Environmental Monitoring Plan
Browns Island Landfill
Marion County

Prepared for

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CERTIFICATION

The technical material and data contained in this document were prepared under the supervision and direction of the undersigned, whose seal, as a professional hydrogeologist licensed to practice as such, is affixed below.

Rick Malin, R.G.

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1. INTRODUCTION

This March 18, 2013 Environmental Monitoring Plan (EMP) for the Browns Island Landfill (BI) is an update completed to reflect changes to the site's groundwater monitoring program that have occurred since development of the April 26, 2001 EMP. Select elements of the April 26, 2001 EMP were updated on September 22, 2005. This EMP for BI address environmental monitoring requirements set forth in Section 14 of Solid Waste Disposal Site Closure Permit Number 255, issued on May 4, 2006, for BI. A copy of the BI Solid Waste Disposal Site Closure Permit (the closure permit) is presented in Appendix A for reference purposes.

Environmental monitoring is required at solid waste disposal facilities to evaluate the performance of engineered control and containment systems and the magnitude and significance of any leachate or gas release impacts from the landfill on human health, welfare and safety, and the environment (DEQ 1996). Environmental monitoring at the BI consists of groundwater quality monitoring. This EMP update considers site-specific conditions to provide a monitoring program that address closure permit requirements while being protective of human health, welfare and safety, and the environment.

The Browns Island Landfill operated as a municipal solid waste disposal facility for the City of Salem and surrounding Marion County area from April 1967 until September 1986 with final closure approval granted in September 1987. The total area of the landfill complex is approximately 87 acres. An unfilled approximately 8 acre area located near the north central portion of the landfill is currently being filled with construction and demolition debris under Solid Waste Disposal Site Permit Number 399. A 4.5-acre composting facility located on the east central portion of the landfill was constructed in September 1999.

1.1 EMP HISTORY

Groundwater quality conditions at the site have been monitored through a network of monitoring wells since 1974. The wells were originally sampled by the DEQ Laboratory on a semi-annual frequency until March 1995 when Marion County assumed site monitoring. Following county assumption of site monitoring in 1995, the April 19, 1996 EMP was completed as required by the closure permit issued on October 11, 1995.

The EMP was updated on April 26, 2001 to reflect monitoring modifications and adjustments that had occurred since completion of the April 19, 1996 EMP. These modification and adjustments were based on additional site characterization and data analysis that resulted in the recommendation and approval for several adjustments and modifications to the facility's groundwater monitoring program. Site activities completed between the April 19, 1996 and the April 26, 2001 EMPs included:

- Monitoring Well Evaluation – An evaluation of the monitoring well network was completed in 1997 to assess the characteristics and integrity of the existing monitoring wells at the site. This evaluation effort and findings are presented in the Monitoring Well Evaluation Plan (Parametrix 1997a) and the Monitoring Well Upgrade Report (Parametrix 1997b). Appendix B includes the 1997 monitoring well evaluation plan and upgrade report along with associated correspondence.
- Groundwater Quality Assessment – A Groundwater Quality Assessment Update Report (GQAR) (Parametrix 1998) was completed to further evaluate groundwater quality conditions at the site, evaluate facility impacts to the Willamette River, and to modify the monitoring well network based on the report findings. The 1996 BI

Groundwater Quality Assessment Report (Parametrix 1996) compiled and evaluated available groundwater quality data collected at the site since April 1985.

Select portions of the April 26, 2001 EMP were updated on September 22, 2005 to reflect modifications and adjustments that had occurred to the site's groundwater monitoring program. Specifically, the September 22, 2005 EMP update incorpoarated permit-specific concentration limits approved by the DEQ in a letter dated May 5, 2005.

This March 18, 2013 EMP update incorporates modification and adjustments that had occurred to the site's groundwater monitoring program since the September 22, 2005 EMP update. Monitoring modifications and adjustments since 2005 include use of dedicated sampling pumps, low-flow sampling methodology, and adjustments to the site's sample analysis schedule. This 2013 EMP update also identifies changes that have occurred in land use of properties adjacent to the landfill complex and results of a nitrate investigation completed in 2007 and 2008.

1.2 PLAN ORGANIZATION

The DEQ's Solid Waste Permit Guidance (DEQ 1996) was referenced in the development of this plan. This EMP update maintains the structure originally presented in the April 26, 2011 and is organized in the following manner:

- Section 1 - Introduction. This section presents site location and operations background, site characterization activities, geologic and hydrogeologic conditions, and area climate. Current and proposed uses of properties adjacent to the site are also described.
- Section 2 – Site Monitoring. This section presents background information on the site's monitoring history. The groundwater monitoring network established at the site is described. Historical groundwater quality conditions are presented.
- Section 3 – Groundwater Quality Monitoring Plan. This section describes groundwater quality monitoring program for the site and monitoring elements such as schedule, analysis, data review, evaluation, and reporting.
- Attachment A contains a site-specific Sampling and Analysis Plan (SAP). The BI SAP describes the procedures recommended for obtaining and documenting water quality samples collected at the site.

EMP appendices contain the following supporting information:

- On-site well logs with installation details and recorded upgrades (Appendix B). Documentation associated with a well evaluation and upgrades completed during 1997 are also presented.
- Well logs on recorded at the Oregon Water Resource Department for Township 7 south, Range 3 west, Sections 29 through 32 (Appendix C). As indicated on a map contained in Appendix C, portions of BI are situated in four sections. The Marion/ Polk County line is located in the middle of the Willamette River
- Landowners and property zoning within a half-mile radius of the site (Appendix D). This listing includes landowners located in both Marion and Polk Counties.
- Activities and findings associated with a nitrate investigation completed during 2007 and 2008 (Appendix E). The material was presented in the 2007 and 2008 BI Annual Water Quality Monitoring Reports.

References cited are presented in Section 4.

Attachment A to the EMP contains the SAP. There are two attachments associated with the SAP. Attachment 1 presents sampling field data sheets. Attachment 2 contains an electronic file of the current designated laboratories quality assurance program (QAP). This QAP is contained on a compact disc.

It is expected that elements of this EMP will continue to be revised from time to time as site conditions and monitoring objectives change. Consequently, this EMP is presented in three-ring binder format to allow for portions of the document to be updated or amended without full plan revision.

1.3 SITE LOCATION AND OPERATING BACKGROUND

Background information regarding the site's location, setting, and operation is presented along with an overview of geologic and hydrogeologic conditions based on findings presented in the GQAR Update.

1.3.1 Site Location

The Browns Island Landfill is located in Marion County approximately 1.5 miles west of Salem, Oregon (Figure 1). The site is located in the northeast ¼ of the northeast ¼ of Section 31 and the northwest ¼ of Section 32, Township 7 South, Range 3 West and situated on Browns Island, a Quaternary (Holocene) river alluvium deposit. Browns Island is bordered by the Willamette River on its north and west sides, and by unnamed interconnecting sloughs on its south and east sides.

The landfill complex (total area of approximately 87 acres) is enclosed within a flood protection berm that is elevated approximately two feet higher than the 100-year flood level. The site is located in and bounded by an area zoned as urban transition. The area around the site was historically used for agricultural purposes but has more recently transitioned over to conservation reserve enhancement use in an effort to protect environmentally sensitive land, decrease erosion, restore wildlife habitat, and enhance water quality in the floodplain area adjacent to the Willamette River. Figure 2 presents a facility site map based on a May 8, 2012, aerial photograph of the site.

1.3.2 Site Description

BI operated as a municipal solid waste disposal facility for the City of Salem and the surrounding Marion County area from April 1967 until September 1986. The Department of Environmental Quality (DEQ) granted final closure approval in a letter dated September 8, 1987. Landfilling began in the central portion of the site in 1967 and expanded onto City and County land in the mid to late 1970s. From 1979 through 1986, landfill expansion was toward the west onto adjacent private (former Trussell) property. The approximate fill thickness is 35 feet in the older eastern portion of the site and 40 feet in the western area of the landfill. The County secured water rights appurtenant to the former Trussell property and a major portion of the adjoining City of Salem property and purchased the Trussell property in 1997. In 2003, surface water irrigation rights were leased back to the State of Oregon as part of the Conservation Reserved Enhancement Project completed at the site.

When the use of the site as a municipal landfill was terminated, there remained an unfilled area (a former gravel pit) of approximately eight acres located near the north central portion of the landfill (Figure 2). This unfilled area, originally bordered on the north by the protection berm and by completed areas on all other sides, is currently being filled with construction and demolition debris under Solid Waste Disposal Site Permit Number 399.

1.3.3 Site Developments

Several site developments have occurred since completion of the 1996 EMP. These developments include construction of a composting facility over a portion of the eastern fill area; conversion of the former Trussell domestic water well to an operations water supply well; and conversion of land north and east/southeast of the landfill from cropland through conservation reserved enhancement program to become part of the Minto-Browns Island Park complex. Aggregate mining is occurring east of the site with a plan to ultimately create a lake that would be integrated into the park complex.

1.3.4 Composting Facility

Construction of the BI composting facility was completed in September 1999. The facility consists of an approximately four-acre asphalt composting pad. A stormwater collection and management system and a water supply system were developed for the facility. The location of the composting pad is shown on Figure 2.

The BI composting facility (BICF) is scheduled to receive and process up to 5,000 tons of Type 1 feedstocks (primarily source-separated yard and garden wastes) material per year. Yard debris is received from various County and City sponsored yard cleanup events held within Marion County. Yard debris is delivered to the BICF by county, city, public, and franchise waste haulers during specific collection events.

The volume of incoming yard debris is recorded and unloaded on a portion of the asphalt pad and shredded using an on-site tub grinder. The shredded yard debris is formed into windrows, watered and turned as required for the composting process. All composting activities occur on the asphalt pad. The BICF Operations Plan further describes composting operations.

1.3.5 On-Site Water Supply

In 1998 the former Trussell domestic water supply well was upgraded and converted to an on-site nonpotable limited use water supply source primarily for dust control on landfill access roads, routine equipment wash down and cleaning, watering of compost to maintain optimal moisture content, and fire suppression. As part of the BICF development, an underground pipe was constructed from the well pump house to the compost facility. The pipeline is designed to provide water to hydrants at the BICF. Water from the hydrants is used to wet and cool the compost.

This well draws from the marine sediments bedrock unit that underlies the site as described in Section 1.4. Water in this deeper rock unit is commonly high in dissolved solids and iron (Sweet 1987). A flow meter and totalizer is installed on the well. The water supply well is sampled on the same frequency for the same parameters as the BI monitoring wells. Samples from the on-site water supply well are designated MW-5, consistent with the historic DEQ site groundwater sample location designation.

1.3.6 Adjacent Properties

In 1997, the County purchased 58.3 acres of cropland adjacent to the Willamette River, which was part of the Brown's Island Demolition Landfill Property acquired from Robert Trussell. The eastern portion of this area is shown on Figure 2 as the area with topographic contours between the landfill and the river. The land had been farmed for many years without cause for concern. Seasonal flooding of the Willamette River resulted in severe erosion of the riverbank and farmland that raised several concerns including the loss of topsoil, sediment and nutrient pollution from agricultural operations adjacent to the river, stability of the river bank, and potential impact to the closed municipal solid waste landfill. Investigation into these concerns led the Marion County to the Conservation Reserve Enhancement Program (CREP).

The U.S. Department of Agriculture's Farm Service Agency Commodity Credit Corporation (CCC) and the State of Oregon agreed to implement a voluntary CREP at the site to improve water quality of streams providing habitat for nine salmon and two trout species listed under the Federal Endangered Species Act. CREP is designed to encourage and assist landowners to voluntarily plant long lasting areas of ground cover (trees and shrubs – riparian buffer) on environmentally sensitive cropland. In return for participation in the program, landowners receive annual rental payments and cost-share assistance for the planting. Under CREP, Marion County entered into a 15-year contract with the CCC and the State of Oregon.

The CREP project initiated by Marion County in 2000 occurred on county land located between the western portion of BI and the Willamette River. This area has become part of the county park system known as Eola Bend Park. This approximately 60 acre area was planted with over 45,000 native plants that serve to control erosion, reduce flood damage, and provide wildlife habitat along the river. On City of Salem property adjacent to the eastern portion of BI is the western portion of the Minto-Brown Island Park. In recent years the City through CREP planted over 5,000 native trees to create a 200-foot buffer along the sloughs and river banks within the Minto-Brown Island Park. Year around footpaths have been established in both parks. The locations of both parks are shown on Figure 3.

The Minto-Browns Island Park includes approximately 286 acres of cropland; approximately 107 acres borders the eastern portion of BI (Figure 3). In 2010, the City entered into a floodplain easement agreement with the U.S. Department of Agriculture Resources Conservation Services to remove approximately 166 acres of cropland. The easement areas are to be restored to a more natural native condition. Initial restoration work began in 2010 with planting of various types of native trees and shrubs.

The cropland (farm field) located southwest of the western portion of BI is located outside the park complex and is still used an active agriculture field. In 2012, a backflow channel or initial expansion cell associated with the aggregate operation located west of BI facility was excavated along the south side of the farm field that is adjacent to the western corner of BI.

Commercial Redimix Aggregate, Inc. operates an aggregate quarry west of BI in the area shown on Figure 3. High quality sand and gravel deposits are extracted by surface mining to produce material for various aggregate-related construction needs. Present operation consists of extracting gravel, sizing the crushed rock, and cleaning sand and gravel for concrete. The facility is permitted by the Department of Geology and Mineral Industries under operating permit aggregate identification number 24-0010. The current disturbed area of the facility is identified to be 115 acres with a total permitted area of 287 acres. As described in a 1997 aggregate expansion plan for the facility, the proposed long term plan for the facility is to continue extraction, processing, and distribution of aggregate products ultimately creating a lake which will be up to 150 surface acres in size. According to the facility's 1997 Eola Point Project description, the lake and a portion of the surrounding property will be incrementally dedicated to the public as an undeveloped regional park and recreation site.

1.3.7 Site Monitoring

Groundwater quality conditions at the BI site have been monitored through a network of monitoring wells since 1974. The location of these wells is shown on Figures 2 and 3. The wells are sampled on a semi-annual basis. Site monitoring activities and findings are discussed in Section 2.

1.4 GEOLOGIC AND HYDROGEOLOGIC CONDITIONS

Geologic and hydrogeologic conditions at the site are described in the BI GQAR Update (Parametrix 1998). The geology at the site can be characterized as young river terrace deposits consisting of stratified sands with well-rounded pebbles, gravels, and cobbles. Underlying the young alluvium deposits is an older marine sedimentary rock unit consisting of tuffaceous siltstone and sandstone. Groundwater flow at the site is primarily toward the northeast with the Willamette River functioning as a discharge or a recharge boundary dependent upon river stage. The base of the uppermost aquifer at the site is at the top of the older marine sedimentary rock unit.

1.4.1 Geologic Conditions

There are two distinct geologic units that underlie the site. These units are the recent river alluvium deposits and Eocene-Oligocene sedimentary rock.

The recent river alluvium consists of Quaternary (Holocene) age deposits from the Willamette River. The unit consists of stratified sands with well-rounded pebbles, gravel, and cobbles. The upper 15 feet of the unit generally consists of light brown sand and silt overburden material. The lower terrace deposits, which may be present in the lower portion of the alluvium unit, consist of unconsolidated to semi-consolidated cobbles and gravel with sand, silt, and clay.

Underlying the river alluvium deposit is an Eocene-Oligocene sedimentary rock unit consisting of tuffaceous siltstone and sandstone of marine depositional origin. On-site well logs describe the unit as consisting of sandstone, silty sand, sandy clay, or blue clayey silt and clay. At the site, the unit has been encountered at depths ranging from 27 to 55 feet below ground surface (bgs). The Columbia River Basalt Group (CRBG) flows that are present northwest and southeast of the site overlie this sedimentary rock unit. However, at the site, the CRBG flows have been eroded away by the Willamette River. No known CRBG flow remnants are present at the site.

Based on well logs, the elevation of the top of the sedimentary rock unit appears to be highest in the central area of the landfill and slopes downward toward the Willamette River. Since the surface elevation is fairly consistent in the unfilled area of the site, the thickness of the recent alluvium appears to increase from the landfill to the river.

1.4.2 Hydrogeologic Conditions

There are two hydrogeologic units present at the site corresponding with the two geologic units. The uppermost aquifer is present in the river alluvium deposit. Water-bearing zones are also present in the deeper marine sedimentary rock unit. The hydrogeologic conditions of these two units are described below. Figure 4 presents a north/south oriented cross-section of the site showing the two hydrogeologic units at the site.

1.4.2.1 Alluvium

The uppermost aquifer is present in the river alluvium with groundwater depths generally ranging from 8 to 18 feet bgs with an average depth of approximately 14 feet bgs. The uppermost aquifer is bounded on all sides by hydraulic boundaries in the form of surface water bodies. The Willamette River forms a boundary on the north and west sides of the site and the slough system forms boundaries on the south and east sides of the site (Figure 1). The water elevation of slough system has been observed to be predominantly higher than the Willamette River (Parametrix 1998). A small spill dam located at the east slough's confluence with the Willamette River helps to maintain a higher slough stage.

The direction of groundwater flow in the uppermost aquifer is predominantly toward the Willamette River. Groundwater flow direction reversals (i.e., flow away from the river) have been observed to occur during periods of high river stage conditions (Parametrix 1998). The Willamette River functions as a losing or gaining stream in the site area dependent upon river stage conditions. In general, changes in river stage level correlate with changes in groundwater elevations measured at the site. Changes in river stage influence the gradient of the alluvial groundwater system (i.e., a rising river stage will decrease the groundwater flux to the river causing a flatter groundwater gradient).

Slug tests were performed on wells MW-8b/c, MW-12a/b, MW-16, and MW-17 on June 16, 1999. Both falling and rising head tests were completed on each well. Well response was recorded using a pressure transducer and data logger. In general, well response to the inclusion or removal of the slug was quick. The average horizontal hydraulic conductivity for rising head was 3.3E-02 cm/sec (93.4 ft/day). The average horizontal hydraulic conductivity for falling head was 3.9E-02 cm/sec (110.4 ft/day). Slug test activities and analysis were presented in an August 23, 1999, memorandum to the DEQ.

As depicted in Figure 4, the saturated thickness of the alluvium aquifer generally increases from the landfill toward the river. As mentioned in Section 1.4.1, this is due to the apparent decreasing elevation of the top of the sedimentary bedrock unit. The area of greatest saturated thickness appears to be in the area of wells MW-12a/b. An increase in saturated thickness represents an increase in the transmissivity of the aquifer. Given the understood hydrogeologic conditions of the site, it appears that the greatest volume of groundwater flowing away from the landfill is moving in the area between wells MW-12a/b and MW-8a/b/c (Parametrix 1998).

1.4.2.2 Marine Bedrock

There are water-bearing zones present in the underlying Tertiary marine sedimentary bedrock unit. Regionally, water-bearing zones present in this bedrock unit have been observed to be confined with vertical upward gradients (Woodward 1998). Tertiary sedimentary units in the Willamette Valley commonly produce saline waters (Woodward 1998) that yield only small quantities of water that may be highly mineralized (Foxworthy 1970). The direction of groundwater flow in this unit is not known but the Willamette River in the site area would appear to function as a local area discharge point.

2. SITE MONITORING BACKGROUND

This section presents background information on the environmental monitoring network established at the site. The network consists of groundwater quality monitoring wells and groundwater level measurement points. Groundwater quality monitoring at the site has been conducted on a semi-annual basis since May 1974. This section describes the existing site groundwater quality monitoring well network and water quality conditions.

2.1 MONITORING WELL NETWORK

Figure 2 shows the locations of active, nonactive, and decomissioned wells at the site. Summary data for both active and nonactive wells are presented in Table 1. Table 1 also identifies abandoned wells. Appendix B contains copies of the monitoring well logs.

Based on the current understanding of site hydrogeologic conditions, the functionality and integrity of the BI monitoring well network is considered good for monitoring groundwater quality conditions at the site. An evaluation of the monitoring well network was completed in 1997 (Parametrix 1997a). The evaluation led to an upgrade effort on several of the older wells (Parametrix 1997b). Documents and correspondence associated with the 1997 monitoring well evaluation and upgrades can be found in Appendix B. All wells at the site are secure, protected, and surveyed.

The SAP (Attachment A) describes the procedure that will be used to routinely evaluate and maintain the integrity of all monitoring points at the site. Section 3 describes in further detail how groundwater quality conditions at the BI will be monitored using the existing monitoring well network.

2.1.1 Network Development

The first monitoring wells at the site were installed in 1973 and additional wells have been installed over time as the site’s groundwater monitoring program has been modified and adjusted. There have been five phases of well installations at the site. These well installation phases are:

- Phase I (May 1973) wells: MW-1a/b/c, MW-2a/b, MW-4a/b/c, and MW-6a/b/c. Wells MW-3 and MW-5 were existing water supply wells. Wells MW-2a/b and MW-6a/b/c were installed in existing supply wells.
- Phase II (October 1975) wells: MW-7a/b and MW-8a/b/c.
- Phase III (May/June 1979) wells: MW-9a/b, MW-10a/b/c, MW-11a/b, and MW-12a/b.
- Phase IV (October 1986) wells: MW-13, MW-14, and MW-15.
- Phase V (November 1998) wells MW-16 and MW-17.

Wells installed prior to 1980 were completed as single, double, or triple installations. The 1997 Monitoring Well Evaluation Plan (Parametrix 1997a) presents additional monitoring well network information in association with a plan that was used to address well suitability issues. The 1997 Monitoring Well Upgrade Report (Parametrix 1997b) describes the upgrades completed to the site monitoring well network.

2.1.2 Completion Depths

Monitoring wells at the site have generally been completed at three different depths or zones in the uppermost aquifer as identified below:

- Shallow wells: MW-9b, MW-10a*, MW-6a*, MW-2a*, MW-8a, and MW-7a*. The screen intervals for these wells are above elevation 110 feet.
- Intermediate wells: MW-10c, MW-15, MW-6b*, MW-12a, MW-1a*, MW-8b, MW-7b*, MW-13*, and MW-14*. The screen intervals for these wells are generally located between elevations 100 feet and 110 feet.
- Deep wells: MW-9a, MW-10b, MW-6c*, MW-12b, MW-1b*, MW-1c*, MW-2b*, MW-8c, MW-16, and MW-17. The screen intervals for these wells are generally below elevation 100 feet.

Several monitoring wells have also been completed in the underlying marine sedimentary rock unit. Wells included in this group are:

- Sedimentary rock wells: MW-6c*, MW-5, MW-1b*, and MW-1c*.

Wells with an asterisk indicate that the well is an inactive water quality monitoring point. All inactive wells are used as piezometers to provide additional information on groundwater flow characteristics at the site.

Figure 5 presents a cross-section showing well depths across the site with respect to elevation.

Well MW-5 is the on-site water supply well and formerly known as the Trussell well and briefly identified as well W-1. The DEQ Laboratory identified this well as MW-5 in their site monitoring program.

2.1.3 Background Monitoring

Well MW-15 functions as the up-gradient background well for the site. However, during temporary groundwater flow reversals that can occur during high river stage events, MW-15 become a down-gradient well. Wells MW-9a/b are located cross-gradient (with respect to groundwater flow) of the landfill and historically have similar water quality concentrations as well MW-15. The 1998 GQAR Update included a limited parameter statistical comparison of wells MW-15 and MW-9a/b. This analysis found that use of wells MW-9a/b as supplemental background water quality monitoring locations was not statistically supported. Given the occurrence of groundwater flow reversals at the site, use of wells MW-9a/b as supplemental background monitoring points may still be justified. However, recent aggregate mining activities occurring just south of MW-9a/b, as discussed in Section 1.3.6, will likely cause geochemical changes to occur at this well pair.

2.1.4 Network Adjustments

Since completion of the 1996 BI EMP, inactive monitoring wells MW-11a/b were abandoned during September 1997 due to erosion of the river bank where they were located. Well group MW-4a/b/c was discovered during construction of the new compost facility during 1999. The MW-4 well nest was abandoned shortly afterward in August 1999.

As recommended in the 1998 GQAR Update, cross-gradient monitoring wells MW-13 and

MW-14 became inactive monitoring points following the spring 1998 event and two new deep replacement monitoring wells MW-16 and MW-17 were installed in November 1998. Inactive wells MW-13 and MW-14 are used as piezometers.

The 1999 AWQMR presented a request to switch shallow well MW-10a with adjacent inactive intermediate well MW-10c. The switch was requested due to shallow well MW-10a not being able to provide water samples year around and yielding turbid samples when water was available. The DEQ approved this request in a letter dated April 27, 2000.

2.1.5 Well Survey

All wells at the site were surveyed during February 2008 by the county. This survey updated the 1998 completed by David Evans and Associates. The 2008 survey included determining the vertical elevations of the water level measurement point (i.e., top of the well PVC) and the top of the aluminum monument caps. Aluminum cap survey monuments were installed next to each well location as part of the 1998 well survey. Elevations are in NAVD88 units and northing/easting coordinates are NAD83 units. The 2008 survey top of the PVC water level measurement point elevations are presented on Table 1.

2.2 GROUNDWATER QUALITY

This section presents a review of historic and recent groundwater quality data from the site.

Review of historical water quality data has indicated that groundwater quality conditions at the site are seasonally variable. The concentrations of water quality parameters are typically higher during the fall event and lower during the spring event. This seasonal variation of groundwater quality is understood to be caused by Willamette River interaction with the uppermost aquifer at the site. During the spring, the river stage is typically high as a result of the wet winter season and spring runoff events, which effectively recharge the aquifer to some extent. During the fall a low river stage has been established for several months in response to dry summer conditions and as a result discharge to the river from the uppermost aquifer has been established. Due to these conditions, groundwater quality conditions at the site can vary substantially between spring and fall events, especially in wells located closest to the river.

Groundwater quality samples at the site have been collected and analyzed on a semi-annual basis since 1974. Table 2 identifies which wells at the site have been sampled 1974 to 2000. Wells indicated as sampled in 2000 are the same wells sampled from 2001 thru 2012.

The following water quality standards are typically exceeded in groundwater samples collected from the site monitoring well network:

- OAR 340-80 Table 3 Guidance Levels or the EPA secondary drinking water standards associated with manganese, iron, and total dissolved solids (TDS). These aesthetic based standards have been exceeded at the site the past four years (2009 through 2013) typically occurring at the following locations: TDS (wells MW-8a/b/c and MW-12a/b), manganese (all wells except MW-9b and MW-15), and iron (all wells except MW-8a/c, MW-9a/b, and MW-15).
- Nitrate has been detected several times in shallow well MW-9b and almost consistently in fall event samples from MW-8s above the OAR 340-80 Table 1 Reference Level, EPA primary drinking water standard associated with nitrate. The PSCL for nitrate, equal to the Primary Drinking Water Standard for nitrate, is also exceeded.

The exceedance of manganese, iron, and TDS Guidance Levels has been reported in past annual environmental monitoring reports.

The exceedance of nitrate Reference Level and PSCL at well MW-8a has been previously reported. The source of nitrate being detected at MW-8a was investigated as reported in the 2007 and 2008 BI AWQMR. Appendix E contains activities and findings presented in these two reports. As noted in the 2012 AWQMR, nitrate is regularly detected above its primary standard at well MW-8a in fall event samples (14 times in the past 16 years). Elevated nitrate concentrations have also been observed in up-gradient well MW-15 and in cross-gradient wells MW-9a/b. In a July 17, 2009 letter, the DEQ concluded that nitrogen compounds do not appear to be adversely affecting the beneficial uses of groundwater.

2.2.1 GQAR Findings

The March 28, 1996, GQAR presented an analysis of groundwater quality data collected from the monitoring well network for the period of April 1985 to March 1995. This time period was selected to evaluate the change in groundwater quality characteristics at the site since closure occurred in 1986.

The 1996 GQAR noted that some landfill indicator parameters are higher in wells down-gradient (north and northeast) of the landfill than in background well MW-15, including: specific conductance, alkalinity, hardness, dissolved iron, dissolved manganese, sulfate, chemical oxygen demand (COD), and total organic carbon (TOC). Wells that were identified as having elevated indicator parameters were MW-8a/b/c, MW-10a/b/c, and MW-12a/b. The GQAR noted that some downward trends are apparent on the time-series plots for some of the parameters in these down-gradient wells, suggesting that closure activities are beginning to reduce leachate generation and subsequent groundwater quality impacts. In the DEQ's letter review of the GQAR, the current and/or past exceedances of water quality standards were identified as; TDS, iron, manganese, sulfate, total coliform, total cadmium, and total lead at the compliance boundary.

2.2.2 GQAR Update Findings

The GQAR Update presented a non-parametric trend analysis (Sen's slope estimator) used to determine whether the concentrations of six indicator parameters (alkalinity, specific conductance, COD, manganese, chloride, and sulfate) were increasing, decreasing, or remaining the same at both active and inactive well locations. Analysis completed on the active wells found that:

1. Upward trends were occurring primarily at down-gradient well MW-12b, to a lesser extent at shallow well MW-12a; and at background well MW-15 with the exception of chemical oxygen demand (COD) (no change) and manganese (down-ward).
2. Downward trends were occurring primarily in down-gradient wells MW-8a/b/c with the exception of sulfate and at well MW-5 (former Trussell supply well) also with the exception of sulfate.

An explanation for the observed upward trends at wells MW-12a/b and downward trends at wells MW-8a/b/c was that:

1. The more westerly wells MW-12a/b are detecting impacts from the more recent use of the western landfill area;
2. The more easterly wells MW-8a/b/c are detecting impacts from the older eastern landfill area.

2.2.3 Annual Monitoring Report Findings

Recent annual water quality monitoring reports for BI have noted the following groundwater quality conditions at the site.

- Examination of recent trends generally indicates site-wide stable or declining concentrations. Wells MW-12b, and to a lesser extent MW-10c, appear to be showing an overall upward trend while wells MW-8b, MW-12a, MW-16, and MW-17 appear to be showing an overall downward trend. The remaining wells are showing either an overall stable trend or no clear overall upward or downward trend.
- Wells MW-8c, MW-10b/c, MW-12a/b, and MW-17 show the greatest indications of water quality impact. These wells are located between the landfill and the river. Some of the highest parameter concentrations are being detected at wells MW-12a/b followed by wells MW-17 and MW-8c. A sustained decreasing concentration trend is occurring at well MW-8c. In general, the greatest impacts are observed in wells completed near the base of the uppermost aquifer down-gradient of the landfill.
- Observed groundwater quality impacts at the site are primary in the form of ions; specifically calcium, magnesium, bicarbonate, and to a lesser extent chloride, sulfate, iron, and manganese. The highest trace metal concentrations are generally observed at locations where high ion concentrations are also observed (wells MW-8a/b/c, MW-10c, and MW-12a/b).
- Recent trace metals results indicate that four (barium, cobalt, nickel, and arsenic) of the nine metals analyzed were detected above the reporting limit in more than 50 percent of the monitoring wells sampled. Selenium and silver were not detected and cadmium was detected in one sample at the reporting limit. The detection frequency of chromium and lead was less than 40 percent. Trace metals were most commonly detected in well MW-9a and MW-10b followed by wells MW-8c, MW-12a/b, and MW-17. The highest concentrations were detected at wells MW-12a/b followed by wells MW-8b and MW-10b. Examination of trends for the four higher frequency detected trace metals found an overall declining concentration trend. Notable concentration increases recently observed in well MW-9a may be related to the recent excavation associated with aggregate mining occurring up-gradient of the well.
- The deep wells (MW-8c, MW-10b, MW-12b, and MW-17) are showing the greatest water quality impacts. The shallower portion of the uppermost aquifer has the greatest water quality changes due to apparent river recharge/discharge interaction.

Groundwater quality impacts at the BI site are being observed primarily at down-gradient well groups MW-12, MW-10, and MW-8. More limited data is available for newer wells MW-16 and MW-17. Concentrations at well MW-16 are generally lower than at well MW-17. These two newer wells were installed to further delineate and characterize the groundwater quality impacts occurring north of the landfill.

2.2.4 Organic Constituent Detections

A review of historical data indicates that volatile organic constituents (VOCs) have been detected at several wells at the site.

VOCs have historically been detected at the following well locations:

Location	Historic Volatile Organic Compound Detections
MW-8a	Toluene 0.0018 mg/l (10/20/93), 0.00561 mg/l (9/2/98).
MW-8b	Toluene 0.0010 mg/l (10/20/93), xylenes 0.0015 mg/l (10/20/93).
MW-10a	Chlorobenzene 0.0026 mg/l (10/20/93)
MW-12a	Chlorobenzene 0.001 mg/l (10/4/89), 0.0015 mg/l (10/20/93), 0.008 mg/l (10/13/96); 1,4-dichlorobenzene 0.001 mg/l (10/4/89), 0.0025 mg/l (10/20/93), 0.00138 mg/l (9/2/98); 1,3-dichlorobenzene 0.008 mg/l (9/6/90); metyhlene methylene chloride 0.011 (10/13/96)
MW-12b	Chlorobenzene 0.001 mg/l (10/4/89), 0.0009 (10/20/93), 0.0009 mg/l (10/13/96), 0.00211 mg/l (9/13/00); 1,4-dichlorobenzene 0.001 mg/l (10/4/89), 0.0007 mg/l (10/20/93), 0.0006 mg/l (10/13/96), 0.00149; 1,3-dichlorobenzene 0.001 mg/l (9/6/90)
MW-13	Methylene Chloride 0.017 mg/l (10/13/96)
MW-17	1,4-dichlorobenzene 0.00073 mg/l (9/13/00)

Methylene chloride detected in the fall 1996 samples from wells MW-12a and MW-13 was noted in the laboratory analytical report as a possible laboratory contaminant. The tentatively identified compound (TIC) tetrahydrofuran has been detected in well MW-12b in samples collected on 9/2/98 (0.00388 mg/l) and on 9/6/00 (0.0024 mg/l). VOCs have historically been detected in wells MW-12a/b and MW-8a/b. More recent sampling found that the 1,4-dichlorobenzene detected in wells MW-12a/b is also present in well MW-17.

More recent analysis for VOCs was completed during the fall 2010 and fall 2012 monitoring events. The results of these analyses are presented in the BI 2010 and 2012 Annual Water Quality Monitoring Reports. Chlorobenzene is typically detected at low concentrations at wells MW-8b and MW-12a/b. Toluene is typically detected at a low concentration at well MW-8a. The compound 1,4-dichlorobenze, which historically was being detected at a decreasing number of locations over time, was not detected in during the fall 2012 event. The greatest number of VOCs (including tentatively identified compounds [TICs]) tends to be detected in the samples from wells MW-12a/b.

Analysis of semi-volatile organic compounds (semi-vols), by EPA Method 8270, was completed on a bi-annual basis from 1996 to 2004. During this period, semi-vols had historically been detected at the following well locations.

Location	Historic Semi-Volatile Organic Compound Detections
MW-8a	Di-n-octylphthalate 0.006 mg/l (10/13/96); bis(2-ethylhexyl)phthalate 0.0152 mg/l (9/2/98)
MW-8b	Di-n-octylphthalate 0.006 mg/l (10/13/96)
MW-8c	Di-n-octylphthalate 0.0091 mg/l (10/13/96)
MW-9a	Di-n-octylphthalate 0.007 mg/l (10/13/96)
MW-9b	Bis(2-ethylhexyl)phthalate 0.0162 mg/l (9/6/00)
MW-12a	Chlorobenzene 0.008 mg/l (10/13/96); di-n-octylphthalate 0.007 mg/l (10/13/96)
MW-12b	Bis(2-ethylhexyl)phthalate 0.0257 mg/l (9/2/98)
MW-14	Bis(2-ethylhexyl)adipate 0.011 mg/l (10/13/96), di-n-octylphthalate 0.012 mg/l (10/13/96),
MW-15	bis(2-ethylhexyl)adipate 0.003 mg/l (10/13/96), di-n-octylphthalate 0.006 mg/l (10/13/96)

During the fall 1998 sampling event, bis(2-ethylhexyl)phthalate was detected at wells MW-8a and MW-12b. Bis(2-ethylhexyl)phthalate is a synonym for dioctyl phthalate (and chemically similar to di-n-octylphthalate), which is used as a plasticizer and may represent possible laboratory contamination (i.e., tubing) or degradation of the PVC well casing. Bis(2-ethylhexyl)phthalate was also detected by the DEQ Laboratory in every sample that they collected from the site during the fall 1998 split sampling event including their transfer and transport blanks. The DEQ did not collect a sample from well MW-9b during that event.

During the fall 2000 sampling event, several unknown compounds were detected primarily in well MW-12a. The laboratory reported the TICs as unknown compounds because poor correlation existed with associating them to any specific compound names. Further examination of the above unknown TICs by the laboratory identified them as long-chain hydrocarbons from a non-petroleum source. There were also several more peaks present but at levels below the mrl. In essence the semi-vol TIC detections may represent breakdown products of potentially naturally occurring long-chain hydrocarbon compounds.

None of the VOCs or semi-vols detected at the site has exceeded a DEQ Numerical Groundwater Standard or an EPA Primary Drinking Water Quality Standard.

2.2.5 River Water Quality

The 1998 GQAR Update included an analysis of groundwater discharge into the Willamette River. Groundwater discharge rates into the river were found to be negligible (less than one gallon per day) due to equilibrium conditions that exist between the surface water and the river alluvium deposit groundwater system. The results of the June 1999 slug test further supported the 1998 analysis conclusions.

An estimate of chemical loading to the river was also examined in the GQAR Update using the principle of mass balance. This analysis indicated that when considering worst-case conditions (low river stage, high groundwater discharge rate), no measurable increase in the water quality parameters is observed down river of the landfill. This is due to the high river flow volume compared with the rate of groundwater discharged from the site.

In an attempt to confirm the chemical loading analysis findings, samples of the river up and down-stream of the site were collected during the fall 2000 event river when river stage conditions are lowest and groundwater discharge to the river is greatest. Examination of the results of fall 2000 river samples indicate that the concentration of the various parameters analyzed are similar at the two locations sampled. The most notable difference were bacteria results where the up-stream river sample location had higher reported enterococcus and total coliform concentrations. Fecal coliform concentrations were similar. The detected concentrations of site-specific parameters such a bicarbonate, chloride, iron, magnesium, and sulfate at the two river sample locations were either the same or very similar. The calcium concentration at the up-stream location was slightly higher than the down-stream sample location. However, the up-stream sample concentration was qualified as an estimated value. The detected total alkalinity concentration was slightly higher in the down-river sample compared with the up-river sample. The field conductivity readings were slightly higher at the down river location whereas the laboratory conductivity reading was slightly higher in the up-stream sample.

The results of the fall event sampling of the Willamette River are consistent with the results of the groundwater discharge analysis presented in the BI GQAR Update. In a letter dated March 30, 2001, the DEQ indicated that while the up-stream and down-stream concentrations of inorganic parameter tends to support the no notable difference observation, the estimated values for the bacteria results (their hold times were exceeded) cannot be used as conclusive evidence that groundwater discharge from the site has resulted in no notable impact to the river.

3. GROUNDWATER MONITORING PLAN

The existing groundwater quality monitoring network at the site consists of 13 groundwater monitoring wells as described in Section 2.1. Historic and recent groundwater conditions at the site were presented in Section 2.2. Based on the information presented in Section 2, a plan for the continued use of these monitoring wells for groundwater quality compliance sampling is presented in this section. The existing site groundwater quality database is described along with procedures that will be used to analyze, review, and report water quality results.

Attachment A presents a Sampling and Analysis Plan (SAP) which provides information to guide the collection and analysis of groundwater quality samples at the BI site. The SAP describes the procedures recommended for preparing, obtaining, documenting, preserving, and shipping water quality samples collected at the BI. The SAP establishes Quality Assurance/Quality Control (QA/QC) requirements for sample acquisition and handling at the site.

3.1 GROUNDWATER QUALITY MONITORING POINTS

Table 1 identifies the 13 active monitoring wells that will serve as the groundwater quality monitoring network for the site. As shown on Figure 2, wells MW-8a/b/c, MW-12a/b, MW-16, and MW-17 are down-gradient compliance boundary wells. Wells MW-9a/b and inactive wells MW-13 and MW-14 are also located on the compliance boundary shown on Figure 2. Potentiometric maps and water quality data indicate that wells MW-9a/b are cross-gradient wells. Potentiometric maps have indicated that wells MW-13 and MW-14 appear to be recharged from the adjacent east slough. The 13 inactive wells will be used as piezometers. Water levels are collected from all 26 wells and used to develop potentiometric maps for the site.

All 13 active wells are capable of yielding representative groundwater quality samples from the uppermost aquifer beneath the site. The wells were evaluated for suitability and upgraded in 1997 (see Appendix E). The security casing of each well consists of steel casing with a lock protected access cap. Each well is equipped with a dedicated bladder sampling pump that has been in uses since the fall 2008 event. Dedicated sampling pumps were installed in the 12 active monitoring wells to limit the potential for cross-contamination while increasing sample collection efficiency and representativeness. Prior to the fall 2008 event, the monitoring wells were purged and sampled using a dedicated PVC bailer stored (suspended) in each active well. An exception is sample point MW-5, which is a supply well that is sampled from a tap. All well locations are currently accessible by vehicles using gravel and dirt roads or trails.

Section 13.2 of the closure permit indicates that the County shall protect and maintain each groundwater or surface water monitoring well or device so that sample representative of actual conditions can be collected. Any damage discovered shall be reported to the DEQ in writing within 14 days of the discovery, along with a description of the proposed repair or replacement measures and time schedule for completion of repair work. All monitoring well repairs, abandonments, replacements and installations must be documented in a report prepared by an Oregon registered geologist and must be submitted to the DEQ within 30 days of the action and included in the next annual environmental monitoring report.

3.2 MONITORING SCHEDULE

Section 10.4 of the BI closure permit identifies a semi-annual sampling schedule for environmental monitoring at the site in accordance with the approved EMP. The following compliance sample event periods are identified in the closure permit:

- Spring – March 1st through May 31st.
- Fall – September 1st through October 31st.

During the spring and fall compliance periods, groundwater quality sampling will be completed on the 13 active monitoring wells as identified on Table 3. Table 3 identifies the analytes to be sampled, the sampling frequency and schedule. Table 4 identifies the analytes or parameter included in each parameter group listed in Table 3.

As indicated on Table 3, analysis of BI Permit Parameters is completed every two years on even years during fall events (i.e., fall 2014, fall 2016). With the exception of the even year fall events, analysis of BI Indicator Parameters is completed. Table 4 identifies the analytes and parameters associated BI Permit Parameters and BI Indicator Parameters. BI Indicator Parameters were applied beginning with the fall 2011 event.

Water level measurement events from all monitoring wells at the site will also be completed during a semi-annual monitoring.

3.3 COMPLIANCE BOUNDARY AND CONCENTRATION LIMITS

Permit-specific concentration limits (PSCLs) proposed on October 24, 2003 were approved by the DEQ in a letter dated May 5, 2005. The following PSCLs have been established for the BI site.

Contaminant	Concentration Limit
Arsenic	0.05 mg/l
Barium	1.0 mg/l
Cadmium	0.0163 mg/l
Chromium	0.0469 mg/l
Lead	0.05 mg/l
Nitrate-N	10.0 mg/l
Selenium	0.01 mg/l
Silver	0.0140 mg/l

The above PSCLs are based on Groundwater Quality Protection Reference Levels (OAR 340-40 Table 1) or a site-specific derived concentration. The 1996 BI EMP identified compliance boundary for the site is shown on Figure 2. The GQAR Update indicated that trend analysis using time series plots and Sen’s slope estimator (Gilbert 1987) would be used to periodically to assess the trends in compliance well concentrations.

3.4 REVIEW OF GROUNDWATER QUALITY RESULTS

The existing BI groundwater quality database is in Microsoft Access format and includes groundwater quality data, dating back to April 1985. As new site water quality data is obtained, electronic data deliverables (EDDs) from the laboratory are directly uploaded into the database. This database update methodology increases data transfer efficiency and reduces data entry errors. Templates and queries have been developed that can provide various types of data reports and formats.

The analysis and evaluation of water quality data collected from BI is completed in the following manner. A review of field and laboratory data is initially completed, upon receipt of the data from the laboratory, to identify and address data that: 1) did not meet QA/QC control objectives, 2) represents a significant change in water quality, or 3) exceeds a primary groundwater, drinking water quality standard, or a PSCL.

3.4.1 Routine Event Data Review Action Criteria

Section 11.4 of the closure permit indicates that if there is a significant change in water quality, then the County shall notify the DEQ within 10 days of the receipt of the laboratory data. Dependent upon the data review findings, a resampling event may be required as described in this section.

The following actions shall be taken based on this data review:

- Data indicates there is no significant change (below primary numerical groundwater reference levels, primary drinking water quality standards, or PSCLs: → continue groundwater monitoring with next scheduled event.
- Data indicates a significant change in water quality at any monitoring point: → notify the DEQ within 10 days of receipt of laboratory results and perform resampling within 15 days.
- Data is above a PSCL: → notify the DEQ within 10 days of receipt of laboratory results and perform resampling within 15 days.

Note if this is a known release previously confirmed to the DEQ in writing, then resampling is not required.

Examples of a significant change in water quality include:

- Detection of a volatile organic constituent (VOC) or other hazardous constituent not detected in the background monitoring point (well MW-15) and previously not reported.
- Exceedance of a Table 1 value listed in OAR 340-40-020 unless the background monitoring point (well MW-15) is above these numerical limits and the exceedance has previously been reported.
- Exceedance of a primary EPA Primary Drinking Water Standard that has previously not been reported.

Note that established permit specific concentration limits and compliance points are listed in Section 3.3.

3.4.2 Resampling Event Data Review Action Criteria

As indicated in Section 11.5 of the closure permit, in the case where a routine data review indicates that a resampling event needs to be completed, the data from the resampling event shall be reviewed upon receipt and responded to in the following manner:

- If the resampling results do not confirm the routine results, then:
  1. Continue with routine monitoring.

2. Discuss the data from the routine sampling event and the resampling event in the next Annual Water Quality Monitoring Report.

- If the resampling results confirm that a significant change in water quality has occurred, as noted in the routine results:
  1. Notify the DEQ within 10 days of receipt of the laboratory data or within 60 days of the sample date (whichever occurs first).
  2. Submit a plan within 30 days (unless another time period is authorized) for developing an assessment program with the DEQ.

3.5 DATA ANALYSIS AND EVALUATION

This section describes procedures that will be used to evaluate data quality (data QA/QC) and data analysis using statistical methods.

3.5.1 Data QA/QC

A QA/QC review will be completed for each sampling event and will be summarized in a QA/QC summary report that will accompany all data presentation reports. The QA/QC summary report will present the following information: project and sample information; a quality assurance summary; a review of analytical methods and holding times; and a review of laboratory and field quality control samples. Data exclusions from statistical consideration and/or analysis will be identified based on the QA/QC review. Data presentation reports (i.e., Annual Water Quality Monitoring Reports) will also include a review of field activities or observations that may have had an influence on the representativeness of water quality data collected from the site.

3.5.2 Data Presentation and Analysis

Water quality data from the site will be tabulated by sample location and parameter. The summary data tables will be organized in a manner consistent with the parameter groups listed on Table 4. Each table will present chemical data for that parameter for each monitoring point in chronological order (i.e., for each sample point the most recent data is presented on the bottom row). Tables organized in this manner facilitate the review and statistical analysis of data.

The following formats will be used to present data collected from the BI site, including: potentiometric contour maps, time series plots, trilinear plots, and Stiff diagrams. Note that analysis of BI Indicator Parameters does not allow for development of trilinear plots or Stiff diagrams.

The Sen's slope estimator has been used in the past to evaluate trends in the compliance well data as noted in Section 2.2.2 and represents an accepted DEQ statistics method. EPA's March 2009 Statistical analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance is now considered to provide current recommended and approved statistical analysis methodologies. For trend tests, the Unified Guidance identifies three primary methods: (1) linear regression be used to identify a linear trend and estimate its maganitude; (2) Mann-Kendall test provides a method for identifying trends; and (3) the Theil-Sen trend line method can be used to gauge trend of magnitude.

As noted in Section 2.2, groundwater concentrations at BI vary notably over time due seasonal variability and in response to other geochemical changes. As a consequence, time series plots for BI show a lot of variability in groundwater quality data over time. Some of this variability is seasonal while some variability does not appear to be seasonally related. The variability at a given well is not necessarily consistent for all parameters or locations or at similar locations but different depths. For example, a well could show a notable concentration increase of ammonia and total dissolved solids while showing, at the same time, a notable decrease in sodium and potassium. An adjacent well screened slightly deeper may show different conditions. The extent of data variability at the site can make it difficult to characterize whether a given parameter is actually increasing or decreasing over time.

