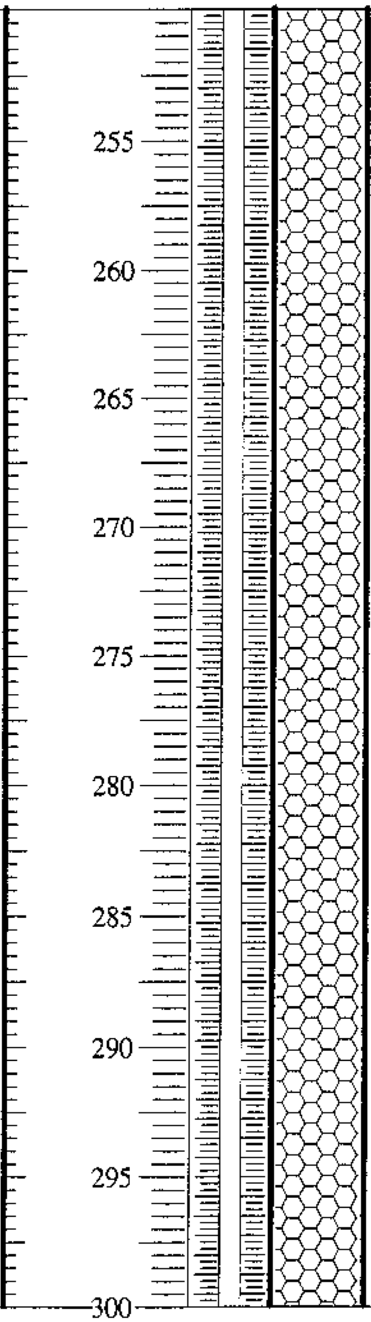
REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte/Valley Landfills
LOCATION Benton County, Oregon
DRILLED BY GeoTech Explorations, Inc.
DRILL METHOD Air Rotary
LOGGED BY John Renda

PAGE 6 OF 8
BORING NO. QP-3S
TOTAL DEPTH 354.4'
DATE COMPLETED 9/9/98

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
								13.0 to 354.4 feet: BASALT; continued.

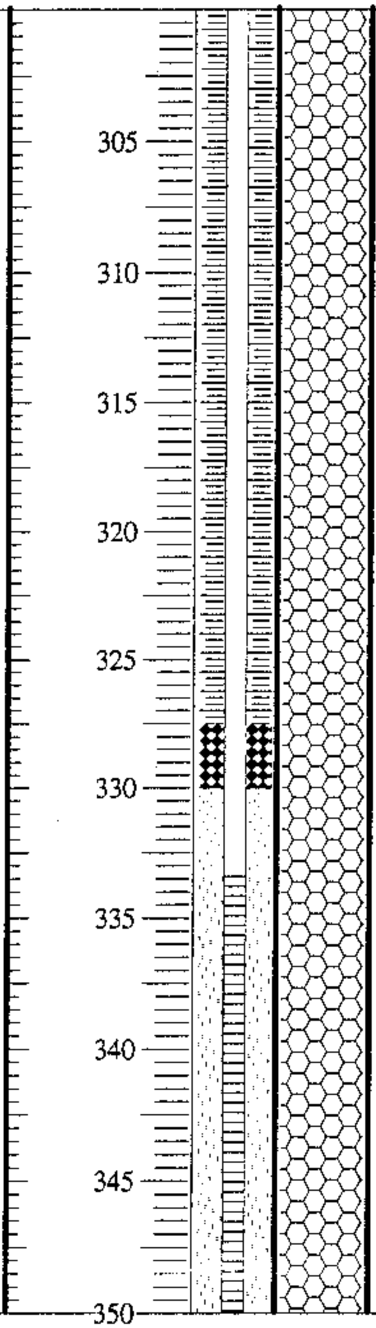


REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte/Valley Landfills**		
LOCATION	**Benton County, Oregon**	PAGE	**7 OF 8**
DRILLED BY	**GeoTech Explorations, Inc.**	BORING NO.	**QP-3S**
DRILL METHOD	**Air Rotary**	TOTAL DEPTH	**354.4'**
LOGGED BY	**John Renda**	DATE COMPLETED	**9/9/98**

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
								13.0 to 354.4 feet: BASALT; continued. @ 302.0 feet: iron oxide staining noted on fractures.



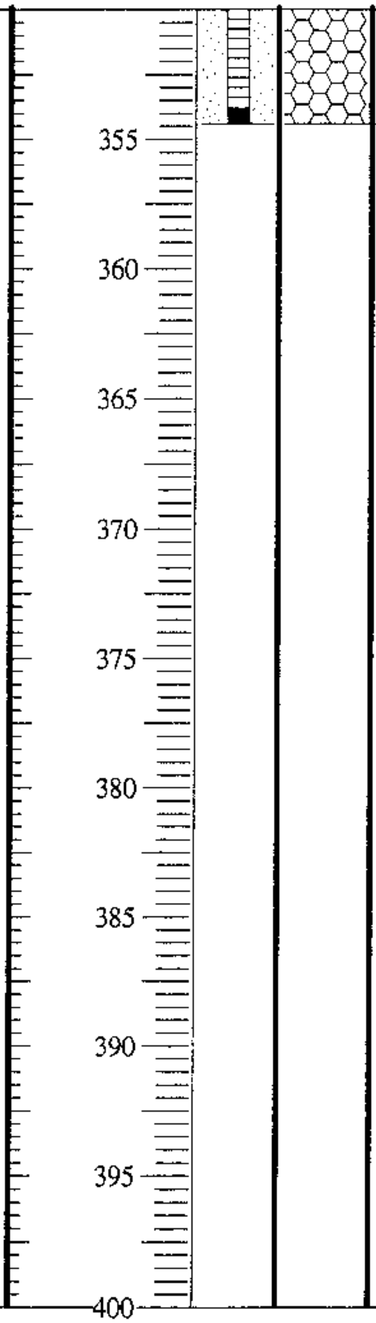
REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME **Coffin Butte/Valley Landfills**
LOCATION **Benton County, Oregon**
DRILLED BY **GeoTech Explorations, Inc.**
DRILL METHOD **Air Rotary**
LOGGED BY **John Renda**

PAGE **8 OF 8**
BORING NO. **QP-3S**
TOTAL DEPTH **354.4'**
DATE COMPLETED **9/9/98**

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION



13.0 to 354.4 feet: BASALT; continued.

@ 354.4 feet: boring terminated.

WELL CONSTRUCTION DETAILS:
0.3 to 333.4 feet: 2-inch-diameter schedule 80 PVC blank riser pipe.
333.4 to 353.8 feet: 2-inch-diameter, 0.020-inch machine-cut slot well screen.
353.8 to 354.4 feet: schedule 80 PVC end cap.

0.0 to 1.0 feet: Concrete.
1.0 to 327.5 feet: Bentonite grout.
327.5 to 330.0 feet: Bentonite chips.
330.0 to 330.5 feet: 20-40 Colorado silica sand.
330.5 to 354.4 feet: 8-12 Colorado silica sand.

REMARKS

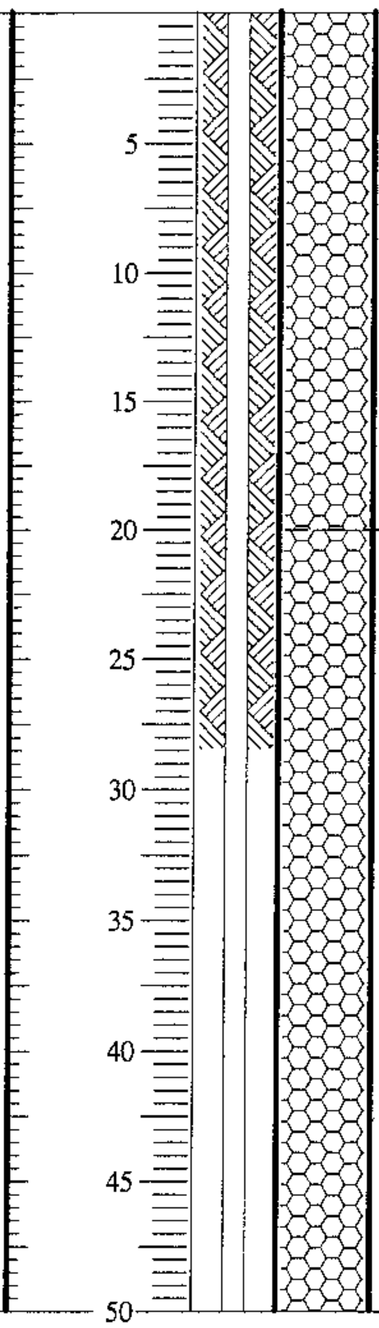
EMCON®

LOG OF EXPLORATORY BORING

PROJECT NAME **Coffin Butte/Valley Landfills**
LOCATION **Benton County, Oregon**
DRILLED BY **GeoTech Explorations, Inc.**
DRILL METHOD **Air Rotary**
LOGGED BY **John Renda**

PAGE **1 OF 9**
BORING NO. **QP-4S**
TOTAL DEPTH **403.05'**
DATE COMPLETED **9/15/98**

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION



0.0 to 20.0 feet: BASALT; brown (7.5 YR, 4/4); moderate to low hardness; deeply weathered; 30% weathered to medium to high plasticity silt and clay particles; dry; hardness increased and fines decrease toward contact. (WEATHERED BASALT)

20.0 to 145.0 feet: BASALT; dark greenish-gray (10 GY, 3/1); hard; fresh to weakly weathered; 20 to 30% blue-green mineralization (soft); trace pyrite, quartz, and calcite.

@ 30.0 feet: iron oxide staining along fractures.

REMARKS

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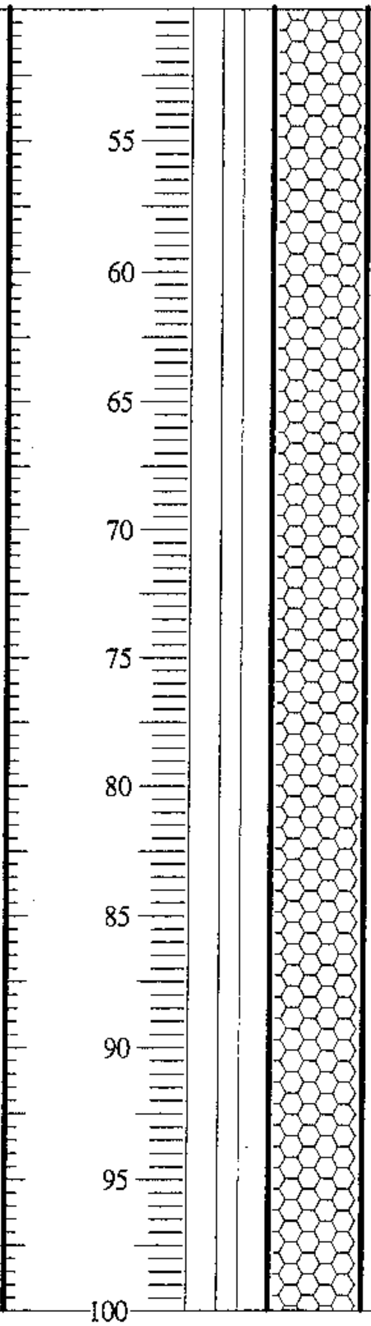
LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte/Valley Landfils**		
LOCATION	**Benton County, Oregon**	PAGE	**2 OF 9**
DRILLED BY	**GeoTech Explorations, Inc.**	BORING NO.	**QP-4S**
DRILL METHOD	**Air Rotary**	TOTAL DEPTH	**403.05'**
LOGGED BY	**John Renda**	DATE COMPLETED	**9/15/98**

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
								20.0 to 145.0 feet: BASALT; continued.
								@ 50.0 to 75.0 feet: intensely fractured.



REMARKS

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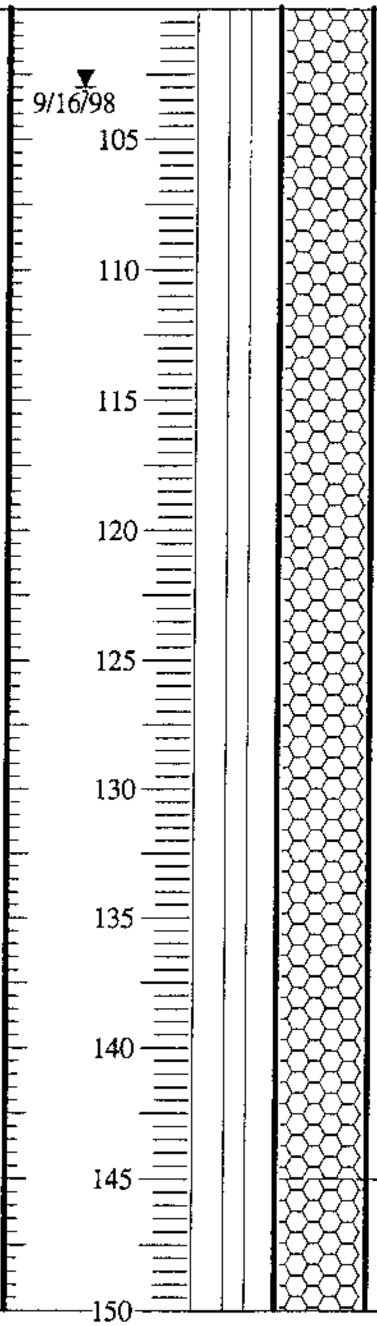
LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte/Valley Landfills**		
LOCATION	**Benton County, Oregon**	PAGE	**3 OF 9**
DRILLED BY	**GeoTech Explorations, Inc.**	BORING NO.	**QP-4S**
DRILL METHOD	**Air Rotary**	TOTAL DEPTH	**403.05'**
LOGGED BY	**John Renda**	DATE COMPLETED	**9/15/98**

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION



20.0 to 145.0 feet: BASALT; continued.

@ 105.0 to 115.0 feet: increase in blue-green mineral to 50%.

145.0 to 160.0 feet: BASALT; grayish-green (5G, 5/2); low hardness; easily crushed to clay-sized particles.

REMARKS

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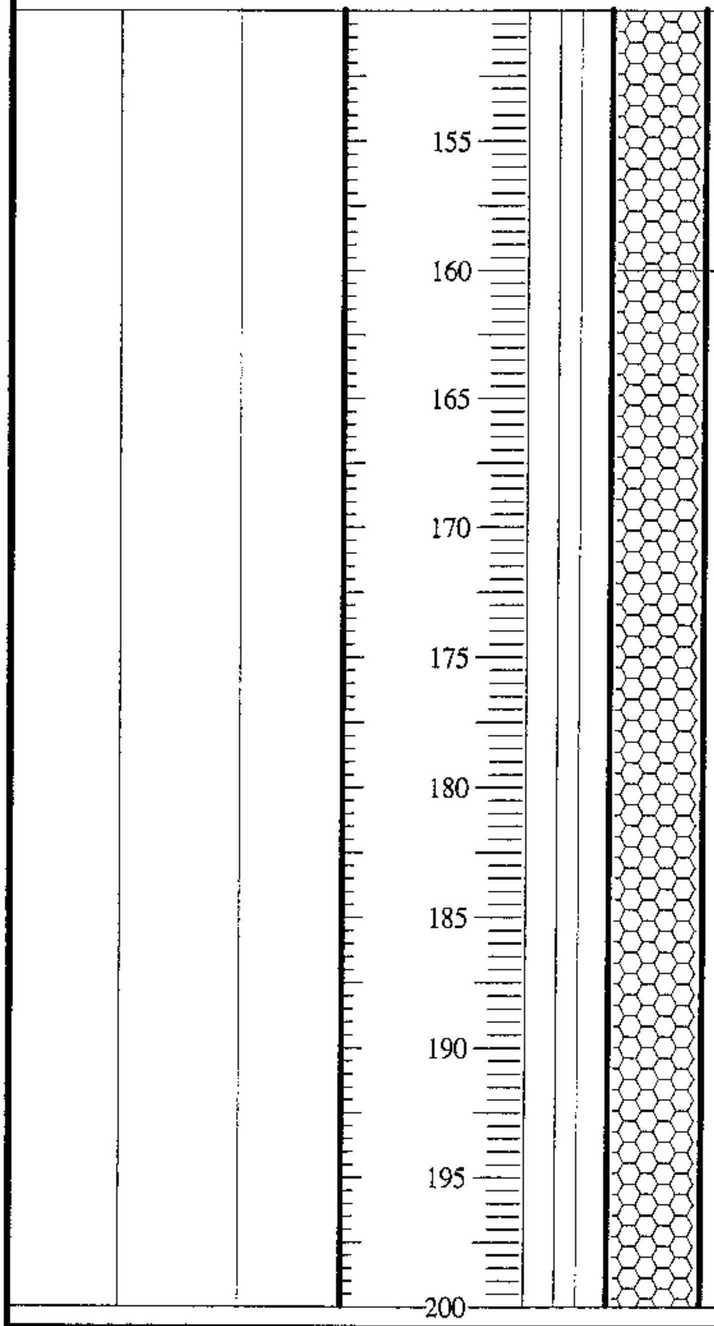
LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte/Valley Landfills**		
LOCATION	**Benton County, Oregon**	PAGE	**4 OF 9**
DRILLED BY	**GeoTech Explorations, Inc.**	BORING NO.	**QP-4S**
DRILL METHOD	**Air Rotary**	TOTAL DEPTH	**403.05'**
LOGGED BY	**John Renda**	DATE COMPLETED	**9/15/98**

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION



20.0 to 145.0 feet: BASALT; continued.

160.0 to 403.05 feet: BASALT; dark greenish-gray (10 GY, 3/1); hard; fresh to weakly weathered; 20 to 30% blue-green mineralization (soft); trace pyrite, quartz, and calcite.

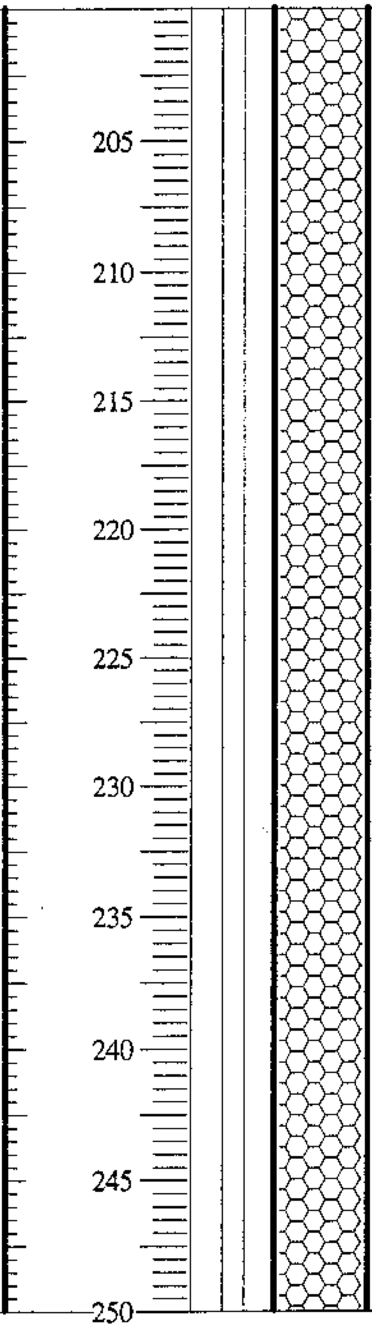
REMARKS

EMCON

LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte/Valley Landfills**	PAGE	**5 OF 9**
LOCATION	**Benton County, Oregon**	BORING NO.	**QP-4S**
DRILLED BY	**GeoTech Explorations, Inc.**	TOTAL DEPTH	**403.05'**
DRILL METHOD	**Air Rotary**	DATE COMPLETED	**9/15/98**
LOGGED BY	**John Renda**		

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
								20.0 to 145.0 feet: BASALT; continued.

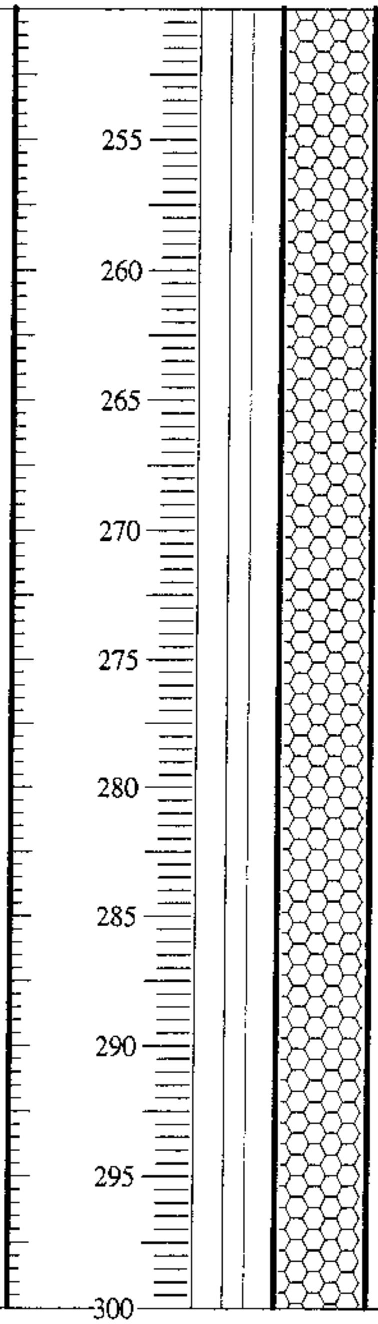


REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte/Valley Landfills**		
LOCATION	**Benton County, Oregon**	PAGE	**6 OF 9**
DRILLED BY	**GeoTech Explorations, Inc.**	BORING NO.	**QP-4S**
DRILL METHOD	**Air Rotary**	TOTAL DEPTH	**403.05'**
LOGGED BY	**John Renda**	DATE COMPLETED	**9/15/98**

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
								20.0 to 145.0 feet: BASALT; continued.



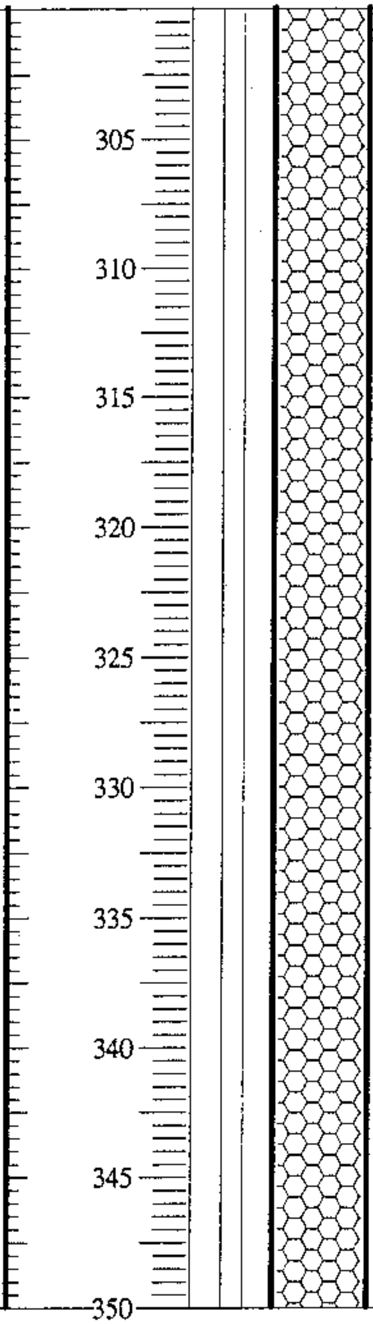
REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME **Coffin Butte/Valley Landfills**
LOCATION **Benton County, Oregon**
DRILLED BY **GeoTech Explorations, Inc.**
DRILL METHOD **Air Rotary**
LOGGED BY **John Renda**

PAGE **7 OF 9**
BORING NO. **QP-4S**
TOTAL DEPTH **403.05'**
DATE COMPLETED **9/15/98**

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION



20.0 to 145.0 feet: BASALT; continued.

@ 320.0 to 340.0 feet: increase in quartz crystals up to 5%.

@ 325.0 to 375.0 feet: drilling slows; cuttings are fine.

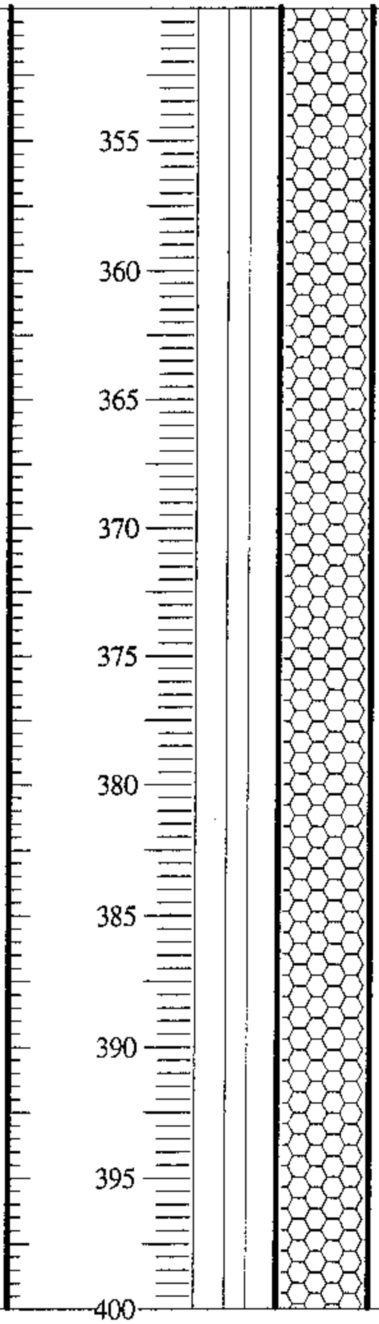
REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME **Coffin Butte/Valley Landfills**
LOCATION **Benton County, Oregon**
DRILLED BY **GeoTech Explorations, Inc.**
DRILL METHOD **Air Rotary**
LOGGED BY **John Renda**

PAGE **8 OF 9**
BORING NO. **QP-4S**
TOTAL DEPTH **403.05'**
DATE COMPLETED **9/15/98**

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
								20.0 to 145.0 feet: BASALT; continued.



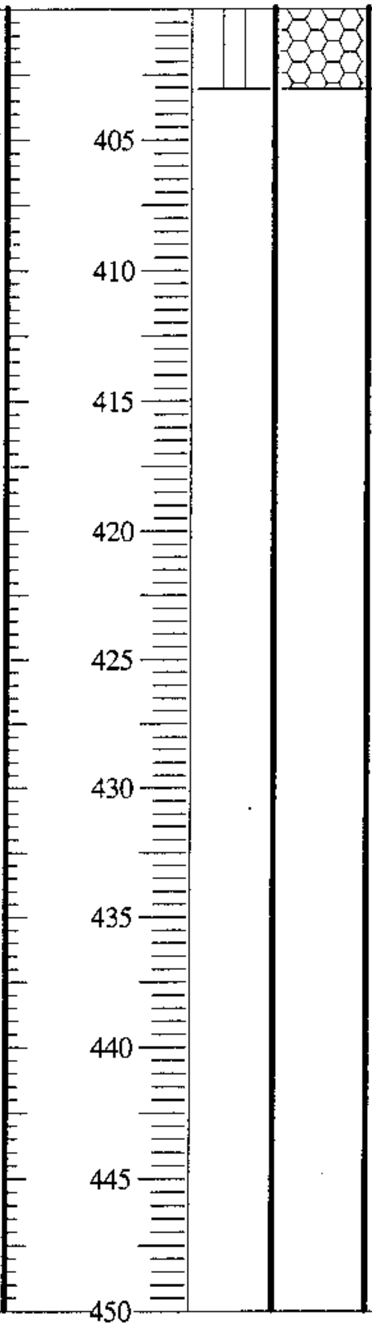
REMARKS

EMCON

LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte/Valley Landfills**		
LOCATION	**Benton County, Oregon**	PAGE	**9 OF 9**
DRILLED BY	**GeoTech Explorations, Inc.**	BORING NO.	**QP-4S**
DRILL METHOD	**Air Rotary**	TOTAL DEPTH	**403.05'**
LOGGED BY	**John Renda**	DATE COMPLETED	**9/15/98**

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION



20.0 to 145.0 feet: BASALT; continued.

@ 403.05 feet: boring terminated.

WELL CONSTRUCTION DETAILS:

2.7 to 363.1 feet: 5-inch-diameter schedule 80 PVC blank riser pipe.

363.1 to 403.05 feet: 5-inch-diameter, 0.020-inch machine-cut slot well screen.

0.0 to 28.4 feet: Concrete.

QP-4S was completed as a domestic well. Drilled to 20.8 feet with a 10-inch hammer bit. Sealed with concrete and drilled the remainder with a 6-inch hammer bit. PVC casing hung in well. No filter pack or seals placed in annulus.

REMARKS

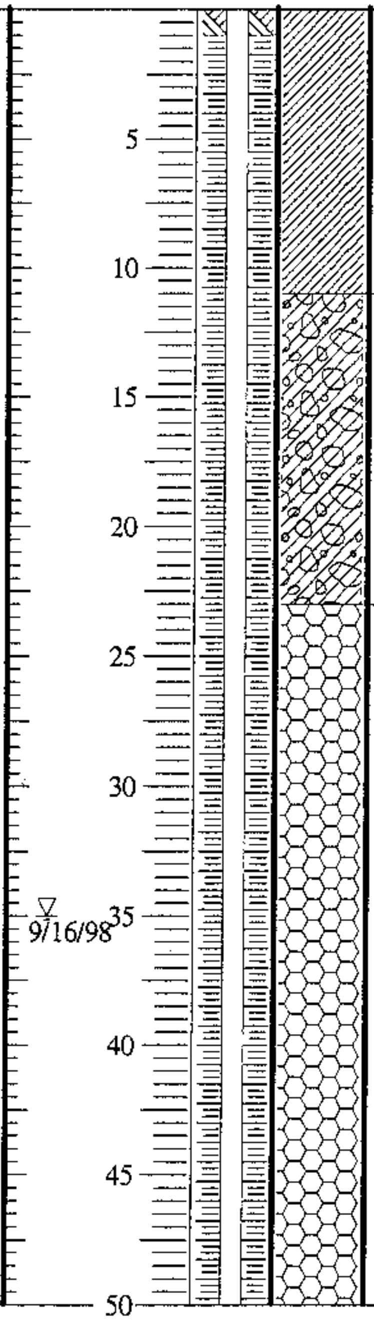
EMCON

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte/Valley Landfills
LOCATION Benton County, Oregon
DRILLED BY GeoTech Explorations, Inc.
DRILL METHOD Air Rotary
LOGGED BY John Renda

PAGE 1 OF 5
BORING NO. QP-5N
TOTAL DEPTH 230.9'
DATE COMPLETED 9/16/98

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION



0.0 to 11.0 feet: SILTY CLAY WITH GRAVEL (CL); reddish-brown (5 YR, 3/4); silty clay, 80 to 90% medium to high plasticity; 10 to 20% coarse gravel and cobbles (weathered basalt); moist. (ALLUVIUM)

11.0 to 23.0 feet: CLAYEY GRAVEL (GC); reddish-brown (5 YR, 3/4); 80% weathered basalt cobbles and gravel, 20% medium to high plasticity silty clay. (WEATHERED BASALT)

23.0 to 230.9 feet: BASALT; dark greenish-gray (10 GY, 3/1); hard; fresh to weakly weathered; 5 to 10% blue-green mineralization (soft); trace pyrite, quartz, and calcite.

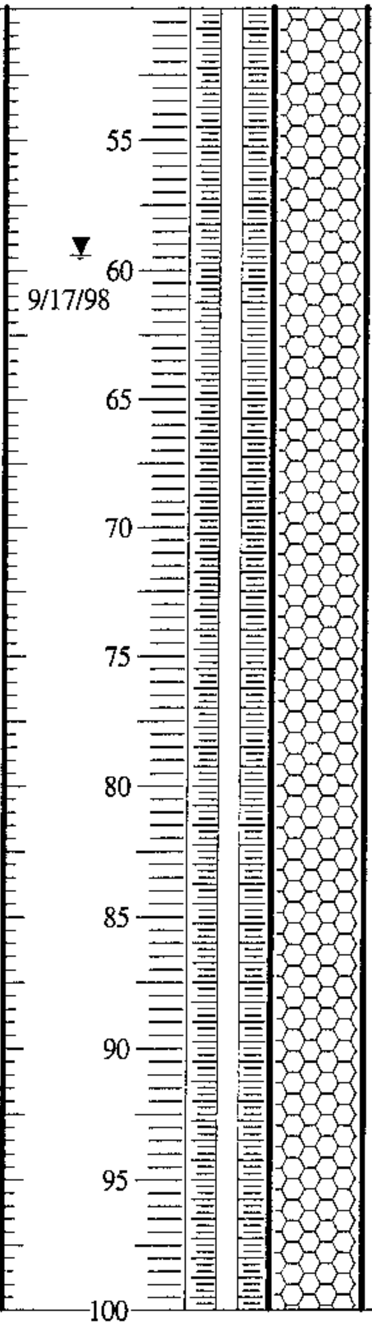
@ 35.0 feet: wet.

REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte/Valley Landfills**		
LOCATION	**Benton County, Oregon**	PAGE	**2 OF 5**
DRILLED BY	**GeoTech Explorations, Inc.**	BORING NO.	**QP-5N**
DRILL METHOD	**Air Rotary**	TOTAL DEPTH	**230.9'**
LOGGED BY	**John Renda**	DATE COMPLETED	**9/16/98**

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION



23.0 to 230.9 feet: BASALT; continued.

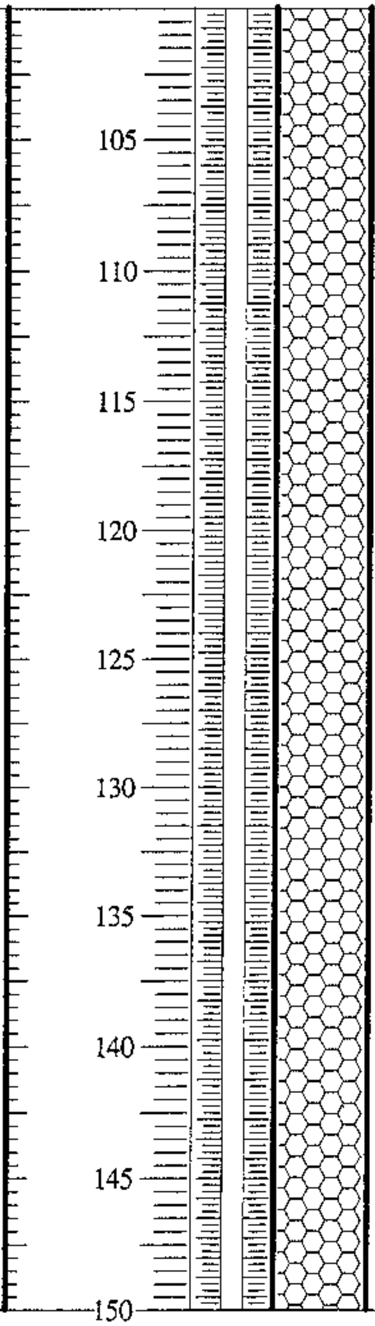
@ 80.0 feet: increase in blue-green mineral to 20 to 30%.

REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte/Valley Landfills**		
LOCATION	**Benton County, Oregon**	PAGE	**3 OF 5**
DRILLED BY	**GeoTech Explorations, Inc.**	BORING NO.	**QP-5N**
DRILL METHOD	**Air Rotary**	TOTAL DEPTH	**230.9'**
LOGGED BY	**John Renda**	DATE COMPLETED	**9/16/98**

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
								23.0 to 230.9 feet: BASALT; continued.

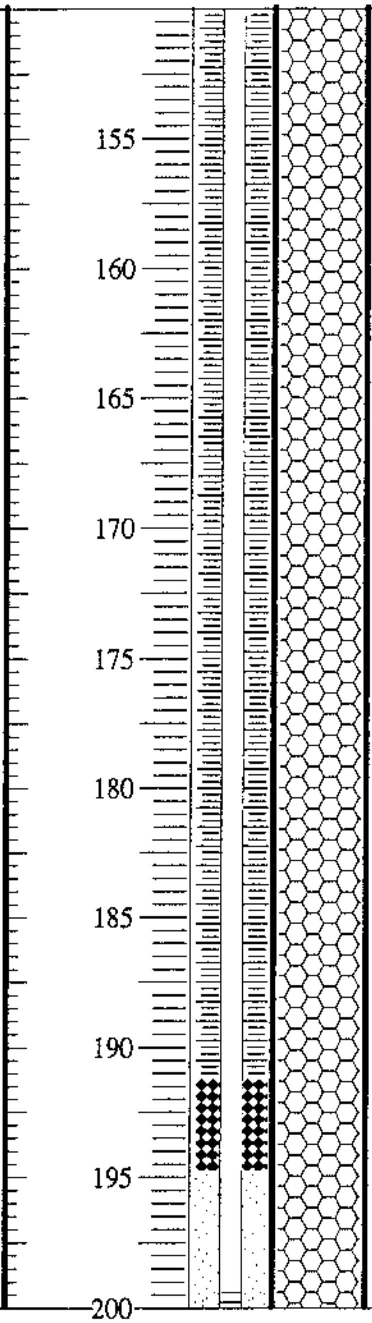


REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte/Valley Landfills**	PAGE	**4 OF 5**
LOCATION	**Benton County, Oregon**	BORING NO.	**QP-5N**
DRILLED BY	**GeoTech Explorations, Inc.**	TOTAL DEPTH	**230.9'**
DRILL METHOD	**Air Rotary**	DATE COMPLETED	**9/16/98**
LOGGED BY	**John Renda**		

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
								23.0 to 230.9 feet: BASALT; continued. @ 180.0 to 200.0 feet: trace to 3% altered to clay.



REMARKS

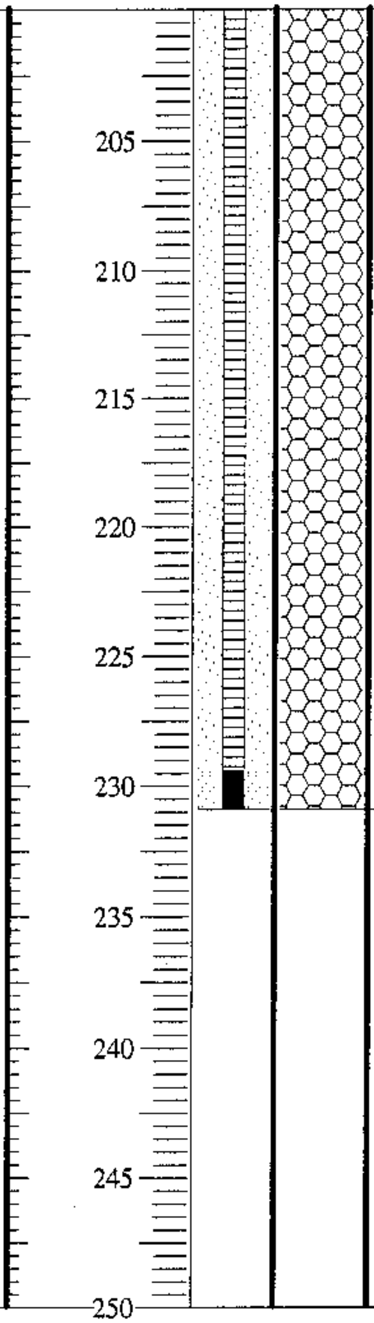
EMCON®

LOG OF EXPLORATORY BORING

PROJECT NAME **Coffin Butte/Valley Landfills**
LOCATION **Benton County, Oregon**
DRILLED BY **GeoTech Explorations, Inc.**
DRILL METHOD **Air Rotary**
LOGGED BY **John Renda**

PAGE **5 OF 5**
BORING NO. **QP-5N**
TOTAL DEPTH **230.9'**
DATE COMPLETED **9/16/98**

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION



23.0 to 230.9 feet: BASALT; continued.

@ 230.9 feet: boring terminated.

WELL CONSTRUCTION DETAILS:

0.3 to 199.4 feet: 2-inch-diameter schedule 80 PVC blank riser pipe.
199.4 to 229.4 feet: 2-inch-diameter, 0.020-inch machine-cut slot well screen.
229.4 to 230.9 feet: schedule 80 PVC end cap.

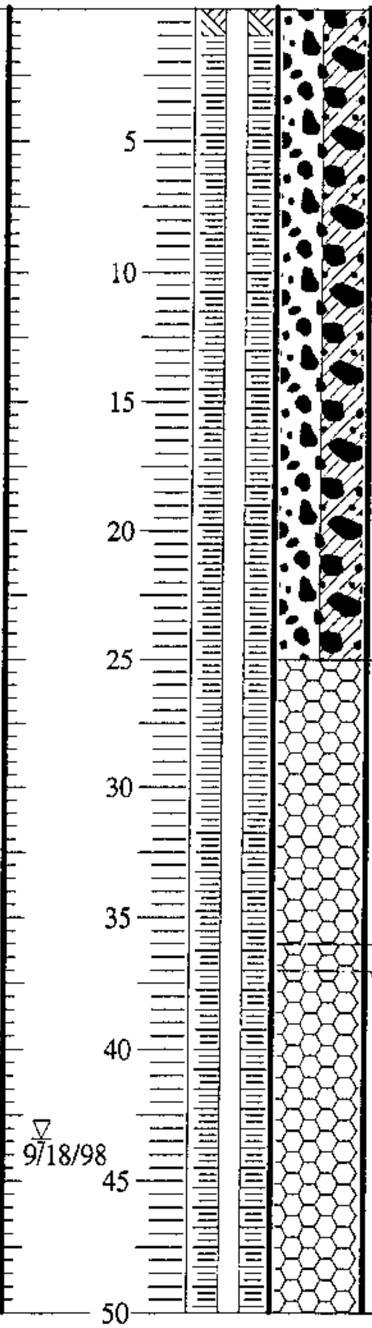
0.0 to 1.0 feet: Concrete.
1.0 to 191.2 feet: Bentonite grout.
191.2 to 194.7 feet: Bentonite chips.
194.7 to 197.7 feet: 20-40 Colorado silica sand.
197.7 to 230.9 feet: 8-12 Colorado silica sand.

REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte/Valley Landfills**		
LOCATION	**Benton County, Oregon**	PAGE	**1 OF 4**
DRILLED BY	**GeoTech Explorations, Inc.**	BORING NO.	**QP-6N**
DRILL METHOD	**Air Rotary**	TOTAL DEPTH	**150'**
LOGGED BY	**John Renda**	DATE COMPLETED	**9/18/98**

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION



0.0 to 25.0 feet: CLAYEY GRAVEL (GW-GC); yellowish-red (5YR, 4/6); 60% weathered basalt gravel and cobbles; hard to friable; 40% medium to high plasticity silty clay. (WEATHERED BASALT)

@ 9.0 to 12.0 feet: basalt boulder.

@ 12.0 to 25.0 feet: basalt/silty clay ratio changed to 80/20.

25.0 to 36.0 feet: BASALT; dark greenish-gray (10 GY, 3/1); hard; fresh to weakly weathered; 20 to 30% blue-green mineralization; trace pyrite, quartz, and calcite.

36.0 to 37.0 feet: BASALT; grayish-green (5 G, 4/2); low hardness; easily crushed to clay-sized particles.

37.0 to 150.0 feet: BASALT; dark greenish-gray (10 GY, 3/1); hard; fresh to weakly weathered; 20 to 30% blue-green mineralization; trace pyrite, quartz, and calcite.

EMCON

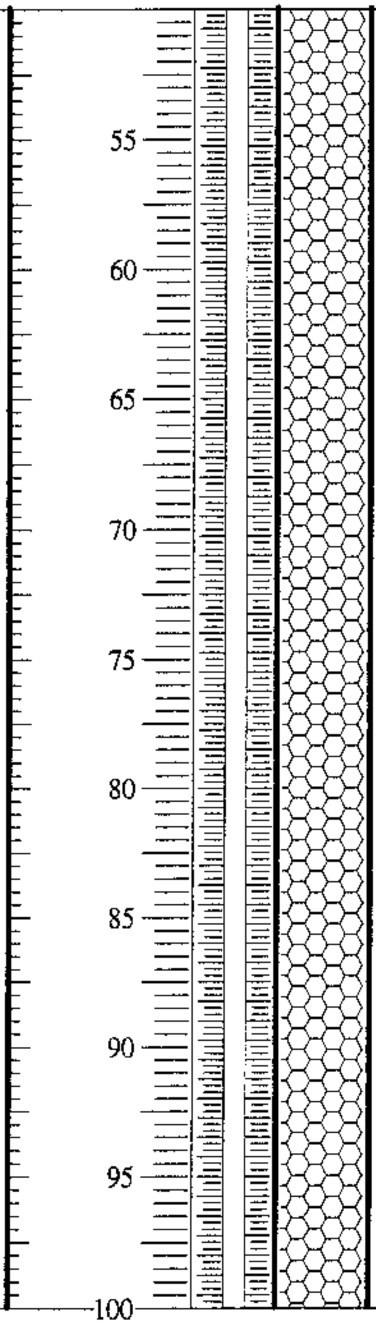
REMARKS

9/21/98 well was flowing artesian.

LOG OF EXPLORATORY BORING

PROJECT NAME	Coffin Butte/Valley Landfills		
LOCATION	Benton County, Oregon	PAGE	2 OF 4
DRILLED BY	GeoTech Explorations, Inc.	BORING NO.	QP-6N
DRILL METHOD	Air Rotary	TOTAL DEPTH	150'
LOGGED BY	John Renda	DATE COMPLETED	9/18/98

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
								37.0 to 150.0 feet: BASALT; continued.



REMARKS

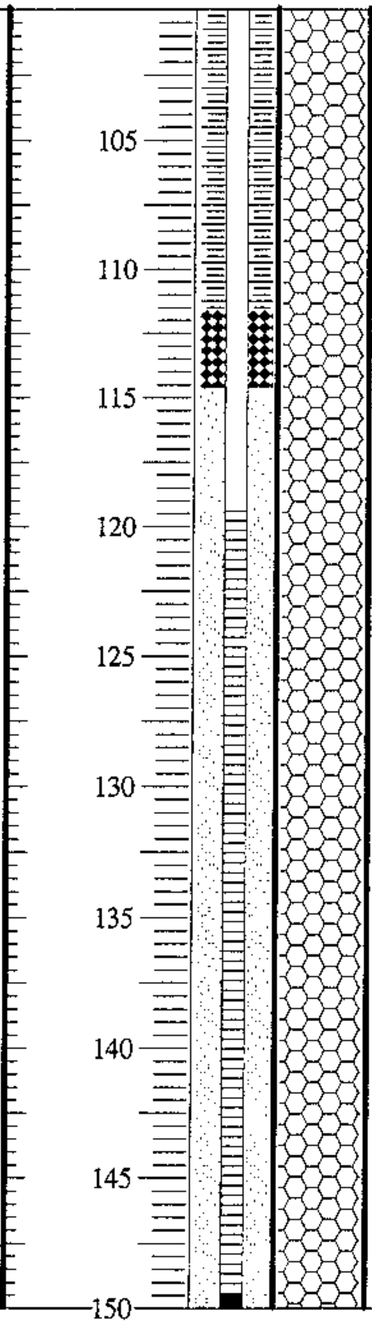
9/21/98 well was flowing artesian.

LOG OF EXPLORATORY BORING

PROJECT NAME **Coffin Butte/Valley Landfills**
LOCATION **Benton County, Oregon**
DRILLED BY **GeoTech Explorations, Inc.**
DRILL METHOD **Air Rotary**
LOGGED BY **John Renda**

PAGE 3 OF 4
BORING NO. QP-6N
TOTAL DEPTH 150'
DATE COMPLETED 9/18/98

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
								37.0 to 150.0 feet: BASALT; continued. @ 150.0 feet: boring terminated.



REMARKS
9/21/98 well was flowing artesian.

EMCON

LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte/Valley Landfills**		
LOCATION	**Benton County, Oregon**	PAGE	**4 OF 4**
DRILLED BY	**GeoTech Explorations, Inc.**	BORING NO.	**QP-6N**
DRILL METHOD	**Air Rotary**	TOTAL DEPTH	**150'**
LOGGED BY	**John Renda**	DATE COMPLETED	**9/18/98**

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
								WELL CONSTRUCTION DETAILS: 0.3 to 119.4 feet: 2-inch-diameter schedule 80 PVC blank riser pipe. 119.4 to 149.4 feet: 2-inch-diameter, 0.020-inch machine-cut slot well screen. 149.4 to 150.0 feet: schedule 80 PVC end cap.
				155				
				160				0.0 to 1.0 feet: Concrete. 1.0 to 111.6 feet: Bentonite grout. 111.6 to 114.6 feet: Bentonite chips. 114.6 to 117.3 feet: 20-40 Colorado silica sand. 117.3 to 150.0 feet: 8-12 Colorado silica sand.
				165				
				170				
				175				
				180				
				185				
				190				
				195				
				200				

EMCON®

REMARKS

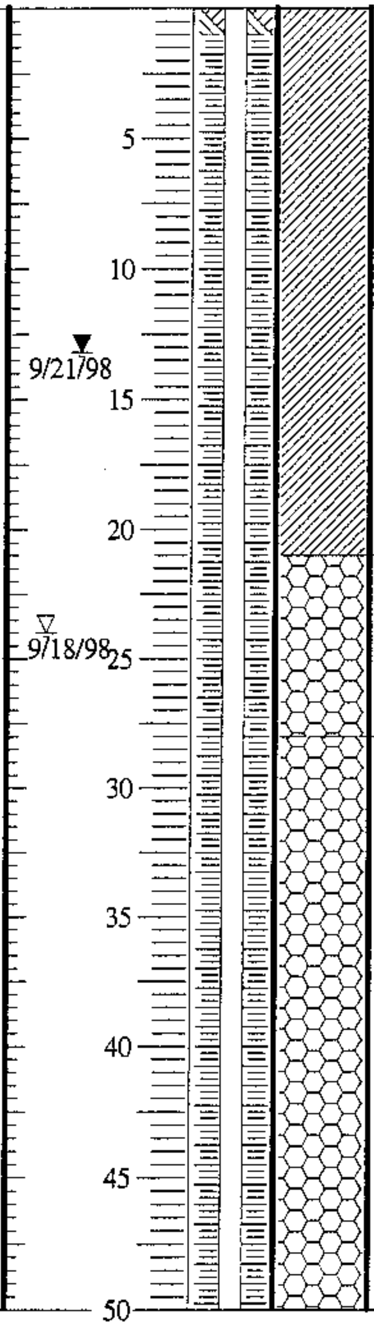
9/21/98 well was flowing artesian.

LOG OF EXPLORATORY BORING

PROJECT NAME **Coffin Butte Landfill**
LOCATION **Benton County, Oregon**
DRILLED BY **GeoTech Explorations, Inc.**
DRILL METHOD **Air Rotary**
LOGGED BY **John Renda**

PAGE **1 OF 3**
BORING NO. **QP-7N**
TOTAL DEPTH **119.6'**
DATE COMPLETED **9/21/98**

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION



0.0 to 21.0 feet: SILTY CLAY WITH GRAVEL (CL); reddish-yellow (7.5 YR, 6/8); 80% silty clay, medium to high plasticity; 20% coarse gravel and cobbles; friable weathered basalt; moist.

@ 15.0 to 21.0 feet: gravel increases to 80%; moist.

21.0 to 28.0 feet: BASALT; dark greenish-gray (10 GY, 3/1); hard; fresh to weakly weathered; dry.

@ 24.0 feet: wet.

28.0 to 66.0 feet: BASALT; grayish-green (5G, 4/2); low hardness; oxidizes to black.

REMARKS

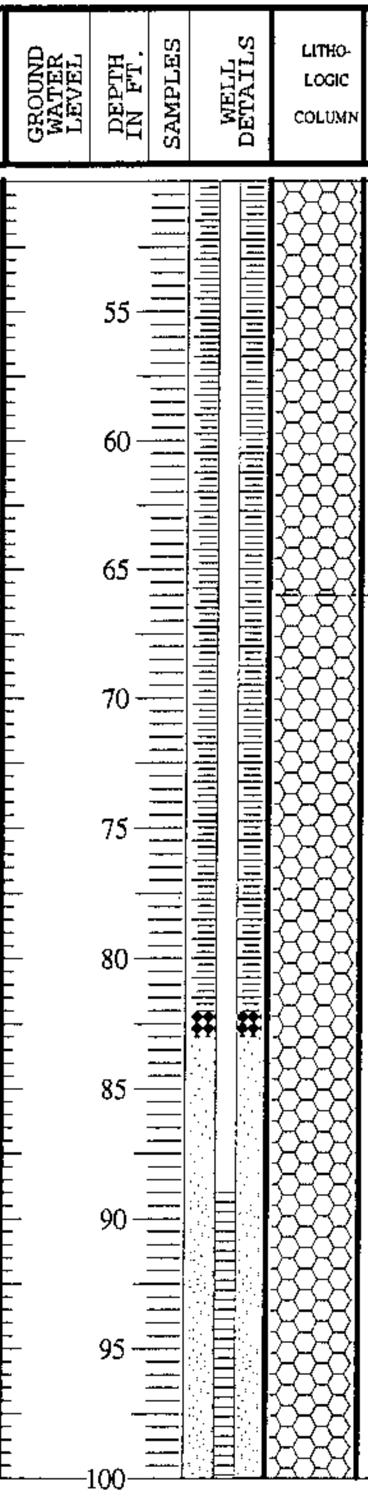
EMCON®

LOG OF EXPLORATORY BORING

PROJECT NAME Coffin Butte Landfill
LOCATION Benton County, Oregon
DRILLED BY GeoTech Explorations, Inc.
DRILL METHOD Air Rotary
LOGGED BY John Renda

PAGE 2 OF 3
BORING NO. QP-7N
TOTAL DEPTH 119.6'
DATE COMPLETED 9/21/98

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT



LITHOLOGIC DESCRIPTION

28.0 to 66.0 feet: BASALT; continued.

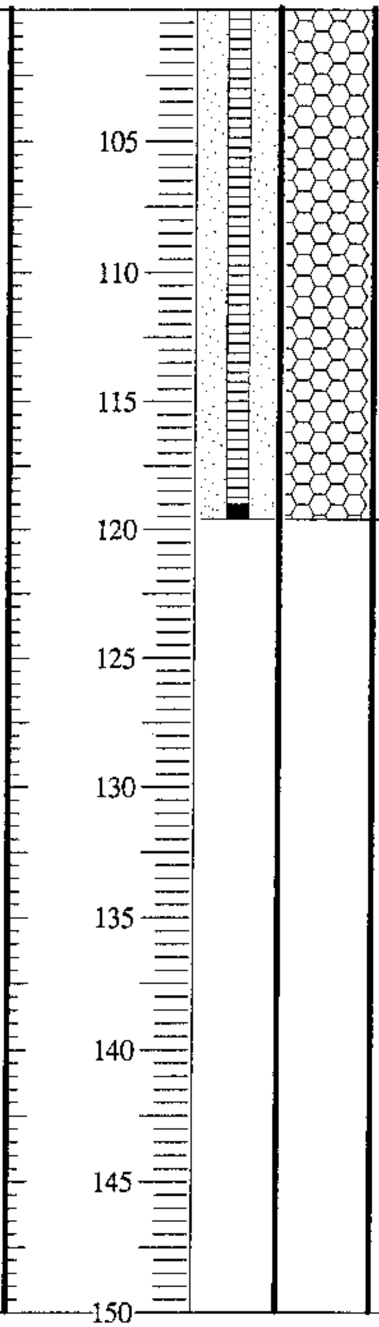
66.0 to 120.0 feet: BASALT; dark greenish-gray (10 GY, 3/1); hard; fresh to weakly weathered; 20 to 30% blue-green mineralization; trace pyrite, quartz, and calcite.

REMARKS

EMCON®

LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte Landfill**		
LOCATION	**Benton County, Oregon**	PAGE	**3 OF 3**
DRILLED BY	**GeoTech Explorations, Inc.**	BORING NO.	**QP-7N**
DRILL METHOD	**Air Rotary**	TOTAL DEPTH	**119.6'**
LOGGED BY	**John Renda**	DATE COMPLETED	**9/21/98**

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
								**66.0 to 120.0 feet:** BASALT; continued. @ 119.6 feet: boring terminated.

WELL CONSTRUCTION DETAILS:

0.3 to 89.0 feet: 2-inch-diameter schedule 80 PVC blank riser pipe.
89.0 to 119.0 feet: 2-inch-diameter, 0.020-inch machine-cut slot well screen.
119.0 to 119.6 feet: schedule 80 PVC end cap.

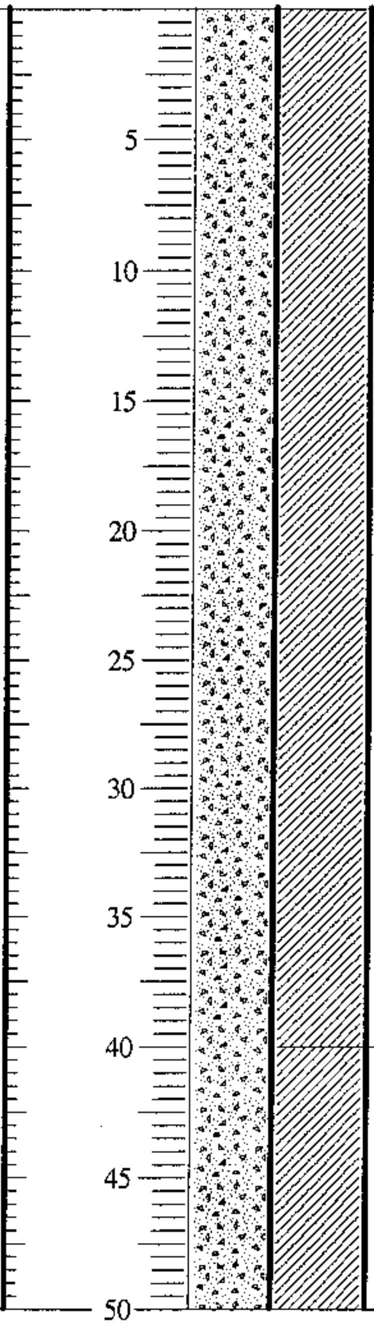
0.0 to 1.0 feet: Concrete.
1.0 to 82.0 feet: Bentonite grout.
82.0 to 83.0 feet: Bentonite chips.
83.0 to 85.2 feet: 20-40 Colorado silica sand.
85.2 to 119.6 feet: 8-12 Colorado silica sand.

REMARKS

LOG OF EXPLORATORY BORING

PROJECT NAME	Coffin Butte/Valley Landfill		
LOCATION	Benton County, Oregon	PAGE	1 OF 2
DRILLED BY	GeoTech Explorations, Inc.	BORING NO.	QP-8Nd
DRILL METHOD	Air Rotary	TOTAL DEPTH	65'
LOGGED BY	John Renda	DATE COMPLETED	9/10/98

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION



0.0 to 40.0 feet: SILTY CLAY (CL); dark yellowish-brown (10 YR, 4/); medium to high plasticity fines; trace fine sand; dry. (ALLUVIUM)

@ 6.0 feet: moist.

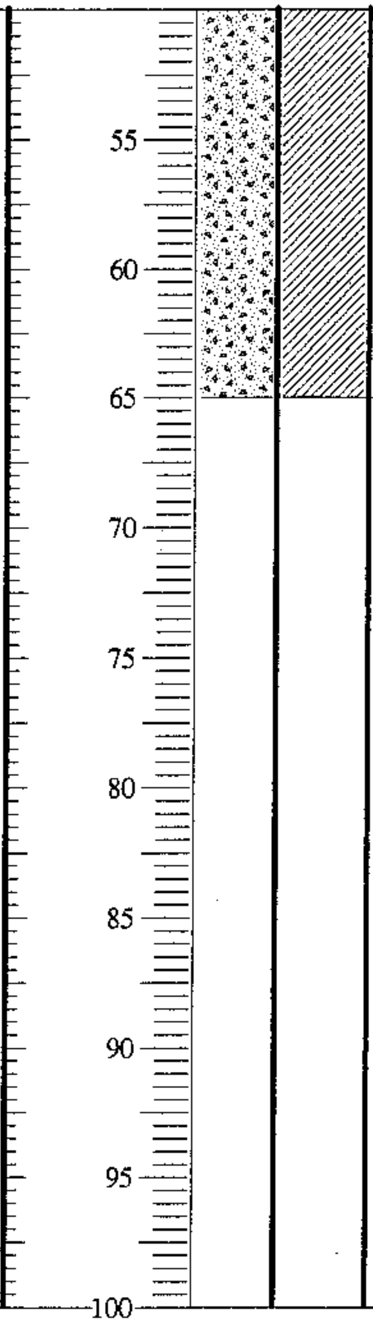
40.0 to 65.0 feet: SILTY CLAY WITH GRAVEL (CL); reddish-yellow (7/5 YR, 6/8); 80% silty clay, medium to high plasticity; 20% coarse basalt gravel and cobbles; friable; deeply weathered. (WEATHERED BASALT)

REMARKS

EMCON

LOG OF EXPLORATORY BORING

PROJECT NAME	**Coffin Butte/Valley Landfill**	PAGE	**2 OF 2**
LOCATION	**Benton County, Oregon**	BORING NO.	**QP-8Nd**
DRILLED BY	**GeoTech Explorations, Inc.**	TOTAL DEPTH	**65'**
DRILL METHOD	**Air Rotary**	DATE COMPLETED	**9/10/98**
LOGGED BY	**John Renda**		

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOWS PER FOOT	GROUND WATER LEVEL	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
				 				**40.0 to 65.0 feet: SILTY CLAY WITH GRAVEL (CL);** continued. @ 65.0 feet: boring terminated; abandoned with concrete.

REMARKS

EMCON®

WELL DETAILS

Project Number: 40139-001.066

Client Name: Valley Landfills, Inc.

Project Name: Coffin Butte Landfill

Location: Benton County, Oregon

Driller: Geo-Tech Explorations, Inc.

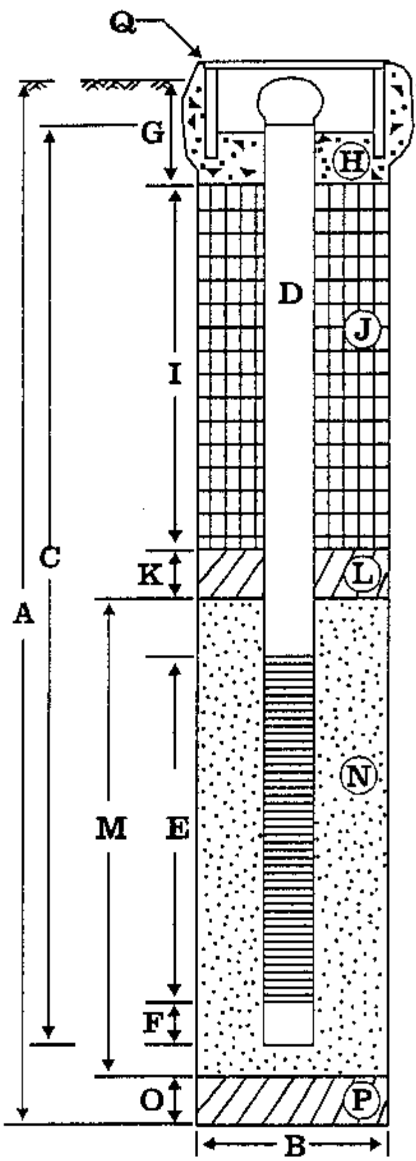
Boring/Well No.: QP-1S

Top of Casing Elev.: 425.55

Ground Surface Elev.: 426.13

Installation Date: 9/3/98

Permit/Start Card No.: 112469



Depth (ft, bgs)	Elev. (ft, msl)
0.0	426.13
0.6	426.55
1.0	425.13
87.6	337.53
89.8	336.33
93.5	332.63
223.5	202.63
224.1	202.03
224.1	202.03

EXPLORATORY BORING

A. Total depth: 224.1 ft.

B. Diameter: 6 in.

Drilling method: Air Rotary

WELL CONSTRUCTION

C. Well casing length: 223.5 ft.

Well casing material: Sched 80 PVC

D. Well casing diameter: 2 in.

E. Well screen length: 130 ft.

Well screen type: Machine Slotted

Well screen slot size: 0.020 in.

F. Well sump/end cap length: 0.65 ft.

G. Surface seal thickness: 1.0 ft.

H. Surface seal material: Concrete

I. Annular seal thickness: 86.6 ft.

J. Annular seal material: Bentonite Grout

K. Filter pack seal thickness: 3.5 ft.

L. Filter pack seal material: See Below

M. Sand pack thickness: 134.3 ft.

N. Sand pack material: 8X12 Silica Sand

O. Bottom material thickness: NA ft.

P. Bottom material: NA

Q. Vault box type: Sherwood Flush

Well centralizer depths: 24 ft.
64 ft.
104 ft.
144 ft.
184 ft.
223 ft.

NOTES: Well screen constructed of seven 10-foot screen sections alternating with 10 foot riser pipe. Filter pack seal constucted of 2.2 feet bentonite chips overlaying 1.3 feet 20X40 Silica Sand.

Installed by: John J. Renda

Reviewed by:

Date:

WELL DETAILS

Project Number: 40139-001.066

Client Name: Valley Landfills, Inc.

Project Name: Coffin Butte Landfill

Location: Benton County, Oregon

Driller: Geo-Tech Explorations, Inc.

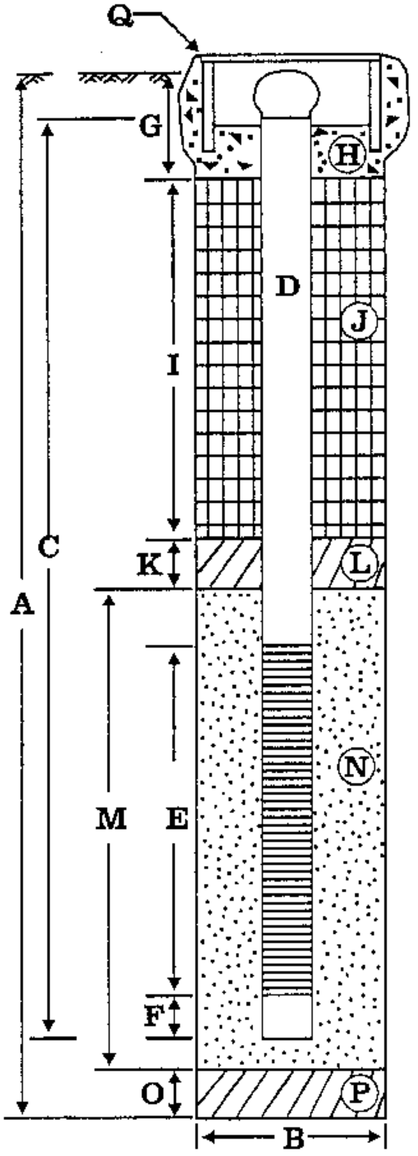
Boring/Well No.: QP-2S

Top of Casing Elev.: 355.66

Ground Surface Elev.: 355.40

Installation Date: 9/2/98

Permit/Start Card No.: 112468



Depth (ft, bgs)	Elev. (ft, msl)
0.0	355.40
0.3 ags	355.66
1.0	354.40
68.1	287.30
74.6	280.80
79.6	275.80
99.6	255.8
100.1	255.3
100.1	255.3

EXPLORATORY BORING

A. Total depth: 100.1 ft.

B. Diameter: 6 in.

Drilling method: Air Rotary

WELL CONSTRUCTION

C. Well casing length: 100.4 ft.

Well casing material: Sched 40 PVC

D. Well casing diameter: 2 in.

E. Well screen length: 20 ft.

Well screen type: Machine Slotted

Well screen slot size: 0.020 in.

F. Well sump/end cap length: 0.5 ft.

G. Surface seal thickness: 1.0 ft.

H. Surface seal material: Concrete

I. Annular seal thickness: 68.1 ft.

J. Annular seal material: Bentonite Grout

K. Filter pack seal thickness: 6.5 ft.

L. Filter pack seal material: See Below

M. Sand pack thickness: 23.5 ft.

N. Sand pack material: 8X12 Silica Sand

O. Bottom material thickness: NA ft.

P. Bottom material: NA

Q. Vault box type: Sherwood Flush

Well centralizer depths: 4 ft.
40 ft.
80 ft.
99 ft.

NOTES: Well screen constructed of seven 10-foot screen sections alternating with 10 foot riser pipe. Filter pack seal constucted of 5.5 feet bentonite chips overlaying 1. foot 20X40 Silica Sand.

Installed by: John J. Renda

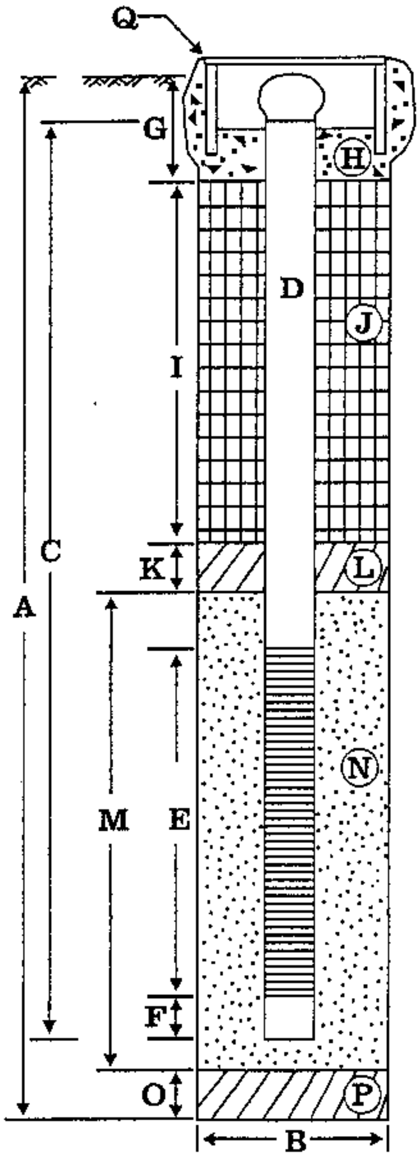
Reviewed by:

Date:

WELL DETAILS

Project Number: 40139-001.066
Client Name: Valley Landfills, Inc.
Project Name: Coffin Butte Landfill
Location: Benton County, Oregon
Driller: Geo-Tech Explorations, Inc.

Boring/Well No.: QP-3S
Top of Casing Elev.: 602.02
Ground Surface Elev.: 601.70
Installation Date: 9/9/98
Permit/Start Card No.: 112470



Depth (ft, bgs)	Elev. (ft, msl)
0.0	601.70
0.3 ags	602.02
1.0	600.70
327.5	274.20
330.5	271.20
333.4	268.30
353.8	247.90
354.4	247.30
354.4	247.30

EXPLORATORY BORING

A. Total depth: 354.4 ft.
B. Diameter: 6 in.
Drilling method: Air Rotary

WELL CONSTRUCTION

C. Well casing length: 354.7 ft.
Well casing material: Sched 80 PVC
D. Well casing diameter: 2 in.
E. Well screen length: 20 ft.
Well screen type: Machine Slotted
Well screen slot size: 0.020 in.
F. Well sump/end cap length: 0.65 ft.
G. Surface seal thickness: 1.0 ft.
H. Surface seal material: Concrete
I. Annular seal thickness: 326.5 ft.
J. Annular seal material: Bentonite Grout
K. Filter pack seal thickness: 3.0 ft.
L. Filter pack seal material: See Below
M. Sand pack thickness: 23.9 ft.
N. Sand pack material: 8X12 Silica Sand
O. Bottom material thickness: NA ft.
P. Bottom material: NA
Q. Vault box type: Sherwood Flush
Well centralizer depths: 34 ft.
74 ft.
114 ft.
154 ft.
194 ft.
234 ft.
274 ft.
314 ft.
353 ft.

Installed by: John J. Renda

Reviewed by:

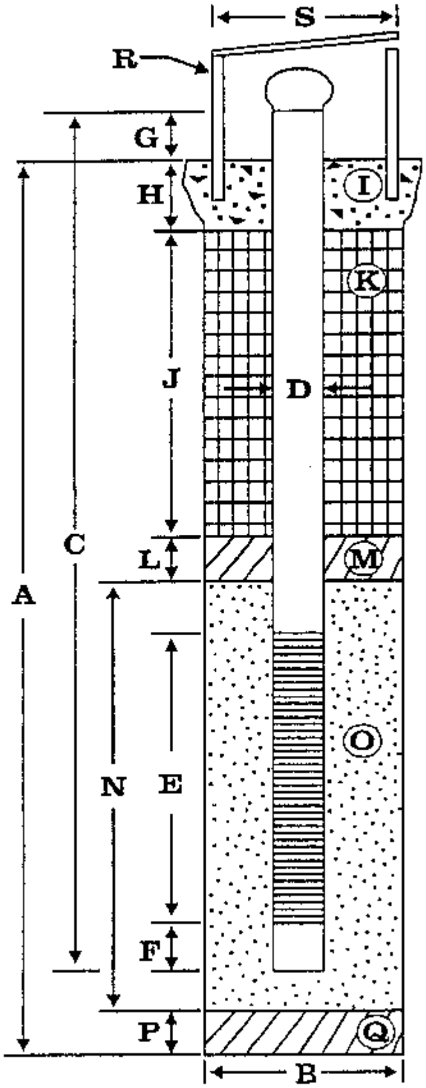
Date:

NOTES: Filter pack seal constucted of 2.5 feet bentonite chips overlaying 0.5 feet 20X40 Silica Sand.

WELL DETAILS

Project Number: 40139-001.065
Client Name: Valley Landfills, Inc.
Project Name: Coffin Butte Landfill
Location: Benton County, Oregon
Driller: Geo-Tech Explorations, Inc.

Boring/Well No.: QP-4S
Top of Casing Elev.: 718.95
Ground Surface Elev.: 717.15
Installation Date: 9/15/98
Permit/Start Card No.: 112477



Depth (feet)	Elev. (ft, msl)
1.8 ags	718.95
3.1 bgs	714.05
0.0	717.15
28.4	688.75
363.1	354.05
403.1	314.05
403.1	314.05

EXPLORATORY BORING

A. Total depth: 403.1 ft.
B. Diameter 10 in. (0-20.8 feet)
6 in (20.8-403.1 feet)
Drilling method: Air Rotary

WELL CONSTRUCTION

C. Well casing length: 400.0 ft.
Well casing material: Sched 80 PVC
D. Well casing diameter: 5.0 in.
E. Well screen length: 40.0 ft.
Well screen type: Machine Slotted
Well screen slot size: 0.020 in.
F. Well sump/end cap length: Open End
G. Well casing height (stickup): 0.0 ft.
H. Surface seal thickness: 28.4 ft.
I. Surface seal material: Concrete
J. Annular seal thickness: NA ft.
K. Annular seal material: NA
L. Filter pack seal thickness: NA ft.
M. Filter pack seal material: NA
N. Sand pack thickness: NA ft.
O. Sand pack material: NA
P. Bottom material thickness: NA ft.
Q. Bottom material: NA
R. Protective casing material: Steel
Well centralizer depths: NA
S. Protective casing diameter: 6.0 in.

NOTES:

QP-4S was completed as a domestic well. Drilled to 20.8 feet with a 10-inch hammer bit. Sealed with concrete and drilled the remainder with a 6-inch hammer bit. PVC casing hung in well. No filter pack or seals placed in annulus.

Installed by: John J. Renda

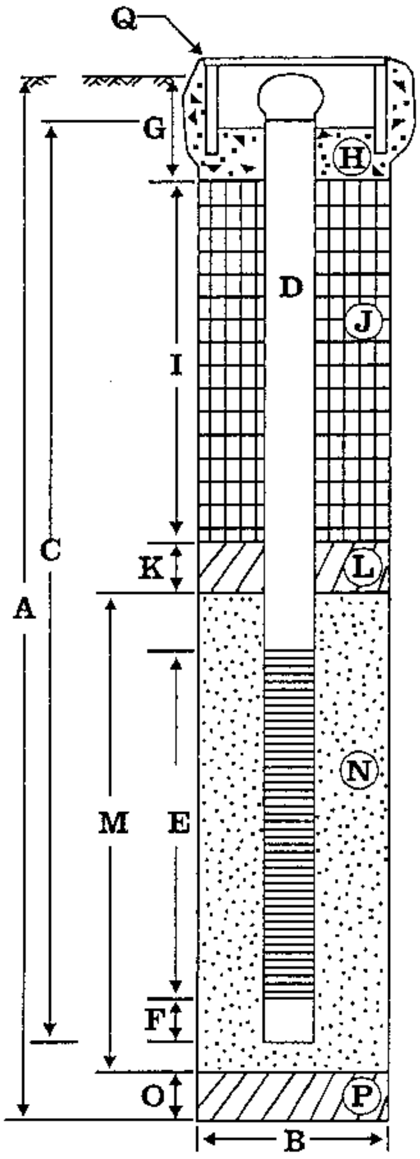
Reviewed by:

Date:

WELL DETAILS

Project Number: 40139-001.066
Client Name: Valley Landfills, Inc.
Project Name: Coffin Butte Landfill
Location: Benton County, Oregon
Driller: Geo-Tech Explorations, Inc.

Boring/Well No.: QP-5N
Top of Casing Elev.: 601.53
Ground Surface Elev.: 601.48
Installation Date: 9/16/98
Permit/Start Card No.: 112471



Depth (ft, bgs)	Elev. (ft, msl)
0.0	601.48
0.3	601.53
1.0	600.48
191.2	410.28
197.7	403.78
200.3	401.18
230.3	371.18
230.9	370.58
230.9	370.58

EXPLORATORY BORING

A. Total depth: 230.9 ft.
B. Diameter: 6 in.
Drilling method: Air Rotary

WELL CONSTRUCTION

C. Well casing length: 230.6 ft.
Well casing material: Sched 80 PVC
D. Well casing diameter: 2 in.
E. Well screen length: 30 ft.
Well screen type: Machine Slotted
Well screen slot size: 0.020 in.
F. Well sump/end cap length: 0.65 ft.
G. Surface seal thickness: 1.0 ft.
H. Surface seal material: Concrete
I. Annular seal thickness: 190 ft.
J. Annular seal material: Bentonite Grout
K. Filter pack seal thickness: 6.5 ft.
L. Filter pack seal material: See Below
M. Sand pack thickness: 33.2 ft.
N. Sand pack material: 8X12 Silica Sand
O. Bottom material thickness: NA ft.
P. Bottom material: NA
Q. Vault box type: Sherwood Flush
Well centralizer depths: 5 ft.
40 ft.
80 ft.
120 ft.
160 ft.
200 ft.
229 ft.

NOTES: Filter pack seal constucted of 3.5 feet bentonite chips overlaying 3.0 feet 20X40 Silica Sand.

Installed by: John J. Renda

Reviewed by:

Date:

PJ:\GEOLOGY\COFFIN-B\QUARRY\QP5NDET.DOC\JRENDA

WELL DETAILS

Project Number: **40139-001.066**

Client Name: **Valley Landfills, Inc.**

Project Name: **Coffin Butte Landfill**

Location: **Benton County, Oregon**

Driller: **Geo-Tech Explorations, Inc.**

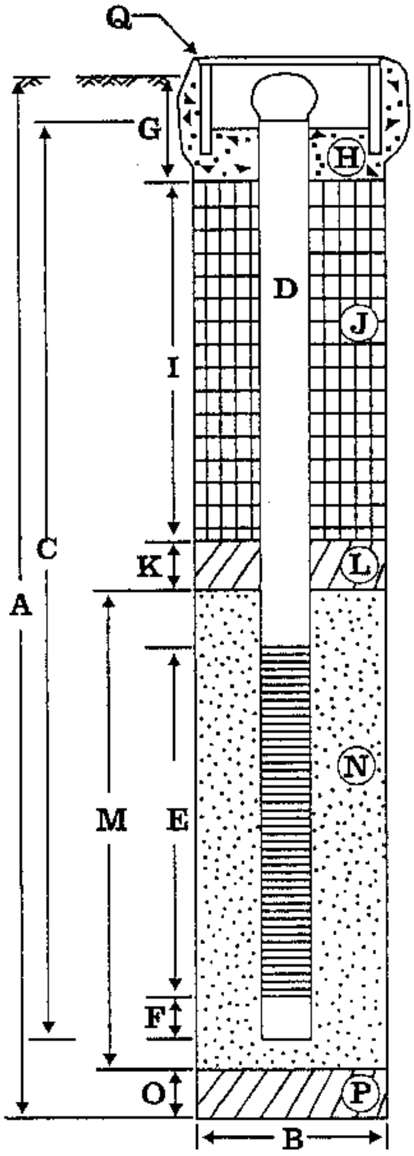
Boring/Well No.: **QP-6N**

Top of Casing Elev.: **445.82**

Ground Surface Elev.: **445.39**

Installation Date: **9/18/98**

Permit/Start Card No.: **112472**



Depth (ft, bgs)	Elev. (ft, msl)
0.0	445.3
0.4 ags	445.8
1.0	444.3
111.6	334.7
117.3	328.0
119.4	325.9
149.4	295.9
150.0	295.3
150.0	295.3

EXPLORATORY BORING

A. Total depth: 150.0 ft.

B. Diameter: 6 in.

Drilling method: Air Rotary

WELL CONSTRUCTION

C. Well casing length: 150.4 ft.

Well casing material: Sched 80 PVC

D. Well casing diameter: 2 in.

E. Well screen length: 30 ft.

Well screen type: Machine Slotted

Well screen slot size: 0.020 in.

F. Well sump/end cap length: 0.65 ft.

G. Surface seal thickness: 1.0 ft.

H. Surface seal material: Concrete

I. Annular seal thickness: 110.6 ft.

J. Annular seal material: Bentonite Grout

K. Filter pack seal thickness: 5.7 ft.

L. Filter pack seal material: See Below

M. Sand pack thickness: 33.2 ft.

N. Sand pack material: 8X12 Silica Sand

O. Bottom material thickness: NA ft.

P. Bottom material: NA

Q. Vault box type: Sherwood Flush

Well centralizer depths: 5 ft.
40 ft.
80 ft.
120 ft.
149 ft.

NOTES: Filter pack seal constucted of 3.0 feet bentonite chips overlaying 2.7 feet 20X40 Silica Sand.

Installed by: John J. Renda

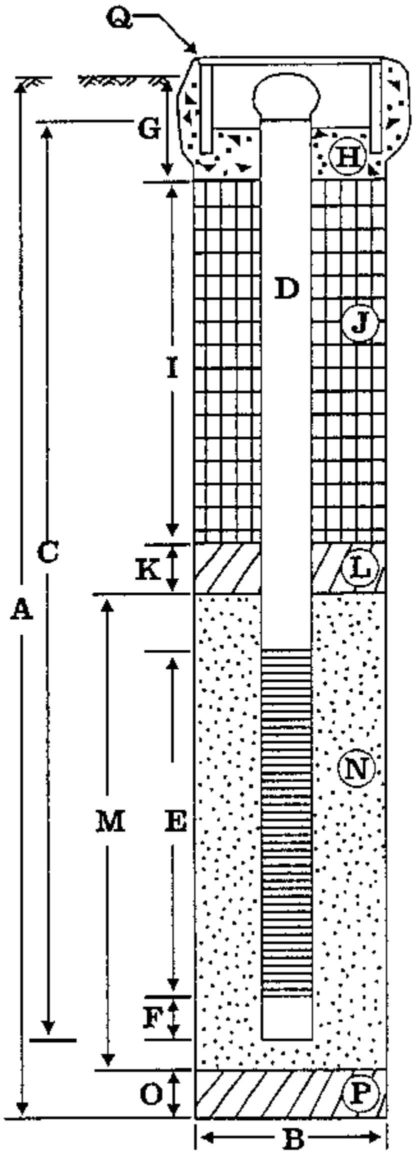
Reviewed by:

Date:

WELL DETAILS

Project Number: **40139-001.066**
Client Name: **Valley Landfills, Inc.**
Project Name: **Coffin Butte Landfill**
Location: **Benton County, Oregon**
Driller: **Geo-Tech Explorations, Inc.**

Boring/Well No.: **QP-7N**
Top of Casing Elev.: **374.50**
Ground Surface Elev.: **374.43**
Installation Date: **9/9/98**
Permit/Start Card No.: **112473**



Depth (ft, bgs)	Elev. (ft, msl)
0.0	374.43
0.1 ags	374.50
1.0	373.43
82.0	292.43
85.2	289.23
89.0	285.43
119.0	255.43
119.6	254.83
119.6	254.83

EXPLORATORY BORING

A. Total depth: **119.6** ft.
B. Diameter: **6** in.
Drilling method: **Air Rotary**

WELL CONSTRUCTION

C. Well casing length: **119.7** ft.
Well casing material: **Sched 80 PVC**
D. Well casing diameter: **2** in.
E. Well screen length: **30** ft.
Well screen type: **Machine Slotted**
Well screen slot size: **0.020** in.
F. Well sump/end cap length: **0.65** ft.
G. Surface seal thickness: **1.0** ft.
H. Surface seal material: **Concrete**
I. Annular seal thickness: **81.0** ft.
J. Annular seal material: **Bentonite Grout**
K. Filter pack seal thickness: **3.2** ft.
L. Filter pack seal material: **See Below**
M. Sand pack thickness: **34.4** ft.
N. Sand pack material: **8X12 Silica Sand**
O. Bottom material thickness: **NA** ft.
P. Bottom material: **NA**
Q. Vault box type: **Sherwood Flush**
Well centralizer depths: **10** ft.
50 ft.
90 ft.
114 ft.

NOTES: Filter pack seal constucted of 1.0 feet bentonite chips overlaying 2.2 feet 20X40 Silica Sand.

Installed by: **John J. Renda**

Reviewed by:

Date:

P:\J:\GEOLOGY\COFFIN-B\QUARRY\QP7NDET.DOC\RENDA

PROJECT: Coffin Butte Landfill - Piezometer Installation
LOCATION: Benton Co, Oregon
NUMBER: C031.001.0801

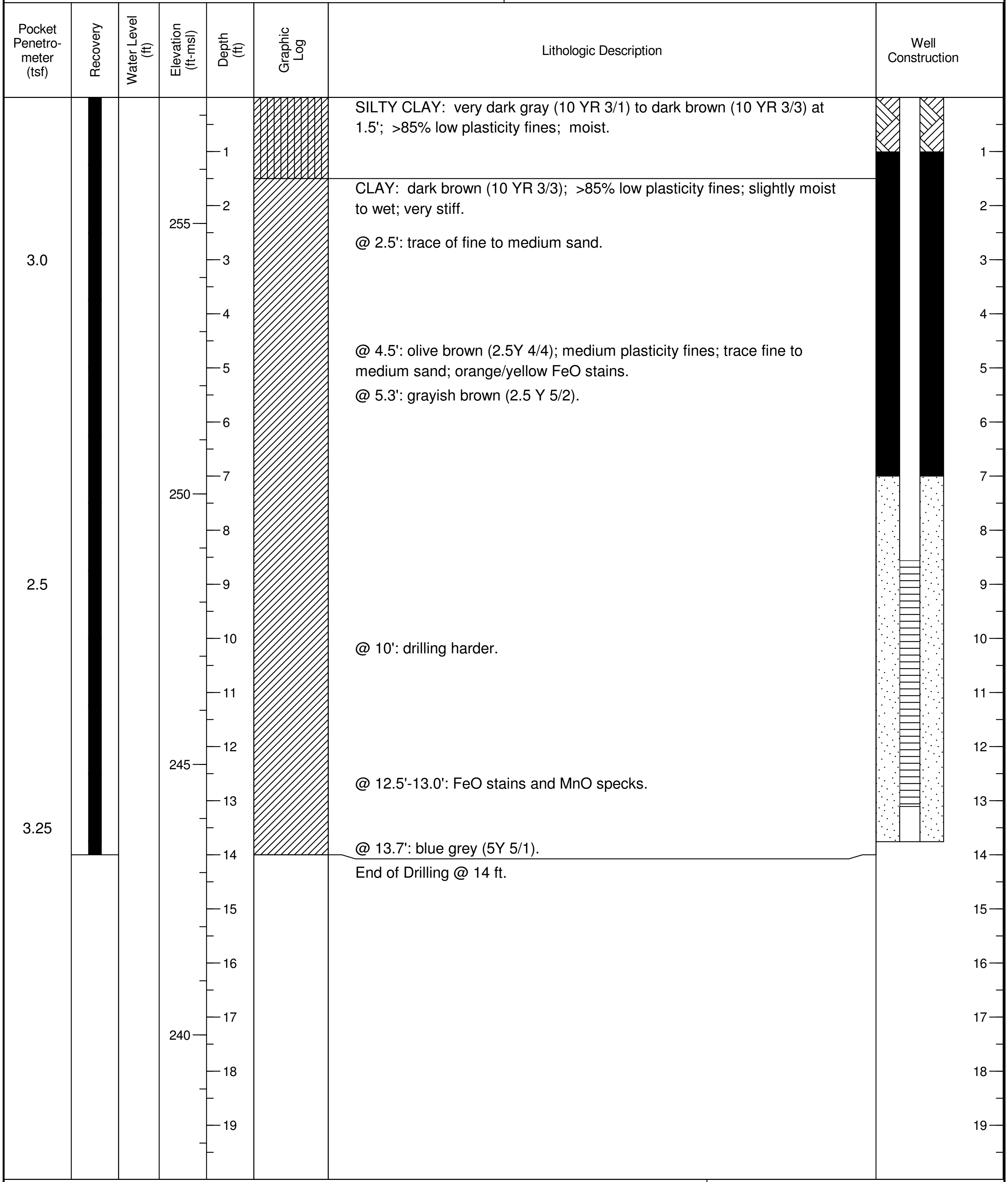
WELL / BORING NO: WP-1
PAGE 1 of 1
GEOLOGIST/ENGINEER: S. Weaver

STARTED: 1/18/2008
COMPLETED: 1/18/2008

ELEVATION (ft-msl): 257.33
TOC ELEV (ft): 259.83

DRILLING COMPANY: Boart Longyear
DRILLING METHOD: Geoprobe
HOLE DIAMETER (in): 3.5

TOTAL DEPTH (ft): 14
NORTHING: 387199.43
EASTING: 7488891.35



SILTY CLAY: very dark gray (10 YR 3/1) to dark brown (10 YR 3/3) at 1.5'; >85% low plasticity fines; moist.

CLAY: dark brown (10 YR 3/3); >85% low plasticity fines; slightly moist to wet; very stiff.

@ 2.5': trace of fine to medium sand.

@ 4.5': olive brown (2.5Y 4/4); medium plasticity fines; trace fine to medium sand; orange/yellow FeO stains.

@ 5.3': grayish brown (2.5 Y 5/2).

@ 10': drilling harder.

@ 12.5'-13.0': FeO stains and MnO specks.

@ 13.7': blue grey (5Y 5/1).

End of Drilling @ 14 ft.

NOTES: Continuous core with 1.5" inner diameter push probe to total depth. Hole reamed out w/ 3.5" probe with expendable alumina tip. 2" diameter well installed inside temporary push probe casing.

KENNEC
12725 SW 66th Ave. Suite 202
Portland, OR 97223
(503) 619-0501

PROJECT: Coffin Butte Landfill - Piezometer Installation
LOCATION: Benton Co, Oregon
NUMBER: C031.001.0801

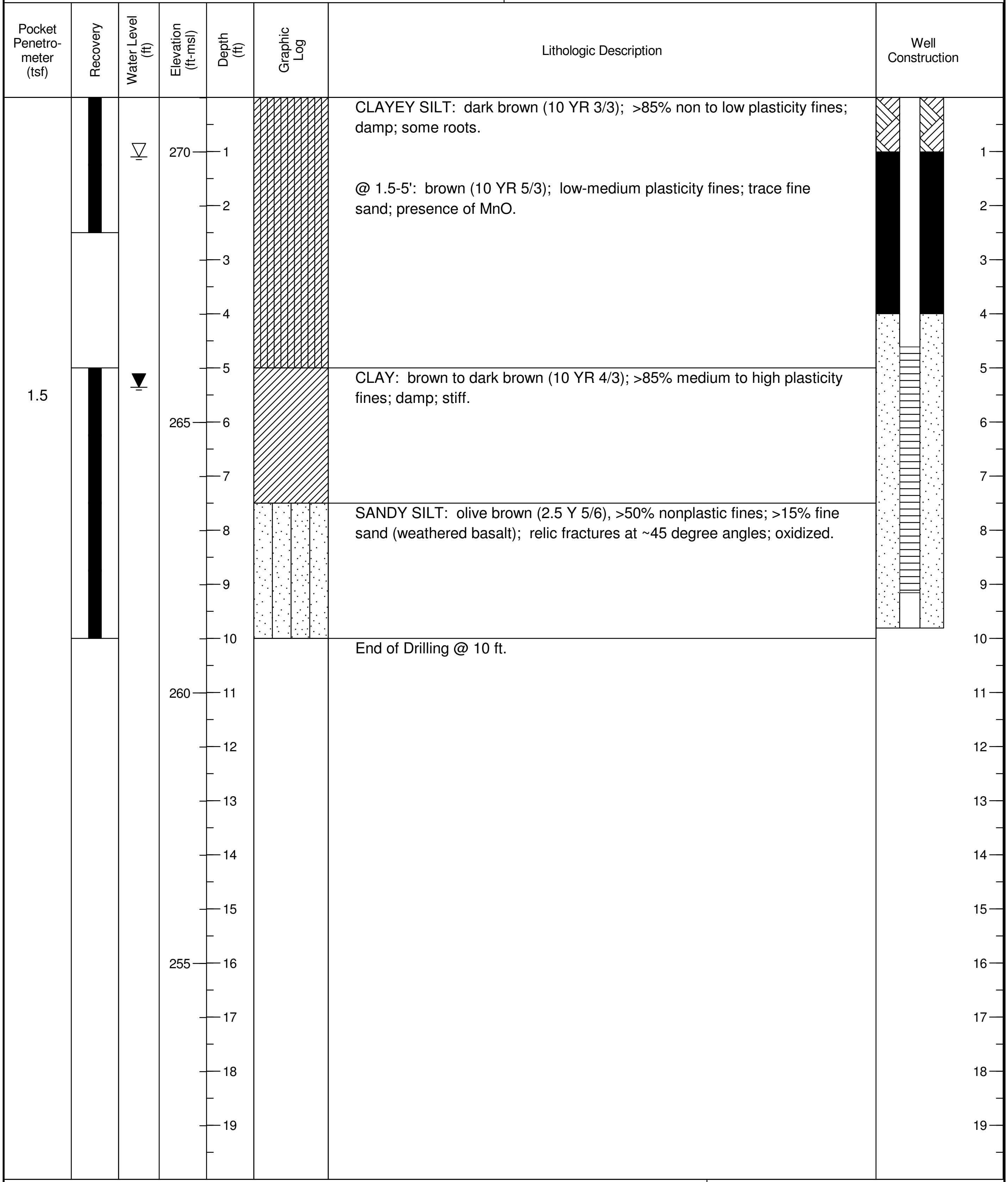
WELL / BORING NO: WP-3
PAGE 1 of 1
GEOLOGIST/ENGINEER: S. Weaver

STARTED: 1/18/2008
COMPLETED: 1/18/2008

ELEVATION (ft-msl): 271.01
TOC ELEV (ft): 273.39

DRILLING COMPANY: Boart Longyear
DRILLING METHOD: Geoprobe
HOLE DIAMETER (in): 3.5

TOTAL DEPTH (ft): 10
NORTHING: 386661.8
EASTING: 7489643.8



CLAYEY SILT: dark brown (10 YR 3/3); >85% non to low plasticity fines; damp; some roots.

@ 1.5-5': brown (10 YR 5/3); low-medium plasticity fines; trace fine sand; presence of MnO.

CLAY: brown to dark brown (10 YR 4/3); >85% medium to high plasticity fines; damp; stiff.

SANDY SILT: olive brown (2.5 Y 5/6), >50% nonplastic fines; >15% fine sand (weathered basalt); relic fractures at ~45 degree angles; oxidized.

End of Drilling @ 10 ft.

NOTES: Continuous core with 1.5" inner diameter push probe to total depth. Hole reamed out w/ 3.5" probe with expendable alumina tip. 2" diameter well installed inside temporary push probe casing.

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PROJECT: Coffin Butte Landfill - Piezometer Installation
LOCATION: Benton Co, Oregon
NUMBER: C031.001.0801

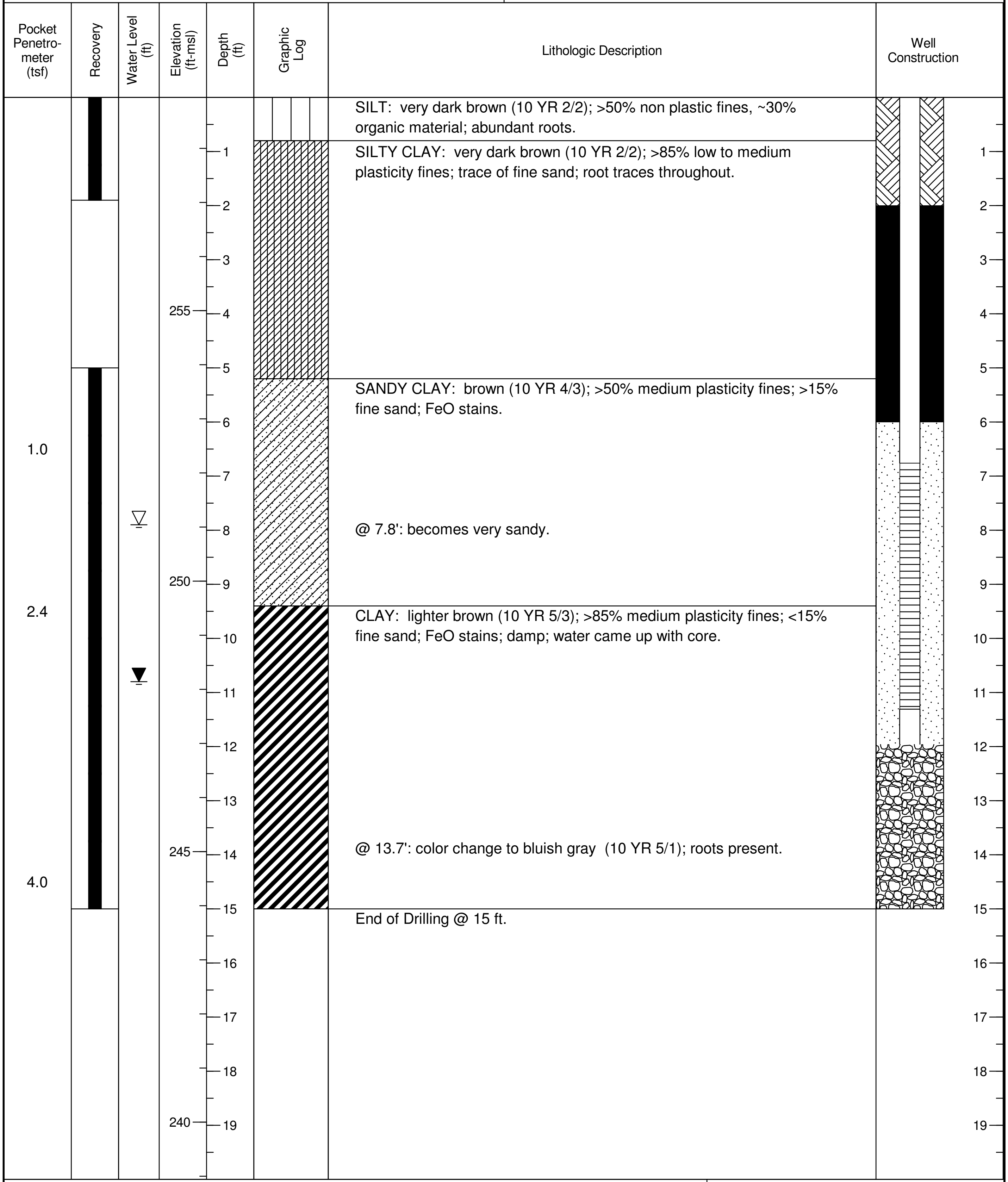
WELL / BORING NO: WP-5
PAGE 1 of 1
GEOLOGIST/ENGINEER: S. Weaver

STARTED: 1/18/2008 COMPLETED: 1/18/2008

ELEVATION (ft-msl): 258.94 TOC ELEV (ft): 261.55

DRILLING COMPANY: Boart Longyear
DRILLING METHOD: Geoprobe
HOLE DIAMETER (in): 3.5

TOTAL DEPTH (ft): 15
NORTHING: 386542.49
EASTING: 7488194.58



SILT: very dark brown (10 YR 2/2); >50% non plastic fines, ~30% organic material; abundant roots.

SILTY CLAY: very dark brown (10 YR 2/2); >85% low to medium plasticity fines; trace of fine sand; root traces throughout.

SANDY CLAY: brown (10 YR 4/3); >50% medium plasticity fines; >15% fine sand; FeO stains.

@ 7.8': becomes very sandy.

CLAY: lighter brown (10 YR 5/3); >85% medium plasticity fines; <15% fine sand; FeO stains; damp; water came up with core.

@ 13.7': color change to bluish gray (10 YR 5/1); roots present.

End of Drilling @ 15 ft.

NOTES: Continuous core with 1.5" inner diameter push probe to total depth. Hole reamed out w/ 3.5" probe with expendable alumina tip. 2" diameter well installed inside temporary push probe casing. Slough in bottom 3' of original borehole.

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PROJECT: Coffin Butte Landfill - Piezometer Installation
LOCATION: Benton Co, Oregon
NUMBER: C031.001.0801

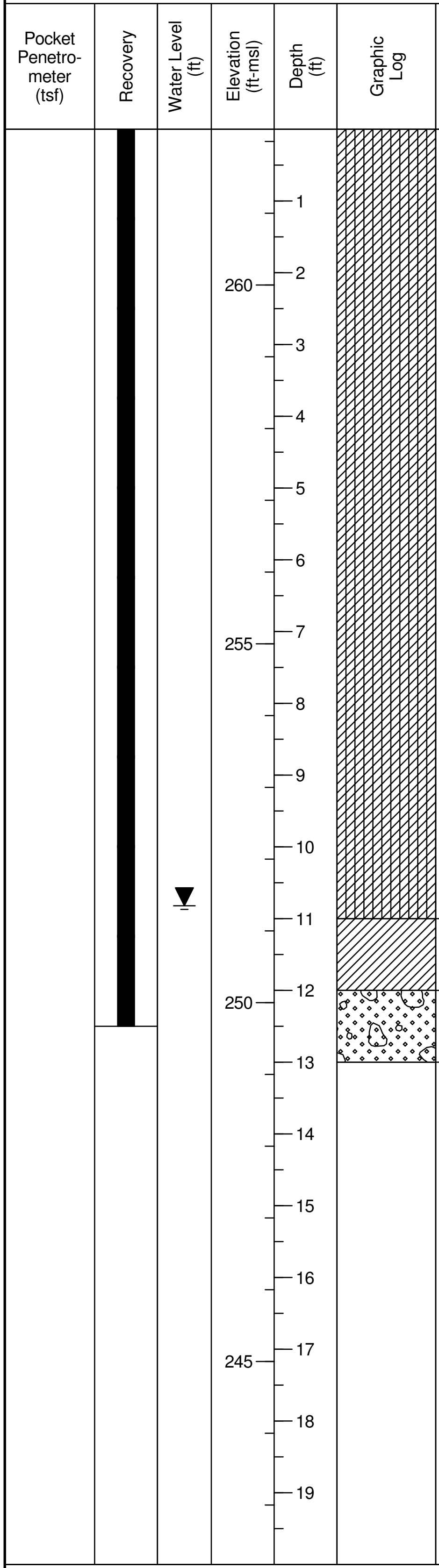
WELL / BORING NO: WP-6
PAGE 1 of 1
GEOLOGIST/ENGINEER: S. Weaver

STARTED: 1/18/2008 COMPLETED: 1/19/2008

ELEVATION (ft-msl): 262.17 TOC ELEV (ft): 264.85

DRILLING COMPANY: Boart Longyear
DRILLING METHOD: Geoprobe
HOLE DIAMETER (in): 3.5

TOTAL DEPTH (ft): 13
NORTHING: 385927.41
EASTING: 7487995.09



Lithologic Description

SILTY CLAY: dark gray (10 YR 4/1); >85% low plasticity fines; trace of sand.

@ 2.5': dark brown (10 YR 3/3); trace of FeO stains and hackly fracture; damp.

@ 8.7': becomes sandy; moist.

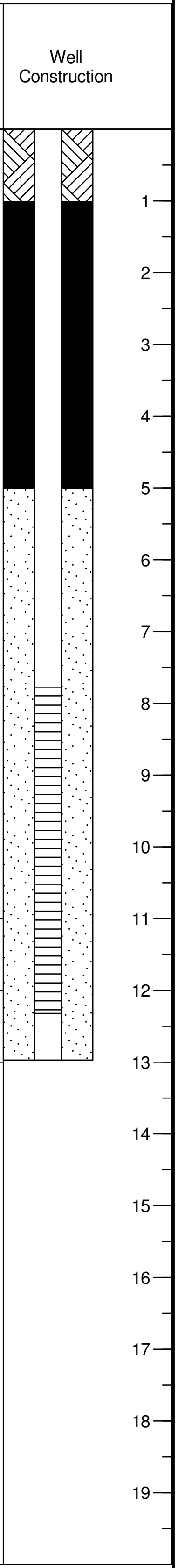
@ 9.8': gray brown (10 YR 5/2); root traces.

@ 10-11': moist; organic material present.

CLAY: bluish gray (2.5Y 5/0); >85% low plasticity fines; <15% medium to coarse sand (weathered bedrock); damp.

GRAVELLY SAND (Weathered bedrock): dark grey (2.5 Y 4/0); >50% medium to coarse sand; >15% fine gravel.

End of Drilling @ 13 ft.



NOTES: Continuous core with 1.5" inner diameter push probe to total depth. Hole reamed out w/ 3.5" probe with expendable alumina tip. 2" diameter well installed inside temporary push probe casing.

PROJECT: Coffin Butte Landfill - Piezometer Installation
LOCATION: Benton Co, Oregon
NUMBER: C031.001.0801

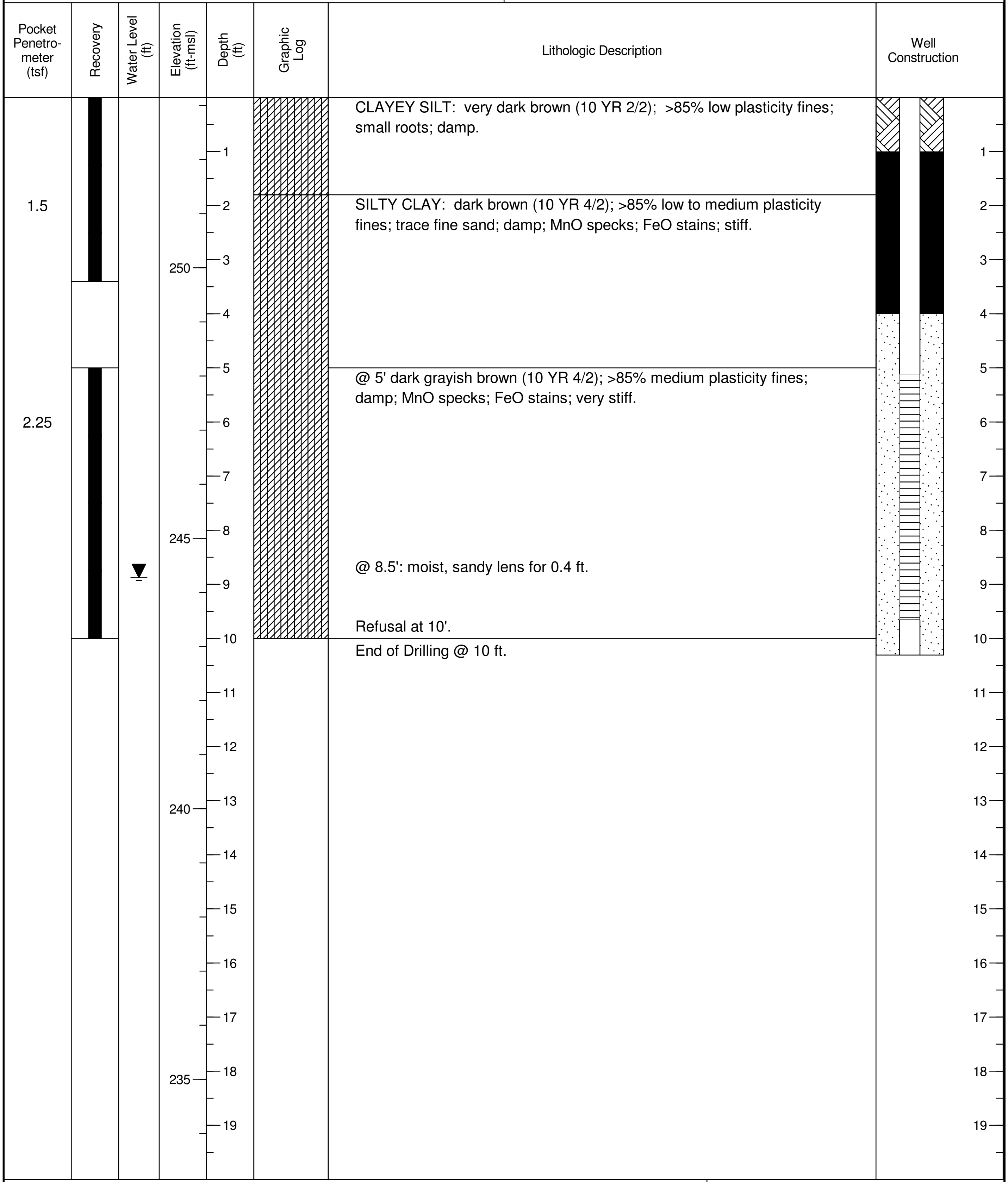
WELL / BORING NO: WP-8
PAGE 1 of 1
GEOLOGIST/ENGINEER: S. Weaver

STARTED: 1/19/2008 COMPLETED: 1/19/2008

ELEVATION (ft-msl): 253.15 TOC ELEV (ft): 255.8

DRILLING COMPANY: Boart Longyear
DRILLING METHOD: Geoprobe
HOLE DIAMETER (in): 3.5

TOTAL DEPTH (ft): 10
NORTHING: 387859.11
EASTING: 7487857.45



CLAYEY SILT: very dark brown (10 YR 2/2); >85% low plasticity fines; small roots; damp.

SILTY CLAY: dark brown (10 YR 4/2); >85% low to medium plasticity fines; trace fine sand; damp; MnO specks; FeO stains; stiff.

@ 5' dark grayish brown (10 YR 4/2); >85% medium plasticity fines; damp; MnO specks; FeO stains; very stiff.

@ 8.5': moist, sandy lens for 0.4 ft.

Refusal at 10'.

End of Drilling @ 10 ft.

NOTES: Continuous core with 1.5" inner diameter push probe to total depth. Hole reamed out w/ 3.5" probe with expendable alumina tip. 2" diameter well installed inside temporary push probe casing.

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PROJECT: Coffin Butte Landfill - Piezometer Installation
LOCATION: Benton Co, Oregon
NUMBER: C031.001.0801

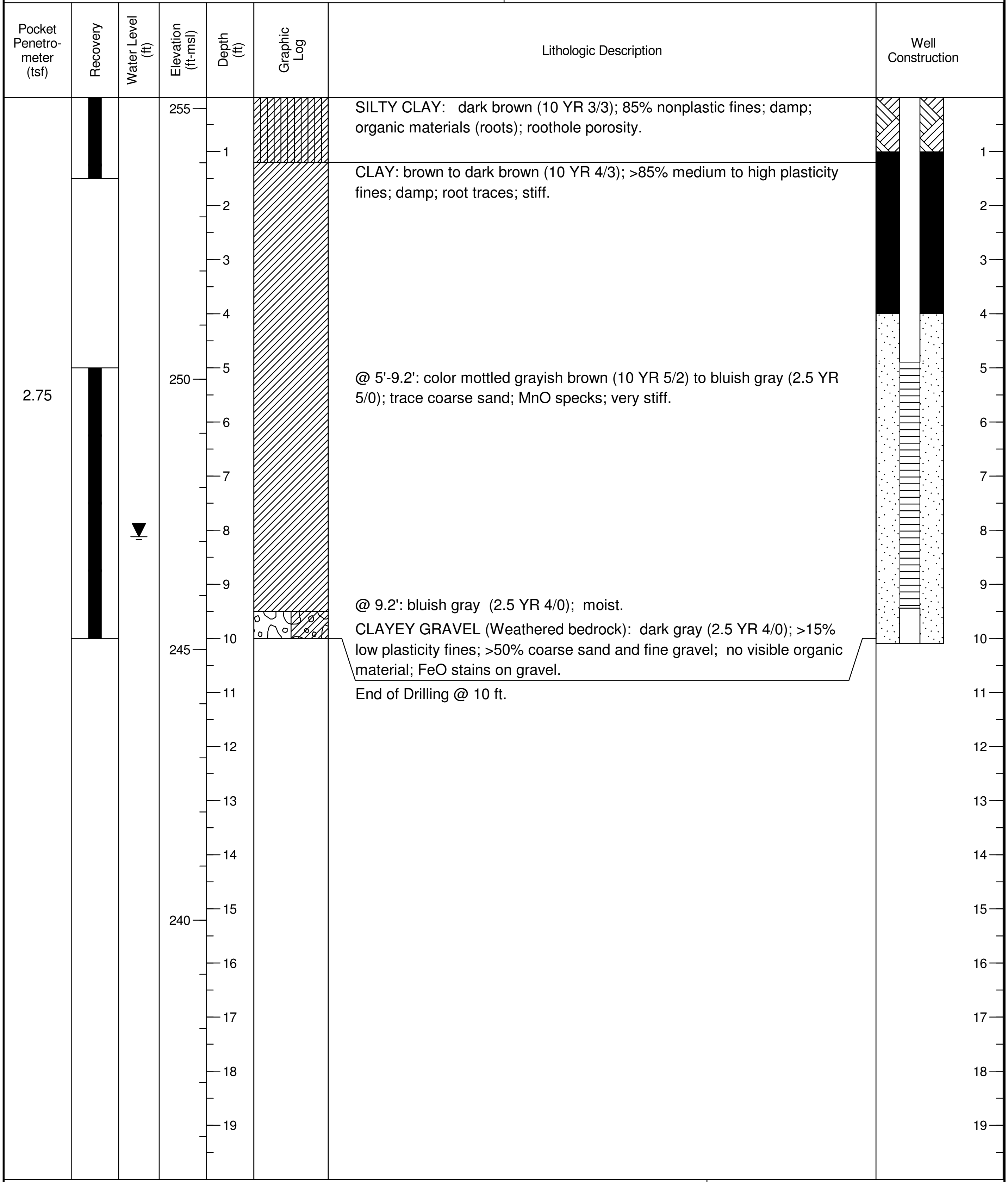
WELL / BORING NO: WP-9
PAGE 1 of 1
GEOLOGIST/ENGINEER: S. Weaver

STARTED: 1/19/2008
COMPLETED: 1/19/2008

ELEVATION (ft-msl): 255.21
TOC ELEV (ft): 257.9

DRILLING COMPANY: Boart Longyear
DRILLING METHOD: Geoprobe
HOLE DIAMETER (in): 3.5

TOTAL DEPTH (ft): 10
NORTHING: 387473.26
EASTING: 7486843.08



SILTY CLAY: dark brown (10 YR 3/3); 85% nonplastic fines; damp; organic materials (roots); roothole porosity.

CLAY: brown to dark brown (10 YR 4/3); >85% medium to high plasticity fines; damp; root traces; stiff.

@ 5'-9.2': color mottled grayish brown (10 YR 5/2) to bluish gray (2.5 YR 5/0); trace coarse sand; MnO specks; very stiff.

@ 9.2': bluish gray (2.5 YR 4/0); moist.

CLAYEY GRAVEL (Weathered bedrock): dark gray (2.5 YR 4/0); >15% low plasticity fines; >50% coarse sand and fine gravel; no visible organic material; FeO stains on gravel.

End of Drilling @ 10 ft.

NOTES: Continuous core with 1.5" inner diameter push probe to total depth. Hole reamed out w/ 3.5" probe with expendable alumina tip. 2" diameter well installed inside temporary push probe casing.

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12725 SW 66th Ave. Suite 202
Portland, OR 97223
(503) 619-0501

The original and first copy of this report are to be filed with the
WATER RESOURCES DEPARTMENT.
SALEM, OREGON 97310
within 30 days from the date of well completion.

RECEIVED
AUG 2 9 1977
WATER RESOURCES DEPT
SALEM, OREGON

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

State Well No. 10S/5W-13
State Permit No.
PW-1

1) OWNER:
Name Valley Land Fill Inc.
Address P.O. Box 1
Corvallis, Oregon 97330

2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

3) TYPE OF WELL:
otary ☒ Driven ☐
able ☐ Jetted ☐
ug ☐ Bored ☐

(4) PROPOSED USE (check):
Domestic ☒ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

CASING INSTALLED:
Threaded ☐ Welded ☐
6" Diam. from 0 ft. to 60 ft. Gage .250
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

PERFORATIONS:
Perforated? ☐ Yes ☒ No.
ype of perforator used
ze of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

7) CREENS:
Well screen installed? ☐ Yes ☒ No
cturer's Name
ype Model No.
iam. Slot size Set from ft. to ft.
am. Slot size Set from ft. to ft.

3) WELL TESTS:
Drawdown is amount water level is lowered below static level
as a pump test made? ☐ Yes ☒ No If yes, by whom?
l: gal./min. with ft. drawdown after hrs.
" " "
Tested with air: could fluctuate
iler test 12 gal./min. with 92 ft. drawdown after 4 hrs.
sian flow g.p.m.
rature of water Depth artesian flow encountered ft.

) CONSTRUCTION:
ll seal—Material used Cement
ll sealed from land surface to 58 ft.
ameter of well bore to bottom of seal 10 in.
ameter of well bore below seal 6 in.
mber of sacks of cement used in well seal 10 sacks
w was cement grout placed?
Pumped through tremie
[illegible]
rive shoe used? ☐ Yes ☒ No Plugs Size: location ft.
d any strata contain unusable water? ☐ Yes ☒ No
pe of water? depth of strata
thod of sealing strata off
s well gravel packed? ☐ Yes ☒ No Size of gravel:
vel placed from ft. to ft.

(10) LOCATION OF WELL:
County Benton Driller's well number S/76/K
¼ ¼ Section 13 T. 10S R. 5W W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 89 ft.
Static level 20 ft. below land surface. Date 8/3/77
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:
Diameter of well below casing 6
Depth drilled 125 ft. Depth of completed well 125 ft.

Formation: Describe color, texture, grain size and structure of materials; and show thickness and nature of each stratum and aquifer penetrated, with at least one entry for each change of formation. Report each change in position of Static Water Level and indicate principal water-bearing strata.

MATERIAL	From	To	SWL
Topsoil	0	1	-
Brown sandy clay	1	3	
Tan sticky clay	3	14	
Brown sandstone (broken)	14	52	
Dark grey sandstone	52	80	
Brown basalt (cong)	80	83	
Black basalt W/Quartz	83	89	
Brown basalt	89	91	
Black basalt	91	107	
Brown sandstone	107	109	
Blue sandstone	109	125	

Work started 8/3/77 19 Completed 8/3/77 19
Date well drilling machine moved off of well 8/3/77 19

Drilling Machine Operator's Certification:

This well was constructed under my direct supervision. Materials used and information reported above are true to my best knowledge and belief.

[Signed] (Drilling Machine Operator) Date 8/4/77 19
Drilling Machine Operator's License No. 689

Water Well Contractor's Certification:

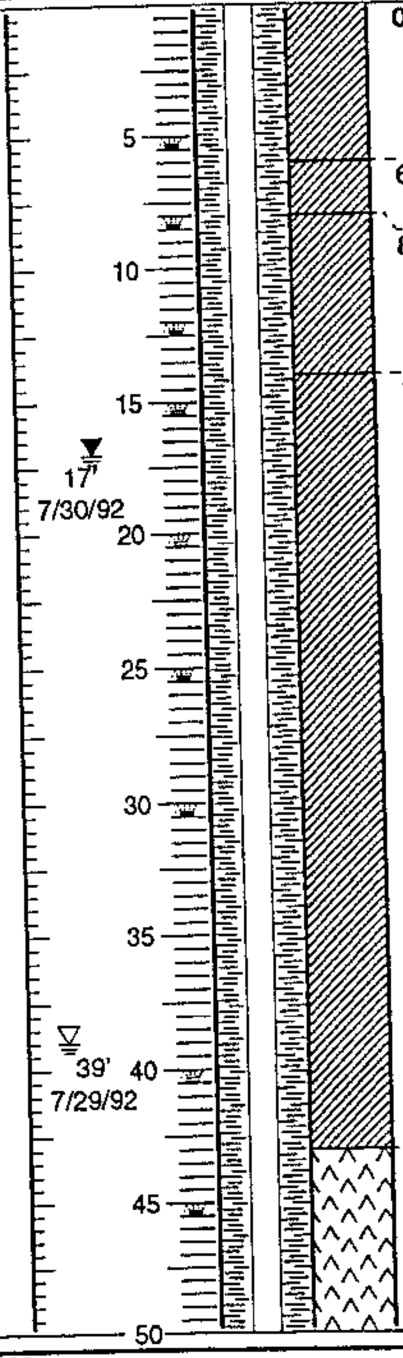
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Name Corvallis Drilling Co. Inc.
(Person, firm or corporation) (Type or print)
Address 3440 SW 3rd St. Corvallis, Oregon 97330
[Signed] (Water Well Contractor)
Contractor's License No. 560 Date 8/4/77 19

LOG OF EXPLORATORY BORING

PROJECT NAME **COFFIN BUTTE LANDFILL**
LOCATION **Benton County, Oregon**
DRILLED BY **Staco Well Services**
DRILL METHOD **Air rotary**
LOGGED BY **Craig D. Fanshier**

BORING NO. **PW- 2**
PAGE **1 OF 5**
REFERENCE ELEV. **248.90'**
TOTAL DEPTH **199.00'**
DATE COMPLETED **7/30/92**



RECOVERY PERCENT	POCKET PENETRO-METER (TSF)	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
								0-6 feet: SILTY CLAY (CL), brown, hard, dry. (ALLUVIUM)
								6-8 feet: GRAVELLY CLAY (CL), brown, 60-80% clay, soft, 20-40% gravel (medium grain gray basalt), dry.
								8-14 feet: SILTY CLAY (CL), light brown, low plasticity, damp.
								14-43 feet: GRAVELLY CLAY (CL), light brown to light yellowish brown clay, low plasticity, 20-30% gravels (1/8-1/2").
								43-89 feet: BASALT, brown to gray, 5% green, 5% purple tint, fine to medium grained, moderately weathered.

REMARKS

Boring drilled with air rotary using a 10-inch downhole hammer to 94 feet bgs and with a 6-inch downhole hammer from 94 to 199 feet bgs.

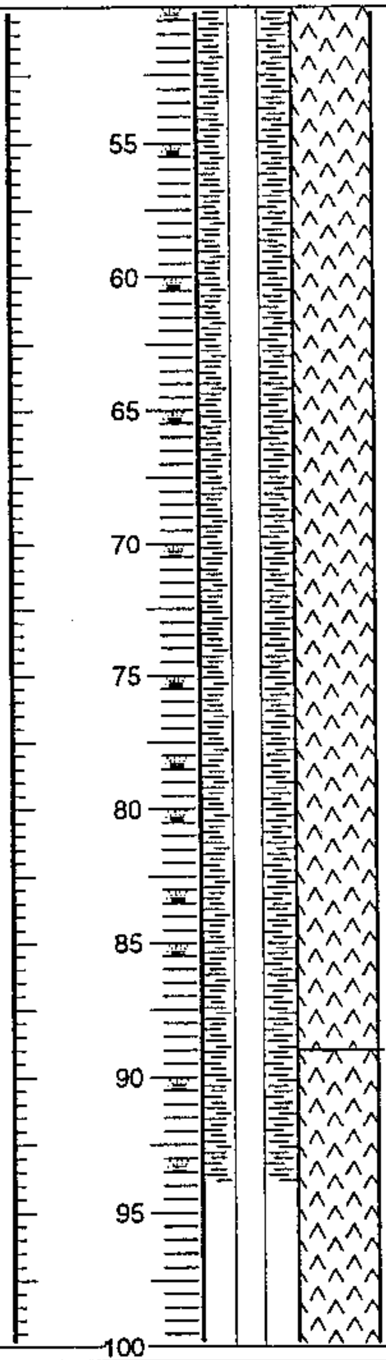
EMCON Northwest, Inc.

LOG OF EXPLORATORY BORING

PROJECT NAME COFFIN BUTTE LANDFILL
LOCATION Benton County, Oregon
DRILLED BY Staco Well Services
DRILL METHOD Air rotary
LOGGED BY Craig D. Fanshier

BORING NO. PW-2
PAGE 2 OF 5
REFERENCE ELEV. 248.90'
TOTAL DEPTH 199.00'
DATE COMPLETED 7/30/92

RECOVERY PERCENT	POCKET PENETRO-METER (TSF)	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION



43-89 feet: **BASALT**, brown to gray, 5% green, 5% purple tint, fine to medium grained, moderately weathered.

@ 52-57 feet: No green or purple tint.

@ 57 feet: Easier drilling, trace quartz and plagioclase.

@ 65 feet: Traces of quartz or plagioclase.

@ 71-72 feet: Easier drilling.

@ 85 feet: Harder drilling.

89-199 feet: **BASALT**, 60% greenish gray, 40% purple tint, fine to medium grained. Fresh basalt.

@ 95 feet: Borehole produces approximately 10 gpm water by air lifting through the drill pipe using the drilling air compressor.

REMARKS

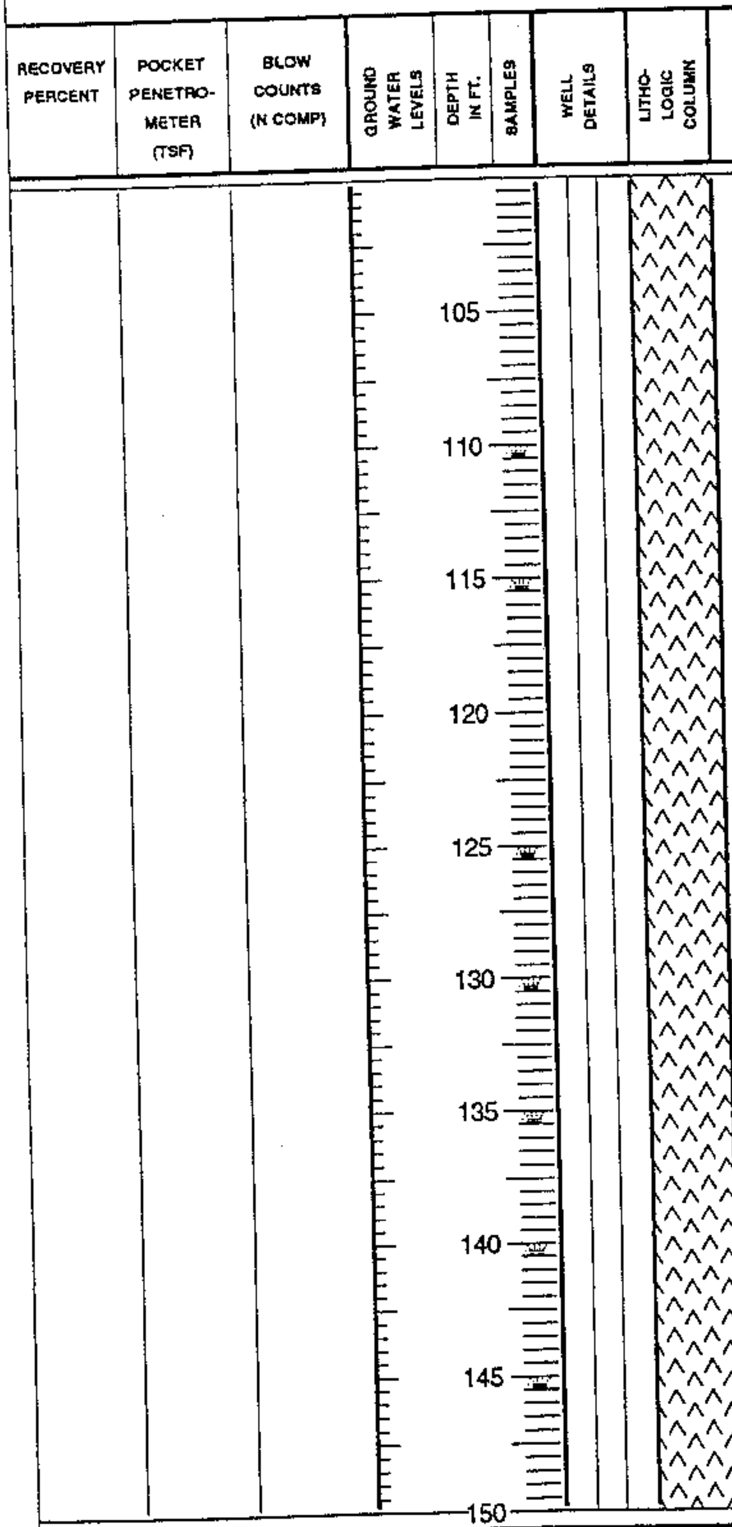
Boring drilled with air rotary using a 10-inch downhole hammer to 94 feet bgs and with a 6-inch downhole hammer from 94 to 199 feet bgs.

EMCON Northwest, Inc.

LOG OF EXPLORATORY BORING

PROJECT NAME COFFIN BUTTE LANDFILL
LOCATION Benton County, Oregon
DRILLED BY Staco Well Services
DRILL METHOD Air rotary
LOGGED BY Craig D. Fanshier

BORING NO. PW- 2
PAGE 3 OF 5
REFERENCE ELEV. 248.90'
TOTAL DEPTH 199.00'
DATE COMPLETED 7/30/92



LITHOLOGIC DESCRIPTION

89-199 feet: BASALT, 60% greenish gray, 40% purple tint, fine to medium grained. Fresh basalt.

REMARKS

Boring drilled with air rotary using a 10-inch downhole hammer to 94 feet bgs and with a 6-inch downhole hammer from 94 to 199 feet bgs.

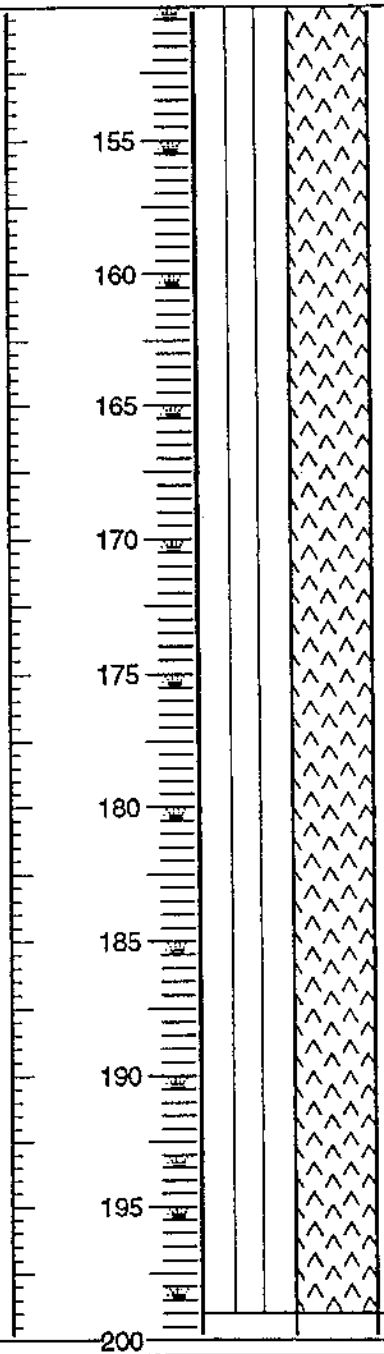
EMCON Northwest, Inc.

LOG OF EXPLORATORY BORING

PROJECT NAME **COFFIN BUTTE LANDFILL**
LOCATION **Benton County, Oregon**
DRILLED BY **Staco Well Services**
DRILL METHOD **Air rotary**
LOGGED BY **Craig D. Fanshier**

BORING NO. **PW- 2**
PAGE **4 OF 5**
REFERENCE ELEV. **248.90'**
TOTAL DEPTH **199.00'**
DATE COMPLETED **7/30/92**

RECOVERY PERCENT	POCKET PENETRO-METER (TSF)	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
								89-199 feet: BASALT, 60% greenish gray, 40% purple tint, fine to medium grained. Fresh basalt.



REMARKS

Boring drilled with air rotary using a 10-inch downhole hammer to 94 feet bgs and with a 6-inch downhole hammer from 94 to 199 feet bgs.

EMCON Northwest, Inc.

LOG OF EXPLORATORY BORING

PROJECT NAME **COFFIN BUTTE LANDFILL**
LOCATION **Benton County, Oregon**
DRILLED BY **Staco Well Services**
DRILL METHOD **Air rotary**
LOGGED BY **Craig D. Fanshier**

BORING NO. **PW- 2**
PAGE **5 OF 5**
REFERENCE ELEV. **248.90'**
TOTAL DEPTH **199.00'**
DATE COMPLETED **7/30/92**

RECOVERY PERCENT	POCKET PENETRO-METER (TSF)	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHO-LOGIC COLUMN	LITHOLOGIC DESCRIPTION
				205 210 215 220 225 230 235 240 245 250				Total depth drilled 199 feet below ground surface. Total depth sampled 199 feet below ground surface. **WELL COMPLETION DETAILS:** 0-94 feet: Bentonite grout slurry surface seal. +1.37-94 feet: 6-inch dia., 0.250-inch steel surface casing. 94-199 feet: Open borehole. 1.3-199 feet: 4.5-inch Class 160 PVC liner. 149-199 feet: 0.5-inch drilled perforation, 4 per foot (around circumference). End cap: PVC slip cap. **BOREHOLE DIMENSIONS:** 0-94 feet: 10-inch. 94-199 feet: 6-inch.

REMARKS

Boring drilled with air rotary using a 10-inch downhole hammer to 94 feet bgs and with a 6-inch downhole hammer from 94 to 199 feet bgs.

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460 SECOND STREET, SUITE 103
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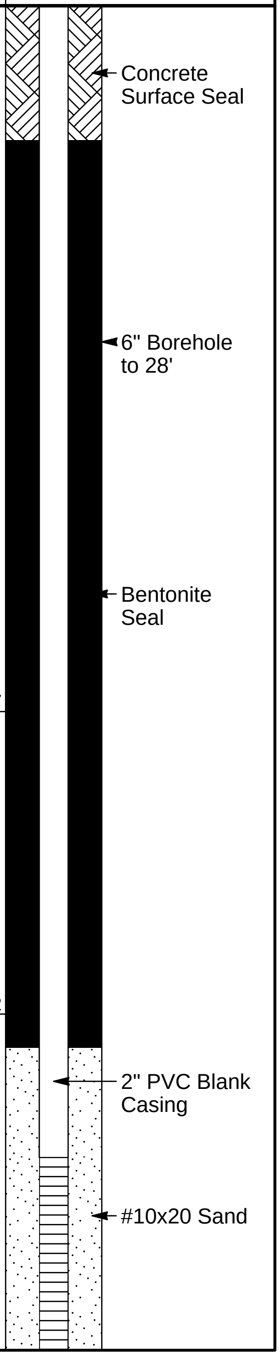
WELL NUMBER MW-26

CLIENT Valley Landfills, Inc.
PROJECT NAME Cell 4
PROJECT NUMBER VLI-001-004
PROJECT LOCATION Coffin Butte Landfill
DATE STARTED 10/17/11 **COMPLETED** 10/17/11
GROUND ELEVATION 235.18 ft MSL **HOLE SIZE** 6"
DRILLING CONTRACTOR Major Drilling Environmental
GROUND WATER LEVELS:
DRILLING METHOD Sonic
▽ **AT TIME OF DRILLING** 15.00 ft / Elev 220.18 ft
LOGGED BY Eric Tuppan **CHECKED BY** EJT
AT END OF DRILLING ---
NOTES
▼ **AFTER DRILLING** 5.60 ft / Elev 229.58 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM Casing Top Elev: 237.91 (ft) Casing Type: PVC
0					▩	(CL) **CLAY FILL**: dark yellow brown (10YR, 4/4) with splotchy brown/black; low plasticity fines; trace fine sand; very stiff; damp.	
	RC	100	PP = 3.0 tsf				
						@4.5': grass	
5				CL		▼ @5.0: angular to rounded pebbles.	
	RC	100	PP = 2.5 tsf				
						@7.5': splotchy very dark grayish brown (10YR, 3/2) to dark yellowish brown (10YR, 4/4); low to moderate plasticity fines; very stiff to hard; damp.	
			PP = 4.0 tsf				
10						@9.5': angular basalt chips.	
						10.5 — 224.7	
	RC	100			▨	(CL) **CLAY**: dark brown (10YR, 3/3); low to moderate plasticity fines with trace sand grains; iron oxide and manganese oxide stain; uniform texture; stiff to very stiff; damp.	
			PP = 2.5 tsf	CL			
			PP = 1.3 tsf			@14.5': 2"-thick layer of dark gray (10YR, 4/1).	
15						15.0 ▽ — 220.2	
					▥	(ML) **CLAYEY SILT**: dark olive (5Y, 3/3); low plasticity fines with mica flecks and some clay; uniform; very stiff to stiff; moist to wet on fresh core surfaces.	
	RC	100		ML			
			PP = 2.0 tsf				
20							



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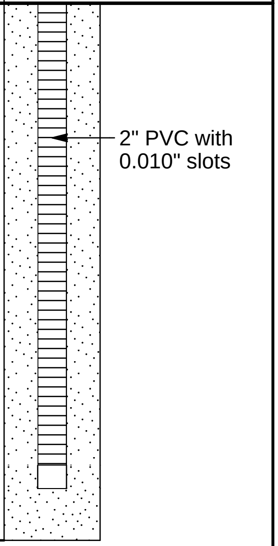
CLIENT Valley Landfills, Inc.

PROJECT NAME Cell 4

PROJECT NUMBER VLI-001-004

PROJECT LOCATION Coffin Butte Landfill

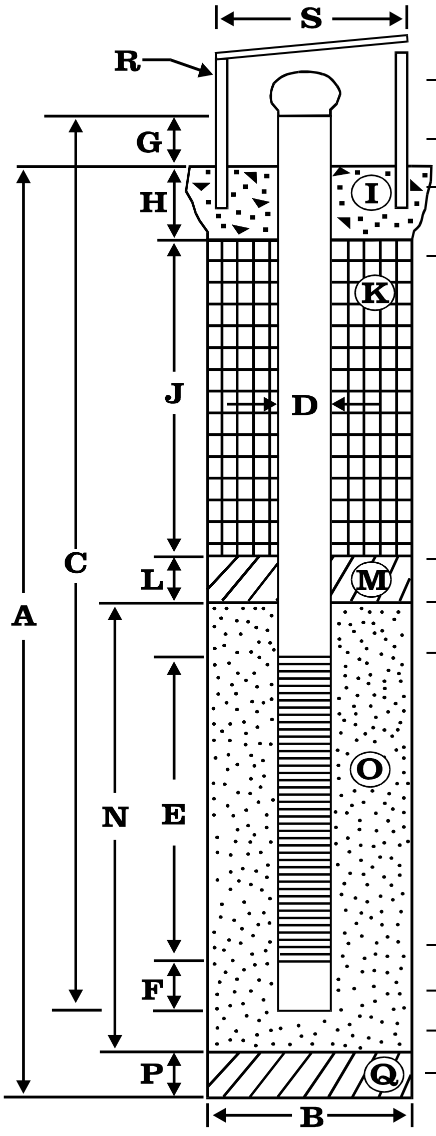
DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
20						(ML) **CLAYEY SILT**: dark olive (5Y, 3/3); low plasticity fines with mica flecks and some clay; uniform; very stiff to stiff; moist to wet on fresh core surfaces. *(continued)*	 2" PVC with 0.010" slots
						@21'-28': dark gray (5Y, 4/1); uniform low plasticity fines; very stiff to hard; moist to wet on fresh surfaces; trace brown roots.	
25	RC	100	PP = 2.3 tsf	ML			
			PP = 4.0 tsf			28.0 207.2	

Bottom of borehole at 28.0 feet.

WELL DETAILS

Project Number: **VLI-001-004**
Client Name: **Valley Landfills, Inc.**
Project Name: **Cell 4 Well Installation**
Location: **Coffin Butte Landfill**
Driller: **Major Drilling Environmental**

Boring/Well No.: **MW-26**
Top of Casing Elev.: **237.91**
Ground Surface Elev.: **235.18**
Installation Date: **10/17/11**
Permit/Start Card No.: **L108324/1015035**



Depth (feet)	Elev. (ft, msl)
3.26	238.44
2.73	237.91
0.00	235.18
2.00	233.18
15.50	
17.13	218.05
26.88	208.30
27.23	207.95
28.0	207.18
—	

Installed by: **Eric Tuppan**

Reviewed by: **EJT**

Date: **11/3/2011**

EXPLORATORY BORING

A. Total depth: **28.0 ft.**
B. Diameter **6 in.**
Drilling method: **Sonic**

WELL CONSTRUCTION

C. Well casing length: **30.13 ft.**
Well casing material: **PVC**
D. Well casing diameter: **2 in.**
E. Well screen length: **9.75 ft.**
Well screen type: **PVC**
Well screen slot size: **0.010 in.**
F. Well sump: **0.35 ft.**
G. Well casing height (stickup): **2.73 ft.**
H. Surface seal thickness: **2.0 ft.**
I. Surface seal material: **Concrete**
J. Annular seal thickness: **13.5 ft.**
K. Annular seal material: **Bent. Chips**
L. Filter pack seal thickness: **— ft.**
M. Filter pack seal material: **—**
N. Sand pack thickness: **12.5 ft.**
O. Sand pack material: **10/20 Sand**
P. Bottom material thickness: **— ft.**
Q. Bottom material:
R. Protective casing material: **Steel**
Well centralizer depths: **— ft.**
S. Protective casing diameter: **6 in.**

NOTES:

Installed open hole.

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WELL NUMBER MW-27

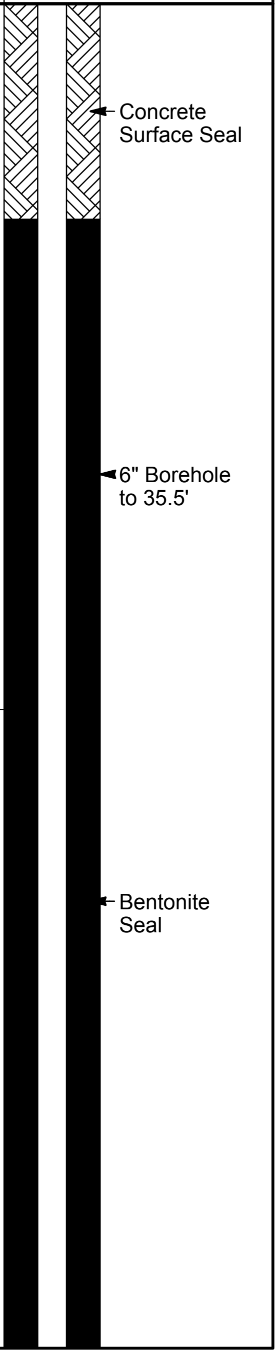
PAGE 1 OF 2

CLIENT Valley Landfills, Inc.
PROJECT NAME Cell 4
PROJECT NUMBER VLI-001-004
PROJECT LOCATION Coffin Butte Landfill
DATE STARTED 10/17/11 **COMPLETED** 10/17/11
GROUND ELEVATION 252.12 ft MSL **HOLE SIZE** 6"
DRILLING CONTRACTOR Major Drilling Environmental
GROUND WATER LEVELS:
DRILLING METHOD Sonic
AT TIME OF DRILLING ---
LOGGED BY Eric Tuppan **CHECKED BY** EJT
AT END OF DRILLING ---
NOTES
▽ **AFTER DRILLING** 19.35 ft / Elev 232.77 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0–10	RC	10		CL	▨	(CL) **SANDY CLAY FILL:** very dark gray brown (10YR, 4/2); 10-20% fine sand with small gravel; damp.
10.5						241.6
10–15	RC	100	PP = 3.3 tsf	CL	▨	(CL) **CLAY FILL:** dark brown (10YR, 3/3); low plasticity fines with less than 10% fine sand; damp; very stiff.
						@14.5': low plasticity fines with some fine sand and coarse sand; damp; very stiff.
15–20	RC	100	PP = 3.0 tsf PP = 2.0 tsf		▨	@17.5: blackish to very dark brown (10YR, 2/1); gravelly clay.
						▽ @18.8: dark grayish brown (10YR, 4/2); low plasticity fines with trace fine to coarse sand and occasional angular pebbles (1.5-2"); some roots; damp; very stiff.

WELL DIAGRAM

Casing Top Elev: 254.76 (ft)
Casing Type: PVC



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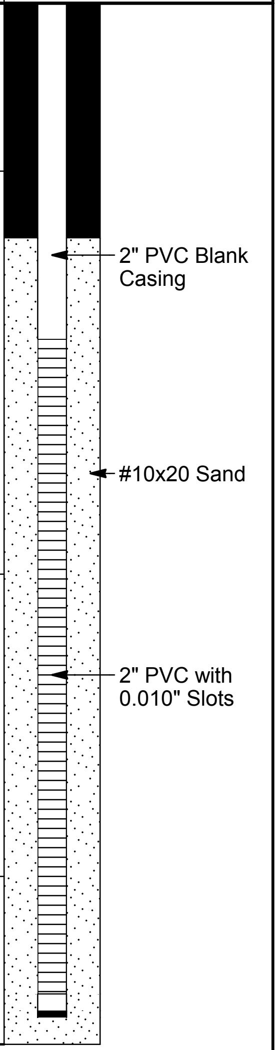
WELL NUMBER MW-27

CLIENT Valley Landfills, Inc.
PROJECT NAME Cell 4
PROJECT NUMBER VLI-001-004
PROJECT LOCATION Coffin Butte Landfill

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
20	RC	100	PP = 2.5 tsf	CL	22.5	(CL) **CLAY FILL:** dark brown (10YR, 3/3); low plasticity fines with less than 10% fine sand; damp; very stiff. *(continued)* @22.5: piece of blue plastic indicates fill. 229.6	
25	RC RC	100 100	PP = 1.8 tsf PP = 1.3 tsf	CH	28.5	(CH) **CLAY With ORGANICS**: black (10YR, 2/1); high plasticity fines; less than 10% fine sand, with rounded medium sand grains; abundant roots, pieces of wood, and organic material at 9.6%; moist to wet (38.8% water content). @23-25': geotechnical sample collected. 223.6	
30	RC	100	PP = 1.3 tsf PP = 1.5 tsf	CH	33.0	(CH) **CLAY:** dark gray (10YR, 4/1); grades from organic rich clay to clay at 28-29'; moderate to high plasticity fines; trace coarse sand; reddish iron oxide stains; stiff; damp. 219.1	
35	RC RC	100 100	PP = 2.0 tsf PP = 2.3 tsf PP = 3.8 tsf	CL	35.5	(CL) **CLAY:** dark olive gray (5Y, 3/2); low plasticity fines with trace sand, slightly silty; flecks of mica; very stiff to hard; damp. 216.6	

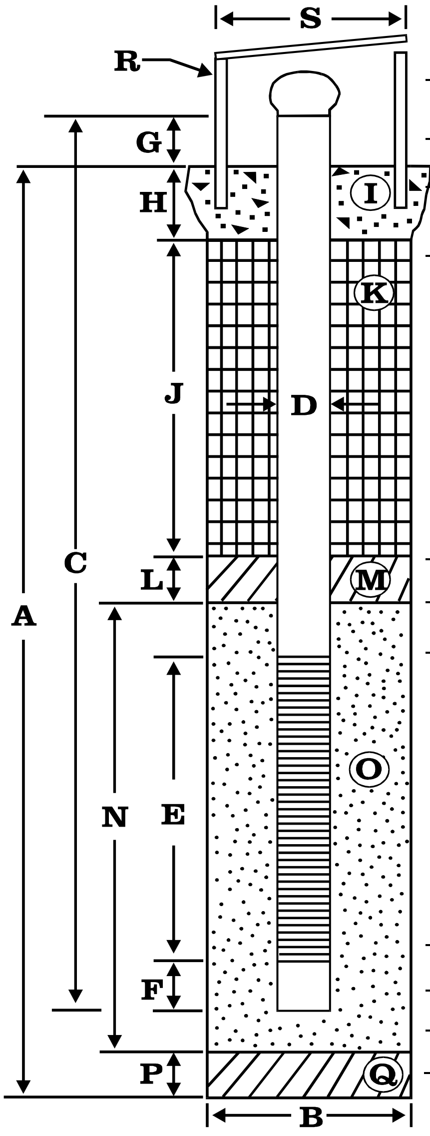


Bottom of borehole at 35.5 feet.

WELL DETAILS

Project Number: **VLI-001-004**
Client Name: **Valley Landfills, Inc.**
Project Name: **Cell 4 Well Installation**
Location: **Coffin Butte Landfill**
Driller: **Major Drilling Environmental**

Boring/Well No.: **MW-27**
Top of Casing Elev.: **254.76**
Ground Surface Elev.: **252.12**
Installation Date: **10/17/11**
Permit/Start Card No.: **L108323/1015034**



Depth (feet)	Elev. (ft, msl)
3.14	255.26
2.64	254.76
0.00	252.12
3.20	248.92
23.50	228.62
25.00	227.12
34.75	217.37
35.10	217.02
35.50	216.62
—	

Installed by: **Eric Tuppan**

Reviewed by: **EJT**

Date: **11/3/2011**

EXPLORATORY BORING

A. Total depth: **35.5 ft.**
B. Diameter **6 in.**
Drilling method: **Sonic**

WELL CONSTRUCTION

C. Well casing length: **37.71 ft.**
Well casing material: **PVC**
D. Well casing diameter: **2 in.**
E. Well screen length: **9.75 ft.**
Well screen type: **PVC**
Well screen slot size: **0.010 in.**
F. Well sump: **0.35 ft.**
G. Well casing height (stickup): **2.61 ft.**
H. Surface seal thickness: **3.2 ft.**
I. Surface seal material: **Concrete**
J. Annular seal thickness: **20.3 ft.**
K. Annular seal material: **Bent. Chips**
L. Filter pack seal thickness: **— ft.**
M. Filter pack seal material: **—**
N. Sand pack thickness: **12.0 ft.**
O. Sand pack material: **10/20 Sand**
P. Bottom material thickness: **— ft.**
Q. Bottom material:
R. Protective casing material: **Steel**
Well centralizer depths: **— ft.**
S. Protective casing width: **6 in.**

NOTES:

Installed open hole.

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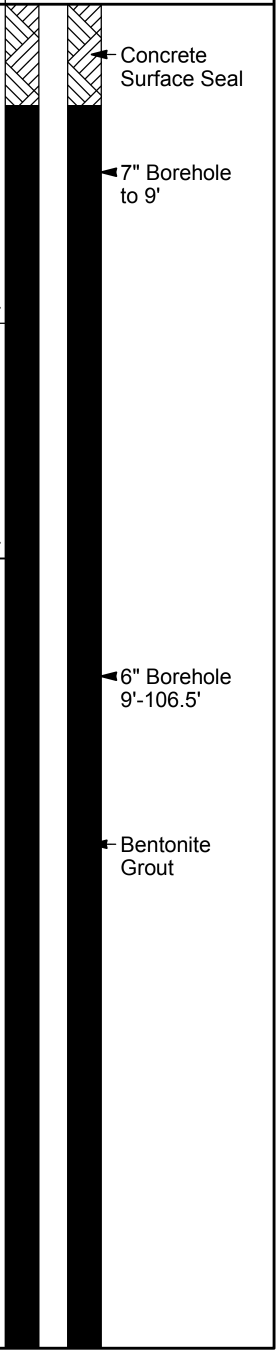
WELL NUMBER P-19

CLIENT Valley Landfills, Inc.
PROJECT NAME Cell 5
PROJECT NUMBER VLI-001-004
PROJECT LOCATION Coffin Butte Landfill
DATE STARTED 8/16/12 **COMPLETED** 8/17/12
GROUND ELEVATION 383.15 ft MSL **HOLE SIZE** 6"
DRILLING CONTRACTOR Boart Longyear
GROUND WATER LEVELS:
DRILLING METHOD Air Rotary
▽ **AT TIME OF DRILLING** 101.50 ft / Elev 281.65 ft 5 gpm
LOGGED BY Eric Tuppan **CHECKED BY** EJT
AT END OF DRILLING ---
NOTES 7" Sonic surface casing to 9' depth.
▼ **AFTER DRILLING** 15.94 ft / Elev 367.21 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	U.S.C.S.	MATERIAL DESCRIPTION	Elev.
0			SP-SM	(SP-SM) **SAND to SILTY SAND with Gravel:** moderate brown (5YR, 3/4); <10-15% low plasticity fines; 50-60% fine-coarse sand; 30-40% gravel; friable; deeply weathered soil zone of basalt; damp to dry; iron oxide stain on grains; basalt cobbles to 3", angular to subrounded.	
5	RC	100			
8	RC	100		@8': moderate yellowish brown (10YR, 5/4); silty sand and gravel as above.	
9.5				**BASALT:** brownish black (5YR, 2/1) to dusky yellowish brown (10YR, 2/2); <20% medium sand; moderately weathered with iron oxide coating on chips; hard to moderate hardness.	373.7
11.5	GB			@11.5'-16.5': transition from moderately weathered to fresh basalt; greenish tone to wash water indicating chloritic alteration.	
16.5 ▼	GB			**BASALT**: black (5YR, N1) to grayish black (5Y, N2); fine-grained with crystals of mica and plagioclase; slight greenish chloritic alteration in places; fresh to weakly weathered; hard, massive.	366.7
20.5	GB			@20.5': ; large samples (1-2") jamming hole indicate possible fracture zone. @21': water check, dry.	
26.5	GB				
31.5	GB			@31.5': minor iron oxide on chips, vug filling of pyrite crystals; dry.	
36.5	GB				
40					

WELL DIAGRAM
Casing Top Elev: 385.65 (ft)
Casing Type: PVC



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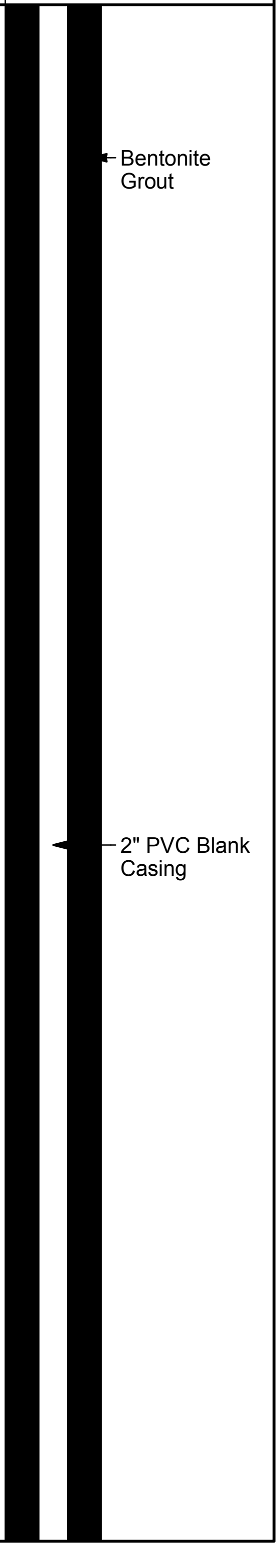
WELL NUMBER P-19

CLIENT Valley Landfills, Inc.
PROJECT NAME Cell 5
PROJECT NUMBER VLI-001-004
PROJECT LOCATION Coffin Butte Landfill

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
40					**BASALT**: black (5YR, N1) to grayish black (5Y, N2); fine-grained with crystals of mica and plagioclase; slight greenish chloritic alteration in places; fresh to weakly weathered; hard, massive. *(continued)*
	GB				@41': light olive gray (5Y, 5/2); chloritic alteration of cuttings; some whitish chips of very hard chalcedony; dry.
45					
	GB				@46': fresh to weakly weathered.
50					
	GB				@51': water check: after blowing hole dry, wait for 30 minutes, then blow out hole, dry with only trickle of residual water.
55					
	GB				
60					
	GB				
65					
	GB				
70					
	GB				@71.3': water check after flushing hole of drilling water; pulled drill rods and checked for water with meter after 1 hour; hole dry at 71.3'.
75					
	GB				
80					@79'-81': driller believes fractured because large cuttings keep jamming hole.
	GB				
85					

WELL DIAGRAM



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WELL NUMBER P-19

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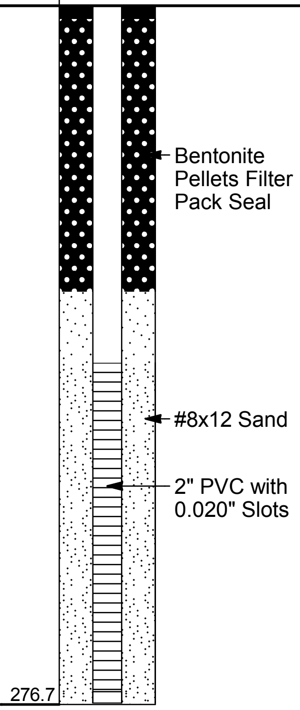
CLIENT Valley Landfills, Inc.
PROJECT NAME Cell 5
PROJECT NUMBER VLI-001-004
PROJECT LOCATION Coffin Butte Landfill

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
	GB				**BASALT**: black (5YR, N1) to grayish black (5Y, N2); fine-grained with crystals of mica and plagioclase; slight greenish chloritic alteration in places; fresh to weakly weathered; hard, massive. *(continued)*
90					@86'-91': zone of chloritic alteration from green color of wash water; water check shows dry hole after 5 minutes.
	GB				@91'-96': fresh basalt with decrease in green water or cuttings.
95					
	GB				
100					
	GB				∇ @101.5': olive gray (5Y, 3/2); chloritic alteration; moderate weathering, moderate hardness; water check at >5 gpm.
105					
	GB			106.5	Flushed hole at total depth with formation water until runs clear.