In response to the presence of notably variable groundwater concentration conditions, review of BI time series plots has consisted of examining short-term plots, consisting of 5 years of most recent data [10 sample data sets], along with review of long-term plots (consisting up to more than 25 years of data) to provide context for the short-term plots. A best fit line using linear regression is applied to the 10 sample data set and used to assist in examining the overall recent linear trend of the data.

As needed, summary statistics can also be completed including: sample size, average, median, standard deviation, interquartile range, standardized skewness, standardized kurtosis, and interquartile range of parameter detections. All nondetects will be replaced with a value that is 1/2 of the reported method detection limit (MDL). The summary statistics will be computed using either Microsoft Excel, an Excel statistics add-on package such as Analyzs-it, Statgraphics, or a comparable statistical software package.

Data evaluation will also include a comprehensive comparison of groundwater quality sample results to the following applicable water quality standard and site-specific concentration limits:

- State of Oregon Numerical Groundwater Quality Reference and Guidance Levels (OAR 340-40-020 Tables 1 through 3).
- EPA National Primary Drinking Water Regulations.
- Permit Specific Concentration Limits listed in Section 3.3.

These water quality standards are presented on Table 4.

3.6 REPORTING

Reporting of environmental data includes the submittal of Annual Water Quality Monitoring Reports and the results of split-sampling events. These reporting requirements are addressed in this section.

3.6.1 Annual Water Quality Monitoring Report

As indicated in Section 12.2 of the closure permit, an Annual Water Quality Monitoring Report (AWQMR) is to be submitted prior to March 15th of each calendar year for the duration of the closure permit. The AWQMR will address environmental monitoring activities, results, and findings from the previous year. Whenever possible, the report needs to be completed as a two-sided document. To reduce physical size of the report and reduce paper usage, report appendices can be presented as electronic files contained on a compact disc attached to the report's back inside cover page. Two copies of the report, stamped by an Oregon registered geologist or engineering geologist, are to be submitted to the DEQ.

The AWQMR is to include a statement of compliance, a one-page cover letter that presents a concise comparison of the analytical results with the monitoring standards identified above in Section 3.5.2. Specifically, the statement of compliance letter will:

- Compare the analytical results with the relevant monitoring standards (PSCLs).
- State whether or not federal or state standards were exceeded for the relevant media.
- State whether or not a significant change in water quality has occurred.

Examples of significant change in water quality are provided in Section 3.4.1.

As indicated in Section 12.4 of the closure permit, the AWQMR needs to include the following information:

- An executive summary.
- Site background and recent site activity information.
- A summary presentation of all environmental monitoring performed during the past year.
- A summary presentation of data validity (i.e., review of holding times, comparison of blanks and duplicates, major cation/anion balance for each groundwater sample collected, identification of data problems or discrepancies, field QA/QC issues, and laboratory compliance with QA/QC standards) and identification of data problems.
- Summary tables of all analytical results by sampling location organized by the parameter groups as described in Section 3.5.2.
- Itemization of any activities resulting from the exceedance of a relevant standard or significant change in water quality. Examples include resampling events, submittal of a Preliminary Assessment or an Assessment Monitoring Report.
- Presentation of water level data and groundwater flow direction using contour maps, tables, and graphs.
- Updated time-series plots and other completed statistical analysis as described in Section 3.5.2.
- Copies of all field data sheets, laboratory analytical reports, and chain-of-custody documents completed for the year being reported.
- Copies of all monitoring well repairs, abandonments, replacements, and installations that occurred at the site during the reported year.
- A summary of new or proposed activities at the site.

Note that application of the BI Indicator Parameters does not allow for completion of cation/anion balances or the generation of Stiff and Piper diagrams.

Copies of the AWQMR are to be submitted to the following address:

Oregon Department of Environmental Quality
Manager – Western Region Solid Waste Program
750 Front Street NE, Suite 120
Salem, Oregon 97301-1039

3.6.2 DEQ Laboratory Split Sampling Report

The BI closure permit does not contain specifies split sampling event dates but indicates in Section 10.3 that spit sampling with DEQ shall occur when requested. If requested, scheduling the event with the DEQ Lab must occur at least 45 days prior to the sampling event.

In the event of a DEQ split sampling event, the following information will be submitted to the DEQ laboratory, located in Portland, Oregon, within 90 days of the split-sampling event:

- Copy of all information pertinent to the sample collection, handling, transport and storage, including field notes.
- Site map showing groundwater flow directions and contours.
- Copies of all laboratory analytical data, QA/QC reports, and any additional data specifically requested by the DEQ laboratory.

The address for the DEQ laboratory is:

Oregon Department of Environmental Quality
Laboratory Division, Groundwater Monitoring Section
3150 NE 229th Avenue, Suite 150
Hillsboro, Oregon 97124
(503) 693-5700

3.7 REDUCTION IN MONITORING

The County may petition for a reduction in the sampling frequency, a reduction in the number of locations to be sampled, or the elimination of selected monitoring parameters for the site environment monitoring program. A demonstration would need to be presented to the DEQ's satisfaction that, for each monitoring point or parameter in consideration, sufficient samples have been analyzed to allow for adequate assessment of the data. Adequate justification for all proposed reductions in sampling frequency and parameters will need to be provided to the DEQ.

4. REFERENCES

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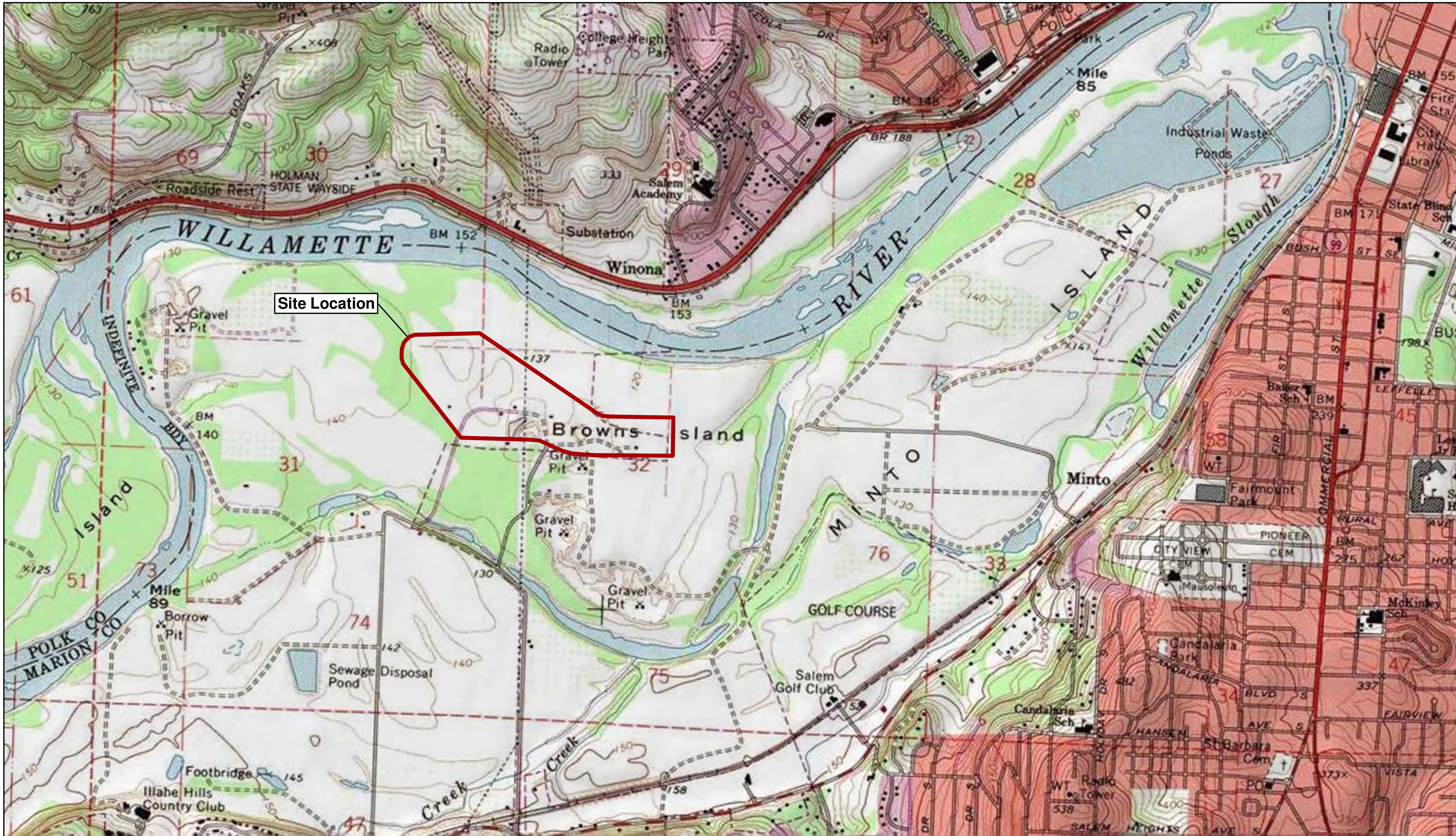
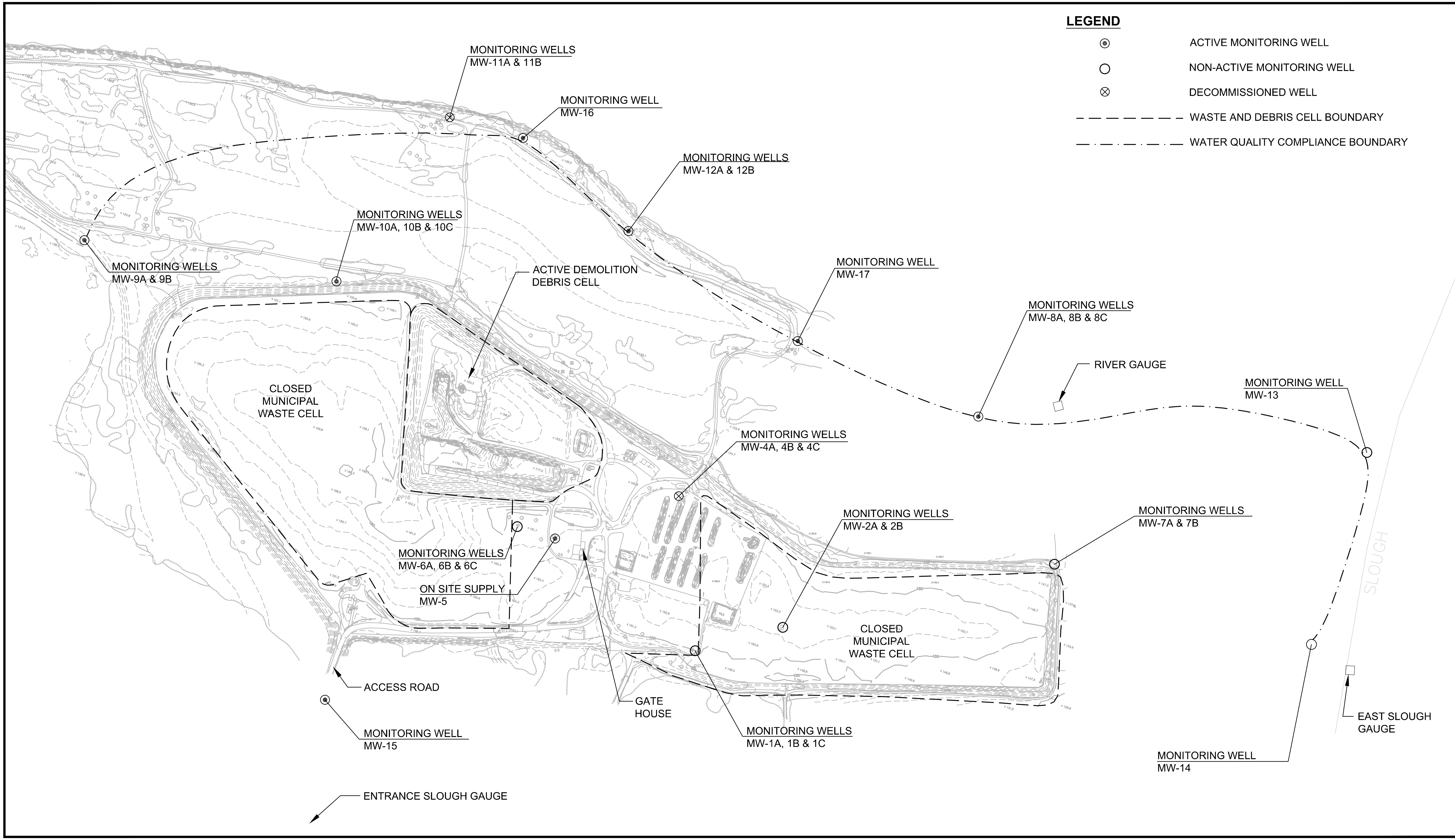


Parametrix DATE: March 1, 2011 FILE: BrownIsland_SiteLocation.mxd

N
0 0.5 1
Miles

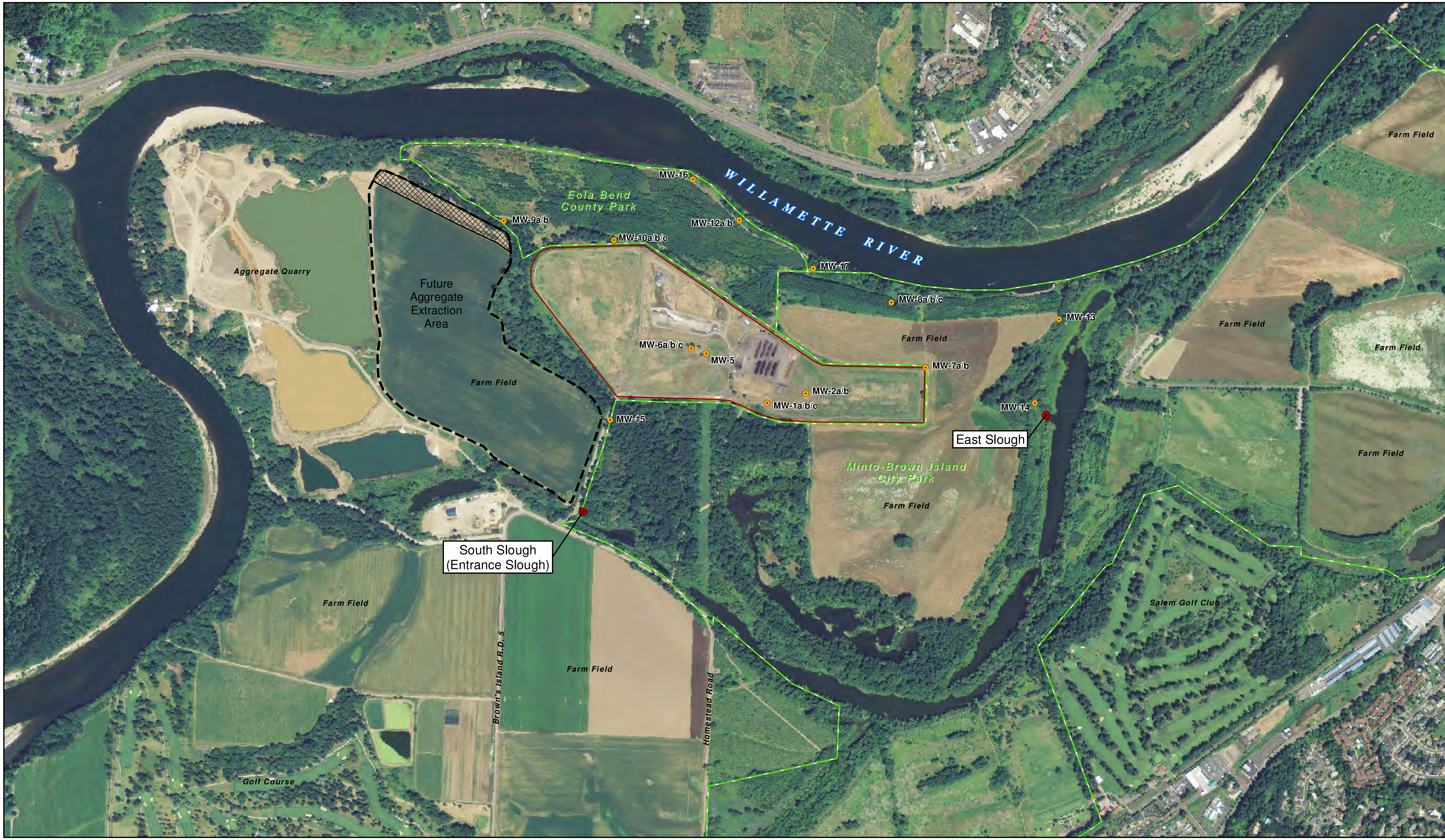
Figure 1
Site Location

Annual Water Quality
Monitoring Report
Brown's Island Landfill



Parametrix DATE: Oct 19, 2012 FILE: PO2063007F-91

Figure 2
Facility Map
Annual Water Quality Monitoring Report
BROWN'S ISLAND LANFILL
MARION COUNTY, OREGON



Parametrix DATE: March 3, 2011 FILE: BrownIsland_AerialSiteMap.mxd

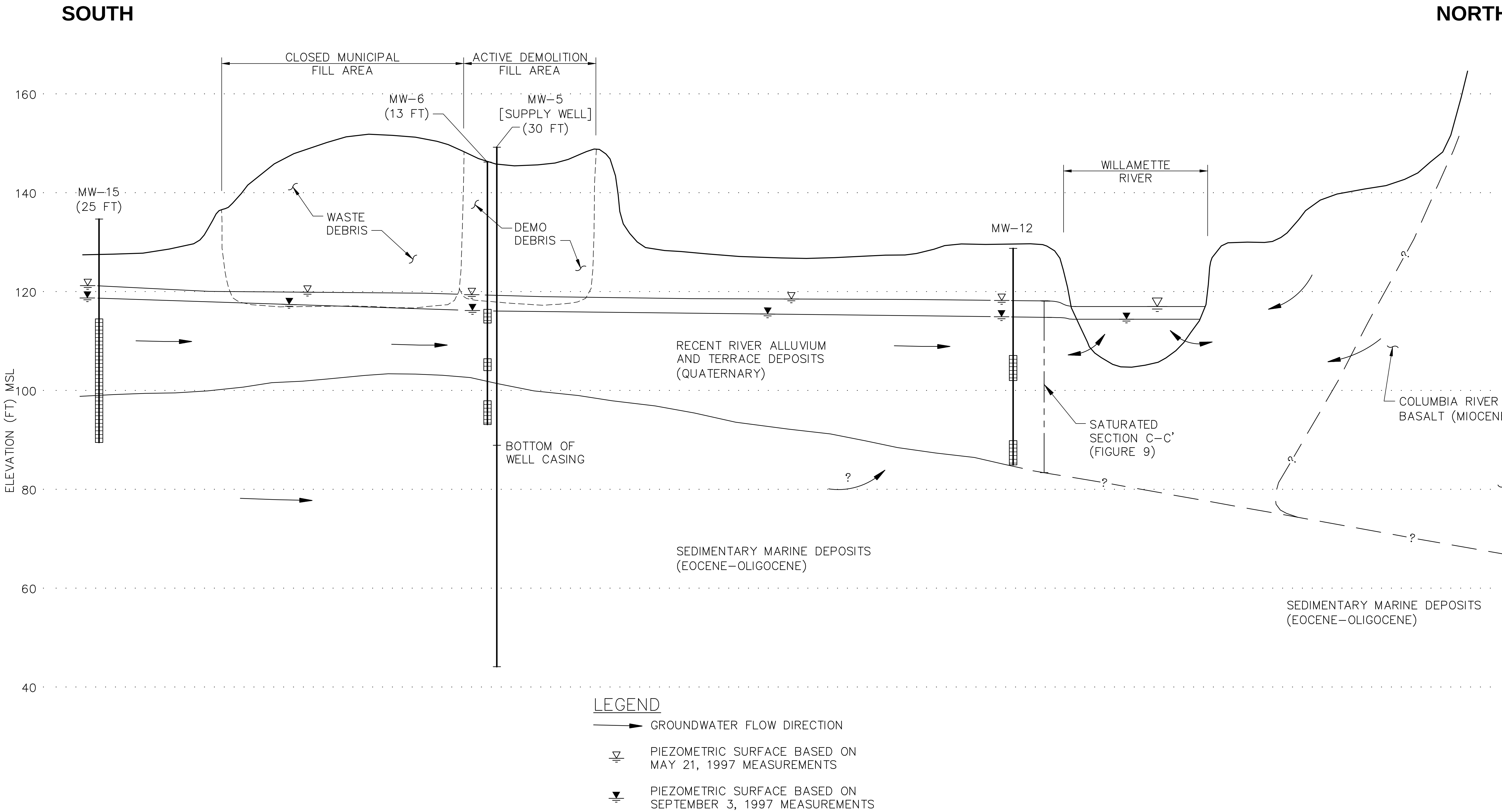
N

0 0.25 0.5
Miles

Site Location
Future Aggregate Extraction Area
Recent Excavated Area
Monitoring Well
Surface Water Elevation Monitoring Point
Park Boundary

Figure 3
Aerial Site Map

Annual Water Quality
Monitoring Report
Browns Island Landfill

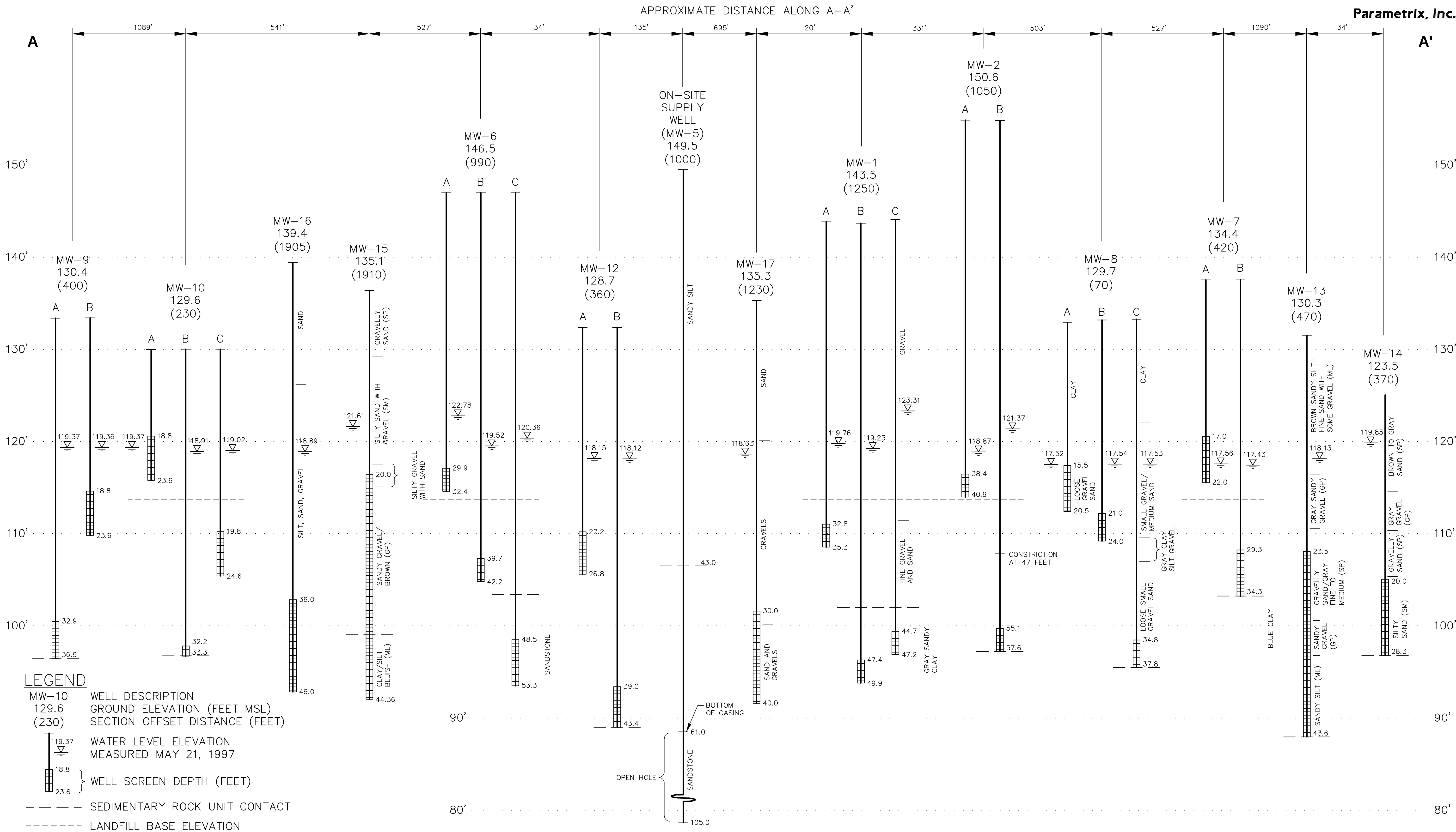


FILE: P02063007F-99
DATE: 02/14/13

SCALE: 1"=250' HORIZ
1"=20' VERT

Figure 4
North/South Cross-Section
BROWNS ISLAND LANDFILL
MARION COUNTY, OREGON

Parametrix, Inc.



FILE: P02063007F–100
DATE: 02/14/13

SCALE: VERT 1"=10'
HORIZ NONE

Figure 5
Well Cross-Section A-A'
Environmental Monitoring Plan Update
BROWNS ISLAND LANDFILL
MARION COUNTY, OREGON

Table 1: Monitoring Well Summary Data
Sampling and Analysis Plan
Browns Island Landfill

Active Monitoring Wells

Well ID	Date Installed	Well Log	Construction Type	Well Depth (from top of PVC - ft)	Top of PVC Casing Elevation (ft)	Screen Length (ft)	Screen interval (ft below top of PVC)
MW-5	1/5/1969	yes	supply	105	153.84	none	61-105
MW-8a	10/16/1975	yes	single	20.47	136.72	5	15.3 - 20.3
MW-8b/c	10/15/1975	yes	double	23.90/37.72	136.88/136.62	3/3	23-26/32-35
MW-9a/b	3/76-7/79	no	double	37.08/23.78	136.98/137.02	4.0/4.9	32.9-36.9/18.8-23.9
MW-10b/c	3/76-7/79	no	double	33.42/24.70	134.78/134.94	1.1/4.8	32.2-33.3/19.8-24.6
MW-12a/b	3/76-7/79	no	double	26.90/43.51	136.17/135.83	4.6/4.4	22.2-26.8/39.0-43.4
MW-15	10/31/1986	yes	single	44.36	140.24	20	20-40
MW-16	11/11/1998	yes	single	48.77	141.92	10	36/46
MW-17	11/10/1998	yes	single	42.38	137.81	10	30/40

Inactive Monitoring Wells

Well ID	Date Installed	Well Log	Construction Type	Well Depth (ft)	Top of PVC Casing Elevation (ft)	Screen Length (ft)	Screen interval (ft below top of PVC
MW-1a/b/c	5/8-5/21/73	yes	triple	40.67/47.17/51.33	151.75/152.01/152.16	2.5/2.5/2.5	38.2-40.6/44.7-47.1/48.8-51.3
MW-2a/b	5/22-23/73	yes	double	41.75/57.5	158.63/158.68	2.5/2.5	39.2-41.7/55.0-57.5
MW-6a/b/c	5/23-5/31/73	yes	triple	33.3/43.33/54.3	151.89/151.89/151.90	5/5/4	28.3-33.3/38.3-43.3/50.3-54.3
MW-7a	10/13/1973	yes	single	22.0	141.36	5	15-20
MW-7b	10/8/1973	yes	single	34.3	141.90	5	30-35
MW-10a	3/76-7/79	no	single	14.32	134.78	4.8	9.4-14.2
MW-13	10/29/1986	yes	single	43.55	135.31	20	21/41
MW-14	10/30/1986	yes	single	28.25	128.85	5	21/26

Abandoned Monitoring Wells

Well ID	Date Installed	Well Log	Construction Type	Well Depth (ft)	Date Abandoned
MW-4a/b/c	4/16-5/7/73	yes	triple	40/48/62	7/29/99-8/2/99
MW-11a/b	3/76-7/79	no	double	15.08/21.31	9/8/1997

TABLE 2: SAMPLE LOCATION SUMMARY - 1994 thru 2000
ENVIRONMENTAL MONITORING PLAN UPDATE
BROWNS ISLAND LANDFILL

WELL ID	Well 1A	Well 1B	Well 1C	Well 2A	Well 2B	Well 3	Well 4A	Well 4B	Well 4C	Well 5	Well 6A	Well 6B	Well 6C	Well 7A	Well 7B	Well 8A	Well 8B	Well 8C	Well 9A	Well 9B	Well 10A	Well 10B	Well 10C	Well 11A	Well 11B	Well 12A	Well 12B	Well 13	Well 14	Well 15	Well 16	Well 17	River Up	River Down	QA Sample
5/2/1974	X	X	X	X	X	X	X	X	X	X	X	X	X																						
9/11/1974	X	X	X		X	X	X	X	X	X	X	X	X																						
12/30/1974	X	X	X	X	X	X	X	X	X	X																									
3/10/1975	X	X	X	X	X	X	X	X	X	X																									
7/9/1975	X	X	X	X	X	X	X	X	X	X	X	X																							
9/9/1975	X	X	X		X	X		X	X	X	X	X																							
3/9/1976		X		X	X	X		X	X	X	X	X	X	X	X	X	X	X																	
4/13/1976	X	X		X		X		X	X	X	X	X	X	X	X	X	X	X																	
5/24/1976	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																	
6/23/1976	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																	
7/27/1976	X	X		X	X	X		X	X	X	X	X	X		X	X	X	X																	
9/23/1976	X	X	X		X	X		X	X	X	X	X			X																				
7/11/1977	X	X		X	X			X	X	X	X	X	X		X		X	X	X																
3/6/1978	X	X	X				X	X	X	X	X	X	X		X	X	X	X																	
9/18/1978	X	X	X		X		X	X	X	X	X	X	X	X	X	X	X	X																	
5/21/1979	X	X	X		X			X	X	X	X	X	X	X	X			X																	
9/10/1979	X	X	X		X			X	X	X	X	X			X			X	X	X		X	X		X	X	X								
10/7/1980	X	X	X				X	X	X						X	X		X	X	X		X	X		X	X									
5/27/1981	X	X	X					X	X					X		X		X	X	X		X	X		X	X									
7/7/1982	X	X	X												X	X		X	X	X		X	X		X	X									
9/22/1982	X	X														X		X	X	X		X	X		X	X									
5/11/1983	X	X												X	X	X		X	X	X	X	X	X	X	X	X	X								Well 9B
9/8/1983	X	X		X	X											X		X	X	X		X	X		X	X	X								
5/2/1984	X	X	X	X	X											X		X	X	X	X	X	X	X	X	X	X								
10/31/1984	X	X		X										X		X	X	X	X	X	X	X	X		X	X	X								Well 12A
4/17/1985	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X		X	X	X								Well 12B
11/7/1985	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X		X	X	X								Well 9B
6/3/1986	X	X	X	X	X										X	X	X	X	X	X		X	X		X	X	X								Well 10C
10/29/1986																X		X	X	X	X	X	X			X	X								
12/30/1986																												X	X	X					SEA Data/No Dup.
4/22/1987	X	X	X	X	X										X	X	X	X	X	X	X	X	X		X	X	X	X	X	X					Well 13A
11/12/1987	X	X	X		X											X	X	X	X	X		X	X			X	X	X	X	X					Well 13A
4/6/1988																X	X	X	X	X	X	X	X			X	X	X	X	X					Well 15A
9/7/1988																X	X	X	X	X		X	X			X	X	X	X	X					Well 8B
5/2/1989																X	X	X	X	X	X	X	X			X	X			X					Well 8A
10/4/1989										X						X	X	X	X	X		X	X			X	X	X	X	X					Well 5
4/11/1990																			X	X										X					Well 15C
4/12/1990										X						X	X	X								X	X	X	X						Well 5
9/5/1990										X																	X			X					Well 5
9/6/1990																X	X	X	X	X						X		X	X						
4/18/1991										X						X	X	X	X	X	X	X	X			X	X	X	X	X					Well 5 & 15
10/8/1991										X									X	X						X	X	X	X	X					Well 5
10/9/1991																X	X	X				X	X	X											Well10B
5/13/1992																X	X	X								X	X	X	X						Well 8B
5/14/1992										X									X	X	X	X	X												Well 5
6/4/1992																														X					
10/5/1992																X	X	X								X	X	X	X	X					Well 14B
10/6/1992										X									X	X		X	X												Well 10B
4/7/1993																X	X	X										X		X					Well 8A
4/8/1993										X									X	X	X	X	X			X	X								Well 5
10/20/1993										X						X	X	X	X	X	X	X	X			X	X	X	X	X					Well 5
4/11/1994																X	X	X										X	X	X					Well 8C
4/12/1994										X									X	X	X	X	X			X	X								Well 5
9/13/1994										X						X	X	X	X	X		X	X			X	X	X	X	X					Well 15
3/7/1995										X						X	X	X	X	X	X	X	X			X	X	X	X	X					Well 13A
3/27/1996																X	X	X	X	X	X	X				X	X	X	X	X					Well 10B
10/3/1996										X						X	X	X	X	X	X					X	X	X	X	X					Well 12A
5/22/1997		X								X			X			X	X	X	X	X	X	X				X	X	X	X	X					Well 8C &10B
9/3/1997																X	X	X	X	X		X				X	X	X	X	X					Well 9A &12A
5/28/1998										X						X	X	X	X	X	X	X				X	X	X	X	X					Well 5 & 8C
9/2/1998										X						X	X	X	X	X		X				X	X			X					Well 12A
5/26/1999										X						X	X	X	X	X	X	X				X	X			X	X	X			Well 16
9/21/1999										X						X	X	X	X	X		X				X	X			X	X	X			Well 5
5/31/2000										X						X	X	X	X	X		X	X			X	X			X	X	X	X	X	Well 10C
9/13/2000										X						X	X	X	X	X		X	X			X	X			X	X	X	X	X	Well 15

NOTES: 9/13/94 data indentified as 9/12/94 data in Storet.

Former Trussel water supply well and Well 5 are the same well.

- Indicates related events

TABLE 3: WATER QUALITY SAMPLE LOCATIONS, FREQUENCY, AND SCHEDULE
ENVIRONMENTAL MONITORING PLAN
BROWNS ISLAND LANDFILL

Locations	Analytes *	Frequency	Schedule
Alluvium wells: Shallow: MW-8a. Intermediate: MW-8b, MW-9b, MW-10c, MW-12a, and MW-15. Deep: MW-8c, MW-9a, MW-10b, MW-12b, MW-16, and MW-17.	Group 1a Group 1b Group 2a	Semi-annual	Spring and Fall
	Group 2b Group 3	Bi-annual	Every two years in Fall beginning in 2006
Marine Sedimentary Rock wells: MW-5 (on-site supply well)	Group 1a Group 1b Group 2a	Semi-annual	Spring and Fall
	Group 2b Group 3	Bi-annual	Every two years in Fall beginning in 2006
Piezometers: MW-1a/b/c, MW-2a/b, MW-6a/b/c, MW-7a/b, MW-10a, MW-13, and MW-14.	Water levels	Semi-annual: all monitoring wells	Spring and Fall

NOTES:

***** See Table 2, Water Quality Monitoring Parameters, for analytes/parameters included in each parameter group. BI Indicator Parameter list is applied except during even year Fall events (i.e., Fall 2012, Fall 2014, etc.) when the BI Permit Parameter list is applied.

The semi-annual compliance monitoring periods are:

Spring: March 1st through May 31st.

Fall: September 1st through October 31st.

TABLE 4: WATER QUALITY MONITORING PARAMETERS
ENVIRONMENTAL MONITORING PLAN
BROWNS ISLAND LANDFILL

BI INDICATOR PARAMETERS	BI PERMIT PARAMETERS	METHOD	METHOD DESCRIPTION	METHOD REPORTING LEVEL (mg/L)	DEQ REFERENCE LEVELS[d] (mg/L)	DEQ GUIDANCE LEVELS[e] (mg/L)	EPA DRINKING WATER STD[f] (mg/L)
GROUP 1a: FIELD INDICATOR PARAMETERS							
ELEVATION OF WATER LEVEL	ELEVATION OF WATER LEVEL	FIELD	Electric Probe				
pH	pH	FIELD	Reference Electrode Probe			6.5 to 8.5 su	
TEMPERATURE	TEMPERATURE	FIELD	Temperature Probe				
SPECIFIC CONDUCTANCE	SPECIFIC CONDUCTANCE	FIELD	Conductivity Probe				
DISSOLVED OXYGEN	DISSOLVED OXYGEN	FIELD	Metal Cathode Probe				
REDOX POTENTIAL (Eh)	REDOX POTENTIAL (Eh)	FIELD	Platinum Band Sensor Probe				
GROUP 1b: LABORATORY INDICATOR PARAMETERS							
	HARDNESS (as $CaCO_3$)	6020[a]	ICP-MS	2.00			
TOTAL ALKALINITY (as $CaCO_3$)	TOTAL ALKALINITY (as $CaCO_3$)	310.1[b]	Titrimetric	10.0			
TOTAL DISSOLVED SOLIDS (TDS)	TOTAL DISSOLVED SOLIDS (TDS)	160.1[b]	Gravimetric	10.0		500	
TOTAL SUSPENDED SOLIDS (TSS)	TOTAL SUSPENDED SOLIDS (TSS)	160.1[b]	Gravimetric	10.0			
	CHEMICAL OXYGEN DEMAND (COD)	410.4[b]	Spectrophotometric	5.00			
	TOTAL ORGANIC CARBON (TOC)	415.1[b]	UV, Persulfate Oxidation-IR	1.00			
GROUP 2a: COMMON ANIONS AND CATIONS[#]							
CALCIUM (Ca)	CALCIUM (Ca)	200.7[b]	ICP-MS	0.050			
	MAGNESIUM (Mg)	200.7[b]	ICP-MS	0.002			
	SODIUM (Na)	200.7[b]	ICP-MS	1.00			
	POTASSIUM (K)	200.7[b]	ICP-MS	1.00			
IRON (Fe)	IRON (Fe)	200.7[b]	ICP-MS	0.0250		0.3	
MANGANESE (Mn)	MANGANESE (Mn)	200.7[b]	ICP-MS	0.00200		0.05	
AMMONIA-NITROGEN (NH_3-N)	AMMONIA-NITROGEN (NH_3-N)	350.3[b]	Electrode	0.100			
	BICARBONATE ALKALINITY (HCO_3)	310.1[b]	Titrimetric	10.0			
SULFATE (SO_4)	SULFATE (SO_4)	300.0[b]	Ion Chromotography	1.00		250	
CHLORIDE (Cl)	CHLORIDE (Cl)	325.3[b]	Ion Chromotography	0.500		250	
NITRATE (NO_3-N)	NITRATE (NO_3-N)	353.3[b]	Ion Chromotography	0.100	10.0		10
	SILICA (Si)	370.1[b]	Spectrophotometric Reduction	0.250			
GROUP 2b: TRACE METALS							
	ARSENIC (As)	6020[a]	ICP-MS	0.00100	0.05		0.05
	BARIUM (Ba)	6020[a]	ICP-MS	0.00100	1.0		2
	CADMIUM (Cd)	6020[a]	ICP-MS	0.00100	0.01		0.005
	CHROMIUM (Cr)	6020[a]	ICP-MS	0.00200	0.05		0.1
	COBALT (Co)	6020[a]	ICP-MS	0.00100			
	LEAD (Pb)	6020[a]	ICP-MS	0.00100	0.05		0.015***
	NICKEL (Ni)	6020[a]	ICP-MS	0.00200			
	SELENIUM (Se)	6020[a]	ICP-MS	0.00100	0.01		0.05
	SILVER (Ag)	6020[a]	ICP-MS	0.00100	0.05		0.1
GROUP 3: VOLATILE ORGANIC CONSTITUENTS							
	VOLATILE ORGANIC CONSTITUENTS	8260[a]	Gas Chromotography/Mass Spect	0.50-1.0 ug/L			

[#] DISSOLVED CONCENTRATIONS. SAMPLES MUST BE FIELD-FILTERED.

[a] TEST METHODS FOR EVALUATING SOLID WASTE - PHYSICAL/CHEMICAL METHODS. 3rd edition. EPA SW-846 (November 1990).

[b] METHODS FOR CHEMICAL ANALYSIS OF WATER AND WASTES. EPA-600/4-79-020 (revised March 1983).

[d] DEQ NUMERICAL GROUNDWATER QUALITY REFERENCE LEVELS (HEALTH BASED). OAR 340-040-080 (January 1990).

[e] DEQ NUMERICAL GROUNDWATER QUALITY GUIDANCE LEVELS (NONHEALTH BASED). OAR 340-040-080 (January 1990).

[f] EPA NATIONAL PRIMARY DRINKING WATER STANDARDS. EPA 816-F-02-013 July 2002.

*** EPA ACTION LEVELS.

ICP-MS: Inductively Coupled Plasma-Mass Spectrometry

TRACE METALS - TOTAL CONCENTRATIONS IF TSS <100 mg/L; BOTH TOTAL AND DISSOLVED CONCENTRATIONS IF TSS >100 mg/L.

APPENDIX A

Solid Waste Disposal Site Closure Permit
Number 255

State of Oregon
Department of Environmental Quality

SOLID WASTE DISPOSAL SITE CLOSURE PERMIT: MUNICIPAL LANDFILL

Oregon Department of Environmental Quality
750 Front Street NE, Suite 120
SALEM OR 97301-1039
(503) 378-8240 x252

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

ISSUED TO:

Marion County Public Works
MCPW Environmental Services
PO Box 14500
Salem, OR 97309

503.588.5169

FACILITY NAME AND LOCATION:

Brown's Island Landfill
2895 Faragate Avenue S
Salem, OR 97302

Section 30, T7S, R3W, WM, Marion County

OWNER:

Marion County Public Works

OPERATOR:

Marion County Public Works
MCPW Environmental Services

ISSUED IN RESPONSE TO:

- a solid waste permit renewal application received December 2, 2004

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

Gil Hargreaves

Gil Hargreaves, Manager Hazardous and Solid Waste
Permitting and Compliance
Western Region

May 4, 2006
Date

Permitted Activities

Until such time as this permit expires or is modified or revoked, the permittee is authorized to maintain a closed 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 in accordance with Oregon Revised Statutes (ORS) 459 and Oregon Administrative Rules (OAR), Chapter 340.

In this document This document contains the following sections:

PERMIT ADMINISTRATION

1.0 ISSUANCE

1.1	**In this section**	This section describes the parameters surrounding permit issuance, including the following information: • permittee • permit number • permit term • facility type • facility owner/operator • basis for issuance, and • definitions
1.2	**Permittee**	This permit is issued to Marion County Public Works.
1.3	**Permit number**	This permit will be referred to as Solid Waste Permit Number 255.
1.4	**Permit term**	The issue date of this permit is the date the document is signed. The expiration date of this permit is September 30, 2015.
1.5	**Facility type**	The facility is permitted as a Closed Municipal Landfill.
1.6	**Facility owner/ operator**	The owner of this facility is: Marion County Public Works The operator of this facility is: Marion County Public Works MCPW Environmental Services
1.7	**Basis for issuance**	This permit is Issued based upon the following documents submitted by the permittee: • solid waste permit application received December 2, 2004 • Closure/Post-closure Plan approved by the Department.
1.8	**Definitions**	Unless otherwise specified, all terms are as defined in OAR 340-93-030.
1.9	**Submittal address**	All submittals to the Department, 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) 378-8240

2.0 DISCLAIMERS

2.1	**In this section**	This section describes disclaimer information for the Department, including property rights and Department liability.
2.2	**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.
2.3	**Department liability**	The Department, 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	**In this section**	This section describes the authority of the Oregon Department of Environmental Quality to issue this permit, including the following information: • 10 year permit • documents superseded • binding nature • other compliance, and • penalties
3.2	**Ten year permit**	This permit is issued for a maximum of 10 years as authorized by Oregon Revised Statutes 459.245 (2).
3.3	**Documents superseded**	This document is the primary solid waste permit for the facility, superseding all other solid waste permits issued for Brown's Island Landfill by the Department.
3.4	**Binding nature**	Conditions of this permit are binding upon the permittee. The permittee is liable for all acts and omissions of the permittee's contractors and agents.
3.5	**Other compliance**	Issuance of this permit does not relieve the permittee from the responsibility to comply with all other applicable federal, state, or local laws or regulations. This includes the following solid waste requirements, as well as all updates or additions to these requirements: • solid waste permit application received December 2, 2004 • Oregon Revised Statutes, Chapters 459 and 459A • Oregon Administrative Rules Chapter 340, and • any documents submitted by the permittee and approved by the Department.
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	**In this section**	This section describes information about modification of this permit, including: • 5 year review • modification • modification by Department • modification by permittee • public participation, and • changes in ownership
4.2	**Five year review**	Between the 4th and 6th year of the life of the permit, the Department will review the permit and determine whether or not the permit should be amended. While not an exclusive list, the following factors will be used in making that 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 Department-approved site development plan and/or conceptual design
4.3	**Modification**	At any time in the life of the permit, the Department or the permittee may propose changes to the permit.
4.4	**Modification and revocation by Department**	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, or • a significant change in the quantity or character of solid waste received or in the operation of the disposal site
4.5	**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 activities described in this document.
4.6	**Public participation**	Significant changes in the permit will be made public by the issuance of a public notice as required by Department rules.
4.7	**Changes in ownership**	The permittee must report to the Department any changes in either ownership of the disposal site property, or of the name and address of the permittee or operator within ten (10) days of the change.

CLOSURE CARE

5.0 AUTHORIZATIONS

5.1	**In this section**	This section describes the activities the permittee is authorized to conduct.
5.2	**Closure care**	The permittee is authorized to provide post-closure care to the facility.
5.3	**Authorization of activities**	All facility activities are to be conducted in accordance with the provisions of this permit. All plans required by this permit become part of the permit by reference once approved by the Department. Any conditions of the approval are also incorporated into this permit unless contested by the permittee within 30 days of the receipt of a conditional approval.

6.0 PROHIBITIONS

6.1	**In this section**	This section describes specific activities the permittee is prohibited from conducting.
6.2	**Waste receipt**	The disposal site is closed to waste receipt. The permittee is prohibited from accepting solid waste.
6.3	**Open burning**	The permittee must not conduct any open burning at the site.

7.0 CLOSURE CONSTRUCTION AND MAINTENANCE

7.1	**In this section**	This section describes closure construction and maintenance requirements for the facility. • plan compliance • vegetation • surface contour maintenance • surface water • leachate prevention • additional soil cover, and • design plans
7.2	**Plan compliance**	The permittee must maintain the disposal site in accordance with the approved Closure/Post-Closure Plan, and any amendments to the Plan, approved in writing by the Department.
7.3	**Vegetation**	The permittee must maintain a dense, healthy growth of native vegetation over the closed areas of the landfill consistent with the proposed final use.
7.4	**Surface contour maintenance**	The permittee must maintain the final surface contours of the landfill cover so that erosion and ponding of water is prevented to the maximum extent practicable. Erosion damage (cuts) must be repaired and seeded so that all waste remains covered. The permittee must refill with soil, grade, and seed all areas that have settled or where water ponds, and all areas where the cover soil has been damaged by cracking or erosion. Areas where vegetation has not been fully established must be fertilized, re-seeded, and maintained.

7.5	**Surface water**	The permittee must divert surface water drainage around or away from the landfill at all times. The permittee must maintain surface water diversion ditches or structures free of obstructions and debris at all times.
7.6	**Leachate prevention**	The permittee must maintain the disposal site in a manner which deters leachate production to the maximum extent practical. Leachate must be prevented, collected, evaporated, or otherwise treated and controlled in a manner approved by the Department.
7.7	**Additional soil cover**	If surface or groundwater monitoring indicates significant leachate discharges, an additional cover shall be placed over the landfill, in accordance with the approved Closure/Post-Closure Plan. The permittee may also voluntarily place additional soil cover on the landfill, in accordance with the Plan.
7.8	**Design plans**	The permittee must submit engineering design plans for any closure construction or ancillary facilities for Department review and approval at least six months prior to the anticipated construction date.

8.0 FACILITY MANAGEMENT

8.1	**In this section**	This section describes requirements for the on-going management of the facility after closure. • discovery of prohibited waste • inspection • evaluation • fees • access control • fire protection, and • future use
8.2	**Inspection**	The permittee must physically inspect the entire disposal site at least monthly to determine compliance with this permit and the rules of the Department. The permittee must record any post-closure repairs performed. Inspection records must be made available to the Department upon request.
8.3	**Evaluation**	The permittee must conduct and submit to the Department an evaluation of the facility's status, including: • a discussion of implementation of the closure and post-closure plans • a description of unanticipated occurrences and any changes to the closure or post-closure plans, and • a discussion of the status and adequacy of the financial assurance plan, including an accounting of amounts deposited, expenses drawn from the fund, and the current balance. This information must be made part of the Annual Environmental Monitoring Report (see condition 12.2).
8.4	**Fees**	The permittee must pay the solid waste fee each year this permit is in effect. An invoice indicating the amount of the fee will be mailed prior to the date due.
8.5	**Access control**	The permittee must control public access to the facility as necessary to prevent unauthorized entry and dumping.

8.6	**Fire protection**	Arrangements must be made with the local fire control agency to immediately acquire their services when needed and adequate on-site fire control protection, as determined through the local fire control agency, must be provided. Fires must be immediately and thoroughly extinguished and promptly reported to the Department.
8.7	**Future use**	Any future use, activity, or construction of buildings, structures, or utilities on this disposal site must have prior written approval of the Department and must be done in a manner that protects the integrity of the final cover system, landfill stability, gas monitoring devices, and surface water control systems.

9.0 FINANCIAL ASSURANCE

9.1	**In this section**	This section describes requirements for financial assurance at the facility, including: • financial assurance plan • submittal • use of financial assurance, and • continuous nature
9.2	**Financial assurance plan**	The permittee must prepare an updated financial assurance plan, as necessary, and provide financial assurance for the costs of post-closure care, and corrective action, if any. The plan must be placed 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.
9.3	**Submittal**	The permittee must submit to the Department evidence of the financial assurance consisting of: • a copy of the first financial assurance mechanism • a written certification that the financial assurance meets all state requirements
9.4	**Use of financial assurance**	The permittee must not use the financial assurance for any purpose other than to finance the approved closure, post-closure, and corrective action activities or to guarantee that those activities will be completed.
9.5	**Continuous nature**	Continuous financial assurance must be maintained for the facility until the permittee or other person owning or controlling the site is no longer required to demonstrate financial responsibility for closure, post-closure care, or corrective action (if required).

ENVIRONMENTAL MONITORING

10.0 ENVIRONMENTAL SAMPLING REQUIREMENTS

10.1 In this section

This section describes general sampling requirements, including:

- notification
- split sampling
- monitoring schedule and
- changes in sampling or split sampling

10.2 Notification

The permittee must notify the Department in writing of all upcoming sampling events at least ten (10) working days prior to the scheduled date of the sampling event.

10.3 Split sampling

The permittee must split samples with the Department when requested, and must schedule all requested split-sampling events with the Department laboratory at least forty-five (45) days prior to the sampling event. The following sampling events must be conducted as split sampling events with the Department:

None is scheduled at this time.

10.4 Monitoring schedule

The permittee must perform environmental monitoring in accordance with the facility approved Environmental Monitoring Plan.

The table below defines the time period for each quarter:

If sampling in the...	Schedule the sampling event	
	On or after...	But on or before...
Spring	March 1	May 31
Fall	September 1	October 31

10.5 Changes in sampling or split sampling

The Department reserves the right to add to or delete from the list of scheduled sampling events, sample locations, parameters to be sampled for, and to conduct unscheduled samplings or split sampling. In the event of changes to the split sampling schedule, the Department will make every effort to notify the permittee of the changes at least 30 days prior to the split sampling event.

11.0 ENVIRONMENTAL MONITORING STANDARDS

11.1 In this section

This section describes requirements for evaluating compliance with environmental monitoring standards, including:

- rule
- review of results
- resampling results and
- certified environmental laboratory data

11.2 Rule

The permittee must not allow the release of any substance from the landfill into a water media which will result in a violation of any applicable federal or state surface water, groundwater, or drinking water rules or regulations beyond the solid waste boundary of the disposal site or an alternative boundary specified by the Department.

11.3 Compliance wells The following wells are designated as compliance wells:

MW-8a/b/c
MW-9a/b
MW-12a/b
MW-16, and
MW-17

11.4 Review of results The permittee must review the analytical results after each monitoring event according to the following table.

If data show results...	then...
above any one permit-specific concentration limit (PSCL) or any three action limits (ALs), or indicating a significant change in water quality at any monitoring point, Examples of significant changes: • Detection of a VOC or other hazardous constituent not detected in background; or, • Exceeded a Table 1 or 3 value listed in OAR 340-40 unless the background water quality is above these numerical limits; or, • Detection of a compound an order of magnitude higher than background.	1. Notify the Department within 10 days of receipt of laboratory results, and 2. Perform resampling immediately and evaluate results as described below in condition 11.5. Note: If this is a known release, previously confirmed to the Department in writing, resampling is not required. Resampling must be completed and the results reviewed within three months of the original sample date.
none of the above	continue groundwater monitoring with next scheduled sampling event

Note: Permit-specific concentration limits established to date are listed in Attachment 2.

11.5 Resampling results Upon receipt of data from resampling, the permittee must review the results according to the following table.

If resampling data show results...	Then...
That confirm the exceedance of a permit-specific concentration limit	1. notify the Department within 10 days of receipt of laboratory data, or within 60 days of the sample date (whichever comes sooner), and 2. submit a Preliminary Assessment workplan for Department approval within 90 days of the date of resampling. Plan must specify how the objectives of OAR 340-40 will be met by the proposed investigation. This must include the monitoring of Group 4 parameters, in addition to routine detection monitoring.
That confirm that three or more action limits were exceeded, or there is a significant change in water quality results noted in the routine sampling event	1. notify the Department within 10 days of receipt of laboratory data, or within 60 days of the sample date (whichever comes sooner), and 2. submit a plan within 30 days (unless another time period is authorized) for developing an assessment program with the Department.
That do not confirm the results noted in the routine sampling event	1. continue with routine monitoring, and 2. discuss the data from the routine sampling event and the resampling results in the next annual environmental monitoring report.

11.6	**Certified environmental laboratory data**	The Department suggests the use of only environmental sampling data analyzed by an Oregon Laboratory Accredited Program (ORLAP) lab or a National Volunteer Laboratory Accreditation Program (NVLAP) lab. A copy of the certification should accompany the submitted data. Use of an ORLAP or NVLAP approved lab will aid you and the Department in Environmental Monitoring Plan and Annual Environmental Monitoring Report preparation and review.

12.0 RECORDKEEPING AND REPORTING – ENVIRONMENTAL MONITORING

12.1	**In this section**	This section describes recordkeeping and reporting requirements associated with environmental monitoring, including: • annual environmental monitoring report (AEMR) • statement of compliance • annual report contents • submittal address • split sampling submittal • lab address and • Department response to split samples
12.2	**Annual Environ-mental Monitoring Report (AEMR)**	Prior to March 15th of each year for the duration of this permit, the permittee must submit to the Department two copies of an annual monitoring report covering the previous year. The report must be prepared in accordance with the approved format and stamped by an Oregon Registered Geologist or an Oregon Registered Engineering Geologist and must follow the format approved in the Environmental Monitoring Plan. Note: Whenever possible, the permittee must submit two-sided copies of all reports
12.3	**Statement of compliance**	A short (approximately one-page) cover letter must accompany the Annual Environmental Monitoring Report that: • compares the analytical results with the relevant monitoring standards (PSCLs and ALs); • 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. The cover letter must be signed by a licensed professional familiar with this site and experienced in hydrogeological investigations at solid waste facilities.

12.4	**Annual monitoring report contents**	Each annual environmental monitoring report must reflect actual and true conditions at the facility. Data presented in the reports must be error-free as compared to the original lab data. The annual report, at a minimum, must contain: • Review of all significant events that occurred at the site during the report period • Review of the monitoring network performance and recommendations for improvements • Summary of all the data collected in the reporting period [GW, SW, and LFG] • A summary of any data problems (examples could include QA/QC failures, flagged data, switched samples, etc.) • Piezometric maps from each sampling event for the upper water bearing zone • Time history plots for dissolved oxygen (DO) and specific conductivity (SC) and all group 1b and all group 2 parameters • Stiff and Piper diagrams for all group 1b and group 2 parameters; • For each sample event an anion-cation balance; • A copy of all lab data for the past year (Note: lab data can be omitted from the annual report if the permittee agrees in writing to keep electronic and hard copies available until the permit is terminated and the permittee agrees to supply these copies to the Department within 72 hours of a written request).
12.5	**Split sampling submittal**	Within 90 days of any split sampling event, the permittee must submit the following information from the split sampling event to the Department'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 • site map showing flow directions and contours and • any other data or reports requested by the Department
12.6	**Lab address**	All split sampling reporting must be sent to: Oregon Department of Environmental Quality Lab, Groundwater Monitoring Section 1712 SW 11th Avenue Portland, OR 97201 (503) 229-5983
12.7	**Department response to split samples**	If requested by the permittee in writing and after the permittee has submitted all split sampling data information, the Department lab may send the permittee a copy of: • the Department's analysis of the split sample • a copy of the QA/QC report • a copy of the analytical report and • a copy of field data sheet

13.0 ENVIRONMENTAL MONITORING NETWORK

13.1	**In this section**	This section describes requirements for the environmental monitoring network, including: • monitoring devices • damage reporting • device construction • construction reporting, and • abandoning
13.2	**Monitoring devices**	The permittee must protect, operate, and maintain gas, groundwater, leachate, and surface water monitoring devices so that samples representative of actual conditions can be collected.
13.3	**Damage reporting**	Any damage to a monitoring device must be reported to the Department in writing within fourteen (14) days of the discovery, along with a description of proposed repair or replacement measures and a time schedule for completion of this work. <u>Examples:</u> damage impairing well function or changing the physical location to any degree
13.4	**Device construction**	All monitoring well abandonment (decommissions), replacements, repairs, and installations must be conducted to comply with the Water Resources Department Rules OAR 690-240 and with the Department's *Guidelines for Groundwater Monitoring Well drilling, Construction, and Decommissioning* dated August 1992.
13.5	**Construction reporting**	All monitoring well repairs, abandonments, replacements, and installations, including driller's logs, well location information, and construction information must be documented in a report prepared and stamped by an Oregon Registered Geologist or Oregon Registered Engineering Geologist and must be submitted to the Department within thirty (30) days of the action and included in the next AEMR.
13.6	**Recommendation to abandon**	The permittee must submit a recommendation to the Department to decommission or replace any well in the monitoring network that: • has been installed in a borehole that hydraulically intersects two saturated stratas; • does not have the corresponding and necessary supporting documentation of appropriate installation or construction; or, • is damaged or destroyed during the time frame of this permit.

14.0 ENVIRONMENTAL MONITORING PLAN (EMP)

14.1	**In this section**	This section describes requirements for an environmental monitoring plan for the facility, including: • EMP to be submitted • EMP contents • EMP maintenance • EMP Compliance • Long-term monitoring, and • additional monitoring points
14.2	**EMP Submittal**	If requested in writing by the Department, the permittee must submit, for approval, three copies of an Environmental Monitoring Plan (EMP) to the Department. The plan 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 including all conditions of the approval. <u>Note</u>: Whenever possible, the permittee must submit two-sided copies of all reports.
14.3	**EMP contents**	The EMP must include plans implementing an environmental monitoring program that will characterize potential facility impacts. This plan may consist of the previous approved SAPs (Sampling and Analysis Plans) with any changes or additions since that time (i.e., approved permit-specific concentration limits, new wells, etc.) <u>Reference</u>: The *Solid Waste Landfill Guidance, September 1996,* provides information on applicable elements of what the Department considers an acceptable Environmental Monitoring Plan. Following the organizational format provided in the Guidance will expedite Department review of the plan.
14.4	**EMP maintenance**	The permittee must revise the EMP as necessary to keep it current and reflective of current facility conditions, procedures, and sampling requirements or changes. The permittee must submit all EMP revisions to the Department for approval.
14.5	**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.
14.6	**Long-term monitoring plan**	After approval of any additional PSCLs and/or ALs, the permittee must update the EMP to reflect these new compliance levels and any other changes to the long-term monitoring plan. The permittee must submit the updated plan for Department review and approval. <u>Note</u>: See also the requirements for establishing PSCLs in this permit
14.7	**Additional monitoring points**	Any new or replacement monitoring point or device established during the time frame of this permit must be incorporated into the environmental monitoring plan. The updated plan must be resubmitted to the Department for approval.

15.0 INSTRUCTIONS FOR ESTABLISHING PERMIT-SPECIFIC CONCENTRATION AND ACTION LIMITS

15.1	**In this section**	This section describes requirements for establishing permit-specific concentration limits (PSCLs) for groundwater monitoring, including: • Gathering data • Statistical analysis • Proposing PSCLs or ALs, and • Changing PSCLs or ALs
15.2	**Gathering data**	Monitoring of the background well (MW-15) in accordance with the approved Environmental Monitoring Plan must be conducted until all necessary data sets have been collected, and permit-specific concentration or action limits are proposed for each individual parameter. If an intra-well approach is to be used to set PSCLs or ALs then the permittee must demonstrate in advance to the Department's satisfaction that the data is valid and that no impacts from the facility have influenced the data.
15.3	**Statistical analysis**	The permittee must perform statistical evaluations of monitoring results for each sampling event in accordance with 40 CFR 258.53 or other methods approved of in advance by the department in order to establish compliance concentration or action limits. <u>References:</u> *Statistical Analysis of Groundwater Monitoring Data at RCRA facilities, Addendum to Interim Final Guidance,* USEPA, June 1992; and, *Statistical Guidance for all RCRA Sites,* DEQ:SWPC, August 3, 1992.
15.4	**Proposing additional PSCLs or ALs**	The permittee must propose to the Department, for review and approval, permit-specific concentration limits (PSCLs) or action limits (ALs) pursuant to the guidelines specified in OAR 340-40. Either a PSCL or an AL must be generated for all parameters the Department deems necessary that are to be included in the long-term monitoring of the site once there are at least nine acceptable data points from the appropriate background well(s) as established under this permit.
15.5	**Changing PSCLs or ALs**	If the permittee can demonstrate, to the Department's satisfaction that the background groundwater quality has significantly changed since a PSCL or AL was established, and this change is not due to any influence from the permitted facility, then the permittee can propose for Department approval a revised level of the PSCL(s) and/or AL(s) that are affected.

COMPLIANCE SCHEDULE

16.0 SUMMARY OF DUE DATES

16.1 Summary The following is a summary of event-driven reporting required by this permit. This section does not include routine reporting and submittals required by this permit.

Due Date	Activity	See section… V
By every March 15th	Submit an annual site evaluation	8.4 Evaluation
By every March 15th	Submit an Annual Environmental Monitoring Report (AEMR)	12.2 AEMR
6 months before any construction	Submit design plans	7.8 Design plans
14 days after discovery of damage to a monitoring device	Submit proposal to repair or replace	13.3 Damage reporting
30 days after any physical monitoring well change	Submit monitoring well report	13.5 Construction reporting

ATTACHMENTS

17.0 ATTACHMENTS TO PERMIT

17.1 Attachment listing

The following attachments to this document are:

Number	Description
1	Parameter Groups
2	Permit-specific concentration limits

ATTACHMENT 1: PARAMETER GROUPS

Parameter group can be found in the currently approved Environmental Monitoring Plan Table 4.

ATTACHMENT 2: PERMIT SPECIFIC CONCENTRATION LIMITS

PSCLs have been set for compliance wells MW-8a/b/c, MW-9a/b, MW-12a/b, MW-16, and MW-17. These limits can be found in the currently approved Environmental Monitoring Plan (EMP). PSCLs and ALs for all other compliance wells have not been set at this time. Once approved, the EMP will be updated to contain all currently approved PSCLs and ALs.

APPENDIX B

Monitoring Well Logs
1997 Well Evaluation and Upgrade Reports

Oregon

DEPARTMENT OF ENVIRONMENTAL QUALITY

Western Region - Salem Office

January 6, 1997

RECEIVED JAN 8

Mr. James V. Sears, Director
Marion County
Dept. of Solid Waste Management
388 State Street - Suite 735
Salem, Oregon 97301-3538

Re: Browns Island Landfill
Solid Waste Closure Permit No. 255
Groundwater Quality Assessment Report
Environmental Monitoring Plan

Dear Mr. Sears:

We have completed our review of the March 28, 1996, ***Groundwater Quality Assessment Report*** (GWQAR) and the April 19, 1996, ***Environmental Monitoring Plan*** (EMP) submitted for the Browns Island Landfill. The reports were prepared by Parametrix Inc. in response to Schedule C conditions 1 and 2 of the October 11, 1995, Solid Waste Site Closure Permit No. 255.

PURPOSE OF THE REPORTS

Groundwater monitoring has been conducted at this facility by the Department's laboratory since May of 1974. The purpose of the reports is as follows:

- Compile all of the groundwater quality data collected to date.
- Evaluate the current and past impacts of the disposal site on groundwater and the effects of post-closure activities in reducing the groundwater quality impacts.
- Evaluate groundwater quality at the established alternative compliance boundary.
- Develop a long-term monitoring program for this facility under the responsibility of the permittee.
- Evaluate the characteristics and integrity of the existing monitoring wells.

COMMENTS ON THE GROUNDWATER QUALITY ASSESSMENT REPORT

The GWQAR indicates current and/or past exceedences of water quality standards for several parameters including TDS, iron, manganese, sulfate, total Coliform, total cadmium, and total lead at the compliance boundary. Additionally, volatile organic compounds have been previously detected in onsite wells. Based on the current and past data for the site, additional information is needed to complete the assessment as follows:

STATE OF OREGON 1859

750 Front St. NE
Suite 120
Salem, OR 97310
(503) 378-8240
(503) 378-3684 TDD

3.3 Proposed Monitoring Approach

The EMP proposes compliance wells MW-8a/8b/8c, MW-9a/9b, MW-10a/10b/ MW-12a/12b, MW-13a, and MW-14b and background well MW-15c for continued monitoring. This program seems to be the most cost-effective and practical approach to monitoring at this time. The Department would like to see this approach implemented, possibly with some supplemental wells to cover a few data gaps, once the following concerns are addressed:

- The wells are screened at varying intervals of the aquifer and may not be representative of a single depth or interval in the aquifer.
- The proposed background well, MW-15c, is screened at a much longer interval than most of the downgradient compliance wells. This well may not represent background water quality to all of the wells.
- Data gaps exist in the proposed monitoring network. The distance between downgradient monitoring points is over a quarter of a mile. Gaps in the monitoring program occur between MW-9 and MW-12 series, between the MW-12 and the MW-8 series, and between the MW-8 series and MW-13.
- A permitted operating demolition landfill (permit no. 399) exists adjacent to the closed municipal landfill. Schedule C of the permit for the demolition landfill indicates that groundwater monitoring for this landfill is to be covered under the permit for the closed municipal landfill (number 255). The proposed monitoring network may not adequately address the demolition landfill.
- As discussed above, the integrity of the nested wells (MW-9a/b, MW-10a/b/c and MW-12a/b/c) will need to be further evaluated before they can be accepted for the monitoring program.

Attachment A- Sampling and Analysis Plan (SAP)

Below are a few comments and/or discrepancies noted during the review of the SAP:

- **Table 2 and 3** - several of the reference methods provided in Tables 2 and 3 of the SAP do not correspond with the reference methods used in North Creek Analytical's Quality Assurance Program in Attachment 2, Figure 3.
- **Page 6, 3rd bullet** - field duplicates should be collected at a minimum frequency of once per day of sampling or one for every ten samples, whichever is more frequent.
- **Page 9, 4th paragraph from the bottom** - water extracted from the well during purging may be disposed of on the ground, away from the well, unless water quality indicates another disposal method is necessary.

- Updated assessment report to include additional data collected from the onsite wells discussed under number 2 above and an evaluation of the impacts on the Willamette River.
- Plan for biennial evaluations of concentrations at the compliance boundary and methods for establishing concentrations limits and/or other alternative evaluation methods approved by the Department.
- A proposal for siting and installing any additional monitoring wells determined necessary to fill in the existing gaps, to replace any wells determined unacceptable, and to monitor the background and downgradient groundwater quality of the demolition landfill.
- A plan to abandon any monitoring wells determined unacceptable for monitoring.

An updated long-term monitoring plan will probably be needed in the future once all of the assessment and investigative work is completed. Until that time, monitoring will continue to be conducted at this site in accordance with the requirements of the permit, or the SAP once approved.

We thank you for your timely submittal of the GWQAR and EMP for the Brown's Island Landfill. The Department would like to work closely with you to get the Brown's Island landfills under the most well-designed and cost-effective monitoring program practical for this site. If you have any questions about this letter or would like to discuss the requirements listed above, please do not hesitate to contact Nancy Sawka at (530)38-8240, extension 262.

Sincerely,

Charles W. Donaldson
Manager, Solid Waste Program

Felicia D. Sonnenstein
for Nancy A. Sawka, R.G.
Hydrogeologist, Solid Waste Program

enclosures
cc: Rick Malin, Parametrix,
7820 NE Holman,
Suite B-6,
Portland, OR 97218
Ernie Schmidt, NWR
Mark Davis, Marion County
x:\fsonnen\nsawka\255let.doc

RECEIVED
APR 07 1997
WESTERN REGION-SALEM OFFICE

interoffice
MEMORANDUM

to: Nancy Sawka - Department of Environmental Quality
from: Rob Carter, Tracy Eichenlaub - Water Resources Department
subject: Brown's Island Landfill, Marion County
date: April 2, 1997

Thank you for your patience in waiting for this information. In this memo, we will list the Water Resources Department's (WRD) repair requirements concerning the monitoring wells and water supply well located at the Brown's Island Landfill property. The wells in question are located in Township 7S, Range 3W, Sections 28, 31 and 32. For clarity, we will discuss each well cluster individually by number designation. A map showing the locations of the wells relative to the landfill is attached. All described work must be accomplished by or in the presence of a licensed monitoring well constructor with the exception of the Trussel well, which must be accomplished by or in the presence of a licensed water supply well constructor.

Trussel Water Supply Well:

This well is located within a plywood box and the wellhead is level with land surface. Either the wellhead should be extended to a minimum of 1 foot above land surface, or the well should be placed in a WRD approved vault (diagram available upon request). The well is currently covered with debris, which must be cleaned off. In addition the well should be sampled for water quality if the county desires to maintain the well. If there is no further use for the well, it should be properly abandoned according to Oregon Administrative Rule (OAR) 690-220.

Monitoring Wells 1abc:

This cluster of wells is located in a small depression. The depression must be filled in to be level with the local grade and the casings extended to a minimum of one foot above the new finished grade. The current slip end caps must be replaced with locking gasketed caps to prevent surface water infiltration. Debris located within the protective steel casing must be removed and replaced with clean sand.

Monitoring Wells 2ab:

No sealing material was encountered outside the protective steel casing surrounding these wells. A hard material (possibly cement) was felt at 9 feet below land surface on the inside of the protective casing. An annular space at least 5 feet deep and 2 inches wide must be constructed on the outside of the protective steel casing and filled with bentonite chips. In addition, the interior of the steel casing (surrounding the casings) must be filled to 5 feet below land surface with bentonite chips and the remainder with clean sand. The current slip end caps must be replaced with locking gasketed caps to prevent surface water infiltration.

Monitoring Wells 6abc:

This cluster of wells is located in the driveway of the Trussel residence. Locking gasketed caps must be placed on these wells immediately to prevent surface water infiltration. Given that the residence will be demolished in the near future, the location of this well cluster should be accurately determined. This will allow the wells to be found should demolition activities cover them. The well head must be properly protected with either a flush grade monument or above ground protective casing and posts as described in OAR 690-240-110. If no surface seal is present around these wells, one must be provided to a minimum of 5 feet below land surface as described in MW 2ab, above.

Monitoring Wells 7ab:

Debris within the protective steel casing must be removed down to grout sealing material. If necessary, clean sand can be added above the grout. Gasketed caps must be placed on the well casings to prevent surface water infiltration. The locking lid covering the protective casing on well "a" must be replaced.

Monitoring Wells 8abc:

Sand from recent floods has covered much of these wells. This sand must be removed from the inside and outside of the protective steel casings. Gasketed caps must be placed on the well casings to prevent surface water infiltration. The locking lid covering the protective casing on well "a" must be replaced.

Monitoring Wells 9ab:

Sand from recent floods has covered much of these wells. This sand and any additional debris must be removed from the inside and outside of the protective steel casings. The current slip end caps must be replaced with locking gasketed caps to prevent surface water infiltration. The well casing on well "b" must be shortened to allow the locking lid covering the protective casing to fit properly.

Monitoring Wells 10abc:

The debris within the protective casing must be removed down to grout sealing material. If necessary, clean sand can be added above the grout. The current slip end caps must be replaced with locking gasketed caps to prevent surface water infiltration. The locking lid covering the protective casing on well "a" must be replaced. The well casings and protective steel casings must be raised so that they are a minimum of one foot above land surface. If no surface seal is found to be present around these wells, one must be provided to a minimum of 5 feet below land surface as described in MW 2ab, above.

Monitoring Wells 11ab:

The debris within the protective casing must be removed down to grout sealing material. If necessary, clean sand can be added above the grout. The current slip end caps must be replaced with locking gasketed caps to prevent surface water infiltration. If no surface seal is found to be present around these wells, one must be provided to a minimum of 5 feet below land surface as described in MW 2ab, above. There was some discussion that these wells may be abandoned due to nearby river erosion. If abandoned, the methodology must comply with OAR 690-240-135.

Monitoring Wells 12ab:

Sand from recent floods has covered much of these wells. This sand must be removed from the inside and outside of the protective steel casings. The current slip end caps must be replaced with locking gasketed caps to prevent surface water infiltration. The well casing on well "a" must be shortened to allow the locking lid covering the protective casing to fit properly.

Monitoring Well 13:

The current slip end cap must be replaced with a locking gasketed cap to prevent surface water infiltration.

Monitoring Well 14b:

The current slip end cap must be replaced with a locking gasketed cap to prevent surface water infiltration.

Monitoring Well 15c:

The current slip end cap must be replaced with a locking gasketed cap to prevent surface water infiltration. In addition, the protective steel casing must be raised to a minimum of one foot above land surface.

If during repair activities, if it is found that the above requirements cannot be met, the owner or the owner's agent should contact us to discuss other options on a case by case basis.

Please feel free to contact us if you have any questions concerning this memo. Rob Carter can be reached at (503) 378-8455 x283 and Tracy Eichenlaub can be reached at (503) 378-8455 x226.

Oregon

DEPARTMENT OF ENVIRONMENTAL QUALITY

Western Region - Salem Office

April 18, 1997

APR 21

Mr. Mark Davis
Marion County Department of
Solid Waste Management
388 State Street, Suite 735
Salem, OR 97301-3538

Re: Browns Island Landfill
Solid Waste Closure Permit #255
Monitoring Well Inspection

Dear Mr. Davis:

We would like to thank you, your staff and Rick Malin of Parametrix, Inc. for taking the time to meet with us during our monitoring well inspection at the Browns Island Landfill on February 28, 1997. The inspection was conducted by the Department's Solid Waste Program and the State Water Resources Department (WRD) to determine the suitability of the existing site monitoring wells.

The attached memorandum (April 2, 1997) from the WRD discusses monitoring well repair requirements based on the inspection. The Department concurs with all of WRD's requirements and has the following additional comments:

- As indicated in the attached memorandum, immediately provide locking, gasket caps to wells without fitted well caps. This will help prevent surface water infiltration and the potential introduction of contaminants into the wells.
- Provide new, working locks to wells without locks or with locks that no longer function properly.
- Confirm the construction of wells without documentation including MW-9a/9b, MW-10a/10b/10c, and MW-12a/12b/12c. At a minimum, this should include screen depth and length, total depth, seal characteristics, and further evaluation of the constriction in MW-12b.
- Install concrete pads where needed and protective posts around MW-8 as discussed in Section 2.4 of the April 19, 1996, Environmental Monitoring Plan (EMP).
- As feasible, repair the constriction in MW-8b.
- Conduct additional evaluation of the water quality characteristics and trends in the Trussel domestic well. Currently, it is difficult to determine whether water quality of this well is natural or influenced by landfill leachate. Discuss the proposed continued usage and monitoring or abandonment of this well.

750 Front St. NE
Suite 120
Salem, OR 97310
(503) 378-8240
(503) 378-3684 TDD

REQUIREMENTS OF THIS LETTER

Within 60 (sixty) days from receipt of this letter you should submit a plan to the Department that includes:

- Proposed methods to confirm the construction of well groups MW-9, MW-10, and MW-12.
- Proposed method(s) for evaluating the integrity of the well seals, where needed.
- A maintenance program for upgrading the damaged monitoring wells as discussed in the April 19, 1996, EMP and the attached WRD memorandum.
- A plan for decommissioning those wells that will not be part of the site monitoring program and/or can not be repaired or upgraded.
- A plan to address any other additional comments or requirements discussed above and in the attached memorandum.
- A schedule for implementing and completing the work and submitting a report to the Department and WRD.

If you have any questions, please do not hesitate to contact Nancy Sawka at (503)378-8240, extension 262.

Sincerely,

Charles W. Donaldson, Manager,
Solid Waste Program

Nancy Sawka

Nancy Sawka, R.G. Hydrogeologist,
Solid Waste Program

Attachment
cc: Rick Malin, Parametrix, Inc.,
7820 NW Holman, Suite B-6,
Portland, OR 97218-2859
Rob Carter, Water Resources Department,
Commerce Building
158 12th St. NE
Salem, OR 97310-0210
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MONITORING WELL EVALUATION PLAN

BROWN'S ISLAND LANDFILL
MARION COUNTY, OREGON

Prepared For:

MARION COUNTY
DEPARTMENT OF SOLID WASTE MANAGEMENT
388 STATE STREET - SUITE 735
SALEM, OREGON 97301

Prepared By:

PARAMETRIX, INC.
7820 NE HOLMAN, SUITE B-6
PORTLAND, OREGON 97218

June 16, 1997

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MONITORING WELL EVALUATION PLAN
FOR THE
BROWN'S ISLAND LANDFILL

1. INTRODUCTION

This Monitoring Well Evaluation Plan (MWEP) addresses requirements that were set forth in Department of Environmental Quality (DEQ) letters dated January 6, 1997 and April 18, 1997 regarding the Brown's Island Landfill (BI) site (Figure 1). The requirements of the letters are primary oriented toward monitoring well acceptability and development of a long-term monitoring approach for the site. Some of the requirements presented in the Department's January 6th letter were reiterated and expanded upon in the April 18th letter. This MWEP attempts to be comprehensive by addressing all issues and requirements brought forth in the two DEQ letters.

The January 6, 1997 DEQ letter presented review comments to the submitted March 28, 1996 Groundwater Quality Assessment Report (GQAR) and April 19, 1996 Environmental Monitoring Plan (EMP) for BI. This letter presented five requirement items which are addressed in Section 3 of this MWEP.

On February 28, 1997, a joint inspection of the BI monitoring well network was completed with the DEQ and State Water Resource Department (WRD). The April 18, 1997 letter presented DEQ's comments and requirements based on the joint monitoring well inspection event. The objective of the inspection was to determine the suitability of the existing monitoring wells at the site (Figure 2). A WRD memorandum, dated April 2, 1997, presenting their comments and requirements regarding BI monitoring wells, was included with the Department's April 18th letter. The April 18th letter presented six requirement items which are addressed in Section 2 of this MWEP.

Marion County has taken a proactive approach in addressing well suitability issues at BI. During the BI Spring 1997 sampling event, which occurred on May 21 and 22, 1997, several requirement items were completed with plans developed to address remaining issues. Consequently, this MWEP presents both completed activities and findings along with a description of how and when remaining issues will be addressed.

2. APRIL 1997 LETTER REQUIREMENTS

The Department's April 18, 1997 letter required submittal of a plan addressing six bulleted items. This section presents a response to each bullet item.

2.1 First Bullet. *Proposed methods to confirm the construction of well groups MW-9, MW-10, and MW-12.*

Well logs for well groups MW-9, MW-10, and MW-12 have not been located. The wells were constructed sometime during the period of March 1976 through July 1997. Construction specific information has been requested by the DEQ.

Following the collection of water quality samples from well groups MW-9, MW-10, and MW-12 on May 22nd, the depth to the bottom of each well was measured from the top of the PVC well casing. A probe (consisting of half-inch diameter PVC with a metal feeler plate secured at the end) was lowered into each well (MW-9a/b, MW-10a/b/c, and MW-12a/b), which allowed for the start and end of slotting present in each well to be determined. In all wells, the slotted interval extended to within 0.2 feet of the well's bottom. Well slotting appears to have been produced by a hand (e.g., saw or mills knife) creating approximately 1/16th-inch wide slots. Generally, the slotted interval of each well was approximately 5 feet in length. An exception is well MW-10b which had a slotted interval of 1.1 feet.

The screen interval for each well, as determined by this method, is as follows:

Well Location	Depth of well (in feet from top of PVC)	Distance from top of slotting to bottom of well (ft)	Slot interval (in feet below top of PVC)
MW-9a	37.08	4.0	32.9 - 36.9
MW-9b	23.78	4.9	18.8 - 23.6
MW-10a	14.32	4.8	9.4 - 14.2
MW-10b	33.42	1.1	32.2 - 33.3
MW-10c	24.70	4.8	19.8 - 24.6
MW-12a	26.90	4.6	22.2 - 26.8
MW-12b	43.51	4.4	39.0 - 43.4

In general, the slot intervals presented above are slightly longer than the estimated interval length shown on Figure 3 (Well Cross-Section A-A') of the BI EMP.

2.2 Second Bullet. *Proposed method(s) for evaluating the integrity of well seals, where needed.*

Active monitoring wells MW-8b/c, MW-9a/b, MW-10b/c, and MW-12a/b are double completed wells (i.e., two wells have been constructed in the same boring). Well MW-10a is abutted to wells MW-10b/c and could be considered a triple completed well due to its close proximity.

A well seal integrity evaluation test was completed during the BI Spring 1997 event on May 21, 1997. The evaluation test was completed in the following manner. The deep well at each well group was pumped using an electric submersible pump. During deep well pumping, the water level in the shallow wells were measured for change in water level. The table below presents the results of this evaluation.

Well group	Pumped well	Pumping rate (gpm)	Total volume pumped (gals)	Monitored well	Initial static water level (ft)	Final static water level (ft)	Change in static water level (ft)
MW-8	MW-8c	1.10	11.0	MW-8b	15.65	15.66	0.01
MW-9	MW-9a	1.15	11.5	MW-9b	14.06	14.06	no change
MW-10	MW-10b	0.85	11.0	MW-10a	10.61	10.61	no change
				MW-10c	11.00	11.01	0.01
MW-12	MW-12b	1.15	15.0	MW-12a	14.24	14.27	0.03

The results indicate that the integrity of the seals between the active multi-completed wells are good. Minimal change (or no change) in water level was observed in the shallow wells while pumping the deeper well. Pumping these wells with a similar pump in the past has created dry well conditions due to low yield characteristics of the wells. Given the level of stress placed on the deep wells by continuous pumping, it was expected that if an interconnection (leakage) between the wells was present (i.e., faulty seal) there would be a fairly significant change in water level in the shallow well (e.g., a static water level change of a foot or greater). This level of water level change in the shallow wells did not occur indicating good seal integrity.

2.3 Third Bullet. *A maintenance program for upgrading the damaged monitoring wells as discussed in the April 19, 1996, EMP and the attached WRD memorandum.*

For each well group, the following presents a brief background description, activities recently completed, and planned maintenance activities.

At all monitoring well locations, locking gasket caps have been fitted on each well as requested. All inactive monitoring wells are currently planned to function as piezometers to help characterize groundwater flow conditions at the site.

2.3.1 Trussel Water Supply Well

Background

The Trussel well was cable drilled in 1969 for Salem Sanitary Services as a domestic water well. Figure 2 shows the location of the former Trussel domestic well. The well was constructed in the following manner: 1) a 10-inch diameter boring was drilled to a depth of 61 feet into the underlying Tertiary sediments; 2) steel casing (diameter 6.25-inches) was set and sealed using a cement and bentonite grout; and 3) an uncased boring was extended to a total depth of 105 feet below ground surface (i.e., open-hole completion). The intent of the Trussel well construction was to seal the well from groundwater present in the overlying Holocene river gravels.

The Trussel well is currently in the process of being converted from a residential water supply well to an on-site nonpotable limited use water supply source for equipment wash down. The Trussel property has been purchased by the County. The former residence is scheduled for demolition this summer.

The WRD has required that the well head be extended to a minimum of one foot above land surface, or the well be placed in a WRD approved vault.

Completed Activities

The well was sampled during the Spring 1997 event for standard landfill parameters per current permit requirements.

Planned Activities

A contract for development of an engineered design and specifications for a new vault and pump house for the former Trussel well has recently been awarded by Marion County. The design will call for a WRD approved continuous pour concrete vault and pump house foundation. Upon completion, the design and specification packet will be forwarded to the DEQ and WRD for their review.

Sampling of the well will continue consistent with current permit requirements.

2.3.2 Monitoring Well Group 1a/b/c

Background

Well group 1 is an inactive triple completion well cluster located in fill near the southern boundary of the eastern area of the closed landfill (Figure 2). Well group 1 was last sampled by the DEQ in November 1987. Well MW-1c has been noted as commonly dry which may be due to its slotting in the underlying Tertiary sediments (sandy clay).

Completed Activities

Well MW-1b was sampled during the Spring 1997 event. An attempt was made to sample Well MW-1c which to did not recover from purging after a 24 hour period. Field parameter readings were collected from all three MW-1 wells and presented in Section 3.1.

Planned Activities

The well cluster is located in a small depression. The wells will be extended a minimum of one foot above the surrounding grade. The exterior steel casing will be extended above the wells and completed as an above ground security monument. Debris within the current protective steel casing will be removed prior to extending the annular seal with the exterior casing. Clean sand will be placed above the existing well seal inside the protective steel casing, as appropriate. Protective bollards will be placed around the well casing due to its location near active access roads. A concrete pad will be completed around the base of protective steel well casing. The overall objective is to create positive drainage conditions away from the well.

2.3.3 Monitoring Well Group 2a/b

Background

Well group 2 is an inactive double completion well cluster located in fill in the eastern area of the site (Figure 2). Well group 2 was last sampled by the DEQ in November 1987. Well MW-2a has been noted as being commonly dry and appears to be slotted at the base of the fill. Well MW-2b appears to be slotted in the underlying Tertiary sediments (sandy clay).

Completed Activities

An attempt was made to sample well MW-2b during the Spring 1997 event. Well MW-2b did not recover from purging after a 24 hour period. A constriction at a depth of 47 feet does not allow for passage of a bailer beyond that point. Well MW-2a had a 4.8 foot water column. It was anticipated that well MW-2a would not recover within 24 hours with an appropriate sample volume.

Planned Activities

Sealing material was not encountered outside the protective steel casing of these wells. Hard material was detected 9 feet below ground surface on the inside of the protective casing. The annular space both inside and outside of the steel casing will be excavated to a depth of 5 feet or more and filled with bentonite chips as described in the WRD memorandum. A small concrete pad will be constructed around the base of the steel protective well casing. A new locking security cap will be constructed over the steel casing. The overall objective is to limit surface water infiltration at the well head.

2.3.4 Monitoring Well Group 6a/b/c

Background

Well group 6 is an inactive triple completion well cluster located in the central area of the site adjacent to the western fill area (Figure 2). Well group 6 appears to have been last sampled by the DEQ in September 1979. Well MW-6c has been noted as being occasionally dry and appears to be slotted in the underlying Tertiary sediments (sandy clay).

Completed Activities

Well MW-6c was sampled during the Spring 1997 event. Field parameters measurements collected during sampling of well MW-6c are presented in Section 3.1. All three group 6 wells had water level and depth to well bottom measurements completed.

Planned Activities

Well group 6 is located in the driveway of the former Trussel residence. The residence is scheduled for demolition this summer. The location of the well cluster will be accurately determined and identified to limit damage or burial during residence demolition activities. Following demolition, the wells will be extended and secured in a protective above ground monument with a concrete base and bollards. The presence of a surface seal around the well cluster will be investigated. If no such seal is evident, a new seal will be placed as described in the WRD memorandum. The overall objective is to limit surface water infiltration at the well head.

2.3.5 Monitoring Well Group 7a/b

Background

Well group 7 is an inactive single completion well group; the two wells are located within four feet of each other. The well group is located adjacent to the northeast corner of the closed eastern fill area (Figure 2). Well MW-7b was last sampled by the DEQ in April 1987. Well MW-7a was last sampled November 1985. Both wells have been noted as being commonly dry.

Completed Activities

An attempt was made to sample well MW-7b during the Spring 1997 event. The well did not recover within 24 hours for sample collection. Well MW-7a had a two foot water column in the well.

Locking protective lid covers have been placed over each well's protective steel casing.

Planned Activities

Debris within the protective casing down to the grout sealing material will be removed. Clean sand will be used to fill the area above the grout seal, as appropriate..

2.3.6 Monitoring Well Group 8a/b/c

Background

Well group 8 is an active double completion well with a third single completed well (MW-8a) located within three feet of the double completed well cluster. The well group is located approximately 620 feet north of the eastern closed fill area (Figure 2).

Completed Activities

All three wells were sampled during the Spring 1997 event. During the sampling event, a test for well seal integrity was completed (see Section 2.2). Sand from recent flooding has been removed from the inside of the protective steel casings. Following water level measurements, well depths were measured to check for change in well depth due to flooding. The following table presents well depth measurements made during the Spring 1996 and 1997 events.

Well number	Spring 1996 well depth (ft)	Spring 1997 well depth (ft)	Well depth difference (ft)
MW-8a	20.45	20.47	+ 0.02
MW-8b	24.05	23.90	- 0.15
MW-8c	37.76	37.72	- 0.04

As indicated in the above table, no substantial changes in well depth due to flooding occurred at well group 8.

Planned Activities

The area around well group 8 will be cleaned up with excess sand and debris removed. The steel casing at wells MW-8b/c will be temporally lowered allowing removal of the shallow constriction (at a depth of 1.2 feet) in well MW-8b. The protective steel casings will be fitted with new locking protective caps. A concrete base will be constructed around the well cluster and completed with protective bollards due to its exposed location in an active field.

2.3.7 Monitoring Well Group 9a/b

Background

Well group 9 is an active double completion well located approximately 500 feet northwest of the western closed fill area (Figure 2).

Completed Activities

The two wells were sampled during the Spring 1997 event. During the sampling event a test for slot interval (see Section 2.1) and well seal integrity (see Section 2.2) was completed on well group 9. Following water level measurements, well depths were also measured to check for change in well depth due to flooding. The following table presents well depth measurements made during the Spring 1996 and 1997 events.

Well number	Spring 1996 well depth (ft)	Spring 1997 well depth (ft)	Well depth difference (ft)
MW-9a	37.07	37.08	+ 0.01
MW-9b	23.78	23.78	no change

As indicated in the above table, no substantial changes in well depth due to flooding occurred at well group 9.

Planned Activities

The inside of the protective casing will be cleaned of debris and backfilled with clean sand, as appropriate. The wells will be lowered and a protective locking metal cap will be mounted on the steel protective casing.

2.3.8 <u>Monitoring Well Group 10a/b/c</u>

Background

Well group 10 is an active double completed well (MW-10b/c) with well MW-10a abutted to wells MW-10b/c and could be considered a triple completed well due to its close proximity. The well group is located approximately 70 feet north of the western closed fill area in a protected location (Figure 2).

Completed Activities

The wells (MW-10a and MW-10b) were sampled during the Spring 1997 event. Well MW-10c is not an active water quality well. During the sampling event, a test for well slot interval (see Section 2.1) and well seal integrity was completed (see Section 2.2) on well group 10. Following water level measurements, well depths were measured to check for change in depth due to flooding. The following table presents well depth measurements made during the Spring 1996 and 1997 events.

Well number	Spring 1996 well depth (ft)	Spring 1997 well depth (ft)	Well depth difference (ft)
MW-10a	14.31	14.32	+ 0.01
MW-10b	33.40	33.42	+ 0.02
MW-10c	24.70	24.76	+ 0.06

As indicated in the above table, there were slight increases in well depth since the Spring 1996 well depth measurement at well group 10.

Planned Activities

The wells casings and protective steel casing will be raised so that they are at least one foot above land surface. A new protective casing (approximately 16-inches in diameter) with a locking cap that will encompass all three wells will be constructed. The presence of an existing surface seal around the well group will be determined. If not present, a new seal will be placed either around the existing steel protective casing or the new protective casing to a minimum depth of five feet below ground surface as specified in the WRD memorandum. Debris within the protective casing will be removed down to the grout sealing material and clean sand added above the seal, as appropriate.

2.3.9 Monitoring Well Group 11a/b

Background

Well group 11 is an inactive double completion well located approximately 800 feet north of the western closed fill area (Figure 2). Wells MW-11a and MW-11b were last sampled in May 1984 and April 1987, respectively. Well MW-11a is noted as a dry well and appears to have been only sampled twice.

Heavy erosion of the river bank in the area of well group 11 occurred last winter. The wells are currently located adjacent to the new river bank.

Completed Activities

Inspection of the river bank adjacent to the well group noted that none of the wells PVC casing has been exposed. Approximately three feet of protective casing has been exposed at a depth of approximately nine feet below the top of the casing. Well MW-11a was dry. Well depths were measured to check for change in well depth due to flooding. The following table presents well depth measurements made during the Spring 1996 and 1997 events.

Well number	Spring 1996 well depth (ft)	Spring 1997 well depth (ft)	Well depth difference (ft)
MW-11a	15.00	15.08	+ 0.08
MW-11b	21.17	21.31	+ 0.14

As indicated in the above table, there were increases in well depth since the Spring 1996 well depth measurement at well group 11.

Planned Activities

The County is currently evaluating a reclamation/maintenance program for the eroded river bank area (i.e., the placement of protective rip-rap in the area of well group 11). Given the current extent of bank erosion and the close proximity of well group 11 to the river bank, the two wells (MW-11a/b) will be abandoned per OAR 690-240-0135 (Abandonment of Monitoring Wells). An abandonment variance from the WRD may be necessary if the wells cannot be safely accessed by required abandonment equipment (i.e., drill rig, etc). The installation of a new well or piezometer in the area of well group 11 will be evaluated as part of the updated GQAR (see Section 3.2.2). Currently, piezometric data from well group 11 indicates that this area of the site is an apparent groundwater recharge zone (river recharge) for the shallow uppermost aquifer (see Figure 3).

2.3.10 Monitoring Well Group 12a/b

Background

Well group 12 is an active double completion well located approximately 750 feet northeast of the active demolition fill area (Figure 2).

Completed Activities

The two wells were sampled during the Spring 1997 event. During the sampling event, a test for well slot interval (see Section 2.1) and well seal integrity was completed (see Section 2.2) on well group 12. Sand from recent floods deposited inside the protective steel casing was removed. A protective locking metal cap has been mounted on the steel protective casing.

Following water level measurements, well depths were measured to check for change in well depth due to flooding. The following table presents well depth measurements made during the Spring 1996 and 1997 events.

Well number	Spring 1996 well depth (ft)	Spring 1997 well depth (ft)	Well depth difference (ft)
MW-12a	26.78	26.90	+ 0.12
MW-12b	43.07	43.51	+ 0.44

As indicated in the above table, both wells have become deeper since the Spring 1996 event measurement.

Well MW-12b has a constriction at a depth of approximately 13 feet below the top of the PVC well casing. Depth to static water level in well MW-12b is usually below 13 feet (average since 1985 is 15.2 feet). The constriction is such that an electric submersible pump (1.5-inches in diameter by 5.5-inches in length) easily passes but not a standard (1.2-inch in diameter by 4.0-feet in length) PVC bailer. The dedicated 0.5-inch diameter PVC bailer does pass the constriction. Given these conditions, the well can be appropriately purged and sampled with the existing constriction. Most likely the constriction was created by heat dispersion created by the curing of concrete used in the well seal grout. This type of heat-related PVC well casing damage can occur when a void is formed during drilling and a larger than normal volume is filled creating a sink where excess heat can develop, due to concrete curing, that deforms (i.e., melts) but does not fracture the well casing.