Bottom of borehole at 106.5 feet.

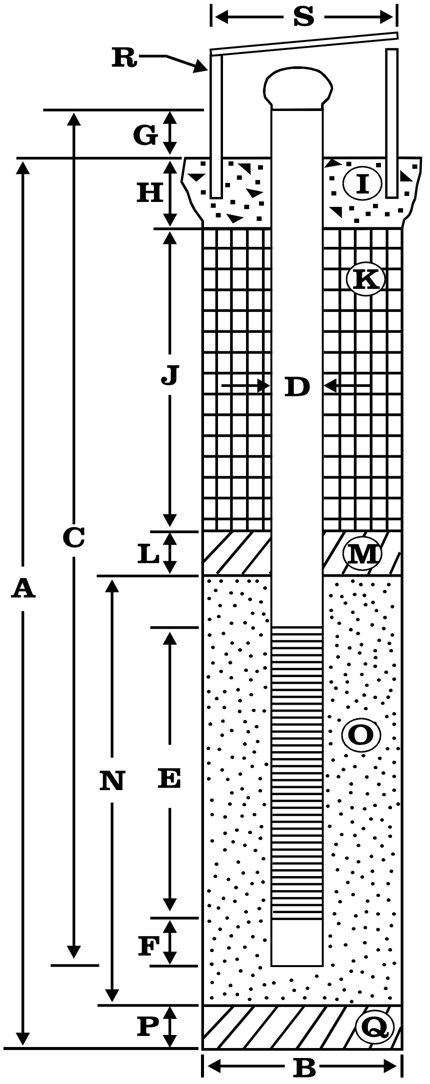
WELL DIAGRAM



WELL DETAILS

Project Number: **VLI-001-004**
Client Name: **Valley Landfills, Inc.**
Project Name: **Cell 5 Well Installation**
Location: **Coffin Butte Landfill**
Driller: **Boart Longyear E&I Division**

Boring/Well No.: **P-19**
Top of Casing Elev.: **385.65**
Ground Surface Elev.: **383.15***
Installation Date: **8/17/12**
Well ID/Start Card No.: **L99288/1017351**



Depth (feet)	Elev. (ft, msl)
2.92	386.07
2.50	385.65
0.00	383.15
3.00	380.15
86.10	297.05
94.20	288.95
96.33	268.82
106.11	277.04
106.45	276.70
106.50	276.65

Installed by: **Eric Tuppan**

Reviewed by: **EJT**

Date: **8/20/12**

EXPLORATORY BORING

A. Total depth: **106.5 ft.**
B. Diameter **6 in.**
Drilling method: **Air Rotary**

WELL CONSTRUCTION

C. Well casing length: **108.95 ft.**
Well casing material: **Sch. 40 PVC**
D. Well casing diameter: **2 in.**
E. Well screen length: **9.78 ft.**
Well screen type: **Machine slot**
Well screen slot size: **0.020 in.**
F. Well sump/end cap length: **0.34 ft.**
G. Well casing height (stickup): **2.50 ft.**
H. Surface seal thickness: **3.00 ft.**
I. Surface seal material: **Concrete**
J. Annular seal thickness: **83.10 ft.**
K. Annular seal material: **Bent. Grout**
L. Filter pack seal thickness: **8.10 ft.**
M. Filter pack seal material: **Bent. Pellets**
N. Sand pack thickness: **12.30 ft.**
O. Sand pack material: **8x12 Silica Sand**
P. Bottom material thickness: **N/A ft.**
Q. Bottom material: **N/A**
R. Protective casing material: **Galv. Steel**
Well centralizer depths: **106, 97, 47, 8 ft.**
S. Protective casing width: **4 in.**

NOTES:

Drilled upper 9 feet with 7-inch sonic casing that was left in place as surface casing during drilling. Drilled 9 feet to total depth with air rotary.

***Original ground surface not surveyed; measured PVC stickup from original ground surface was 2.50 feet, which was subtracted from surveyed TOC.**

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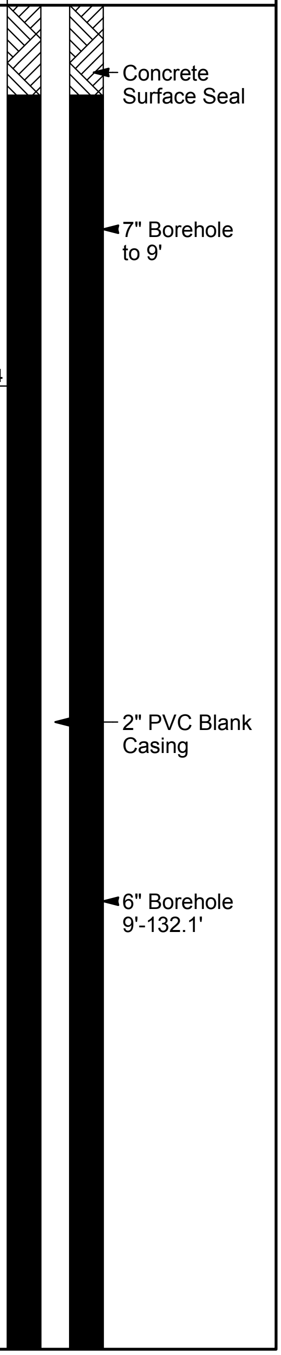
WELL NUMBER P-20

CLIENT Valley Landfills, Inc.
PROJECT NAME Cell 5
PROJECT NUMBER VLI-001-004
PROJECT LOCATION Coffin Butte Landfill
DATE STARTED 8/15/12 **COMPLETED** 8/16/12
GROUND ELEVATION 585.92 ft MSL **HOLE SIZE** 6"
DRILLING CONTRACTOR Boart Longyear
GROUND WATER LEVELS:
DRILLING METHOD Air Rotary
▽ **AT TIME OF DRILLING** 102.00 ft / Elev 483.92 ft <1/4 gpm
LOGGED BY Eric Tuppan **CHECKED BY** EJT
AT END OF DRILLING ---
NOTES 7" Sonic surface casing to 9' depth.
▼ **AFTER DRILLING** 72.70 ft / Elev 513.22 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	U.S.C.S.	MATERIAL DESCRIPTION
0			SP-SM	(SP-SM) **SAND to SILTY SAND with Gravel:** moderate brown (5YR, 3/4) to dark yellowish brown (10YR, 4/2); <20% low plasticity fines; fine to medium sand with pebbles of basalt; dry to damp; deeply weathered basalt.
5	RC	100		@5': iron oxide staining common with cobbles to 5"; degree of weathering decreases between 8' and 9' indicated by harder drilling.
	RC	100		
8.5				577.4
				BASALT: black (5YR, N1) to grayish black (5Y, N2); fine-grained with crystals of mica and plagioclase; slight greenish chloritic alteration in places; fresh to weakly weathered; hard, massive.
10				
	GB			
15				
	GB			
20				
	GB			
25				
	GB			
30				

WELL DIAGRAM

Casing Top Elev: 588.32 (ft)
Casing Type: PVC



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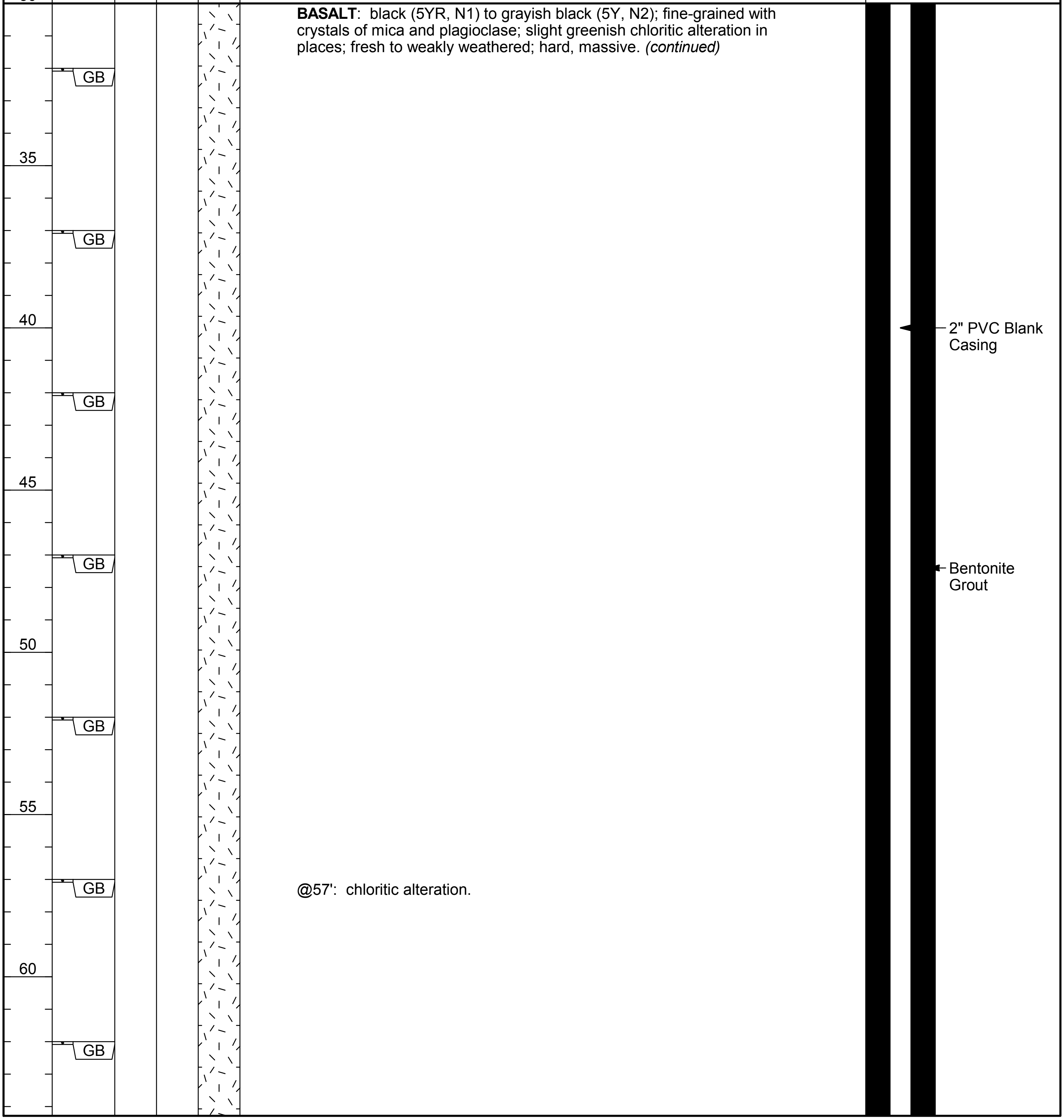
WELL NUMBER P-20

CLIENT Valley Landfills, Inc.
PROJECT NAME Cell 5
PROJECT NUMBER VLI-001-004
PROJECT LOCATION Coffin Butte Landfill

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM



BASALT: black (5YR, N1) to grayish black (5Y, N2); fine-grained with crystals of mica and plagioclase; slight greenish chloritic alteration in places; fresh to weakly weathered; hard, massive. *(continued)*

@57': chloritic alteration.

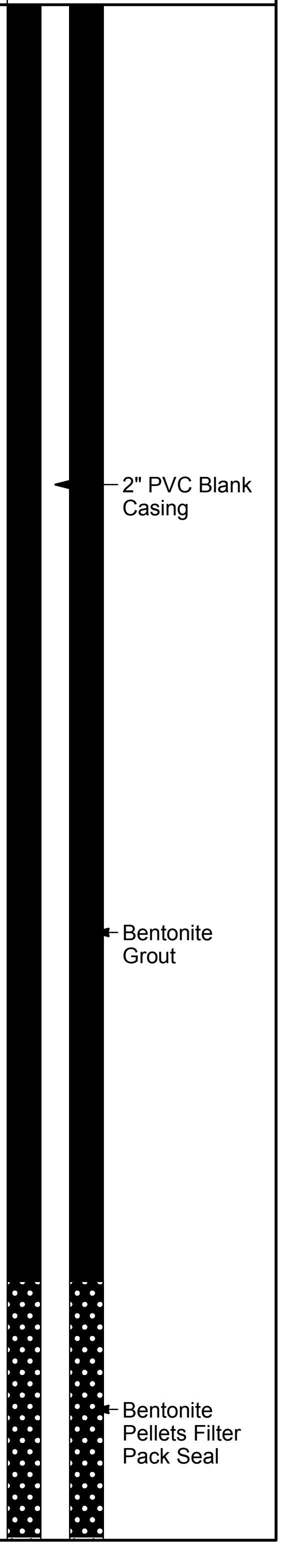
(Continued Next Page)

WELL NUMBER P-20

CLIENT Valley Landfills, Inc.
PROJECT NAME Cell 5
PROJECT NUMBER VLI-001-004
PROJECT LOCATION Coffin Butte Landfill

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
65					**BASALT**: black (5YR, N1) to grayish black (5Y, N2); fine-grained with crystals of mica and plagioclase; slight greenish chloritic alteration in places; fresh to weakly weathered; hard, massive. *(continued)*
	GB				
70					
	GB				▼ @72.7: static water in well on 8/17/12.
75					
	GB				
80					
	GB				@82': whitish zeolites in cuttings, likely from filling of vugs.
85					
	GB				
90					
	GB				@92': water check after blowing hole of drilling water and lunch break; hole dry.
95					
	GB				

WELL DIAGRAM



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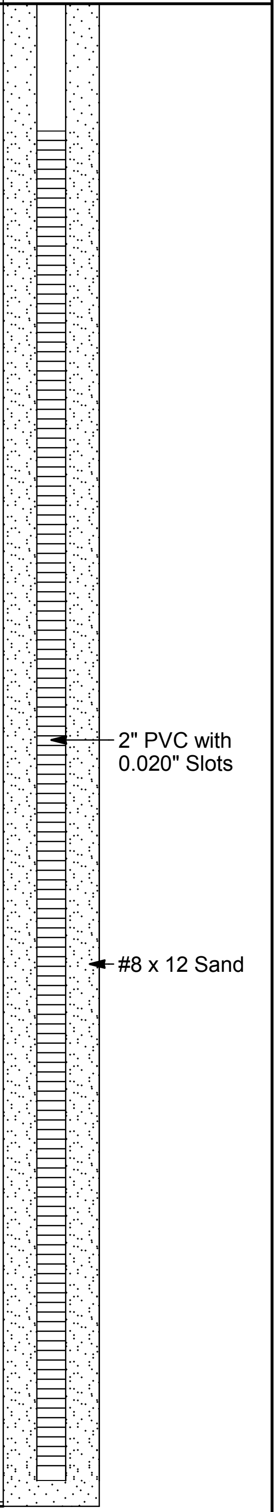
WELL NUMBER P-20

CLIENT Valley Landfills, Inc.
PROJECT NAME Cell 5
PROJECT NUMBER VLI-001-004
PROJECT LOCATION Coffin Butte Landfill

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
100					**BASALT**: black (5YR, N1) to grayish black (5Y, N2); fine-grained with crystals of mica and plagioclase; slight greenish chloritic alteration in places; fresh to weakly weathered; hard, massive. *(continued)*
	GB				∇ @102': trickle of water (<1/4 gpm) for 6 minutes; possible top of water zone.
105					
	GB				
110					
	GB				@112': trickle of water to dry after 8 minutes.
					@114'-116': very hard drilling.
115					
	GB				
120					
	GB				@122': trickle of water (<1/4 gpm) with approximately 2-3 gallons flushed from hole.
125					
130					@132': flushed hole with clean water and then blew for 5 minutes, producing approximately 1/4-1/2 gpm.
	GB			132.0	453.9

Bottom of borehole at 132.1 feet.

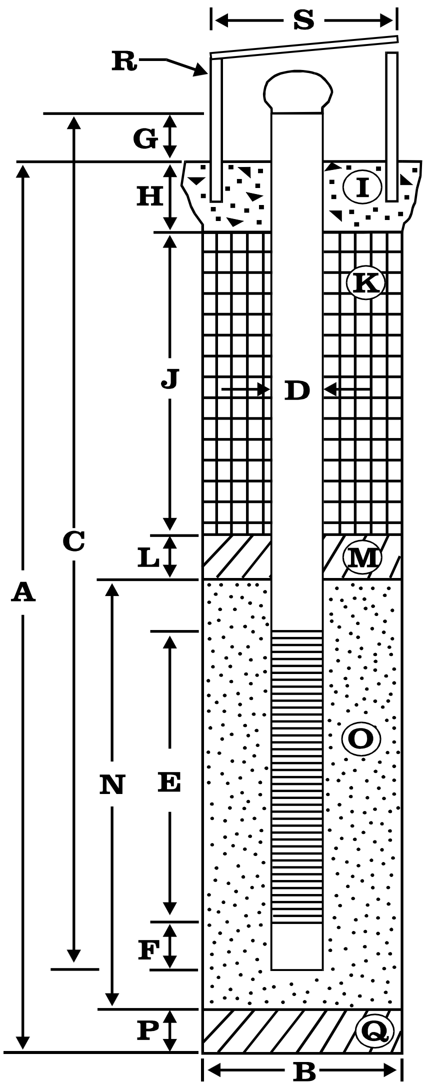
WELL DIAGRAM



WELL DETAILS

Project Number: **VLI-001-004**
Client Name: **Valley Landfills, Inc.**
Project Name: **Cell 5 Well Installation**
Location: **Coffin Butte Landfill**
Driller: **Boart Longyear E&I Division**

Boring/Well No.: **P-20**
Top of Casing Elev.: **588.32**
Ground Surface Elev.: **585.92***
Installation Date: **8/16/12**
Well ID/Start Card No.: **L99287/1017349**



Depth (feet)	Elev. (ft, msl)
2.64	588.56
2.40	588.32
0.00	585.92
3.00	582.92
92.80	493.12
98.50	487.42
101.41	484.51
131.19	457.73
131.53	454.39
132.10	453.82

Installed by: **Eric Tuppan**

Reviewed by: **EJT**

Date: **8/20/12**

EXPLORATORY BORING

A. Total depth: **132.1 ft.**
B. Diameter **6 in.**
Drilling method: **Air Rotary**

WELL CONSTRUCTION

C. Well casing length: **133.93 ft.**
Well casing material: **Sch. 40 PVC**
D. Well casing diameter: **2 in.**
E. Well screen length: **29.78 ft.**
Well screen type: **Machine slot**
Well screen slot size: **0.020 in.**
F. Well sump/end cap length: **0.34 ft.**
G. Well casing height (stickup): **2.40 ft.**
H. Surface seal thickness: **3.00 ft.**
I. Surface seal material: **Concrete**
J. Annular seal thickness: **89.80 ft.**
K. Annular seal material: **Bent. Grout**
L. Filter pack seal thickness: **5.70 ft.**
M. Filter pack seal material: **Bent. Pellets**
N. Sand pack thickness: **33.60 ft.**
O. Sand pack material: **8x12 Silica Sand**
P. Bottom material thickness: **N/A ft.**
Q. Bottom material: **N/A**
R. Protective casing material: **Galv. Steel**
Well centralizer depths: **132, 102, 50, 7 ft.**
S. Protective casing width: **4 in.**

NOTES:

Drilled upper 9 feet with 7-inch sonic casing that was left in place as surface casing during drilling. Drilled 9 feet to total depth with air rotary.

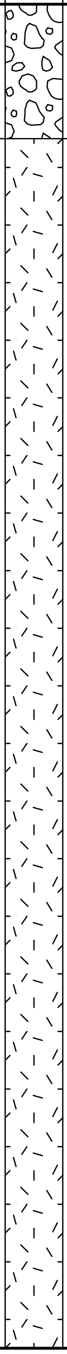
***Original ground surface not surveyed; measured PVC stickup from original ground surface was 2.40 feet, which was subtracted from surveyed TOC.**

TUPPAN CONSULTANTS LLC
460 SECOND STREET, SUITE 103
LAKE OSWEGO, OREGON 97034
TELEPHONE: (503) 675-1335

WELL NUMBER P-21

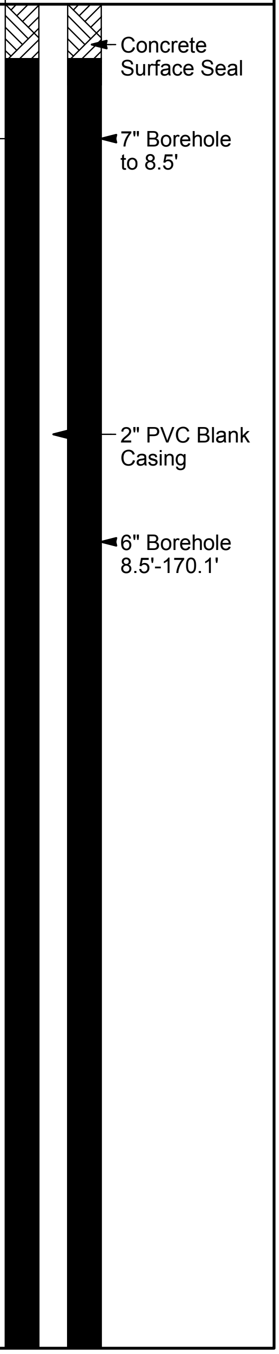
CLIENT Valley Landfills, Inc.
PROJECT NAME Cell 5
PROJECT NUMBER VLI-001-004
PROJECT LOCATION Coffin Butte Landfill
DATE STARTED 8/13/12 **COMPLETED** 8/14/12
GROUND ELEVATION 624.09 ft MSL **HOLE SIZE** 6"
DRILLING CONTRACTOR Boart Longyear
GROUND WATER LEVELS:
DRILLING METHOD Air Rotary
∇ **AT TIME OF DRILLING** 152.00 ft / Elev 472.09 ft
LOGGED BY Eric Tuppan **CHECKED BY** EJT
▼ **AT END OF DRILLING** 133.80 ft / Elev 490.29 ft
NOTES 7" Sonic surface casing to 8.5' depth.
▼ **AFTER DRILLING** 22.92 ft / Elev 601.17 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	U.S.C.S.	MATERIAL DESCRIPTION
0				
			GP	(GP) **GRAVEL:** dark yellowish brown (10YR, 4/2) to moderate yellowish brown (10YR, 5/4); <10% low plasticity fines; cobbles of basalt with fine to medium sand; friable, iron oxide staining on sand grains and clasts; dry; moderately to deeply weathered basalt.
	RC	100		5.0 619.1
				BASALT: dusky yellowish brown (10YR, 2/2) grading to black (5YR, N1) or grayish black (5Y, N2); fine-grained with crystals of mica and plagioclase; iron oxide staining to 12'; slight greenish chloritic alteration in places; fresh to weakly weathered; hard, massive.
	GB			
10				
	GB			
				@15': basalt below this depth is weakly weathered to fresh; hard to very hard.
	GB			
20				
	GB			▼ @22.9: static water in well on 8/17/12.
	GB			
30				
	GB			@32': water check, borehole blows dry.
	GB			
40				
	GB			@42': water check, borehole blows dry.
	GB			
50				



WELL DIAGRAM

Casing Top Elev: 626.74 (ft)
Casing Type: PVC



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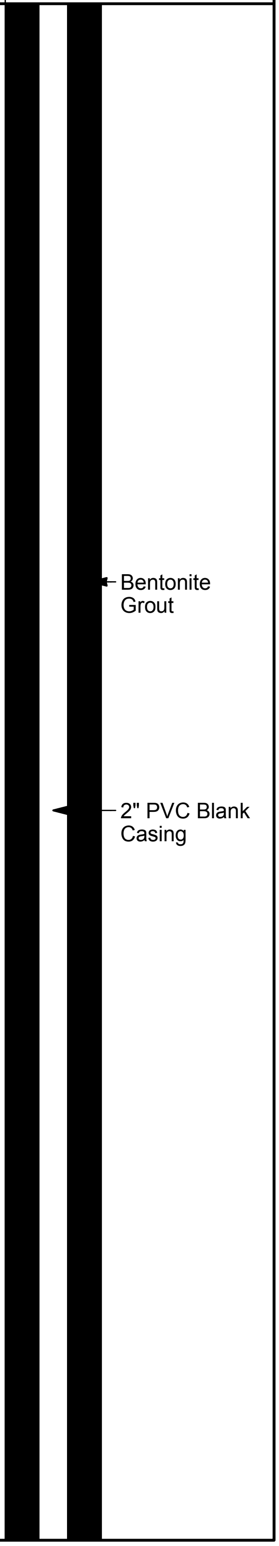
CLIENT Valley Landfills, Inc.
PROJECT NAME Cell 5
PROJECT NUMBER VLI-001-004
PROJECT LOCATION Coffin Butte Landfill

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
50					**BASALT**: dusky yellowish brown (10YR, 2/2) grading to black (5YR, N1) or grayish black (5Y, N2); fine-grained with crystals of mica and plagioclase; iron oxide staining to 12'; slight greenish chloritic alteration in places; fresh to weakly weathered; hard, massive. *(continued)*
	GB				
					@52': water check, borehole blows dry; some chloritic alteration, moderate hardness and weathering.
	GB				
60					
	GB				@62': water check, borehole blows dry.
	GB				
70					
	GB				@72': water check, borehole blows dry.
	GB				
80					
	GB				
	GB				
90					
	GB				@92': water check, borehole blows dry.
	GB				
100					
	GB				@102': water check, borehole blows dry.

WELL DIAGRAM



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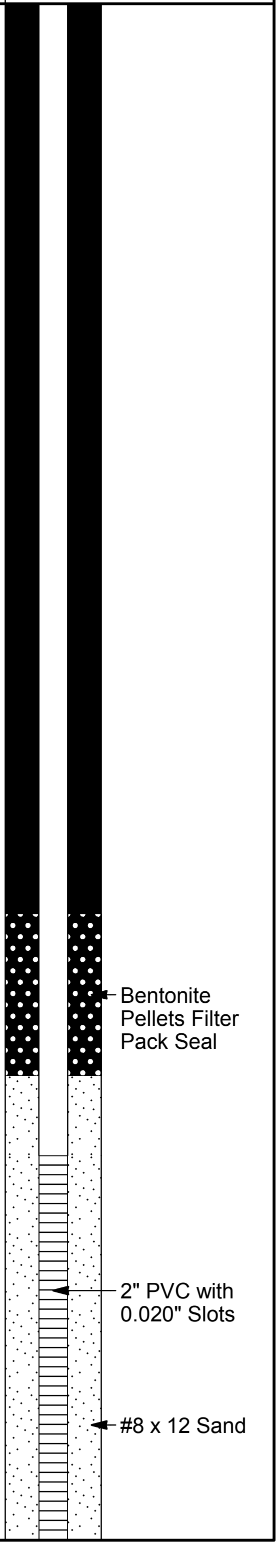
WELL NUMBER P-21

CLIENT Valley Landfills, Inc.
PROJECT NAME Cell 5
PROJECT NUMBER VLI-001-004
PROJECT LOCATION Coffin Butte Landfill

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
	GB				**BASALT**: dusky yellowish brown (10YR, 2/2) grading to black (5YR, N1) or grayish black (5Y, N2); fine-grained with crystals of mica and plagioclase; iron oxide staining to 12'; slight greenish chloritic alteration in places; fresh to weakly weathered; hard, massive. *(continued)*
110					
	GB				@112': water check, borehole blows dry.
	GB				
120					
	GB				@122': water check, borehole blows dry.
	GB				
130					@129'-132': soft drilling; chloritic alteration prevalent; greenish gray (5GY, 4/1), moderate hardness; dry.
	GB				
					▼ @134: depth to water after pulled drill rods from hole, approximately 30 minutes after reaching total depth of 170.1'.
	GB				
140					
	GB				@142': brownish black (5YR, 2/1) to black (5YR, N1); weakly weathered to fresh, hard to moderate hardness; some greenish chloritic alteration; dry.
150					
	GB				▽ @152': first indication of water in borehole produces ~ 1/4-1/2 gpm after 10 minutes.
	GB				
160					
	GB				@162': water check produces 1-1.5 gpm.

WELL DIAGRAM



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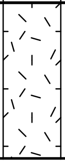
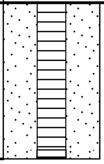
WELL NUMBER P-21

CLIENT Valley Landfills, Inc.
PROJECT NAME Cell 5
PROJECT NUMBER VLI-001-004
PROJECT LOCATION Coffin Butte Landfill

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	U.S.C.S.	GRAPHIC LOG		MATERIAL DESCRIPTION		WELL DIAGRAM
170	GB				170.1	**BASALT**: dusky yellowish brown (10YR, 2/2) grading to black (5YR, N1) or grayish black (5Y, N2); fine-grained with crystals of mica and plagioclase; iron oxide staining to 12'; slight greenish chloritic alteration in places; fresh to weakly weathered; hard, massive. *(continued)* @162'-165': very hard drilling. @170': well producing 1.5-2 gpm; flush borehole clean for 5 minutes.	454.0	

Bottom of borehole at 170.1 feet.

WELL DETAILS

Project Number: **VLI-001-004**

Client Name: **Valley Landfills, Inc.**

Project Name: **Cell 5 Well Installation**

Location: **Coffin Butte Landfill**

Driller: **Boart Longyear E&I Division**

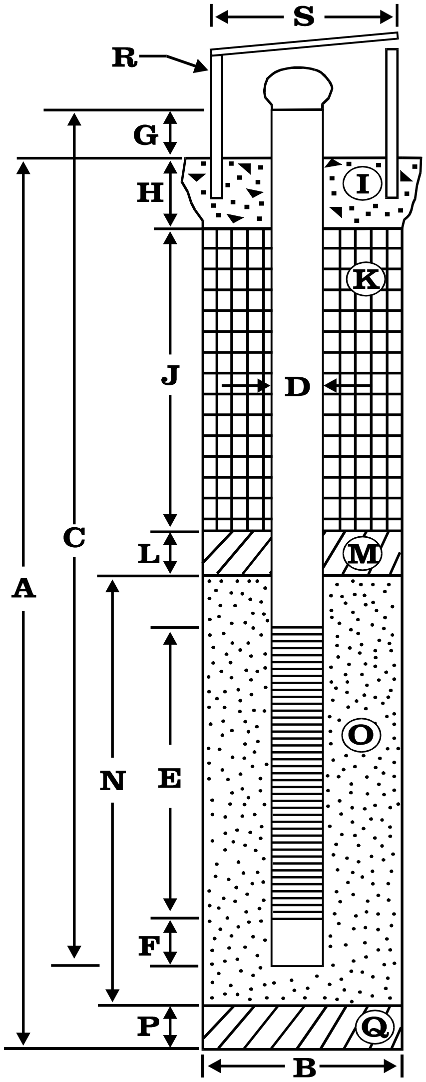
Boring/Well No.: **P-21**

Top of Casing Elev.: **626.74**

Ground Surface Elev.: **624.09***

Installation Date: **8/14/12**

Well ID/Start Card No.: **L99286/1017350**



Depth (feet)	Elev. (ft, msl)
3.11	627.20
2.65	626.74
0.00	624.09
3.00	621.09
141.00	483.09
147.00	477.09
149.98	474.11
169.76	454.33
170.10	453.99
170.10	453.99

EXPLORATORY BORING

A. Total depth: **170.1 ft.**

B. Diameter **6 in.**

Drilling method: **Air Rotary**

WELL CONSTRUCTION

C. Well casing length: **172.75 ft.**

Well casing material: **Sch. 40 PVC**

D. Well casing diameter: **2 in.**

E. Well screen length: **19.78 ft.**

Well screen type: **Machine slot**

Well screen slot size: **0.020 in.**

F. Well sump/end cap length: **0.34 ft.**

G. Well casing height (stickup): **2.65 ft.**

H. Surface seal thickness: **3.00 ft.**

I. Surface seal material: **Concrete**

J. Annular seal thickness: **138.00 ft.**

K. Annular seal material: **Bent. Grout**

L. Filter pack seal thickness: **6.00 ft.**

M. Filter pack seal material: **Bent. Pellets**

N. Sand pack thickness: **23.10 ft.**

O. Sand pack material: **8x12 Silica Sand**

P. Bottom material thickness: **N/A ft.**

Q. Bottom material: **N/A**

R. Protective casing material: **Galv. Steel**

Well centralizer depths: **170, 150, 100, 50 ft.**

S. Protective casing width: **4 in.**

Installed by: **Eric Tuppan**

Reviewed by: **EJT**

Date: **8/20/12**

NOTES:

Drilled upper 8.5 feet with 7-inch sonic casing that was left in place as surface casing during drilling. Drilled from 8.5 feet to total depth with air rotary.

***Original ground surface not surveyed; measured PVC stickup from original ground surface was 2.65 feet, which was subtracted from surveyed TOC.**

APPENDIX C

SAMPLING AND ANALYSIS PLAN

APPENDIX C
SAMPLING AND ANALYSIS PLAN

COFFIN BUTTE LANDFILL

CORVALLIS, OREGON

Prepared for

Valley Landfills, Inc.

March 23, 2011
October 26, 2012 (Rev. 2)
June 27, 2014 (Rev. 3)

Prepared by

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

Project VLI-001-005

CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

TABLES

Following Report:

Tables

1 INTRODUCTION

On behalf of Valley Landfills, Inc. (VLI), TUPPAN CONSULTANTS LLC updated this sampling and analysis plan (SAP) to guide the collection of groundwater and surface water samples at the Coffin Butte Landfill in Corvallis, Oregon.

The SAP describes the standard operating procedures (SOPs) for conducting water quality monitoring at the landfill. It has been designed to produce data of a known quality by using adequate and consistent methods for sample collection, handling, and analysis. Because water quality samples will be collected from several different types of locations in the monitoring network, a variety of specialized methods must be used.

The intent of this SAP is to present acceptable sampling protocols and describe selected equipment that will provide representative, systematic, and consistent groundwater quality data, but not to rigidly define specific methods for specific locations in the monitoring network. When new sampling methods (protocol, equipment, or procedures) are identified, they may be incorporated into this SAP. They will be introduced in the recommended changes section of the annual report and should be added to the SAP. Changes may also be implemented after the DEQ has approved a specific request.

This SAP will provide the following:

- SOPs for sampling groundwater, surface water, leachate from the sumps or ponds, and liquid from the secondary leachate collection system (SLCS).
- Sample handling procedures such as recordkeeping and documentation.
- Information on analytical methods; bottling, preservation, and shipment procedures; holding times; and detection limits.
- Field quality assurance and quality control.
- Laboratory quality assurance and quality control.

2 STANDARD OPERATING PROCEDURES

Each SOP is intended for use by field personnel. When sampling conditions call for a deviation from the SOP, the change will be recorded on the appropriate sampling collection form or field notebook.

2.1 General Sampling Considerations

Sampling personnel will take reasonable care to limit the potential for cross contamination. Samplers will wear new, clean, chemically resistant gloves when handling downhole sampling equipment. The order of sample bottle filling will be consistent with the method described in Section 2.14. During the purging and sampling process, drawdown should be maintained above the screened interval to the extent possible. Drawdown into the screened interval should be limited because cascading water may enter the monitoring well and affect constituent concentrations. Some of the wells at the site however, are slow to recharge, and in practice, make this goal difficult to meet, especially in the fall when groundwater levels are low. In the case of those wells where low-flow purging is employed, drawdown will be minimized to decrease the potential for in-well disturbance and screen dewatering.

2.2 Monitoring Point Inspection

The integrity of the well cap, lock, and protective casing of each well will be checked at each sampling event. Each well, well point, and piezometer will be observed for unusual conditions, identification, and location (i.e., where it is shown on the site map). Changes in the well structure, lock, security, or other factors that could influence the access to or collection of representative groundwater information, will be noted in the field record or water level form.

2.3 Water Level Measurements

Depth-to-water (groundwater elevation) will be measured in existing monitoring wells, piezometers, and surface water locations using the procedures in this section. The data will be used to estimate the horizontal groundwater flow direction and gradient at the site.

- The protective shroud installed over the monitoring well will be unlocked and the well cap removed.

- Water level will be measured with either an electrical or mechanical meter.

- The water level indicator will be decontaminated before its use in each well to reduce the potential for cross-contamination (see decontamination procedures in Section 2.13.2).

- Water levels will be recorded on the water level and field sampling forms (see Exhibit A) to the nearest 0.01 foot. The full date (month, day, and year) and time (by the 24-hour clock) of measurement will be recorded.

- The water level will be measured by lowering the measuring device until contact with the water is made. At the audible and/or visual response, pinch the cable with forefinger and thumb against the reference point. Generally, the reference is at the highest inside edge of the casing top or at the mark on the top of the casing. Repeat the measurement again to verify accuracy.

- Care will be taken so that the water-level measuring device hangs freely in the monitoring well and does not adhere to the wall of the well casing.

- The groundwater elevation at each monitoring location will be calculated by subtracting the measured distance to the top of the water column from the reference elevation measuring point.

2.4 Field Meter Operations

Generally field meters are the only equipment used in the field to quantify transient conditions. The common field meters measure pH, Eh (also referred to as oxidation-reduction potential [redox]), specific conductivity, dissolved oxygen (DO), and temperature. Other field meters may include turbidity, flame ionization detector (FID), photoionization detector (PID), and combustible gas indicator (CGI).

2.4.1 Use

- During well purging and sample collection from wells with dedicated bladder pumps, field parameters are measured with an automated flow cell meter (QED Model MP20 or equivalent). This instrument can simultaneously measure temperature, pH, specific conductance, redox, and DO. Water samples from wells with no dedicated equipment or from surface water also can be measured with the suite of meters, however when doing so, the cell is not set in the flow-through mode. If needed, or in the case of meter malfunction, water samples can be tested with individual backup meters that measure pH, specific conductance, and temperature. Samples collected from the leachate system, primary or secondary sumps, should be only tested with portable field meters (pH, specific conductance, and temperature) so as not to contaminate the flow-through cell and meters.

- Measurements will be recorded to the following standards: pH to ±0.01 units; conductivity to +1 µmhos/cm; temperature to ±0.1°C; DO to ±0.2 mg/L; and redox to ±1 millivolt (mV).
- The field meters will be operated in a manner consistent with the manufacturers' recommendations. The manufacturers' instrument manuals will be available for reference during sampling.

2.4.2 Calibration

- Instruments will be calibrated daily before they are used to a known standard and for those instruments that are not stabilizing consistently, will also be checked at the end of the day. For instruments that are not calibrating correctly, results will be communicated to the project manager for appropriate action (e.g., field tested parameters (pH, specific conductance) may be checked by the laboratory.
- Instrument calibration standards will be prepared according to the instrument manufacture's specifications.
- Calibration procedures, dates, and times will be recorded on field sheets.
- Field instruments will be appropriately maintained.

2.5 Purging and Development Criteria

Monitoring wells will be purged before samples are collected. Wells will be purged by either standard or low-flow purging procedures.

2.5.1 Standard Purging Procedures

For the standard procedure, purging will continue until at least 3 casing volumes have been removed, until the field parameters have stabilized, or until the well has been purged dry, whichever occurs first. One casing volume is defined as the amount contained within the casing, from static water level to total depth (reported or sounded, whichever is deeper). Table C-1 lists depths to the bottoms of site wells and in which wells dedicated pumps are installed. Some of the monitoring wells are expected to be evacuated to dryness after the removal of less than 3 casing volumes (e.g., MW-12S, MW-17, and MW-27). In instances where the water level is below the pump intake (generally the top of the pump), but above the bottom of the well, remove the pump and place it temporarily on new clean plastic beside the well. Purge the well slowly with a single-use bailer and then let recharge (take care to purge slowly with the bailer to minimize disturbance to the sediment that might accumulate in the bottom of the well). These low-yield wells can be allowed to recharge for up to 24 hours. Samples will be taken as soon as the monitoring wells have recharged to a level sufficient for sample collection. If an adequate volume of water has not recharged after 24 hours, the monitoring well will be recorded as dry for the sampling event. Sample collection priority may be different for low recharge wells, with VOCs typically collected first (see Section 2.14). Check with Project Manager if this condition occurs.

- Field parameters will consist of pH, temperature (in Celsius), and specific conductance. Dissolved oxygen or redox potential will be recorded as appropriate with the last set of readings.

- Initial field parameters will be recorded when purging begins.

- Field parameters will be recorded on the field sampling data sheet (FSDS) (see example in Exhibit A).

- Field parameters will be measured at selected intervals during purging. Sufficient measurements will be taken to document changes in the parameters. The frequency and total number of measurements will depend on well productivity. Generally, field parameters will be recorded after each well volume is purged.

- Field parameters will be considered stable when the last two measurements are within ten (10) percent of each other.

2.5.2 Low Flow Purge Procedures

Low-flow refers to the velocity with which water enters the pump intake and that is imparted to the formation pore water in the immediate vicinity of the well screen. It does not necessarily refer to the flow rate of water discharged at the surface, which can be affected by flow regulators or restrictions. Water level drawdown provides the best indication of the stress imparted by a given flow-rate for a given hydrogeological situation. The objective is to pump in a manner that minimizes stress (drawdown) to the system to the extent practical. Typically, flow rates on the order of 100 to 500 milliliters per minute are used. Performance criteria include achieving stabilization of water quality parameters commonly measured with an in-line flow cell. These typically stabilize in the following order: pH, temperature, specific conductance, redox, and DO. Current studies show that specific conductance and DO are the most sensitive in indicating that formation water is being sampled and thus water samples are representative of the aquifer (QED, 2011). In addition, the U.S. Environmental Protection Agency (EPA) considers minimized drawdown as a primary indication that water from the formation is being sampled rather than the well casing being dewatered. Guidance on low-flow sampling procedures is provided by EPA (1996a, 1996b, 2010).

As a general criterion for selection, wells in which the water level stabilizes within 1 to 5 feet of the static level are considered candidates for low-flow purging procedures. At Coffin Butte Landfill, deep wells MW-1D, MW-3D, MW-10D, MW-11D, MW-12D, and shallow wells MW-8S, MW-15, MW-20, MW-23, MW-24 and MW-26 typically stabilize within 1 to 5 feet of the static water level. If in the future, it can be shown at other wells that the water level during purging is stable within several feet of the static level, then they will be considered for purging by the low-flow method. Low-flow procedures are summarized as follows:

- Measure initial depth-to-water.

- Connect compressor or compressed gas canister to flow regulator and tubing at well head and begin purging. With dedicated bladder pumps, the rate of purging is governed by the number of pump cycles per minute at a volume of 180-200 milliliters per cycle. The lowest setting is 2 cycles per minute with flow rates of 360 to 400 milliliters per minute (within the range specified by USEPA).

- Measure drawdown in well during purging and record on FSDS. Drawdown at site wells typically stabilizes after an initial drawdown of from 1 to 5 feet. These levels of drawdown support the goal of minimizing stress on the aquifer to the extent practical and are acceptable for site conditions.

- Record field parameters pH, specific conductance, and temperature with flow-through cell attached to discharge line. Each of these parameters should stabilize relatively rapidly to within criteria listed by the EPA based on historical results. For temperature, no criterion is indicated but changes in field measurements should be less than or equal to 0.5 degree Celsius. For pH, the criterion is a variance of less than 0.2 units. Specific conductance should vary from 3 to 10 percent from the previous measurement.

- Record redox and DO with flow-through cell attached to discharge line. Redox should stabilize to less than a variance of 10 millivolts. For DO, the measurements should be within the criterion of 10 percent or within the accuracy of the flow-through cell (0.2 milligrams per liter [mg/L]).

- After field parameters stabilize and/or minimum purge volume removed, collect water quality samples.
- Field parameters will be measured at selected intervals during purging. Sufficient measurements will be taken to document changes in the parameters. The frequency and total number of measurements will depend on well productivity. Generally, field parameters will be recorded every 5 minutes.
- Field parameters will be recorded on the field sampling data form.

2.6 Purging and Sampling Equipment

The following equipment is described to provide flexibility to the sampler during the course of a sampling event, or in rare instances, to substitute a type of sampling equipment because of primary equipment malfunction. Most of the wells routinely sampled at the site are equipped with dedicated bladder pumps. Wells which are sampled less than annually, are typically purged and sampled by bailing (shallow wells) or by submersible pump (deep wells).

2.6.1 Dedicated Bladder Pumps

Bladder pumps are submersible mechanisms consisting of a flexible membrane bladder enclosed in a rigid (usually stainless steel or plastic) housing. The internal bladder can be compressed and expanded under the influence of gas (air, carbon dioxide, or nitrogen). Water enters the bladder through the lower check valve; compressed gas is injected into the cavity between the housing and bladder. The sample is transported through the upper check valve and into the discharge line through compression of the bladder. The upper check valve prevents water from reentering the bladder. The process is repeated to cycle the water to the surface. Dedicated bladder pumps are installed at each Coffin Butte compliance well and at detection wells that are sampled annually (see Table C-1).

Purging Procedures

- Connect the appropriate hose from the gas cylinder or compressor to the controller box and to the pump.

- Start the pump and record the pumping rate and the depth to water. Control the pumping rate by a controller. During pumping, monitor the water level so the pump will not run dry.

Sampling Procedures

- While pumping is ongoing, the sample bottles can be filled directly from the discharge line.

- When collecting samples for volatile organic analysis, regulate the flow rate to approximately 100 milliliters per minute to minimize pump effluent turbulence and aeration. The VOC container will be completely filled so that no headspace remains and then capped; it will be checked for air bubbles by turning the bottle upside down and tapping it lightly to move any air bubbles to the bottom. If bubbles are observed, the container will be opened and more sample added, repeating the sequence until no more bubbles are evident.

- When collecting samples for dissolved constituents, filtering can be performed by attaching a disposable 0.45-micron acrylic copolymer filter directly to the pump effluent line with a pressure fitting. As the pump cycles, the effluent will be pressured through the filter and directed into the appropriate containers.

Limitations and Special Considerations. Bladder pumps prevent contact between the gas and water sample and are suitable for collecting groundwater samples for almost any given organic or inorganic constituent. Disadvantages of bladder pumps include the large gas volumes required (especially at depth), and potential bladder rupture.

2.6.2 Bailers

Bailing is often the most convenient method for evacuating well water. Bailers are constructed in a variety of materials and sizes, usually of PVC, stainless steel, or Teflon.® The line for the bailer is usually polyethylene rope. Bailers can be reusable (after decontamination), dedicated, or disposable. Dedicated bailers or single-use bailers are currently used for some wells at the site to reduce the chance for cross contamination. During bailing, the bailer cord is not allowed to touch the ground with the cord managed by holding the line between the sampling person's hands, contained in a clean bucket, or reeled on to a clean spool. Bailers can also be used to collect grab samples from surface water locations.

Purging Procedures

- Remove bailer from the protective sleeve.
- Tie the line to the bailer with a bowline or equivalent knot, lower the bailer to the bottom of the monitoring well, and cut the cord to the desired length.
- Before inserting the bailer into the well, test the knot for security and the bailer to evaluate whether or not the parts are intact.
- Take care and bail slowly to minimize disturbance to sediments in the well and reduce the amount of aeration of the sample. In fine-grained aquifers, rapid bailing can also pull sediment from the formation into the well casing (i.e., redevelop the well).

Sampling Procedures

- After completing the purging, collect a water sample.
- If the well was evacuated with the bailer, collect the sample with the bailer.
- If another method was used for purging the well, discard the first bailer-full of water before sampling.
- Attach a bottom-discharging device to the bailer to fill the sample bottles.
- When filling the volatile organics bottle, direct the bottom discharge down the side of the sample bottom to reduce the potential for analyte volatilization from turbulent flow.

Limitations and Special Consideration. Purging monitoring wells by bailing presents two potential problems. Rapid bailing can stir up the sediments on the bottom of the monitoring well and increase the suspended solids in the groundwater samples. Bailing is not practical for deep wells or where large volumes of groundwater must be evacuated.

2.6.3 Peristaltic Pumps

Peristaltic pumps provide a low flow rate, typically 0.02 to 1 gallon per minute. Peristaltic pumps are suitable where depth to groundwater is less than 20 feet and the water column must not be disturbed, or where in-line filtering for dissolved constituents is wanted.

Purging Procedures

- Insert new or decontaminated tubing into the wellhead and lower it below the water surface.
- Slice an angle section from the bottom of the intake tubing to keep the tubing off the bottom of the monitoring well.
- Install new or decontaminated tubing in the pump head of the peristaltic pump.
- Attach the intake and discharge tubing to the peristaltic pump head.
- Record the time (on a 24-hour clock) and date pumping started and stopped in the field notes.
- Monitor pumping for continuous discharge. If drawdown causes the discharge to stop, move the intake line farther down into the well.

Sampling Procedures

- Attach an in-line filter to the discharge tubing to collect samples for dissolved constituents analysis. Collect samples for other inorganic parameters directly from the discharge tubing.
- Do not collect samples for volatile or semivolatile organic compounds analysis from the peristaltic pump; these should be collected by bailer gently to minimize disturbance of the water in the casing, after purging and sampling for other parameters through the pump.
- Fill the sample bottle directly from the discharge tubing or in-line filter.

Limitations and Special Considerations. Peristaltic pumps are limited to conditions where groundwater does not require lifting more than approximately 20 feet. Peristaltic pumping cannot be used to collect samples for volatile or semivolatile organic compounds analysis.

Pumping with a peristaltic pump may change the field parameters slightly. Tubing material types need to be considered for different analytical suites.

2.6.4 Electric Submersible Pump

Selecting from the variety of electric submersible pumps available depends on the requirements of the individual application. Submersible pumps effectively purge wells and, in some cases can be used to collect samples. Submersible pumps are particularly useful where water is deeper than 20 to 30 feet below the ground surface or when large volumes of water will be purged.

Purging Procedures

- Unless the well has already been sampled by submersible pump, test the straightness of the well before lowering the submersible pump down the well. This can be done by lowering a decontaminated cylinder (e.g., a bailer) approximately 5 feet long and of the appropriate diameter (1.75-inch for a 2-inch monitoring well) into the well to see that the well is plumb and that alignment will accept the submersible pump.

- Connect the appropriate hose, safety line, and power cables.

- Lower pump into the casing with the water intake at the top of the well screen.

- Start the pump and record the pumping rate and the depth to water. Control the pumping rate by a controller (if equipped) or a discharge valve. During pumping, monitor the water level so the pump will not run dry.

- If drawdown continues, turn off the pump before the water level reaches the pump. The on-off cycle may have to be repeated several times in order to purge the well.

Sampling Procedures

- While pumping is on-going, the sample bottles can be filled directly from the discharge line. (Note: samples for volatile organic compounds [VOCS] can be collected from certain low purge-volume submersible pumps, such as Grundfos Redi-Flo2.)

Limitations and Special Considerations. High-volume submersible pumps should not be used to collect samples for volatile or semivolatile organic compounds analysis or for dissolved oxygen analysis. Various types of submersible pumps have their limitations for development use. Small-diameter monitoring wells restrict the selection of available submersible pumps. Many submersible pumps are heavy and require special pump-handling equipment. Decontamination of the pump may require special equipment.

2.6.5 Inertia Pumps

Inertia pumps (such as the Watera™) are well suited for removing moderate quantities of groundwater from 2-inch wells. The major advantage of an inertia pump system is that samples for VOC analysis can be collected through the pump tubing and the tube may be dedicated to an individual well.

Purging Procedures

- Use new 5/8-inch outside diameter, high-density polyethylene (HDPE) tubing.
- Install an HDPE foot valve onto the bottom end of the HDPE tubing.
- Lower the tubing into the monitoring well until the foot valve rests on the bottom of the well.
- Cut the tubing so approximately 2 feet is left above the well casing. Fold over and insert the extra tubing into the well casing so that the well cap and lock can be replaced. Be careful not to push the folded tubing too far down inside the well, where it is beyond reach.
- Remove the water in the well by rapidly lifting the HDPE tubing up and down in the well, either by hand or with an automatic unit.

Sampling Procedures

- Fill sample bottles directly from the HDPE tubing discharge.
- Attach a disposable in-line filter to the discharge end to collect samples for dissolved constituent analysis.

Limitations and Special Considerations. Use care when the intake is at the water surface. Do not use inertia pumps in wells with diameters larger than 4 inches because it is inefficient. Use inertia pumps at depths less than 150 feet (the total effective depth is 200 feet or less).

2.7 Groundwater Supply Well Sampling

Purge volumes need not be calculated, nor purging strictly performed, at the groundwater supply wells, because the water supply systems are in continual operation. The water sample can be collected immediately and directly from the sample tap which will be opened and allowed to discharge 5 to 10 minutes to flush the piping system. Field-measured water quality parameters (pH, specific conductance, temperature) will be recorded. Samples should be collected at a point before treatment (if present).

2.8 Secondary Leachate Collection System (SLCS)

The secondary leachate collection system (SLCS) underlies each landfill cell beginning with Cell 2B. It was previously referred to as the leak detection system (LDS), and sampling point designations retain the LDS identifier for continuity in the database and on site drawings. Monitoring procedures from each of the SLCS sumps have evolved as the site has expanded. The current configuration at each SLCS monitoring point is shown on Table C-2; sump geometries for both systems and the primary sump for Cell 1 are shown in Exhibit B.

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. Through 2010 and into the first part of 2011, data for the sumps/riser pipes were recorded in the sensor and subsequently downloaded through the cable with a laptop computer. Unfortunately, the corrosive environment within the leachate sumps degraded the seals on the probes, causing the batteries and memory to fail when attempting to download the data in early Spring 2011.

Since then, VLI has employed another system that appears to be more resilient to the conditions in the leachate sumps. In early March 2011, VLI installed a bubbler system in the Cell 2B and Cell 3 primary sumps.

The bubblers, manufactured by LevelCom (http://levelcom.net/) in Portland, Oregon, are hydrostatic measurement devices. They are ideal for monitoring leachate sumps because there are no sensitive electronics or moving parts in contact with the leachate. The system is designed with a 1-inch diameter PVC dip tube installed along the inner wall of the sump. The bottom end of the tube is installed 12 inches from the sump bottom while the top end is connected to the bubbler. A purge gas (compressed air) is pumped into the sump through the tube. As gas flows down to the dip tube’s outlet, the pressure in the tube rises until it overcomes the hydrostatic pressure produced by the liquid level at the outlet. That pressure is monitored by a pressure transducer connected to the tube. A microprocessor in the bubbler converts the pressure reading into a liquid depth taking into consideration the 12 inches that the dip tube is set from the sump bottom. A Global Water GL500 data logger records the leachate depth readings.

As a note, LevelCom has installed bubblers in a wide range of harsh environments ranging from marine drilling platforms to asphalt shingle manufacturing plants. This is the first landfill application The sumps for Cell 4 (L-4 and LDS-4) will be controlled by transducer as described above. Depending on how the transducers perform, VLI may switch to bubblers in the future.

2.8.1 System Description

LDS-2B. The secondary sump consists of a 1-foot thick gravel layer that directly underlies the primary composite liner, and shadows the geometry of the primary sump (see Figure 1 in Exhibit B). Sump operation and control are as follows.

- A 4-inch diameter riser pipe of high density polyethylene (HDPE) extends from the sump up a 3:1 slope, and daylights in the perimeter road.
- A Dayton 2-inch diameter, 3HP centrifugal pump has been installed outside of the riser with 2-inch HPDE suction pipe installed inside of the riser. (see Figure 2 in Exhibit B). The pump discharge pipe exits the riser at the top of the slope and discharges to the primary sump. The pump is turned on and off by a custom built controller. The controller monitors pump motor load and shuts off power when it senses a change to keep it from pumping dry and burning out the motor. After the motor has shut down, the controller checks every 120 minutes to see if there is any liquid to pump. If the pump/riser pipe is still dry, the controller will shut down and rest again.
- Water levels in the sump are monitored with the bubbler system described above.
- A mechanical flow meter is located in-line on the pump discharge pipe to totalize the volume of fluid being pumped from the secondary leachate collection layer. The totalized volumes are recorded manually once a week from in-line flow meters.
- The rationale for the maximum allowable liquid head in the secondary system is as follows:
  - The supplemental protection provided by the GCL under the secondary liner is 237.75. Allowing up to 1-foot of head buildup, the allowable elevation is 238.75.
  - The bottom elevation in the sump is 234.25. Therefore, the maximum allowable liquid depth is 238.75 - 234.25 = 4.5 feet (54 inches). (Note: The maximum allowable depth in the secondary sump is the same as in the primary sump. This is to be expected since their geometries mirror each other.)

LDS-3. This sump is configured similar to the one in LDS-2B but with an 8-inch diameter riser pipe (see drawing in Exhibit B). The sump is outfitted with a submersible pump controlled automatically by a Franklin Pumptec controller using on-off logic similar to that programmed for LDS-2B. The totalized volumes are recorded manually once a week from an in-line flow meter. The configuration of the sump geometry creates a maximum allowable liquid level for the secondary sump of 30 inches.

LDS-4. This sump is configured similar to the one in LDS-3 but with a 12-inch diameter riser pipe (see drawing in Exhibit B). The sump is outfitted with a submersible pump and controlled by a transducer. Totalized volumes are recorded manually once a week from a magnetic in-line flow meter. The configuration of the sump geometry creates a maximum allowable liquid level for the secondary sump of 36 inches.

LDS-5. This sump is configured similar to the one in LDS-3/4 with a 12-inch diameter riser pipe (see drawing in Exhibit B). The sump is outfitted with a submersible pump and controlled by a transducer. Totalized volumes are recorded manually once a week from a magnetic in-line flow meter. The configuration of the sump geometry creates a maximum allowable liquid level for the secondary sump of 60 inches.

LDS-WLP and LDS-ELP. The surge ponds are double-lined with primary and secondary geomembrane liners separated by single-sided geocomposite; the secondary (bottom) geomembrane is underlain by a geosynthetic clay liner. The liner system for each pond is underlain by a gravel subdrain to relieve pressure from high groundwater levels in the area; these drain through a 4-inch diameter pipe to a discharge point northeast of the respective ponds. The secondary liner systems are designed so that any fluids collected in the drainage layer (LDS) will flow to a sump (filled with gravel) in the northwest end of the west pond and west end of the east pond. Access to the SLCS for both ponds is through a 6-inch HDPE riser pipe installed between the primary and secondary geomembrane liners. The pipe extends from the ground surface to the sump area. Grundfos Redi-Flo2 electric submersible pumps are installed in the SLCS riser pipes of each pond to purge the systems of accumulated liquid and for sampling. Automated pump controllers are installed with on-off logic as described above to control the operation of the pump. A flow meter is attached in line to measure the volume pumped during pump operations. Any liquid is pumped from the LDS back to the surge pond. Liquid levels are currently not measured in these sumps.

2.8.2 Sampling and Analysis

The presence of liquid is detected by the bubbler system (Cell 2B, Cell 3) or transducer (Cell 4 and Cell 5), or measured by recording the liquid volume removed (LDS-WLP and LDS-ELP). Since the SLCSs are controlled with automated pumping systems, they are not purged before sampling. Also, at drier times of the year, there can be inadequate liquid to sample. In those instances where liquid is not forthcoming because of low recharge to the system, they will be considered dry for the event. During sample collection, the flow will be regulated to a low rate (approximately 100 ml/min) to reduce volatilization of VOCs. Since each of the SLCSs are plumbed and have automatic controllers, grab samples can be collected from a stopcock connected in line with the discharge line while the pump is operating. If not pumping, the pumps for these systems should be turned on manually at the control panel to collect a sample. As noted above, if not enough liquid is present for sampling and analysis during one event, it will recorded as dry and be sampled during the next event. The analytical parameters to be tested and monitoring frequency are listed in the EMP.

Field parameters specific conductance, pH, and temperature can be measured with portable field meters; a flow-through cell is not used because of potential for damage to the probes from higher contaminant concentrations potentially present in the effluent.

2.9 Leachate Sampling

Leachate can be sampled either from the existing sumps for Cell 1 (L-1), Cell 2 (L-2B), Cell 3 (L-3), Cell 4 (L-4), and Cell 5 (L-5) or from the west or east leachate pond (L-Pond)(see photo in Exhibit B of sampling port for the west leachate pond). Leachate is sampled from a stopcock connected in line to the pump discharge line. Bubbler systems or transducers measure and record leachate levels in the primary sumps.

2.10 Surface Water and Underdrain Sampling

Grab samples will be collected from the surface water and underdrain sampling locations listed for the monitoring program (EMP Table 4-1). A sample bottle will be dipped directly into the stream or into flow from the underdrain pipe, capped, and stored consistent with protocols outlined in Section 2.14.

In instances where access to Soap Creek is unsafe, surface water samples can be collected by lowering a bucket or bailer from the bridge passing over the creek. In addition, for the underdrain below Cell 5 (S-U7) access is gained through a manhole covered by a protective grate. The grate can be removed to lower a bucket to the bottom of the drain.

Water will be sampled as follows:

- Temperature, pH, and specific conductance will be measured with portable meters at the time of sampling. The data will be recorded immediately on a field sampling data form.
- When holding the sample bottle, hands and other objects will be kept away from the opening to prevent contaminating the sample.
- Surface water will be collected in appropriate containers by allowing water to flow directly into the container (making sure that any preservative does not flow out), or by submerging the container in a small pool formed naturally or

excavated for that purpose. Samples will be collected in a manner to minimize aeration. Bottles will not be rinsed or overfilled. As an alternative, a clean, extra sample bottle can be used to dip and transfer water from the flow to the sample container.

- Equipment used for sample collection will be decontaminated both before it is used on site and after each sample is collected.
- Clean gloves will be worn at each sampling site to avoid the potential for cross-contamination.
- Field activities and sampling data (e.g., sample containers, preservatives used) will be documented in the field on the field sampling data form. Deviations from the general procedures will be noted on field documentation records and brought to the attention of the project manager.

2.11 Sample Nomenclature

Groundwater samples from facility monitoring wells will be blind-labeled (an additional laboratory quality control procedure). Each blind-labeled sample will be designated by the abbreviation “VLI-,” followed by the date of collection, then by “-” and a unique identification number. Numbers will be assigned in sequence, starting with 1, during a single monitoring event, regardless of the collection date. For example, a sample labeled “VLI-100514-7” would indicate that it was obtained at the VLI site on October 5, 2014, and that it was the seventh sample obtained for that sampling event. To ensure the integrity of quality assurance and quality control (QA/QC) samples, duplicates or equipment blanks will be blind-labeled so that their identity will not be evident to the laboratory.

2.12 Dissolved Constituent Field Filtering

Groundwater samples collected for dissolved constituents analyses (e.g., metals, orthophosphate) will be filtered with a 0.45-micron filter before they are placed in sample containers. Filtration can be accomplished with in-line filters using the peristaltic pump, submersible pump, bladder pump, or inertia pump. Filtering can also be performed through a reusable, stand-alone filtration apparatus. When filtering in the field is not practical, filtering will be performed at the laboratory. In this case, samples should not be preserved in the field but should be collected in an unpreserved container, and requested, on the chain-of-custody, to be filtered and preserved in the laboratory.

2.13 Equipment Cleaning and Decontamination

2.13.1 Sampling Equipment

All nondedicated groundwater sampling equipment will be decontaminated in the following sequence before samples are collected at each monitoring well, water supply well, sump, or surface water site:

- Rinse with tap or distilled water.
- Wash with nonphosphatic detergent consisting of a dilute mixture of Liquinox (or its equivalent) and tap or distilled water.
- Rinse with distilled water.
- Rinse with methanol solution (50 percent methanol and 50 percent distilled water).
- Finally, rinse with distilled water.

2.13.2 Water Level Measurement Equipment

The portion of the water level detector that enters the water (the tip) and a 5-foot section above that portion will be decontaminated before its use in each well. Decontamination will consist of a distilled water rinse.

2.14 Sample Handling and Collection Order

The sample containers will be prepared and provided by the analytical laboratory. Samples will be preserved consistent with analytical laboratory recommendations (see Table C-3). The type and size of container used for each analysis and the type of preservative added, if any, will be recorded on the FSDS (Exhibit A). Samples will be collected in the order shown below except for wells purged with peristaltic pumps (because VOCs or semi-VOCs cannot be collected through peristaltic pumps, they are collected after the inorganic parameter are sampled through the pump; the VOCs are collected with a bailer after the pump tubing has been removed from the well):

- VOCs
- Dissolved gases and total organic carbon (TOC)
- Semivolatile organic compounds (semi-VOCs)
- Total metals and cyanide

- Major water quality anions and cations
- Dissolved inorganic constituents
- Miscellaneous monitoring parameters

Sample containers are placed in an iced cooler (approximately 4°C) immediately after sample collection. Sample containers are kept closed, maintained under chain-of-custody, and cooled until analysis. Recommended holding times from sample collection until sample analysis should not be exceeded (see Table C-3).

2.15 Waste Fluid Handling

Wastewater includes waters generated by well purging and during decontamination of sampling equipment. Since quantities are minimal and concentration of constituents relatively low, the wastewater will be discharged to the ground surface away from the monitoring well. Purging from the secondary leachate collections systems is directed to the primary sumps. Used sampling equipment such as tubing and gloves will be appropriately disposed of off-site.

3 QUALITY ASSURANCE AND QUALITY CONTROL

This section includes QA/QC procedures for field activities, sampling procedures, and data validation and data entry of laboratory data. Functionally, this section provides a consistent set of QA/QC procedures that will be used throughout routine monitoring activities described in the EMP. Applicable sections could support other types of field activities, such as monitoring well installation.

3.1 Purpose

Effective multidisciplinary field studies combine QA/QC with efficient use of personnel and other resources. A well-documented QA/QC program facilitates obtaining data that are scientifically and legally defensible and that meet applicable standards.

The procedures and guidelines are based on standard QA/QC programs, consistent with applicable parts of U.S. Environmental Protection guidance documents for evaluating solid waste (USEPA, 1983 and 1986a, known as SW-846), for technical enforcement of groundwater monitoring (USEPA, 1986b), and for preparing quality assurance plans (USEPA, 1987, 1990). The QA goals for monitoring are as follows:

- Collect high-quality, verifiable data.
- Use resources cost-effectively.
- Collect data that are usable by VLI and the DEQ.

3.2 Responsibilities

The project team includes engineers, hydrogeologists, field technicians, and other scientists. The project manager will be responsible for seeing that the procedures and guidelines described in this section of the SAP are followed during the monitoring events or if deviated from, then proper alternative procedures are followed and documented.

Reports that are prepared as part of routing monitoring will be submitted to the DEQ. VLI will notify the DEQ at least ten days before beginning field activities such as water sampling. If requested, DEQ representatives will be given the opportunity to take split samples during the field investigations; these are typically schedule once every 5 years.

3.3 Objectives for Measurement

The procedures and guidelines outlined in this section of the SAP will be used to evaluate qualitative and quantitative data obtained during site monitoring. Consistency of sampling, analysis, data validation, data evaluation, and reporting procedures is a high priority. Data quality objectives for laboratory analyses will follow the guidelines published in SW-846.

Measurements are intended to yield results representative of the media and conditions involved. QA/QC objectives for limits of detection, precision, accuracy, and completeness have been established for each measurement variable, where reasonably possible and are included in the laboratory quality assurance manual.

An appendix to the Annual Environmental Monitoring Report will summarize the QA/QC review, as appropriate. The review will include field documentation; field audits; duplicate sample, method blank, and trip blank results; sample holding times; and matrix spike recoveries, matrix spike duplicate results, surrogate recoveries, and laboratory method blank results.

3.4 Sampling Procedures

The quality of the data collected in an environmental study depends on the procedures and consistency used during sample collection. Detailed protocols for sample collection are provided in Section 2 of this SAP; handling and shipment procedures are described below.

3.4.1 Container Preparation and Preservatives

Clean sample containers will be prepared and provided by the laboratories. Samples will be preserved consistent with recommendations given in SW-846 (Table C-3). The type and size of container used for each parameter and the type of preservative added, if any, will be recorded on a field sampling data form. Containers will remain closed until use.

3.4.2 Handling

Once filled, sample containers will be kept closed, maintained under custody, and refrigerated or cooled with ice until analysis.

Samples will be labeled when they are collected. Sample collection data, including label information, will be recorded on field sampling data sheets (FSDSs) when the samples are collected. Sample containers will be placed in an iced cooler immediately after sample collection. Maximum holding times from the time of sample collection until sample analysis are listed in Table C-3. Samples will be shipped or delivered to the laboratory as soon as reasonably possible.

3.4.3 QA/QC Samples

QA samples will be collected in the field, as appropriate to the level of investigation. Samples could include field equipment blanks, trip blanks, or field duplicates. QA samples will be blind-labeled and preserved as if they were typical samples. QA samples will be clearly identified on the FSDSs. Analytical results from the blanks and duplicates will facilitate cross-checking of the data. Blank results may indicate possible contamination introduced by field or laboratory procedures, and field duplicates indicate overall precision in both field and laboratory procedures. Results will be evaluated and discussed in the data validation report.

Trip Blanks. Trip blanks are water quality control (QC) samples prepared in the laboratory by filling a water sample container with laboratory-grade, distilled, organic-free, deionized water. Trip blanks will be prepared at the same time and location as the sample containers for a particular sampling event. Trip blanks will accompany the sample containers to and from the event, but at no time will they be opened or exposed to the atmosphere. One trip blank for volatile organic compounds (VOCs) will generally be included per sampling event.

Field Blanks. There are two common types of field blanks that could be used at this site.

> *Atmospheric Condition Field Blanks* - These are prepared in the same manner as trip blanks, but they will be exposed to the ambient atmosphere at a specified monitoring point during sample collection. This is to determine the influence of external field conditions on sample integrity. For example, if it suspected that there are external sources of VOCs that might influence sample collection at the site, a field blank for VOCs will be included per day of sampling.
>
> *Equipment Field Blank* - These are obtained after nondedicated sampling equipment is decontaminated, and deionized organic-free water is passed through the sampling equipment and transferred into an appropriate sample container. Equipment Field Blanks (also known as Rinsate Blanks) will not be collected if single-use or dedicated equipment (e.g., bailers or tubing) is used for sampling. Equipment Field Blanks will be analyzed to determine whether decontamination of sampling equipment is adequate. One Equipment Field Blank will be collected for every 10 samples collected with nondedicated equipment, or at least one will be collected for each sampling event.

Field Duplicates. A duplicate water sample will be collected to check the precision of groundwater sampling and analytical procedures. During each sampling event, at least one blind duplicate sample will be taken from one sampling point at the same time as the regular sample. Duplicate samples will be obtained by alternately filling like sample bottles for the two sample sets (original and duplicate). One field duplicate sample will be collected for every 10 samples collected.

3.4.4 Changes in Procedures

Changes to the procedures outlined in this SAP will be documented in a field logbook. Approval from the project manager will be required to implement on-site changes. Major modifications of the sampling plan or procedures must be approved in advance by both the project manager and the DEQ.

3.5 Sample Custody

Sample custody is an important part of field work. The samples must be traceable from the time they are collected until the chemical analysis results are reported.

3.5.1 Field Operations

The key to documenting sample custody is thorough record keeping. A field logbook and field sampling data forms will be maintained daily, as appropriate, to document field activities and sample collection. Entries in the field logbook will be made in indelible ink, and any changes to entries will be made by crossing out the original entry with a single line and initialing it.

Sample containers will be labeled, before or immediately after sampling, as follows:

- Project number
- Sampling date and time
- Sample number and place of collection
- Sampler’s name and company

During sampling, the appropriate sample containers will be selected, and the appropriate sample number will be recorded in the field logbook or on a field sampling data form.

At the end of each sampling day and before samples are transferred off site, chain-of-custody entries will be made on a chain-of-custody/laboratory analysis request form to document sample custody. Information on the container labels will be compared with the information on the chain-of-custody form, the field sampling data form, and the field logbook.

3.5.2 Chain of Custody

Once a sample is collected, it will remain in the custody of the person who collected it, or other authorized personnel, until it is shipped to the laboratory. On transfer of sample possession to subsequent custodians, the persons transferring custody will sign the chain-of-custody form (Exhibit A). Signed and dated chain-of-custody seals will be attached to coolers before they are shipped. When the samples are received at the laboratory, the custody seal on the shipping container will be broken and the condition of the samples recorded by the laboratory custodian (see below). Chain-of-custody records will be included in the report prepared by the laboratory. The sampler or environmental consultant will retain copies of the chain-of-custody records.

3.5.3 Shipping

Samples will be shipped or delivered by hand to the laboratory as soon after collection as possible to meet holding times. Packaging and shipment will follow these procedures:

- Sample containers will be preserved and transported on ice in a sealed, insulated cooler.
- Glass bottles will be separated in the shipping container by shock-absorbent packaging material to prevent breakage.
- Ice will be sealed in separate plastic bags and placed on top of the samples.
- Place a laboratory-supplied trip blank in each cooler containing samples for VOC analysis.
- Sample shipments will be accompanied by a chain-of-custody/laboratory analysis request form, which will be sealed in a plastic bag and taped to the inside lid of the cooler.

3.5.4 Laboratory

On receipt of the samples, the laboratory sample custodian will fill out the chain-of-custody record. The custodian will note the condition of each sample container and, if appropriate, questions or observations about sample integrity. The custodian will also maintain a sample-tracking record that will follow each sample through the laboratory process. The sample-tracking record must show the dates of sample extraction or preparation, and the analysis carried out for each sample. These records will be used to determine compliance with specified holding times.

3.6 Analytical Procedures

Samples will be analyzed by a qualified analytical laboratory certified by ORELAP (Oregon Environmental Laboratory Accreditation Program) and/or NELAP (National Environmental Laboratory Accreditation Program). The current analytical laboratory for this project is TestAmerica Laboratories, Inc., in Denver, Colorado. The quality assurance manuals followed by TestAmerica describe equipment, personnel, QA/QC checks, and other important elements of their quality assurance protocol. Analytical procedures and QA/QC measures for the contracted laboratory are available on request.

3.6.1 Laboratory

The analytical methods and references for most analyses to be used are summarized in Table C-3. Procedural details not specified in this SAP should follow the protocol described in U.S. Environmental Protection Agency (EPA) SW-846 “Test Methods for Evaluating solid Wastes, Physical/Chemical Methods” (1986) guidelines and any updates.

Quantitation limit goals for each analyte are based on the following:

- For inorganic parameters and metals – less than or equal to 10 percent of the regulatory threshold.

- For organic parameters – based on the method practical quantitation limit (PQL) or estimated quantitation limit (EQL).

The method reporting limits (MRLs) for TestAmerica are compared to quantitation goals for the methods in Table C-4. For several constituents, the laboratory reports concentrations below the standard laboratory reporting limit (RL) but above the method detection limit (MDL) to meet project specific RLs. Those results will be designated as estimated by the laboratory (“J”) on their reports.

3.6.2 Internal QA/QC Checks

The laboratory will demonstrate its ability to produce acceptable results using recommended methods or their equivalent. The following criteria will be used to evaluate the data (as appropriate for inorganic or organic chemical analyses):

- Performance on method tests (USEPA, 1986a)

  - Matrix spike performance
  - Gas chromatograph performance (tailing factors)
  - Blanks
  - Precision of calibration and samples

- Percentage of surrogate recovery (organics)

- Adequacy of detection limits obtained

- Precision of replicate sample analyses

- Comparison of percentage of missing or undetected substances between replicate samples.

3.6.3 Field Preventive Maintenance

Preventive maintenance of specific pieces of equipment used in sampling and monitoring will follow the manufacturers' specifications and recommended field and laboratory practices.

3.7 Data Validation

Laboratories can provide several levels of data reporting deliverables to meet specific project needs. For the Coffin Butte Landfill data, TestAmerica provides a Tier II½ data package that includes a transmittal letter, sample analytical results, method blank results, surrogate recovery results, chain of custody documents, laboratory control sample, laboratory duplicate results where required by the method, and matrix spike and matrix spike duplicate results. Validation of laboratory data will follow applicable portions of USEPA guidelines for organic and inorganic data review (USEPA, 1999 and 2004). The environmental consultant will be responsible for data validation and compilation as described below.

3.7.1 Laboratory Reporting QC

- Comparing chain-of-custody documentation (analyses requested) with laboratory report (analyses performed).

- Giving data a preliminary proofing for anomalies; investigation and correction where reasonably possible.

- Proofing laboratory data sheets for detection limits, holding times, surrogate recovery performance, and spike recovery performance.
- Checking computerized data entries.

3.7.2 Laboratory QC

- Check sample holding time against the recommended holding time criteria established by USEPA to determine the data validity and usability. The holding time is period between the date of sample collection and extraction or analysis by the laboratory.
- Check laboratory method blank frequency and results to assess the effect of the laboratory environment on the analytical results. Method blanks are analyte-free water that is processed through the entire analytical system using procedures identical to those for the environmental samples.
- Surrogate standards (compounds similar to the parameters of interest, however, not normally found in environmental samples) are added to each environmental and QC sample, where applicable. Surrogate results are reported as percent recoveries and are used to assess the effect of the sample matrix on the analysis and analytical accuracy.
- Use matrix spike and matrix spike duplicate (MS/MSD) results to assess analytical accuracy and precision in the analytical system. A selected sample is spiked in duplicate with known concentrations of parameters. The results are reported as percent recovery, which determines accuracy and is a measure of the bias in a system. The relative percent difference between the matrix spike and the matrix spike duplicate results assess precision (reproducibility).
- Quantify and report all concentrations above method reporting limits (MRLs). MRLs are the minimum amount of analytes that the analytical systems can routinely and reproducibility distinguish from background system noise with 95 percent confidence. Because of matrix interferences or because a sample has been diluted in order to quantify the most concentrated analyte observed, actual MRLs may sometimes exceed those routinely used.

As outlined above, routine procedures intended to promote measuring precision and accuracy include using replicate analyses, standard reference materials, matrix spikes, and procedural blanks. The minimum QA/QC analyses that will be performed for both the organic and inorganic analyses are as follows:

- Matrix spikes and matrix spike duplicates: one of every 20 samples will be spiked with target analytes and analyzed. Matrix spikes will be analyzed for inorganic analytes, and both matrix spikes and matrix spike duplicates will be analyzed for organic analytes. If fewer than 20 samples are analyzed, at least one sample per phase will be spiked.

- Method blank: a method blank will be analyzed at a frequency of 5 percent of the total number of samples (i.e., one of every 20 samples), one per batch of samples, or one per day, whichever is greater.

QA/QC goals for accuracy, precision, and completeness have been developed for each analytical parameter identified in this SAP.

Precision is a measure of data variation when more than one measurement is taken on the same sample. The precision estimate for duplicate measurements can be expressed as the relative percent difference (RPD):

$$\text{RPD} = \frac{(c_1 - c_2) \text{ x } 100}{C}$$

where

c_1 = concentration for replicate 1.
c_2 = concentration for replicate 2.
c = mean concentration.

The accuracy of laboratory analysis is assessed by measuring standard reference material and spiked samples. Standard reference materials are used to calibrate laboratory measurement instruments.

Spike recovery is determined by splitting a sample into two portions, spiking one portion with a known quantity of a constituent of interest, and analyzing both portions. Spike recovery is expressed as percent recovery:

$$\textit{Percent recovery} = \frac{\Delta c \text{ x } 100}{\Delta c_s}$$

where

Δc = measured concentration increase.
Δc_s = known concentration increase.

Acceptable spike recovery limits are based on historical data sets, as defined by the USEPA.

Completeness is an estimate of the amount of valid data obtained from the analytical measurement system for a given set of data. Data qualified as estimates are usable and will therefore be considered in the calculation of completeness. Percent completeness is defined as the number of samples analyzed that meet the data quality goals, divided by the total number of samples analyzed, and multiplied by 100.

3.7.3 Field QC

- Check trip blank (prepared by the laboratory and used when sampling for volatile organic compounds) results to assess whether or not contamination was introduced during sample container preparation or sample transportation and storage.

- Check field blank (prepared by field personnel during sampling) results and rinsate blank (prepared after decontamination of field sampling equipment) results to assess the effects of field conditions on the analytical results and to identify false positives.

- Collect field duplicates to evaluate sampling and analytical precision (field and laboratory). Duplicates also assess the homogeneity of the sample. Collection procedures for the field duplicate sample and the primary sample are identical, both are analyzed for the same suite of parameters and the relative percent difference is calculated between the samples. Data qualifiers are not assigned on the basis of field duplicate results, however, an RPD of 50 percent will be considered satisfactory for this project.

3.7.4 Data Review Documentation

Upon completion of the review and assignment of data qualifiers (if applicable), a data review memorandum will be prepared that documents and clearly identifies any problems associated with the data and states any limitations for its use.

3.8 Data Management and Reduction

Raw data generated in the field or received from the laboratory will be validated and assigned qualifiers as appropriate, entered into a computerized database, and verified. The data provided by the laboratory for this project include copies of Portable Document Format (PDF) and an electronic data deliverable (EDD) in Excel® spreadsheet or comma separated value (.csv) format. The data is subsequently normalized and imported to a Microsoft Access® database designed for the landfill. Field data is subsequently entered manually to the database for electronic storage.

After validation and assignment of qualifiers, the data will be tabulated in a spreadsheet or database. The tabulation of laboratory and field data, with the appropriate data qualifiers, will be stored electronically for archival purposes.

3.9 Corrective Actions

Corrective action measures generally lie within three areas of project management: concerns associated with sample collection, sample handling, and equipment failures; data processing, data management, or data analysis; and nonconformance or noncompliance of analytical laboratories with QA/QC requirements.

The project manager will be notified immediately should a field or laboratory QA/QC problem arise that could jeopardize the use of collected data. Corrective action will be taken by the project manager when field methods are determined to be inappropriate or analytical data are found to be outside predetermined limits of acceptability. Corrective actions may include procedural changes, resampling or additional data collection, additional performance or system audits, meeting with laboratory personnel, and, in extreme cases, obtaining a new analytical laboratory. Minor corrective actions are to appear in the Annual Environmental Monitoring Report. Major corrective actions might necessitate notifying the DEQ as early as reasonably possible.

3.10 Performance and System Audits

Performance and system audits of sampling and analysis consist of reviewing field and laboratory QA/QC systems and sampling equipment and methods. They are designed to assess the capability and reliability of the measurement systems.

Key personnel from the environmental consultant will review field procedures, including observing and documenting field activities, and will regularly present findings and recommendations to the respective project manager. In addition, DEQ representatives who are on site during field activities may present findings and recommendations to the project manager.

REFERENCES

USEPA. 1983. Methods for chemical analysis of water and wastes. U.S. Environmental Protection Agency. EPA-600/4-79-020. March.

USEPA. 1986a. Test methods for evaluating solid waste. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. SW-846. September (update 1, July 1992; update 2a, August 1993; update 2, September 1994; update 2b, January 1995).

USEPA. 1986b. RCRA ground-water monitoring technical enforcement guidance document (TEGD). U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Office of Waste Programs Enforcement.

USEPA. 1987. Data quality objectives for remedial response activities, development process. U.S. Environmental Protection Agency.

USEPA. 1990. Preparing perfect project plans: a pocket guide for the preparation of quality assurance project plans. U.S. Environmental Protection Agency, Risk Reduction Engineering Laboratory. Cincinnati, Ohio.

USEPA. 1996a. Ground Water Issue: low-flow (minimal drawdown) ground-water sampling procedures. U.S. Environmental Protection Agency, Office of Research and Development (OSWER). EPA 540/S-95/504. April.

USEPA. 1996b. Low stress (low flow) purging and sampling procedure for the collection of ground water samples from monitoring wells. U.S. Environmental Protection Agency, Region I, Revision 2. July 30.

USEPA. 1999. USEPA contract laboratory program national functional guidelines for organic data review. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response. EPA 540/R-99/008. October.

USEPA. 2004. USEPA contract laboratory program national functional guidelines for inorganic data review. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response. EPA 540-R-04-004. October.

EPA. 2010. Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells. USEPA Region 1, Quality Assurance Unit, Publication EQADOP-GW 001. 30 pages. January 19.

QED. 2011. Low-Flow Ground-Water Sampling, An Update on Proper Application and Use. Webinar presented by QED Environmental Systems by David Kaminski. November.

TABLES

Table C-1
Well Construction Summary
Sampling and Analysis Plan
Coffin Butte Landfill

Monitoring Station	Bladder Pump	Purge Method	Ground Surface Elevation (ft msl)	Surveyed Reference Elevation (ft msl)	Stickup/ (-) stickdown	Total Casing Depth (ft bgs)	Total Casing Depth below TOC	Screened Interval (ft bgs)	Filter Pack Interval (ft bgs)	Well Diameter (Inches)
MONITORING/OBSERVATION WELLS										
MW-1S			288.50	289.87	1.37	23.0	24.4	18-23	16-23	2
MW-1D	Y	LF	288.50	289.89	1.39	40.0	41.4	35-40	34-40	2
MW-3S			284.70	285.86	1.16	26.0	27.2	21-26	20-26	2
MW-3D	Y	LF	284.70	285.94	1.24	54.3	55.6	49-54	47-54	2
MW-8S	Y	LF	240.30	244.01	3.71	30.8	34.5	21-31	16-31	2
MW-8D			240.10	244.04	3.94	75.0	78.9	65-75	60-75	2
MW-9S			221.40	223.27	1.87	35.0	36.9	25-35	20-35	2
MW-10S	Y	SP	289.03	291.42	2.39	41.1	43.5	30.1-40.1	25.8-41.1	2
MW-10D	Y	LF	289.02	291.38	2.36	82.2	84.6	73.0-82.2	60.1-82.2	2
MW-11S	Y	SP	274.80	274.71	-0.09	31.8	31.7	22-32	20-32	2
MW-11D	Y	LF	274.80	274.96	0.16	75.0	75.2	65-75	55-75	2
MW-12S	Y	SP	283.80	285.59	1.79	26.1	27.9	21-26	18.9-26.2	2
MW-12D	Y	LF	283.80	285.43	1.63	60.3	61.9	55-60	52.6-61.3	2
MW-14S			287.50	289.58	2.08	30.1	32.2	19.5-29.5	16.5-30	4
MW-14D			287.80	290.27	2.47	70.6	73.1	60-70	57.5-71	2
MW-15	Y	LF	233.45	235.66	2.21	28.9	31.1	19.0-28.0	16.5-29.0	2
MW-17	Y	SP	277.45	279.67	2.22	26.9	29.1	16.7-26.2	15.0-27.0	2
MW-18	Y	SP	267.70	269.90	2.20	20.9	23.1	11.2-20.8	9.0-21.4	2
MW-19	Y	SP	261.00	263.29	2.29	23.0	25.3	13.5-23.0	11.7-24.1	2
MW-20	Y	LF	256.81	259.22	2.41	21.4	23.8	11.3-20.7	9.5-22.5	2
MW-21	Y	SP	254.25	256.67	2.42	16.9	19.3	11.0-16.7	9.0-17.0	2
MW-23	Y	LF	242.81	244.76	1.95	22.3	24.3	12.4-22.1	9.6-22.7	2
MW-24	Y	LF	273.94	276.76	2.82	34.9	37.7	19.5-34.5	18.0-35.0	2
MW-26	Y	LF	235.18	237.91	2.73	27.2	30.0	17.1-26.9	15.5-28.0	2
MW-27	Y	SP	252.12	254.76	2.64	35.1	37.7	25.0-34.8	23.5-35.5	2
LANDFILL WATER SUPPLY										
PW-2			248.90	250.27	1.37	199.0	200.4	95-199 OH	none	8
PRIVATE WATER SUPPLY										
Duplex Well			289.01	289.01	0.00	74.0	74.0	26-74 OH	none	6
Berkland well			327.63	327.63	0.00	220.0	220.0	20-220 OH	none	6
Phillips Well			291.00	291.00	0.00	—	—	—	—	—
PIEZOMETERS										
P-8	Y	SP	282.40	284.02	1.62	28.4	30.0	18.7-27.6	16.4-28.4	2
P-9			273.66	276.01	2.35	23.3	25.7	17.2-23.0	15.0-23.3	2
P-10			243.00	245.12	2.12	18.0	20.1	7.7-17.2	5.7-18.5	2
P-19			383.15	385.65	2.50	106.5	109.0	96.3-106.1	94.2-106.5	2
P-20			585.92	588.32	2.40	131.5	133.9	101.4-131.2	98.5-132.1	2
P-21			624.09	626.74	2.65	170.1	172.8	150.0-169.8	147.0-170.1	2
QUARRY PIEZOMETERS										
QP-2S			355.40	355.66	0.26	100.1	100.4	79.6-99.6	74.6-100.1	2
QP-3S			601.70	602.02	0.32	354.4	354.7	333.4-353.8	330.5-354.4	2
QP-4S			717.15	718.95	1.80	403.1	404.9	363.1-403.1	none	2
QP-5N			601.48	601.53	0.05	230.9	231.0	200.3-230.3	197.7-230.9	2
QP-6N			445.39	445.82	0.43	150.0	150.4	119.4-149.4	117.3-150.0	2
QP-7N			374.43	374.5	0.07	119.6	119.7	89.0-119.0	85.2-119.6	2
WETLAND PIEZOMETERS										
WP-1			257.33	259.83	2.50	13.8	16.3	8.56-13.11	Prepack	2
WP-3			271.01	273.39	2.38	9.8	12.2	4.61-9.16	Prepack	2
WP-5			258.94	261.55	2.61	12.0	14.6	6.76-11.31	Prepack	2
WP-6			262.17	264.85	2.68	13.0	15.7	7.77-12.32	Prepack	2
WP-8			253.15	255.80	2.65	10.3	13.0	5.11-9.66	Prepack	2
WP-9			255.21	257.90	2.69	10.1	12.8	4.89-9.44	Prepack	2

Note: Bladder pump well caps add 0.02 ft to the surveyed reference elevation.
LF: low-flow purge; SP: standard purge.

Table C-2
Secondary Leachate Collection Monitoring Points
Sampling and Analysis Plan
Coffin Butte Landfill

Sampling Point	Area Monitored	Submersible Pump	Liquid Level Monitoring	Volume Monitoring	Sampling Procedure	Comments
LDS-2B	Cell 2B, 2C, 2D	Yes	Bubbler	Flow meter	Pump discharge	Automated pump controller
LDS-3	Cell 3A, 3B	Yes	Bubbler	Flow meter	Pump discharge	Automated pump controller
LDS-4	Cell 4	Yes	Transducer	Flow meter	Pump discharge	Automated pump controller
LDS-5	Cell 5	Yes	Transducer	Flow meter	Pump discharge	Automated pump controller
LDS-WLP	West Leachate Pond	Yes	No	Flow meter	Pump discharge	Automated pump controller
LDS-ELP	East Leachate Pond	Yes	No	Flow meter	Pump discharge	Automated pump controller

Table C-3
Sample Analytical Methods, Volumes, Containers, Preservatives, and Holding Times
Sampling And Analysis Plan
Coffin Butte Landfill

Parameter	Analytical Method	Volumes Required (mL)	Container Type	Preservative	Holding Time
Common Anions and Cations					
Calcium	200.7/6010	500	Plastic	HNO_3 to pH<2	6 months
Iron	200.7/6010	500	Plastic	HNO_3 to pH<2	6 months
Magnesium	200.7/6010	500	Plastic	HNO_3 to pH<2	6 months
Manganese	200.7/6010	500	Plastic	HNO_3 to pH<2	6 months
Sodium	200.7/6010	500	Plastic	HNO_3 to pH<2	6 months
Silicon	200.7/6010	500	Plastic	HNO_3 to pH<2	6 months
Potassium	200.7/6010	500	Plastic	HNO_3 to pH<2	6 months
Bicarbonate	310.1/2320B	500	Plastic	None	14 days
Carbonate	310.1/2320B	500	Plastic	None	14 days
Sulfate	300.0	500	Plastic	Cool, 4°C	28 days
Chloride	300.0	500	Plastic	None	28 days
Nitrate/Nitrite Nitrogen	353.2	500	Plastic	H_2SO_4 to pH<2 Cool, 4°C	28 days
Trace Metals					
Antimony	200.8/6020	500	Plastic	HNO_3 to pH<2	6 months
Arsenic	200.8/6020	500	Plastic	HNO_3 to pH<2	6 months
Barium	200.8/6020	500	Plastic	HNO_3 to pH<2	6 months
Beryllium	200.8/6020	500	Plastic	HNO_3 to pH<2	6 months
Cadmium	200.8/6020	500	Plastic	HNO_3 to pH<2	6 months
Chromium	200.8/6020	500	Plastic	HNO_3 to pH<2	6 months
Cobalt	200.8/6020	500	Plastic	HNO_3 to pH<2	6 months
Copper	200.8/6020	500	Plastic	HNO_3 to pH<2	6 months
Lead	200.8/6020	500	Plastic	HNO_3 to pH<2	6 months
Mercury	245.1/7470	500	Plastic	HNO_3 to pH<2	28 days
Nickel	200.8/6020	500	Plastic	HNO_3 to pH<2	6 months
Selenium	200.8/6020	500	Plastic	HNO_3 to pH<2	6 months
Silver	200.8/6020	500	Plastic	HNO_3 to pH<2	6 months
Thallium	200.8/6020	500	Plastic	HNO_3 to pH<2	6 months

Table C-3
Sample Analytical Methods, Volumes, Containers, Preservatives, and Holding Times
Sampling And Analysis Plan
Coffin Butte Landfill

Parameter	Analytical Method	Volumes Required (mL)	Container Type	Preservative	Holding Time
Trace Metals (cont'd)					
Vanadium	200.8/6020	500	Plastic	HNO_3 to pH<2	6 months
Zinc	200.8/6020	500	Plastic	HNO_3 to pH<2	6 months
Indicator Compounds and Other Parameters					
Ammonia-nitrogen	350.1	500	Plastic	H_2SO_4 to pH<2 Cool, 4°C	28 days
Biological Oxygen Demand	405.1/5210B	500	Plastic/glass	Cool, 4°C	48 hours
Chemical Oxygen Demand	410.2/410.4	1,000	Plastic	H_2SO_4 to pH<2 Cool, 4°C	28 days
Cyanide	9010	500	Plastic	NaOH to pH>12 Cool, 4°C	14 days
Orthophosphate	365.3	100	Plastic/glass	Filter immediately Cool, 4°C	48 hours
Total Dissolved Solids	160.1/2540C	1,000	Plastic	Cool, 4°C	7 days
Total Kjeldahl nitrogen	351.4/351.2	1,000	Plastic/glass	H_2SO_4 to pH<2 Cool, 4°C	28 days
Total organic carbon	415.1/5310B	1,000	Plastic	H_2SO_4 to pH<2 Cool, 4°C	28 days
Total phosphorus	365.3	100	Plastic/glass	H_2SO_4 to pH<2 Cool, 4°C	28 days
Total suspended solids	160.2/2540D	1,000	Plastic	Cool, 4°C	7 days
Volatile Organic Compounds	8260B/524.2	340-ml vials	Glass with Teflon-lined septum caps	HCl to pH<2 Cool, 4°C	14 days
Semivolatile Organic Compounds	8270	1,000	Amber glass with Teflon-line cap	Cool, 4°C	7 days

Table C-4
Quantitation Limit Goals
Sampling and Analysis Plan
Coffin Butte Landfill

Analyte	Units	Laboratory Method Reporting Limits	Quantitation Goals^{a,b}
Volatile Organic Compounds			
Acetone	µg/L	10	20
Benzene	µg/L	0.5	0.5
Bromobenzene	µg/L	1.0	2.0
Bromochloromethane	µg/L	0.5	0.5
Bromodichloromethane	µg/L	0.5	0.5
Bromoform	µg/L	0.5	0.5
Bromomethane	µg/L	0.5	0.5
2-Butanone (MEK)	µg/L	6.0	20
Carbon Disulfide	µg/L	2.0	0.5
Carbon Tetrachloride	µg/L	0.5	0.5
Chlorobenzene	µg/L	0.5	0.5
Chloroethane	µg/L	0.5	0.5
Chloroform	µg/L	0.5	0.5
Chloromethane	µg/L	0.5	0.5
2-Chlorotoluene	µg/L	1.0	2.0
4-Chlorotoluene	µg/L	1.0	2.0
1,2-Dibromo-3-chloropropane	µg/L	2.0	2.0
1,2-Dibromoethane (EDB)	µg/L	1.0	2.0
1,2-Dichlorobenzene	µg/L	0.5	0.5
1,2-Dichloroethane (EDC)	µg/L	0.5	0.5
1,2-Dichloropropane	µg/L	0.5	0.5
1,3,5-Trimethylbenzene	µg/L	1.0	2.0
1,3-Dichlorobenzene	µg/L	0.5	0.5
1,3-Dichloropropane	µg/L	0.5	0.5
1,4-Dichlorobenzene	µg/L	0.5	0.5
2,2-Dichloropropane	µg/L	0.5	0.5
1,1-Dichloroethane	µg/L	0.5	0.5
1,1-Dichloroethene	µg/L	0.5	0.5
1,1-Dichloropropene	µg/L	0.5	0.5
cis-1,2-Dichloroethene	µg/L	0.5	0.5
cis-1,3-Dichloropropene	µg/L	0.5	0.5
Dibromochloromethane	µg/L	0.5	0.5
Dibromomethane	µg/L	0.5	0.5
Dichlorodifluoromethane	µg/L	0.5	0.5
Ethylbenzene	µg/L	0.5	0.5
Hexachlorobutadiene	µg/L	1.0	2.0
2-Hexanone	µg/L	5.0	20
Isopropylbenzene	µg/L	1.0	2.0
4-Isopropyltoluene	µg/L	1.0	2.0
Methylene Chloride	µg/L	2.0	2.0
4-Methyl-2-pentanone (MIBK)	µg/L	5.0	20
Naphthalene	µg/L	1.0	2.0
n-Butylbenzene	µg/L	1.0	2.0
n-Propylbenzene	µg/L	1.0	2.0
sec-Butylbenzene	µg/L	1.0	2.0
Styrene	µg/L	0.5	0.5
tert-Butylbenzene	µg/L	1.0	2.0
1,1,1,2-Tetrachloroethane	µg/L	0.5	0.5

Table C-4
Quantitation Limit Goals
Sampling and Analysis Plan
Coffin Butte Landfill

Analyte	Units	Laboratory Method Reporting Limits	Quantitation Goals[a,b]
Tetrachloroethene (PCE)	µg/L	0.5	0.5
1,1,1-Trichloroethane (TCA)	µg/L	0.5	0.5
1,1,2,2-Tetrachloroethane	µg/L	0.5	0.5
1,1,2-Trichloroethane	µg/L	0.5	0.5
1,2,3-Trichlorobenzene	µg/L	1.0	2.0
1,2,3-Trichloropropane	µg/L	0.5	0.5
1,2,4-Trichlorobenzene	µg/L	1.0	2.0
1,2,4-Trimethylbenzene	µg/L	1.0	2.0
Toluene	µg/L	0.5	0.5
trans-1,2-Dichloroethene	µg/L	0.5	0.5
trans-1,3-Dichloropropene	µg/L	0.5	0.5
Trichloroethene (TCE)	µg/L	0.5	0.5
Trichlorofluoromethane	µg/L	0.5	0.5
Vinyl Chloride	µg/L	0.5	0.5
m,p-Xylenes	µg/L	0.5	0.5
o-Xylene	µg/L	0.5	0.5
Common Anions and Cations			
Calcium	mg/L	0.2	—
Iron	mg/L	0.1	0.03
Magnesium	mg/L	0.2	—
Manganese	mg/L	0.005	0.005
Sodium	mg/L	1.0	—
Silicon	mg/L	0.5	—
Potassium	mg/L	3.0	—
Bicarbonate	mg/L	5.0	—
Carbonate	mg/L	5.0	—
Sulfate	mg/L	5.0	25
Chloride	mg/L	3.0	25
Nitrate/Nitrite Nitrogen	mg/L	0.2	1
Trace Metals			
Antimony	µg/L	0.16	0.6
Arsenic	µg/L	0.5	1.0
Barium	µg/L	1.0	100
Beryllium	µg/L	1.0/0.15	0.4
Cadmium	µg/L	1.0/0.04	0.5
Chromium	µg/L	3.0	5.0
Cobalt	µg/L	1.0	—
Copper	µg/L	2.0	100
Lead	µg/L	1.0	1.0
Mercury	µg/L	0.2	0.2
Nickel	µg/L	2.0	10
Selenium	µg/L	1.0	1.0
Silver	µg/L	1.0	5.0
Thallium	µg/L	1.0/0.066	0.2
Vanadium	µg/L	5	—
Zinc	µg/L	10	500

Table C-4
Quantitation Limit Goals
Sampling and Analysis Plan
Coffin Butte Landfill

Analyte	Units	Laboratory Method Reporting Limits	Quantitation Goals[a,b]
Indicator Compounds and Other Parameters			
Ammonia-nitrogen	mg/L	0.1	—
Biological Oxygen Demand	mg/L	2.0	—
Chemical Oxygen Demand	mg/L	20	—
Cyanide	mg/L	0.01	0.02
Orthophosphate	mg/L	0.05	—
Total Dissolved Solids	mg/L	10	50
Total Kjeldahl nitrogen	mg/L	0.5	—
Total organic carbon	mg/L	1.0	—
Total phosphorus	mg/L	0.05	—
Total suspended solids	mg/L	4.0	—

NOTE:

[a] Quantitation limits goals based on DEQ guideline of 10 percent of drinking water standard or PQL for VOCs.

[b] Specific quantitation limits are matrix-dependent. Quantitation limits listed are provided for guidance and may not always be achievable.
1.0/0.029: Laboratory Reporting Limit/Method Dection Limit (laboratory has ability to report to method detection limit but is estimated "J".

EXHIBIT A

FORMS

Denver
4955 Yarrow Street

Arvada, CO 80002
phone 303.736.0100 fax 303.431.7171

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager:**	**Site Contact:**	**Date:**	COC No:
Valley Landfills, Inc.	**Tel/Fax:**	**Lab Contact:**	**Carrier:**	_______ of ______ COCs

28972 Coffin Butte Road
Corvallis, Oregon 97330
(541) 745-2018 Phone
(541) 745-3826 FAX
Project Name: Semi-Annual Water Quality Sampling
Site: Coffin Butte Landfill
P O #

Analysis Turnaround Time
Calendar (C) or Work Days (W) __________
TAT if different from Below _________
☐ 2 weeks
☐ 1 week
☐ 2 days
☐ 1 day

Job No.

SDG No.

Sample Identification	**Sample Date**	**Sample Time**	**Sample Type**	**Matrix**	**# of Cont.**	**Filtered Sample**																			Sample Specific Notes:

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other _____________

Possible Hazard Identification
☐ *Non-Hazard* ☐ *Flammable* ☐ *Skin Irritant* *Poison B* ☐ *Unknown* ☐

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ *Return To Client* ☐ *Disposal By Lab* ☐ *Archive For __________ Months*

Special Instructions/QC Requirements & Comments:

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:

FIELD SAMPLING DATA SHEET

Valley Landfills, Inc.

28972 Coffin Butte Road
Corvallis, Oregon 97330

Office: (541) 745-2018 Fax: (541) 745-3826

PROJECT NAME: **Valley Landfills, Inc.**

WELL ID:

SITE ADDRESS: **Coffin Butte Landfill, Corvallis, Oregon**

BLIND ID:

DUP ID: **NA**

WEATHER:	SUNNY	CLOUDY	RAIN	?

TEMPERATURE: ° F . ° C
[Circle appropriate units]

HYDROLOGY/LEVEL MEASUREMENTS (Nearest 0.01 ft)

					[Product Thickness]	[Water Column]		[Water Column x Gal/ft]
Date	Time	DT-Bottom	DT-Product	DT-Water	DTP-DTW	DTB-DTW		Volume (gal)
/ /	:	.	.	.	.	.	X 1	.
/ /	:	.	.	.	.		X 3	.

Gal/ft = (dia./2)^2 x 0.163	1" =	0.041	2" =	0.163	3" =	0.367	4" =	0.653	6" =	1.469	10" =	4.080	12" = 5.875

§ METHODS: (A) Submersible Pump (B) Peristaltic Pump (C) Disposable Bailer (D) PVC/Teflon Bailer (E) Dedicated Bailer (F) Dedicated Pump (G) Other =

GROUNDWATER SAMPLING DATA (if product is detected, do NOT sample)

Sample Depth: [√ if used]

Bottle Type	Date	Time	Method §	Amount & Volume mL		Preservative [circle]	Ice	Filter	pH	√
VOA Glass	/ /	:		3	40 ml	HCl	YES	NO	NA	
Amber Glass	/ /	:			250, 500, 1L	(None) (HCl) (H_2SO_4)	YES	NO	NA	
White Poly	/ /	:			250, 500, 1L	None	YES	NO	NA	
Red Total Poly	/ /	:			250, 500, 1L	HNO_3	YES	NO	NA	
Red Diss. Poly	/ /	:			250, 500, 1L	HNO_3	YES	YES	NA	
	/ /	:								

Total Bottles (include duplicate count):

Analysis Allowed per Bottle Type

BOTTLE TYPE	TYPICAL ANALYSIS ALLOWED PER BOTTLE TYPE
VOA - Glass	(3) non-pres Voas: 8260B VOCs or 524.2 VOCs
AMBER - Glass	(2) H_2SO_4 500-mL Ambers: (Ammonia) (TKN) (COD) (TOC)
WHITE (non-pres) - Poly	(1) 1-L NP: BOD (1) 500-mL NP: (Bicarbonate - HCO_3^-) (Chloride - Cl) (Sulfate - SO_4^{2-}) (TDS) (TSS) (Orthophosphate - PO_4)
Yellow (sulfuric pres) Poly	(1) 500-mL sulfuric-pres: (Nitrate/Nitrite) (Total Phosphorus)
RED TOTAL - Poly	[(Sb) (As) (Ba) (Cr) (Pb) (Ni) (Se) (Zn)] or [(Sb) (As) (Ba) (Be) (Cd) (Co) (Cu) (Cr) (Pb) (Ni) (Se) (Ag) (Tl) V) (Zn)]
RED DISSOLVED - Poly	(1) 1-L Nitric Poly: [(Ca) (Fe) (Mg) (Mn) (Na)] or [(Ca) (Fe) (Mg) (Mn) (K) (Na) (Si)]

WATER QUALITY DATA

Purge Start Time: :

Pump/Bailer Inlet Depth:

Meas.	Method §	Purged ( )	pH	E Cond (µS)	Temp °C	ORP	D/O	DTW	Water Quality
0			.		.		.	.	
1			.		.		.	.	
2			.		.		.	.	
3			.		.		.	.	
4			.		.		.	.	
5			.		.		.	.	
[Casing]	[Select A-G]	[Cumulative Totals]							[Clarity, Color]

SAMPLER: ______________________________ ______________________________

(PRINTED NAME) (SIGNATURE)

WATER LEVEL SURVEY

Site: Coffin Butte Landfill

Date:

Personnel:

Project No.

Weather:

Sounder No.

Well	Time (24:00)	DTW (feet)	Comments
Monitoring Wells			
MW-1S	:	.	
MW-1D	:	.	
MW-3S	:	.	
MW-3D	:	.	
MW-8S	:	.	
MW-8D	:	.	
MW-9S	:	.	
MW-10S	:	.	
MW-10D	:	.	
MW-11S	:	.	
MW-11D	:	.	
MW-12S	:	.	
MW-12D	:	.	
MW-14S	:	.	
MW-14D	:	.	
MW-15	:	.	
MW-17	:	.	
MW-18	:	.	
MW-19	:	.	
MW-20	:	.	
MW-21	:	.	
MW-23	:	.	
MW-24	:	.	
MW-26	:	.	
MW-27	:	.	

WATER LEVEL SURVEY

Site: Coffin Butte Landfill Date:

Personnel: Project No.

Weather: Sounder No.

Well	Time (24:00)	DTW (feet)	Comments
Piezometers			
P-8	:	.	
P-9	:	.	
P-10	:	.	
P-19	:	.	
P-20	:	.	
P-21	:	.	
Production Well			
PW-2	:	.	
Private Wells			
Duplex	:	.	
Phillips	:	.	
Berkland	:	.	
Merril	:	.	
Surface Water			
S-2	:	.	
S-4	:	.	
Quarry Piezometers			
QP-2S	:	.	
QP-3S	:	.	
QP-4S	:	.	
QP-5N	:	.	
QP-6N	:	.	
QP-7N	:	.	

WATER LEVEL SURVEY

Site: Coffin Butte Landfill
Date:
Personnel:
Project No.
Weather:
Sounder No.

Well	Time (24:00)	DTW (feet)	Comments
Wetland Piezometers			
WP-1	:	.	
WP-3	:	.	
WP-5	:	.	
WP-6	:	.	
WP-8	:	.	
WP-9	:	.	

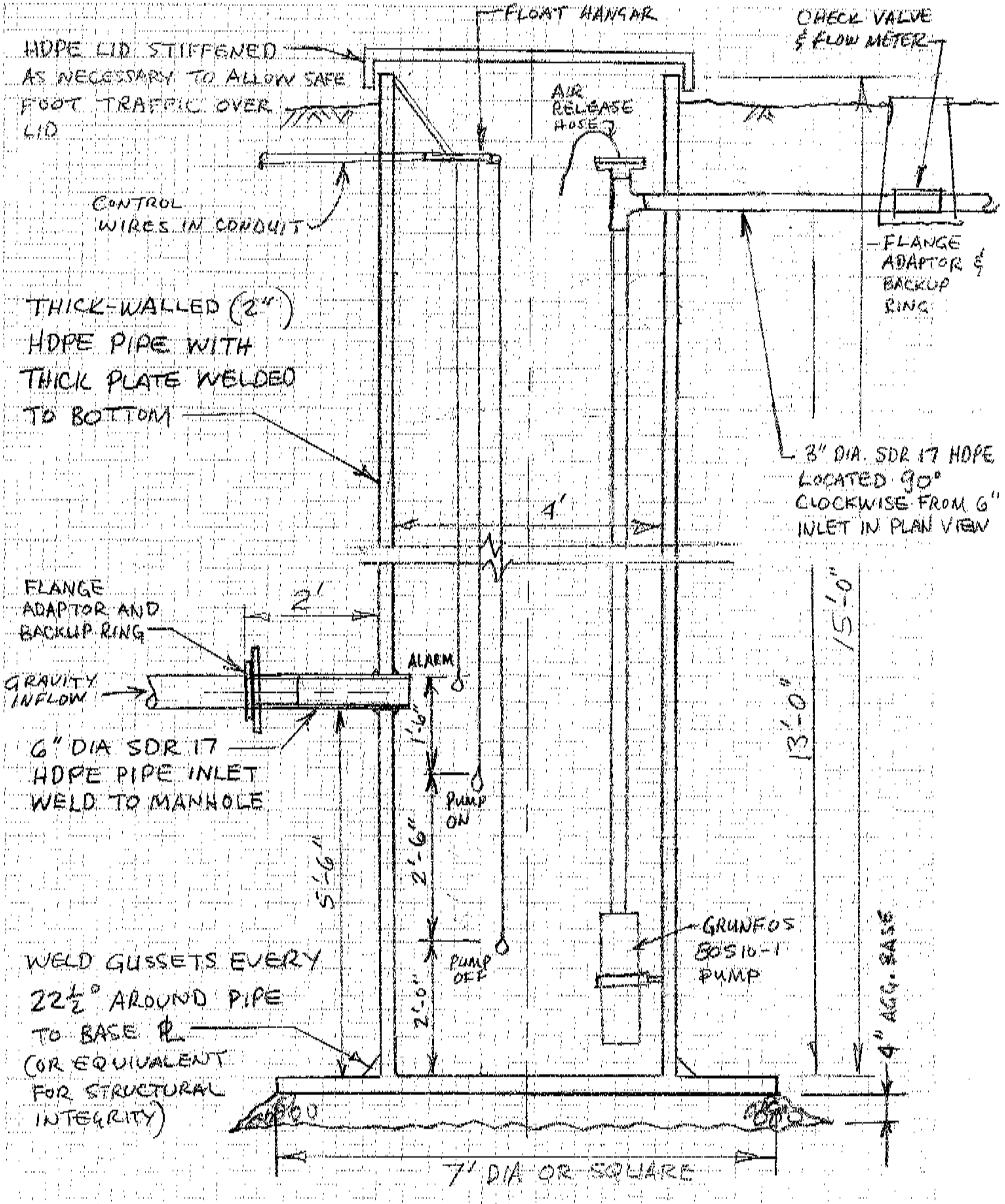
EXHIBIT B

PRIMARY AND SLCS DRAWINGS

P.O. Box 1010, Oregon House, CA 95962
Phone (916) 692-9114 Fax (916) 692-9115

Thiel Engineering

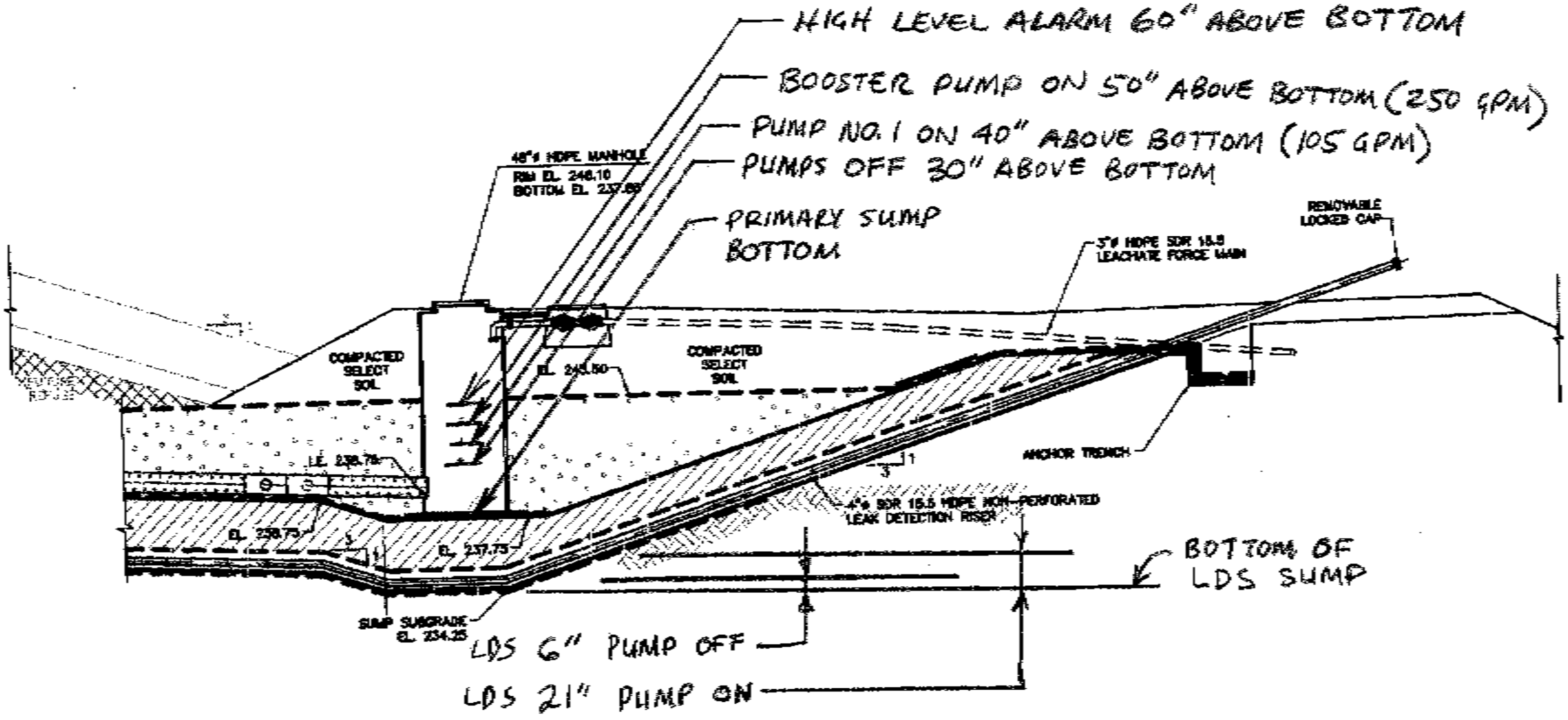
Project Name: COFFIN BUTTE
Sheet:
Subject: CELL 1 SUMP MANHOLE
Date: 6/11/98
Prepared By:
Checked By:



FIGURE

1" 1/2" 0" 1"

IMAGE Files: <No Images>
Dimscale: 40 Ltscale: 40 Psltscale: 0 XREF Files: 8X11L.dwg
ENW-PORTLAND1/CADD: N:\DWG\40139001.062\062FIG1.DWG Tue, 25/May/99 10:56am rlloyd



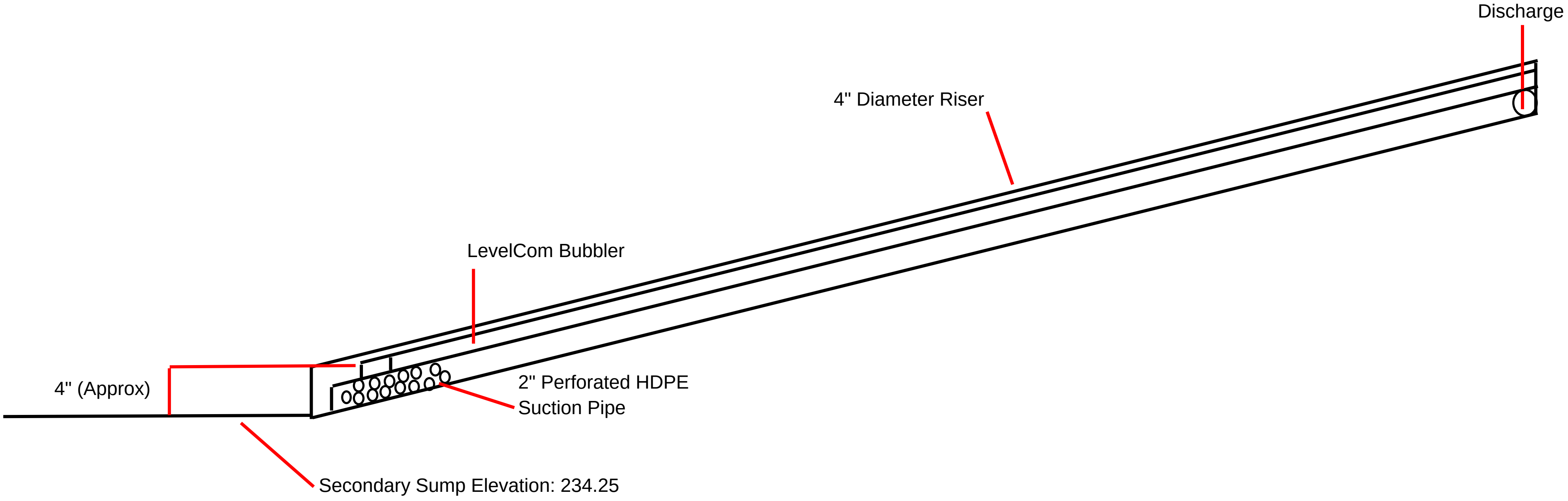
LEACHATE COLLECTION SUMP AND RISER

EMCON

DATE 5/25/99
DWN RJF
APP
REV
PROJECT NO.
40139-001.062

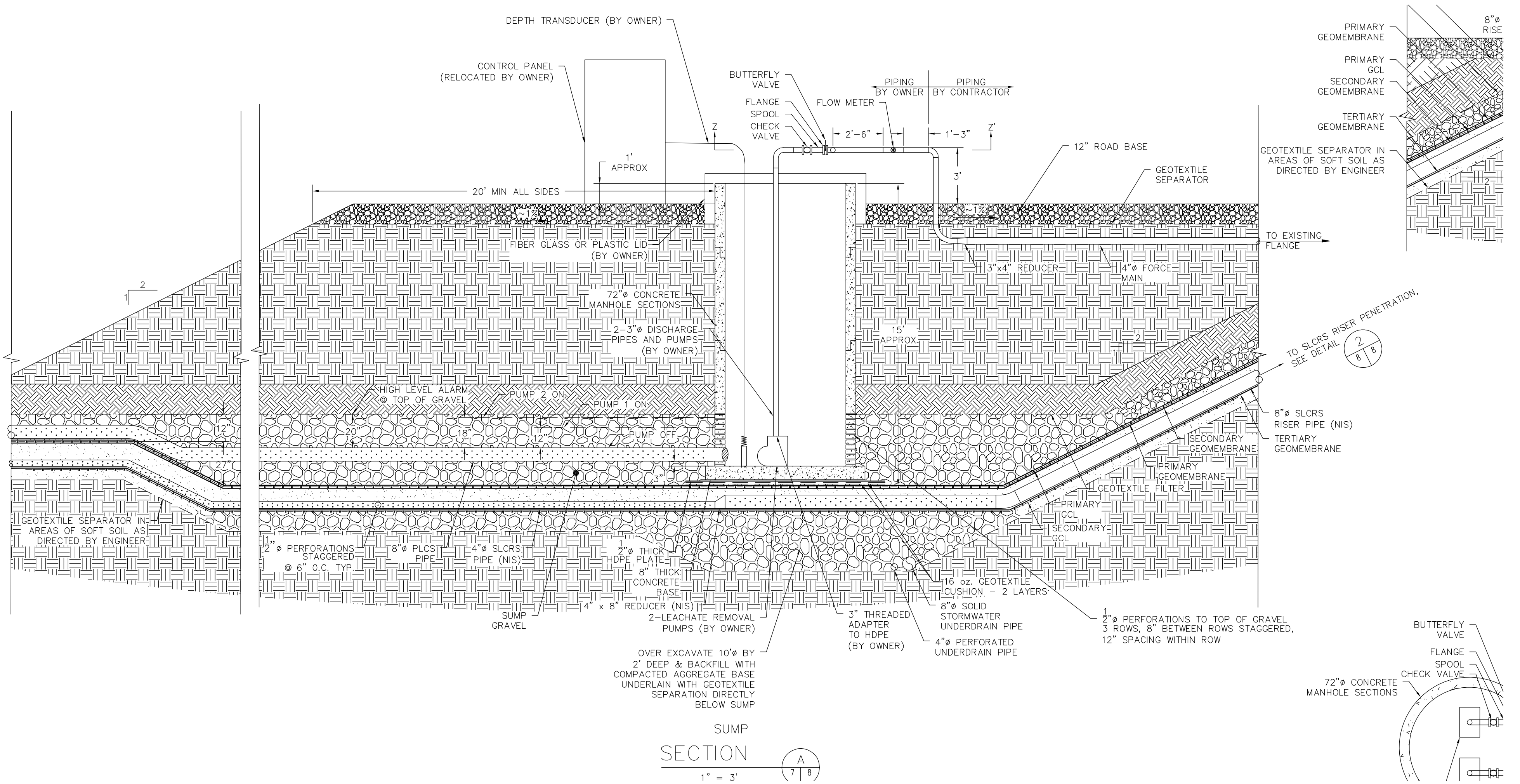
Figure 1
VALLEY LANDFILLS, INC.
COFFIN BUTTE LANDFILL
BENTON COUNTY, OREGON

LEACHATE SUMP DETAILS



Project Name: Coffin Butte Cell 2
Secondary Leachate Collection System
Date:6/25/14

C:\FINAL DRAWINGS\RECORD DWGS\Dwg 8-12 DETAILS.DWG PLOT SCALE: 1=1 DATE: 11/10/04

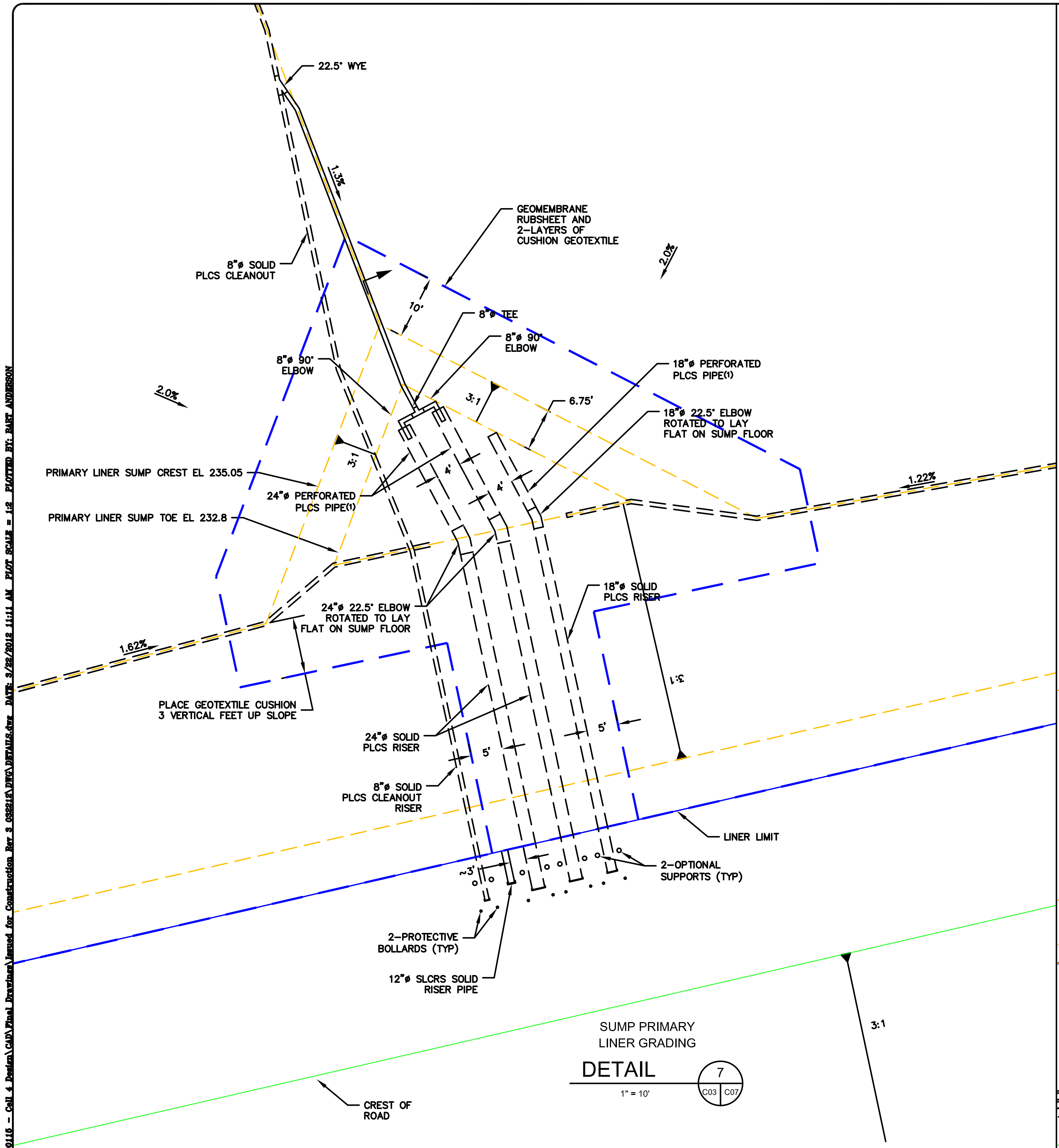


SUMP

SECTION A 7 | 8

1" = 3'

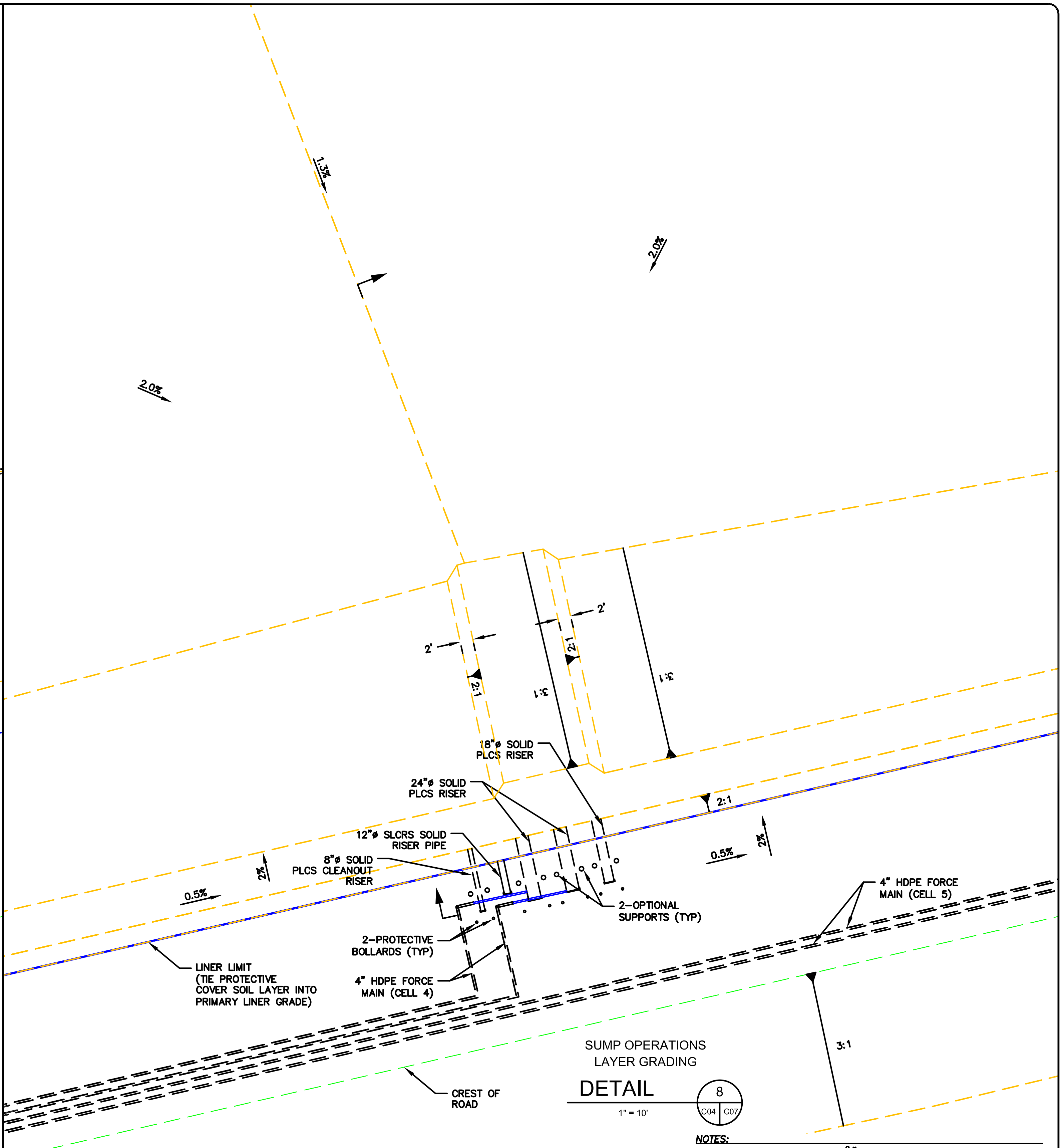
COFFIN BUTTE CELL 3 SUMP



SUMP PRIMARY LINER GRADING

DETAIL 7 C03 C07

1" = 10'



SUMP OPERATIONS LAYER GRADING

DETAIL 8 C04 C07

1" = 10'

NOTES:

1. PERFORATIONS SHALL BE $\frac{9}{16}$"ø, 8 HOLES SPACED EVENLY AROUND CIRCUMFERENCE, SPACED AT 6" OC, WITH STAGGERED ROWS. PERFORATED SECTION SHALL BE 6.5 FT FOR EACH PIPE, OR A COMBINED 13 FT FOR THE TWO.

REV. NO.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY
0	04/18/11	ISSUED FOR BIDDING & REGULATORY REVIEW	BGA	RT	RT	RT
1	06/01/11	ISSUED FOR CONSTRUCTION	BGA	RT	RT	RT
2	03/22/12	MODIFIED SUMP CONFIGURATION	BGA	RT	RT	RT

DATE OF ISSUE: 03/22/2012
DESIGNED BY: RT
DRAWN BY: BGA
CHECKED BY: RT
APPROVED BY: RT

Prepared by:
Thiel
Engineering
Richard Thiel, P.E.

VALLEY LANDFILLS, INC.

COFFIN BUTTE LANDFILL
CELL 4 & STORMWATER
FACILITIES CONSTRUCTION
BENTON COUNTY, OREGON

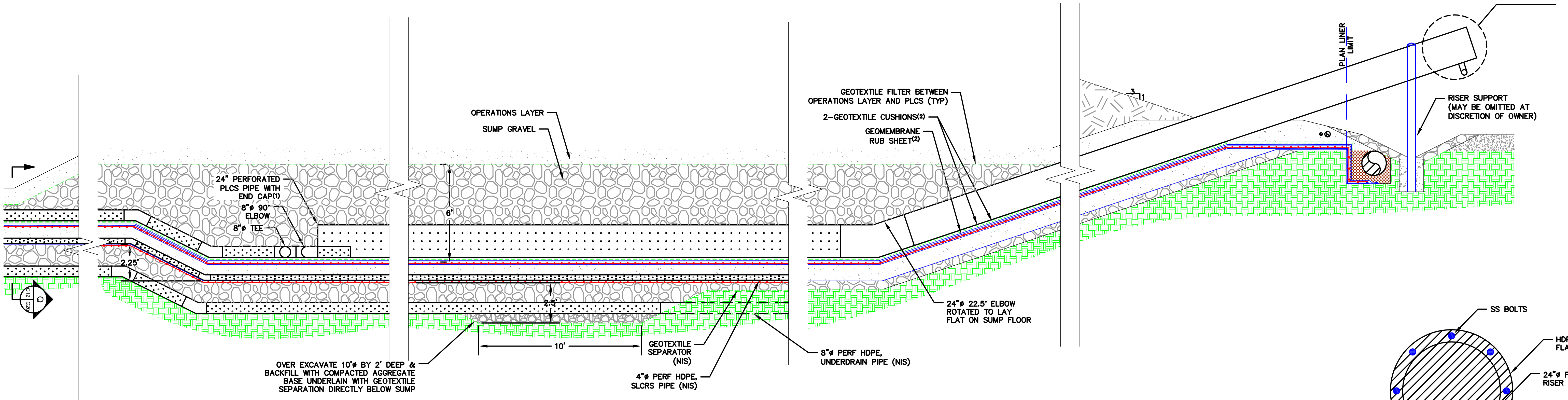
SUMP DETAILS

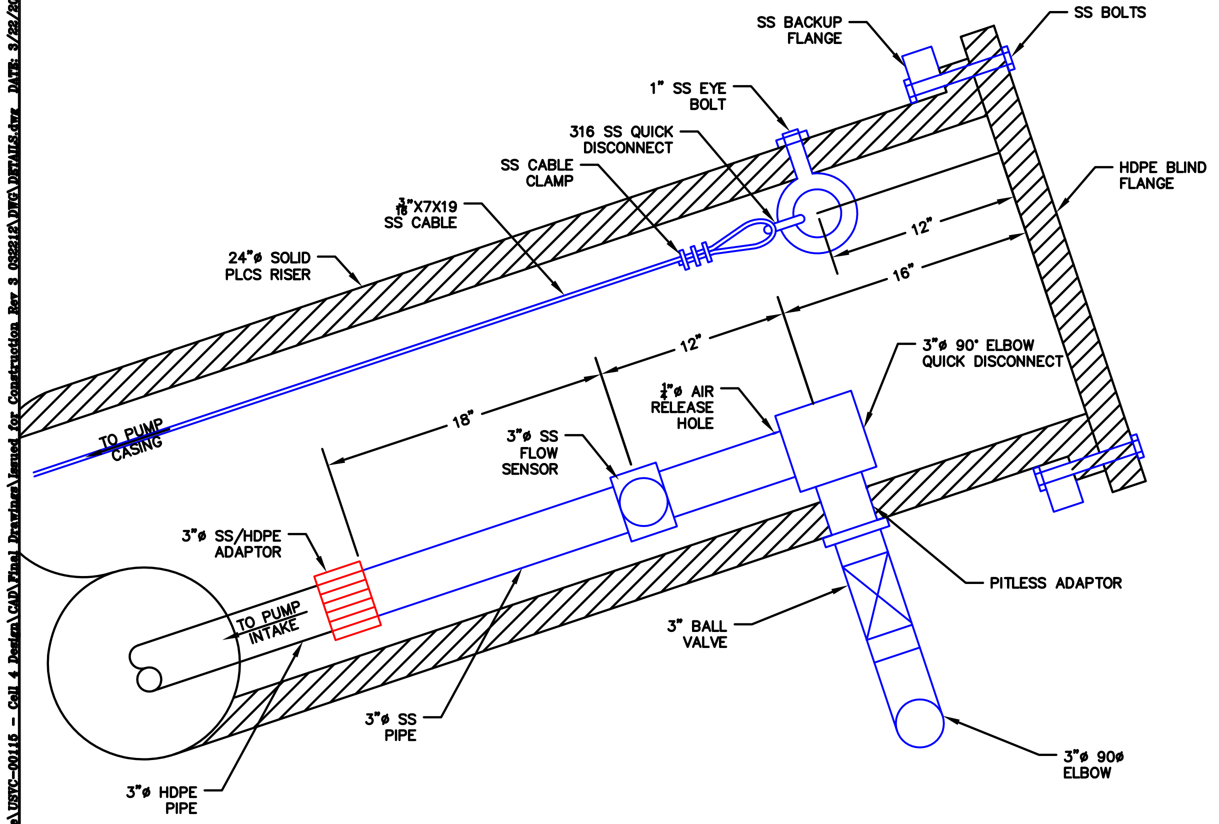
DRAWING NO.
C07
PROJECT NO.
USVC-00115

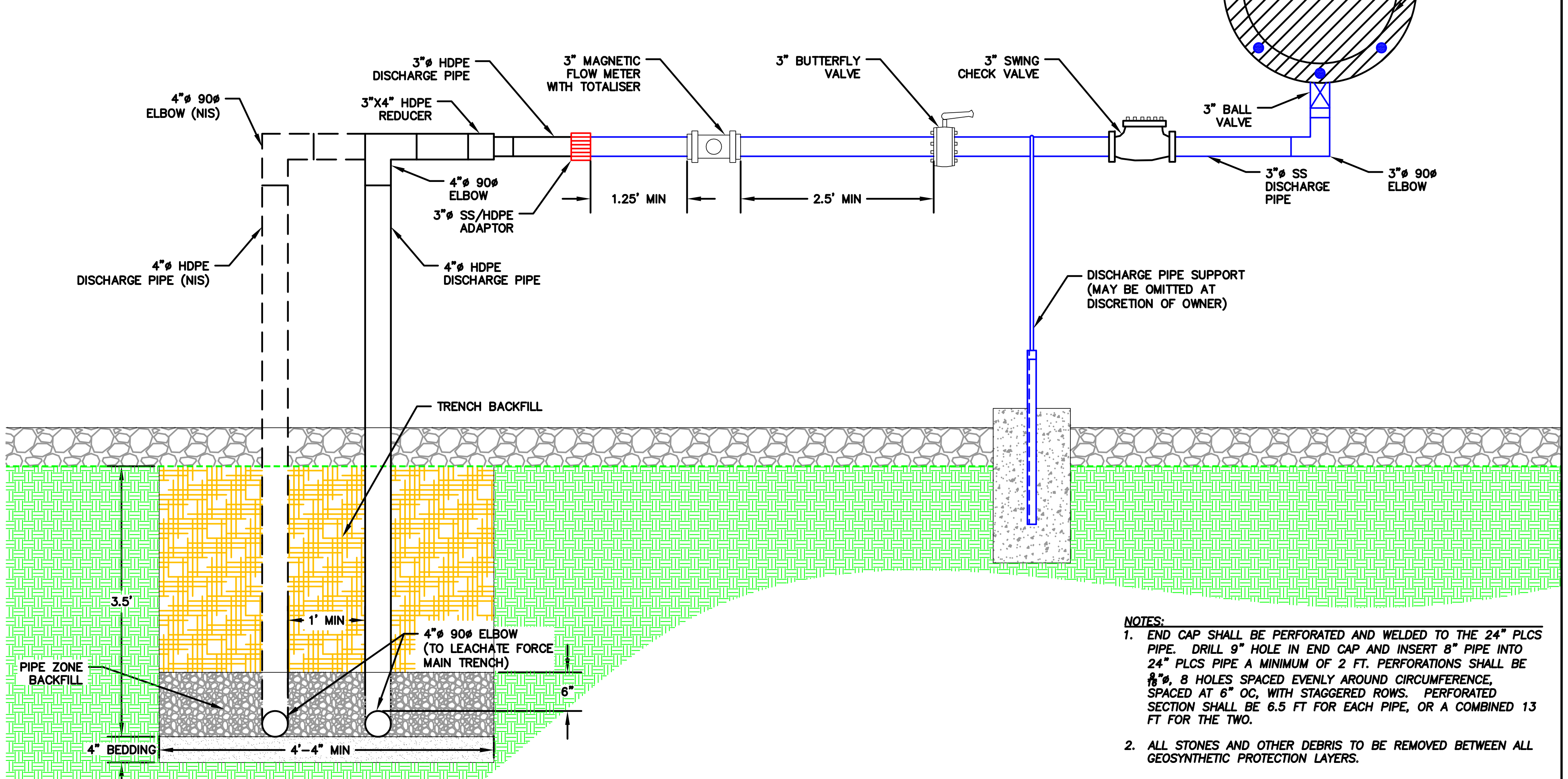
LOCATION: N:\Coffin Butte\USVC-00115 - Cell 4 Design\CAD\Final Drawings\Issued for Construction Rev 3 032212\DWG\DETAILS.dwg DATE: 3/22/2012 11:11 AM PLOT SCALE = 1:2 PLOTTED BY: BART ANDERSON

ISSUED FOR CONSTRUCTION

LOCATION: N:\Coffin Butte\USVC-00115 – Cell 4 Design\CAD\Final Drawings\Issued for Construction Rev 3 032212\DWG\DETAILS.dwg DATE: 3/22/2012 11:11 AM PLOT SCALE = 1:2 PLOTTED BY: BART ANDERSON







NOTES:

1. *END CAP SHALL BE PERFORATED AND WELDED TO THE 24" PLCS PIPE. DRILL 9" HOLE IN END CAP AND INSERT 8" PIPE INTO 24" PLCS PIPE A MINIMUM OF 2 FT. PERFORATIONS SHALL BE 9/16"ø, 8 HOLES SPACED EVENLY AROUND CIRCUMFERENCE, SPACED AT 6" OC, WITH STAGGERED ROWS. PERFORATED SECTION SHALL BE 6.5 FT FOR EACH PIPE, OR A COMBINED 13 FT FOR THE TWO.*
2. *ALL STONES AND OTHER DEBRIS TO BE REMOVED BETWEEN ALL GEOSYNTHETIC PROTECTION LAYERS.*

REV. NO.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY
0	03/22/16	MODIFIED SUMP CONFIGURATION	BGA	RT	RT	RT

DATE OF ISSUE: 03/22/2012
DESIGNED BY: RT
DRAWN BY: BGA
CHECKED BY: RT
APPROVED BY: RT

Prepared by:
Thiel
Engineering
Richard Thiel, P.E.

VALLEY LANDFILLS, INC.

COFFIN BUTTE LANDFILL
CELL 4 & STORMWATER
FACILITIES CONSTRUCTION
BENTON COUNTY, OREGON

LEACHATE FORCE MAIN DETAILS

DRAWING NO.
C12A
PROJECT NO.
USVC-00115

ISSUED FOR CONSTRUCTION

LOCATION:N:\Coffin Butte\2012.A031 Cell 5A Design\CAD\Final Drawings\Rev 0 121712\DWG\DESIGN.dwg DATE:4/16/2013 2:10 PM PLOT SCALE = 1:1 PLOTTED BY: WICH CHOOMWISET

REV. NO.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY
0	12/17/12	ISSUED FOR BIDDING AND REGULATORY REVIEW	BGA	RT	RT	RT

DATE OF ISSUE: 12/17/2012
DESIGNED BY: RT
DRAWN BY: BGA
CHECKED BY: RT
APPROVED BY: RT

Prepared by:
Thiel Engineering
Richard Thiel, P.E.

0 1" THIS SCALE BAR EQUALS ONE INCH ON ORIGINAL DRAWINGS

VALLEY LANDFILLS, INC.

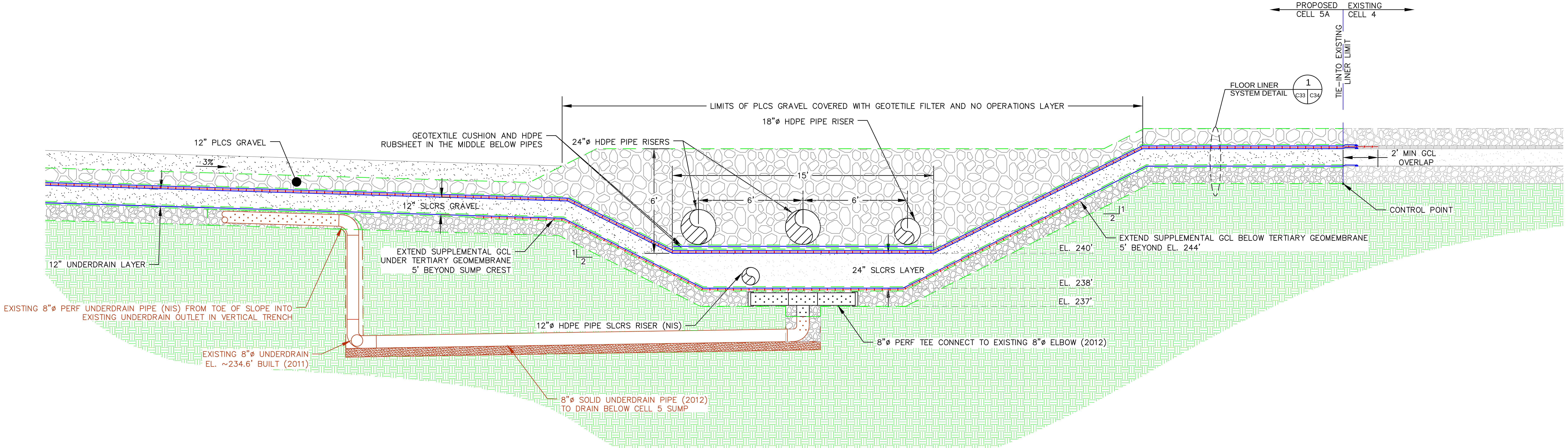
COFFIN BUTTE LANDFILL
CELL 5A EXPANSION
CONSTRUCTION DRAWINGS
BENTON COUNTY, OREGON

SUMP DETAIL PLAN

DRAWING NO.
C25

PROJECT NO.
2012.A031

ISSUED FOR BIDDING AND REGULATORY REVIEW

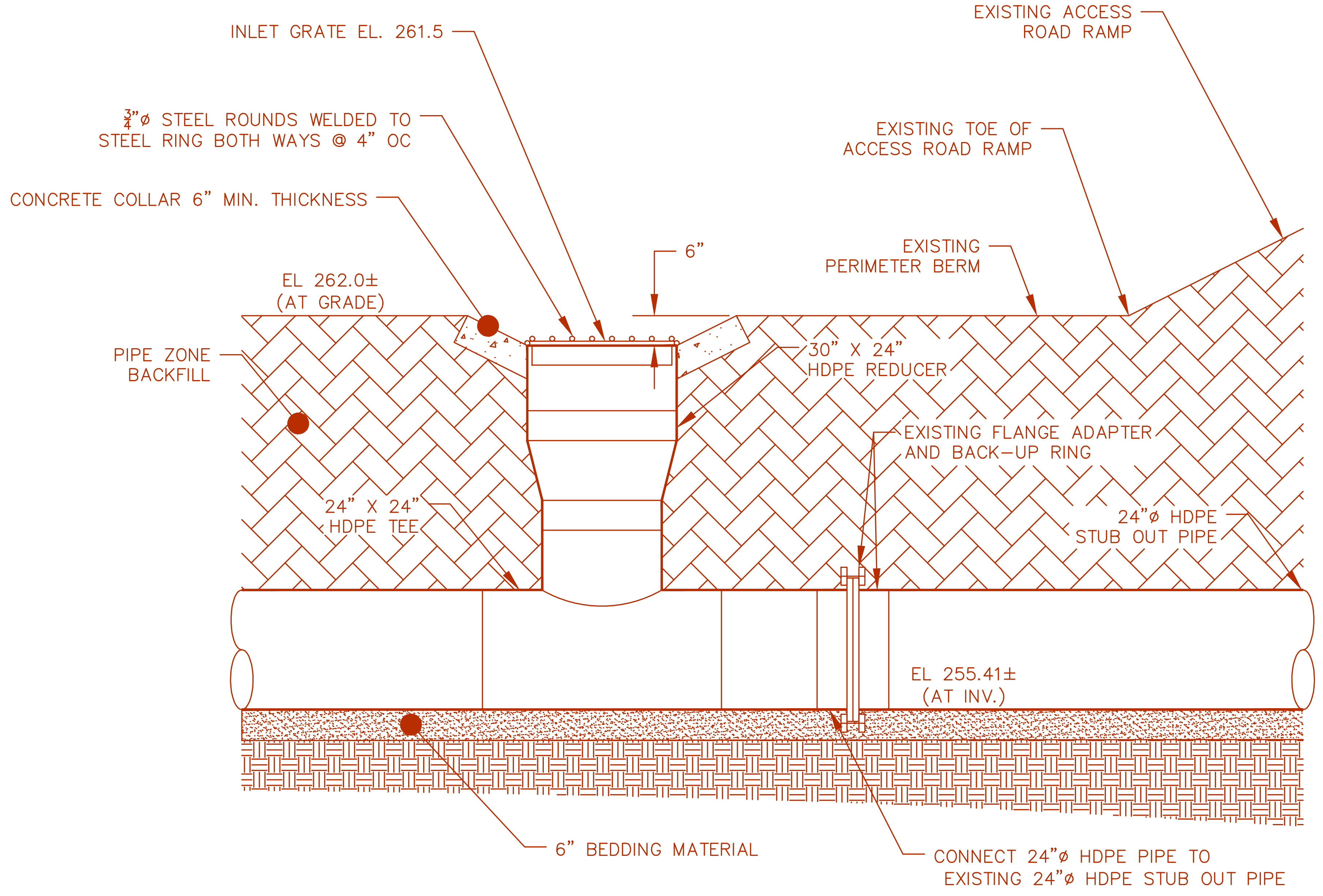


CELL 5 SUMP

SECTION

I
C01 | C33

1" = 3'

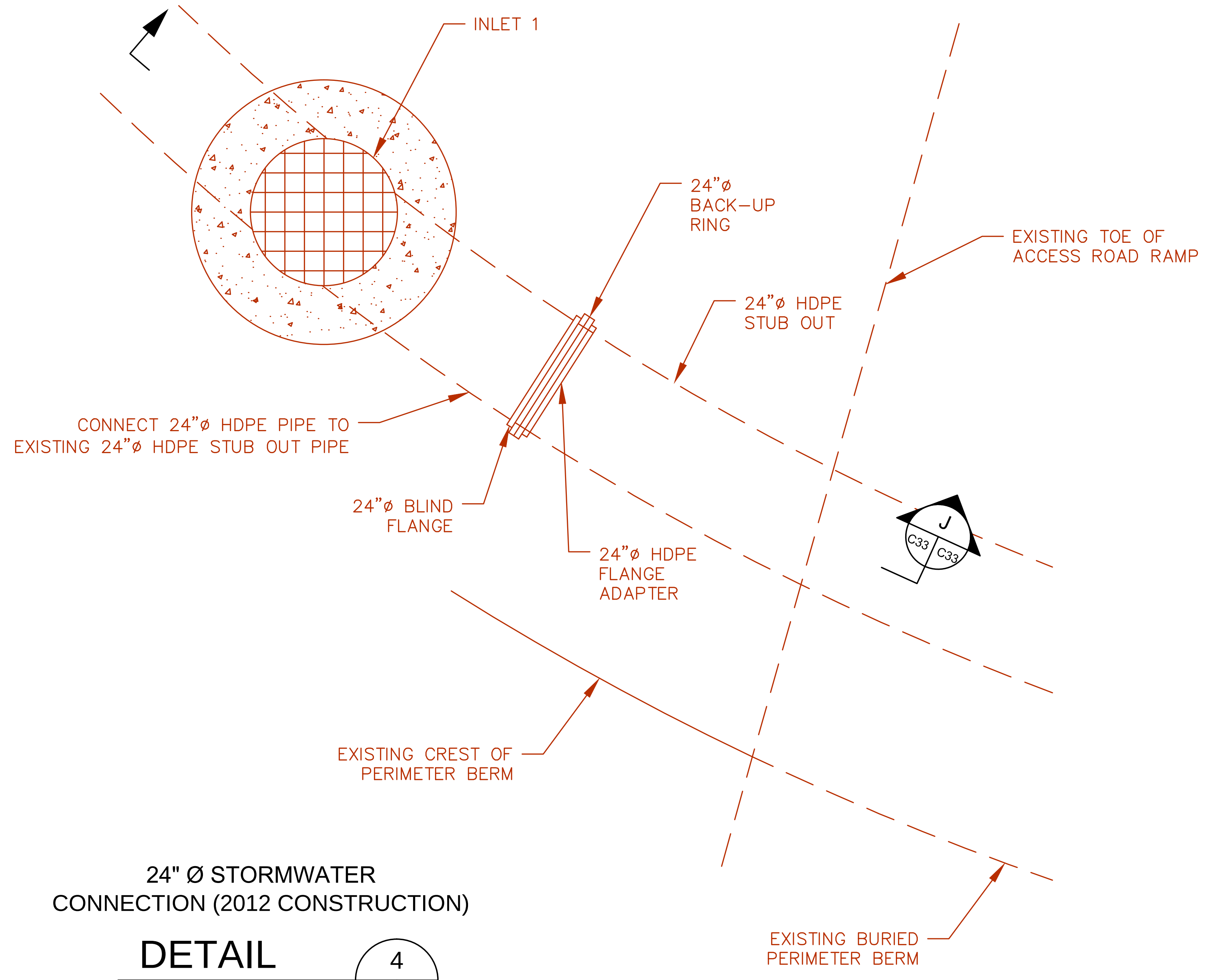


NORTHERN CELL 4
STORMWATER TIE-IN AT INLET 1 (2012 CONSTRUCTION)

SECTION

J
C33 | C33

1" = 2'



24" Ø STORMWATER
CONNECTION (2012 CONSTRUCTION)

DETAIL

4
C01 | C33

1" = 2'

NOTES:

1. PLCS AND SLCRS PIPES MAY NOT BE INCLUDED IN SECTION. VERIFY RESPECTIVE PLANS FOR PLACEMENT OF PIPES.

REV. NO.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY
0	12/17/12	ISSUED FOR BIDDING AND REGULATORY REVIEW	BGA	RT	RT	RT

DATE OF ISSUE: 12/17/2012
DESIGNED BY: RT
DRAWN BY: BGA
CHECKED BY: RT
APPROVED BY: RT

Prepared by:
Thiel Engineering
Richard Thiel, P.E.