Planned Activities

The PVC casing on the two wells will be shortened allowing for a better fit of the new locking protective cover that has been placed over the wells.

2.3.11 Monitoring Well 13

Background

Well MW-13 is an active single completion well located approximately 1400 feet northeast of the eastern closed fill area (Figure 2).

Completed Activities

A locking gasket well cap has been placed over the well.

Planned Activities

No additional activities have been planned for this well. Possible conversion of monitoring well for only piezometric purposes in the future (see Section 2.4).

2.3.12 Monitoring Well 14

Background

Well MW-14 is an active single completion well located approximately 1060 feet east of the eastern closed fill area (Figure 2).

Completed Activities

A locking gasket well cap has been placed over the well.

Planned Activities

No additional activities have been planned for this well. Possible conversion of monitoring well for only piezometric purposes in the future (see Section 2.4).

2.2.13 Monitoring Well 15

Background

Well MW-15 is an active single completion background well located approximately 400 feet south of the western closed fill area (Figure 2). The well's protective steel casing is 1.25 feet above ground surface. The well has a good protective locking cap and concrete base.

Completed Activities

A locking gasket well cap has been placed over the well.

Planned Activities

No additional activities have been planned for this well. Possible conversion of monitoring well for only piezometric purposes in the future (see Section 2.4).

2.4 Fourth Bullet. *A plan for decommissioning those wells that will not be part of the site monitoring program and/or can not be repaired or upgraded.*

Currently, only wells MW-11a and MW-11b are scheduled from decommissioning. Repairs and/or upgrades can be made on the remaining existing monitoring wells such that they can continue to be used as water quality monitoring locations and/or piezometers.

The County is currently examining the monitoring network at the site. Wells MW-13 and MW-14 appear to be monitoring adjacent slough recharge water quality conditions and not down-gradient water quality conditions associated with the landfill. Consequently, consideration should be given to discontinue the collection of water quality samples from these wells and convert them to piezometers. The fairly close proximity (200 feet) of slough water to well MW-15 has the potential to influence the representativeness of the well as a background groundwater quality location for the site. Well group 9 may be a more appropriate background location. Analysis of water quality data needs to be completed to verify and support this observation. If this transfer occurs, well MW-15 will be converted to a piezometer. Proposed modifications to the existing monitoring well network at the site will be presented in the updated GQAR (Section 3.2.2).

2.5 Fifth Bullet. *A plan to address any other additional comments or requirements discussed above and in the attached memorandum.*

As required in the WRD memorandum dated April 2, 1997 and the Departments April 18, 1997 letter, all wells have been fitted with locking gasket caps to prevent surface water infiltration into the well casing. Wells with a dedicated bailer have been fitted with modified locking gasket caps that allows for the bailer to continue to be suspended from the cap.

Placement of these caps at all monitoring well locations was completed on May 22, 1997. All wells without locks or nonfunctioning locks have received new locks as of May 22, 1997.

2.6 Sixth Bullet. *A schedule for implementing and completing the work and submitting a report to the Department and the WRD.*

Within 75 days of DEQ approval of this work plan, planned activities for each well group, as presented in Section 2.2, will be completed. Within 45 days of completion of planned activities, a report of completed activities will be submitted to the DEQ and WRD.

3. JANUARY 1997 LETTER REQUIREMENTS

The DEQ in a letter dated January 6, 1997 presented their review and comments of the March 28, 1996 GQAR and April 19, 1996 EMP for BI. Based on the DEQ's review of these documents, six items were required by the letter as follows:

- Item 1 - An updated Sampling and Analysis Plan (SAP) or an addendum. This item was addressed in a letter dated April 3, 1997.
- Item 2 - Monitoring well evaluation. This item was expanded upon in the DEQ's April 18, 1997 letter and has been addressed in Section 2 of this plan.
- Item 3 - Sampling of inactive wells. This item was completed during the Spring 1997 sampling event and is discussed further in Section 3.1 of this plan.
- Item 4 - Joint WRD/DEQ monitoring well inspection. This item was completed on February 28, 1997.
- Item 5 - Requires the submittal of a findings report from work completed under items 2 through 4 and an updated GQAR. This item is discussed in Section 3.2 of this plan.

3.1 Item Number 3 - Inactive Well Sampling

3.1.1 Spring 1997 Event

As required in item number 3 of the Department's January 6, 1997 letter, the collection of water quality samples was attempted from inactive well groups 1, 2, 6, and 7 during the Spring 1997 event. Sampling of these well groups represented a one-time event to determine current conditions at these inactive locations. The deep well present at each inactive well group was identified and agreed upon with the DEQ as the targeted water quality sampling point at each inactive well group location. The objective of this effort was to collect data from the inactive well groups to help in determining the best long-term monitoring approach for the site.

The collection of water quality samples was attempted from well groups 2 and 7. However, these wells either were dry or did not recover within 24 hours of purging.

All collected samples from these well groups were submitted for laboratory analysis of laboratory indicator parameters, common anions and cations, other parameters, trace metals, and volatile organic constituents as presented in Tables 2 through 4 of the BI SAP, dated April 19, 1996.

Section 2.3 presents specific information for well groups 1a/b/c, 2a/b, 6a/b/c, and 7a/b. Laboratory analytical results of water samples collected from wells MW-1b and MW-6c are still pending. The following table presents field parameter measurements collected from the inactive wells and the Willamette River during the Spring 1997 sampling event.

Well location	pH	Conductivity (uS)	Temp. (C)	Dissolved Oxygen (mg/L)	Redox Potential (mV)	Measurement collection time
MW-1a	7.6	157	11.2	7.0	-46.5	2 gals purged
MW-1b	7.1	454	11.1	3.6	-24.3	sample
MW-1c	8.4	227	11.0	8.3	-93.4	3.8 gals purged
MW-2b	7.6	589	13.3	3.4	-42.4	4.5 gals purged
MW-6c	7.5	931	14.9	3.1	-43.2	sample
MW-7b	12.9	619	13.2	7.9	-289	2.3 gals purged
River	9.1	69	15.8	8.7	-109.5	grab

Presentation of inactive well sampling results will be included in the updated GQAR report described in Section 3.2.

3.1.2 Water Level Measurements

Depth to water level measurements were completed on all wells (except the former Trussel well; currently no access) at the site during the Spring 1997 event. Figure 3 presents a piezometric map based on these water level measurements. This contour map is consistent with piezometric maps generated from 1996 measurements. The observed groundwater flow pattern at the site appears to be influenced by several factors, including; surface water recharge/discharge by adjacent river and sloughs and the top of unit subsurface topography of the Tertiary sediments which underlie the Holocene gravels at the site. The installation of slough staff gauges are planned at locations east of well MW-14 and southeast of well MW-15 (Figure 4). These gauges will be used to help evaluate slough surface water/groundwater interaction at the site.

3.2 Item Number 5 - Findings Report

3.2.1 Finding Report Submittal Schedule

As required in item number 5 of the Department's January 6, 1997 letter, a report of the findings from any work completed under items 2 through 4 is to be submitted prior to July 15, 1997. These finding report requirements are similar to those required in the Department's April 18, 1997 letter. Consequently, the County requests that the schedule for completing items 2 through 4 activities, as detailed in Section 2.3 of this plan, and submittal of a findings report follow the schedule presented in Section 2.6 of this plan.

3.2.2 Updated GQAR

A second requirement of item number 5 of the Department's January 6, 1997 letter is the following:

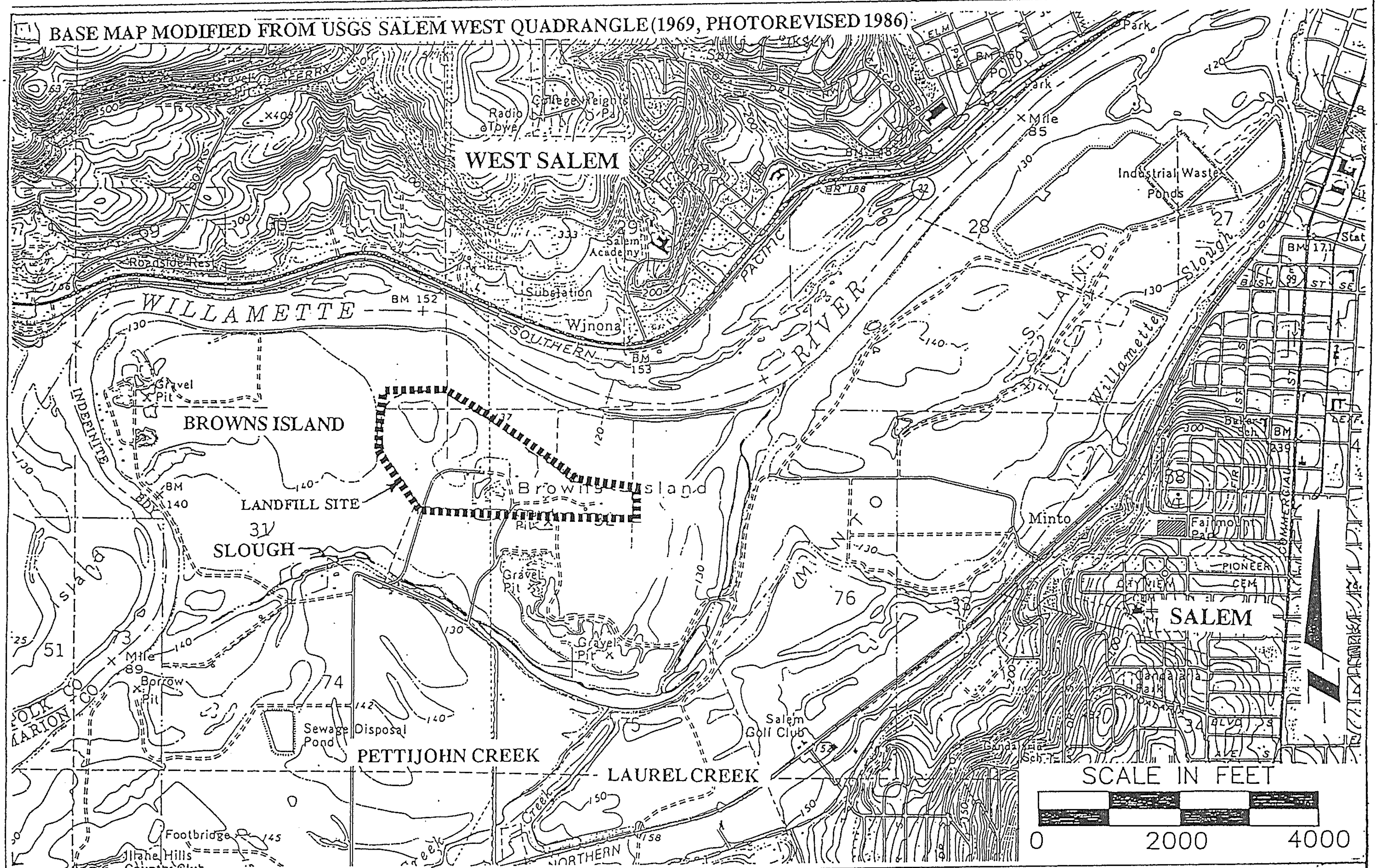
- Submittal of an updated assessment report (GQAR) to include additional data collected from the inactive wells.
- An evaluation of landfill impacts on the Willamette River.
- A plan for evaluating compliance boundary concentrations and methods for establishing concentration limits and/or other alternative evaluation methods.
- A proposal for siting and installing any additional monitoring wells.

An updated GQAR will be completed that addresses the four bulleted requirements described above. The updated GQAR will include additional data collected from the inactive wells and may be supplemented by historic DEQ data from these wells to help evaluate water quality trends at the inactive well locations. Data analysis will be limited to chemicals of concern and parameters of interest (e.g., may not include trace metals).

The objective of the updated GQAR will be to evaluate compliance boundary concentrations and trends. This evaluation will provide the basis for a proposed method for establishing concentration limits or an alternative evaluation technique for the site. An evaluation of landfill impact on the Willamette River will be included in this effort. Evaluation of river impact is complicated by the apparent hydraulic interconnection with the uppermost aquifer. Current piezometric maps indicate river recharge at in the area of well group 11 (Figure 3). Graphical comparison of river stage changes with well water level over time indicates a strong correlation. Consequently, it would appear that there are times when the river is recharging the uppermost aquifer and vice versa.

The updated GQAR will provide the basis for the proposed siting and installation of additional monitoring wells and the deactivation of select current water quality monitoring locations. The report will present an evaluation of well MW-15 as representing site groundwater quality background conditions compared with wells MW-9/b. Well MW-15 is located relatively close to a surface water body (slough) compared with well group 9 (Figure 4). It may be that well group 9 may be more representative of site background groundwater quality conditions.

Given the scope of the updated GQAR, the County requests submittal of the document within 120 days of approval of this plan.



JUNE 1997
PMX #27-2063-04

FIGURE 1: FACILITY LOCATION MAP
MONITORING WELL EVALUATION PLAN
BROWN'S ISLAND LANDFILL, MARION COUNTY

PARAMETRIX, INC.

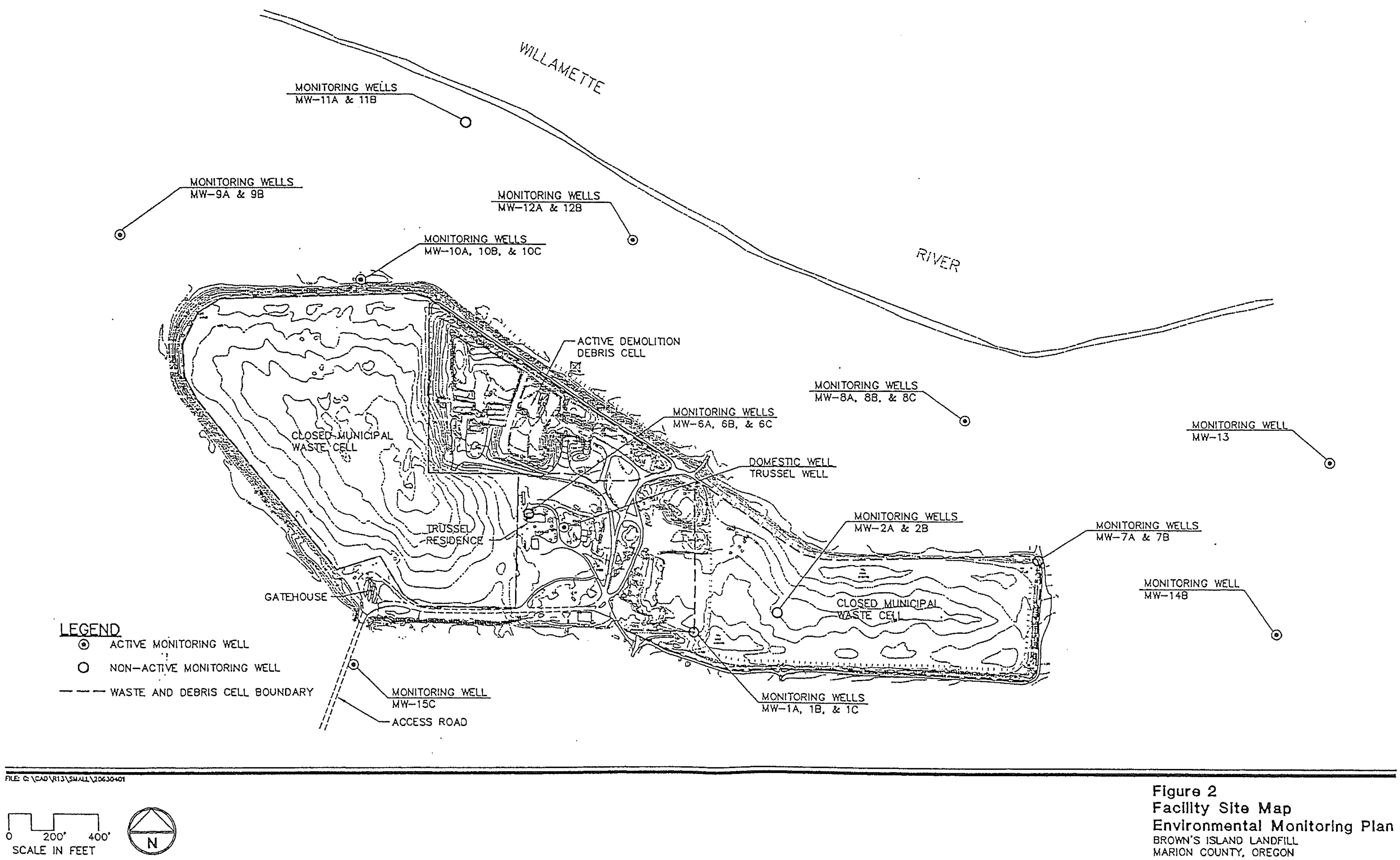
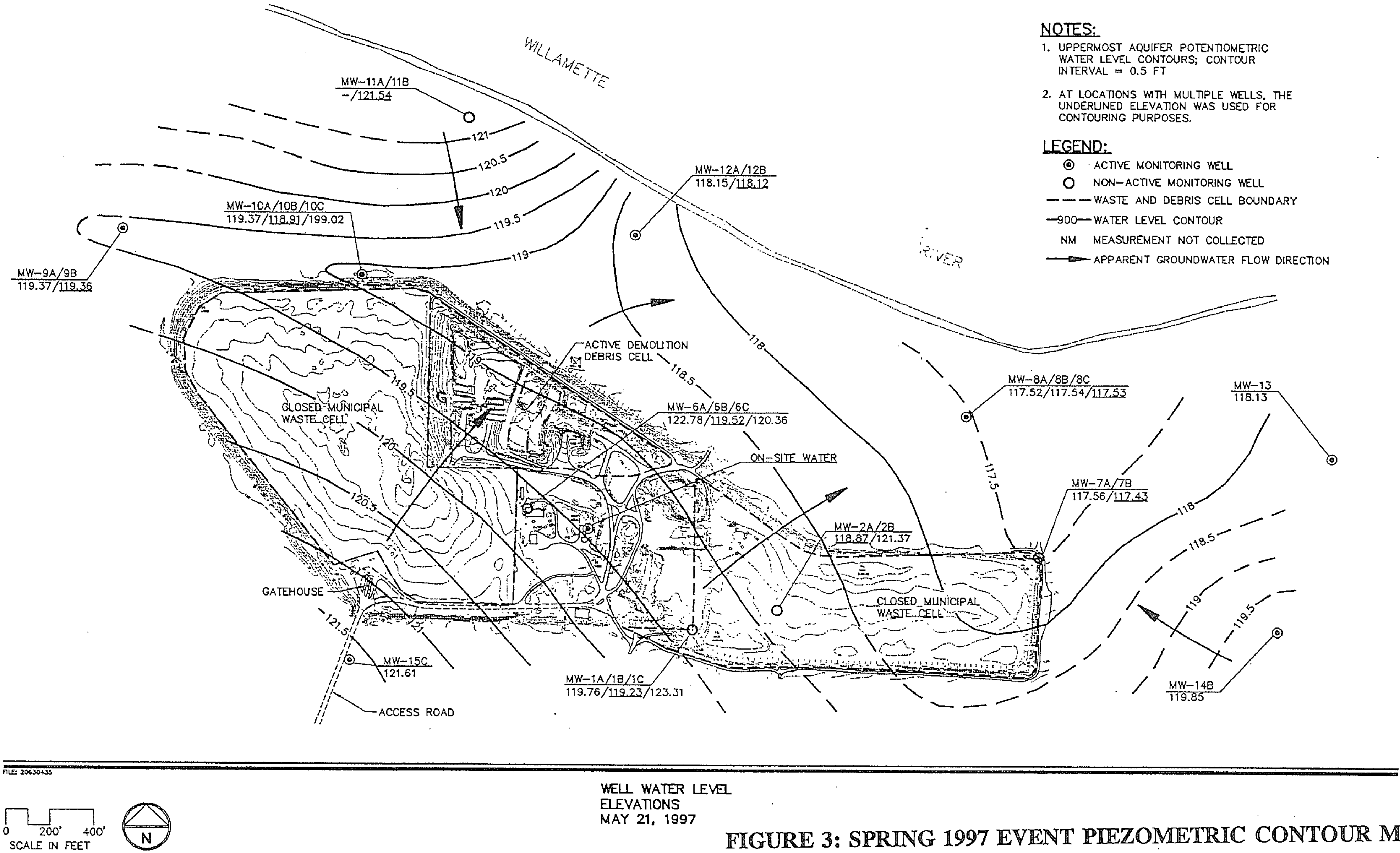


Figure 2
Facility Site Map
Environmental Monitoring Plan
BROWN'S ISLAND LANDFILL
MARION COUNTY, OREGON

Parametrix, Inc.



WELL WATER LEVEL
ELEVATIONS
MAY 21, 1997

FIGURE 3: SPRING 1997 EVENT PIEZOMETRIC CONTOUR MAP
MONITORING WELL EVALUATION PLAN
BROWN'S ISLAND LANDFILL, MARION COUNTY

JUNE 1997
PMX #27-2063-04

FIGURE 4: PROPOSED SLOUGH STAFF GAUGE LOCATION MAP
MONITORING WELL EVALUATION PLAN
BROWN'S ISLAND LANDFILL, MARION COUNTY

Parametrix, Inc. Consultants in Engineering and Environmental Sciences

7820 N.E. Holman Suite B-6 Portland, OR 97218-2859
503-256-5444 • 360-694-5020 • Fax: 503-256-4221

December 8, 1997

Mr. Charles Donaldson
Manager - Western Region Solid Waste Program
Department of Environmental Quality
750 Front Street Northeast
Salem, Oregon 97310

RE: Monitoring Well Upgrade Report
Brown's Island Landfill, Marion County
Solid Waste Disposal Site Closure Permit 255.

Dear Mr. Donaldson:

Enclosed are two copies of a Monitoring Well Upgrade Report (MWUR) for the Brown's Island Landfill (BI) site. The MWUR describes repairs and upgrades that have been completed on monitoring wells at BI during September and October 1997. The approved June 16, 1997 Monitoring Well Evaluation Plan for BI described the proposed well upgrade program. The Department approved the plan in a letter dated July 29, 1997.

Appropriate or necessary well upgrades were identified during a joint inspection of the BI monitoring well network with the DEQ and State Water Resource Department (WRD) on February 28, 1997. The DEQ presented their comments and requirements based on the joint monitoring well inspection event in a letter dated April 18, 1997. The objective of the inspection was to determine the suitability of the existing monitoring wells at the site. A WRD memorandum, dated April 2, 1997, presented their comments and requirements regarding BI monitoring wells and was included with the DEQ's April 18th letter.

If you have any questions regarding this report, please contact me at (503) 256-5444.

Sincerely,
PARAMETRIX, INC.

Rick Malin, R.G.
Project Manager

cc: Don Alexander, Marion County
Rob Carter, WRD w/rpt

MONITORING WELL UPGRADE REPORT

BROWN'S ISLAND LANDFILL
MARION COUNTY, OREGON

Prepared For:

MARION COUNTY
DEPARTMENT OF SOLID WASTE MANAGEMENT
388 STATE STREET - SUITE 735
SALEM, OREGON 97301

REGISTERED PROFESSIONAL
OREGON
RICHARD MALIN
G1[illegible]34
GEOLOGIST

Prepared By:

PARAMETRIX, INC.
7820 NE HOLMAN, SUITE B-6
PORTLAND, OREGON 97218

December 8, 1997

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MONITORING WELL UPGRADE REPORT
FOR THE
BROWN'S ISLAND LANDFILL

1. INTRODUCTION

This Monitoring Well Upgrade Report (MWUR) describes the repairs and upgrades completed on monitoring wells at the Brown's Island Landfill (BI) site. A Monitoring Well Evaluation Plan (MWEP) for BI, dated June 16, 1997, described the proposed maintenance program for upgrading monitoring wells at the site. The MWEP was approved by the Department of Environmental Quality (DEQ) in a letter dated July 29, 1997.

For each well group, a description of proposed activities are redescribed along with a description of the upgrades completed. Appropriate or necessary upgrades were identified during a joint inspection of the BI monitoring well network with the DEQ and State Water Resource Department (WRD) on February 28, 1997. The DEQ presented their comments and requirements based on the joint monitoring well inspection event in a letter dated April 18, 1997. The objective of the inspection was to determine the suitability of the existing monitoring wells at the site (Figure 1). A WRD memorandum, dated April 2, 1997, presented their comments and requirements regarding BI monitoring wells and was included with the DEQ's April 18th letter.

2. WELL UPGRADE ACTIVITIES

For each well group with upgrades proposed, the following presents; a brief background description of the well group, a description of completed and activities proposed in the MWEP, and a description of upgrade activities completed during the Summer of 1997. All well upgrades at BI were completed by a licensed monitoring well constructor. Appendix A contains copies of the start card and monitoring well report for each upgraded well.

At all monitoring well locations, locking gasket caps have been fitted on each well along with protective security caps. All inactive monitoring wells are functioning as piezometers to aid in characterizing groundwater flow conditions at the site. All well security monuments and bullards have been painted yellow.

Table 1 presents new water level elevations for wells and identifies well requiring the raising or lowering of the PVC well casing. The County is planning on having the BI wells resurveyed to verify water level measurement elevations and to have well locations correspond with the state plane coordinate system.

2.1 MONITORING WELL GROUP 1a/b/c

Background

Well group 1 is an inactive triple completion well cluster located in fill near the southern boundary of the eastern area of the closed landfill (Figure 1). Well group 1 was last sampled by the DEQ in November 1987. Well MW-1b was recently sampled by Parametrix on May 22, 1997.

Proposed Upgrade Activities

The well cluster is located in a small depression. The wells will be extended a minimum of one foot above the surrounding grade. The exterior steel casing will be extended above the wells and completed as an above ground security monument. Debris within the current protective steel casing will be removed prior to extending the annular seal with the exterior casing. Clean sand will be placed above the existing well seal inside the protective steel casing, as appropriate. Protective bullards will be placed around the well casing due to its location near active access roads. The overall objective is to create positive drainage conditions away from the well.

Completed Upgrade Activities

The exterior steel eight-inch diameter well casing was raised 55 inches. The two-inch diameter PVC well casing was also raised 55 inches. Compression couplers were used to attach the PVC extensions to the existing PVC. A 13-inch diameter temporary surface casing was used to place a bentonite surface seal around the well casing. The depression around the well group was backfilled to grade. Protective bullards were placed around the well monument. Work on the well group MW-1 was initiated on September 4, 1997 and completed on September 23, 1997.

2.2 MONITORING WELL GROUP 2a/b

Background

Well group 2 is an inactive double completion well cluster located in fill in the eastern area of the site (Figure 1). Well group 2 was last sampled by the DEQ in November 1987. Parametrix unsuccessfully attempted to sample the wells on May 22, 1997.

Proposed Upgrade Activities

Sealing material was not encountered outside the protective steel casing of these wells. Hard material was detected 9 feet below ground surface on the inside of the protective casing. The annular space both inside and outside of the steel casing will be excavated to a depth of

5 feet or more and filled with bentonite chips as described in the WRD memorandum. A small concrete pad will be constructed around the base of the steel protective well casing. A new locking security cap will be constructed over the steel casing. The overall objective is to limit surface water infiltration at the well head.

Completed Upgrade Activities

The area around the well cluster was excavated down to six feet around the six-inch steel protective casing. A 12-inch diameter temporary steel casing was used to install a bentonite surface seal around the well. Debris within the protective casing down to the grout seal was cleaned out and replaced with granular bentonite topped with clean sand. Work on the well group MW-2 was initiated on September 9, 1997 and completed on September 30, 1997.

2.3 MONITORING WELL GROUP 6a/b/c

Background

Well group 6 is an inactive triple completion well cluster located in the central area of the site adjacent to the western fill area (Figure 1). Well group 6 was last sampled by the DEQ in September 1979. Well MW-6c was sampled by Parametrix during the Spring 1997 event.

Proposed Upgrade Activities

The MW-6 well cluster was located in the driveway of the former Trussel residence. The residence is scheduled for removal during September 1997. Following residence removal, the wells will be extended and secured in a protective above ground monument with a concrete base and protective bullards. The presence of a surface seal will be determined and placed if not present.

Completed Upgrade Activities

The exterior ten-inch diameter casing was overshot down to 12 feet and sealed with bentonite. The exterior casing was raised 1.5 feet above the ground. The 2-inch diameter PVC well casings were extended 13 inches. The exterior protective casing was surrounded with protective bullards. Work on the well group MW-6 was initiated on October 14, 1997 and completed on October 14, 1997.

2.4 MONITORING WELL GROUP 7a/b

Background

Well group 7 is an inactive single completion well group; the two wells are located within four feet of each other. The well group is located adjacent to the northeast corner of the closed eastern fill area (Figure 1). Well MW-7b was last sampled by the DEQ in April 1987. Well MW-7a was last sampled November 1985. An unsuccessful sampling attempt by Parametrix occurred during the Spring 1997 event. Both wells have been noted as being commonly dry.

Proposed Upgrade Activities

Debris within the protective casing down to the grout sealing material will be removed. Clean sand will be used to fill the area above the grout seal, as appropriate.

Completed Upgrade Activities

High pressure air with a jetting tool was used to clean sand debris out of the protective steel casing. The casing was clean out until bentonite was reached. The casing was then backfilled with clean sand. Locking protective security caps have been mounted over both wells. Well upgrade activities were initiated on September 9, 1997 and completed on September 23, 1997.

2.5 MONITORING WELL GROUP 8a/b/c

Background

Well group 8 is an active double completion well with a third single completed well (MW-8a) located within three feet of the double completed well cluster. The well group is located approximately 620 feet north of the eastern closed fill area (Figure 1).

Proposed Upgrade Activities

The area around well group 8 will be cleaned of excess sand and debris will be removed. The steel casing at wells MW-8b/c will be temporally lowered allowing removal of the shallow constriction (at a depth of 1.2 feet) in well MW-8b. The protective steel casings will be fitted with new locking protective caps. A concrete base will be constructed around the well cluster and completed with protective bullards due to its exposed location in an active field.

Completed Upgrade Activities

An excavator was used to remove snag trees and vegetation away from the well group. The area around the exterior casing of well MW-8a was excavated and backfilled with bentonite. The interior of the steel protective casing was then cleaned out and refilled with new sand. The area around the protective steel casing of adjacent wells MW-8b/c was also excavated. The 10-inch casing was cut off allowing for the repair of the damaged 2-inch PVC of well MW-8b. The damaged section of the PVC was removed and a compression coupler was used to reattach the upper section of PVC. The 10-inch diameter steel casing was reattached. The interior area of the protective casing was cleaned out using high pressure air and refilled with clean sand. Protective metal bullards were placed around the well group. Well upgrades on well group MW-8 was initiated on September 8, 1997 and completed on September 24, 1997.

2.6 MONITORING WELL GROUP 9a/b

Background

Well group 9 is an active double completion well located approximately 500 feet northwest of the western closed fill area (Figure 1).

Proposed Upgrade Activities

The inside of the protective casing will be cleaned of debris and backfilled with clean sand. The wells will be lowered and a protective locking metal cap will be mounted on the steel protective casing.

Completed Upgrade Activities

The inside of the protective casing was cleaned of debris and backfilled with clean sand. The PVC well casings were lowered 2 inches. A protective locking metal cap was mounted on the steel protective casing. Protective bullards were placed around the well group. Upgrade activities were initiated and completed on September 24, 1997.

2.7 MONITORING WELL GROUP 10a/b/c

Background

Well group 10 is an active double completed well (MW-10b/c) with well MW-10a abutted to wells MW-10b/c and could be considered a triple completed well due to its close proximity. The well group is located approximately 70 feet north of the western closed fill area in a protected location (Figure 1).

Proposed Upgrade Activities

The wells casings and protective steel casing will be raised so that they are at least one foot above land surface. A new protective casing (approximately 16-inches in diameter) with a locking cap that will encompass all three wells will be constructed. The presence of an existing surface seal around the well group will be determined. If not present, a new seal will be placed either around the existing steel protective casing or the new protective casing to a minimum depth of five feet below ground surface as specified in the WRD memorandum. Debris within the protective casing will be removed down to the grout sealing material and clean sand added above the seal, as appropriate.

Completed Upgrade Activities

The area around the steel protective casings of well group MW-10 was excavated requiring the removal of nearby trees and stumps located within close proximity of the wells. The PVC casing of MW-10a was damaged during tree removal and repaired using a compression coupler. The exterior area around the protective well casing was backfilled with bentonite down to a depth of eight feet. A void was encountered at a depth of four feet. Eighteen inches of PVC casing was added to each well. The steel protective casings were also raised 18 inches. Sand debris in the protective casing was cleaned out and replaced with clean sand. Upgrade activities were initiated on September 9, 1997 and completed on September 23, 1997.

2.8 MONITORING WELL GROUP 11a/b

Background

Well group 11 was an inactive double completion well located approximately 800 feet north of the western closed fill area (Figure 1). Wells MW-11a and MW-11b were last sampled in May 1984 and April 1987, respectively. Well MW-11a was noted as a dry well and appears to have been only sampled twice.

Heavy erosion of the river bank in the area of well group MW-11 occurred last winter. The wells are currently located adjacent to the new river bank. Inspection of the river bank adjacent to the well group noted that none of the wells PVC casing was exposed. However, approximately three feet of protective casing was exposed at a depth of approximately nine feet below the top of the casing.

Proposed Activities

Given the current extent of bank erosion and the close proximity of well group MW-11 to the river bank, the two wells (MW-11a/b) will be abandoned per OAR 690-240-0135 (Abandonment of Monitoring Wells). An abandonment variance from the WRD may be necessary if the wells cannot be safely accessed by required abandonment equipment (i.e., drill rig, etc).

Completed Activities

Wells MW-11a/b were abandoned. Seven feet of eight-inch diameter steel protective casing was removed along with the two-inch diameter PVC casing and well screens. The boring was then backfilled with granular bentonite. The two wells were abandoned on September 8, 1997.

2.9 MONITORING WELL GROUP 12a/b

Background

Well group 12 is an active double completion well located approximately 750 feet northeast of the active demolition fill area (Figure 1).

Proposed Upgrade Activities

The PVC casing on the two wells will be shortened allowing for a better fit of the new locking protective cover that has been placed over the wells.

Completed Upgrade Activities

The sand debris in the protective steel casing was removed and replaced with new sand down to the bentonite seal. The PVC casing was lowered two inches. Upgrade activities were initiated on September 9, 1997 and completed on September 23, 1997.

2.10 WATER SUPPLY WELL

Background

The former Trussel residential water supply well was cable drilled in 1969 for Salem Sanitary Services. Figure 1 shows the location of the former Trussel domestic well. The well was constructed in the following manner: 1) a 10-inch diameter boring was drilled to a depth of 61 feet into the underlying Tertiary sedimentary rock; 2) steel casing (diameter 6.25-inches) was set and sealed using a cement and bentonite grout; and 3) an uncased boring was extended to a total depth of 105 feet below ground surface (i.e., open-hole completion). The intent of the Trussel well construction was to seal the well from groundwater present in the overlying Holocene river gravels.

The Trussel well is currently in the process of being converted from a residential water supply well to an on-site nonpotable limited use water supply source for equipment wash down. The Trussel property has been purchased by the County. The former residence has been removed.

The WRD has required that the well head be extended to a minimum of one foot above land surface, or the well be placed in a WRD approved vault.

BROWN'S ISLAND LANDFILL
Monitoring Well Upgrade Report
Table 1: Revised Water Level Measurment Point Elevations
Well elevation corrected for 1997 well upgrade activities

Well Identification	Previous Elevation	Height Adjustment (in.)	New Elevation
MW-1a	148.83	55	153.41
MW-1b	143.69	55	148.27
MW-1c	144.09	55	148.67
MW-2a	154.87		154.87
MW-2b	154.81		154.81
MW-6a	146.99	13	148.07
MW-6b	147.04	13	148.12
MW-6c	147.01	13	148.09
MW-7a	137.53		137.53
MW-7b	137.53		137.53
MW-8a	132.89		132.89
MW-8b	133.19		133.19
MW-8c	133.26		133.26
MW-9a	133.38	-2	133.21
MW-9b	133.42	-3	133.17
MW-10a	129.98	18	131.48
MW-10b	130.02	18	131.52
MW-10c	130.02	18	131.52
MW-12a	132.39	-2	132.22
MW-12b	132.36	-2	132.19
MW-13	131.54		131.54
MW-14	125.05		125.05
MW-15	136.39		136.39
entrance gauge	128.08		128.08
slough gauge	123.18		123.18
river gauge	125.57		125.57

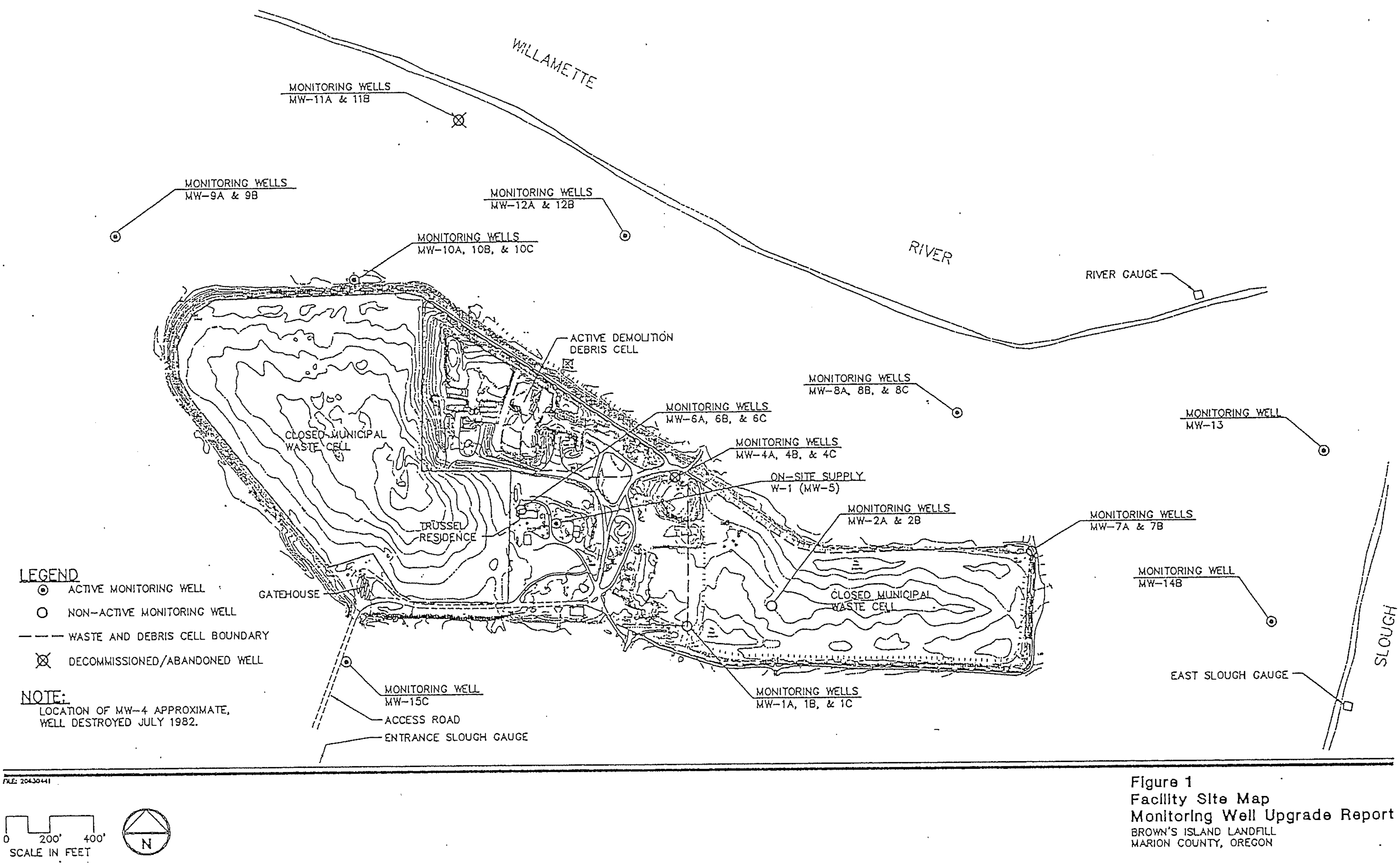

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Figure 1
Facility Site Map
Monitoring Well Upgrade Report
BROWN'S ISLAND LANDFILL
MARION COUNTY, OREGON

Marion County
OREGON
DEPARTMENT OF
SOLID WASTE MANAGEMENT

OCT -6 1997
Rick / NO enclosures

DIRECTOR
James V. Sears

(503) 588-5169

BOARD OF COMMISSIONERS
Randall Franke
Gary Heer
Mary Pearmine

ADMINISTRATIVE OFFICER
Ken Roudybush

October 2, 1997

Mr. Chuck Donaldson
Department of Environmental Quality
811 SW 6th Ave.
Portland, OR 97204

Re: Plans and Specifications for the Brown's Island Pump Station (Former "Trussel" Water Well)

Dear Mr. Donaldson:

Enclosed for your review are the engineering plans and specifications for the Brown's Island Pump Station. Construction of the pump station is part of the planned activities as stated in Section 2.3.1 of the Brown's Island Monitoring Well Evaluation Plan (MWEP).

The County is currently advertising the project for bid and has tentatively scheduled to begin construction in November, with a final completion date of no later than January 16, 1998.

I appreciate your departments timely response to this plan review . Should you have any questions regarding this matter, please contact me or Don Alexander at 588-5169, extension 5919.

Sincerely,

Jeff Bradford
for James Sears, P.E.
Director, Marion County Solid Waste Management

dra
Attachments

c: Nancy Sawka, ODEQ
Rob Carter, Oregon Water Resources Department
Rick Malin, Parametrix, Inc.

Oregon

DEPARTMENT OF ENVIRONMENTAL QUALITY

Western Region - Salem Office

July 29, 1997

JUL 3 1 1997
Rick

Mr. Mark Davis
Marion County Dept. of S W Mgmt.
388 State Street, Suite 735
Salem, OR 97301-3538

Re: Browns Island Landfill
Solid Waste Closure Permit #255
Monitoring Well Evaluation Plan

Dear Mr. Davis:

The Department has reviewed the June 16, 1997, ***Monitoring Well Evaluation Plan*** (MWEP) for the Brown's Island Landfill. The plan was prepared by your consultant, Parametrix, Inc. in accordance with the requirements discussed in the Department's January 6, 1997, and April 18, 1997, letters. These letters require a plan to evaluate the acceptability/integrity of the existing monitoring well network and a maintenance program to upgrade existing monitoring wells where needed.

The June 16, 1997, MWEP is approved as submitted. Any variance needed for the decommissioning of MW-11 must be accepted by the State Water Resources Department (WRD) and supported by this Department. The schedule proposed in the plan for maintenance and reporting is approved as follows:

- complete planned activities presented in Section 2.3 of the MWEP within 75 (seventy-five) days from receipt of this letter,
- submit a completion report to the Department and WRD within 45 (forty-five) days from completion of the activities, and
- submit an updated Groundwater Quality Assessment Report (GQAR) within 120 (one hundred and twenty) days from receipt of this plan approval letter.

The GQAR should include an evaluation of water quality impacts and trends over time in the Trussel Domestic well. The continued usage of this well and potential impacts caused by this continued use should be discussed.

If you have any questions, please contact Nancy Sawka at (503) 378-8240, extension 262.

Sincerely,

Charles W. Donaldson,
Manager, Solid Waste Program

cc: Rick Malin, Parametrix, Inc.
7820 NW Holman, Suite B-6, Portland, OR 97218-2859
Rob Carter - Water Resources Department
Commerce Building, 158 12th St. NE
Salem, OR 97310-0210
x:\fsonnen\nsawka\255mwep.doc

750 Front St. NE
Suite 120
Salem, OR 97310
(503) 378-8240
(503) 378-3684 TDD

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the
STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date of well completion.

8148
M. AKI

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

RECEIVED
APR 1 0 1974
STATE ENGINEER
SALEM, OREGON

State Well No. 7/3-32
State Permit No. ....

MW-1A/1B/1C

(1) OWNER: #2

Name Sanitary Service, Inc.
Address 496 Ferry Street, S. E.
Salem, Oregon

(2) TYPE OF WORK (check):

New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:

Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):

Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☒

(5) CASING INSTALLED: Threaded ☐ Welded ☒

" Diam. from +4 ft. to 30 ft. Gage .250
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

(6) PERFORATIONS: Perforated? ☐ Yes ☒ No.

Type of perforator used
Size of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS: Well screen installed? ☐ Yes ☒ No

Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(8) WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☒ No If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m.
Temperature of water Depth artesian flow encountered ft.

(9) CONSTRUCTION:

Well seal—Material used ~~Bentonite~~
Well sealed from land surface to 18 ft.
Diameter of well bore to bottom of seal 12 in.
Diameter of well bore below seal 8 in.
Number of sacks of cement used in well seal 0 sacks
Number of sacks of bentonite used in well seal 4 sacks
Brand name of bentonite International Gel
Number of pounds of bentonite per 100 gallons of water 50 lbs./100 gals.
Was a drive shoe used? ☐ Yes ☒ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☐ No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:

County Marion Driller's well number
¼ NW¼ Section 32 T. 7 S R. 3 W. W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.

Depth at which water was first found 31 ft.
Static level 31 ft. below land surface. Date 5/21/7
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:

Diameter of well below casing 8"
Depth drilled 51 ft. Depth of completed well 51 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
Coarse sand & gravel	0	5	
Med. fine sand & gravel	5	18	
Fine sand with some gravel	18	33	
Med. fine gravel & sand	33	38	
Conglomerate: gray clay w/ fine gravel	38	41	
Hard light gray sandy clay	41	51	
Pisometer screens set at 34', 40' and 46' as per attached sketch.			

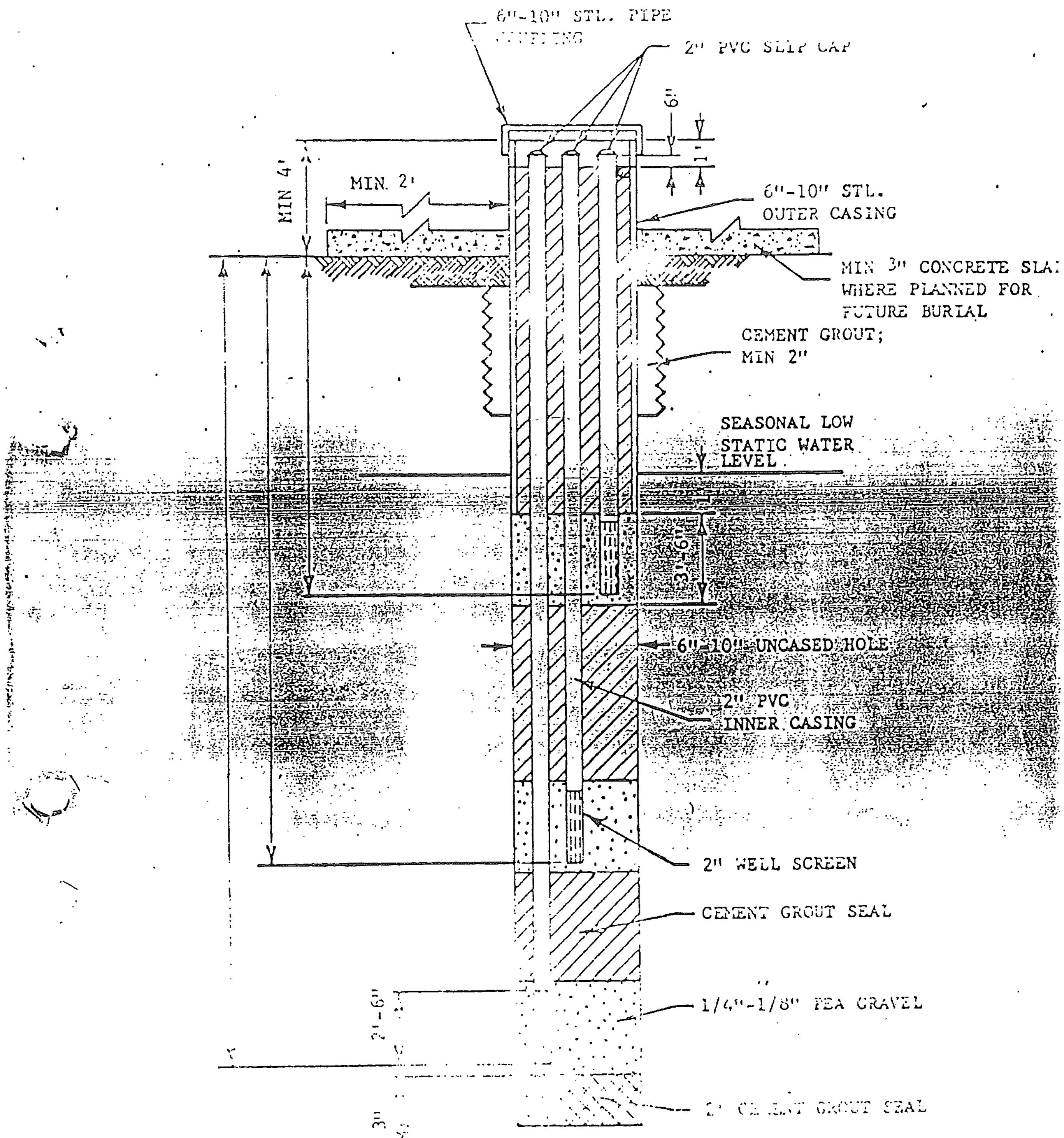
Work started 5/8/73 19 Completed 5/21/73 19
Date well drilling machine moved off of well 5/21/73 19

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] (signature) Date 4/4/74 19
(Drilling Machine Operator)
Drilling Machine Operator's License No. 751

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 A. M. Jannsen Drilling Co.
(Person, firm or corporation) (Type or print)
Address 21075 S.W. Tualatin Valley Hwy, Aloha, O
[Signed] (signature)
(Water Well Contractor)
Contractor's License No. 79 Date 3/27/74, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

SP*45656-



MULTIPLE COMPLETION MONITORING WELL

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-095)
Instructions for completing this report are on the last page of this form.

MACK DRILLING COMPANY
1345 20TH STREET SE
P O BOX 12067
SALEM, OR 97309-0067

15810 - MW 1A
Start Card # 101833

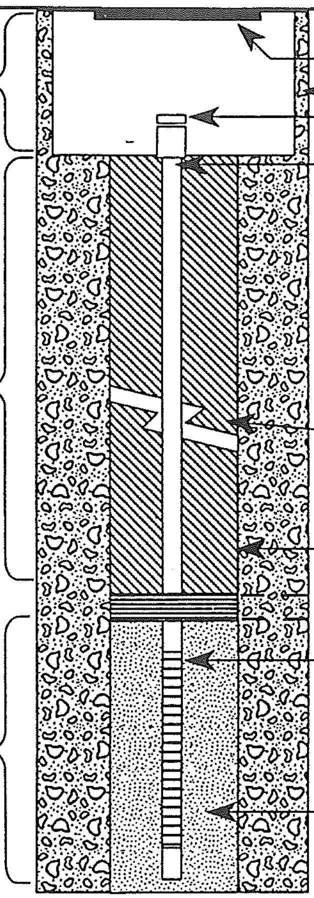
FILE COPY

(1) OWNER/PROJECT: WELL NO. 15810
Name Marion County Solid Waste
Address 388 State Street, Suite 735
City Salem State OR Zip 97301

(2) TYPE OF WORK:
- [ ] New construction
- [x] Alteration (Repair/Recondition)
- [ ] Conversion
- [ ] Deepening
- [ ] Abandonment

(3) DRILLING METHOD
- [ ] Rotary Air
- [ ] Rotary Mud
- [ ] Cable
- [ ] Hollow Stem Auger
- [x] Other H/S Truck + mini Excavator

(4) BORE HOLE CONSTRUCTION
Special Standards Yes [ ] No [x]   Depth of completed well 40'3" ft.



Land surface
Vault ___ ft. TO ___ ft.
Water-tight cover
Surface flush vault
Locking cap
Casing diameter 2" in.
material PVC
Welded [ ] Threaded [x] Glued [ ]
Seal 0 ft. TO 7 ft.
Liner diameter ___ in.
material ___
Welded [ ] Threaded [ ] Glued [ ]
Well seal:
Material Bentonite
Amount 5 Sacks
Grout weight ___
Borehole diameter 13 in.
Bentonite plug at least 3 ft. thick
Filter pack ___ ft. TO ___ ft.
Screen material ___
interval(s):
From ___ To ___
From ___ To ___
Slot size ___ in.
Filter pack:
Material ___
Size ___ in.

(5) WELL TEST:
- [ ] Pump
- [ ] Bailer
- [ ] Air
- [ ] Flowing Artesian

Permeability ___ Yield ___ GPM
Conductivity ___ PH ___
Temperature of water ___ °F/C Depth artesian flow found ___ ft.
Was water analysis done? [ ] Yes [x] No
By whom? ___
Depth of strata to be analyzed. From ___ ft. to ___ ft.
Remarks: ___

Name of supervising Geologist/Engineer ___

(6) LOCATION OF WELL By legal description
Well Location: County Marion
Township 7 (N or S) Range 3 (E or W) Section 32
1. NW 1/4 of NW 1/4 of above section.
2. Either Street address of well location Browns Island Demolition Landfill
or Tax lot number of well location None
3. ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:
30'2" Ft. below land surface. Date 9-23-97
Artesian Pressure ___ lb/sq. in. Date ___

(8) WATER BEARING ZONES:
Depth at which water was first found ___

From	To	Est. Flow Rate	SWL

(9) WELL LOG: Ground elevation ___

Material	From	To	SWL
Added 55"			
to 3" casing &			
Pinned up 2"			
casing approx			
55" attached			
w/ compression			
coupler			
Installed 13" OD			
surface casing &			
removed as seal			
was placed			
Installed pipe			
ballards			
Backfilled de-			
pression area to			
grade			

Date started 9-8-97 Completed 9-23-97

(unbonded) Monitor Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.
MWC Number ___
Signed ___ Date ___

(bonded) Monitor Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.
MWC Number 10166
Signed [signature] Date 9-29-97

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-095)
Instructions for completing this report are on the last page of this form.

MACK DRILLING COMPANY
1345 20TH STREET SE
P O BOX 12067
SALEM, OR 97309-0067

19766 - MW 1B
Start Card # 106832

(1) OWNER/PROJECT: WELL NO. 19766
Name Marion County Solid Waste
Address 388 State Street Suite 735
City Salem State OR Zip 97301

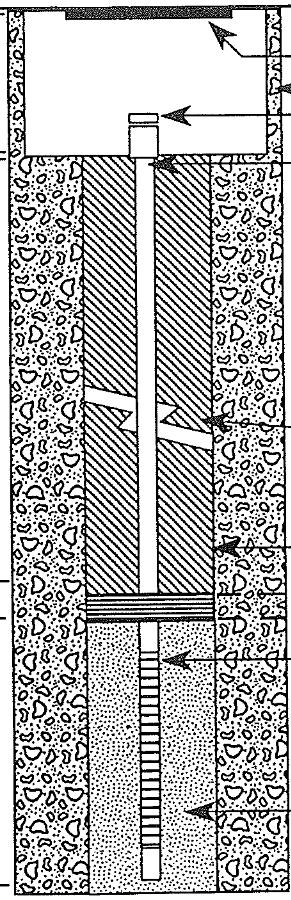
(2) TYPE OF WORK:

FILE COPY

☐ New construction ☒ Alteration (Repair/Recondition)
☐ Conversion ☐ Deepening ☐ Abandonment

(3) DRILLING METHOD
☐ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Hollow Stem Auger ☒ Other Hoist Truck & Mini Excavator

(4) BORE HOLE CONSTRUCTION
Special Standards Yes ☐ No ☒ Depth of completed well 47' 2" ft.



Land surface
Vault ___ ft. TO ___ ft.
Water-tight cover
Surface flush vault
Locking cap
Casing diameter 2" in.
material PVC
Welded ☐ Threaded ☒ Glued ☐
Liner diameter ___ in.
material ___
Welded ☐ Threaded ☐ Glued ☐
Seal 0 ft. TO 7 ft.
Well seal:
Material Bentonite
Amount 5 SACKS
Grout weight ___
Borehole diameter 13 in.
Bentonite plug at least 3 ft. thick
Filter pack ___ ft. TO ___ ft.
Screen material ___
interval(s):
From ___ To ___
From ___ To ___
Slot size ___ in.
Filter pack:
Material ___
Size ___ in.

(5) WELL TEST:
☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian
Permeability ___ Yield ___ GPM
Conductivity ___ PH ___
Temperature of water ___ °F/C Depth artesian flow found ___ ft.
Was water analysis done? ☐ Yes ☒ No
By whom? ___
Depth of strata to be analyzed. From ___ ft. to ___ ft.
Remarks: ___

Name of supervising Geologist/Engineer ___

(6) LOCATION OF WELL By legal description
Well Location: County Marion
Township 7 (N or (S)) Range 3 (E or (W)) Section 32
1. NW 1/4 of NW 1/4 of above section.
2. Either Street address of well location Browns Island Demolition Landfill
or Tax lot number of well location None
3. ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:
30'4" Ft. below land surface. Date 9-23-97
Artesian Pressure ___ lb/sq. in. Date ___

(8) WATER BEARING ZONES:
Depth at which water was first found ___

From	To	Est. Flow Rate	SWL

(9) WELL LOG: Ground elevation ___

Material	From	To	SWL
Added 55 inches to 9" casing.			
Raised up 2" casing approx. 55" attached w/ compression coupler			
Installed 13" OD surface casing & removed as seal was placed.			
Installed pipe ballards			
Backfilled depression area to grade			

Date started 9-9-97 Completed 9-23-97

(unbonded) Monitor Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.
MWC Number ___
Signed ___ Date ___

(bonded) Monitor Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.
MWC Number 10166
Signed [signature] Date 9-30-97

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

STATE OF OREGON

MONITORING WELL REPORT

(as required by ORS 537.765 & OAR 690-240-095)

Instructions for completing this report are on the last page of this form.

MACK DRILLING COMPANY
1345 20TH STREET SE
P O BOX 12067
SALEM, OR 97309-0067

19767 - MW1C

Start Card # 106831

FILE COPY

(1) OWNER/PROJECT: WELL NO. 19767

Name Marion County Solid Waste

Address 388 State Street, Suite 735

City Salem State OR Zip 97301

(2) TYPE OF WORK:

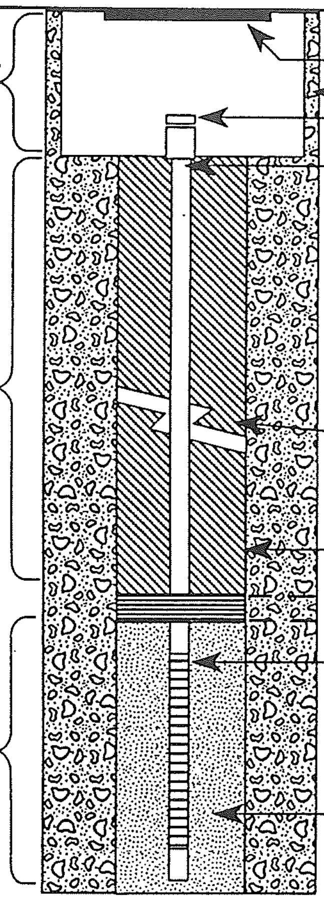
☐ New construction ☒ Alteration (Repair/Recondition)
☐ Conversion ☐ Deepening ☐ Abandonment

(3) DRILLING METHOD

☐ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Hollow Stem Auger ☒ Other

(4) BORE HOLE CONSTRUCTION

Special Standards Yes ☐ No ☒ Depth of completed well 51'4" ft.



Land surface

Vault 0 ft. TO 7 ft.

Water-tight cover

Surface flush vault

Locking cap

Casing diameter 7" in.

material

Welded ☐ Threaded ☒ Glued ☒

Liner diameter in.

material

Welded ☐ Threaded ☐ Glued ☐

Seal 0 ft. TO 7 ft.

Well seal:

Material Bentonite

Amount 5 SACKS

Grout weight

Borehole diameter 13 in.

Bentonite plug at least 3 ft. thick

Filter pack ft. TO ft.

Screen material

interval(s):

From To

From To

Slot size in.

Filter pack:

Material

Size in.

(5) WELL TEST:

☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Permeability Yield GPM

Conductivity PH

Temperature of water °F/C Depth artesian flow found ft.

Was water analysis done? ☐ Yes ☒ No

By whom?

Depth of strata to be analyzed. From ft. to ft.

Remarks:

Name of supervising Geologist/Engineer

(6) LOCATION OF WELL By legal description

Well Location: County Marion

Township 7 (N or (S)) Range 3 (E or (W)) Section 32

1. NW 1/4 of NW 1/4 of above section.

2. Either Street address of well location Browns Island Demolition Landfill

or Tax lot number of well location None

3. ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:

34'9" Ft. below land surface. Date

Artesian Pressure lb/sq. in. Date

(8) WATER BEARING ZONES:

Depth at which water was first found

From	To	Est. Flow Rate	SWL

(9) WELL LOG: Ground elevation

Material	From	To	SWL
Added 55 inches to 8" casing			
Raised up 7" casing approx 55" attached w/ slip coupler.			
Installed 13" OD surface casing & removed as seal was placed			
Installed pipe ballards.			
Backfilled depression area to grade.			

Date started 9-9-97 Completed 9-23-97

(unbonded) Monitor Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.

MWC Number

Signed Date

(bonded) Monitor Well Constructor Certification:

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.

MWC Number 10166

Signed [signature] Date 9-30-97

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the
STATE ENGINEER, SALEM, OREGON 97310 within 30 days from the date of well completion.

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

8126

RECEIVED
APR 10 1974
STATE ENGINEER
SALEM, OREGON

State Well No. 7/3-31 cac
State Permit No.

MW-2A/2B

(1) OWNER:
Name Sanitary Service, Inc. #3
Address 496 Ferry Street, S. E.
Salem, Oregon 97301

(2) TYPE OF WORK (check):
New Well ☐ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☐ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):
Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☒ Other ☒

(5) CASING INSTALLED:
Threaded ☐ Welded ☐
6" Diam. from unknown to ft. Gage
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

(6) PERFORATIONS:
Perforated? ☒ Yes ☐ No.
Type of perforator used Mills Knife
Size of perforations 1/4 in. by 1-1/2 in.
20 perforations from 28 ft. to 32 ft.
20 perforations from 45 ft. to 49 ft.
perforations from ft. to ft.

(7) SCREENS:
Well screen installed? ☐ Yes ☒ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(8) WELL TESTS:
Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " "
" " " "
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m.
Temperature of water Depth artesian flow encountered ft.

(9) CONSTRUCTION:
Well seal—Material used UNKNOWN
Well sealed from land surface to ft.
Diameter of well bore to bottom of seal in.
Diameter of well bore below seal in.
Number of sacks of cement used in well seal sacks
Number of sacks of bentonite used in well seal sacks
Brand name of bentonite
Number of pounds of bentonite per 100 gallons of water lbs./100 gals.
Was a drive shoe used? ☐ Yes ☐ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☐ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☐ No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:
County Marion Driller's well number
¼ NW ¼ Section 31 T. 7 S R. 3 W. W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well. Unknown
Depth at which water was first found ft.
Static level ft. below land surface. Date
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:
Diameter of well below casing unknown
Depth drilled ft. Depth of completed well 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
Previously drilled			
Pisometer screens set at 30 feet, and 47 feet.			

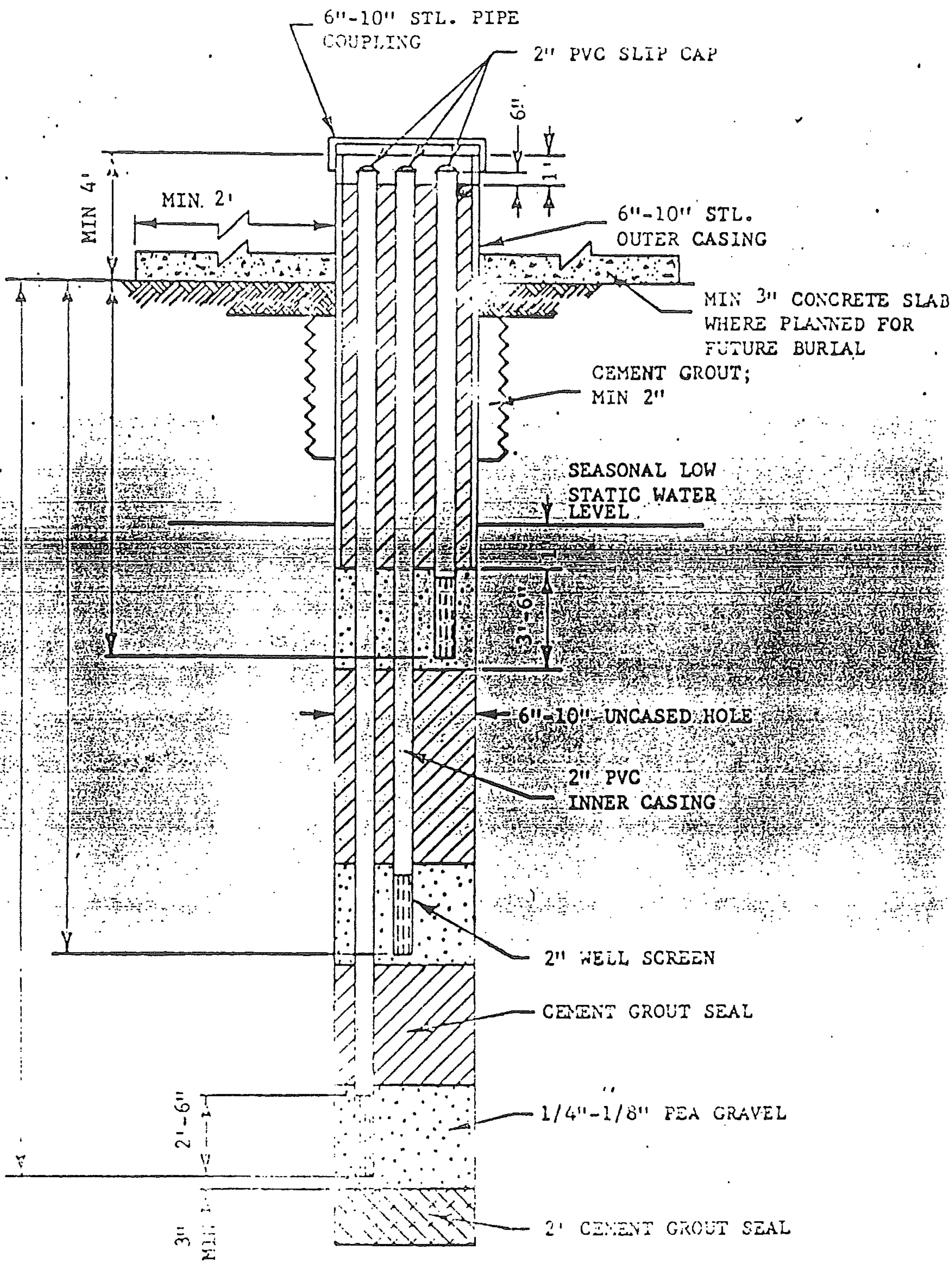
Work started 5/22/73 19 Completed 5/23/73 19
Date well drilling machine moved off of well 5/23/73 19

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 4/4/74 19
Drilling Machine Operator's License No. 751

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 A. M. JANNSEN DRILLING CO. (Person, firm or corporation) (Type or print)
Address 21075 S.W. Tualatin Valley Hwy, Aloha, Or
[Signed] (Water Well Contractor)
Contractor's License No. 79 Date 4/4/74, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

SP*45656-119



MULTIPLE COMPLETION MONITORING WELL

11/19/97 09:06 ☎503 375 0961 MACK DRILLING ☑002/005

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-095)
Instructions for completing this report are on the last page of this form.

MACK DRILLING COMPANY
1345 20TH STREET SE
P O BOX 12067
SALEM, OR 97309-0067

19768 - MW 2A

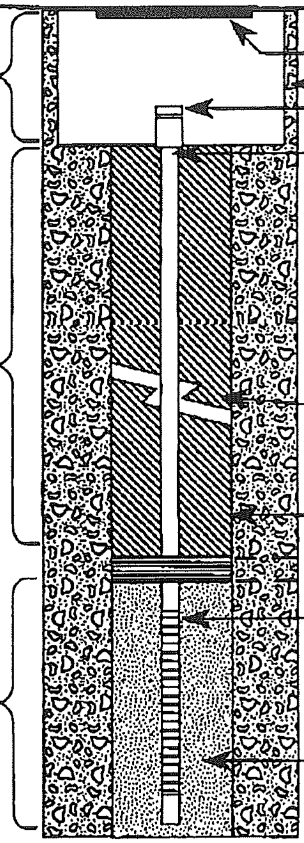
Start Card # 106834

(1) OWNER/PROJECT:
WELL NO. 19768
Name Marion County Solid Waste
Address 388 State Str. Suite 735
City Salem State OR Zip 97301

(2) TYPE OF WORK:
☐ New construction ☒ Alteration (Repair/Recondition)
☐ Conversion ☐ Deepening ☐ Abandonment

(3) DRILLING METHOD
☒ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Hollow Stem Auger ☒ Other Hoist Truck & mini Excavator

(4) BORE HOLE CONSTRUCTION
Special Standards Yes ☐ No ☒ Depth of completed well 41'9" ft.



Land surface

Vault ___ ft. TO ___ ft.

Water-tight cover
Surface flush vault
Locking cap

Casing diameter 2 in.
material PVC
Welded ☐ Threaded ☒ Glued ☐

Liner diameter ______ in.
material ______
Welded ☐ Threaded ☐ Glued ☐

Seal 0 ft. TO 6+ ft.

Well seal:
Material Bentonite
Amount 4 SKS
Grout weight ______

Borehole diameter 12 in.

Bentonite plug at least 3 ft. thick

Filter pack ___ ft. TO ___ ft.

Screen material ______
interval(s):
From ______ To ______
From ______ To ______
Slot size ______ in.

Filter pack:
Material ______
Size ______ in.

(5) WELL TEST:
☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian
Permeability ______ Yield ______ GPM
Conductivity ______ PH ______
Temperature of water ______ °F/C Depth artesian flow found ______ ft.
Was water analysis done? ☐ Yes ☐ No
By whom? ______
Depth of strata to be analyzed. From ______ ft. to ______ ft.
Remarks: ______

Name of supervising Geologist/Engineer ______

(6) LOCATION OF WELL By legal description
Well Location: County Marion
Township 7 (N or S) Range 3 (E or W) Section 32
1. NW 1/4 of NW 1/4 of above section.
2. Either Street address of well location Browns Island Demolition Landfill
or Tax lot number of well location None
3. ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:
37'4" Ft. below land surface. Date 9-23-97
Artesian Pressure ______ lb/sq. in. Date ______

(8) WATER BEARING ZONES:
Depth at which water was first found ______

From	To	Est. Flow Rate	SWL

(9) WELL LOG:
Ground elevation ______

Material	From	To	SWL
Excavated out & down to 6 feet around 6" protective casing. Installed 12" temporary surface casing and removed as seal was installed.			
Cleaned out between internal annular space w/ high pressure air & jetting tool			
Backfilled internal annular space w/ bentonite then clean silica sand			

Date started 9-9-97 Completed 9-30-97

(unbonded) Monitor Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.
MWC Number ______
Signed ______ Date ______

(bonded) Monitor Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.
MWC Number 10166
Signed [signature] Date 11-19-97

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

11/19/97 09:07 ☎503 375 0961 MACK DRILLING 003/005

STATE OF OREGON

MONITORING WELL REPORT

(as required by ORS 537.765 & OAR 690-240-095)

Instructions for completing this report are on the last page of this form.

MACK DRILLING COMPANY
1345 20TH STREET SE
P O BOX 12087
SALEM, OR 97309-0087

Amended Log

19769-MW2B

Start Card # 106835

(1) OWNER/PROJECT: WELL NO. 19769

Name Marion County Solid Waste

Address 388 State Street, Suite 735

City Salem State OR Zip 97301

(2) TYPE OF WORK:

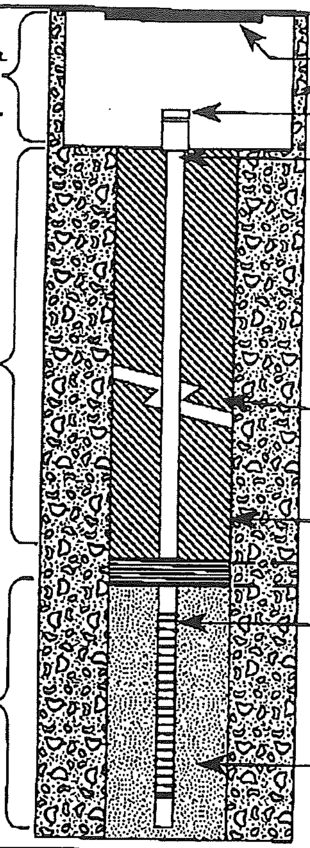
☐ New construction ☒ Alteration (Repair/Recondition)
☐ Conversion ☐ Deepening ☐ Abandonment

(3) DRILLING METHOD

☐ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Hollow Stem Auger ☒ Other Hoist truck & Mini-Excavator

(4) BORE HOLE CONSTRUCTION

Special Standards Yes ☐ No ☒ Depth of completed well 57' 6" ft.



Vault ___ ft. TO ___ ft.

Land surface

Water-tight cover

Surface flush vault

Locking cap

Casing diameter 2" in. material PVC

Welded ☐ Threaded ☐ Glued ☐

Liner diameter ______ in. material ______

Welded ☐ Threaded ☐ Glued ☐

Seal 0 ft. TO 6+ ft.

Well seal: Material Bentonite Amount 4 sacks Grout weight ______

Borehole diameter 12 in.

Bentonite plug at least 3 ft. thick

Filter pack ___ ft. TO ___ ft.

Screen material ______ interval(s): From ___ To ___ From ___ To ___ Slot size ___ in.

Filter pack: Material ______ Size ______ in.

(5) WELL TEST:

☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Permeability ______ Yield ______ GPM

Conductivity ______ PH ______

Temperature of water ______ °F/C Depth artesian flow found ______ ft.

Was water analysis done? ☐ Yes ☐ No

By whom? ______

Depth of strata to be analyzed. From ______ ft. to ______ ft.

Remarks: ______

Name of supervising Geologist/Engineer ______

(6) LOCATION OF WELL By legal description

Well Location: County Marion

Township 7 (N or (S)) Range 3 (E or (W)) Section 32

1. NW 1/4 of NW 1/4 of above section.

2. Either Street address of well location Browns Island Demolition Landfill

or Tax lot number of well location None

3. ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:

39 Ft. below land surface. Date 9-23-97

Artesian Pressure ______ lb/sq. in. Date ______

(8) WATER BEARING ZONES:

Depth at which water was first found ______

From	To	Est. Flow Rate	SWL

(9) WELL LOG: Ground elevation ______

Material	From	To	SWL
Excavated out & down to 6 feet around 6" protective casing. Installed 12" temporary surface casing and removed as ~~ste~~ seal was installed.			
Cleaned out between internal annular space w/high pressure air & jetting tool			
Backfilled internal annular space w/ bentonite then clean silica sand.			

Date started 9-9-97 Completed 9-30-97

(unbonded) Monitor Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.

MWC Number ______

Signed ______ Date ______

(bonded) Monitor Well Constructor Certification:

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.

MWC Number 10166

Signed Eugene A. Mack Date 11-18-97

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

STATE OF OREGON
~~MONI~~TORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-095)
Instructions for completing this report are on the last page of this form.

MACK DRILLING COMPANY
1345 20TH STREET SE
P O BOX 12057
SALEM, OR 97309-0057

MARI 54242

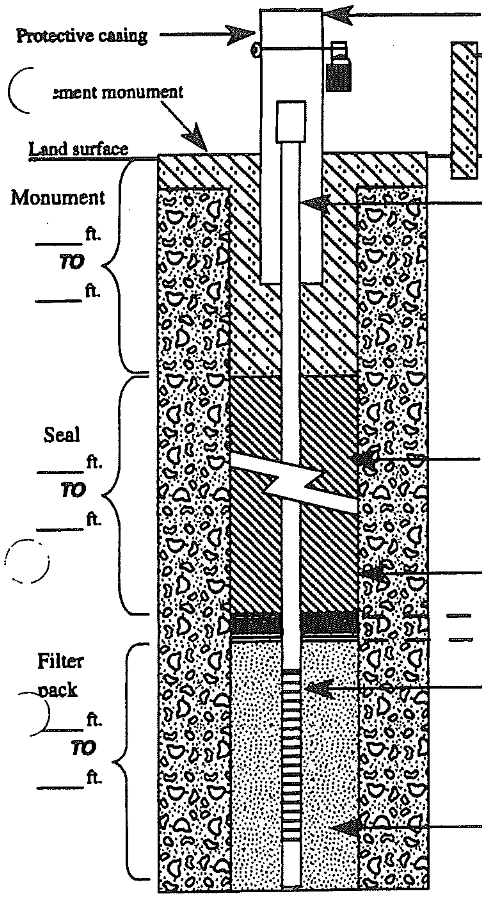
Start Card # 124260

(1) OWNER/PROJECT: WELL NO. MW#4 a,b,c
Name Marion County Solid Waste
Address 388 State Street
City Salem State OR Zip 97301

(2) TYPE OF WORK:
☐ New construction ☐ Alteration (Repair/Recondition)
☐ Conversion ☐ Deepening ☒ Abandonment

(3) DRILLING METHOD
☒ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Hollow Stem Auger ☐ Other ______

(4) BORE HOLE CONSTRUCTION
Special Standards Yes ☐ No ☒
Depth of completed well 65 ft.



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SEP 2 4 1999
WATER RESOURCES DEPT
SALEM, OREGON

Casing diameter 3-2 in.
material PVC
Welded ☐ Threaded ☒ Glued ☐
Liner diameter ______ in.
material ______
Welded ☐ Threaded ☐ Glued ☐
Well seal:
Material Cement
Amount ______
Grout weight ______
Borehole diameter ______ in.
Bentonite plug at least 3 ft. thick
Screen material PVC
interval(s):
From ____ To ____
From ____ To ____
Slot size ______ in.
Filter pack:
Material Silica Sand
Size ______ in.

(5) WELL TEST:
☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian
Permeability ______ Yield ______ GPM
Conductivity ______ PH ______
Temperature of water 58 °F/C Depth artesian flow found ______ ft.
Was water analysis done? ☐ Yes ☒ No
By whom? ______
Depth of strata to be analyzed. From ______ ft. to ______ ft.
Remarks: Methane gas was igniting during welding & cutting

(6) LOCATION OF WELL By legal description
Well Location: County Marion
Township 7 (N or S) Range 3 (E or W) Section 3
1. NW 1/4 of NW 1/4 of above section.
2. Either Street address of well location Browns Islan[d] Demolition Landfill Salem, OR
or Tax lot number of well location None
3. ATTACH MAP WITH LOCATION IDENTIFIED. Map shall inc[lude] approximate scale and north arrow.

(7) STATIC WATER LEVEL:
______ Ft. below land surface. Date ______
Artesian Pressure ______ lb/sq. in. Date ______

(8) WATER BEARING ZONES:
Depth at which water was first found ______

From	To	Est. Flow Rate	SWL
Drilled in 16" Casing w/under Re[amer]			
System to 65 Feet. Removed under			
reamer & pressure grouted throu[gh]			
16" casing as pipe was removed			

(9) WELL LOG: Ground elevation ______

Material	From	To	S[WL]
Drilled 8" from	0	65	
To remove monitoring			
well			
Pulled 8" Casing	0	35	
12" casing was			
cemented to 8"	0	18	
Filled hole with			
cement grout	0	65	
Total of 62 bags			
of cement with			
5% Bentonite in			
mix			
Bull Dozer hit			
casing and bent			
both the 8" and			
12" pipe prior to			
abandonment			

RECEIVED
AUG 1 9 19[99]
WATER RESOURCE[S]
SALEM, OREG[ON]

Date started 7/29/99 Completed 8/2/99

(unbonded) Monitor Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the b[est] knowledge and belief.
MWC Number 1[…]
Signed [signature] Date ______

(bonded) Monitor Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well const[ruction] standards. This report is true to the best of my knowledge and belief.
MWC Number 1[…]
[signature]

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the
STATE ENGINEER, SALEM, OREGON 97310 within 30 days from the date of well completion.

8/317 M1 21 MARL

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

NC

RECEIVED
APR 1 0 1974
STATE ENGINEER
SALEM, OREGON

State Well No. 7/3w 32 Ecd
State Permit No.

MW-4A/4B/4C —

(1) OWNER: #1
Name Sanitary Service, Inc.
Address 496 Ferry Street, S. E.
Salem, Oregon 97301

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):
Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☒

(5) CASING INSTALLED: Threaded ☐ Welded ☒
8" Diam. from +4 ft. to 34 ft. Gage .250
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

(6) PERFORATIONS: Perforated? ☐ Yes ☒ No.
Type of perforator used
Size of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS: Well screen installed? ☐ Yes ☒ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(8) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m.
Temperature of water Depth artesian flow encountered ft.

(9) CONSTRUCTION:
Well seal—Material used ~~Bentonite~~
Well sealed from land surface to 18 ft.
Diameter of well bore to bottom of seal 12 in.
Diameter of well bore below seal 8 in.
Number of sacks of cement used in well seal 0 sacks
Number of sacks of bentonite used in well seal 4 sacks
Brand name of bentonite International Gel
Number of pounds of bentonite per 100 gallons of water 50 lbs./100 gals.
Was a drive shoe used? ☐ Yes ☒ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☒ No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:
County Marion Driller's well number
¼ NW¼ Section 32 T. 7 S R. 3 W. W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 35 ft.
Static level 35 ft. below land surface. Date 4/25/7
Artesian pressure lbs. per square inch. Date

(12) WELL LOG: Diameter of well below casing 8"
Depth drilled 65 ft. Depth of completed well 65 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
Fill - gravel & sand	0	6	
Coarse gravel	6	10	
Fill - sand & gravel	10	16	
Brown sand & gravel	16	22	
Soft gray silty clay	22	27	
Med.fine brown sand & gravel	27	30	
Coarse sand & gravel	30	40	
Med.coarse gravel w/some sand	40	49	
Brown sand w/some gravel	49	54	
Gray silty clay w/some gravel	54	55	
Hard gray sandy clay	55	65	
Pisometer screens set at 40 ft; 48 ft; and 62 ft. as per attached sketch			

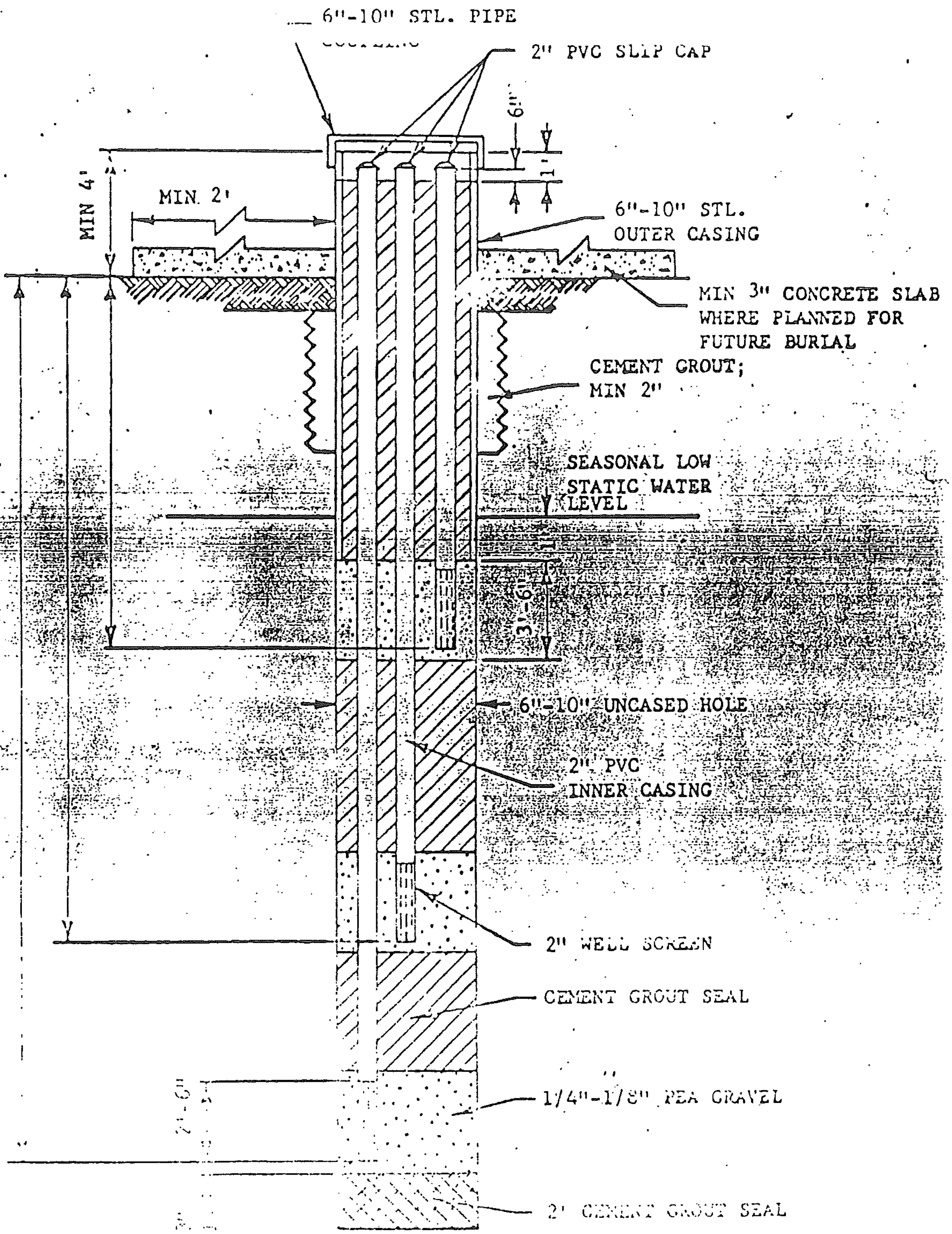
Work started 4/16/74 ~~73~~ 19 Completed 5/7/74 ~~3~~ 19
Date well drilling machine moved off of well 5/8/73 19

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] [signature] (Drilling Machine Operator) Date 4/4/74, 19
Drilling Machine Operator's License No. 751

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 A. M. Jannsen Drilling Co. (Person, firm or corporation) (Type or print)
Address 21075 S. W. Tualatin Valley Hwy, Aloha (
[Signed] [signature] (Water Well Contractor)
Contractor's License No. 79 Date 3/27/74, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

SP*45656-119



MULTIPLE COMPLETION MONITORING WELL

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the
STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date of well completion

RECEIVED
JAN 16 1970
STATE ENGINEER

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

MARI

State Well No. 1/3W-32
State Permit No.

TRUSSELL DOMESTIC WELL

MW-5

(1) OWNER.
Name Salem Sanitary Service
Address 496 Ferry

(2) TYPE OF WORK (check):
New Well ☑ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☑ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):
Domestic ☑ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

CASING INSTALLED: Threaded ☐ Welded ☐
6/4" Diam. from +2 ft. to 61 ft. Gage .025
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

PERFORATIONS: Perforated? ☐ Yes ☑ No
Type of perforator used
Size of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS: Well screen installed? ☐ Yes ☑ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(8) WATER LEVEL: Completed well.
Static level 20 ft. below land surface Date 12/5/70
ian pressure lbs. per square inch Date

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☑ No If yes, by whom?
ld: gal./min. with ft. drawdown after hrs.
" " " "
" " " "
Bailer test 75 gal./min. with 10 ft. drawdown after 1 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? ☐ Yes ☑ No

(10) CONSTRUCTION:
Well seal—Material used Cement & Bentonite
Depth of seal 61 ft.
Diameter of well bore to bottom of seal 10 in.
Were any loose strata cemented off? ☐ Yes ☑ No Depth
Was a drive shoe used? ☐ Yes ☑ No
Did any strata contain unusable water? ☐ Yes ☑ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☑ No Size of gravel:
Gravel placed from ft. to ft.

(11) LOCATION OF WELL:
County Marion Driller's well number
¼ ¼ Section 32 T. 7S R. 3W W.M.
Bearing and distance from section or subdivision corner

(12) WELL LOG: Diameter of well below casing
Depth drilled ft. Depth of completed well 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 as drilling proceeds. Note drilling rates.

MATERIAL	From	To	SWL
Sandy Clay	0	25	
Gravel & Sand	25	43	
Sandstone	43	105	

Work started 12-30 1969 Completed 1-5 1970
Date well drilling machine moved off of well 1-7 1970

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] [illegible] (Drilling Machine Operator) Date 1-7, 1970
Drilling Machine Operator's License No. 455

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 Robinson's Echo Drilling (Person, firm or corporation) (Type or print)
Address 1734 52nd S.E. Salem
[Signed] George L. Robinson (Water Well Contractor)
Contractor's License No. 13 Date 1/13, 1970

(USE ADDITIONAL SHEETS IF NECESSARY)

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the
STATE ENGINEER, SALEM, OREGON 97310
within 30 days from the date of well completion.

8146 MAR

WATER WELL REPORT
STATE OF OREGON

RECEIVED APR 10 1974 STATE ENGINEER SALEM, OREGON

(Please type or print)
(Do not write above this line)

State Well No. 7/3W-32
State Permit No.

MW-6A/6B/6C

(1) OWNER:
Name Sanitary Service, Inc. #4
Address 496 Ferry Street, S. E.
Salem, Oregon

(2) TYPE OF WORK (check):
New Well ☐ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☐ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):
Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☒

(5) CASING INSTALLED: Threaded ☐ Welded ☐
10 " Diam. from Unknown ft. to ft. Gage
" Diam. from ft. to ft. Gage
" Diam. from ft. to ft. Gage

(6) PERFORATIONS: Perforated? ☒ Yes ☐ No.
Type of perforator used Mills Knife
Size of perforations 3/8 in. by 1-1/2 in.
20 perforations from 30 ft. to 35 ft.
20 perforations from 40 ft. to 45 ft.
20 perforations from 52 ft. to 56 ft.

(7) SCREENS: Well screen installed? ☐ Yes ☒ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(8) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m.
Temperature of water Depth artesian flow encountered ft.

(9) CONSTRUCTION: UNKNOWN
Well seal—Material used
Well sealed from land surface to ft.
Diameter of well bore to bottom of seal in.
Diameter of well bore below seal in.
Number of sacks of cement used in well seal sacks
Number of sacks of bentonite used in well seal sacks
Brand name of bentonite
Number of pounds of bentonite per 100 gallons of water lbs./100 gals.
Was a drive shoe used? ☐ Yes ☐ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☐ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☐ No Size of gravel:
Gravel placed from ft. to ft.

(10) LOCATION OF WELL:
County Marion Driller's well number
¼ NW ¼ Section 32 T. 7 S R. 3 W. W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well. UNKNOWN
Depth at which water was first found ft.
Static level ft. below land surface. Date
Artesian pressure lbs. per square inch. Date

(12) WELL LOG: Diameter of well below casing UNKNOWN
Depth drilled ft. Depth of completed well 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
Previously drilled	0	57	
Pisometerx screens set at 33 ft, 43 ft., & 54 ft. as per attached sketch.			

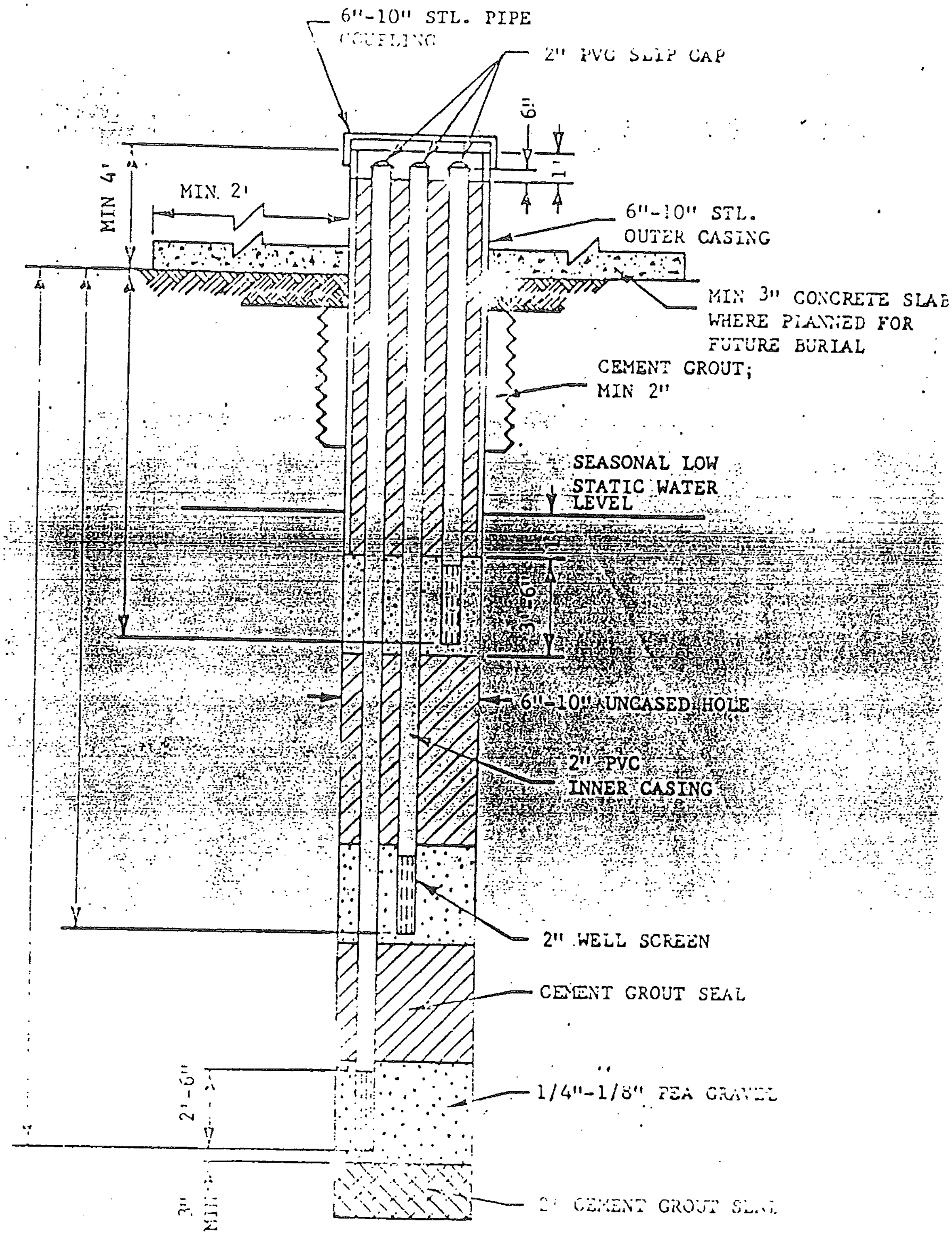
Work started 5/23/73 19 Completed 5/31/73 19
Date well drilling machine moved off of well 5/31/73 19

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] (signature) (Drilling Machine Operator) Date 4/4/74, 19
Drilling Machine Operator's License No. 751

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 A. M. JANNSEN DRILLING CO. (Person, firm or corporation) (Type or print)
Address 21075 S. W. Tualatin Valley Hwy, Aloha,
[Signed] (signature) (Water Well Contractor)
Contractor's License No. 79 Date 4/4/74, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

SP*45656-119



MULTIPLE COMPLETION MONITORING WELL

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-095)
Instructions for completing this report are on the last page of this form.

MACK DRILLING COMPANY
1345 20TH STREET SE
P O BOX 12057
SALEM, OR 97309-0057

19782 - MW6A

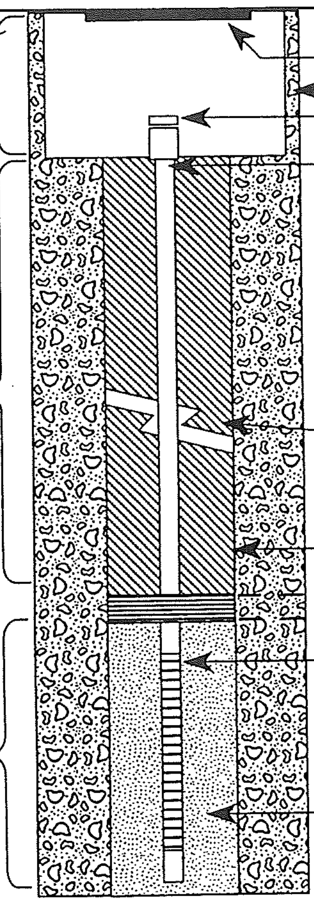
Start Card # 106836

(1) OWNER/PROJECT:
WELL NO. 19782
Name Marion County Solid Waste
Address 388 State Street, Suite 735
City Salem State OR Zip 97301

(2) TYPE OF WORK:
- [ ] New construction
- [x] Alteration (Repair/Recondition)
- [ ] Conversion
- [ ] Deepening
- [ ] Abandonment

(3) DRILLING METHOD
- [x] Rotary Air
- [ ] Rotary Mud
- [ ] Cable
- [ ] Hollow Stem Auger
- [ ] Other ______

(4) BORE HOLE CONSTRUCTION
Special Standards Yes [ ] No [x]
Depth of completed well 43'-4" ft.