0 1" THIS SCALE BAR EQUALS ONE INCH ON ORIGINAL DRAWINGS

VALLEY LANDFILLS, INC.

COFFIN BUTTE LANDFILL
CELL 5A EXPANSION
CONSTRUCTION DRAWINGS
BENTON COUNTY, OREGON

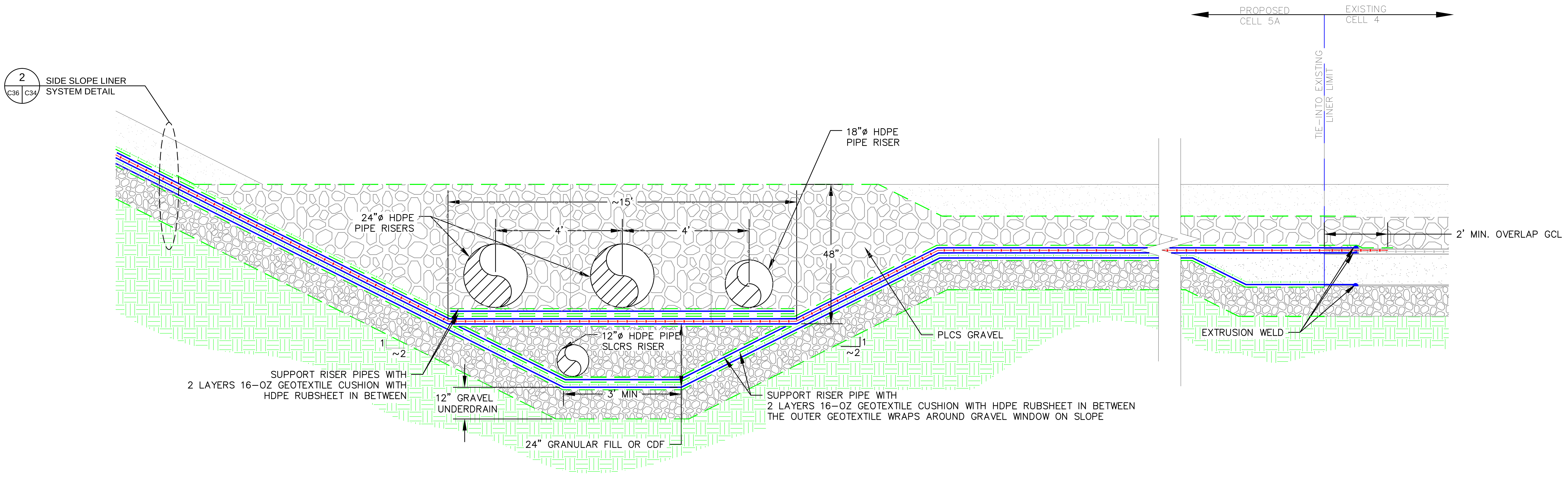
SECTIONS AND DETAILS: SUMP AND STORMWATER INLETS

DRAWING NO.
C33

PROJECT NO.
2012.A031

LOCATION: N:\Coffin Butte\2012.A031 Cell 5A Design\CAD\Final Drawings\Rev 0 121712\DWG\DETAILS.dwg DATE: 4/16/2013 10:47 AM PLOT SCALE = 1:1 PLOTTED BY: WICH CHOOMWISET

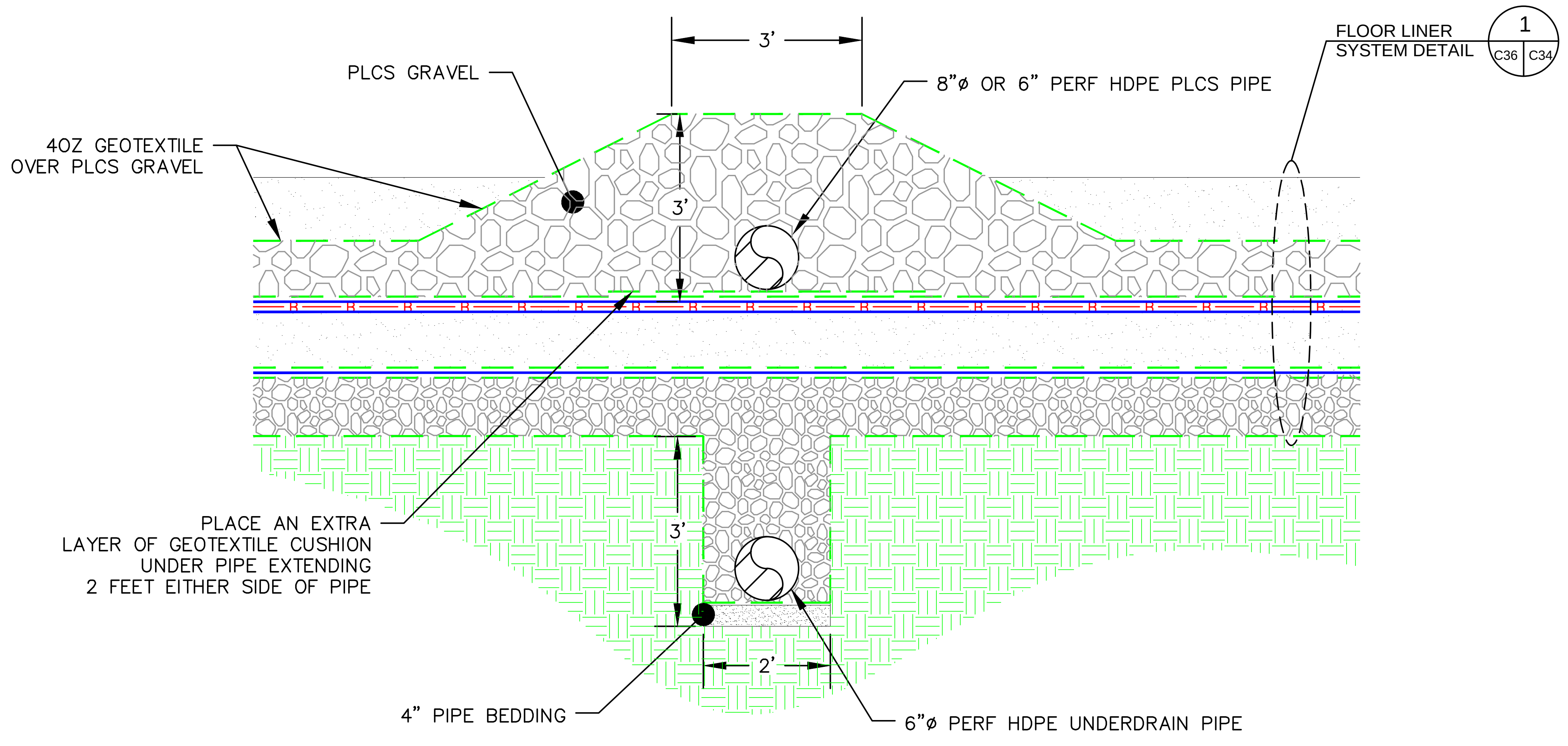
ISSUED FOR BIDDING AND REGULATORY REVIEW



CELL 5 SUMP RISER PIPES

SECTION Q C07 C36

1" = 2'



LINER AND PIPE SYSTEM
ON FLOOR

DETAIL 5 C01 C36

1" = 2'

LOCATION: N:\Coffin Butte\2012.A031 Cell 5A Design\CAD\Final Drawings\Rev 0 121712\DWG\DETAILS.dwg DATE: 4/16/2013 10:47 AM PLOT SCALE = 1:1 PLOTTED BY: WICH CHOOMWISET

REV. NO.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY
0	12/17/12	ISSUED FOR BIDDING AND REGULATORY REVIEW	BGA	RT	RT	RT

DATE OF ISSUE: 12/17/2012
DESIGNED BY: RT
DRAWN BY: BGA
CHECKED BY: RT
APPROVED BY: RT

Prepared by:
Thiel Engineering
Richard Thiel, P.E.

0 1" THIS SCALE BAR EQUALS ONE INCH ON ORIGINAL DRAWINGS

VALLEY LANDFILLS, INC.

COFFIN BUTTE LANDFILL
CELL 5A EXPANSION
CONSTRUCTION DRAWINGS
BENTON COUNTY, OREGON
SECTIONS AND DETAILS: SUMP RISER AND FLOOR PIPES

DRAWING NO.
C36
PROJECT NO.
2012.A031

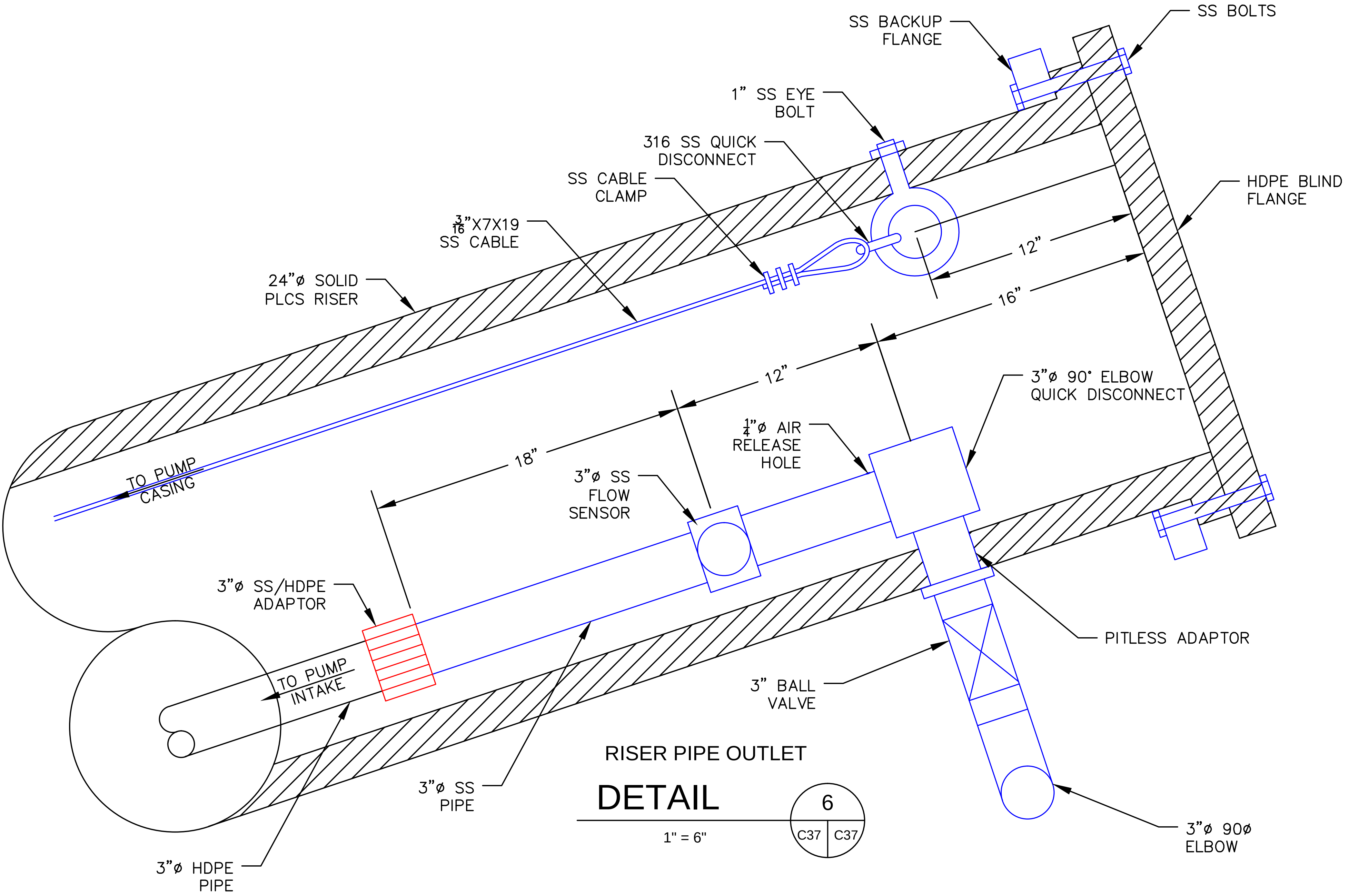
ISSUED FOR BIDDING AND REGULATORY REVIEW

SUMP

SECTION R

C07 C37

1" = 3'

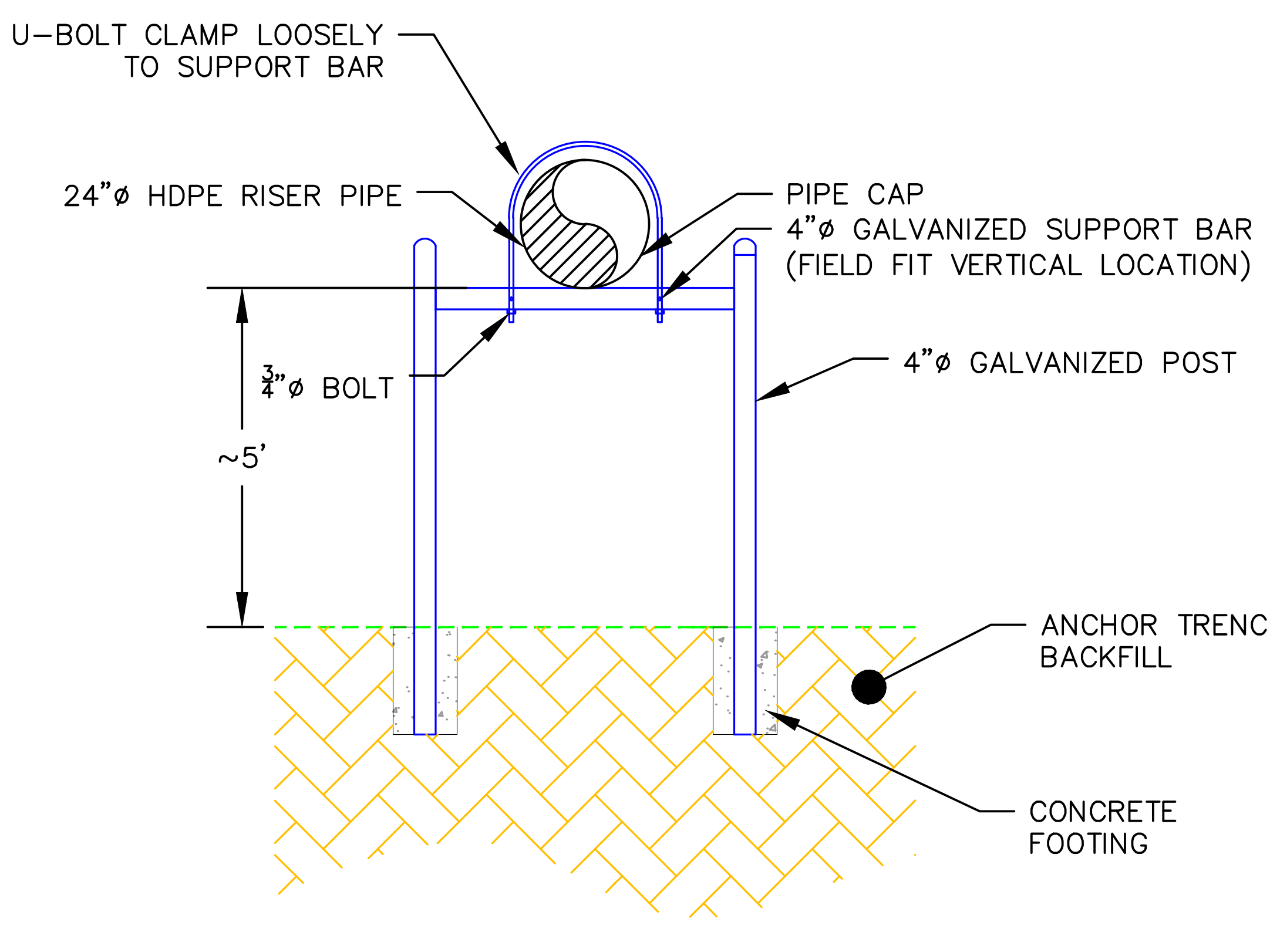


RISER PIPE OUTLET

DETAIL 6

C37 C37

1" = 6"

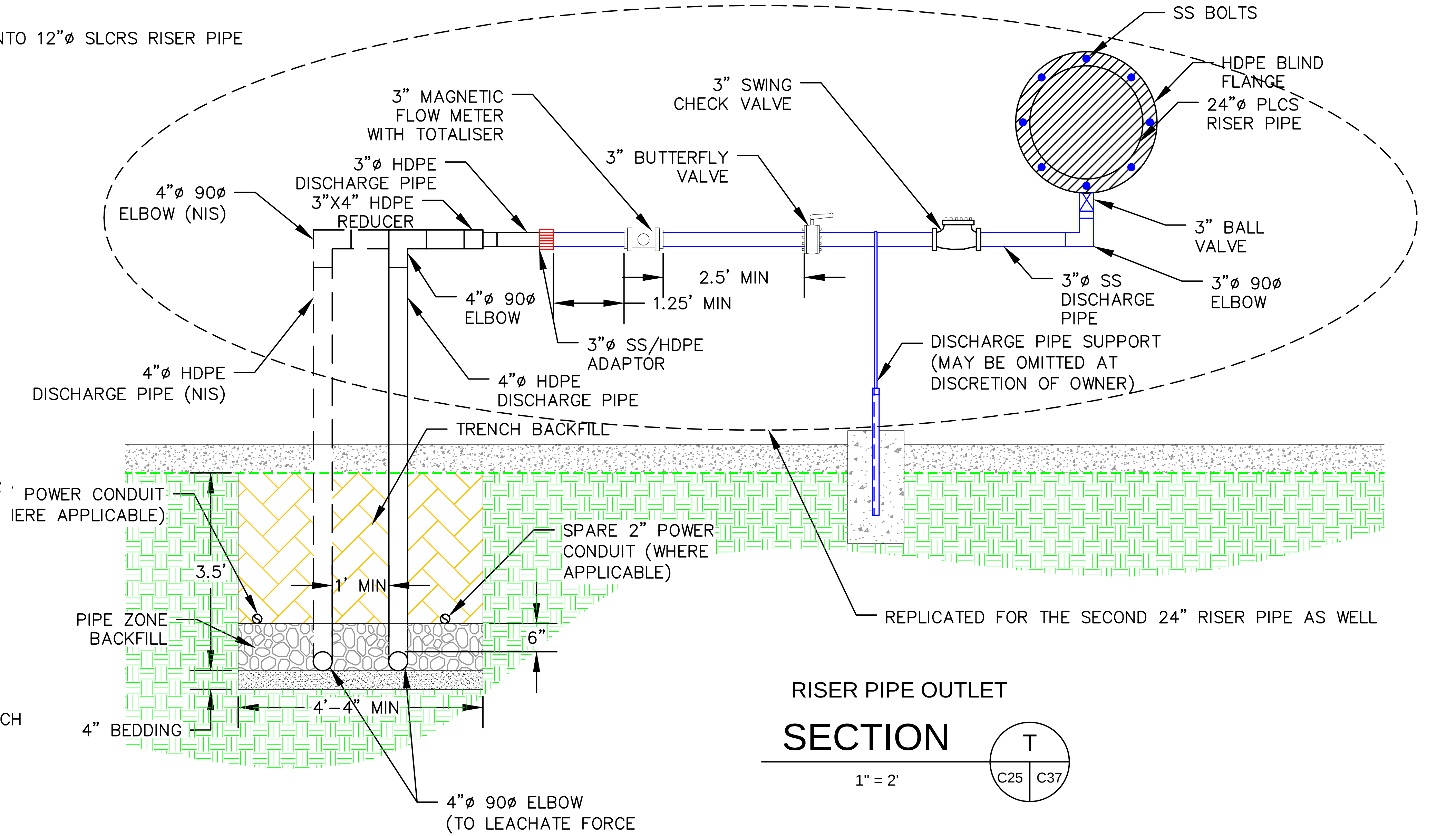


RISER PIPE SUPPORT

SECTION S

C37 C37

1" = 3'



RISER PIPE OUTLET

SECTION T

C25 C37

1" = 2'

NOTES:

1. *END CAP SHALL BE PERFORATED AND WELDED TO THE 24" PLCS PIPE. DRILL 9" HOLE IN END CAP AND INSERT 8" PIPE INTO 24" PLCS PIPE A MINIMUM OF 2 FT. PERFORATIONS SHALL BE 9/16"ø, 8 HOLES SPACED EVENLY AROUND CIRCUMFERENCE, SPACED AT 6" OC, WITH STAGGERED ROWS. PERFORATED SECTION SHALL BE 6.5 FT FOR EACH PIPE, OR A COMBINED 13 FT FOR THE TWO.*
2. *ALL STONES AND OTHER DEBRIS TO BE REMOVED BETWEEN ALL GEOSYNTHETIC PROTECTION LAYERS.*

LOCATION: N:\Coffin Butte\2012.A031 Cell 5A Design\CAD\Final Drawings\Rev 0 121712\DWG\DETAILS.dwg DATE: 4/16/2013 10:48 AM PLOT SCALE = 1:1 PLOTTED BY: WICH CHOOMWISET

REV. NO.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY
0	12/17/12	ISSUED FOR BIDDING AND REGULATORY REVIEW	BGA	RT	RT	RT

DATE OF ISSUE: 12/17/2012
DESIGNED BY: RT
DRAWN BY: BGA
CHECKED BY: RT
APPROVED BY: RT

Prepared by:
Thiel
Engineering
Richard Thiel, P.E.

0 1" THIS SCALE BAR EQUALS ONE INCH ON ORIGINAL DRAWINGS

VALLEY LANDFILLS, INC.

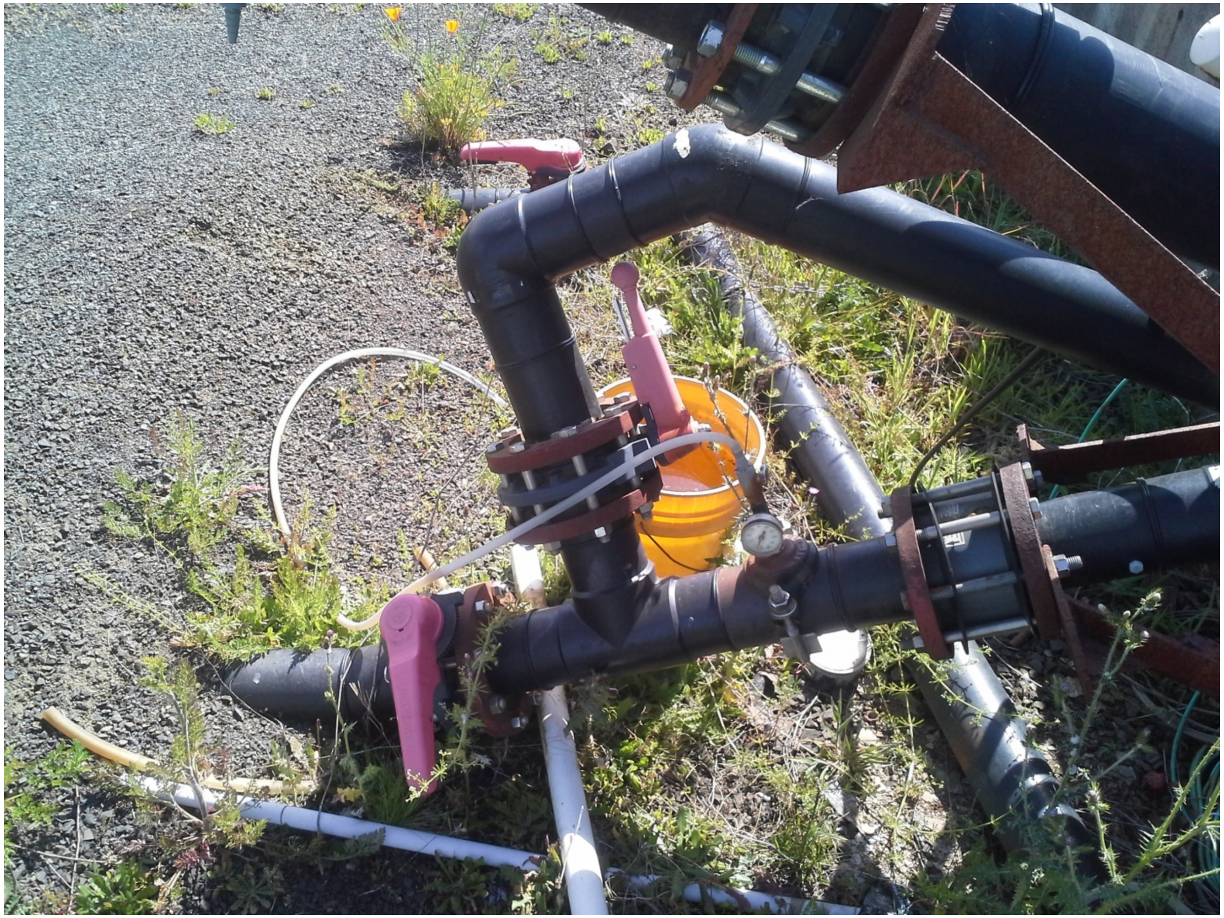
COFFIN BUTTE LANDFILL
CELL 5A EXPANSION
CONSTRUCTION DRAWINGS
BENTON COUNTY, OREGON

SECTIONS AND DETAILS: SUMP SECTIONS AND DETAILS

DRAWING NO.
C37

PROJECT NO.
2012.A031

ISSUED FOR BIDDING AND REGULATORY REVIEW



Sampling Port and Tubing at West Leachate Pond (L-Pond)

APPENDIX D

LANDFILL GAS MIGRATION MONITORING PLAN

LANDFILL GAS MIGRATION MONITORING PLAN

COFFIN BUTTE LANDFILL

BENTON COUNTY, OREGON

Prepared for

Valley Landfills, Inc.

March 23, 2011

Prepared by

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

Project VLI-001-005

INTRODUCTION

This monitoring plan describes procedures that Valley Landfills, Inc. (VLI) environmental staff use to measure and evaluate results for the landfill gas (LFG) migration monitoring program at Coffin Butte Landfill. It combines procedures originally developed in a 1995 manual for LFG monitoring with current protocols required by VLI's parent company Republic Services for this type of monitoring. Landfill gas monitoring and procedures associated with operations for Pacific Northwest Generating Cooperative (PNGC), are available for review at the VLI operations office.

Gas monitoring probes are used to determine the degree of subsurface gas migration away from the landfill into surrounding native soils. Spaced along the perimeter of the landfill property boundary, gas probes installed in boreholes provide conduits to the subsurface soils and enable measurement of gas composition and concentration. Probe monitoring is necessary to determine compliance with Oregon Administrative Rules (OAR) 340-94-0060(4). Gas control compliance guidelines were originally established under the Resource Conservation and Recovery Act (RCRA) of 1976. Under both the OAR and RCRA, the following criteria apply:

- Methane concentrations at the property boundary shall not exceed 5 percent by volume, 100 percent of the lower explosive limit (LEL) for methane.

- Methane concentrations inside buildings and structures on landfills shall not exceed 25 percent of the LEL or 1.25 percent by volume.

Monitoring data from the probes are also used to evaluate the gas system performance and to indicate any needed system operation adjustments, and to assess whether any off-site monitoring is needed.

1.0 MONITORING PROCEDURES - PROBES

Six gas monitoring probes were installed around Coffin Butte Landfill to address concerns for potential gas migration at distances away from the landfill. Probe locations are shown in Figure 2-1 of the EMP. All of the gas probes are single completion since the shallow geology between the landfill and areas of monitoring is relatively homogenous, being either alluvial clay or basalt that has weathered to clayey sand. In addition, it is more effective to monitor more permeable sandy zone that transmit methane laterally away from the source. Where possible, the depth of boring for a completed gas probe should approximately equal the elevation at the bottom of refuse within a 1,000-foot radius of the probe, and should be no deeper than the top of the water table. Refer to Table D-1 for gas probe depths; construction diagrams and boring logs are attached.

The construction of a typical gas probe consists of solid 1/2-inch polyvinyl chloride (PVC) riser pipe connected to a 2-foot length of slotted 1/2-inch PVC pipe, which acts as the sensing tip. At the surface, the end of the solid PVC pipe is capped to prevent moisture or dirt from entering and obstructing the probe. The top few feet of each probe is backfilled with a bentonite surface seal to prevent surface water infiltration. The capped probe tops are encased within a 3-foot high lockable security casing at ground surface and embedded in concrete collars at the base. Each probe is labeled designating its number (GP-l, GP-2, etc.). The exterior of each security casing is also visibly marked to show the probe's identity. A diagram illustrating the probe details is also attached.

1.1 Monitoring

1.1.1 Monitoring Parameters

Gas probes are monitored to assess regulatory compliance in likely areas of LFG migration. Site compliance is determine by the concentration of combustible gas (measured as methane) detected at the gas probes. Parameters typically measured consist of the LEL, and the methane and oxygen concentrations as percent.

1.1.2 Gas Composition

Methane. Methane is the major combustible gas component found in landfill gas. Traces of other combustible gases are sometimes found in LFG samples, but concentrations are quite small. Portable combustible gas detectors are used for landfill gas monitoring. They also read other non-methane hydrocarbon gases, provided they are present in concentrations within the detection limits of the instrument. Methane concentrations in landfills typically range between 0 to 70 percent by volume, and sometimes higher. The other combustible gases, when present, are generally well below the minimum detection capabilities for combustible gas meters typically used for probe and well monitoring. Therefore, combustible gas detected during LFG monitoring should be assumed to be methane. Due to interference caused by trace gases and the other major landfill gases, most gas meters should be considered accurate within ± 1 to 2 percent.

Oxygen. High concentrations of oxygen in the LFG extraction system are cause for concern, but this is not the case for probe monitoring. In general, the oxygen concentrations measured at gas probes are inversely proportional to methane concentrations. Oxygen (O_2) can range between 0 and 21 percent during gas probe monitoring. In the absence of methane, oxygen concentrations generally range between 10 to 21 percent. The typical percentage of oxygen in ambient air is 21 percent.

1.1.3 Instrumentation

Gas Composition. Under regulatory performance criteria, landfill-derived combustible gas should not exceed its LEL of 5 percent by volume at the property boundary and 25 percent of its LEL within habitable zones of on-site structures. The Landtech GEM unit can be used to monitor gas composition at these concentrations. The GEM can also be used to monitor O_2 as well as carbon dioxide (CO_2) concentrations or static pressure, if needed.

Equipment Care and Calibration. Because probe data are used to evaluate and determine site compliance with environmental regulations, monitoring equipment must be routinely maintained and calibrated in accord with manufacturer's recommendations. The GEM unit should be checked and recalibrated before each use. Calibration gas standards are commercially available through the equipment manufacturer, or by special order through a local industrial gas supplier. The mixture and concentration of the custom calibration gas currently used to calibrate the meters is a mixture of 15 percent methane, 15 percent carbon dioxide, and the balance of nitrogen.

Use, storage, maintenance, and calibration procedures for all instruments should always be performed in accord with the equipment manufacturer's recommendations.

1.1.4 Monitoring Frequency

Although the OAR does not specify a monitoring frequency, RCRA Subtitle D regulations mandate a quarterly monitoring frequency. Therefore, the gas probes at Coffin Butte should be monitored at least four times a year unless the Oregon Department of Environmental Quality (DEQ) requires monitoring more often. VLI’s policy is to monitor the probes and structures on a monthly basis.

1.1.5 Monitoring Procedures

Monitoring is performed by qualified personnel trained in the proper use and calibration of the monitoring instruments. Typically, a 4-foot length of 1/8-inch inside-diameter clear vinyl tubing is used to connect the combustible gas detector to the probe top. The tubing should be connected to the instrument and probe with an air-tight seal to prevent air leakage which could affect the monitoring results. Before monitoring, the operator checks for possible probe obstructions and determines whether groundwater could be pulled into the GEM unit by vacuum of the instrument’s pump. Using the tubing, the operator can see whether water or moisture originating within the probe is pumped into the instrument. Liquids can damage the unit if absorbed.

A recommended method to test for obstructions is to attach a squeeze-type aspirator bulb to the probe top with clear vinyl tubing and evacuate an air sample from the probe with the aspirator bulb. If the deflated bulb fails to expand, the probe tip or the tubing within the probe may be obstructed by foreign matter or water. If the bulb expands slowly, watch the clear tubing for water being extracted from the probe. If a steady stream or a large amount of moisture is observed, do not use the combustible gas detector. As a precaution, a moisture trap can be connected at the entry to the GEM unit to trap any free moisture. Small droplets of moisture should not cause concern, but excess moisture could damage detector elements, making the instrument inoperable. Dirt or other obstructing particles can block perforations of the probe tip, decreasing the rate at which the sample volume is extracted by the probe and causing slow expansion of the bulb.

Recommended Procedures. Follow the step-by-step procedures for monitoring LFG probes described in the GEM unit's operations manuals. If the system is under vacuum, care should be taken to insure that air is not sucked into the system while making measurements by keeping the petcock valves closed except when measuring pressures, taking samples, or evacuating condensate from the valve prior to monitoring.

Gas Composition Measurement Procedures:

1. Follow Manufacturer’s calibration and use procedures.

2. Note whether or not groundwater is present in probe and measure depth.

3. Connect the GEM unit to the probe labcock and open the labcock valve.

4. Take the percent oxygen, percent LEL, and percent methane gas readings per the manufacturer's procedures manual.

5. Observe "PERCENT GAS" scale.

    a. If the unit indicates more than 5 percent, record percent combustible gas value on monitoring data form. Proceed to Step 6.

    b. If the unit indicates less than or equal to 5 percent, and the oxygen concentration measured in Step 6 is less than or equal to 9 percent, record percent combustible gas value on monitoring data form. Proceed to Step 6.

    c. If unit indicates less than or equal to 5 percent, and the oxygen concentration is greater than 9 percent, proceed to Step 5.

6. Observe and record the LEL concentration.

7. Disconnect the GEM unit from the probe. Replace probe top and allow GEM unit to continue to run approximately one minute to purge any residual combustible gas. Shut off "POWER" switch.

8. Proceed to the next probe and repeat procedure.

If detectable concentrations of combustible gas are immediately recorded at a probe, the combustible gas detector should be immediately recalibrated and the probe again monitored for verification of results.

1.2 Factors That Affect Probe Readings

In general, two factors can affect LFG migration and probe readings: barometric pressure and the operation of an active LFG extraction system within the landfill. Changes to either of these can impact lateral gas movement within the soils.

Barometric Pressure. At most landfills, changes in barometric pressure, either diurnal or weather-based, impact gas migration. Typically, probe static pressures vacillate between relative high positive pressures to negative pressures of equal magnitude with changes to barometric conditions. Monitoring records indicate pressures of certain probes will vary with an inverse proportionality due to changes in barometric pressure. When a high barometric pressure system advances, probe static pressures become negative and the concentration of combustible gas decreases; when a low barometric pressure region develops, probe pressures become positive and return to their previous high state, while an increase in gas concentration is usually observed.

These phenomena probably result from the atmosphere weighing down on the earth's surface. The refuse decomposition rate, over short time periods, can be considered uniform as is the positive pressure of the generated gas within the landfill. As the barometric pressure varies, LFG in permeable native soils tends to act like a balloon. At a single point in time, a constant static pressure exerted on both the inside and outside of the balloon causes it to remain in equilibrium. An increase in the exterior pressure exerts more force on the outside wall of the balloon, causing the balloon to contract and reducing its interior volume. A decrease in external pressure enables the volume of the balloon to expand.

External barometric pressure changes cause a similar respiration effect on the gas within the soils. A probe located near the outward limit of the gas migration may exhibit the presence of combustible gas if the barometric pressure decreases and allows the gas to migrate farther away from the landfill. Conversely, that same probe under high barometric conditions may not exhibit detectable concentrations of combustible gas as the limit of gas migration is forced away from the probe and back towards the landfill.

Active Gas Extraction Systems. In theory, if negative pressure is high enough to overcome the positive pressure created by the decomposition of the refuse materials and the effects caused by low barometric conditions, the gas should not be able to escape. This is the principle on which gas extraction systems work. The Coffin Butte gas system applies a negative pressure through vertical wells and horizontal trenches installed in refuse. The extracted gas is conveyed to the southeast end of the landfill where it is combusted, generating electricity. Performance is measured by the concentrations of methane detected at the gas probes. If gas is detected at a probe, either the amount of negative pressure applied to the wells adjacent to the probe location is too low to overcome the internal static pressure of the gas, or it is unable to overcome the impacts of low barometric conditions. Increasing the vacuum at the wells reduces pressure-induced gas migration into the surrounding soils. The amount of vacuum that can be applied to a well has limits.

1.3 Responding to Monitoring Results

Immediately following each probe monitoring session, data should be evaluated and any needed corrective actions should be determined. Actions taken are based on methane concentrations monitored at the probes. If the methane concentration is below the regulatory performance standard of 5 percent (by volume), the probes are in compliance, and no action is necessary. Concentrations greater than 5 percent (by volume) require notification and mitigating measures to correct the situation, according to RCRA Subtitle D, and Section 18.7 of the Solid Waste Permit. The following provides recommended responses to each of the two scenarios:

Note: These procedures assume all probes are in compliance with the regulatory standard for gas migration.

1.3.1 Probes Less Than 5 Percent Methane

1. If probes are 20 percent LEL or less, no further action is needed. Record data on permanent forms, and provide a copy to the landfill supervisor.

2. For probes greater than 20 percent LEL, identify all gas extraction wells within a 400-foot radius of the affected probe(s). Look up the most recent well data recorded at those wells and determine if their gas extraction rates could be increased. Where possible, increase the extraction rates on those wells in coordination with PNGC.

3. Monitor probes again in accord with regular monitoring schedule.

1.3.2 Probes Greater Than 5 Percent Methane

If combustible gas is detected at concentrations exceeding the performance standards, Section 18.7 of the permit specifies the following actions:

1. Take immediate steps to protect human health and safety and notify DEQ within 24 hours.

2. Within seven days of detection, confirm the measures taken to protect human health and safety (unless DEQ approves an alternative schedule), and describe the methane test results and response measures in the facility operating record.

3. Within 60 days of the methane exceedances, develop and implement a remediation plan, incorporate the plan into the monitoring records, and submit a progress report to DEQ.

As part of these actions, VLI may perform the following:

- Immediately notify the Coffin Butte Landfill supervisor.

- Re-monitor the probe(s) the following day to verify findings.

- Identify all gas extraction wells within a 400-foot radius of the affected probe(s). Look up the most recent well data recorded at those wells and determine if their gas extraction rates could be increased. Where possible and in consultation with PNGC personnel, increase the extraction rates on those wells and monitor well performance.

- Check the soils and foundations of nearby on-site structures for evidence of gas migration. If necessary, monitor soil gases using bar-hole technique or other technique to determine the lateral extent of methane migration.
- Re-monitor affected probes and all adjusted gas extraction wells daily.
- Repeat steps 4 and 5 until methane concentrations at probe(s) drop within compliance levels.
- Follow-up with progress report to the DEQ once the probe(s) are within compliance.

1.4 Probe Maintenance

The physical integrity of the gas probes is crucial. Federal regulatory guidelines suggest a minimum post-closure period of 30 years for gas control monitoring. This means gas probes would remain in place several decades past the landfill's project closure date. Gas probes generally require very little maintenance. Most of the probe is below ground, making the only portion requiring attention the security casing and its surrounding area.

Maintenance. The security casings used on the Coffin Butte gas probes are fabricated from steel. Since they are constantly exposed to the weather elements, rust can be a major concern over time. Probes, therefore, should be inspected yearly and the following tasks performed as needed:

1. Probes showing evidence of deterioration should be cleaned, rust deposits removed, primed, and coated with a rust-inhibiting paint.
2. Probe identification numbers shall be repainted and kept legible at all times.
3. Security locks shall be kept clean and the key assembly lubricated.
4. Excess vegetation shall be cleared around the probes for access ease.
5. Vehicular access to the probe locations will be maintained.

Probe Replacement. If a probe is destroyed and must be replaced or relocated, the DEQ, or other regulatory agencies having jurisdiction, will be notified by letter or email. The notification should describe the reasons for its replacement, and its new proposed location and construction details. Following work completion, a second notification will be sent within 30 days of completion of field activities showing the probe's new location and completion details.

1.5 Records and Reporting

1.5.1 Records

Construction Records. Keep as-built construction records of all installed gas probes (see attached). Geologic boring logs should describe the subsurface soil conditions encountered during drilling to identify potential gas migration conduits. Completion details for each of the probes should include:

- Probe installation date
- Probe identification number
- Probe installer's name
- Boring depth
- Depth of completed probe tip
- Elevations and dimensions of all backfill materials
- Description of backfill materials used
- Any unusual occurrences or circumstances encountered during the probe installation

Monitoring Records. Because the collected probe monitoring data will be used to assess site compliance, the monitoring program should include reliable and accurate records. Collected monitoring data should be field-recorded for later transfer onto permanent forms or for entry into a computerized database. In addition to the probe data, record the following information during each monitoring session:

- Date and time of monitoring session
- Name of person performing the monitoring
- Instrumentation used
- Any problems associated with the monitoring equipment that may impact accuracy of the monitoring results

A typical probe monitoring data form is attached. All records, including field originals, should be stored for future reference.

1.5.2 Reporting Results

Copies of monitoring data are submitted to the DEQ as part of the Annual Environmental Monitoring Report (see EMP Section 6.0).

2.0 MONITORING INTERIORS OF STRUCTURES

Site structures are monitored on a monthly basis in conjunction with the probe monitoring. These structures are listed on the attached Gas Probe Data Sheet. When monitoring a structure's interior, direct the inlet port of the gas meter device toward cracks in the concrete slab, the base of walls, comers, floor drains, or any other point where gas may seep into the building. Also check small confined spaces without much circulation where gas may accumulate to detectable concentrations. If gas concentrations found exceed 25 percent of the LEL (1.25 percent by volume):

1. Immediately evacuate the structure and notify the Coffin Butte Supervisor.
2. Document the finding in the operating record within 7 days of the detection, and the health and safety actions taken. Within 60 days of the detection, implement a remediation plan and notify the DEQ that the plan has been implemented.

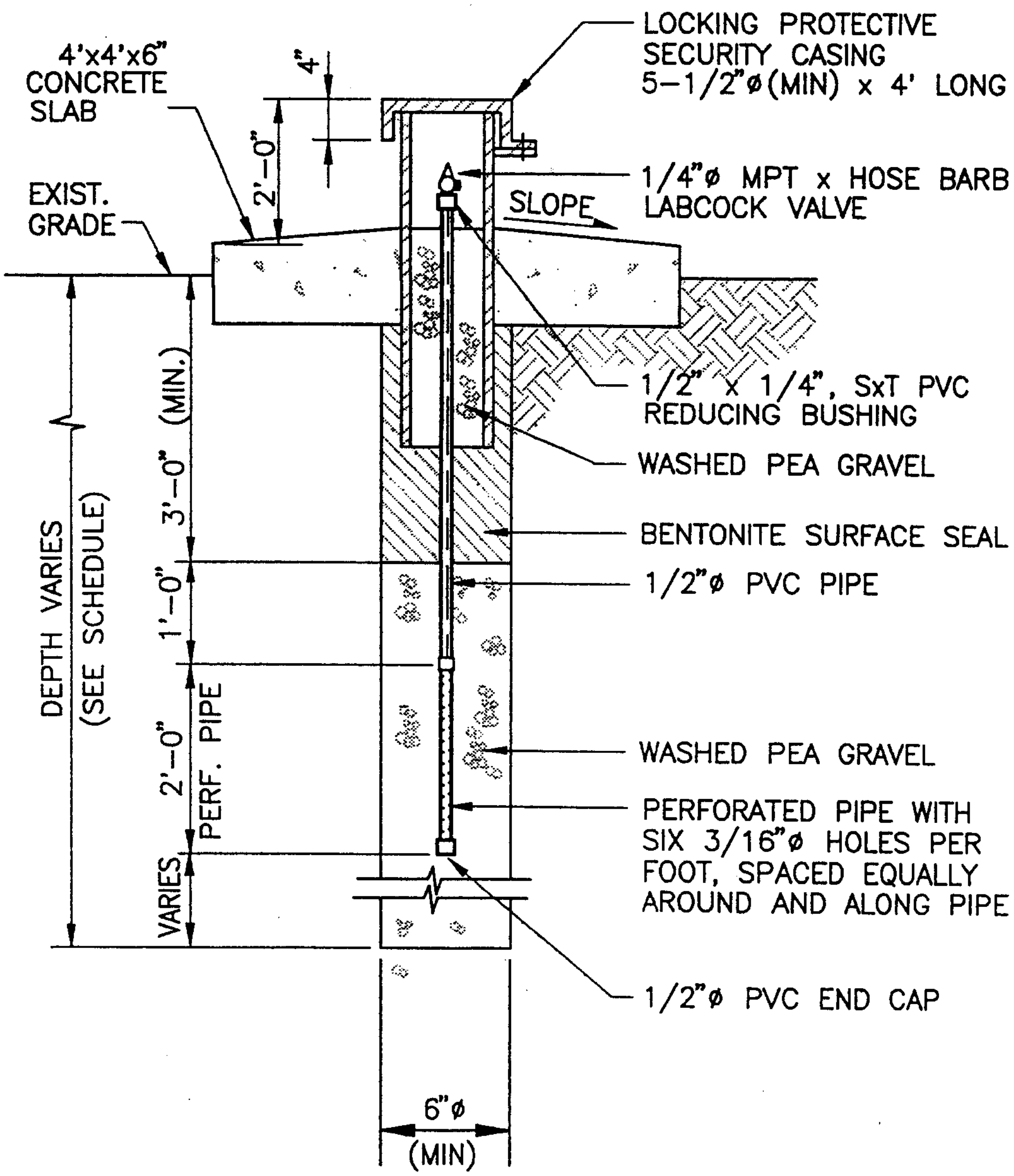
ATTACHMENTS

Table D-1 - Gas Probe Construction Data
Gas Monitoring Probe Detail
Landfill Gas Probe Data Sheet
Example of Landfill Gas Reporting Form for AEMR
Construction Logs and Exploratory Boring Logs

Table D-1
Gas Probe Construction Data
Landfill Gas Migration Monitoring Plan
Coffin Butte Landfill

Well Name	Date Installed	Geologic Unit	Ground Elevation* (ft-msl)	Casing Stickup (ft)	Boring Depth (feet bgs)	Borehole Diameter (inches)	Well Diameter (inches)	Screen Interval (feet bgs)	Screen Length (ft)	Gravel Pack Interval (feet bgs)
GP-2	09/20/94	Qal	263	2.6	10.0	8.0	0.5	7.8-9.8	2	7-10
GP-3	09/19/94	Qal	274	2.5	6.0	8.0	0.5	3.8-5.8	2	3-6
GP-4	09/19/94	Wx Basalt	279	2.6	10.0	8.0	0.5	7.8-9.8	2	7-10
GP-5	09/19/94	Wx Basalt	290	2.6	20.0	8.0	0.5	17.8-19.8	2	17-20
GP-5A	09/19/94	Wx Basalt	286	2.8	20.0	8.0	0.5	17.8-19.8	2	17-20
GP-6	09/19/94	Qal	282	2.6	10.4	8.0	0.5	8-10	2	7-10.4

Note:
bgs: below ground surface
ft-msl: feet above mean sea level.
*Approximate based on topographic map.



EMCON
Northwest, Inc.

DATE 10-94
DWN. MLP
REV.
APPR.
PROJECT NO.
0139-001.39

Figure 4-2
COFFIN BUTTE LANDFILL
LFG O&M MANUAL

GAS MONITORING PROBE DETAIL

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Valley Landfills, Inc.
Coffin Butte
Landfill Gas Probe Data Sheet

Operator(s): ____________________

Date: ____________________

Instrument: GEM 2000

LFG Probe Location	LEL %	Methane %	Oxygen %	Time
GP-2				
GP-3				
GP-4				
GP-5				
GP-5A				
GP-6				

Buildings	LEL %	Methane %	Oxygen %	Time
Knife River Scales				
Office				
LTF- Change Room				
Hazmat				
Gas Lock Box				
CB Scales				
Pump House				
Lock-up #1				

Example of Landfill Gas Reporting Form for
Annual Environmental Monitoring Report
Coffin Butte Landfill

			Monitoring Location													
			Landfill Perimeter						Buildings							
Date	Time	Levels	GP2	GP3	GP4	GP5	GP5A	GP6	Office	Scale House	Pump House	Haz Mat Box	Quarry Scalehouse	Gas Lock Box	Lock-up 1	LTF
01/22/10	1312	LEL %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		CH4 %	0.4	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
		O2 %	20.3	20.5	17.2	8.1	18.3	10.8	-	-	-	-	-	-	-	-
02/18/10	0847	LEL %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		CH4 %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		O2 %	20.5	20.7	17.2	5.1	20.4	10.8	-	-	-	-	-	-	-	-
03/31/10	0822	LEL %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		CH4 %	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
		O2 %	20.4	20.4	16.1	4.9	20.5	17.4	-	-	-	-	-	-	-	-
04/28/10	1008	LEL %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		CH4 %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		O2 %	13.0	19.9	9.7	5.9	16.4	13.3	-	-	-	-	-	-	-	-
05/21/10	0810	LEL %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		CH4 %	0.4	0.3	0.3	0.2	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		O2 %	19.6	20.5	8.5	8.8	20.5	8.9	-	-	-	-	-	-	-	-
06/18/10	0853	LEL %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		CH4 %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		O2 %	19.8	20.1	10.5	4.7	20.2	9.9	-	-	-	-	-	-	-	-
07/20/10	1343	LEL %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		CH4 %	0.2	0.2	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
		O2 %	19.7	20.0	19.9	19.8	19.8	19.9	-	-	-	-	-	-	-	-
08/18/10	1132	LEL %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		CH4 %	0.3	0.2	0.2	0.3	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		O2 %	19.7	18.5	18.4	17.8	19.8	7.8	-	-	-	-	-	-	-	-
09/16/10	0923	LEL %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		CH4 %	0.1	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		O2 %	20.2	19.6	17.6	11.6	20.1	7.6	-	-	-	-	-	-	-	-
10/22/10	0848	LEL %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		CH4 %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		O2 %	20.4	19.8	16.6	15.5	20.6	11.0	-	-	-	-	-	-	-	-
11/11/10	1447	LEL %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		CH4 %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		O2 %	16.3	19.9	19.7	20.1	20.1	18.5	-	-	-	-	-	-	-	-
12/17/10	1324	LEL %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		CH4 %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		O2 %	20.3	20.7	16.7	10.0	20.6	10.1	-	-	-	-	-	-	-	-

EMCON

GAS WELL CONSTRUCTION LOG

WELL No. GP-2

Landfill name: Coffin Butte Project No. 0139-001.39(6) Date 9/20/94

I. DIMENSIONS:

a. Total depth of ~~well~~ borehole 10 ft.

b. Diameter of ~~well~~ borehole 8"

c. Well casing interval 9.8 to +2.6 ft.

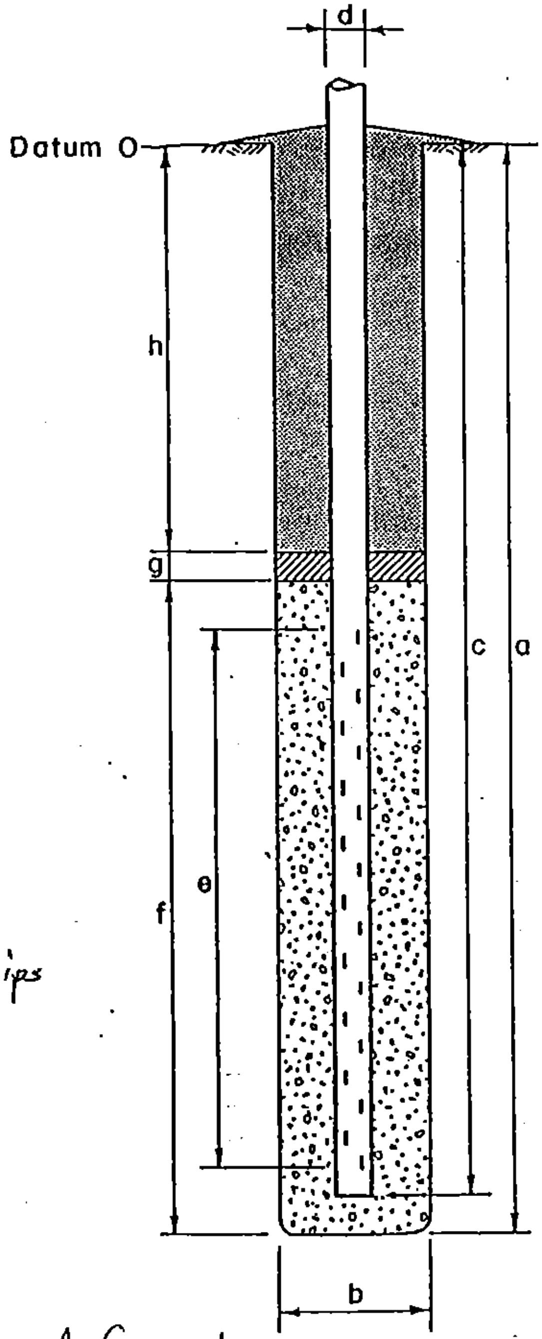
d. Diameter of well casing ½" I.D.

e. Slotted interval of well casing 2 ft.
from 9.8 to 7.8

f. Permeable material interval 10 to 7 ft.

g. Impermeable plug interval 7 to 0 ft.

h. Backfill material interval /



II. MATERIALS:

Permeable material 3/8" pea gravel washed

Impermeable plug Volclay bentonite chips hydrated

Backfill material /

Casing material (incl. slip joints) PVC

III. CONSTRUCTION:

Method of placing fill materials: by hand, poured from bags

Method of placing casing: by hand. Includes 8" locking security casing surrounded by 6" by 3 ft. diameter concrete s/a w/ weephole

Problems encountered: none / 3 stainless guard posts 120° apart ≈ 2 ft. from security casing 3 ft. bgs to 3 ft. abs. concrete inside and outside. domed.

EMCON Northwest, Inc.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME Valley Landfills

PROJECT= 0139-001.39(6)

GEOLOGIST/ENGINEER B. Thoms

DRILLING CONTRACTOR Geo-tech

DRILLING METHOD Mobile drilling

HSA

HOLE DIA. 8" OD

BORING NO. GP-2

DATE BEGAN 9/20/94

DATE COMPLETED 9/20/94

TOTAL DEPTH 10

SHEET 1 OF 1

WATER LEVEL DATA

DEPTH				
TIME				
DATE				
BORING DEPTH				

FIELD LOCATION OF BORING:

GROUND ELEVATION

DATUM

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	BLOWS/FT	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
time		SPT 1.8" SS						
8:38						0		
						1		
						2		
						3		
						4		
		▨		2	1.5/1.8	5		CLAY WITH SAND (CL), greyish brown, 90% med plast. fines, 10% med-coarse subangular sand, moist, firm, trace pores/rootholes trace ¼ → ½" gravel (subangular)
				3				
				4		6		
						7		
						8		
						9		
9:00		▨		6	1.5/1.8	10		CLAY WITH SAND and GRAVEL (CL) greyish brown - ~~yellowish~~ reddish brown, 80% med plast. fines, 10% med-coarse sand subangular, 10% gravel (< 1"), subangular, moist, firm, trace pores/rootholes, ~~(weathered basalt colluvium)~~ (WEATHERED BASALT COLLUVIUM)
				7				
				14				
								terminated boring @ 10 ft. @ 9:00
								4 bags Volclay 1 bag pea gravel

REMARKS:

*NOTE: Specify data recorded in undesignated column (e.g. conductance, pH, tip reading, pocket torvane, etc.)

EMCON

GAS WELL CONSTRUCTION LOG

WELL No. GP-3

Landfill name: Coffin Butte Project No. 0139-001,39(6) Date 9/19/94

I. DIMENSIONS:

a. Total depth of ~~well~~ borehole 6 ft.

b. Diameter of ~~well~~ borehole 8"

c. Well casing interval 6 to +2.5 ft.

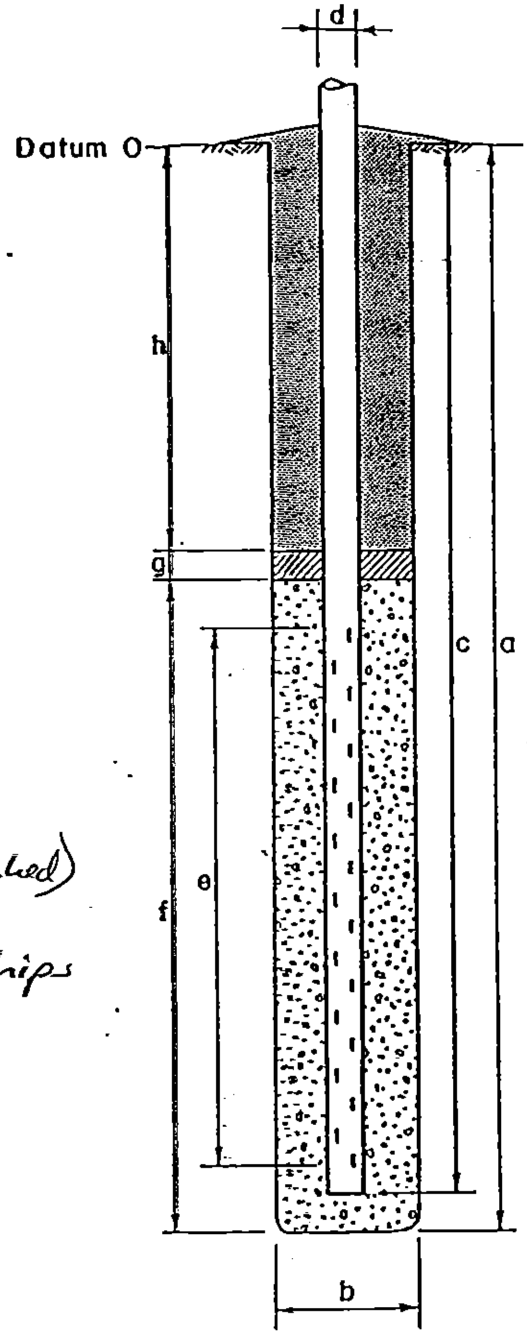
d. Diameter of well casing 1/2" I.D.

e. Slotted interval of well casing 2 ft.
from ~~6~~ 5.8 to ~~4~~ 3.8

f. Permeable material interval 6 to 3 ft.

g. Impermeable plug interval 3 to 0 ft.

h. Backfill material interval ——



II. MATERIALS:

Permeable material 3/8" pea gravel (washed)

Impermeable plug Volclay bentonite chips hydrated

Backfill material ——

Casing material (incl. slip joints) PVC

III. CONSTRUCTION:

Method of placing fill materials: by hand, poured in from bags

Method of placing casing: by hand, 8" locking sec. casing w/ weep hole. surrounded by 6" x 3 ft. diameter concrete slab.

Problems encountered: none / 3 SS guard posts @ 120° apart ≈ 2 ft. from sec. casing installed from 3 ft. bgs to 3 ags. w/ domed concrete inside and out.

EMCON
Northwest, Inc.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME Valley Landfills
PROJECT# 0139-001.3⑥
GEOLOGIST/ENGINEER B. Thoms
DRILLING CONTRACTOR Geo-tech
DRILLING METHOD HSA Mobile Drill rig
HOLE DIA. 8" OD

BORING NO. GP-3
DATE BEGAN 9/19/94
DATE COMPLETED 9/19/94
TOTAL DEPTH 6
SHEET 1 OF 1

WATER LEVEL DATA

DEPTH				
TIME				
DATE				
BORING DEPTH				

FIELD LOCATION OF BORING:

GROUND ELEVATION
DATUM

OTHER* Time	WELL OR PIEZOMETER DETAILS	SAMPLING DATA: SAMPLING METHOD	SAMPLE NUMBER	BLOWS/FT.	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
15:05						0		
						1		
						2		
						3		
						4		
15:16		▨		2 3 4	1.8/1.8 ↓	5 6	▨	CLAY (CL), dark brown w/ very dark brown to black mottles, 95-100% med. plast. fines, trace - 5% fine sand (micaceous), trace roots/pores, moist, soft.
						7		
								Boring terminated @ 6 ft @ 15:21
								1 bag pea gravel (90 lbs)
								1.5 bags bentonite.

REMARKS:

*NOTE: Specify data recorded in undesignated column (e.g. conductance, pH, tip reading, pocket torvane, etc.)

SE/E 300-03

EMCON

GAS WELL CONSTRUCTION LOG

WELL No. GP-4

Landfill name: Coffin Butte Project No. 0139-001.34(c) Date 9/19/94

I. DIMENSIONS:

a. Total depth of ~~well~~ borehole 10 ft.

b. Diameter of ~~well~~ borehole 8"

c. Well casing interval 9.8 to +2.6 ft.

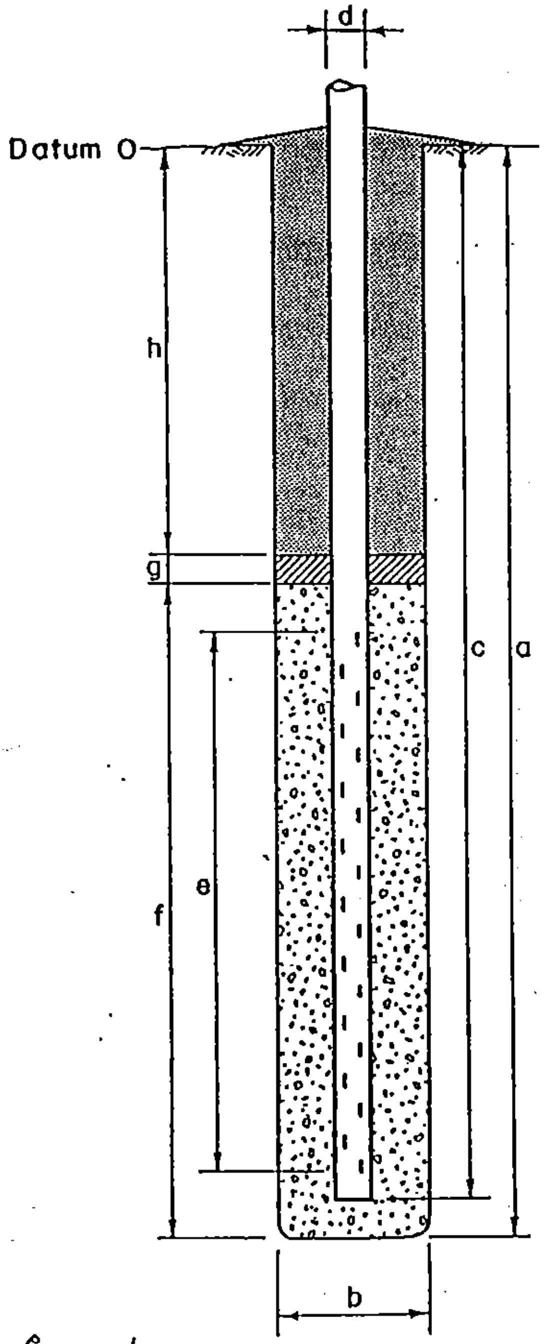
d. Diameter of well casing ½" I.D.

e. Slotted interval of well casing 2 ft.
from 9.8 to 7.8

f. Permeable material interval 10 to 7 ft.

g. Impermeable plug interval 7 to 0 ft.

h. Backfill material interval /



II. MATERIALS:

Permeable material 3/8" washed pea gravel

Impermeable plug bentonite chips hydrated

Backfill material /

Casing material (incl. slip joints) PVC

III. CONSTRUCTION:

Method of placing fill materials: hand, poured from bags

Method of placing casing: hand, 8" locking sec. casing w/ weep hole, surrounded by 6" x 3 ft. diameter concrete slab, ~~domed~~, sloped.

Problems encountered: none / 3 stainless guard posts @ 120° apart & 2 ft. from sec. casing installed from 3 ft. bgs to 3 ft. abs w/ domed concrete inside and out.

EMCON Northwest, Inc.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME Valley landfills
PROJECT# 0139-001.38(6)
GEOLOGIST/ENGINEER B. Thoms
DRILLING CONTRACTOR Geo-Tech
DRILLING METHOD HSA Mobile drilling
HOLE DIA. 8" OD

BORING NO. GP-4
DATE BEGAN 9/19/94
DATE COMPLETED 9/19/94
TOTAL DEPTH 10 ft.
SHEET 1 OF 1

WATER LEVEL DATA

DEPTH				
TIME				
DATE				
BORING DEPTH				

FIELD LOCATION OF BORING:

GROUND ELEVATION
DATUM

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING DATA: SAMPLING METHOD	SAMPLE NUMBER	BLOWS/FT	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
		SPT 1.5" SS						
13:07						0		0-3 SILTY CLAY (CL), dark reddish brown, 95-100% med. plast. fines, trace fine sand, dark brown-black mottles, ~~mois~~ moist, firm to stiff.
						1		
						2		
						3		3-
						4		
				27 50/5"	1.3	5		SILTY ~~GRAVEL~~ SAND WITH ~~SAND~~ GRAVEL (SM), 30% non-low plast. fines, 50% fine-coarse sand, 20% angular gravel, (<1.5") dense-very dense, moist, weathered basalt.
						6		
						7		
						8		
						9		
13:30				16 27 32	1.5/1.5	10		CLAYEY SILT WITH SAND (ML), reddish brown, 80% low plast. fines, 20% fine-med. sand, trace angular gravel (<½"), moist, dense, dark ~~brown to~~ reddish brown layers (≈ 1") thick interbedded with reddish brown layers (≈ 2") thick.

Boring terminated @ 10 ft. @ 13:30 completed well

2 bags pea gravel
3 bags ~~bentonite~~ bentonite

3 quad posts 120° apart ≈ 2 ft. from sec. casing. 3 ft. bgs to 3 ft. ags

REMARKS:

*NOTE: Specify data recorded in undesignated column (e.g. conductance, pH, tip reading, pocket torvane, etc.)

EMCON

GAS WELL CONSTRUCTION LOG

WELL No. GP-5

Landfill name: Coffin Butte Project No. 0139-001.34(6) Date 9/19/94

I. DIMENSIONS:

a. Total depth of ~~well~~ borehole 20 ft.

b. Diameter of ~~well~~ borehole 8"

c. Well casing interval 19.8 ~~to 17.8~~ to +2.6 ft.

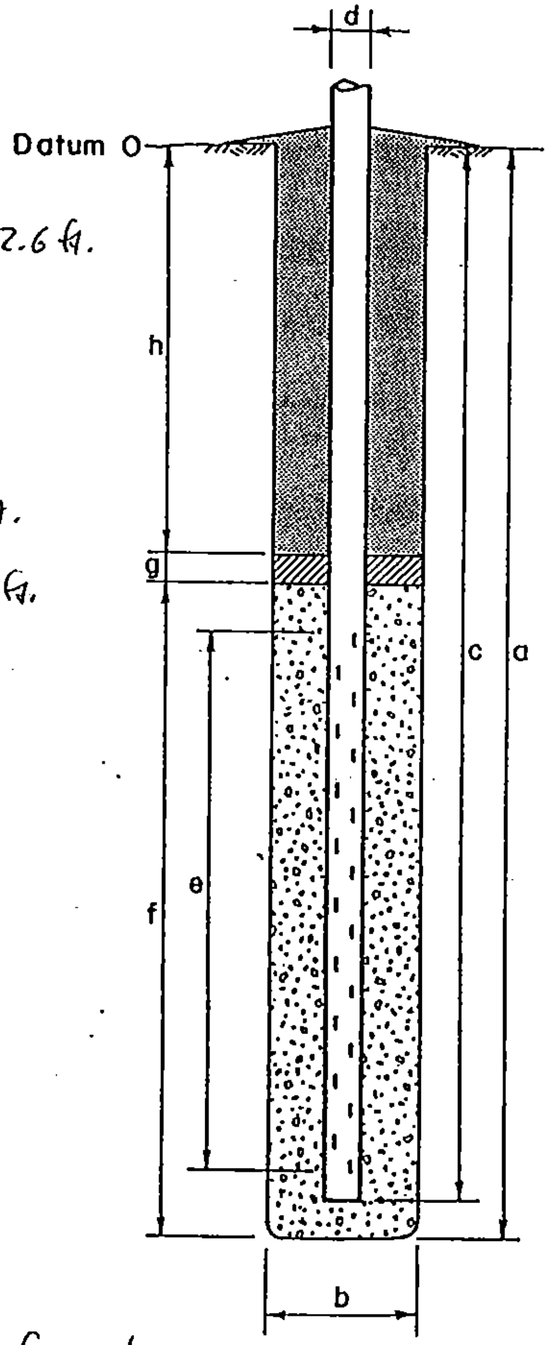
d. Diameter of well casing 1/2" I.D.

e. Slotted interval of well casing 2 ft.
from 19.8 to 17.8

f. Permeable material interval 20 to 17 ft.

g. Impermeable plug interval 17 ft. to 0 ft.

h. Backfill material interval /



II. MATERIALS:

Permeable material 3/8" washed pea gravel

Impermeable plug bentonite chips hydrated

Backfill material /

Casing material (incl. slip joints) PVC

III. CONSTRUCTION:

Method of placing fill materials: hand, pored from bags

Method of placing casing: hand / 8" locking sec. casing w/ weep hole, surrounded by 6" x 3 ft. diameter sloped concrete slab.

Problems encountered: none / 3 stainless guard posts @ 120° apart ≈ 2 ft. from sec. casing installed from 3 ft. bgs to 3 ft. abs w/ domed concrete inside and out.

EMCON Northwest, Inc.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME Valley Landfills

PROJECT# 0134-001.34(c)

GEOLOGIST/ENGINEER B. Thoms

DRILLING CONTRACTOR Geo-tech

DRILLING METHOD Mobile Drill HSA

HOLE DIA. 8" OD

BORING NO. GP-5

DATE BEGAN 9/19/94

DATE COMPLETED 9/19/94

TOTAL DEPTH 20

SHEET 1 OF 2

WATER LEVEL DATA

DEPTH				
TIME				
DATE				
BORING DEPTH				

FIELD LOCATION OF BORING:

GROUND ELEVATION

DATUM

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	BLOWS/FT	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
time								
13.59						0		0 - Topsoil ~~SILTY CLAY~~ CLAYEY SILT (ML), dark brown, 95% ~~[illegible]~~ low plast. fines, 5% fine sand, damp, firm,
						1		
						2		
						3		
						4		
					NS	5		NS @ 5 ft.
						6		
						7		@ ≈ 8 ft. some gravel
						8		
						9		
		▨		22 50/6	1.5/1.0 ↓	10	▨	GRAVELLY SAND WITH SILT/CLAY (SM) reddish brown, 20% lowplasti. fines, 60% sand (well graded), 20% gravel angular (< 3/4"), damp, v.g. dense, small veins of clay, (weathered basalt)
						11		
						12		
						13		
						14		
14:14		▨		33 50/5	0.5/1.0 ↓	15	▨	SILTY SAND (SM), reddish brown, 20% non low plast. fines, 70% ~~well grad. sand~~, fine sand, 10% med. coarse sand, trace gravel (< ½"), moist, very dense, (weathered basalt).
						16		
						17		
						18		
						19		
						20		

REMARKS:

*NOTE: Specify data recorded in undesignated column (e.g. conductance, pH, tip reading, pocket torvane, etc.)

SE/E 300-03

EMCON
Northwest, Inc.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME ~~[illegible]~~ Valley Landfills
PROJECT# 0139-001.39(6)
GEOLOGIST/ENGINEER B. Thomas
DRILLING CONTRACTOR Geo-tech
DRILLING METHOD Mobile drill rig HSA
HOLE DIA. 8" OD

BORING NO. GP-5
DATE BEGAN 9/19/94
DATE COMPLETED 9/19/94
TOTAL DEPTH 20
SHEET 2 OF 2

WATER LEVEL DATA

DEPTH				
TIME				
DATE				
BORING DEPTH				

FIELD LOCATION OF BORING:

GROUND ELEVATION

DATUM

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING DATA: SAMPLING METHOD	SAMPLE NUMBER	BLOWS/FT	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
time		SPT 1.5"						
14:25		[illegible]		50/6	6"	20	[illegible]	20 - 20.5 GRAVELLY SAND WITH SILT ~~([illegible])~~ (SW - SM), dark ~~reddish~~ brown, 10-20% nonplastic fines, 40-50% well graded sand, 30% gravel angular (< 1"), moist, very dense.
						21		
						22		

Boring terminated @ 20 ft. @ 14:29 well completed.

2 bags pea gravel
8 bags bentonite chips

REMARKS: 3 SS guard posts 120° apart ≈ 2 ft. from sec. casing. 3 ft. bgs to 3 ft. abs.

*NOTE: Specify data recorded in undesignated column (e.g. conductance, pH, tip reading, pocket torvane, etc.)

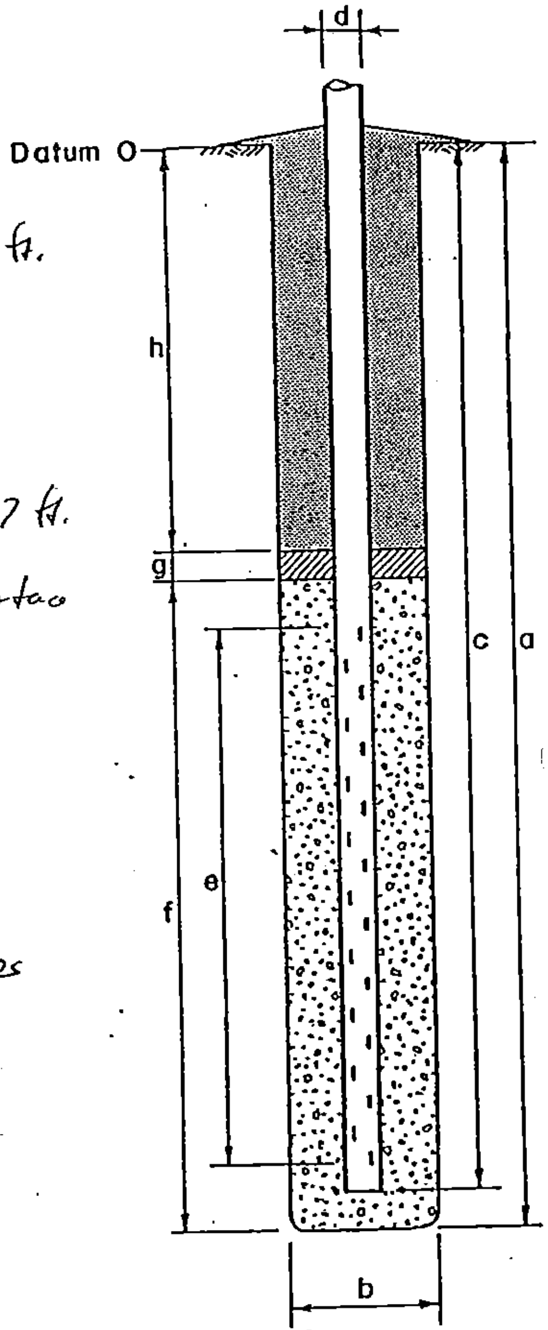
EMCON

GAS WELL CONSTRUCTION LOG

WELL No. GP-5a → GP-5a is the Gas probe 320 ft. East of planned location for GP-5

Landfill name: Coffin Butte Project No. 0139-001.39(6) Date 9/19/94

I. DIMENSIONS:



a. Total depth of ~~well~~ borehole 20 ft.

b. Diameter of ~~well~~ borehole 8"

c. Well casing interval ~~20~~ 19.8 → +2.8 ft.

d. Diameter of well casing 1/2" I.D.

e. Slotted interval of well casing 2 ft.
from 19.8 to 17.8

f. Permeable material interval 20 to ~~18~~ 17 ft.

g. Impermeable plug interval 17 ft. to surface

h. Backfill material interval —

II. MATERIALS:

Permeable material 3/8" pea gravel

Impermeable plug coarse bentonite chips

Backfill material /

Casing material (incl. slip joints) PVC

III. CONSTRUCTION:

Method of placing fill materials: by hand, poured out of bags through auger

Method of placing casing: by hand / 8" locking seccasing w/ weep hole, surrounded by 6"x 3ft. diameter sloped concrete slab.

Problems encountered: none / 3 SS guard posts @ 120° apart set a 2' from sec. casing from 3.0' ft. bgs to 3.0 above ground. w/ concrete inside and out, domed.

EMCON Northwest, Inc.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME: Utility landfills
PROJECT# 0139.001.39(?)
GEOLOGIST/ENGINEER: B. Thoms
DRILLING CONTRACTOR: Geo-Tech
DRILLING METHOD: Mobile Drill rig
8' HSA
HOLE DIA. 8

BORING NO. GP-5a
DATE BEGAN 9/19/94
DATE COMPLETED 9/19/94
TOTAL DEPTH 20
SHEET 1 OF 2

WATER LEVEL DATA				
DEPTH				
TIME				
DATE				
BORING DEPTH				

FIELD LOCATION OF BORING:

GROUND ELEVATION

DATUM

OTHER*	WELL OR PIEZOMETER DETAILS	SAMPLING METHOD	SAMPLE NUMBER	BLOWS/FT	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
time		SPT 1.5" SS						
11:06						0		
						1		
						2		
						3		
						4		
11:11				4	1.8/1.8	5		5-5.5 SILT (ML), dark brown, 95% nonplastic fines, 5% - trace fine sand (micaceous), damp, firm (Topsoil)
				5 6	↓	6		
						7		
						8		5.5-6.8 SILTY CLAY (CL), reddish brown, 95% med plast. fines, 5% fine-med sand, white (calcareous) and weathered basalt fragments, moist, firm, trace rootholes/pores (pologonite)
						9		
11:18				21	1.8/1.8	10		
				37 42	↓	11		10.0-11.8 SANDY SILT (ML) reddish brown 85% low plast. fines, 10% fine-med. sand, dark brown-black, 5% fine gravel, dark brown-black, moist, stiff, trace white ~~clakeroous veins~~, calcerous veins (weathered basalt)
						12		
						13		@11 hit gravel (felt by driller)
						14		
				20	1.4/1.4	15		15.0-15.5 SANDY SILT (ML), reddish brown, 70% low-nonplastic fines, 20% fine-med. sand, 10% fine gravel, dark brown-black, moist, stiff-dense, weathered basalt.
				37 50/5		16		
						17		
						18		15.5-16.4 ~~SANDY GRAVEL~~ SILTY GRAVEL WITH SAND (GM), tan-brown, 50% gravel (< 1"), 30% nonplastic fines, 20% well graded sand, moist, dense, weathered basalt.
						19		
						20		

REMARKS:

*NOTE: Specify data recorded in undesignated column (e.g. conductance, pH, tip reading, pocket torvane, etc.)

SE/E 300-03

EMCON
Northwest, Inc.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME Valley landfill
PROJECT# 0139-001.39(c)
GEOLOGIST/ENGINEER B. Thoms
DRILLING CONTRACTOR Geo-Tech
DRILLING METHOD 8"HSA Mobile Drilling B-57
HOLE DIA. 8"

BORING NO. GP-5a
DATE BEGAN 9/19/94
DATE COMPLETED 9/19/94
TOTAL DEPTH 20
SHEET 2 OF 2

WATER LEVEL DATA

DEPTH				
TIME				
DATE				
BORING DEPTH				

FIELD LOCATION OF BORING:

GROUND ELEVATION

DATUM

OTHER *	WELL OR PIEZOMETER DETAILS	SAMPLING DATA SAMPLING METHOD	SAMPLE NUMBER	BLOWS/FT	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)	LITHOLOGIC DESCRIPTION
time		SPT 1.5" SS						
11:46		▨		50/6		20		SILTY GRAVEL WITH SAND (GM), tan-brown, 60% gravel (angular, ~~3/5~~, <1.5") 30% nonplastic fines, 10% fine-med sand, moist, ~~dense~~ very dense, weathered basalt.
								Boring terminated @ 20 ft. @ 11:50. installed well.

REMARKS:

2¾ (90 lb. bags) of pea gravel
8 bags chips

*NOTE: Specify data recorded in undesignated column (e.g. conductance, pH, tip reading, pocket torvane, etc.)

EMCON

GAS WELL CONSTRUCTION LOG

WELL No. GP-6

Landfill name: Coffin Butte Project No. 0139-001.39(9) Date 9/19/92

I. DIMENSIONS:

a. Total depth of ~~well~~ borehole 10.4 ft.

b. Diameter of ~~well~~ borehole 8"

c. Well casing interval 10 to +2.6 ft.

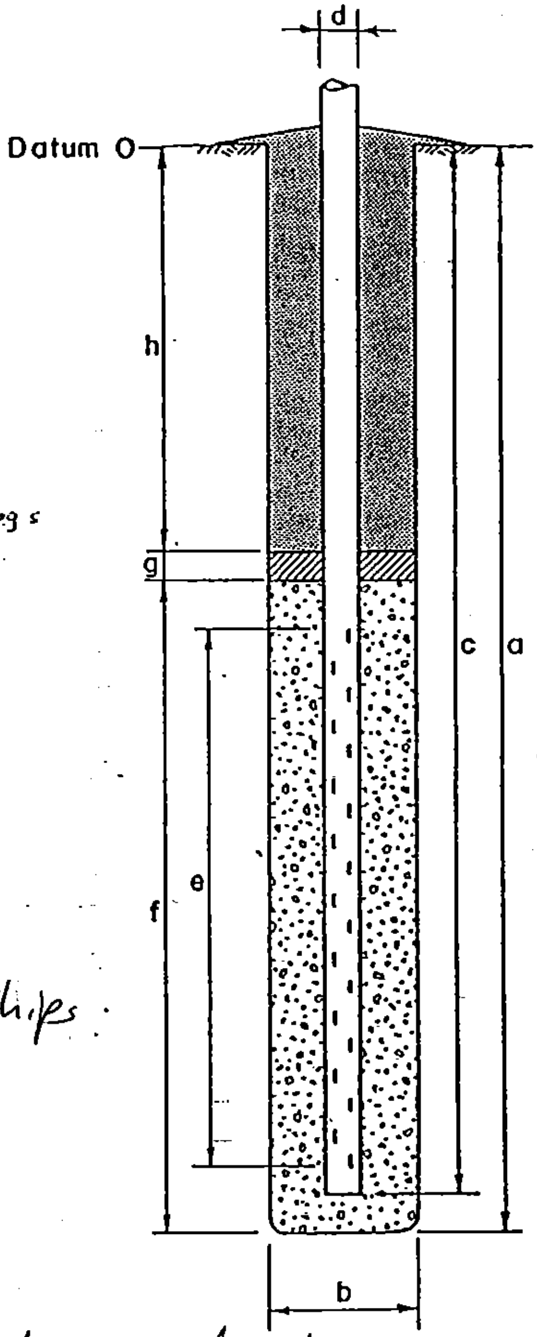
d. Diameter of well casing 1/2" I.D.

e. Slotted interval of well casing 2 ft.
from 10 to 8 ft. bgs

f. Permeable material interval 10.4 to 7 ft. bgs

g. Impermeable plug interval 7 ft. to 0 ft.

h. Backfill material interval —



II. MATERIALS:

Permeable material 3/8" washed pea gravel

Impermeable plug ~~Enviroplug~~ Puregold Bentonite chips hydrated

Backfill material —

Casing material (incl. slip joints) PVC

III. CONSTRUCTION:

Method of placing fill materials: by hand poured down open borehole.

Method of placing casing: by hand / 8" locking sec. casing w/ weephole surrounded by 6"x3 ft. diameter sloped concrete slab

Problems encountered / Comments: none, 3 stainless steel guard posts placed 120° apart ≈ 2 ft from sec. casing 2.5' ft bgs. to 3.0-3.5 ft above ground, placed with concrete inside and around outside. domed,

EMCON Northwest, Inc.

LOG OF EXPLORATORY BORING

CLIENT/PROJECT NAME Valley Landfills

PROJECT# 0137-001.3(6)

GEOLOGIST/ENGINEER B. Thoms

DRILLING CONTRACTOR Geo Tech.

DRILLING METHOD HSA, Mobile Drill rig. 8" HSA

HOLE DIA. 8" o.d.

BORING NO. GP-6

DATE BEGAN 9/19/94

DATE COMPLETED 9/19/94

TOTAL DEPTH 10 ft

SHEET 1 OF 1

WATER LEVEL DATA				
DEPTH				
TIME				
DATE				
BORING DEPTH				

FIELD LOCATION OF BORING:

GROUND ELEVATION

DATUM

OTHER*	SAMPLING METHOD	SAMPLE NUMBER	BLOWS/FT	DEPTH SAMPLED	DEPTH IN FEET	SOIL GROUP SYMBOL (USCS)
time	SPT 1.5" 1.8'					
10:09					0	
					1	
					2	
					3	
					4	
			7	1.2/1.8	5	
			8		6	
			10	NR		
					7	
					8	
					9	
10:20			15	1.8/1.8	10	
			22			
			24		11	
					12	
					13	
					14	
					15	
					16	

LITHOLOGIC DESCRIPTION

SILTY ~~CL~~ CLAY (CL) brown - reddish brown, 95% med. plasticity fines, 5% ~~fine~~ sand, damp, firm - stiff, ~~[illegible]~~ trace roots/ rootlets → coarse sand, rounded → lgt brown [illegible] mottle

10-11.3 SILTY CLAY (CL) brown-reddish brown w/ dark brown-black mottles, 95% med. plasti. fines, 5% fine med. ~~[illegible]~~ sand, damp, firm-stiff, trace roots.

11.3 - 11.8 CLAYEY SILT (ML) brown-yellowish brown, w/ reddish brown mottles 95% low plast. - nonplast. fines 5% fine sand, damp, firm-stiff trace calcified veins white

Boring terminated @ 10:25 @ 10 ft
well installed

1.5 bags (90 lb.) pea gravel (3/8")
3 bags Volclay coarse chips
7 bags sacrete

REMARKS:

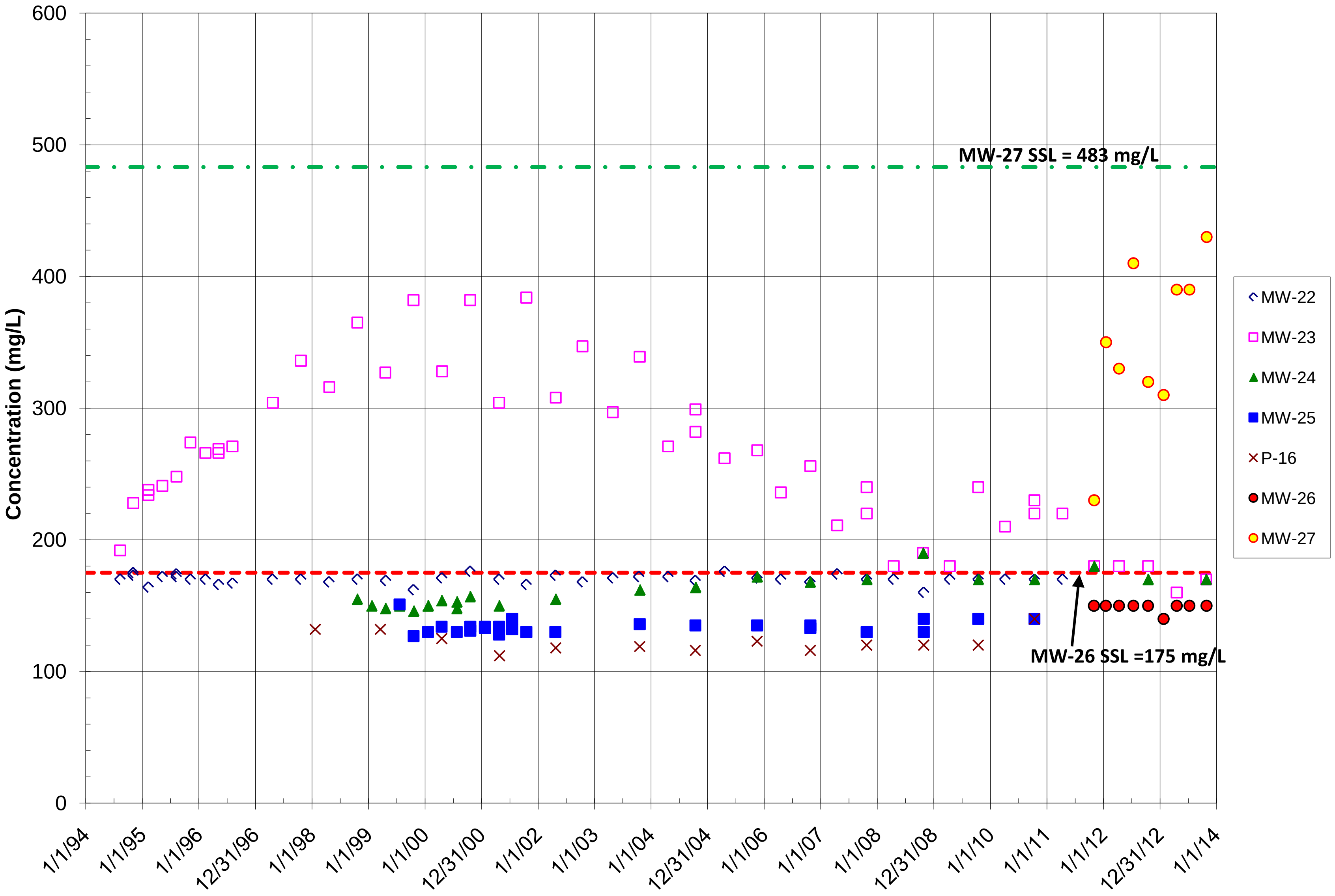
*NOTE: Specify data recorded in undesignated column (e.g. conductance, pH, tip reading, pocket torvane, etc.)

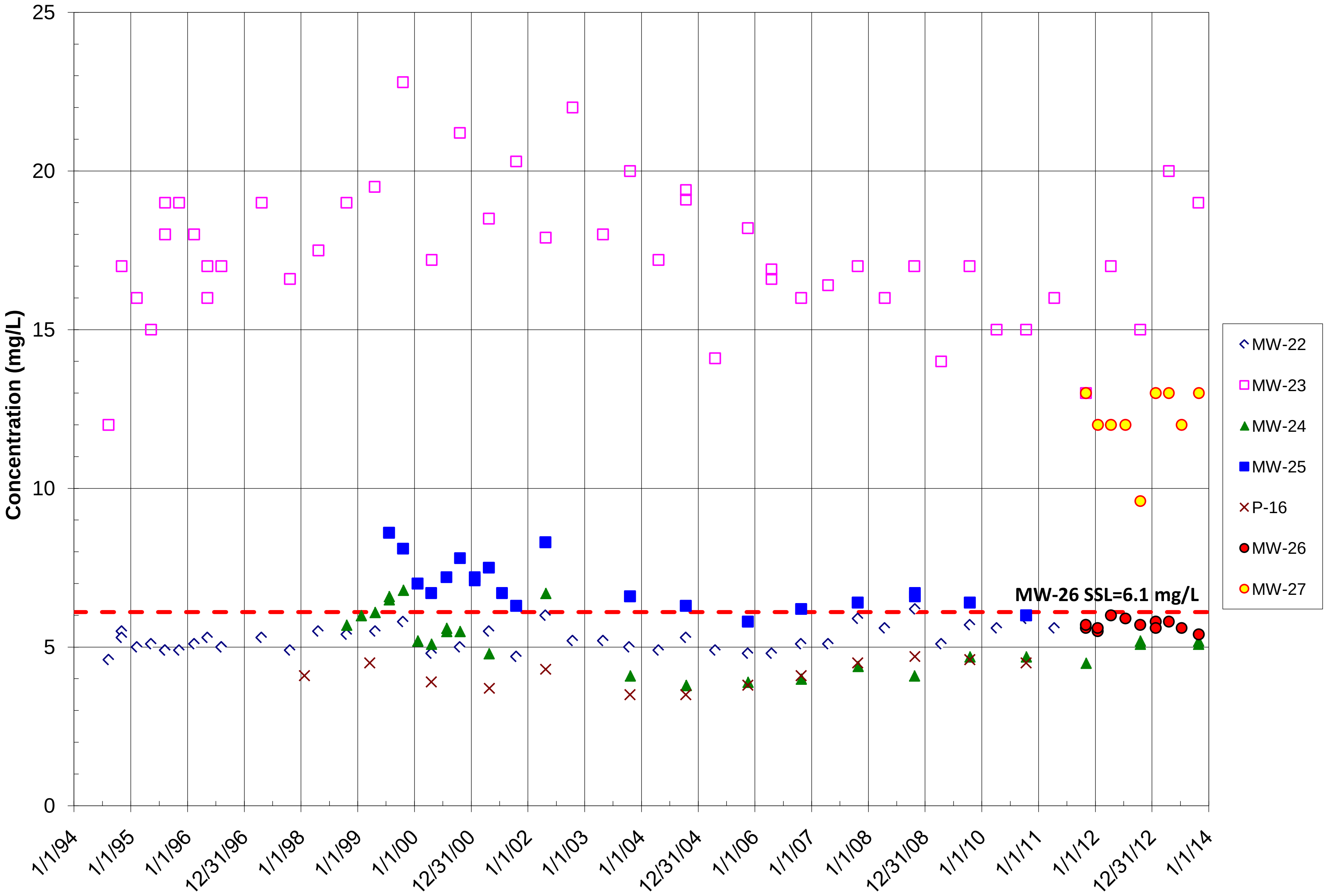
SE/E 300-03

APPENDIX E

STATISTICS FOR EAST-SIDE WELLS
(IN PDF ON ATTACHED CD)

Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Bicarbonate Alkalinity (SSL)

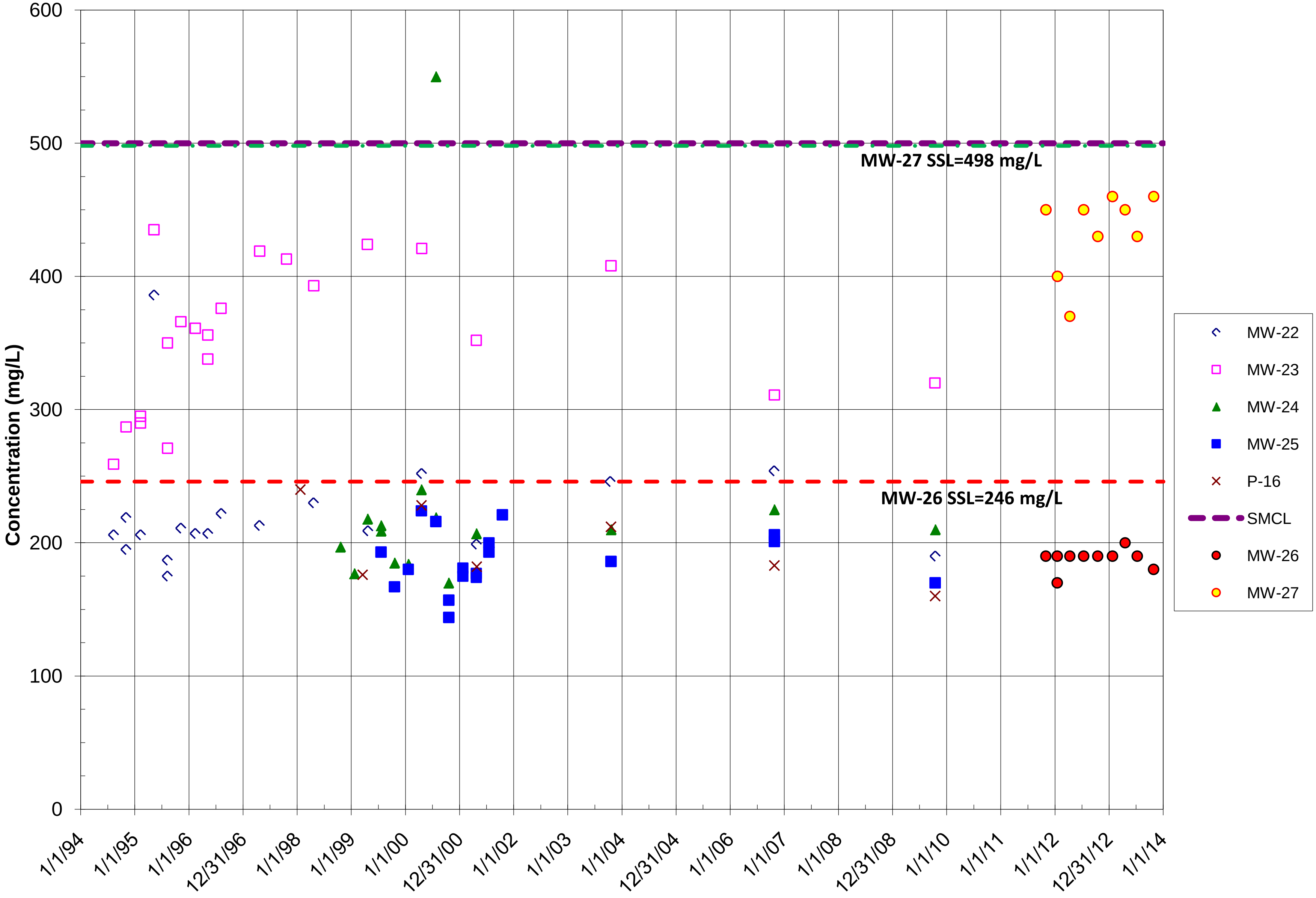




Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Chloride

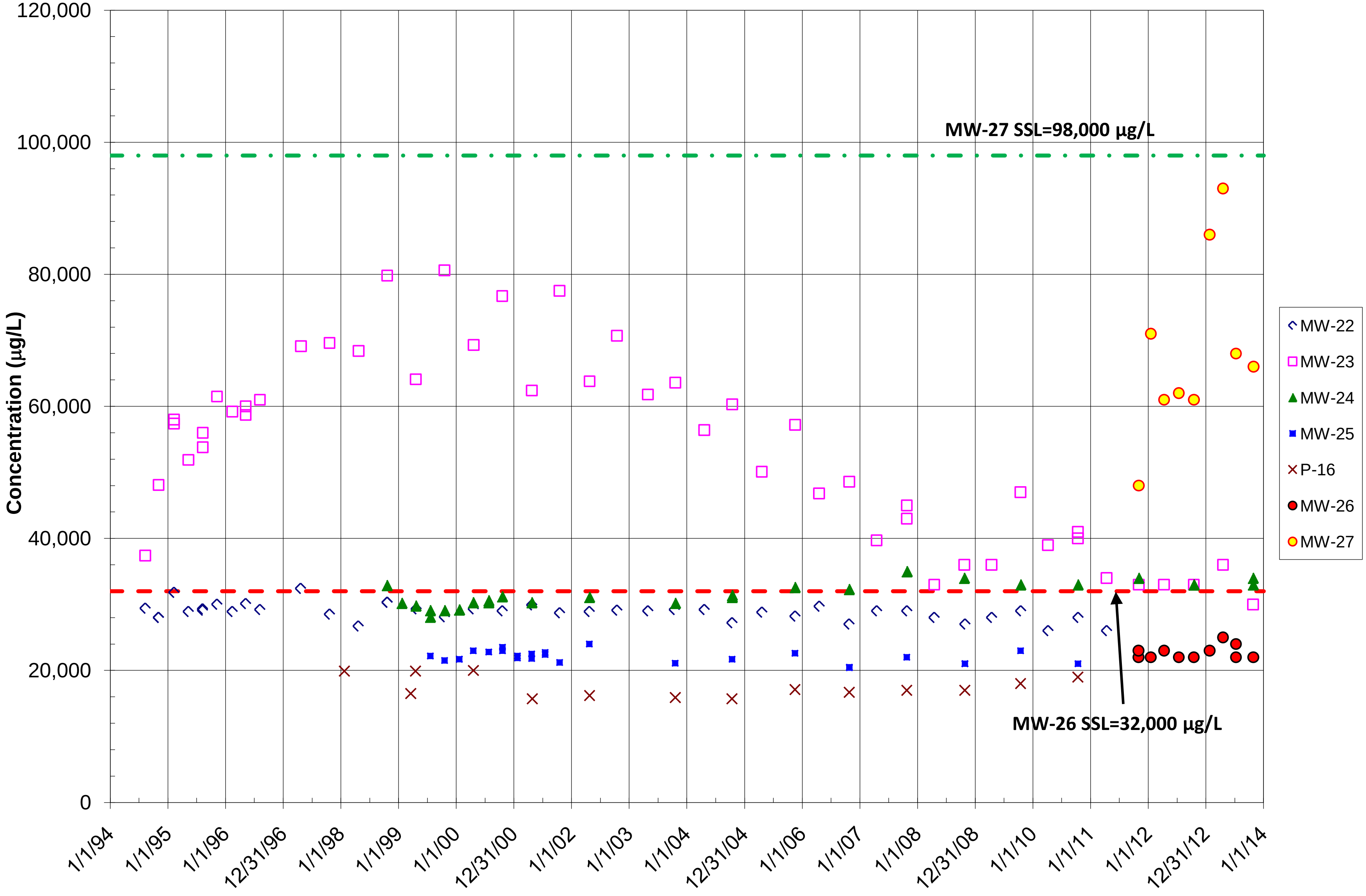
Coffin Butte Landfill

MW-23, MW-24, MW-26, and MW-27: Total Dissolved Solids



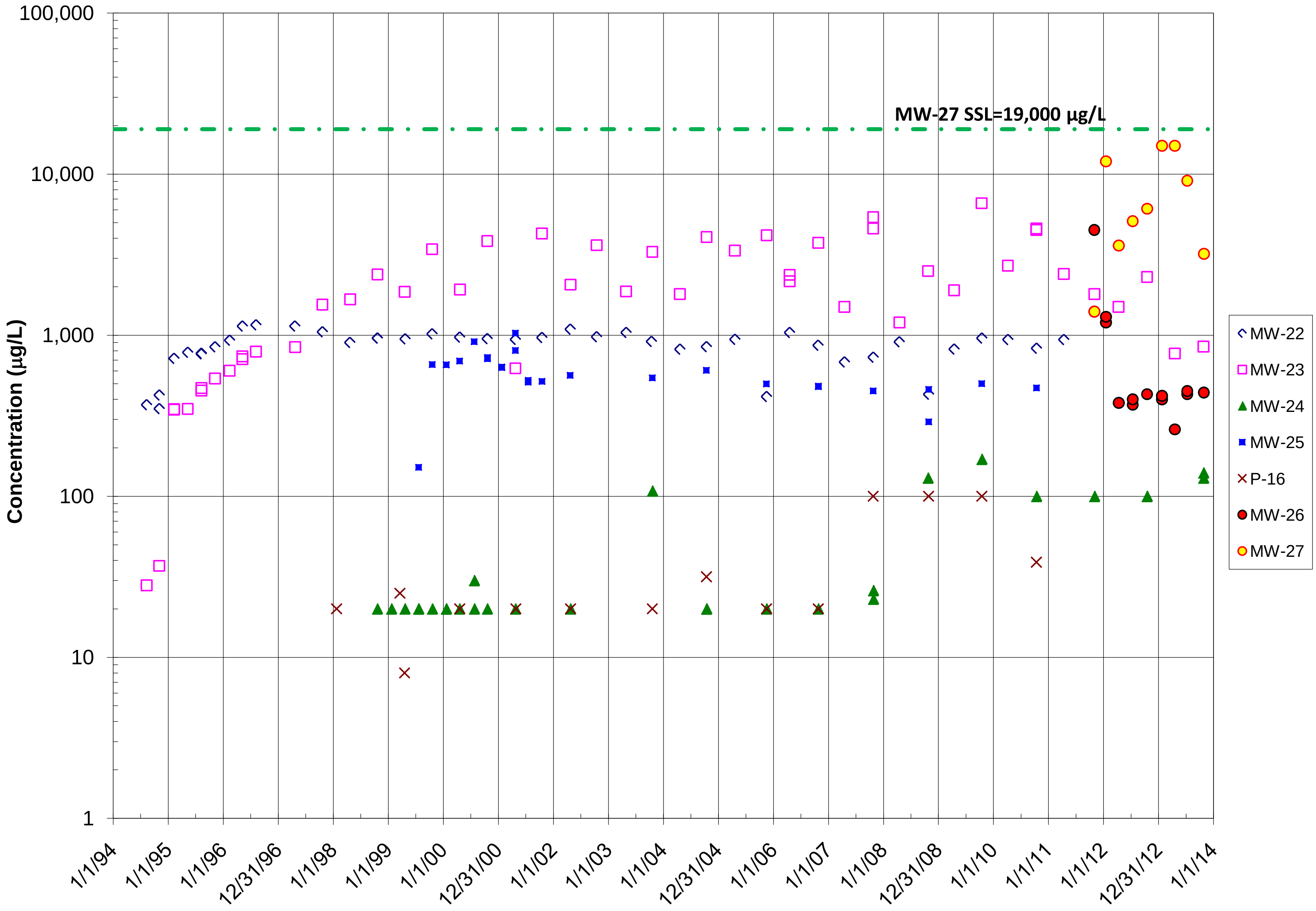
MW-26-27/TDS (SSL)

Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Calcium (SSL)



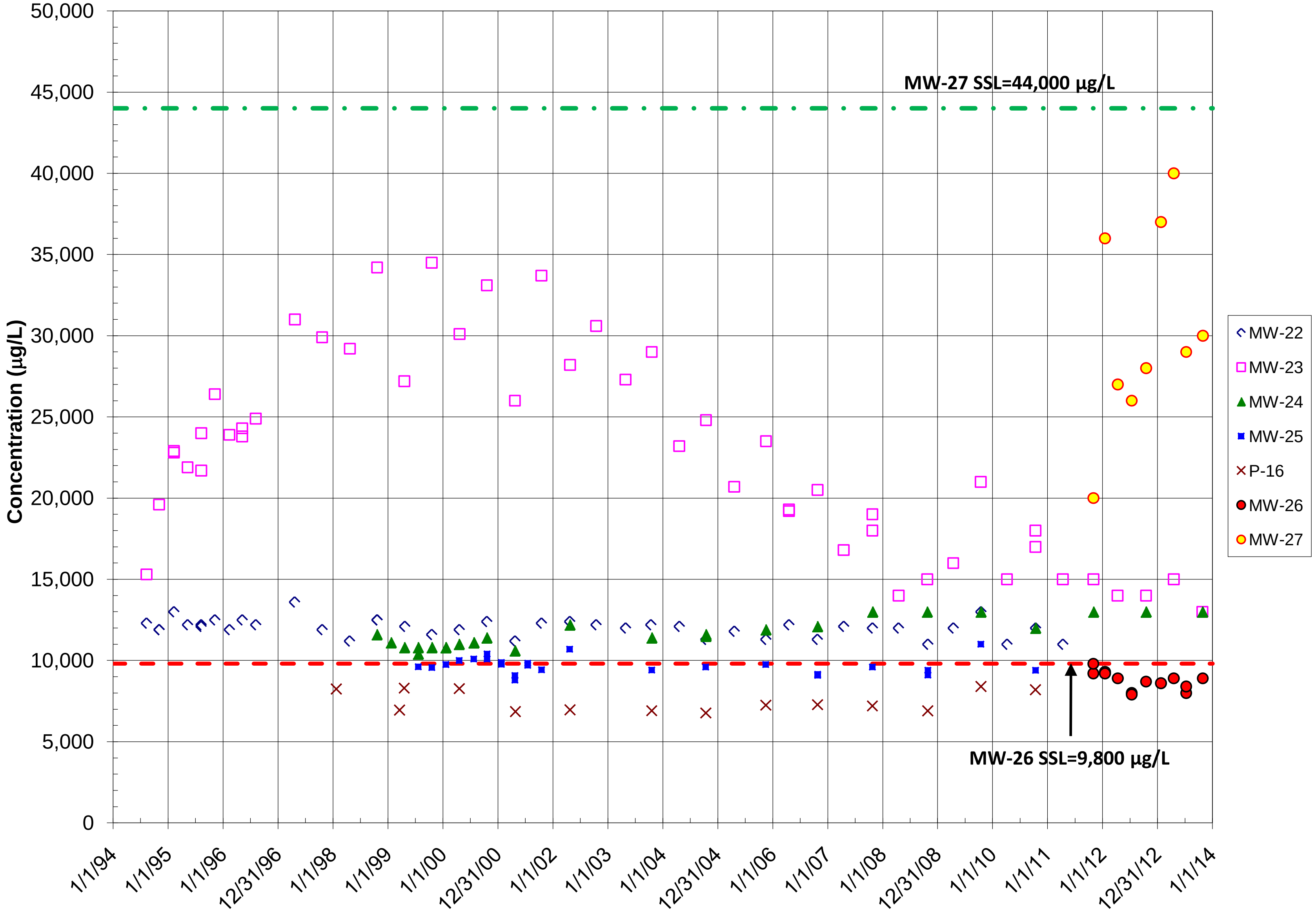
MW-26-27/Calcium (SSL)

Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Iron (SSL)

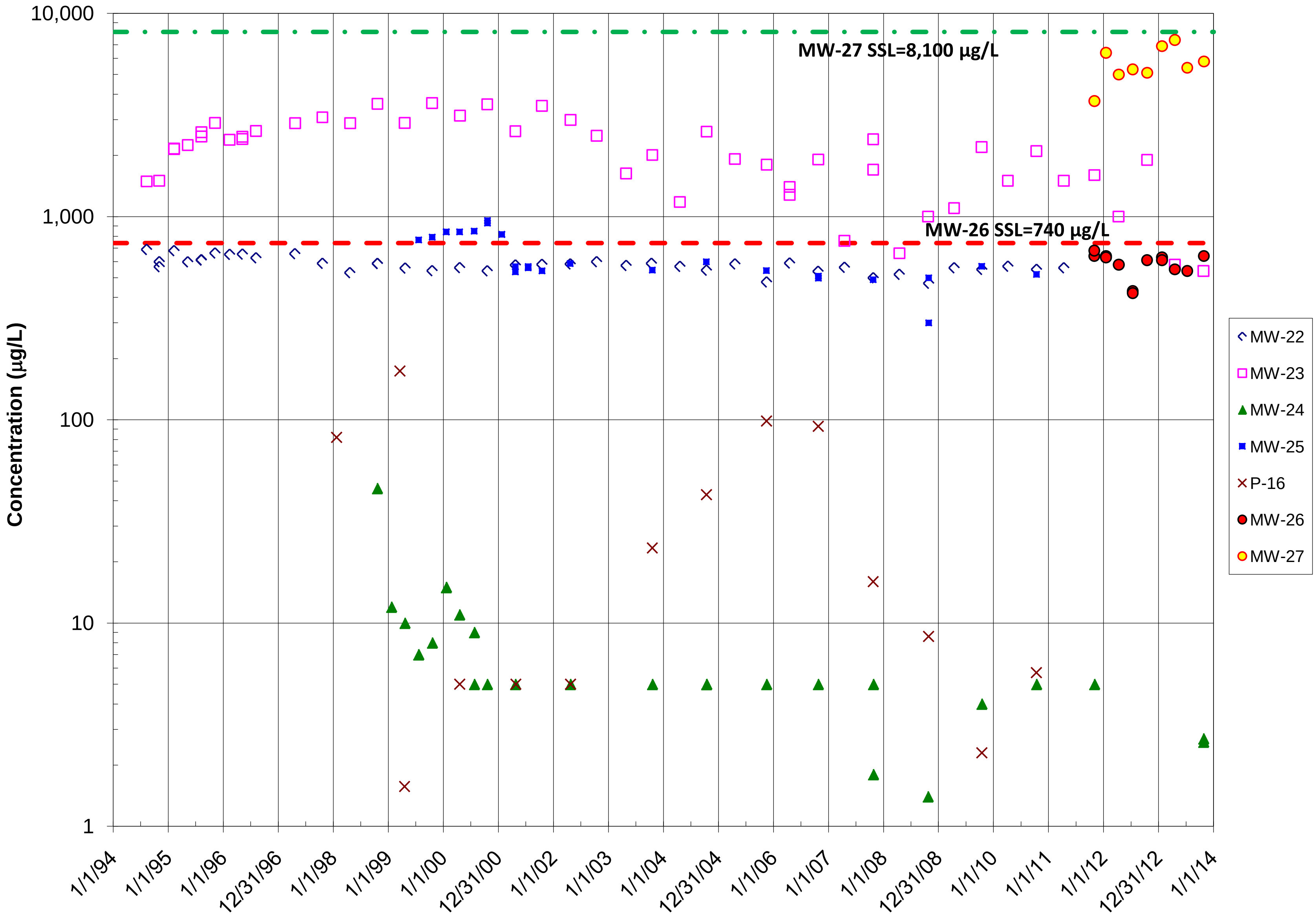


MW-26-27/Iron (SSL)

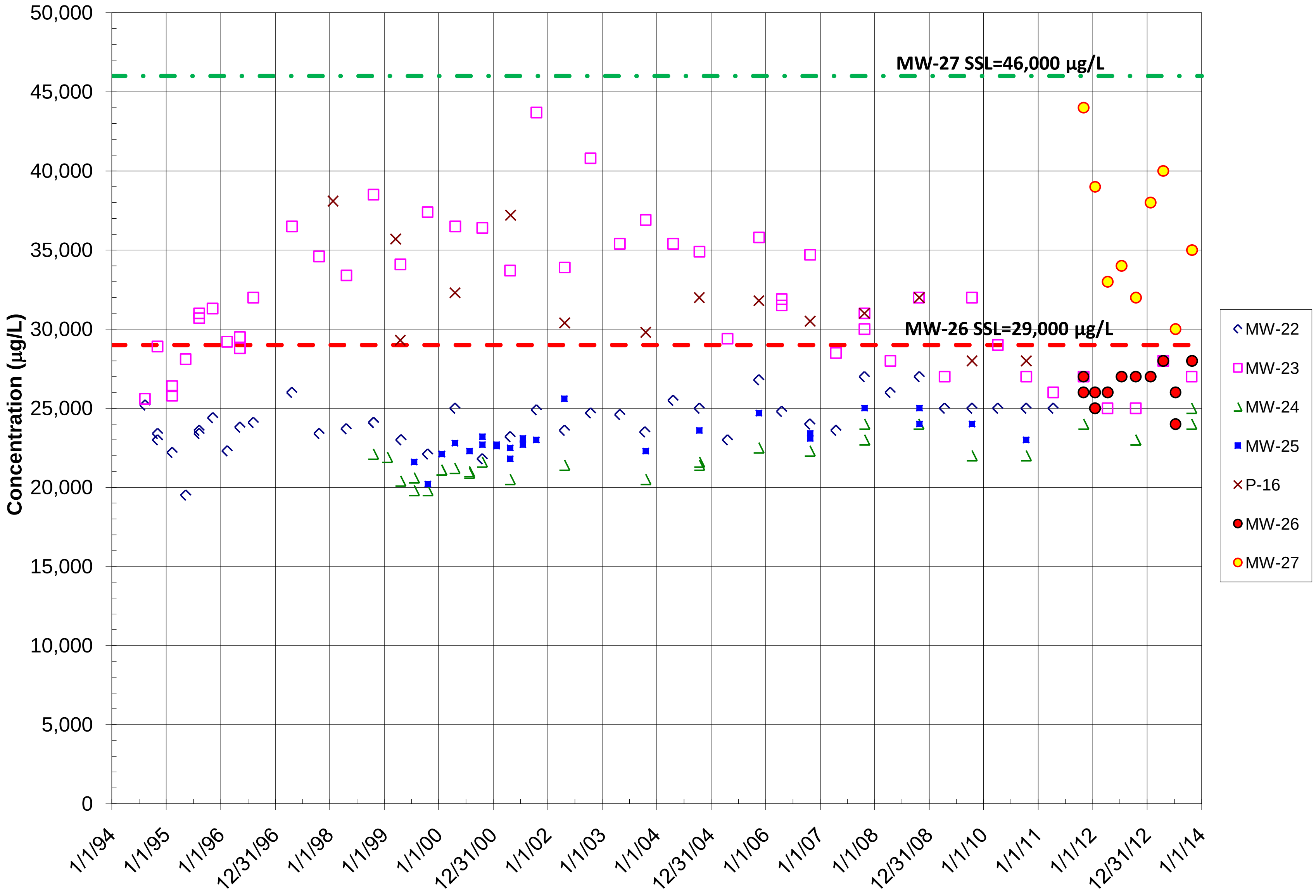
Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Magnesium (SSL)



Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Manganese (SSL)



Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Sodium (SSL)



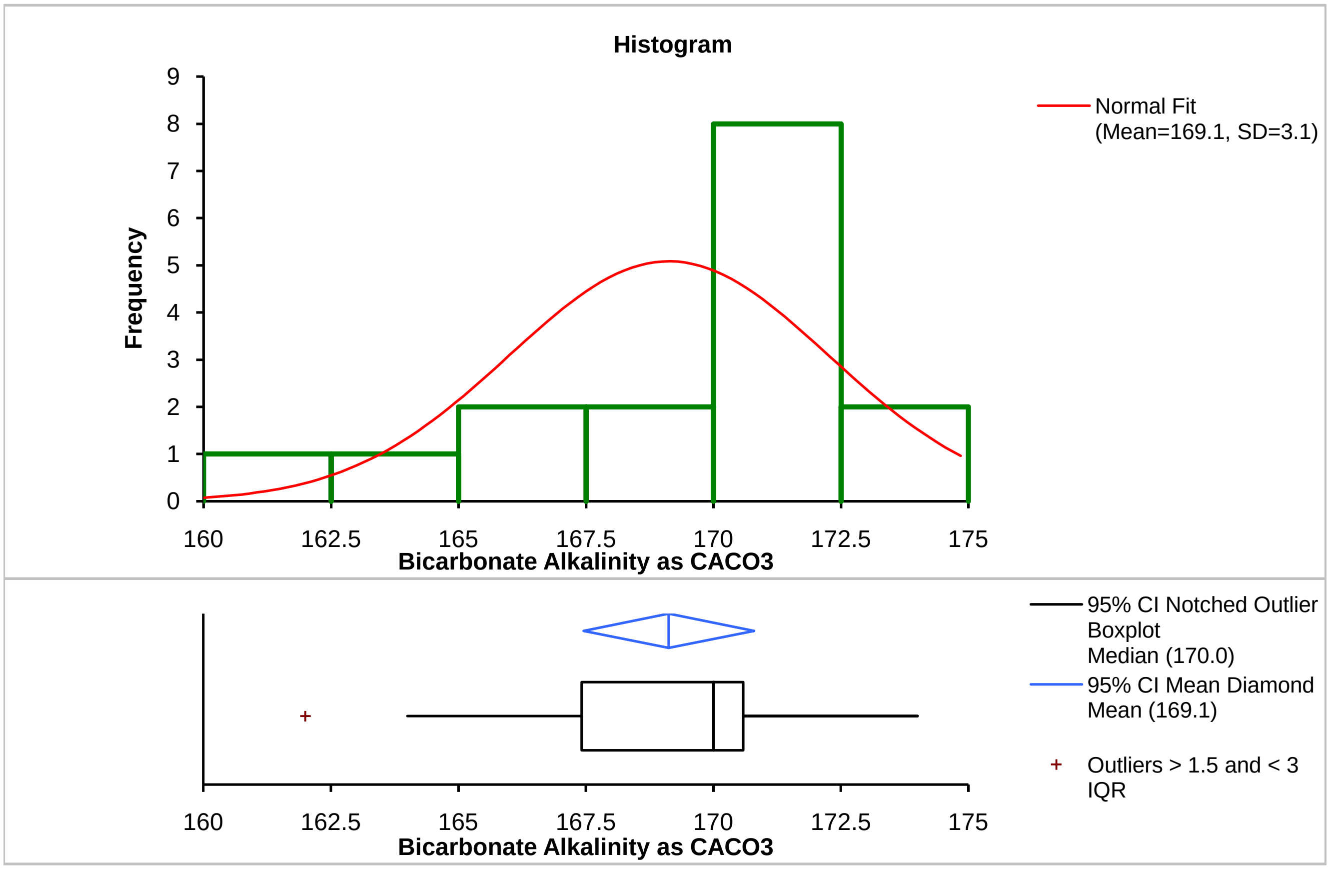
MW-26-27/Sodium (SSL)

Coffin Butte Descriptive Statistics - Edited Data Set
Inorganic Parameters

Well	Alkalinity (as CaCO3)	Bicarbonate Alkalinity as CACO3	Carbonate as CaCO3	Chemical Oxygen Demand	Chloride	Hardness as CaCO3	Nitrogen, Ammonia (as N)	Nitrogen, Nitrate-Nitrite	Sulfate	Suspended Solids	Total Dissolved Solids	Total Organic Carbon (TOC)		Sample ID	Date	Type
MW-22	170	170	20	7	4.6	124	1.72	0.2	0.6	46	206	2.5		CB-081194-13	08/11/94	Primary Sample
MW-22	174	174	20	6.5	5.4	119	1.86	0.2	0.3	16	207	2.4		CB-110394-04	11/03/94	Average
MW-22	164	164	20	6	5	133	1.82	0.2	0.5	6	206	1.9		CB-020995-22	02/09/95	Primary Sample
MW-22	172	172	20	5	5.1	122	1.63	0.2	0.7	6	[386]	1.3		CB-051195-4	05/11/95	Primary Sample
MW-22	173	173	20	6.5	4.9	122.5	1.71	0.2	0.6	24	181	1.65		CB-080995-14	08/09/95	Average
MW-22	170	170	20	5	4.9	126	1.87	0.2	0.9	5	211	2.2		CB-110795-5	11/08/95	Primary Sample
MW-22	170	170	20	6	5.1	121	1.94	0.2	0.9	5	207	2.4		CB-021396-27	02/13/96	Primary Sample
MW-22	166	166	20	5	5.3	127	1.98	0.2	0.9	8	207	2		CB-050896-11	05/08/96	Primary Sample
MW-22	167	167	20	10	5	123	1.91	0.2	1	5	222	2		CB-080696-1	08/06/96	Primary Sample
MW-22	170	170	20	5	5.3	122	1.89	0.2	1	5	213	2.3		CB-042197-1	04/21/97	Primary Sample
MW-22		170	20		4.9					12				CB-102197-11	10/21/97	Primary Sample
MW-22	168	168	20	8	5.5	116	2.03	0.2	1.2	5	230	2.2		CB-042198-5	04/21/98	Primary Sample
MW-22		170	2		5.4									CB-102198-22	10/21/98	Primary Sample
MW-22	169	169	2	8	5.5	123	2.04	0.2	1.2	7	209	2		CB-042399-31	04/23/99	Primary Sample
MW-22		162			5.8					11				CB-101999-10	10/19/99	Primary Sample
MW-22	171	171	2	8	4.8	128	1.98	0.2	1	8	252	1.7		CB-041900-7	04/19/00	Primary Sample
MW-22		176			5					5				CB-101900-14	10/19/00	Primary Sample
MW-22	170	170	2	9	5.5	127	1.95	0.2	1.5	6	199	1.8		VLF-042401-4	04/24/01	Primary Sample
MW-22		166	2		4.7					18				VLF-011017-1	10/17/01	Primary Sample
MW-22		173			6					5				VLF-042302-1	04/23/02	Primary Sample
MW-22		168			5.2					5				VLF-101502-8	10/15/02	Primary Sample
MW-22		171			5.2					5				VLF-042903-2	04/29/03	Primary Sample
MW-22		172		8	5		2.09	0.2	0.2	5	246	2.4		VLF-101403-3	10/14/03	Primary Sample
MW-22		172			4.9					5				VLF-042004-12	04/20/04	Primary Sample
MW-22		169			5.3					5				VLF-101304-15	10/13/04	Primary Sample
MW-22		176			4.9					6				VLF-041905-1	04/20/05	Primary Sample
MW-22		171			4.8					5				VLF-111605-16	11/16/05	Primary Sample
MW-22		170			4.8					5				VLF-060418-9	04/18/06	Primary Sample
MW-22		168		6	5.1		2.04	0.05	0.2	5	254	2.5		VLF-061024-5	10/24/06	Primary Sample
MW-22		174			5.1					5				VLF-070417-10	04/17/07	Primary Sample
MW-22		170			5.9					4				VLF-071025-20	10/25/07	Primary Sample
MW-22		170			5.6					4.8				VLF-080415-8	04/15/08	Primary Sample
MW-22		[160]			6.2					4				VLF-081027-31	10/27/08	Primary Sample
MW-22		170			5.1					4				VLF090414-15	04/14/09	Primary Sample
MW-22		170		20	5.7		2.3	0.2	5	4	190	1		VLF-091015-26	10/15/09	Primary Sample
MW-22		170			5.6					3.6				VLF-100406-13	04/06/10	Primary Sample
MW-22		170			5.9					4				VLF-101013-9	10/13/10	Primary Sample
MW-22		170			5.6					1.6				VLF-110412-4	04/12/11	Primary Sample
All concentrations in mg/L																

Analyse-it v2.26

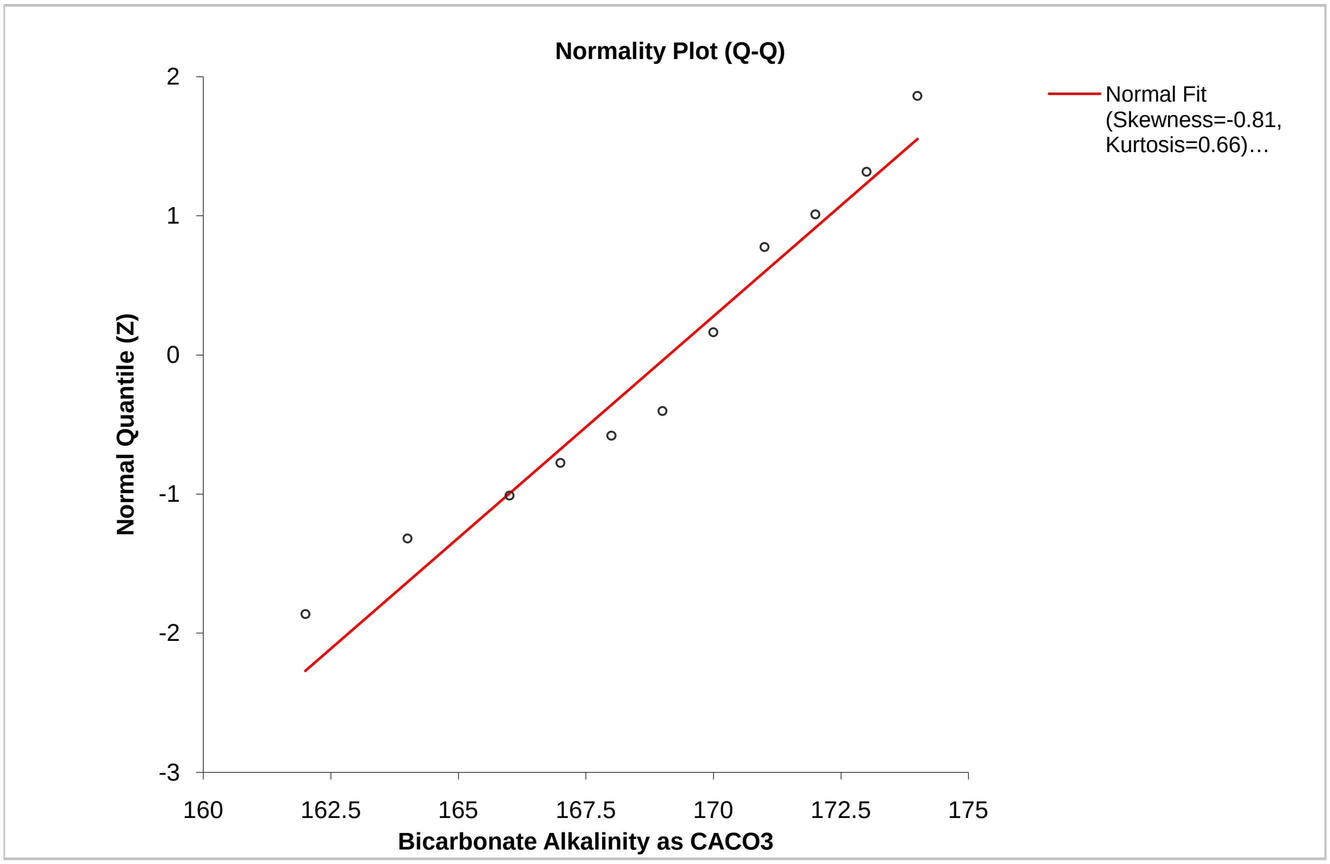
Test	**MW-22 (1994-2000)**
Performed by	Eric Tuppan
Date	29 April 2014



n	16
Mean	169.1
95% CI	167.5 to 170.8
SE	0.78
Variance	9.9
SD	3.1
95% CI	2.3 to 4.9
CV	1.9%
Skewness	-0.81
Kurtosis	0.66
Shapiro-Wilk W	0.93 **w(0.05,16)=0.887**
p	0.223

Median	170.0
97.9% CI	167.0 to 171.0
Range	12
IQR	3.2

Percentile		
0th	162.0	(minimum)
25th	167.4	(1st quartile)
50th	170.0	(median)
75th	170.6	(3rd quartile)
100th	174.0	(maximum)



MW-22 updated Box Normality\HC03-early data

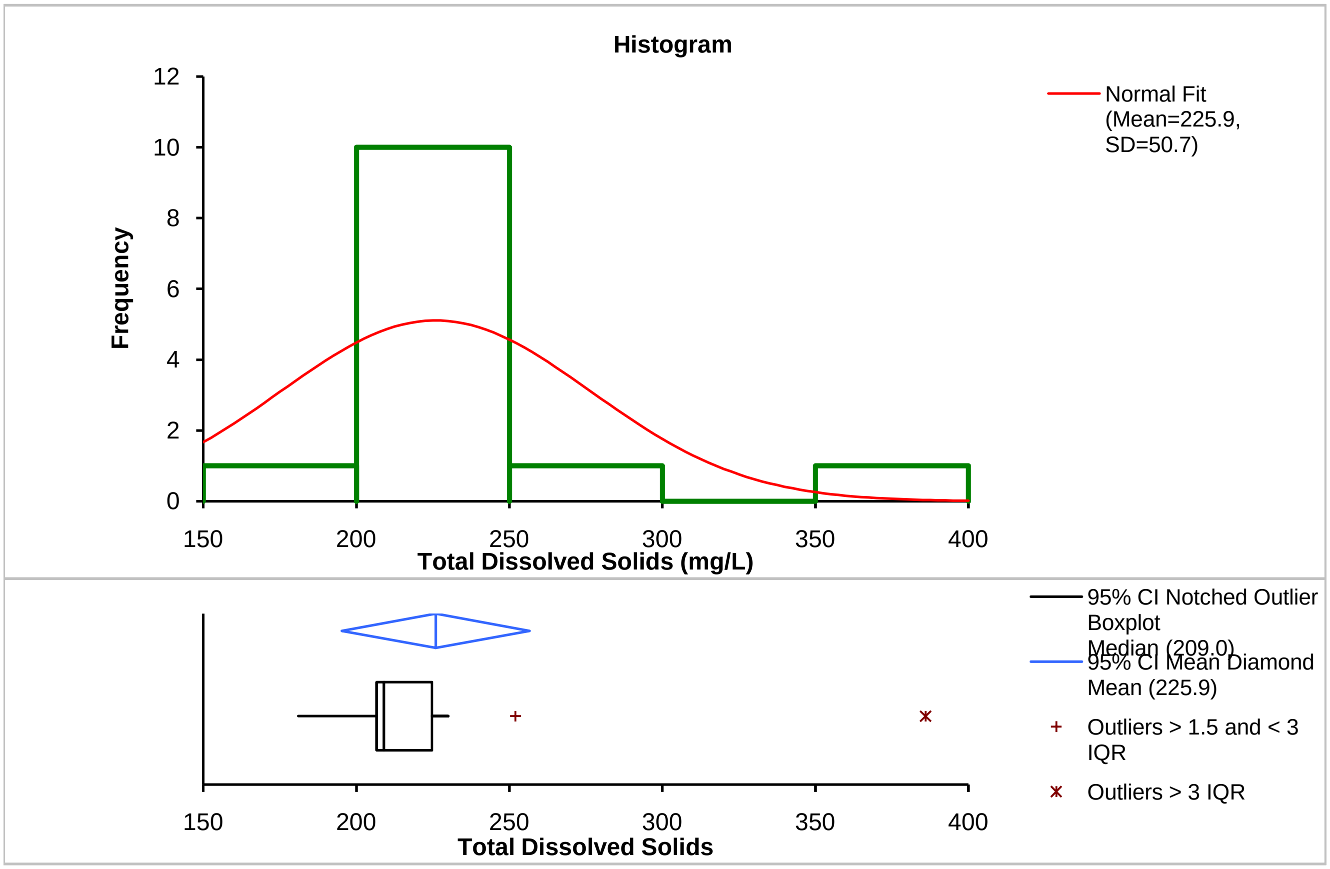
Analyse-it v2.26

Test **MW-22 (1994-2000)**

Total Dissolved Solids

Performed by Eric Tuppan

Date 29 April 2014

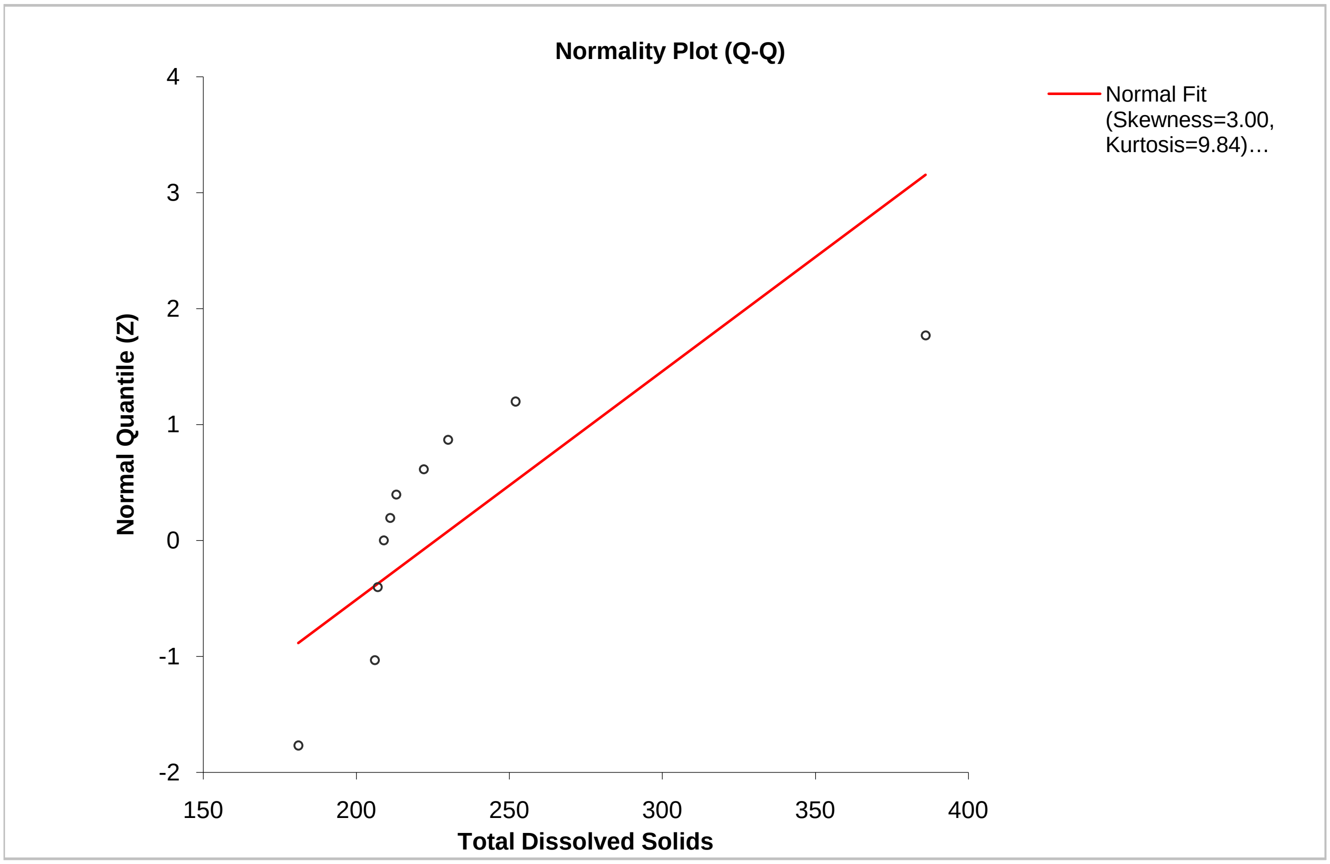


n	13 (cases excluded: 3 due to missing values)

Mean	225.9
95% CI	195.3 to 256.6
SE	14.07
Variance	2,574.9
SD	50.7
95% CI	36.4 to 83.8
CV	22.5%
Skewness	3.00
Kurtosis	9.84
Shapiro-Wilk W	0.58 **w(0.05,13)=0.866**
p	<0.0001

Median	209.0
97.8% CI	206.0 to 230.0
Range	205
IQR	18.0

Percentile		
0th	181.0	(minimum)
25th	206.7	(1st quartile)
50th	209.0	(median)
75th	224.7	(3rd quartile)
100th	386.0	(maximum)

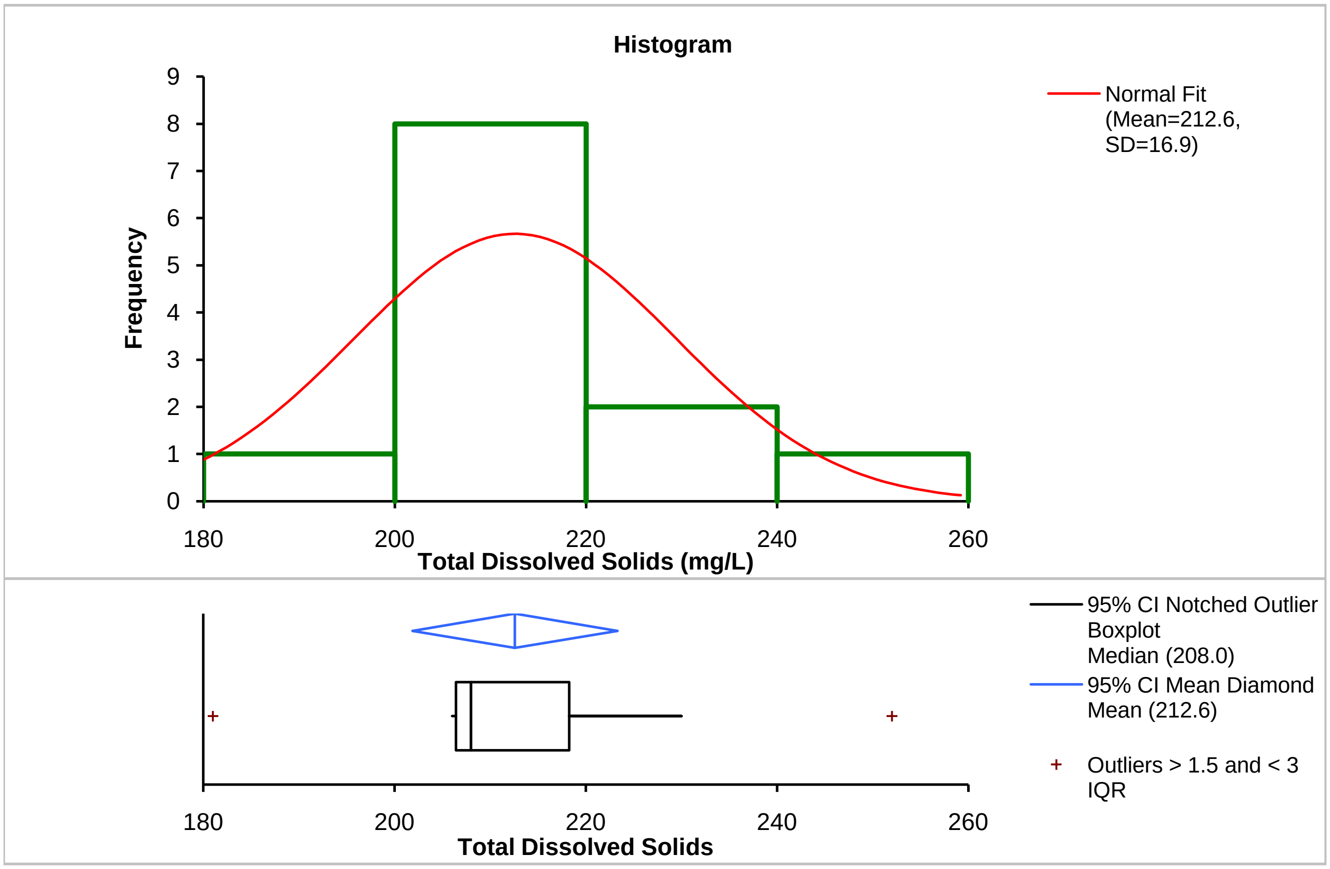


MW-22 updated Box Normality\TDS-early data

Analyse-it v2.26

Test **MW-22 (1994-2000) remove >3IQR**

Total Dissolved Solids
Performed by Eric Tuppan
Date 29 April 2014

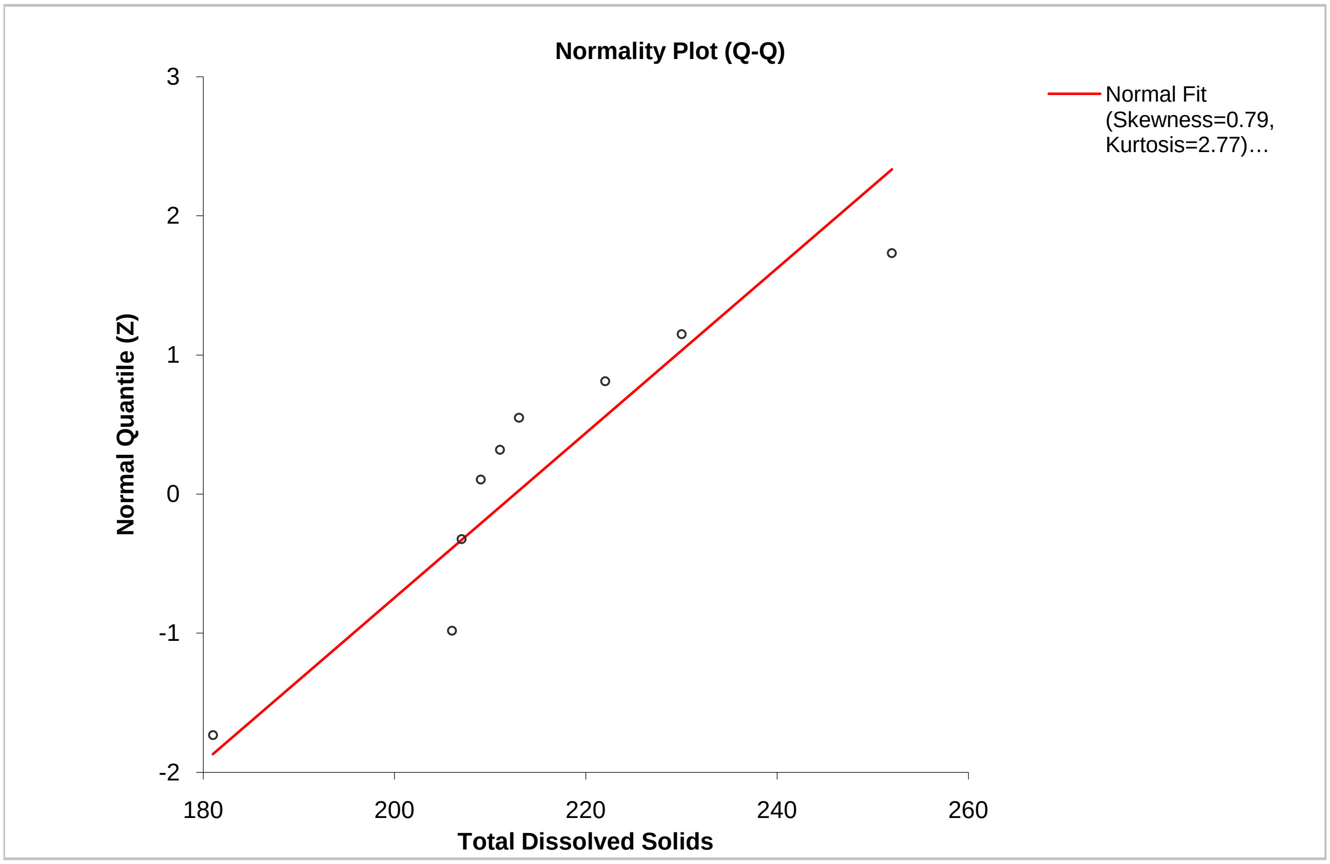


n	12 (cases excluded: 4 due to missing values)

Mean	212.6
95% CI	201.9 to 223.3
SE	4.88
Variance	285.4
SD	16.9
95% CI	12.0 to 28.7
CV	7.9%
Skewness	0.79
Kurtosis	2.77
Shapiro-Wilk W	0.86 **w(.05,12)=0.859**
p	0.050

Median	208.0
96.1% CI	206.0 to 222.0
Range	71
IQR	11.8

Percentile	
0th	181.0 (minimum)
25th	206.4 (1st quartile)
50th	208.0 (median)
75th	218.3 (3rd quartile)
100th	252.0 (maximum)



MW-22 updated Box Normality\TDS-early<3IQR

Coffin Butte - Descriptive Statistics - Edited Data Set
Dissolved Metals - (Filtered)

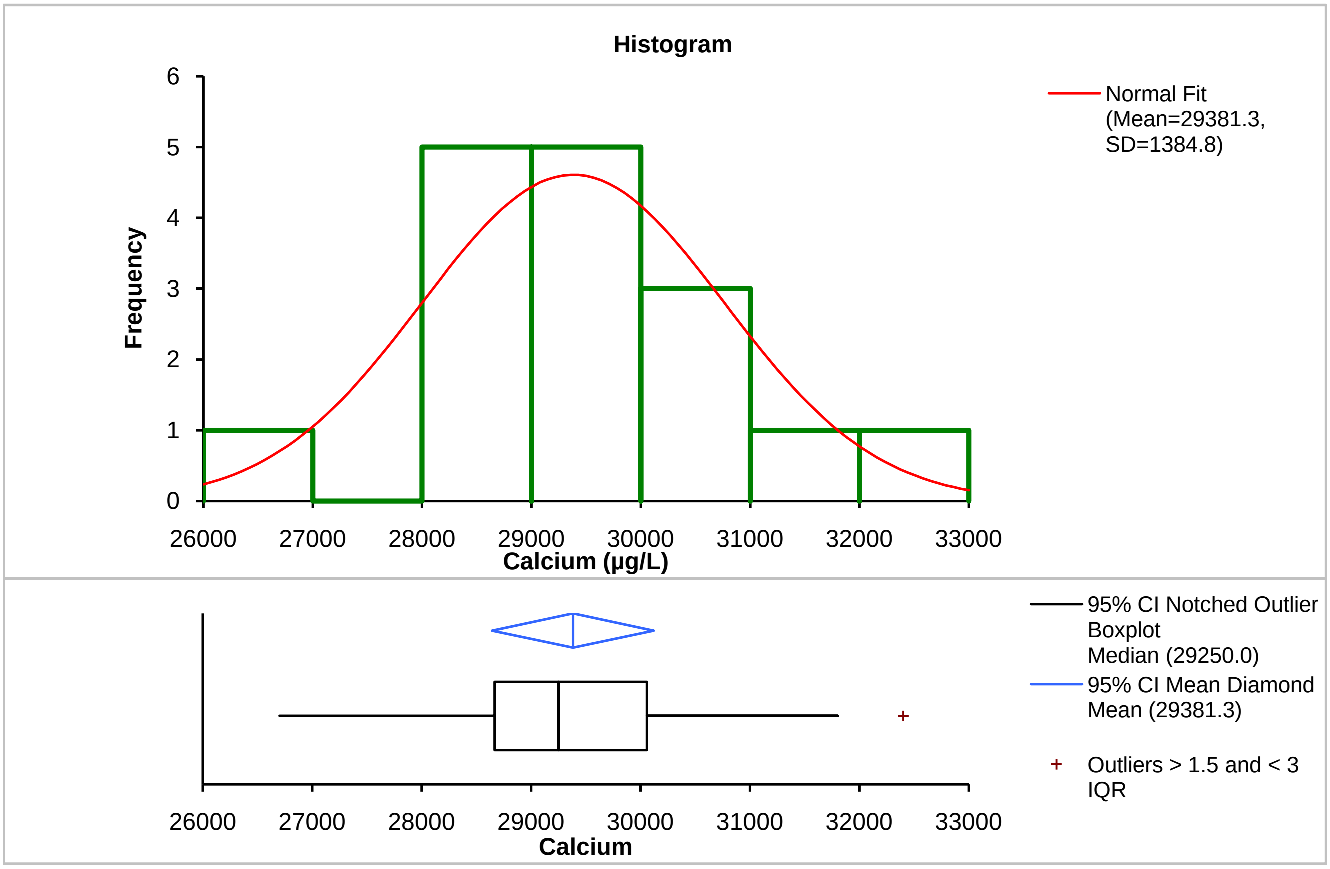
Well	Calcium	Iron	Magnesium	Manganese	Potassium	Silicon	Sodium		Sample ID	Date	Type
MW-22	29,400	370	12,300	689	2,000	18,900	25,200		CB-081194-13	08/11/94	Primary Sample
MW-22	28,000	388	11,900	584	2,000	43,000	23,200		CB-110394-04	11/03/94	Average
MW-22	31,800	718	13,000	680	2,000	22,100	22,200		CB-020995-22	02/09/95	Primary Sample
MW-22	28,900	783	12,200	599	2,000	19,500	23,600		CB-051195-4	05/11/95	Primary Sample
MW-22	29,200	770	12,150	613	2,000	19,450	23,500		CB-080995-14	08/09/95	Average
MW-22	30,000	847	12,500	662	2,000	20,800	24,400		CB-110795-5	11/08/95	Primary Sample
MW-22	28,900	931	11,900	652	2,000	19,800	22,300		CB-021396-27	02/13/96	Primary Sample
MW-22	30,100	1,140	12,500	654	2,000	20,200	23,800		CB-050896-11	05/08/96	Primary Sample
MW-22	29,200	1,160	12,200	627	2,000	20,000	24,100		CB-080696-1	08/06/96	Primary Sample
MW-22	32,400	1,140	13,600	657	2,000	20,900	26,000		CB-042197-1	04/21/97	Primary Sample
MW-22	28,500	1,050	11,900	589			23,400		CB-102197-11	10/21/97	Primary Sample
MW-22	26,700	902	11,200	530	2,000	18,000	23,700		CB-042198-5	04/21/98	Primary Sample
MW-22	30,300	960	12,500	588			24,100		CB-102198-22	10/21/98	Primary Sample
MW-22	29,300	949	12,100	558	2,000	19,900	23,000		CB-042399-31	04/23/99	Primary Sample
MW-22	28,100	1,020	11,600	542			22,100		CB-101999-10	10/19/99	Primary Sample
MW-22	29,300	973	11,900	561	2,000	18,900	25,000		CB-041900-7	04/19/00	Primary Sample
MW-22	29,000	952	12,400	541			21,800		CB-101900-14	10/19/00	Primary Sample
MW-22	29,900	942	11,200	578	2,000	17,700	23,200		VLF-042401-4	04/24/01	Primary Sample
MW-22	28,700	968	12,300	582			24,900		VLF-011017-1	10/17/01	Primary Sample
MW-22	28,900	1,090	12,400	585			23,600		VLF-042302-1	04/23/02	Primary Sample
MW-22	29,100	978	12,200	600			24,700		VLF-101502-8	10/15/02	Primary Sample
MW-22	29,000	1,040	12,000	575			24,600		VLF-042903-2	04/29/03	Primary Sample
MW-22	29,200	915	12,200	589	2,000	19,200	23,500		VLF-101403-3	10/14/03	Primary Sample
MW-22	29,200	819	12,100	569			25,500		VLF-042004-12	04/20/04	Primary Sample
MW-22	27,200	849	11,300	545			25,000		VLF-101304-15	10/13/04	Primary Sample
MW-22	28,800	943	11,800	585			23,000		VLF-041905-1	04/20/05	Primary Sample
MW-22	28,200	416	11,300	477			26,800		VLF-111605-16	11/16/05	Primary Sample
MW-22	29,700	1,040	12,200	591			24,800		VLF-060418-9	04/18/06	Primary Sample
MW-22	27,000	866	11,300	538	2,000	18,100	24,000		VLF-061024-5	10/24/06	Primary Sample
MW-22	29,000	682	12,100	563			23,600		VLF-070417-10	04/17/07	Primary Sample
MW-22	29,000	730	12,000	500			27,000		VLF-071025-20	10/25/07	Primary Sample
MW-22	28,000	910	12,000	520			26,000		VLF-080415-8	04/15/08	Primary Sample
MW-22	27,000	430	11,000	470			27,000		VLF-081027-31	10/27/08	Primary Sample
MW-22	28,000	820	12,000	560			25,000		VLF090414-15	04/14/09	Primary Sample
MW-22	29,000	960	13,000	550	900	18,000	25,000		VLF-091015-26	10/15/09	Primary Sample
MW-22	26,000	940	11,000	570			25,000		VLF-100406-13	04/06/10	Primary Sample
MW-22	28,000	830	12,000	550			25,000		VLF-101013-9	10/13/10	Primary Sample
MW-22	26,000	940	11,000	560			25,000		VLF-110412-4	04/12/11	Primary Sample

All concentrations in µg/L

v2.26

Test	**MW-22 (1994-2000)**
	Calcium
Performed by	Eric Tuppan

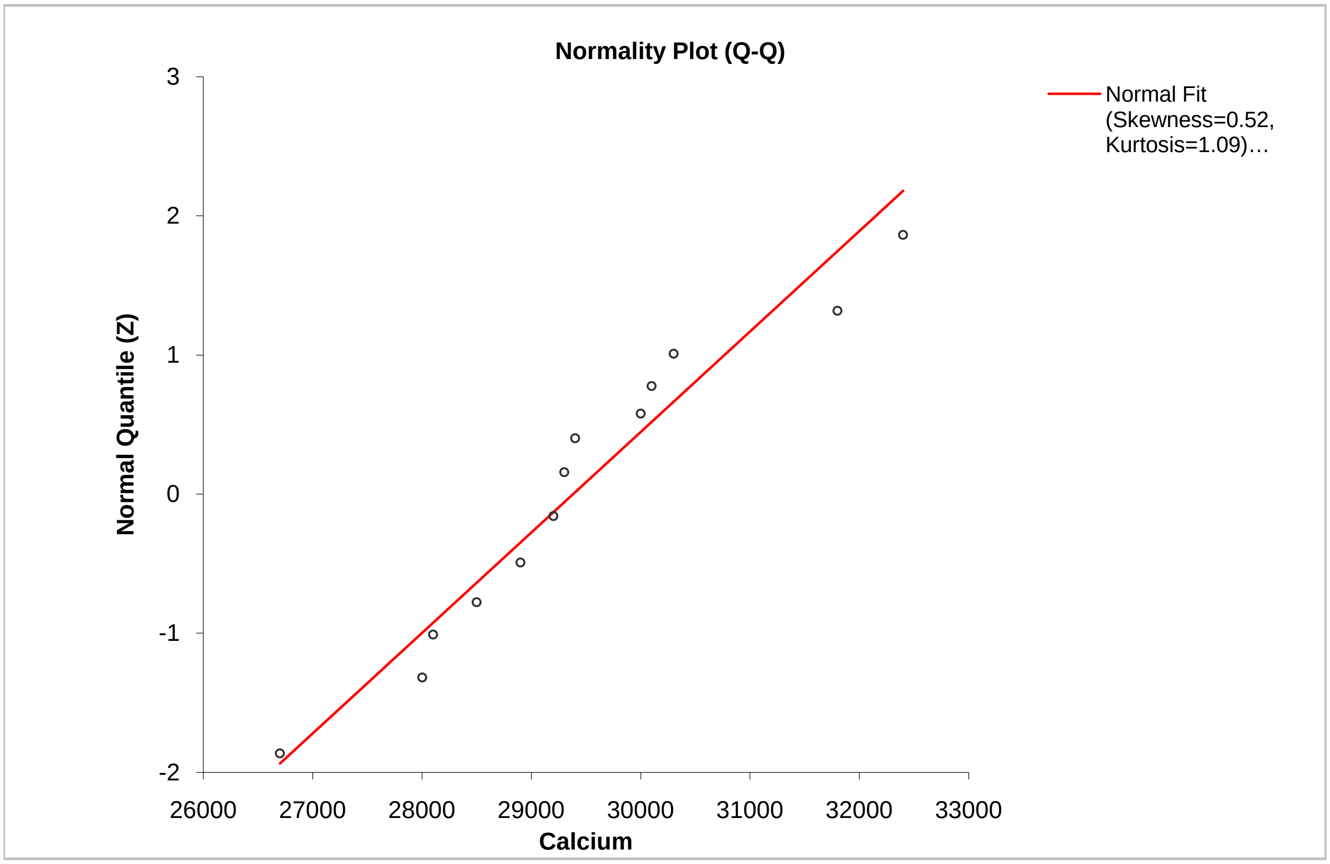
Date 13 May 2014



n	16
Mean	29,381.3
95% CI	28,643.4 to 30,119.1
SE	346.20
Variance	1,917,625.0
SD	1,384.8
95% CI	1,022.9 to 2,143.2
CV	4.7%
Skewness	0.52
Kurtosis	1.09
Shapiro-Wilk W	0.95 **w(0.05,16)=0.887**
p	0.420

Median	29,250.0
97.9% CI	28,500.0 to 30,100.0
Range	5,700
IQR	1,391.7

Percentile		
0th	26,700.0	(minimum)
25th	28,666.7	(1st quartile)
50th	29,250.0	(median)
75th	30,058.3	(3rd quartile)
100th	32,400.0	(maximum)


Normality Plot (Q-Q)
Normal Fit (Skewness=0.52, Kurtosis=1.09)…
Normal Quantile (Z)
3
2
1
0
-1
-2
26000
27000
28000
29000
30000
31000
32000
33000
Calcium

MEMORANDUM

TO: Jack Arendt; DEQ DATE: January 16, 2014

FROM: Eric Tuppan PROJECT: VLI-001-005

RE: Statistical Summary for Compliance Wells MW-26 and MW-27, Cell 4: Coffin Butte Landfill

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Over the past two and a half years, Valley Landfills, Inc. (VLI) collected a baseline dataset for compliance wells MW-26 and MW-27, downgradient of the eastern margin of Cell 4 at its Coffin Butte Landfill. This memorandum summarizes that data and presents a preliminary analysis of the characteristics of the water quality. This information will form the basis for selecting a suite of indicator parameters to be used in long-term monitoring, and in developing concentration limits for those wells. The discussion in this memo is organized to present you with background information on the site to provide context as to influences on the water quality and then discuss various aspects about the water quality character to consider for selecting indicator parameters and workable concentration limits.