Land surface
Vault monument 0 ft. TO 1½ ft.
Water-tight cover
Surface flush vault
Locking cap
Casing diameter 2" in.
material PVC
Welded [ ] Threaded [x] Glued [ ]
Liner diameter ______ in.
material ______
Welded [ ] Threaded [ ] Glued [ ]
Seal 0 ft. TO 12 ft.
Well seal:
Material Bentonite
Amount 8½ sacks
Grout weight ______
Borehole diameter 14" in.
Bentonite plug at least 3 ft. thick
Screen
material ______
interval(s):
From ______ To ______
From ______ To ______
Slot size ______ in.
Filter pack ____ ft. TO ____ ft.
Filter pack:
Material ______
Size ______ in.

(5) WELL TEST:
- [ ] Pump
- [ ] Bailer
- [ ] Air
- [ ] Flowing Artesian

Permeability ______ Yield ______ GPM
Conductivity ______ PH ______
Temperature of water ______ °F/C Depth artesian flow found ______ ft.
Was water analysis done? [ ] Yes [x] No
By whom? ______
Depth of strata to be analyzed. From ______ ft. to ______ ft.
Remarks: ______

Name of supervising Geologist/Engineer ______

(6) LOCATION OF WELL By legal description
Well Location: County Marion
Township 7 (N or (S)) Range 3 (E or (W)) Section 32
1. NW 1/4 of SW 1/4 of above section.
2. Either Street address of well location Browns Island Demolition Landfill
or Tax lot number of well location None
3. ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:
28 Ft. below land surface. Date 10-14-97
Artesian Pressure ______ lb/sq. in. Date ______

(8) WATER BEARING ZONES:
Depth at which water was first found ______

From	To	Est. Flow Rate	SWL

(9) WELL LOG:
Ground elevation ______

Material	From	To	SWL
Gravel med	0	4	
Sand Grey	4	12	
Over shot 10" casing sealed			
with bentonite			
Raised casing to 1½ FT			
Above Ground			
Raised well 13"			

Date started 10-14-97 Completed 10-14-97

(unbonded) Monitor Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.
MWC Number 10100
Signed [signature] Date 10-14-97

(bonded) Monitor Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.
MWC Number 10166
Signed [signature] Date 10-14-97

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

MACK DRILLING COMPANY
1345 20TH STREET SE
P O BOX 12057
SALEM, OR 97309-0287

STATE OF OREGON
MONITORING WELL REPORT
as required by ORS 537.765 & OAR 690-240-095)
Instructions for completing this report are on the last page of this form.

19783 - MW6B

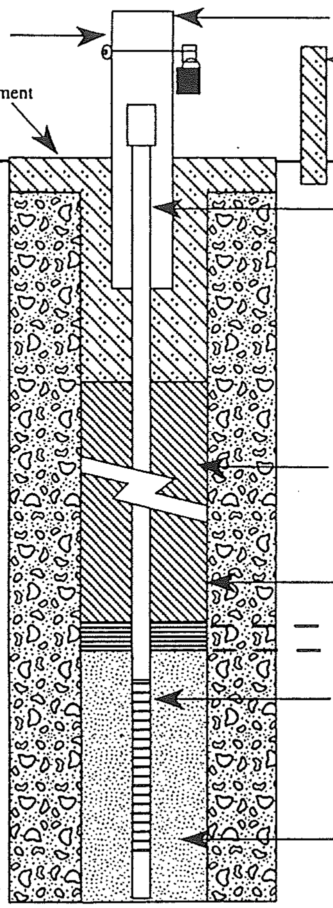
Start Card # 106837

1) OWNER/PROJECT:
WELL NO. 19783
Name Marion County Solid Waste
Address 388 State Street, Suite 735
City Salem State OR Zip 97301

2) TYPE OF WORK:
☒ New construction ☐ Alteration (Repair/Recondition)
☐ Conversion ☐ Deepening ☐ Abandonment

3) DRILLING METHOD
☒ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Hollow Stem Auger ☐ Other ____

4) BORE HOLE CONSTRUCTION
Special Standards Yes ☐ No ☒ Depth of completed well 33-4 ft.



Monument 0 ft. TO 1 1/2 ft.

Seal 0 ft. TO 12 ft.

Filter pack ___ ft. TO ___ ft.

Casing diameter 2" in.
material PVC
Welded ☐ Threaded ☒ Glued ☐
Liner diameter ____ in.
material ____
Welded ☐ Threaded ☐ Glued ☐
Well seal:
Material Bentonite
Amount 8 1/2 sacks
Grout weight ____
Borehole diameter 14 in.
Bentonite plug at least 3 ft. thick
Screen
material ____
interval(s):
From ____ To ____
From ____ To ____
Slot size ____ in.
Filter pack:
Material ____
Size ____ in.

(5) WELL TEST:
☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian
Permeability ____ Yield ____ GPM
Conductivity ____ PH ____
Temperature of water ____ °F/C Depth artesian flow found ____ ft.
Was water analysis done? ☐ Yes ☒ No
By whom? ____
Depth of strata to be analyzed. From ____ ft. to ____ ft.
Remarks: ____

Name of supervising Geologist/Engineer ____

(6) LOCATION OF WELL By legal description
Well Location: County Marion
Township 7 (N or S) Range 3 (E or W) Section 32
1. NW 1/4 of SW 1/4 of above section.
2. Either Street address of well location Browns Island Demolition Landfill
or Tax lot number of well location None
3. ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:
25-7" Ft. below land surface. Date 10-14-97
Artesian Pressure ____ lb/sq. in. Date ____

(8) WATER BEARING ZONES:
Depth at which water was first found ____

From	To	Est. Flow Rate	SWL

(9) WELL LOG:
Ground elevation ____

Material	From	To	SWL
Gravel med	0	4	
Sand Grey	4	12	
OverShot 10" casing sealed			
with bentonite			
Raised casing 1 1/2 FT Above			
Grade			
Raised 2" well 13"			

Date started 10-14-97 Completed 10-14-97

(unbonded) Monitor Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.
MWC Number 10100
Signed [signature] Date 10-14-97

(bonded) Monitor Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.
MWC Number 10166
Signed [signature] Date 10-14-97

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

STATE OF OREGON
MONITORING WELL REPORT
as required by ORS 537.765 & OAR 690-240-095)
Instructions for completing this report are on the last page of this form.

MACK DRILLING COMPANY
1345 20TH STREET SE
P O BOX 12067
SALEM, OR 97309-0067

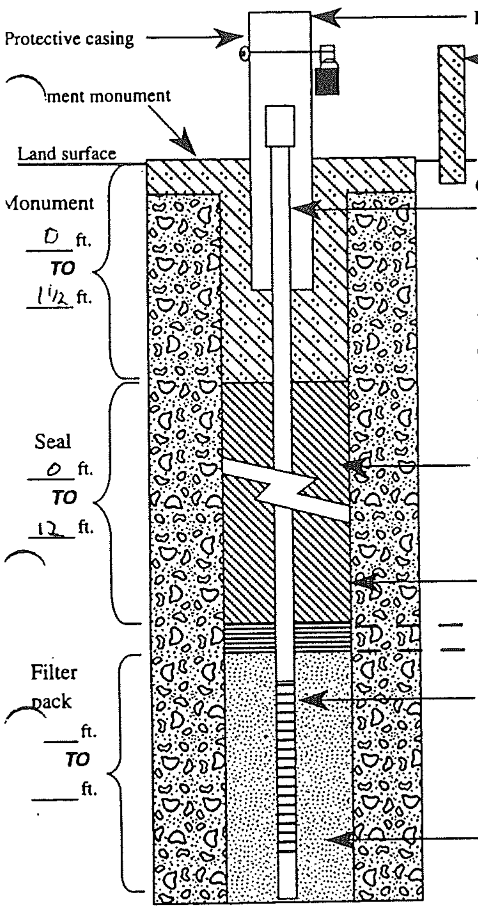
19784 - MW6C
Start Card # 106838

1) OWNER/PROJECT: WELL NO. 19784
Name Marion County Solid Waste
Address 388 State Street, Suite 735
City Salem State OR Zip 97301

(2) TYPE OF WORK:
☐ New construction ☒ Alteration (Repair/Recondition)
☐ Conversion ☐ Deepening ☐ Abandonment

(3) DRILLING METHOD
☒ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Hollow Stem Auger ☐ Other ______

(4) BORE HOLE CONSTRUCTION
Special Standards Yes ☐ No ☒ Depth of completed well 54'-3" ft.



Monument 0 ft. TO 1½ ft.
Seal 0 ft. TO 12 ft.
Filter pack ___ ft. TO ___ ft.

Casing diameter 2" in.
material PVC
Welded ☐ Threaded ☒ Glued ☐
Liner diameter ______ in.
material ______
Welded ☐ Threaded ☐ Glued ☐
Well seal:
Material Bentonite
Amount 8½ sacks
Grout weight ______
Borehole diameter 14 in.
Bentonite plug at least 3 ft. thick
Screen material ______
interval(s):
From ____ To ____
From ____ To ____
Slot size ______ in.
Filter pack:
Material ______
Size ______ in.

(5) WELL TEST:
☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian
Permeability ______ Yield ______ GPM
Conductivity ______ PH ______
Temperature of water ______ °F/C Depth artesian flow found ______ ft.
Was water analysis done? ☐ Yes ☒ No
By whom? ______
Depth of strata to be analyzed. From ______ ft. to ______ ft.
Remarks: ______

Name of supervising Geologist/Engineer ______

(6) LOCATION OF WELL By legal description
Well Location: County Marion
Township 7 (N or (S)) Range 3 (E or (W)) Section 32
1. NW 1/4 of SW 1/4 of above section.
2. Either Street address of well location Browns Island Demolition Landfill
or Tax lot number of well location None
3. ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:
28'-3" Ft. below land surface. Date 10-14-97
Artesian Pressure ______ lb/sq. in. Date ______

(8) WATER BEARING ZONES:
Depth at which water was first found ______

From	To	Est. Flow Rate	SWL

(9) WELL LOG: Ground elevation ______

Material	From	To	SWL
Gravel mud	0	4	
Sand Grey	4	12	
Over shot 10" casing			
Raised 10" casing 1½ FT			
Above Grade			
Raised 2" well	13"		

Date started 10-14-97 Completed 10-14-97

(unbonded) Monitor Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.
MWC Number 10100
Signed [signature] Date 10-14-97

(bonded) Monitor Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.
MWC Number 10166
Signed [signature] Date 10-14-97

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

The original and first copy of this report are to be filed with the STATE ENGINEER, SALEM, OREGON 97310 within 30 days from the date of well completion.

RECEIVED OCT 22 1975 WATER RESOURCES SALEM, OREGON

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

8113

State Well No. 7S/3W-28

State Permit No.

MW-7A

(1) OWNER:
Name Sanitary Service Co Inc
Address 496 Ferry SE
Salem Oregon

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):
Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☒ Observation

CASING INSTALLED:
Threaded ☐ Welded ☒

6" Diam. from ... ft. to ... ft. Gage ...
8" Diam. from +4 ft. to 4 ft. Gage 250
2" Diam. from +4 ft. to 20 ft. Gage ...

PERFORATIONS:
Perforated? ☒ Yes ☐ No.
Type of perforator used Saw
Size of perforations 3 in. by 1/8 in.
40 perforations from 15 ft. to 20 ft.
... perforations from ... ft. to ... ft.
... perforations from ... ft. to ... ft.

(7) SCREENS:
Well screen installed? ☐ Yes ☒ No
Manufacturer's Name
Type ... Model No.
Diam. ... Slot size ... Set from ... ft. to ... ft.
Diam. ... Slot size ... Set from ... ft. to ... ft.

(8) WELL TESTS:
Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " "
" " "
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m.
Temperature of water Depth artesian flow encountered ... ft.

(9) CONSTRUCTION:
Well seal—Material used Cement grout
Well sealed from land surface to 15 ft.
Diameter of well bore to bottom of seal 8 in.
Diameter of well bore below seal 6 in.
Number of sacks of cement used in well seal ... sacks
Number of sacks of bentonite used in well seal 6 ... sacks
Brand name of bentonite
Number of pounds of bentonite per 100 gallons of water ... lbs./100 gals.
Was a drive shoe used? ☒ Yes ☐ No Plugs ... Size: location ... ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☒ Yes ☐ No Size of gravel: [illegible]
Gravel placed from 15 ft. to 20 ft.

(10) LOCATION OF WELL:
County Marion Driller's well number Well #2
¼ ¼ Section 28 T. 7S R. 3W W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 14 ft.
Static level 10 ft. below land surface. Date Oct 13
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:
Diameter of well below casing —
Depth drilled 20 ft. Depth of completed well 20 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
Sand, silt, clay	0	9'	
Clay gravel small med	9'	14'	
loose sand, gravel small med	14'	20'	
Monitoring Well			

Work started Oct 13 1975 Completed Oct 13 1975
Date well drilling machine moved off of well Oct 13 1975

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] [illegible] (Drilling Machine Operator) Date Oct 13, 1975
Drilling Machine Operator's License No. 724

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 ROBINSON'S EOLA WELL DRILLING (Person, firm or corporation) (Type or print)
Address 4510 DALLAS RD., N. W. SALEM, OREGON 97304
[Signed] George H. Robinson (Water Well Contractor)
Contractor's License No. 13 Date 11-20, 1975

(USE ADDITIONAL SHEETS IF NECESSARY)

SP*45656-119

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-095)

MACK DRILLING COMPANY
1345 20TH STREET SE
P O BOX 12067
SALEM, OR 97309-0067

19770 – MW7A

Start Card # 106246

Instructions for completing this report are on the last page of this form.

FILE COPY

(1) OWNER/PROJECT: WELL NO. 19770

Name Marion County Solid Waste
Address 388 State Street Suite 735
City Salem State OR Zip 97301

(2) TYPE OF WORK:

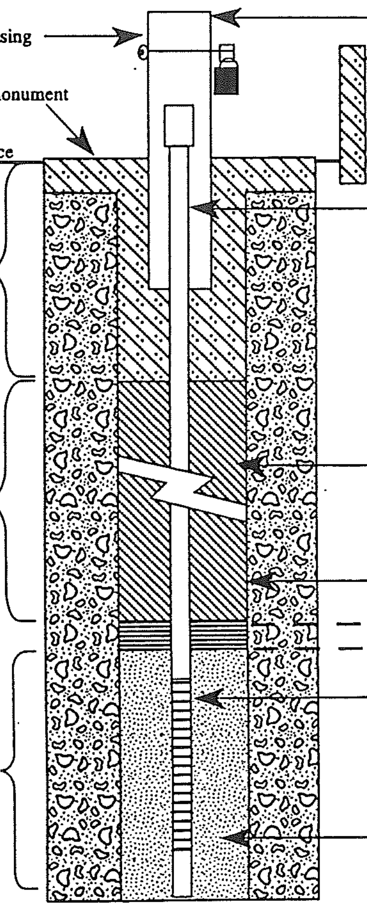
☐ New construction ☒ Alteration (Repair/Recondition)
☐ Conversion ☐ Deepening ☐ Abandonment

(3) DRILLING METHOD

☒ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Hollow Stem Auger ☐ Other ______

(4) BORE HOLE CONSTRUCTION

Special Standards Yes ☐ No ☒ Depth of completed well 22 ft.



Monument ___ ft. TO ___ ft.

Seal ___ ft. TO ___ ft.

Filter pack ___ ft. TO ___ ft.

Casing diameter 2 in.
material PVC
Welded ☐ Threaded ☒ Glued ☐

Liner diameter ______ in.
material ______
Welded ☐ Threaded ☐ Glued ☐

Well seal:
Material Bentonite
Amount ______
Grout weight ______

Borehole diameter ______ in.

Screen
material ______
interval(s):
From ______ To ______
From ______ To ______
Slot size ______ in.

Filter pack:
Material ______
Size ______ in.

(5) WELL TEST:

☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Permeability ______ Yield ______ GPM
Conductivity ______ PH ______
Temperature of water ______ °F/C Depth artesian flow found ______ ft.
Was water analysis done? ☐ Yes ☒ No
By whom? ______
Depth of strata to be analyzed. From ______ ft. to ______ ft.
Remarks: ______

Name of supervising Geologist/Engineer ______

(6) LOCATION OF WELL By legal description

Well Location: County Marion
Township 7 (N or S) Range 3 (E or W) Section 32
1. NW 1/4 of SW 1/4 of above section.
2. Either Street address of well location Browns Island Demolition Landfill
or Tax lot number of well location None
3. ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:

19'9" Ft. below land surface. Date 9-23-97
Artesian Pressure ______ lb/sq. in. Date ______

(8) WATER BEARING ZONES:

Depth at which water was first found ______

From	To	Est. Flow Rate	SWL

(9) WELL LOG: Ground elevation ______

Material	From	To	SWL
Used high pressure air & jetting tool to clean sand & debris out of protective casing. Blew down until Bentonite was reach. Backfilled w/ silica sand.			

Date started 9-9-97 Completed 9-23-97

(unbonded) Monitor Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.

MWC Number ______

Signed ______ Date ______

(bonded) Monitor Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.

MWC Number 10166

Signed Eugene O Adair Date 9-30-97

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

NOTICE TO WATER WELL CONTRACTOR
The original and first copy of this report are to be filed with the
STATE ENGINEER, SALEM, OREGON 97310 within 30 days from the date of well completion.

RECEIVED
OCT 22 1975
WATER RESOURCES DEPT.
SALEM, OREGON

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

8/1/2 MAR

State Well No. 7S/3W-28
State Permit No.

MW-7B

(1) OWNER:
Name Sanitary Service
Address 416 Perry SE
Salem

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):
Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☒ Observation

(5) CASING INSTALLED: Threaded ☐ Welded ☒
8" Diam. from 4 ft. to 31 ft. Gage .250
2" PVC Diam. from 4 ft. to 35 ft. Gage
" Diam. from ft. to ft. Gage

(6) PERFORATIONS: Perforated? ☒ Yes ☐ No.
Type of perforator used Saw
Size of perforations 3 in. by 1/8 in.
60 perforations from 30 ft. to 35 ft.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS: Well screen installed? ☐ Yes ☒ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(8) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " "
" " "
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m.
Temperature of water Depth artesian flow encountered ft.

(9) CONSTRUCTION:
Well seal—Material used cement grout
Well sealed from land surface to 27 ft.
Diameter of well bore to bottom of seal 8 in.
Diameter of well bore below seal 8 in.
Number of sacks of cement used in well seal sacks
Number of sacks of bentonite used in well seal 1 sacks
Brand name of bentonite
Number of pounds of bentonite per 100 gallons of water lbs./100 gals.
Was a drive shoe used? ☒ Yes ☐ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☒ Yes ☐ No Size of gravel: pea gravel
Gravel placed from 30 ft. to 35 ft.

(10) LOCATION OF WELL:
County Marion Driller's well number Well #1
¼ ¼ Section 28 T. 7S R. 3W W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 14 ft.
Static level 10 ft. below land surface. Date 10-7
Artesian pressure lbs. per square inch. Date

(12) WELL LOG: Diameter of well below casing
Depth drilled 35 ft. Depth of completed well 35 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
Sand silt clay	0	9'	
Clay gravel	9'	14'	
loose sand gravel	14'	22'	
Clay gravel sand silt	22'	26'	
Gravel small-med. coarse sand	26	35	18
Eugene (blue clay)	35	–	

Monitoring Well
Well

Work started 3 Oct 1975 Completed Oct 7 1975
Date well drilling machine moved off of well Oct 7 1975

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] [signature] (Drilling Machine Operator) Date Oct 7, 1975
Drilling Machine Operator's License No. 724

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 ROBINSON'S LOLA WELL DRILLING (Person, firm or corporation) (Type or print)
Address 4510 DALLAS RD. SALEM, OREGON 97304
[Signed] George H. Robinson (Water Well Contractor)
Contractor's License No. 13 Date 11-20, 1975

(USE ADDITIONAL SHEETS IF NECESSARY)

SP*45656-119

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-095)
Instructions for completing this report are on the last page of this form.

MACK DRILLING COMPANY
1345 20TH STREET SE
P O BOX 12067
SALEM, OR 97309-0067

19771-MW7B
Start Card # 106247

(1) OWNER/PROJECT: WELL NO. 19771
Name Marion County Solid Waste
Address 388 State Street Suite 735
City Salem State OR Zip 97301

(2) TYPE OF WORK:

FILE COPY

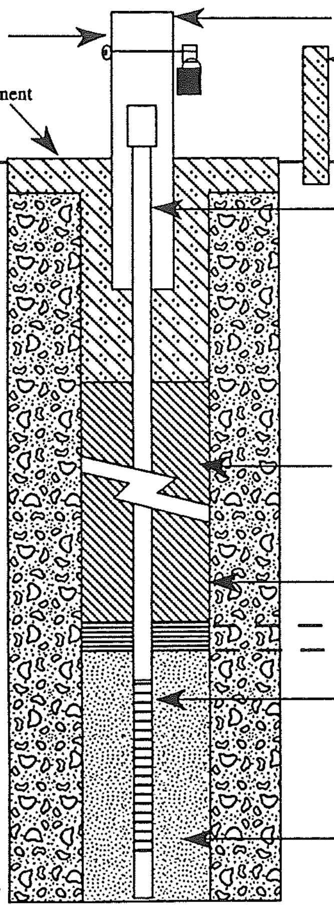
☐ New construction ☒ Alteration (Repair/Recondition)
☐ Conversion ☐ Deepening ☐ Abandonment

(3) DRILLING METHOD
☒ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Hollow Stem Auger ☐ Other ______

(6) LOCATION OF WELL By legal description
Well Location: County Marion
Township 7 (N or S) Range 3 (E or W) Section 32
1. NE 1/4 of SE 1/4 of above section.
2. Either Street address of well location Browns Island Demolition Landfill
or Tax lot number of well location None
3. ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:
6" Ft. below land surface. Date 9-23-97
Artesian Pressure ______ lb/sq. in. Date ______

(4) BORE HOLE CONSTRUCTION
Special Standards Yes ☐ No ☒ Depth of completed well 34' 3" ft.



Protective casing
Locking cap
Protective post
Cement monument
Land surface
Monument ____ ft. TO ____ ft.
Casing diameter 2 in.
material PVC
Welded ☐ Threaded ☐ Glued ☐
Liner diameter ______ in.
material ______
Welded ☐ Threaded ☐ Glued ☐
Seal ____ ft. TO ____ ft.
Well seal:
Material ______
Amount ______
Grout weight ______
Borehole diameter ______ in.
Bentonite plug at least 3 ft. thick
Filter pack ____ ft. TO ____ ft.
Screen
material ______
interval(s):
From ____ To ____
From ____ To ____
Slot size ______ in.
Filter pack:
Material ______
Size ______ in.

(8) WATER BEARING ZONES:
Depth at which water was first found ______

From	To	Est. Flow Rate	SWL

(9) WELL LOG: Ground elevation ______

Material	From	To	SWL
Used high pressure air & jetting tool to clean sand & debris out of protective casing. Blew down until bentonite was reach. Backfilled with Silica Sand.			

Date started 9-9-97 Completed 9-23-97

(5) WELL TEST:
☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian
Permeability ______ Yield ______ GPM
Conductivity ______ PH ______
Temperature of water ______ °F/C Depth artesian flow found ______ ft.
Was water analysis done? ☐ Yes ☒ No
By whom? ______
Depth of strata to be analyzed. From ______ ft. to ______ ft.
Remarks: ______

Name of supervising Geologist/Engineer ______

(unbonded) Monitor Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.
MWC Number ______
Signed ______ Date ______

(bonded) Monitor Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.
MWC Number 10166
Signed Eugene R. Ulloff Date 9-30-97

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

(Copies) of this report are to be filed with the STATE ENGINEER, SALEM, OREGON 97310 within 30 days from the date of well completion.

RECEIVED
OCT 22 1975
WATER RESOURCES DEPT.
SALEM, OREGON

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

State Well No. 7S/3W-28
State Permit
MW-8A
8115
MARI

(1) OWNER:
Name Sanitary Service Inc.
Address 496 Ferry St.
Salem Oregon

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☐ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):
Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☒ monitoring

(5) CASING INSTALLED: Threaded ☐ Welded ☒
6" Diam. from +3 1/2 ft. to 4 ft. Gage .250
2 pvc " Diam. from +3 1/2 ft. to 17 ft. Gage
" Diam. from ft. to ft. Gage

(6) PERFORATIONS: Perforated? ☒ Yes ☐ No.
Type of perforator used Saw
Size of perforations 3 in. by 1/8 in.
45 perforations from 12 ft. to 17 ft.
perforations from ft. to ft.
perforations from ft. to ft.

(7) SCREENS: Well screen installed? ☒ Yes ☐ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(8) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " "
" " "
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m.
Temperature of water Depth artesian flow encountered ft.

(9) CONSTRUCTION:
Well seal—Material used cement grout
Well sealed from land surface to 0-12 ft.
Diameter of well bore to bottom of seal 6 in.
Diameter of well bore below seal 6 in.
Number of sacks of cement used in well seal sacks
Number of sacks of bentonite used in well seal 1 sacks
Brand name of bentonite
Number of pounds of bentonite per 100 gallons of water lbs./100 gals.
Was a drive shoe used? ☒ Yes ☐ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☒ Yes ☐ No Size of gravel: 1/4 [illegible]
Gravel placed from 12 ft. to 17 ft.

(10) LOCATION OF WELL:
County Marion Driller's well number well #1
¼ ¼ Section 28 T. 7S R. 3W W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 12 ft.
Static level 10 ft. below land surface. Date
Artesian pressure lbs. per square inch. Date

(12) WELL LOG: Diameter of well below casing —
Depth drilled 17 ft. Depth of completed well 17 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
Clay	0	12	
loose Gravel sand med small	12'	17'	10

Montoring well

Work started Oct 15 1975 Completed Oct 16 1975
Date well drilling machine moved off of well Oct 16 1975

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] [signature] (Drilling Machine Operator) Date Oct 17, 1975
Drilling Machine Operator's License No. 524

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 ROBINSON'S EOLA WELL DRILLING (Person, firm or corporation) (Type or print)
Address 4510 DALLAS RD. N.W. SALEM, OREGON 97304
[Signed] [signature] (Water Well Contractor)
Contractor's License No. 13 Date 11-20, 1975

(USE ADDITIONAL SHEETS IF NECESSARY)

SP*45656-119

STATE OF OREGON

MONITORING WELL REPORT

(as required by ORS 537.765 & OAR 690-240-095)

Instructions for completing this report are on the last page of this form.

MACK DRILLING COMPANY
1345 20TH STREET SE
P O BOX 12067
SALEM, OR 97309-0067

19772 -MW8A

Start Card # 106249

FILE COPY

(1) OWNER/PROJECT: WELL NO. 19772

Name Marion County Solid Waste

Address 388 State Street, Suite 735

City Salem State OR Zip 97301

(2) TYPE OF WORK:

☐ New construction ☒ Alteration (Repair/Recondition)

☐ Conversion ☐ Deepening ☐ Abandonment

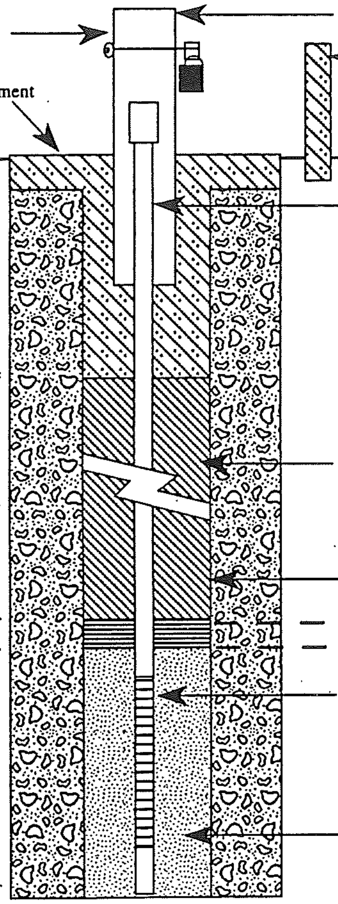
(3) DRILLING METHOD

☒ Rotary Air ☐ Rotary Mud ☐ Cable

☐ Hollow Stem Auger ☐ Other ______

(4) BORE HOLE CONSTRUCTION

Special Standards Yes ☐ No ☒ Depth of completed well 20'5" ft.



Protective casing — Locking cap — Protective post — Cement monument — Land surface

Monument ____ ft. TO ____ ft.

Seal ____ ft. TO ____ ft.

Filter pack ____ ft. TO ____ ft.

Casing diameter 2" in. material PVC

Welded ☐ Threaded ☐ Glued ☐

Liner diameter ______ in. material ______

Welded ☐ Threaded ☐ Glued ☐

Well seal: Material ______ Amount ______ Grout weight ______

Borehole diameter ______ in.

Bentonite plug at least 3 ft. thick

Screen material ______ interval(s): From ____ To ____ From ____ To ____

Slot size ______ in.

Filter pack: Material ______ Size ______ in.

(5) WELL TEST:

☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Permeability ______ Yield ______ GPM

Conductivity ______ PH ______

Temperature of water ______ °F/C Depth artesian flow found ______ ft.

Was water analysis done? ☐ Yes ☒ No

By whom? ______

Depth of strata to be analyzed. From ______ ft. to ______ ft.

Remarks: ______

Name of supervising Geologist/Engineer ______

(6) LOCATION OF WELL By legal description

Well Location: County Marion

Township 7 (N or S) Range 3 (E or W) Section 28

1. SW 1/4 of SW 1/4 of above section.

2. Either Street address of well location Browns Island Demolition Landfill

or Tax lot number of well location None

3. ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:

14'10½" Ft. below land surface. Date 9-23-97

Artesian Pressure ______ lb/sq. in. Date ______

(8) WATER BEARING ZONES:

Depth at which water was first found ______

From	To	Est. Flow Rate	SWL

(9) WELL LOG: Ground elevation ______

Material	From	To	SWL
Used Excavator			
to remove snag			
trees back away			
from Well.			
Dug down along			
casing then backfilled			
w/ bentonite.			
Cleaned SAND			
out of 6" protective			
casing			

Date started 9-8-97 Completed 9-24-97

(unbonded) Monitor Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.

MWC Number ______

Signed ______ Date ______

(bonded) Monitor Well Constructor Certification:

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.

MWC Number 10166

Signed Eugene D. Wilcox Date 9-30-97

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

The original and first copy of this report are to be filed with the STATE ENGINEER, SALEM, OREGON 97310 within 30 days from the date of well completion.

RECEIVED
OCT 22 1975
WATER RESOURCES DEPT.
SALEM, OREGON

WATER WELL REPORT
STATE OF OREGON
(Please type or print)
(Do not write above this line)

State Well No. 7S/3W-28
State Permit No.
MW-8B/8C

MARI 20708

(1) OWNER:
Name Sanitary Service Co Inc
Address 496 Ferry SE
Salem Oregon

(2) TYPE OF WORK (check):
New Well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 12.

(3) TYPE OF WELL:
Rotary ☐ Driven ☐
Cable ☒ Jetted ☐
Dug ☐ Bored ☐

(4) PROPOSED USE (check):
Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☒ Other ☒ Observation

(5) CASING INSTALLED: Pull back out Threaded ☐ Welded ☒
8" Diam. from 0 ft. to 37 ft. Gage
10" Diam. from +3½ ft. to 34 ft. Gage .250
2" PVC Diam. from +3½ ft. to 35 ft. Gage PVC.
2" PVC +3½ 26

(6) PERFORATIONS: Perforated? ☒ Yes ☐ No.
Type of perforator used
Size of perforations 3 in. by 1/8 in.
25 perforations from 32 ft. to 35 ft.
23-30 perforations from 23 ft. to 26 ft.
perforations from ft. to ft.

(7) SCREENS: Well screen installed? ☐ Yes ☒ No
Manufacturer's Name
Type Model No.
Diam. Slot size Set from ft. to ft.
Diam. Slot size Set from ft. to ft.

(8) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " "
" " "
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m.
Temperature of water Depth artesian flow encountered ft.

(9) CONSTRUCTION:
Well seal—Material used Cement grout
Well sealed from land surface to 23 ft.
Diameter of well bore to bottom of seal 8 in.
Diameter of well bore below seal in.
Number of sacks of cement used in well seal sacks
Number of sacks of bentonite used in well seal 1 sacks
Brand name of bentonite
Number of pounds of bentonite per 100 gallons of water lbs./100 gals.
Was a drive shoe used? ☐ Yes ☐ No Plugs Size: location ft.
Did any strata contain unusable water? ☐ Yes ☐ No
Type of water? depth of strata
Method of sealing strata off
Was well gravel packed? ☐ Yes ☐ No Size of gravel: pea gravel
Gravel placed from 23 ft. to 26 ft.
32 35

(10) LOCATION OF WELL:
County Marion Driller's well number Well #3
¼ ¼ Section S28 T. 7S R. 3W W.M.
Bearing and distance from section or subdivision corner

(11) WATER LEVEL: Completed well.
Depth at which water was first found 12 ft.
Static level 10 ft. below land surface. Date 0[illegible]
Artesian pressure lbs. per square inch. Date

(12) WELL LOG:
Diameter of well below casing
Depth drilled 37 ft. Depth of completed well 37 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
clay	0	10	
boulders clay	10'	12'	
gravel small/med sand	12'	25'	10
gray clay silt gravel	25'	28'	
loose small gravel sand	28'	37'	18
Eugene (blue clay)	37'	—	

Monitoring Well

Work started [illegible] 1975 Completed [illegible] 1975
Date well drilling machine moved off of well [illegible] 1975

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] [illegible] (Drilling Machine Operator) Date [illegible], 19
Drilling Machine Operator's License No. [illegible]

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 (Person, firm or corporation) (Type or print)
Address
[Signed] George H. Rahmer (Water Well Contractor)
Contractor's License No. 13 Date 11-20, 1975

(USE ADDITIONAL SHEETS IF NECESSARY)

SP*45656-119

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-095)
Instructions for completing this report are on the last page of this form.

MACK DRILLING COMPANY
1345 20TH STREET SE
P O BOX 12057
SALEM, OR 97309-0067

19773 - MW8B
Start Card # 106839

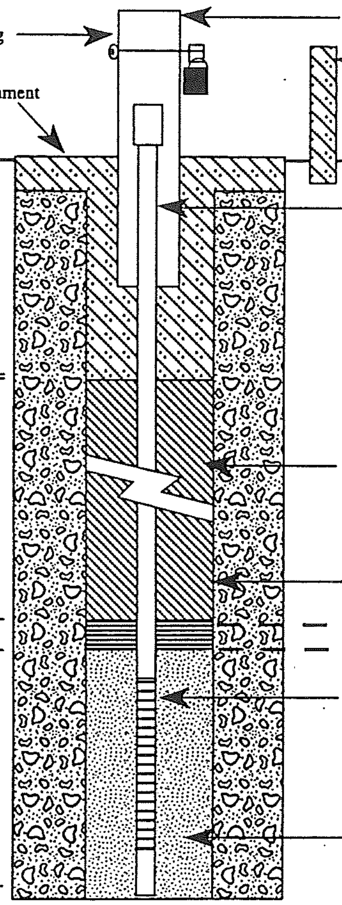
FILE COPY

(1) OWNER/PROJECT: WELL NO. 19773
Name Marion County Solid Waste
Address 388 State Street, Suite 735
City Salem State OR Zip 97301

(2) TYPE OF WORK:
☐ New construction ☒ Alteration (Repair/Recondition)
☐ Conversion ☐ Deepening ☐ Abandonment

(3) DRILLING METHOD
☒ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Hollow Stem Auger ☐ Other ______

(4) BORE HOLE CONSTRUCTION
Yes No
Special Standards ☐ ☒ Depth of completed well 23'9" ft.



Protective casing
Locking cap
Protective post
Cement monument
Land surface
Monument ___ ft. TO ___ ft.
Seal ___ ft. TO ___ ft.
Filter pack ___ ft. TO ___ ft.

Casing diameter 2 in.
material PVC
Welded ☐ Threaded ☒ Glued ☐
Liner
diameter ______ in.
material ______
Welded ☐ Threaded ☐ Glued ☐
Well seal:
Material ______
Amount ______
Grout weight ______
Borehole diameter ______ in.
Bentonite plug at least 3 ft. thick
Screen
material ______
interval(s):
From ___ To ___
From ___ To ___
Slot size ___ in.
Filter pack:
Material ______
Size ______ in.

(5) WELL TEST:
☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian
Permeability ______ Yield ______ GPM
Conductivity ______ PH ______
Temperature of water ______ °F/C Depth artesian flow found ______ ft.
Was water analysis done? ☐ Yes ☒ No
By whom? ______
Depth of strata to be analyzed. From ______ ft. to ______ ft.
Remarks: ______

Name of supervising Geologist/Engineer ______

(6) LOCATION OF WELL By legal description
Well Location: County Marion
Township 7 (N or S) Range 3 (E or W) Section 28
1. SW 1/4 of SW 1/4 of above section.
2. Either Street address of well location Browns Island Demolition Landfill
or Tax lot number of well location None
3. ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:
15'1" Ft. below land surface. Date 9-23-97
Artesian Pressure ______ lb/sq. in. Date ______

(8) WATER BEARING ZONES:
Depth at which water was first found ______

From	To	Est. Flow Rate	SWL

(9) WELL LOG: Ground elevation ______

Material	From	To	SWL
Dug down			
around 10" casing			
& cut off in			
order to cut			
off 2" PVC casing			
and cut out			
dented in 2"			
PVC. Used 2"			
compression coupler			
on connection.			
Didn't change			
10" casing height			
from original.			
Cleaned out			
sand debris &			
installed clean			
silica sand.			

Date started 9-9-97 Completed 9-24-97

(unbonded) Monitor Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.
MWC Number ______
Signed ______ Date ______

(bonded) Monitor Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.
MWC Number 10166
Signed Eugene O. Mack Date 9-30-97

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-095)
Instructions for completing this report are on the last page of this form.

MACK DRILLING COMPANY
1345 20TH STREET SE
P O BOX 12057
SALEM, OR 97309-0067

19774 - MW8C

Start Card # 106840

FILE COPY

(1) OWNER/PROJECT: WELL NO. 19774

Name Marion County Solid Waste
Address 388 State Street Suite 735
City Salem State OR Zip 97301

(2) TYPE OF WORK:

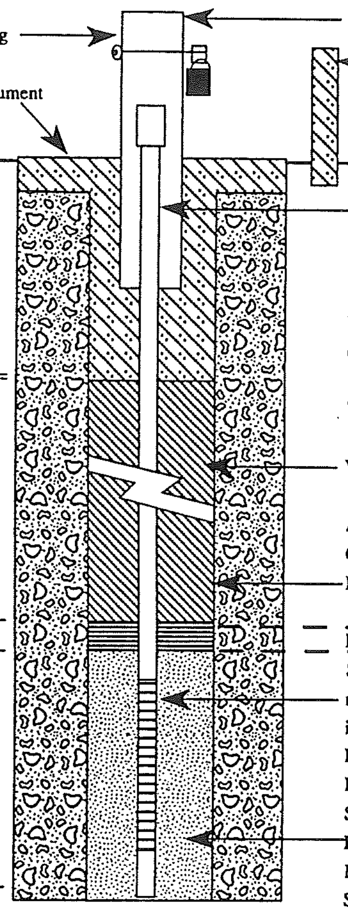
☐ New construction ☒ Alteration (Repair/Recondition)
☐ Conversion ☐ Deepening ☐ Abandonment

(3) DRILLING METHOD

☒ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Hollow Stem Auger ☐ Other ______

(4) BORE HOLE CONSTRUCTION

Special Standards Yes ☐ No ☒ Depth of completed well 37 ft.



Monument ____ ft. TO ____ ft.

Seal ____ ft. TO ____ ft.

Filter pack ____ ft. TO ____ ft.

Casing diameter 2 in.
material PVC
Welded ☐ Threaded ☐ Glued ☐
Liner diameter ______ in.
material ______
Welded ☐ Threaded ☐ Glued ☐
Well seal:
Material ______
Amount ______
Grout weight ______
Borehole diameter ______ in.
Bentonite plug at least 3 ft. thick
Screen material ______
interval(s):
From ____ To ____
From ____ To ____
Slot size ____ in.
Filter pack:
Material ______
Size ____ in.

(5) WELL TEST:

☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian
Permeability ______ Yield ______ GPM
Conductivity ______ PH ______
Temperature of water ______ °F/C Depth artesian flow found ______ ft.
Was water analysis done? ☐ Yes ☒ No
By whom? ______
Depth of strata to be analyzed. From ______ ft. to ______ ft.
Remarks: ______

Name of supervising Geologist/Engineer ______

(6) LOCATION OF WELL By legal description

Well Location: County Marion
Township 7 (N or S) Range 3 (E or W) Section 28
1. SW 1/4 of SW 1/4 of above section.
2. Either Street address of well location Browns Island Demolition Landfill
or Tax lot number of well location None
3. ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:

14' 11" Ft. below land surface. Date 9-23-97
Artesian Pressure ______ lb/sq. in. Date ______

(8) WATER BEARING ZONES:

Depth at which water was first found ______

From	To	Est. Flow Rate	SWL

(9) WELL LOG: Ground elevation ______

Material	From	To	SWL
Cleaned out			
SAND debris			
with high pressur			
Air between			
2" & 10" protec-			
tive CASING.			
Installed clean			
Silica Sand.			

Date started 9-8-97 Completed 9-24-97

(unbonded) Monitor Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.
MWC Number ______
Signed ______ Date ______

(bonded) Monitor Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.
MWC Number 10166
Signed Eugene W. Mack Date 9-30-97

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-095)

MACK DRILLING COMPANY
1345 20TH STREET SE
P O BOX 12067
SALEM, OR 97309-0067

19780 - MW 9A

Start Card # 106251

Instructions for completing this report are on the last page of this form.

FILE COPY

(1) OWNER/PROJECT: WELL NO. 19780

Name Marion County Solid Waste

Address 388 State Street, Suite 735

City Salem State OR Zip 97301

(2) TYPE OF WORK:

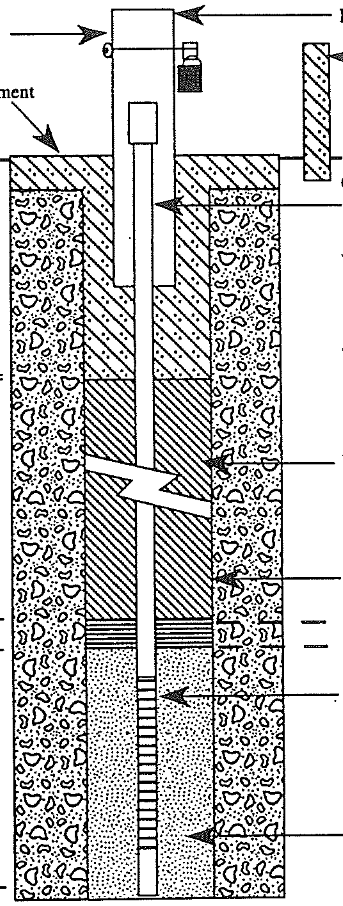
☐ New construction ☒ Alteration (Repair/Recondition)
☐ Conversion ☐ Deepening ☐ Abandonment

(3) DRILLING METHOD

☒ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Hollow Stem Auger ☐ Other ______

(4) BORE HOLE CONSTRUCTION

Special Standards Yes ☐ No ☒ Depth of completed well 36' 9½" ft.



Protective casing — Locking cap — Protective post

Cement monument

Land surface

Monument ____ ft. TO ____ ft.

Casing diameter 2 in. material PVC

Welded ☐ Threaded ☒ Glued ☐

Liner diameter ______ in. material ______

Welded ☐ Threaded ☐ Glued ☐

Seal ____ ft. TO ____ ft.

Well seal:
Material ______
Amount ______
Grout weight ______

Borehole diameter ______ in.

Bentonite plug at least 3 ft. thick

Filter pack ____ ft. TO ____ ft.

Screen material ______
interval(s):
From ____ To ____
From ____ To ____
Slot size ______ in.

Filter pack:
Material ______
Size ______ in.

(5) WELL TEST:

☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Permeability ______ Yield ______ GPM

Conductivity ______ PH ______

Temperature of water ______ °F/C Depth artesian flow found ______ ft.

Was water analysis done? ☐ Yes ☒ No

By whom? ______

Depth of strata to be analyzed. From ______ ft. to ______ ft.

Remarks: ______

Name of supervising Geologist/Engineer ______

(6) LOCATION OF WELL By legal description

Well Location: County Marion

Township 7 (N or (S)) Range 3 (E or (W)) Section 31

1. NE 1/4 of NW 1/4 of above section.

2. Either Street address of well location Browns Island Demolition Landfill

or Tax lot number of well location None

3. **ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.**

(7) STATIC WATER LEVEL:

15' 9" Ft. below land surface. Date 9-24-97

Artesian Pressure ______ lb/sq. in. Date ______

(8) WATER BEARING ZONES:

Depth at which water was first found ______

From	To	Est. Flow Rate	SWL

(9) WELL LOG: Ground elevation ______

Material	From	To	SWL
Removed sand & debris and lowered PVC casing, 2" inches Installed pipe Ballards			

Date started 9-24-97 Completed 9-24-97

(unbonded) Monitor Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.

MWC Number ______

Signed ______ Date ______

(bonded) Monitor Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This ~~report is~~ true to the best of my knowledge and belief.

MWC Number ~~100~~ 10166

Signed Eugene D. Mack Date 9-30-97

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-095)

MACK DRILLING COMPANY
1345 20TH STREET SE
P O BOX 12067
SALEM, OR 97309-0067

19781 - MW9B

Start Card # 100222

Instructions for completing this report are on the last page of this form.

(1) OWNER/PROJECT: WELL NO. 19781

Name Marion County Solid Waste

Address 388 State Street, Suite 735

City Salem State OR Zip 97301

(2) TYPE OF WORK:

FILE COPY

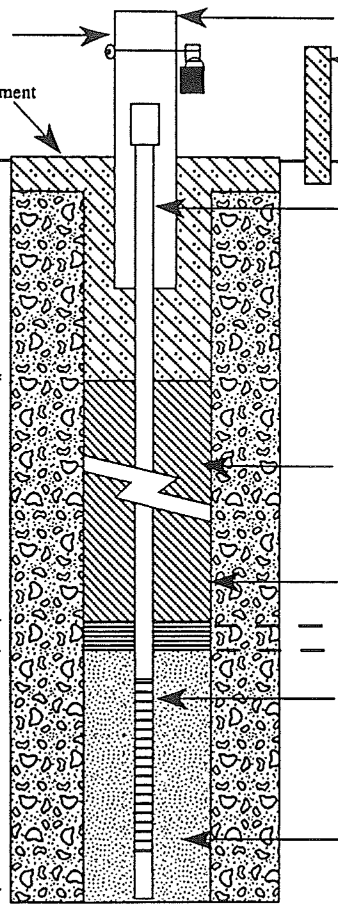
☐ New construction ☒ Alteration (Repair/Recondition)
☐ Conversion ☐ Deepening ☐ Abandonment

(3) DRILLING METHOD

☒ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Hollow Stem Auger ☐ Other ______

(4) BORE HOLE CONSTRUCTION

Special Standards Yes ☐ No ☒ Depth of completed well 23'6" ft.



Monument ____ ft. TO ____ ft.

Casing diameter 2 in. material PVC
Welded ☐ Threaded ☒ Glued ☐

Liner diameter ______ in. material ______
Welded ☐ Threaded ☐ Glued ☐

Seal ____ ft. TO ____ ft.

Well seal: Material ______ Amount ______ Grout weight ______

Borehole diameter ______ in.

Bentonite plug at least 3 ft. thick

Filter pack ____ ft. TO ____ ft.

Screen material ______ interval(s): From ____ To ____ From ____ To ____ Slot size ____ in.

Filter pack: Material ______ Size ______ in.

(5) WELL TEST:

☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Permeability ______ Yield ______ GPM

Conductivity ______ PH ______

Temperature of water ______ °F/C Depth artesian flow found ______ ft.

Was water analysis done? ☐ Yes ☒ No

By whom? ______

Depth of strata to be analyzed. From ______ ft. to ______ ft.

Remarks: ______

Name of supervising Geologist/Engineer ______

(6) LOCATION OF WELL By legal description

Well Location: County Marion

Township 7 (N or S) Range 3 (E or W) Section 31

1. NE 1/4 of NW 1/4 of above section.

2. Either Street address of well location Browns Island Demolition Landfill

or Tax lot number of well location None

3. ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:

15'10" Ft. below land surface. Date 9-24-97

Artesian Pressure ______ lb/sq. in. Date ______

(8) WATER BEARING ZONES:

Depth at which water was first found ______

From	To	Est. Flow Rate	SWL

(9) WELL LOG: Ground elevation ______

Material	From	To	SWL
Removed sand debris between casings, lowered 2" PVC casing 3", Installed pipe ballards			

Date started 9-24-97 Completed 9-24-97

(unbonded) Monitor Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.

MWC Number ______

Signed ______ Date ______

(bonded) Monitor Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.

MWC Number ______

Signed ______ Date ______

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-095)
Instructions for completing this report are on the last page of this form.

MACK DRILLING COMPANY
1345 20TH STREET SE
P O BOX 12067
SALEM, OR 97309-0067

19777-MW10A
Start Card # 106223

(1) OWNER/PROJECT: WELL NO. 19777
Name Marion County Solid Waste
Address 388 State Street, Suite 735
City Salem State OR Zip 97301

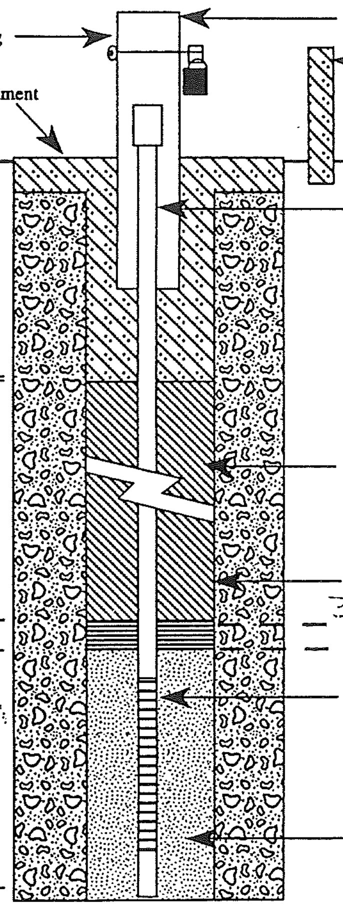
(2) TYPE OF WORK:

FILE COPY

☐ New construction ☒ Alteration (Repair/Recondition)
☐ Conversion ☐ Deepening ☐ Abandonment

(3) DRILLING METHOD
☒ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Hollow Stem Auger ☒ Other Mini Excavator & Hoist Truck

(4) BORE HOLE CONSTRUCTION
Special Standards Yes ☐ No ☒ Depth of completed well 15' 3" ft.



Protective casing
Locking cap
Protective post
Cement monument
Land surface

Monument ___ ft. TO ___ ft.

Seal 0 ft. TO 8 ft.

Filter pack ___ ft. TO ___ ft.

Casing diameter 2" in. material PVC
Welded ☐ Threaded ☒ Glued ☐
Liner diameter ___ in. material ___
Welded ☐ Threaded ☐ Glued ☐
Well seal:
Material Bentonite
Amount 21 SACKS
Grout weight ___
Borehole diameter 30 to 16 in.
Bentonite plug at least 3 ft. thick
Screen material ___
interval(s):
From ___ To ___
From ___ To ___
Slot size ___ in.
Filter pack:
Material ___
Size ___ in.

(5) WELL TEST:
☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian
Permeability ___ Yield ___ GPM
Conductivity ___ PH ___
Temperature of water ___ °F/C Depth artesian flow found ___ ft.
Was water analysis done? ☐ Yes ☒ No
By whom? ___
Depth of strata to be analyzed. From ___ ft. to ___ ft.
Remarks: ___

Name of supervising Geologist/Engineer ___

(6) LOCATION OF WELL By legal description
Well Location: County Marion
Township 7 (N or S) Range 3 (E or W) Section 31
1. NE 1/4 of NE 1/4 of above section.
2. Either Street address of well location Browns Island Demolition Landfill
or Tax lot number of well location None
3. ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:
8" Ft. below land surface. Date 9 23-97
Artesian Pressure ___ lb/sq. in. Date ___

(8) WATER BEARING ZONES:
Depth at which water was first found ___

From	To	Est. Flow Rate	SWL

(9) WELL LOG: Ground elevation ___

Material	From	To	SWL
Added 19" of 4" casing & 19" of 2" PVC casing			
Damaged 2" PVC casing while removing trees.			
Excavated out ground casings & installed 2" compression coupler to repair 2" PVC casing			
Backfilled w/ bentonite down to 8 feet found void below 4 feet			

Date started 9-8-97 Completed 9-23-97

(unbonded) Monitor Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.
MWC Number ___
Signed ___ Date ___

(bonded) Monitor Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.
MWC Number 10166
Signed [signature] Date 9-30-97

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

STATE OF OREGON

MONITORING WELL REPORT

(as required by ORS 537.765 & OAR 690-240-095)

Instructions for completing this report are on the last page of this form.

MACK DRILLING COMPANY
1345 20TH STREET SE
P O BOX 12067
SALEM, OR 97309-0067

19778 - MW10B

Start Card # 100224

FILE COPY

(1) OWNER/PROJECT: WELL NO. 19778

Name Marion County Solid Waste

Address 388 State Street Suite 735

City Salem State OR Zip 97301

(2) TYPE OF WORK:

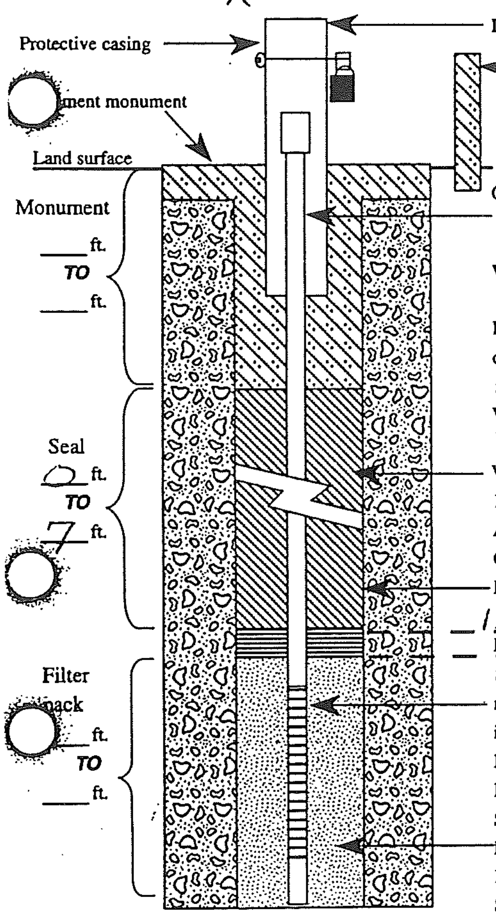
☐ New construction ☒ Alteration (Repair/Recondition) ☐ Conversion ☐ Deepening ☐ Abandonment

(3) DRILLING METHOD

☒ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Hollow Stem Auger ☒ Other Mini Excavator & Boist Truck

(4) BORE HOLE CONSTRUCTION

Special Standards Yes ☐ No ☒ Depth of completed well 34' 5" ft.



Monument ____ ft. TO ____ ft.

Seal 0 ft. TO 7 ft.

Filter pack ____ ft. TO ____ ft.

Casing diameter 2 in. material PVC

Welded ☐ Threaded ☒ Glued ☐

Liner diameter ______ in. material ______

Welded ☐ Threaded ☐ Glued ☐

Well seal: Material Bentonite Amount 21 SACKS Grout weight ______

Borehole diameter 12 to 24 in.

Bentonite plug at least 3 ft. thick

Screen material ______ interval(s): From ____ To ____ From ____ To ____ Slot size ____ in.

Filter pack: Material ______ Size ____ in.

(5) WELL TEST:

☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Permeability ______ Yield ______ GPM

Conductivity ______ PH ______

Temperature of water ______ °F/C Depth artesian flow found ______ ft.

Was water analysis done? ☐ Yes ☒ No

By whom? ______

Depth of strata to be analyzed. From ______ ft. to ______ ft.

Remarks: ______

Name of supervising Geologist/Engineer ______

(6) LOCATION OF WELL By legal description

Well Location: County Marion

Township 7 (N or S) Range 3 (E or W) Section 31

1. NE 1/4 of NE 1/4 of above section.

2. Either Street address of well location Browns Island Demolition Landfill

or Tax lot number of well location None

3. ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:

14 Ft. below land surface. Date 9-23-97

Artesian Pressure ______ lb/sq. in. Date ______

(8) WATER BEARING ZONES:

Depth at which water was first found ______

From	To	Est. Flow Rate	SWL

(9) WELL LOG: Ground elevation ______

Material	From	To	SWL
Added 18" of			
8" casing & 18"			
of 2" PVC pipe.			
Cleaned out			
sand Debris			
between casings			
Installed surface			
seal.			
Removed trees			
stumps and all			
that were close			
to Well			

Date started 9-9-97 Completed 9-23-97

(unbonded) Monitor Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.

MWC Number ______

Signed ______ Date ______

(bonded) Monitor Well Constructor Certification:

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.

MWC Number 10166

Signed Eugene A. Mack Date 9-30-97

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-095)
Instructions for completing this report are on the last page of this form.

MACK DRILLING COMPANY
1345 20TH STREET SE
P O BOX 12067
SALEM, OR 97309-0067

19779 - MW10C
Start Card # 106225

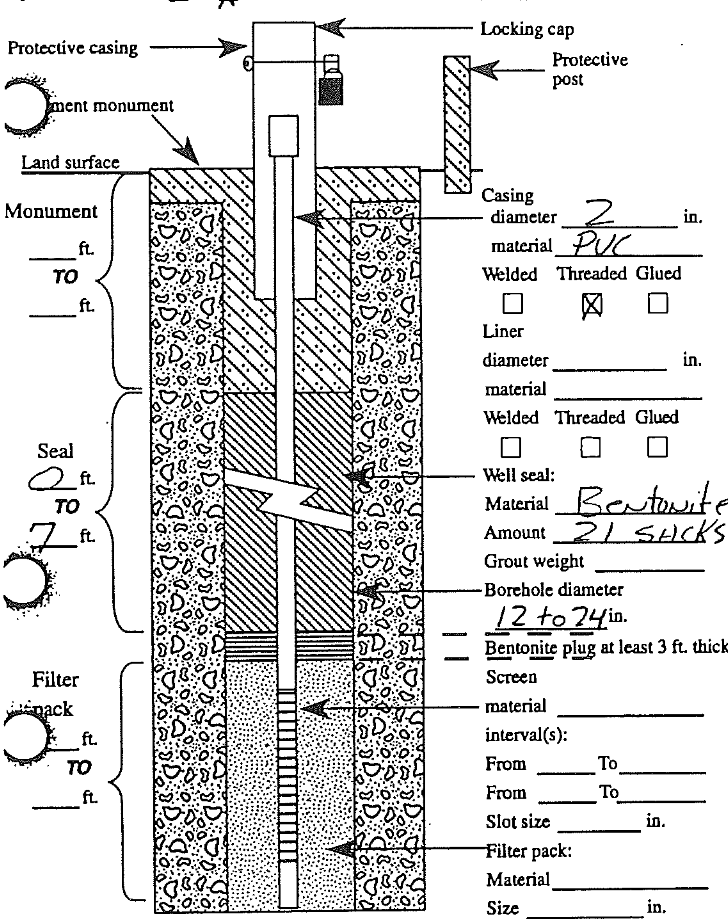
(1) OWNER/PROJECT: WELL NO. 19779
Name Marion County Solid Waste
Address 388 State Street, Suite 735
City Salem State OR Zip 97301

(2) TYPE OF WORK: FILE COPY

☐ New construction ☒ Alteration (Repair/Recondition)
☐ Conversion ☐ Deepening ☐ Abandonment

(3) DRILLING METHOD
☒ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Hollow Stem Auger ☒ Other Lin. Excavator & Hoist Truck

(4) BORE HOLE CONSTRUCTION
Special Standards Yes ☐ No ☒ Depth of completed well 25' 7" ft.



Monument ___ ft. TO ___ ft.
Seal 0 ft. TO 7 ft.
Filter pack ___ ft. TO ___ ft.

Casing diameter 2 in. material PVC
Welded ☐ Threaded ☒ Glued ☐
Liner diameter ___ in. material ___
Welded ☐ Threaded ☐ Glued ☐
Well seal: Material Bentonite Amount 21 sacks
Grout weight ___
Borehole diameter 12 to 24 in.
Bentonite plug at least 3 ft. thick
Screen material ___
interval(s): From ___ To ___
From ___ To ___
Slot size ___ in.
Filter pack: Material ___ Size ___ in.

(5) WELL TEST:
☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian
Permeability ___ Yield ___ GPM
Conductivity ___ PH ___
Temperature of water ___ °F/C Depth artesian flow found ___ ft.
Was water analysis done? ☐ Yes ☒ No
By whom? ___
Depth of strata to be analyzed. From ___ ft. to ___ ft.
Remarks: ___

Name of supervising Geologist/Engineer ___

(6) LOCATION OF WELL By legal description
Well Location: County Marion
Township 7 (N or S) Range 3 (E or W) Section 31
1. NE 1/4 of NE 1/4 of above section.
2. Either Street address of well location Browns Island Demolition Landfill
or Tax lot number of well location None
3. ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:
13'10½" Ft. below land surface. Date 9-23-97
Artesian Pressure ___ lb/sq. in. Date ___

(8) WATER BEARING ZONES:
Depth at which water was first found ___

From	To	Est. Flow Rate	SWL

(9) WELL LOG: Ground elevation ___

Material	From	To	SWL
Added 18" of 8" casing & 18" of 2" PVC pipe. Clean out sand debris between casings. Installed surface seal.			
Removed trees stumps and all that were close to well.			

Date started 9-9-97 Completed 9-23-97

(unbonded) Monitor Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.
MWC Number ___
Signed ___ Date ___

(bonded) Monitor Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.
MWC Number 10166
Signed Eugene R. [signature] Date 10-1-97

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-095)
Instructions for completing this report are on the last page of this form.

MACK DRILLING COMPANY
1345 20TH STREET SE
P O BOX 12057
SALEM, OR 97309-0067

MW11A

Start Card # 1062226

(1) OWNER/PROJECT: WELL NO. MW11A
Name Marion County Solid Waste
Address 388 State Street Suite 735
City Salem State OR Zip 97301

(2) TYPE OF WORK:

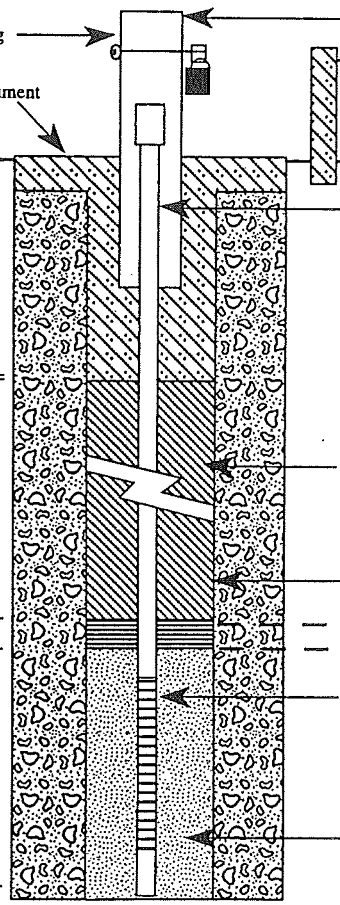
FILE COPY

☐ New construction ☐ Alteration (Repair/Recondition)
☐ Conversion ☐ Deepening ☒ Abandonment

(3) DRILLING METHOD
☐ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Hollow Stem Auger ☒ Other Mini Excavator + Hoist Truck

(4) BORE HOLE CONSTRUCTION
	Yes	No
Special Standards	☐	☒

Depth of completed well 0 ft.



Protective casing
Locking cap
Protective post
Cement monument
Land surface

Monument ___ ft. TO ___ ft.

Casing diameter 2" in.
material PVC
Welded ☐ Threaded ☒ Glued ☒

Liner diameter ___ in.
material ___
Welded ☐ Threaded ☐ Glued ☐

Seal 7 ft. TO 15 ft.

Well seal:
Material Bentonite
Amount 1/2 bag
Grout weight ___
Borehole diameter 2 in.
Bentonite plug at least 3 ft. thick

Filter pack ___ ft. TO ___ ft.

Screen
material ___
interval(s):
From ___ To ___
From ___ To ___
Slot size ___ in.
Filter pack:
Material ___
Size ___ in.

(5) WELL TEST:
☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian
Permeability ___ Yield ___ GPM
Conductivity ___ PH ___
Temperature of water ___ °F/C Depth artesian flow found ___ ft.
Was water analysis done? ☐ Yes ☒ No
By whom? ___
Depth of strata to be analyzed. From ___ ft. to ___ ft.
Remarks: ___

Name of supervising Geologist/Engineer ___

(6) LOCATION OF WELL By legal description
Well Location: County Marion
Township 7 (N or (S)) Range 3 (E or (W)) Section 29
1. SW 1/4 of SW 1/4 of above section.
2. Either Street address of well location Browns Island Demolition Landfill
or Tax lot number of well location None
3. ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:
NONE Ft. below land surface. Date 9-8-97
Artesian Pressure ___ lb/sq. in. Date ___

(8) WATER BEARING ZONES:
Depth at which water was first found ___

From	To	Est. Flow Rate	SWL

(9) WELL LOG: Ground elevation ___

Material	From	To	SWL
Removed 7 feet of 8" protective casing.			
Removed 2" PVC casing + 5 feet of screen.			
Backfilled w/ 1/2 bag of Bentonite			
Ground ground 8" casing had been eroded out by the river from 0 to 7 feet			

Date started 9/8/97 Completed 9/9/97

(unbonded) Monitor Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.
MWC Number ___
Signed ___ Date ___

(bonded) Monitor Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.
MWC Number 10166
Signed ___ Date 10-1-97

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-095)
Instructions for completing this report are on the last page of this form.

MACK DRILLING COMPANY
1345 20TH STREET SE
P O BOX 12067
SALEM, OR 97309-0067

MW11B
Start Card # 1016227

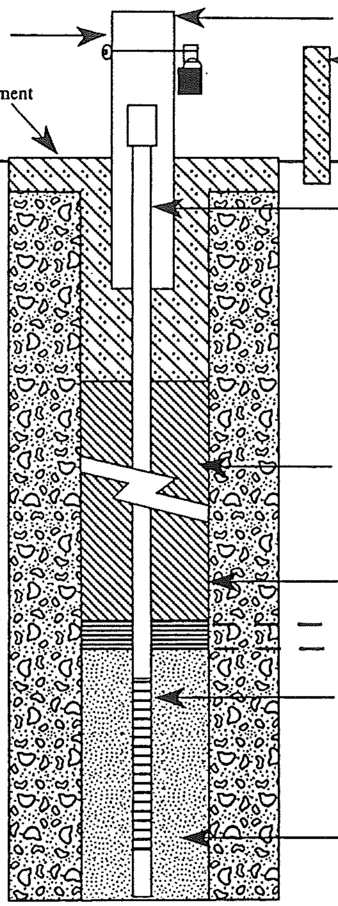
FILE COPY

(1) OWNER/PROJECT: WELL NO. MW11B
Name Marion County Solid Waste
Address 388 State Street, Suite 735
City Salem State OR Zip 97301

(2) TYPE OF WORK:
☐ New construction ☐ Alteration (Repair/Recondition)
☐ Conversion ☐ Deepening ☒ Abandonment

(3) DRILLING METHOD
☐ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Hollow Stem Auger ☒ Other Mini Excavator & Hoist Truck

(4) BORE HOLE CONSTRUCTION
Yes No
Special Standards ☐ ☒ Depth of completed well 0 ft.



Protective casing — Locking cap — Protective post
Cement monument
Land surface
Monument ___ ft. TO ___ ft.
Casing diameter 2" in.
material PVC Removed
Welded Threaded Glued
☐ ☐ ☒
Liner diameter ___ in.
material ___
Welded Threaded Glued
☐ ☐ ☐
Seal 0 ft. TO 25 ft.
Well seal:
Material Bentonite
Amount 1 SACK
Grout weight ___
Borehole diameter 2 in.
Bentonite plug at least 3 ft. thick
Filter pack ___ ft. TO ___ ft.
Screen material PVC
interval(s):
From 20 To 25
From ___ To ___
Slot size ___ in.
Filter pack:
Material ___
Size ___ in.

(5) WELL TEST:
☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian
Permeability ___ Yield ___ GPM
Conductivity ___ PH ___
Temperature of water ___ °F/C Depth artesian flow found ___ ft.
Was water analysis done? ☐ Yes ☒ No
By whom? ___
Depth of strata to be analyzed. From ___ ft. to ___ ft.
Remarks: ___

Name of supervising Geologist/Engineer ___

(6) LOCATION OF WELL By legal description
Well Location: County Marion
Township 7 (N or S) Range 3 (E or W) Section 29
1. SW 1/4 of SW 1/4 of above section.
2. Either Street address of well location Browns Island Demolition Landfill
or Tax lot number of well location None
3. ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:
19 Ft. below land surface. Date 9-9-97
Artesian Pressure ___ lb/sq. in. Date ___

(8) WATER BEARING ZONES:
Depth at which water was first found ___

From	To	Est. Flow Rate	SWL

(9) WELL LOG: Ground elevation ___

Material	From	To	SWL
Pulled out			
PVC casing but			
broke off glued			
on screen.			
PVC casing was			
sch 80 gray			
pipe.			
Backfilled hole			
w/ 1 bag bentonite			
Ground around			
8" protective			
casing had been			
eroided out by			
the river from			
0 to 7 feet			

Date started 9-9-97 Completed 9-8-97

(unbonded) Monitor Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.
MWC Number ___
Signed ___ Date ___

(bonded) Monitor Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.
MWC Number 10166
Signed Eugene W. Wick Date 10-1-97

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

STATE OF OREGON

MONITORING WELL REPORT

(as required by ORS 537.765 & OAR 690-240-095)

Instructions for completing this report are on the last page of this form.

MACK DRILLING COMPANY
1345 20TH STREET SE
P O BOX 12057
SALEM, OR 97309-0057

19775 - WW12A

Start Card # 106228

(1) OWNER/PROJECT: WELL NO. 19775

Name Marion County Solid Waste

Address 388 State St. Suite 735

City Salem State OR Zip 97301

(2) TYPE OF WORK:

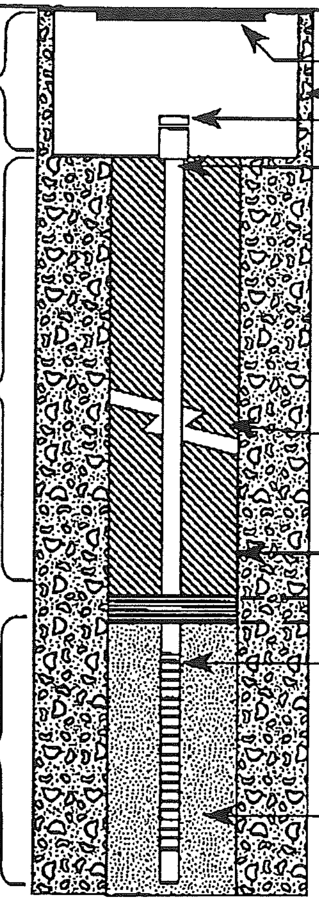
☐ New construction ☒ Alteration (Repair/Recondition)
☐ Conversion ☐ Deepening ☐ Abandonment

(3) DRILLING METHOD

☒ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Hollow Stem Auger ☐ Other ________

(4) BORE HOLE CONSTRUCTION

Special Standards Yes ☐ No ☒ Depth of completed well 27 9½ ft.



Land surface

Vault ___ ft. TO ___ ft.

Water-tight cover

Surface flush vault

Locking cap

Casing diameter 2 in. material PVC

Welded ☐ Threaded ☐ Glued ☐

Liner diameter ______ in. material ______

Welded ☐ Threaded ☐ Glued ☐

Seal ___ ft. TO ___ ft.

Well seal: Material ______ Amount ______ Grout weight ______

Borehole diameter ______ in.

Bentonite plug at least 3 ft. thick

Filter pack ___ ft. TO ___ ft.

Screen material ______ interval(s): From ___ To ___ From ___ To ___ Slot size ___ in.

Filter pack: Material ______ Size ______ in.

(5) WELL TEST:

☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Permeability ______ Yield ______ GPM

Conductivity ______ PH ______

Temperature of water ______ °F/C Depth artesian flow found ______ ft.

Was water analysis done? ☐ Yes ☐ No

By whom? ______

Depth of strata to be analyzed. From ______ ft. to ______ ft.

Remarks: ______

Name of supervising Geologist/Engineer ______

(6) LOCATION OF WELL By legal description

Well Location: County Marion

Township 7 (N or (S)) Range 3 (E or (W)) Section 29

1. SW 1/4 of SW 1/4 of above section.

2. Either Street address of well location Browns Island Demolition Landfill

or Tax lot number of well location None

3. ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:

14'9" Ft. below land surface. Date 9-23-97

Artesian Pressure ______ lb/sq. in. Date ______

(8) WATER BEARING ZONES:

Depth at which water was first found ______

From	To	Est. Flow Rate	SWL

(9) WELL LOG: Ground elevation ______

Material	From	To	SWL
Removed sand			
debris between			
casing & back-			
filled w/ clean			
silica sand down			
to bentonite seal			
Cut 2" of PVC			
casing off so			
lid would fit.			
Apparently the			
surface seal is			
not holding steel			
casing secure.			
There is probably			
a void below			
steel casing.			

Date started 9-9-97 Completed 9-23-97

(unbonded) Monitor Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.

MWC Number ______

Signed ______ Date ______

(bonded) Monitor Well Constructor Certification:

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.

MWC Number 10166

Signed [signature] Date 11-18-97

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

11/19/97 09:07 ☎503 375 0961 MACK DRILLING ☑004/005

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-095)

1345 20TH STREET SE
P O BOX 12067
SALEM, OR 97309-0067

19776 - MW12B

Start Card # 106811

(1) OWNER/PROJECT: WELL NO. 19776

Name Marion County Solid Waste
Address 388 State St. Suite 735
City Salem State OR Zip 97301

(2) TYPE OF WORK:

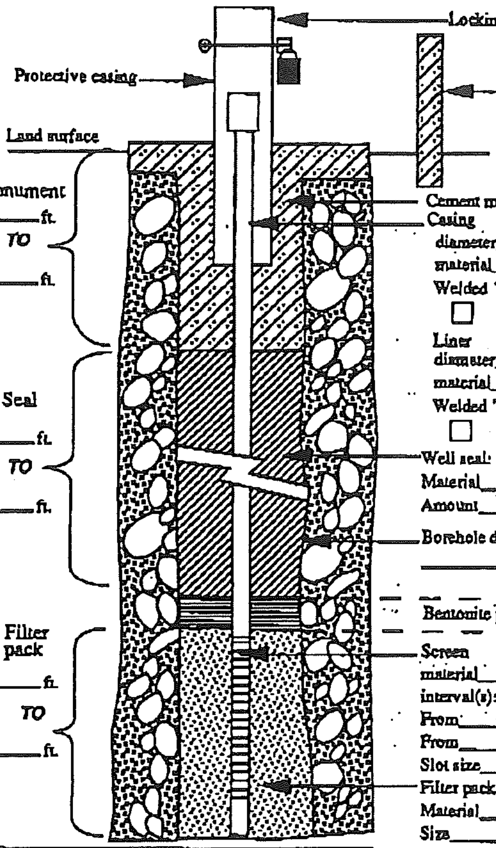
☐ New construction ☐ Repair ☒ Recondition
☐ Conversion ☐ Deepening ☐ Abandonment

(3) DRILLING METHOD

☒ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Hollow Stem Auger ☐ Other______

(4) BORE HOLE CONSTRUCTION

Special Standards Yes ☐ No ☒ Depth of completed well 43 1/2 ft.



Monument ____ft. TO ____ft.

Cement monument
Casing diameter 2 in. material PVC
Welded ☐ Threaded ☐ Glued ☐
Liner diameter________in. material________
Welded ☐ Threaded ☐ Glued ☐

Seal ____ft. TO ____ft.

Well seal: Material________ Amount________

Borehole diameter________in.

Bentonite plug at least 2 ft. thick

Filter pack ____ft. TO ____ft.

Screen material________ interval(s): From______To______ From______To______ Slot size________in.

Filter pack: Material________ Size________in.

(5) WELL TEST:

☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Permeability____________ Yield________GPM
Conductivity____________ PH________
Temperature of water________°F/C Depth artesian flow found________ft.
Was water analysis done? ☐ Yes ☐ No
By whom?________________
Depth of strata to be analyzed. From________ft. to________ft.
Remarks:________________

Name of supervising Geologist/Engineer________________

(6) LOCATION OF WELL By legal description

Well Location: County Marion
Township 7 (N or S) Range 3 (E or W) Section 29
1. SW 1/4 of SW 1/4 of above section.
2. Street address of well location Brown Island Demolition Landfill
3. Tax lot number of well location NONE
4. ATTACH MAP WITH LOCATION IDENTIFIED.

(7) STATIC WATER LEVEL:

14.5 ft. below land surface. Date 9-23-97
Artesian Pressure______lb/sq. in. Date______

(8) WATER BEARING ZONES:

Depth at which water was first found________

From	To	Est. Flow Rate	SWL

(9) WELL LOG: Ground elevation________

Material	From	To	SWL
Removed sand			
debris between			
casings & back			
filled w/ clean			
silica sand down			
to bentonite seal.			
Cut 2" of PVC			
casing off so			
lid would fit			

Date started 9-9-97 Completed 9-23-97

(unbonded) Monitor Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.

MWC Number________
Signed________________ Date________

(bonded) Monitor Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.

MWC Number 10166
Signed Eugene [signature] Date 11-19-97

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT Brown's Island Landfill

Page 1 **of** 2

Location North of Landfill

Boring No. Well 13 (A)

Surface Elevation

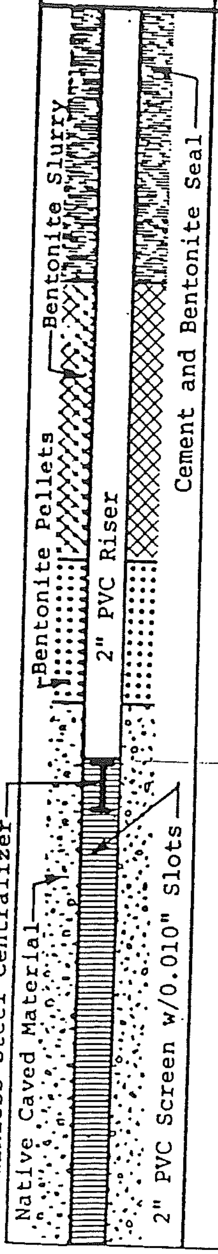
Drilling Method Air Rotary

Total Depth 41 feet

Drilled By Casey Jones Well Drilling Co. Inc

Date Completed 10/29/86

Logged By D.E. Mills

WELL DETAILS	PENE-TRATION TIME/RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERME-ABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
		0				ML	0-17 ft. Sandy SILT, brown, saturated, sticky. Fine to medium sand, some coarse. About 15% sub-rounded gravel to 3-in. diameter.	
		5						
			1	Grab				
		10						
		15						
			2	"		GP	17-24 ft. Sandy GRAVEL, gray, saturated. Fine to medium sand. Medium to coarse gravel (to 3 inches), rounded.	
		20						
		25	3	"		SP	24-36 ft. Gravelly SAND, gray, saturated. Fine to medium. Gravel to 1.5-inches dia., sub-rounded to rounded. Trace silt.	
		30	4	"				
		35	5	"				

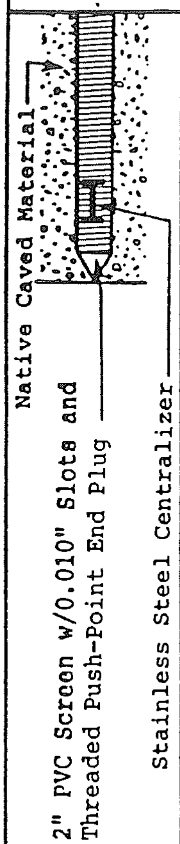
SEA-300-02a

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT Brown's Island Landfill

Boring No. Well 13 (A)



WELL DETAILS	PENE-TRATION TIME/RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERME-ABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
		35	5	Grab		SP		
						GP	36-40.5 ft Sandy GRAVEL, grey, saturated. Fine to medium sand. Gravel 0.25 to 2-in. dia., subrounded to rounded.	
		40	6	"				
			7	"		ML	40.5-42 ft. Sandy SILT, grey, saturated. Trace to 10% clay. Very fine to fine sand. (BEDROCK)	
							Bottom at 42 feet.	
		45						

SEA-300-02b

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT Brown's Island Landfill

Page 1 of 1

Location Northeast of landfill

Boring No. Well 14 (B)

Surface Elevation

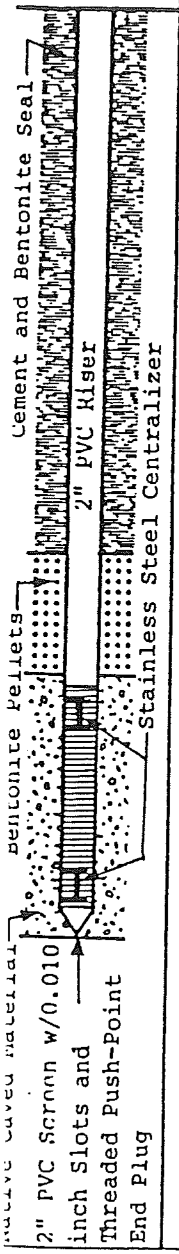
Drilling Method Air Rotary

Total Depth 27 feet

Drilled By Casey Jones Well Drilling Co.

Date Completed 10-30-86

Logged By D.E. Mills



WELL DETAILS	PENETRATION TIME/RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
			1	Grab		SP	0-11 ft. SAND, brown to grey with brown mottling below 5 feet, saturated. Fine to medium, trace silt.	
		5						
			2	"				
		10						
			3	"		GP	11-16 ft. GRAVEL, grey, saturated, 0.5-2-in. dia. rounded to subrounded. Trace to 10% sand (fine to medium).	
		15						
			4	"		SP	16-22 ft. Gravelly SAND, grey, saturated. Fine to medium. Gravel to 1.5 in. dia., subrounded. Gravel content decreases below 20 feet.	
		20						
			5	"		SM	22-27 ft. Silty SAND, light grey, moist. (BEDROCK)	
		25						
							Bottom at 27 feet.	
		30						

SEA-300-02a

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT Brown's Island Landfill

Location South of main entrance

Boring No. Well 15 (C)

Surface Elevation

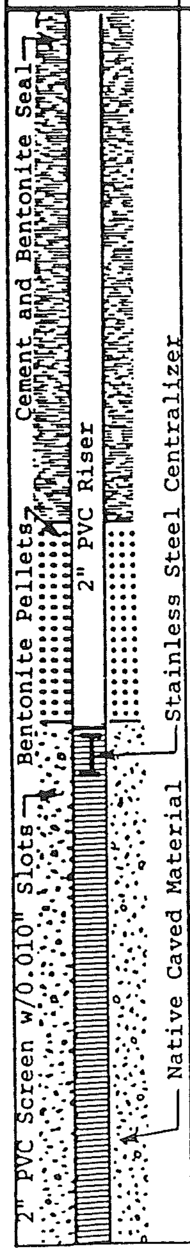
Drilling Method Air Rotary

Total Depth 41 feet

Drilled By Casey Jones Well Drilling Co.

Date Completed 10/31/86

Logged By D.E. Mills



WELL DETAILS	PENETRATION TIME/RATE	DEPTH (FEET)	SAMPLE NO.	SAMPLE TYPE	PERMEABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
			1	Grab		SP	0-7.5 ft. Gravelly SAND with silt, brown, saturated. Medium to coarse. Gravel to 1-in. dia., Subrounded.	
		5						
			2	"		SM	7.5-19 ft. Silty SAND with gravel, gray, saturated. Fine to medium. Gravel to 1-in. dia., Subrounded to rounded.	
		10						
			3	"				
		15						
			4	"				
		20				GM	19-21 ft. Silty GRAVEL with sand, gray, saturated.	
			5	"		GP	21-36 ft. Sandy GRAVEL, brown, saturated. 1- to 2-in. dia., subrounded to rounded. Sand is fine to medium. Trace silt.	
		25						
		30	6	"				
		35						

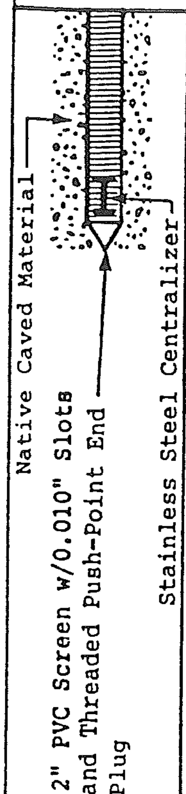
SEA-300-02a

Sweet, Edwards & Associates, Inc.

BORING LOG

PROJECT Brown's Island Landfill

Boring No. Well 15 (C)



WELL DETAILS	PENE-TRATION TIME/ RATE	DEPTH (FEET)	SAMPLE		PERME-ABILITY TESTING	SYMBOL	LITHOLOGIC DESCRIPTION	WATER QUALITY
			NO.	TYPE				
		35				GP		
			7	Grab		ML	36-41 ft. Clayey SILT with sand, light blueish grey, saturated. (BEDROCK)	
		40						
							Bottom at 41 feet.	
		45						

STATE OF OREGON

MONITORING WELL REPORT

MARI 53662

Received Date 12/02/1998
Well ID Tag# L 29715
Start Card # 117227

(as required by ORS 537.765 & OAR 690-240-095) Instructions for completing this report are on the last page of this form.

(1) OWNER/PROJECT

Well No. 29715
Co Job No. MW-16

Name COUNTY OF MARION
Street 388 STATE ST SUITE 735
City SALEM State OR Zip 97301

(2) TYPE OF WORK

[X] New Construction [ ] Alter (Recondition) [ ] Alter (Repair)
[ ] Conversion [ ] Deepening [ ] Abandonment

(3) DRILLING METHOD

[ ] Rotary Air [ ] Rotary Mud [ ] Cable
[X] Hollow Stem Auger Other *****

(4) BORE HOLE CONSTRUCTION

Special Standards [ ] Depth of completed well 46 ft.

Diameter	From	To
10.00	0.00	46

Material	Begin Depth	End Depth	Material Amount	Units
Concrete	0.00	1.00	1.00	S
Bentonite	1.00	20.00	16.00	S
Bentonite	20.00	33.00	200.0	G

Vault ft. TO ft.

Casing Diameter Liner [ ]

Monument 3 ft. TO -3 ft.

Casing or Liner	Diameter	Begin Depth	End Depth	Gauge	Material	Construction Weld	Threaded	Location Of Shoe
C	2.00				Plastic			

Seal ft. TO ft.

From	To	Material	Amount	Seal Grout Weight	Units
0.00	1.00	Concrete	1.00		S
1.00	20.00	Bentonite	16.00		S
20.00	33.00	Bentonite	00.00	12	G

Filter Pack 33 ft. TO 46 ft.

Screen [ ]

Diameter	From	To	Gauge	Material	Type	Slot Size
	36	46		PL		.020

Filter Pack
Material SA
Size 20.00 in.

(5) WELL TEST

Permeability Yield
Conductivity PH
Temperature of water 56 °F/C Depth artesian flow found ft.
Was water analysis done? [X]
By Whom? HAROLD SLAVIK
Depth of strata to be analyzed. From ft. to ft.
Remarks

Name of supervising Geologist/Engineer

(6) LOCATION OF WELL By legal description

County
Township 7.00 S Range 3.00 W Section 32
1. NW 1/4 of NW 1/4 of above section.
Legal Desc:

2. Either Street address of well location
2895 FARAGATE ST; BROWNS ISLND DEMOLITION
or Tax lot number of well location 100
3. ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arr

(7) STATIC WATER LEVEL

13.2 Ft. below land surface. Date 11/18/1998
Artesian Pressure lb/sq. in. Date

(8) WATER BEARING ZONES

Depth at which water was first found 13 ft.

From	To	Est. Flow Rate	SWL
13	46		13

(9) WELL LOG

Ground elevation ft.

Material	From	To	SWL
SAND	0	13	13
SILT, SAND, GRAVELS	13	45	
SANDSTONE	45	46	

Date started 11/11/1998 Completed 11/11/1998

(unbonded) Monitor Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.

MWC Number 10308
Signed By J TRENT CASTNER Date

(bonded) Monitor Well Constructor Certification:

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.

MWC Number 10011
Signed By GREG MCINNIS Date

FIELD LOG

SHEET 1 OF 1

LOCATION OF BORING: Diagram Attached	PROJECT NO. & PROJECT NAME: 98-138 GeoTech
SURFACE CONDITIONS:	PROJECT LOCATION: Brown's Island LandFill
	CLIENT: GeoTech Explorations
	DRILL HOLE NO. MW-16
	DRILLING CO./FOREMAN: GeoTech / T. Castner
	DRILLING METHOD/RIG MODEL: Track-mtd. hollow stem
	SAMPLING METHOD(S): N/A
	DRILLING DATE/TIME: START 11/11/98 1000; END 11 1350
	SEC - TOWNSHIP - RANGE
	ELEVATION -
	DATUM -
	GEOPHYS. LOGS: N/A
	TOTAL DEPTH -

H. J. Slavik Jr.

REGISTERED PROFESSIONAL GEOLOGIST
OREGON
HAROLD J. SLAVIK, JR.
Exp. 7-31-99
G1237

WATER LEVEL	DATE	TIME	GEOLOGIST
Approx 13' bgs	11/11/98	1415	H. Slavik

LABORATORY	NO. SAMPLES	C-O-C NO.	C-O-C RELEASE DATE/TIME	OTHER
Oregon Analytical	1	N/A	N/A	

DEPTH FEET	SAMPLE TYPE & NUMBER	SPT		USCS / CLASS	NAME	DENSE	COLOR	MOIST	DESCRIPTION AND REMARKS
0–10					SM		Med. Brn to yel.-brn	Moist	Silty Sand
~12	Dissolved Oxygen only Sample ID: DO#16		13' (est.)		12-14 SC		≈12' Dk Brn	wet	clayey @ ≈ 12' Minor organic particles Mod → strong clay
15–18.5					CL				
18.5					SM/SC		Med. blue-gy		18.5' Sandy silt becoming wkly clayey
25–27.5					GC				27.5 Minor rdd. gravels
30–35					GM		Med. Gray		Increased rdd. gravels moderately sorted w/ silt/sand
45								46'	Bedrock: Med. bluish-gray sandy siltstone Mod. to strongly friable

STATE OF OREGON

MONITORING WELL REPORT MARI 53661

Received Date 12/02/1998
Well ID Tag# L 29714
Start Card # 117226

(as required by ORS 537.765 & OAR 690-240-095) Instructions for completing this report are on the last page of this form.

(1) OWNER/PROJECT

Well No. 29714
Co Job No. MW-17

Name COUNTY OF MARION
Street 388 STATE ST SUITE 735
City SALEM State OR Zip 97301

(2) TYPE OF WORK

[X] New Construction [ ] Alter (Recondition) [ ] Alter (Repair)
[ ] Conversion [ ] Deepening [ ] Abandonment

(3) DRILLING METHOD

[ ] Rotary Air [ ] Rotary Mud [ ] Cable
[X] Hollow Stem Auger Other *****

(4) BORE HOLE CONSTRUCTION

Special Standards [ ] Depth of completed well 40 ft.

Diameter	From	To
10.00	0.00	40

Material	Begin Depth	End Depth	Material Amount	Units
Concrete	0.00	1.00	1.00	S
Bentonite	1.00	9.00	9.00	S
Bentonite	9.00	28.00	120.0	G

Vault ft. TO ft.

Casing Diameter Liner [ ]

Monument 3 ft. TO -3 ft.

Casing or Liner	Diameter	Begin Depth	End Depth	Gauge	Material	Construction Weld	Threaded	Location Of Shoe
C	2.00				Plastic			

Seal ft. TO ft.

From	To	Material	Amount	Seal Grout Weight	Units
0.00	1.00	Concrete	1.00		S
1.00	9.00	Bentonite	9.00		S
9.00	28.00	Bentonite	20.00	11	G

Filter Pack 28 ft. TO 40 ft.

Screen [ ]

Diameter	From	To	Gauge	Material	Type	Slot Size
	30	40		PL		.020

Filter Pack
Material SA
Size 20.00 in.

(5) WELL TEST

Permeability Yield
Conductivity PH
Temperature of water 54 °F/C Depth artesian flow found ft.
Was water analysis done? [X]
By Whom? HAROLD SLAVIK
Depth of strata to be analyzed. From ft. to ft.
Remarks

Name of supervising Geologist/Engineer

(6) LOCATION OF WELL By legal description

County
Township 7.00 S Range 3.00 W Section 32
1. NW 1/4 of NW 1/4 of above section.
Legal Desc:

2. Either Street address of well location
2895 FARAGATE ST; BROWNS ISLND DEMOLITION
or Tax lot number of well location 100
3. ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arr

(7) STATIC WATER LEVEL

12.6 Ft. below land surface. Date 11/17/1998
Artesian Pressure lb/sq. in. Date

(8) WATER BEARING ZONES

Depth at which water was first found 12 ft.

From	To	Est. Flow Rate	SWL
12	40		12

(9) WELL LOG

Ground elevation ft.

Material	From	To	SWL
SAND	0	12	12
GRAVELS	12	32	
SAND & GRAVELS	32	40	

Date started 11/10/1998 Completed 11/10/1998

(unbonded) Monitor Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.

MWC Number 10306
Signed By J TRENT CASTNER Date

(bonded) Monitor Well Constructor Certification:

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.