WATER QUALITY DATA SET

The data set includes quarterly sampling from fall 2011 through fall of 2013, a total of nine sampling events. Descriptive statistics for field parameters, inorganic parameters, dissolved metals, and total trace metals are compiled in Attachment A for those wells. In addition, statistics for several other wells in the eastern part of the landfill are included for comparison: MW-22 and MW-25 (alluvial wells downgradient of Cell 2B and along the southern edge of Cell 4); MW-23 (alluvial well along the south side of Cell 2B with past water quality impacts); P-16 (alluvial well within the footprint of Cell 4); MW-9S (alluvial well downgradient of Cell 4 along Highway 99E); and leachate from Cell 4 (L-4). Wells MW-22, MW-25, and P-16 were all decommissioned before construction of Cell 4.

The descriptive statistics were calculated for the data using standard Excel® statistical functions and the tables list the baseline data by date, minimum, maximum, mean, median, standard deviation, interquartile range, skew, kurtosis, coefficient of variance, number of analyses, number of nondetect (“ND”), and percent nondetect. The statistical parameters are calculated using nondetect values at the method reporting limit (MRL). A second "edited" data set is also included exclusively for MW-26 and MW-27. The only difference in these tables is that duplicates were averaged to eliminate weighting of results that fall on duplicate sampling dates. Lastly, the data set includes detected volatile organic parameters for these wells. Given the one-time detections and chemicals detected (acetone, chloroform, and styrene), these can be attributed to incidental field or laboratory contamination, and not originating in the monitored zone.

HYDROGEOLOGIC INFLUENCES OF MONITORED INTERVALS

Hydrogeology

There are two principal water-bearing units at the landfill: unconsolidated alluvium and bedrock volcanics. The Cell 4 compliance wells are both completed in the alluvium, boring logs can be found in Attachment B. At MW-26, the upper 10.5 feet was clay fill that had been backfilled and compacted at this location during construction of the landfill's stormwater pond. Below this was another 5-foot thick clay layer, but it could not be discerned whether it was fill or native alluvium since the fill is composed of reworked and compacted native soils. The lowest unit in the borehole was clayey silt from a depth of 15 feet to the bottom at 28 feet. It was very uniform in texture with several roots in the lower interval of core indicating that it was native, likely Willamette Silt. At MW-27, the upper 22 to 23 feet of clay was engineered fill. Below this depth, we encountered a clay layer with an organic content of up to 9.6 percent. This layer was reported in parts of the Cell 4 excavation with a thickness of 2 to 3 feet. It was moist to wet in fresh core, with abundant roots, pieces of wood and organic matter. The organic rich clay graded into dark gray clay with moderate plasticity and was damp. Below this to the bottom of the borehole was a silty clay with low plasticity, that was similar in uniformity and texture to the silt found at the bottom of MW-26.

Water Chemistry

The major ion geochemistry of the water from both wells and other nearby wells is shown on the Piper plot in Attachment B. Piper diagrams are a graphical method to distinguish between waters with different ionic signatures. The plot shows normalized concentrations in milliequivalents per liter of the major cations (Mg, Na, K, Ca) and anions (Cl, SO_4, HCO_3) in triangles and then projects them onto a diamond. Water samples with equivalent ion ratios plot in the same area and indicate similar origin. Waters with different ratios of the ions plot in different areas of the diagram and suggest different sources of water. This concept of ion ratio is significant because water with a particular ion ratio will retain that character (i.e., signature), even though it might become more dilute with distance from its point of origin.

Water quality in the eastern part of the landfill plot in 4 different areas. Wells MW-26 and MW-27 are both bicarbonate waters, but with MW-27 having a higher ratio of calcium to sodium than MW-26. Otherwise, the anion ratios are comparable. Both waters are similar to nearby wells P-16 and MW-22. The bedrock (unweathered basalt) is represented by MW-13. Farther east, is well MW-9S, which is affected by saline conditions related to connate water of the Siletz River formation. That well has much higher chloride relative to bicarbonate as well as sodium relative to calcium and magnesium. The Piper plots also shown the slight seasonal change in chemistry between spring and fall at MW-26 and MW-27.

The other notable characteristic of water from both wells is that it is highly reduced, with negative oxidation reduction potential (see Field Parameters in Appendix A). This is caused by the former depositional environment being a marsh or wetland with organic rich clays (e.g., MW-27 from a depth of 22 to 28 feet). The effect on water quality is elevated natural levels of redox-sensitive parameters, such as total organic carbon (TOC), chemical oxygen demand (COD), iron, manganese, and arsenic. In the Willamette Valley, arsenic is associated with volcanic glass (e.g., from air fall ash layers), adsorbed to and co-precipitated with metal oxides, particularly iron oxide, adsorbed to clay-mineral surfaces, and associated with organic carbon. Reducing conditions and high concentrations of dissolved iron in alluvial sediments suggest the dissolution of iron oxides with subsequent release of adsorbed or co-precipitated arsenic.

Time Series Concentration Plots

The differences in water quality from soil are illustrated over time during the last two years on time-series concentration plots in Attachment C. These plots also provide a visual tool regarding the statistical distribution of data points between the wells. Observations from these plots relative to area water quality include the following:

- Generally, well MW-26 is more comparable to water quality at alluvial wells MW-22, MW-25, and P-16, while MW-27 tends to have relatively higher concentrations.

- The variability of concentrations at MW-27 is significantly greater than at MW-26. For most parameters, MW-26 has very steady water quality over the past 2 year.

- With the exception of iron, manganese and arsenic, concentrations are below secondary and primary maximum contaminant levels (MCLs).

- There are no upward or downward trends in the data for MW-26 and MW-27 suggestive of impacts.

STATISTICAL EVALUATION

In addition to the descriptive statistics, each of the parameters were evaluated to approximate their distribution (normal or non-normal). These statistical calculations were done using an Excel add-on called Analyse-it, which constructed box plots, histograms, and normality plots, as well as tested for normality by calculating the Shapiro Wilk statistic. Statistical calculations and plots are provided in Attachment D. The remainder of this section describes some of the findings of the statistical calculations.

Comparative Statistics and Indicator Selection

This section compares average concentrations of parameters at MW-26 and MW-27 with other east-side wells and with leachate. The intent is to describe common relationships that might be used to identify appropriate indicator parameters for long term monitoring. Desirable attributes for indicator parameters include detectability, presence in leachate and groundwater, a contrast between concentrations in background groundwater and leachate, mobility and persistence in the subsurface, analytical reliability, and cost-effectiveness. In addition to these criteria, part of the assessment examines whether compounds have been elevated historically in groundwater at the facility (e.g., at MW-23). It is also critical that any changes in groundwater quality at compliance wells can be recognized. This may be difficult if a parameter has a naturally higher concentration in background groundwater than in leachate.

The steps in the evaluation process consisted of:

- Compare average concentrations at MW-26/MW-27 with leachate.
- Assess whether a compound has shown an upward trend at other wells; known historical impacts are present in well MW-23, which cross gradient of Cell 2.
- Examine the concentration variability of the contaminant and whether the statistical distribution of the data lends itself to developing a practical test for estimating a concentration limit.

Table 1 summarizes relevant statistics used to evaluate selection criteria. This table shows average concentrations for the sampling points. Averages used for MW-26 and MW-27 are taken from the edited data set, which removed average duplicate values. Other wells used unedited data sets that included duplicates. Descriptive statistical calculations can be found in Appendix A.

Comparison of Well and Leachate Concentrations. In general, concentrations of leachate are significantly higher than those in groundwater. The concentration contrast between these concentrations is shown in Table 1.[1] Higher values for the general chemistry parameters, cations and anions (i.e., 10 times greater in leachate) are shaded as an initial consideration. This comparison primarily gives an idea of whether a chemical is present in the leachate at a concentration significantly higher than in groundwater and therefore could potentially affect groundwater if released. It should be noted that the

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[1] Concentration contrast should not be confused with Dilution Attenuation Factor (DAF), which is used by EPA to assess the reduction in concentration between a source area (i.e., the original soil leachate concentration) to the receptor point concentration. Estimates of DAF are done by modeling and include a multitude of site-specific factors, physical and bio-chemical processes, and also depends on the nature of the contaminant itself and whether or not the chemical degrades or sorbs.

statistical comparisons for several trace metals are affected by the presence of non-detects which biases the average concentrations used for these comparisons, and therefore, may not provide a true indication of relative contrast.

Concentration Trend or Impacts in Site Wells. Past impacts are noted in MW-23 for several cations and anions as well as for total dissolved solids (TDS) and arsenic.

Variability and Analytical Detectability. Several parameters (e.g., iron, COD, and TOC) are highly variable or have a high rate of nondetects, indicating a lack of persistence. This can potentially limit their usefulness as an indicator since they do not portray a steady trend that is important to assess increasing concentrations. Nondetect values create difficulty both in calculating a practical concentration limit (based on surrogate values or the MRL) and identifying whether a trend is occurring in real time.

Discussion. Table 2 lists some observations to consider in selecting indicator parameters. Based on a combination of the pros and cons, this table proposes indicator parameters for the long-term monitoring program.

Box Plots and Outlier Identification

Box plots (also known as Box and Whisker plots) were plotted for each parameter by well (Attachment D). The box-plot divides the data into 4 sections, each containing 25 percent of the data. Whiskers are the lines drawn to the minimum and maximum data values from the 25th and 75th percentiles. The box shows the interquartile range (IQR) which is defined as the difference between the 75th and the 25th percentiles. In addition, the mean and the 95 percent confidence limits around the mean are shown as are potential outliers based on a multiplier of the interquartile range (i.e., between 1.5 and 3 or greater than 3 interquartile ranges). The outlier identification was used in attempting to resolve tests for normality as described below. However, it should be remembered that while removing the outliers may improve the data distribution, the primary disadvantage of this type of data adjustment is that it may in fact remove real expressions of the normal variability of the sample population, and ultimately increase the possibility of a false positive during routine sampling.

Normality Testing and Complicating Issues

For each of the wells, data distribution was tested using normality plots and the Shapiro-Wilk test (Appendix D). In addition to these, time concentration plots were examined for any trends and to distinguish overall variability of the parameter with time. The results of the normality tests (W statistic and critical values) are shown in Table 3. Normally distributed data have a W statistic that is greater than the critical value. Those that are very close to normal (i.e., COD for MW-26) are also indicated.

The primary purpose in identifying data distribution is to assist in selecting an appropriate statistical test for calculating the concentration limit. Since these will occur for indicator parameters, the distribution of possible indicator parameters was further explored in Table 4.

For parameters that were not distributed normally, two approaches were taken to resolve the distribution. The first was to take the natural log of the data set and then test for normality. In each case, normality could not be achieved by taking the log value. Next, outliers were removed from the data set and then again tested for normality. In all but iron at MW-26, this resulted in either bimodal or trimodal distribution with little or no variance. Data sets with no variance have no standard deviation and therefore, parametric statistical tests such as prediction limits are not valid (i.e., there is no standard deviation).

In summary, several issues will need to be examined as part of developing concentration limits.

- Agreement on the set of indicator parameters and whether selection should be influenced by distribution of a particular parameter For instance, if there is no acceptable statistical test based the data distribution (e.g., because there is no variance) should we still retain the parameter as an indicator?

- Treatment of non-detects in the normality testing and in any selection of a valid statistical test that will be used for a prediction limits. Parameters with a significant amount of nondetects are not recommended by EPA.

- Which statistical test is most appropriate for particular data distribution.

- Some parameters, which have been demonstrated as effective indicators like bicarbonate, have such steady trends in groundwater that there is no variance with which to calculate a standard deviation used for estimating a prediction limit. This also presents issues if using a non-parametric approach by selecting the highest value.

PROPOSING CONCENTRATION LIMITS

The primary purpose of this memo was to present the data with preliminary descriptive statistics that can be used to explore possible scenarios to develop concentration limits. We anticipate that once we meet and identify the goals of monitoring and discuss the possibilities and limitations of the data, we'll be able to move quickly in conducting any further statistical calculations and finalizing the methods to be used.

Attachments: Tables 1 through 4
Attachment A: Data Set and Descriptive Statistics
Attachment B: Boring Logs and Piper Plot
Attachment C: Time Series Concentration Plots
Attachment D: Box Plots and Normality Testing

Table 1
Comparison of Statistics for Indicator Parameter Selection
Coffin Butte Landfill
Corvallis, Oregon

	Units	DWS **(MCL)** *(SMCL)*	Upgradient Wells		Compliance Wells		Down-gradient	Leachate	Concentration Contrast	Concentration Contrast	Impact at	Current Indicator	Recom. Indicator
			P-16	MW-22	MW-26	MW-27	MW-9S	L-4	L-4/MW-26	L-4/MW-27	MW-23	Parameter	Parameter
General Chemistry													
Chemical Oxygen Demand	mg/L	—	9.33	7.2	10.5	25.3	10.1	3,350	319	132			
Total Dissolved Solids	mg/L	*500*	197	221	189	433	714	9,150	48	21	Yes		(?) redundant
Total Organic Carbon	mg/L	—	1.87	1.97	1.75	9.39	2.36	1,115	637	119			
Common Cations and Anions													
Calcium	µg/L	—	17,471	28,784	22,722	68,444	135,339	400,000	18	5.8	Yes	√	√
Iron	µg/L	*300*	39	864	772	7,833	886	13,100	17	1.7	Yes	√	(?) high var.
Magnesium	µg/L	—	7,464	12,014	8,767	30,333	13,849	420,000	48	14	Yes	√	√
Manganese	µg/L	*50*	40	578	584	5,667	734	5,850	10	1.0	Yes	√	√
Potassium	µg/L	—	1,581	1,786	1,356	964	3,277	455,000	336	472			
Silicon	µg/L	—	16,557	21,540	21,889	19,000	26,427	23,000	1.1	1.2			
Sodium	µg/L	—	31,864	24,148	26,667	36,111	163,867	1,750,000	66	48	Yes	√	√
Ammonia	mg/L	calc.	0.06	1.91	1.07	1.23	1.08	810	757	659			
Bicarbonate Alkalinity	mg/L	—	123	170	149	351	200	4,400	30	13	Yes	√	√
Chloride	mg/L	*250*	4.13	5.3	5.7	12.2	259	3,400	596	279	Yes	√	√
Nitrate	mg/L	**10**	0.22	0.17	0.13	0.189	0.09	0.6	4.6	3.2			
Sulfate	mg/L	*250*	16.9	0.88	3.98	4.34	3.51	124	31	29			
Trace Metals													
Antimony	µg/L	**6**	0.47	0.48	1.9	1.8	5.95	10.8	5.7	6.0			
Arsenic	µg/L	**10**	1.76	8.92	13.9	12.8	34.3	70.5	5.1	5.5	Yes	√	√
Barium	µg/L	**1,000**	30.4	35.6	27.4	146	92.5	1,090	40	7.5			
Beryllium	µg/L	**4**	0.29	0.19	*1*	0.88	3.58	3	3.0	3.4			
Cadmium	µg/L	**5**	0.26	0.23	0.72	0.47	2.83	0.77	1.1	1.6			
Chromium	µg/L	**50**	3.91	3.95	2.82	3.01	12.9	151	54	50			
Cobalt	µg/L	—	6.36	7.5	0.64	26.6	23.9	36	56	1.4			
Copper	µg/L	*1,000*	6.74	7.13	1.33	4.47	13.6	22	17	4.9			
Lead	µg/L	**50**	0.76	0.64	0.39	1.83	2.36	5.4	14	3.0			
Nickel	µg/L	—	1.47	3.68	0.96	8.68	17.2	240	250	28			
Selenium	µg/L	**10**	1.83	2.09	*5*	4.71	2.46	14.8	3.0	3.1			
Silver	µg/L	**50**	0.25	0.14	*0.84*	0.68	3.95	0.39	0.5	0.6			
Thallium	µg/L	**2**	1.57	0.58	*1*	0.8	1.03	3	3.0	3.8			
Vanadium	µg/L	—	12.3	8.2	2.67	4.73	21.3	204	76	43			
Zinc	µg/L	*5,000*	8.47	8.48	6.93	8.12	15.1	255	37	31			

Notes:
Shaded indicates greater than 10x contrast.

Table 2
Indicator Parameter Selection Rationale
Coffin Butte Landfill
Corvallis, Oregon

DEQ Parameter Groups	Proposed	Reason for Selection/Removal
Group 1b: Laboratory Indicators		
Chemical Oxygen Demand (COD)		Very good CC, but highly variable in groundwater
Total Dissolved Solids (TDS)	(?)	Good CC; very stable in MW-26, more variable in MW-27; redundant.
Total Organic Carbon (TOC)		Excellent CC, highly variable in MW-27 from organic layer, steady in MW-26.
Group 2a: Common Cations and Anions		
Calcium	√	Low CC; correlates with site impacts; steady in MW-26, variable in MW-27.
Iron	(?)	Low to poor CC; highly variable in both wells.
Magnesium	√	Good CC; correlates with site impacts; steady in MW-26, variable in MW-27.
Manganese	√	Low to poor CC; correlates with site impacts; relatively steady in both wells.
Potassium		Excellent CC; does not correlate with impacts; reported values below MRL.
Silicon		Poor CC; poor correlation with site impacts;
Sodium	√	Good CC; correlates with site impacts; steady in MW-26, variable in MW-27.
Ammonia		Excellent CC; does not correlate with known impacts; naturally occurring.
Bicarbonate Alkalinity	√	Good CC; corrrelates with known impacts; variable at MW-27.
Chloride	√	Excellent CC; correlates with known impacts, relatively stable in new wells.
Nitrate		Poor CC; nondetect in groundwater or detected below MRL.
Sulfate		Good CC; nondetect in groundwater or detected below MRL.
Group 2b: Trace Metals		
Antimony		Poor to low CC; ND in groundwater or detected below MRL; not mobile.
Arsenic	√	Poor to low CC; correlates with site impacts; naturally occurring above MCL.
Barium		Good CC; no correlation to impacts; steady in MW-26, variable in MW-27.
Beryllium		Poor CC; ND in groundwater or detected below MRL; generally not mobile.
Cadmium		Poor CC; ND in groundwater or detected below MRL; generally not mobile.
Chromium		Moderate CC; mostly ND in groundwater or detected below MRL; not mobile.
Cobalt		Poor to good CC; present in MW-27 at same concentration as leachate.
Copper		Poor to moderate CC, variable concentrations; generally not mobile.
Lead		Poor to moderate CC; does not correlate with impacts; generally not mobile.
Nickel		Excellent CC; does not correlate with impacts; generally not mobile.
Selenium		Poor CC; ND in groundwater or detected below MRL; generally not mobile.
Silver		Reverse CC; ND in groundwater or detected below MRL; generally not mobile.
Thallium		Poor CC; ND in groundwater or detected below MRL; generally not mobile.
Vanadium		Good CC; ND in groundwater or detected below MRL; generally not mobile.
Zinc		Good CC; ND in groundwater or detected below MRL; generally not mobile.
Group 3: Volatile Organic Compounds	√	Generally man-made contaminants-good as indicators.

Table 3
Shapiro Wilk Normality Testing Results
Coffin Butte Landfill
Corvallis, Oregon

	MW-26			MW-27		
	W-Calc	W (>)	Distribution	W-Calc	W (>)	Distribution
General Chemistry						
Chemical Oxygen Demand	0.82	0.829	Close	0.86	0.829	Normal
Total Dissolved Solids	0.78	0.829	—	0.83	0.829	Normal
Total Organic Carbon	0.93	0.829	Normal	0.96	0.829	Normal
Common Cations and Anions						
Calcium	0.75	0.829	—	0.92	0.829	Normal
Iron	0.59	0.829	—	0.9	0.829	Normal
Magnesium	0.96	0.829	Normal	0.95	0.829	Normal
Manganese	0.88	0.829	Normal	0.97	0.829	Normal
Potassium	0.89	0.829	Normal	0.76	0.829	—
Silicon	0.93	0.829	Normal	0.86	0.829	Normal
Sodium	0.94	0.829	Normal	0.97	0.829	Normal
Ammonia	0.83	0.829	Normal	0.82	0.829	Close
Bicarbonate Alkalinity	0.39	0.829	—	0.94	0.829	Normal
Chloride	0.99	0.829	Normal	0.72	0.829	—
Nitrate	0.74	0.829	—	0.54	0.829	—
Sulfate	0.54	0.829	—	0.83	0.829	Normal
Trace Metals						
Antimony	0.39	0.829	—	0.39	0.829	—
Arsenic	0.94	0.829	Normal	0.9	0.829	Normal
Barium	0.78	0.829	—	0.81	0.829	Close
Beryllium	NC	—	—	0.54	0.829	—
Cadmium	NC	—	—	0.8	0.829	Close
Chromium	0.39	0.829	—	0.88	0.829	Normal
Cobalt	0.92	0.829	Normal	0.83	0.829	Normal
Copper	0.77	0.829	—	0.72	0.829	—
Lead	0.81	0.829	Close	0.8	0.829	Close
Nickel	0.8	0.829	Close	0.98	0.829	Normal
Selenium	NC	—	—	0.39	0.829	—
Silver	0.54	0.829	—	0.62	0.829	—
Thallium	NC	—	—	0.54	0.829	—
Vanadium	0.81	0.829	Close	0.72	0.829	
Zinc	0.82	0.829	Close	0.93	0.829	Normal

Notes:
NC: cannot calculate because data has no variance.

Table 4
Indicator Parameters - Data Distribution
Coffin Butte Landfill
Corvallis, Oregon

MW-26	Data Set	W-calc	W (>)	Distribution	Ln Test	Removed outliers
Bicarbonate	All	0.390	0.829	N-P	No change	Biomodal, when remove 140 mg/L, all are 150 mg/L, no variance
Chloride	All	0.990	0.829	Normal		
TDS	All	0.780	0.829	N-P	No change	Trimodal, when remove outliers of 180 and 200 mg/L, only 190 mg/L remains, no variance.
Calcium	All	0.750	0.829	N-P	No change	Remove outlier of 25, becomes uniform but remains non-normal with W of 0.740.
Iron	All	0.590	0.829	N-P	Still N-P with W=0.75	Removed 2 outliers >3 IQR, still N-P
Iron (removed >1.5 IQR)	Adjusted	0.860	0.788	Normal	—	Removed 3 outliers >1.5 IQR, becomes normal
Magnesium	All	0.960	0.829	Normal		
Manganese	All	0.880	0.829	Normal		
Sodium	All	0.940	0.829	Normal		
Arsenic	All	0.940	0.829	Normal		
MW-27						
Bicarbonate	All	0.940	0.829	Normal		
Chloride	All	0.720	0.829	N-P	Still N-P with W=0.70	Remove outlier of 9.6, becomes bimodal with two values of 12 and 13 mg/L.
TDS	All	0.830	0.829	Normal		
Calcium	All	0.920	0.829	Normal		
Iron	All	0.900	0.829	Normal		
Magnesium	All	0.950	0.829	Normal		
Manganese	All	0.970	0.829	Normal		
Sodium	All	0.970	0.829	Normal		
Arsenic	All	0.900	0.829	Normal		

ATTACHMENT A

DATA SET & DESCRIPTIVE STATISTICS

Coffin Butte Landfill Descriptive Statistics
Field Parameters

Locatior	Sample ID	Date	Type	pH	Specific Conductance	Temperature	Oxidation-Reduction Potential	Oxygen, Dissolved
				pH Units	µmhos/cm	Deg C	Millivolts	mg/L
MW-26	VLF-111101-1	11/01/11	Primary Sample	7.21	217	14.88	-32.5	0.46
MW-26	VLF-20120117-01	01/17/12	Primary Sample	7.7	206	14.62	-147.3	0.61
MW-26	VLF-120411-18	04/11/12	Primary Sample	7.02	182.1	14.2		
MW-26	VLF-120713-2	07/13/12	Primary Sample	7.72	231	15.14	-144.2	0.2
MW-26	VLF-121016-1	10/16/12	Primary Sample	7.33	236	15.12	-89.5	0.63
MW-26	VLF-130124-2	01/24/13	Primary Sample	7.64	199	14.2	-109	0.9
MW-26	VLF-130419-9	04/19/13	Primary Sample	7.03	197	14	-81	1.1
MW-26	VLF-130710-2	07/10/13	Primary Sample	7.21	219	15.6	-78	2.8
MW-26	VLI-102813-25	10/28/13	Primary Sample	6.79	240	15.3	46	1.8
			Minimum	6.79	182	14.0	-147.3	0.2
			Maximum	7.72	240	15.6	46	2.8
			Mean	7.29	214	14.8	-79.4	1.06
			Median	7.21	217	14.9	-85.3	0.765
			Standard Deviation	0.332	19.6	0.560	62.9	0.853
			Interquartile Range	0.61	32	0.94	51.2	0.703
			Skew	0.072	-0.194	-0.113	1.121	1.42
			Kurtosis	-1.263	-1.038	-1.416	1.486	1.70
			Coefficient of Variance	0.045	0.092	0.038	-0.792	0.803
			Number of Analyses	9	9	9	8	8
			Number of Nondetect	0	0	0	0	0
			Percent Nondetect	0.0%	0.0%	0.0%	0.0%	0.0%
MW-27	VLF-111102-8	11/02/11	Primary Sample	6.46	449	15.1	26.1	0.95
MW-27	VLF-20120118-01	01/18/12	Primary Sample	6.57	437	14.41	-25.9	1.45
MW-27	VLF-120411-17	04/11/12	Primary Sample	6.53	793	15.54	-188.3	0.69
MW-27	VLF-120713-1	07/13/12	Primary Sample	6.79	734	16.31	-89.3	0.23
MW-27	VLF-121017-19	10/17/12	Primary Sample	6.59	731	15.49	-71.3	2.9
MW-27	VLF-130124-1	01/24/13	Primary Sample	7.13	458	14.5	-21	1.6
MW-27	VLF-130419-8	04/19/13	Primary Sample	6.57	747	15.1	-147	0.9
MW-27	VLF-130710-1	07/10/13	Primary Sample	6.52	597	15.81	-74	3.4
MW-27	VLI-102913-26	10/29/13	Primary Sample	6.72	633	15	-52	3
			Minimum	6.46	437	14.41	-188.3	0.23
			Maximum	7.13	793	16.31	26.1	3.4
			Mean	6.65	620	15.3	-71.4	1.68
			Median	6.57	633	15.1	-71.3	1.45
			Standard Deviation	0.206	142	0.608	65.4	1.14
			Interquartile Range	0.19	276	0.54	63.4	2.00
			Skew	1.814	-0.296	0.256	-0.505	0.46
			Kurtosis	3.510	-1.835	-0.273	0.129	-1.44
			Coefficient of Variance	0.031	0.229	0.040	-0.916	0.681
			Number of Analyses	9	9	9	9	9
			Number of Nondetect	0	0	0	0	0
			Percent Nondetect	0.0%	0.0%	0.0%	0.0%	0.0%

Coffin Butte Descriptive Statistics
Inorganic Parameters

Location	Sample ID	Date	Type	Alkalinity (as CaCO3)		Bicarbonate Alkalinity as CACO3		Carbonate as CaCO3		Chemical Oxygen Demand		Chloride		Hardness as CaCO3		Nitrogen, Ammonia (as N)		Nitrogen, Nitrate-Nitrite		Sulfate		Suspended Solids		Total Dissolved Solids		Total Organic Carbon (TOC)	
				mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
MW-26	VLF-111101-1	11/01/11	Primary Sample			150				5	J	5.6				0.86	J	0.2	U	5	U	130		190		1.4	UJ
MW-26	VLF-111101-2	11/01/11	Field Duplicate			150				5.7	J	5.7				0.91	J	0.2	U	5	U	74		190		1.5	UJ
MW-26	VLF-20120117-01	01/17/12	Primary Sample			150				6.5	J	5.5				1		0.2	U	5	U	18		170		1.3	
MW-26	VLF-20120117-02	01/17/12	Field Duplicate			150				20	U	5.6				1		0.2	U	5	U	16		190		1.4	
MW-26	VLF-120411-18	04/11/12	Primary Sample			150				20	UJ	6				1		0.2	U	5	UB	47		190		1.5	
MW-26	VLF-120713-2	07/13/12	Primary Sample			150				20	U	5.9				1		0.2	U	5	U	4.8		190	J	1.6	
MW-26	VLF-120713-3	07/13/12	Field Duplicate			150				6	J	5.9				1.1		0.024	J	5	U	4.4		190	J	1.5	
MW-26	VLF-121016-1	10/16/12	Primary Sample			150				4.2	J	5.7				0.92	J-	0.026	J	0.35	J	13		190		2	UB
MW-26	VLF-130124-2	01/24/13	Primary Sample			140				20	U	5.8				1.2		0.024	J	5	U	36		190		2.1	
MW-26	VLF-130124-3	01/24/13	Field Duplicate			140				20	U	5.6				1.2		0.019	J	5	U	61		190		2.3	
MW-26	VLF-130419-9	04/19/13	Primary Sample			150				9.3	J	5.8				1.2		0.2	U	5	U	16		200		2	JB
MW-26	VLF-130710-2	07/10/13	Primary Sample			150				10	J	5.6				1.2		0.2	U	5	U	12		190		1.8	UB
MW-26	VLF-130710-3	07/10/13	Field Duplicate			150				11	J	5.6				1.2		0.07	J	5	U	12		190		1.8	UB
MW-26	VLI-102813-25	10/28/13	Primary Sample			150				9.3	J	5.4				1.2		0.2	U	0.51	J	18		180		1.9	UB
			Minimum			***140***				***4.20***		***5.40***				***0.86***		***0.019***		***0.35***		***4.40***		***170***		***1.30***	
			Maximum			***150***				***20.0***		***6.00***				***1.20***		***0.20***		***5.00***		***130***		***200***		***2.30***	
			Mean			***149***				***11.9***		***5.69***				***1.07***		***0.14***		***4.35***		***33.0***		***189***		***1.72***	
			Median			***150***				***9.65***		***5.65***				***1.05***		***0.20***		***5.00***		***17.0***		***190***		***1.70***	
			Standard Deviation			***3.63***				***6.54***		***0.17***				***0.13***		***0.08***		***1.66***		***35.1***		***6.6***		***0.31***	
			Interquartile Range			***0.000***				***13.9***		***0.20***				***0.20***		***0.16***		***0.00***		***32.00***		***0.00***		***0.48***	
			Skew			***-2.29***				***0.38***		***0.24***				***-0.23***		***-0.73***		***-2.30***		***1.90***		***-1.70***		***0.38***	
			Kurtosis			***3.79***				***-1.77***		***-0.51***				***-1.62***		***-1.66***		***3.81***		***3.76***		***5.12***		***-0.99***	
			Coefficient of Variance			***0.02***				***0.55***		***0.03***				***0.12***		***0.60***		***0.38***		***1.06***		***0.04***		***0.18***	
			Number of Analyses			***14***				***14***		***14***				***14***		***14***		***14***		***14***		***14***		***14***	
			Number of Nondetect			***0***				***5***		***0***				***0***		***9***		***12***		***0***		***0***		***6***	
			Percent Nondetect			***0.0%***				***35.7%***		***0.0%***				***0.0%***		***64.3%***		***85.7%***		***0.0%***		***0.0%***		***42.9%***	
MW-27	VLF-111102-8	11/02/11	Primary Sample			230				18	J	13				0.8		0.2	U	11		84		450		10	
MW-27	VLF-20120118-01	01/18/12	Primary Sample			350				32		12				1.2		0.2	U	2	J	110		400		11	
MW-27	VLF-120411-17	04/11/12	Primary Sample			330				17	J	12				0.85		0.2	U	5	UB	63		370		9.2	
MW-27	VLF-120713-1	07/13/12	Primary Sample			410				19	J	12				1		0.2	U	5	UB	220		450	J	9.2	
MW-27	VLF-121017-19	10/17/12	Primary Sample			320				15	J	9.6				0.83	J-	0.15	J	0.58	J	39		430		6	
MW-27	VLF-130124-1	01/24/13	Primary Sample			310				35		13				1.9		0.2	U	5	U	35		460		12	
MW-27	VLF-130419-8	04/19/13	Primary Sample			390				33	J	13				1.8		0.15	J	5	U	23		450		11	
MW-27	VLF-130710-1	07/10/13	Primary Sample			390				32		12				1.7		0.2	U	5	U	43		430		8.7	
MW-27	VLI-102913-26	10/29/13	Primary Sample			430				27		13				0.95		0.2	U	0.52	J	36		460		7.4	
			Minimum			***230***				***15.0***		***9.60***				***0.80***		***0.15***		***0.52***		***23.0***		***370***		***6.00***	
			Maximum			***430***				***35.0***		***13.0***				***1.90***		***0.20***		***11.0***		***220***		***460***		***12.0***	
			Mean			***351***				***25.3***		***12.2***				***1.23***		***0.189***		***4.34***		***72.6***		***433***		***9.39***	
			Median			***350***				***27.0***		***12.0***				***1.0***		***0.20***		***5.00***		***43.0***		***450***		***9.20***	
			Standard Deviation			***61.7***				***8.02***		***1.09***				***0.4***		***0.02***		***3.18***		***61.8***		***30.4***		***1.9***	
			Interquartile Range			***70.0***				***14.0***		***1.00***				***0.85***		***0.00***		***3.00***		***48.00***		***20.00***		***2.30***	
			Skew			***-0.73***				***-0.12***		***-1.86***				***0.67***		***-1.62***		***0.87***		***2.02***		***-1.37***		***-0.50***	
			Kurtosis			***0.49***				***-2.18***		***4.21***				***-1.60***		***0.73***		***1.76***		***4.35***		***1.24***		***-0.14***	
			Coefficient of Variance			***0.18***				***0.32***		***0.09***				***0.37***		***0.12***		***0.73***		***0.85***		***0.07***		***0.20***	
			Number of Analyses			***9***				***9***		***9***				***9***		***9***		***9***		***9***		***9***		***9***	
			Number of Nondetect			***0***				***0***		***0***				***0***		***7***		***5***		***0***		***0***		***0***	
			Percent Nondetect			***0.0%***				***0.0%***		***0.0%***				***0.0%***		***77.8%***		***55.6%***		***0.0%***		***0.0%***		***0.0%***	

Coffin Butte Descriptive Statistics
Inorganic Parameters

Location	Sample ID	Date	Type	Alkalinity (as CaCO3)		Bicarbonate Alkalinity as CACO3		Carbonate as CaCO3		Chemical Oxygen Demand		Chloride		Hardness as CaCO3		Nitrogen, Ammonia (as N)		Nitrogen, Nitrate-Nitrite		Sulfate		Suspended Solids		Total Dissolved Solids		Total Organic Carbon (TOC)	
				mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
MW-22	CB-081194-13	08/11/94	Primary Sample	170		170		20	U	7		4.6		124		1.72		0.2	U	0.6		46		206		2.5	
MW-22	CB-110394-04	11/03/94	Primary Sample	173		173		20	U	7		5.5		119		1.86		0.2	U	0.3		12		219		2.5	
MW-22	CB-110394-04	11/03/94	Primary Sample	175		175		20	U	6		5.3		119		1.86		0.2	U	0.3		20		195		2.3	
MW-22	CB-020995-22	02/09/95	Primary Sample	164		164		20	U	6		5		133		1.82		0.2	U	0.5		6		206		1.9	
MW-22	CB-051195-4	05/11/95	Primary Sample	172		172		20	U	5	U	5.1		122		1.63		0.2	U	0.7		6		386		1.3	
MW-22	CB-080995-14	08/09/95	Primary Sample	172		172		20	U	6		4.9		122		1.74		0.2	U	0.6		28		175	J	1.6	
MW-22	CB-080995-14	08/09/95	Primary Sample	174		174		20	U	7		4.9		123		1.68		0.2	U	0.6		20		187	J	1.7	
MW-22	CB-110795-5	11/08/95	Primary Sample	170		170		20	U	5	U	4.9		126		1.87		0.2	U	0.9		5	U	211		2.2	
MW-22	CB-021396-27	02/13/96	Primary Sample	170		170		20	U	6		5.1		121		1.94		0.2	U	0.9		5	U	207		2.4	
MW-22	CB-050896-11	05/08/96	Primary Sample	166		166		20	U	5	U	5.3		127		1.98		0.2	U	0.9		8		207		2	
MW-22	CB-080696-1	08/06/96	Primary Sample	167		167		20	U	10		5		123		1.91		0.2		1		5	U	222		2	
MW-22	CB-042197-1	04/21/97	Primary Sample	170		170		20	U	5	U	5.3		122		1.89		0.2	U	1		5	U	213		2.3	
MW-22	CB-102197-11	10/21/97	Primary Sample			170		20	U			4.9										12					
MW-22	CB-042198-5	04/21/98	Primary Sample	168		168		20	U	8		5.5		116		2.03		0.2	U	1.2		5	U	230		2.2	
MW-22	CB-102198-22	10/21/98	Primary Sample			170		2	U			5.4															
MW-22	MW-22	04/19/99	Primary Sample											119													
MW-22	CB-042399-31	04/23/99	Primary Sample	169		169		2	U	8		5.5		123		2.04		0.2	U	1.2		7		209		2	
MW-22	CB-101999-10	10/19/99	Primary Sample			162						5.8										11					
MW-22	CB-041900-7	04/19/00	Primary Sample	171		171		2	U	8		4.8		128		1.98		0.2	U	1		8		252		1.7	
MW-22	CB-101900-14	10/19/00	Primary Sample			176						5										5	U				
MW-22	VLF-042401-4	04/24/01	Primary Sample	170		170		2	U	9		5.5		127		1.95		0.2	U	1.5		6		199		1.8	
MW-22	VLF-011017-1	10/17/01	Primary Sample			166		2	U			4.7										18					
MW-22	VLF-042302-1	04/23/02	Primary Sample			173						6										5	U				
MW-22	VLF-101502-8	10/15/02	Primary Sample			168						5.2										5	U				
MW-22	VLF-042903-2	04/29/03	Primary Sample			171						5.2										5					
MW-22	DEQ-001-14459	10/14/03	Primary Sample			170				5	U	5.9				1.9		0.018		0.31		1	U	210		2	
MW-22	DEQ-002-14459	10/14/03	Field Duplicate			170				5	U	5.9				1.8		0.0169		0.34		1	U	210		2	
MW-22	VLF-101403-3	10/14/03	Primary Sample			172				8		5				2.09		0.2	U	0.2		5	U	246		2.4	
MW-22	VLF-042004-12	04/20/04	Primary Sample			172						4.9										5	U				
MW-22	VLF-101304-15	10/13/04	Primary Sample			169						5.3										5	U				
MW-22	VLF-041905-1	04/20/05	Primary Sample			176						4.9										6					
MW-22	VLF-111605-16	11/16/05	Primary Sample			171						4.8										5	U				
MW-22	VLF-060418-9	04/18/06	Primary Sample			170						4.8										5					
MW-22	DEQ-14459	10/24/06	Primary Sample	167		167				7		6		122		2		0.0173		0.2	U	1	U	220		1	
MW-22	VLF-061024-5	10/24/06	Primary Sample			168				6		5.1				2.04		0.05	U	0.2	U	5	U	254		2.5	
MW-22	VLF-070417-10	04/17/07	Primary Sample			174						5.1										5					
MW-22	VLF-071025-20	10/25/07	Primary Sample			170						5.9										4	U				
MW-22	VLF-080415-8	04/15/08	Primary Sample			170						5.6										4.8					
MW-22	VLF-081027-31	10/27/08	Primary Sample			160						6.2										4	U				
MW-22	VLF090414-15	04/14/09	Primary Sample			170						5.1										4	U				
MW-22	VLF-091015-26	10/15/09	Primary Sample			170				20	U	5.7				2.3		0.2	U	5	U	4	U	190		1	U
MW-22	VLF-100406-13	04/06/10	Primary Sample			170						5.6										3.6	J				
MW-22	VLF-101013-9	10/13/10	Primary Sample			170						5.9										4	U				
MW-22	VLF-110412-4	04/12/11	Primary Sample			170						5.6										1.6	J				
			Minimum	***164***		***160***		***2.00***		***5.00***		***4.60***		***116***		***1.63***		***0.02***		***0.20***		***1.00***		***175***		***1.00***	
			Maximum	***175***		***176***		***20.0***		***20.0***		***6.20***		***133***		***2.30***		***0.20***		***5.00***		***46.0***		***386***		***2.50***	
			Mean	***170***		***170***		***15.3***		***7.2***		***5.30***		***123***		***1.91***		***0.17***		***0.88***		***7.79***		***221***		***1.97***	

Coffin Butte Descriptive Statistics
Inorganic Parameters

Location	Sample ID	Date	Type	Alkalinity (as CaCO3)		Bicarbonate Alkalinity as CACO3		Carbonate as CaCO3		Chemical Oxygen Demand		Chloride		Hardness as CaCO3		Nitrogen, Ammonia (as N)		Nitrogen, Nitrate-Nitrite		Sulfate		Suspended Solids		Total Dissolved Solids		Total Organic Carbon (TOC)	
				mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
			Median	***170***		***170***		***20.0***		***6.5***		***5.20***		***123***		***1.91***		***0.20***		***0.65***		***5.00***		***210***		***2.00***	
			Standard Deviation	***2.89***		***3.20***		***8.14***		***3.19***		***0.41***		***4.00***		***0.15***		***0.07***		***0.99***		***8.16***		***41.8***		***0.45***	
			Interquartile Range	***4.00***		***2.50***		***9.00***		***2.75***		***0.65***		***4.25***		***0.17***		***0.00***		***0.68***		***1.90***		***15.5***		***0.58***	
			Skew	***-0.18***		***-0.80***		***-1.17***		***3.28***		***0.43***		***0.67***		***0.37***		***-1.80***		***3.65***		***3.16***		***3.15***		***-0.88***	
			Kurtosis	***-0.16***		***1.94***		***-0.72***		***12.93***		***-0.86***		***1.01***		***0.99***		***1.43***		***15.34***		***11.84***		***12.19***		***0.23***	
			Coefficient of Variance	***0.02***		***0.02***		***0.53***		***0.44***		***0.08***		***0.03***		***0.08***		***0.41***		***1.12***		***1.05***		***0.19***		***0.23***	
			Number of Analyses	***17***		***43***		***19***		***22***		***43***		***18***		***22***		***22***		***22***		***42***		***22***		***22***	
			Number of Nondetect	***0***		***0***		***19***		***7***		***0***		***0***		***0***		***18***		***3***		***21***		***0***		***1***	
			Percent Nondetect	***0.0%***		***0.0%***		***100.0%***		***31.8%***		***0.0%***		***0.0%***		***0.0%***		***81.8%***		***13.6%***		***50.0%***		***0.0%***		***4.5%***	
MW-23	CB-081194-17	08/11/94	Primary Sample	192		192		20	U	5	U	12		156		0.15		0.2	U	14		100		259		1.6	
MW-23	CB-130394-6	11/03/94	Primary Sample	228		228		20	U	5	U	17		201		0.17		0.2	U	27		7		287		1.1	
MW-23	CB-020995-20	02/09/95	Primary Sample	238		238		20	U	5		16		145		0.24		0.2	U	23		5	U	295		0.9	
MW-23	CB-020995-20	02/09/95	Primary Sample	234		234		20	U	5	U	16		143		0.2		0.2	U	23		5	U	290		0.8	
MW-23	CB-051195-5	05/11/95	Primary Sample	241		241		20	U	5	U	15		220		0.2		0.2	U	20		5	U	435		0.6	
MW-23	CB-081095-16	08/10/95	Primary Sample	248		248		20	U	6		18		223		0.21		0.2	U	26		5	U	271	J	0.9	
MW-23	COFFIN38	08/10/95	Primary Sample	235		235				5	U	19		240		0.32		0.04		28		1	U	350		1	U
MW-23	CB-110795-6	11/08/95	Primary Sample	274		274		20	U	5	U	19		262		0.26		0.2	U	29		5	U	366		1	
MW-23	CB-021396-30	02/13/96	Primary Sample	266		266		20	U	5	U	18		246		0.26		0.2	U	25		5	U	361		1	
MW-23	CB-050896-5	05/08/96	Primary Sample	266		266		20	U	5	U	16		244		0.37		0.2	U	19		5	U	338		0.9	
MW-23	CB-050896-5	05/08/96	Primary Sample	269		269		20	U	5	U	17		250		0.31		0.2	U	19		5	U	356		0.9	
MW-23	CB-080696-2	08/06/96	Primary Sample	271		271		20	U	6		17		255		0.26		0.2	U	25		5	U	376		1	
MW-23	CB-042397-23	04/23/97	Primary Sample	304		304		20	U	5	U	19		292		0.28		0.2	U	23		5	U	419		1	
MW-23	CB-102197-10	10/21/97	Primary Sample			336		20	U	3	U	16.6				0.35		0.2	U	21.7		8		413		0.5	U
MW-23	CB-042398-24	04/23/98	Primary Sample	316		316		20	U	5	U	17.5		298		11.8		0.2	U	18.4		5	U	393		1.1	
MW-23	CB-102198-25	10/21/98	Primary Sample			365		2	U			19															
MW-23	CB-042099-1	04/20/99	Primary Sample	327		327		2	U	5	U	19.5		290		0.25		0.2	U	2.9		5	U	424		1.1	
MW-23	CB-101999-9	10/19/99	Primary Sample			382						22.8										7					
MW-23	CB-042100-35	04/21/00	Primary Sample	328		328		2	U	5	U	17.2		277		0.28		0.2	U	12.4		13		421		0.9	
MW-23	CB-101900-13	10/19/00	Primary Sample			382						21.2										6					
MW-23	VLF-042401-7	04/24/01	Primary Sample	304		304		2	U	5		18.5		256		0.18		0.2	U	8.8		5	U	352		0.9	
MW-23	VLF-011017-4	10/17/01	Primary Sample			384		2	U			20.3										6					
MW-23	VLF-042502-24	04/25/02	Primary Sample			308						17.9										7					
MW-23	VLF-101502-9	10/15/02	Primary Sample			347						22										9					
MW-23	VLF-042903-1	04/29/03	Primary Sample			297						18										12					
MW-23	VLF-102003-37	10/20/03	Primary Sample			339				5	U	20				0.37		0.3		9.2		9		408		1.6	
MW-23	VLF-042004-13	04/20/04	Primary Sample			271						17.2										7					
MW-23	VLF-101404-30	10/14/04	Primary Sample			299						19.1										11					
MW-23	VLF-101404-31	10/14/04	Field Duplicate			282						19.4										7					
MW-23	VLF-041905-2	04/20/05	Primary Sample			262						14.1										8					
MW-23	VLF-111705-27	11/17/05	Primary Sample			268						18.2										9					
MW-23	VLF-060418-10	04/18/06	Primary Sample			236						16.6										5	U				
MW-23	VLF-060418-11	04/18/06	Field Duplicate			236						16.9										5	U				
MW-23	VLF-061026-23	10/26/06	Primary Sample			256				5	U	16				0.2		0.24		5		8		311		1.3	
MW-23	VLF-070417-11	04/17/07	Primary Sample			211						16.4										6					
MW-23	VLF-071025-22	10/25/07	Primary Sample			220						17										8.4					
MW-23	VLF-071025-23	10/25/07	Field Duplicate			240						17										9.6					
MW-23	VLF-080416-11	04/16/08	Primary Sample			180						16										6.8					

Coffin Butte Descriptive Statistics
Inorganic Parameters

Location	Sample ID	Date	Type	Alkalinity (as CaCO3)		Bicarbonate Alkalinity as CACO3		Carbonate as CaCO3		Chemical Oxygen Demand		Chloride		Hardness as CaCO3		Nitrogen, Ammonia (as N)		Nitrogen, Nitrate-Nitrite		Sulfate		Suspended Solids		Total Dissolved Solids		Total Organic Carbon (TOC)	
				mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
MW-23	VLF081023-24	10/23/08	Primary Sample			190						17										11					
MW-23	VLF090414-17	04/14/09	Primary Sample			180						14										5.2					
MW-23	DEQ-14460	10/14/09	Primary Sample	225		225				10	U	16.9		193		0.17		0.005	U	5.07		12		290		1	U
MW-23	DEQ-14461	10/14/09	Field Duplicate	235		235				10	U	16.5		197		0.19		0.005	U	4.68		12		290		1	U
MW-23	VLF-091014-6	10/14/09	Primary Sample			240				20	U	17				0.49	J+	0.2	U	5	U	14		320		1.4	
MW-23	VLF-100406-12	04/06/10	Primary Sample			210						15										8.8					
MW-23	VLF-101013-10	10/13/10	Primary Sample			220						15										10					
MW-23	VLF-101013-11	10/13/10	Field Duplicate			230						15										17					
MW-23	VLF-110412-5	04/12/11	Primary Sample			220						16										6					
MW-23	VLF-111102-14	11/02/11	Primary Sample			180						13										12					
MW-23	VLF-120410-1	04/10/12	Primary Sample			180						17										19					
MW-23	VLF-121016-2	10/16/12	Primary Sample			180						15										17					
MW-23	VLF-130419-13	04/19/13	Primary Sample			160						20										28					
MW-23	VLI-102613-1	10/26/13	Primary Sample			170						19										26					
			Minimum	***192***		***160***		***2.00***		***3.00***		***12.0***		***143***		***0.15***		***0.01***		***2.90***		***1.00***		***259***		***0.50***	
			Maximum	***328***		***384***		***20.0***		***20.0***		***22.8***		***298***		***11.8***		***0.30***		***29.0***		***100***		***435***		***1.60***	
			Mean	***263***		***259***		***15.3***		***6.09***		***17.3***		***231***		***0.76***		***0.18***		***17.1***		***10.6***		***349***		***1.02***	
			Median	***266***		***245***		***20.0***		***5.00***		***17.0***		***244***		***0.26***		***0.20***		***19.0***		***7.00***		***352***		***1.00***	
			Standard Deviation	***38.14***		***58.66***		***8.14***		***3.40***		***2.12***		***47.9***		***2.41***		***0.07***		***8.69***		***13.8***		***55.4***		***0.26***	
			Interquartile Range	***54.00***		***80.25***		***9.00***		***0.00***		***3.00***		***60.0***		***0.12***		***0.00***		***15.0***		***6.00***		***108***		***0.20***	
			Skew	***0.29***		***0.45***		***-1.17***		***3.51***		***0.16***		***-0.54***		***4.79***		***-1.80***		***-0.38***		***5.73***		***0.02***		***0.63***	
			Kurtosis	***-0.65***		***-0.47***		***-0.72***		***13.62***		***0.54***		***-0.58***		***22.94***		***3.20***		***-1.36***		***36.87***		***-1.34***		***1.17***	
			Coefficient of Variance	***0.14***		***0.23***		***0.53***		***0.56***		***0.12***		***0.21***		***3.16***		***0.38***		***0.51***		***1.30***		***0.16***		***0.26***	
			Number of Analyses	***19***		***52***		***19***		***23***		***52***		***19***		***23***		***23***		***23***		***51***		***23***		***23***	
			Number of Nondetect	***0***		***0***		***19***		***19***		***0***		***0***		***0***		***20***		***1***		***16***		***0***		***4***	
			Percent Nondetect	***0.0%***		***0.0%***		***100.0%***		***82.6%***		***0.0%***		***0.0%***		***0.0%***		***87.0%***		***4.3%***		***31.4%***		***0.0%***		***17.4%***	
MW-25	MW-25	04/18/99	Primary Sample											94													
MW-25	CB-072199-3	07/21/99	Primary Sample	151		151		2	U	68		8.6	J	488		0.81		0.2	U	4.5		5000		193		10.1	
MW-25	CB-102099-16	10/20/99	Primary Sample	127		127				15		8.1		98.6		0.63		0.2	U	0.6		25		167		1.4	
MW-25	CB-012100-7	01/21/00	Primary Sample	130		130		2	U	5	U	7		97.6		0.77		0.2	U	1.3		16		180		1.2	
MW-25	CB-041800-5	04/18/00	Primary Sample	134		134		2	U	5	U	6.7		103		0.76		0.2	U	1.5				224		1.1	
MW-25	CB-041800-5	04/19/00	Primary Sample																			25					
MW-25	CB-072500-3	07/25/00	Primary Sample	130		130		2	U	5	U	7.2		101		0.74		0.2	U	1.7		26		216		0.6	
MW-25	CB-102000-18	10/20/00	Primary Sample	131		131		2	U	6		7.8		104		0.65		0.2	U	1.1		46		157		0.9	
MW-25	CB-102000-19	10/20/00	Field Duplicate	134		134		2	U	7		7.8		102		0.72		0.2	U	1.3		38		144		0.9	
MW-25	CB-012301-4	01/23/01	Primary Sample	134		134				9		7.2		98.5		0.75		0.2		1.6		8		175		1.1	
MW-25	CB-012301-5	01/23/01	Field Duplicate	133		133				5		7.1		100		0.76		0.2		1.7		18		181		1.2	
MW-25	VLF-042401-5	04/24/01	Primary Sample	134		134		2	U	10		7.5		101		0.88		0.2		1.7		53		174		1.6	
MW-25	VLF-042401-6	04/24/01	Field Duplicate	128		128		2	U	13		7.5		104		0.89		0.2	U	1.6		43		177		1.4	
MW-25	VLF-071801-MW-2	07/18/01	Primary Sample	132		132		2	U	5	U	6.7		102		0.76		0.2	U	1.9		26		193		1.2	
MW-25	VLF-071801-MW-2	07/18/01	Field Duplicate	140		140		2	U	6		6.7		101		0.78		0.2	U	1.7		35		200		1.2	
MW-25	VLF-011017-2	10/17/01	Primary Sample	130		130		2	U	5	U	6.3		91.8		0.63		0.2	U	1.3		61		221		1.4	
MW-25	VLF-042302-2	04/23/02	Primary Sample			130						8.3										27					
MW-25	VLF-102003-35	10/20/03	Primary Sample			136				9		6.6				0.99		0.2	U	2.3		18		186		1.9	
MW-25	VLF-101304-14	10/13/04	Primary Sample			135						6.3										5	U				
MW-25	VLF-111605-18	11/16/05	Primary Sample			135						5.8										5	U				
MW-25	VLF-061026-20	10/26/06	Primary Sample			133				5	U	6.2				0.89		0.05	U	1.5		18		206		2.1	

Coffin Butte Descriptive Statistics
Inorganic Parameters

Location	Sample ID	Date	Type	Alkalinity (as CaCO3)		Bicarbonate Alkalinity as CACO3		Carbonate as CaCO3		Chemical Oxygen Demand		Chloride		Hardness as CaCO3		Nitrogen, Ammonia (as N)		Nitrogen, Nitrate-Nitrite		Sulfate		Suspended Solids		Total Dissolved Solids		Total Organic Carbon (TOC)	
				mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
MW-25	VLF-061026-21	10/26/06	Field Duplicate			135				6		6.2				0.89		0.05	U	1.5		14		201		2	
MW-25	VLF-071025-19	10/25/07	Primary Sample			130						6.4										6					
MW-25	VLF-081027-32	10/27/08	Primary Sample			140						6.6										4.8					
MW-25	VLF-081027-33	10/27/08	Field Duplicate			130						6.7										8.8					
MW-25	VLF-091015-25	10/15/09	Primary Sample			140				20	U	6.4				1	J+	0.2	U	5	U	4.8		170		1.6	
MW-25	VLF-101013-8	10/13/10	Primary Sample			140						6										88					
			Minimum	***127***		***127***		***2.00***		***5.00***		***5.80***		***91.8***		***0.63***		***0.05***		***0.60***		***5***		***144***		***0.60***	
			Maximum	***151***		***151***		***2.00***		***68.0***		***8.60***		***488***		***1.00***		***0.20***		***5.00***		***5000***		***224***		***10.1***	
			Mean	***133***		***134***		***2.00***		***11.3***		***6.95***		***126***		***0.79***		***0.18***		***1.88***		***225***		***187***		***1.83***	
			Median	***133***		***134***		***2.00***		***6.00***		***6.70***		***101***		***0.77***		***0.20***		***1.60***		***25.0***		***184***		***1.30***	
			Standard Deviation	***6.00***		***5.15***		***0.00***		***14.75***		***0.75***		***100***		***0.11***		***0.05***		***1.10***		***995***		***21.8***		***2.10***	
			Interquartile Range	***4.00***		***5.00***		***0.00***		***4.75***		***1.10***		***3.95***		***0.15***		***0.00***		***0.35***		***29.2***		***26.5***		***0.48***	
			Skew	***2.14***		***1.55***		***#DIV/0!***		***3.72***		***0.64***		***3.87***		***0.33***		***-2.71***		***2.22***		***5.00***		***0.02***		***4.00***	
			Kurtosis	***5.65***		***3.64***		***#DIV/0!***		***14.67***		***-0.39***		***14.96***		***-0.45***		***5.98***		***4.59***		***25.0***		***-0.42***		***16.5***	
			Coefficient of Variance	***0.04***		***0.04***		***0.00***		***1.30***		***0.11***		***0.80***		***0.14***		***0.26***		***0.59***		***4.43***		***0.12***		***1.15***	
			Number of Analyses	***14***		***25***		***11***		***18***		***25***		***15***		***18***		***18***		***18***		***25***		***18***		***18***	
			Number of Nondetect	***0***		***0***		***11***		***7***		***0***		***0***		***0***		***15***		***1***		***2***		***0***		***0***	
			Percent Nondetect	***0.0%***		***0.0%***		***100.0%***		***38.9%***		***0.0%***		***0.0%***		***0.0%***		***83.3%***		***5.6%***		***8.0%***		***0.0%***		***0.0%***	
MW-9S	MW-9S	08/06/85	Primary Sample									54.5															
MW-9S	MW-9S	12/05/85	Primary Sample	197		197				5	U	290		310		0.95		0.02	U	3.3						2	
MW-9S	MW-9S	02/20/86	Primary Sample	192		192				7		260		280		1.65		0.02	U	2.4						2	
MW-9S	MW-9S	10/16/86	Primary Sample	200		200				5	U	280		320		1.07		0.02		6.9						2	
MW-9S	MW-9S	04/01/87	Primary Sample	200		200				5	U	280		310		0.96		0.02	U	3.6						1	
MW-9S	MW-9S	04/27/88	Primary Sample	190		190				5	U	280		300		0.97		0.03		3.6						2	
MW-9S	MW-9S	10/05/88	Primary Sample	189		189				5	U	320		310		1.19		0.02	U	5.4						2	
MW-9S	MW-9S	10/24/89	Primary Sample	195		195				6		290		320		1.11		0.04		4.3		52		740		3	
MW-9S	MW-9S	04/11/91	Primary Sample	204		204				5		260		301		1.17		0.02		4.1		11		690		2	
MW-9S	MW-9S	04/11/91	Primary Sample											294													
MW-9S	MW-9S	01/22/92	Primary Sample	193		193				8		270		300		1.13		0.02	U	8.8		18		700		3	
MW-9S	MW-9S	01/22/92	Primary Sample											300													
MW-9S	MW-9S	04/22/92	Primary Sample	197		197				11		260		300		1.08		0.04		3.3		12		730		4	
MW-9S	MW-9S	04/22/92	Primary Sample											300													
MW-9S	MW-9S	08/07/92	Primary Sample	207		207				11		350		263		1.39				4.6		141		1,030		3	
MW-9S	MW-9S	11/04/92	Primary Sample	203		203				8		270		300		1.37		0.02		1.5		81		740		4	
MW-9S	MW-9S	11/04/92	Primary Sample											310													
MW-9S	CB-081194-18	08/11/94	Primary Sample	210		210		20	U	15		280		305		0.91		0.2	U	2.1		50		796		1.9	
MW-9S	CB-020895-5	02/08/95	Primary Sample	210		210		20	U	10		250		290		0.92		0.2	U	2.4		416		655		1.8	
MW-9S	CB-020796-1	02/07/96	Primary Sample	202		202		20	U	10		280		294		1		0.2	U	1.2		183		737		2.6	
MW-9S	MW-9S	04/18/99	Primary Sample											249													
MW-9S	CB-041800-1	04/18/00	Primary Sample	206		206		2	U	8		226		268		0.95		0.2	U	1		35		696		1.8	
MW-9S	VLF-102103-42	10/21/03	Primary Sample			203				16		227				1.04		0.2	U	1.1		205		625		2.1	
MW-9S	VLF-061027-33	10/27/06	Primary Sample			191				32		193				0.27		0.19		2.1		22		459		2.6	
MW-9S	VLF-091016-32	10/16/09	Primary Sample			220				20	U	260				1.3	J+	0.2	U	5	U	6		690		2	
			Minimum	***189***		***189***		***2.00***		***5.00***		***55***		***249***		***0.27***		***0.02***		***1.00***		***6.00***		***459***		***1.00***	
			Maximum	***210***		***220***		***20.0***		***32.0***		***350***		***320***		***1.65***		***0.20***		***8.80***		***416***		***1030***		***4.00***	
			Mean	***200***		***200***		***15.5***		***10.1***		***259***		***296***		***1.08***		***0.09***		***3.51***		***94.8***		***714***		***2.36***	
			Median	***200***		***200***		***20.0***		***8.00***		***270***		***300***		***1.07***		***0.04***		***3.30***		***50.0***		***700***		***2.00***	

Coffin Butte Descriptive Statistics
Inorganic Parameters

Location	Sample ID	Date	Type	Alkalinity (as CaCO3)		Bicarbonate Alkalinity as CACO3		Carbonate as CaCO3		Chemical Oxygen Demand		Chloride		Hardness as CaCO3		Nitrogen, Ammonia (as N)		Nitrogen, Nitrate-Nitrite		Sulfate		Suspended Solids		Total Dissolved Solids		Total Organic Carbon (TOC)	
				mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
			Standard Deviation	***6.78***		***8.09***		***9.00***		***6.81***		***58.38***		***18.05***		***0.27***		***0.09***		***2.05***		***117.54***		***124.77***		***0.76***	
			Interquartile Range	***10.00***		***11.00***		***4.50***		***6.00***		***22.50***		***16.00***		***0.23***		***0.18***		***2.35***		***123.00***		***50.00***		***0.80***	
			Skew	***-0.01***		***0.58***		***-2.00***		***2.14***		***-2.30***		***-1.26***		***-0.83***		***0.48***		***1.02***		***1.95***		***0.73***		***0.91***	
			Kurtosis	***-1.09***		***0.27***		***4.00***		***5.31***		***8.01***		***1.43***		***3.98***		***-1.97***		***1.12***		***4.09***		***4.21***		***0.81***	
			Coefficient of Variance	***0.03***		***0.04***		***0.58***		***0.67***		***0.23***		***0.06***		***0.26***		***0.95***		***0.58***		***1.24***		***0.17***		***0.32***	
			Number of Analyses	***16***		***19***		***4***		***19***		***20***		***21***		***19***		***18***		***19***		***13***		***13***		***19***	
			Number of Nondetect	***0***		***0***		***4***		***6***		***0***		***0***		***0***		***11***		***1***		***0***		***0***		***0***	
			Percent Nondetect	***0.0%***		***0.0%***		***100.0%***		***31.6%***		***0.0%***		***0.0%***		***0.0%***		***61.1%***		***5.3%***		***0.0%***		***0.0%***		***0.0%***	
P-16	CB-012398-3	01/23/98	Primary Sample			132		20	U			4.1						0.2	U	30.4				240			
P-16	CB-031999-2	03/19/99	Primary Sample	132		132		2	U	16		4.5		69.9		0.05	U	0.2	U	20.6		2440		176		7.2	J
P-16	P-16	04/19/99	Primary Sample											84.9													
P-16	CB-041900-6	04/19/00	Primary Sample	125		125		2	U	5	U	3.9		87		0.05	U	0.3		16.9		41		228		0.5	U
P-16	VLF-042701-33	04/27/01	Primary Sample	112		112		2	U	5	U	3.7		68.3		0.05	U	0.2		15.6		23		182		0.5	U
P-16	VLF-042502-25	04/25/02	Primary Sample			118						4.3										36					
P-16	VLF-102003-36	10/20/03	Primary Sample			119				5	U	3.5				0.05	U	0.2	U	12.8		5	U	212		0.5	U
P-16	VLF-101304-16	10/13/04	Primary Sample			116						3.5										16					
P-16	VLF-111605-17	11/16/05	Primary Sample			123						3.8										13					
P-16	VLF-061026-22	10/26/06	Primary Sample			116				5	U	4.1				0.05	U	0.27		12.3		5		183		0.5	U
P-16	VLF-071025-21	10/25/07	Primary Sample			120						4.5										4					
P-16	VLF-081027-34	10/27/08	Primary Sample			120						4.7										13					
P-16	VLF-091015-27	10/15/09	Primary Sample			120				20	U	4.6				0.1	U	0.2	U	10		4	U	160		2	
P-16	VLF-101013-7	10/13/10	Primary Sample			140						4.5										9.6					
			Minimum	***112***		***112***		***2.00***		***5.00***		***3.50***		***68***		***0.05***		***0.20***		***10.0***		***4.00***		***160***		***0.50***	
			Maximum	***132***		***140***		***20.0***		***20.0***		***4.70***		***87***		***0.10***		***0.30***		***30.4***		***2440***		***240***		***7.20***	
			Mean	***123***		***123***		***6.50***		***9.33***		***4.13***		***78***		***0.06***		***0.22***		***16.9***		***217***		***197***		***1.87***	
			Median	***125***		***120***		***2.00***		***5.00***		***4.10***		***77***		***0.05***		***0.20***		***15.6***		***13.0***		***183***		***0.50***	
			Standard Deviation	***10.1***		***7.85***		***9.00***		***6.83***		***0.42***		***9.79***		***0.02***		***0.04***		***6.87***		***700***		***29.6***		***2.68***	
			Interquartile Range	***10.0***		***7.00***		***4.50***		***8.25***		***0.70***		***15.9***		***0.00***		***0.04***		***6.20***		***21.3***		***41.0***		***1.13***	
			Skew	***-0.85***		***1.04***		***2.00***		***1.11***		***-0.25***		***0.02***		***2.45***		***1.40***		***1.42***		***3.46***		***0.38***		***2.20***	
			Kurtosis	***#DIV/0!***		***0.64***		***4.00***		***-1.00***		***-1.40***		***-5.64***		***6.00***		***0.24***		***2.15***		***11.99***		***-1.46***		***4.90***	
			Coefficient of Variance	***0.08***		***0.06***		***1.38***		***0.73***		***0.10***		***0.13***		***0.35***		***0.19***		***0.41***		***3.22***		***0.15***		***1.44***	
			Number of Analyses	***3***		***13***		***4***		***6***		***13***		***4***		***6***		***7***		***7***		***12***		***7***		***6***	
			Number of Nondetect	***0***		***0***		***4***		***5***		***0***		***0***		***6***		***4***		***0***		***2***		***0***		***4***	
			Percent Nondetect	***0.0%***		***0.0%***		***100.0%***		***83.3%***		***0.0%***		***0.0%***		***100.0%***		***57.1%***		***0.0%***		***16.7%***		***0.0%***		***66.7%***	
Leachate																											
L-4	VLF-121017-18	10/17/12	Primary Sample			3,300				4,200		1,900				660	J-	1	U	230		200		7,300		1,400	B
L-4	VLI-102913-36	10/29/13	Primary Sample			5,500				2,500		4,900				960		0.19	J+	18	J	44		11,000		830	B
			Minimum			***3,300***				***2,500***		***1,900***				***660***		***0.19***		***18.0***		***44.0***		***7,300***		***830***	
			Maximum			***5,500***				***4,200***		***4,900***				***960***		***1.00***		***230***		***200***		***11,000***		***1,400***	
			Mean			***4,400***				***3,350***		***3,400***				***810***		***0.60***		***124***		***122***		***9,150***		***1,115***	
			Median			***4,400***				***3,350***		***3,400***				***810***		***0.60***		***124***		***122***		***9,150***		***1,115***	
			Standard Deviation			***1,556***				***1,202***		***2,121***				***212***		***0.57***		***150***		***110***		***2,616***		***403***	
			Interquartile Range			***1,100***				***850***		***1,500***				***150***		***0.41***		***106***		***78.0***		***1,850***		***285***	
			Skew			***#DIV/0!***				***#DIV/0!***		***#DIV/0!***				***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***	
			Kurtosis			***#DIV/0!***				***#DIV/0!***		***#DIV/0!***				***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***	
			Coefficient of Variance			***0.35***				***0.36***		***0.62***				***0.26***		***0.96***		***1.21***		***0.90***		***0.29***		***0.36***	

Coffin Butte Descriptive Statistics
Inorganic Parameters

Location	Sample ID	Date	Type	Alkalinity (as CaCO3)		Bicarbonate Alkalinity as CACO3		Carbonate as CaCO3		Chemical Oxygen Demand		Chloride		Hardness as CaCO3		Nitrogen, Ammonia (as N)		Nitrogen, Nitrate-Nitrite		Sulfate		Suspended Solids		Total Dissolved Solids		Total Organic Carbon (TOC)	
				mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
		Number of Analyses				***2***				***2***		***2***				***2***		***2***		***2***		***2***		***2***		***2***	
		Number of Nondetect				***0***				***0***		***0***				***0***		***1***		***0***		***0***		***0***		***0***	
		Percent Nondetect				***0.0%***				***0.0%***		***0.0%***				***0.0%***		***50.0%***		***0.0%***		***0.0%***		***0.0%***		***0.0%***	

Coffin Butte - Descriptive Statistics
Dissolved Metals - (Filtered)

Location	Sample ID	Date	Type	Calcium		Iron		Magnesium		Manganese		Potassium		Silicon		Sodium	
				µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
MW-26	VLF-111101-1	11/01/11	Primary Sample	22,000		1,400		9,200		640		1,500	J	23,000		26,000	
MW-26	VLF-111101-2	11/01/11	Field Duplicate	23,000		4,500		9,800		680		1,600	J	27,000		27,000	
MW-26	VLF-20120117-01	01/17/12	Primary Sample	22,000		1,200		9,300		640		1,500	J	23,000		25,000	
MW-26	VLF-20120117-02	01/17/12	Field Duplicate	22,000		1,300		9,200		630		1,400	J	23,000		26,000	
MW-26	VLF-120411-18	04/11/12	Primary Sample	23,000		380		8,900		580		1,400	J	21,000		26,000	
MW-26	VLF-120713-2	07/13/12	Primary Sample	22,000		370		8,000		430		1,100	J	20,000		27,000	
MW-26	VLF-120713-3	07/13/12	Field Duplicate	22,000		400		7,900		420		1,000	J	20,000		27,000	
MW-26	VLF-121016-1	10/16/12	Primary Sample	22,000		430		8,700		610		1,300	J	23,000		27,000	
MW-26	VLF-130124-2	01/24/13	Primary Sample	23,000		400		8,600		630		1,400	J	23,000		27,000	
MW-26	VLF-130124-3	01/24/13	Field Duplicate	23,000		420		8,600		610		1,400	J	22,000		27,000	
MW-26	VLF-130419-9	04/19/13	Primary Sample	25,000		260		8,900		550		1,400	J	22,000		28,000	
MW-26	VLF-130710-2	07/10/13	Primary Sample	22,000		430		8,000		540		1,200	J	20,000		24,000	
MW-26	VLF-130710-3	07/10/13	Field Duplicate	24,000		450		8,400		540		1,300	J	21,000		26,000	
MW-26	VLI-102813-25	10/28/13	Primary Sample	22,000		440		8,900		640		1,400	J	20,000		28,000	
			Minimum	***22,000***		***260***		***7,900***		***420***		***1,000***		***20,000***		***24,000***	
			Maximum	***25,000***		***4,500***		***9,800***		***680***		***1,600***		***27,000***		***28,000***	
			Mean	***22,643***		***884***		***8,743***		***581***		***1,350***		***22,000***		***26,500***	
			Median	***22,000***		***430***		***8,800***		***610***		***1,400***		***22,000***		***27,000***	
		Standard Deviation		***929***		***1,110***		***547***		***78***		***161***		***1,922***		***1,092***	
		Interquartile Range		***1,000***		***613***		***675***		***95***		***100***		***2,750***		***1,000***	
			Skew	***1.53***		***3.04***		***0.05***		***-1.12***		***-0.85***		***1.21***		***-0.83***	
			Kurtosis	***2.03***		***10.0***		***-0.35***		***0.56***		***0.65***		***2.41***		***0.88***	
		Coefficient of Variance		***0.04***		***1.25***		***0.06***		***0.13***		***0.12***		***0.09***		***0.04***	
		Number of Analyses		***14***		***14***		***14***		***14***		***14***		***14***		***14***	
		Number of Nondetect		***0***		***0***		***0***		***0***		***0***		***0***		***0***	
		Percent Nondetect		***0.0%***		***0.0%***		***0.0%***		***0.0%***		***0.0%***		***0.0%***		***0.0%***	
MW-27	VLF-111102-8	11/02/11	Primary Sample	48,000		1,400		20,000		3,700		1,700	J	20,000		44,000	
MW-27	VLF-20120118-01	01/18/12	Primary Sample	71,000		12,000		36,000		6,400		1,600	J	18,000		39,000	
MW-27	VLF-120411-17	04/11/12	Primary Sample	61,000		3,600		27,000		5,000		1,000	J	20,000		33,000	
MW-27	VLF-120713-1	07/13/12	Primary Sample	62,000		5,100		26,000		5,300		700	J	20,000		34,000	
MW-27	VLF-121017-19	10/17/12	Primary Sample	61,000		6,100		28,000		5,100		830	J	23,000		32,000	
MW-27	VLF-130124-1	01/24/13	Primary Sample	86,000		15,000		37,000		6,900		760	J	17,000		38,000	
MW-27	VLF-130419-8	04/19/13	Primary Sample	93,000		15,000		40,000		7,400		750	J	18,000		40,000	
MW-27	VLF-130710-1	07/10/13	Primary Sample	68,000		9,100		29,000		5,400		740	J	17,000		30,000	
MW-27	VLI-102913-26	10/29/13	Primary Sample	66,000		3,200		30,000		5,800		600	J	18,000		35,000	
			Minimum	***48,000***		***1,400***		***20,000***		***3,700***		***600***		***17,000***		***30,000***	
			Maximum	***93,000***		***15,000***		***40,000***		***7,400***		***1,700***		***23,000***		***44,000***	
			Mean	***68,444***		***7,833***		***30,333***		***5,667***		***964***		***19,000***		***36,111***	
			Median	***66,000***		***6,100***		***29,000***		***5,400***		***760***		***18,000***		***35,000***	
		Standard Deviation		***13,667***		***5,159***		***6,265***		***1,114***		***404***		***1,936***		***4,457***	
		Interquartile Range		***10,000***		***8,400***		***9,000***		***1,300***		***260***		***2,000***		***6,000***	
			Skew	***0.67***		***0.40***		***0.09***		***-0.08***		***1.36***		***1.06***		***0.44***	
			Kurtosis	***0.35***		***-1.49***		***-0.46***		***0.12***		***0.31***		***1.03***		***-0.51***	
		Coefficient of Variance		***0.20***		***0.66***		***0.21***		***0.20***		***0.42***		***0.10***		***0.12***	
		Number of Analyses		***9***		***9***		***9***		***9***		***9***		***9***		***9***	
		Number of Nondetect		***0***		***0***		***0***		***0***		***0***		***0***		***0***	
		Percent Nondetect		***0.0%***		***0.0%***		***0.0%***		***0.0%***		***0.0%***		***0.0%***		***0.0%***	

Coffin Butte - Descriptive Statistics
Dissolved Metals - (Filtered)

Location	Sample ID	Date	Type	Calcium		Iron		Magnesium		Manganese		Potassium		Silicon		Sodium	
				µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
MW-22	CB-081194-13	08/11/94	Primary Sample	29,400		370		12,300		689		2,000	U	18,900		25,200	
MW-22	CB-110394-04	11/03/94	Primary Sample	28,000		350		11,900		567		2,000	U	43,400		23,400	
MW-22	CB-110394-04	11/03/94	Primary Sample	28,000		425		11,900		600		2,000	U	42,600		23,000	
MW-22	CB-110394-05	11/03/94	Field Duplicate											20,280			
MW-22	CB-110394-05	11/03/94	Field Duplicate											19,910			
MW-22	CB-020995-22	02/09/95	Primary Sample	31,800		718		13,000		680		2,000	U	22,100		22,200	
MW-22	CB-051195-4	05/11/95	Primary Sample	28,900		783		12,200		599		2,000	U	19,500		23,600	
MW-22	CB-080995-14	08/09/95	Primary Sample	29,100		766		12,100		611		2,000	U	19,400		23,400	
MW-22	CB-080995-14	08/09/95	Primary Sample	29,300		773		12,200		614		2,000	U	19,500		23,600	
MW-22	CB-110795-5	11/08/95	Primary Sample	30,000		847		12,500		662		2,000	U	20,800		24,400	
MW-22	CB-021396-27	02/13/96	Primary Sample	28,900		931		11,900		652		2,000	U	19,800		22,300	
MW-22	CB-050896-11	05/08/96	Primary Sample	30,100		1,140		12,500		654		2,000	U	20,200		23,800	
MW-22	CB-080696-1	08/06/96	Primary Sample	29,200		1,160		12,200		627		2,000	U	20,000		24,100	
MW-22	CB-042197-1	04/21/97	Primary Sample	32,400		1,140		13,600		657		2,000	U	20,900		26,000	
MW-22	CB-102197-11	10/21/97	Primary Sample	28,500		1,050		11,900		589						23,400	
MW-22	CB-042198-5	04/21/98	Primary Sample	26,700		902		11,200		530		2,000	U	18,000		23,700	
MW-22	CB-102198-22	10/21/98	Primary Sample	30,300		960		12,500		588						24,100	
MW-22	MW-22	04/19/99	Primary Sample	27,800		1,020		11,900		583		1,100				21,000	
MW-22	CB-042399-31	04/23/99	Primary Sample	29,300		949		12,100		558		2,000	U	19,900		23,000	
MW-22	CB-101999-10	10/19/99	Primary Sample	28,100		1,020		11,600		542						22,100	
MW-22	CB-041900-7	04/19/00	Primary Sample	29,300		973		11,900		561		2,000	U	18,900		25,000	
MW-22	CB-101900-14	10/19/00	Primary Sample	29,000		952		12,400		541						21,800	
MW-22	VLF-042401-4	04/24/01	Primary Sample	29,900		942		11,200		578		2,000	U	17,700		23,200	
MW-22	VLF-011017-1	10/17/01	Primary Sample	28,700		968		12,300		582						24,900	
MW-22	VLF-042302-1	04/23/02	Primary Sample	28,900		1,090		12,400		585						23,600	
MW-22	VLF-101502-8	10/15/02	Primary Sample	29,100		978		12,200		600						24,700	
MW-22	VLF-042903-2	04/29/03	Primary Sample	29,000		1,040		12,000		575						24,600	
MW-22	DEQ-001-14459	10/14/03	Primary Sample	28,900		877		12,100		556		1,050		20,140		23,300	
MW-22	DEQ-002-14459	10/14/03	Field Duplicate	29,500		890		12,300		557		1,020		19,953		23,700	
MW-22	VLF-101403-3	10/14/03	Primary Sample	29,200		915		12,200		589		2,000	U	19,200		23,500	
MW-22	VLF-042004-12	04/20/04	Primary Sample	29,200		819		12,100		569						25,500	
MW-22	VLF-101304-15	10/13/04	Primary Sample	27,200		849		11,300		545						25,000	
MW-22	VLF-041905-1	04/20/05	Primary Sample	28,800		943		11,800		585						23,000	
MW-22	VLF-111605-16	11/16/05	Primary Sample	28,200		416		11,300		477						26,800	
MW-22	VLF-060418-9	04/18/06	Primary Sample	29,700		1,040		12,200		591						24,800	
MW-22	DEQ-14459	10/24/06	Primary Sample	29,100		924		12,000		568		1,000		19,770		24,200	
MW-22	VLF-061024-5	10/24/06	Primary Sample	27,000		866		11,300		538		2,000	U	18,100		24,000	
MW-22	VLF-070417-10	04/17/07	Primary Sample	29,000		682		12,100		563						23,600	
MW-22	VLF-071025-20	10/25/07	Primary Sample	29,000		730		12,000		500						27,000	
MW-22	VLF-080415-8	04/15/08	Primary Sample	28,000		910		12,000		520						26,000	
MW-22	VLF-081027-31	10/27/08	Primary Sample	27,000		430		11,000		470						27,000	
MW-22	VLF090414-15	04/14/09	Primary Sample	28,000		820		12,000		560						25,000	
MW-22	VLF-091015-26	10/15/09	Primary Sample	29,000		960		13,000		550		900	J	18,000		25,000	
MW-22	VLF-100406-13	04/06/10	Primary Sample	26,000		940		11,000		570						25,000	
MW-22	VLF-101013-9	10/13/10	Primary Sample	28,000		830		12,000		550						25,000	
MW-22	VLF-110412-4	04/12/11	Primary Sample	26,000		940		11,000		560						25,000	
			Minimum	***26,000***		***350***		***11,000***		***470***		***900***		***17,700***		***21,000***	

Coffin Butte - Descriptive Statistics
Dissolved Metals - (Filtered)

Location	Sample ID	Date	Type	Calcium		Iron		Magnesium		Manganese		Potassium		Silicon		Sodium	
				µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
			Maximum	***32,400***		***1,160***		***13,600***		***689***		***2,000***		***43,400***		***27,000***	
			Mean	***28,784***		***864***		***12,014***		***578***		***1,786***		***21,540***		***24,148***	
			Median	***29,000***		***920***		***12,050***		***573***		***2,000***		***19,850***		***24,050***	
			Standard Deviation	***1,241***		***201***		***532***		***47.6***		***417***		***6,687***		***1,329***	
			Interquartile Range	***1,300***		***159***		***325***		***44.8***		***0.00***		***1,095***		***1,600***	
			Skew	***0.18***		***-1.24***		***0.18***		***0.26***		***-1.49***		***3.09***		***0.12***	
			Kurtosis	***1.69***		***1.24***		***1.21***		***0.54***		***0.28***		***8.60***		***0.16***	
			Coefficient of Variance	***0.04***		***0.23***		***0.04***		***0.08***		***0.23***		***0.31***		***0.06***	
			Number of Analyses	***44***		***44***		***44***		***44***		***23***		***24***		***44***	
			Number of Nondetect	***0***		***0***		***0***		***0***		***18***		***0***		***0***	
			Percent Nondetect	***0.0%***		***0.0%***		***0.0%***		***0.0%***		***78.3%***		***0.0%***		***0.0%***	
MW-23	CB-081194-17	08/11/94	Primary Sample	37,400		28		15,300		1,490		2,000	U	14,200		25,600	
MW-23	CB-130394-6	11/03/94	Primary Sample	48,100		37		19,600		1,500		2,000	U	34,400		28,900	
MW-23	CB-130394-6	11/03/94	Primary Sample											16,070			
MW-23	CB-020995-20	02/09/95	Primary Sample	58,000		347		22,900		2,150		2,000	U	16,500		25,800	
MW-23	CB-020995-20	02/09/95	Primary Sample	57,400		345		22,800		2,160		2,000	U	16,400		26,400	
MW-23	CB-051195-5	05/11/95	Primary Sample	51,900		349		21,900		2,250		2,000	U	28,100		15,200	
MW-23	CB-081095-16	08/10/95	Primary Sample	53,800		453		21,700		2,480		2,000	U	15,700		30,700	
MW-23	COFFIN38	08/10/95	Primary Sample	56,000		470		24,000		2,600		500	U	33,000		31,000	
MW-23	CB-110795-6	11/08/95	Primary Sample	61,500		538		26,400		2,890		2,000	U	17,700		31,300	
MW-23	CB-021396-30	02/13/96	Primary Sample	59,200		602		23,900		2,390		2,000	U	17,600		29,200	
MW-23	CB-050896-5	05/08/96	Primary Sample	58,700		710		23,800		2,410		2,000	U	17,200		28,800	
MW-23	CB-050896-5	05/08/96	Primary Sample	60,000		738		24,300		2,470		2,000	U	17,500		29,500	
MW-23	CB-042397-23	04/23/97	Primary Sample	69,100		844		31,000		2,880		2,000	U	18,300		36,500	
MW-23	CB-102197-10	10/21/97	Primary Sample	69,600		1,550		29,900		3,080		2,000	U	18,300		34,600	
MW-23	CB-042398-24	04/23/98	Primary Sample	68,400		1,670		29,200		2,880		2,000	U	19,100		33,400	
MW-23	CB-102198-25	10/21/98	Primary Sample	79,800		2,380		34,200		3,590						38,500	
MW-23	CB-042099-1	04/20/99	Primary Sample	64,100		1,860		27,200		2,890		2,000	U	17,100		34,100	
MW-23	CB-101999-9	10/19/99	Primary Sample	80,600		3,420		34,500		3,620						37,400	
MW-23	CB-042100-35	04/21/00	Primary Sample	69,300		1,920		30,100		3,140		2,000	U	20,000		36,500	
MW-23	CB-101900-13	10/19/00	Primary Sample	76,700		3,840		33,100		3,570						36,400	
MW-23	VLF-042401-7	04/24/01	Primary Sample	62,400		623		26,000		2,630		2,000	U	18,900		33,700	
MW-23	VLF-011017-4	10/17/01	Primary Sample	77,500		4,280		33,700		3,510						43,700	
MW-23	VLF-042502-24	04/25/02	Primary Sample	63,800		2,060		28,200		2,990						33,900	
MW-23	VLF-101502-9	10/15/02	Primary Sample	70,700		3,620		30,600		2,500						40,800	
MW-23	VLF-042903-1	04/29/03	Primary Sample	61,800		1,870		27,300		1,630						35,400	
MW-23	VLF-102003-37	10/20/03	Primary Sample	63,600		3,290		29,000		2,010		2,000	U	20,500		36,900	
MW-23	VLF-042004-13	04/20/04	Primary Sample	56,400		1,800		23,200		1,180						35,400	
MW-23	VLF-101404-30	10/14/04	Primary Sample	60,300		4,070		24,800		2,620						34,900	
MW-23	VLF-041905-2	04/20/05	Primary Sample	50,100		3,350		20,700		1,920						29,400	
MW-23	VLF-111705-27	11/17/05	Primary Sample	57,200		4,170		23,500		1,800						35,800	
MW-23	VLF-060418-10	04/18/06	Primary Sample	46,800		2,370		19,300		1,400						31,900	
MW-23	VLF-060418-11	04/18/06	Field Duplicate	46,800		2,160		19,200		1,280						31,500	
MW-23	VLF-061026-23	10/26/06	Primary Sample	48,600		3,750		20,500		1,910		2,000	U	19,600		34,700	
MW-23	VLF-070417-11	04/17/07	Primary Sample	39,700		1,500		16,800		760						28,500	
MW-23	VLF-071025-22	10/25/07	Primary Sample	43,000		4,600		18,000		1,700						30,000	
MW-23	VLF-071025-23	10/25/07	Field Duplicate	45,000		5,400		19,000		2,400						31,000	

Coffin Butte - Descriptive Statistics
Dissolved Metals - (Filtered)

Location	Sample ID	Date	Type	Calcium		Iron		Magnesium		Manganese		Potassium		Silicon		Sodium	
				µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
MW-23	VLF-080416-11	04/16/08	Primary Sample	33,000		1,200		14,000		660						28,000	
MW-23	VLF081023-24	10/23/08	Primary Sample	36,000		2,500		15,000		1,000						32,000	
MW-23	VLF090414-17	04/14/09	Primary Sample	36,000		1,900		16,000		1,100						27,000	
MW-23	DEQ-14460	10/14/09	Primary Sample	46,600		6,760		20,400		2,200		500	U	19,800		31,200	
MW-23	DEQ-14461	10/14/09	Field Duplicate	44,500		6,750		19,300		2,220		500	U	18,200		29,800	
MW-23	VLF-091014-6	10/14/09	Primary Sample	47,000		6,600		21,000		2,200		390	J	18,000		32,000	
MW-23	VLF-100406-12	04/06/10	Primary Sample	39,000		2,700		15,000		1,500						29,000	
MW-23	VLF-101013-10	10/13/10	Primary Sample	40,000		4,500		17,000		2,100						27,000	
MW-23	VLF-101013-11	10/13/10	Field Duplicate	41,000		4,600		18,000		2,100						27,000	
MW-23	VLF-110412-5	04/12/11	Primary Sample	34,000		2,400		15,000		1,500						26,000	
MW-23	VLF-111102-14	11/02/11	Primary Sample	33,000		1,800		15,000		1,600						27,000	
MW-23	VLF-120410-1	04/10/12	Primary Sample	33,000		1,500		14,000		1,000						25,000	
MW-23	VLF-121016-2	10/16/12	Primary Sample	33,000		2,300		14,000		1,900						25,000	
MW-23	VLF-130419-13	04/19/13	Primary Sample	36,000		770		15,000		580						28,000	
MW-23	VLI-102613-1	10/26/13	Primary Sample	30,000		850		13,000		540						27,000	
			Minimum	***30,000***		***28***		***13,000***		***540***		***390***		***14,200***		***15,200***	
			Maximum	***80,600***		***6,760***		***34,500***		***3,620***		***2,000***		***34,400***		***43,700***	
			Mean	***52,708***		***2,363***		***22,346***		***2,098***		***1,722***		***19,660***		***31,166***	
			Median	***52,850***		***1,910***		***21,800***		***2,155***		***2,000***		***18,200***		***31,000***	
			Standard Deviation	***13,971***		***1,789***		***6,109***		***807***		***603***		***5,140***		***4,881***	
			Interquartile Range	***22,000***		***2,782***		***9,750***		***1,115***		***0.00***		***2,550***		***6,675***	
			Skew	***0.19***		***0.85***		***0.34***		***-0.03***		***-1.78***		***2.12***		***-0.19***	
			Kurtosis	***-0.93***		***0.11***		***-0.88***		***-0.57***		***1.28***		***3.87***		***1.51***	
			Coefficient of Variance	***0.27***		***0.76***		***0.27***		***0.38***		***0.35***		***0.26***		***0.16***	
			Number of Analyses	***50***		***50***		***50***		***50***		***22***		***23***		***50***	
			Number of Nondetect	***0***		***0***		***0***		***0***		***21***		***0***		***0***	
			Percent Nondetect	***0.0%***		***0.0%***		***0.0%***		***0.0%***		***95.5%***		***0.0%***		***0.0%***	
MW-25	MW-25	04/18/99	Primary Sample	22,300		736		10,100		882		690				20,200	
MW-25	CB-072199-3	07/21/99	Primary Sample	22,200		151		9,620		768		2,000	U	16,800		21,600	
MW-25	CB-102099-16	10/20/99	Primary Sample	21,500		658		9,560		792		2,000	U	19,500		20,200	
MW-25	CB-012100-7	01/21/00	Primary Sample	21,700		655		9,760		842		2,000	U	19,200		22,100	
MW-25	CB-041800-5	04/19/00	Primary Sample	23,000		690		10,000		840		2,000	U	19,300		22,800	
MW-25	CB-102000-18	10/20/00	Primary Sample	23,500		727		10,400		955		2,000	U	20,000		23,200	
MW-25	CB-102000-19	10/20/00	Field Duplicate	23,000		715		10,100		928		2,000	U	19,500		22,700	
MW-25	CB-012301-4	01/23/01	Primary Sample	22,200		630		9,880		818		2,000	U	20,200		22,700	
MW-25	CB-012301-5	01/23/01	Field Duplicate	21,900		634		9,770		818		2,000	U	20,000		22,600	
MW-25	VLF-042401-5	04/24/01	Primary Sample	21,800		804		8,790		535		2,000	U	19,200		21,800	
MW-25	VLF-042401-6	04/24/01	Field Duplicate	22,500		1,030		9,070		567		2,000	U	20,200		22,500	
MW-25	VLF-071801-MW-2	07/18/01	Primary Sample	22,700		511		9,830		568		2,000	U	20,200		23,100	
MW-25	VLF-071801-MW-2	07/18/01	Field Duplicate	22,400		524		9,710		560		2,000	U	19,900		22,700	
MW-25	VLF-011017-2	10/17/01	Primary Sample	21,200		516		9,430		541		2,000	U	19,500		23,000	
MW-25	VLF-042302-2	04/23/02	Primary Sample	24,000		564		10,700		587						25,600	
MW-25	VLF-102003-35	10/20/03	Primary Sample	21,100		543		9,410		545		2,000	U	20,300		22,300	
MW-25	VLF-101304-14	10/13/04	Primary Sample	21,700		606		9,600		600						23,600	
MW-25	VLF-111605-18	11/16/05	Primary Sample	22,600		498		9,750		542						24,700	
MW-25	VLF-061026-20	10/26/06	Primary Sample	20,500		483		9,150		509		2,000	U	20,500		23,400	
MW-25	VLF-061026-21	10/26/06	Field Duplicate	20,400		479		9,090		498		2,000	U	20,400		23,100	

Coffin Butte - Descriptive Statistics
Dissolved Metals - (Filtered)

Location	Sample ID	Date	Type	Calcium		Iron		Magnesium		Manganese		Potassium		Silicon		Sodium	
				µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
MW-25	VLF-071025-19	10/25/07	Primary Sample	22,000		450		9,600		490						25,000	
MW-25	VLF-081027-32	10/27/08	Primary Sample	21,000		290		9,400		300						25,000	
MW-25	VLF-081027-33	10/27/08	Field Duplicate	21,000		460		9,100		500						24,000	
MW-25	VLF-091015-25	10/15/09	Primary Sample	23,000		500		11,000		570		750	J	20,000		24,000	
MW-25	VLF-101013-8	10/13/10	Primary Sample	21,000		470		9,400		520						23,000	
			Minimum	***20,400***		***151***		***8,790***		***300***		***690***		***16,800***		***20,200***	
			Maximum	***24,000***		***1,030***		***11,000***		***955***		***2,000***		***20,500***		***25,600***	
			Mean	***22,008***		***573***		***9,689***		***643***		***1,858***		***19,688***		***22,996***	
			Median	***22,000***		***543***		***9,620***		***568***		***2,000***		***20,000***		***23,000***	
			Standard Deviation	***922***		***171***		***512***		***171***		***414***		***857***		***1,312***	
			Interquartile Range	***1,400***		***175***		***480***		***283***		***0.00***		***700***		***1,100***	
			Skew	***0.16***		***0.15***		***0.74***		***0.35***		***-2.71***		***-2.57***		***-0.17***	
			Kurtosis	***-0.44***		***2.03***		***0.86***		***-0.80***		***6.00***		***8.32***		***0.52***	
			Coefficient of Variance	***0.04***		***0.30***		***0.05***		***0.27***		***0.22***		***0.04***		***0.06***	
			Number of Analyses	***25***		***25***		***25***		***25***		***18***		***17***		***25***	
			Number of Nondetect	***0***		***0***		***0***		***0***		***16***		***0***		***0***	
			Percent Nondetect	***0.0%***		***0.0%***		***0.0%***		***0.0%***		***88.9%***		***0.0%***		***0.0%***	
MW-9S	MW-9S	08/06/85	Primary Sample	868,900				12,490				24,200				710,000	
MW-9S	MW-9S	12/05/85	Primary Sample	98,000		80		16,000		580							
MW-9S	MW-9S	02/20/86	Primary Sample	88,000		190		15,000		570							
MW-9S	MW-9S	10/16/86	Primary Sample	99,000		190		17,000		580							
MW-9S	MW-9S	04/01/87	Primary Sample			500				800							
MW-9S	MW-9S	04/27/88	Primary Sample	95,000		800		15,000		800							
MW-9S	MW-9S	10/05/88	Primary Sample	100,000		650		15,000		790		1,200				130,000	
MW-9S	MW-9S	04/09/91	Primary Sample	96,000		330		15,000		960		1,500		40,000		130,000	
MW-9S	MW-9S	11/06/91	Primary Sample	98,000		830		14,000		800		1,500		40,000		130,000	
MW-9S	MW-9S	01/16/92	Primary Sample			1,020				730							
MW-9S	MW-9S	04/21/92	Primary Sample	97,000		1,100	U	14,000		750		1,400		39,000		130,000	
MW-9S	MW-9S	11/04/92	Primary Sample	97,000		1,300		15,000		770		1,300		41,000		120,000	
MW-9S	MW-9S	11/04/92	Primary Sample							790						120,000	
MW-9S	CB-081194-18	08/11/94	Primary Sample	98,400		1,350		14,300		748		2,000	U	17,900		138,000	
MW-9S	CB-020895-5	02/08/95	Primary Sample	92,900		586		13,300		749		2,000	U	19,000		130,000	
MW-9S	CB-020796-1	02/07/96	Primary Sample	95,400		250		13,600		716		2,000	U	19,500		128,000	
MW-9S	MW-9S	04/18/99	Primary Sample	79,100		1,210		11,200		732		1,480				113,000	
MW-9S	CB-041800-1	04/18/00	Primary Sample	79,000		1,070		11,100		593		2,000	U	17,600		114,000	
MW-9S	VLF-102103-42	10/21/03	Primary Sample	78,300		2,360		11,500		673		2,000	U	19,400		114,000	
MW-9S	VLF-061027-33	10/27/06	Primary Sample	76,100		1,510		10,800		800		2,000	U	19,300		121,000	
MW-9S	VLF-091016-32	10/16/09	Primary Sample	100,000		1,500		15,000		740		1,300	J	18,000		130,000	
			Minimum	***76,100***		***80***		***10,800***		***570***		***1,200***		***17,600***		***113,000***	
			Maximum	***868,900***		***2,360***		***17,000***		***960***		***24,200***		***41,000***		***710,000***	
			Mean	***135,339***		***886***		***13,849***		***734***		***3,277***		***26,427***		***163,867***	
			Median	***96,500***		***830***		***14,150***		***749***		***1,750***		***19,400***		***130,000***	
			Standard Deviation	***183,260***		***585***		***1,788***		***96.0***		***6,030***		***10,788***		***151,267***	
			Interquartile Range	***9,075***		***840***		***2,308***		***87.3***		***580***		***21,000***		***10,000***	
			Skew	***4.23***		***0.68***		***-0.38***		***-0.09***		***3.72***		***0.65***		***3.86***	
			Kurtosis	***17.9***		***0.59***		***-0.68***		***0.68***		***13.9***		***-1.94***		***14.9***	
			Coefficient of Variance	***1.35***		***0.66***		***0.13***		***0.13***		***1.84***		***0.41***		***0.92***	

Coffin Butte - Descriptive Statistics
Dissolved Metals - (Filtered)

Location	Sample ID	Date	Type	Calcium		Iron		Magnesium		Manganese		Potassium		Silicon		Sodium	
				µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
			Number of Analyses	***18***		***19***		***18***		***20***		***14***		***11***		***15***	
			Number of Nondetect	***0***		***1***		***0***		***0***		***6***		***0***		***0***	
			Percent Nondetect	***0.0%***		***5.3%***		***0.0%***		***0.0%***		***42.9%***		***0.0%***		***0.0%***	
P-16	CB-012398-3	01/23/98	Primary Sample	19,900		20	U	8,250		82		2,000	U	12,700		38,100	
P-16	CB-031999-2	03/19/99	Primary Sample	16,500		25		6,950		174		2,000	U	15,800		35,700	
P-16	P-16	04/19/99	Primary Sample	19,900		8		8,300		1.57		334				29,300	
P-16	CB-041900-6	04/19/00	Primary Sample	20,000		20	U	8,270		5	U	2,000	U	15,800		32,300	
P-16	VLF-042701-33DIS	04/27/01	Primary Sample	15,700		20	U	6,850		5		2,000	U	19,900		37,200	
P-16	VLF-042502-25	04/25/02	Primary Sample	16,200		20	U	6,960		5	U					30,400	
P-16	VLF-102003-36	10/20/03	Primary Sample	15,900		20	U	6,910		23.4		2,000	U	17,400		29,800	
P-16	VLF-101304-16	10/13/04	Primary Sample	15,700		31.6		6,770		42.8						32,000	
P-16	VLF-111605-17	11/16/05	Primary Sample	17,100		20	U	7,250		98.6						31,800	
P-16	VLF-061026-22	10/26/06	Primary Sample	16,700		20	U	7,280		92.9		2,000	U	17,300		30,500	
P-16	VLF-071025-21	10/25/07	Primary Sample	17,000		100	U	7,200		16						31,000	
P-16	VLF-081027-34	10/27/08	Primary Sample	17,000		100	U	6,900		8.6						32,000	
P-16	VLF-091015-27	10/15/09	Primary Sample	18,000		100	U	8,400		2.3	UB	310	J	17,000		28,000	
P-16	VLF-101013-7	10/13/10	Primary Sample	19,000		39	J	8,200		5.7						28,000	
			Minimum	***15,700***		***8***		***6,770***		***1.6***		***310***		***12,700***		***28,000***	
			Maximum	***20,000***		***100***		***8,400***		***174***		***2,000***		***19,900***		***38,100***	
			Mean	***17,471***		***38.8***		***7,464***		***40.2***		***1,581***		***16,557***		***31,864***	
			Median	***17,000***		***20.0***		***7,225***		***12.3***		***2,000***		***17,000***		***31,400***	
			Standard Deviation	***1,600***		***33.9***		***653***		***52.3***		***777***		***2,185***		***3,135***	
			Interquartile Range	***2,475***		***17.2***		***1,318***		***67.2***		***417***		***1,550***		***2,275***	
			Skew	***0.65***		***1.41***		***0.52***		***1.56***		***-1.44***		***-0.44***		***0.88***	
			Kurtosis	***-1.12***		***0.24***		***-1.77***		***1.96***		***0.00***		***1.71***		***0.03***	
			Coefficient of Variance	***0.09***		***0.87***		***0.09***		***1.30***		***0.49***		***0.13***		***0.10***	
			Number of Analyses	***14***		***14***		***14***		***14***		***8***		***7***		***14***	
			Number of Nondetect	***0***		***10***		***0***		***3***		***6***		***0***		***0***	
			Percent Nondetect	***0.0%***		***71.4%***		***0.0%***		***21.4%***		***75.0%***		***0.0%***		***0.0%***	
Leachate																	
L-4	VLF-121017-18	10/17/12	Primary Sample	510,000		21,000		340,000		10,000		290,000		23,000		1,000,000	
L-4	VLI-102913-36	10/29/13	Primary Sample	290,000		5,200		500,000		1,700		620,000		23,000		2,500,000	
			Minimum	***290,000***		***5,200***		***340,000***		***1,700***		***290,000***		***23,000***		***1,000,000***	
			Maximum	***510,000***		***21,000***		***500,000***		***10,000***		***620,000***		***23,000***		***2,500,000***	
			Mean	***400,000***		***13,100***		***420,000***		***5,850***		***455,000***		***23,000***		***1,750,000***	
			Median	***400,000***		***13,100***		***420,000***		***5,850***		***455,000***		***23,000***		***1,750,000***	
			Standard Deviation	***155,563***		***11,172***		***113,137***		***5,869***		***233,345***		***0***		***1,060,660***	
			Interquartile Range	***110,000***		***7,900***		***80,000***		***4,150***		***165,000***		***0***		***750,000***	
			Skew	***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***	
			Kurtosis	***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***	
			Coefficient of Variance	***0.39***		***0.85***		***0.27***		***1.00***		***0.51***		***0.00***		***0.61***	
			Number of Analyses	***2***		***2***		***2***		***2***		***2***		***2***		***2***	
			Number of Nondetect	***0***		***0***		***0***		***0***		***0***		***0***		***0***	
			Percent Nondetect	***0.0%***		***0.0%***		***0.0%***		***0.0%***		***0.0%***		***0.0%***		***0.0%***	

Coffin Butte Descriptive Statistics
Total Metals (Unfiltered)

Location	Sample ID	Date	Type	Antimony		Arsenic		Barium		Beryllium		Cadmium		Chromium		Cobalt		Copper	
				UG/L		ug/L		UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
MW-26	VLF-111101-1	11/01/11	Primary Sample	0.92	J	14		35		1	U	1	U	1.4	J	1.1		3.7	UJB
MW-26	VLF-111101-2	11/01/11	Field Duplicate	0.86	J	12		32		1	U	1	U	1.3	J	1		2.5	UJB
MW-26	VLF-20120117-01	01/17/12	Primary Sample	2	U	14		27		1	U	1	U	3	U	0.76	J	1.1	J
MW-26	VLF-20120117-02	01/17/12	Field Duplicate	2	U	14		27		1	U	1	U	3	U	0.82	J	1.3	J
MW-26	VLF-120411-18	04/11/12	Primary Sample	2	UB	14		27		1	U	1	U	3	U	0.96	J	1.3	J
MW-26	VLF-120713-2	07/13/12	Primary Sample	2	U	15		25		1	U	1	U	3	U	0.48	J	1.1	J
MW-26	VLF-120713-3	07/13/12	Field Duplicate	2	U	16		26		1	U	1	U	3	U	0.47	J	0.79	J
MW-26	VLF-121016-1	10/16/12	Primary Sample	2	U	15		28		1	U	1	U	3	U	0.57	J	1	J
MW-26	VLF-130124-2	01/24/13	Primary Sample	2	U	14		24		1	U	0.11	J	3	U	0.36	J	2	UB
MW-26	VLF-130124-3	01/24/13	Field Duplicate	2	U	14		26		1	U	0.21	J	3	U	0.3	J	2	UB
MW-26	VLF-130419-9	04/19/13	Primary Sample	2	U	12		28		1	U	1	U	3	U	0.65	J	0.75	J
MW-26	VLF-130710-2	07/10/13	Primary Sample	2	U	14		27		1	U	0.045	J	3	U	0.46	J	0.78	J
MW-26	VLF-130710-3	07/10/13	Field Duplicate	2	U	13		25		1	U	1	U	3	U	0.49	J	1.2	J
MW-26	VLI-102813-25	10/28/13	Primary Sample	2	U	14		27		1	U	0.043	J	3	U	0.43	J	0.7	J
			Minimum	***0.86***		***12.0***		***24.0***		***1.0***		***0.043***		***1.3***		***0.30***		***0.70***	
			Maximum	***2.0***		***16.0***		***35.0***		***1.0***		***1.0***		***3.0***		***1.1***		***3.7***	
			Mean	***1.8***		***13.9***		***27.4***		***1.0***		***0.74***		***2.76***		***0.63***		***1.44***	
			Median	***2.00***		***14.0***		***27.0***		***1.00***		***1.00***		***3.00***		***0.53***		***1.15***	
			Standard Deviation	***0.40***		***1.07***		***2.87***		***0.00***		***0.42***		***0.60***		***0.25***		***0.84***	
			Interquartile Range	***0.00***		***0.00***		***1.75***		***0.00***		***0.59***		***0.00***		***0.34***		***0.98***	
			Skew	***-2.30***		***-0.28***		***1.72***		***#DIV/0!***		***-1.10***		***-2.30***		***0.63***		***1.71***	
			Kurtosis	***3.82***		***0.75***		***3.22***		***#DIV/0!***		***-0.91***		***3.83***		***-0.89***		***2.99***	
			Coefficient of Variance	***0.22***		***0.08***		***0.10***		***0.00***		***0.57***		***0.22***		***0.40***		***0.58***	
			Number of Analyses	***14***		***14***		***14***		***14***		***14***		***14***		***14***		***14***	
			Number of Nondetect	***12***		***0***		***0***		***14***		***10***		***12***		***0***		***2***	
			Percent Nondetect	***85.7%***		***0.0%***		***0.0%***		***100.0%***		***71.4%***		***85.7%***		***0.0%***		***14.3%***	
MW-27	VLF-111102-8	11/02/11	Primary Sample	0.21	J	9.8		290		0.46	J	0.2	J	4.9		15		13	
MW-27	VLF-20120118-01	01/18/12	Primary Sample	2	U	4.3	J	200		1	U	0.1	J	1.4	J	36		3.4	
MW-27	VLF-120411-17	04/11/12	Primary Sample	2	UB	19		130		1	U	0.45	J	1.6	J	18		4.2	
MW-27	VLF-120713-1	07/13/12	Primary Sample	2	U	19		220		0.45	J+	0.33	J+	4.2		30		11	
MW-27	VLF-121017-19	10/17/12	Primary Sample	2	U	18		93		1	U	0.072	J	3	U	15		1.5	J
MW-27	VLF-130124-1	01/24/13	Primary Sample	2	U	9.8		97		1	U	1	U	3	U	34		2	UB
MW-27	VLF-130419-8	04/19/13	Primary Sample	2	U	10		100		1	U	1	U	3	U	35		2	U
MW-27	VLF-130710-1	07/10/13	Primary Sample	2	U	14		85		1	U	0.058	J	3	U	22		1.3	J
MW-27	VLI-102913-26	10/29/13	Primary Sample	2	U	11		100		1	U	1	U	3	U	34		1.8	J
			Minimum	***0.21***		***4.3***		***85.0***		***0.45***		***0.06***		***1.4***		***15.0***		***1.30***	
			Maximum	***2.0***		***19.0***		***290***		***1.0***		***1.0***		***4.9***		***36.0***		***13.0***	
			Mean	***1.8***		***12.8***		***146***		***0.88***		***0.47***		***3.01***		***26.6***		***4.47***	
			Median	***2.00***		***11.0***		***100***		***1.00***		***0.33***		***3.00***		***30.0***		***2.00***	
			Standard Deviation	***0.60***		***5.08***		***72.9***		***0.24***		***0.42***		***1.09***		***8.97***		***4.40***	
			Interquartile Range	***0.00***		***8.20***		***103***		***0.00***		***0.90***		***0.00***		***16.0***		***2.40***	
			Skew	***-3.00***		***-0.07***		***1.18***		***-1.62***		***0.55***		***0.18***		***-0.33***		***1.50***	
			Kurtosis	***9.00***		***-0.91***		***0.20***		***0.74***		***-1.80***		***0.19***		***-2.06***		***0.74***	
			Coefficient of Variance	***0.33***		***0.40***		***0.50***		***0.27***		***0.89***		***0.36***		***0.34***		***0.98***	
			Number of Analyses	***9***		***9***		***9***		***9***		***9***		***9***		***9***		***9***	
			Number of Nondetect	***8***		***0***		***0***		***7***		***3***		***5***		***0***		***2***	
			Percent Nondetect	***88.9%***		***0.0%***		***0.0%***		***77.8%***		***33.3%***		***55.6%***		***0.0%***		***22.2%***	

Coffin Butte Descriptive Statistics
Total Metals (Unfiltered)

Location	Sample ID	Date	Type	Lead		Nickel		Selenium		Silver		Thallium		Vanadium		Zinc	
				UG/L		UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
MW-26	VLF-111101-1	11/01/11	Primary Sample	0.66	J	2	UB	5	U	0.02	J	1	U	3.8	J	4.4	J
MW-26	VLF-111101-2	11/01/11	Field Duplicate	0.49	J	2	UB	5	U	1	U	1	U	3.2	J	3.1	J
MW-26	VLF-20120117-01	01/17/12	Primary Sample	0.27	J	0.7	J	5	U	1	U	1	U	1.3	J	2.4	J
MW-26	VLF-20120117-02	01/17/12	Field Duplicate	0.29	J	0.76	J	5	U	1	U	1	U	1.5	J	2.7	J
MW-26	VLF-120411-18	04/11/12	Primary Sample	0.4	J	1.1	J	5	U	1	U	1	U	2.5	J	10	U
MW-26	VLF-120713-2	07/13/12	Primary Sample	0.17	J	0.64	J	5	U	0.021	J	1	U	5	U	10	U
MW-26	VLF-120713-3	07/13/12	Field Duplicate	0.16	J	0.66	J	5	U	1	U	1	U	5	U	8.2	J+
MW-26	VLF-121016-1	10/16/12	Primary Sample	0.28	J	0.71	J	5	U	1	U	1	U	1.4	J	10	U
MW-26	VLF-130124-2	01/24/13	Primary Sample	1	U	0.32	J	5	U	1	U	1	U	5	U	10	U
MW-26	VLF-130124-3	01/24/13	Field Duplicate	1	U	0.29	J	5	U	1	U	1	U	5	U	10	U
MW-26	VLF-130419-9	04/19/13	Primary Sample	0.41	J	0.64	J	5	U	1	U	1	U	2	J	10	U
MW-26	VLF-130710-2	07/10/13	Primary Sample	0.2	J	0.47	J	5	U	1	U	1	U	5	U	3.7	J
MW-26	VLF-130710-3	07/10/13	Field Duplicate	0.25	J	0.52	J	5	U	1	U	1	U	1.2	J	2.7	J
MW-26	VLI-102813-25	10/28/13	Primary Sample	0.16	J	2	UB	5	U	1	U	1	U	1.4	J	6.3	J
			Minimum	***0.16***		***0.29***		***5.0***		***0.02***		***1.0***		***1.2***		***2.4***	
			Maximum	***1.0***		***2.0***		***5.0***		***1.0***		***1.0***		***5.0***		***10.0***	
			Mean	***0.41***		***0.92***		***5.0***		***0.86***		***1.00***		***3.09***		***6.68***	
			Median	***0.29***		***0.68***		***5.00***		***1.00***		***1.00***		***2.85***		***7.25***	
			Standard Deviation	***0.29***		***0.62***		***0.00***		***0.36***		***0.00***		***1.65***		***3.35***	
			Interquartile Range	***0.26***		***0.47***		***0.00***		***0.00***		***0.00***		***3.58***		***6.75***	
			Skew	***1.38***		***1.19***		***#DIV/0!***		***-2.29***		***#DIV/0!***		***0.15***		***-0.16***	
			Kurtosis	***0.89***		***-0.09***		***#DIV/0!***		***3.79***		***#DIV/0!***		***-1.95***		***-2.04***	
			Coefficient of Variance	***0.70***		***0.68***		***0.00***		***0.41***		***0.00***		***0.53***		***0.50***	
			Number of Analyses	***14***		***14***		***14***		***14***		***14***		***14***		***14***	
			Number of Nondetect	***2***		***3***		***14***		***12***		***14***		***5***		***6***	
			Percent Nondetect	***14.3%***		***21.4%***		***100.0%***		***85.7%***		***100.0%***		***35.7%***		***42.9%***	
MW-27	VLF-111102-8	11/02/11	Primary Sample	4.5		11		5	U	0.036	J	0.083	J	14		14	UJB
MW-27	VLF-20120118-01	01/18/12	Primary Sample	1.1		12		5	U	1	U	1	U	3.6	J	8.2	J
MW-27	VLF-120411-17	04/11/12	Primary Sample	1.9		7.1		5	U	1	U	1	U	4.1	J	5.7	J
MW-27	VLF-120713-1	07/13/12	Primary Sample	5.3		9.8		5	U	0.036	J	0.079	J	10		15	J+
MW-27	VLF-121017-19	10/17/12	Primary Sample	0.77	J	4.5		2.4	J	1	U	1	UE	2.1	J	2.5	J
MW-27	VLF-130124-1	01/24/13	Primary Sample	1	U	9.1		5	U	1	U	1	U	1.9	J	10	U
MW-27	VLF-130419-8	04/19/13	Primary Sample	0.16	J	8.4		5	U	1	U	1	U	2.2	J	10	U
MW-27	VLF-130710-1	07/10/13	Primary Sample	0.46	J	6.4		5	U	0.02	J	1	U	1.8	J	3	J
MW-27	VLI-102913-26	10/29/13	Primary Sample	1.3		9.8		5	U	1	U	1	U	2.9	J	4.7	J
			Minimum	***0.16***		***4.50***		***2.4***		***0.02***		***0.079***		***1.8***		***2.5***	
			Maximum	***5.3***		***12.0***		***5.0***		***1.0***		***1.0***		***14.0***		***15.0***	
			Mean	***1.83***		***8.68***		***4.71***		***0.68***		***0.80***		***4.73***		***8.12***	
			Median	***1.10***		***9.10***		***5.00***		***1.00***		***1.00***		***2.90***		***8.20***	
			Standard Deviation	***1.82***		***2.35***		***0.87***		***0.48***		***0.41***		***4.31***		***4.53***	
			Interquartile Range	***1.13***		***2.70***		***0.00***		***0.96***		***0.00***		***2.00***		***5.30***	
			Skew	***1.37***		***-0.45***		***-3.00***		***-0.86***		***-1.62***		***1.71***		***0.30***	
			Kurtosis	***0.54***		***-0.28***		***9.00***		***-1.71***		***0.73***		***1.93***		***-1.20***	
			Coefficient of Variance	***0.99***		***0.27***		***0.18***		***0.72***		***0.51***		***0.91***		***0.56***	
			Number of Analyses	***9***		***9***		***9***		***9***		***9***		***9***		***9***	
			Number of Nondetect	***1***		***0***		***8***		***6***		***7***		***0***		***2***	
			Percent Nondetect	***11.1%***		***0.0%***		***88.9%***		***66.7%***		***77.8%***		***0.0%***		***22.2%***	

Coffin Butte Descriptive Statistics
Total Metals (Unfiltered)

Location	Sample ID	Date	Type	Antimony		Arsenic		Barium		Beryllium		Cadmium		Chromium		Cobalt		Copper	
				UG/L		ug/L		UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
MW-22	CB-081194-13	08/11/94	Primary Sample	0.04		8.2		57		0.04		0.06		5	U	10	U	10	U
MW-22	CB-110394-04	11/03/94	Primary Sample	0.06		9.7		39		0.02	U	0.05		5	U	10	U	10	U
MW-22	CB-110394-04	11/03/94	Primary Sample	0.03		9.8		40		0.02	U	0.08		5	U	10	U	10	U
MW-22	CB-020995-22	02/09/95	Primary Sample	0.02	UJ	9.1		39		0.02	U	0.09	J	5	U	10	U	10	U
MW-22	CB-051195-4	05/11/95	Primary Sample	0.02		8.7		37		0.02	U	0.02	U	5	U	10	U	10	U
MW-22	CB-080995-14	08/09/95	Primary Sample	0.03		8.8		45		0.07		0.05		5	U	10	U	10	U
MW-22	CB-080995-14	08/09/95	Primary Sample	0.04		9.2		41		0.05		0.03		5	U	10	U	10	U
MW-22	CB-110795-5	11/08/95	Primary Sample	0.03		8.8		38		0.02	U	0.03		5	U	10	U	10	U
MW-22	CB-021396-27	02/13/96	Primary Sample	0.04	J	9.8		39		0.02	U	0.02		5	U	10	U	10	U
MW-22	CB-050896-11	05/08/96	Primary Sample	0.02	U	10		41		0.02	U	0.04		5	U	10	U	10	U
MW-22	CB-080696-1	08/06/96	Primary Sample	0.02	U	9.6		39		0.02	U	0.22		0.2	U	10	U	0.01	
MW-22	CB-042197-1	04/21/97	Primary Sample	0.02		9.4		39						5	U				
MW-22	CB-042198-5	04/21/98	Primary Sample	0.05	U	10		36						5	U				
MW-22	CB-102198-22	10/21/98	Primary Sample			10													
MW-22	MW-22	04/19/99	Primary Sample	3		11.8		33.5		0.01		0.1		0.78		1.24		0.7	
MW-22	CB-042399-31	04/23/99	Primary Sample	0.05	U	10		38						5	U				
MW-22	CB-101999-10	10/19/99	Primary Sample			9													
MW-22	CB-041900-7	04/19/00	Primary Sample	0.05	U	9		38		0.02	U	0.05	U	5	U	10	U	10	U
MW-22	CB-101900-14	10/19/00	Primary Sample			7.5													
MW-22	VLF-042401-4	04/24/01	Primary Sample	0.05	U	9.2		38.1						5	U				
MW-22	VLF-011017-1	10/17/01	Primary Sample			7.8													
MW-22	VLF-042302-1	04/23/02	Primary Sample	0.05	U	9.7		44.6						5	U				
MW-22	VLF-101502-8	10/15/02	Primary Sample			9.9													
MW-22	VLF-042903-2	04/29/03	Primary Sample			8.7													
MW-22	DEQ-001-14459	10/14/03	Primary Sample	2	U	9.1		30.8		1	U	1	U	1	U	0.5	U	1.5	U
MW-22	DEQ-002-14459	10/14/03	Field Duplicate	2	U	9.1		30.6		1	U	1	U	1	U	0.5	U	1.5	U
MW-22	VLF-101403-3	10/14/03	Primary Sample	0.05	U	8.9		29.7		0.02	U	0.18		5	U	10	U	10	U
MW-22	VLF-042004-12	04/20/04	Primary Sample			8													
MW-22	VLF-101304-15	10/13/04	Primary Sample	0.05	U	7.4		28.7						5	U				
MW-22	VLF-041905-1	04/20/05	Primary Sample			9.8													
MW-22	VLF-111605-16	11/16/05	Primary Sample	0.05	U	6		25.9						5	U				
MW-22	VLF-060418-9	04/18/06	Primary Sample			9.9													
MW-22	DEQ-14459	10/24/06	Primary Sample	2	U	9.2		30.4		0.3	U	0.3	U	1	U	0.2	U	1.5	U
MW-22	VLF-061024-5	10/24/06	Primary Sample	0.05	U	9.1		30.5		0.02	U	0.02	U	5	U	10	U	10	U
MW-22	VLF-070417-10	04/17/07	Primary Sample			8.9													
MW-22	VLF-071025-20	10/25/07	Primary Sample	2	U	6.1		23						1					
MW-22	VLF-080415-8	04/15/08	Primary Sample			8.6													
MW-22	VLF-081027-31	10/27/08	Primary Sample	0.06	U	4	J	20						1.7	UJB				
MW-22	VLF090414-15	04/14/09	Primary Sample			7.5													
MW-22	VLF-091015-26	10/15/09	Primary Sample	0.06	U	9.6		30		1	U	1	U	5	U	0.13	J	0.27	J
MW-22	VLF-100406-13	04/06/10	Primary Sample			10													
MW-22	VLF-101013-9	10/13/10	Primary Sample	2	U	9.1		30						3	U				
MW-22	VLF-110412-4	04/12/11	Primary Sample			9.4													
			Minimum	***0.02***		***4.0***		***20.0***		***0.01***		***0.02***		***0.20***		***0.13***		***0.01***	
			Maximum	***3.0***		***11.8***		***57.0***		***1.0***		***1.0***		***5.0***		***10.0***		***10.0***	
			Mean	***0.48***		***8.92***		***35.6***		***0.19***		***0.23***		***3.95***		***7.50***		***7.13***	
			Median	***0.05***		***9.10***		***38.0***		***0.02***		***0.06***		***5.00***		***10.0***		***10.0***	

Coffin Butte Descriptive Statistics
Total Metals (Unfiltered)

Location	Sample ID	Date	Type	Lead		Nickel		Selenium		Silver		Thallium		Vanadium		Zinc	
				UG/L		UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
MW-22	CB-081194-13	08/11/94	Primary Sample	1.1		20	U	5	U	0.04	U	0.04	U	7.2		10	U
MW-22	CB-110394-04	11/03/94	Primary Sample	0.29		20	U	0.5	U	0.02	U	0.02	U	1.6		10	U
MW-22	CB-110394-04	11/03/94	Primary Sample	0.28		20	U	0.5	U	0.02	U	0.02	U	1.7		10	U
MW-22	CB-020995-22	02/09/95	Primary Sample	0.1	J	0.7		0.5	U	0.04		0.02	U	10	U	10	U
MW-22	CB-051195-4	05/11/95	Primary Sample	0.04		0.8		1	U	0.02	U	0.02	U	10	U	10	U
MW-22	CB-080995-14	08/09/95	Primary Sample	0.99		2.3		5	U	0.04		0.02		10	U	10	U
MW-22	CB-080995-14	08/09/95	Primary Sample	0.61		1.9		5	U	0.04		0.02	U	10	U	10	U
MW-22	CB-110795-5	11/08/95	Primary Sample	0.09		1.3		1	U	0.02	U	0.02	U	10	U	10	U
MW-22	CB-021396-27	02/13/96	Primary Sample	0.1		0.8		1	U	0.02	UJ	0.02	U	10	U	10	U
MW-22	CB-050896-11	05/08/96	Primary Sample	0.24		0.6		5	U	0.02	U	0.03		10	U	10	U
MW-22	CB-080696-1	08/06/96	Primary Sample	0.08		0.9		2	U	0.02	U	0.02	U	10	U	10	U
MW-22	CB-042197-1	04/21/97	Primary Sample	0.1		0.7		1	U							10	U
MW-22	CB-042198-5	04/21/98	Primary Sample	0.05	U	20	U	1	U							10	U
MW-22	CB-102198-22	10/21/98	Primary Sample														
MW-22	MW-22	04/19/99	Primary Sample	3		1.79		3		0.2		8.6		1.21		0.05	
MW-22	CB-042399-31	04/23/99	Primary Sample	0.13		0.9		2	U							10	U
MW-22	CB-101999-10	10/19/99	Primary Sample														
MW-22	CB-041900-7	04/19/00	Primary Sample	0.18		0.2	U	1	U	0.02	U	0.02	U	10	U	10	U
MW-22	CB-101900-14	10/19/00	Primary Sample														
MW-22	VLF-042401-4	04/24/01	Primary Sample	0.16		0.6		1	U							10	U
MW-22	VLF-011017-1	10/17/01	Primary Sample														
MW-22	VLF-042302-1	04/23/02	Primary Sample	0.05		0.4		1	U							10	U
MW-22	VLF-101502-8	10/15/02	Primary Sample														
MW-22	VLF-042903-2	04/29/03	Primary Sample														
MW-22	DEQ-001-14459	10/14/03	Primary Sample	3	U	1	U	3	U	0.5	U	0.5	U	10	U	3	U
MW-22	DEQ-002-14459	10/14/03	Field Duplicate	3	U	1	U	3	U	0.5	U	0.5	U	10	U	3	U
MW-22	VLF-101403-3	10/14/03	Primary Sample	0.02		5	U	1	U	0.02	U	0.02	U	10	U	10	U
MW-22	VLF-042004-12	04/20/04	Primary Sample														
MW-22	VLF-101304-15	10/13/04	Primary Sample	0.05		0.2	UJ	1	U							10	U
MW-22	VLF-041905-1	04/20/05	Primary Sample														
MW-22	VLF-111605-16	11/16/05	Primary Sample	0.03		1.4		1	U							10	U
MW-22	VLF-060418-9	04/18/06	Primary Sample														
MW-22	DEQ-14459	10/24/06	Primary Sample	1.5	U	1	U	2	U	0.1	U	0.1	U	4	U	3	U
MW-22	VLF-061024-5	10/24/06	Primary Sample	0.06		0.5		1	U	0.02	U	0.02	U	10	U	10	U
MW-22	VLF-070417-10	04/17/07	Primary Sample														
MW-22	VLF-071025-20	10/25/07	Primary Sample	1	U	1.2		5	U							2.6	
MW-22	VLF-080415-8	04/15/08	Primary Sample														
MW-22	VLF-081027-31	10/27/08	Primary Sample	1	U	0.28	J	1	U							4.2	J
MW-22	VLF090414-15	04/14/09	Primary Sample														
MW-22	VLF-091015-26	10/15/09	Primary Sample	1	U	0.64	J	1	U	1	U	1	U	10	U	10	U
MW-22	VLF-100406-13	04/06/10	Primary Sample														
MW-22	VLF-101013-9	10/13/10	Primary Sample	0.26	J	0.5	J	5	UJ							10	U
MW-22	VLF-110412-4	04/12/11	Primary Sample														
			Minimum	***0.02***		***0.20***		***0.50***		***0.02***		***0.02***		***1.21***		***0.05***	
			Maximum	***3.0***		***20.0***		***5.0***		***1.0***		***8.6***		***10.0***		***10.0***	
			Mean	***0.64***		***3.68***		***2.09***		***0.14***		***0.58***		***8.20***		***8.48***	
			Median	***0.18***		***0.90***		***1.00***		***0.02***		***0.02***		***10.0***		***10.0***	

Coffin Butte Descriptive Statistics
Total Metals (Unfiltered)

Location	Sample ID	Date	Type	Antimony		Arsenic		Barium		Beryllium		Cadmium		Chromium		Cobalt		Copper	
				UG/L		ug/L		UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
			Standard Deviation	***0.89***		***1.30***		***7.40***		***0.36***		***0.35***		***1.77***		***4.30***		***4.35***	
			Interquartile Range	***0.03***		***1.05***		***8.60***		***0.04***		***0.17***		***2.00***		***4.38***		***8.50***	
			Skew	***1.70***		***-1.60***		***0.38***		***1.93***		***1.86***		***-1.21***		***-1.18***		***-0.89***	
			Kurtosis	***1.36***		***4.56***		***1.49***		***2.06***		***1.93***		***-0.41***		***-0.68***		***-1.33***	
			Coefficient of Variance	***1.86***		***0.15***		***0.21***		***1.88***		***1.54***		***0.45***		***0.57***		***0.61***	
			Number of Analyses	***29***		***43***		***29***		***19***		***19***		***29***		***19***		***19***	
			Number of Nondetect	***19***		***0***		***0***		***15***		***7***		***26***		***17***		***16***	
			Percent Nondetect	***65.5%***		***0.0%***		***0.0%***		***78.9%***		***36.8%***		***89.7%***		***89.5%***		***84.2%***	
MW-23	CB-081194-17	08/11/94	Primary Sample	0.11		13.5		92		0.1		0.22		6		10	U	15	
MW-23	CB-130394-6	11/03/94	Primary Sample	0.03		14.3		74		0.02	U	0.08		5	U	10	U	10	U
MW-23	CB-020995-20	02/09/95	Primary Sample	0.08	J	15.7		64		0.02	U	0.12	J	5	U	10	U	10	U
MW-23	CB-020995-20	02/09/95	Primary Sample	0.19	J	15.6		64		0.02	U	0.08	J	5	U	10	U	10	U
MW-23	CB-051195-5	05/11/95	Primary Sample	0.09		17.7		59		0.02		0.08		5	U	10	U	10	U
MW-23	CB-081095-16	08/10/95	Primary Sample	0.06		18.4		62		0.11		0.09		5	U	10	U	10	U
MW-23	COFFIN38	08/10/95	Primary Sample			19		60		10	U	10	U	30	U	60	U	20	U
MW-23	CB-110795-6	11/08/95	Primary Sample	0.08		19.2		70		0.39		0.2		5	U	10	U	10	U
MW-23	CB-021396-30	02/13/96	Primary Sample	0.04	J	23.4		49		0.02	U	0.08		5	U	10	U	10	U
MW-23	CB-050896-5	05/08/96	Primary Sample	0.04		22		48		0.02	U	0.03		5	U	10	U	10	U
MW-23	CB-050896-5	05/08/96	Primary Sample	0.03		22		47		0.02	U	0.04		5	U	10	U	10	U
MW-23	CB-080696-2	08/06/96	Primary Sample	0.04		30.8		56		0.02	U	0.05		0.2	U	10	U	10	U
MW-23	CB-042397-23	04/23/97	Primary Sample	0.04		23.6		56						5	U				
MW-23	CB-102197-10	10/21/97	Primary Sample	0.17		27		64		0.05	U	0.08		5	U	10	U	10	U
MW-23	CB-042398-24	04/23/98	Primary Sample	0.02		32.8		55						5	U				
MW-23	CB-102198-25	10/21/98	Primary Sample			25													
MW-23	CB-042099-1	04/20/99	Primary Sample	0.02	U	28		53						5	U				
MW-23	CB-101999-9	10/19/99	Primary Sample			25													
MW-23	CB-042100-35	04/21/00	Primary Sample	0.05	U	22		45		0.02	U	0.06		5	U	10	U	10	U
MW-23	CB-101900-13	10/19/00	Primary Sample			25.3													
MW-23	VLF-042401-7	04/24/01	Primary Sample	0.05	U	10.5		27.7						5	U				
MW-23	VLF-011017-4	10/17/01	Primary Sample			28.3													
MW-23	VLF-042502-24	04/25/02	Primary Sample	0.05	U	23.3		37.5						5	U				
MW-23	VLF-101502-9	10/15/02	Primary Sample			29.9													
MW-23	VLF-042903-1	04/29/03	Primary Sample			14.2													
MW-23	VLF-102003-37	10/20/03	Primary Sample	0.05	U	16.5		52.2		0.02	U	0.02		5	U	10	U	10	U
MW-23	VLF-042004-13	04/20/04	Primary Sample			13.3													
MW-23	VLF-101404-30	10/14/04	Primary Sample	0.05	U	19.8		64.4						5	U				
MW-23	VLF-041905-2	04/20/05	Primary Sample			15.4													
MW-23	VLF-111705-27	11/17/05	Primary Sample	0.05	U	18.8		65.1						5	U				
MW-23	VLF-060418-10	04/18/06	Primary Sample			12.5													
MW-23	VLF-060418-11	04/18/06	Field Duplicate			10.9													
MW-23	VLF-061026-23	10/26/06	Primary Sample	0.05	U	10.1		42.8		0.03		0.02	U	5	U	10	U	10	U
MW-23	VLF-070417-11	04/17/07	Primary Sample			9.1													
MW-23	VLF-071025-22	10/25/07	Primary Sample	2	U	13		41						5	U				
MW-23	VLF-071025-23	10/25/07	Field Duplicate	2	U	13		40						5	U				
MW-23	VLF-080416-11	04/16/08	Primary Sample			25													
MW-23	VLF081023-24	10/23/08	Primary Sample	0.06	U	14		40						5	U				
MW-23	VLF090414-17	04/14/09	Primary Sample			11													

Coffin Butte Descriptive Statistics
Total Metals (Unfiltered)

Location	Sample ID	Date	Type	Lead		Nickel		Selenium		Silver		Thallium		Vanadium		Zinc	
				UG/L		UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
		Standard Deviation		***0.91***		***6.71***		***1.66***		***0.26***		***1.96***		***3.32***		***3.09***	
		Interquartile Range		***0.92***		***1.19***		***2.00***		***0.05***		***0.05***		***1.40***		***0.00***	
			Skew	***1.89***		***2.14***		***1.01***		***2.59***		***4.24***		***-1.51***		***-1.68***	
			Kurtosis	***2.70***		***2.90***		***-0.62***		***6.82***		***18.2***		***0.58***		***1.22***	
		Coefficient of Variance		***1.43***		***1.82***		***0.80***		***1.84***		***3.38***		***0.41***		***0.36***	
		Number of Analyses		***29***		***29***		***29***		***19***		***19***		***19***		***29***	
		Number of Nondetect		***7***		***10***		***28***		***15***		***16***		***15***		***26***	
		Percent Nondetect		***24.1%***		***34.5%***		***96.6%***		***78.9%***		***84.2%***		***78.9%***		***89.7%***	
MW-23	CB-081194-17	08/11/94	Primary Sample	2.28		20	U	5	U	0.04		0.03		11.9		20	
MW-23	CB-130394-6	11/03/94	Primary Sample	0.23		20	U	1.4		0.02	U	0.02	U	2.9		10	U
MW-23	CB-020995-20	02/09/95	Primary Sample	0.87	J	2.8		1		0.06		0.02		10	U	12	
MW-23	CB-020995-20	02/09/95	Primary Sample	0.77	J	3		1.1		0.68		0.02		10	U	10	U
MW-23	CB-051195-5	05/11/95	Primary Sample	2.5		2.9		1	U	0.02	U	0.02		10	U	21	
MW-23	CB-081095-16	08/10/95	Primary Sample	0.54		3.7		5	U	0.02	U	0.03		10	U	11	
MW-23	COFFIN38	08/10/95	Primary Sample	5	U	40	U	5	U	10	U			30	U	20	U
MW-23	CB-110795-6	11/08/95	Primary Sample	0.31		4.5		3	U	0.02	U	0.02		10	U	11	
MW-23	CB-021396-30	02/13/96	Primary Sample	0.34		2.2		1	U	0.02	UJ	0.02		10	U	10	U
MW-23	CB-050896-5	05/08/96	Primary Sample	0.08		1.9		5	U	0.02	U	0.04		10	U	10	U
MW-23	CB-050896-5	05/08/96	Primary Sample	0.06		1.9		5	U	0.02	U	0.04		10	U	10	U
MW-23	CB-080696-2	08/06/96	Primary Sample	0.06		2.9		2	U	0.02	U	0.02		10	U	10	U
MW-23	CB-042397-23	04/23/97	Primary Sample	0.43		4.4		1	U							10	U
MW-23	CB-102197-10	10/21/97	Primary Sample	0.39		4.44		1	U	0.1		0.05	U	10	U	10	U
MW-23	CB-042398-24	04/23/98	Primary Sample	0.16		3.7		1	U							10	U
MW-23	CB-102198-25	10/21/98	Primary Sample														
MW-23	CB-042099-1	04/20/99	Primary Sample	0.05		2.7		1	U							10	U
MW-23	CB-101999-9	10/19/99	Primary Sample														
MW-23	CB-042100-35	04/21/00	Primary Sample	0.18		2.7		1	U	0.02	U	0.02	U	10	U	13	
MW-23	CB-101900-13	10/19/00	Primary Sample														
MW-23	VLF-042401-7	04/24/01	Primary Sample	0.26		1.8		1	U							10	U
MW-23	VLF-011017-4	10/17/01	Primary Sample														
MW-23	VLF-042502-24	04/25/02	Primary Sample	0.05		2.6		1	U							11	
MW-23	VLF-101502-9	10/15/02	Primary Sample														
MW-23	VLF-042903-1	04/29/03	Primary Sample														
MW-23	VLF-102003-37	10/20/03	Primary Sample	0.28		1.8		1	U	0.02	U	0.02	U	10	U	10	U
MW-23	VLF-042004-13	04/20/04	Primary Sample														
MW-23	VLF-101404-30	10/14/04	Primary Sample	0.07		1.2	J-	1	U							10	U
MW-23	VLF-041905-2	04/20/05	Primary Sample														
MW-23	VLF-111705-27	11/17/05	Primary Sample	0.31		2.5		1	U							10.1	
MW-23	VLF-060418-10	04/18/06	Primary Sample														
MW-23	VLF-060418-11	04/18/06	Field Duplicate														
MW-23	VLF-061026-23	10/26/06	Primary Sample	0.13		2.5		1	U	0.02	U	0.02	U	10	U	10	U
MW-23	VLF-070417-11	04/17/07	Primary Sample														
MW-23	VLF-071025-22	10/25/07	Primary Sample	0.76		2.5		5	U							13	
MW-23	VLF-071025-23	10/25/07	Field Duplicate	0.68		1.9		5	U							11	
MW-23	VLF-080416-11	04/16/08	Primary Sample														
MW-23	VLF081023-24	10/23/08	Primary Sample	1		0.54	J	1	U							9.7	J
MW-23	VLF090414-17	04/14/09	Primary Sample														

Coffin Butte Descriptive Statistics
Total Metals (Unfiltered)

Location	Sample ID	Date	Type	Antimony		Arsenic		Barium		Beryllium		Cadmium		Chromium		Cobalt		Copper	
				UG/L		ug/L		UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
MW-23	DEQ-14460	10/14/09	Primary Sample	2	U	17.3		48.5		0.3	U	0.3	U	1	U	1.01		1.5	U
MW-23	DEQ-14461	10/14/09	Field Duplicate	2	U	18.2		49.2		0.3	U	0.3	U	1	U	1.06		1.5	U
MW-23	VLF-091014-6	10/14/09	Primary Sample	0.24	UB	18		52		1	U	1	U	5	U	1.1	J	0.52	J
MW-23	VLF-100406-12	04/06/10	Primary Sample			17													
MW-23	VLF-101013-10	10/13/10	Primary Sample	2	U	17		43						3	U				
MW-23	VLF-101013-11	10/13/10	Field Duplicate	2	U	17		41						3	U				
MW-23	VLF-110412-5	04/12/11	Primary Sample			14													
MW-23	VLF-111102-14	11/02/11	Primary Sample	0.44	J	15		53						3	U				
MW-23	VLF-120410-1	04/10/12	Primary Sample			17													
MW-23	VLF-121016-2	10/16/12	Primary Sample	2	U	25		78						3	U				
MW-23	VLF-130419-13	04/19/13	Primary Sample			16													
MW-23	VLI-102613-1	10/26/13	Primary Sample	2	U	40		140						3	U				
			Minimum	***0.02***		***9.10***		***27.7***		***0.02***		***0.02***		***0.20***		***1.01***		***0.52***	
			Maximum	***2.0***		***40.0***		***140***		***10.0***		***10.0***		***30.0***		***60.0***		***20.0***	
			Mean	***0.55***		***19.2***		***56.9***		***0.66***		***0.68***		***5.09***		***11.2***		***9.40***	
			Median	***0.06***		***17.7***		***53.0***		***0.02***		***0.08***		***5.00***		***10.0***		***10.0***	
			Standard Deviation	***0.84***		***6.53***		***19.6***		***2.28***		***2.27***		***4.61***		***12.3***		***4.42***	
			Interquartile Range	***0.39***		***9.25***		***18.5***		***0.19***		***0.16***		***0.00***		***0.00***		***0.00***	
			Skew	***1.23***		***0.88***		***2.47***		***4.28***		***4.29***		***4.98***		***3.79***		***-0.22***	
			Kurtosis	***-0.48***		***0.77***		***9.29***		***18.5***		***18.6***		***27.8***		***15.9***		***2.02***	
			Coefficient of Variance	***1.52***		***0.34***		***0.34***		***3.46***		***3.35***		***0.90***		***1.09***		***0.47***	
			Number of Analyses	***33***		***51***		***34***		***19***		***19***		***34***		***19***		***19***	
			Number of Nondetect	***18***		***0***		***0***		***14***		***5***		***33***		***16***		***17***	
			Percent Nondetect	***54.5%***		***0.0%***		***0.0%***		***73.7%***		***26.3%***		***97.1%***		***84.2%***		***89.5%***	
MW-25	MW-25	04/18/99	Primary Sample	3		9.3		21		0.019		0.1		0.35		1.62		1.68	
MW-25	CB-072199-3	07/21/99	Primary Sample	0.13	J	30		1100		5.64		3.14		238		216		565	
MW-25	CB-102099-16	10/20/99	Primary Sample	0.05	U	29		27		0.04		0.03		5	U	10	U	10	U
MW-25	CB-012100-7	01/21/00	Primary Sample	0.02	U	30		22		0.02	U	0.03		5	U	10	U	10	U
MW-25	CB-041800-5	04/18/00	Primary Sample	0.05	U	25		25		0.02	U	0.05	U	5	U	10	U	10	U
MW-25	CB-072500-3	07/25/00	Primary Sample	0.05	U	26.8		26		0.02	U	0.05	U	5	U	10	U	10	U
MW-25	CB-102000-18	10/20/00	Primary Sample	0.05	U	24.6		31.8		0.06		0.05	U	5	U	10	U	10	U
MW-25	CB-102000-19	10/20/00	Field Duplicate	0.02		24.8		29.8		0.05		0.05	U	5	U	10	U	10	U
MW-25	CB-012301-4	01/23/01	Primary Sample	0.25		26.6		25.4		0.1	U	0.25	U	5	U	10	U	10	U
MW-25	CB-012301-5	01/23/01	Field Duplicate	0.25	U	26		27.2		0.1	U	0.25	U	5	U	10	U	10	U
MW-25	VLF-042401-5	04/24/01	Primary Sample	0.09		13.4		46.4		0.18		0.11		7.4		10	U	15	
MW-25	VLF-042401-6	04/24/01	Field Duplicate	0.1		12.1		52.7		0.2		0.11		9.3		10	U	27.3	
MW-25	VLF-071801-MW-25	07/18/01	Primary Sample	0.05	U	17.9		28.5		0.05		0.05	U	5	U	10	U	10	U
MW-25	VLF-071801-MW-25A	07/18/01	Field Duplicate	0.05	U	20.4		25.3		0.05		0.05	U	5	U	10	U	10	U
MW-25	VLF-011017-2	10/17/01	Primary Sample	0.1	U	12.4		42.6		0.05		0.1	U	5	U	10	U	10	U
MW-25	VLF-042302-2	04/23/02	Primary Sample	0.05	U	12.1		28						5	U				
MW-25	VLF-102003-35	10/20/03	Primary Sample	0.05	U	12.3		21.3		0.02		0.02		5	U	10	U	10	U
MW-25	VLF-101304-14	10/13/04	Primary Sample	0.05	U	18.9		20						5	U				
MW-25	VLF-111605-18	11/16/05	Primary Sample	0.05	U	8.4		19.7						5	U				
MW-25	VLF-061026-20	10/26/06	Primary Sample	0.05	U	9.9		26		0.04		0.03		5	U	10	U	10	U
MW-25	VLF-061026-21	10/26/06	Field Duplicate	0.05	U	9.3		25.8		0.04		0.04		5	U	10	U	10	U
MW-25	VLF-071025-19	10/25/07	Primary Sample	2	U	8.3		21						1.1					
MW-25	VLF-081027-32	10/27/08	Primary Sample	0.06	U	7	J	21						2	UJB				

Coffin Butte Descriptive Statistics
Total Metals (Unfiltered)

Location	Sample ID	Date	Type	Lead		Nickel		Selenium		Silver		Thallium		Vanadium		Zinc	
				UG/L		UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
MW-23	DEQ-14460	10/14/09	Primary Sample	0.2	U	1.3		2	U	0.1	U	0.1	U	4	U	3	U
MW-23	DEQ-14461	10/14/09	Field Duplicate	0.2	U	1.4		2	U	0.1	U	0.1	U	4	U	3	U
MW-23	VLF-091014-6	10/14/09	Primary Sample	1	U	1.9	J	1	U	1	U	1	U	10	U	5.2	J
MW-23	VLF-100406-12	04/06/10	Primary Sample														
MW-23	VLF-101013-10	10/13/10	Primary Sample	0.19	J	1.3	J	5	UJ							10	U
MW-23	VLF-101013-11	10/13/10	Field Duplicate	0.28	J	1.2	J	5	UJ							2.5	J
MW-23	VLF-110412-5	04/12/11	Primary Sample														
MW-23	VLF-111102-14	11/02/11	Primary Sample	0.53	J	1.1	J	5	U							11	UJB
MW-23	VLF-120410-1	04/10/12	Primary Sample														
MW-23	VLF-121016-2	10/16/12	Primary Sample	0.48	J	1	J	5	U							11	UB
MW-23	VLF-130419-13	04/19/13	Primary Sample														
MW-23	VLI-102613-1	10/26/13	Primary Sample	1.1		2	UB	5	U							16	
			Minimum	***0.05***		***0.54***		***1.0***		***0.02***		***0.02***		***2.90***		***2.50***	
			Maximum	***5.0***		***40.0***		***5.0***		***10.0***		***1.0***		***30.0***		***21.0***	
			Mean	***0.64***		***4.48***		***2.57***		***0.65***		***0.09***		***10.1***		***10.7***	
			Median	***0.31***		***2.50***		***1.25***		***0.02***		***0.02***		***10.0***		***10.0***	
			Standard Deviation	***0.95***		***7.63***		***1.87***		***2.28***		***0.23***		***5.40***		***4.06***	
			Interquartile Range	***0.56***		***1.18***		***4.00***		***0.08***		***0.02***		***0.00***		***1.00***	
			Skew	***3.40***		***3.76***		***0.51***		***4.27***		***4.16***		***2.75***		***0.58***	
			Kurtosis	***13.4***		***15.1***		***-1.73***		***18.4***		***17.5***		***11.1***		***1.97***	
			Coefficient of Variance	***1.49***		***1.70***		***0.73***		***3.52***		***2.59***		***0.53***		***0.38***	
			Number of Analyses	***34***		***34***		***34***		***19***		***18***		***19***		***34***	
			Number of Nondetect	***4***		***4***		***31***		***15***		***8***		***17***		***19***	
			Percent Nondetect	***11.8%***		***11.8%***		***91.2%***		***78.9%***		***44.4%***		***89.5%***		***55.9%***	
MW-25	MW-25	04/18/99	Primary Sample	3		2.56		3		0.2		9.3		2.41		0.73	
MW-25	CB-072199-3	07/21/99	Primary Sample	107		145		8	U	0.6		0.75		706		520	
MW-25	CB-102099-16	10/20/99	Primary Sample	0.61		2.1		1	U	0.02	U	0.02	U	10	U	10	U
MW-25	CB-012100-7	01/21/00	Primary Sample	0.37		2.2		1	U	0.02	U	0.02	U	10	U	10	U
MW-25	CB-041800-5	04/18/00	Primary Sample	0.28		0.5		1	U	0.02	U	0.02	U	10	U	10	U
MW-25	CB-072500-3	07/25/00	Primary Sample	0.41		1.5		1	U	0.02	U	0.02	U	10	U	12	
MW-25	CB-102000-18	10/20/00	Primary Sample	0.84		2.25		1	U	0.02	U	0.05	U	10	U	10	U
MW-25	CB-102000-19	10/20/00	Field Duplicate	0.85		2.11		1	U	0.22		0.05	U	10	U	10	U
MW-25	CB-012301-4	01/23/01	Primary Sample	0.32		3.3		1	U	0.1	U	0.25	U	10	U	10	U
MW-25	CB-012301-5	01/23/01	Field Duplicate	0.43		3.33		1	U	0.1	U	0.25	U	10	U	10	U
MW-25	VLF-042401-5	04/24/01	Primary Sample	3		5.8		1	U	0.04		0.04		16.3		16.1	
MW-25	VLF-042401-6	04/24/01	Field Duplicate	3.15		6.2		1	U	0.04		0.05		25		18.5	
MW-25	VLF-071801-MW-25	07/18/01	Primary Sample	0.76		2.2		1	U	0.02	U	0.02	U	10	U	10	U
MW-25	VLF-071801-MW-25A	07/18/01	Field Duplicate	0.63		2.1		1	U	0.02	U	0.02	U	10	U	10	U
MW-25	VLF-011017-2	10/17/01	Primary Sample	1.05		3.9		1	U	0.04	U	0.04	U	10.2		10	U
MW-25	VLF-042302-2	04/23/02	Primary Sample	0.56		1.4		1	U							10	U
MW-25	VLF-102003-35	10/20/03	Primary Sample	0.34		0.9		1	U	0.02	U	0.02	U	10	U	10	U
MW-25	VLF-101304-14	10/13/04	Primary Sample	0.07		0.2	J-	1	U							10	U
MW-25	VLF-111605-18	11/16/05	Primary Sample	0.13		1.2		1	U							10	U
MW-25	VLF-061026-20	10/26/06	Primary Sample	0.48		1.3		1	U	0.02	U	0.02	U	10	U	10	U
MW-25	VLF-061026-21	10/26/06	Field Duplicate	0.54		1.3		1	U	0.02	U	0.02	U	10	U	10	U
MW-25	VLF-071025-19	10/25/07	Primary Sample	0.13		1.1		5	U							12	
MW-25	VLF-081027-32	10/27/08	Primary Sample	0.14	J	0.52		1	U							6.7	J

Coffin Butte Descriptive Statistics
Total Metals (Unfiltered)

Location	Sample ID	Date	Type	Antimony		Arsenic		Barium		Beryllium		Cadmium		Chromium		Cobalt		Copper	
				UG/L		ug/L		UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
MW-25	VLF-081027-33	10/27/08	Field Duplicate	0.06	U	7.7	J	21						2.2	UJB				
MW-25	VLF-091015-25	10/15/09	Primary Sample	0.06	U	13		21		1	U	1	U	5	U	0.2	J	0.63	J
MW-25	VLF-101013-8	10/13/10	Primary Sample	0.06	J	9.9		36						4.8					
			Minimum	***0.02***		***7.0***		***19.7***		***0.02***		***0.02***		***0.35***		***0.20***		***0.63***	
			Maximum	***3.0***		***30.0***		***1100***		***5.6***		***3.1***		***238***		***216***		***565***	
			Mean	***0.26***		***17.1***		***68.9***		***0.41***		***0.29***		***13.7***		***19.9***		***39.5***	
			Median	***0.05***		***13.2***		***25.9***		***0.05***		***0.05***		***5.00***		***10.0***		***10.0***	
			Standard Deviation	***0.68***		***8.06***		***210***		***1.29***		***0.72***		***45.8***		***47.6***		***127***	
			Interquartile Range	***0.05***		***15.05***		***8.40***		***0.07***		***0.07***		***0.00***		***0.00***		***0.00***	
			Skew	***3.59***		***0.35***		***5.09***		***4.17***		***3.80***		***5.09***		***4.33***		***4.35***	
			Kurtosis	***12.50***		***-1.54***		***25.9***		***17.7***		***15.1***		***25.9***		***18.8***		***18.9***	
			Coefficient of Variance	***2.59***		***0.47***		***3.05***		***3.18***		***2.50***		***3.35***		***2.39***		***3.23***	
			Number of Analyses	***26***		***26***		***26***		***19***		***19***		***26***		***19***		***19***	
			Number of Nondetect	***19***		***0***		***0***		***6***		***10***		***18***		***16***		***14***	
			Percent Nondetect	***73.1%***		***0.0%***		***0.0%***		***31.6%***		***52.6%***		***69.2%***		***84.2%***		***73.7%***	
MW-9S	MW-9S	04/09/91	Primary Sample			33		60		10	U	1	U	30	U	60	U	20	U
MW-9S	MW-9S	11/06/91	Primary Sample					80		10	U	10	U	30	U	60	U	20	U
MW-9S	MW-9S	11/06/91	Primary Sample																
MW-9S	MW-9S	04/21/92	Primary Sample					70		10	U	10	U	30	U	60	U	20	U
MW-9S	MW-9S	08/06/92	Primary Sample	50	U	32		127		5	U	3	U	5	U	10	U	14	
MW-9S	MW-9S	11/04/92	Primary Sample					90		10	U	10	U	30	U	60	U	20	U
MW-9S	CB-081194-18	08/11/94	Primary Sample	0.04		34.8		97		0.03		0.13		5	U	10	U	10	U
MW-9S	CB-020895-5	02/08/95	Primary Sample	0.17		30.4		130		0.16		0.89		9		10	U	20	
MW-9S	CB-020796-1	02/07/96	Primary Sample	0.09	J	30.3		117		0.14		0.48		8		10	U	20	
MW-9S	MW-9S	04/18/99	Primary Sample	3		41		72.1		0.01		0.1		1.19		0.98		2.19	
MW-9S	CB-041800-1	04/18/00	Primary Sample	0.05	U	36		80		0.02	U	0.13		5	U	10	U	10	U
MW-9S	VLF-102103-42	10/21/03	Primary Sample	0.05	U	32.3		88.2		0.09		0.27		5	U	10	U	10	U
MW-9S	VLF-061027-33	10/27/06	Primary Sample	0.05	U	41.8		99.7		0.06		0.76		5	U	10	U	10	U
MW-9S	VLF-091016-32	10/16/09	Primary Sample	0.06	U	31		91		1	U	0.049	J	5	U	0.17	J	0.42	J
			Minimum	***0.04***		***30.3***		***60.0***		***0.01***		***0.05***		***1.19***		***0.17***		***0.42***	
			Maximum	***50.0***		***41.8***		***130***		***10.0***		***10.0***		***30.0***		***60.0***		***20.0***	
			Mean	***5.95***		***34.3***		***92.5***		***3.58***		***2.83***		***12.9***		***23.9***		***13.6***	
			Median	***0.06***		***32.7***		***90.0***		***0.16***		***0.76***		***5.00***		***10.0***		***14.0***	
			Standard Deviation	***16.5***		***4.18***		***21.6***		***4.65***		***4.16***		***12.0***		***25.3***		***7.08***	
			Interquartile Range	***0.12***		***4.45***		***19.70***		***9.94***		***2.87***		***25.0***		***50.0***		***10.0***	
			Skew	***2.98***		***1.07***		***0.50***		***0.73***		***1.33***		***0.86***		***0.88***		***-0.66***	
			Kurtosis	***8.91***		***-0.11***		***-0.52***		***-1.60***		***-0.12***		***-1.36***		***-1.34***		***-0.76***	
			Coefficient of Variance	***2.78***		***0.12***		***0.23***		***1.30***		***1.47***		***0.93***		***1.06***		***0.52***	
			Number of Analyses	***9***		***10***		***13***		***13***		***13***		***13***		***13***		***13***	
			Number of Nondetect	***5***		***0***		***0***		***7***		***5***		***10***		***11***		***8***	
			Percent Nondetect	***55.6%***		***0.0%***		***0.0%***		***53.8%***		***38.5%***		***76.9%***		***84.6%***		***61.5%***	
P-16	P-16	04/19/99	Primary Sample	3		4.5		51.6		0.209		0.1		0.7		1.72		3.16	
P-16	CB-041900-6	04/19/00	Primary Sample	0.06		1		52		0.21		0.08		5	U	10	U	10	U
P-16	VLF-042701-33	04/27/01	Primary Sample	0.06		1.5		23.7						5	U				
P-16	VLF-042502-25	04/25/02	Primary Sample	0.05	U	1.3		33.2						5	U				
P-16	VLF-102003-36	10/20/03	Primary Sample	0.07		1.1		9.1		0.02	U	0.05		5	U	10	U	10	U

Coffin Butte Descriptive Statistics
Total Metals (Unfiltered)

Location	Sample ID	Date	Type	Lead UG/L		Nickel UG/L		Selenium UG/L		Silver UG/L		Thallium UG/L		Vanadium UG/L		Zinc UG/L	
MW-25	VLF-081027-33	10/27/08	Field Duplicate	0.15	J	0.57		1	U							6.6	J
MW-25	VLF-091015-25	10/15/09	Primary Sample	0.11	J	0.73		1	U	1	U	1	U	10	U	10	U
MW-25	VLF-101013-8	10/13/10	Primary Sample	1.6		3.7		5	UJ							9.1	J
			Minimum	***0.07***		***0.20***		***1.00***		***0.02***		***0.02***		***2.41***		***0.73***	
			Maximum	***107***		***145***		***8.0***		***1.0***		***9.3***		***706***		***520***	
			Mean	***4.88***		***7.61***		***1.65***		***0.13***		***0.63***		***47.4***		***29.7***	
			Median	***0.51***		***2.10***		***1.00***		***0.02***		***0.04***		***10.0***		***10.0***	
			Standard Deviation	***20.8***		***28.1***		***1.72***		***0.25***		***2.12***		***160***		***100***	
			Interquartile Range	***0.56***		***1.99***		***0.00***		***0.08***		***0.13***		***0.00***		***0.00***	
			Skew	***5.08***		***5.07***		***2.79***		***2.87***		***4.25***		***4.35***		***5.09***	
			Kurtosis	***25.9***		***25.8***		***7.55***		***8.33***		***18.3***		***19.0***		***25.9***	
			Coefficient of Variance	***4.27***		***3.69***		***1.04***		***1.88***		***3.36***		***3.37***		***3.37***	
			Number of Analyses	***26***		***26***		***26***		***19***		***19***		***19***		***26***	
			Number of Nondetect	***0***		***0***		***25***		***14***		***15***		***14***		***17***	
			Percent Nondetect	***0.0%***		***0.0%***		***96.2%***		***73.7%***		***78.9%***		***73.7%***		***65.4%***	
MW-9S	MW-9S	04/09/91	Primary Sample	5	U	40	U	5	U	10	U			30	U	20	U
MW-9S	MW-9S	11/06/91	Primary Sample			40	U			10	U			30	U	20	U
MW-9S	MW-9S	11/06/91	Primary Sample			40	U										
MW-9S	MW-9S	04/21/92	Primary Sample			40	U			10	U			50		20	U
MW-9S	MW-9S	08/06/92	Primary Sample	4		20	U	5	U	10	U	5	U	17		15	
MW-9S	MW-9S	11/04/92	Primary Sample			20	U			10	U			30	U	20	U
MW-9S	CB-081194-18	08/11/94	Primary Sample	1.15		20	U	5	U	0.03		0.02	U	11.5		10	U
MW-9S	CB-020895-5	02/08/95	Primary Sample	4.01	J	5.9		1.6		0.04		0.05		31		24	
MW-9S	CB-020796-1	02/07/96	Primary Sample	4.07		5.3		1	U	0.03	J	0.05		29		19	
MW-9S	MW-9S	04/18/99	Primary Sample	3		1.47		3		0.2		3.1		3.32		0.5	
MW-9S	CB-041800-1	04/18/00	Primary Sample	0.35		1.5		1	U	0.02	U	0.02	U	10	U	10	U
MW-9S	VLF-102103-42	10/21/03	Primary Sample	1.16		2.5		1	U	0.02	U	0.02	U	15.6		11.1	
MW-9S	VLF-061027-33	10/27/06	Primary Sample	0.69		3.4		1	U	0.02	U	0.02	U	10	U	16.9	
MW-9S	VLF-091016-32	10/16/09	Primary Sample	0.2	J	1.4	J	1	U	1	U	1	U	10	U	10	U
			Minimum	***0.20***		***1.40***		***1.0***		***0.02***		***0.02***		***3.32***		***0.50***	
			Maximum	***5.0***		***40.0***		***5.0***		***10.0***		***5.0***		***50.0***		***24.0***	
			Mean	***2.36***		***17.2***		***2.46***		***3.95***		***1.03***		***21.3***		***15.1***	
			Median	***2.08***		***13.0***		***1.30***		***0.20***		***0.05***		***17.0***		***16.9***	
			Standard Deviation	***1.83***		***16.5***		***1.86***		***4.98***		***1.80***		***13.1***		***6.5***	
			Interquartile Range	***3.20***		***32.3***		***3.50***		***9.97***		***0.98***		***20.0***		***10.0***	
			Skew	***0.13***		***0.53***		***0.72***		***0.53***		***1.79***		***0.68***		***-0.86***	
			Kurtosis	***-1.96***		***-1.54***		***-1.62***		***-2.05***		***2.31***		***0.15***		***0.56***	
			Coefficient of Variance	***0.77***		***0.95***		***0.75***		***1.26***		***1.75***		***0.61***		***0.43***	
			Number of Analyses	***10***		***14***		***10***		***13***		***9***		***13***		***13***	
			Number of Nondetect	***1***		***7***		***8***		***9***		***6***		***6***		***7***	
			Percent Nondetect	***10.0%***		***50.0%***		***80.0%***		***69.2%***		***66.7%***		***46.2%***		***53.8%***	
P-16	P-16	04/19/99	Primary Sample	3		2.59		3		0.2		6.8		12.9		4.01	
P-16	CB-041900-6	04/19/00	Primary Sample	1.49		1.5		1	U	0.02	U	0.02	U	14		10	U
P-16	VLF-042701-33	04/27/01	Primary Sample	0.41		0.7		1	U							10.3	
P-16	VLF-042502-25	04/25/02	Primary Sample	0.65		1.1		1	U							10	U
P-16	VLF-102003-36	10/20/03	Primary Sample	0.09		0.6		1	U	0.02	U	0.02	U	10.7		10	U

Coffin Butte Descriptive Statistics
Total Metals (Unfiltered)

Location	Sample ID	Date	Type	Antimony		Arsenic		Barium		Beryllium		Cadmium		Chromium		Cobalt		Copper	
				UG/L		ug/L		UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
P-16	VLF-101304-16	10/13/04	Primary Sample	0.05	U	1.3		16.3						5	U				
P-16	VLF-111605-17	11/16/05	Primary Sample	0.05		1		28.1						5	U				
P-16	VLF-061026-22	10/26/06	Primary Sample	0.05	U	1		28.3		0.02	U	0.08		5	U	10	U	10	U
P-16	VLF-071025-21	10/25/07	Primary Sample	0.069		5	U	43						1.1					
P-16	VLF-081027-34	10/27/08	Primary Sample	0.11		0.5	U	48						2.1	UJB				
P-16	VLF-091015-27	10/15/09	Primary Sample	0.12	UB	1.6		10		1	U	1	U	5	U	0.067	J	0.54	J
P-16	VLF-101013-7	10/13/10	Primary Sample	2	U	1.3	J	22						3	U				
			Minimum	***0.05***		***0.5***		***9.1***		***0.02***		***0.05***		***0.70***		***0.07***		***0.54***	
			Maximum	***3.0***		***5.0***		***52.0***		***1.0***		***1.0***		***5.0***		***10.0***		***10.0***	
			Mean	***0.47***		***1.76***		***30.4***		***0.29***		***0.26***		***3.91***		***6.36***		***6.74***	
			Median	***0.06***		***1.30***		***28.2***		***0.21***		***0.08***		***5.00***		***10.0***		***10.0***	
			Standard Deviation	***0.97***		***1.43***		***15.3***		***0.41***		***0.41***		***1.70***		***5.02***		***4.56***	
			Interquartile Range	***0.06***		***0.53***		***23.7***		***0.19***		***0.02***		***2.23***		***8.28***		***6.84***	
			Skew	***2.27***		***1.89***		***0.15***		***1.94***		***2.23***		***-1.14***		***-0.67***		***-0.79***	
			Kurtosis	***4.22***		***2.40***		***-1.28***		***3.95***		***4.96***		***-0.44***		***-2.98***		***-2.27***	
			Coefficient of Variance	***2.05***		***0.81***		***0.50***		***1.40***		***1.58***		***0.44***		***0.79***		***0.68***	
			Number of Analyses	***12***		***12***		***12***		***5***		***5***		***12***		***5***		***5***	
			Number of Nondetect	***5***		***2***		***0***		***3***		***1***		***9***		***3***		***3***	
			Percent Nondetect	***41.7%***		***16.7%***		***0.0%***		***60.0%***		***20.0%***		***75.0%***		***60.0%***		***60.0%***	
Leachate																			
L-4	VLF-121017-18	10/17/12	Primary Sample	12		31		780		5	U	1.2	J	42		32		27	
L-4	VLI-102913-36	10/29/13	Primary Sample	9.6		110		1400	J+	1	U	0.34	J	260		40		17	
			Minimum	***9.6***		***31.0***		***780***		***1.0***		***0.34***		***42***		***32.0***		***17.0***	
			Maximum	***12.0***		***110.0***		***1,400***		***5.0***		***1.2***		***260***		***40.0***		***27.0***	
			Mean	***10.8***		***70.5***		***1,090***		***3.00***		***0.77***		***151***		***36.0***		***22.0***	
			Median	***10.8***		***70.5***		***1,090***		***3.00***		***0.77***		***151***		***36.0***		***22.0***	
			Standard Deviation	***1.70***		***55.9***		***438***		***2.83***		***0.61***		***154***		***5.66***		***7.07***	
			Interquartile Range	***1.20***		***39.5***		***310***		***2.00***		***0.43***		***109***		***4.00***		***5.00***	
			Skew	***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***	
			Kurtosis	***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***	
			Coefficient of Variance	***0.16***		***0.79***		***0.40***		***0.94***		***0.79***		***1.02***		***0.16***		***0.32***	
			Number of Analyses	***2***		***2***		***2***		***2***		***2***		***2***		***2***		***2***	
			Number of Nondetect	***0***		***0***		***0***		***2***		***0***		***0***		***0***		***0***	
			Percent Nondetect	***0.0%***		***0.0%***		***0.0%***		***100.0%***		***0.0%***		***0.0%***		***0.0%***		***0.0%***	

Coffin Butte Descriptive Statistics
Total Metals (Unfiltered)

Location	Sample ID	Date	Type	Lead		Nickel		Selenium		Silver		Thallium		Vanadium		Zinc	
				UG/L		UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
P-16	VLF-101304-16	10/13/04	Primary Sample	0.27		0.6	J-	1	U							10	U
P-16	VLF-111605-17	11/16/05	Primary Sample	0.31		2.3		1	U							10	U
P-16	VLF-061026-22	10/26/06	Primary Sample	0.21		1.4		1	U	0.02	U	0.02	U	13.1		10	U
P-16	VLF-071025-21	10/25/07	Primary Sample	0.58		2.8		5	U							8.6	
P-16	VLF-081027-34	10/27/08	Primary Sample	0.62	J	2.7	J	1	U							13	
P-16	VLF-091015-27	10/15/09	Primary Sample	1	U	0.6	J	1	U	1	U	1	U	11		2.2	J
P-16	VLF-101013-7	10/13/10	Primary Sample	0.45	J	0.78	J	5	UJ							3.5	J
			Minimum	***0.09***		***0.60***		***1.0***		***0.02***		***0.02***		***10.7***		***2.2***	
			Maximum	***3.0***		***2.8***		***5.0***		***1.0***		***6.8***		***14.0***		***13.0***	
			Mean	***0.76***		***1.47***		***1.83***		***0.25***		***1.57***		***12.3***		***8.47***	
			Median	***0.52***		***1.25***		***1.00***		***0.02***		***0.02***		***12.9***		***10.0***	
			Standard Deviation	***0.80***		***0.89***		***1.59***		***0.43***		***2.95***		***1.43***		***3.33***	
			Interquartile Range	***0.44***		***1.70***		***0.50***		***0.18***		***0.98***		***2.10***		***2.55***	
			Skew	***2.31***		***0.51***		***1.64***		***2.06***		***2.13***		***-0.23***		***-1.00***	
			Kurtosis	***5.85***		***-1.58***		***1.13***		***4.29***		***4.56***		***-2.41***		***-0.16***	
			Coefficient of Variance	***1.06***		***0.60***		***0.87***		***1.69***		***1.88***		***0.12***		***0.39***	
			Number of Analyses	***12***		***12***		***12***		***5***		***5***		***5***		***12***	
			Number of Nondetect	***1***		***0***		***11***		***4***		***4***		***0***		***6***	
			Percent Nondetect	***8.3%***		***0.0%***		***91.7%***		***80.0%***		***80.0%***		***0.0%***		***50.0%***	
Leachate																	
L-4	VLF-121017-18	10/17/12	Primary Sample	2.7	J	200		25	U	0.68	J	5	U	98		260	
L-4	VLI-102913-36	10/29/13	Primary Sample	8.1		280		4.5	J	0.1	J	1	U	310		250	
			Minimum	***2.7***		***200***		***4.5***		***0.10***		***1.0***		***98***		***250***	
			Maximum	***8.1***		***280***		***25.0***		***0.68***		***5.0***		***310***		***260***	
			Mean	***5.40***		***240***		***14.8***		***0.39***		***3.0***		***204***		***255***	
			Median	***5.40***		***240***		***14.8***		***0.39***		***3.0***		***204***		***255***	
			Standard Deviation	***3.82***		***56.6***		***14.5***		***0.41***		***2.83***		***150***		***7.07***	
			Interquartile Range	***2.70***		***40.0***		***10.3***		***0.29***		***2.00***		***106***		***5.00***	
			Skew	***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***	
			Kurtosis	***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***		***#DIV/0!***	
			Coefficient of Variance	***0.71***		***0.24***		***0.98***		***1.05***		***0.94***		***0.73***		***0.03***	
			Number of Analyses	***2***		***2***		***2***		***2***		***2***		***2***		***2***	
			Number of Nondetect	***0***		***0***		***1***		***0***		***2***		***0***		***0***	
			Percent Nondetect	***0.0%***		***0.0%***		***50.0%***		***0.0%***		***100.0%***		***0.0%***		***0.0%***	

Coffin Butte Database
Detected Volatile Organic Compounds

Location	Sample ID	Date	Type	1,1-Dichloroethane	1,1-Dichloroethene	1,2,4-Trimethylbenzene	1,2-Dibromoethane	1,2-Dichloroethane	1,2-Dichloropropane	1,2-Dimethylbenzene	1,3,5-Trimethylbenzene	1,4-Dichlorobenzene	2-Butanone	2-Chloroethyl vinyl ether	2-Hexanone	4-Isopropyltoluene	4-Methyl-2-pentanone	Acetone	Benzene	Bromomethane	Carbon disulfide
				µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
MW-22	CB-081194-13	08/11/94	Primary Sample																		
MW-23	VLF-041905-2	04/20/05	Primary Sample																		
MW-23	VLF-120410-1	04/10/12	Primary Sample															1.9 J			
MW-26	VLF-130710-2	07/10/13	Primary Sample															8.7 UJ			
MW-27	VLF-111102-8	11/02/11	Primary Sample																		
MW-9S	MW-9S	05/31/89	Primary Sample	1			1							1						1	
MW-9S	MW-9S	10/24/89	Primary Sample				1			1				1						1	
MW-9S	MW-9S	08/06/92	Primary Sample				2											3			
L-4	VLF-121017-18	10/17/12	Primary Sample										27000				630 J	22000			
L-4	VLI-102913-36	10/29/13	Primary Sample	0.67 J		15		3.3	0.8 J		5.3	6.7	110		390	9.5	47	180	10		1.5 J
LDS-4	VLF-120411-24	04/11/12	Primary Sample										230		3.9 J		1.3 J	350			
LDS-4	VLF-121018-35	10/18/12	Primary Sample																		
LDS-4	VLF-130419-10	04/19/13	Primary Sample	0.25 J	0.66																
LDS-4	VLI-102813-28	10/28/13	Primary Sample																		

Coffin Butte Database
Detected Volatile Organic Compounds

Location	Sample ID	Date	Type	Chlorobenzene		Chloroform		Chloromethane		cis-1,2-Dichloroethene		Ethylbenzene		Isopropylbenzene		Methylene chloride		Naphthalene		n-Propylbenzene		o-Xylene		Styrene		Tetrachloroethene (PCE)		Toluene		trans-1,2-Dichloroethene		trans-1,3-Dichloropropene		Trichloroethene (TCE)		Vinyl chloride		Xylene, Isomers m & p		Xylenes	
				µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
MW-22	CB-081194-13	08/11/94	Primary Sample																																					0.6	
MW-23	VLF-041905-2	04/20/05	Primary Sample																									0.77													
MW-23	VLF-120410-1	04/10/12	Primary Sample																																						
MW-26	VLF-130710-2	07/10/13	Primary Sample																																						
MW-27	VLF-111102-8	11/02/11	Primary Sample			0.56																		0.61																	
MW-9S	MW-9S	05/31/89	Primary Sample					1																						1						1					
MW-9S	MW-9S	10/24/89	Primary Sample					1																												1					
MW-9S	MW-9S	08/06/92	Primary Sample													2	J																								
L-4	VLF-121017-18	10/17/12	Primary Sample													64	J											270													
L-4	VLI-102913-36	10/29/13	Primary Sample	0.53	J					2.2		49		2.2				50		2.2		47		7.3				170		0.6	J	0.69	J	2.6		6.6		88			
LDS-4	VLF-120411-24	04/11/12	Primary Sample																									1													
LDS-4	VLF-121018-35	10/18/12	Primary Sample																			0.22	J															0.41	J		
LDS-4	VLF-130419-10	04/19/13	Primary Sample							0.19	J																									0.14	J				
LDS-4	VLI-102813-28	10/28/13	Primary Sample							0.26	J															0.38	J									0.25	J				

Coffin Butte Descriptive Statistics - Edited Data Set
Inorganic Parameters

Location	Sample ID	Date	Type	Alkalinity (as CaCO3)		Bicarbonate Alkalinity as CACO3		Carbonate as CaCO3		Chemical Oxygen Demand		Chloride		Hardness as CaCO3		Nitrogen, Ammonia (as N)		Nitrogen, Nitrate-Nitrite		Sulfate		Suspended Solids		Total Dissolved Solids		Total Organic Carbon (TOC)	
				mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
MW-26	VLF-111101-2	11/01/11	Average			150				5.35	J	5.65				0.885	J	0.2	U	5	U	102		190		1.45	UJ
MW-26	VLF-20120117-02	01/17/12	Average			150				8.25	U	5.55				1		0.2	U	5	U	17		180		1.35	
MW-26	VLF-120411-18	04/11/12	Primary Sample			150				20	UJ	6				1		0.2	U	5	UB	47		190		1.5	
MW-26	VLF-120713-3	07/13/12	Average			150				8	J	5.9				1.05		0.062	J	5	U	4.6		190	J	1.55	
MW-26	VLF-121016-1	10/16/12	Primary Sample			150				4.2	J	5.7				0.92	J-	0.026	J	0.35	J	13		190		2	UB
MW-26	VLF-130124-3	01/24/13	Average			140				20	U	5.7				1.2		0.0215	J	5	U	48.5		190		2.2	
MW-26	VLF-130419-9	04/19/13	Primary Sample			150				9.3	J	5.8				1.2		0.2	U	5	U	16		200		2	JB
MW-26	VLF-130710-3	07/10/13	Average			150				10.5	J	5.6				1.2		0.085	J	5	U	12		190		1.8	UB
MW-26	VLI-102813-25	10/28/13	Primary Sample			150				9.3	J	5.4				1.2		0.2	U	0.51	J	18		180		1.9	UB
			Minimum			***140***				***4.20***		***5.40***				***0.885***		***0.0215***		***0.35***		***4.60***		***180***		***1.35***	
			Maximum			***150***				***20.0***		***6.00***				***1.20***		***0.20***		***5.00***		***102***		***200***		***2.20***	
			Mean			***149***				***10.5***		***5.70***				***1.07***		***0.13***		***3.98***		***30.9***		***189***		***1.75***	
			Median			***150***				***9.30***		***5.70***				***1.05***		***0.20***		***5.00***		***17.0***		***190***		***1.80***	
			Standard Deviation			***3.33***				***5.71***		***0.18***				***0.13***		***0.08***		***2.02***		***30.8***		***6.0***		***0.30***	
			Interquartile Range			***0.000***				***2.5***		***0.20***				***0.20***		***0.14***		***0.00***		***34.00***		***0.00***		***0.50***	
			Skew			***-3.00***				***1.09***		***0.12***				***-0.20***		***-0.45***		***-1.62***		***1.82***		***-0.02***		***0.07***	
			Kurtosis			***9.00***				***0.07***		***-0.05***				***-1.83***		***-2.10***		***0.75***		***3.36***		***1.13***		***-1.52***	
			Coefficient of Variance			***0.02***				***0.54***		***0.03***				***0.12***		***0.62***		***0.51***		***1.00***		***0.03***		***0.17***	
			Number of Analyses			***9***				***9***		***9***				***9***		***9***		***9***		***9***		***9***		***9***	
			Number of Nondetect			***0***				***3***		***0***				***0***		***5***		***7***		***0***		***0***		***4***	
			Percent Nondetect			***0.0%***				***33.3%***		***0.0%***				***0.0%***		***55.6%***		***77.8%***		***0.0%***		***0.0%***		***44.4%***	
MW-27	VLF-111102-8	11/02/11	Primary Sample			230				18	J	13				0.8		0.2	U	11		84		450		10	
MW-27	VLF-20120118-01	01/18/12	Primary Sample			350				32		12				1.2		0.2	U	2	J	110		400		11	
MW-27	VLF-120411-17	04/11/12	Primary Sample			330				17	J	12				0.85		0.2	U	5	UB	63		370		9.2	
MW-27	VLF-120713-1	07/13/12	Primary Sample			410				19	J	12				1		0.2	U	5	UB	220		450	J	9.2	
MW-27	VLF-121017-19	10/17/12	Primary Sample			320				15	J	9.6				0.83	J-	0.15	J	0.58	J	39		430		6	
MW-27	VLF-130124-1	01/24/13	Primary Sample			310				35		13				1.9		0.2	U	5	U	35		460		12	
MW-27	VLF-130419-8	04/19/13	Primary Sample			390				33	J	13				1.8		0.15	J	5	U	23		450		11	
MW-27	VLF-130710-1	07/10/13	Primary Sample			390				32		12				1.7		0.2	U	5	U	43		430		8.7	
MW-27	VLI-102913-26	10/29/13	Primary Sample			430				27		13				0.95		0.2	U	0.52	J	36		460		7.4	
			Minimum			***230***				***15.0***		***9.60***				***0.80***		***0.15***		***0.52***		***23.0***		***370***		***6.00***	
			Maximum			***430***				***35.0***		***13.0***				***1.90***		***0.20***		***11.0***		***220***		***460***		***12.0***	
			Mean			***351***				***25.3***		***12.2***				***1.23***		***0.189***		***4.34***		***72.6***		***433***		***9.39***	
			Median			***350***				***27.0***		***12.0***				***1.0***		***0.20***		***5.00***		***43.0***		***450***		***9.20***	
			Standard Deviation			***61.7***				***8.02***		***1.09***				***0.4***		***0.02***		***3.18***		***61.8***		***30.4***		***1.9***	
			Interquartile Range			***70.0***				***14.0***		***1.00***				***0.85***		***0.00***		***3.00***		***48.00***		***20.00***		***2.30***	
			Skew			***-0.73***				***-0.12***		***-1.86***				***0.67***		***-1.62***		***0.87***		***2.02***		***-1.37***		***-0.50***	
			Kurtosis			***0.49***				***-2.18***		***4.21***				***-1.60***		***0.73***		***1.76***		***4.35***		***1.24***		***-0.14***	
			Coefficient of Variance			***0.18***				***0.32***		***0.09***				***0.37***		***0.12***		***0.73***		***0.85***		***0.07***		***0.20***	
			Number of Analyses			***9***				***9***		***9***				***9***		***9***		***9***		***9***		***9***		***9***	
			Number of Nondetect			***0***				***0***		***0***				***0***		***7***		***5***		***0***		***0***		***0***	
			Percent Nondetect			***0.0%***				***0.0%***		***0.0%***				***0.0%***		***77.8%***		***55.6%***		***0.0%***		***0.0%***		***0.0%***	

Coffin Butte - Descriptive Statistics - Edited Data Set
Dissolved Metals - (Filtered)

Location	Sample ID	Date	Type	Calcium		Iron		Magnesium		Manganese		Potassium		Silicon		Sodium	
				µg/L		µg/L		µg/L		µg/L		µg/L		µg/L		µg/L	
MW-26	VLF-111101-2	11/01/11	Average	22,500		2,950		9,500		660		1,550	J	25,000		26,500	
MW-26	VLF-20120117-02	01/17/12	Average	22,000		1,250		9,250		635		1,450	J	23,000		25,500	
MW-26	VLF-120411-18	04/11/12	Primary Sample	23,000		380		8,900		580		1,400	J	21,000		26,000	
MW-26	VLF-120713-3	07/13/12	Average	22,000		385		7,950		425		1,050	J	20,000		27,000	
MW-26	VLF-121016-1	10/16/12	Primary Sample	22,000		430		8,700		610		1,300	J	23,000		27,000	
MW-26	VLF-130124-3	01/24/13	Average	23,000		410		8,600		620		1,400	J	22,500		27,000	
MW-26	VLF-130419-9	04/19/13	Primary Sample	25,000		260		8,900		550		1,400	J	22,000		28,000	
MW-26	VLF-130710-3	07/10/13	Average	23,000		440		8,200		540		1,250	J	20,500		25,000	
MW-26	VLI-102813-25	10/28/13	Primary Sample	22,000		440		8,900		640		1,400	J	20,000		28,000	
			Minimum	***22,000***		***260***		***7,950***		***425***		***1,050***		***20,000***		***25,000***	
			Maximum	***25,000***		***2,950***		***9,500***		***660***		***1,550***		***25,000***		***28,000***	
			Mean	***22,722***		***772***		***8,767***		***584***		***1,356***		***21,889***		***26,667***	
			Median	***22,500***		***430***		***8,900***		***610***		***1,400***		***22,000***		***27,000***	
			Standard Deviation	***972***		***866***		***480***		***72***		***142***		***1,673***		***1,031***	
			Interquartile Range	***1,000***		***55***		***300***		***85***		***100***		***2,500***		***1,000***	
			Skew	***1.81***		***2.48***		***-0.32***		***-1.44***		***-1.19***		***0.56***		***-0.24***	
			Kurtosis	***3.84***		***6.2***		***-0.07***		***2.30***		***2.19***		***-0.24***		***-0.75***	
			Coefficient of Variance	***0.04***		***1.12***		***0.05***		***0.12***		***0.11***		***0.08***		***0.04***	
			Number of Analyses	***9***		***9***		***9***		***9***		***9***		***9***		***9***	
			Number of Nondetect	***0***		***0***		***0***		***0***		***0***		***0***		***0***	
			Percent Nondetect	***0.0%***		***0.0%***		***0.0%***		***0.0%***		***0.0%***		***0.0%***		***0.0%***	
MW-27	VLF-111102-8	11/02/11	Primary Sample	48,000		1,400		20,000		3,700		1,700	J	20,000		44,000	
MW-27	VLF-20120118-01	01/18/12	Primary Sample	71,000		12,000		36,000		6,400		1,600	J	18,000		39,000	
MW-27	VLF-120411-17	04/11/12	Primary Sample	61,000		3,600		27,000		5,000		1,000	J	20,000		33,000	
MW-27	VLF-120713-1	07/13/12	Primary Sample	62,000		5,100		26,000		5,300		700	J	20,000		34,000	
MW-27	VLF-121017-19	10/17/12	Primary Sample	61,000		6,100		28,000		5,100		830	J	23,000		32,000	
MW-27	VLF-130124-1	01/24/13	Primary Sample	86,000		15,000		37,000		6,900		760	J	17,000		38,000	
MW-27	VLF-130419-8	04/19/13	Primary Sample	93,000		15,000		40,000		7,400		750	J	18,000		40,000	
MW-27	VLF-130710-1	07/10/13	Primary Sample	68,000		9,100		29,000		5,400		740	J	17,000		30,000	
MW-27	VLI-102913-26	10/29/13	Primary Sample	66,000		3,200		30,000		5,800		600	J	18,000		35,000	
			Minimum	***48,000***		***1,400***		***20,000***		***3,700***		***600***		***17,000***		***30,000***	
			Maximum	***93,000***		***15,000***		***40,000***		***7,400***		***1,700***		***23,000***		***44,000***	
			Mean	***68,444***		***7,833***		***30,333***		***5,667***		***964***		***19,000***		***36,111***	
			Median	***66,000***		***6,100***		***29,000***		***5,400***		***760***		***18,000***		***35,000***	
			Standard Deviation	***13,667***		***5,159***		***6,265***		***1,114***		***404***		***1,936***		***4,457***	
			Interquartile Range	***10,000***		***8,400***		***9,000***		***1,300***		***260***		***2,000***		***6,000***	
			Skew	***0.67***		***0.40***		***0.09***		***-0.08***		***1.36***		***1.06***		***0.44***	
			Kurtosis	***0.35***		***-1.49***		***-0.46***		***0.12***		***0.31***		***1.03***		***-0.51***	
			Coefficient of Variance	***0.20***		***0.66***		***0.21***		***0.20***		***0.42***		***0.10***		***0.12***	
			Number of Analyses	***9***		***9***		***9***		***9***		***9***		***9***		***9***	
			Number of Nondetect	***0***		***0***		***0***		***0***		***0***		***0***		***0***	
			Percent Nondetect	***0.0%***		***0.0%***		***0.0%***		***0.0%***		***0.0%***		***0.0%***		***0.0%***	

Coffin Butte Descriptive Statistics - Edited Data Set
Total Metals (Unfiltered)

Location	Sample ID	Date	Type	Antimony		Arsenic		Barium		Beryllium		Cadmium		Chromium		Cobalt		Copper	
				UG/L		ug/L		UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
MW-26	VLF-111101-2	11/01/11	Average	0.89	J	13		33.5		1	U	1	U	1.35	J	1.05		3.1	UJB
MW-26	VLF-20120117-02	01/17/12	Average	2	U	14		27		1	U	1	U	3	U	0.79	J	1.2	J
MW-26	VLF-120411-18	04/11/12	Primary Sample	2	UB	14		27		1	U	1	U	3	U	0.96	J	1.3	J
MW-26	VLF-120713-3	07/13/12	Average	2	U	15.5		25.5		1	U	1	U	3	U	0.475	J	0.945	J
MW-26	VLF-121016-1	10/16/12	Primary Sample	2	U	15		28		1	U	1	U	3	U	0.57	J	1	J
MW-26	VLF-130124-3	01/24/13	Average	2	U	14		25		1	U	0.16	J	3	U	0.33	J	2	UB
MW-26	VLF-130419-9	04/19/13	Primary Sample	2	U	12		28		1	U	1	U	3	U	0.65	J	0.75	J
MW-26	VLF-130710-3	07/10/13	Average	2	U	13.5		26		1	U	0.2725	U	3	U	0.475	J	0.99	J
MW-26	VLI-102813-25	10/28/13	Primary Sample	2	U	14		27		1	U	0.043	J	3	U	0.43	J	0.7	J
			Minimum	***0.89***		***12.0***		***25.0***		***1.0***		***0.043***		***1.4***		***0.33***		***0.70***	
			Maximum	***2.0***		***15.5***		***33.5***		***1.0***		***1.0***		***3.0***		***1.1***		***3.1***	
			Mean	***1.9***		***13.9***		***27.4***		***1.0***		***0.72***		***2.82***		***0.64***		***1.33***	
			Median	***2.00***		***14.0***		***27.0***		***1.00***		***1.00***		***3.00***		***0.57***		***1.00***	
		Standard Deviation		***0.37***		***1.02***		***2.49***		***0.00***		***0.42***		***0.55***		***0.25***		***0.77***	
		Interquartile Range		***0.00***		***0.50***		***2.00***		***0.00***		***0.73***		***0.00***		***0.32***		***0.36***	
			Skew	***-3.00***		***-0.29***		***2.04***		***#DIV/0!***		***-0.93***		***-3.00***		***0.65***		***1.87***	
			Kurtosis	***9.00***		***0.70***		***5.13***		***#DIV/0!***		***-1.40***		***9.00***		***-0.85***		***3.40***	
		Coefficient of Variance		***0.20***		***0.07***		***0.09***		***0.00***		***0.59***		***0.20***		***0.39***		***0.58***	
		Number of Analyses		***9***		***9***		***9***		***9***		***9***		***9***		***9***		***9***	
		Number of Nondetect		***8***		***0***		***0***		***9***		***7***		***8***		***0***		***1***	
		Percent Nondetect		***88.9%***		***0.0%***		***0.0%***		***100.0%***		***77.8%***		***88.9%***		***0.0%***		***11.1%***	
MW-27	VLF-111102-8	11/02/11	Primary Sample	0.21	J	9.8		290		0.46	J	0.2	J	4.9		15		13	
MW-27	VLF-20120118-01	01/18/12	Primary Sample	2	U	4.3	J	200		1	U	0.1	J	1.4	J	36		3.4	
MW-27	VLF-120411-17	04/11/12	Primary Sample	2	UB	19		130		1	U	0.45	J	1.6	J	18		4.2	
MW-27	VLF-120713-1	07/13/12	Primary Sample	2	U	19		220		0.45	J+	0.33	J+	4.2		30		11	
MW-27	VLF-121017-19	10/17/12	Primary Sample	2	U	18		93		1	U	0.072	J	3	U	15		1.5	J
MW-27	VLF-130124-1	01/24/13	Primary Sample	2	U	9.8		97		1	U	1	U	3	U	34		2	UB
MW-27	VLF-130419-8	04/19/13	Primary Sample	2	U	10		100		1	U	1	U	3	U	35		2	U
MW-27	VLF-130710-1	07/10/13	Primary Sample	2	U	14		85		1	U	0.058	J	3	U	22		1.3	J
MW-27	VLI-102913-26	10/29/13	Primary Sample	2	U	11		100		1	U	1	U	3	U	34		1.8	J
			Minimum	***0.21***		***4.3***		***85.0***		***0.45***		***0.06***		***1.4***		***15.0***		***1.30***	
			Maximum	***2.0***		***19.0***		***290***		***1.0***		***1.0***		***4.9***		***36.0***		***13.0***	
			Mean	***1.8***		***12.8***		***146***		***0.88***		***0.47***		***3.01***		***26.6***		***4.47***	
			Median	***2.00***		***11.0***		***100***		***1.00***		***0.33***		***3.00***		***30.0***		***2.00***	
		Standard Deviation		***0.60***		***5.08***		***72.9***		***0.24***		***0.42***		***1.09***		***8.97***		***4.40***	
		Interquartile Range		***0.00***		***8.20***		***103***		***0.00***		***0.90***		***0.00***		***16.0***		***2.40***	
			Skew	***-3.00***		***-0.07***		***1.18***		***-1.62***		***0.55***		***0.18***		***-0.33***		***1.50***	
			Kurtosis	***9.00***		***-0.91***		***0.20***		***0.74***		***-1.80***		***0.19***		***-2.06***		***0.74***	
		Coefficient of Variance		***0.33***		***0.40***		***0.50***		***0.27***		***0.89***		***0.36***		***0.34***		***0.98***	
		Number of Analyses		***9***		***9***		***9***		***9***		***9***		***9***		***9***		***9***	
		Number of Nondetect		***8***		***0***		***0***		***7***		***3***		***5***		***0***		***2***	
		Percent Nondetect		***88.9%***		***0.0%***		***0.0%***		***77.8%***		***33.3%***		***55.6%***		***0.0%***		***22.2%***	

Coffin Butte Descriptive Statistics - Edited Data Set
Total Metals (Unfiltered)

Location	Sample ID	Date	Type	Lead		Nickel		Selenium		Silver		Thallium		Vanadium		Zinc	
				UG/L		UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
MW-26	VLF-111101-2	11/01/11	Average	0.575	J	2	UB	5	U	0.26	UJ	1	U	3.5	J	3.75	J
MW-26	VLF-20120117-02	01/17/12	Average	0.28	J	0.73	J	5	U	1	U	1	U	1.4	J	2.55	J
MW-26	VLF-120411-18	04/11/12	Primary Sample	0.4	J	1.1	J	5	U	1	U	1	U	2.5	J	10	U
MW-26	VLF-120713-3	07/13/12	Average	0.165	J	0.65	J	5	U	0.26	U	1	U	5	U	6.6	J+
MW-26	VLF-121016-1	10/16/12	Primary Sample	0.28	J	0.71	J	5	U	1	U	1	U	1.4	J	10	U
MW-26	VLF-130124-3	01/24/13	Average	1	U	0.305	J	5	U	1	U	1	U	5	U	10	U
MW-26	VLF-130419-9	04/19/13	Primary Sample	0.41	J	0.64	J	5	U	1	U	1	U	2	J	10	U
MW-26	VLF-130710-3	07/10/13	Average	0.225	J	0.495	J	5	U	1	U	1	U	1.85	J	3.2	J
MW-26	VLI-102813-25	10/28/13	Primary Sample	0.16	J	2	UB	5	U	1	U	1	U	1.4	J	6.3	J
			Minimum	***0.16***		***0.31***		***5.0***		***0.26***		***1.0***		***1.4***		***2.6***	
			Maximum	***1.0***		***2.0***		***5.0***		***1.0***		***1.0***		***5.0***		***10.0***	
			Mean	***0.39***		***0.96***		***5.0***		***0.84***		***1.00***		***2.67***		***6.93***	
			Median	***0.28***		***0.71***		***5.00***		***1.00***		***1.00***		***2.00***		***6.60***	
			Standard Deviation	***0.26***		***0.63***		***0.00***		***0.33***		***0.00***		***1.48***		***3.19***	
			Interquartile Range	***0.19***		***0.46***		***0.00***		***0.00***		***0.00***		***2.10***		***6.25***	
			Skew	***1.77***		***1.17***		***#DIV/0!***		***-1.62***		***#DIV/0!***		***0.93***		***-0.26***	
			Kurtosis	***3.44***		***-0.05***		***#DIV/0!***		***0.73***		***#DIV/0!***		***-0.80***		***-1.93***	
			Coefficient of Variance	***0.68***		***0.65***		***0.00***		***0.39***		***0.00***		***0.55***		***0.46***	
			Number of Analyses	***9***		***9***		***9***		***9***		***9***		***9***		***9***	
			Number of Nondetect	***1***		***2***		***9***		***9***		***9***		***2***		***4***	
			Percent Nondetect	***11.1%***		***22.2%***		***100.0%***		***100.0%***		***100.0%***		***22.2%***		***44.4%***	
MW-27	VLF-111102-8	11/02/11	Primary Sample	4.5		11		5	U	0.036	J	0.083	J	14		14	UJB
MW-27	VLF-20120118-01	01/18/12	Primary Sample	1.1		12		5	U	1	U	1	U	3.6	J	8.2	J
MW-27	VLF-120411-17	04/11/12	Primary Sample	1.9		7.1		5	U	1	U	1	U	4.1	J	5.7	J
MW-27	VLF-120713-1	07/13/12	Primary Sample	5.3		9.8		5	U	0.036	J	0.079	J	10		15	J+
MW-27	VLF-121017-19	10/17/12	Primary Sample	0.77	J	4.5		2.4	J	1	U	1	UB	2.1	J	2.5	J
MW-27	VLF-130124-1	01/24/13	Primary Sample	1	U	9.1		5	U	1	U	1	U	1.9	J	10	U
MW-27	VLF-130419-8	04/19/13	Primary Sample	0.16	J	8.4		5	U	1	U	1	U	2.2	J	10	U
MW-27	VLF-130710-1	07/10/13	Primary Sample	0.46	J	6.4		5	U	0.02	J	1	U	1.8	J	3	J
MW-27	VLI-102913-26	10/29/13	Primary Sample	1.3		9.8		5	U	1	U	1	U	2.9	J	4.7	J
			Minimum	***0.16***		***4.50***		***2.4***		***0.02***		***0.079***		***1.8***		***2.5***	
			Maximum	***5.3***		***12.0***		***5.0***		***1.0***		***1.0***		***14.0***		***15.0***	
			Mean	***1.83***		***8.68***		***4.71***		***0.68***		***0.80***		***4.73***		***8.12***	
			Median	***1.10***		***9.10***		***5.00***		***1.00***		***1.00***		***2.90***		***8.20***	
			Standard Deviation	***1.82***		***2.35***		***0.87***		***0.48***		***0.41***		***4.31***		***4.53***	
			Interquartile Range	***1.13***		***2.70***		***0.00***		***0.96***		***0.00***		***2.00***		***5.30***	
			Skew	***1.37***		***-0.45***		***-3.00***		***-0.86***		***-1.62***		***1.71***		***0.30***	
			Kurtosis	***0.54***		***-0.28***		***9.00***		***-1.71***		***0.73***		***1.93***		***-1.20***	
			Coefficient of Variance	***0.99***		***0.27***		***0.18***		***0.72***		***0.51***		***0.91***		***0.56***	
			Number of Analyses	***9***		***9***		***9***		***9***		***9***		***9***		***9***	
			Number of Nondetect	***1***		***0***		***8***		***6***		***7***		***0***		***2***	
			Percent Nondetect	***11.1%***		***0.0%***		***88.9%***		***66.7%***		***77.8%***		***0.0%***		***22.2%***	

ATTACHMENT B

BORING LOGS AND PIPER PLOT

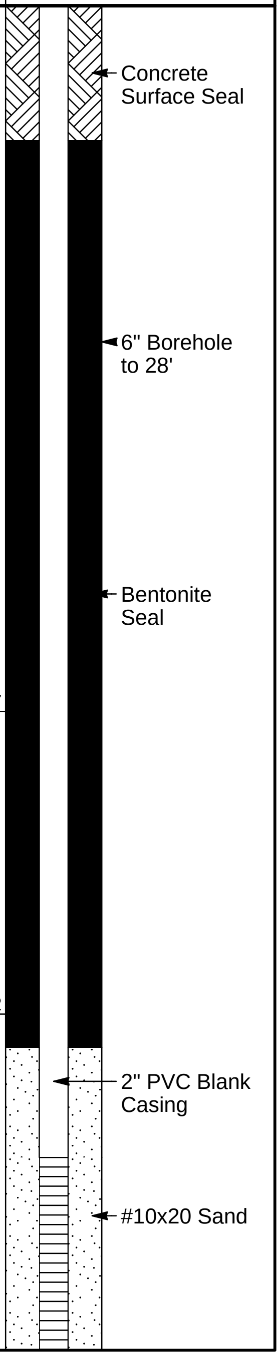
TUPPAN CONSULTANTS LLC
460 SECOND STREET, SUITE 103
LAKE OSWEGO, OREGON 97034
TELEPHONE: (503) 675-1335

WELL NUMBER MW-26

CLIENT Valley Landfills, Inc.
PROJECT NAME Cell 4
PROJECT NUMBER VLI-001-004
PROJECT LOCATION Coffin Butte Landfill
DATE STARTED 10/17/11 **COMPLETED** 10/17/11
GROUND ELEVATION 235.18 ft MSL **HOLE SIZE** 6"
DRILLING CONTRACTOR Major Drilling Environmental
GROUND WATER LEVELS:
DRILLING METHOD Sonic
▽ **AT TIME OF DRILLING** 15.00 ft / Elev 220.18 ft
LOGGED BY Eric Tuppan **CHECKED BY** EJT
AT END OF DRILLING ---
NOTES
▼ **AFTER DRILLING** 5.60 ft / Elev 229.58 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	TESTS	U.S.C.S.	MATERIAL DESCRIPTION
0–5	RC	100	PP = 3.0 tsf	CL	(CL) **CLAY FILL**: dark yellow brown (10YR, 4/4) with splotchy brown/black; low plasticity fines; trace fine sand; very stiff; damp. @4.5': grass
5–10	RC	100	PP = 2.5 tsf PP = 4.0 tsf		@5.0: angular to rounded pebbles. ▼ @7.5': splotchy very dark grayish brown (10YR, 3/2) to dark yellowish brown (10YR, 4/4); low to moderate plasticity fines; very stiff to hard; damp. @9.5': angular basalt chips.
10.5					224.7
10–15	RC	100	PP = 2.5 tsf PP = 1.3 tsf	CL	(CL) **CLAY**: dark brown (10YR, 3/3); low to moderate plasticity fines with trace sand grains; iron oxide and manganese oxide stain; uniform texture; stiff to very stiff; damp. @14.5': 2"-thick layer of dark gray (10YR, 4/1).
15.0 ▽					220.2
15–20	RC	100	PP = 2.0 tsf	ML	(ML) **CLAYEY SILT**: dark olive (5Y, 3/3); low plasticity fines with mica flecks and some clay; uniform; very stiff to stiff; moist to wet on fresh core surfaces.

WELL DIAGRAM
Casing Top Elev: 237.91 (ft)
Casing Type: PVC



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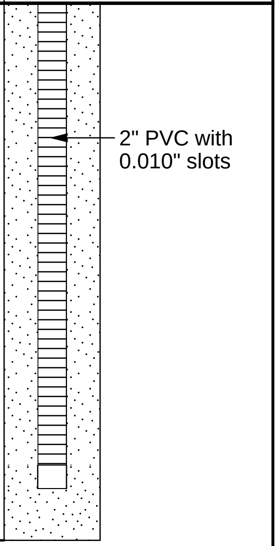
WELL NUMBER MW-26

CLIENT Valley Landfills, Inc.

PROJECT NAME Cell 4

PROJECT NUMBER VLI-001-004

PROJECT LOCATION Coffin Butte Landfill

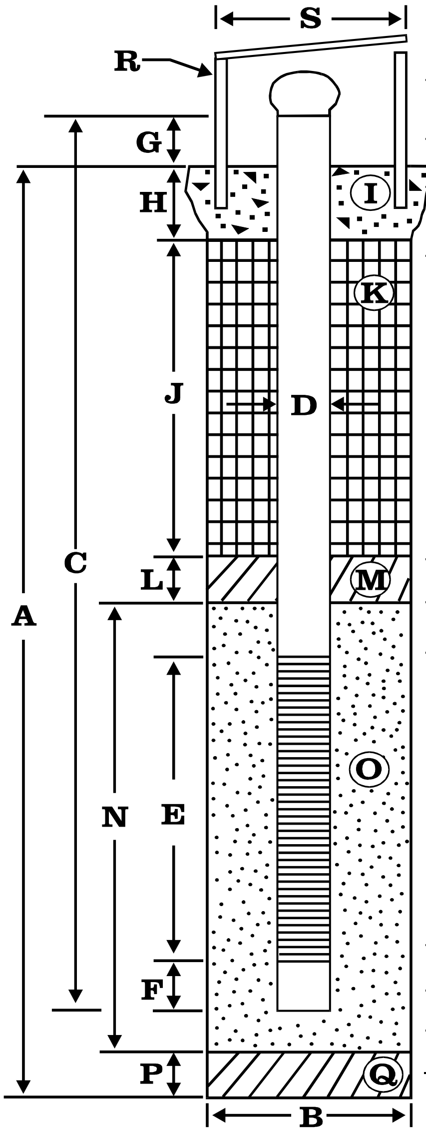
DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
20	RC	100	PP = 2.3 tsf	ML		(ML) **CLAYEY SILT**: dark olive (5Y, 3/3); low plasticity fines with mica flecks and some clay; uniform; very stiff to stiff; moist to wet on fresh core surfaces. *(continued)*	
						@21'-28': dark gray (5Y, 4/1); uniform low plasticity fines; very stiff to hard; moist to wet on fresh surfaces; trace brown roots.	
25			PP = 4.0 tsf			28.0 207.2	

Bottom of borehole at 28.0 feet.

WELL DETAILS

Project Number: **VLI-001-004**
Client Name: **Valley Landfills, Inc.**
Project Name: **Cell 4 Well Installation**
Location: **Coffin Butte Landfill**
Driller: **Major Drilling Environmental**

Boring/Well No.: **MW-26**
Top of Casing Elev.: **237.91**
Ground Surface Elev.: **235.18**
Installation Date: **10/17/11**
Permit/Start Card No.: **L108324/1015035**



Depth (feet)	Elev. (ft, msl)
3.26	238.44
2.73	237.91
0.00	235.18
2.00	233.18
15.50	
17.13	218.05
26.88	208.30
27.23	207.95
28.0	207.18
—	

EXPLORATORY BORING

A. Total depth: **28.0 ft.**
B. Diameter **6 in.**
Drilling method: **Sonic**

WELL CONSTRUCTION

C. Well casing length: **30.13 ft.**
Well casing material: **PVC**
D. Well casing diameter: **2 in.**
E. Well screen length: **9.75 ft.**
Well screen type: **PVC**
Well screen slot size: **0.010 in.**
F. Well sump: **0.35 ft.**
G. Well casing height (stickup)**:** **2.73 ft.**
H. Surface seal thickness: **2.0 ft.**
I. Surface seal material: **Concrete**
J. Annular seal thickness: **13.5 ft.**
K. Annular seal material: **Bent. Chips**
L. Filter pack seal thickness: **— ft.**
M. Filter pack seal material: **—**
N. Sand pack thickness: **12.5 ft.**
O. Sand pack material: **10/20 Sand**
P. Bottom material thickness: **— ft.**
Q. Bottom material:
R. Protective casing material: **Steel**
Well centralizer depths: **— ft.**
S. Protective casing diameter: **6 in.**

NOTES:

Installed open hole.

Installed by: **Eric Tuppan**

Reviewed by: **EJT**

Date: **11/3/2011**

TUPPAN CONSULTANTS LLC
460 SECOND STREET, SUITE 103
LAKE OSWEGO, OREGON 97034
TELEPHONE: (503) 675-1335

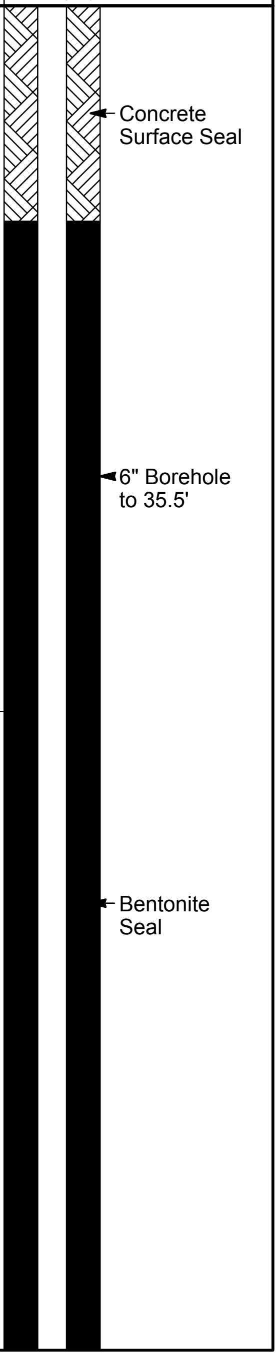
WELL NUMBER MW-27

PAGE 1 OF 2

CLIENT Valley Landfills, Inc.
PROJECT NAME Cell 4
PROJECT NUMBER VLI-001-004
PROJECT LOCATION Coffin Butte Landfill
DATE STARTED 10/17/11 **COMPLETED** 10/17/11
GROUND ELEVATION 252.12 ft MSL **HOLE SIZE** 6"
DRILLING CONTRACTOR Major Drilling Environmental
GROUND WATER LEVELS:
DRILLING METHOD Sonic
AT TIME OF DRILLING ---
LOGGED BY Eric Tuppan **CHECKED BY** EJT
AT END OF DRILLING ---
NOTES
▽ **AFTER DRILLING** 19.35 ft / Elev 232.77 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	TESTS	U.S.C.S.	MATERIAL DESCRIPTION
0					(CL) **SANDY CLAY FILL:** very dark gray brown (10YR, 4/2); 10-20% fine sand with small gravel; damp.
5	RC	10		CL	
10					
10.5					(CL) **CLAY FILL:** dark brown (10YR, 3/3); low plasticity fines with less than 10% fine sand; damp; very stiff. 241.6
	RC	100	PP = 3.3 tsf		
					@14.5': low plasticity fines with some fine sand and coarse sand; damp; very stiff.
15				CL	
	RC	100	PP = 3.0 tsf		@17.5: blackish to very dark brown (10YR, 2/1); gravelly clay.
			PP = 2.0 tsf		▽ @18.8: dark grayish brown (10YR, 4/2); low plasticity fines with trace fine to coarse sand and occasional angular pebbles (1.5-2"); some roots; damp; very stiff.
20					

WELL DIAGRAM
Casing Top Elev: 254.76 (ft)
Casing Type: PVC



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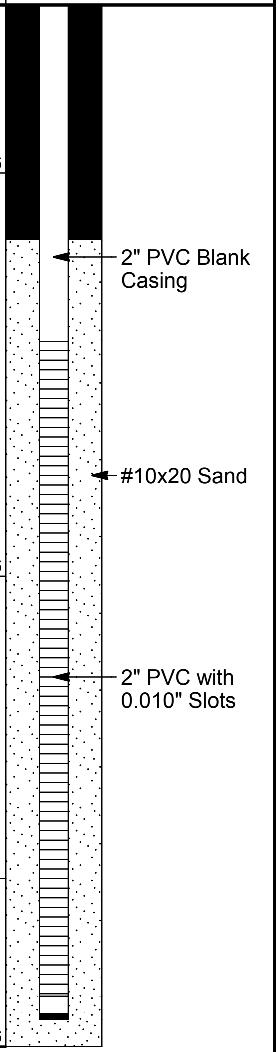
WELL NUMBER MW-27

CLIENT Valley Landfills, Inc.
PROJECT NAME Cell 4
PROJECT NUMBER VLI-001-004
PROJECT LOCATION Coffin Butte Landfill

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
20	RC	100	PP = 2.5 tsf	CL		(CL) **CLAY FILL:** dark brown (10YR, 3/3); low plasticity fines with less than 10% fine sand; damp; very stiff. *(continued)*
						@22.5: piece of blue plastic indicates fill.
					22.5	229.6
			PP = 1.8 tsf	CH		(CH) **CLAY With ORGANICS**: black (10YR, 2/1); high plasticity fines; less than 10% fine sand, with rounded medium sand grains; abundant roots, pieces of wood, and organic material at 9.6%; moist to wet (38.8% water content).
25	RC	100				@23-25': geotechnical sample collected.
			PP = 1.3 tsf		28.5	223.6
			PP = 1.3 tsf	CH		(CH) **CLAY:** dark gray (10YR, 4/1); grades from organic rich clay to clay at 28-29'; moderate to high plasticity fines; trace coarse sand; reddish iron oxide stains; stiff; damp.
30	RC	100	PP = 1.5 tsf			
			PP = 2.0 tsf		33.0	219.1
			PP = 2.3 tsf	CL		(CL) **CLAY:** dark olive gray (5Y, 3/2); low plasticity fines with trace sand, slightly silty; flecks of mica; very stiff to hard; damp.
35	RC	100	PP = 3.8 tsf		35.5	216.6

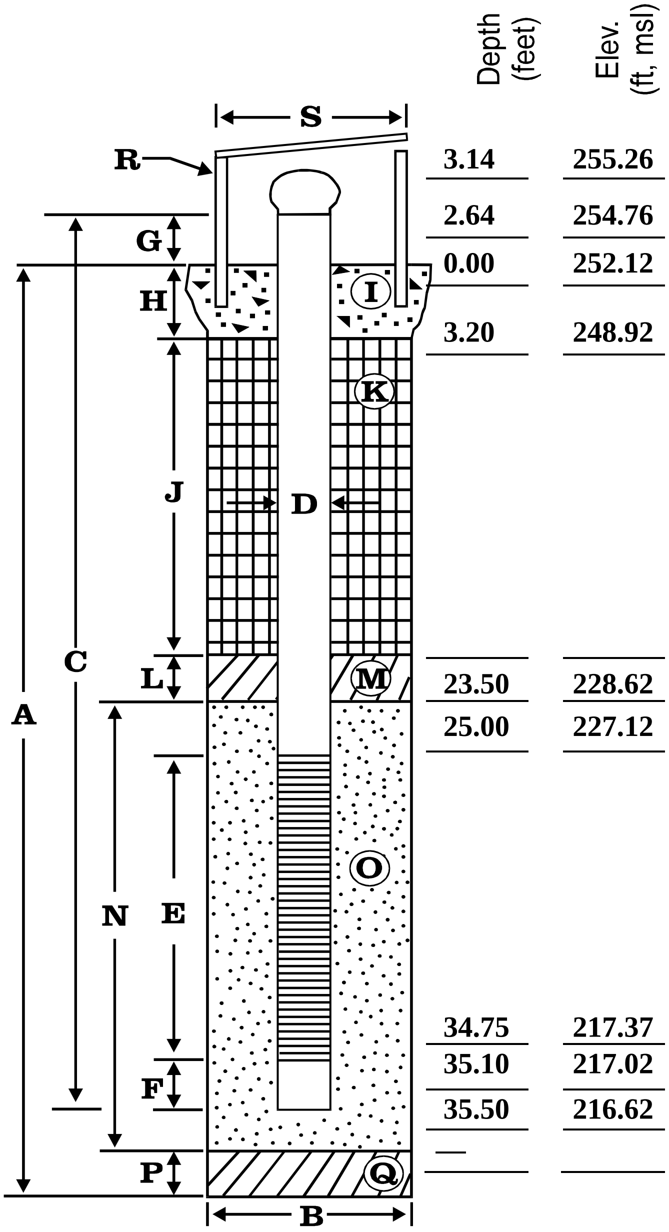
Bottom of borehole at 35.5 feet.



WELL DETAILS

Project Number: **VLI-001-004**
Client Name: **Valley Landfills, Inc.**
Project Name: **Cell 4 Well Installation**
Location: **Coffin Butte Landfill**
Driller: **Major Drilling Environmental**

Boring/Well No.: **MW-27**
Top of Casing Elev.: **254.76**
Ground Surface Elev.: **252.12**
Installation Date: **10/17/11**
Permit/Start Card No.: **L108323/1015034**



EXPLORATORY BORING

A. Total depth: **35.5 ft.**
B. Diameter **6 in.**
Drilling method: **Sonic**

WELL CONSTRUCTION

C. Well casing length: **37.71 ft.**
Well casing material: **PVC**
D. Well casing diameter: **2 in.**
E. Well screen length: **9.75 ft.**
Well screen type: **PVC**
Well screen slot size: **0.010 in.**
F. Well sump: **0.35 ft.**
G. Well casing height (stickup): **2.61 ft.**
H. Surface seal thickness: **3.2 ft.**
I. Surface seal material: **Concrete**
J. Annular seal thickness: **20.3 ft.**
K. Annular seal material: **Bent. Chips**
L. Filter pack seal thickness: **— ft.**
M. Filter pack seal material: **—**
N. Sand pack thickness: **12.0 ft.**
O. Sand pack material: **10/20 Sand**
P. Bottom material thickness: **— ft.**
Q. Bottom material:
R. Protective casing material: **Steel**
Well centralizer depths: **— ft.**
S. Protective casing width: **6 in.**

NOTES:

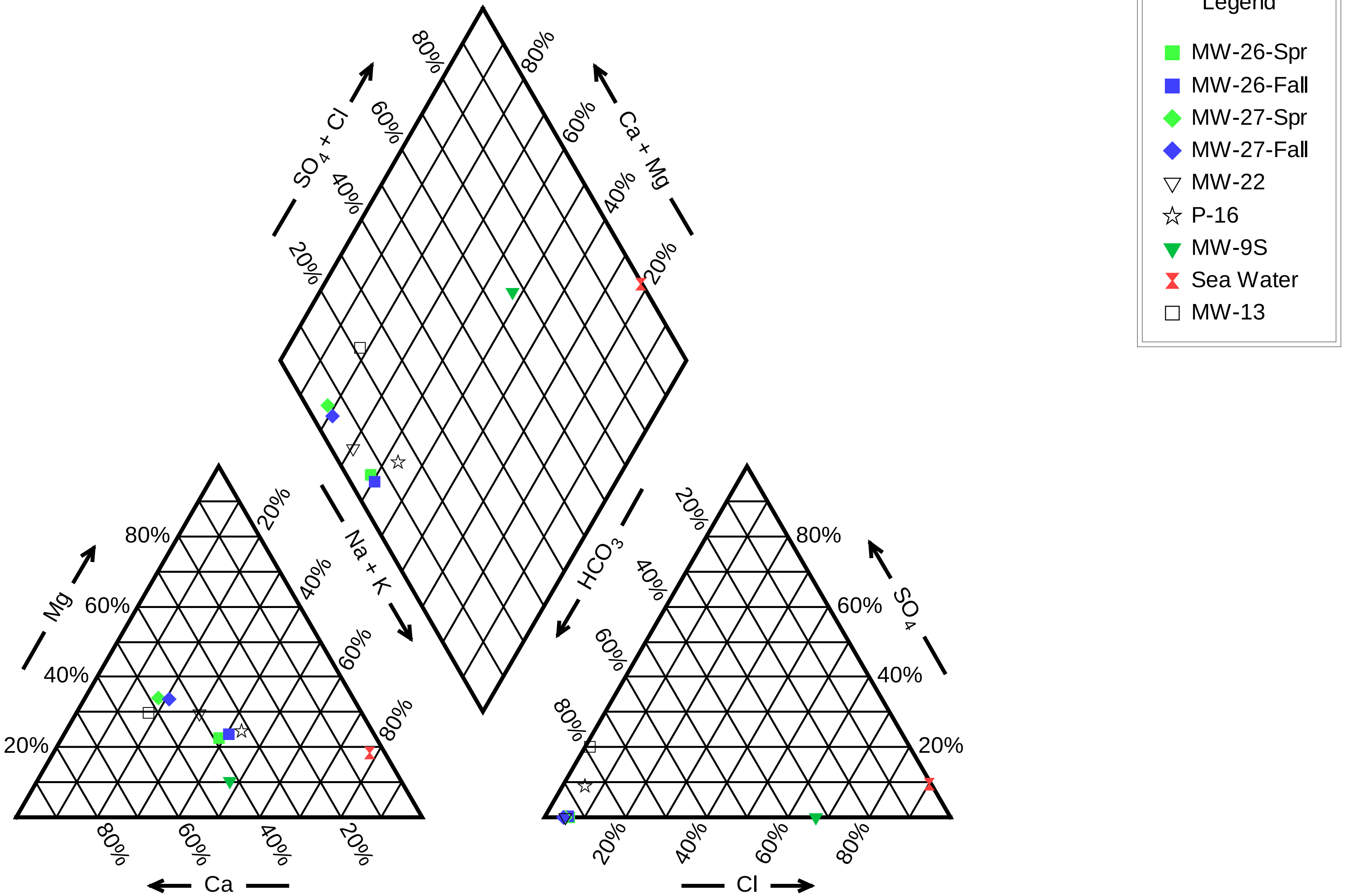
Installed open hole.

Installed by: **Eric Tuppan**

Reviewed by: **EJT**

Date: **11/3/2011**

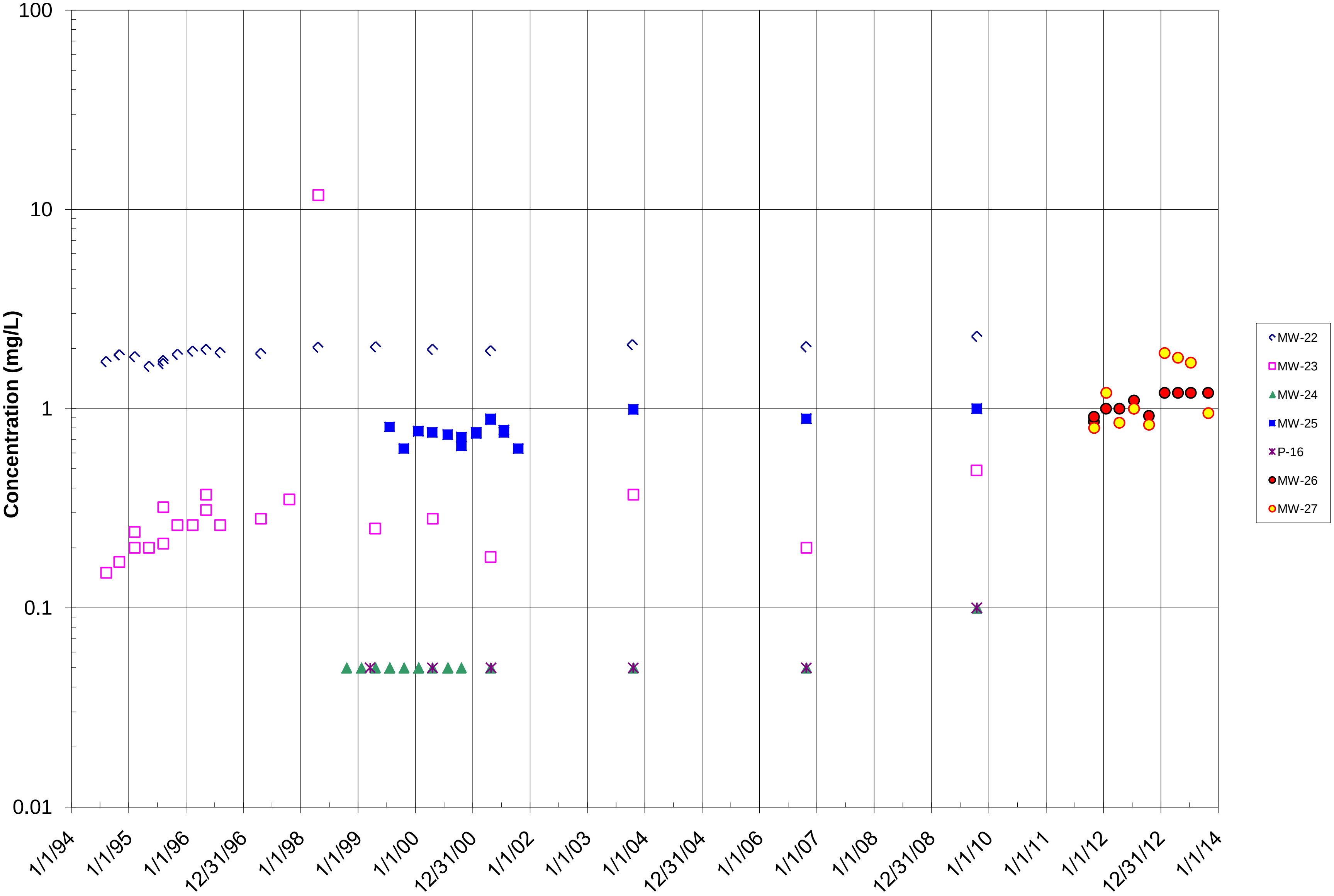
Piper Diagram – Coffin Butte Landfill East Side



ATTACHMENT C

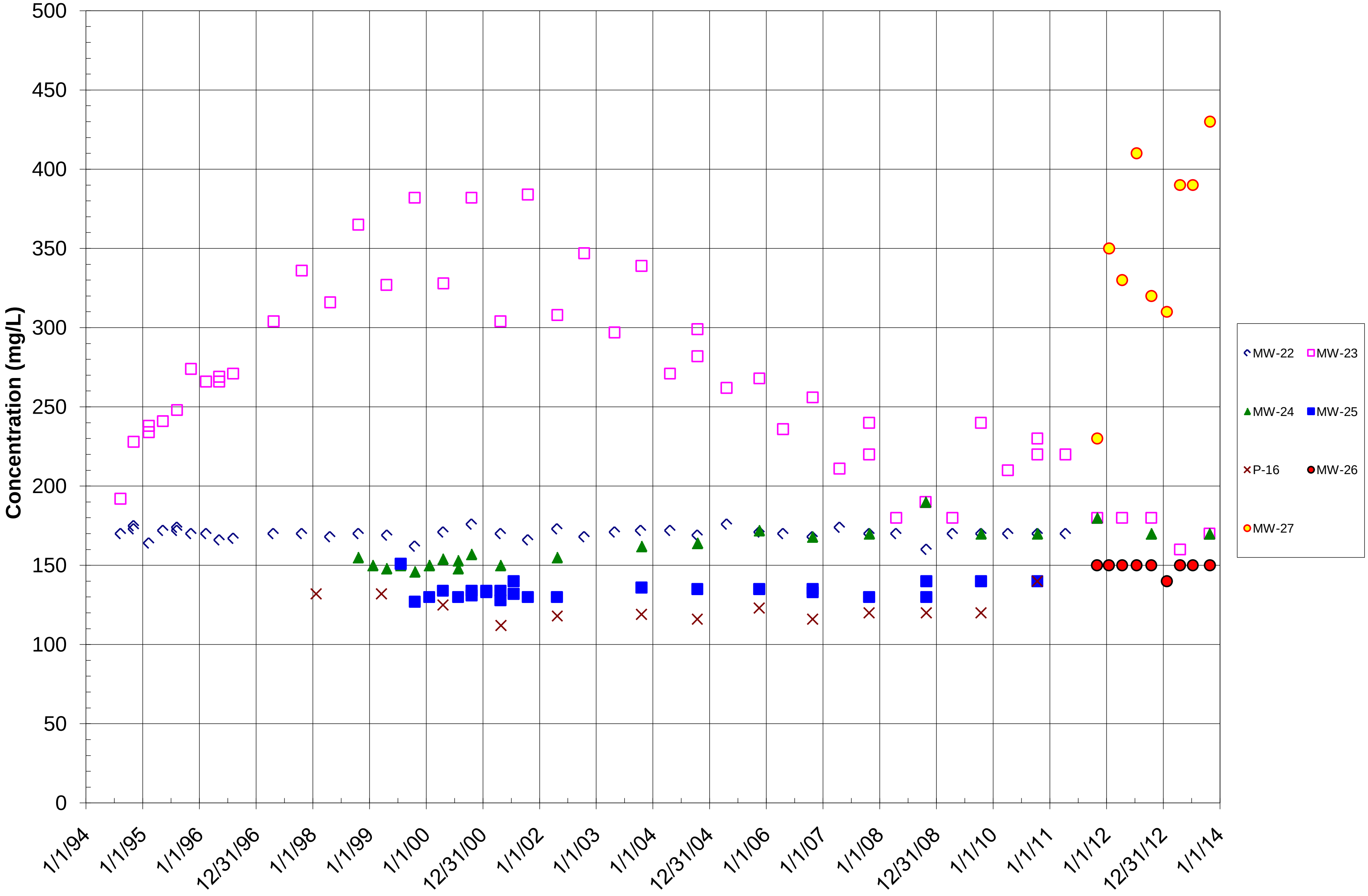
TIME SERIES CONCENTRATION PLOTS

Coffin Butte Landfill
MW-23, MW-24, MW-26, and and MW-27: Ammonia



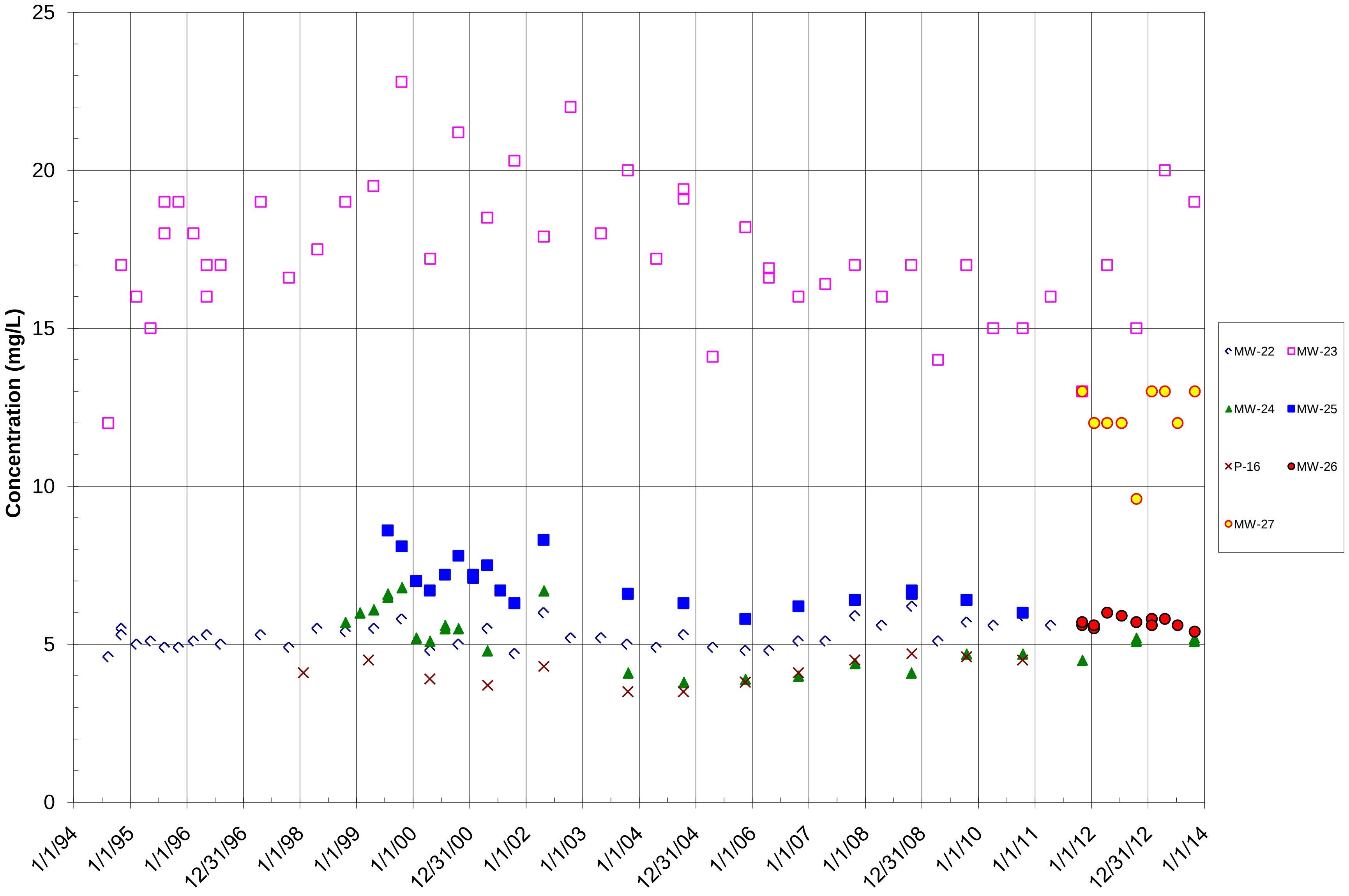
MW-26-27/Ammonia

Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Bicarbonate Alkalinity



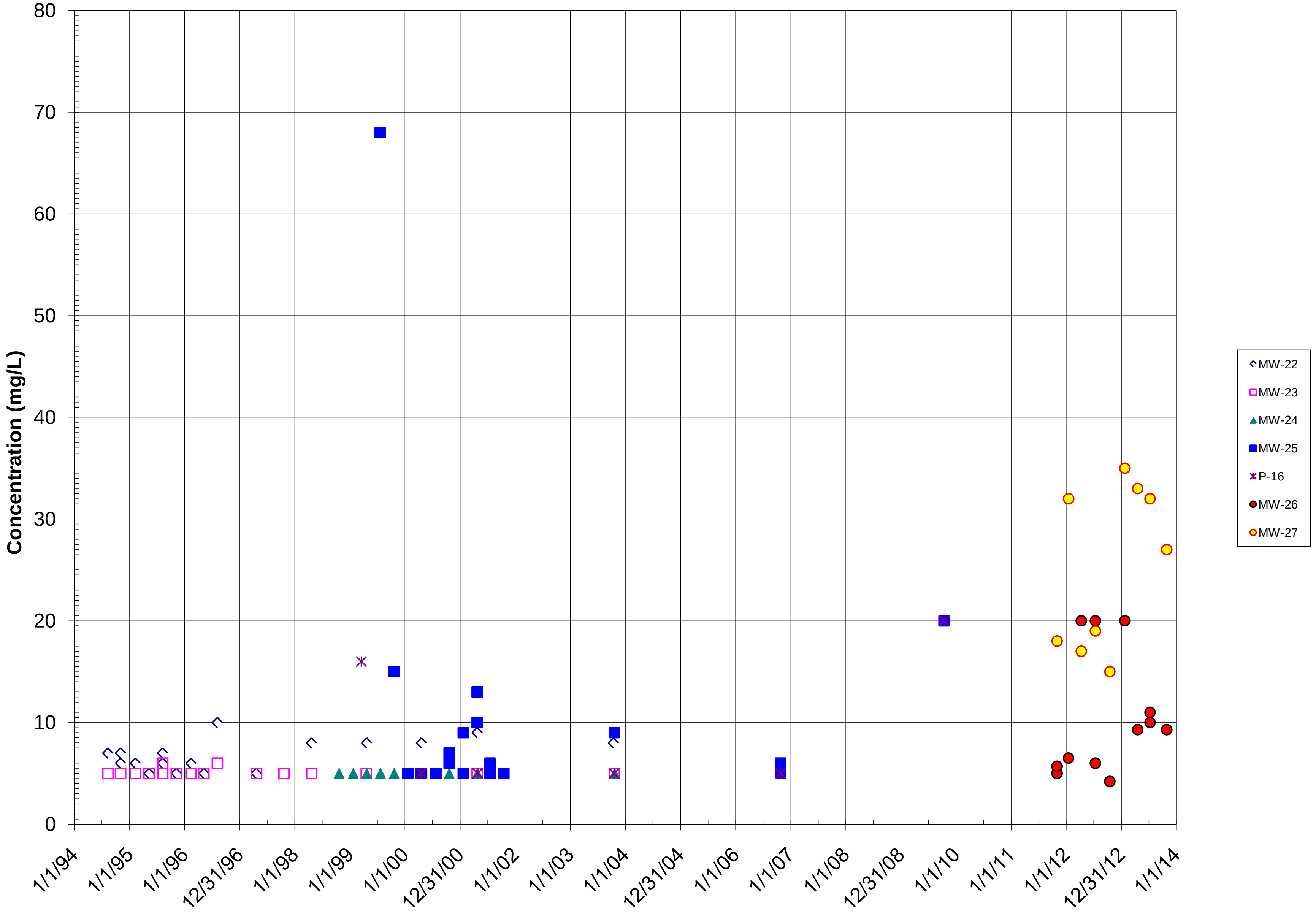
MW-26-27/Bicarbonate Alkalinity

Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Chloride



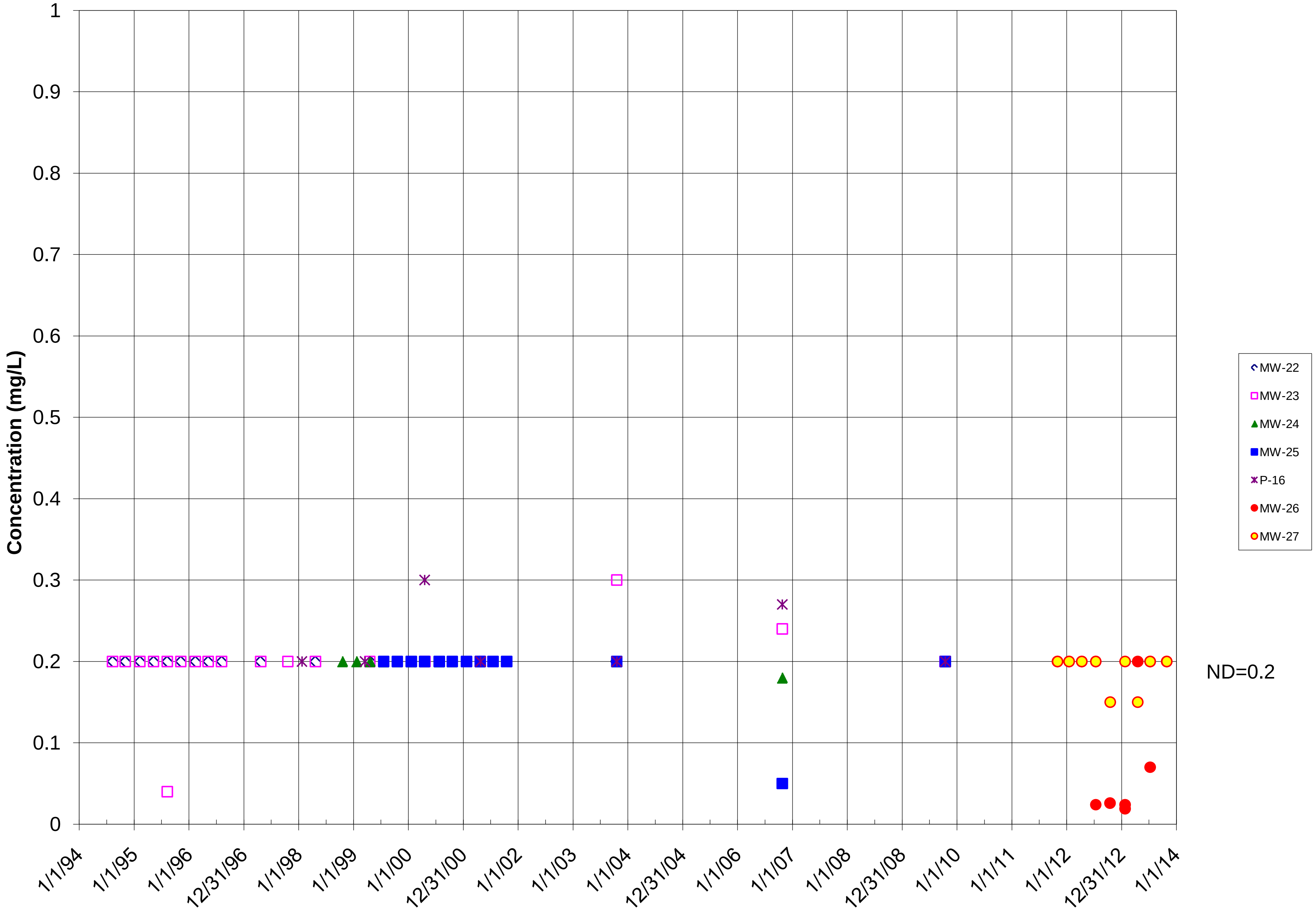
MW-26-27/Chloride

Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Chemical Oxygen Demand

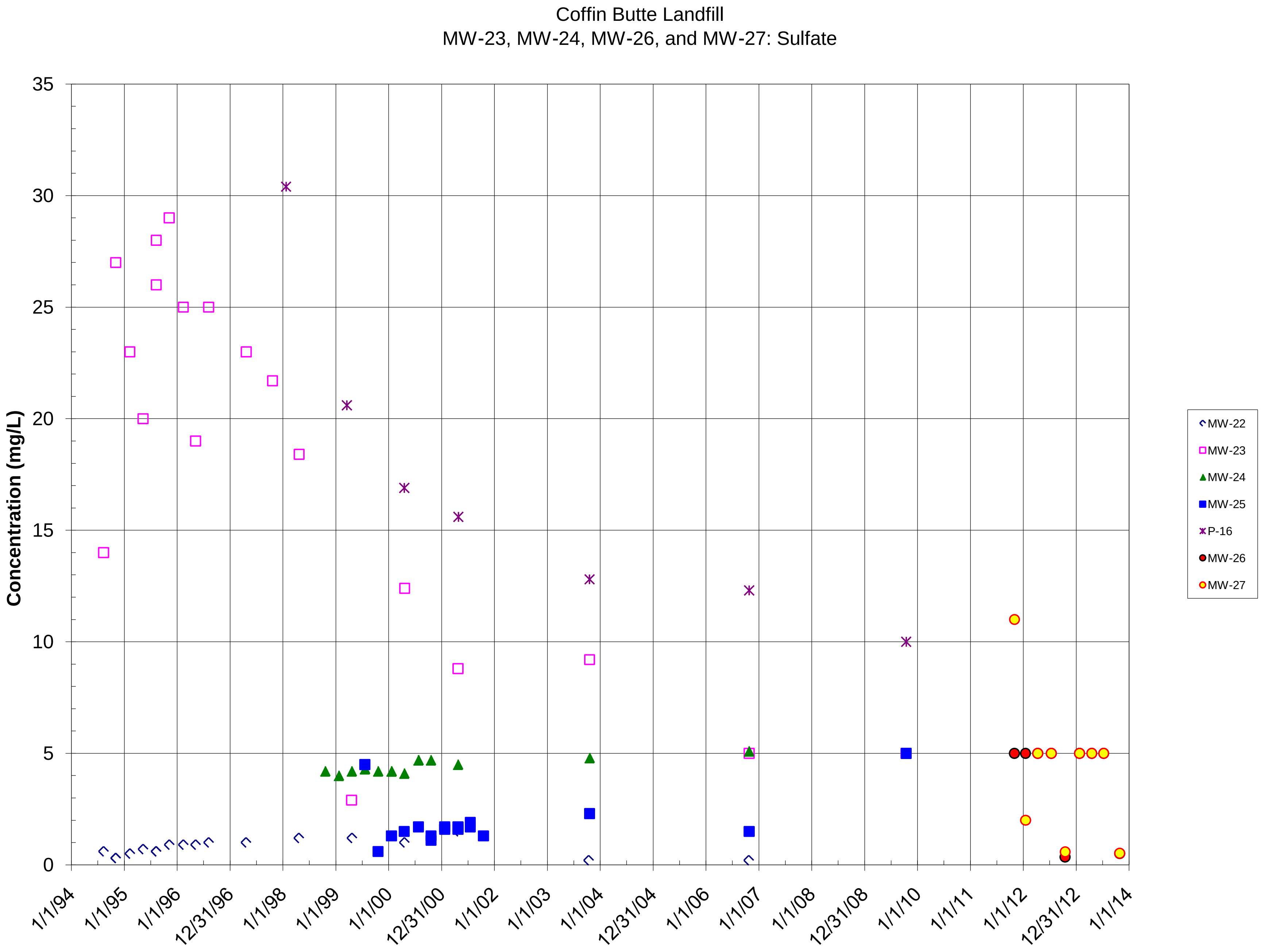


MW-26-27/COD

Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Nitrate/Nitrate

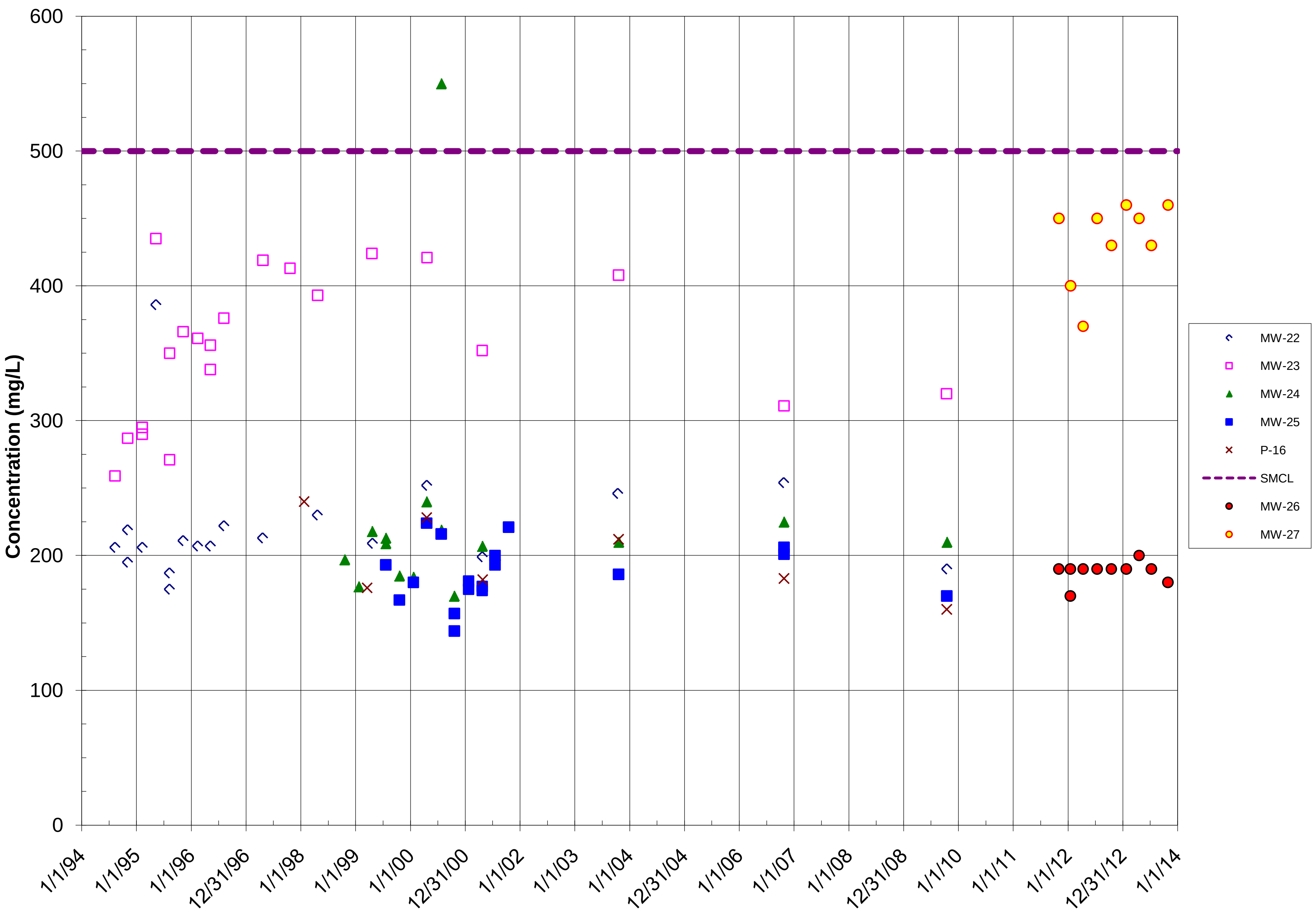


MW-26-27/Nitrate-Nitrite



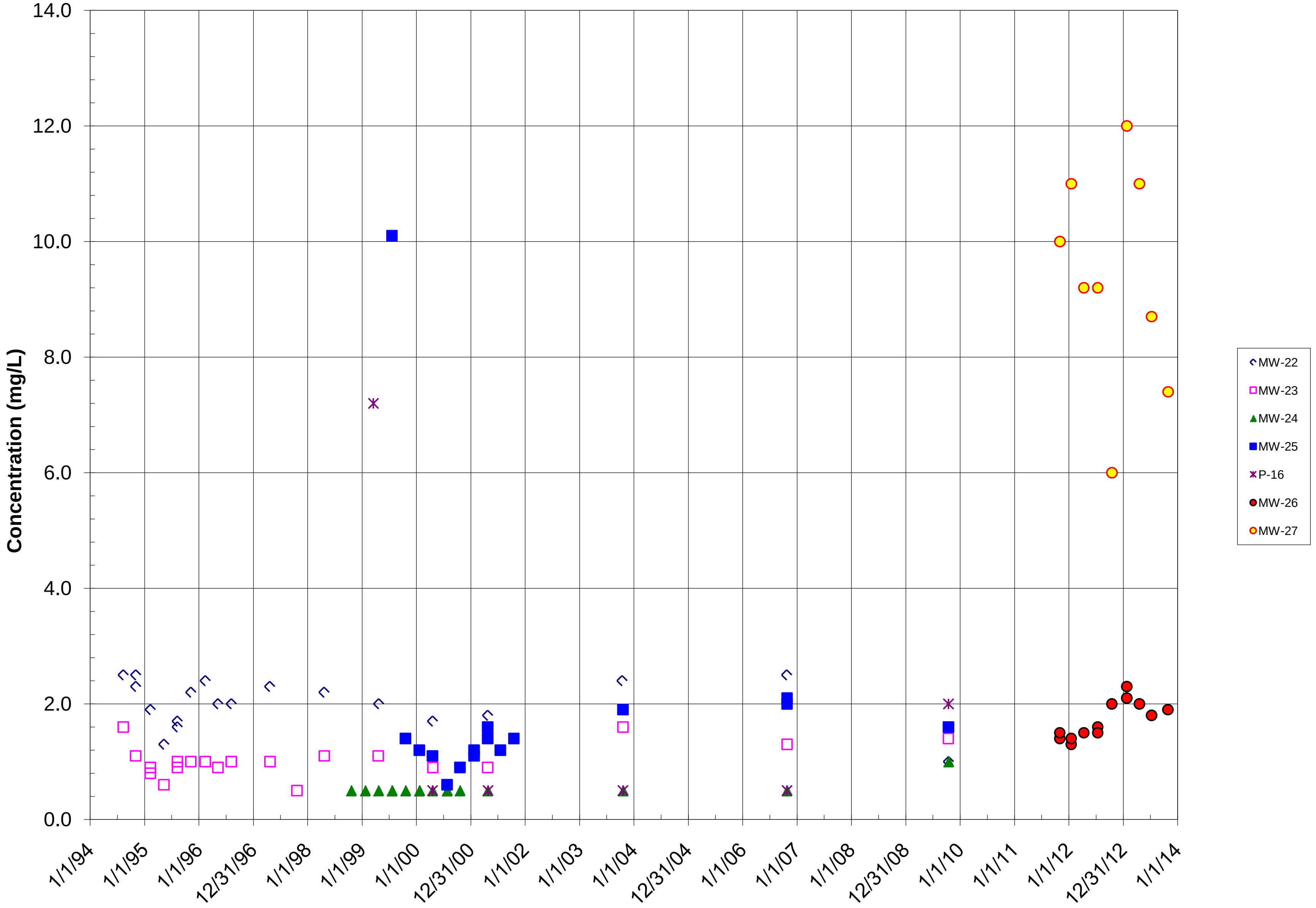
MW-26-27/Sulfate

Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Total Dissolved Solids



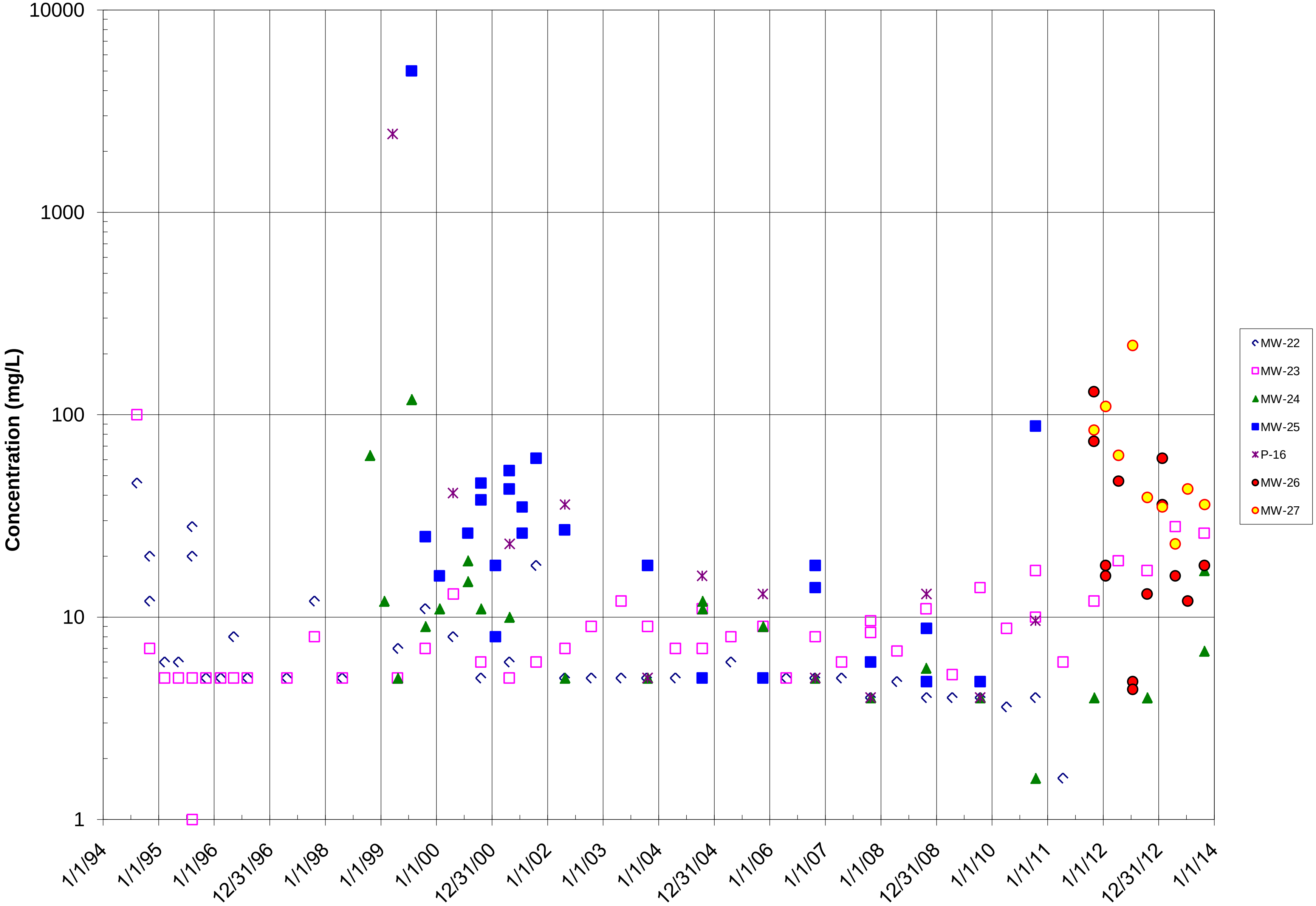
MW-26-27/TDS

Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Total Organic Carbon



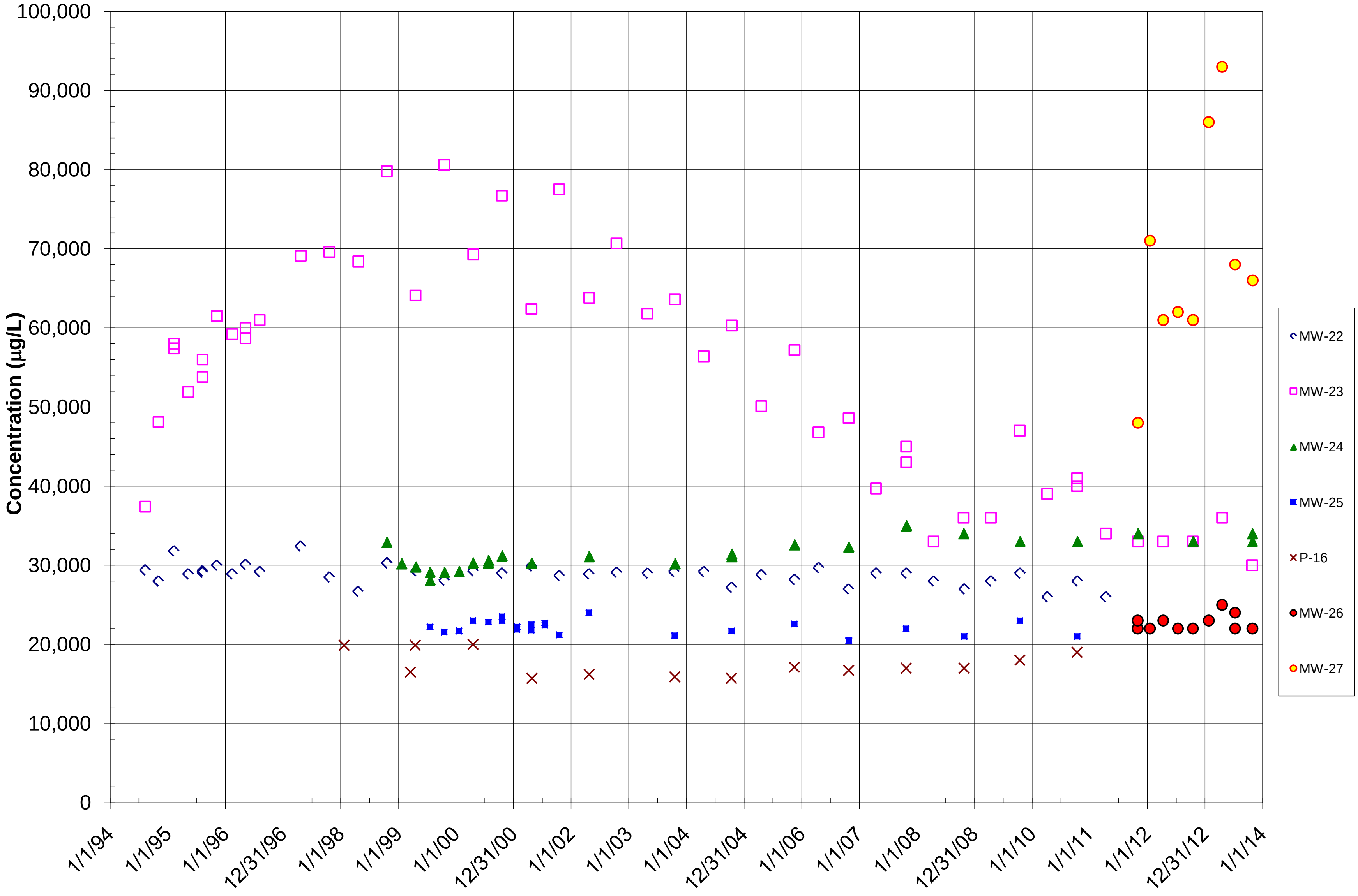
MW-26-27/TOC

Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Total Suspended Solids



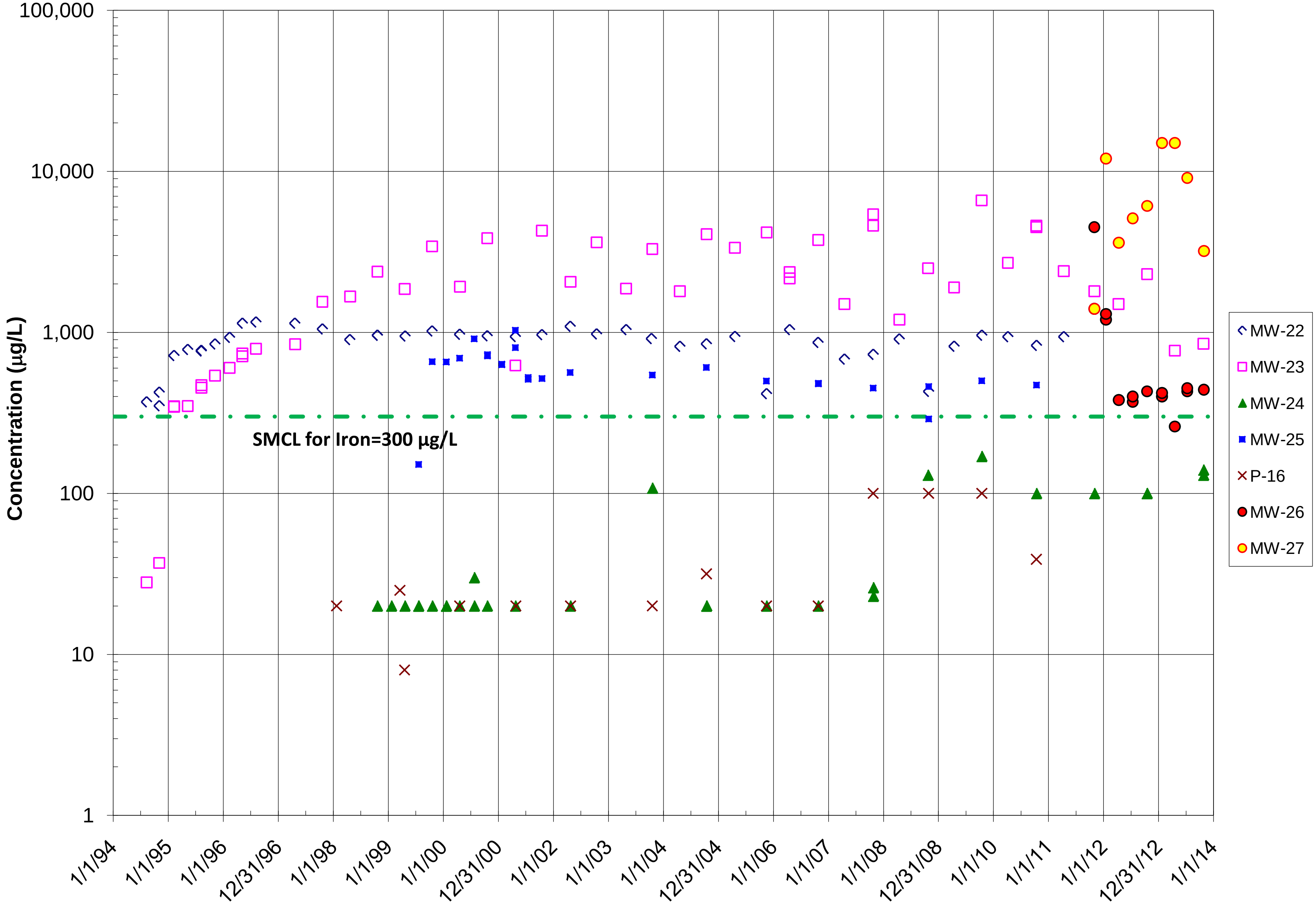
MW-26-27/TSS

Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Calcium



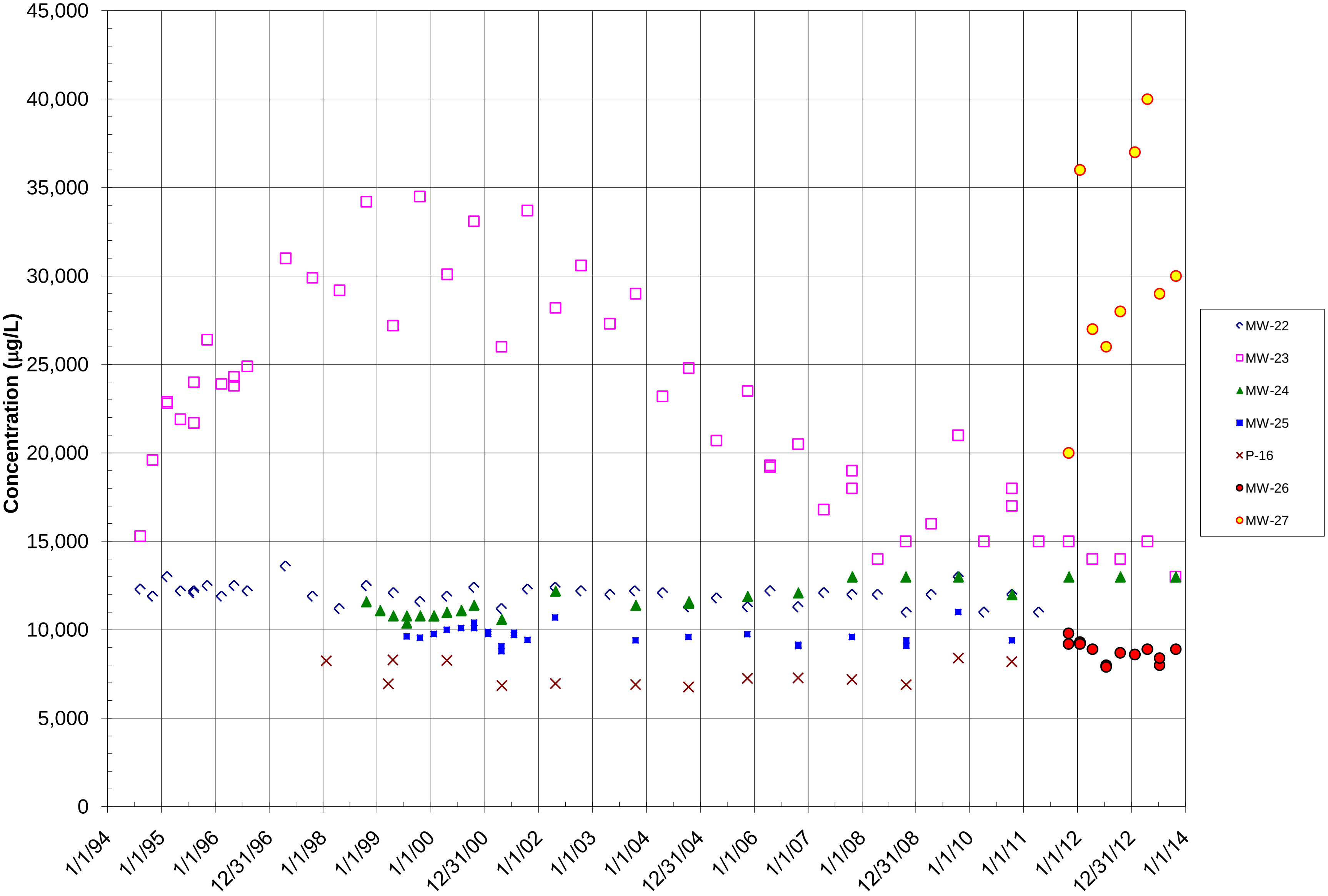
MW-26-27/Calcium

Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Iron (SMCL)



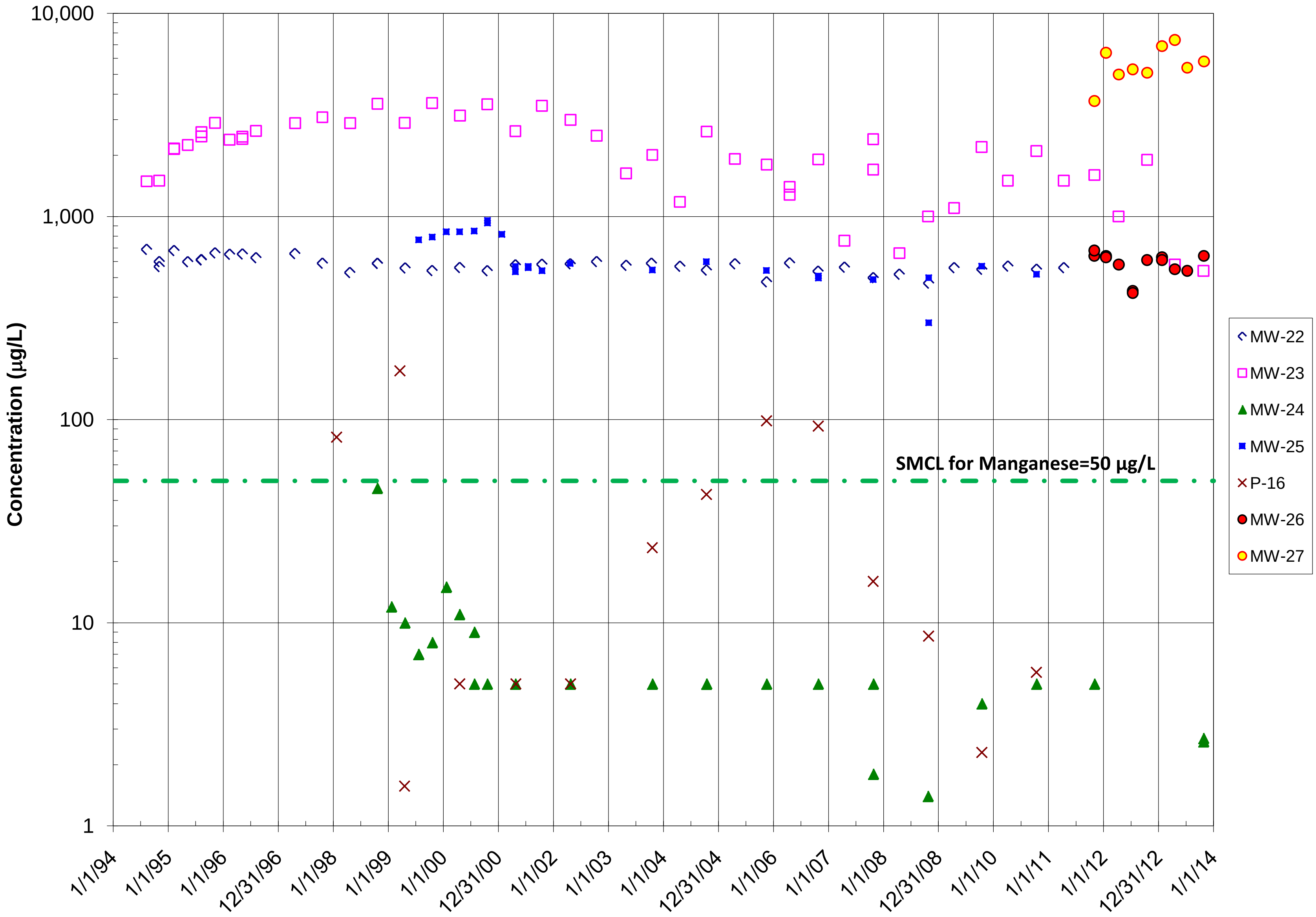
MW-26-27/Iron (SMCL)

Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Magnesium

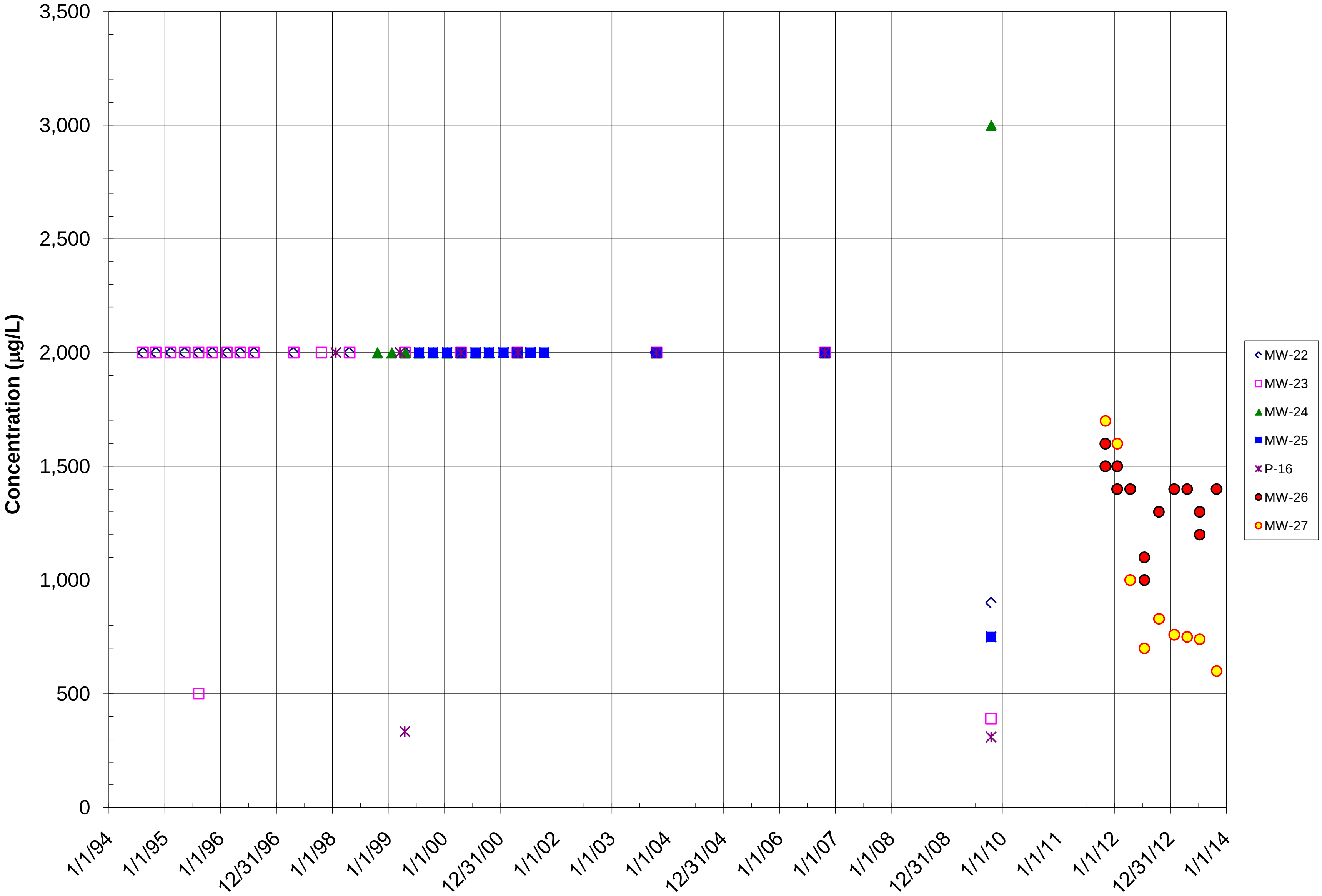


MW-26-27/Magnesium

Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Manganese (SMCL)

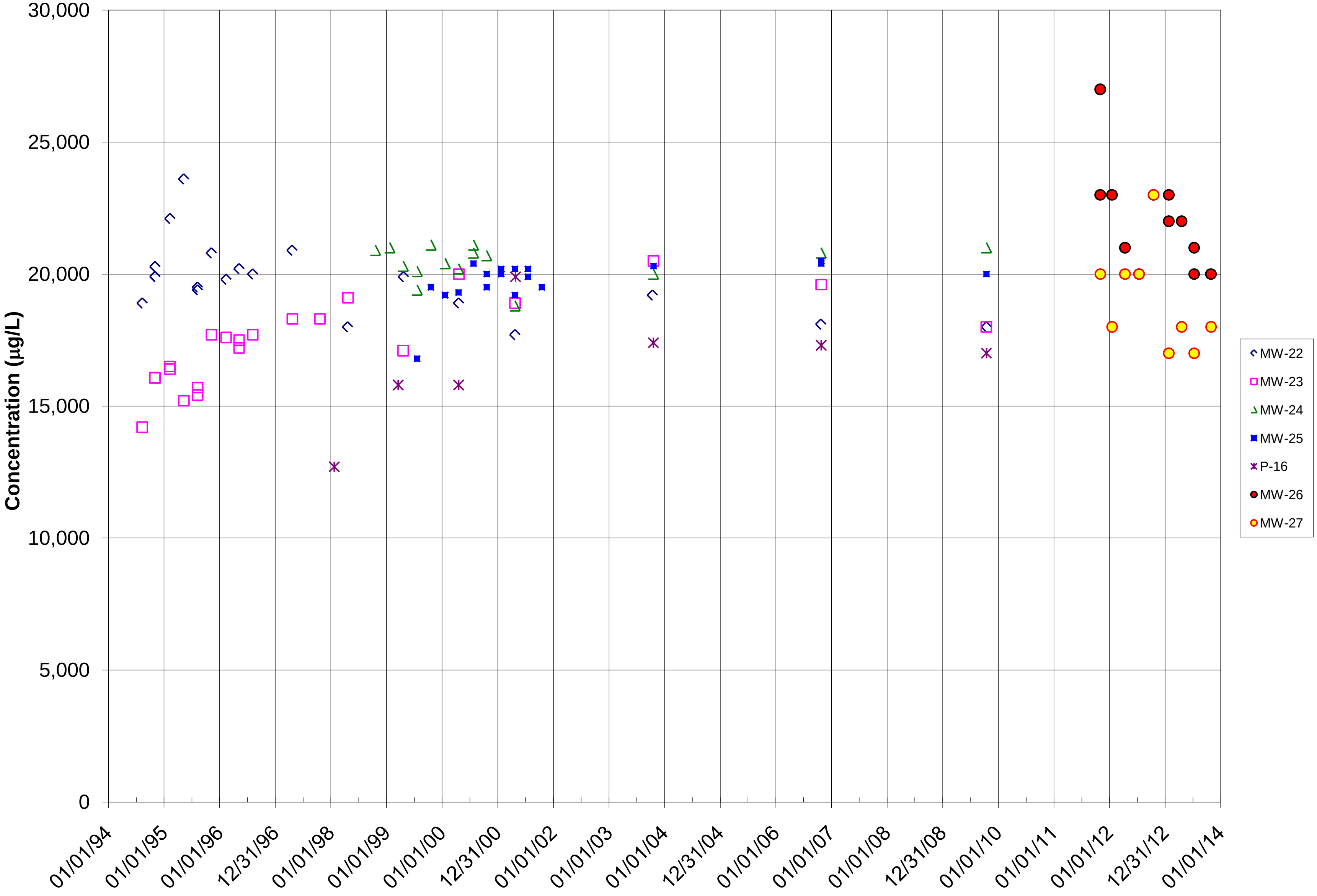


Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Potassium



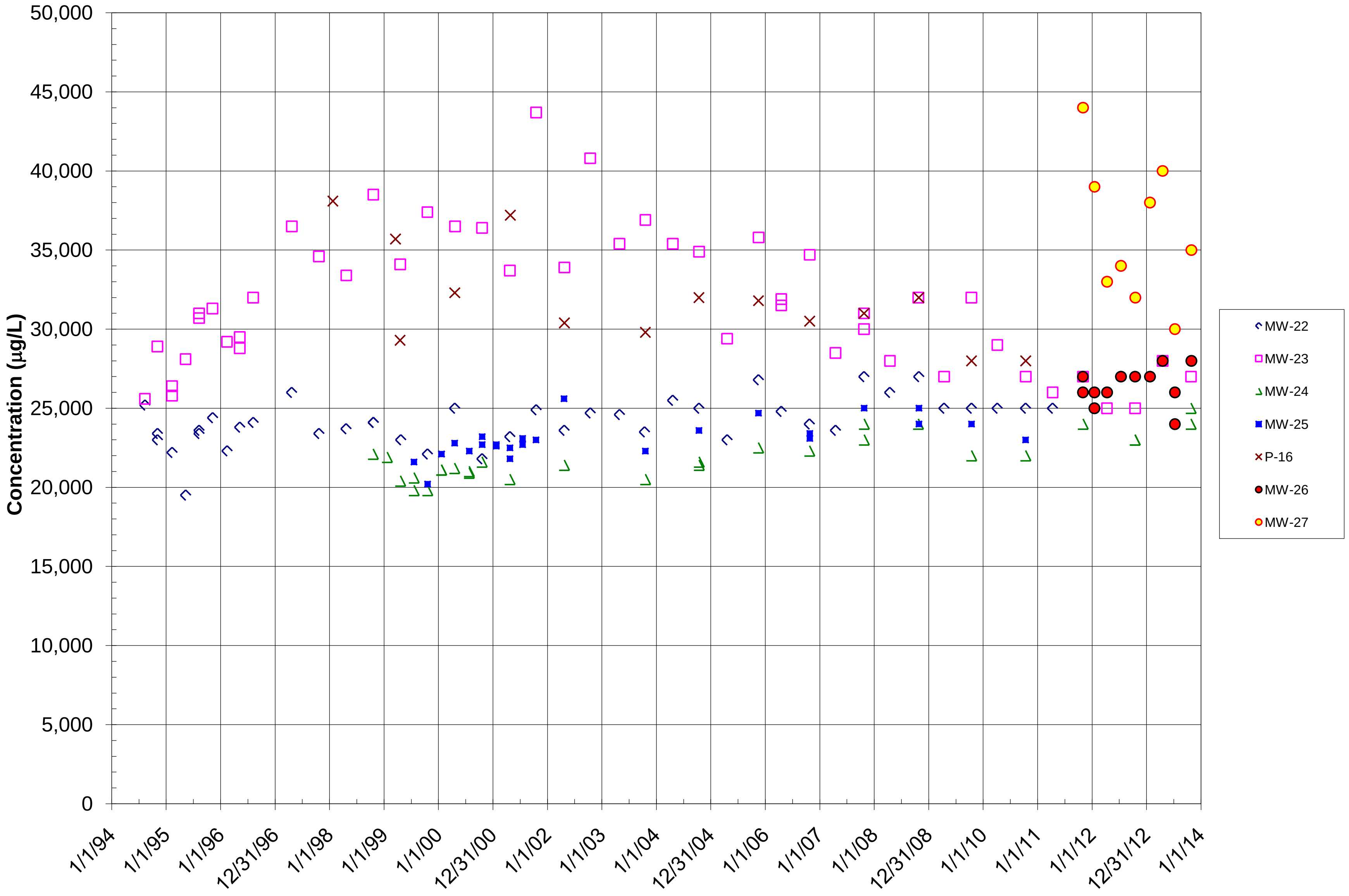
MW-26-27/Potassium

Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Silicon



MW-26-27/Silicon

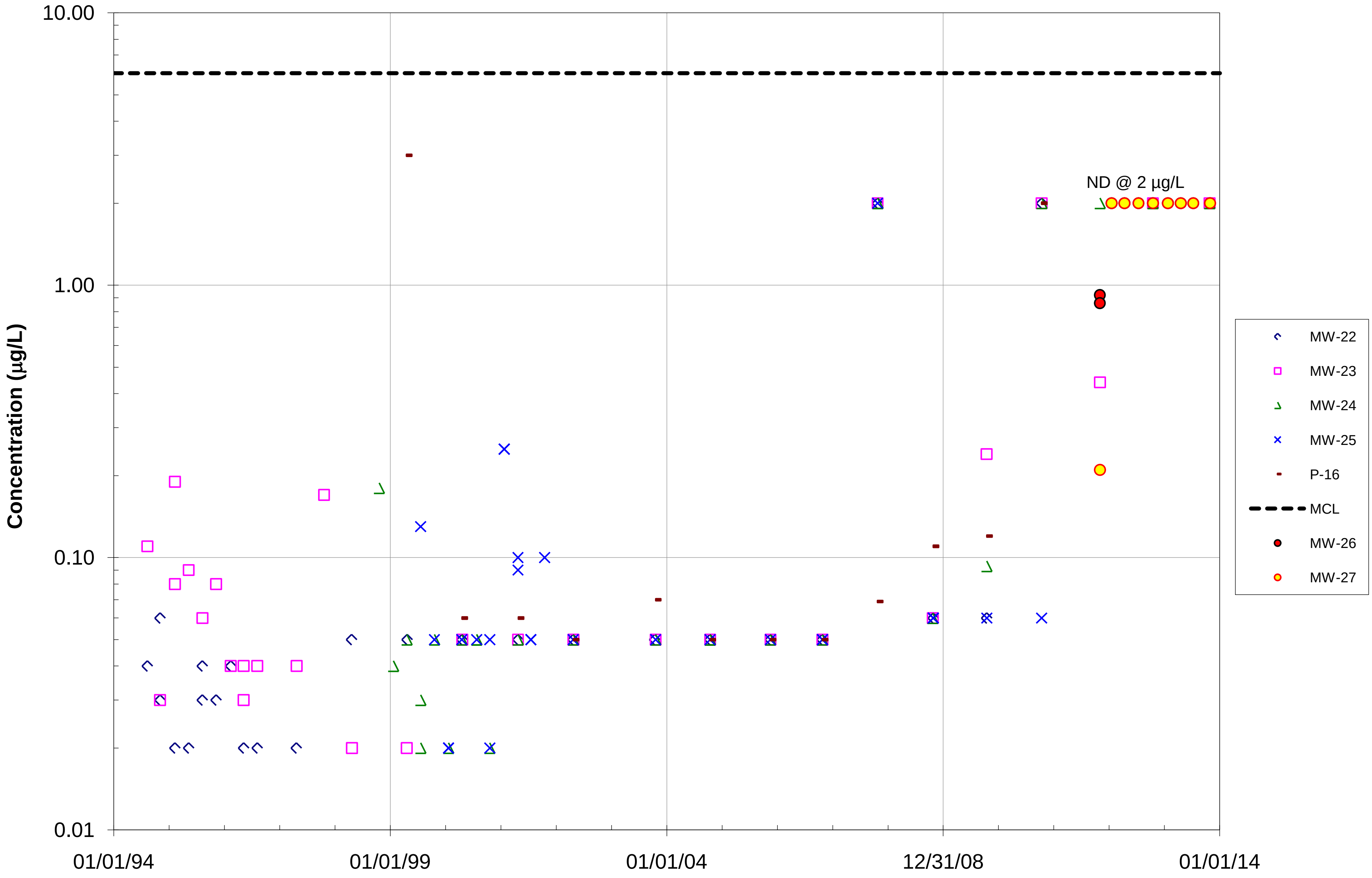
Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Sodium



MW-26-27/Sodium

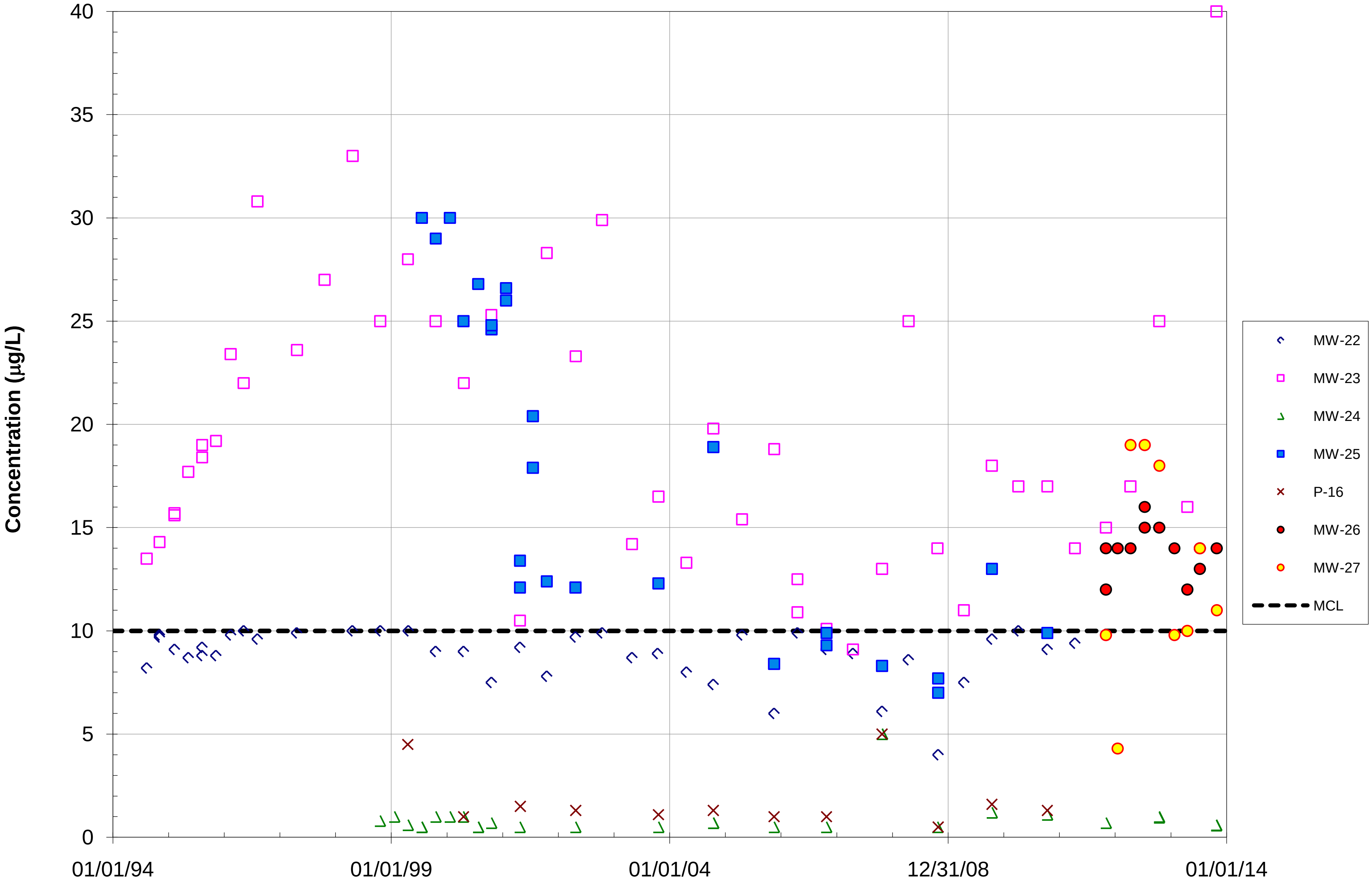
Coffin Butte Landfill

MW-23, MW-24, MW-26, and MW-27: Antimony



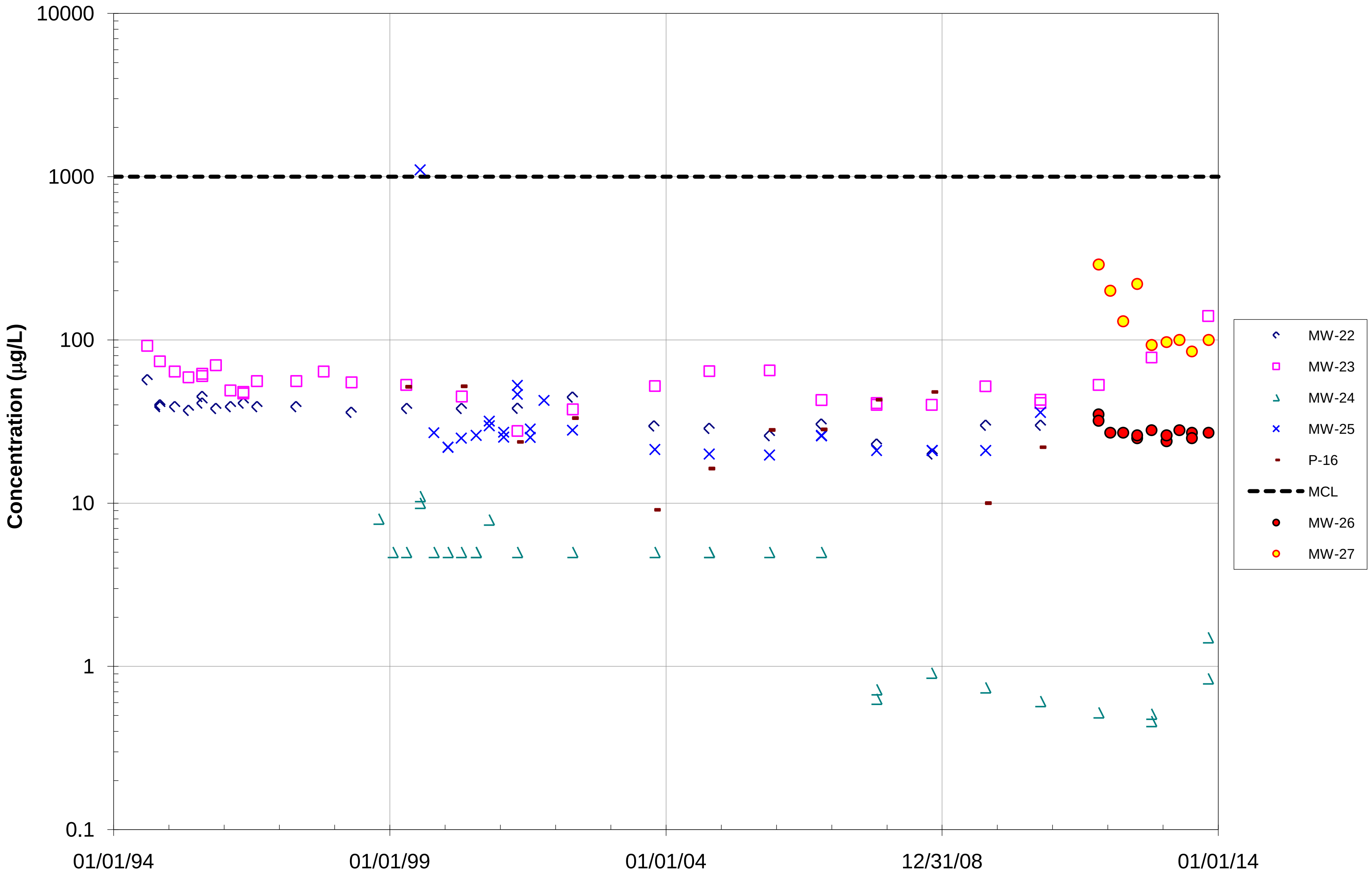
MW-23-27/Antimony

Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Arsenic



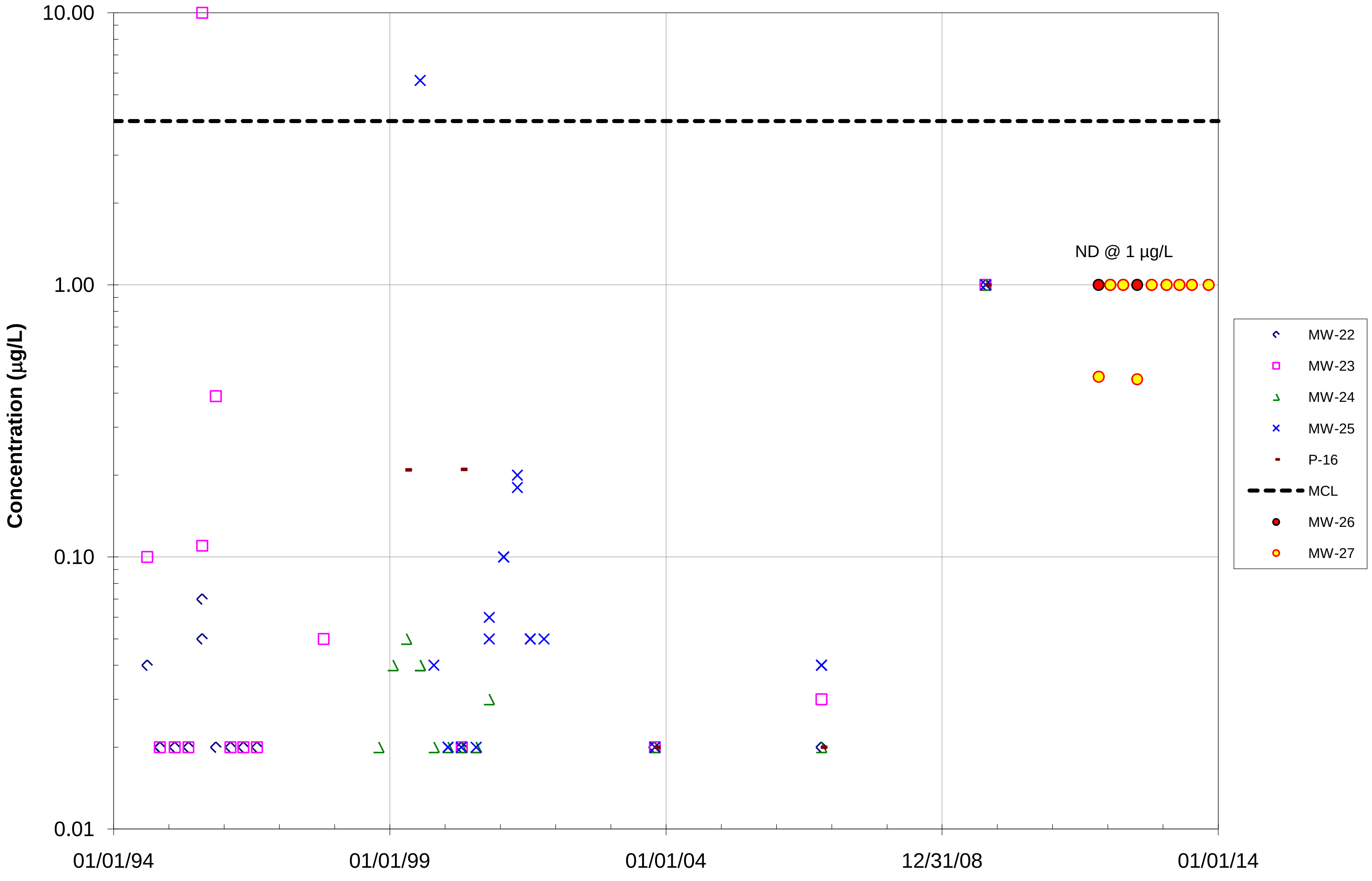
MW-23-27/Arsenic

Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Barium

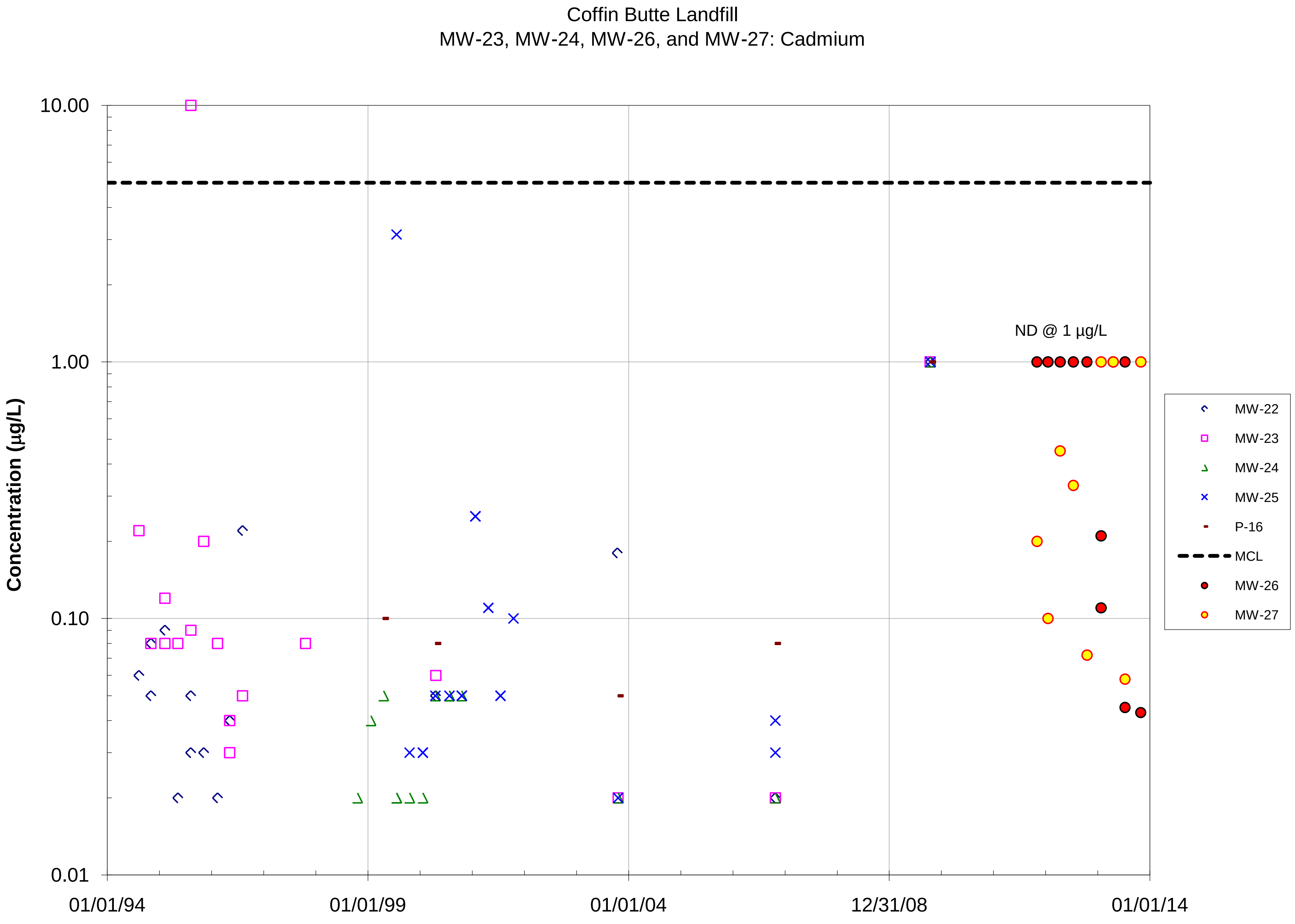


MW-23-27/Barium

Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Beryllium

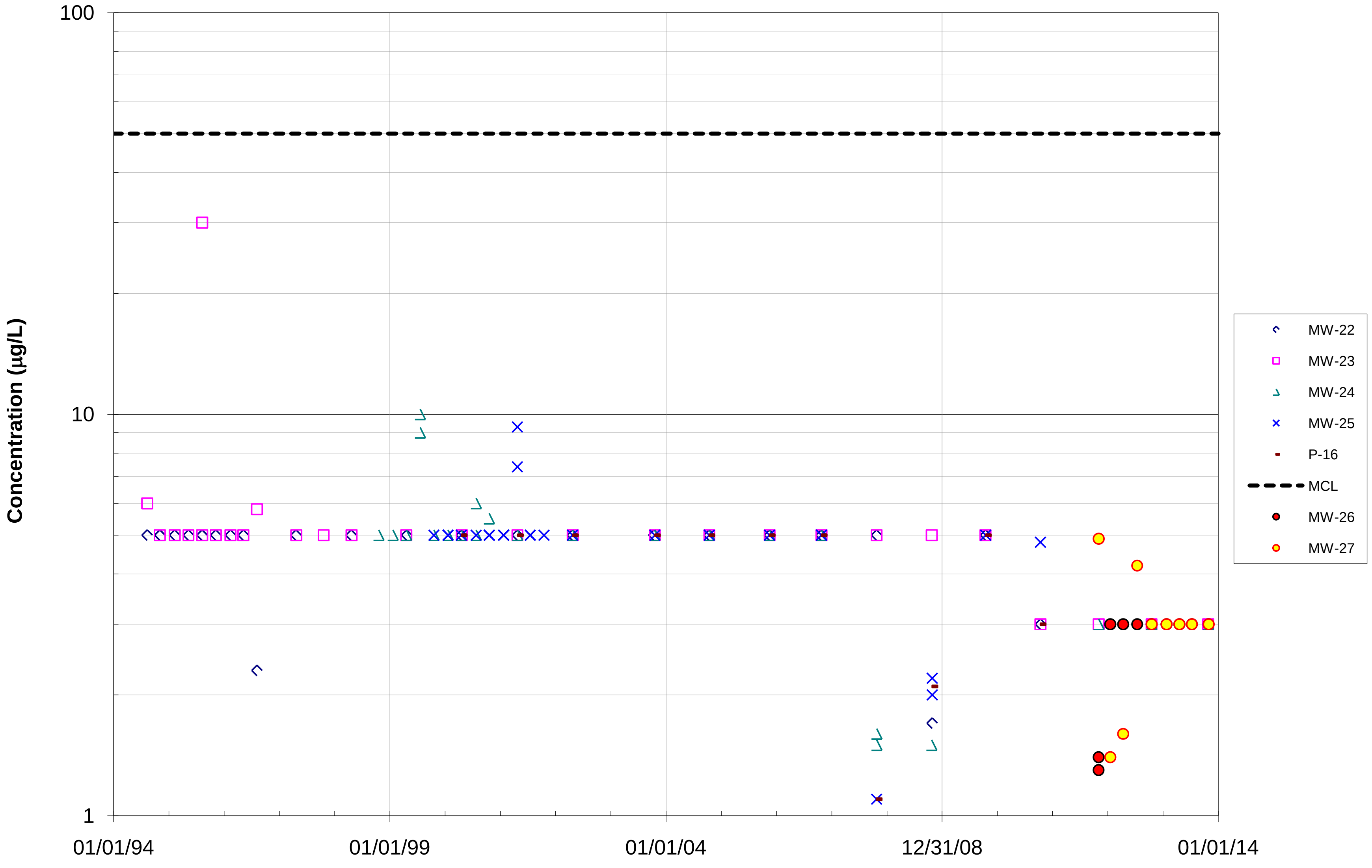


MW-23-27/Beryllium



MW-23-27/Cadmium

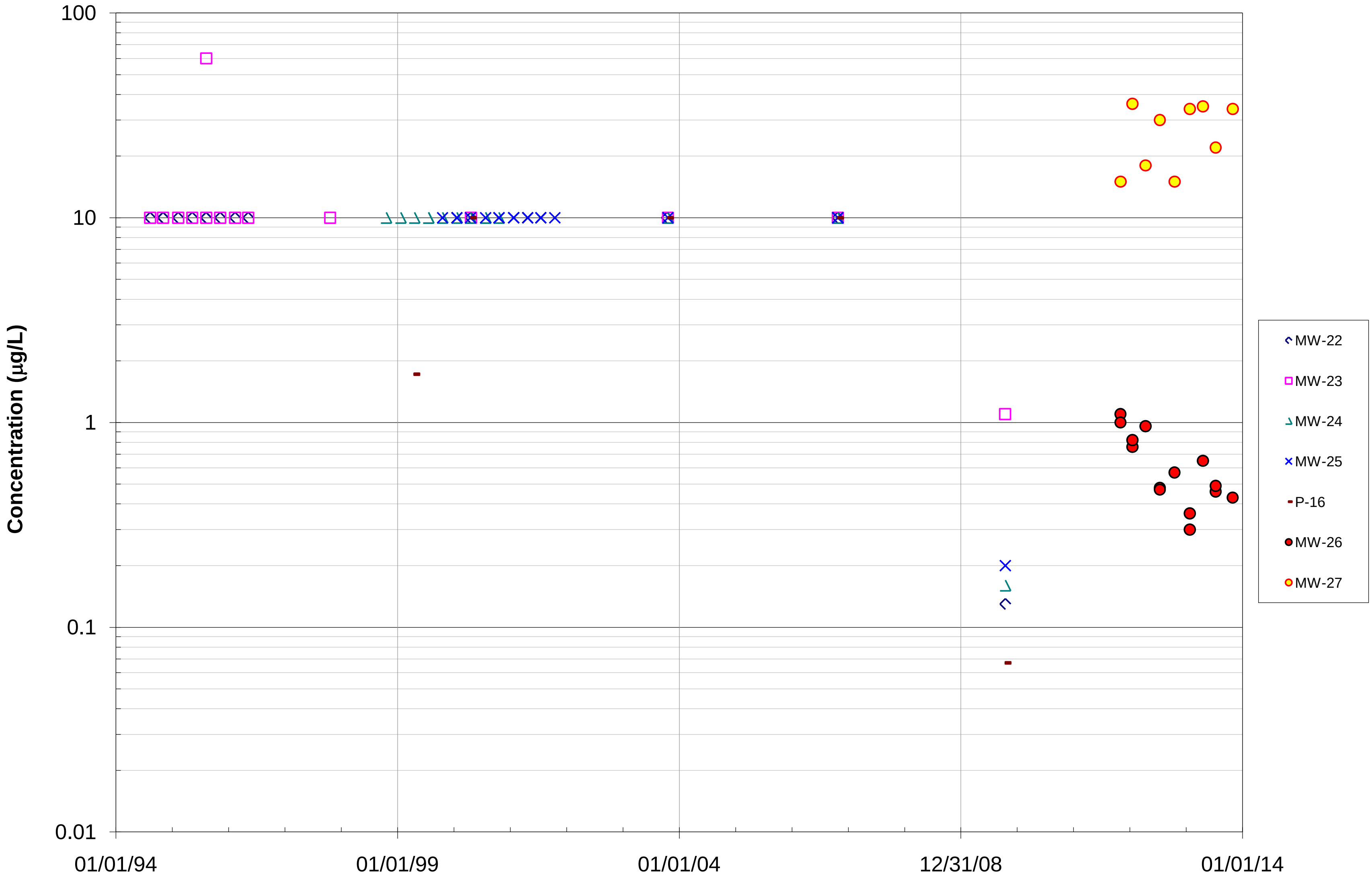
Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Chromium



MW-23-27/Chromium

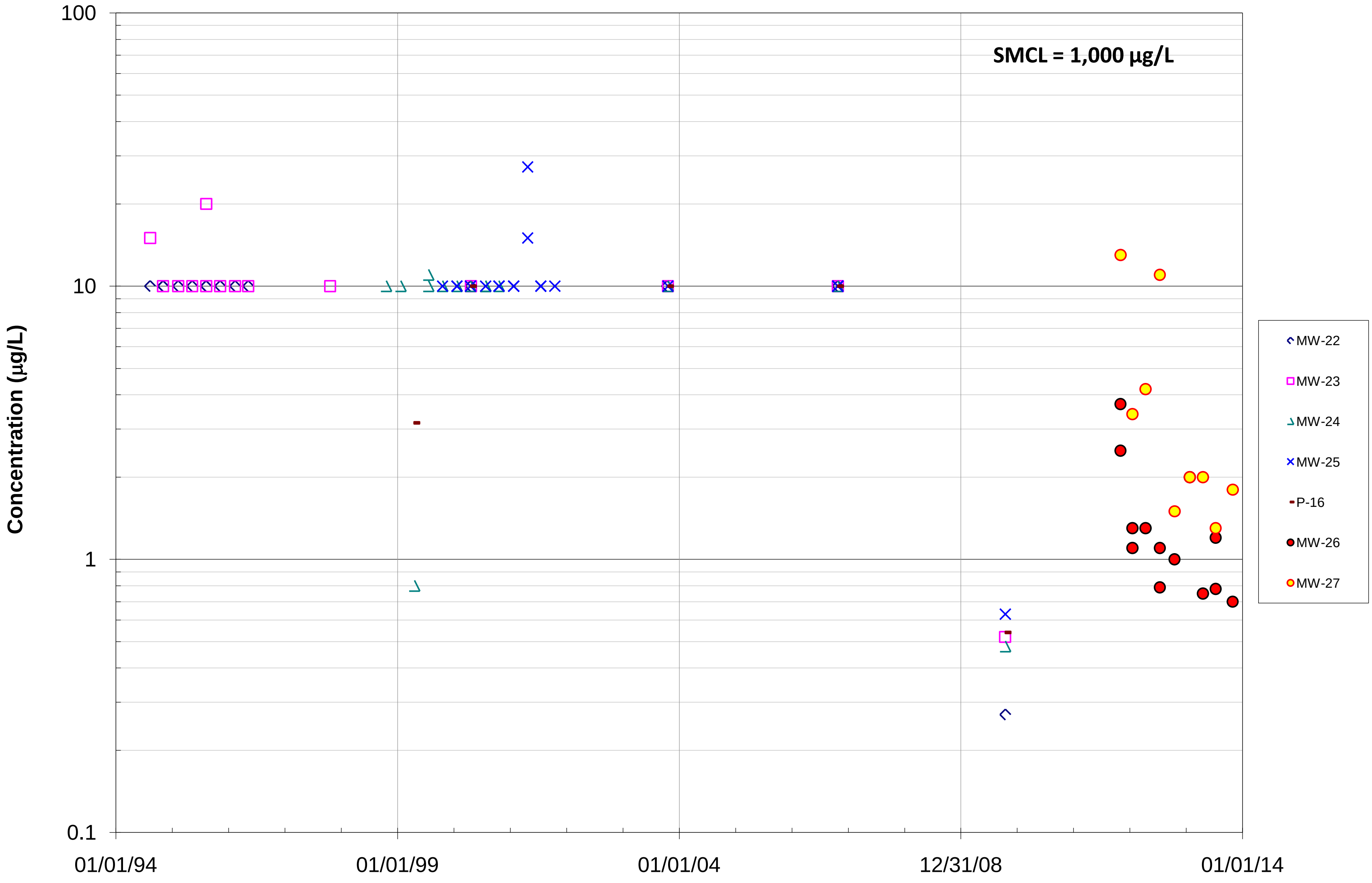
Coffin Butte Landfill

MW-23, MW-24, MW-26, and MW-27: Cobalt

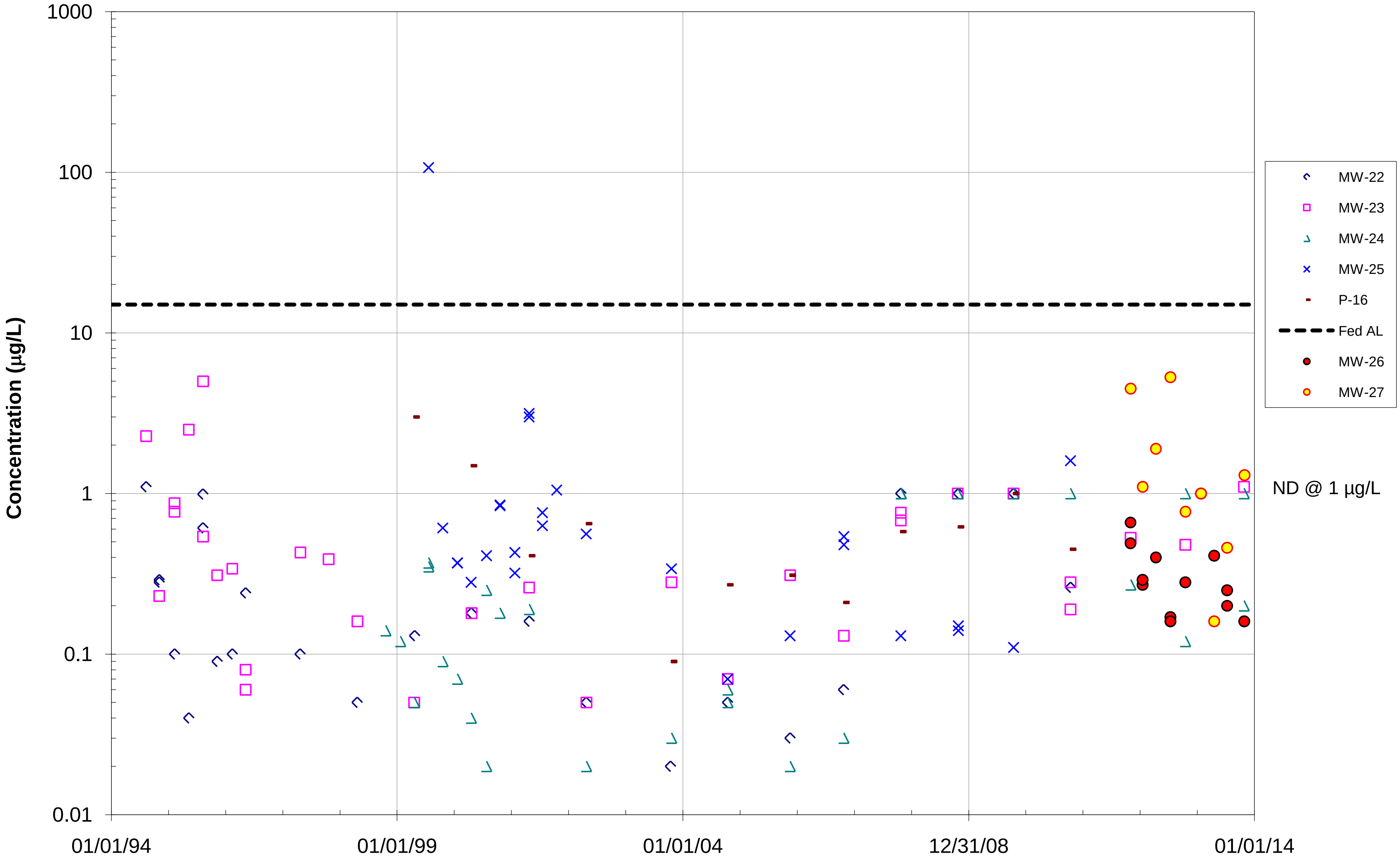


MW-23-27/Cobalt

Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Copper

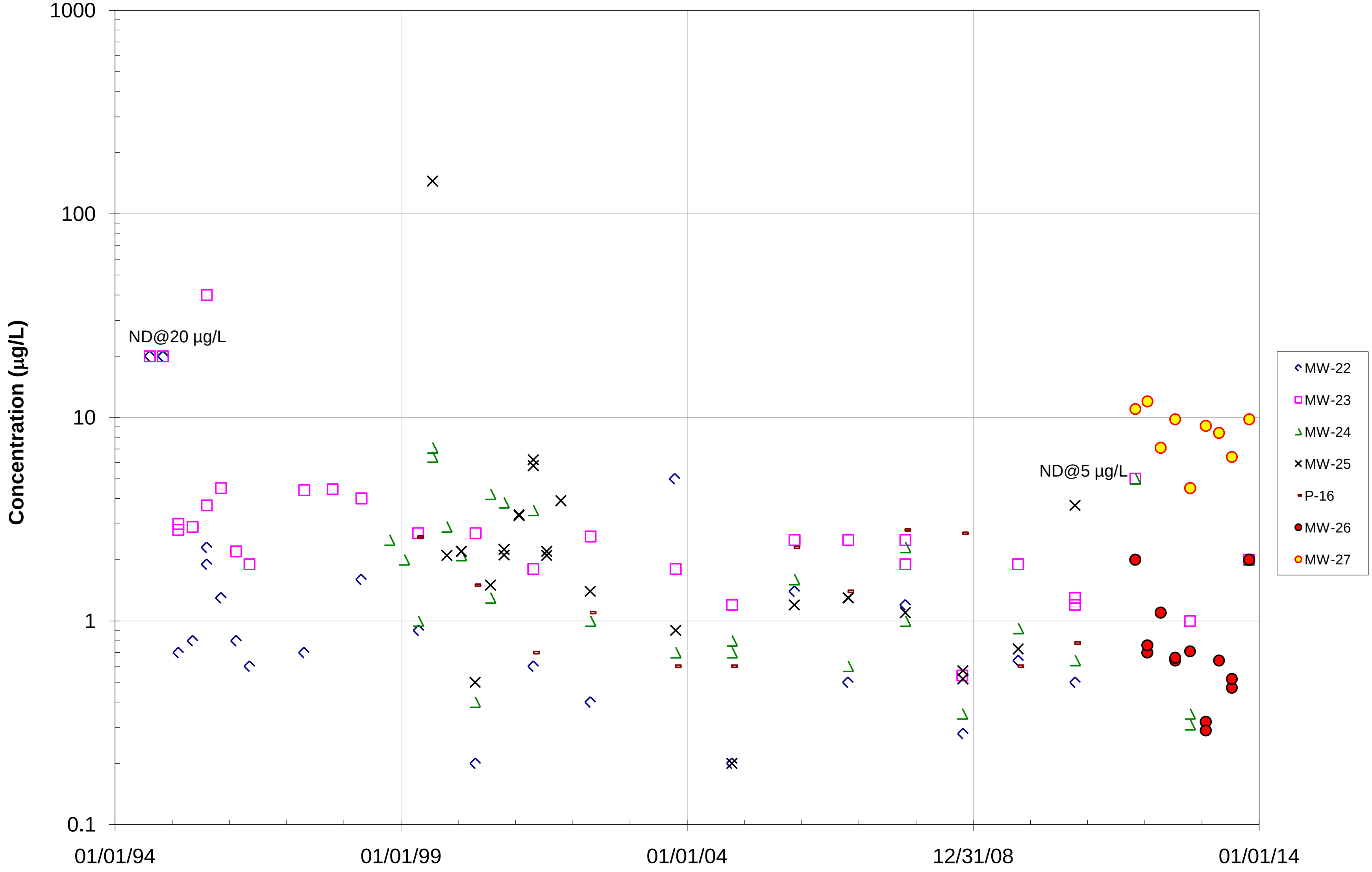


Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Lead



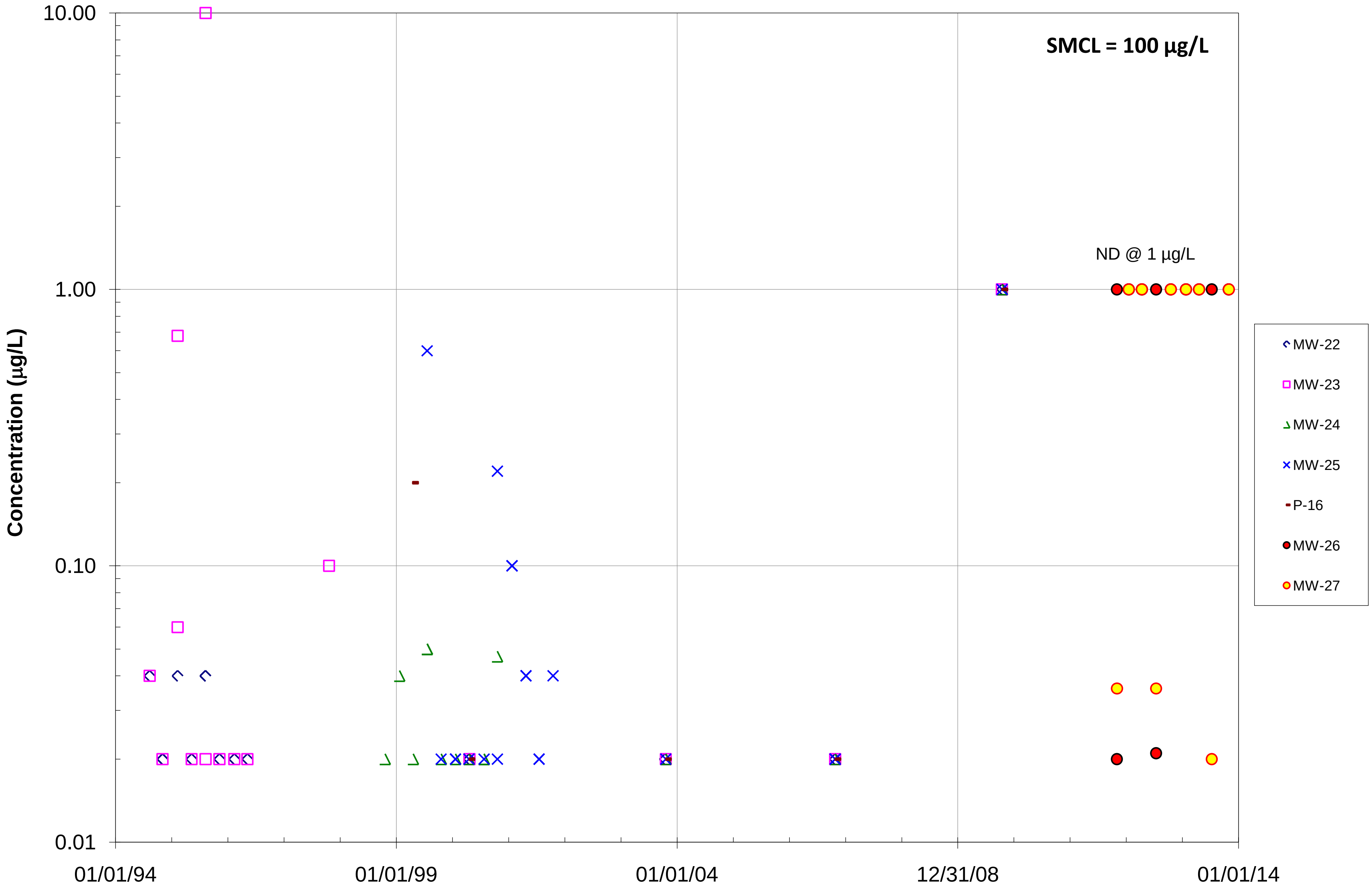
MW-23-27/Lead

Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Nickel

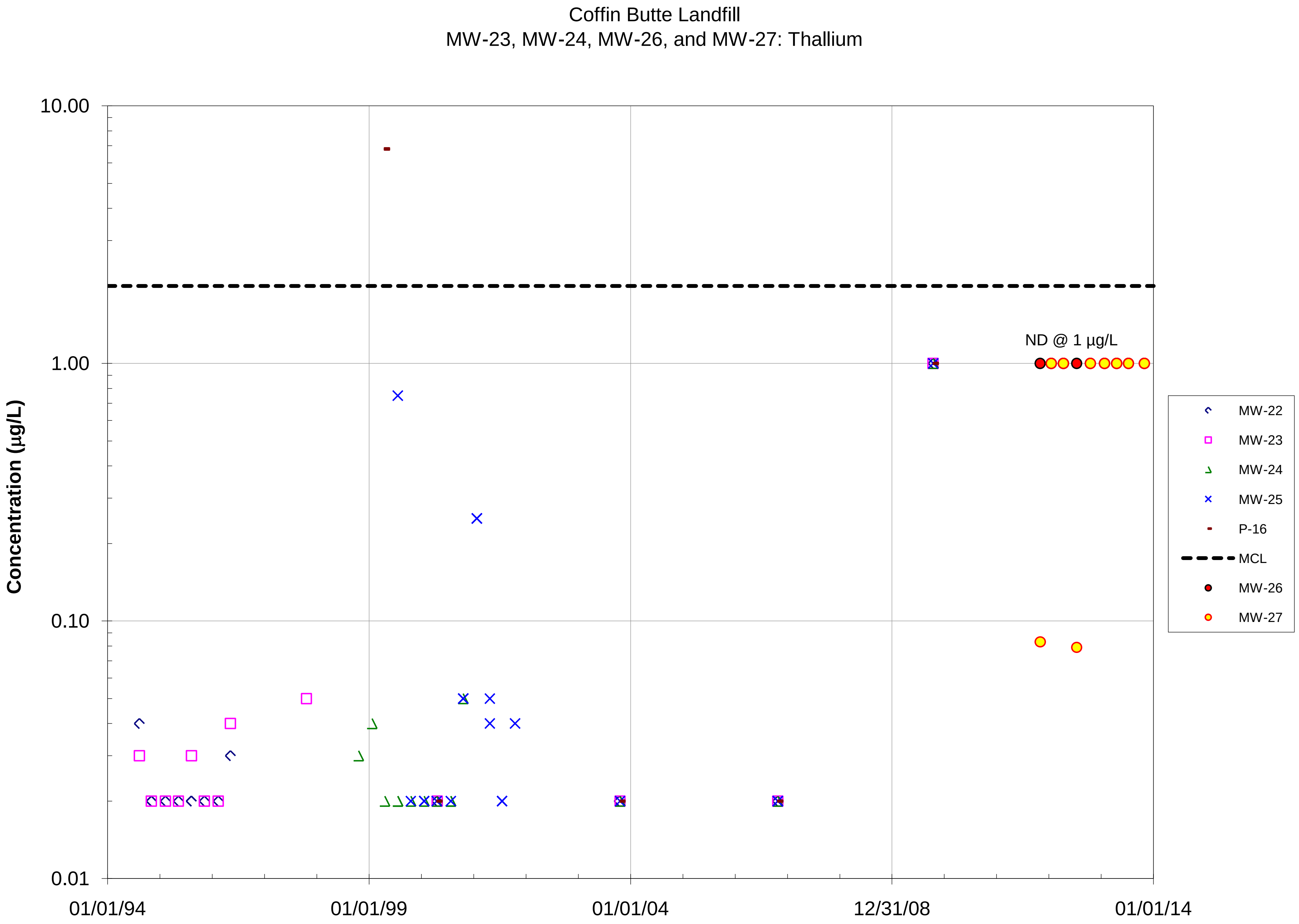


MW-23-27/Nickel

Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Silver

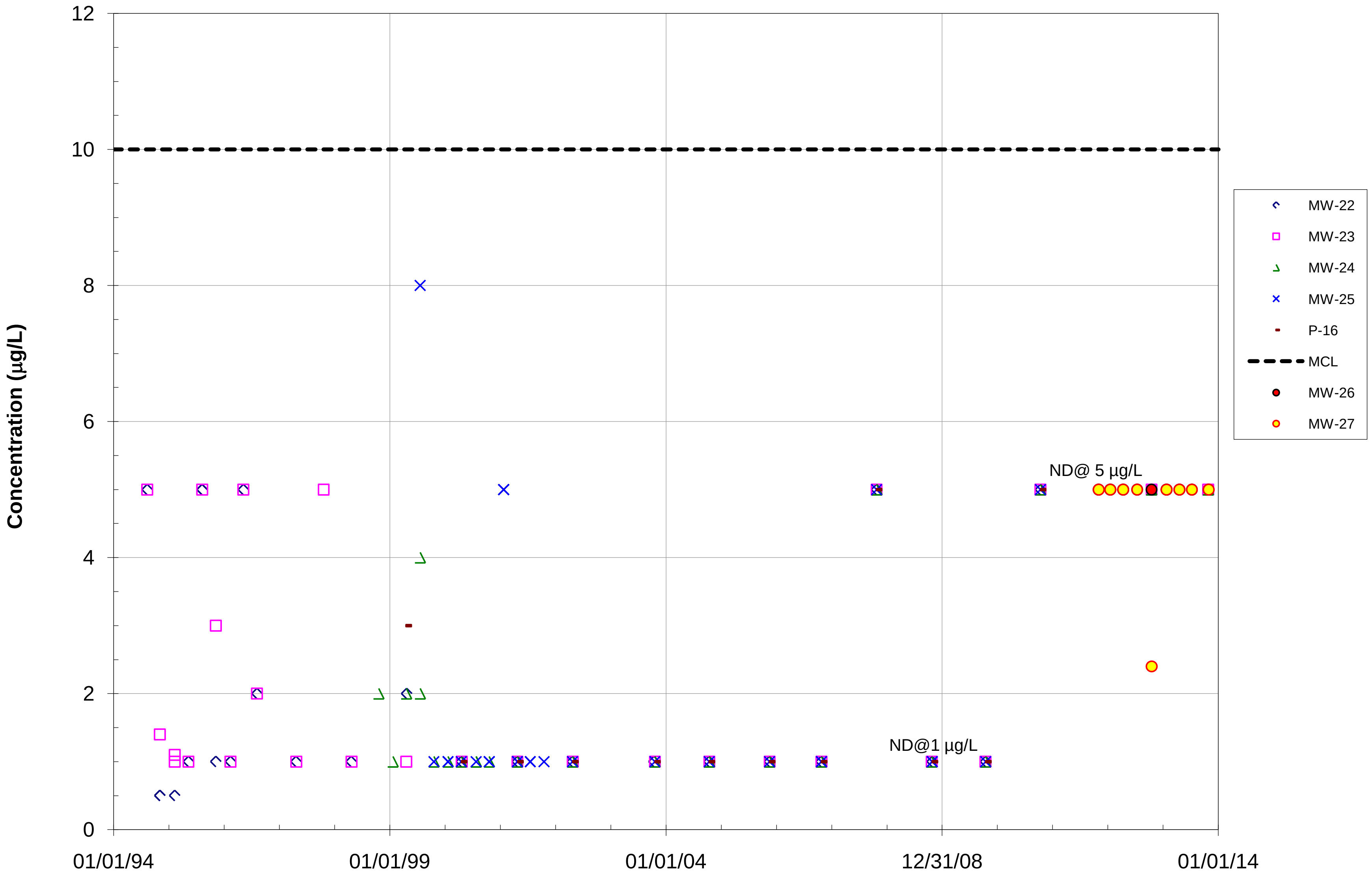


MW-23-27/Silver

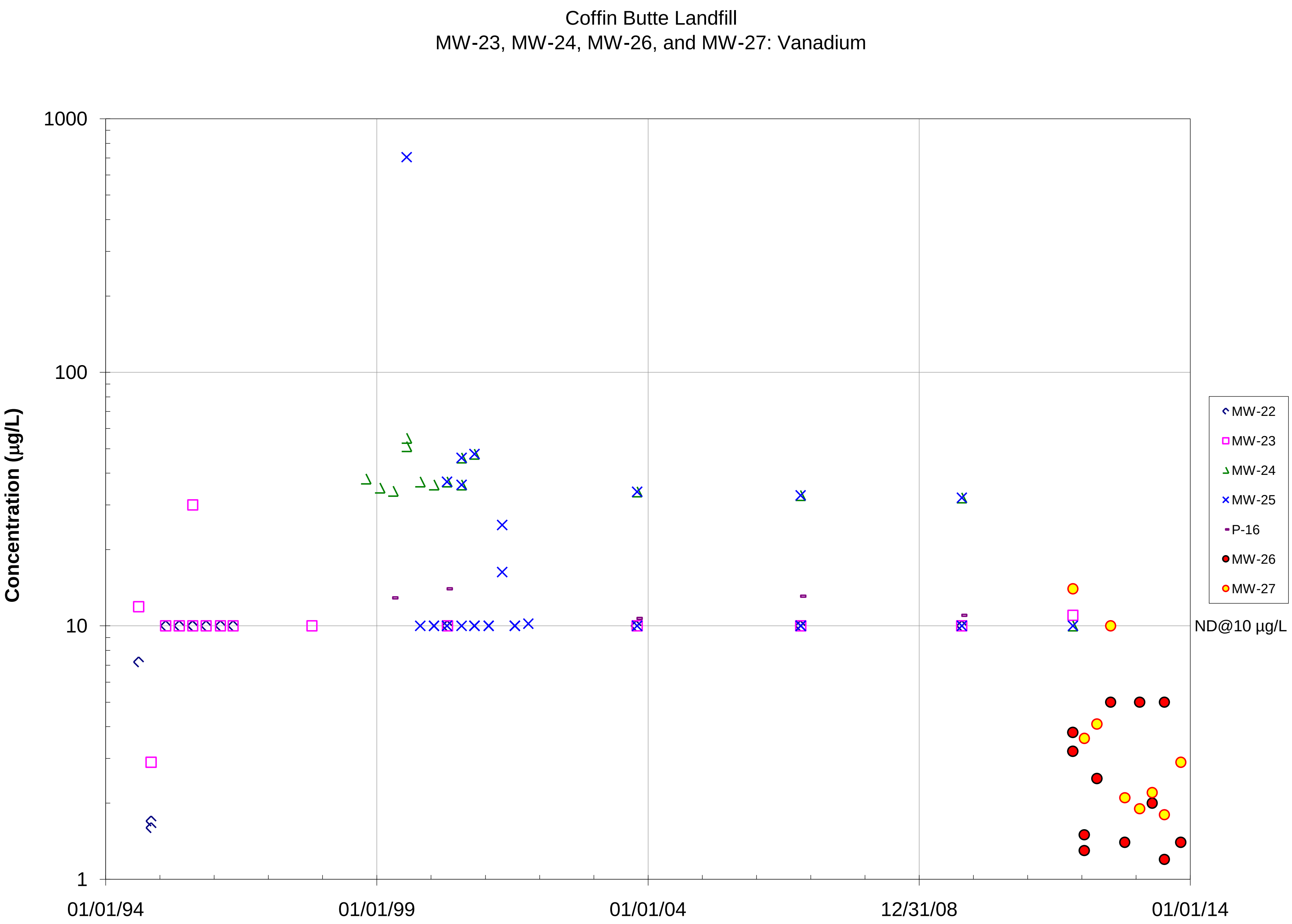


MW-23-27/Thallium

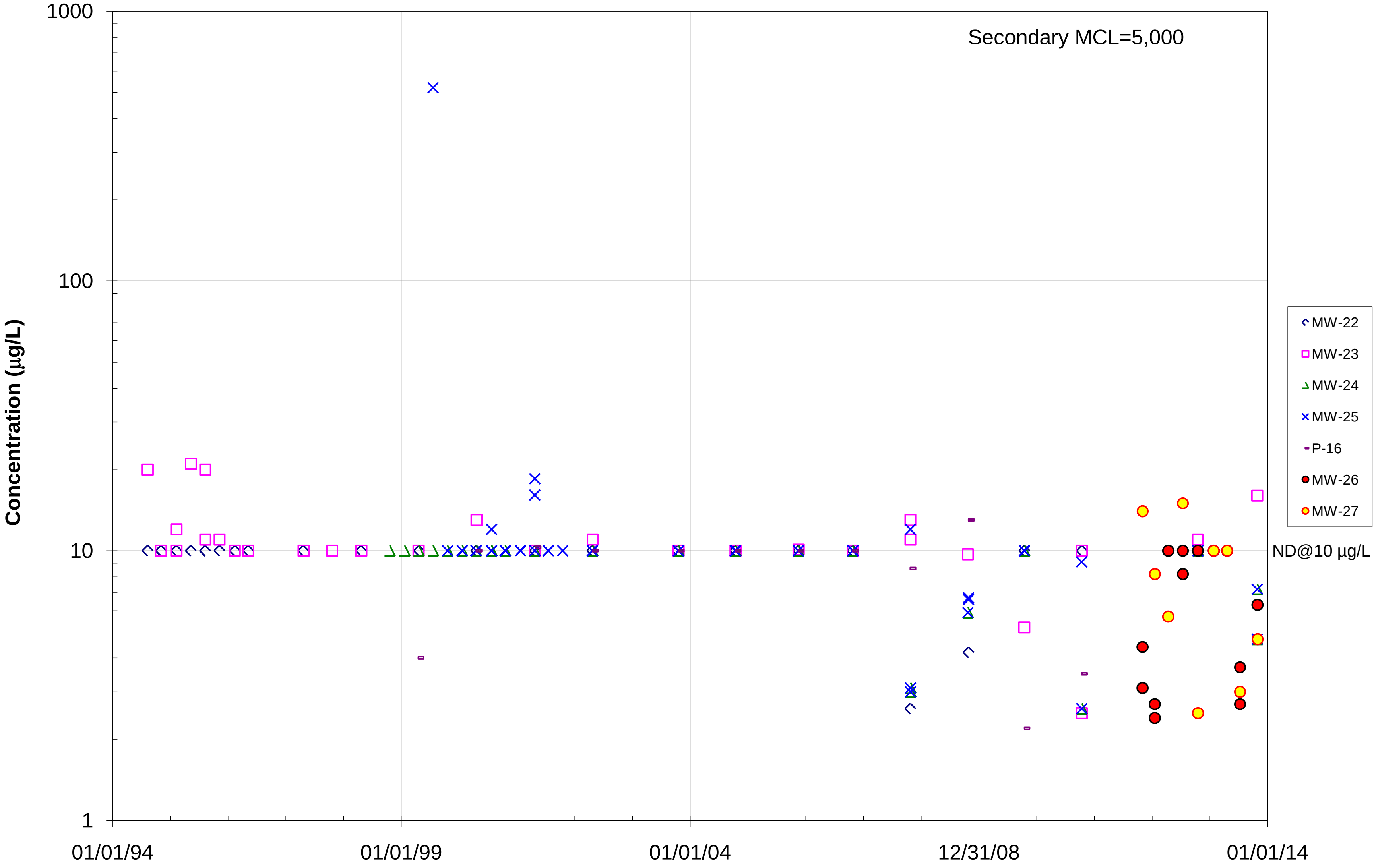
Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Selenium



MW-23-27/Selenium


Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Vanadium
Concentration (µg/L)
1000
100
10
1
01/01/94
01/01/99
01/01/04
12/31/08
01/01/14
ND@10 µg/L
MW-22
MW-23
MW-24
MW-25
P-16
MW-26
MW-27

Coffin Butte Landfill
MW-23, MW-24, MW-26, and MW-27: Zinc



MW-23-27/Zinc

ATTACHMENT D

BOX PLOTS AND NORMALITY TESTING

Coffin Butte Descriptive Statistics
Inorganic Parameters

Location	Bicarbonate	Chemical Oxygen Demand	Chloride	Ammonia	Nitrate-Nitrite	Sulfate	Suspended Solids	Total Dissolved Solids	Total Organic Carbon		Date
MW-26	150	5.35	5.65	0.885	0.2	5	102	190	1.45		11/01/11
MW-26	150	8.25	5.55	1	0.2	5	17	180	1.35		01/17/12
MW-26	150	20	6	1	0.2	5	47	190	1.5		04/11/12
MW-26	150	8	5.9	1.05	0.062	5	4.6	190	1.55		07/13/12
MW-26	150	4.2	5.7	0.92	0.026	0.35	13	190	2		10/16/12
MW-26	140	20	5.7	1.2	0.0215	5	48.5	190	2.2		01/24/13
MW-26	150	9.3	5.8	1.2	0.2	5	16	200	2		04/19/13
MW-26	150	10.5	5.6	1.2	0.085	5	12	190	1.8		07/10/13
MW-26	150	9.3	5.4	1.2	0.2	0.51	18	180	1.9		10/28/13

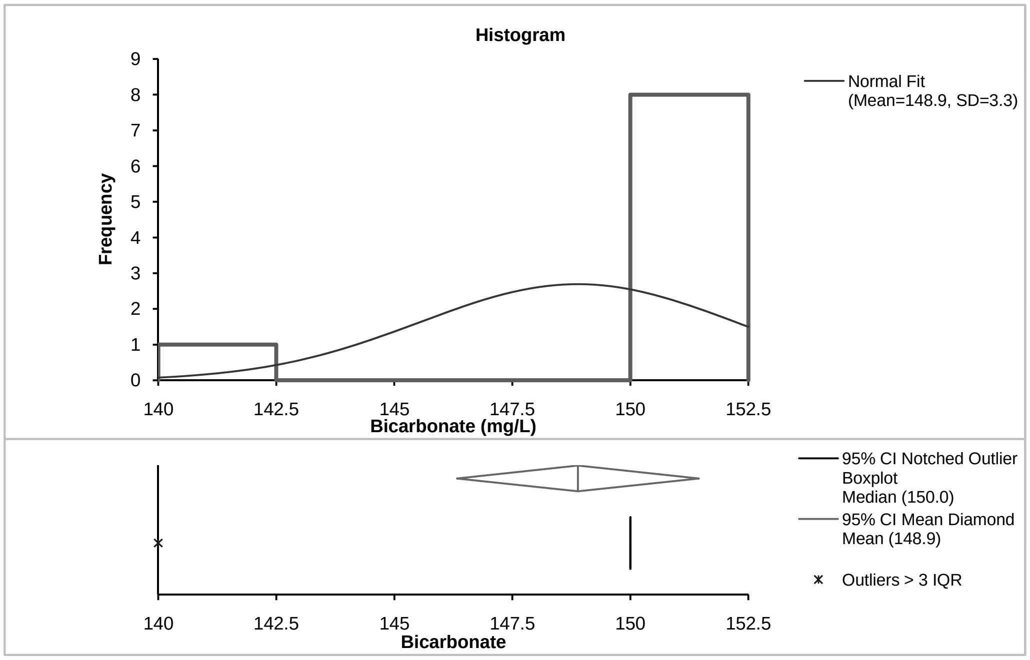
Location	Bicarbonate	Chemical Oxygen Demand	Chloride	Ammonia	Nitrate-Nitrite	Sulfate	Suspended Solids	Total Dissolved Solids	Total Organic Carbon		Date
MW-27	230	18	13	0.8	0.2	11	84	450	10		11/02/11
MW-27	350	32	12	1.2	0.2	2	110	400	11		01/18/12
MW-27	330	17	12	0.85	0.2	5	63	370	9.2		04/11/12
MW-27	410	19	12	1	0.2	5	220	450	9.2		07/13/12
MW-27	320	15	9.6	0.83	0.15	0.58	39	430	6		10/17/12
MW-27	310	35	13	1.9	0.2	5	35	460	12		01/24/13
MW-27	390	33	13	1.8	0.15	5	23	450	11		04/19/13
MW-27	390	32	12	1.7	0.2	5	43	430	8.7		07/10/13
MW-27	430	27	13	0.95	0.2	0.52	36	460	7.4		10/29/13

ALL CONCENTRATIONS IN MG/L

v2.26

Test	**MW-26**
	Bicarbonate
Performed by	Eric Tuppan

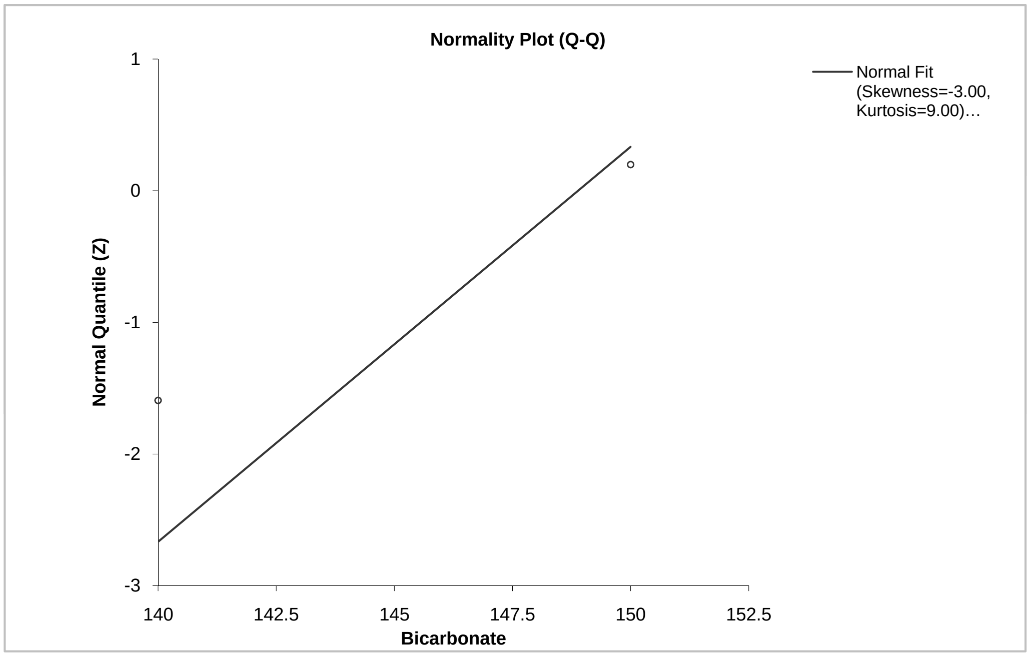
Date 3 December 2013



n	9	
Mean	148.9	
95% CI	146.3	to 151.5
SE	1.11	
Variance	11.1	
SD	3.3	
95% CI	2.3	to 6.4
CV	2.2%	
Skewness	-3.00	
Kurtosis	9.00	
Shapiro-Wilk W	0.39	w(.05,9)=0.829
p	<0.0001	

Median	150.0	
96.1% CI	150.0	to 150.0
Range	10	
IQR	0.0	

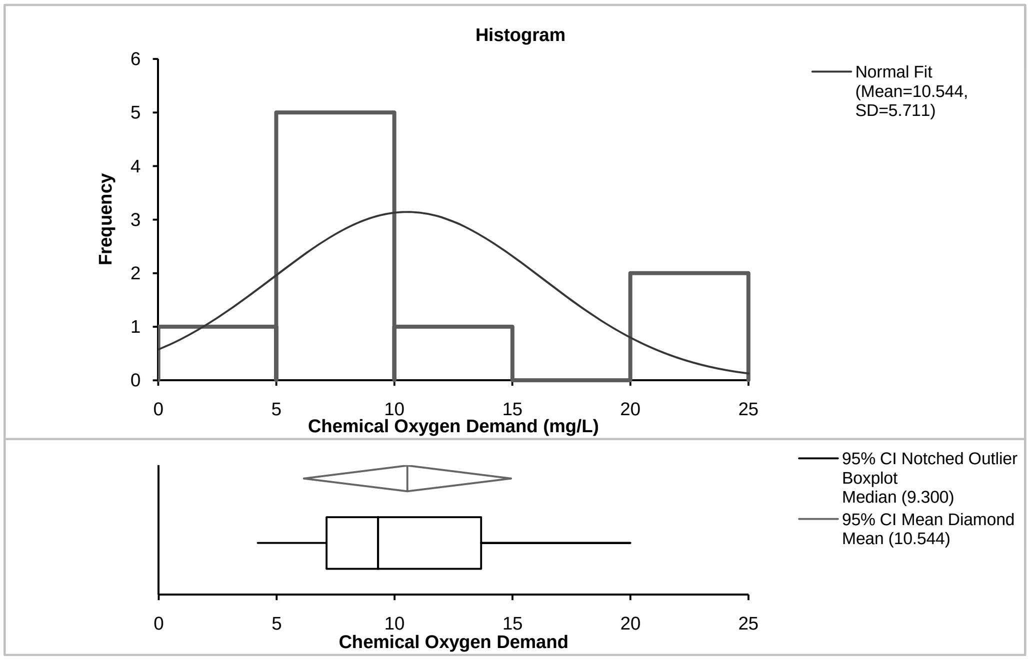
Percentile		
0th	140.0	(minimum)
25th	150.0	(1st quartile)
50th	150.0	(median)
75th	150.0	(3rd quartile)
100th	150.0	(maximum)



Test **MW-26**

Chemical Oxygen Demand
Performed by Eric Tuppan

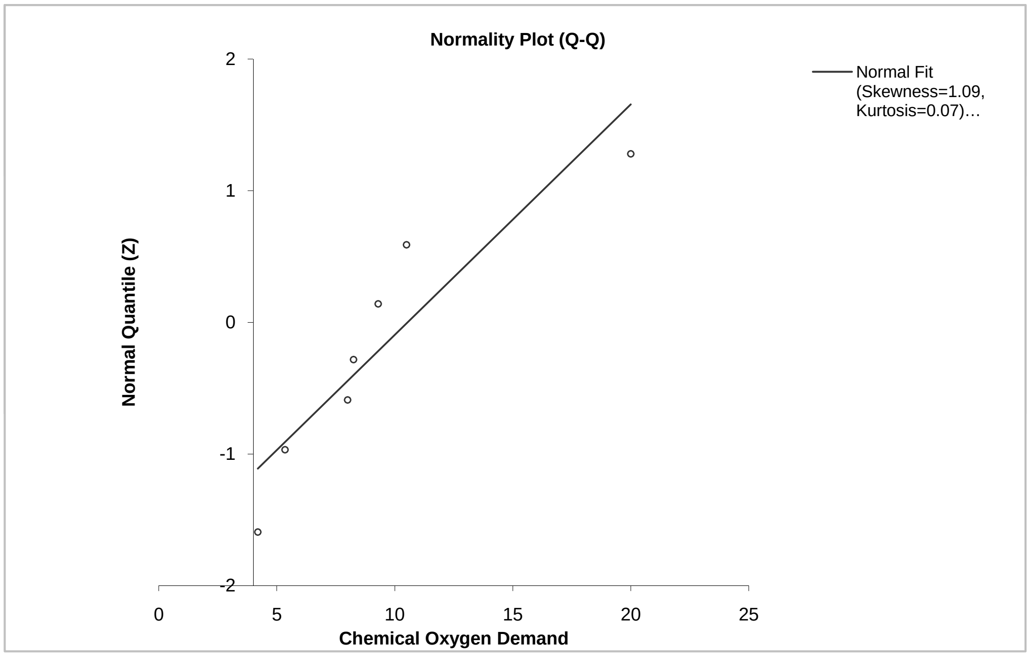
Date 3 December 2013



n	9	
Mean	10.544	
95% CI	6.155	to 14.934
SE	1.9035	
Variance	32.611	
SD	5.711	
95% CI	3.857	to 10.940
CV	54.2%	
Skewness	1.09	
Kurtosis	0.07	
Shapiro-Wilk W	0.82	w(.05,9)=0.829
p	0.037	

Median	9.300	
96.1% CI	5.350	to 20.000
Range	15.80	
IQR	6.550	

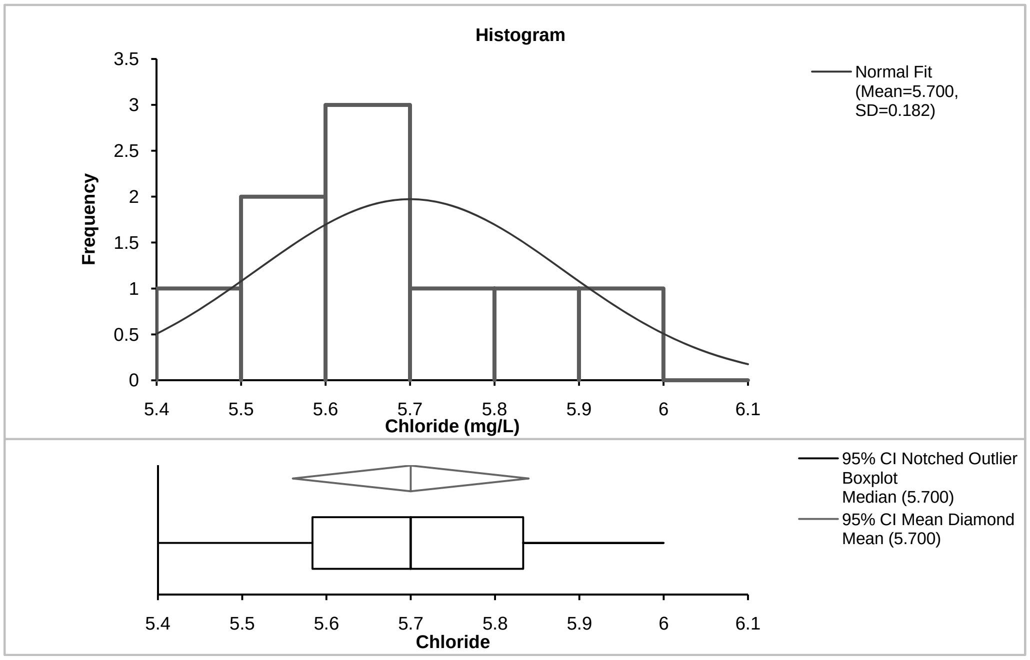
Percentile		
0th	4.200	(minimum)
25th	7.117	(1st quartile)
50th	9.300	(median)
75th	13.667	(3rd quartile)
100th	20.000	(maximum)



Analyse-it v2.26

Test **MW-26**

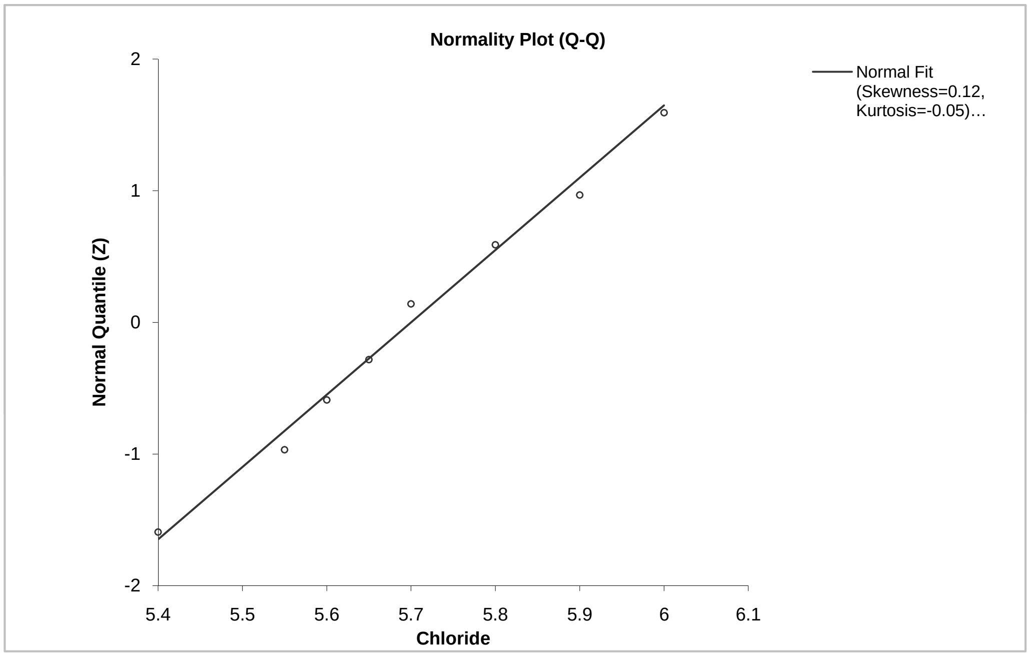
Chloride
Performed by Eric Tuppan
Date 3 December 2013



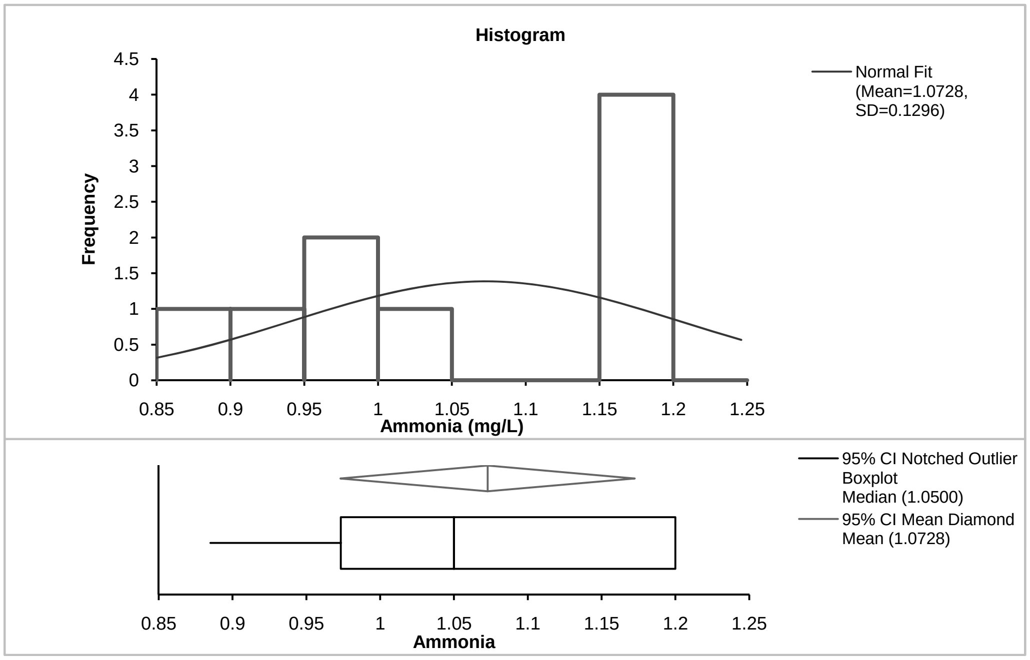
n	9	
Mean	5.700	
95% CI	5.560	to 5.840
SE	0.0607	
Variance	0.033	
SD	0.182	
95% CI	0.123	to 0.349
CV	3.2%	
Skewness	0.12	
Kurtosis	-0.05	
Shapiro-Wilk W	0.99	w(.05,9)=0.829
p	0.987	

Median	5.700	
96.1% CI	5.550	to 5.900
Range	0.60	
IQR	0.250	

Percentile		
0th	5.400	(minimum)
25th	5.583	(1st quartile)
50th	5.700	(median)
75th	5.833	(3rd quartile)
100th	6.000	(maximum)



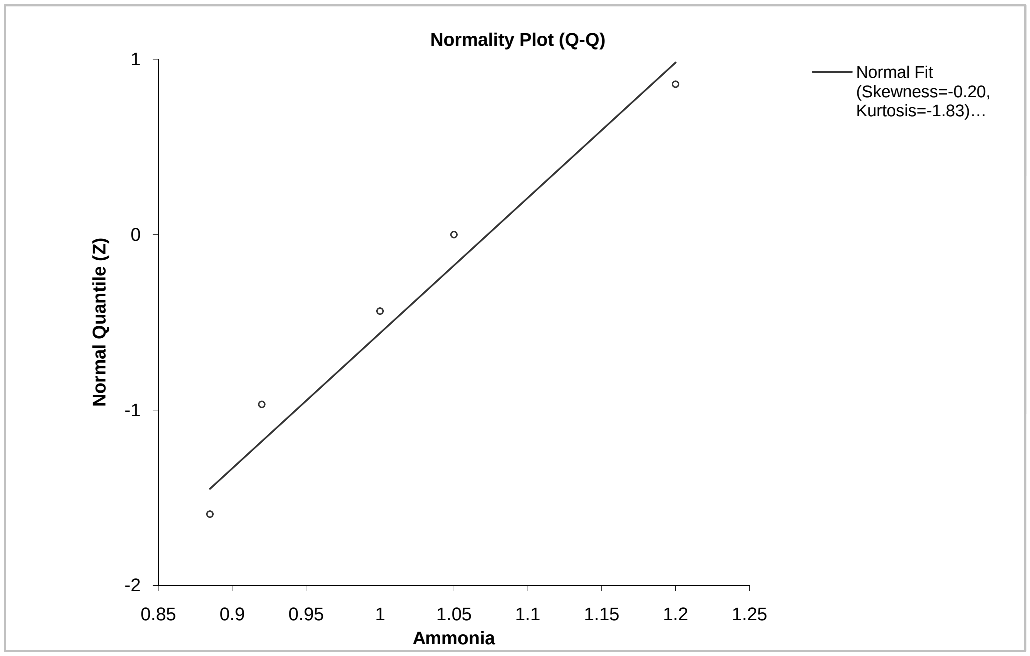
Test	**MW-26**
	Ammonia
Performed by	Eric Tuppan
Date	3 December 2013



n	9	
Mean	1.0728	
95% CI	0.9731	to 1.1724
SE	0.04321	
Variance	0.0168	
SD	0.1296	
95% CI	0.0876	to 0.2484
CV	12.1%	
Skewness	-0.20	
Kurtosis	-1.83	
Shapiro-Wilk W	0.83	w(.05,9)=0.829
p	0.050	

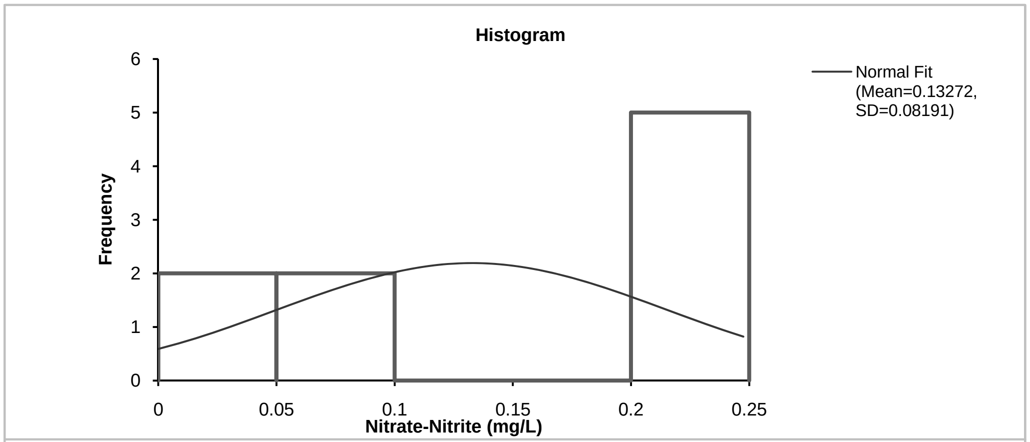
Median	1.0500	
96.1% CI	0.9200	to 1.2000
Range	0.315	
IQR	0.2267	

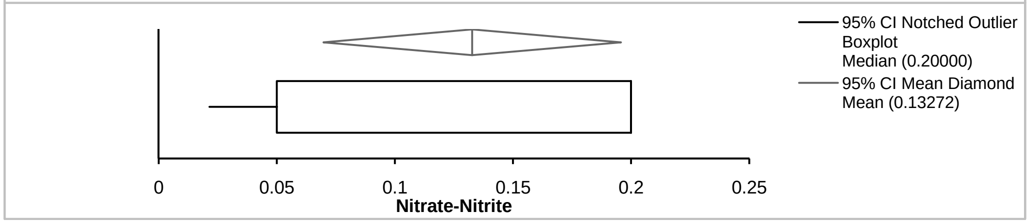
Percentile		
0th	0.8850	(minimum)
25th	0.9733	(1st quartile)
50th	1.0500	(median)
75th	1.2000	(3rd quartile)
100th	1.2000	(maximum)



Analyse-it v2.26

Test	**MW-26**
	Nitrate-Nitrite
Performed by	Eric Tuppan
Date	3 December 2013

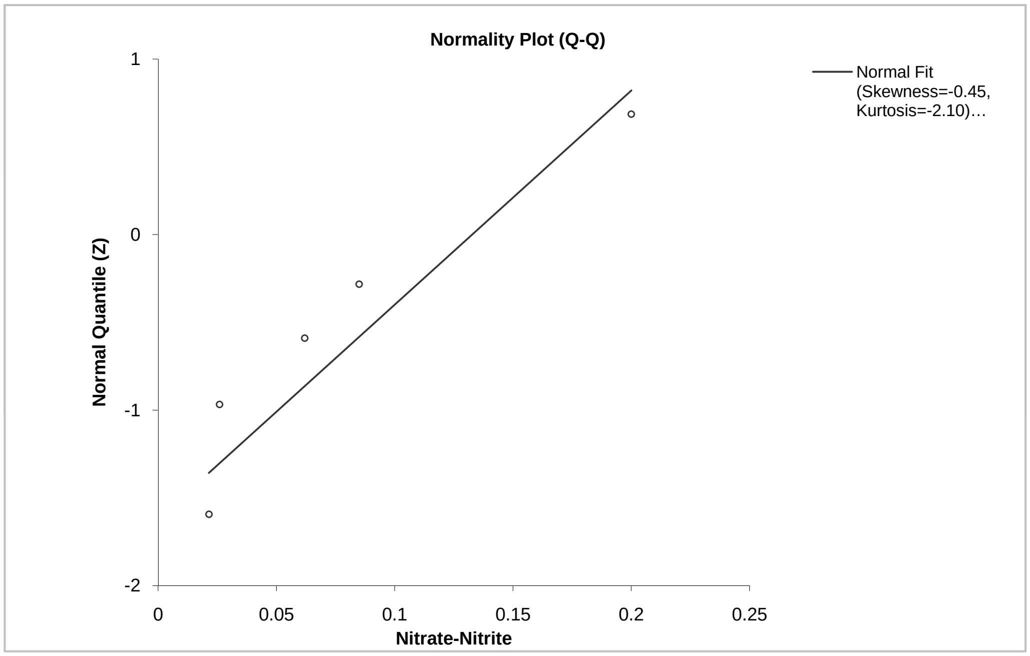




n	9	
Mean	0.13272	
95% CI	0.06976	to 0.19568
SE	0.027302	
Variance	0.00671	
SD	0.08191	
95% CI	0.05532	to 0.15692
CV	61.7%	
Skewness	-0.45	
Kurtosis	-2.10	
Shapiro-Wilk W	0.74	w(.05,9)=0.829
p	0.005	

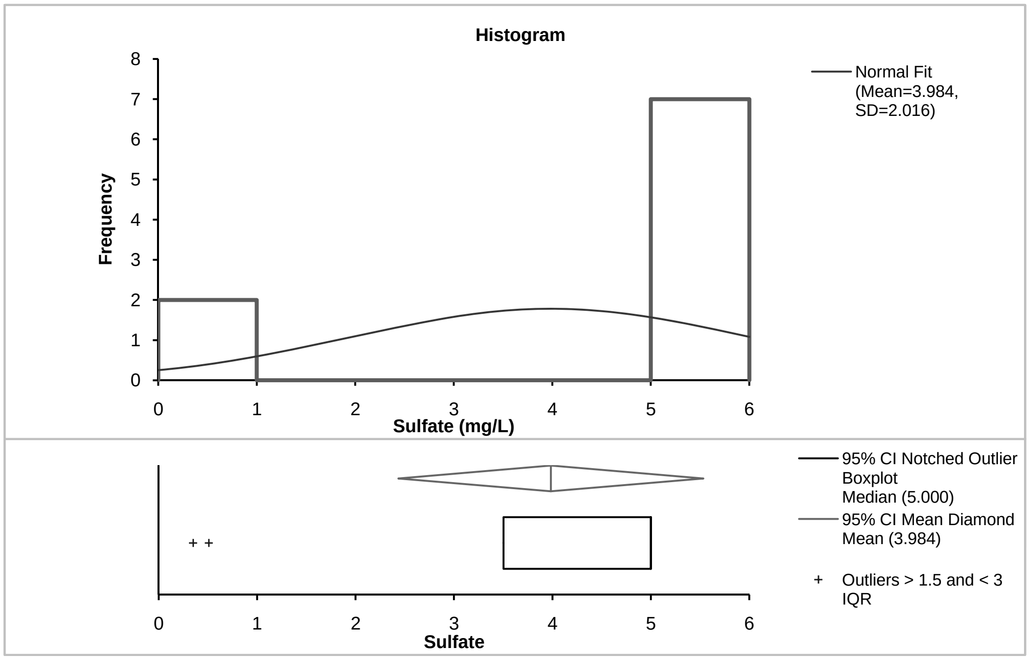
Median	0.20000	
96.1% CI	0.02600	to 0.20000
Range	0.1785	
IQR	0.15000	

Percentile		
0th	0.02150	(minimum)
25th	0.05000	(1st quartile)
50th	0.20000	(median)
75th	0.20000	(3rd quartile)
100th	0.20000	(maximum)



Analyse-it v2.26

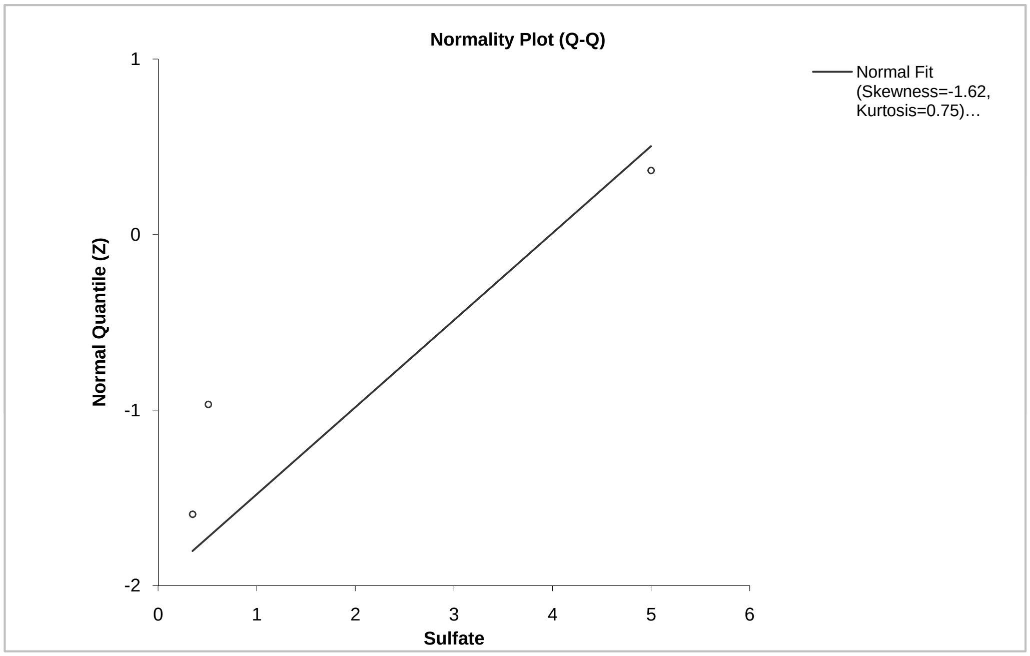
Test	**MW-26**
	Sulfate
Performed by	Eric Tuppan
Date	3 December 2013



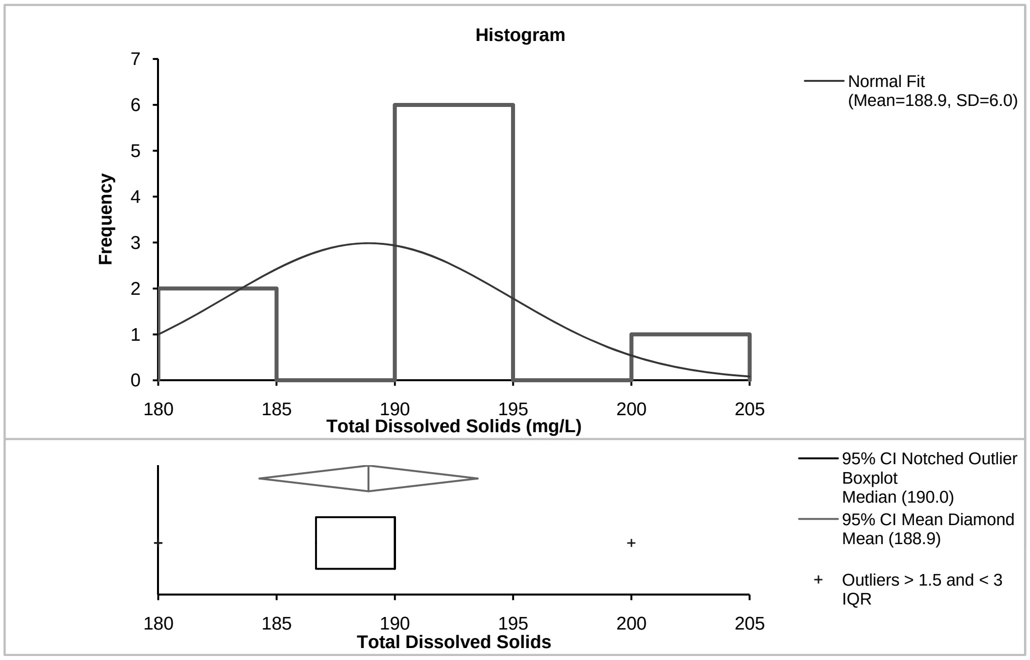
n	9	
Mean	3.984	
95% CI	2.435	to 5.534
SE	0.6719	
Variance	4.063	
SD	2.016	
95% CI	1.361	to 3.861
CV	50.6%	
Skewness	-1.62	
Kurtosis	0.75	
Shapiro-Wilk W	0.54	w(.05,9)=0.829
p	<0.0001	

Median	5.000	
96.1% CI	0.510	to 5.000
Range	4.65	
IQR	1.497	

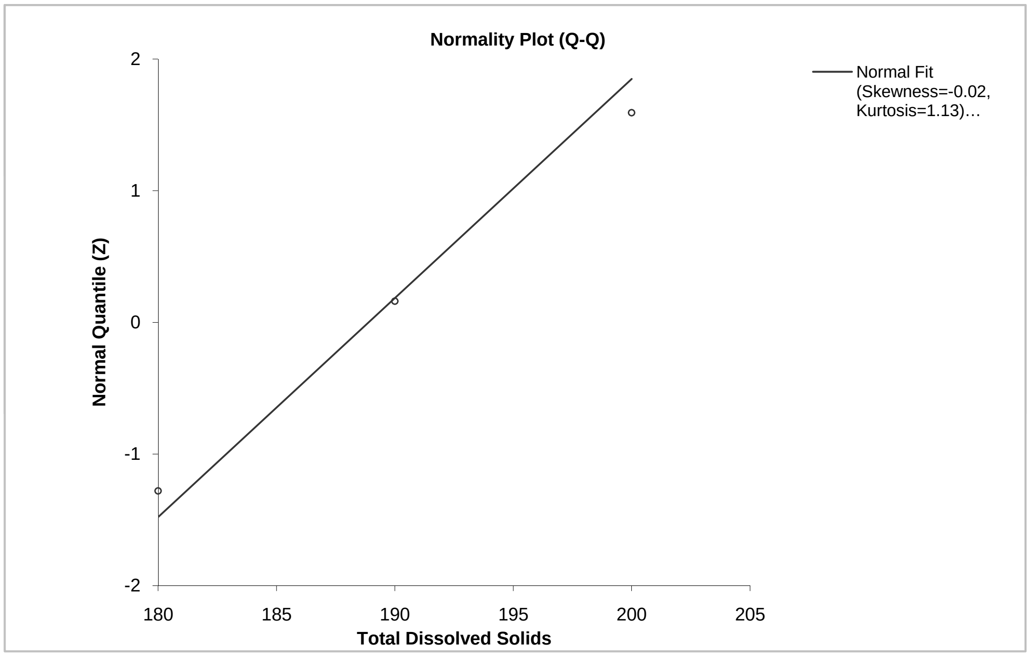
Percentile		
0th	0.350	(minimum)
25th	3.503	(1st quartile)
50th	5.000	(median)
75th	5.000	(3rd quartile)
100th	5.000	(maximum)



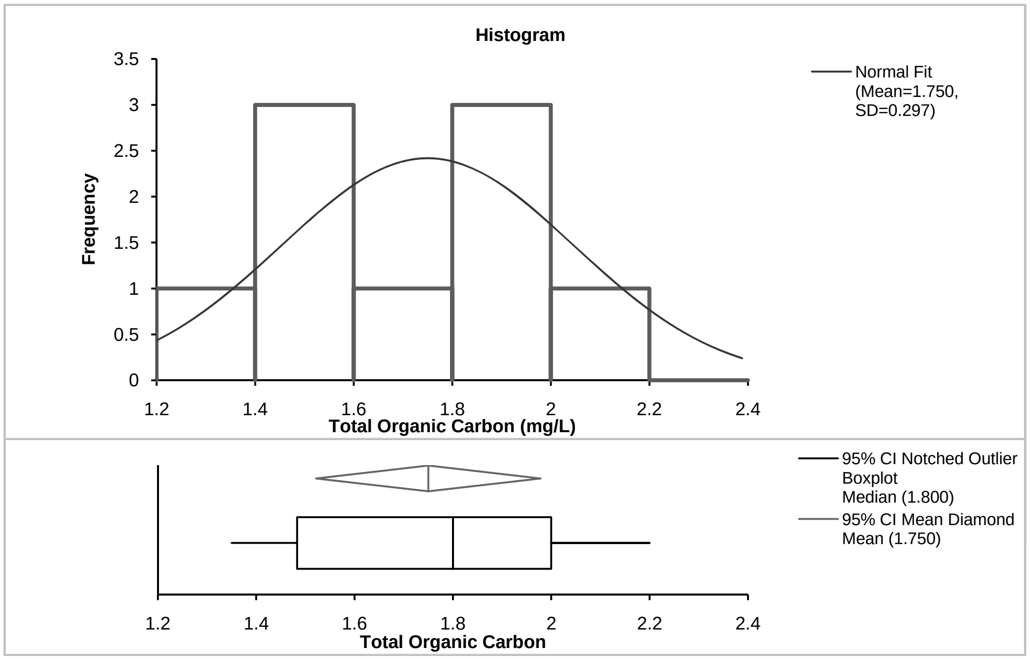
Test	**MW-26**
	Total Dissolved Solids
Performed by	Eric Tuppan
Date	3 December 2013



n	9			
Mean	188.9		Median	190.0
95% CI	184.3 to 193.5		96.1% CI	180.0 to 190.0
SE	2.00			
			Range	20
Variance	36.1		IQR	3.3
SD	6.0			
95% CI	4.1 to 11.5		Percentile	
			0th	180.0 (minimum)
CV	3.2%		25th	186.7 (1st quartile)
			50th	190.0 (median)
Skewness	-0.02		75th	190.0 (3rd quartile)
Kurtosis	1.13		100th	200.0 (maximum)
Shapiro-Wilk W	0.78	w(.05,9)=0.829		
p	0.012			



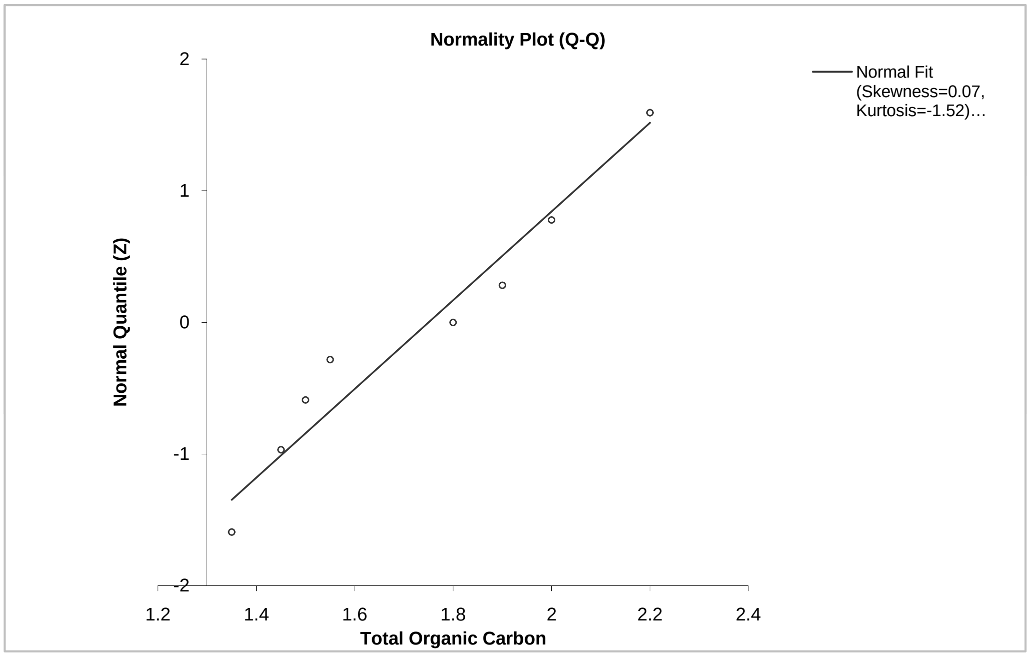
Test	**MW-26**		
	Total Organic Carbon		
Performed by	Eric Tuppan	Date	3 December 2013



n	9	
Mean	1.750	
95% CI	1.522	to 1.978
SE	0.0990	
Variance	0.088	
SD	0.297	
95% CI	0.201	to 0.569
CV	17.0%	
Skewness	0.07	
Kurtosis	-1.52	
Shapiro-Wilk W	0.93	w(.05,9)=0.829
p	0.512	

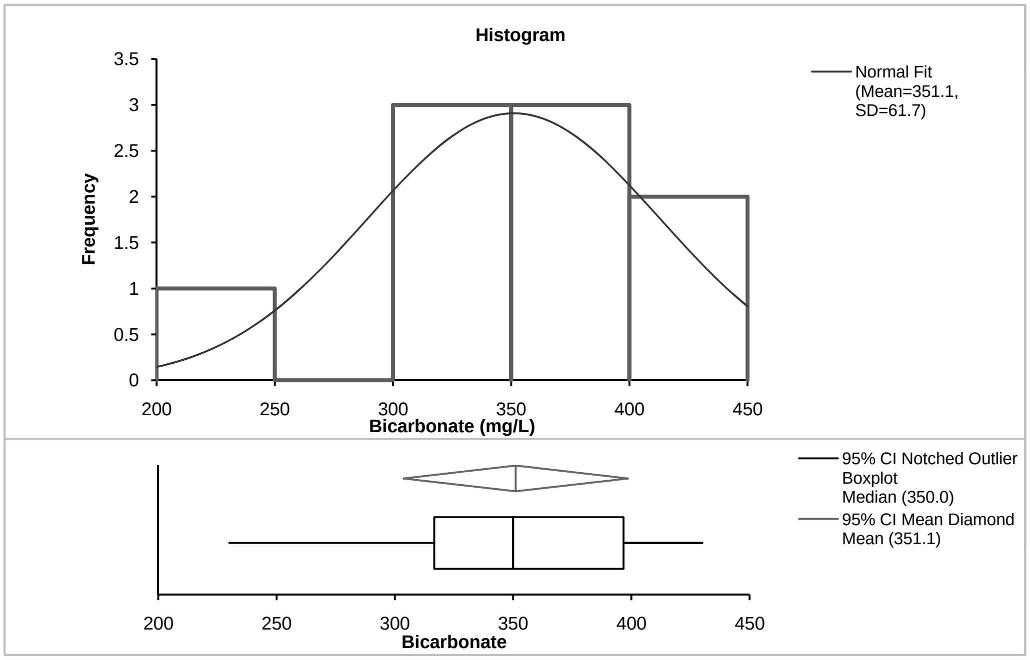
Median	1.800	
96.1% CI	1.450	to 2.000
Range	0.85	
IQR	0.517	

Percentile		
0th	1.350	(minimum)
25th	1.483	(1st quartile)
50th	1.800	(median)
75th	2.000	(3rd quartile)
100th	2.200	(maximum)



Test	**MW-27**
	Bicarbonate
Performed by	Eric Tuppan

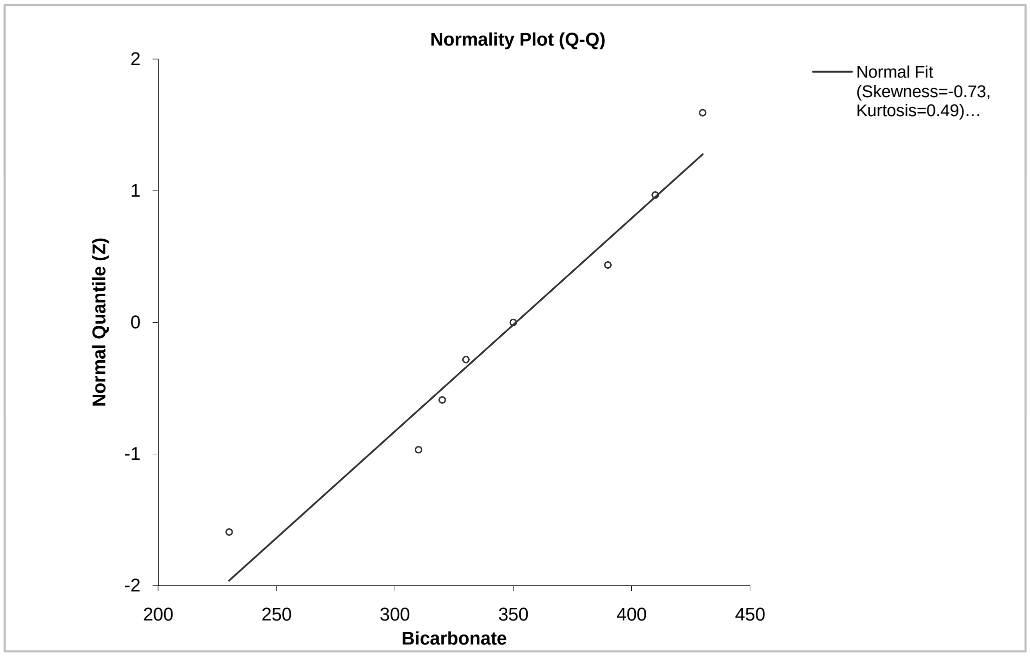
Date 3 December 2013



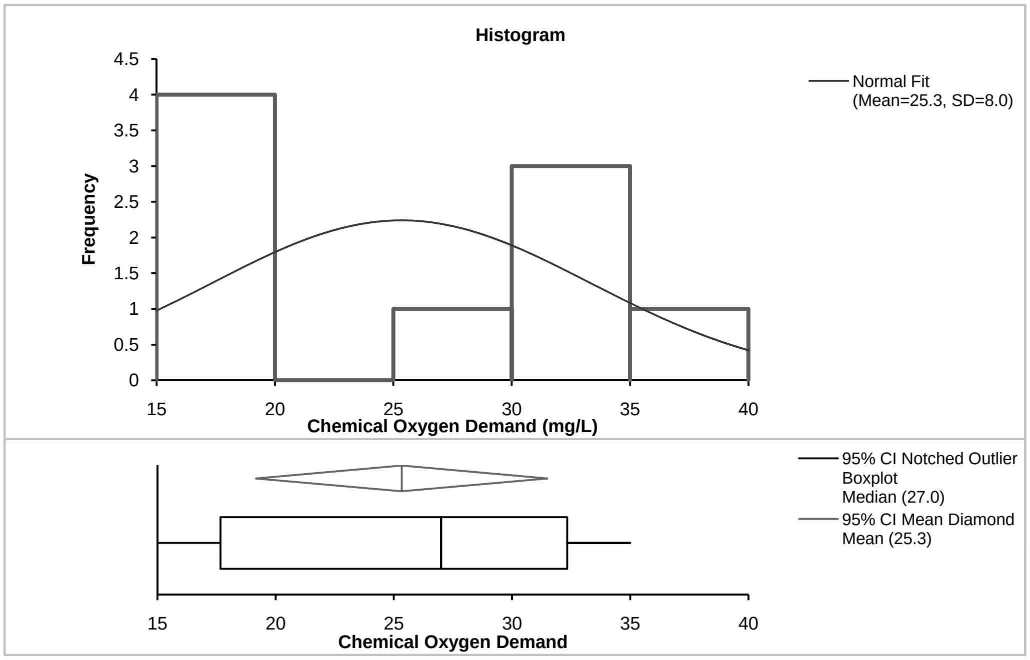
n	9	
Mean	351.1	
95% CI	303.7	to 398.6
SE	20.58	
Variance	3,811.1	
SD	61.7	
95% CI	41.7	to 118.3
CV	17.6%	
Skewness	-0.73	
Kurtosis	0.49	
Shapiro-Wilk W	0.94	w(.05,9)=0.829
p	0.635	

Median	350.0	
96.1% CI	310.0	to 410.0
Range	200	
IQR	80.0	

Percentile		
0th	230.0	(minimum)
25th	316.7	(1st quartile)
50th	350.0	(median)
75th	396.7	(3rd quartile)
100th	430.0	(maximum)



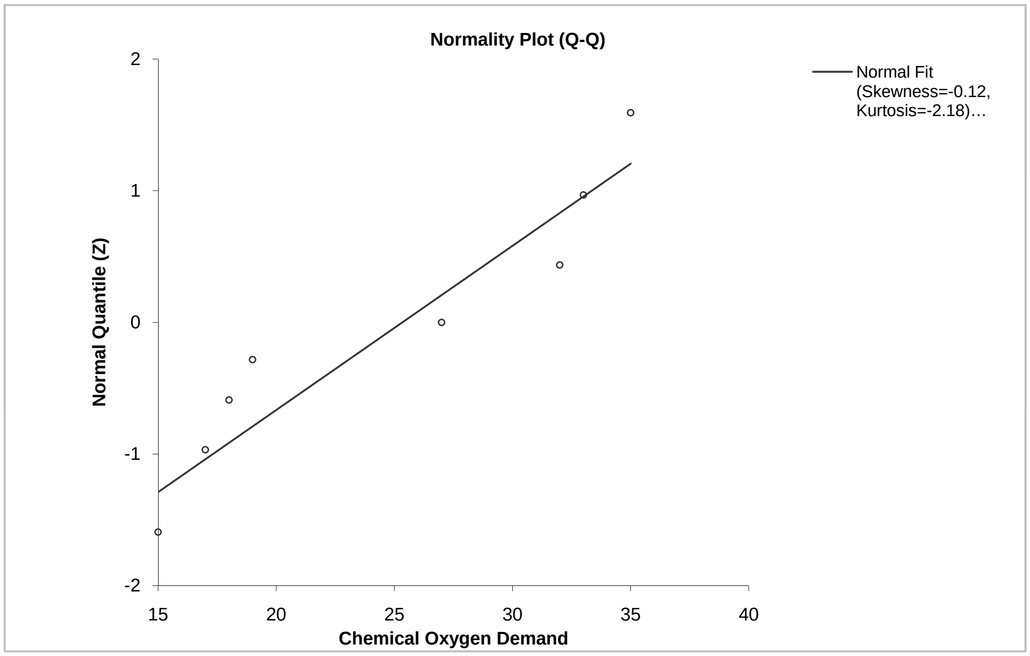
Test	**MW-27**
	Chemical Oxygen Demand
Performed by	Eric Tuppan
Date	3 December 2013



n	9		
Mean	25.3		
95% CI	19.2	to 31.5	
SE	2.67		
Variance	64.3		
SD	8.0		
95% CI	5.4	to 15.4	
CV	31.6%		
Skewness	-0.12		
Kurtosis	-2.18		
Shapiro-Wilk W	0.86	w(.05,9)=0.829	
p	0.086		

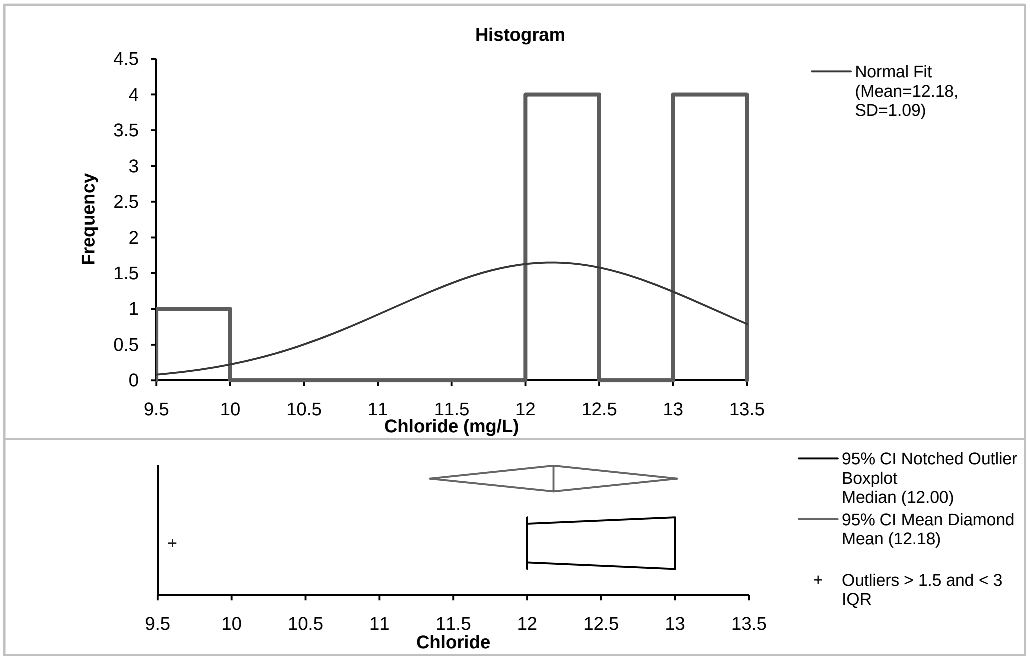
Median	27.0	
96.1% CI	17.0	to 33.0
Range	20	
IQR	14.7	

Percentile		
0th	15.0	(minimum)
25th	17.7	(1st quartile)
50th	27.0	(median)
75th	32.3	(3rd quartile)
100th	35.0	(maximum)



Analyse-it v2.26

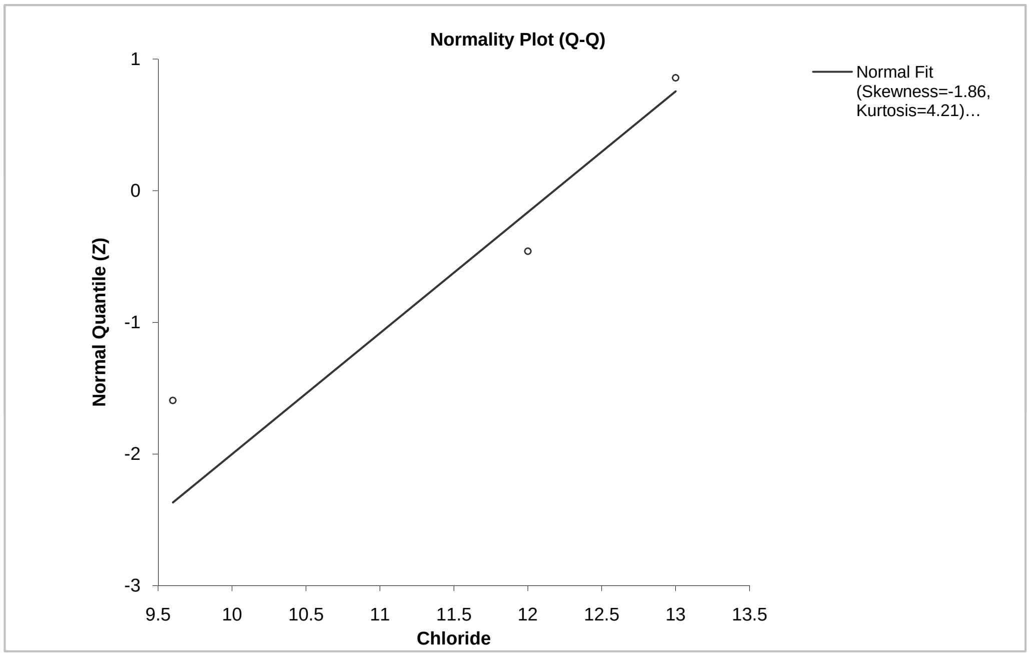
Test	**MW-27**
	Chloride
Performed by	Eric Tuppan
Date	3 December 2013



n	9	
Mean	12.18	
95% CI	11.34	to 13.01
SE	0.363	
Variance	1.18	
SD	1.09	
95% CI	0.74	to 2.08
CV	8.9%	
Skewness	-1.86	
Kurtosis	4.21	
Shapiro-Wilk W	0.72	w(.05,9)=0.829
p	0.003	

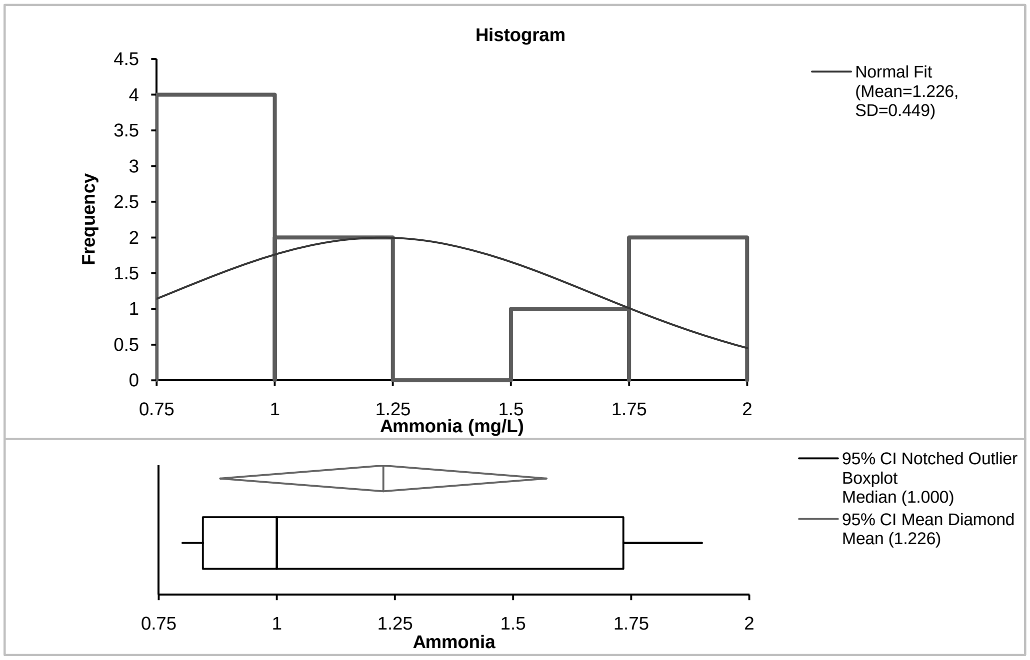
Median	12.00	
96.1% CI	12.00	to 13.00
Range	3.4	
IQR	1.00	

Percentile		
0th	9.60	(minimum)
25th	12.00	(1st quartile)
50th	12.00	(median)
75th	13.00	(3rd quartile)
100th	13.00	(maximum)



Test	**MW-27**
	Ammonia
Performed by	Eric Tuppan

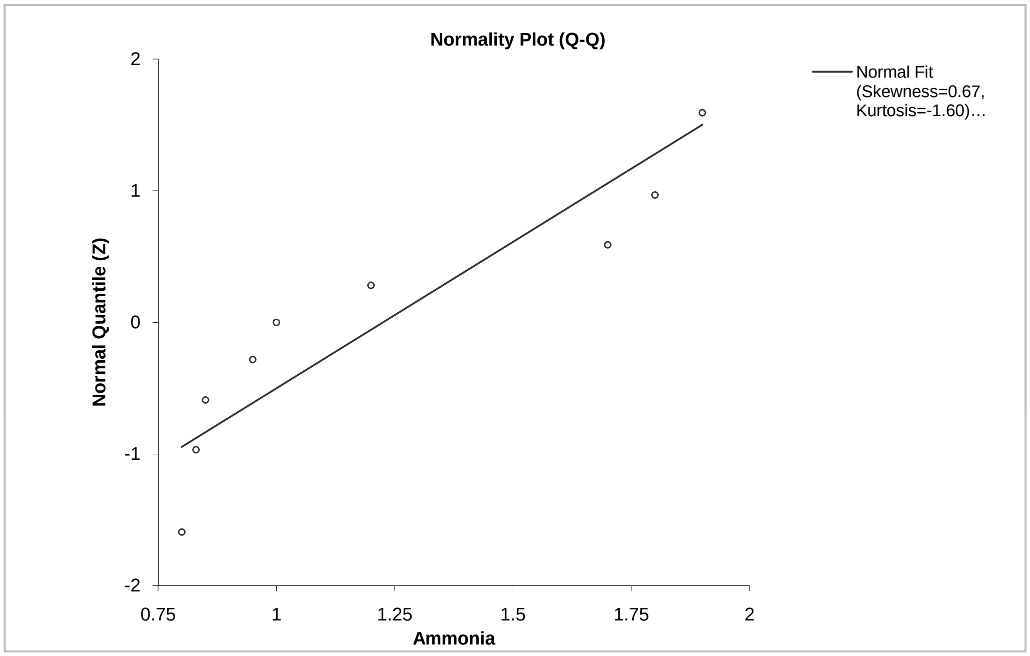
Date 3 December 2013



n	9	
Mean	1.226	
95% CI	0.880	to 1.571
SE	0.1498	
Variance	0.202	
SD	0.449	
95% CI	0.304	to 0.861
CV	36.7%	
Skewness	0.67	
Kurtosis	-1.60	
Shapiro-Wilk W	0.82	w(.05,9)=0.829
p	0.039	

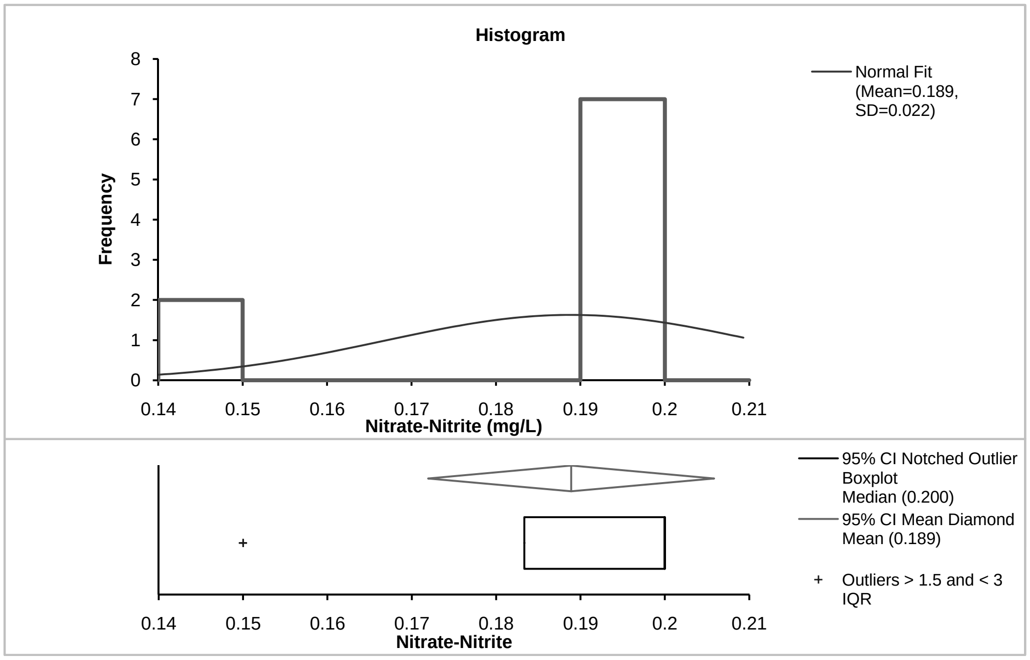
Median	1.000	
96.1% CI	0.830	to 1.800
Range	1.10	
IQR	0.890	

Percentile		
0th	0.800	(minimum)
25th	0.843	(1st quartile)
50th	1.000	(median)
75th	1.733	(3rd quartile)
100th	1.900	(maximum)

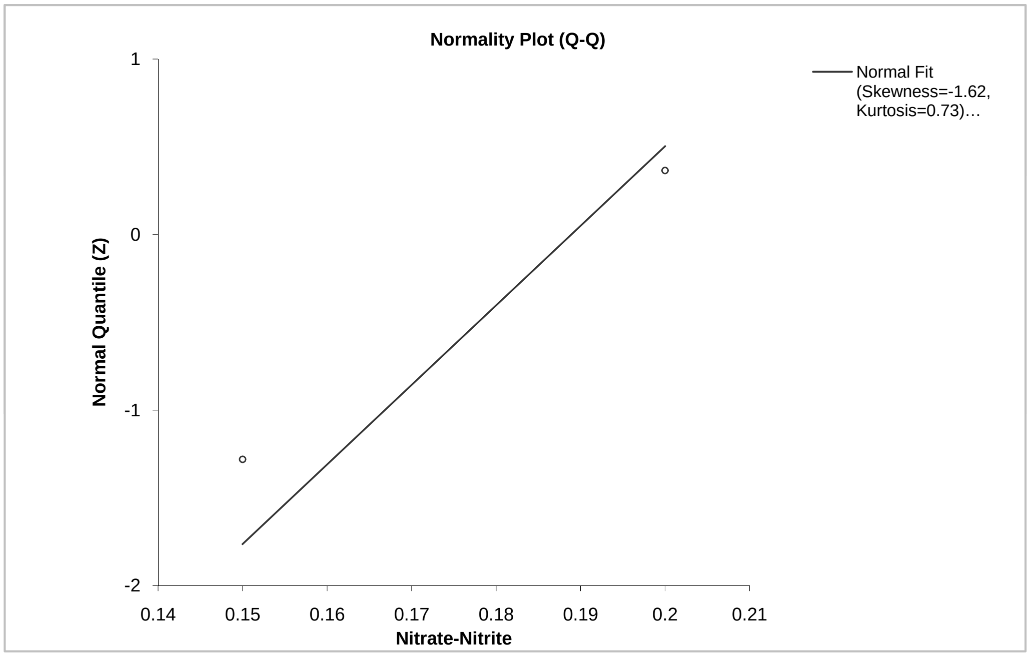


Analyse-it v2.26

Test	**MW-27**
	Nitrate-Nitrite
Performed by	Eric Tuppan
Date	3 December 2013

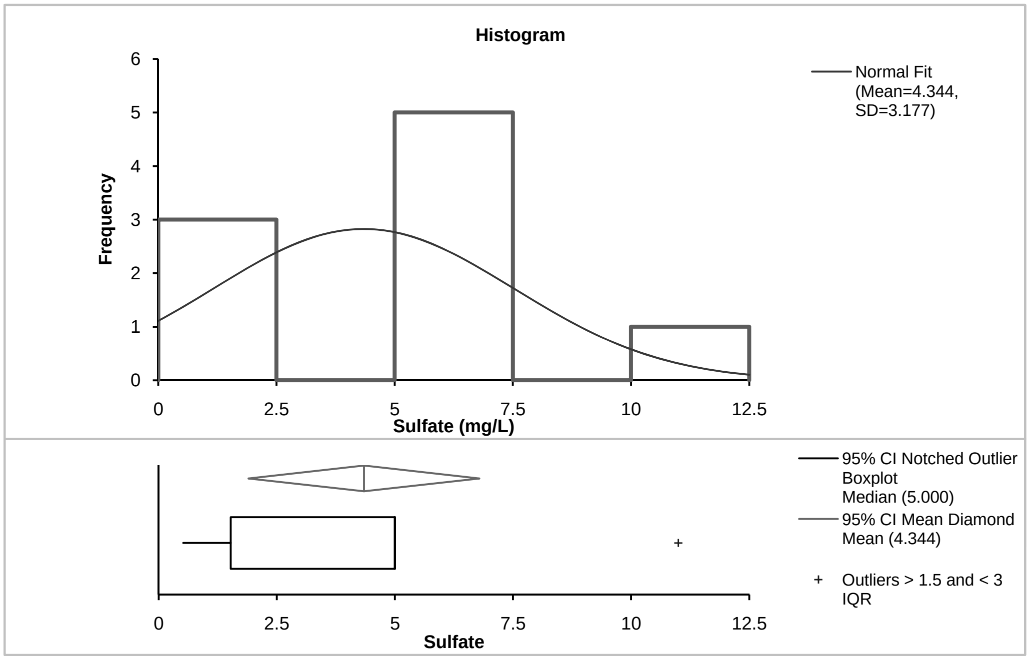


n	9				
Mean	0.189		Median	0.200	
95% CI	0.172	to 0.206	96.1% CI	0.150	to 0.200
SE	0.0073				
			Range	0.05	
Variance	0.000		IQR	0.017	
SD	0.022				
95% CI	0.015	to 0.042	Percentile		
			0th	0.150	(minimum)
CV	11.7%		25th	0.183	(1st quartile)
			50th	0.200	(median)
Skewness	-1.62		75th	0.200	(3rd quartile)
Kurtosis	0.73		100th	0.200	(maximum)
Shapiro-Wilk W	0.54	w(.05,9)=0.829			
p	<0.0001				



Test	**MW-27**
	Sulfate
Performed by	Eric Tuppan

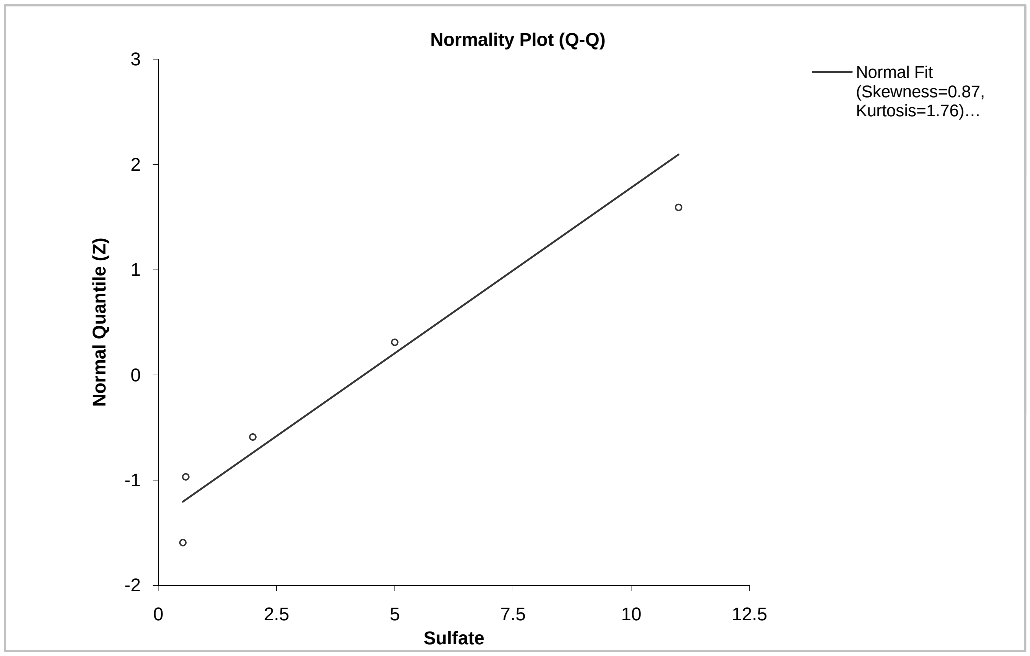
Date	3 December 2013



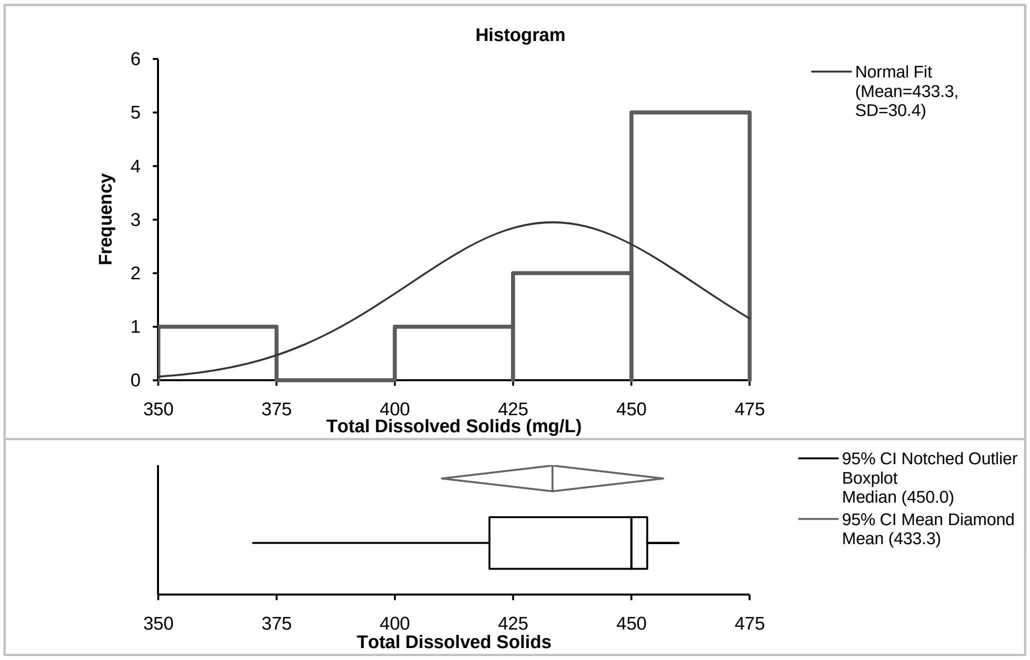
n	9	
Mean	4.344	
95% CI	1.903	to 6.786
SE	1.0590	
Variance	10.092	
SD	3.177	
95% CI	2.146	to 6.086
CV	73.1%	
Skewness	0.87	
Kurtosis	1.76	
Shapiro-Wilk W	0.83	w(.05,9)=0.829
p	0.047	

Median	5.000	
96.1% CI	0.580	to 5.000
Range	10.48	
IQR	3.473	

Percentile		
0th	0.520	(minimum)
25th	1.527	(1st quartile)
50th	5.000	(median)
75th	5.000	(3rd quartile)
100th	11.000	(maximum)



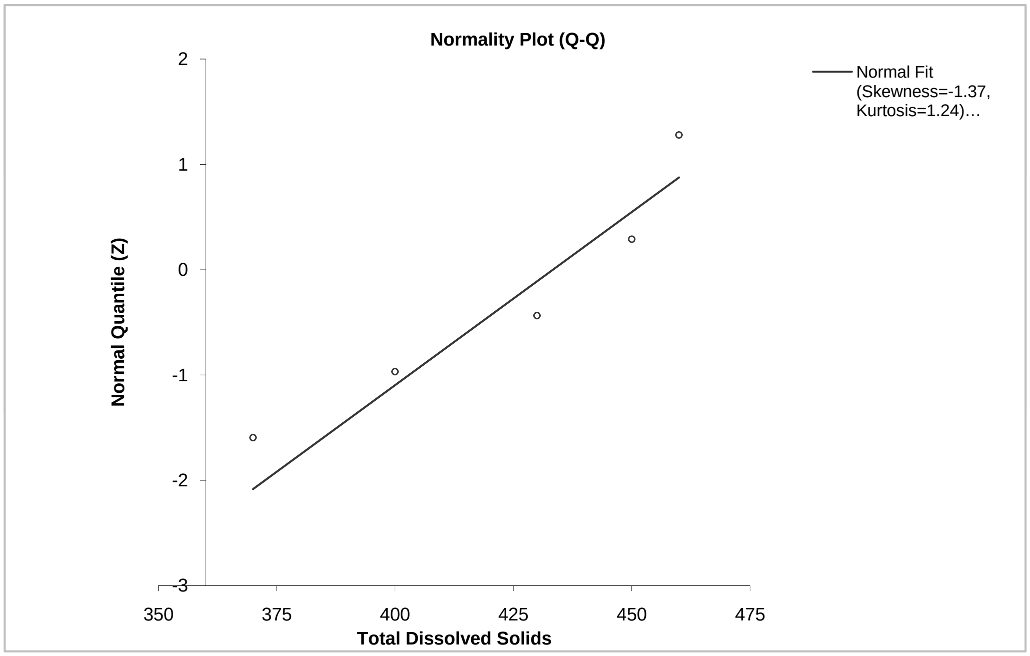
Test	**MW-27**
	Total Dissolved Solids
Performed by	Eric Tuppan
Date	3 December 2013



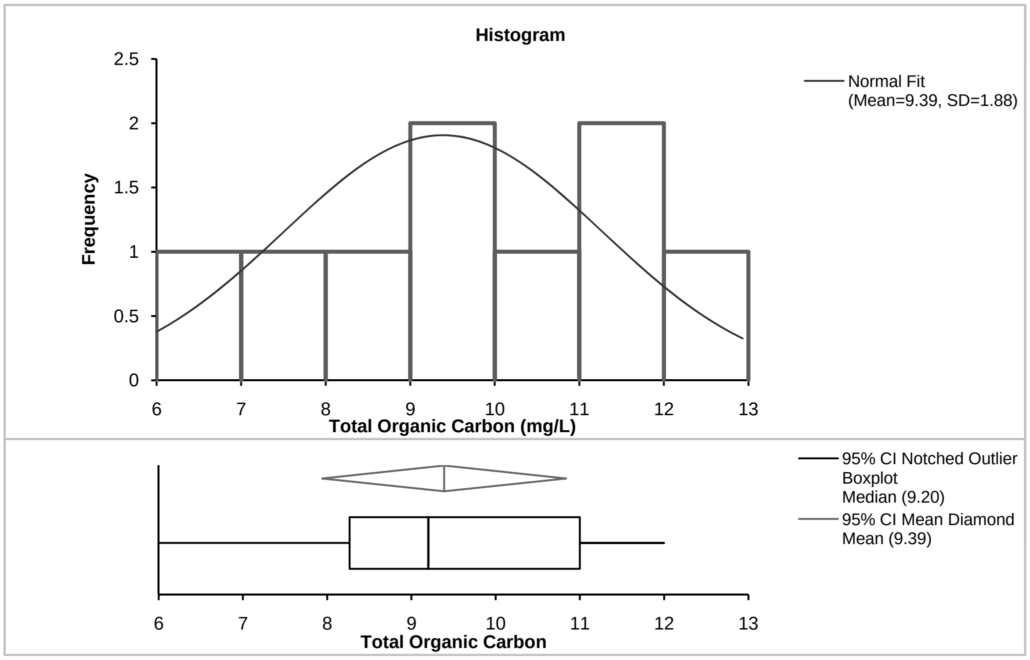
n	9	
Mean	433.3	
95% CI	410.0	to 456.7
SE	10.14	
Variance	925.0	
SD	30.4	
95% CI	20.5	to 58.3
CV	7.0%	
Skewness	-1.37	
Kurtosis	1.24	
Shapiro-Wilk W	0.83	w(.05,9)=0.829
p	0.043	

Median	450.0	
96.1% CI	400.0	to 460.0
Range	90	
IQR	33.3	

Percentile		
0th	370.0	(minimum)
25th	420.0	(1st quartile)
50th	450.0	(median)
75th	453.3	(3rd quartile)
100th	460.0	(maximum)



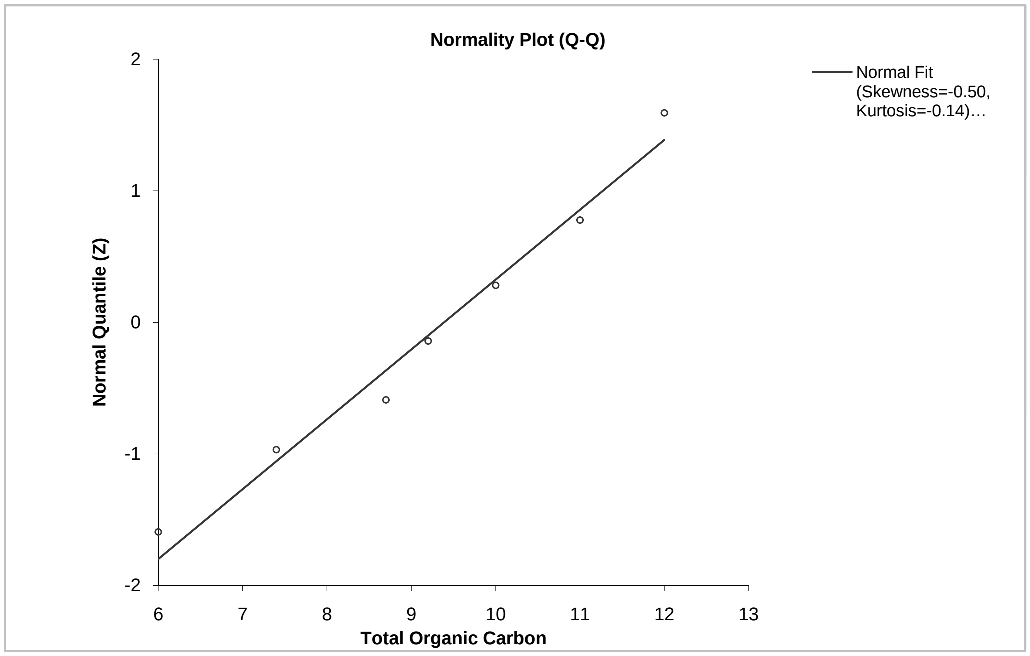
Test	**MW-27**
	Total Organic Carbon
Performed by	Eric Tuppan
Date	3 December 2013



n	9	
Mean	9.39	
95% CI	7.94	to 10.84
SE	0.628	
Variance	3.55	
SD	1.88	
95% CI	1.27	to 3.61
CV	20.1%	
Skewness	-0.50	
Kurtosis	-0.14	
Shapiro-Wilk W	0.96	w(.05,9)=0.829
p	0.846	

Median	9.20	
96.1% CI	7.40	to 11.00
Range	6.0	
IQR	2.73	

Percentile		
0th	6.00	(minimum)
25th	8.27	(1st quartile)
50th	9.20	(median)
75th	11.00	(3rd quartile)
100th	12.00	(maximum)



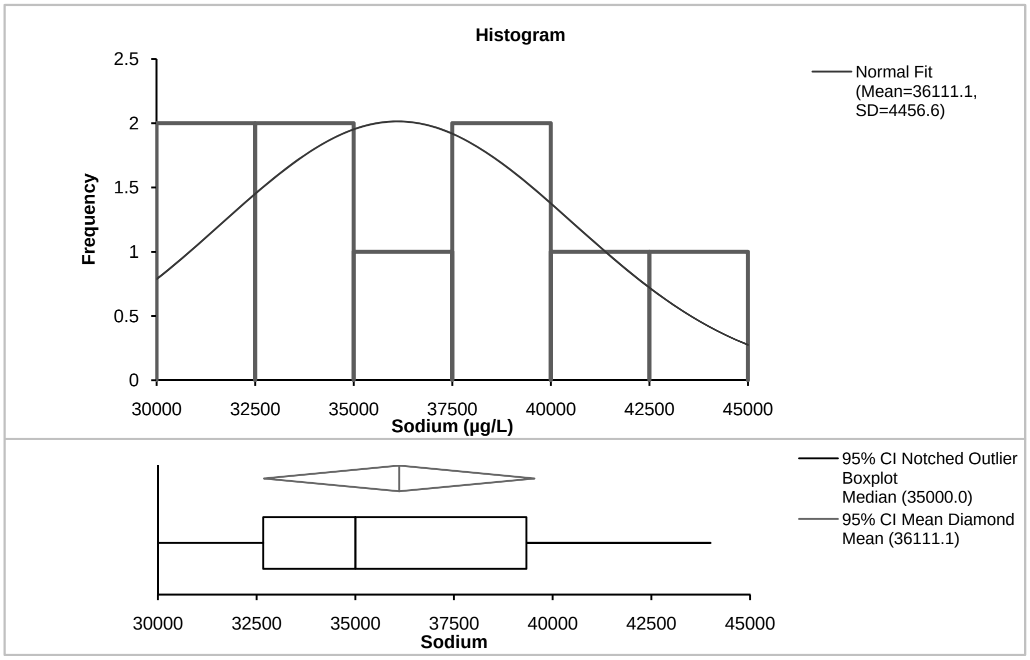
Coffin Butte - Descriptive Statistics
Dissolved Metals - (Filtered)

Location	**Calcium**	**Iron**	**Magnesium**	**Manganese**	**Potassium**	**Silicon**	**Sodium**		Date	Type
MW-26	22,500	2,950	9,500	660	1,550	25,000	26,500		11/01/11	Average
MW-26	22,000	1,250	9,250	635	1,450	23,000	25,500		01/17/12	Average
MW-26	23,000	380	8,900	580	1,400	21,000	26,000		04/11/12	Primary Sample
MW-26	22,000	385	7,950	425	1,050	20,000	27,000		07/13/12	Average
MW-26	22,000	430	8,700	610	1,300	23,000	27,000		10/16/12	Primary Sample
MW-26	23,000	410	8,600	620	1,400	22,500	27,000		01/24/13	Average
MW-26	25,000	260	8,900	550	1,400	22,000	28,000		04/19/13	Primary Sample
MW-26	23,000	440	8,200	540	1,250	20,500	25,000		07/10/13	Average
MW-26	22,000	440	8,900	640	1,400	20,000	28,000		10/28/13	Primary Sample

Location	**Calcium**	**Iron**	**Magnesium**	**Manganese**	**Potassium**	**Silicon**	**Sodium**		Date	Type
MW-27	48,000	1,400	20,000	3,700	1,700	20,000	44,000		11/02/11	Primary Sample
MW-27	71,000	12,000	36,000	6,400	1,600	18,000	39,000		01/18/12	Primary Sample
MW-27	61,000	3,600	27,000	5,000	1,000	20,000	33,000		04/11/12	Primary Sample
MW-27	62,000	5,100	26,000	5,300	700	20,000	34,000		07/13/12	Primary Sample
MW-27	61,000	6,100	28,000	5,100	830	23,000	32,000		10/17/12	Primary Sample
MW-27	86,000	15,000	37,000	6,900	760	17,000	38,000		01/24/13	Primary Sample
MW-27	93,000	15,000	40,000	7,400	750	18,000	40,000		04/19/13	Primary Sample
MW-27	68,000	9,100	29,000	5,400	740	17,000	30,000		07/10/13	Primary Sample
MW-27	66,000	3,200	30,000	5,800	600	18,000	35,000		10/29/13	Primary Sample

Test	**MW-27**
	Sodium
Performed by	Eric Tuppan

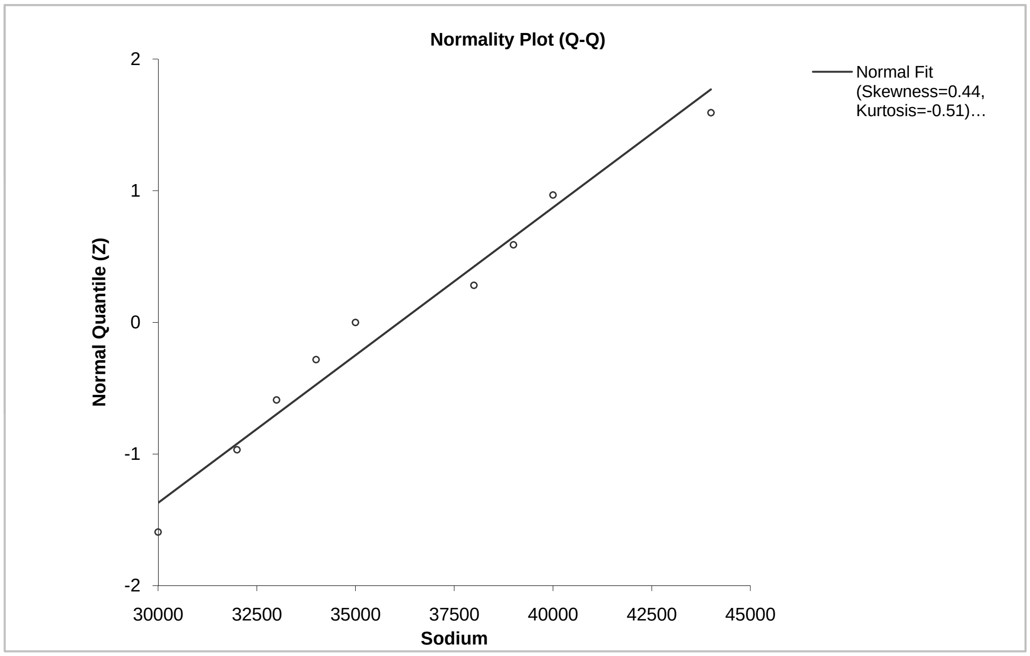
Date 3 December 2013



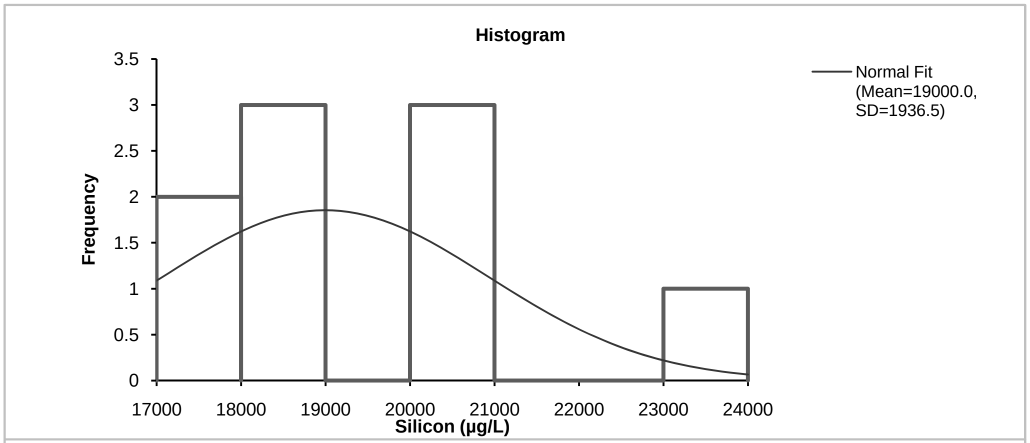
n	9	
Mean	36,111.1	
95% CI	32,685.5	to 39,536.7
SE	1,485.53	
Variance	19,861,111.1	
SD	4,456.6	
95% CI	3,010.2	to 8,537.8
CV	12.3%	
Skewness	0.44	
Kurtosis	-0.51	
Shapiro-Wilk W	0.97	w(.05,9)=0.829
p	0.882	

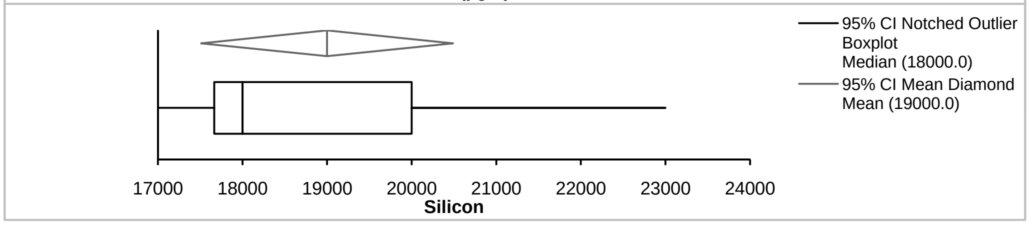
Median	35,000.0	
96.1% CI	32,000.0	to 40,000.0
Range	14,000	
IQR	6,666.7	

Percentile		
0th	30,000.0	(minimum)
25th	32,666.7	(1st quartile)
50th	35,000.0	(median)
75th	39,333.3	(3rd quartile)
100th	44,000.0	(maximum)



Test	**MW-27**
	Silicon
Performed by	Eric Tuppan
Date	3 December 2013

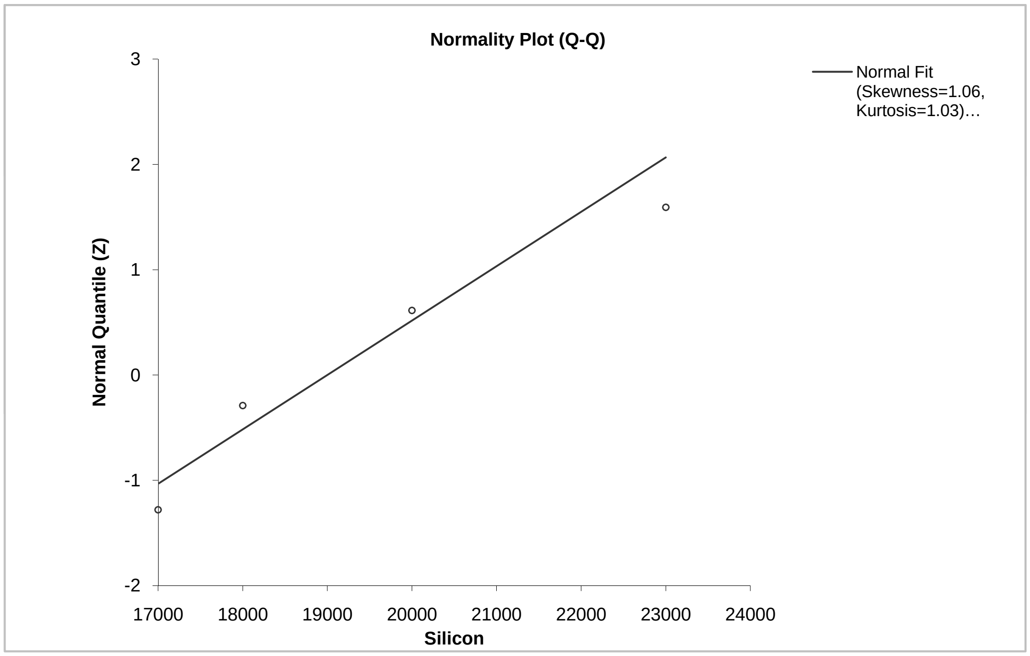




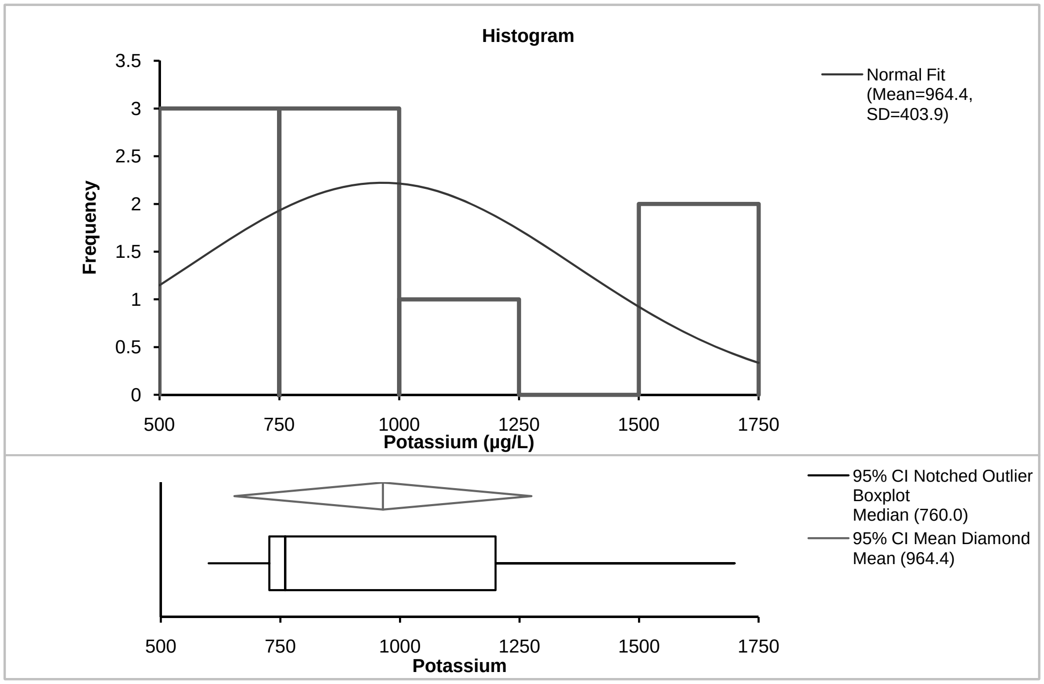
n	9	
Mean	19,000.0	
95% CI	17,511.5	to 20,488.5
SE	645.50	
Variance	3,750,000.0	
SD	1,936.5	
95% CI	1,308.0	to 3,709.9
CV	10.2%	
Skewness	1.06	
Kurtosis	1.03	
Shapiro-Wilk W	0.86	w(.05,9)=0.829
p	0.106	

Median	18,000.0	
96.1% CI	17,000.0	to 20,000.0
Range	6,000	
IQR	2,333.3	

Percentile		
0th	17,000.0	(minimum)
25th	17,666.7	(1st quartile)
50th	18,000.0	(median)
75th	20,000.0	(3rd quartile)
100th	23,000.0	(maximum)



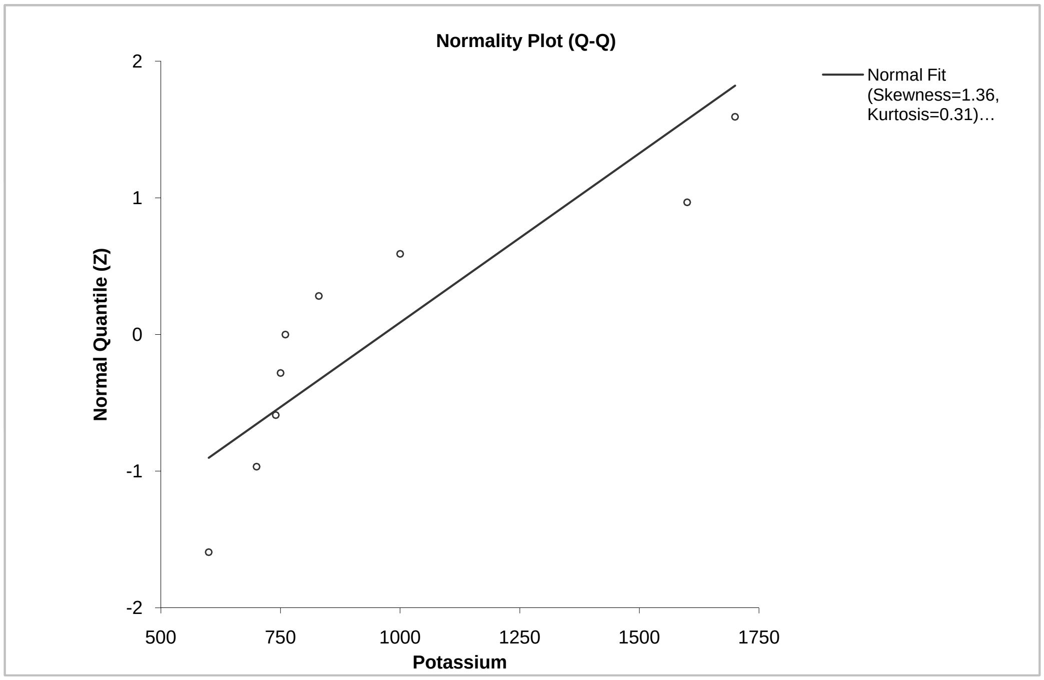
Performed by	Potassium Eric Tuppan	Date	3 December 2013



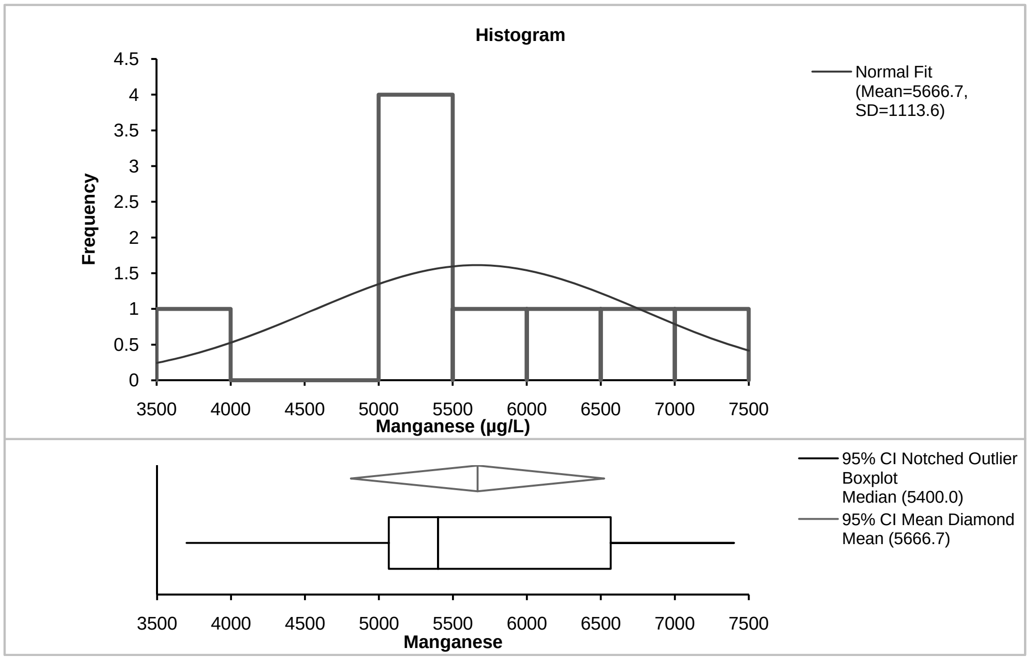
n	9	
Mean	964.4	
95% CI	654.0	to 1,274.9
SE	134.64	
Variance	163,152.8	
SD	403.9	
95% CI	272.8	to 773.8
CV	41.9%	
Skewness	1.36	
Kurtosis	0.31	
Shapiro-Wilk W	0.76	w(.05,9)=0.829
p	0.008	

Median	760.0	
96.1% CI	700.0	to 1,600.0
Range	1,100	
IQR	473.3	

Percentile		
0th	600.0	(minimum)
25th	726.7	(1st quartile)
50th	760.0	(median)
75th	1,200.0	(3rd quartile)
100th	1,700.0	(maximum)



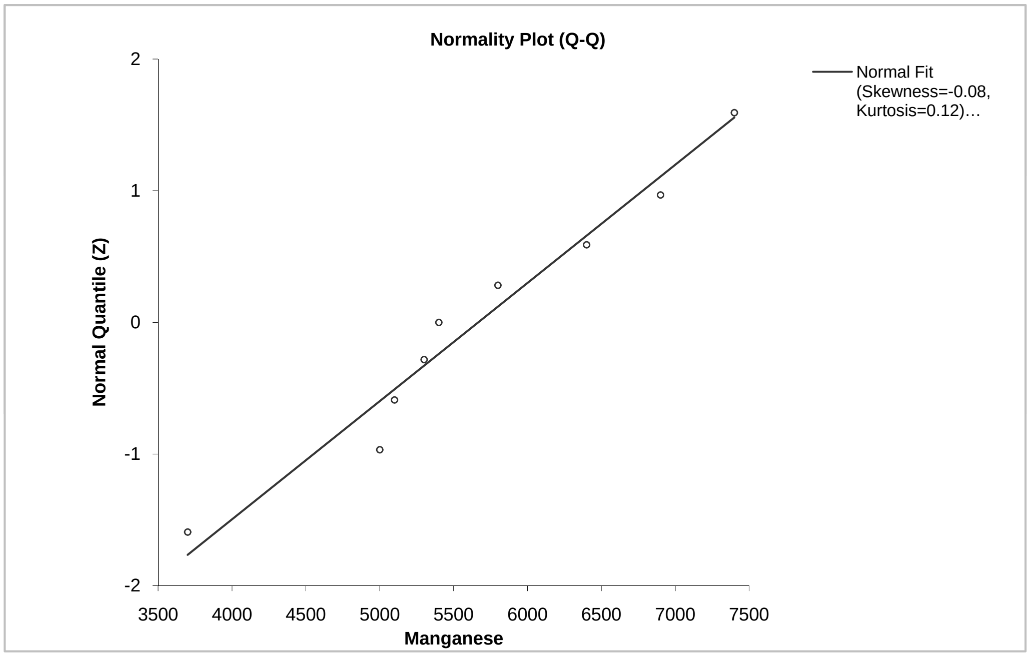
Test	**MW-27**
	Manganese
Performed by	Eric Tuppan
Date	3 December 2013



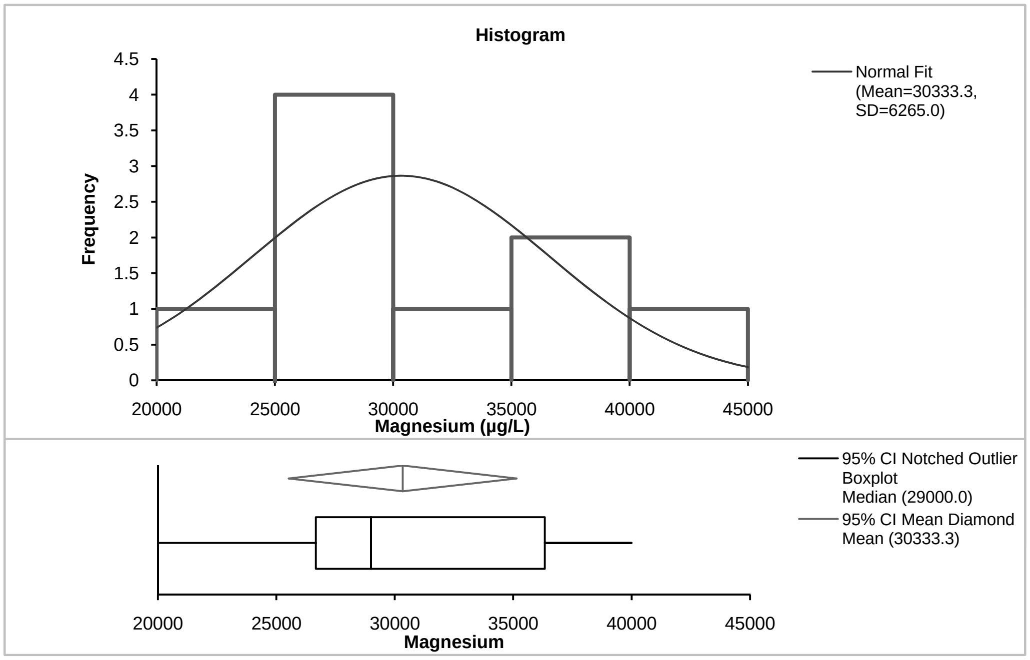
n	9	
Mean	5,666.7	
95% CI	4,810.7	to 6,522.6
SE	371.18	
Variance	1,240,000.0	
SD	1,113.6	
95% CI	752.2	to 2,133.3
CV	19.7%	
Skewness	-0.08	
Kurtosis	0.12	
Shapiro-Wilk W	0.97	w(.05,9)=0.829
p	0.880	

Median	5,400.0	
96.1% CI	5,000.0	to 6,900.0
Range	3,700	
IQR	1,500.0	

Percentile		
0th	3,700.0	(minimum)
25th	5,066.7	(1st quartile)
50th	5,400.0	(median)
75th	6,566.7	(3rd quartile)
100th	7,400.0	(maximum)



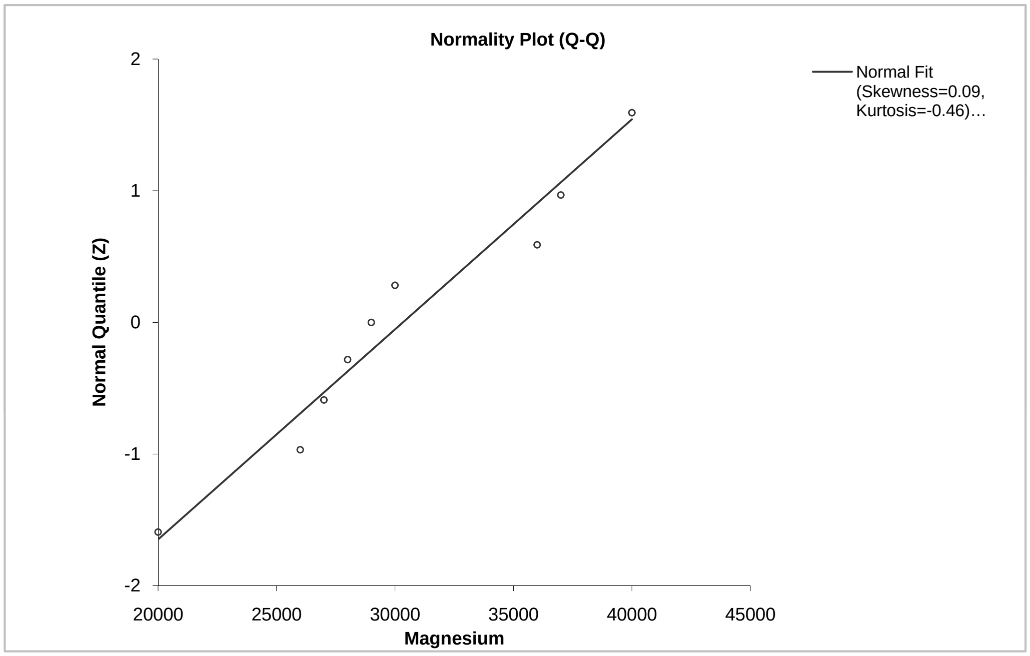
Test	**MW-27**
	Magnesium
Performed by	Eric Tuppan
Date	3 December 2013



n	9	
Mean	30,333.3	
95% CI	25,517.6	to 35,149.0
SE	2,088.33	
Variance	39,250,000.0	
SD	6,265.0	
95% CI	4,231.7	to 12,002.3
CV	20.7%	
Skewness	0.09	
Kurtosis	-0.46	
Shapiro-Wilk W	0.95	w(.05,9)=0.829
p	0.742	

Median	29,000.0	
96.1% CI	26,000.0	to 37,000.0
Range	20,000	
IQR	9,666.7	

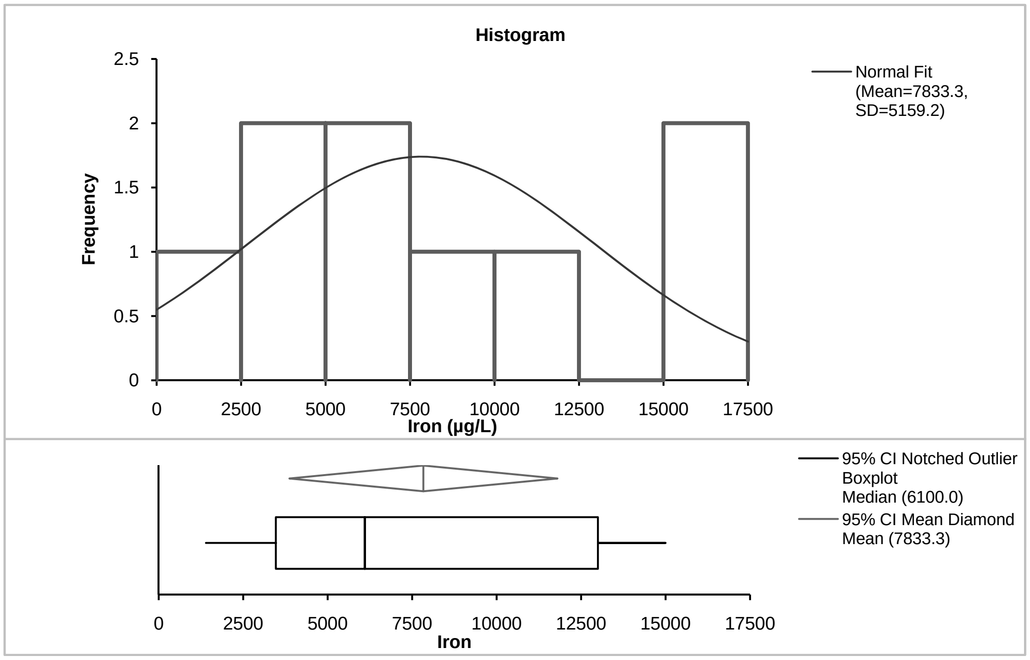
Percentile		
0th	20,000.0	(minimum)
25th	26,666.7	(1st quartile)
50th	29,000.0	(median)
75th	36,333.3	(3rd quartile)
100th	40,000.0	(maximum)



Analyse-it v2.26

Test	**MW-27**
	Iron
Performed by	Eric Tuppan

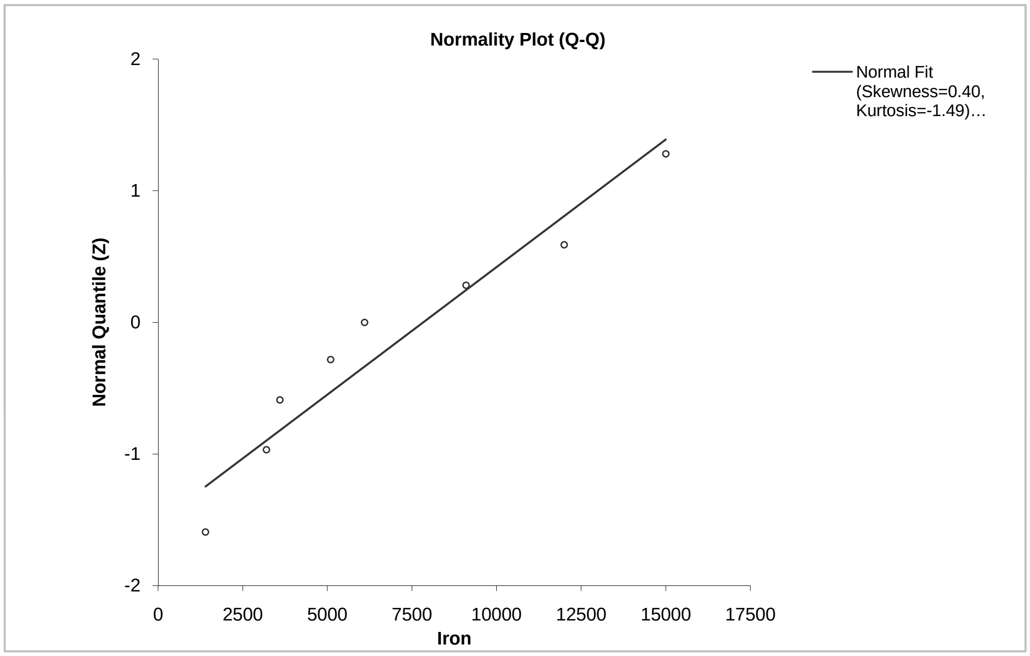
Date 3 December 2013



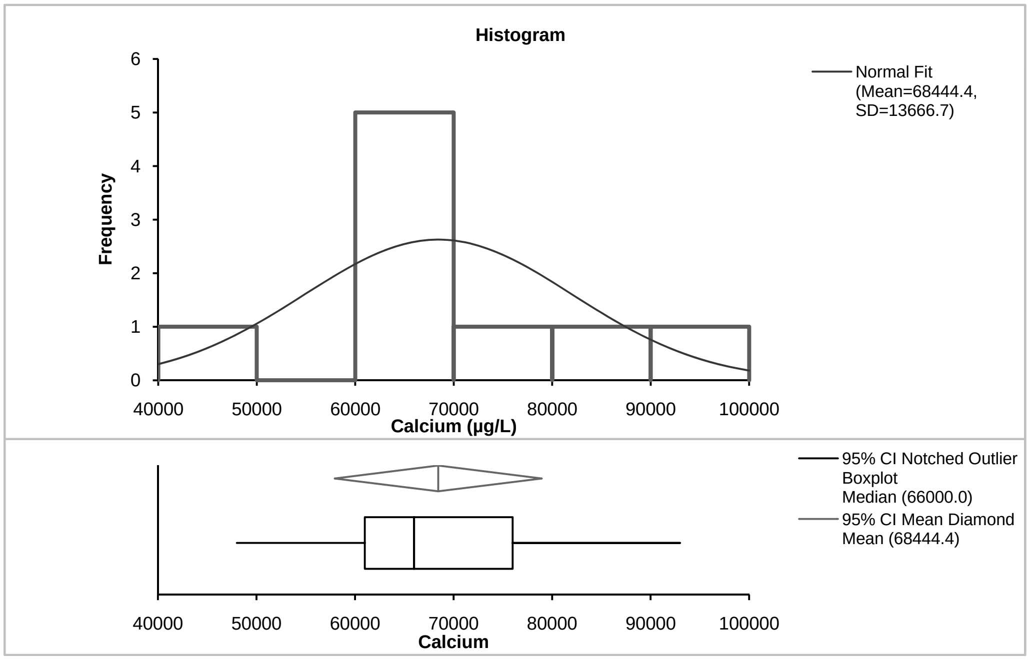
n	9	
Mean	7,833.3	
95% CI	3,867.6	to 11,799.1
SE	1,719.74	
Variance	26,617,500.0	
SD	5,159.2	
95% CI	3,484.8	to 9,883.9
CV	65.9%	
Skewness	0.40	
Kurtosis	-1.49	
Shapiro-Wilk W	0.90	w(.05,9)=0.829
p	0.279	

Median	6,100.0	
96.1% CI	3,200.0	to 15,000.0
Range	13,600	
IQR	9,533.3	

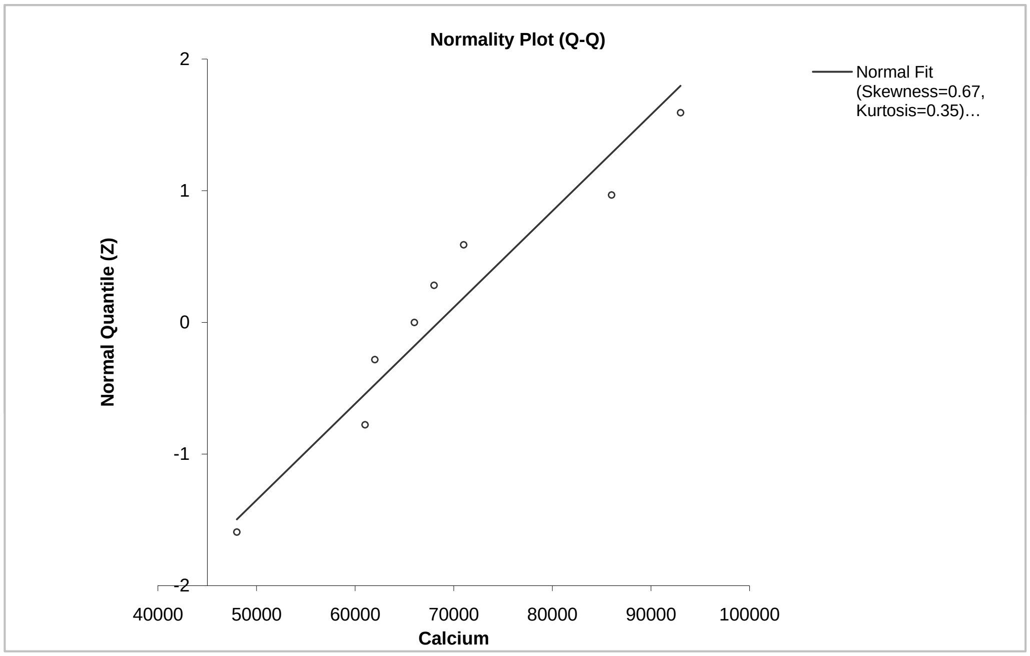
Percentile		
0th	1,400.0	(minimum)
25th	3,466.7	(1st quartile)
50th	6,100.0	(median)
75th	13,000.0	(3rd quartile)
100th	15,000.0	(maximum)



Test	**MW-27**
	Calcium
Performed by	Eric Tuppan
Date	3 December 2013

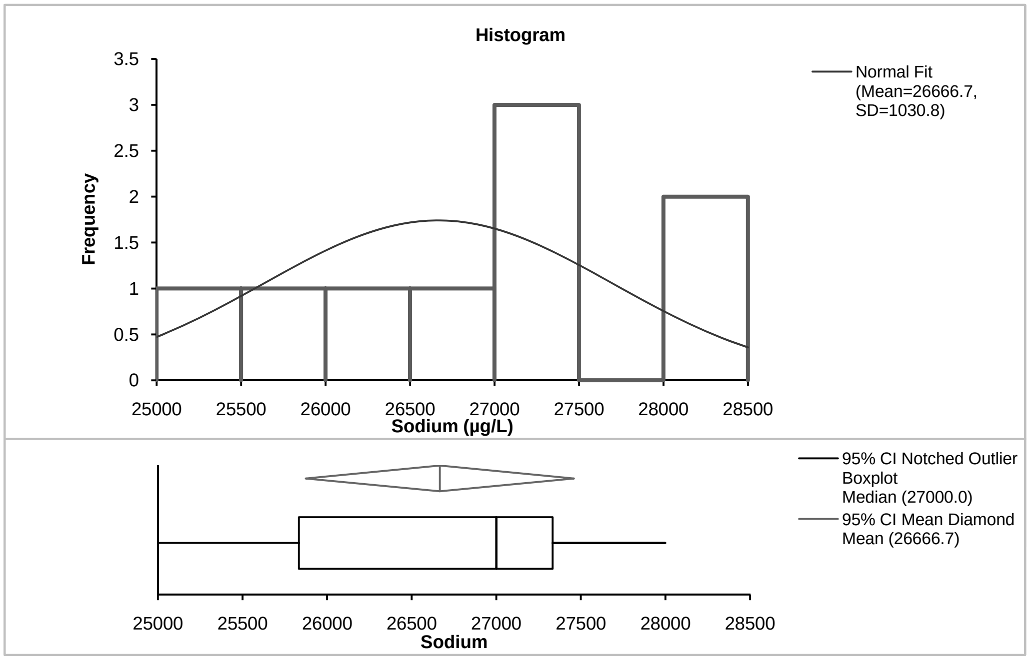


n	9				
Mean	68,444.4		Median	66,000.0	
95% CI	57,939.3	to 78,949.6	96.1% CI	61,000.0	to 86,000.0
SE	4,555.56				
			Range	45,000	
Variance	186,777,777.8		IQR	15,000.0	
SD	13,666.7				
95% CI	9,231.2	to 26,182.2	Percentile		
			0th	48,000.0	(minimum)
CV	20.0%		25th	61,000.0	(1st quartile)
			50th	66,000.0	(median)
Skewness	0.67		75th	76,000.0	(3rd quartile)
Kurtosis	0.35		100th	93,000.0	(maximum)
Shapiro-Wilk W	0.92	w(.05,9)=0.829			
p	0.423				



Analyse-it v2.26

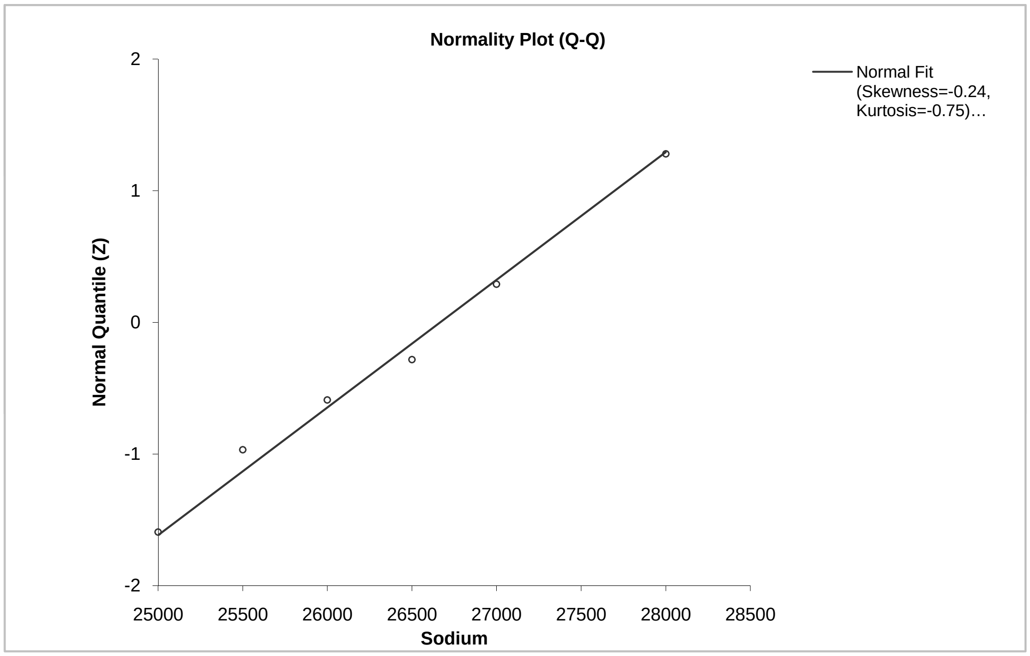
Test	**MW-26**
	Sodium
Performed by	Eric Tuppan
Date	3 December 2013



n	9	
Mean	26,666.7	
95% CI	25,874.3	to 27,459.0
SE	343.59	
Variance	1,062,500.0	
SD	1,030.8	
95% CI	696.2	to 1,974.7
CV	3.9%	
Skewness	-0.24	
Kurtosis	-0.75	
Shapiro-Wilk W	0.94	w(.05,9)=0.829
p	0.553	

Median	27,000.0	
96.1% CI	25,500.0	to 28,000.0
Range	3,000	
IQR	1,500.0	

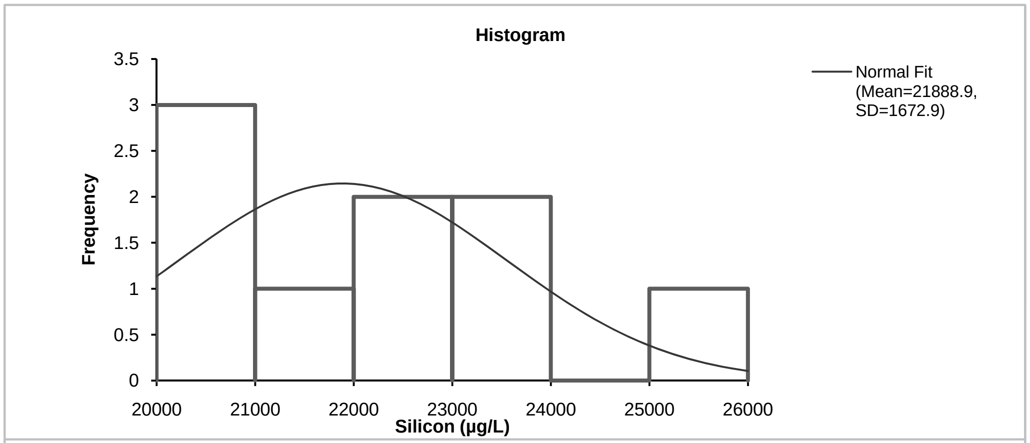
Percentile		
0th	25,000.0	(minimum)
25th	25,833.3	(1st quartile)
50th	27,000.0	(median)
75th	27,333.3	(3rd quartile)
100th	28,000.0	(maximum)

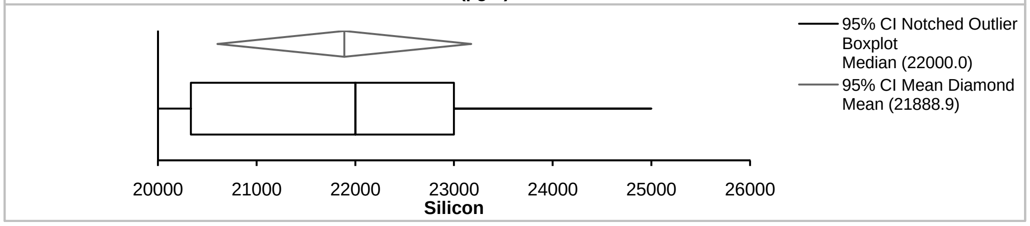


Analyse-it v2.26

Test	**MW-26**
	Silicon
Performed by	Eric Tuppan

Date 3 December 2013

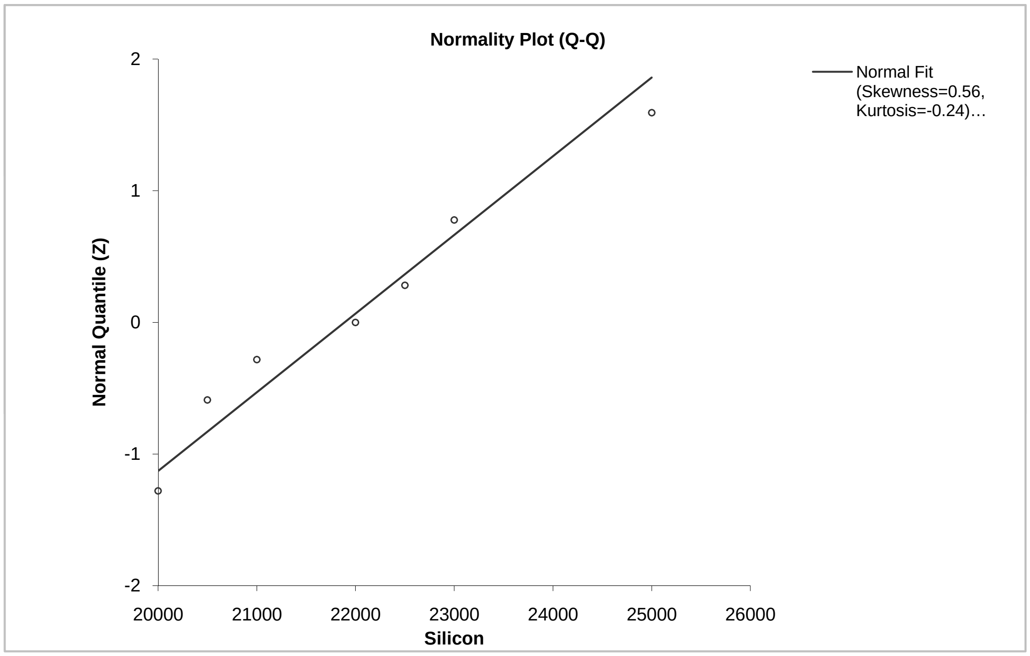




n	9	
Mean	21,888.9	
95% CI	20,603.0	to 23,174.8
SE	557.63	
Variance	2,798,611.1	
SD	1,672.9	
95% CI	1,130.0	to 3,204.9
CV	7.6%	
Skewness	0.56	
Kurtosis	-0.24	
Shapiro-Wilk W	0.93	w(.05,9)=0.829
p	0.448	

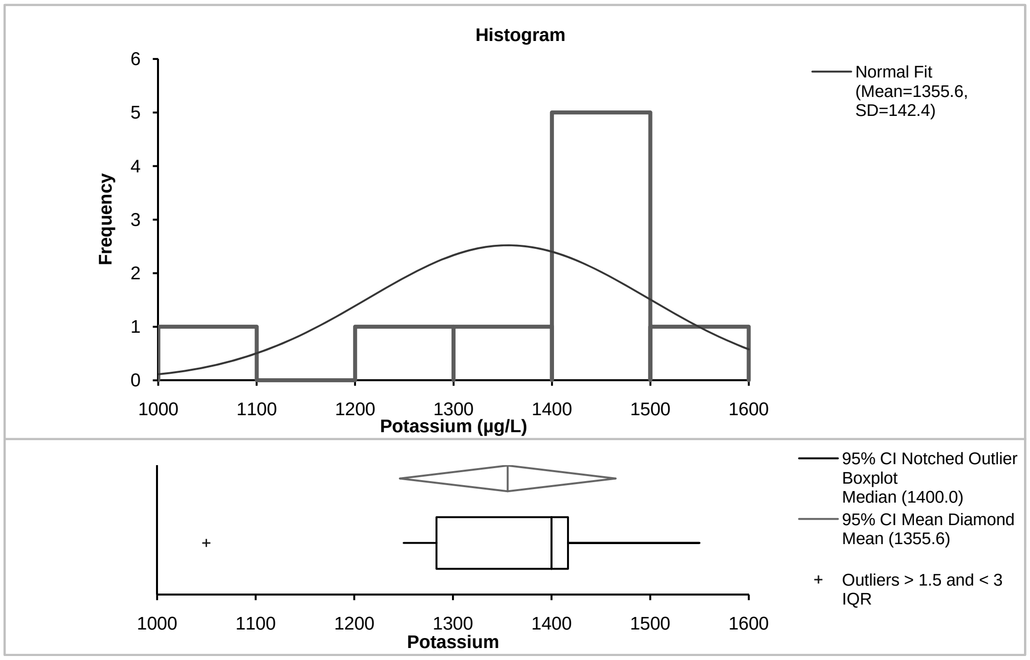
Median	22,000.0	
96.1% CI	20,000.0	to 23,000.0
Range	5,000	
IQR	2,666.7	

Percentile		
0th	20,000.0	(minimum)
25th	20,333.3	(1st quartile)
50th	22,000.0	(median)
75th	23,000.0	(3rd quartile)
100th	25,000.0	(maximum)



Test	**MW-26**
	Potassium
Performed by	Eric Tuppan

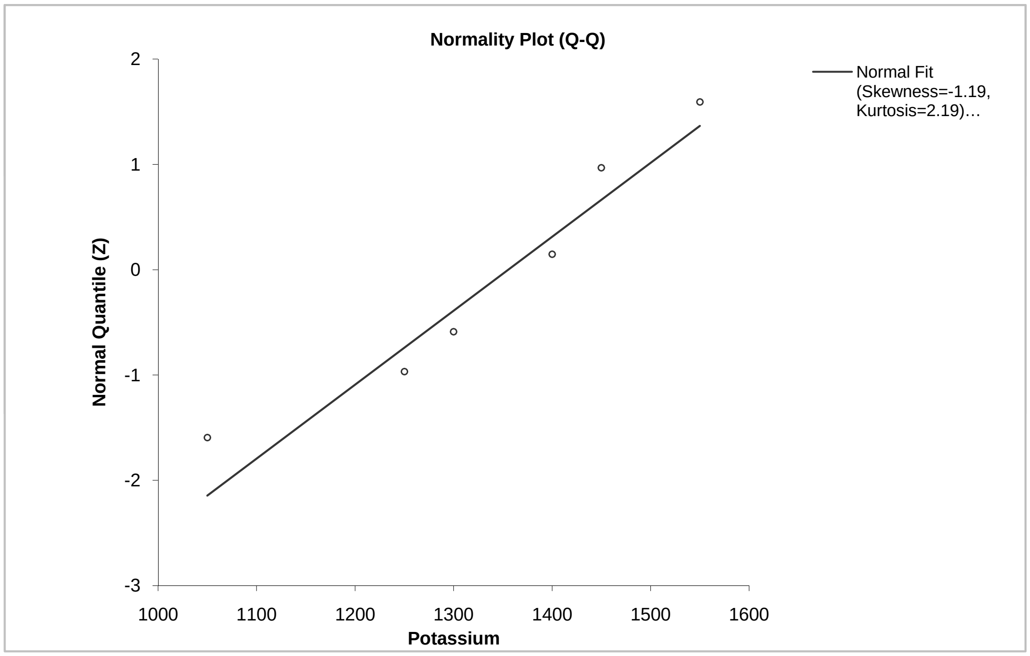
Date 3 December 2013



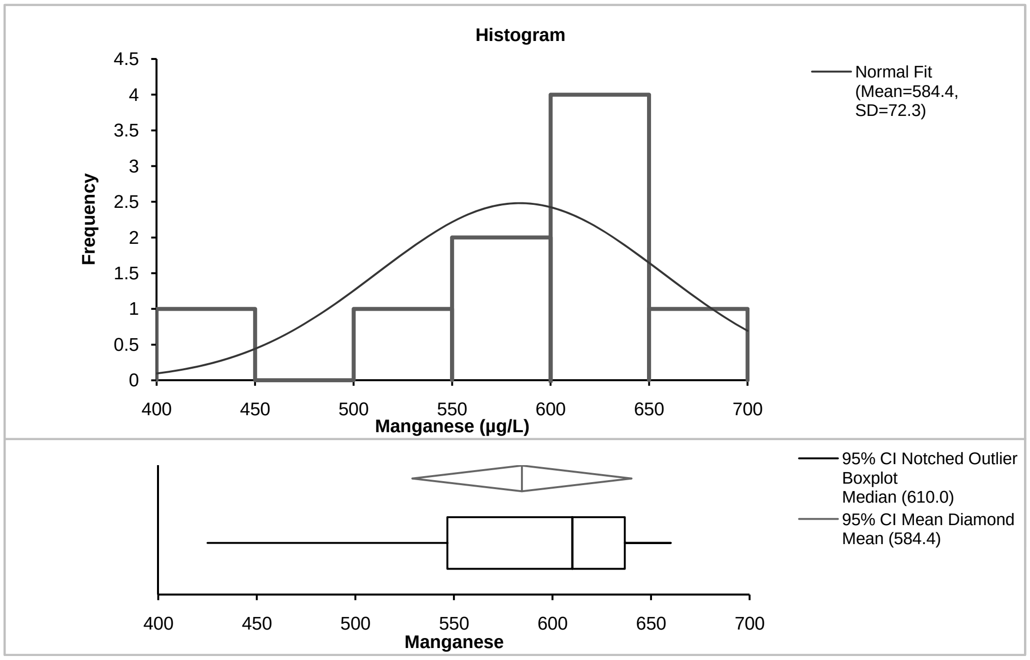
n	9	
Mean	1,355.6	
95% CI	1,246.1	to 1,465.0
SE	47.47	
Variance	20,277.8	
SD	142.4	
95% CI	96.2	to 272.8
CV	10.5%	
Skewness	-1.19	
Kurtosis	2.19	
Shapiro-Wilk W	0.89	w(.05,9)=0.829
p	0.179	

Median	1,400.0	
96.1% CI	1,250.0	to 1,450.0
Range	500	
IQR	133.3	

Percentile		
0th	1,050.0	(minimum)
25th	1,283.3	(1st quartile)
50th	1,400.0	(median)
75th	1,416.7	(3rd quartile)
100th	1,550.0	(maximum)



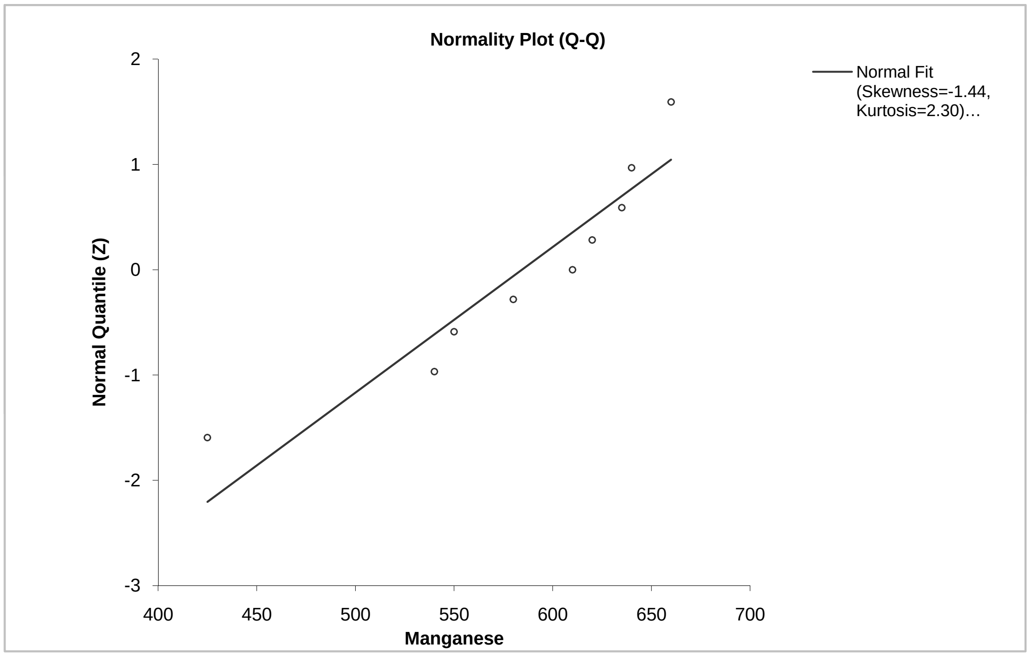
Test	**MW-26** Manganese
Performed by	Eric Tuppan
Date	3 December 2013



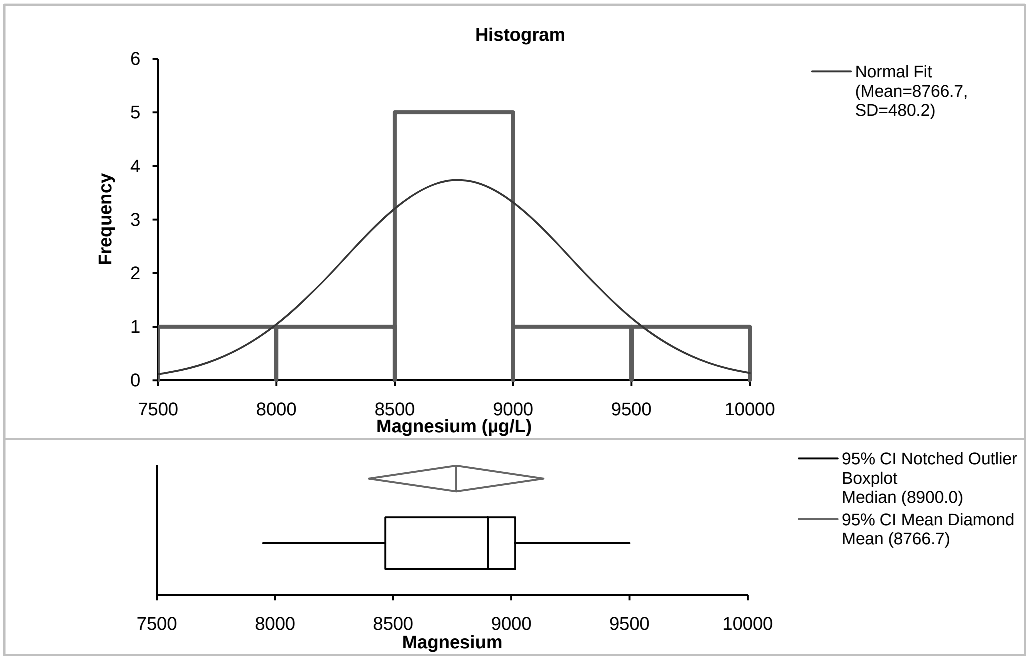
n	9	
Mean	584.4	
95% CI	528.8	to 640.1
SE	24.12	
Variance	5,234.0	
SD	72.3	
95% CI	48.9	to 138.6
CV	12.4%	
Skewness	-1.44	
Kurtosis	2.30	
Shapiro-Wilk W	0.88	w(.05,9)=0.829
p	0.139	

Median	610.0	
96.1% CI	540.0	to 640.0
Range	235	
IQR	90.0	

Percentile		
0th	425.0	(minimum)
25th	546.7	(1st quartile)
50th	610.0	(median)
75th	636.7	(3rd quartile)
100th	660.0	(maximum)



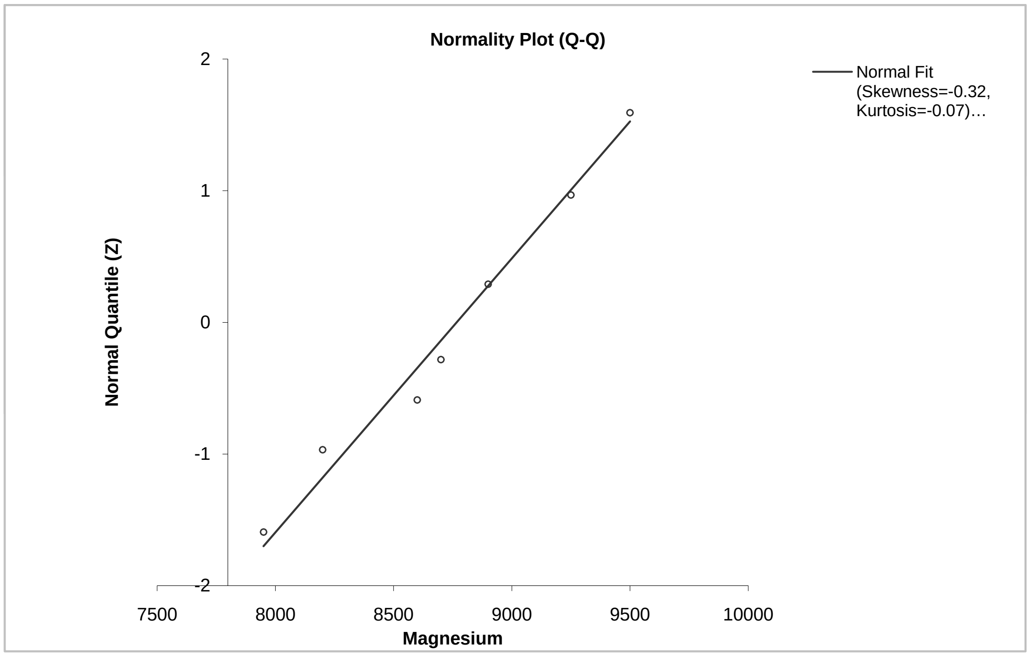
Test	**MW-26**
	Magnesium
Performed by	Eric Tuppan
Date	3 December 2013



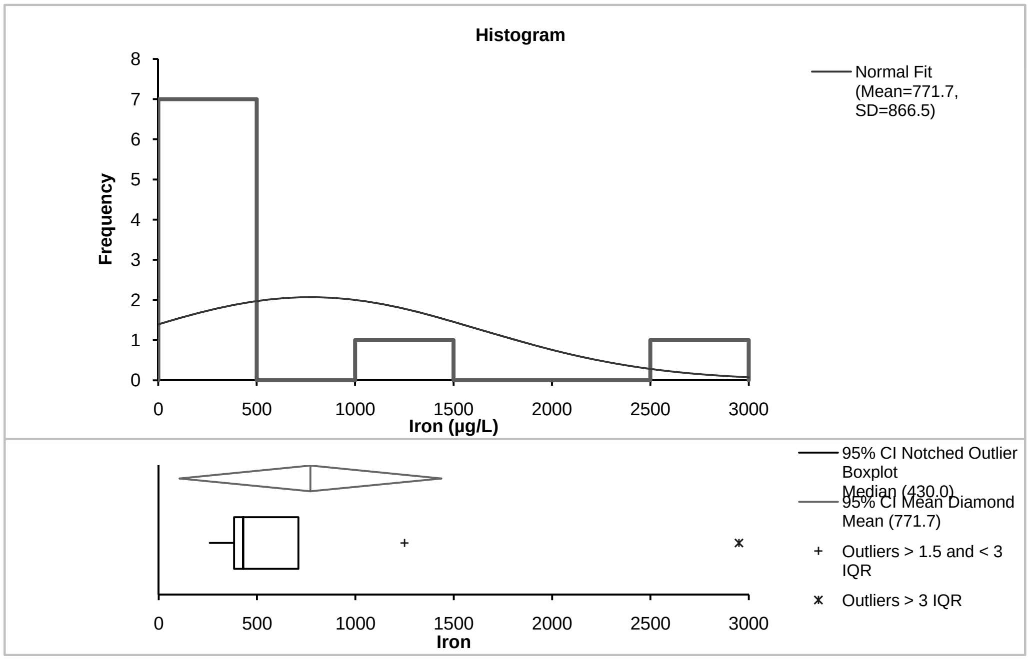
n	9	
Mean	8,766.7	
95% CI	8,397.5	to 9,135.8
SE	160.08	
Variance	230,625.0	
SD	480.2	
95% CI	324.4	to 920.0
CV	5.5%	
Skewness	-0.32	
Kurtosis	-0.07	
Shapiro-Wilk W	0.96	w(.05,9)=0.829
p	0.806	

Median	8,900.0	
96.1% CI	8,200.0	to 9,250.0
Range	1,550	
IQR	550.0	

Percentile		
0th	7,950.0	(minimum)
25th	8,466.7	(1st quartile)
50th	8,900.0	(median)
75th	9,016.7	(3rd quartile)
100th	9,500.0	(maximum)



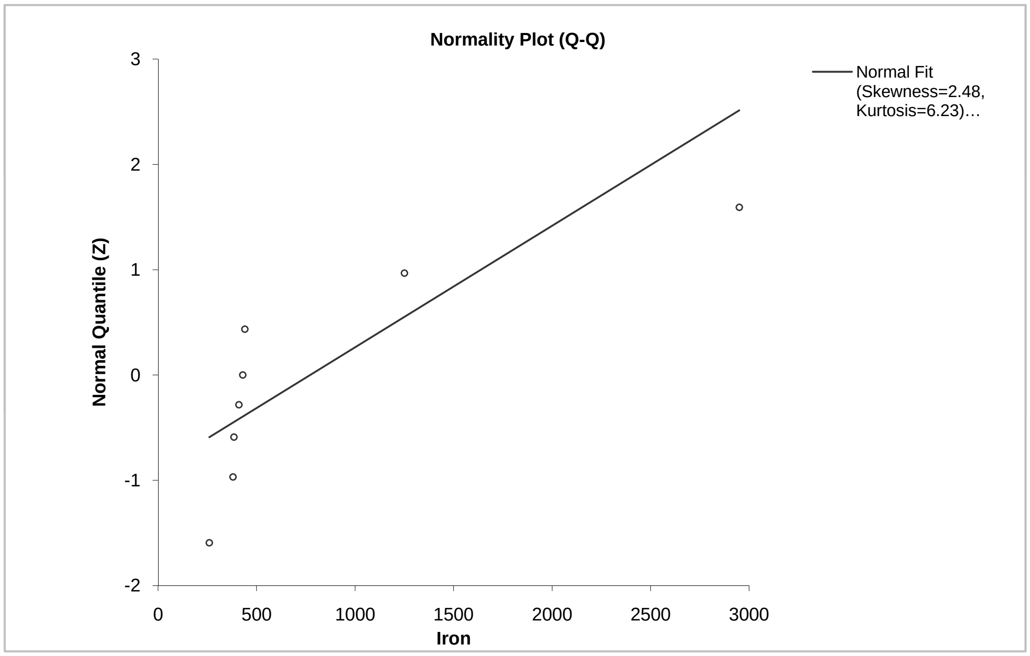
Test	**MW-26**
	Iron
Performed by	Eric Tuppan
Date	3 December 2013



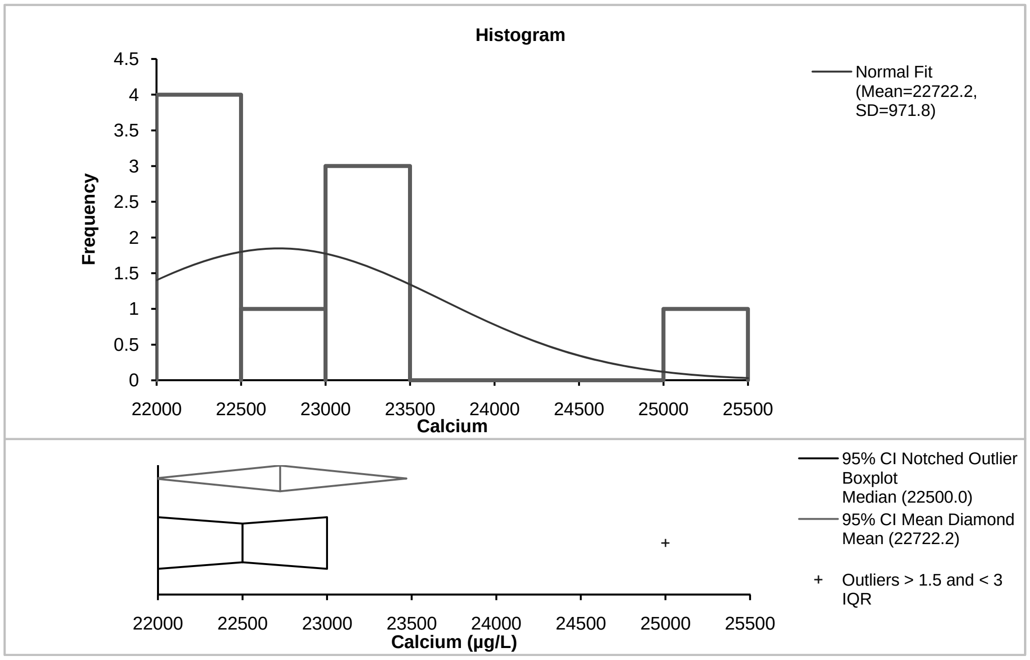
n	9	
Mean	771.7	
95% CI	105.6	to 1,437.7
SE	288.82	
Variance	750,775.0	
SD	866.5	
95% CI	585.3	to 1,660.0
CV	112.3%	
Skewness	2.48	
Kurtosis	6.23	
Shapiro-Wilk W	0.59	w(.05,9)=0.829
p	<0.0001	

Median	430.0	
96.1% CI	380.0	to 1,250.0
Range	2,690	
IQR	326.7	

Percentile		
0th	260.0	(minimum)
25th	383.3	(1st quartile)
50th	430.0	(median)
75th	710.0	(3rd quartile)
100th	2,950.0	(maximum)



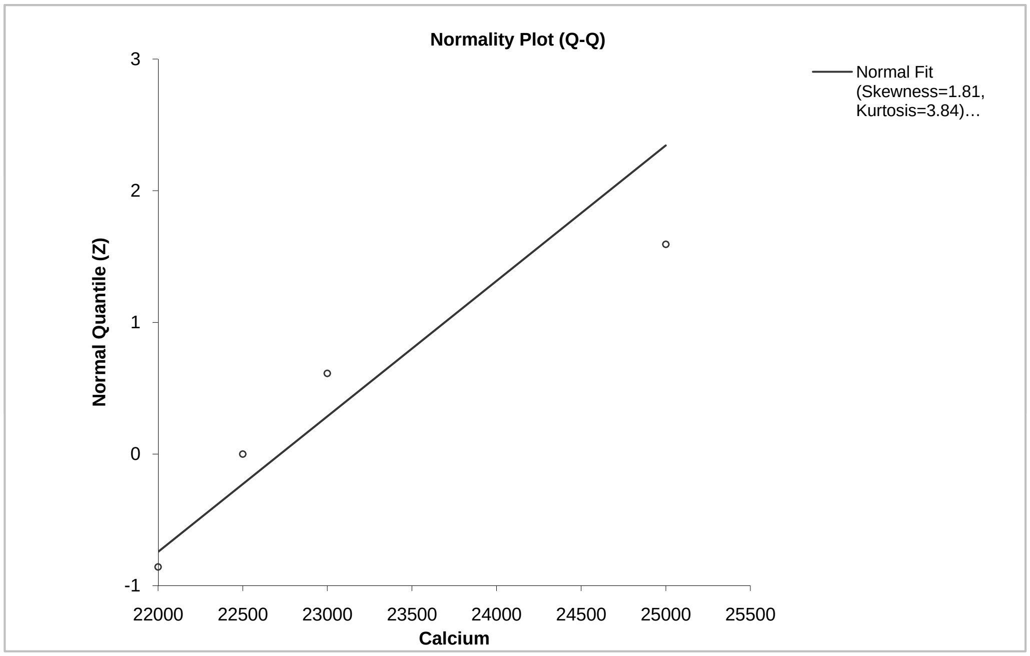
Test	**MW-26**
	Calcium
Performed by	Eric Tuppan
Date	3 December 2013



n	9	
Mean	22,722.2	
95% CI	21,975.2	to 23,469.2
SE	323.94	
Variance	944,444.4	
SD	971.8	
95% CI	656.4	to 1,861.8
CV	4.3%	
Skewness	1.81	
Kurtosis	3.84	
Shapiro-Wilk W	0.75	w(.05,9)=0.829
p	0.006	

Median	22,500.0	
96.1% CI	22,000.0	to 23,000.0
Range	3,000	
IQR	1,000.0	

Percentile		
0th	22,000.0	(minimum)
25th	22,000.0	(1st quartile)
50th	22,500.0	(median)
75th	23,000.0	(3rd quartile)
100th	25,000.0	(maximum)



Coffin Butte Descriptive Statistics
Total Metals (Unfiltered)

Location	**Antimony**	**Arsenic**	**Barium**	**Beryllium**	**Cadmium**	**Chromium**	**Cobalt**	**Copper**	**Lead**	**Nickel**	**Selenium**	**Silver**	**Thallium**	**Vanadium**	**Zinc**		Date	Type
MW-26	0.89	13	33.5	1	1	1.35	1.05	3.1	0.575	2	5	0.26	1	3.5	3.75		11/01/11	Average
MW-26	2	14	27	1	1	3	0.79	1.2	0.28	0.73	5	1	1	1.4	2.55		01/17/12	Average
MW-26	2	14	27	1	1	3	0.96	1.3	0.4	1.1	5	1	1	2.5	10		04/11/12	Primary Sample
MW-26	2	15.5	25.5	1	1	3	0.475	0.945	0.165	0.65	5	0.26	1	5	6.6		07/13/12	Average
MW-26	2	15	28	1	1	3	0.57	1	0.28	0.71	5	1	1	1.4	10		10/16/12	Primary Sample
MW-26	2	14	25	1	0.16	3	0.33	2	1	0.305	5	1	1	5	10		01/24/13	Average
MW-26	2	12	28	1	1	3	0.65	0.75	0.41	0.64	5	1	1	2	10		04/19/13	Primary Sample
MW-26	2	13.5	26	1	0.2725	3	0.475	0.99	0.225	0.495	5	1	1	1.85	3.2		07/10/13	Average
MW-26	2	14	27	1	0.043	3	0.43	0.7	0.16	2	5	1	1	1.4	6.3		10/28/13	Primary Sample

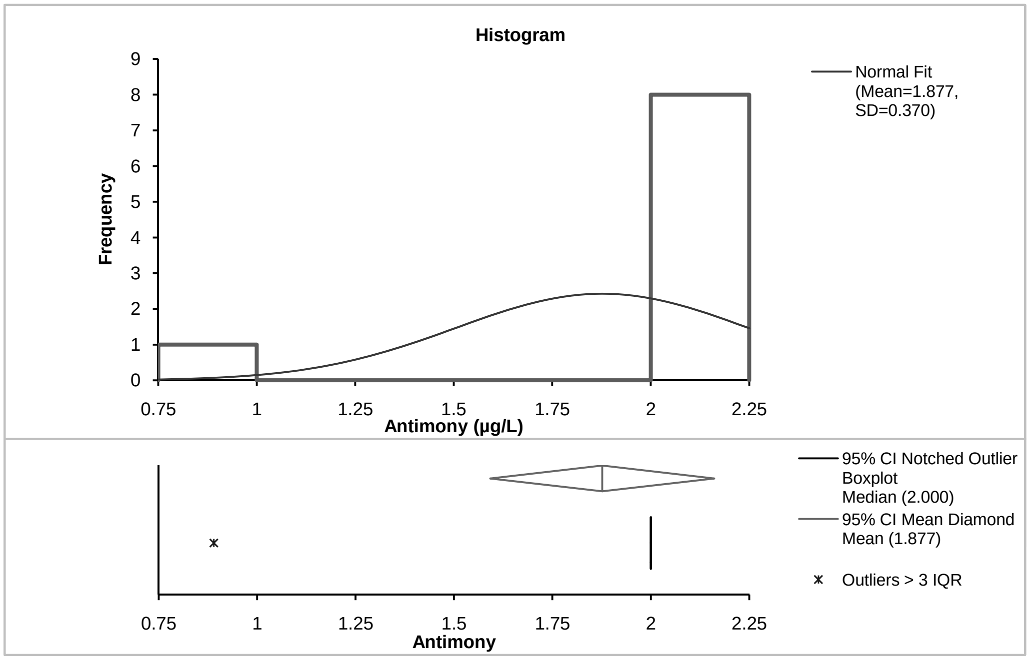
Location	**Antimony**	**Arsenic**	**Barium**	**Beryllium**	**Cadmium**	**Chromium**	**Cobalt**	**Copper**	**Lead**	**Nickel**	**Selenium**	**Silver**	**Thallium**	**Vanadium**	**Zinc**		Date	Type
MW-27	0.21	9.8	290	0.46	0.2	4.9	15	13	4.5	11	5	0.036	0.083	14	14		11/02/11	Primary Sample
MW-27	2	4.3	200	1	0.1	1.4	36	3.4	1.1	12	5	1	1	3.6	8.2		01/18/12	Primary Sample
MW-27	2	19	130	1	0.45	1.6	18	4.2	1.9	7.1	5	1	1	4.1	5.7		04/11/12	Primary Sample
MW-27	2	19	220	0.45	0.33	4.2	30	11	5.3	9.8	5	0.036	0.079	10	15		07/13/12	Primary Sample
MW-27	2	18	93	1	0.072	3	15	1.5	0.77	4.5	2.4	1	1	2.1	2.5		10/17/12	Primary Sample
MW-27	2	9.8	97	1	1	3	34	2	1	9.1	5	1	1	1.9	10		01/24/13	Primary Sample
MW-27	2	10	100	1	1	3	35	2	0.16	8.4	5	1	1	2.2	10		04/19/13	Primary Sample
MW-27	2	14	85	1	0.058	3	22	1.3	0.46	6.4	5	0.02	1	1.8	3		07/10/13	Primary Sample
MW-27	2	11	100	1	1	3	34	1.8	1.3	9.8	5	1	1	2.9	4.7		10/29/13	Primary Sample

ALL CONCENTRATIONS IN µg/L

Analyse-it v2.26

Test	**MW-26**
	Antimony
Performed by	Eric Tuppan

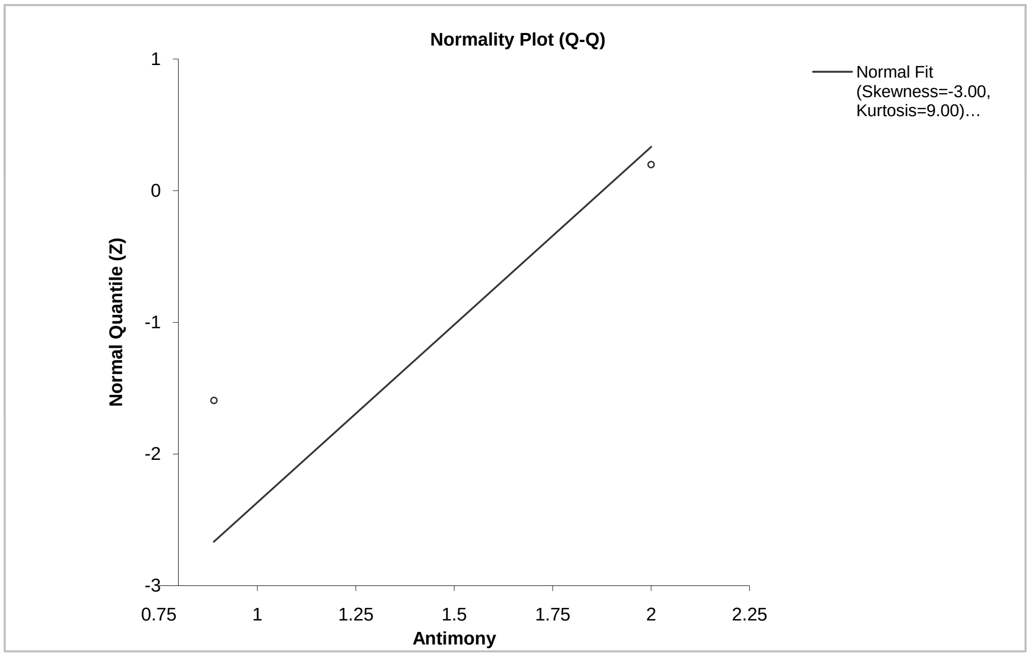
Date 4 December 2013



n	9	
Mean	1.877	
95% CI	1.592	to 2.161
SE	0.1233	
Variance	0.137	
SD	0.370	
95% CI	0.250	to 0.709
CV	19.7%	
Skewness	-3.00	
Kurtosis	9.00	
Shapiro-Wilk W	0.39	W(.05,9)=0.829
p	<0.0001	

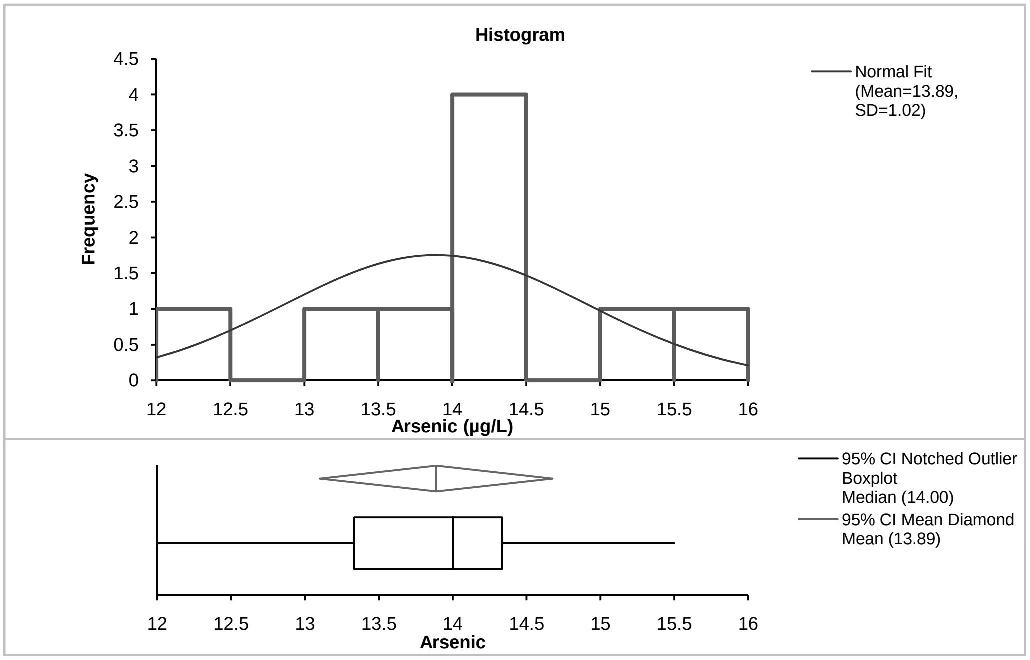
Median	2.000	
96.1% CI	2.000	to 2.000
Range	1.11	
IQR	0.000	

Percentile		
0th	0.890	(minimum)
25th	2.000	(1st quartile)
50th	2.000	(median)
75th	2.000	(3rd quartile)
100th	2.000	(maximum)



Test	**MW-26**
	Arsenic
Performed by	Eric Tuppan

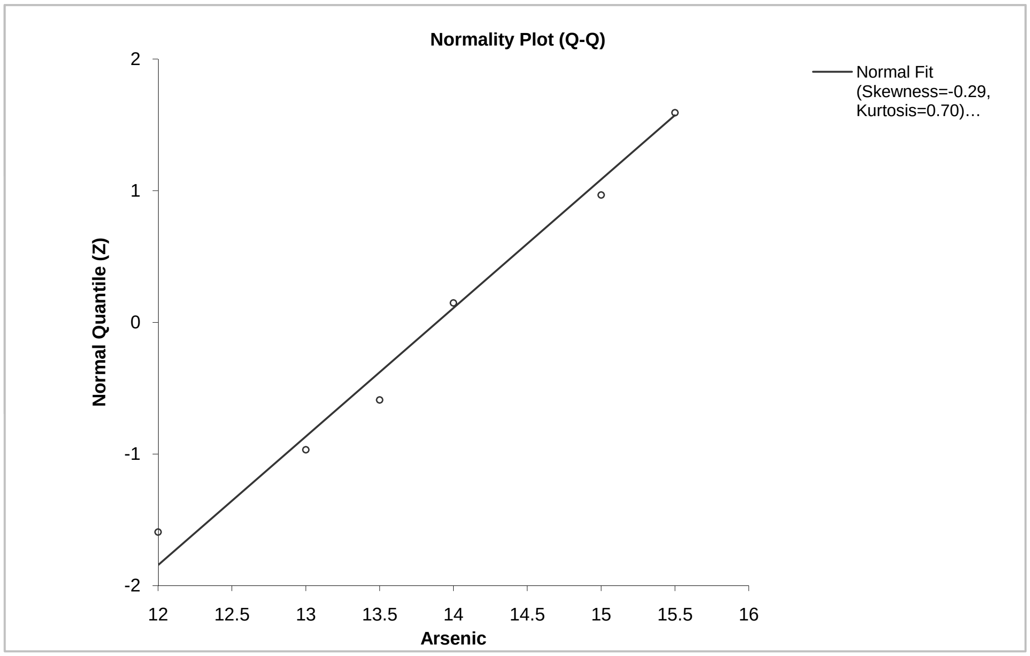
Date 4 December 2013



n	9	
Mean	13.89	
95% CI	13.10	to 14.68
SE	0.341	
Variance	1.05	
SD	1.02	
95% CI	0.69	to 1.96
CV	7.4%	
Skewness	-0.29	
Kurtosis	0.70	
Shapiro-Wilk W	0.94	W(.05,9)=0.829
p	0.581	

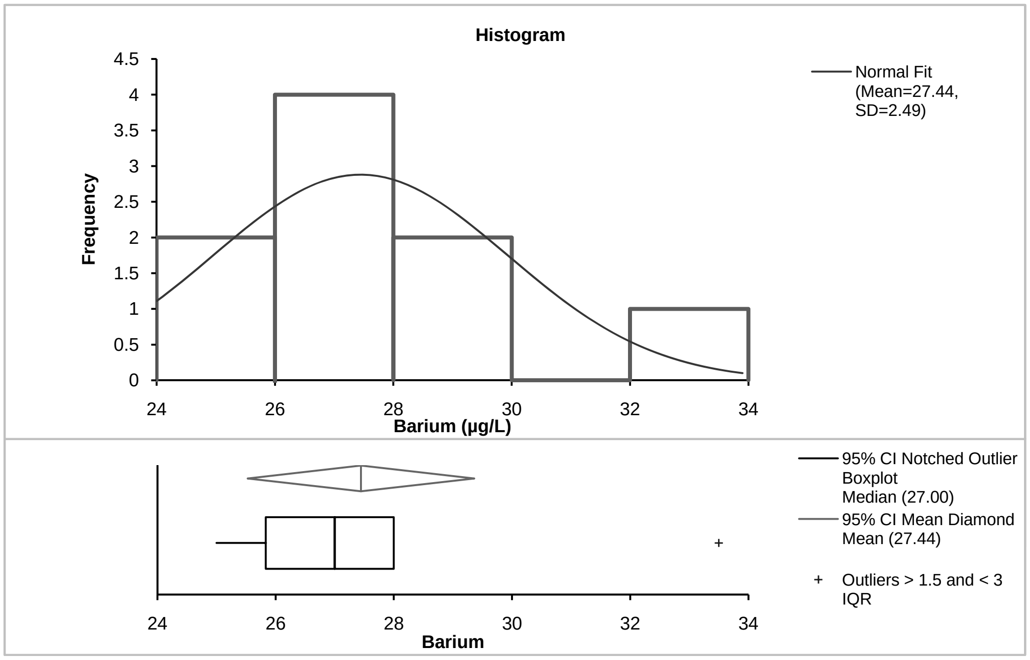
Median	14.00	
96.1% CI	13.00	to 15.00
Range	3.5	
IQR	1.00	

Percentile		
0th	12.00	(minimum)
25th	13.33	(1st quartile)
50th	14.00	(median)
75th	14.33	(3rd quartile)
100th	15.50	(maximum)



Analyse-it v2.26

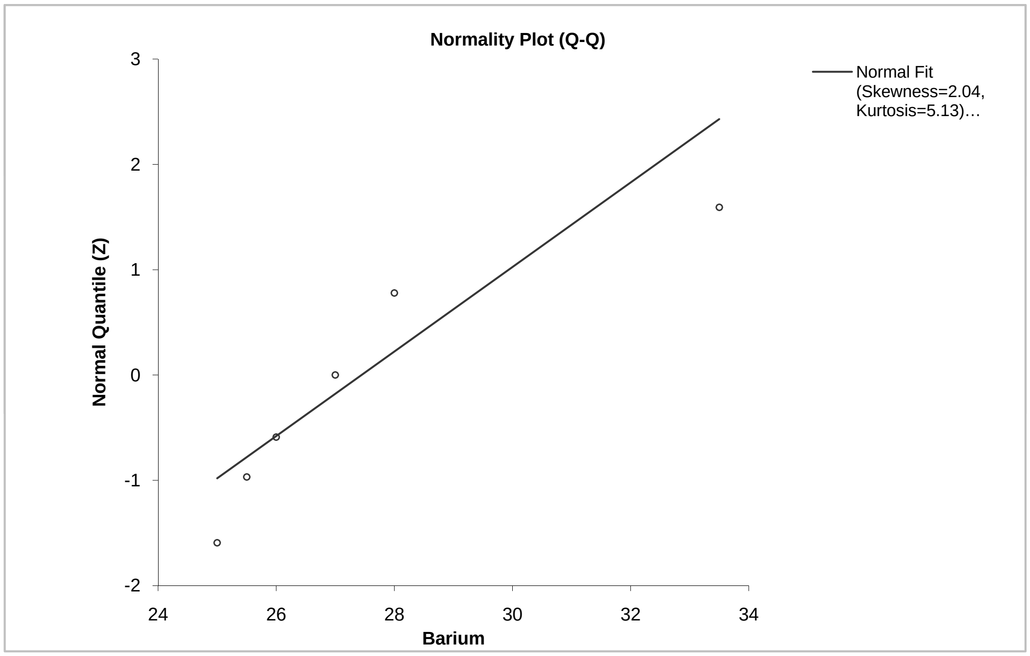
Test	**MW-26**
	Barium
Performed by	Eric Tuppan
Date	4 December 2013



n	9	
Mean	27.44	
95% CI	25.53	to 29.36
SE	0.831	
Variance	6.22	
SD	2.49	
95% CI	1.68	to 4.78
CV	9.1%	
Skewness	2.04	
Kurtosis	5.13	
Shapiro-Wilk W	0.78	W(.05,9)=0.829
p	0.011	

Median	27.00	
96.1% CI	25.50	to 28.00
Range	8.5	
IQR	2.17	

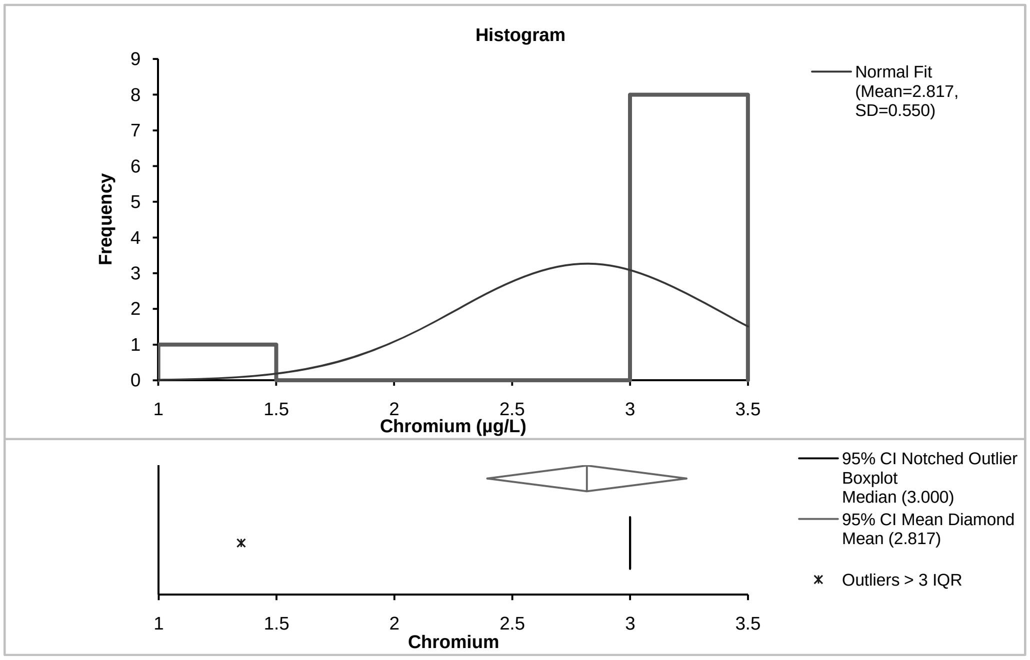
Percentile		
0th	25.00	(minimum)
25th	25.83	(1st quartile)
50th	27.00	(median)
75th	28.00	(3rd quartile)
100th	33.50	(maximum)



Analyse-it v2.26

Test	**MW-26**
	Chromium
Performed by	Eric Tuppan

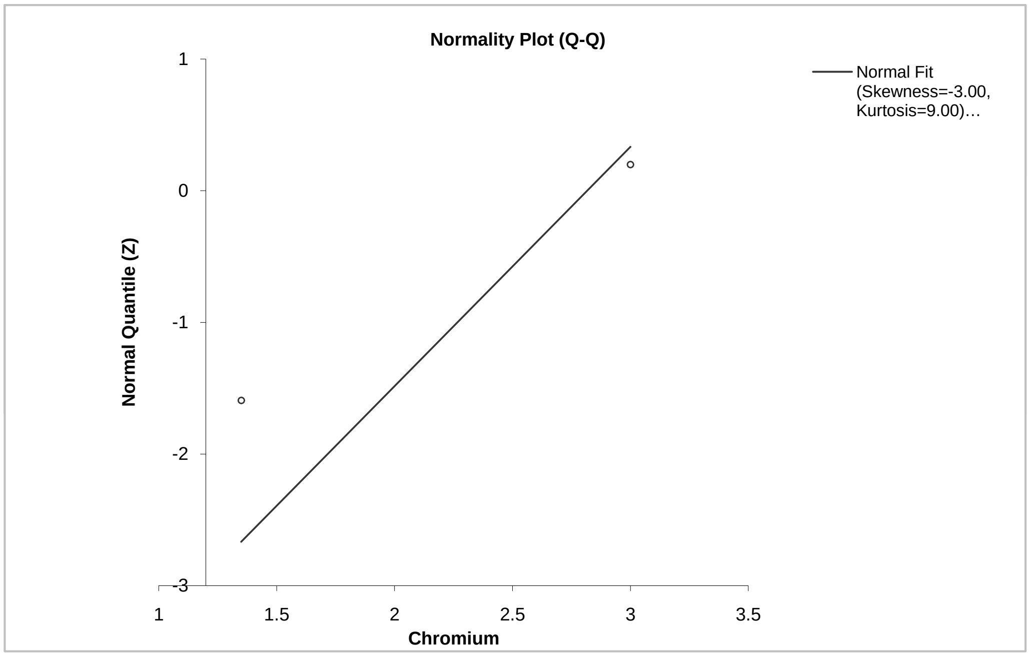
Date 4 December 2013



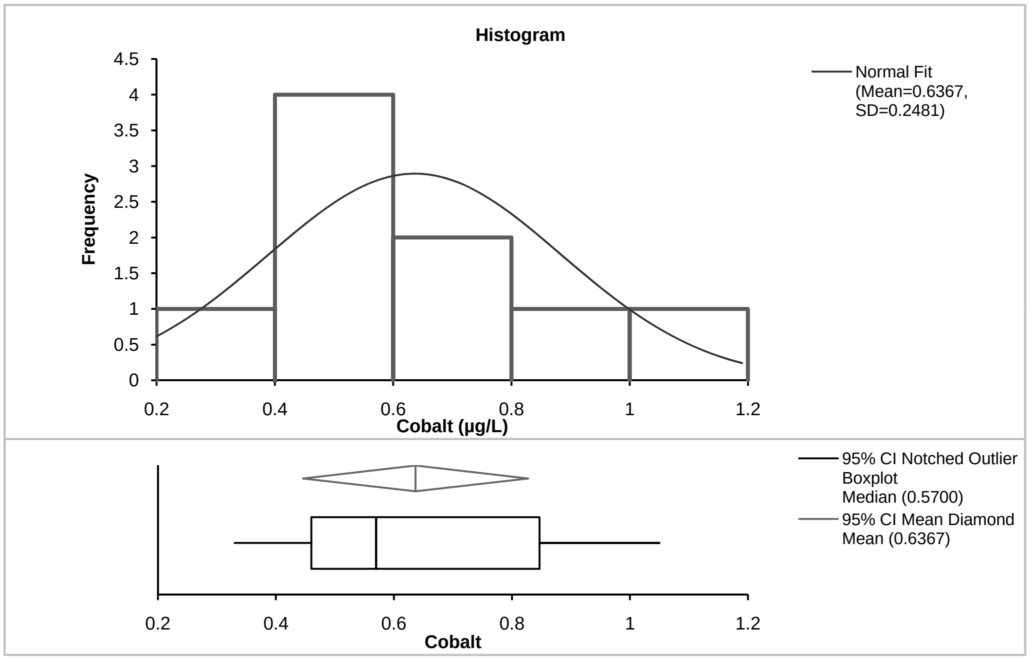
n	9	
Mean	2.817	
95% CI	2.394	to 3.239
SE	0.1833	
Variance	0.303	
SD	0.550	
95% CI	0.372	to 1.054
CV	19.5%	
Skewness	-3.00	
Kurtosis	9.00	
Shapiro-Wilk W	0.39	W(.05,9)=0.829
p	<0.0001	

Median	3.000	
96.1% CI	3.000	to 3.000
Range	1.65	
IQR	0.000	

Percentile		
0th	1.350	(minimum)
25th	3.000	(1st quartile)
50th	3.000	(median)
75th	3.000	(3rd quartile)
100th	3.000	(maximum)



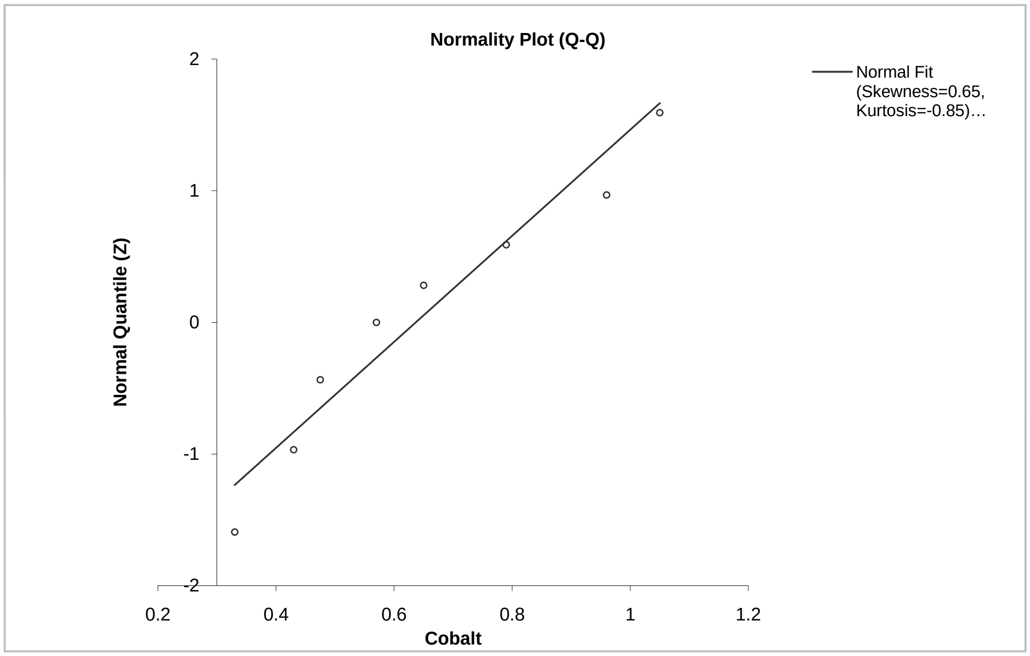
Test	**MW-26**
	Cobalt
Performed by	Eric Tuppan
Date	4 December 2013



n	9	
Mean	0.6367	
95% CI	0.4459	to 0.8274
SE	0.08271	
Variance	0.0616	
SD	0.2481	
95% CI	0.1676	to 0.4754
CV	39.0%	
Skewness	0.65	
Kurtosis	-0.85	
Shapiro-Wilk W	0.92	W(.05,9)=0.829
p	0.430	

Median	0.5700	
96.1% CI	0.4300	to 0.9600
Range	0.720	
IQR	0.3867	

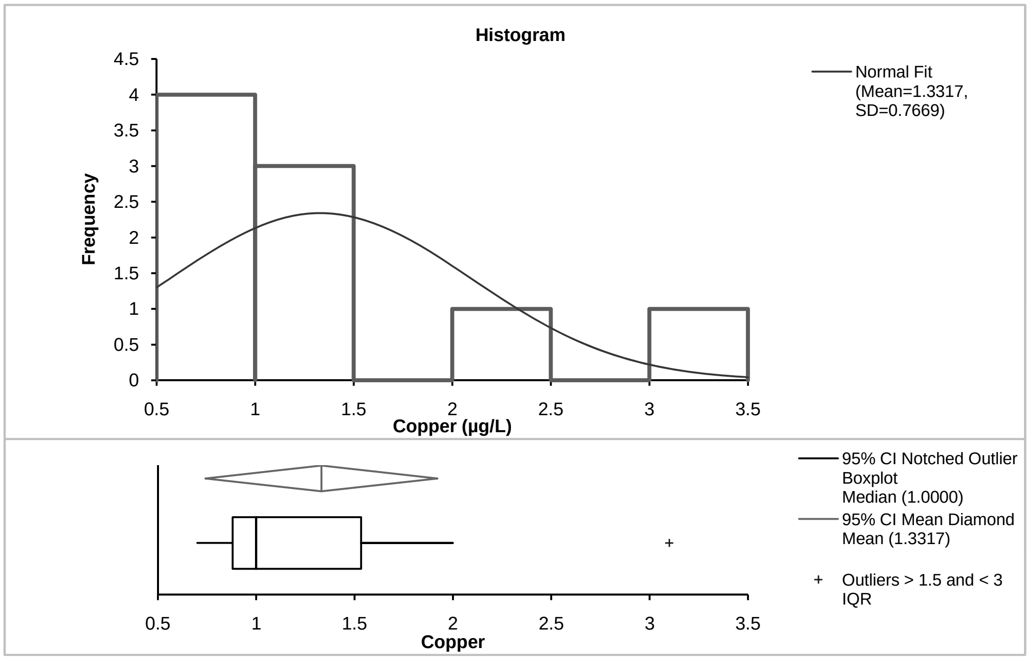
Percentile		
0th	0.3300	(minimum)
25th	0.4600	(1st quartile)
50th	0.5700	(median)
75th	0.8467	(3rd quartile)
100th	1.0500	(maximum)



Test **MW-26**

Copper
Performed by Eric Tuppan

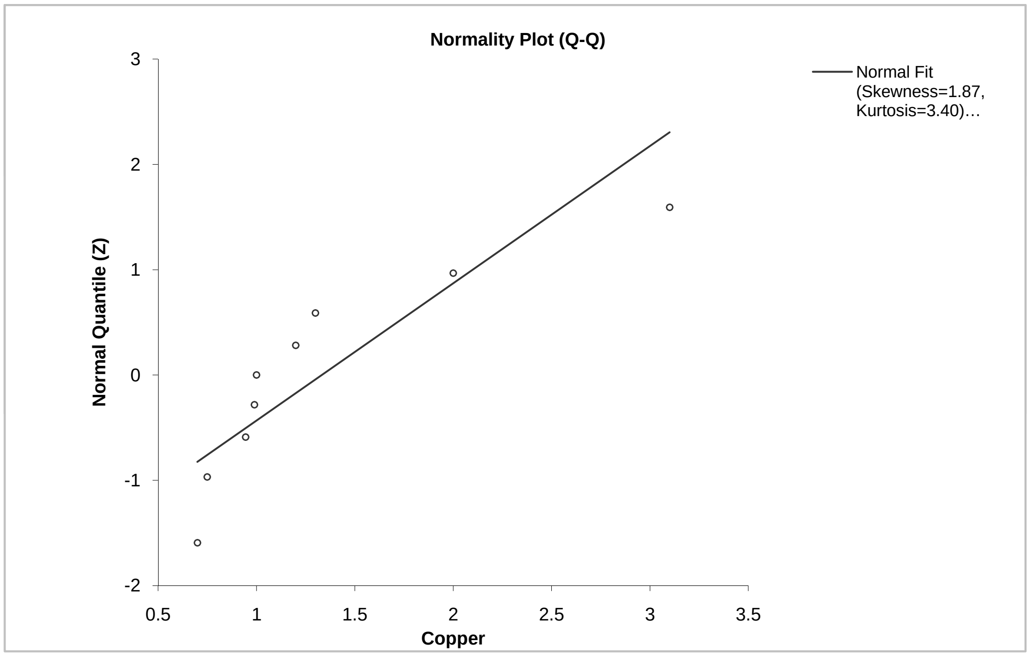
Date 4 December 2013



n	9	
Mean	1.3317	
95% CI	0.7421	to 1.9212
SE	0.25565	
Variance	0.5882	
SD	0.7669	
95% CI	0.5180	to 1.4693
CV	57.6%	
Skewness	1.87	
Kurtosis	3.40	
Shapiro-Wilk W	0.77	W(.05,9)=0.829
p	0.010	

Median	1.0000	
96.1% CI	0.7500	to 2.0000
Range	2.400	
IQR	0.6533	

Percentile		
0th	0.7000	(minimum)
25th	0.8800	(1st quartile)
50th	1.0000	(median)
75th	1.5333	(3rd quartile)
100th	3.1000	(maximum)

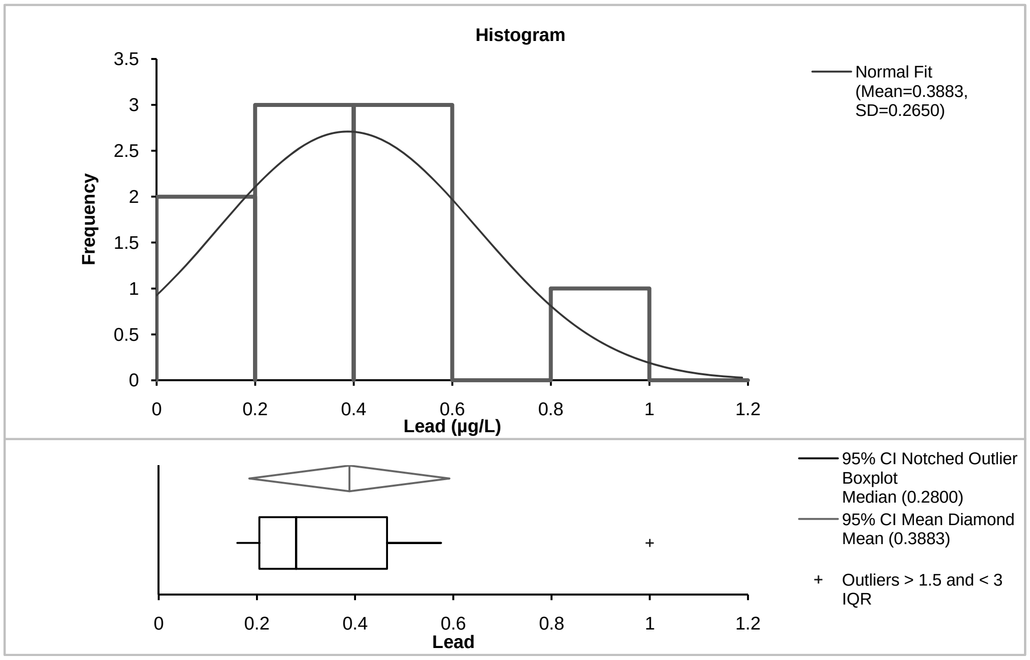


Test **MW-26**

Lead

Performed by Eric Tuppan

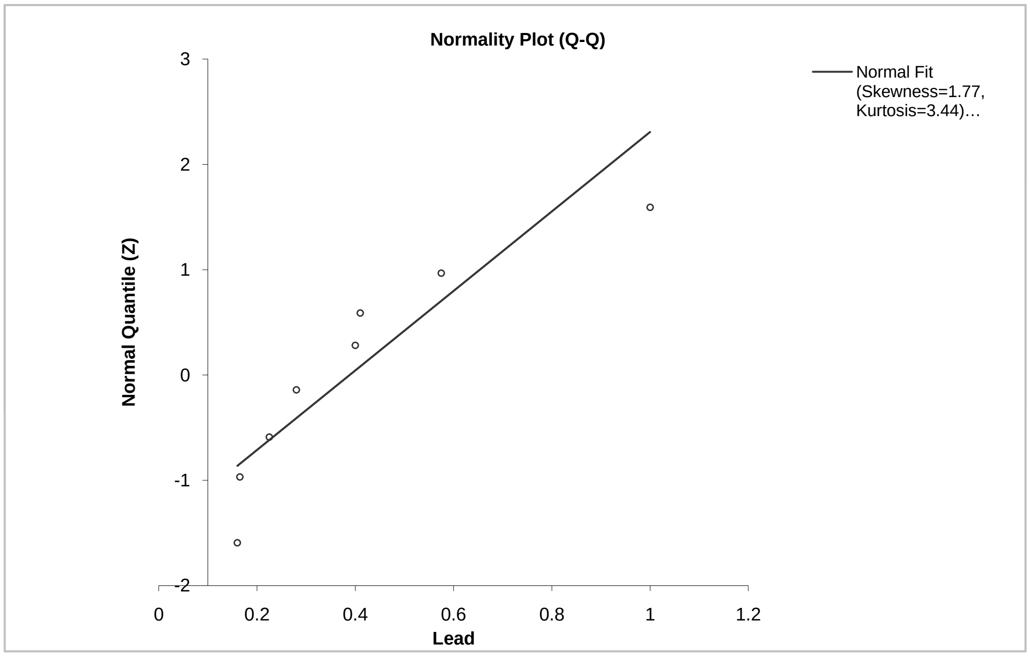
Date 4 December 2013



n	9	
Mean	0.3883	
95% CI	0.1846	to 0.5920
SE	0.08833	
Variance	0.0702	
SD	0.2650	
95% CI	0.1790	to 0.5077
CV	68.2%	
Skewness	1.77	
Kurtosis	3.44	
Shapiro-Wilk W	0.81	W(.05,9)=0.829
p	0.028	

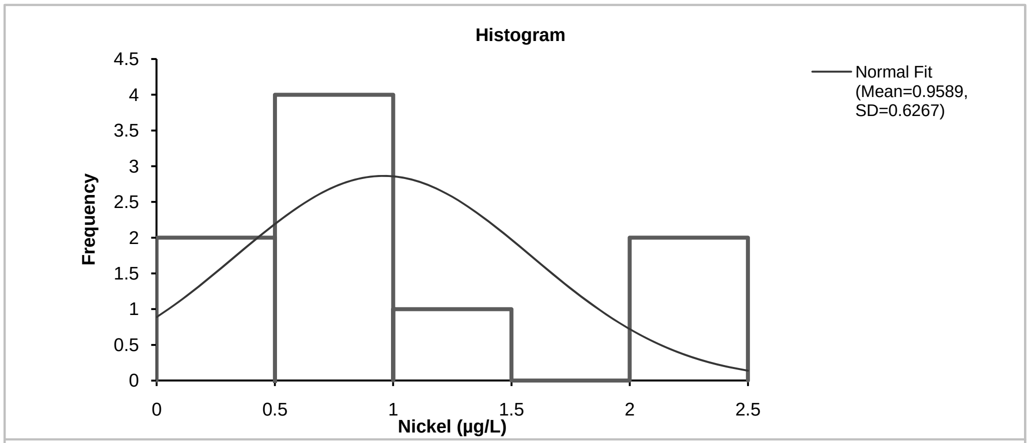
Median	0.2800	
96.1% CI	0.1650	to 0.5750
Range	0.840	
IQR	0.2600	

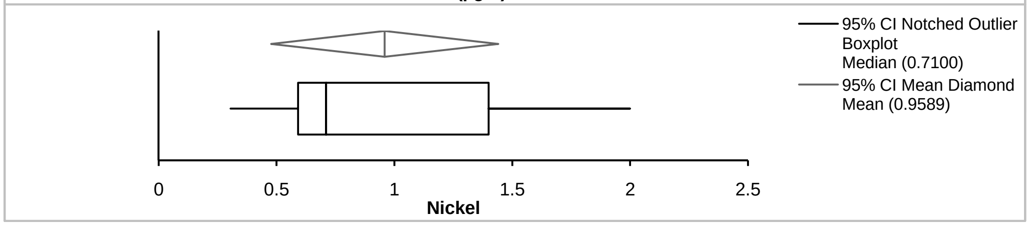
Percentile		
0th	0.1600	(minimum)
25th	0.2050	(1st quartile)
50th	0.2800	(median)
75th	0.4650	(3rd quartile)
100th	1.0000	(maximum)



Analyse-it v2.26

Test	**MW-26**
	Nickel
Performed by	Eric Tuppan
Date	4 December 2013

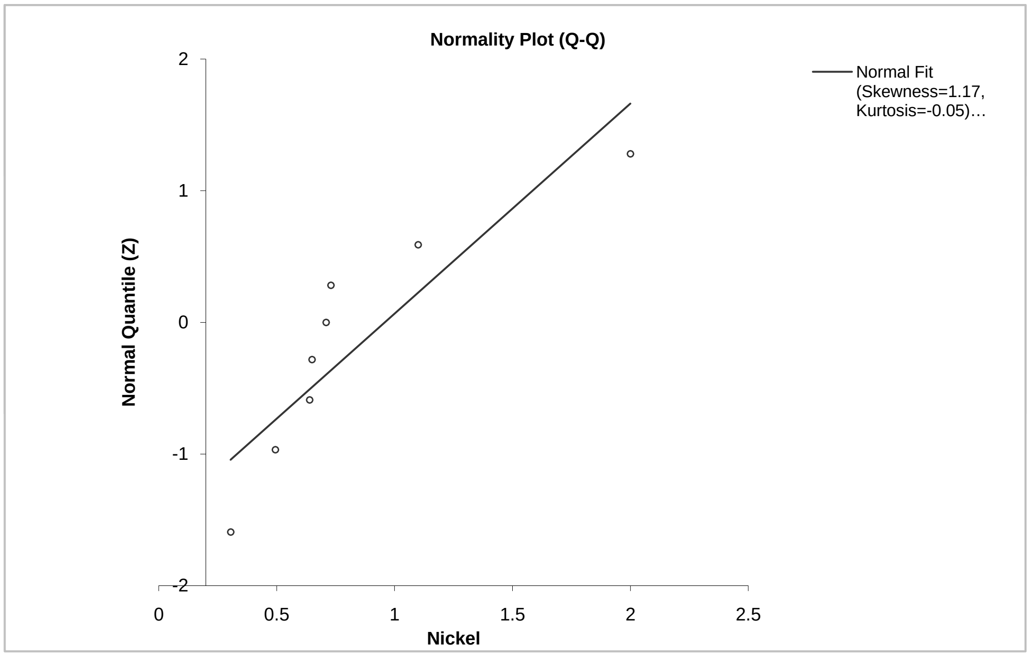




n	9	
Mean	0.9589	
95% CI	0.4772	to 1.4406
SE	0.20890	
Variance	0.3927	
SD	0.6267	
95% CI	0.4233	to 1.2006
CV	65.4%	
Skewness	1.17	
Kurtosis	-0.05	
Shapiro-Wilk W	0.80	W(.05,9)=0.829
p	0.020	

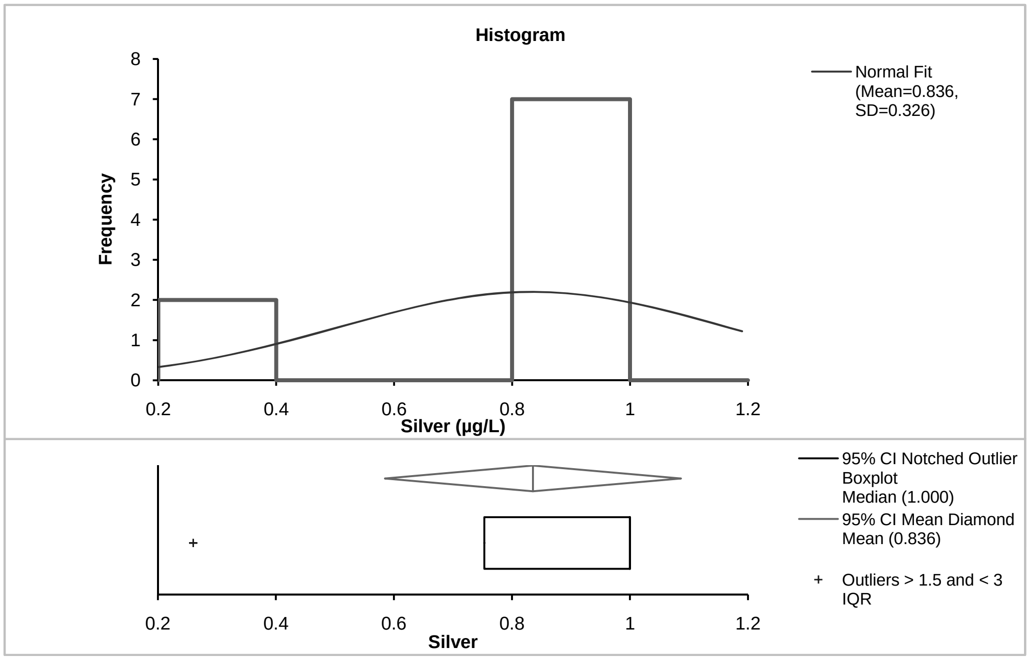
Median	0.7100	
96.1% CI	0.4950	to 2.0000
Range	1.695	
IQR	0.8083	

Percentile		
0th	0.3050	(minimum)
25th	0.5917	(1st quartile)
50th	0.7100	(median)
75th	1.4000	(3rd quartile)
100th	2.0000	(maximum)

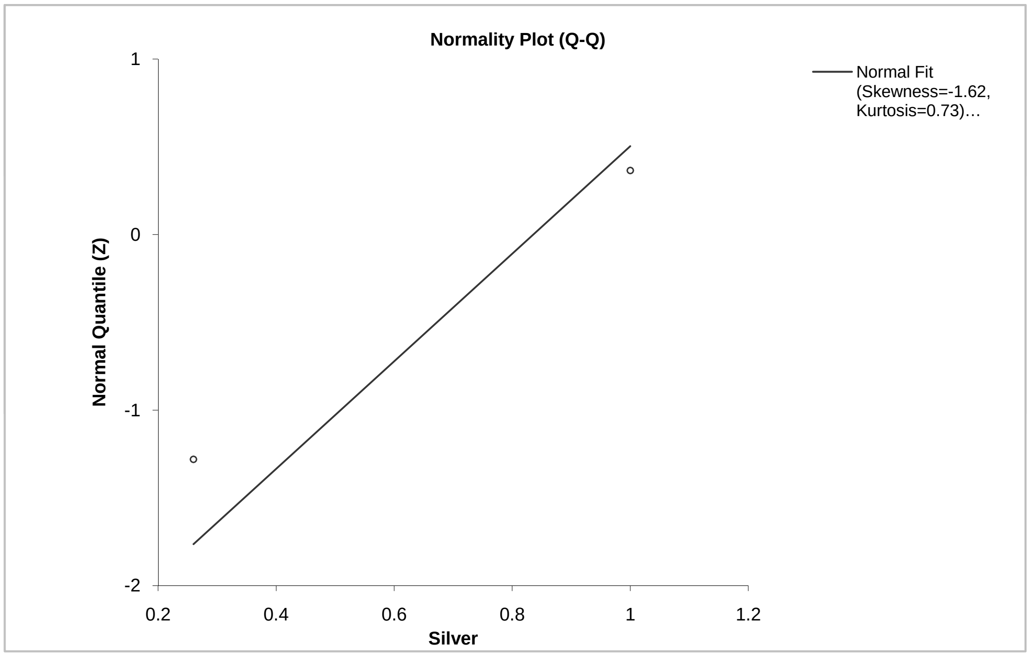


Analyse-it v2.26

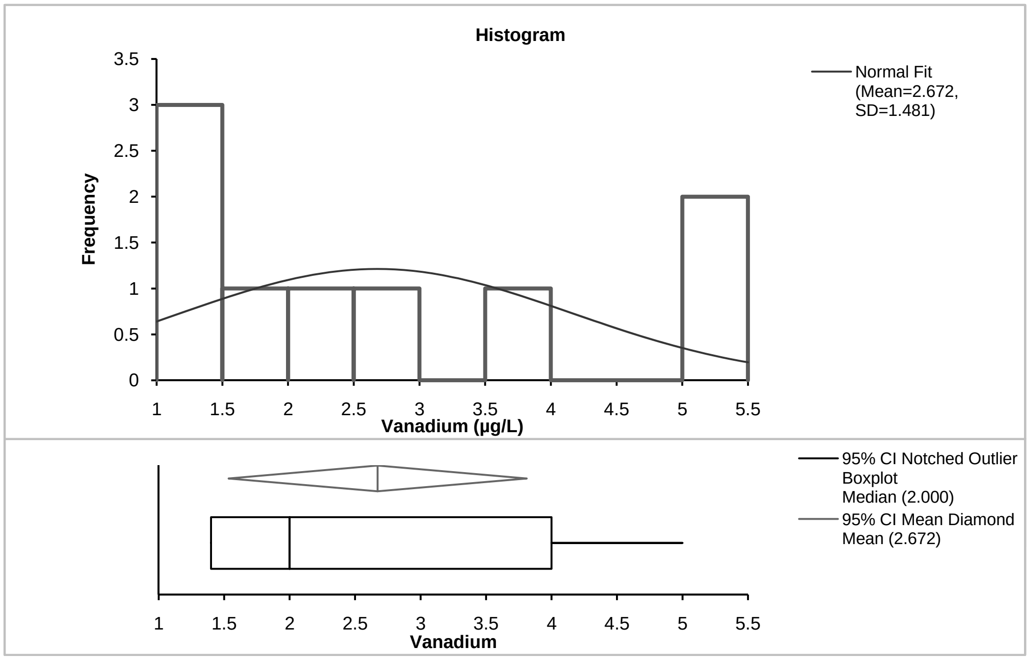
Test	**MW-26**
	Silver
Performed by	Eric Tuppan
Date	4 December 2013



n	9				
Mean	0.836		Median	1.000	
95% CI	0.585 to 1.086		96.1% CI	0.260 to 1.000	
SE	0.1088				
			Range	0.74	
Variance	0.106		IQR	0.247	
SD	0.326				
95% CI	0.220 to 0.625		Percentile		
			0th	0.260	(minimum)
CV	39.1%		25th	0.753	(1st quartile)
			50th	1.000	(median)
Skewness	-1.62		75th	1.000	(3rd quartile)
Kurtosis	0.73		100th	1.000	(maximum)
Shapiro-Wilk W	0.54	W(.05,9)=0.829			
p	<0.0001				



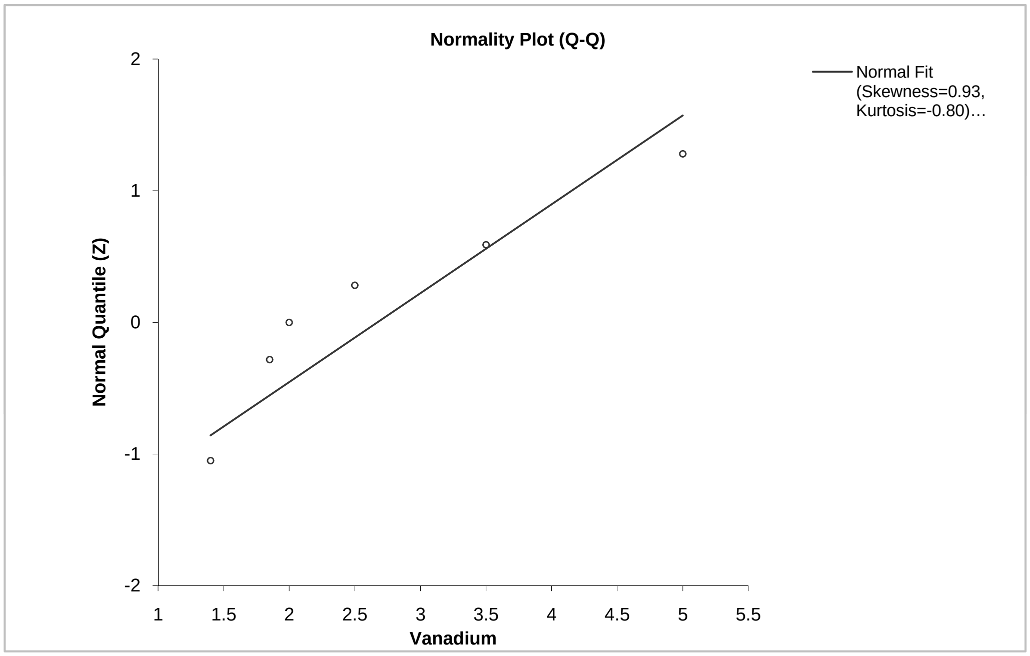
Test	**MW-26**
	Vanadium
Performed by	Eric Tuppan
Date	4 December 2013



n	9			
Mean	2.672			
95% CI	1.534	to 3.810		
SE	0.4935			
Variance	2.192			
SD	1.481			
95% CI	1.000	to 2.836		
CV	55.4%			
Skewness	0.93			
Kurtosis	-0.80			
Shapiro-Wilk W	0.81	W(.05,9)=0.829		
p	0.025			

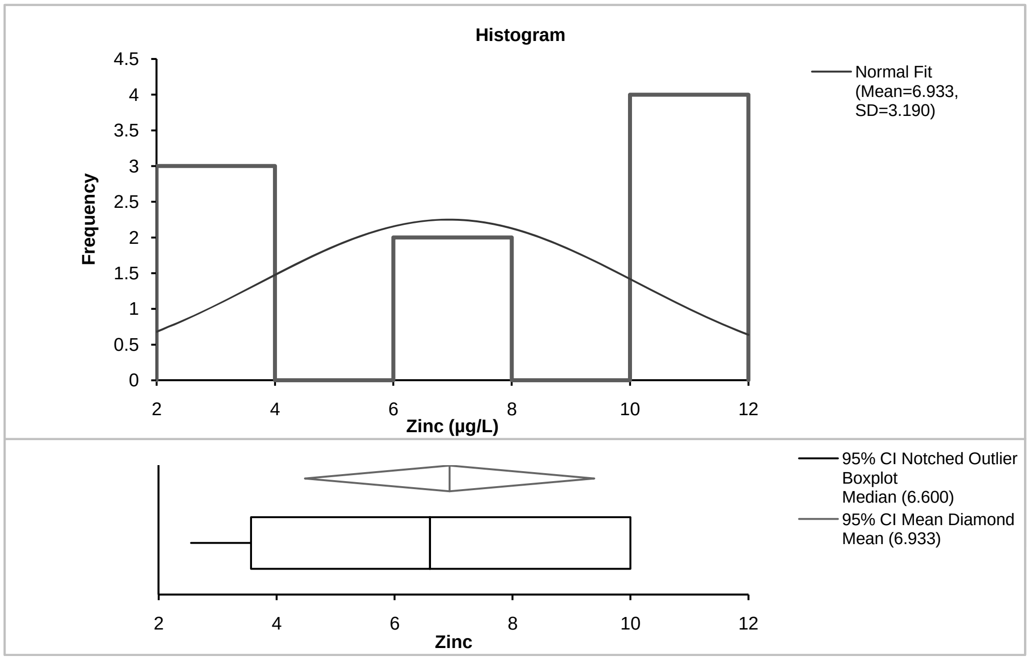
Median	2.000	
96.1% CI	1.400	to 5.000
Range	3.60	
IQR	2.600	

Percentile		
0th	1.400	(minimum)
25th	1.400	(1st quartile)
50th	2.000	(median)
75th	4.000	(3rd quartile)
100th	5.000	(maximum)



Analyse-it v2.26

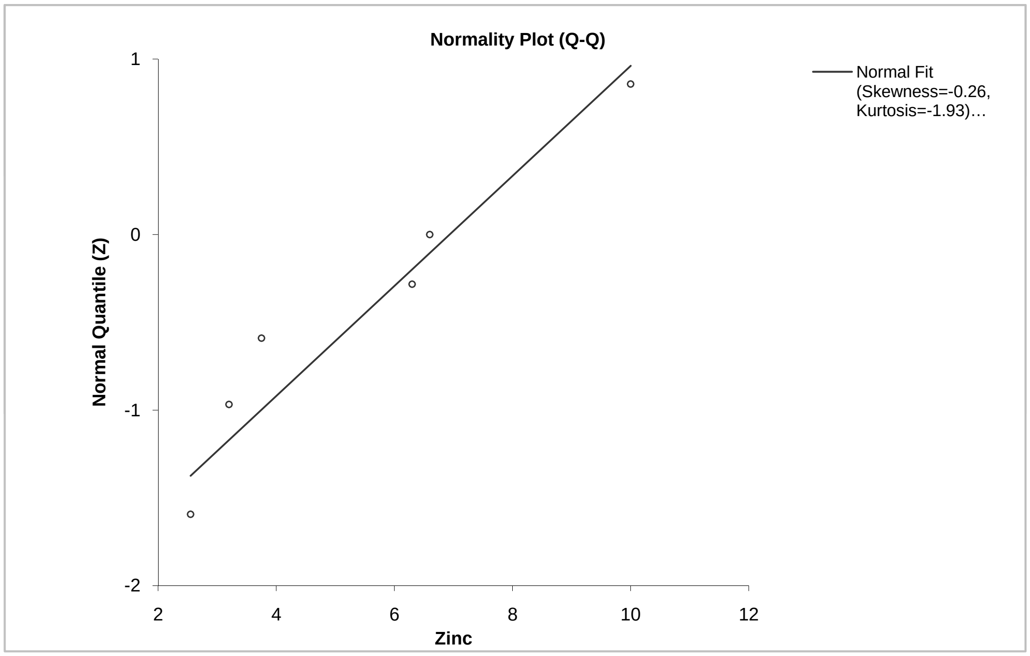
Test	**MW-26**
	Zinc
Performed by	Eric Tuppan
Date	4 December 2013



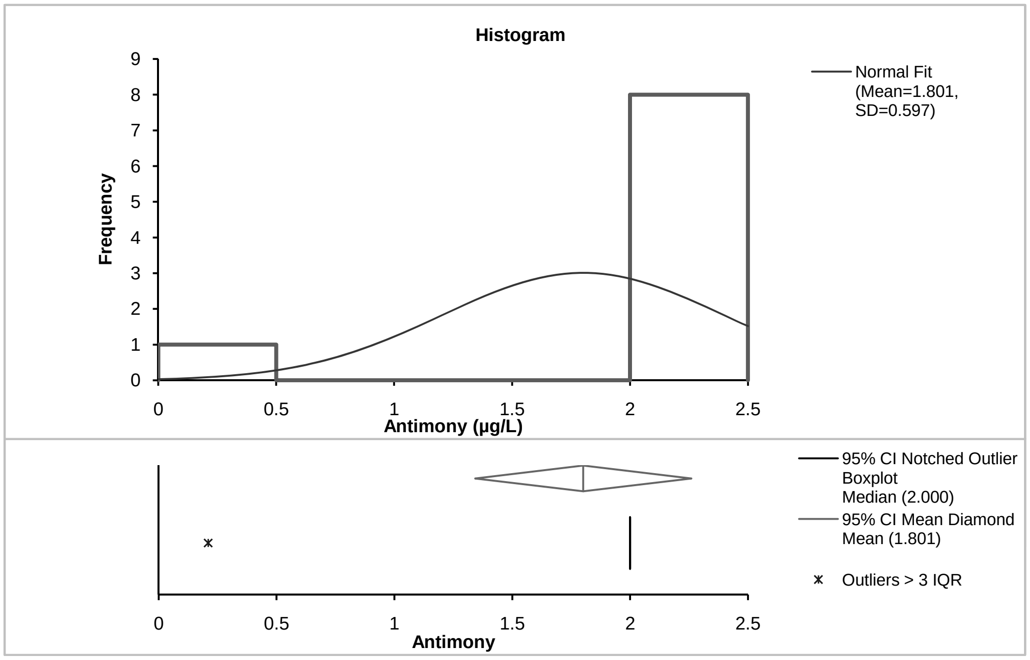
n	9	
Mean	6.933	
95% CI	4.481	to 9.385
SE	1.0634	
Variance	10.177	
SD	3.190	
95% CI	2.155	to 6.112
CV	46.0%	
Skewness	-0.26	
Kurtosis	-1.93	
Shapiro-Wilk W	0.82	W(.05,9)=0.829
p	0.036	

Median	6.600	
96.1% CI	3.200	to 10.000
Range	7.45	
IQR	6.433	

Percentile		
0th	2.550	(minimum)
25th	3.567	(1st quartile)
50th	6.600	(median)
75th	10.000	(3rd quartile)
100th	10.000	(maximum)



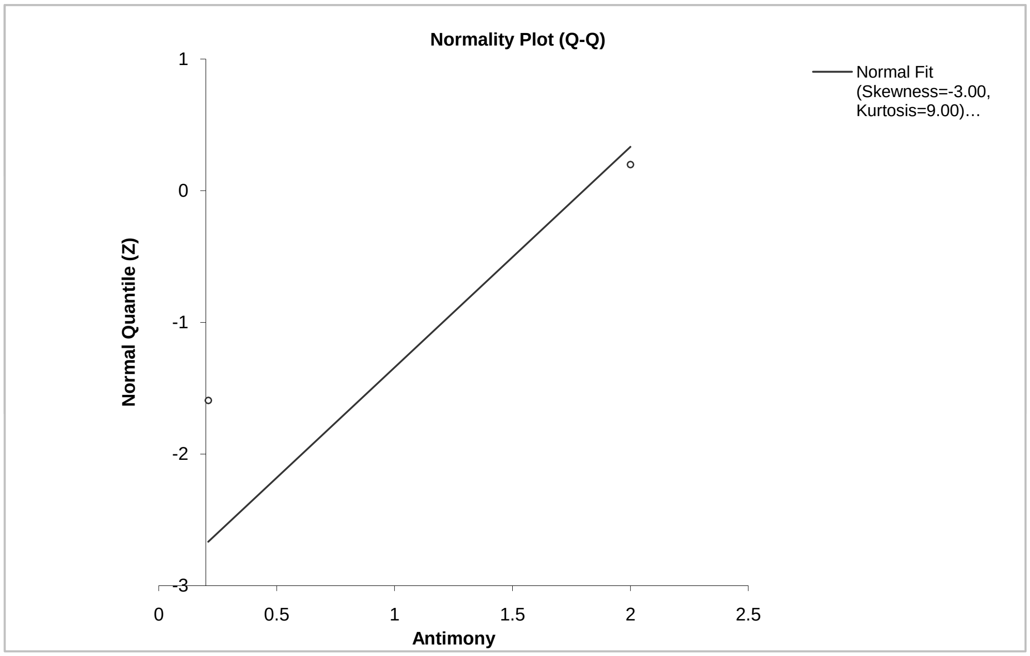
Test	**MW-27**
	Antimony
Performed by	Eric Tuppan
Date	4 December 2013



n	9	
Mean	1.801	
95% CI	1.342	to 2.260
SE	0.1989	
Variance	0.356	
SD	0.597	
95% CI	0.403	to 1.143
CV	33.1%	
Skewness	-3.00	
Kurtosis	9.00	
Shapiro-Wilk W	0.39	W(.05,9)=0.829
p	<0.0001	

Median	2.000	
96.1% CI	2.000	to 2.000
Range	1.79	
IQR	0.000	

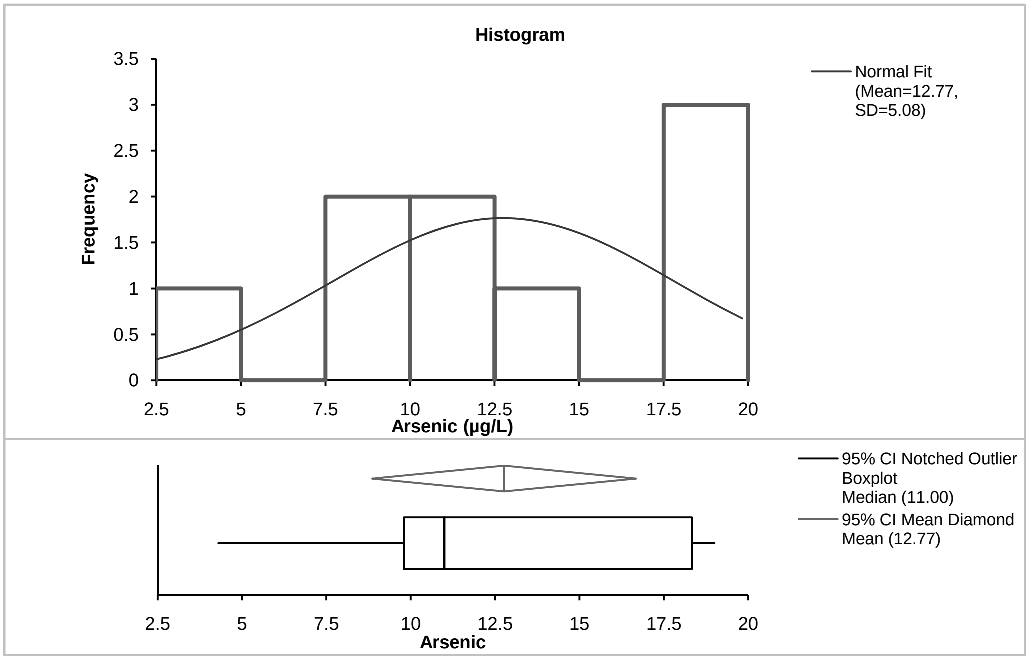
Percentile		
0th	0.210	(minimum)
25th	2.000	(1st quartile)
50th	2.000	(median)
75th	2.000	(3rd quartile)
100th	2.000	(maximum)



Analyse-it v2.26

Test	**MW-27**
	Arsenic
Performed by	Eric Tuppan

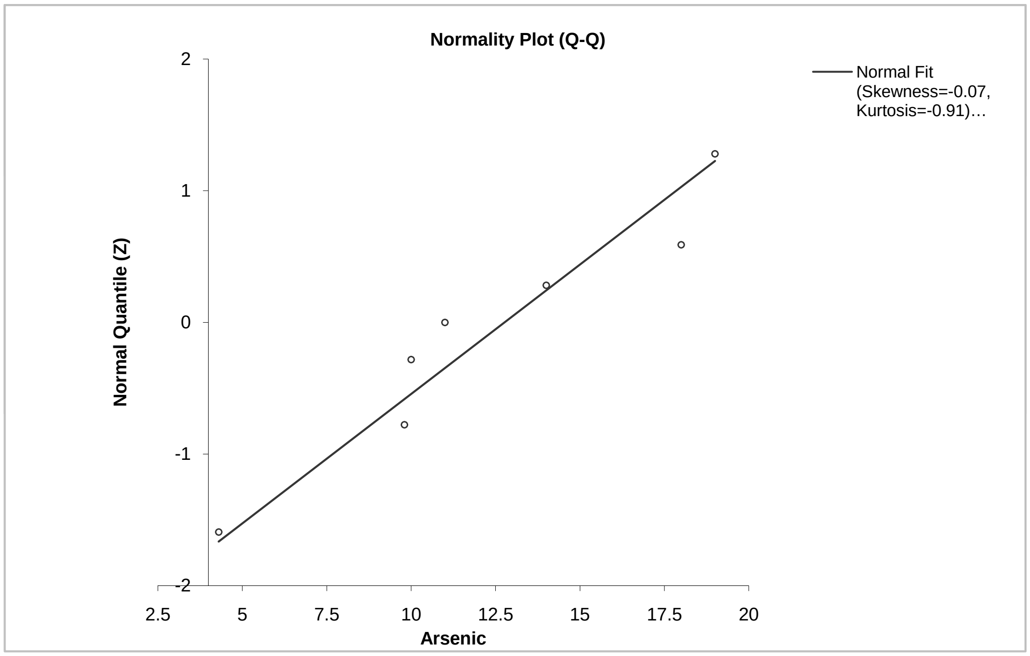
Date 4 December 2013



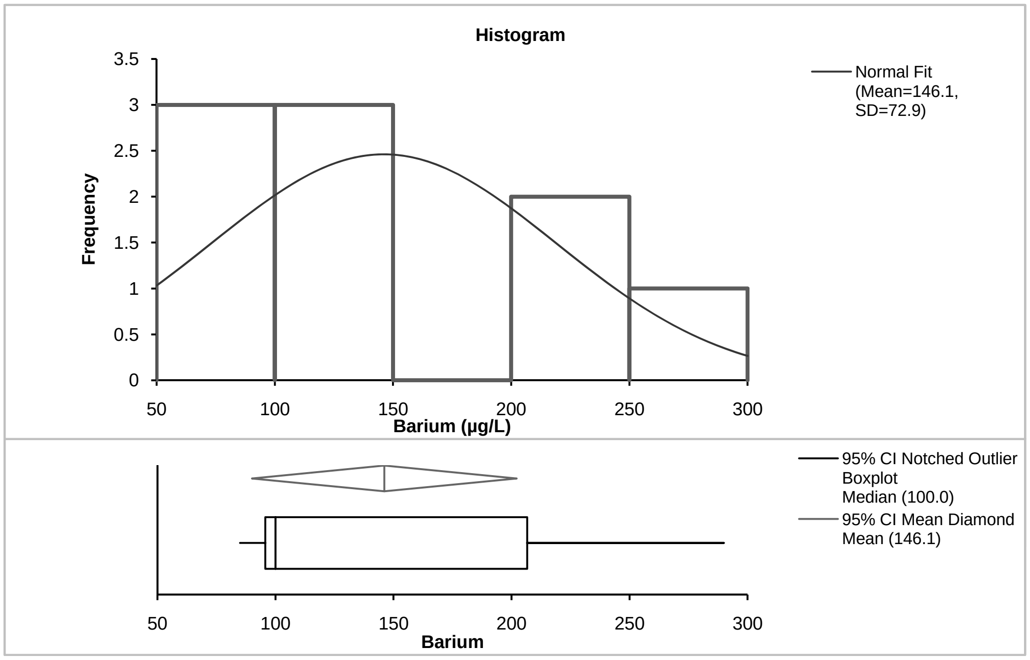
n	9	
Mean	12.77	
95% CI	8.86	to 16.67
SE	1.694	
Variance	25.84	
SD	5.08	
95% CI	3.43	to 9.74
CV	39.8%	
Skewness	-0.07	
Kurtosis	-0.91	
Shapiro-Wilk W	0.90	W(.05,9)=0.829
p	0.255	

Median	11.00	
96.1% CI	9.80	to 19.00
Range	14.7	
IQR	8.53	

Percentile		
0th	4.30	(minimum)
25th	9.80	(1st quartile)
50th	11.00	(median)
75th	18.33	(3rd quartile)
100th	19.00	(maximum)



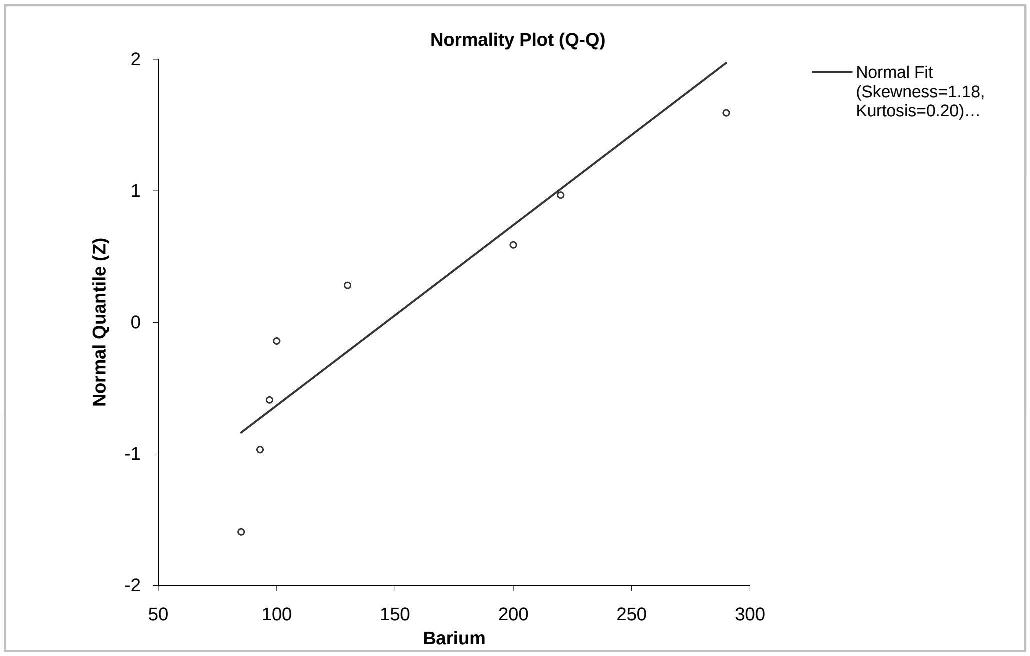
Test	**MW-27**
	Barium
Performed by	Eric Tuppan
Date	4 December 2013



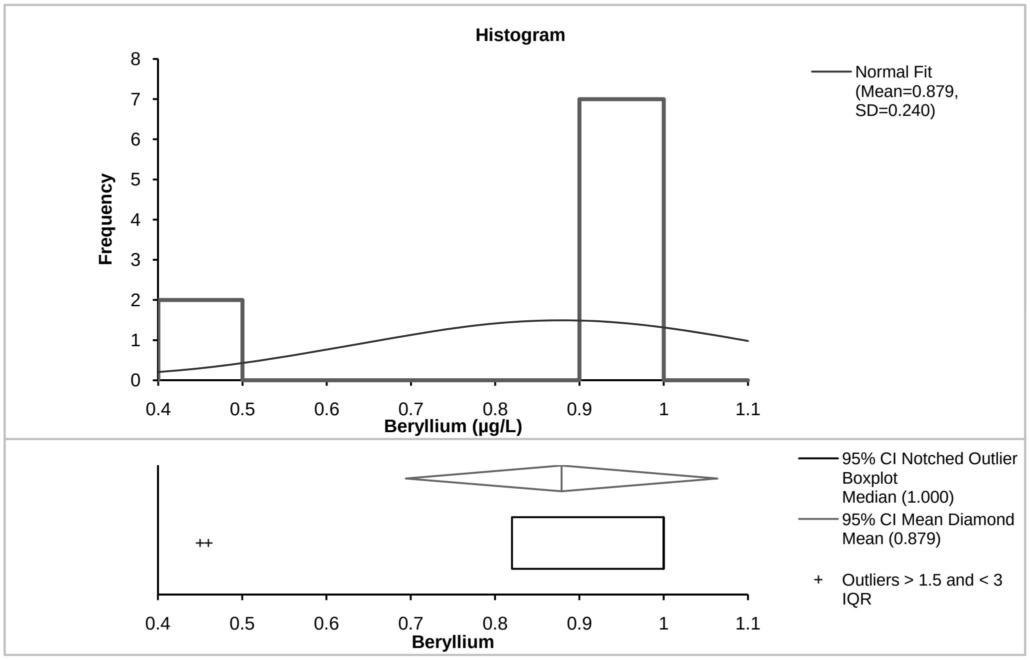
n	9
Mean	146.1
95% CI	90.1 to 202.2
SE	24.31
Variance	5318.4
SD	72.9
95% CI	49.3 to 139.7
CV	49.9%
Skewness	1.18
Kurtosis	0.20
Shapiro-Wilk W	0.81 W(.05,9)=0.829
p	0.024

Median	100.0
96.1% CI	93.0 to 220.0
Range	205
IQR	111.0

Percentile		
0th	85.0	(minimum)
25th	95.7	(1st quartile)
50th	100.0	(median)
75th	206.7	(3rd quartile)
100th	290.0	(maximum)



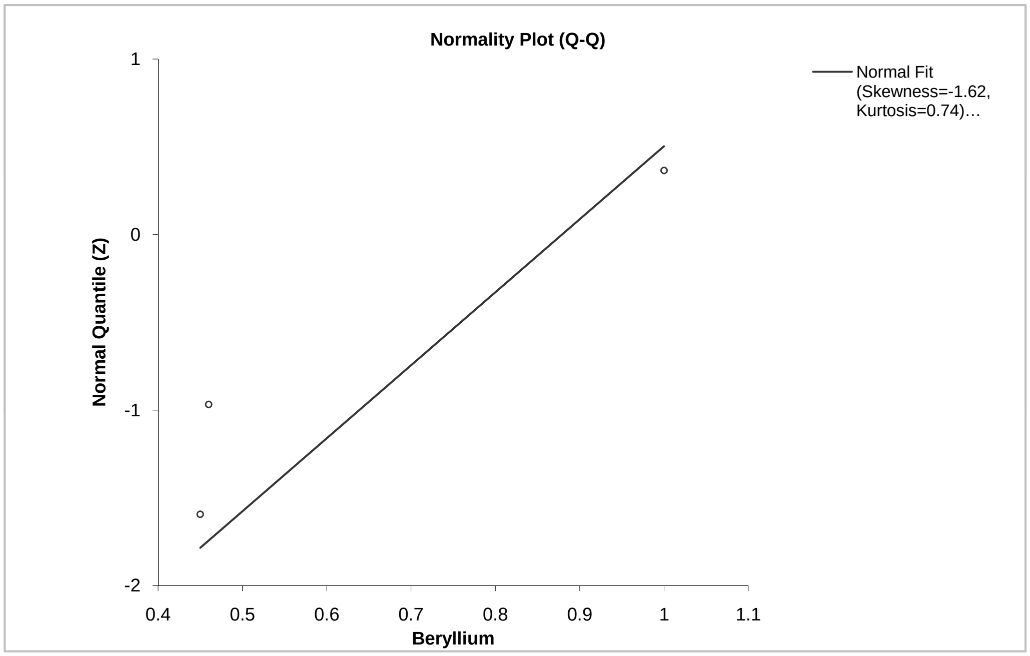
Test	**MW-27**
	Beryllium
Performed by	Eric Tuppan
Date	4 December 2013



n	9	
Mean	0.879	
95% CI	0.694	to 1.064
SE	0.0801	
Variance	0.058	
SD	0.240	
95% CI	0.162	to 0.460
CV	27.3%	
Skewness	-1.62	
Kurtosis	0.74	
Shapiro-Wilk W	0.54	W(.05,9)=0.829
p	<0.0001	

Median	1.000	
96.1% CI	0.460	to 1.000
Range	0.55	
IQR	0.180	

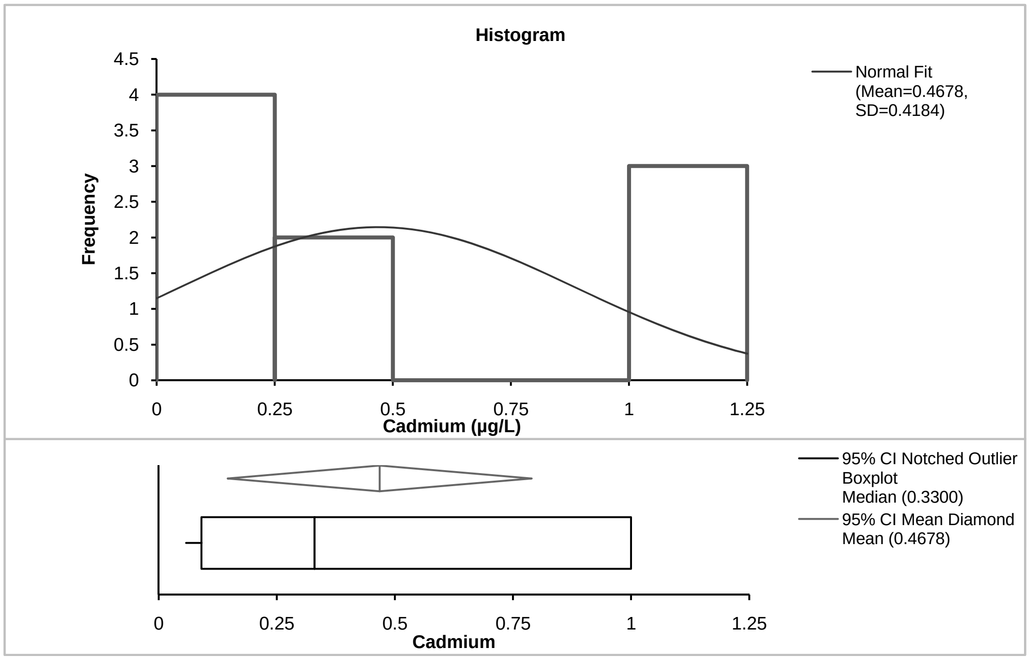
Percentile		
0th	0.450	(minimum)
25th	0.820	(1st quartile)
50th	1.000	(median)
75th	1.000	(3rd quartile)
100th	1.000	(maximum)



Analyse-it v2.26

Test	**MW-27**
	Cadmium
Performed by	Eric Tuppan

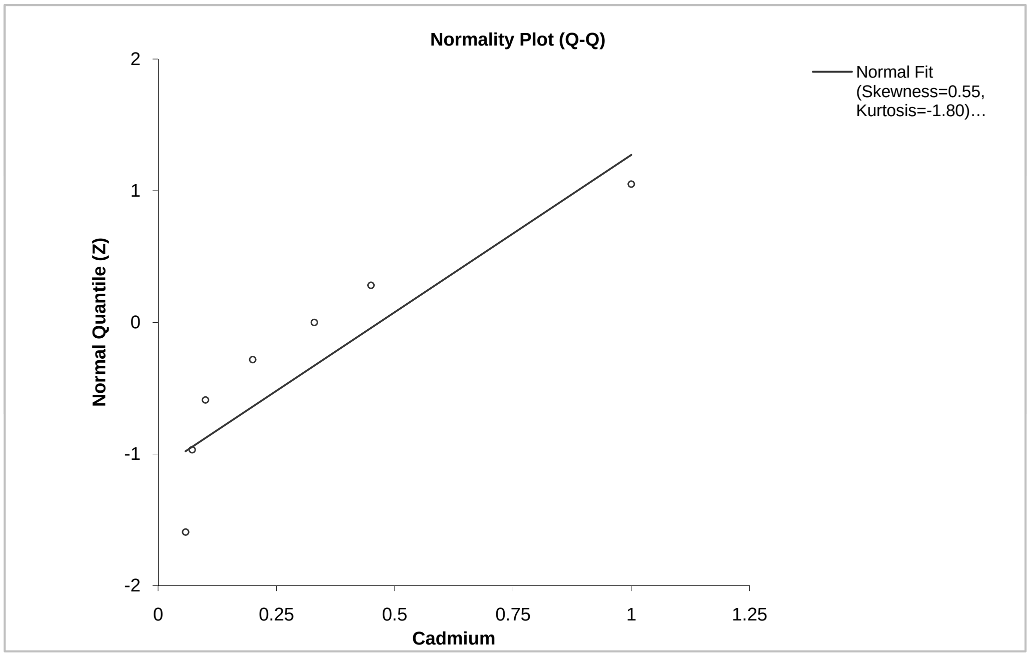
Date 4 December 2013



n	9	
Mean	0.4678	
95% CI	0.1462	to 0.7894
SE	0.13947	
Variance	0.1751	
SD	0.4184	
95% CI	0.2826	to 0.8016
CV	89.4%	
Skewness	0.55	
Kurtosis	-1.80	
Shapiro-Wilk W	0.80	W(.05,9)=0.829
p	0.020	

Median	0.3300	
96.1% CI	0.0720	to 1.0000
Range	0.942	
IQR	0.9093	

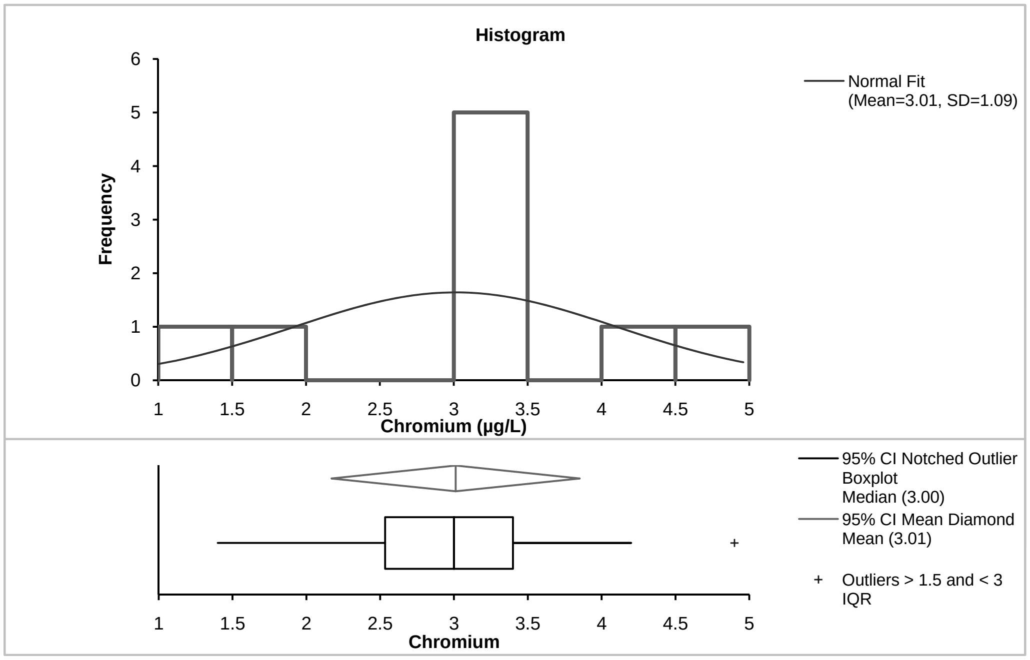
Percentile		
0th	0.0580	(minimum)
25th	0.0907	(1st quartile)
50th	0.3300	(median)
75th	1.0000	(3rd quartile)
100th	1.0000	(maximum)



Analyse-it v2.26

Test	**MW-27**
	Chromium
Performed by	Eric Tuppan

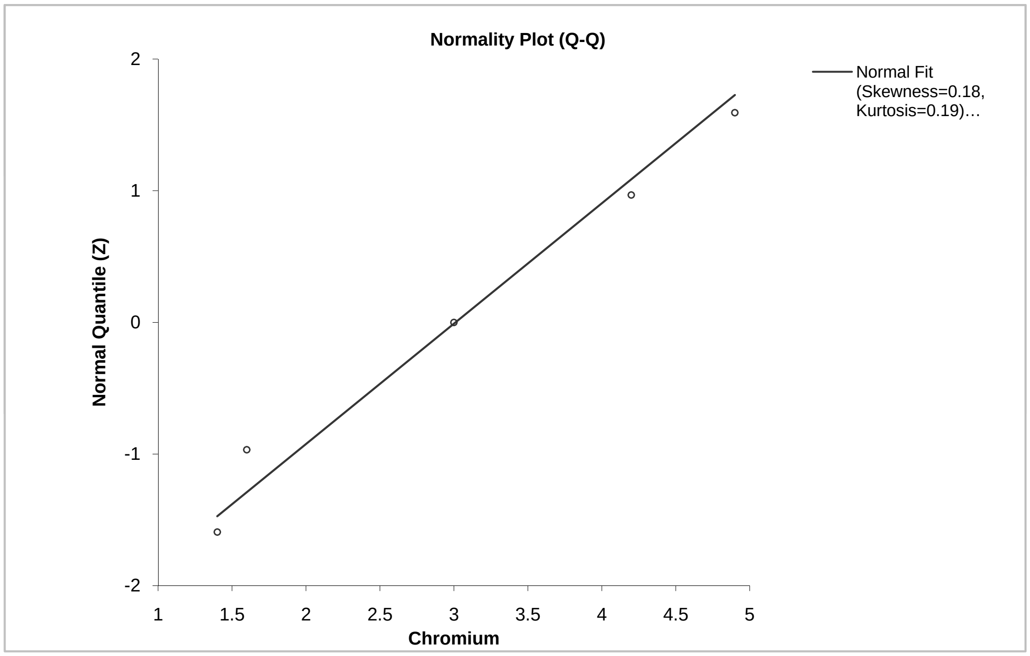
Date 4 December 2013



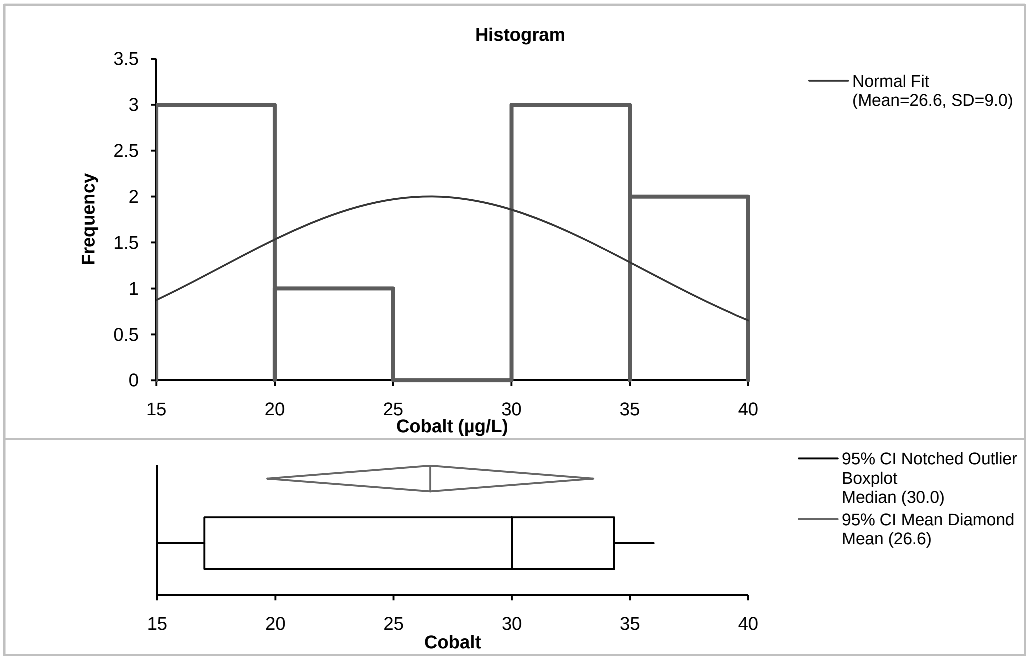
n	9	
Mean	3.01	
95% CI	2.17	to 3.85
SE	0.365	
Variance	1.20	
SD	1.09	
95% CI	0.74	to 2.10
CV	36.3%	
Skewness	0.18	
Kurtosis	0.19	
Shapiro-Wilk W	0.88	W(.05,9)=0.829
p	0.161	

Median	3.00	
96.1% CI	1.60	to 4.20
Range	3.5	
IQR	0.87	

Percentile		
0th	1.40	(minimum)
25th	2.53	(1st quartile)
50th	3.00	(median)
75th	3.40	(3rd quartile)
100th	4.90	(maximum)



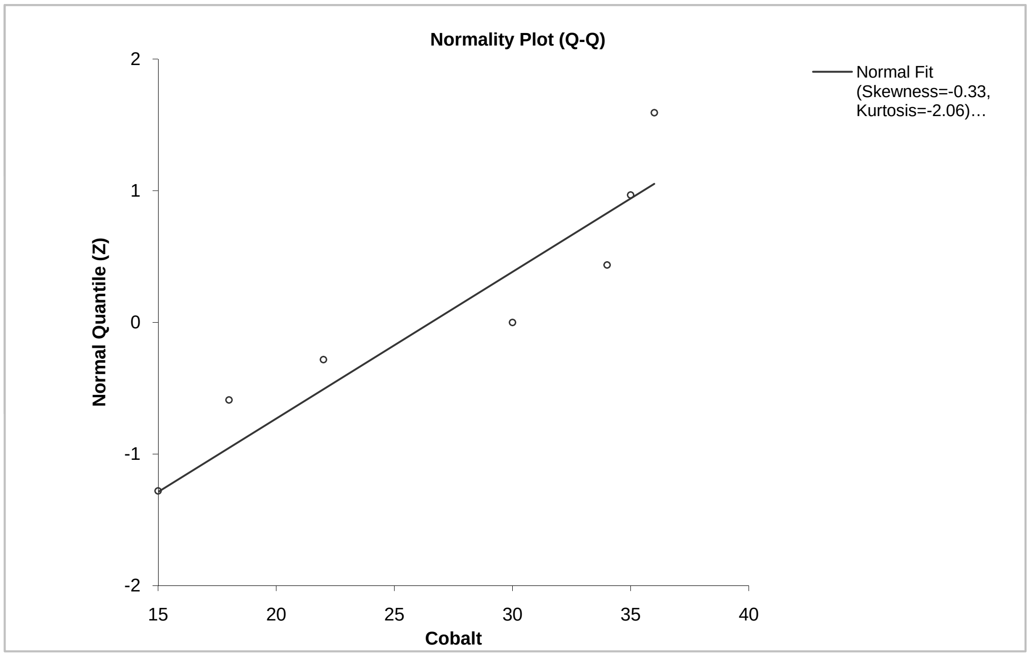
Test	**MW-27**
	Cobalt
Performed by	Eric Tuppan
Date	4 December 2013



n	9	
Mean	26.6	
95% CI	19.7	to 33.5
SE	2.99	
Variance	80.5	
SD	9.0	
95% CI	6.1	to 17.2
CV	33.8%	
Skewness	-0.33	
Kurtosis	-2.06	
Shapiro-Wilk W	0.83	W(.05,9)=0.829
p	0.048	

Median	30.0	
96.1% CI	15.0	to 35.0
Range	21	
IQR	17.3	

Percentile		
0th	15.0	(minimum)
25th	17.0	(1st quartile)
50th	30.0	(median)
75th	34.3	(3rd quartile)
100th	36.0	(maximum)

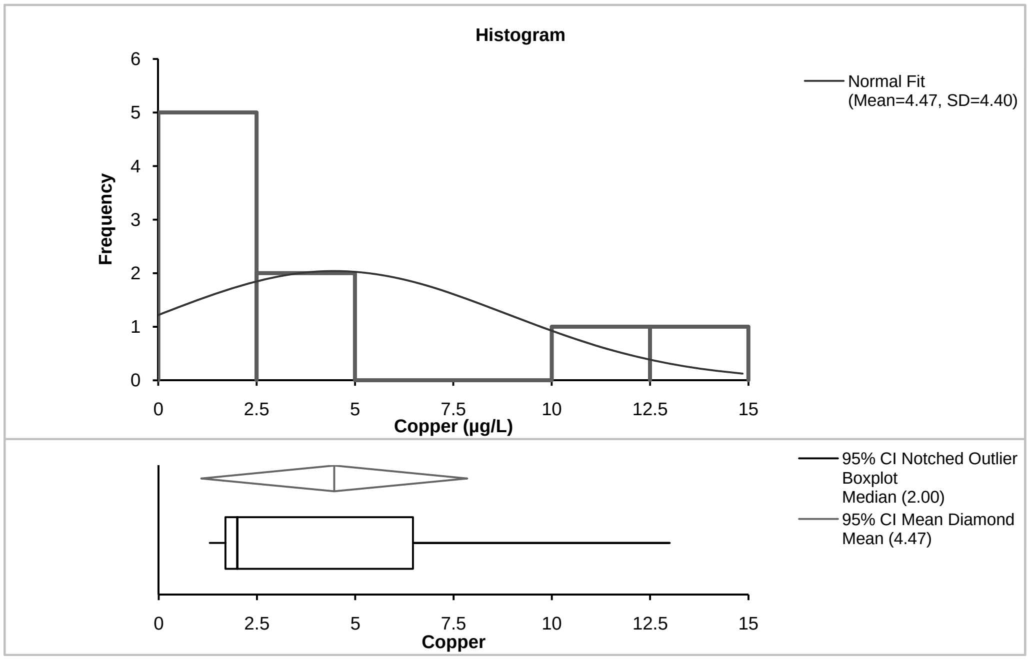


Analyse-it v2.26

Test **MW-27**

Copper
Performed by Eric Tuppan

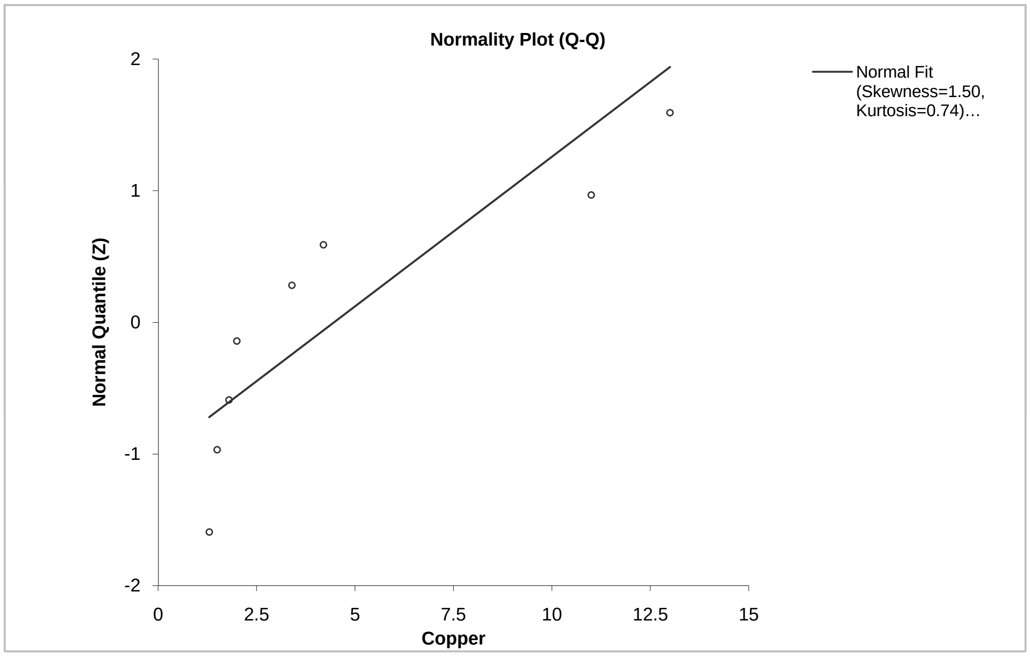
Date 4 December 2013



n	9	
Mean	4.47	
95% CI	1.09	to 7.85
SE	1.466	
Variance	19.35	
SD	4.40	
95% CI	2.97	to 8.43
CV	98.5%	
Skewness	1.50	
Kurtosis	0.74	
Shapiro-Wilk W	0.72	W(.05,9)=0.829
p	0.003	

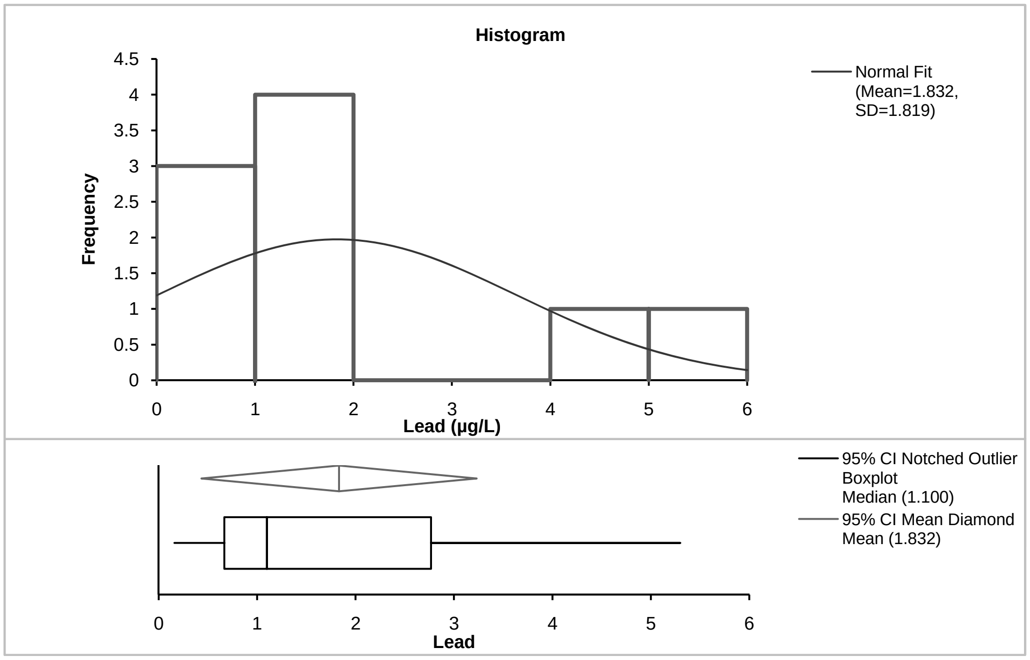
Median	2.00	
96.1% CI	1.50	to 11.00
Range	11.7	
IQR	4.77	

Percentile		
0th	1.30	(minimum)
25th	1.70	(1st quartile)
50th	2.00	(median)
75th	6.47	(3rd quartile)
100th	13.00	(maximum)

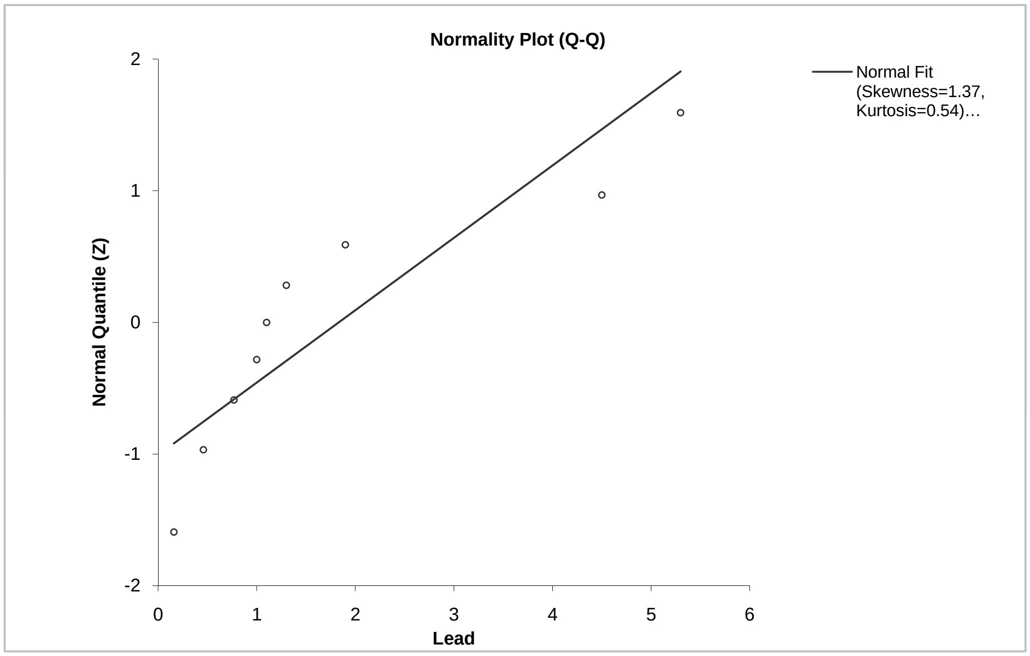


Analyse-it v2.26

Test	**MW-27**		
	Lead		
Performed by	Eric Tuppan	Date	4 December 2013

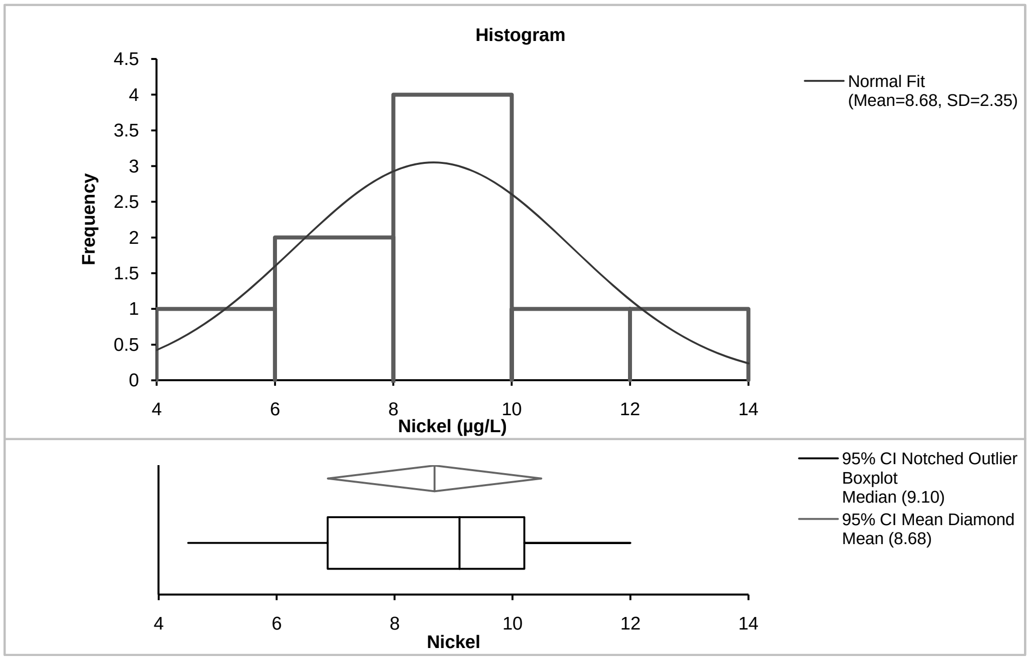


n	9				
Mean	1.832		Median	1.100	
95% CI	0.434 to 3.230		96.1% CI	0.460 to 4.500	
SE	0.6063				
			Range	5.14	
Variance	3.308		IQR	2.100	
SD	1.819				
95% CI	1.229 to 3.485		Percentile		
			0th	0.160	(minimum)
CV	99.3%		25th	0.667	(1st quartile)
			50th	1.100	(median)
Skewness	1.37		75th	2.767	(3rd quartile)
Kurtosis	0.54		100th	5.300	(maximum)
Shapiro-Wilk W	0.80	W(.05,9)=0.829			
p	0.018				



Analyse-it v2.26

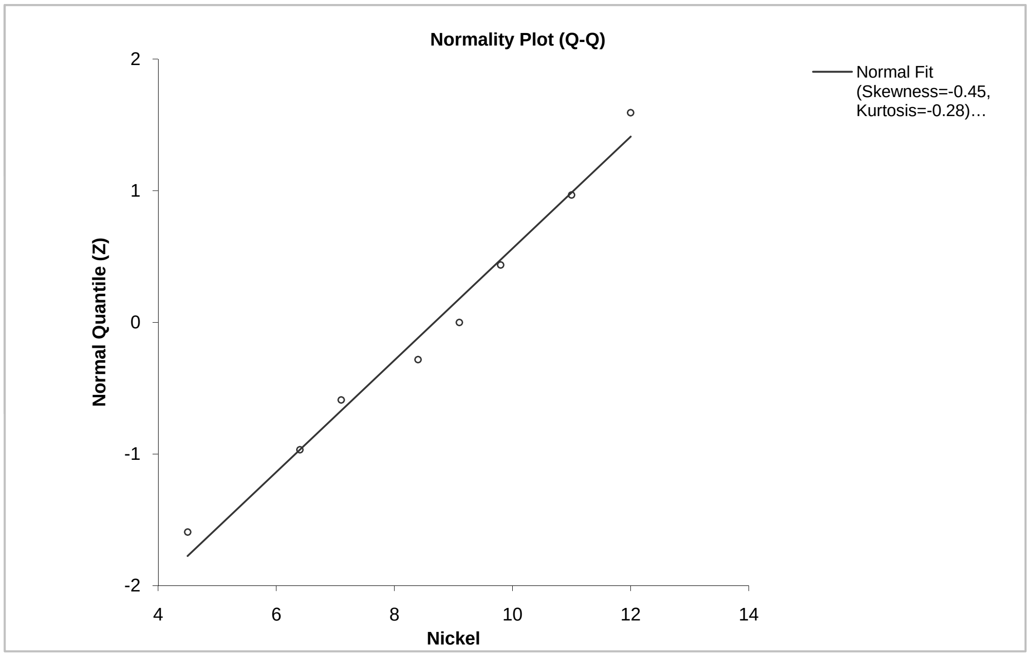
Test	**MW-27**
	Nickel
Performed by	Eric Tuppan
Date	4 December 2013



n	9	
Mean	8.68	
95% CI	6.87	to 10.49
SE	0.785	
Variance	5.54	
SD	2.35	
95% CI	1.59	to 4.51
CV	27.1%	
Skewness	-0.45	
Kurtosis	-0.28	
Shapiro-Wilk W	0.98	W(.05,9)=0.829
p	0.934	

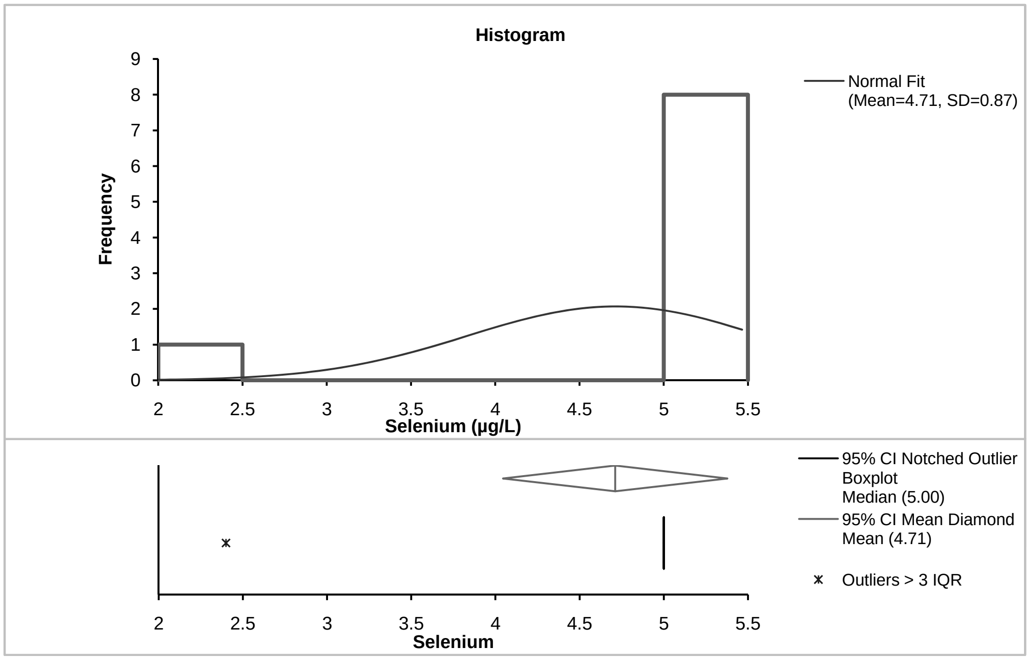
Median	9.10	
96.1% CI	6.40	to 11.00
Range	7.5	
IQR	3.33	

Percentile		
0th	4.50	(minimum)
25th	6.87	(1st quartile)
50th	9.10	(median)
75th	10.20	(3rd quartile)
100th	12.00	(maximum)



Test	**MW-27**
	Selenium
Performed by	Eric Tuppan

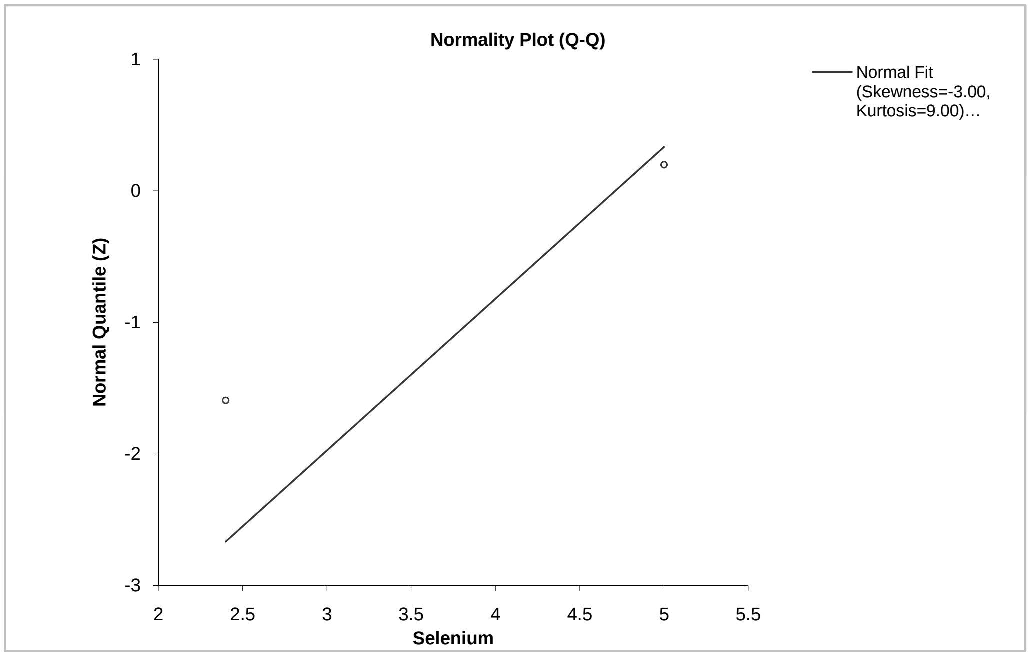
Date 4 December 2013



n	9	
Mean	4.71	
95% CI	4.04	to 5.38
SE	0.289	
Variance	0.75	
SD	0.87	
95% CI	0.59	to 1.66
CV	18.4%	
Skewness	-3.00	
Kurtosis	9.00	
Shapiro-Wilk W	0.39	W(.05,9)=0.829
p	<0.0001	

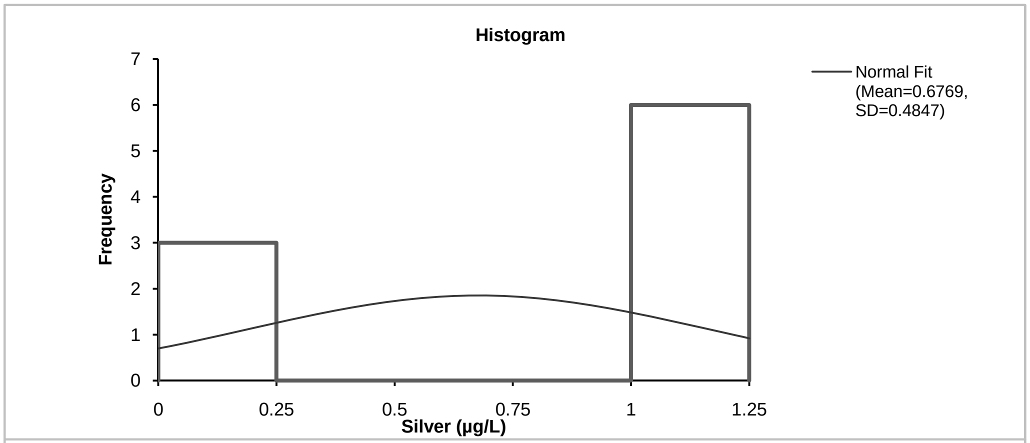
Median	5.00	
96.1% CI	5.00	to 5.00
Range	2.6	
IQR	0.00	

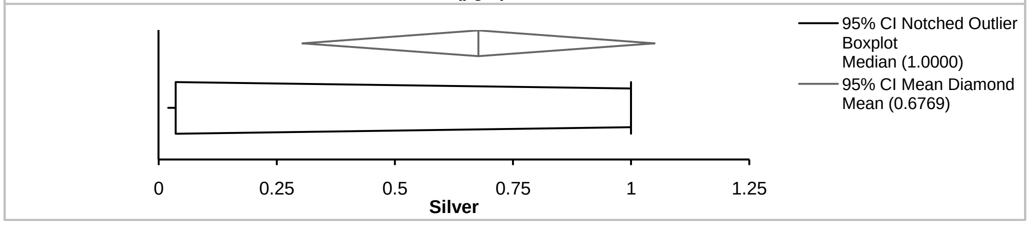
Percentile		
0th	2.40	(minimum)
25th	5.00	(1st quartile)
50th	5.00	(median)
75th	5.00	(3rd quartile)
100th	5.00	(maximum)



Analyse-it v2.26

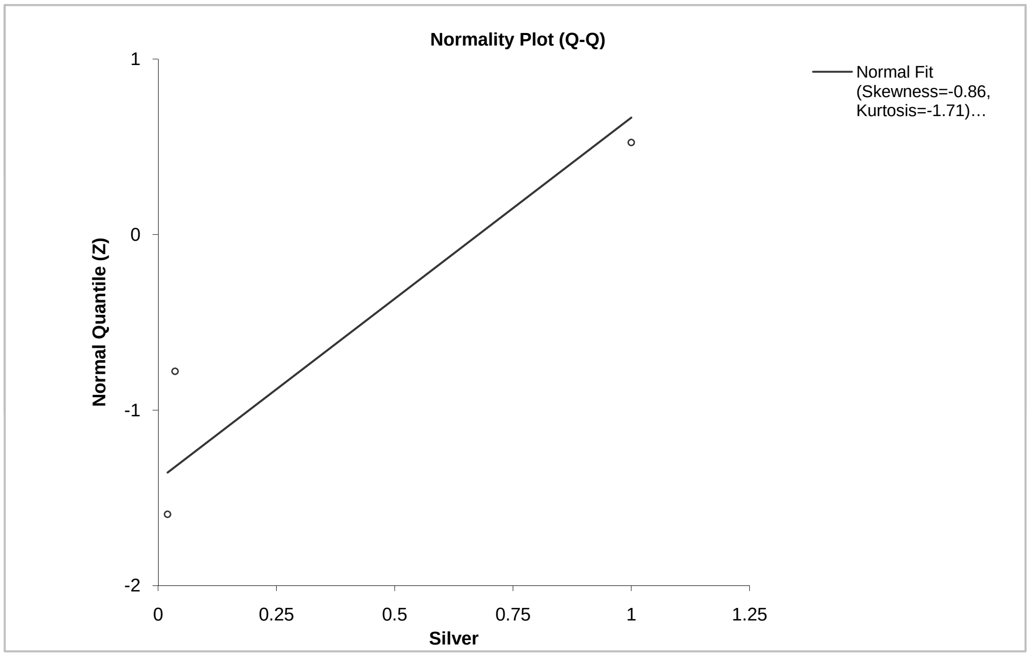
Test	**MW-27**
	Silver
Performed by	Eric Tuppan
Date	4 December 2013





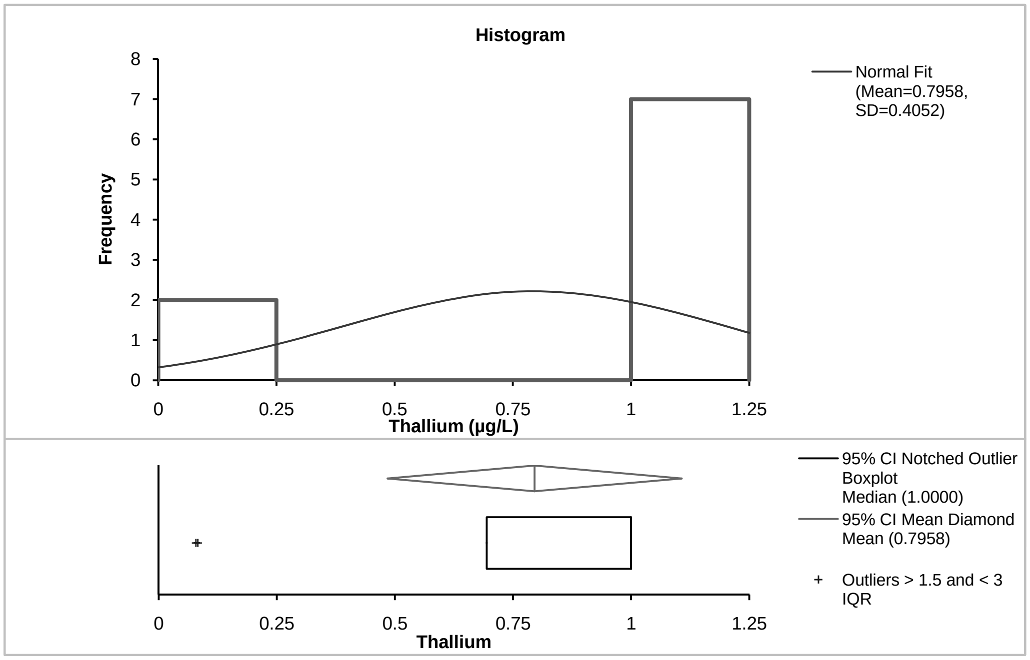
n	9	
Mean	0.6769	
95% CI	0.3043	to 1.0495
SE	0.16156	
Variance	0.2349	
SD	0.4847	
95% CI	0.3274	to 0.9286
CV	71.6%	
Skewness	-0.86	
Kurtosis	-1.71	
Shapiro-Wilk W	0.62	W(.05,9)=0.829
p	0.000	

Median	1.0000	
96.1% CI	0.0360	to 1.0000
Range	0.980	
IQR	0.9640	
Percentile		
0th	0.0200	(minimum)
25th	0.0360	(1st quartile)
50th	1.0000	(median)
75th	1.0000	(3rd quartile)
100th	1.0000	(maximum)

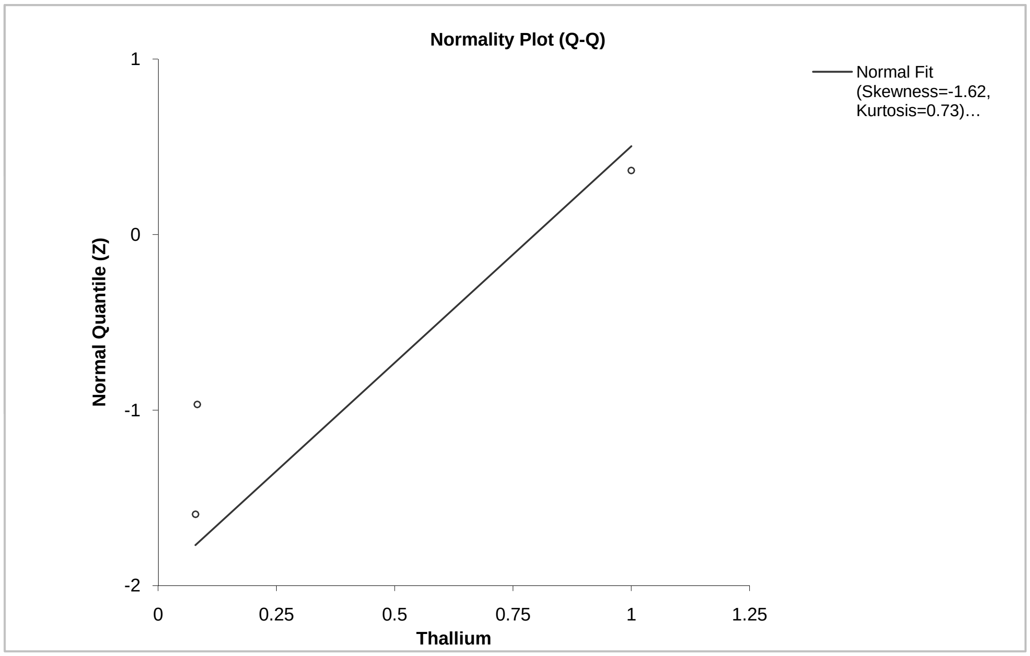


Test	**MW-27**
	Thallium
Performed by	Eric Tuppan

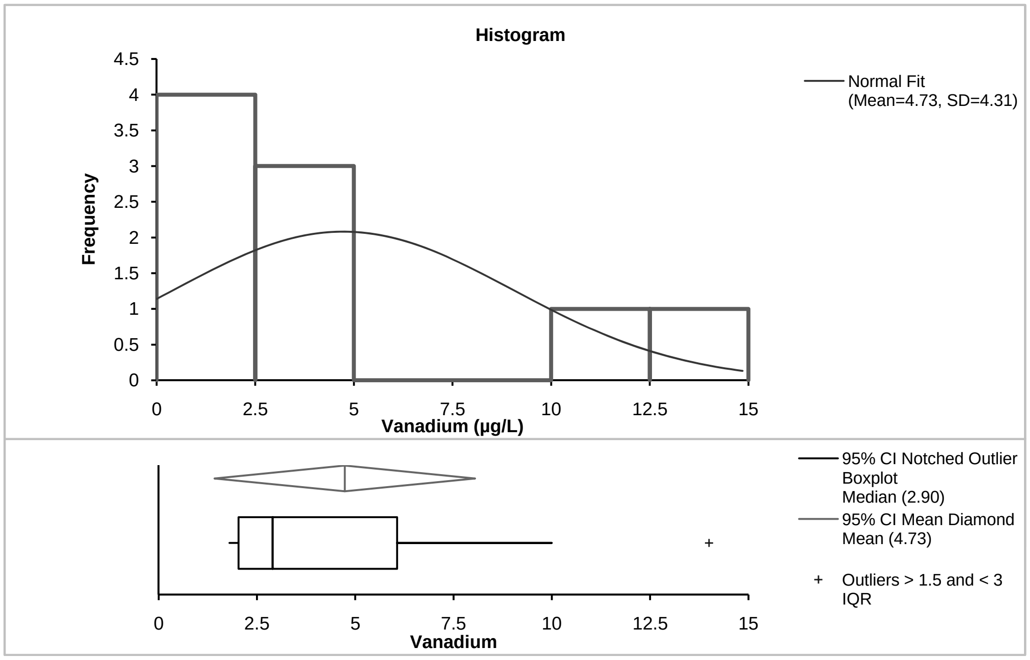
Date 4 December 2013



n	9					
Mean	0.7958		Median	1.0000		
95% CI	0.4843	to 1.1073	96.1% CI	0.0830	to 1.0000	
SE	0.13508					
			Range	0.921		
Variance	0.1642		IQR	0.3057		
SD	0.4052					
95% CI	0.2737	to 0.7764	Percentile			
			0th	0.0790	(minimum)	
CV	50.9%		25th	0.6943	(1st quartile)	
			50th	1.0000	(median)	
Skewness	-1.62		75th	1.0000	(3rd quartile)	
Kurtosis	0.73		100th	1.0000	(maximum)	
Shapiro-Wilk W	0.54	W(.05,9)=0.829				
p	<0.0001					



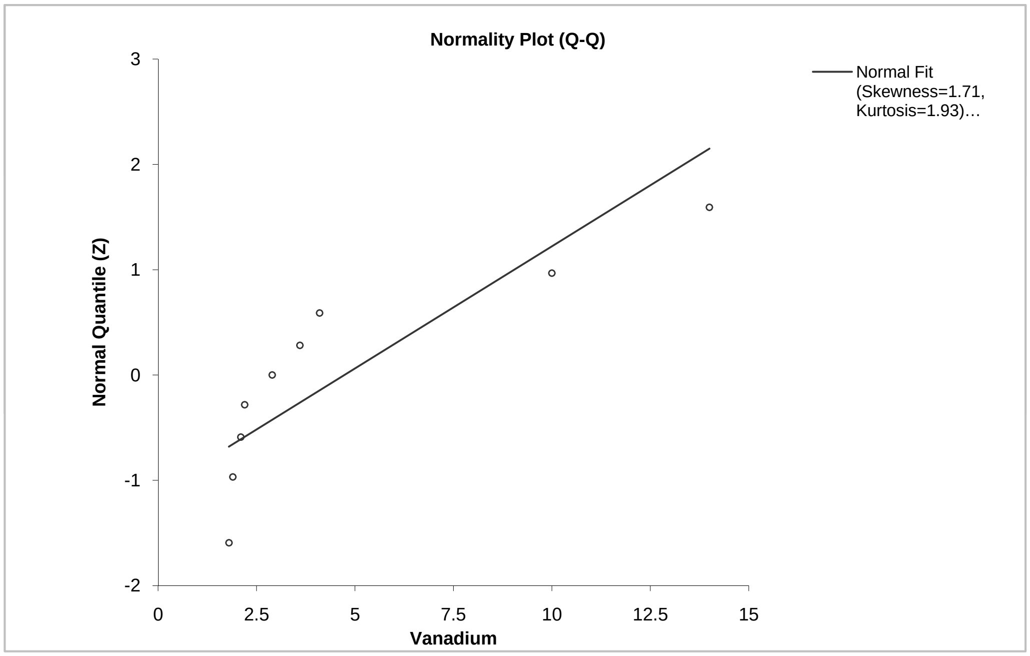
Test	**MW-27**		
	Vanadium		
Performed by	Eric Tuppan	Date	4 December 2013



n	9	
Mean	4.73	
95% CI	1.42	to 8.05
SE	1.437	
Variance	18.58	
SD	4.31	
95% CI	2.91	to 8.26
CV	91.1%	
Skewness	1.71	
Kurtosis	1.93	
Shapiro-Wilk W	0.72	W(.05,9)=0.829
p	0.002	

Median	2.90	
96.1% CI	1.90	to 10.00
Range	12.2	
IQR	4.03	

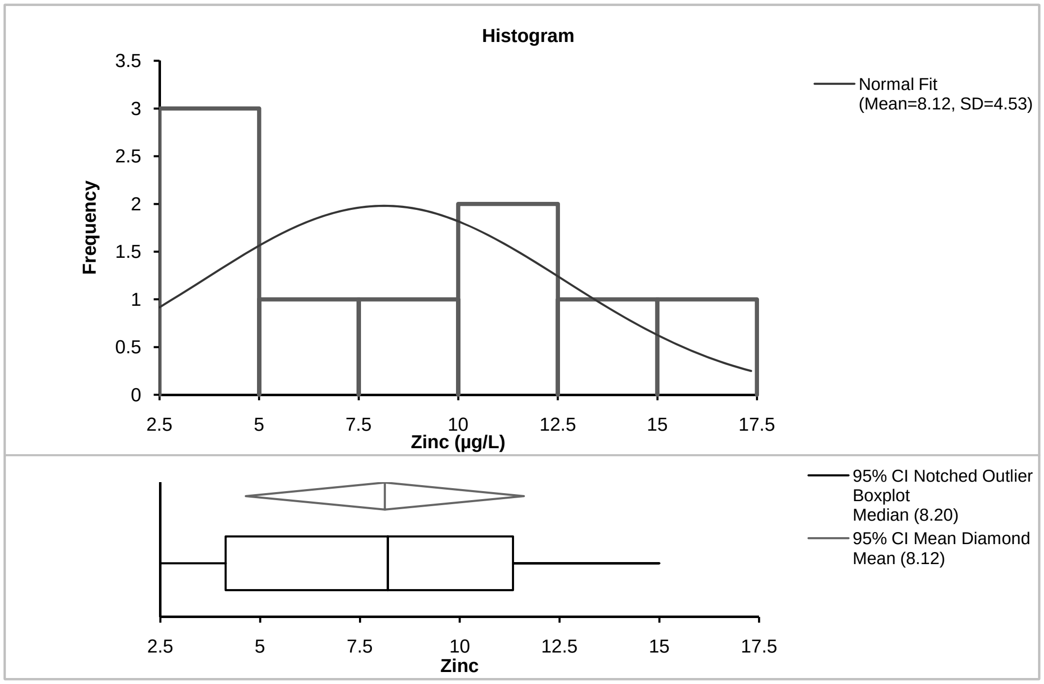
Percentile		
0th	1.80	(minimum)
25th	2.03	(1st quartile)
50th	2.90	(median)
75th	6.07	(3rd quartile)
100th	14.00	(maximum)



Zinc

Performed by Eric Tuppan

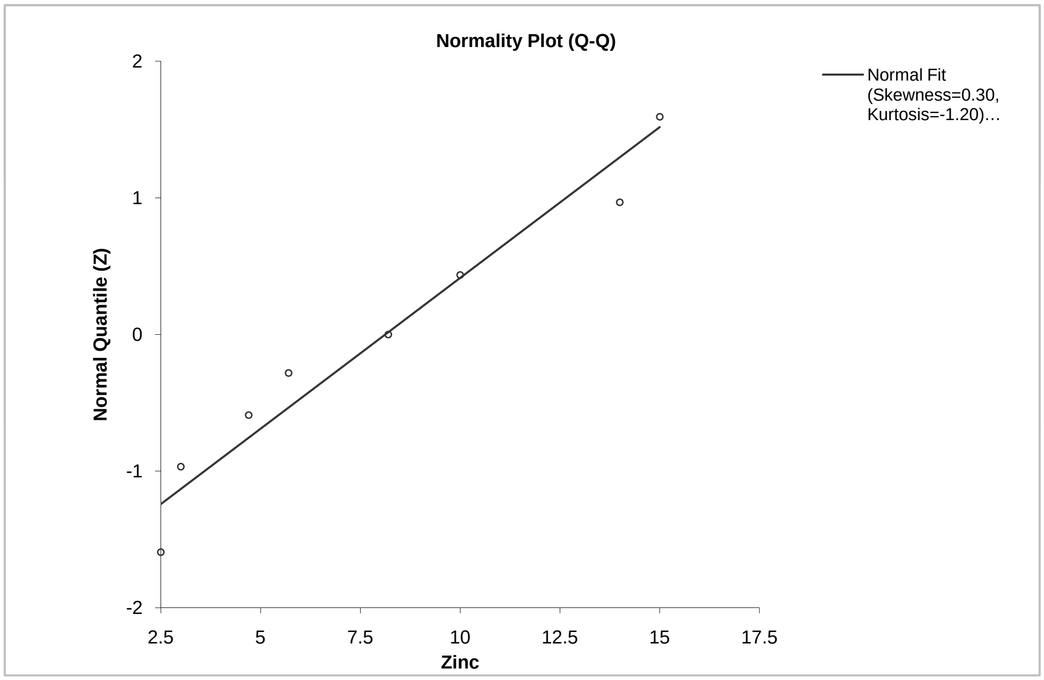
Date 4 December 2013



n	9	
Mean	8.12	
95% CI	4.64	to 11.61
SE	1.511	
Variance	20.54	
SD	4.53	
95% CI	3.06	to 8.68
CV	55.8%	
Skewness	0.30	
Kurtosis	-1.20	
Shapiro-Wilk W	0.93	W(.05,9)=0.829
p	0.514	

Median	8.20	
96.1% CI	3.00	to 14.00
Range	12.5	
IQR	7.20	

Percentile		
0th	2.50	(minimum)
25th	4.13	(1st quartile)
50th	8.20	(median)
75th	11.33	(3rd quartile)
100th	15.00	(maximum)



APPENDIX F

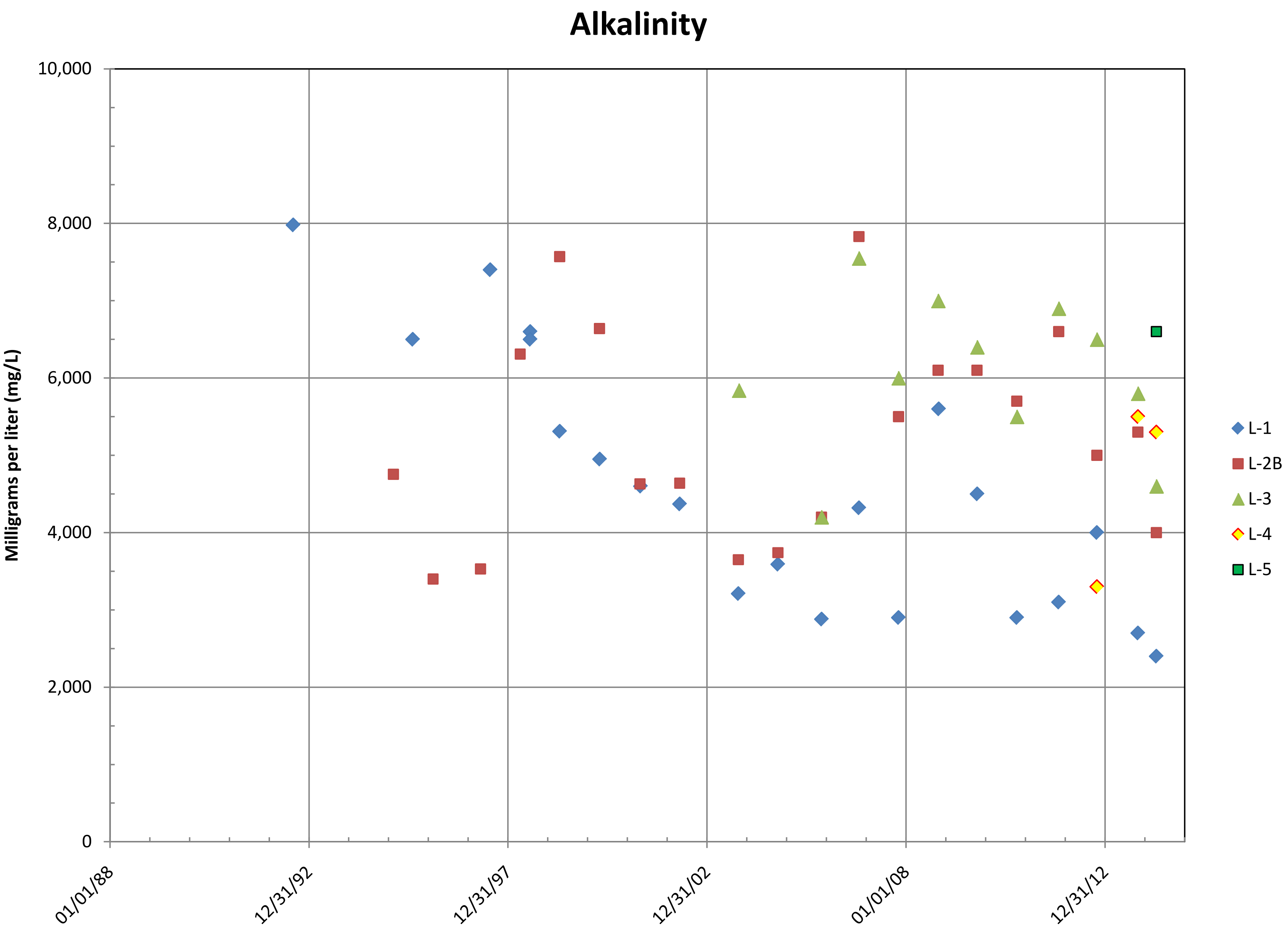
HISTORICAL LEACHATE DATA AND PLOTS
(IN PDF ON ATTACHED CD)

Appendix E
Historical Leachate Data - Inorganic Parameters
Coffin Butte Landfill

Sump	Sample ID	Date	Bicarbonate Alkalinity as CACO3			Biologic Oxygen Demand, Five-Day			Carbonate as CaCO3			Chemical Oxygen Demand			Chloride			Nitrogen, Ammonia (as N)			Nitrogen, Nitrate-Nitrite			Sulfate			Suspended Solids			Total Dissolved Solids			Total Organic Carbon (TOC)		
			MG/L			MG/L			MG/L			MG/L			MG/L			MG/L			MG/L			MG/L			MG/L			MG/L			MG/L		
L-1	L-1	04/12/88													1122			343																	
L-1	L-1	08/28/91													1630			625			1	U													
L-1	L-1	08/28/91													1480			660			1	U													
L-1	L-1	08/08/92	7980									4430			1800			1600						17			40			9420					
L-1	L-1	11/25/92													1300															6160					
L-1	CB-21093-29	02/10/93													640						0.2	U	A							2900					
L-1	CB-050593-3	05/05/93													1300															5970					
L-1	CB-080493-20	08/04/93													2000															8520					
L-1	CB-110293-11	11/02/93													2200															8610					
L-1	CB-022494-32	02/24/94													1300						0.2	U								5440					
L-1	CB-050694-8	05/06/94													1700															6510					
L-1	CB-050694-8	05/06/94													1500															6520					
L-1	CB-081194-19	08/11/94													540															8970					
L-1	CB-110394-3	11/03/94													1600															5420					
L-1	CB-021495-30	02/14/95				96									890						0.4	U					16			3950		J			
L-1	CB-051195-6	05/11/95													1600															898					
L-1	CB-081095-18	08/10/95													1700																				
L-1	COFFIN13	08/10/95	6500			260						1950			1800			1100			0.06			0.8			24			7700			800		
L-1	COFFIN13	08/10/95																																	
L-1	CB-110795-4	11/07/95													1600															6010					
L-1	CB-021396-32	02/13/96				119									910						0.2	U								4250					
L-1	CB-080796-14	08/07/96													1600																				
L-1	CB-110596-6	11/05/96													1600															7630					
L-1	CB-072197-1	07/21/97	7400			260			20	U		2800			1400			1600			0.2	U		17						7830			1100		
L-1	CB-072398-3	07/23/98	6600			882			2	U		4260			1300			1440			0.2	U		4.1			33			7400			1370		
L-1	CB-072398-4	07/23/98	6500			999			2	U		5770			1260			1440			0.2	U		4.2			29			7540			1700		
L-1	CB-042099-17	04/20/99	5310			135			2	U		1690			1340			1250			0.2	U		3.3			11			5400			609		
L-1	CB-042100-42	04/21/00	4950						2	U		1910			831			876			0.2	U		9.6			12			5370			617		
L-1	VLF-050101-42	05/01/01	4600		J	88			2	U	UJ	1740			1120			817			0.2			5.1			5	U		4480			474		
L-1	VLF-042502-38	04/25/02	4370			201						1350			1030			728			0.2	U		2	U	DF	11			4530			404		
L-1	VLF-101503-15	10/15/03	3210			61						1060			612			498			0.2	U		2			22			3200		J	352		
L-1	VLF-101204-5	10/12/04	3590			68						1240			866			609			0.2	U		2	U	DF	47			3420			360		
L-1	VLF-111705-33	11/17/05	2880			96									547			486			0.05	U		10.8			131			2760			279		
L-1	VLF-061026-27	10/26/06	4320			69						1440			1150			770			0.15			2	U	DF	54			4470			485		
L-1	VLF-071024-7	10/24/07	2900			20	U					750			560			430			0.2	U		25	U		49			2800			170		
L-1	VLF-081027-35	10/27/08	5600		Q	1100		Q				6400		Q	1400		Q	1000		Q	0.21			25	U	G	66		Q	6100		Q	2100		Q
L-1	VLF-091015-18	10/15/09	4500			1600		Q				3000		Q	1400		Q	640		J+	2	U	G	25	U	G	10	U	G	7700		Q	990		Q
L-1	VLF-101014-9	10/14/10	2900		B	43		J				880			1000			520		J	0.2	U		4.9		J	30			3600			300		
L-1	VLF-111102-7	11/02/11	3100		B	87						1100			1100			520			0.2	U		25	U		25			3600		H	340		
L-1	VLF-121017-16	10/17/12	4000		B	2000						2600			1300			830		J-	1	U		2.4		J	18		J	5500			950		B
L-1	VLI-102913-33	10/29/13	2700		B^	36		b*				870			1100			470			0.2	U		6.1		J	33			3600			300		B
L-1	VLF-140416-16	04/16/14	2400		B	52		J+				610			770			320			0.2	U		10	U		4			2900			230		

Appendix E
Historical Leachate Data - Inorganic Parameters
Coffin Butte Landfill

Sump	Sample ID	Date	Bicarbonate Alkalinity as CACO3			Biologic Oxygen Demand, Five-Day			Carbonate as CaCO3			Chemical Oxygen Demand			Chloride			Nitrogen, Ammonia (as N)			Nitrogen, Nitrate-Nitrite			Sulfate			Suspended Solids			Total Dissolved Solids			Total Organic Carbon (TOC)		
			MG/L			MG/L			MG/L			MG/L			MG/L			MG/L			MG/L			MG/L			MG/L			MG/L			MG/L		
L-2B	CB-021495-29	02/14/95	4754			5900			20	U		10800			640			310			0.4	U		100			484			6820			3000		
L-2B	CB-021396-29	02/13/96	3400			2900			20	U		5660			970			330			0.2	U		17			328			7060			1700		
L-2B	CB-042397-24	04/23/97	3530			500		D	20	U	D	2620		D	710			260			0.2	U		51			162			4740			800		D
L-2B	CB-042398-25	04/23/98	6310			4	U		20	U		6670			1460			1220			0.2	U		6.2			1040			5070			1770		
L-2B	L-2B	04/19/99																																	
L-2B	CB-042099-4	04/20/99	7570			1614			2	U		6490			1540			2140			0.2	U		6.9			72			8860			2210		
L-2B	CB-041900-13	04/19/00	6640						2	U		12700			1830			1180			0.2	U		300			220			14600			3910		
L-2B	VLF-042601-25	04/26/01	4630			1450			2			5900			2350			3.59			0.2			10.4			160			8820			1570		
L-2B	VLF-042502-39	04/25/02	4640			1540						5070			1790			895			0.2	U		11.6			26			7260			1270		
L-2B	VLF-101503-17	10/15/03	3650			212						3910			2230			669			0.2	U		65			136			6800		J	1260		
L-2B	VLF-101204-7	10/12/04	3740			319						4050			5640			726			38.6			10	U	DF	110			22800			1510		
L-2B	VLF-111705-34	11/17/05	4200			643									786			570			0.05	U		104			446			8660			1670		
L-2B	VLF-061026-29	10/26/06	7830			3760		CI				12000			2800			435			0.05	U		69.5			45			14000			4240		
L-2B	VLF-071024-8	10/24/07	5500			3300						7500			2200			1300			7.2			140			100			10000			2900		
L-2B	VLF-081022-14	10/22/08	6100		Q	6500						4700		Q	2500		Q	1300		Q	0.55			76		G	130		Q	13000		B,	1600		Q
L-2B	VLF-091014-5	10/14/09	6100			6300		Q				14000		Q	2400		Q	1200		J+,	2	U	G	8.6			54		Q	13000		Q	4400		Q
L-2B	VLF-101014-8	10/14/10	5700			4700						11000			2100			1200		J	0.18		J	32		J	49			10000			3300		
L-2B	VLF-111102-5	11/02/11	6600		B	5600						8900			2700			1500			0.43		J	62			16			9500		H	3200		
L-2B	VLF-121017-17	10/17/12	5000		B	1200						3500			2400			1500		J-	1	U		460			44			8300			1200		B
L-2B	VLI-102913-35	10/29/13	5300		B^	1100		J				4400			3000			1200			0.23		J+	28		J	28			9400			1500		B
L-2B	VLF-140416-14	04/16/14	4000		B	770		J+				2900			2100			660		*	0.2	U	B	25	U		3.2		J	6100			630		
L-3	VLF-102103-45	10/21/03	5840									11600			2200			929			0.3			35			400			10800			3710		
L-3	VLF-111705-32	11/17/05	4200			1150									1680			407			0.3			57			297			8580			3690		
L-3	VLF-061026-28	10/26/06	7550			824						8090			1880			1420			0.07			32.7			44			12100			2710		
L-3	VLF-071024-10	10/24/07	6000			530						5100			1900			1300			1	U		50	U		20			8900			1200		
L-3	VLF-081022-15	10/22/08	7000		Q	370						250		Q	2400		Q	1300		Q	0.39			130		Q	16		Q	9900		B,	3400		Q
L-3	VLF-091015-19	10/15/09	6400			450		Q				3800		Q	2200		Q	930		J+,	2	U	G	50	U	G	18			8900		Q	1300		Q
L-3	VLF-101014-10	10/14/10	5500		B	420						2900			1900			930		J	0.19		J	9.5		J	16			7600			990		
L-3	VLF-111102-6	11/02/11	6900		B	610						5800			2300			1200			1	U		50	U		12			9600		H	1900		
L-3	VLF-121017-15	10/17/12	6500		B	660						3800			2300			1500		J-	1	U		8.9		J	78			9400			1300		B
L-3	VLI-102913-34	10/29/13	5800		B^	760		b*				4600			2400			1200			0.16		J+	10		J	26			8200			1700		B
L-3	VLF-140416-15	04/16/14	4600		B	260		J+				2000			1700			700		*	0.2	U	B	25	U		7.6			5900			670		
L-4	VLF-121017-18	10/17/12	3300		B	2200						4200			1900			660		J-	1	U		230			200			7300			1400		B
L-4	VLI-102913-36	10/29/13	5500		B^	190		J				2500			4900			960			0.19		J+	18		J	44			11000			830		B
L-4	VLF-140416-17	04/16/14	5300		B	1900		J+				3900			6200			820		*	1.2		B	25	U		58			11000			1300		
L-5	VLF-140416-18	04/16/14	6600		B	4926.53		J-				21000			1700			620		*	0.2	U	B	550			420			17000			7900		B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Milligrams per liter (mg/L)
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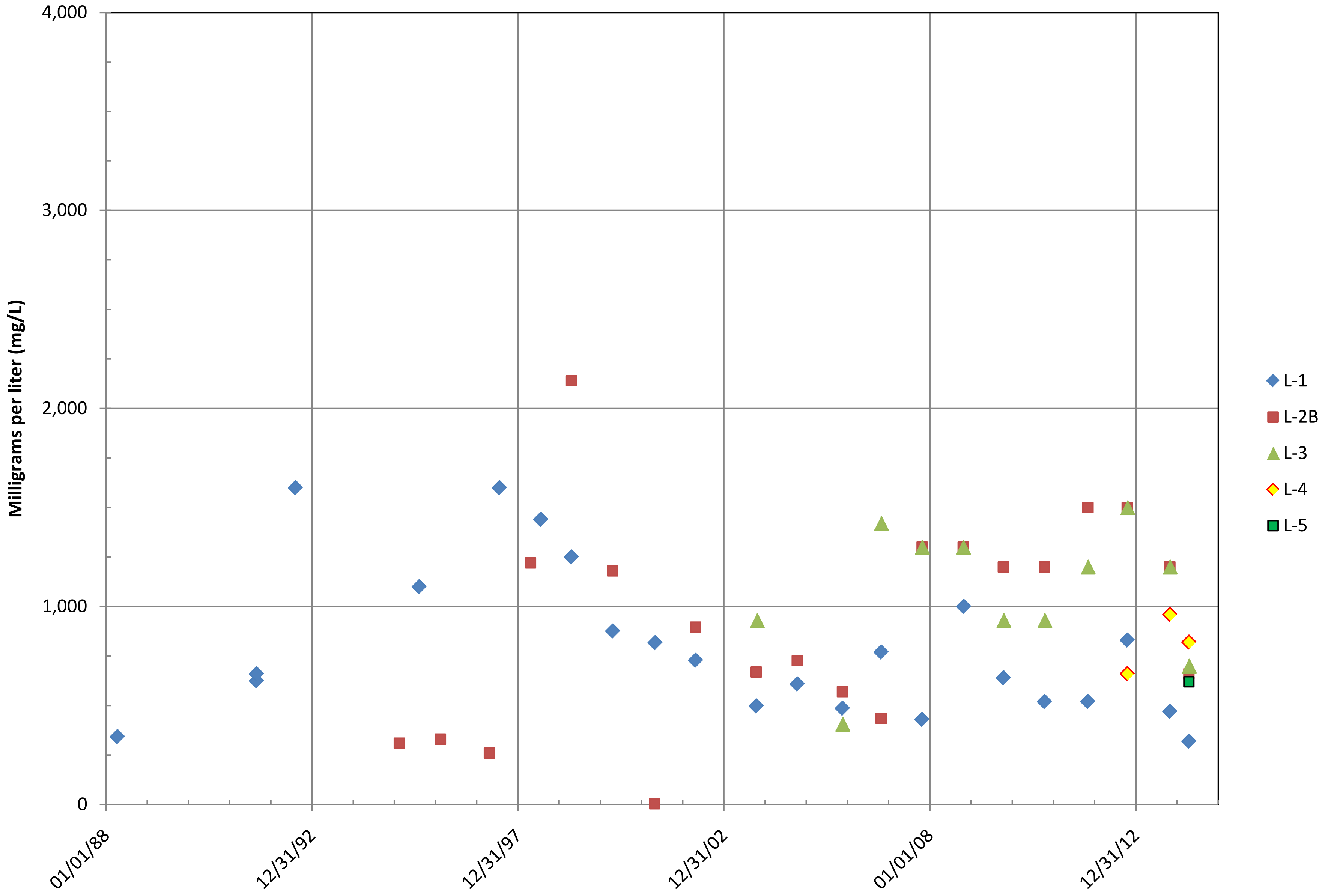
6,000
4,000
2,000
0
01/01/88
12/31/92
12/31/97
12/31/02
01/01/08
12/31/12
L-1
L-2B
L-3
L-4
L-5

Ammonia as Nitrogen



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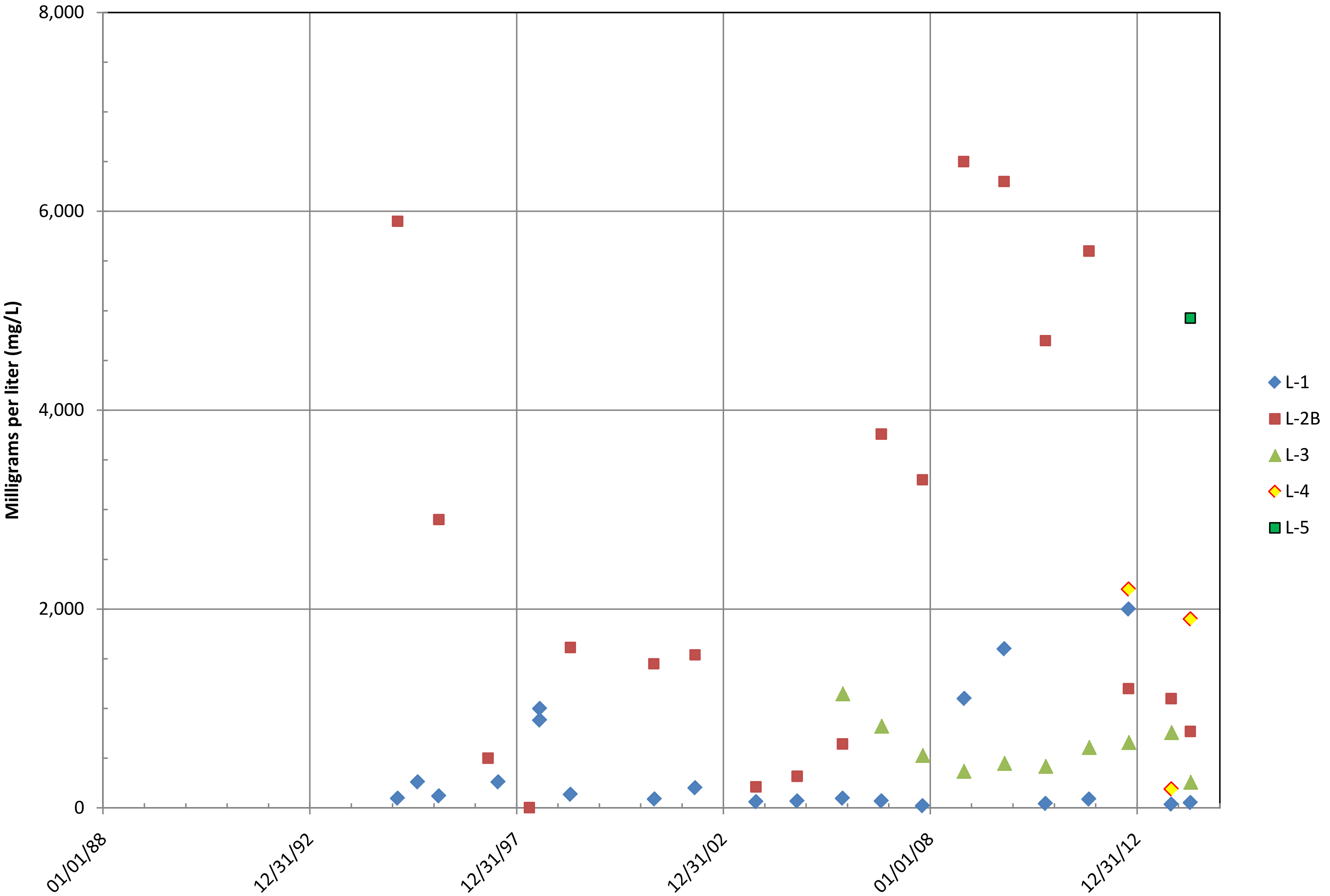
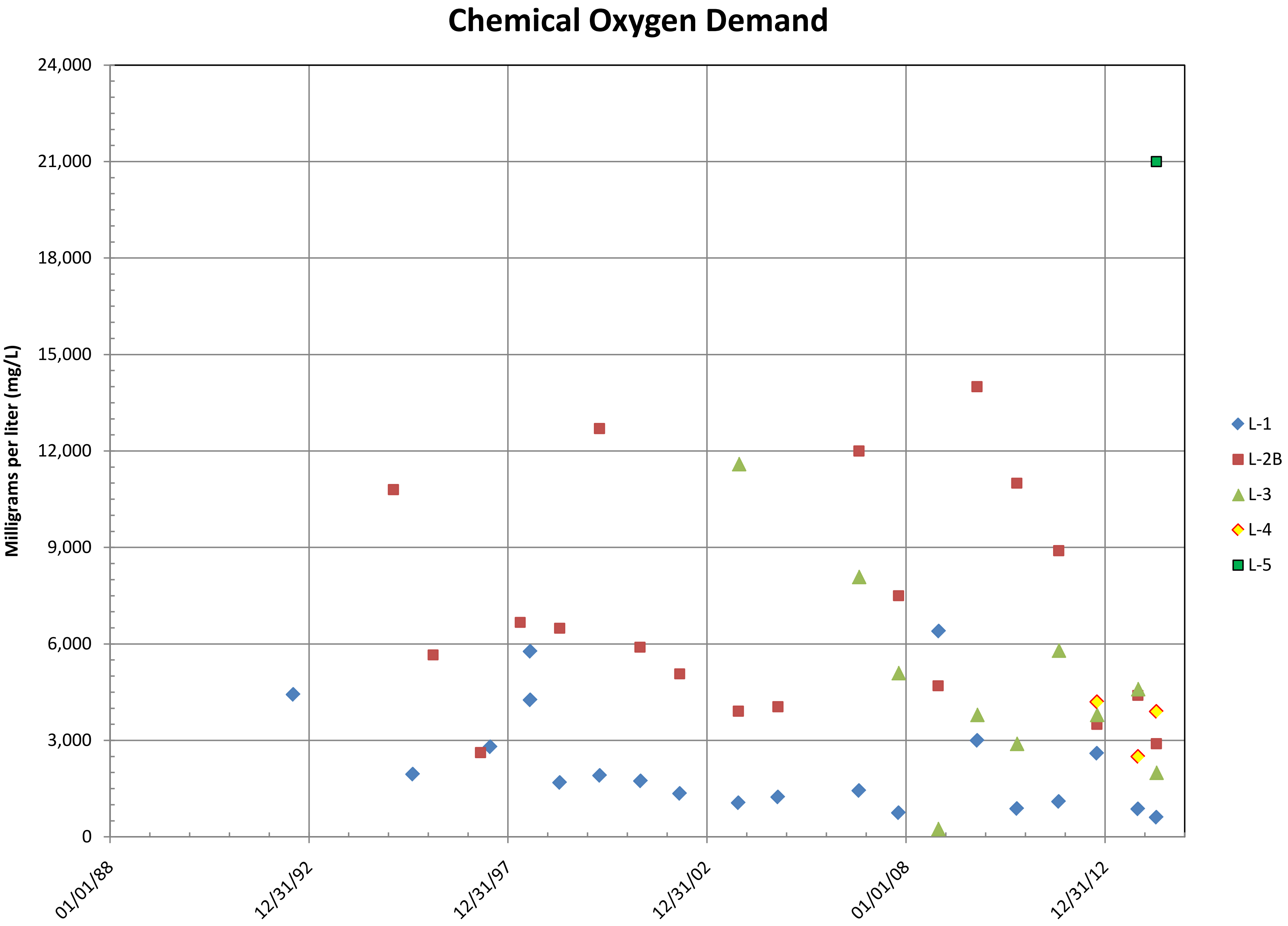
Biological Oxygen Demand




Chemical Oxygen Demand
Milligrams per liter (mg/L)
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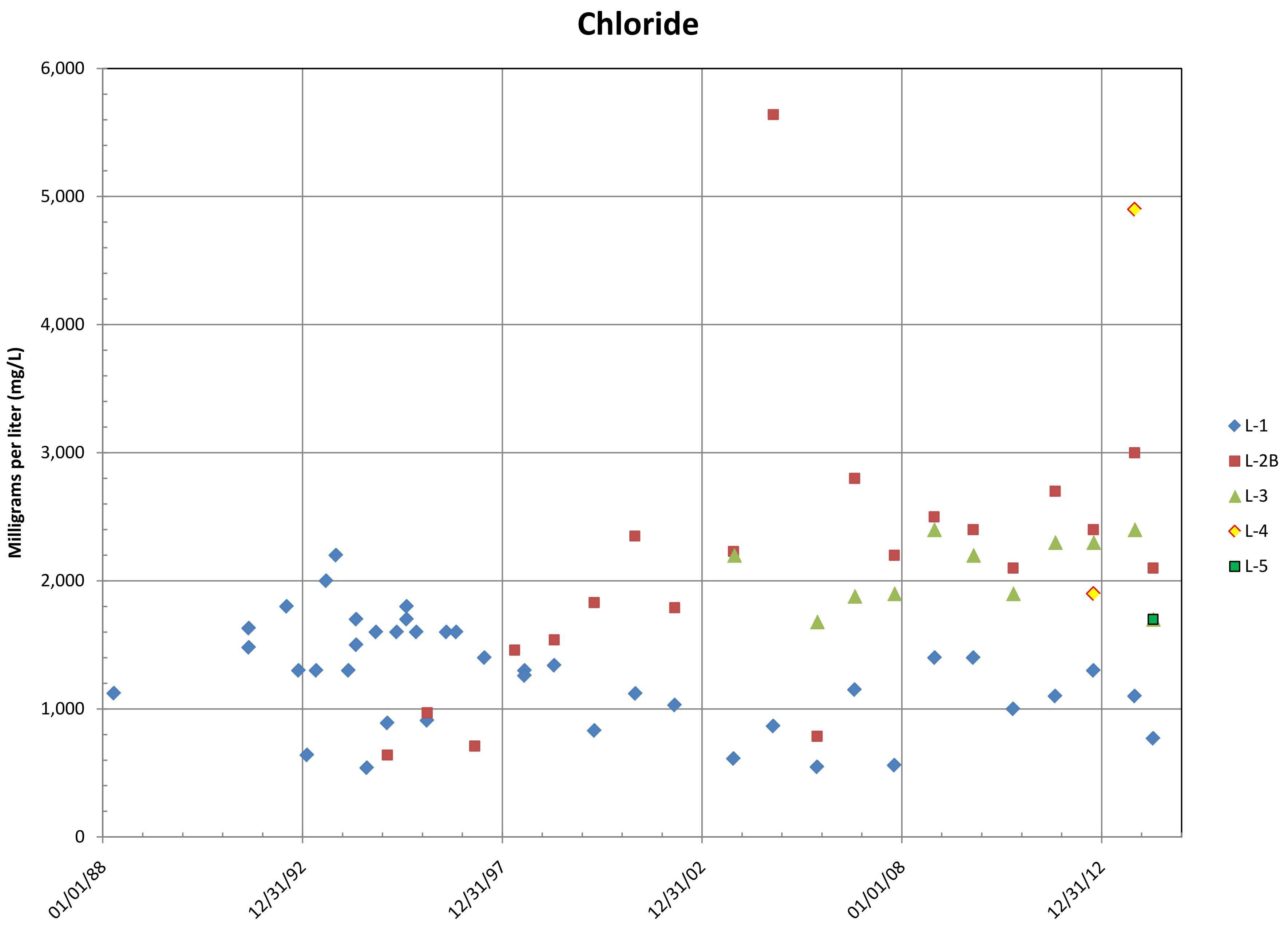
21,000
18,000
15,000
12,000
9,000
6,000
3,000
0
01/01/88
12/31/92
12/31/97
12/31/02
01/01/08
12/31/12
L-1
L-2B
L-3
L-4
L-5


Chloride
Milligrams per liter (mg/L)
6,000
5,000
4,000
3,000
2,000
1,000
0
01/01/88
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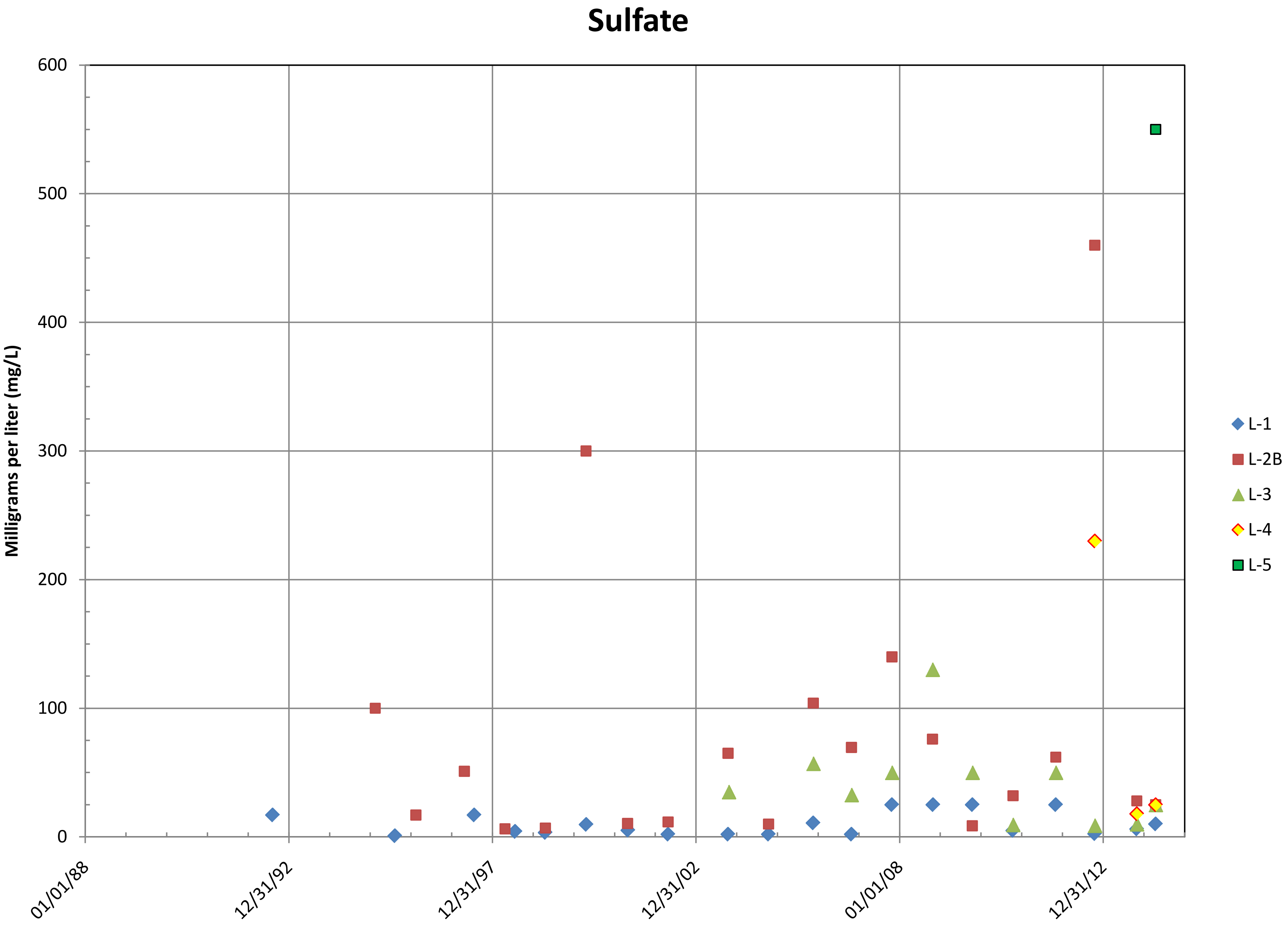
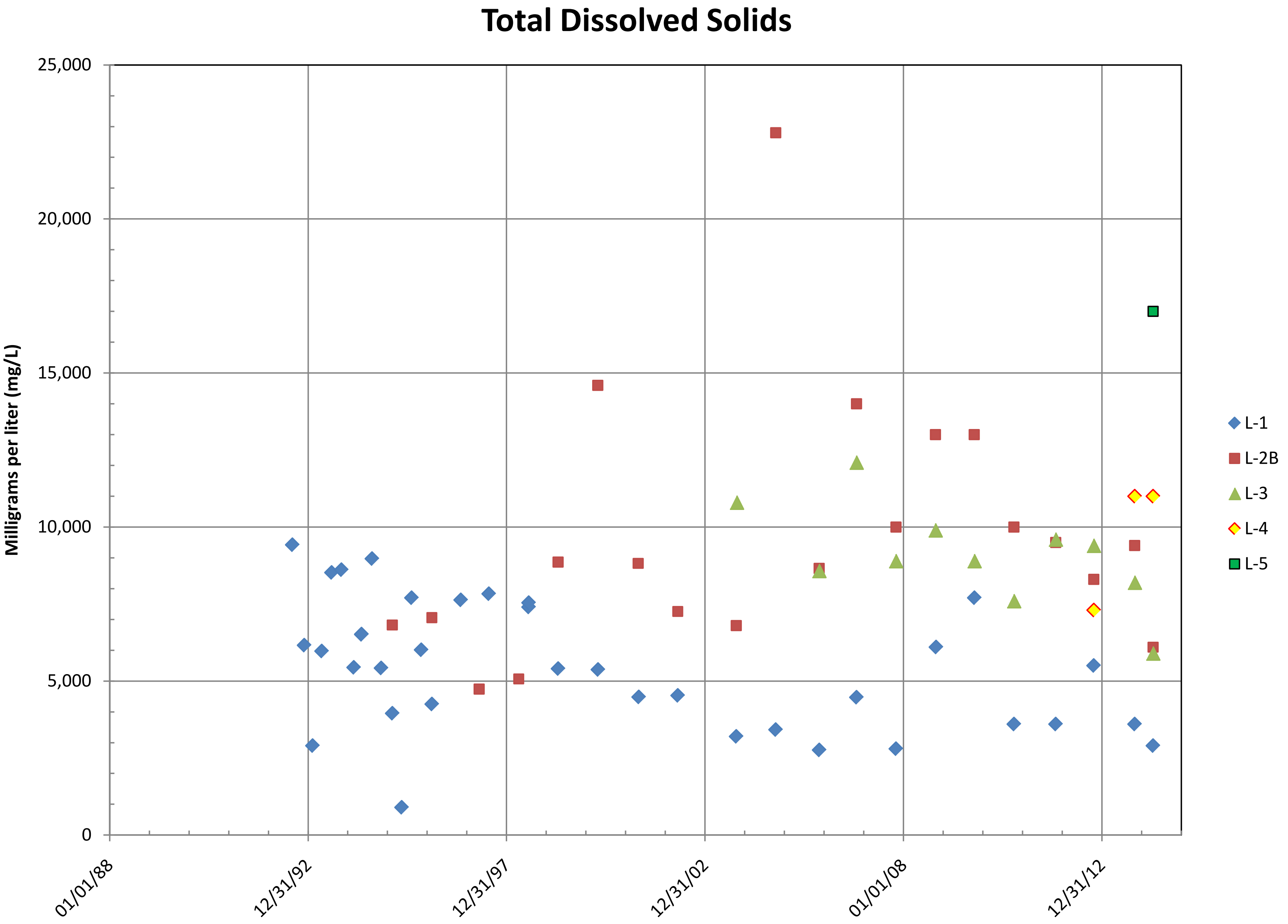
L-3
L-4
L-5


Sulfate
Milligrams per liter (mg/L)
600
500
400
300
200
100
0
01/01/88
12/31/92
12/31/97
12/31/02
01/01/08
12/31/12
L-1
L-2B
L-3
L-4
L-5



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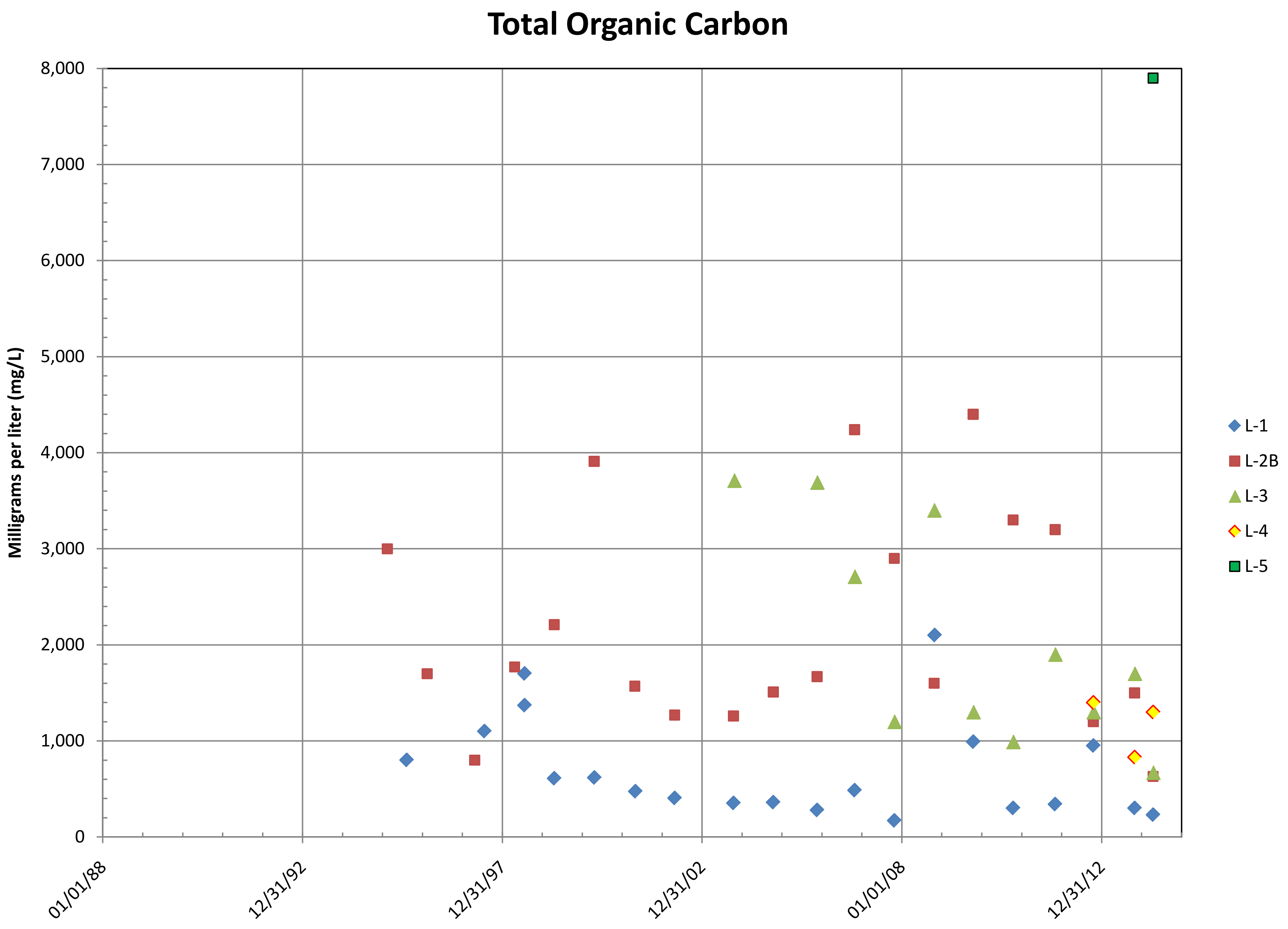
Total Organic Carbon
Milligrams per liter (mg/L)
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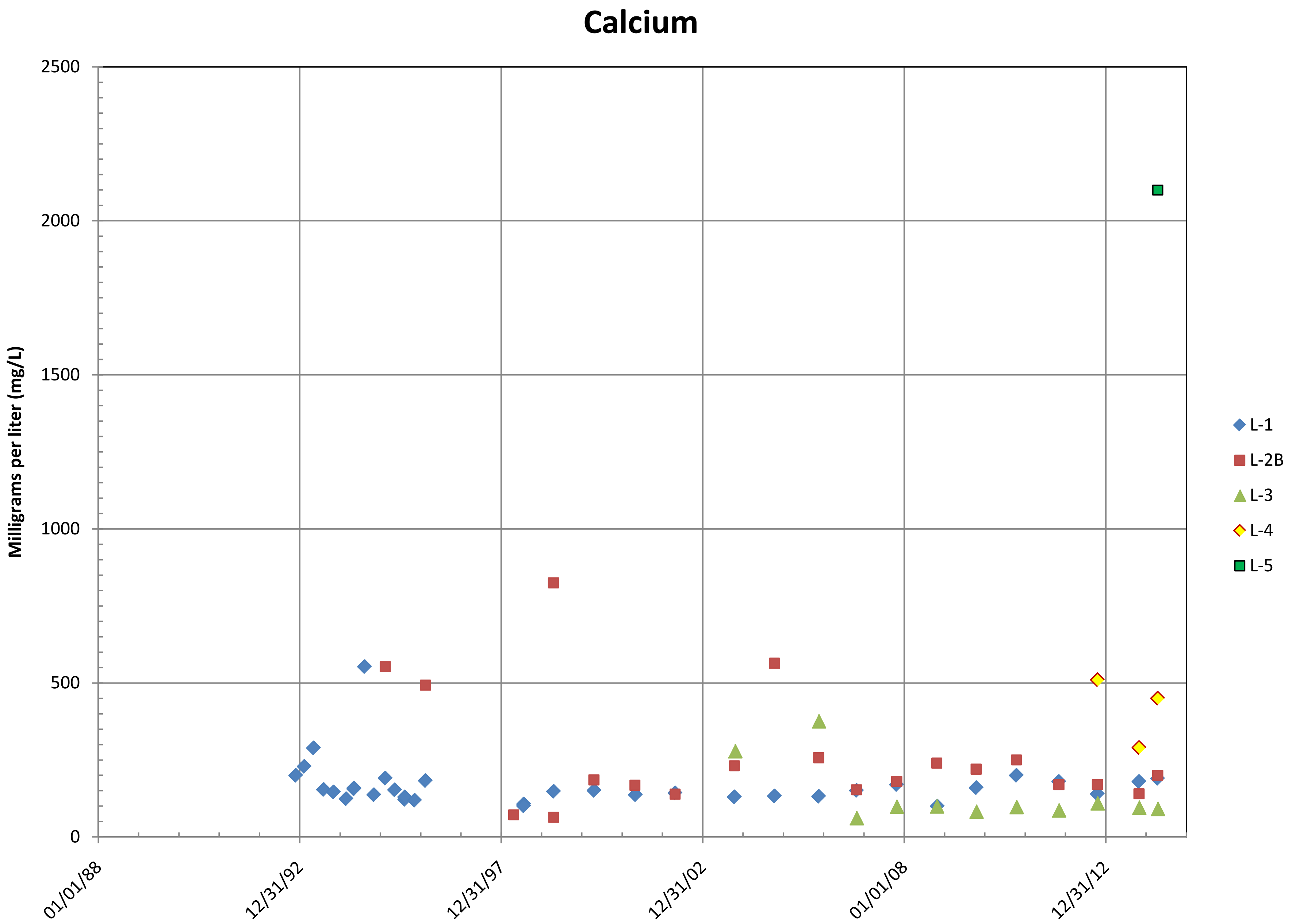
6,000
5,000
4,000
3,000
2,000
1,000
0
01/01/88
12/31/92
12/31/97
12/31/02
01/01/08
12/31/12
L-1
L-2B
L-3
L-4
L-5

Appendix E
Historical Leachate Data - Dissolved Metals
Coffin Butte Landfill

Sump	Sample ID	Date	Calcium			Iron			Magnesium			Manganese			Potassium			Silicon			Sodium		
			mg/L			mg/L			mg/L			mg/L			mg/L			mg/L			mg/L		
L-1	L-1	11/25/92	200						185												845		
L-1	CB-21093-29	02/10/93	229						142												452		
L-1	CB-050593-3	05/05/93	289						235												922		
L-1	CB-080493-20	08/04/93	154						185												1620		
L-1	CB-110293-11	11/02/93	146						177												1650		
L-1	CB-022494-32	02/24/94	124						116												972		
L-1	CB-050694-8	05/06/94	156						163												1090		
L-1	CB-050694-8	05/06/94	159						166												1110		
L-1	CB-081194-19	08/11/94	553						649												583		
L-1	CB-110394-3	11/03/94	137						142												1260		
L-1	CB-021495-30	02/14/95	191						132												667		
L-1	CB-051195-6	05/11/95	153						160												1400		
L-1	CB-081095-18	08/10/95	122						136												1380		
L-1	COFFIN13	08/10/95	130			7.2			150			1.1			480			67			1600		
L-1	CB-110795-4	11/07/95	119						133												1420		
L-1	CB-021396-32	02/13/96	183						126												690		
L-1	CB-072398-3	07/23/98	107			2.48			75.3			0.526			477			48.7			1260		
L-1	CB-072398-4	07/23/98	101			2.43			70.8			0.494			448			45.3			1180		
L-1	CB-042099-17	04/20/99	148			6.45			151			2.07			323			22.7			1080		
L-1	CB-042100-42	04/21/00	151			12			159			2.04			323			23.8			1100		
L-1	VLF-050101-42DI	05/01/01	137			11.7			143			1.81			315			23.9			1010		
L-1	VLF-042502-38	04/25/02	143			14.4			148			2.42			263			22.6			877		
L-1	VLF-101503-15	10/15/03	130			18.1			109			1.99			165			20.8			566		
L-1	VLF-101204-5	10/12/04	133			6.09			118			1.81									675		
L-1	VLF-111705-33	11/17/05	132			9.04			103			1.93			164			23.5			551		
L-1	VLF-061026-27	10/26/06	151			4.49			163			1.69			268			22.9			977		
L-1	VLF-071024-7	10/24/07	170			3.1			110			6.5			140			20			500		
L-1	VLF-081027-35	10/27/08	100			6.5			88			1.4			510			44			2100		
L-1	VLF-091015-18	10/15/09	160			7.3			120			3.3			380			32			1300		
L-1	VLF-101014-9	10/14/10	200			4.8			150			4		B	180			29			790		
L-1	VLF-111102-7	11/02/11	180			11			140			3.6			190			29			730		
L-1	VLF-121017-16	10/17/12	140			8.1			130			2.2			370			36			1600		
L-1	VLI-102913-33	10/29/13	180			4.9			140			3.4			180			30			730		B
L-1	VLF-140416-16	04/16/14	190			2.4			130			4.3			140			34			600		
L-2B	CB-021495-29	02/14/95	553			37.2			272			11.6			225			16.6			796		
L-2B	CB-021396-29	02/13/96	493			1.03			179			5.18			268			19.4			757		
L-2B	CB-042398-25	04/23/98	71.9			1.83			82			0.341			615			28.2			1620		

Appendix E
Historical Leachate Data - Dissolved Metals
Coffin Butte Landfill

Sump	Sample ID	Date	Calcium		Iron		Magnesium		Manganese		Potassium		Silicon		Sodium	
			mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
L-2B	L-2B	04/19/99	825		43.8		257		14		634				2030	
L-2B	CB-042099-4	04/20/99	63.8		0.508		82.8		0.367		675		41.1		1570	
L-2B	CB-041900-13	04/19/00	185		13.8		186		0.452		515		24.2		1770	
L-2B	VLF-042601-25	04/26/01	168		3.53		129		1.74		433		30.3		1660	
L-2B	VLF-042502-39	04/25/02	139		4.86		116		1.96		513		31.2		1850	
L-2B	VLF-101503-17	10/15/03	231		7.38		224		3.73		281		25.1		1310	
L-2B	VLF-101204-7	10/12/04	564		15.9		1380		9.39						2110	
L-2B	VLF-111705-34	11/17/05	257		18.2		190		3.35		415		29.8		1670	
L-2B	VLF-061026-29	10/26/06	153		10.8		146		1.6		823		44.3		2940	
L-2B	VLF-071024-8	10/24/07	180		3.8		130		1.8		500		36		2000	
L-2B	VLF-081022-14	10/22/08	240		12		150		2.6	B	520		51	J	2200	
L-2B	VLF-091014-5	10/14/09	220		17		150		1.7		610		39		2500	
L-2B	VLF-101014-8	10/14/10	250		4.8		150		1.9	B	510		46		2400	
L-2B	VLF-111102-5	11/02/11	170		17		150		1.7		590		42		2500	
L-2B	VLF-121017-17	10/17/12	170		13		170		2.2		390		33		2000	B
L-2B	VLI-102913-35	10/29/13	140		8.7		190		1.7	B	450		34		2100	B
L-2B	VLF-140416-14	04/16/14	200		12		160		4.2		320		30		1500	B
L-3	VLF-102103-45	10/21/03	279		37.9		336		3.16		694		31.3		2310	
L-3	VLF-111705-32	11/17/05	376		1.14		162		4.44		492		31		1730	
L-3	VLF-061026-28	10/26/06	62		6.17		83.7		0.89		755		32.3		2600	
L-3	VLF-071024-10	10/24/07	99		1.3		100		1.8		480		30		1800	
L-3	VLF-081022-15	10/22/08	100		4		97		1.3	B	570		37	J	2400	
L-3	VLF-091015-19	10/15/09	83		3.1		140		0.99		580		29		2400	
L-3	VLF-101014-10	10/14/10	98		2		120		1.3	B	510		29		2300	
L-3	VLF-111102-6	11/02/11	87		3.9		100		1.2		570		37		2300	
L-3	VLF-121017-15	10/17/12	110		5.6		110		1.7		520		38		2400	
L-3	VLI-102913-34	10/29/13	96		5.2		98		1.5		520		35		2300	B
L-3	VLF-140416-15	04/16/14	92		4.9		89		1.5		360		31		1700	
L-4	VLF-121017-18	10/17/12	510		21		340		10		290		23		1000	
L-4	VLI-102913-36	10/29/13	290		5.2		500		1.7	B	620		23		2500	B
L-4	VLF-140416-17	04/16/14	450		6.7		540		5.5		540		25		2300	
L-5	VLF-140416-18	04/16/14	2100		130		560		46		310		30		1100	



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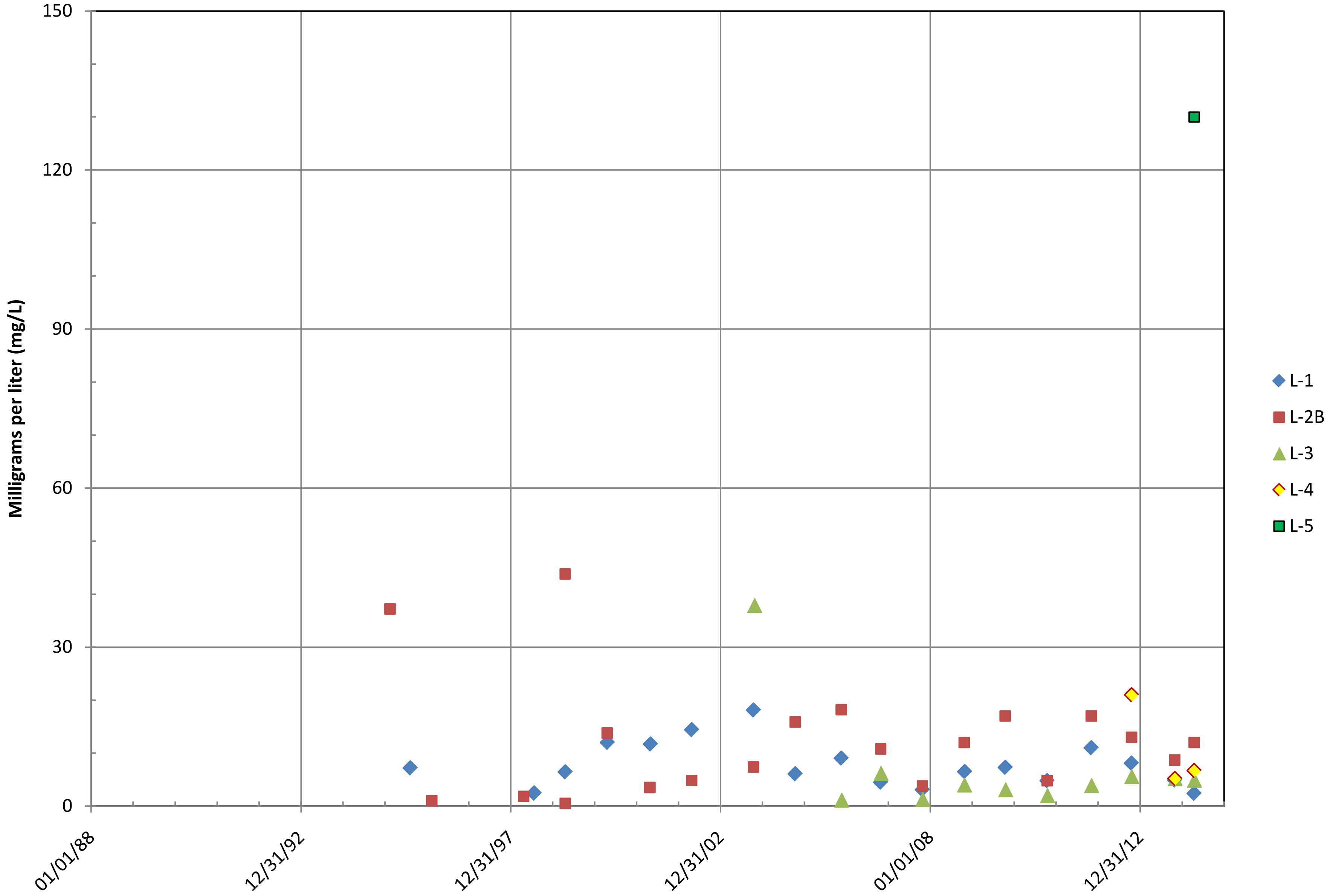
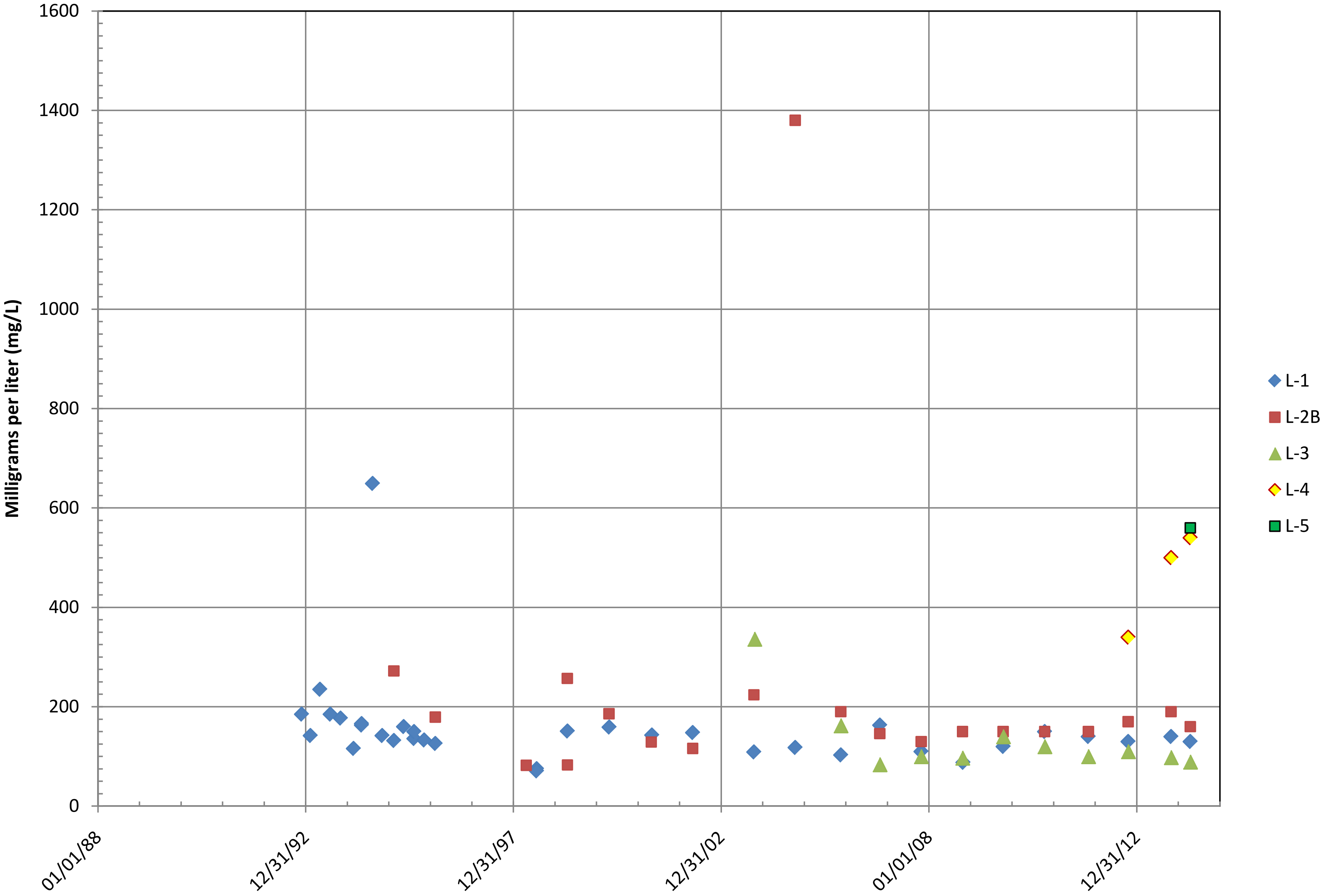
5/22/2014

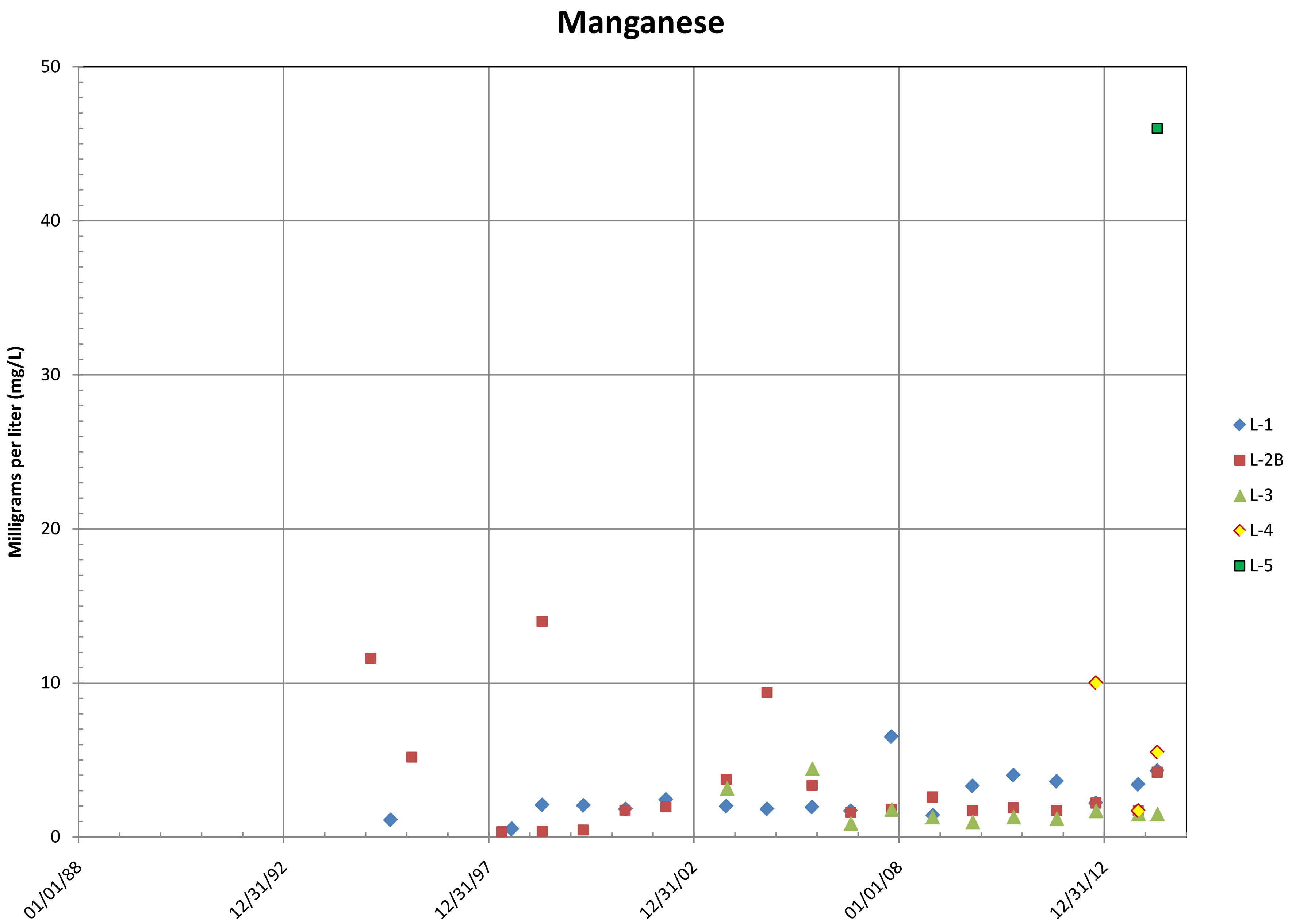
Iron



150
120
90
60
30
0
Milligrams per liter (mg/L)
01/01/88
12/31/92
12/31/97
12/31/02
01/01/08
12/31/12
L-1
L-2B
L-3
L-4
L-5

Magnesium


Milligrams per liter (mg/L)
1600
1400
1200
1000
800
600
400
200
0
01/01/88
12/31/92
12/31/97
12/31/02
01/01/08
12/31/12
◆ L-1
■ L-2B
▲ L-3
◇ L-4
■ L-5



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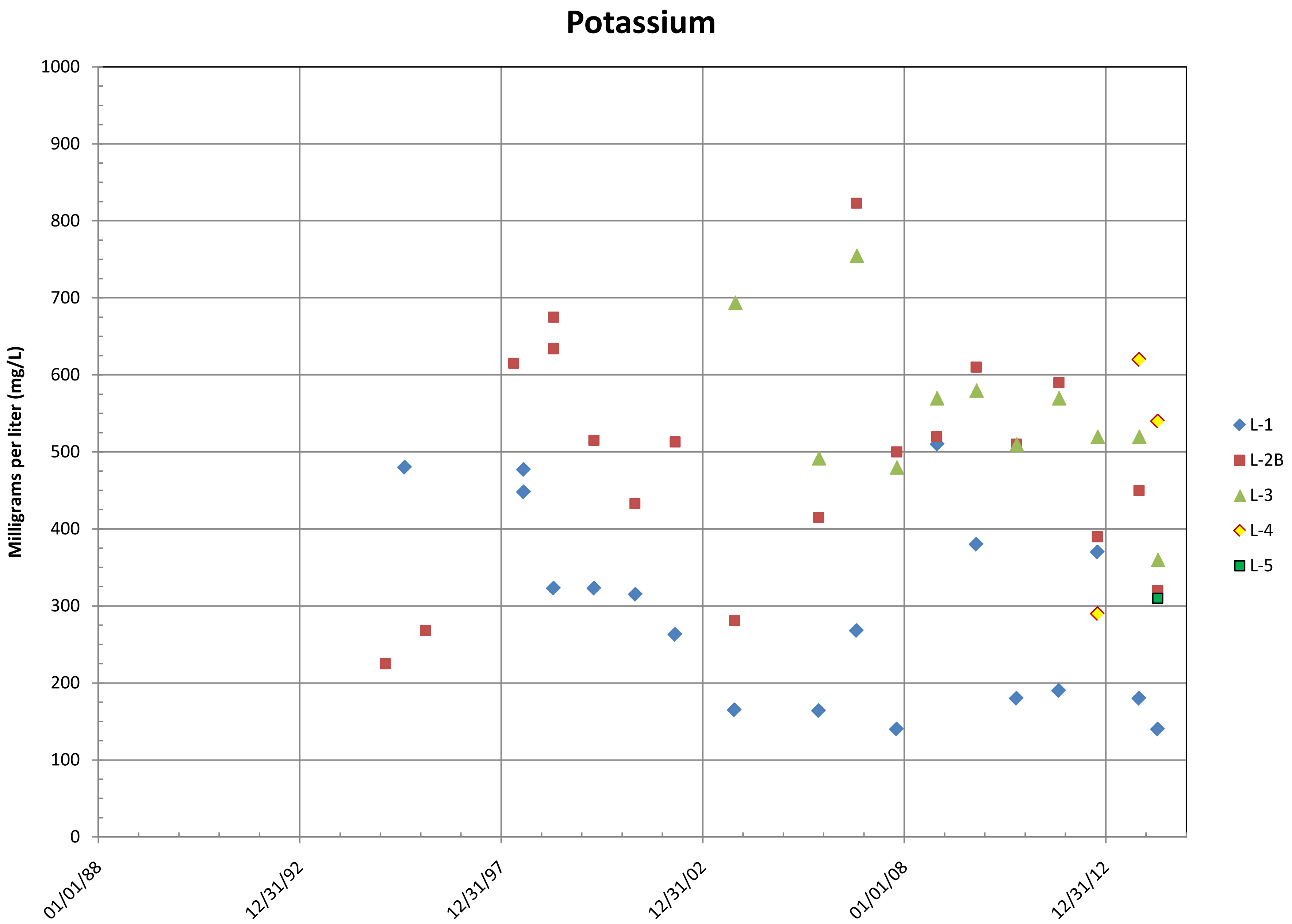
5/22/2014



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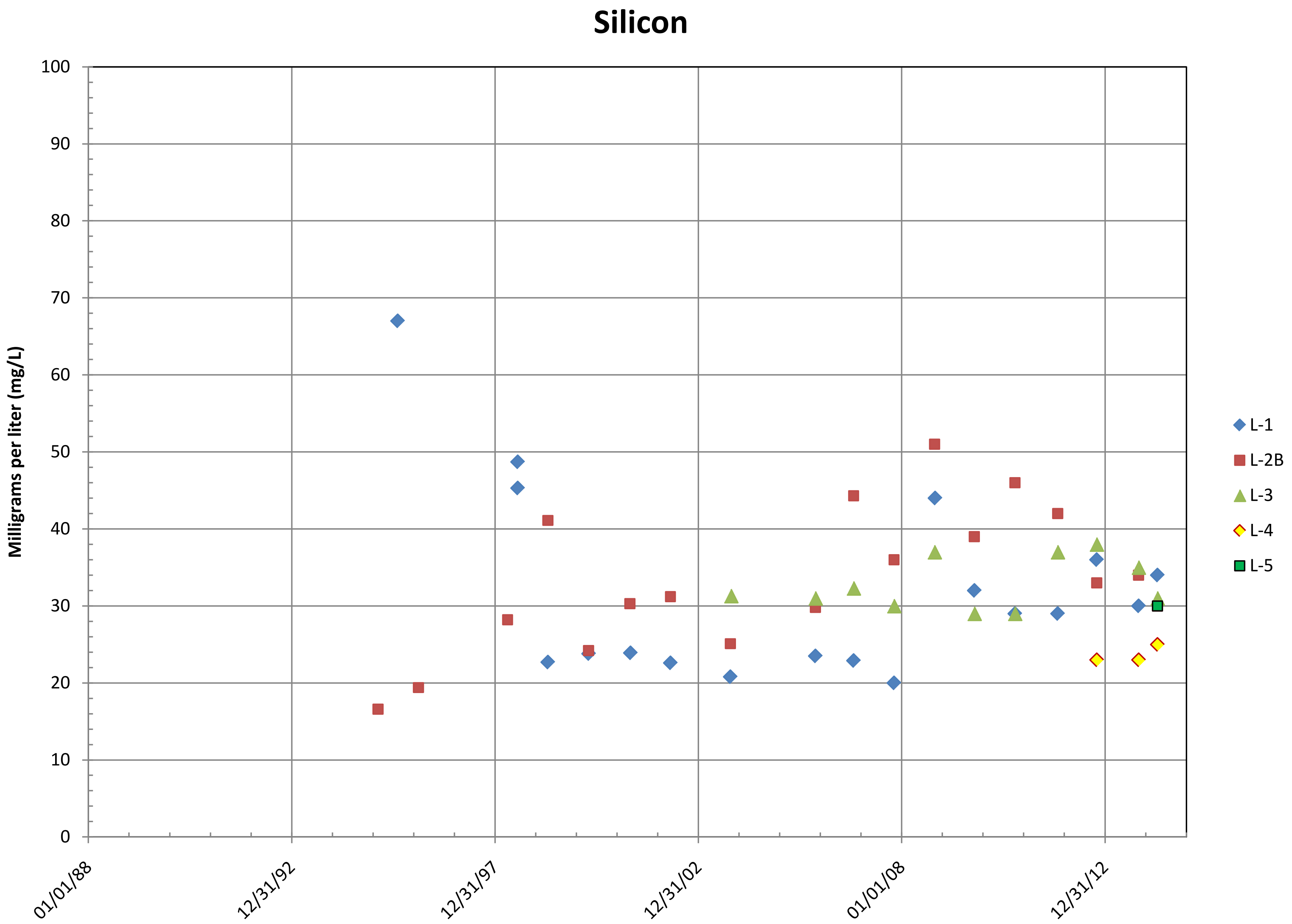
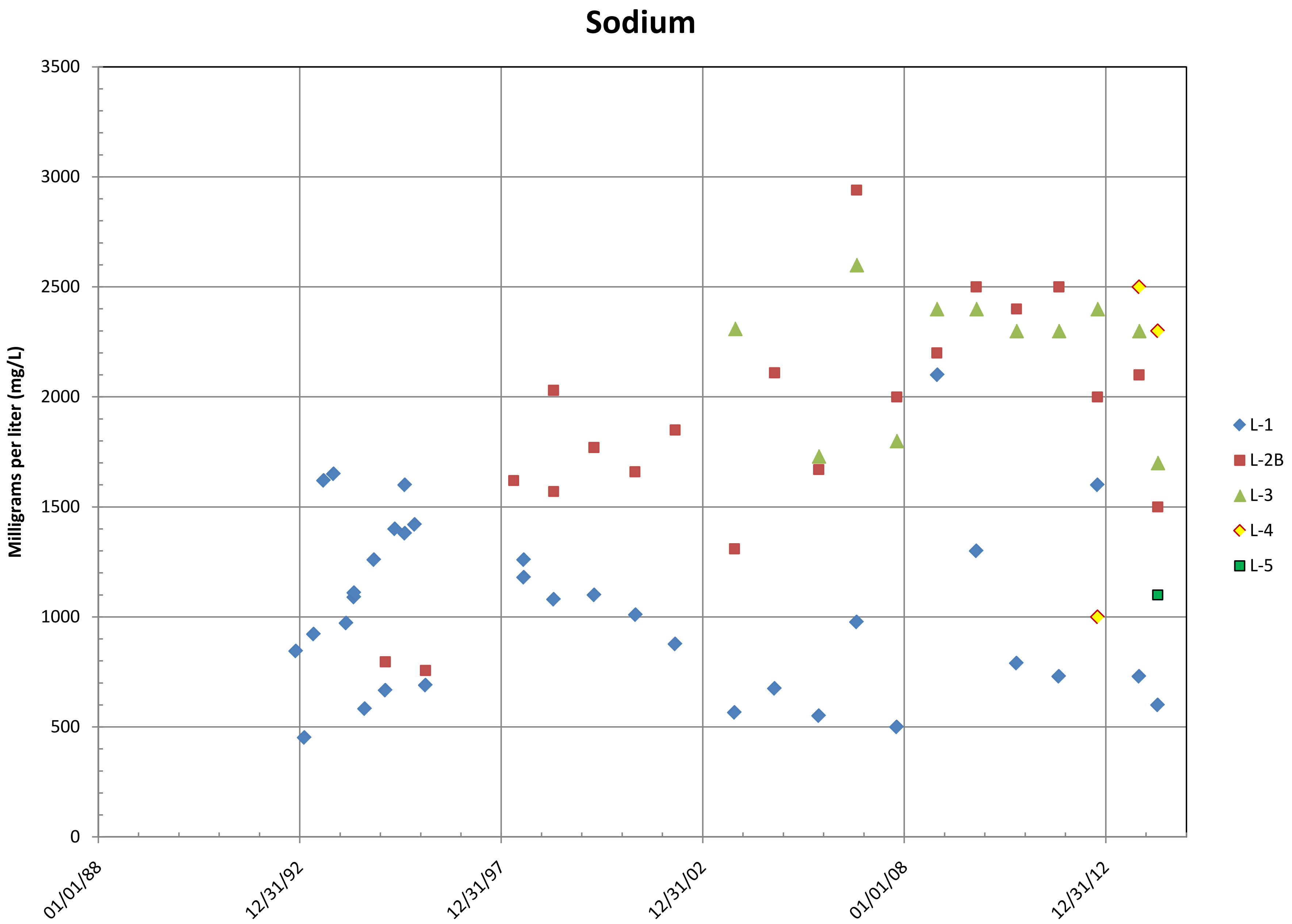
5/22/2014


Silicon
Milligrams per liter (mg/L)
100
90
80
70
60
50
40
30
20
10
0
01/01/88
12/31/92
12/31/97
12/31/02
01/01/08
12/31/12
L-1
L-2B
L-3
L-4
L-5


Sodium
Milligrams per liter (mg/L)
3500
3000
2500
2000
1500
1000
500
0
01/01/88
12/31/92
12/31/97
12/31/02
01/01/08
12/31/12
L-1
L-2B
L-3
L-4
L-5

Appendix E
Historical Leachate Data - Total Metals
Coffin Butte Landfill

Sump	Sample ID	Date	Antimony			Arsenic			Barium			Beryllium			Cadmium			Chromium			Cobalt			Copper		
			UG/L			UG/L			UG/L			UG/L			UG/L			ug/L			UG/L			UG/L		
L-1	L-1	10/05/88				5.5									5	U		10	U							
L-1	L-1	02/27/90				18									2	U		94								
L-1	L-1	08/28/91				19									4			149								
L-1	L-1	08/28/91				29									9			239								
L-1	L-1	01/16/92				17									3	U		77								
L-1	L-1	08/06/92	50	U		35			414			5	U		3			177			98			13		
L-1	CB-21093-29	02/10/93				11			146						3	U		40								
L-1	CB-022494-32	02/24/94				30			301						0.9			74								
L-1	CB-021495-30	02/14/95				16			208						0.5			48								
L-1	COFFIN13	08/10/95				20			540			10	U		10	U		120			70			20	U	
L-1	CB-021396-32	02/13/96	1.4		J	16			208			0.4	U	D	0.5			51			38			10	U	
L-1	CB-080697-1	08/06/97	3.2			10	U		399			0.2	U		5.6			132			79			10	U	
L-1	CB-072398-3	07/23/98	9.1			63			446			2.8			1.9			155			64			50	U	
L-1	CB-072398-4	07/23/98	9			51			425			3			1.9			144			55			50	U	
L-1	CB-042099-17	04/20/99	1.7			22			305			0.1	U		1.2			55			54			10	U	
L-1	CB-042100-42	04/21/00	1.4			10	U		328			0.2	U		1.2			45			54			10	U	
L-1	VLF-050101-42	05/01/01	0.62			14.3			299			0.05			0.66			48.7			49.5			10	U	
L-1	VLF-042502-38	04/25/02	0.9			10			266			0.64			2.25			39.2			47.5			10	U	
L-1	VLF-101503-15	10/15/03	2.46			10	U		221			0.1	U		3.51			23.8			29			10	U	
L-1	VLF-101204-5	10/12/04	0.84			13.6			254			0.16			1.78			28.9			31			20	U	U
L-1	VLF-111705-33	11/17/05	0.64			7.2			182			0.29			0.64			22.1			26.1			10	U	
L-1	VLF-061026-27	10/26/06	0.72		CI,	16.9			331			6.57			1.21			34.2			41.2			10	U	
L-1	VLF-071024-7	10/24/07	0.55			13			240			2	U		0.74			25			41			4.5		
L-1	VLF-081027-35	10/27/08	14			95		J	330			5	U		22			170		B	45		J	4.4		UJ
L-1	VLF-091015-18	10/15/09	8.7		B	64			320		B	1.2		J	22			86			43		J	1.9		J
L-1	VLF-101014-9	10/14/10	0.73		J	12		B	230		B	0.88		J	19			26			42			0.78		J
L-1	VLF-111102-7	11/02/11	1.1		J	13			260			1	U		1	U		24			38			1.3		J
L-1	VLF-121017-16	10/17/12	7.1		J	69			380			5	U		8.1			72			41			1		J
L-1	VLI-102913-33	10/29/13	1.3		J	6.2			230			1	U	^	1	U		23			40			1.9		J
L-1	VLF-140416-16	04/16/14	0.84		J	7			180			1	U		0.051		J	17			32			0.58		J
L-2B	CB-021495-29	02/14/95	8.1			21			577			0.2			3			55			84			38		
L-2B	CB-021396-29	02/13/96	9.6		J	73			1140			0.6			4.9			106			218			110		
L-2B	CB-042397-24	04/23/97	2.09			52.4			270			0.14			0.42			102			18			14		
L-2B	CB-042398-25	04/23/98	8.5		D	253		D	799			1.7		D	1.6		D	241			45			18		
L-2B	L-2B	04/19/99	30.7			280			763			0.01			1.22			333			88.9			74.4		
L-2B	CB-042099-4	04/20/99	72.3			450			356			0.5	U		0.5	U		296			18			10	U	
L-2B	CB-041900-13	04/19/00	16			170			820			0.4	U		5.3			300			84			60		
L-2B	VLF-042601-25	04/26/01	20.9			263			799			0.13			0.38			307			50.7			27.5		
L-2B	VLF-042502-39	04/25/02	21.7			169			484			0.26			1.48			256			34.5			22.2		
L-2B	VLF-101503-17	10/15/03	6.77			62.1			657			0.2	U		5.58			176			46.2			37.8		
L-2B	VLF-101204-7	10/12/04	5.88			117			1270			0.1	U	U	1.69			346			36.8			20	U	U

Appendix E
Historical Leachate Data - Total Metals
Coffin Butte Landfill

Sump	Sample ID	Date	Antimony			Arsenic			Barium			Beryllium			Cadmium			Chromium			Cobalt			Copper		
			UG/L			UG/L			UG/L			UG/L			UG/L			ug/L			UG/L			UG/L		
L-2B	VLF-111705-34	11/17/05	27			97.2			440			0.11			0.14			145			30.5			10	U	
L-2B	VLF-061026-29	10/26/06	27.4		CI,	498			626			2.77			0.4	U		255			34.1			10	U	
L-2B	VLF-071024-8	10/24/07	28			290			580			10	U		10	U		250			44			25		
L-2B	VLF-081022-14	10/22/08	15			170			670			5	U		5	U		200		B	36		J	4.6		J
L-2B	VLF-091014-5	10/14/09	22		B	260			760		B	1		J	0.96		J	240			36			4.4		J
L-2B	VLF-101014-8	10/14/10	18			200		B	710		B	5	U		0.55		J	220			32			2.4		J
L-2B	VLF-111102-5	11/02/11	33			200			670			1	U		1	U		200			31			2.2		
L-2B	VLF-121017-17	10/17/12	22			130			690			5	U		1.5		J	170			39			4.6		J
L-2B	VLI-102913-35	10/29/13	30			140			680		J+	5	U		5	U		160			32			4.5		JB
L-2B	VLF-140416-14	04/16/14	30			96			520			1	U		0.26		J	100			25			5.5		
L-3	VLF-102103-45	10/21/03	14.3			108			508			0.2	U		6.89			236			60.8			85.8		
L-3	VLF-111705-32	11/17/05	30.9			166			643			0.29			7.66			278			55.6			109		
L-3	VLF-061026-28	10/26/06	4.21		CI,	267			673			3.05			0.71			624			42.1			21.2		
L-3	VLF-071024-10	10/24/07	3.1			180			670			10	U		10	U		320			31			6.9		
L-3	VLF-081022-15	10/22/08	3.3			180			610			10	U		5	U		330		B	46		J	8.1		J
L-3	VLF-091015-19	10/15/09	3.6		B	130			650		B	5	U		2.2		J	300			39		J	5.7		J
L-3	VLF-101014-10	10/14/10	8		J	130		B	550		B	5	U		3.1		J	230			39			2.2		J
L-3	VLF-111102-6	11/02/11	18			200			680			1	U		0.23		J	290			42			3.4		
L-3	VLF-121017-15	10/17/12	11			160			660			5	U		2.5		J	310			46			3.6		J
L-3	VLI-102913-34	10/29/13	7.9			150			670			1	U	^	0.11		J	260			45			2.1		
L-3	VLF-140416-15	04/16/14	4.4			75			470			0.24		J	0.083		J	150			32			1.4		J
L-4	VLF-121017-18	10/17/12	12			31			780			5	U		1.2		J	42			32			27		
L-4	VLI-102913-36	10/29/13	9.6			110			1400		J+	1	U		0.34		J	260			40			17		B
L-4	VLF-140416-17	04/16/14	13			90			1200			1	U		0.93		J	200			34			36		
L-5	VLF-140416-18	04/16/14	48			24			1900			0.39		J	2.1			75			390			55		

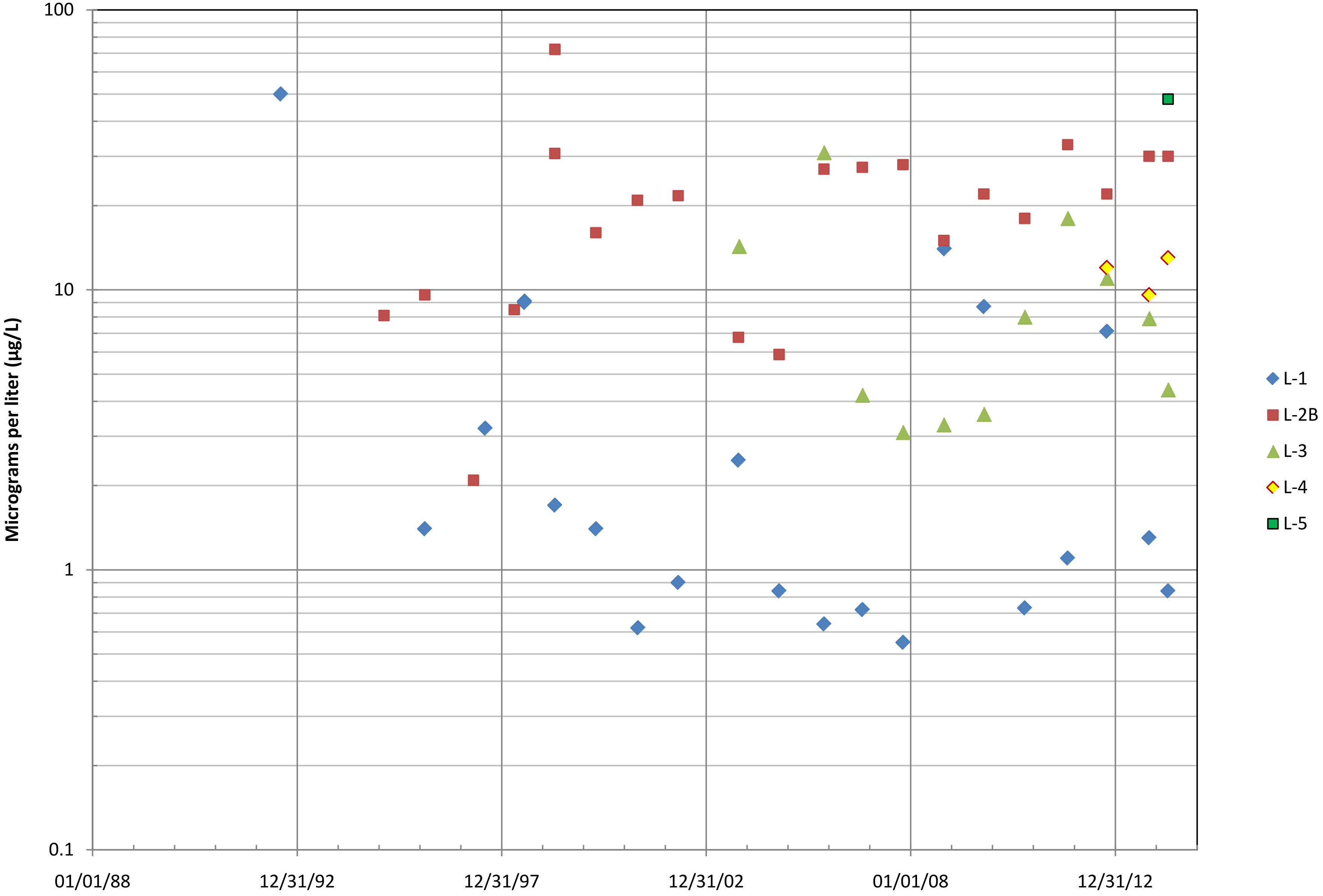
Appendix E
Historical Leachate Data - Total Metals
Coffin Butte Landfill

Sump	Sample ID	Date	Lead			Nickel			Selenium			Silver			Thallium			Vanadium			Zinc		
			ug/L			UG/L			UG/L			UG/L			UG/L			UG/L			UG/L		
L-1	L-1	10/05/88	8.2																				
L-1	L-1	02/27/90	2	U																			
L-1	L-1	08/28/91	32																				
L-1	L-1	08/28/91	128																				
L-1	L-1	01/16/92	13																				
L-1	L-1	08/06/92	16			301			5	U		10	U		5	U		214			558		
L-1	CB-21093-29	02/10/93	3						5	U		10	U										
L-1	CB-022494-32	02/24/94	5.2						5	U		0.21											
L-1	CB-021495-30	02/14/95	2.6						20		J	1.6											
L-1	COFFIN13	08/10/95	6			210			5	U		10	U					80			90		
L-1	CB-021396-32	02/13/96	1.8			101			1	U		1		J	0.4	U	D	37			30		
L-1	CB-080697-1	08/06/97	4.4			219			10	U		17.6			0.2	U		80			42		
L-1	CB-072398-3	07/23/98	7.8			157			6	U		1.7			0.5			67			190		
L-1	CB-072398-4	07/23/98	8.5			167			5	U		1.8			0.6			58			182		
L-1	CB-042099-17	04/20/99	1.5			153			1	U		3.9		J	0.1	U		37			23		
L-1	CB-042100-42	04/21/00	1.6			139			1	U		0.6			0.2	U		36			15		
L-1	VLF-050101-42	05/01/01	1.92			56.3			1	U		2.28			0.04	U		32.1			27.8		
L-1	VLF-042502-38	04/25/02	0.89			109			1	U		4.28			0.2	U		29			11.5		
L-1	VLF-101503-15	10/15/03	0.55			72			1	U		0.8			0.1	U		18.2			10	U	
L-1	VLF-101204-5	10/12/04	0.88			104			2	U	U	0.37			0.1	U	U	20	U	U	20	U	U
L-1	VLF-111705-33	11/17/05	0.3			68.5			1	U		4.45			0.1	U		14.4			10	U	
L-1	VLF-061026-27	10/26/06	1.11			103			1	U		2.84			0.04	U		25.4			26.6		
L-1	VLF-071024-7	10/24/07	0.87			76			9.2			4.9			2	U		17			20		
L-1	VLF-081027-35	10/27/08	2.8			150		J	12			4		J	2	U		110			64		
L-1	VLF-091015-18	10/15/09	0.98		UB	130			5	U		3		J,E	0.45		J,E	66			20		J
L-1	VLF-101014-9	10/14/10	0.26		J	130			2.3		J	2.3			2	U		20			20	U	B
L-1	VLF-111102-7	11/02/11	0.34		J	120		B	5	U		0.032		J	1	U		22			22		
L-1	VLF-121017-16	10/17/12	5	U		140			25	U		0.99		J	5	U		57			50	U	
L-1	VLI-102913-33	10/29/13	0.22		J	120		B	5	U	^	1	U		1	U		17			5.3		J
L-1	VLF-140416-16	04/16/14	0.25		J	98			5	U		0.031		J	0.079		J	14			4.5		J
L-2B	CB-021495-29	02/14/95	16.1			178			7		J	0.1	U		0.1	U		85			4160		J
L-2B	CB-021396-29	02/13/96	27			286			2	U	D	0.4		J	0.4	U	D	160			6340		
L-2B	CB-042397-24	04/23/97	5.85			56.2			1	U		0.1			0.02	U		77			292		
L-2B	CB-042398-25	04/23/98	19.1		D	169		D	2	U		0.7		D	0.2	U	D	188			666		
L-2B	L-2B	04/19/99	3			243			50			0.2			50			287			2760		
L-2B	CB-042099-4	04/20/99	1.3			64			1	U		0.5	U	UJ	0.5	U		88			57		
L-2B	CB-041900-13	04/19/00	17.3			268			1	U		0.4	U		0.4	U		267			2380		
L-2B	VLF-042601-25	04/26/01	7.12			136			1	U		0.37			0.1	U		275			300		
L-2B	VLF-042502-39	04/25/02	4.89			122			1.3			0.58			0.2	U		190			298		
L-2B	VLF-101503-17	10/15/03	2.98			163			1	U		0.32			0.2	U		208			88.5		
L-2B	VLF-101204-7	10/12/04	3.07			368			2	U	U	0.12			0.1	U	U	280			44.1		

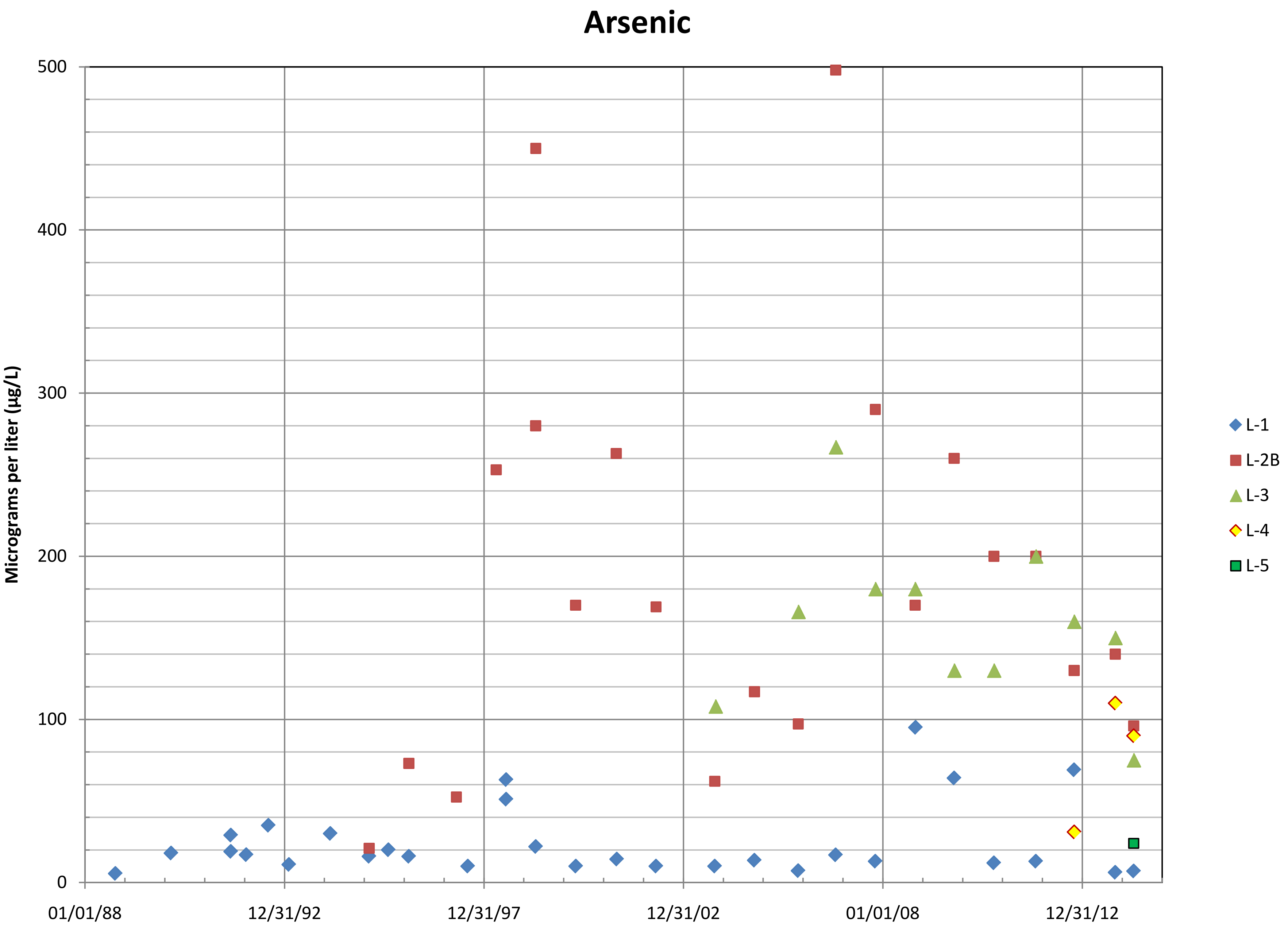
Appendix E
Historical Leachate Data - Total Metals
Coffin Butte Landfill

Sump	Sample ID	Date	Lead			Nickel			Selenium			Silver			Thallium			Vanadium			Zinc		
			ug/L			UG/L			UG/L			UG/L			UG/L			UG/L			UG/L		
L-2B	VLF-111705-34	11/17/05	0.49			88			1	U		0.41			0.1	U		104			59.9		
L-2B	VLF-061026-29	10/26/06	1.66			122			1	U		0.7			0.4	U		106			65.1		
L-2B	VLF-071024-8	10/24/07	3.8			150			16			0.49			10	U		170			180		
L-2B	VLF-081022-14	10/22/08	2.3		J	130		J	5	U		0.48		J	5	U		150			86		
L-2B	VLF-091014-5	10/14/09	4.6		B	120			4.1			0.26		UE	0.088		UE	140			51		
L-2B	VLF-101014-8	10/14/10	2.3		J	120			25	U		5	U		0.15		J	160			200		B
L-2B	VLF-111102-5	11/02/11	2.1			120		B	1.5		J	0.045		J	1	U		140			45		
L-2B	VLF-121017-17	10/17/12	0.95		J	140			25	U		0.32		J	5	U		120			30		J
L-2B	VLI-102913-35	10/29/13	1.4		J	130			25	U		5	U		5	U		110			60		B
L-2B	VLF-140416-14	04/16/14	0.89		J	89			1.2		J	1	U		0.13		J	77			17		
L-3	VLF-102103-45	10/21/03	47.6			240			1.9			0.43			0.2	U		241			3600		
L-3	VLF-111705-32	11/17/05	74.3			381			1.3			0.82			0.14			225			5240		
L-3	VLF-061026-28	10/26/06	13.3			300			1	U		0.69			0.4	U		396			222		
L-3	VLF-071024-10	10/24/07	4.5			200			24			0.33			10	U		260			140		
L-3	VLF-081022-15	10/22/08	3.3		J	290		J	41		B	0.92		J	5	U		300			120		
L-3	VLF-091015-19	10/15/09	2.7		J,E	270			5.2			0.52		J,E	5	U		300			120		
L-3	VLF-101014-10	10/14/10	0.51		J	210			10		J	0.31		J	5	U		240			22		JB
L-3	VLF-111102-6	11/02/11	3.3			190		B	1.7		J	0.039		J	1	U		230			86		
L-3	VLF-121017-15	10/17/12	1.7		J	200			25	U		0.42		J	5	U		230			42		J
L-3	VLI-102913-34	10/29/13	1.5			190		B	10	U		0.023		J	1	U		230			34		
L-3	VLF-140416-15	04/16/14	0.69		J	140			1.8		J	1	U		1	U		130			18		
L-4	VLF-121017-18	10/17/12	2.7		J	200			25	U		0.68		J	5	U		98			260		
L-4	VLI-102913-36	10/29/13	8.1			280			4.5		J	0.1		J	1	U		310			250		B
L-4	VLF-140416-17	04/16/14	8.7			200			2.6		J	0.16		J	1	U		220			380		
L-5	VLF-140416-18	04/16/14	15			400			4.1		J	0.15		J	0.22		J	150			720		

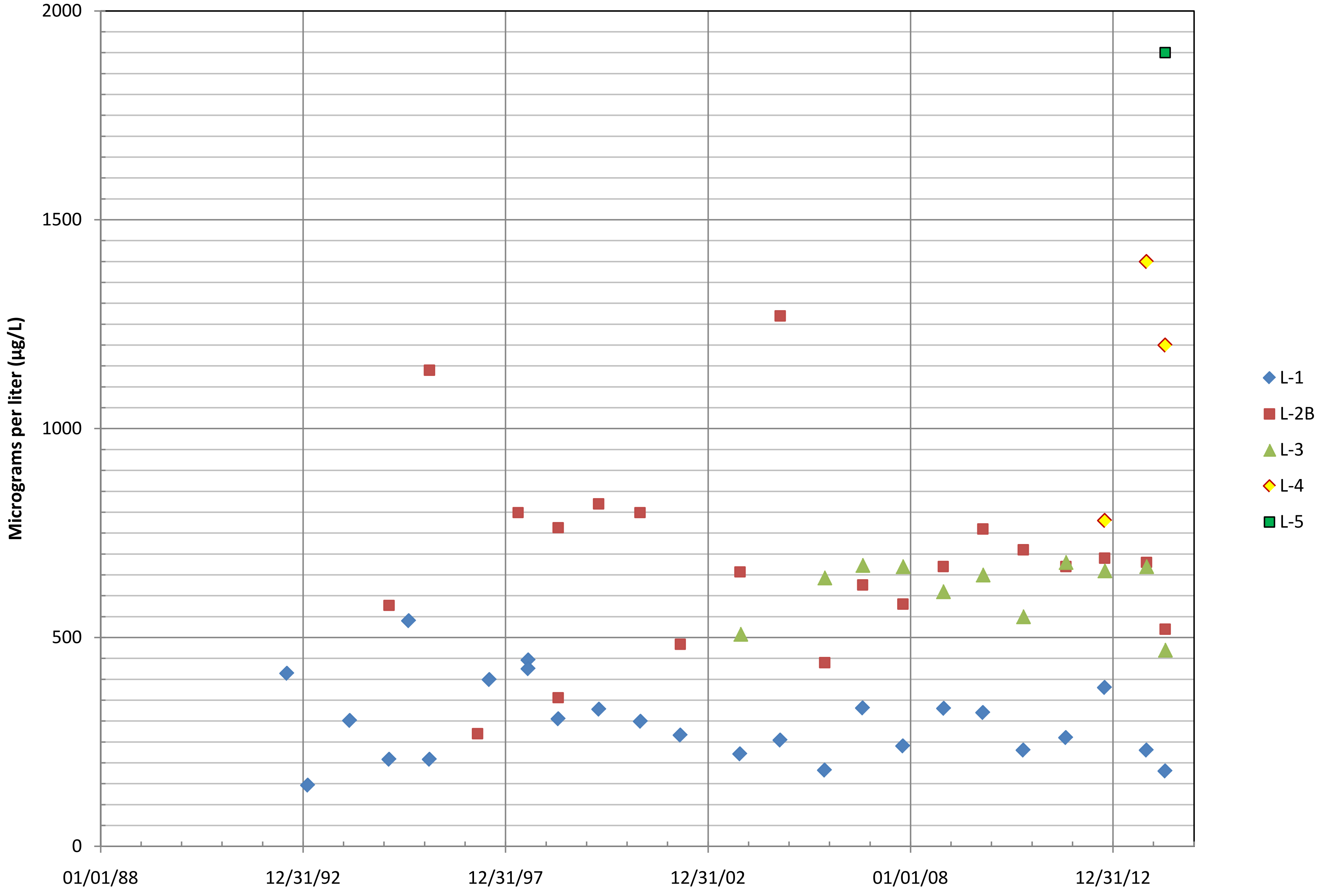
Antimony



100
10
1
0.1
Micrograms per liter (µg/L)
01/01/88
12/31/92
12/31/97
12/31/02
01/01/08
12/31/12
L-1
L-2B
L-3
L-4
L-5


Arsenic
Micrograms per liter (µg/L)
500
400
300
200
100
0
01/01/88
12/31/92
12/31/97
12/31/02
01/01/08
12/31/12
◆ L-1
■ L-2B
▲ L-3
◇ L-4
■ L-5

Barium



leachate historical data\Ba

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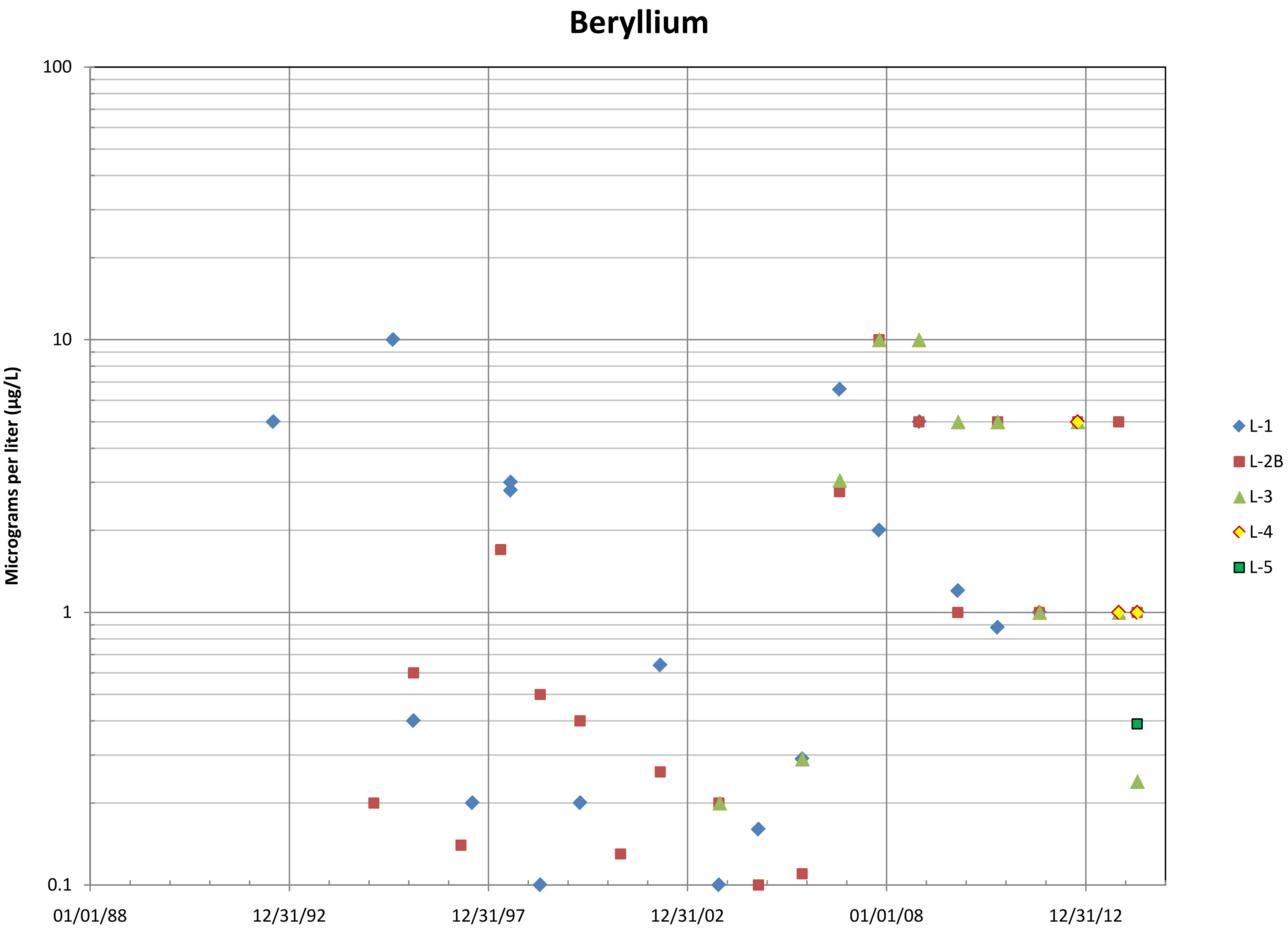
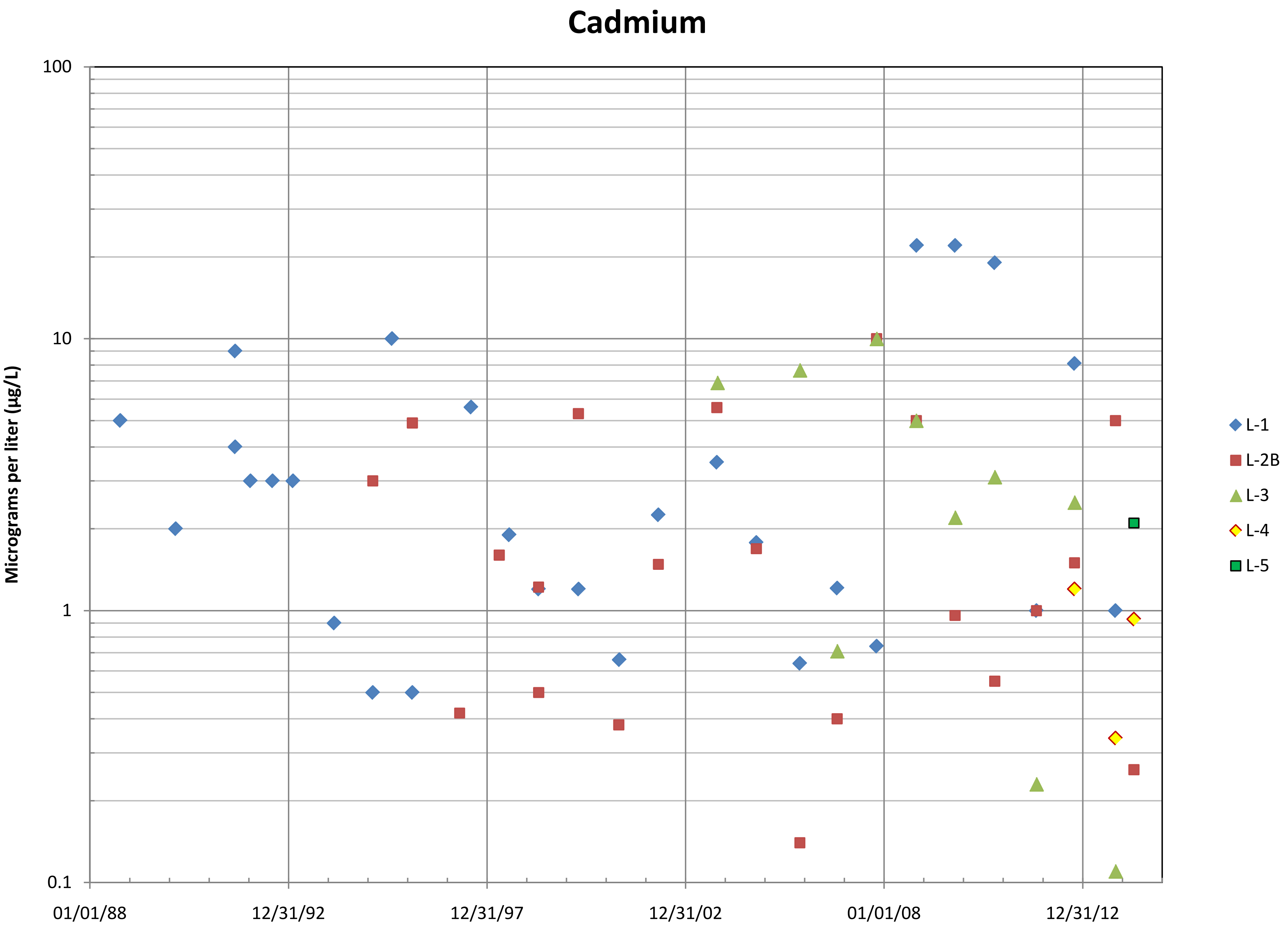
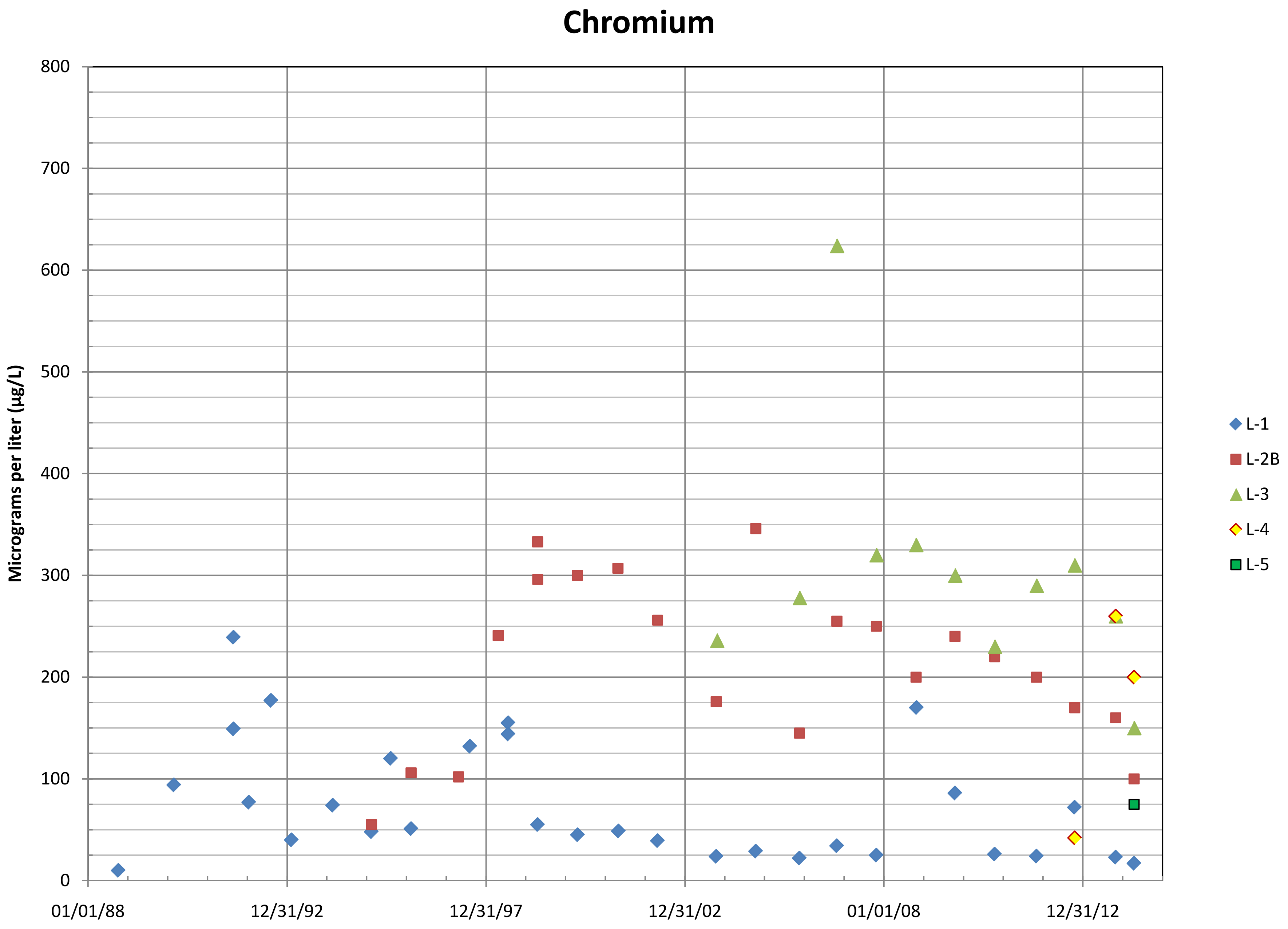
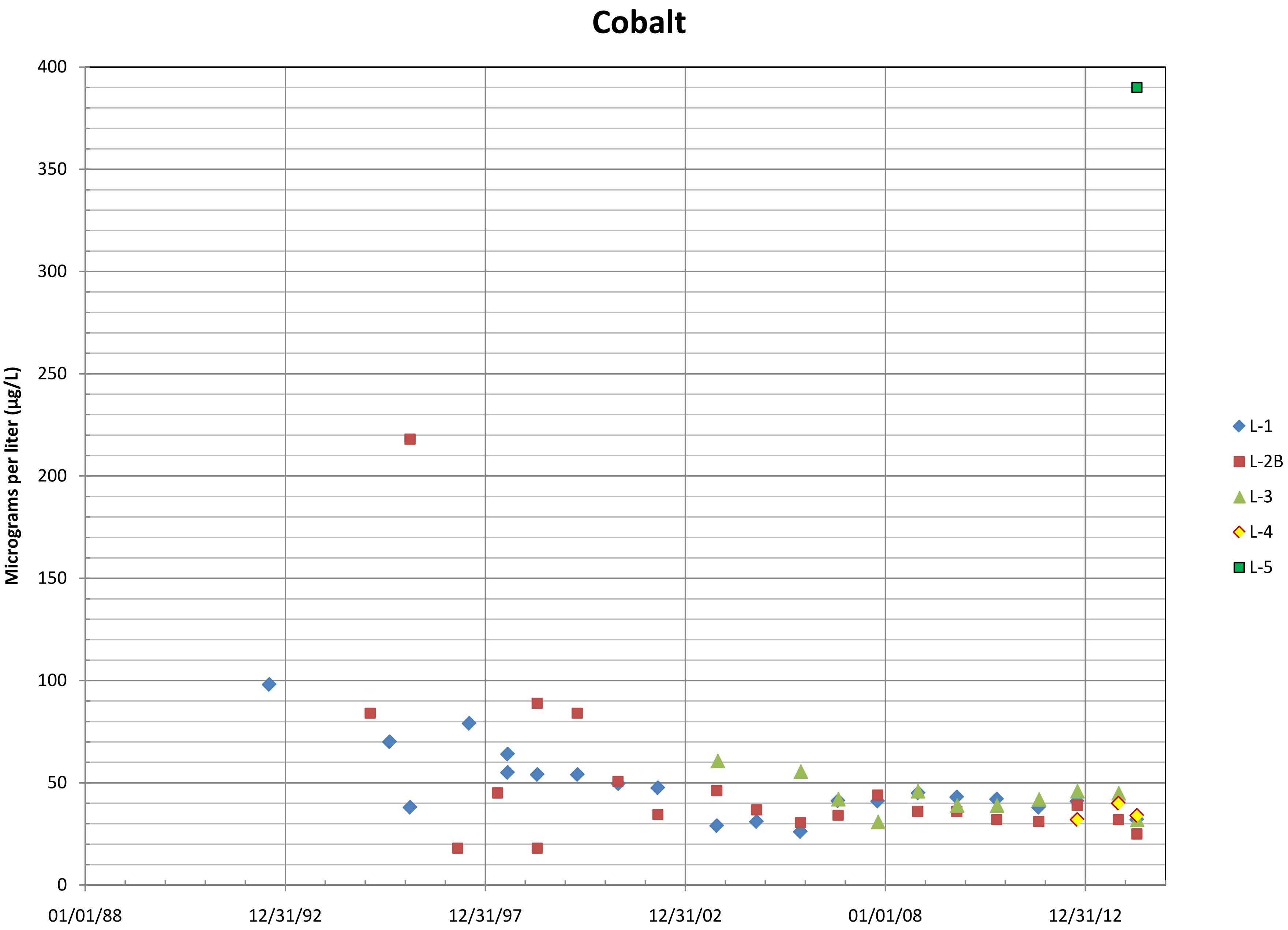
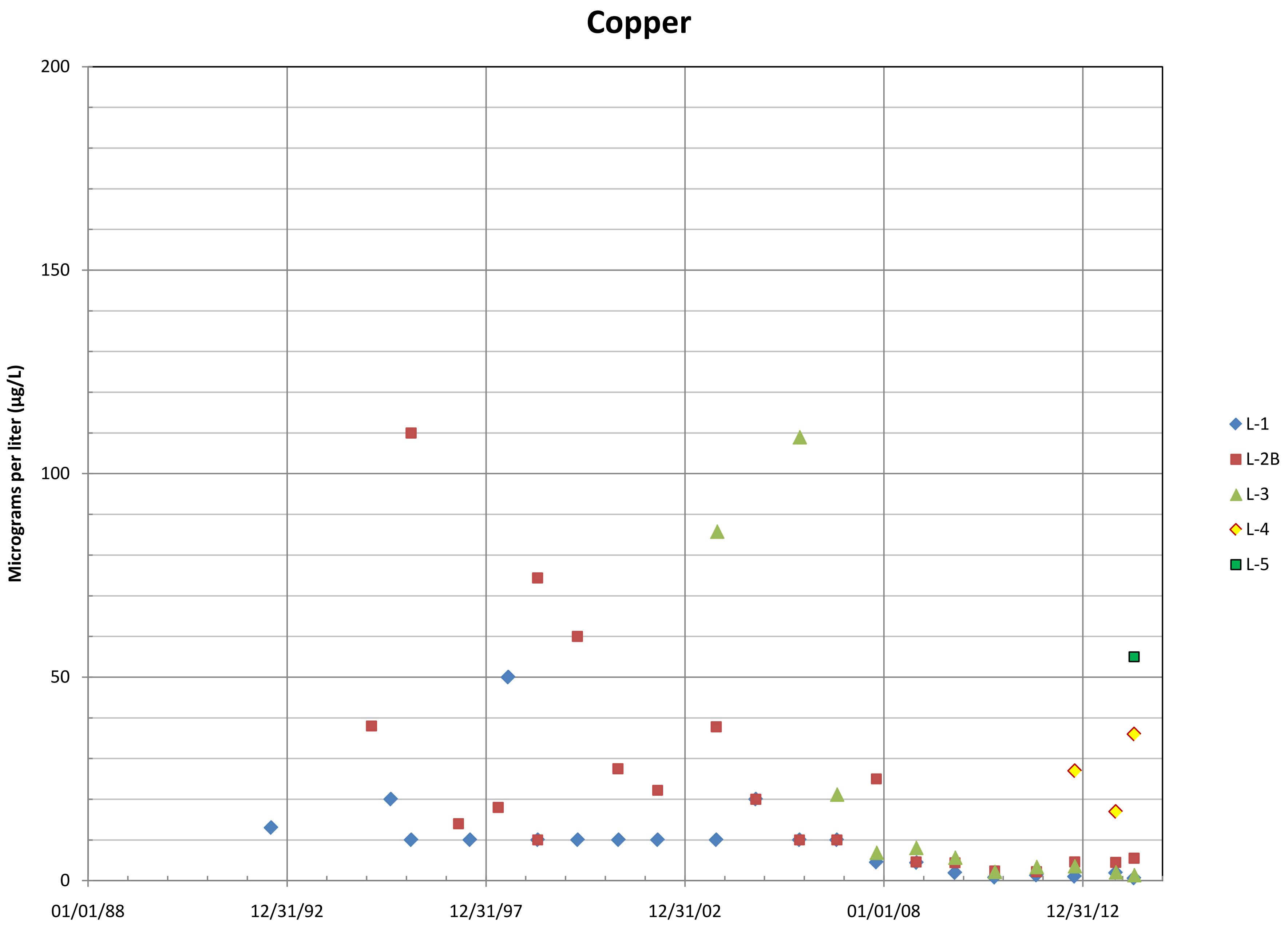

Beryllium
Micrograms per liter (µg/L)
100
10
1
0.1
01/01/88
12/31/92
12/31/97
12/31/02
01/01/08
12/31/12
L-1
L-2B
L-3
L-4
L-5


Cadmium
Micrograms per liter (µg/L)
100
10
1
0.1
01/01/88
12/31/92
12/31/97
12/31/02
01/01/08
12/31/12
L-1
L-2B
L-3
L-4
L-5


Chromium
Micrograms per liter (µg/L)
800
700
600
500
400
300
200
100
0
01/01/88
12/31/92
12/31/97
12/31/02
01/01/08
12/31/12
L-1
L-2B
L-3
L-4
L-5


Cobalt
Micrograms per liter (µg/L)
400
350
300
250
200
150
100
50
0
01/01/88
12/31/92
12/31/97
12/31/02
01/01/08
12/31/12
L-1
L-2B
L-3
L-4
L-5



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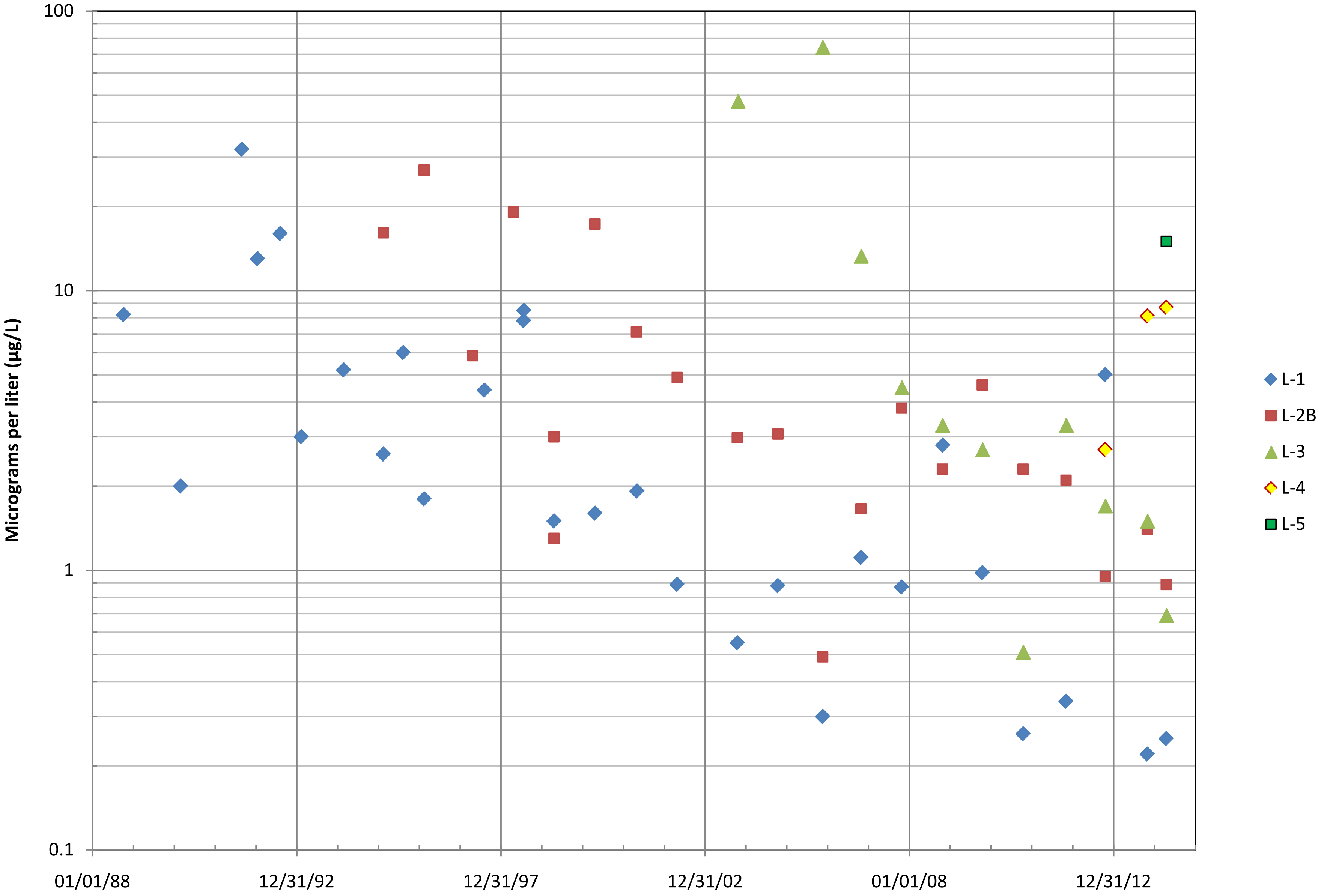
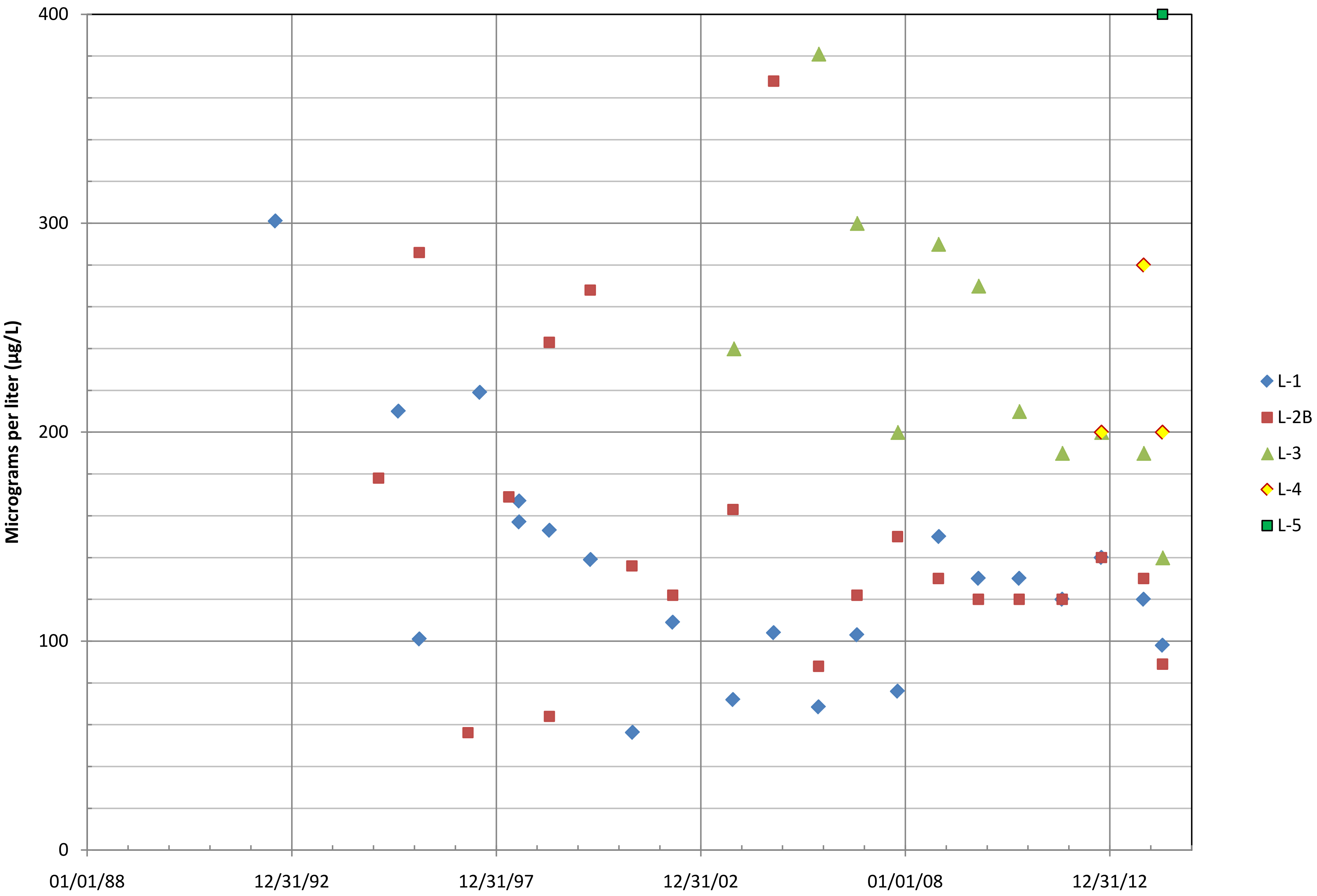
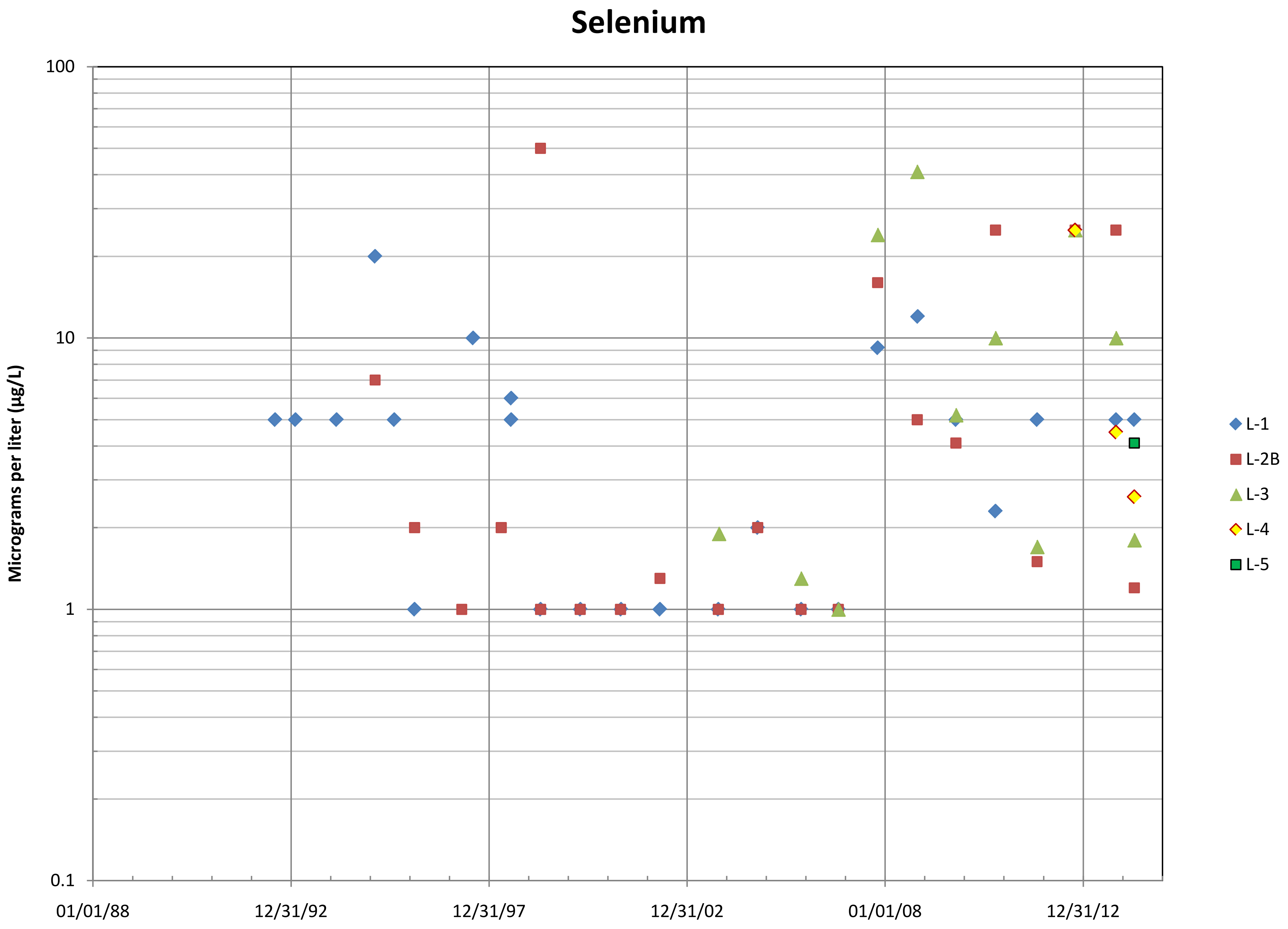
Lead


Micrograms per liter (µg/L)
100
10
1
0.1
01/01/88
12/31/92
12/31/97
12/31/02
01/01/08
12/31/12
L-1
L-2B
L-3
L-4
L-5

Nickel


400
300
200
100
0
Micrograms per liter (µg/L)
01/01/88
12/31/92
12/31/97
12/31/02
01/01/08
12/31/12
L-1
L-2B
L-3
L-4
L-5



leachate historical data\Se

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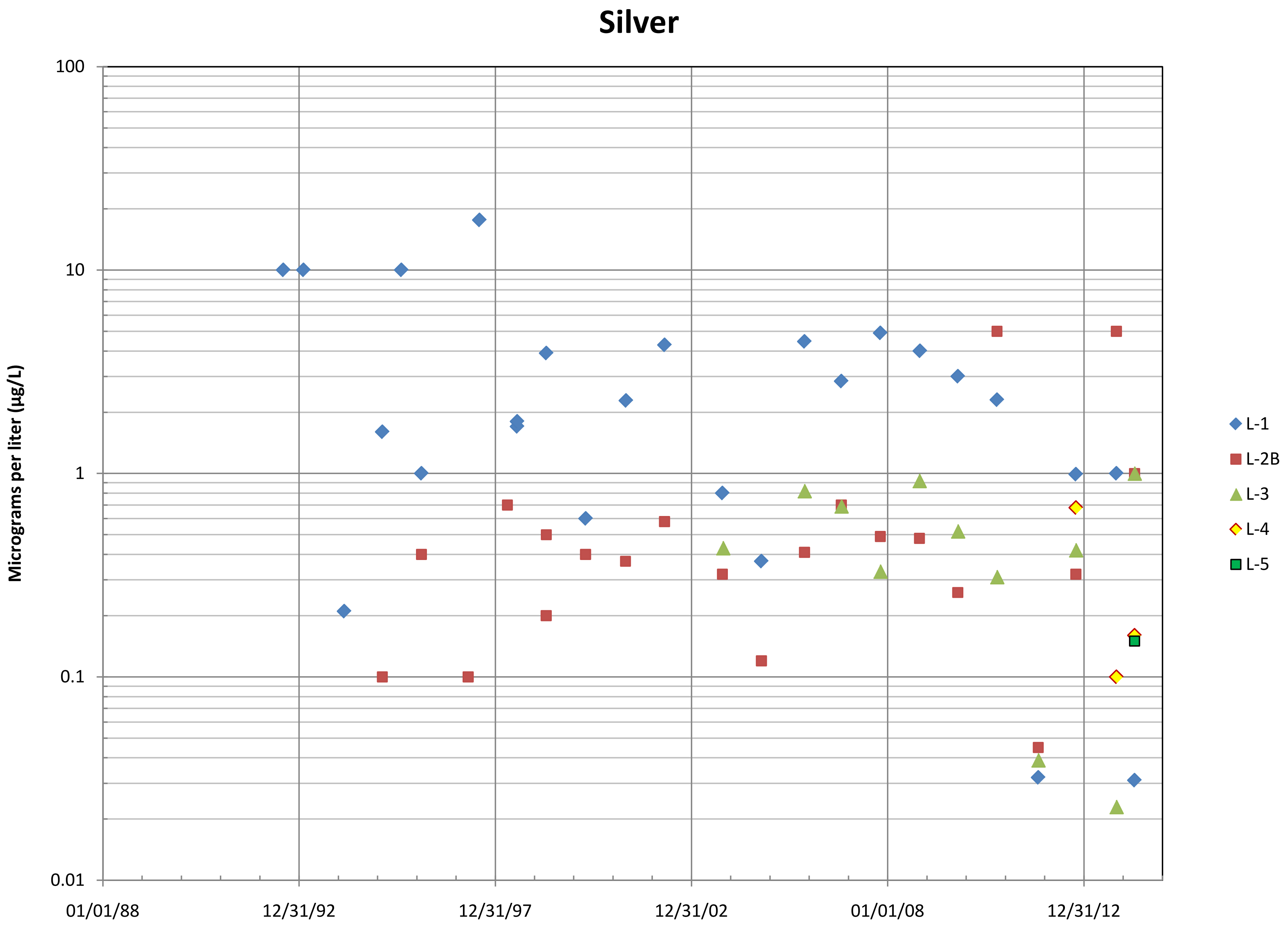
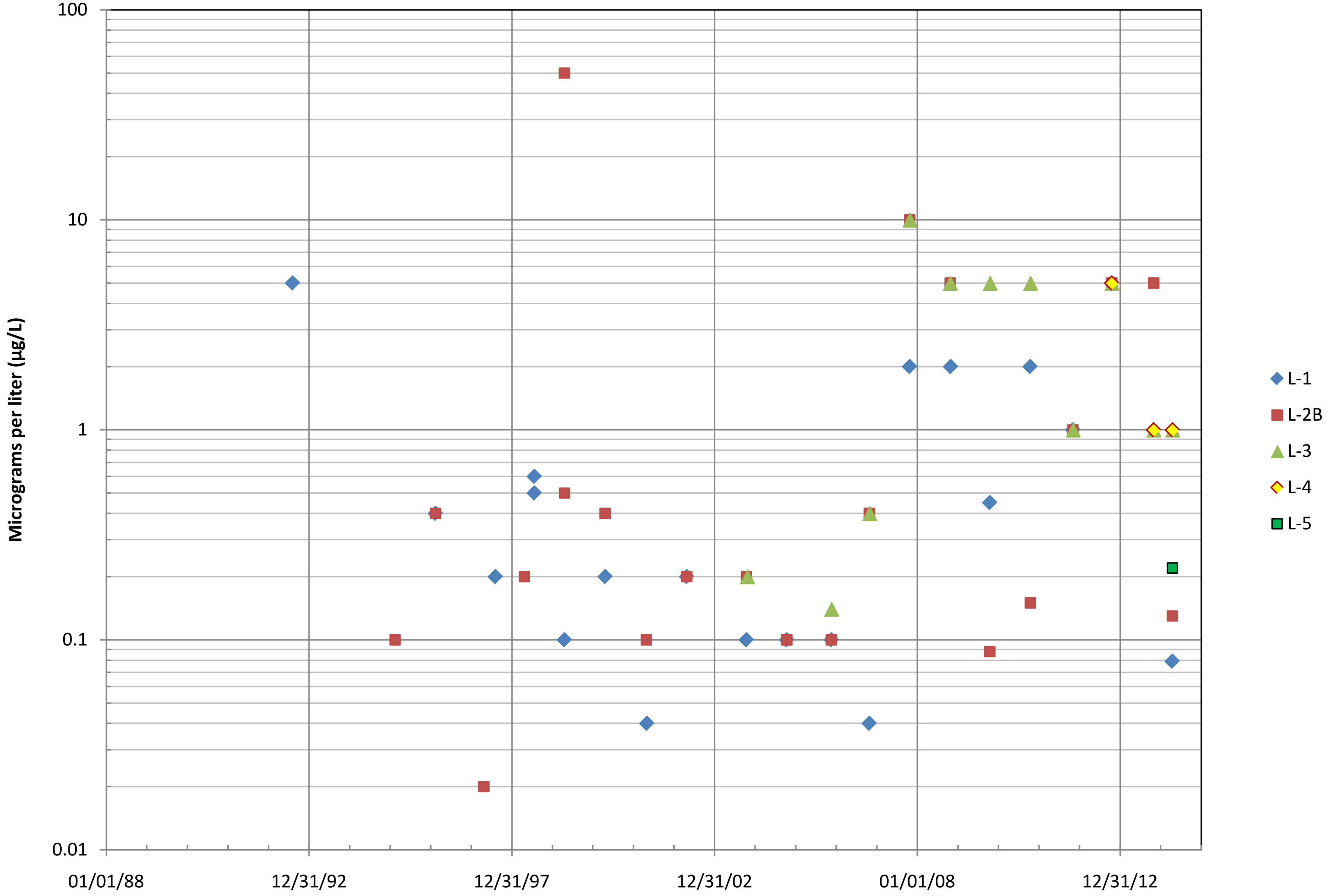
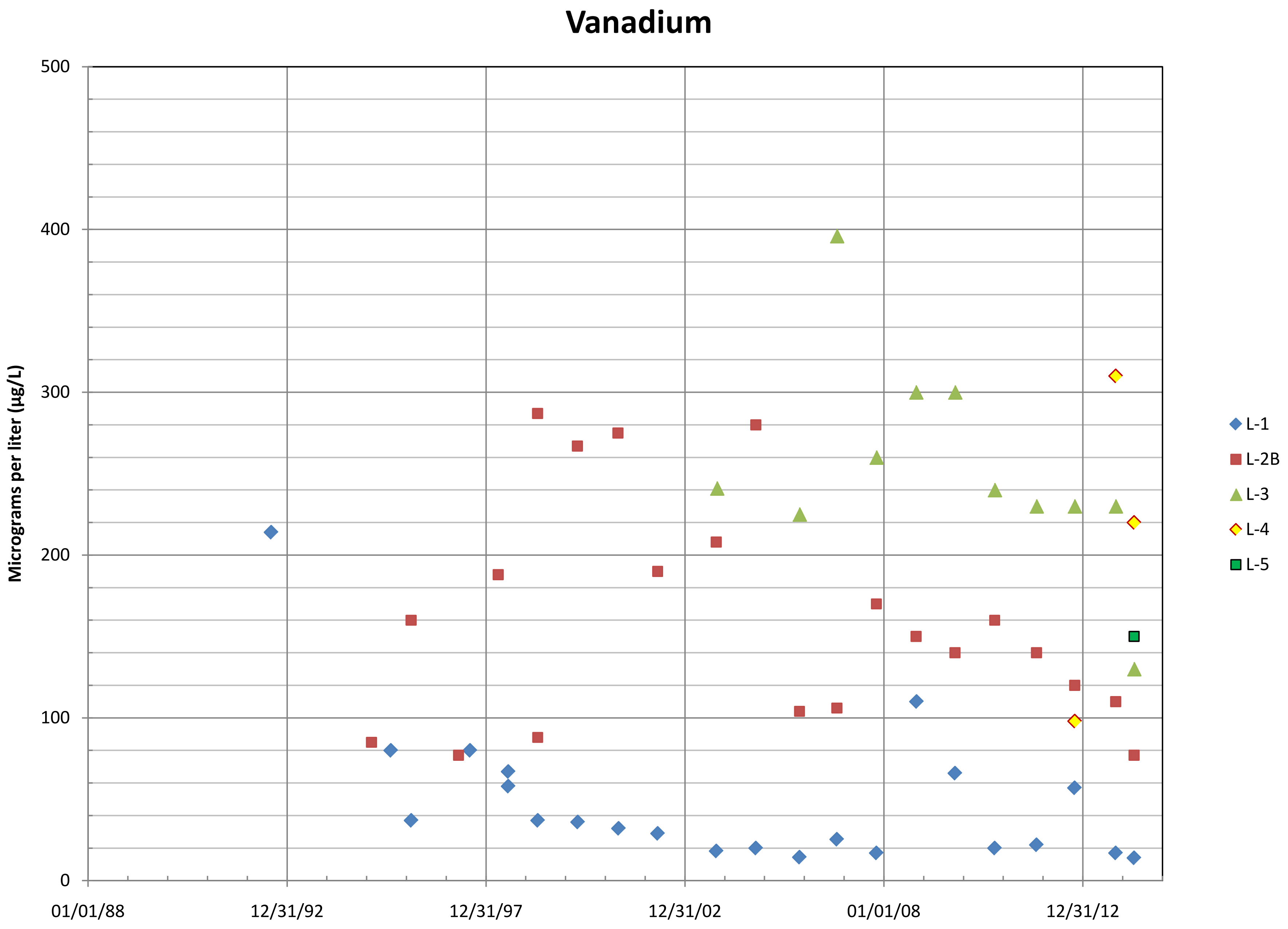
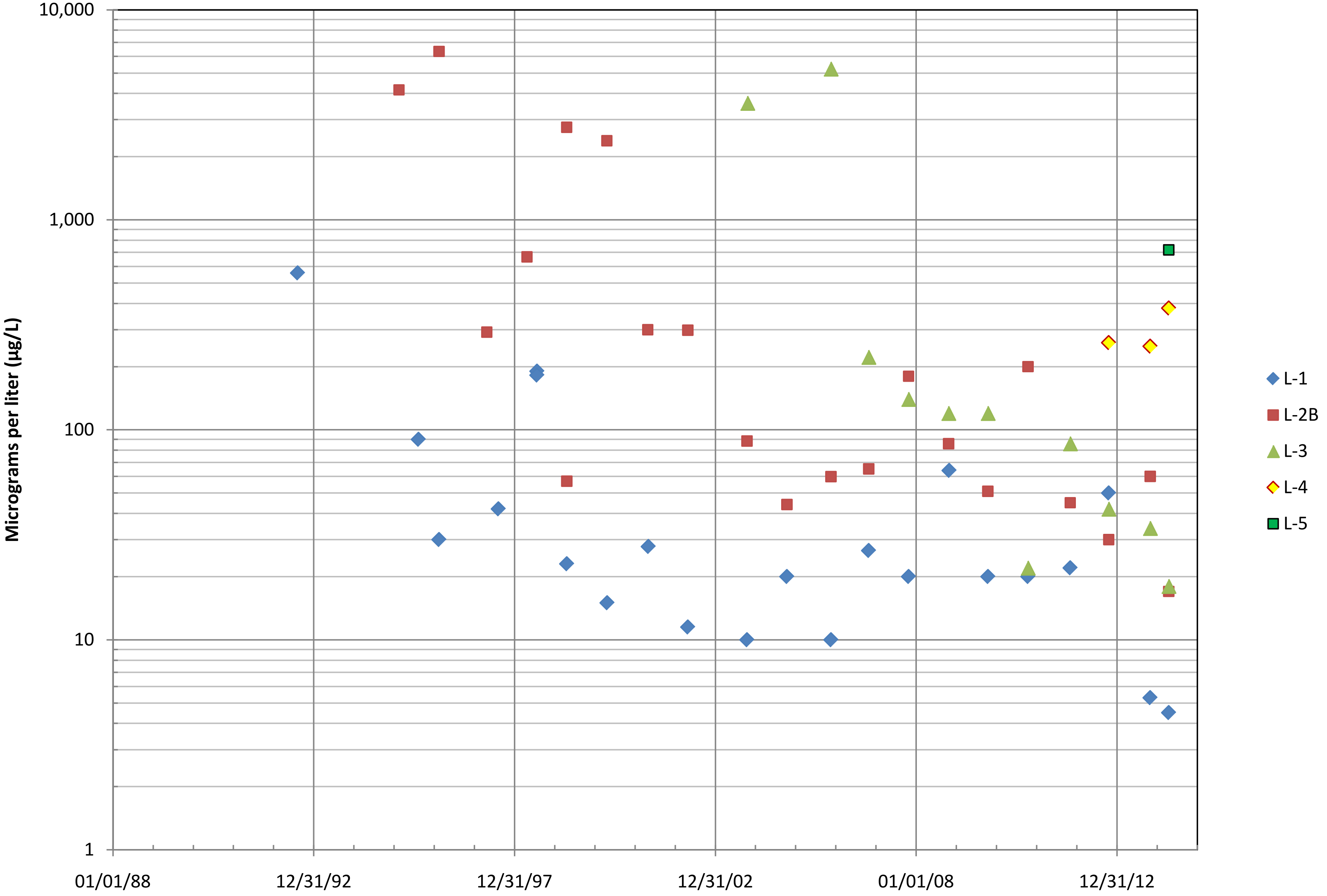

Silver
Micrograms per liter (µg/L)
100
10
1
0.1
0.01
01/01/88
12/31/92
12/31/97
12/31/02
01/01/08
12/31/12
L-1
L-2B
L-3
L-4
L-5

Thallium


100
10
1
0.1
0.01
Micrograms per liter (µg/L)
01/01/88
12/31/92
12/31/97
12/31/02
01/01/08
12/31/12
L-1
L-2B
L-3
L-4
L-5


Vanadium
Micrograms per liter (µg/L)
500
400
300
200
100
0
01/01/88
12/31/92
12/31/97
12/31/02
01/01/08
12/31/12
L-1
L-2B
L-3
L-4
L-5

Zinc



10,000
1,000
100
10
1
Micrograms per liter (µg/L)
01/01/88
12/31/92
12/31/97
12/31/02
01/01/08
12/31/12
L-1
L-2B
L-3
L-4
L-5