MWC Number 10011
Signed By GREG MCINNIS Date

FIELD LOG

SHEET 1 OF 1

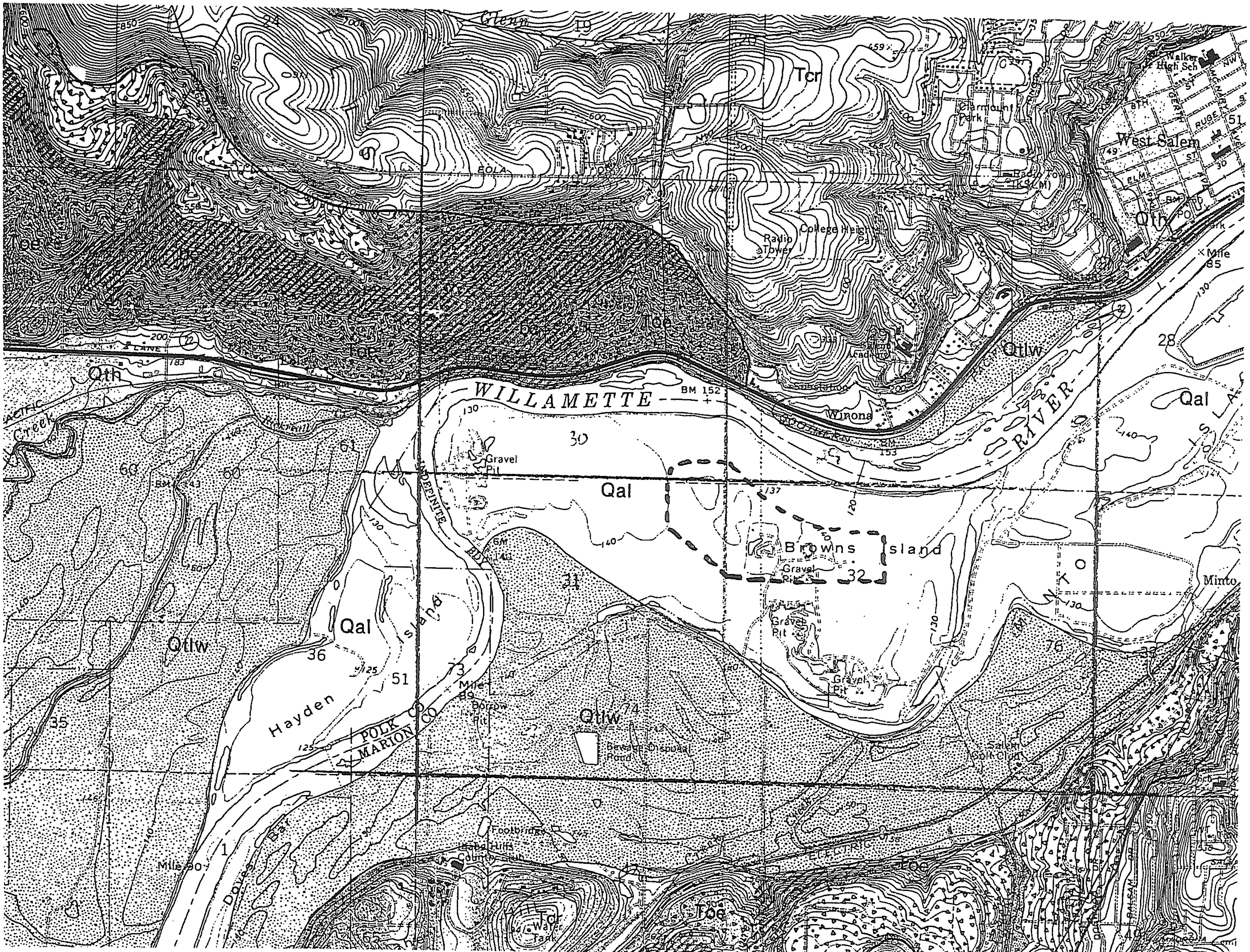
LOCATION OF BORING: Diagram Attached H. J. Slavik Jr. REGISTERED PROFESSIONAL OREGON HAROLD J. SLAVIK, JR. Exp. 7-31-99 G1237 GEOLOGIST SURFACE CONDITIONS:	PROJECT NO. & PROJECT NAME 98-138 GeoTech CLIENT GeoTech Explorations	PROJECT LOCATION Brown's Island Landfill DRILL HOLE NO. MW-17
	DRILLING CO./FOREMAN GeoTech / T. Castner DRILLING METHOD/RIG MODEL Truck-Mtd. Hollow stem SAMPLING METHOD(S) N/A	DRILL G DATE/TIME START 11/10/98 1040 END 11/10/98 1205
	SEC - TOWNSHIP - RANGE	ELEVATION - DATUM -
WATER LEVEL DATE TIME / GEOLOGIST H. Slavik	GEOPHYS. LOGS: N/A	TOTAL DEPTH -

LABORATORY	NO. SAMPLES	C-O-C NO.	C-O-C RELEASE DATE/TIME	OTHER
Oregon Analytical	1	N/A	N/A	

DEPTH FEET	SAMPLE TYPE & NUMBER	SPT		USCS	CLASS / NAME	DENSE	COLOR	MOIST	DESCRIPTION AND REMARKS
5				SM	Silty Sand	—	Med Brn to yl.-brn Dk brn	Moist	6.5 increased silts
15	Dissolved Oxygen only Sample ID: DO#17		▼	GC	clayey silty sand w/ rdd. gravels to 1"			Wet	Static H_2O measured @ ≈13.0' bgs increase in gravels & size @ ≈17.0'
25				GM					Coarsening of gravels to 3"
35									Bedrock ≈35' bgs. Med bluish-gray sandy siltstone mod to strongly friable
45									

APPENDIX C

Well Logs on WRD Record - Sections 29 thru 32



WILLAMETTE
RIVER
Browns Island
Qal
Qtlw
Qth
Tcr
Toe
West Salem
Walker High Sch
Glenn
EOLA
College Heights Park
Radio Tower
Winona
BM 152
Gravel Pit
Minto
Hayden Island
POLK CO
MARION CO
INDEFINITE BDY
Borrow Pit
Salem Golf Club
Footbridge
Mile 85
Mile 89
Mile 90

Well Log Query Results *NEW! GPS points, where available, have been added to the far right of the table. Click link to view on map*

Township: 7 S, Range: 3 W, Sections: 29

Well Log	T-R-S/ QQ-Q	Taxlot	Street of Well	Owner	Company	Special Standards	Well Type	First Water	Completed Depth	Static Water Level	Yield	Completed Date	Received Date	Bonded Constructor	Startcard	Well Id #	New	Abandon	Deepen	Alteration	Conversion	Domestic	Irrigation	Community	Livestock	Industrial	Injection	Thermal	Dewatering	Piezometer	Latitude/ Longitude
MARI 8119	7.00S-3.00W-29 -			TRUSSELL, ROBERT D RT 3 BOX 924 SALEM OR 97302			W		50.00	23.0	15.0	10/08/1964	10/29/1964	BEIER, EMIL O WILLAMETTE DRILLING CO.			√					√									
MARI 52283	7.00S-3.00W-29 SW-SW		BROWNS ISLAND DEMOLITION LANDFILL		COUNTY OF MARION; SOLID WASTE 388 STATE ST SUITE 735 SALEM OR 97301		M		0.00	19.0		09/08/1997	10/03/1997	MACK, EUGENE MACK DRILLING CO.	106227			√													
MARI 52281	7.00S-3.00W-29 SW-SW		BROWNS ISLAND DEMOLITION LANDFILL		COUNTY OF MARION; SOLID WASTE 388 STATE ST SUITE 735 SALEM OR 97301		M		44.00	14.5		09/23/1997	10/03/1997	MACK, EUGENE MACK DRILLING CO.	106811	19776				√											
MARI 52282	7.00S-3.00W-29 SW-SW		BROWNS ISLAND DEMOLITION LANDFILL		COUNTY OF MARION; SOLID WASTE 388 STATE ST SUITE 735 SALEM OR 97301		M		28.00	14.9		09/23/1997	10/03/1997	MACK, EUGENE MACK DRILLING CO.	106228	19775				√											
MARI 52284	7.00S-3.00W-29 SW-SW		BROWNS ISLAND DEMOLITION LANDFILL		COUNTY OF MARION; SOLID WASTE 388 STATE ST SUITE 735 SALEM OR 97301		M		0.00			09/08/1997	10/03/1997	MACK, EUGENE MACK DRILLING CO.	106226			√													
MARI 53492	7.00S-3.00W-29 NE-SE		WINTER ST SE & PRINGLE PKWY		CITY OF SALEM 555 LIBERTY ST, RM 325 SALEM OR 97301		G		35.00			09/18/1998	10/13/1998				√	√													
MARI 53493	7.00S-3.00W-29 NE-SW		WINTER ST & PRINGLE PKWY		CITY OF SALEM 555 LIBERTY ST RM 325 SALEM OR 97301		G		35.00			09/18/1998	10/13/1998				√	√													
MARI 54728	7.00S-3.00W-29 NW-SW		3175 DALLAS HWY, SALEM		BONNEVILLE POWER ADMINISTRATION 905 NE 11TH AVE PORTLAND OR 97208		G		0.00			03/27/2000	04/20/2000				√	√													
POLK 801	7.00S-3.00W-29 -		1955 SALEM DALLAS HWY		CAPITOL MANOR 1955 SALEM DALLAS HWY SALEM OR 97304		W	0.00	0.00	0.0			05/18/1994	STADELI, STEVEN N WESTERBERG DRILLING INC.	51390			√													
POLK 802	7.00S-3.00W-29 -		SALEM		CAPITOL MANOR 1955 SE SALEM DALLAS HWY SALEM OR 97304		W	0.00	0.00	0.0			05/18/1994	STADELI, STEVEN N WESTERBERG DRILLING INC.	51392			√													

1 2 3 4 5

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Well Log Query Results *NEW! GPS points, where available, have been added to the far right of the table. Click link to view on map*

Township: 7 S, Range: 3 W, Sections: 29

Well Log	T-R-S/ QQ-Q	Taxlot	Street of Well	Owner	Company	Special Standards	Well Type	First Water	Completed Depth	Static Water Level	Yield	Completed Date	Received Date	Bonded Constructor	Startcard	Well Id #	New	Abandon	Deepen	Alteration	Conversion	Domestic	Irrigation	Community	Livestock	Industrial	Injection	Thermal	Dewatering	Piezometer	Latitude/ Longitude
POLK 1849	7.00S-3.00W-29 -			MOFFENBIER, MARTHA			W	0.00	115.00	70.0	5.0	07/10/1967	05/18/1994	WESTON, R C			√														
POLK 1850	7.00S-3.00W-29 -				SENIOR SERVICE OREGON NONE PROFIT CORP.		W	0.00	91.00	65.0	20.0	10/23/1967	11/13/1967	UNKNOWN, UNKNOWN					√			√									
POLK 1851	7.00S-3.00W-29 -			HARMS, PETE			W	0.00	157.00	69.0	15.0	07/30/1969	08/24/1967	WESTON, R C			√					√									
POLK 1852	7.00S-3.00W-29 -			MOFFENBIER, MARTHA			W	0.00	115.00	70.0	5.0	07/10/1967	08/02/1967	WESTON, R C			√														
POLK 1853	7.00S-3.00W-29 -			TRUSSELL, DONALD			W	0.00	131.00	40.0	15.0	04/28/1961	05/09/1961	SEARS, DENNIS			√					√	√								
POLK 1854	7.00S-3.00W-29 -				CENTRAL PAVING CO.		W	0.00	34.00	18.0	250.0	07/07/1958	07/09/1958	SNEED, RICHARD F			√					√									
POLK 1855	7.00S-3.00W-29 NW-NW			BAKEL, DON			W	298.00	350.00	240.0	12.0	09/27/1977	10/19/1977	WALDROOP, MICHAEL			√					√									
POLK 1856	7.00S-3.00W-29 NE-SE			ELBERT, HAROLD			W	0.00	40.00	15.0	250.0	12/31/1935	12/31/1935										√								
POLK 1857	7.00S-3.00W-29 NW-SW				BONNEVILLE POWER ADMINISTRATION		W	0.00	375.00	51.0	201.0	04/30/1940	04/30/1940									√									
POLK 1858	7.00S-3.00W-29 SW-SE			SWEARINGEN, REX P			W	0.00	33.00	17.0		12/31/1949	12/31/1949	WEST, MARION									√								

1 2 3 4 5

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Well Log Query Results *NEW! GPS points, where available, have been added to the far right of the table. Click link to view on map*

Township: 7 S, Range: 3 W, Sections: 29

Well Log	T-R-S/ QQ-Q	Taxlot	Street of Well	Owner	Company	Special Standards	Well Type	First Water	Completed Depth	Static Water Level	Yield	Completed Date	Received Date	Bonded Constructor	Startcard	Well Id #	New	Abandon	Deepen	Alteration	Conversion	Domestic	Irrigation	Community	Livestock	Industrial	Injection	Thermal	Dewatering	Piezometer	Latitude/ Longitude
POLK 1859	7.00S-3.00W-29 SW-NW			GWYNN, W D			W	60.00	118.00	0.0	10.0	04/03/1987	04/22/1987	ROBINSON, GEORGE H			√					√									
POLK 1860	7.00S-3.00W-29 -				SALEM ROAD AND DRIVEWAY		W	0.00	0.00	15.0	5.0	12/24/1969	01/08/1970	ROBINSON, GEORGE H			√														
POLK 1861	7.00S-3.00W-29 -			FURSMAN, OLIVER			W	0.00	84.00	0.0		11/03/1965	11/05/1965	SNEED, RICHARD F			√					√									
POLK 1862	7.00S-3.00W-29 -			TRUSSELL, DONALD			W	0.00	81.00	57.0	20.0	03/30/1962	04/06/1962	SEARS, DENNIS			√					√									
POLK 1863	7.00S-3.00W-29 -SW			ISAAC, ROLAND			W	0.00	85.00	30.0	21.0	04/13/1976	05/06/1976	MILLER, HARLAN					√			√	√								
POLK 50208	7.00S-3.00W-29 NE-NW	1400		MCELWAIN, JON 1988 CROZER ST NW SALEM OR 97304			W	121.00	135.00	121.0	15.0	09/25/1996	10/25/1996	MCELWAIN, JON JON MCELWAIN	36374	11101	√					√									
POLK 50587	7.00S-3.00W-29 NE-NW		SUNWOOD DR		GRS ENTERPRISES 1100 LIBERTY ST SUITE 3 SALEM OR 97302		G		0.00			03/31/1998	04/09/1998				√	√													
POLK 50588	7.00S-3.00W-29 NE-NW		SUNWOOD DR		GRS ENTERPRISES 1100 LIBERTY ST SUITE 3 SALEM OR 97302		G		0.00			03/30/1998	04/09/1998				√	√													
POLK 50589	7.00S-3.00W-29 NE-NW		SUNWOOD DR		GRS ENTERPRISES 1100 LIBERTY ST SUITE 3 SALEM OR 97302		G		0.00			03/30/1998	04/09/1998				√	√													
POLK 50834	7.00S-3.00W-29 NW-SE		2385 DALLAS HWY, SALEM	ALBAWAB, BOBBY 2525 PACIFIC BLVD ALBANY OR 97321			G		16.00			01/13/1999	02/04/1999				√	√													

12345

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Well Log Query Results *NEW! GPS points, where available, have been added to the far right of the table. Click link to view on map*

Township: 7 S, Range: 3 W, Sections: 29

Well Log	T-R-S/ QQ-Q	Taxlot	Street of Well	Owner	Company	Special Standards	Well Type	First Water	Completed Depth	Static Water Level	Yield	Completed Date	Received Date	Bonded Constructor	Startcard	Well Id #	New	Abandon	Deepen	Alteration	Conversion	Domestic	Irrigation	Community	Livestock	Industrial	Injection	Thermal	Dewatering	Piezometer	Latitude/ Longitude
POLK 50835	7.00S-3.00W-29 NW-SE		2385 DALLAS HWY, SALEM	ALBAWAB, BOBBY 2525 PACIFC BLVD ALBANY OR 97321			G		16.00			01/13/1999	02/04/1999				√	√													
POLK 50836	7.00S-3.00W-29 NW-SE		2385 DALLAS HWY, SALEM	ALBAWAB, BOBBY 2525 PACIFIC BLVD ALBANY OR 97321			G		16.00			01/13/1999	02/04/1999				√	√													
POLK 50837	7.00S-3.00W-29 NW-SE		2385 DALLAS HWY, SALEM	ALBAWAB, BOBBY 2525 PACIFIC BLVD ALBANY OR 97321			G		16.00			01/13/1999	02/04/1999				√	√													
POLK 50838	7.00S-3.00W-29 NW-SE		2385 DALLAS HWY, SALEM	ALBAWAB, BOBBY 2525 PACIFIC BLVD ALBANY OR 97321			G		24.00	19.8		01/13/1999	02/04/1999				√	√													
POLK 50839	7.00S-3.00W-29 NW-SE		2385 DALLAS HWY, SALEM	ALBAWAB, BOBBY 2525 PACIFIC BLVD ALBANY OR 97321			G		16.00			01/13/1999	02/04/1999				√	√													
POLK 50840	7.00S-3.00W-29 NW-SE		2385 DALLAS HWY, SALEM	ALBAWAB, BOBBY 2525 PACIFIC BLVD ALBANY OR 97321			G		24.00	20.5		01/13/1999	02/04/1999				√	√													
POLK 51149	7.00S-3.00W-29 NW-SE	4300	2385 DALLAS HWY NW, SALEM		YOC INC. PO BOX 87 ALBANY OR 97321	√	M	21.60	25.00	21.6		05/17/2000	06/15/2000	KLOSTERMANN, BILL GEO-TECH EXPLORATIONS INC	129472	41645	√														
POLK 51150	7.00S-3.00W-29 NW-SE	4300	2385 DALLAS HWY NW		YOC INC. PO BOX 87 ALBANY OR 97321	√	M	21.50	29.50	21.5		05/17/2000	06/15/2000	KLOSTERMANN, BILL GEO-TECH EXPLORATIONS INC	129473	41646	√														
POLK 51151	7.00S-3.00W-29 NW-SE		2385 DALLAS HWY NE		YOC INC. PO BOX 87 ALBANY OR 97321	√	M	23.00	30.00	23.0		05/17/2000	06/15/2000	KLOSTERMANN, BILL GEO-TECH EXPLORATIONS INC	129474	41647	√														
MARI 56722	7.00S-3.00W-29 -	76088	4857 AUBURN RD NE		CHASE MANHATTEN 4857 AUBURN RD NE SALEM OR 97301		W						07/29/2002	WELL ID APPLICATION WELL ID APPLICATION		60318															

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Township: 7 S, Range: 3 W, Sections: 29

Well Log	T-R-S/ QQ-Q	Taxlot	Street of Well	Owner	Company	Special Standards	Well Type	First Water	Completed Depth	Static Water Level	Yield	Completed Date	Received Date	Bonded Constructor	Startcard	Well Id #	New	Abandon	Deepen	Alteration	Conversion	Domestic	Irrigation	Community	Livestock	Industrial	Injection	Thermal	Dewatering	Piezometer	Latitude/ Longitude
POLK 52619	7.00S-3.00W-29 -	1804	153 ROSEWOOD DR NW	JACKSON HOCKETT, NATHAN 2391 FARTHING WAY NW SALEM OR 97304			G		0.00			05/23/2007	06/27/2007				√	√													
POLK 52620	7.00S-3.00W-29 -	1804	153 ROSEWOOD DR NW	JACKSON HOCKETT, NATHAN 2391 FARTHING WAY NW SALEM OR 97304			G		0.00			06/04/2007	06/27/2007				√	√													
POLK 52621	7.00S-3.00W-29 -	1804	153 ROSEWOOD DR NW	JACKSON HOCKETT, NATHAN 2391 FARTHING WAY NW SALEM OR 97304			G		0.00			06/04/2007	06/27/2007				√	√													
POLK 52622	7.00S-3.00W-29 -	1804	153 ROSEWOOD DR NW	JACKSON HOCKETT, NATHAN 2391 FARTHING WAY NW SALEM OR 97304			G		0.00			06/04/2007	06/27/2007				√	√													
POLK 52623	7.00S-3.00W-29 -	1804	153 ROSEWOOD DR NW	JACKSON HOCKETT, NATHAN 2391 FARTHING WAY NW SALEM OR 97304			G		0.00			06/04/2007	06/27/2007				√	√													
POLK 52625	7.00S-3.00W-29 NW-SE	2200	COLLEGE DR NW AND HWY 22, SALEM		GEOENGINEERS 15055 SW SEQUOIA PARKWAY SUITE 140 PORTLAND OR 97224		G		0.00			07/02/2007	07/17/2007				√	√													
POLK 52626	7.00S-3.00W-29 SW-SE	800	COLLEGE DR NW AND HWY 22, SALEM		GEOENGINEERS 15055 SW SEQUOIA PARKWAY SUITE 140 PORTLAND OR 97224		G		0.00			07/02/2007	07/17/2007				√	√													
POLK 53206	7.00S-3.00W-29 NE-NE	ROW	EOLA DR NW, 500' EAST OF WOODLAND DR NW SALEM, OR		CITY OF SALEM 555 LIBERTY ST SE SALEM OR 97301		G		35.00			07/14/2011	07/18/2011				√	√													
POLK 53207	7.00S-3.00W-29 NE-NE	ROW	EOLA DR NW, 500' EAST OF WOODLAND DR NW SALEM, OR		CITY OF SALEM 555 LIBERTY ST SE SALEM OR 97301		G		25.00			07/14/2011	07/18/2011				√	√													
POLK 53213	7.00S-3.00W-29 NW-NE	209	1920 TURNAGE ST NW SALEM, OR 97304	SANDERS, BRENT 2755 ADELL LANE NE SALEM OR 97301			W	165.00	203.00	69.5	22.0	08/29/2011	08/29/2011	MACK, EUGENE MACK DRILLING CO INC	207450	106663	√					√									

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Township: 7 S, Range: 3 W, Sections: 30

Well Log	T-R-S/ QQ-Q	Taxlot	Street of Well	Owner	Company	Special Standards	Well Type	First Water	Completed Depth	Static Water Level	Yield	Completed Date	Received Date	Bonded Constructor	Startcard	Well Id #	New	Abandon	Deepen	Alteration	Conversion	Domestic	Irrigation	Community	Livestock	Industrial	Injection	Thermal	Dewatering	Piezometer	Latitude/ Longitude
MARI 8120	7.00S-3.00W-30 -			HOWE, DORIS 3870 CENTER NE SALEM OR 97301			W	75.00	220.00	30.0	3.0	07/27/1982	08/04/1982	BERNDT, GARRET H EOLA WELL DRILLING			√					√									
MARI 8121	7.00S-3.00W-30 SW-SW			BRITTAN, RON	MOORE, DENNIS 1493 JORDAN DR SE SALEM OR 97302		W	36.00	47.00	22.0	40.0	08/19/1982	08/31/1982	BEIER, DALLAS L WILLAMETTE DRILLING CO.			√					√									
MARI 8476	7.00S-3.00W-30 NW-NW			MULKEY, GENE 403 KEENE AV SILVERTON OR 97381			W	67.00	298.00	35.0	10.0	08/17/1979	08/21/1979	FRIESEN, ROBERT FRIESEN DRILLING CO. INC.			√					√									
POLK 139	7.00S-3.00W-30 SW-NE			ANDERSON, MAJOR 3505 SALEM DALLAS HWY NW SALEM OR 97304			W	66.00	122.00	26.0	35.0	05/25/1975	12/15/1975	BELLO, PAUL BELLO WELL DRILLING			√					√									
POLK 617	7.00S-3.00W-30 NE-SE	226699	3505 DALLAS HWY		THE COMMERCIAL BANK; TRUST DEPARTMENT PO BOX 1912 SALEM OR 97304		W		219.00	64.0	7.0	06/18/1993	06/25/1993	ROBINSON, GEORGE H ROBINSON DRILLING WELLS & PUMP	48792		√					√									
POLK 674	7.00S-3.00W-30 NE-SW				HUT DEVELOPMENT CORP. 1620 OXFORD SE SALEM OR 97302		W	55.00	180.00	42.0	16.0	09/15/1993	10/19/1993	WALDROOP, MICHAEL	26347		√							√							
POLK 698	7.00S-3.00W-30 NE-SW		BETWEEN 3760 & 4250 DALLAS HWY		HUT DEVELOPMENT CORP. 1620 OXFORD SE SALEM OR 97302		W	29.00	157.00	38.0	23.0	11/01/1993	11/12/1993	SIPPEL, FLOYD G	38700		√							√							
POLK 51085	7.00S-3.00W-30 SW-SW	800	OLD PARK APPROX. 300 DOAKS FERRY RD		CHEMEKETA COMMUNITY COLLEGE 4000 LANCASTER DR NE SALEM OR 97309		W	68.00	240.00	43.0	60.0	12/25/1999	12/30/1999	BEIER, DALLAS L WILLAMETTE DRILLING	128929	37321	√					√									
POLK 1864	7.00S-3.00W-30 NE-SE			FURSMAN, OLIVER C			W	34.00	63.00	18.0	20.0	10/14/1987	11/23/1987	BEIER, MARK D			√					√									
POLK 1865	7.00S-3.00W-30 -			LOUCKS, JIM			W	0.00	158.00	0.0		06/15/1972	07/13/1972	ROBINSON, GEORGE H			√					√									

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Township: 7 S, Range: 3 W, Sections: 30

Well Log	T-R-S/ QQ-Q	Taxlot	Street of Well	Owner	Company	Special Standards	Well Type	First Water	Completed Depth	Static Water Level	Yield	Completed Date	Received Date	Bonded Constructor	Startcard	Well Id #	New	Abandon	Deepen	Alteration	Conversion	Domestic	Irrigation	Community	Livestock	Industrial	Injection	Thermal	Dewatering	Piezometer	Latitude/ Longitude
POLK 1866	7.00S-3.00W-30 -			FURSMAN, OLIVER			W	172.00	180.00	90.0	17.0	09/15/1984	06/23/1983	BELLO, PAUL			√					√									
POLK 1867	7.00S-3.00W-30 SW-NE			FURSMAN, OLIVER C			W	0.00	140.00	34.0	22.0	12/06/1963	12/11/1963	UNKNOWN, UNKNOWN			√					√									
POLK 1868	7.00S-3.00W-30 -			WIDMER, N W			W	52.00	122.00	55.0	30.0	06/25/1972	07/13/1972	ROBINSON, GEORGE H			√					√									
POLK 1869	7.00S-3.00W-30 -			PASCHALL, H DUANE			W	45.00	298.00	36.0	7.0	05/30/1972	07/13/1972	ROBINSON, GEORGE H			√					√									
POLK 1870	7.00S-3.00W-30 NW-NE			CLARK, MICHAEL L			W	151.00	200.00	80.0	25.0	04/28/1986	04/29/1986	BEIER, MARK D			√					√									
POLK 1871	7.00S-3.00W-30 NE-NE			GILSON, DALE			W	50.00	183.00	76.0	12.0	08/06/1985	10/13/1985	ROBINSON, GEORGE H			√					√									
POLK 1872	7.00S-3.00W-30 -			BUNN, DAN		√	W	180.00	187.00	105.0	30.0	09/15/1983	11/10/1983	MONDERS, JD			√					√									
POLK 1873	7.00S-3.00W-30 -			WILLIAMS, HOLMAN - MAUDE			W	0.00	0.00	23.0	17.0	08/08/1972	10/27/1972	ROBINSON, GEORGE H					√												
POLK 1874	7.00S-3.00W-30 NW-SW			SHIMMON, RAY			W	80.00	109.00	70.0	3.0	01/28/1957	02/04/1957	MILLER, HARLAN			√					√									
POLK 1875	7.00S-3.00W-30 SE-NW			FORSTER, R L			W	0.00	125.00	54.0	4.0	11/13/1964	01/12/1965	MILLER, HARLAN			√														

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Township: 7 S, Range: 3 W, Sections: 30

Well Log	T-R-S/ QQ-Q	Taxlot	Street of Well	Owner	Company	Special Standards	Well Type	First Water	Completed Depth	Static Water Level	Yield	Completed Date	Received Date	Bonded Constructor	Startcard	Well Id #	New	Abandon	Deepen	Alteration	Conversion	Domestic	Irrigation	Community	Livestock	Industrial	Injection	Thermal	Dewatering	Piezometer	Latitude/ Longitude
POLK 1876	7.00S-3.00W-30 -			FORSTER, R L			W	0.00	42.00	10.0	55.0	10/01/1965	10/02/1965	SNEED, RICHARD F			√					√									
POLK 50284	7.00S-3.00W-30 SW-NE		342 DOAKS FERRY RD NW	DOUGLAS, JOHN	DOUGLAS, LOUISE 3790 VALLEY CREEK RD NW SALEM OR 97304		W	125.00	200.00	125.0	60.0	09/02/1993	03/27/1997	BEIER, MARK D WILLAMETTE DRILLING	52469		√					√									
POLK 50617	7.00S-3.00W-30 NE-SE	699	3515 SALEM DALLAS HWY	KELLY, ROBERT 3505 SALEM DALLAS HWY SALEM OR 97304		√	W	80.00	216.00	62.0	3.0	05/12/1998	06/15/1998	SPENGLER, RONALD RON ROBINSON WELL DRILLING	113258	23047	√					√									
MARI 56208	7.00S-3.00W-30 SW-NW		501 LANCASTER DR NE		ATLANTIC RICHFIELD CO. 501 LANCASTER DR NE SALEM OR 97301		G		0.00	15.0		11/07/2001	11/16/2001				√	√													
MARI 56209	7.00S-3.00W-30 SW-NW		501 LANCASTER DR NE		ATLANTIC RICHFIELD CO. 501 LANCASTER DR NE SALEM OR 97301		G		0.00	15.0		11/07/2001	11/16/2001				√	√													
MARI 56210	7.00S-3.00W-30 SW-NW		501 LANCASTER DR NE		ATLANTIC RICHFIELD CO. 501 LANCASTER DR NE SALEM OR 97301		G		0.00	15.0		11/07/2001	11/16/2001				√	√													
MARI 56211	7.00S-3.00W-30 SW-NW		501 LANCASTER DR NE		ATLANTIC RICHFIELD CO. 501 LANCASTER DR NE SALEM OR 97301		G		0.00	15.0		11/07/2001	11/16/2001				√	√													
MARI 56212	7.00S-3.00W-30 SW-NW		501 LANCASTER DR NE		ATLANTIC RICHFIELD CO. 501 LANCASTER DR NE SALEM OR 97301		G		0.00	15.0		11/07/2001	11/16/2001				√	√													
MARI 56213	7.00S-3.00W-30 SW-NW		501 LANCASTER DR NE		ATLANTIC RICHFIELD CO. 501 LANCASTER DR NE SALEM OR 97301		G		0.00	15.0		11/07/2001	11/16/2001				√	√													
POLK 51481	7.00S-3.00W-30 SE-NE	125	3416 SALEM DALLAS HWY	MCDOUGAL, JOHNNY PO BOX 5421 SALEM OR 97304			W	150.00	200.00	72.0	10.0	10/17/2001	02/06/2002	SPENGLER, RONALD RON ROBINSON WELL DRILLING	139859	44013	√					√									

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Township: 7 S, Range: 3 W, Sections: 30

Well Log	T-R-S/ QQ-Q	Taxlot	Street of Well	Owner	Company	Special Standards	Well Type	First Water	Completed Depth	Static Water Level	Yield	Completed Date	Received Date	Bonded Constructor	Startcard	Well Id #	New	Abandon	Deepen	Alteration	Conversion	Domestic	Irrigation	Community	Livestock	Industrial	Injection	Thermal	Dewatering	Piezometer	Latitude/ Longitude
POLK 51684	7.00S-3.00W-30 NE-NW		EOLA DR NW; NEW SUBDIVISION		EOLA RIDGE LLC 1220 20TH ST SE SALEM OR 97302		W	398.00	444.00	170.0	30.0	06/09/2003	06/13/2003	SIPPEL, FLOYD G SIPPEL WELL DRILLING INC.	156924	62649	√					√									
POLK 51696	7.00S-3.00W-30 NW-NW		EOLA DR NW		EOLA RIDGE LLC 1220 20TH ST SE SALEM OR 97302		W	176.00	500.00	191.5	50.0	06/16/2003	06/27/2003	SIPPEL, FLOYD G SIPPEL WELL DRILLING INC.	156925	63626	√					√									
POLK 51697	7.00S-3.00W-30 NW-NW		EOLA DR NW		EOLA RIDGE LLC 1220 20TH ST SE SALEM OR 97302		W	135.00	462.00	198.0	33.0	06/20/2003	06/27/2003	SIPPEL, FLOYD G SIPPEL WELL DRILLING INC.	156926	63628	√					√									
POLK 51699	7.00S-3.00W-30 NW-NW		EOLA DR NW; LOT 11		EOLA RIDGE LLC 1220 20TH ST SE SALEM OR 97302		W	122.00	490.00		10.0	06/28/2003	07/02/2003	SIPPEL, FLOYD G SIPPEL WELL DRILLING INC.	158310	63631	√					√									
POLK 51736	7.00S-3.00W-30 NW-NW		EOLA DR NW		EOLA RIDGE LLC 1220 20TH ST SE SALEM OR 97302		W	177.00	484.00	174.0	75.0	07/18/2003	08/26/2003	SIPPEL, FLOYD G SIPPEL WELL DRILLING INC.	155231	63638	√					√									
POLK 51867	7.00S-3.00W-30 NW-NW		JUSE E OF 4000 EOLA DR NW		EOLA RIDGE LLC 1220 20TH ST SE SALEM OR 97302		W	277.00	500.00	278.0	20.0	11/24/2003	12/05/2003	SIPPEL, FLOYD G SIPPEL WELL DRILLING INC.	160670	63669	√					√									
POLK 51868	7.00S-3.00W-30 NW-NW		EOLA DR NW		EOLA RIDGE LLC 1220 20TH ST SE SALEM OR 97302		W	155.00	482.00	238.0	15.0	09/15/2003	12/05/2003	SIPPEL, FLOYD G SIPPEL WELL DRILLING INC.	160656	63652	√					√									
POLK 52052	7.00S-3.00W-30 NW-NW	700	365 DOAKS FERRY RD NW	FOSTER, MARK	FOSTER, KATHIE 365 DOAKS FERRY RD NW SALEM OR 97304		W	126.00	140.00	52.0	18.0	09/20/2004	09/28/2004	SIPPEL, FLOYD G SIPPEL WELL DRILLING INC.	169803	71031	√					√									
POLK 52522	7.00S-3.00W-30 NW-NW	606	3750 EOLA DR NW	DALKE, TOM 3750 EOLA DR NW SALEM OR 97304			W	492.00	635.00	322.0	50.0	03/29/2007	04/06/2007	SPENGLER, RONALD RON ROBINSON WELL DRILLING	190577	87712	√					√									
MARI 60903	7.00S-3.00W-30 SW-SW	1000	1499 RIVER HAVEN DR S	JENSEN, SANDY 1649 CINNAMON HILL SE SALEM OR 97306		√	W	23.00	45.00	22.5	15.0	09/06/2007	09/17/2007	WALDROOP, MICHAEL BEIER & WALDROOP WELL SERVICES INC.	163066	68871	√					√									

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Township: 7 S, Range: 3 W, Sections: 30

Well Log	T-R-S/ QQ-Q	Taxlot	Street of Well	Owner	Company	Special Standards	Well Type	First Water	Completed Depth	Static Water Level	Yield	Completed Date	Received Date	Bonded Constructor	Startcard	Well Id #	New	Abandon	Deepen	Alteration	Conversion	Domestic	Irrigation	Community	Livestock	Industrial	Injection	Thermal	Dewatering	Piezometer	Latitude/ Longitude
MARI 61260	7.00S-3.00W-30 SW-SW	1100	1509 RIVERHAVEN DR S	KELLY, JULIE 1355 ROSEWAY COURT SE SALEM OR 97302		√	W	21.00	40.00	19.0	35.0	10/22/2007	11/21/2007	WALDROOP, MICHAEL BEIER & WALDROOP WELL SERVICES INC.	163063	68873	√					√									
POLK 52788	7.00S-3.00W-30 -		BEHIND 3545 SALEM DALLAS HWY NW	KELLY, BOB 3545 SALEM DALLAS HWY NW SALEM OR 97304			W	83.00	220.00	24.0	9.0	04/01/2008	05/01/2008	SPENGLER, RONALD RON ROBINSON WELL DRILLING	197421	90480	√					√									
POLK 52820	7.00S-3.00W-30 NW-NW		LOT 3 BEHIND 3545 SALEM DALLAS HWY NW		KELLEY ELEVEN LLC 3545 SALEM DALLAS HWY NW SALEM OR 97304		W	89.00	480.00	54.0	5.0	07/13/2008	07/29/2008	SPENGLER, RONALD RON ROBINSON WELL DRILLING	197432	90486	√					√									
POLK 52822	7.00S-3.00W-30 NW-NW		LOT 2 BEHIND 3545 SALEM DALLAS HWY NW		KELLEY ELEVEN LLC 3545 SALEM DALLAS HWY NW SALEM OR 97304		W	122.00	480.00	64.0	12.0	07/01/2008	07/29/2008	SPENGLER, RONALD RON ROBINSON WELL DRILLING	197430	90484	√					√									

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Township: 7 S, Range: 3 W, Sections: 31

Well Log	T-R-S/ QQ-Q	Taxlot	Street of Well	Owner	Company	Special Standards	Well Type	First Water	Completed Depth	Static Water Level	Yield	Completed Date	Received Date	Bonded Constructor	Startcard	Well Id #	New	Abandon	Deepen	Alteration	Conversion	Domestic	Irrigation	Community	Livestock	Industrial	Injection	Thermal	Dewatering	Piezometer	Latitude/ Longitude
MARI 8122	7.00S-3.00W-31 -			LOURITSEN, CLIFFORD 4021 MAHRT AVE SE SALEM OR 97301			W	45.00	65.00	30.0	20.0	07/27/1979	08/02/1979	BERNDT, GARRET H EOLA WELL DRILLING			√					√									
MARI 8124	7.00S-3.00W-31 -			BRESSLER, JUDSON 2792 COMMERCIAL SE SALEM OR 97302			W		32.00	15.0	20.0	08/27/1968	09/03/1968	SNEED, R F J A SNEED & SONS			√					√									
MARI 8125	7.00S-3.00W-31 -			COTTERMAN, ROBERT 916 NORMAN AVE SALEM OR 97301			W		50.00	20.0	10.0	08/04/1964	08/19/1964	BEIER, EMIL O WILLAMETTE DRILLING CO.			√					√									
MARI 8126	7.00S-3.00W-31 NE-NW				SANITARY SERVICE INC. 496 FERRY ST SE SALEM OR 97301		W					05/23/1973	04/10/1974	JANNSEN, EDWARD W A M JANNSEN DRILLING CO.			√														
MARI 8127	7.00S-3.00W-31 NW-SW			PFIEFER, LINCOLN 1344 TIERRA DR NE SALEM OR 97301			W	144.00	146.00	26.0	15.0	07/27/1974	08/01/1974	BELLO, PAUL BELLO WELL DRILLING			√					√									
MARI 8128	7.00S-3.00W-31 NW-SW			PFIEFER, LINCOLN 1344 TIERRA DR NE SALEM OR 97301			W	0.00	0.00	0.0			08/01/1974	BELLO, PAUL BELLO WELL DRILLING				√													
MARI 8130	7.00S-3.00W-31 NW-NW			ROSBACH, BRUCE L 2360 STATE ST SALEM OR 97301			W		70.00	12.0	45.0	03/25/1966	04/19/1966	DUFFIELD, HOWARD DUFFIELD BROTHERS			√					√									
MARI 8131	7.00S-3.00W-31 NW-NW			FLORA, LYLE H 1730 NE 24TH ST SALEM OR 97303			W	0.00	0.00	0.0			04/29/1968	DUFFIELD, HOWARD DUFFIELD BROTHERS			√					√									
MARI 8132	7.00S-3.00W-31 NW-NW			MURRAY, DALE RT 4 BOX 276A SALEM OR 97302			W		50.00	24.0	40.0	05/07/1968	05/10/1968	DUFFIELD, HOWARD DUFFIELD BROTHERS			√					√									
MARI 8133	7.00S-3.00W-31 SW-NE			HEYDEN, CARL RT 3 SALEM OR 97302			W		47.00								√					√									

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Township: 7 S, Range: 3 W, Sections: 31

Well Log	T-R-S/ QQ-Q	Taxlot	Street of Well	Owner	Company	Special Standards	Well Type	First Water	Completed Depth	Static Water Level	Yield	Completed Date	Received Date	Bonded Constructor	Startcard	Well Id #	New	Abandon	Deepen	Alteration	Conversion	Domestic	Irrigation	Community	Livestock	Industrial	Injection	Thermal	Dewatering	Piezometer	Latitude/ Longitude
MARI 8135	7.00S-3.00W-31 NE-SW			BOJE, E C 2025 S 12TH SALEM OR 97302			W	39.00	39.00	27.0	20.0	08/02/1957	12/31/1957	SNEED, R F J A SNEED & SONS			√					√									
MARI 8136	7.00S-3.00W-31 NW-SW			BEEGLE, ROBERT RT 3 BOX 918 SALEM OR 97302			W		40.00	25.0	15.0	12/21/1965	01/18/1966	DUFFIELD, HOWARD DUFFIELD BROTHERS			√					√									
MARI 8137	7.00S-3.00W-31 SW-SW				ILLAHE COUNTRY CLUB OR		W		76.00	16.0	450.0	03/31/1961	04/11/1961	SNEED, R F J A SNEED & SONS			√							√							
MARI 8138	7.00S-3.00W-31 SE-SW			HARVEY, J W RT 3 BOX 917A SALEM OR 97302			W										√					√									
MARI 8139	7.00S-3.00W-31 SW-SE				CLARK AND GROFF 3240 TRIANGLE DR SE SALEM OR 97302		W		29.00			02/08/1962	02/09/1962	TOMLINSON, R M			√														
MARI 17967	7.00S-3.00W-31 NE-SW			MILLER, WALT	MILLER FORESTS 2775 25TH ST SE SALEM OR 97306		W		43.00	17.0	450.0	07/07/1992	07/21/1992	BELLO, PAUL			√						√								
MARI 18603	7.00S-3.00W-31 NE-NW		2900 FANAGARE RD		COMMERCIAL SAND AND GRAVEL 2455 RIVER RD S SALEM OR 97302		W	125.00	160.00	28.0	25.0	07/30/1993	08/23/1993	MALLETT, DAN	43666		√					√									
MARI 51093	7.00S-3.00W-31 SW-SW		3376 COUNTRY CLUB DR S		SALEM DEVELOPMENT; SAFFRON, MORRIE (C/O) 325 COMMERCIAL ST NE SALEM OR 97301		W		61.00	24.3	300.0	10/16/1996	11/07/1996	WALDROOP, MICHAEL MIKE WALDROOP WELL DRILLING	92253	10935				√				√							
MARI 52287	7.00S-3.00W-31 NE-NE		BROWNS ISLAND DEMOLITION LANDFILL		COUNTY OF MARION; SOLID WASTE 388 STATE ST SUITE 735 SALEM OR 97301		M		15.00	8.0		09/23/1997	10/03/1997	MACK, EUGENE MACK DRILLING CO.	106223	19777				√											
MARI 52288	7.00S-3.00W-31 NE-NW		BROWNS ISLAND DEMOLITION LANDFILL		COUNTY OF MARION; SOLID WASTE 388 STATE ST SUITE 735 SALEM OR 97301		M		24.00	15.8		09/24/1997	10/03/1997	MACK, EUGENE MACK DRILLING CO.	106222	19781				√											

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Township: 7 S, Range: 3 W, Sections: 31

Well Log	T-R-S/ QQ-Q	Taxlot	Street of Well	Owner	Company	Special Standards	Well Type	First Water	Completed Depth	Static Water Level	Yield	Completed Date	Received Date	Bonded Constructor	Startcard	Well Id #	New	Abandon	Deepen	Alteration	Conversion	Domestic	Irrigation	Community	Livestock	Industrial	Injection	Thermal	Dewatering	Piezometer	Latitude/ Longitude
MARI 52289	7.00S-3.00W-31 NE-NW		BROWNS ISLAND DEMOLITION LANDFILL		COUNTY OF MARION; SOLID WASTE 388 STATE ST SUITE 735 SALEM OR 97301		M		37.00	15.8		09/24/1997	10/03/1997	MACK, EUGENE MACK DRILLING CO.	106251	19780				√											
MARI 52285	7.00S-3.00W-31 NE-NE		BROWNS ISLAND DEMOLITION LANDFILL		COUNTY OF MARION; SOLID WASTE 388 STATE ST SUITE 735 SALEM OR 97301		M		26.00	13.9		09/23/1997	10/03/1997	MACK, EUGENE MACK DRILLING CO.	106225	19779				√											
MARI 52286	7.00S-3.00W-31 NE-NE		BROWNS ISLAND DEMOLITION LANDFILL		COUNTY OF MARION; SOLID WASTE 388 STATE ST SUITE 735 SALEM OR 97301		M		34.00	14.0		09/23/1997	10/03/1997	MACK, EUGENE MACK DRILLING CO.	106224	19778				√											
MARI 53562	7.00S-3.00W-31 NE-NE	1600	ILLAHE SEWER LAGOONS OFF BROWNS ISLAND RD		SALEM DEVELOPMENT INC. 325 COMMERCIAL ST NE SALEM OR 97301		M	18.00	25.00	10.0		10/02/1998	10/30/1998	MCINNIS, GREG GEO TECH EXPLORATIONS INC.	112599	29857	√														
MARI 53563	7.00S-3.00W-31 NE-NE	1600	ILLAHE SEWER LAGOONS OFF BROWNS ISLAND RD		SALEM DEVELOPMENT INC. 325 COMMERCIAL ST NE SALEM OR 97301		M	18.00	25.00	18.0		10/03/1998	10/30/1998	MCINNIS, GREG GEO TECH EXPLORATIONS INC.	112601	29859	√														
MARI 53564	7.00S-3.00W-31 NE-NE	1600	ILLAHE SEWER LAGOONS OFF BROWNS ISLAND RD		SALEM DEVELOPMENT INC. 325 COMMERCIAL ST NE SALEM OR 97301		M	22.00	30.00	22.0		10/02/1998	10/30/1998	MCINNIS, GREG GEO TECH EXPLORATIONS INC.	112600	29858	√														
MARI 55403	7.00S-3.00W-31 NE-NE	300			SALEM DEVELOPMENT INC. PO BOX 335 SALEM OR 97301		W	25.00	56.00	23.0	20.0	12/07/2000	12/21/2000	SIPPEL, FLOYD G SIPPEL WELL DRILLING INC.	134400	45790	√							√							
MARI 55404	7.00S-3.00W-31 NE-NE	300			SALEM DEVELOPMENT INC. PO BOX 335 SALEM OR 97301		W	32.00	50.00	25.0	20.0	12/06/2000	12/21/2000	SIPPEL, FLOYD G SIPPEL WELL DRILLING INC.	134399	45789	√							√							
MARI 55405	7.00S-3.00W-31 NE-NE	300			SALEM DEVELOPMENT CO. PO BOX 335 SALEM OR 97301		W	21.00	80.00	17.0	12.0	12/18/2000	12/21/2000	SIPPEL, FLOYD G SIPPEL WELL DRILLING INC.	137238	45792	√							√							
MARI 55783	7.00S-3.00W-31 NW-SW	300	3376 COUNTRY CLUB DR S		SALEM DEVELOPMENT PO BOX 335 SALEM OR 97308		W		42.00	23.0	215.0	04/06/2001	06/18/2001	WALDROOP, MICHAEL STETTLER SUPPLY CO.	138718	48791				√				√							

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Township: 7 S, Range: 3 W, Sections: 31

Well Log	T-R-S/ QQ-Q	Taxlot	Street of Well	Owner	Company	Special Standards	Well Type	First Water	Completed Depth	Static Water Level	Yield	Completed Date	Received Date	Bonded Constructor	Startcard	Well Id #	New	Abandon	Deepen	Alteration	Conversion	Domestic	Irrigation	Community	Livestock	Industrial	Injection	Thermal	Dewatering	Piezometer	Latitude/ Longitude
MARI 58621	7.00S-3.00W-31 NW-SE		INTERSTATE 5 AND HWY 22		OREGON DEPARTMENT OF TRANSPORTATION 455 AIRPORT RD SE; BUILDING A SALEM OR 97301		G		0.00			12/12/2004	01/06/2005				√	√													
MARI 58622	7.00S-3.00W-31 NW-SE		INTERSTATE 5 AND HWY 22		OREGON DEPARTMENT OF TRANSPORTATION 455 AIRPORT RD SE; BUILDING A SALEM OR 97301		G		0.00			12/12/2004	01/06/2005				√	√													
MARI 60356	7.00S-3.00W-31 NW-NW	1000	1809 LOCKMERE AVE S, SALEM	NOFZIGER, ELMER 322 KING RD SILVERLAKE WA 98645			W	25.00	64.00	22.0	10.0	04/30/2007	05/09/2007	SIPPEL, FLOYD G SIPPEL WELL DRILLING INC	191990	87427	√					√									
MARI 62131	7.00S-3.00W-31 NW-SE	6300	810 LANCASTER DR SE		I-Z PROPERTIES PO BOX 7135 SALEM OR 97303		G		0.00	24.0		10/28/2008	10/31/2008				√	√													

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Township: 7 S, Range: 3 W, Sections: 32

Well Log	T-R-S/ QQ-Q	Taxlot	Street of Well	Owner	Company	Special Standards	Well Type	First Water	Completed Depth	Static Water Level	Yield	Completed Date	Received Date	Bonded Constructor	Startcard	Well Id #	New	Abandon	Deepen	Alteration	Conversion	Domestic	Irrigation	Community	Livestock	Industrial	Injection	Thermal	Dewatering	Piezometer	Latitude/ Longitude
MARI 8141	7.00S-3.00W-32 -			STONEBROOK, EARL RT 1 BOX 40 INDEPENDENCE OR 97351			W		32.00	3.0		07/21/1962	07/25/1962	BEIER, EMIL O WILLAMETTE DRILLING CO.			√						√								
MARI 8142	7.00S-3.00W-32 -				RIVER BEND SAND AND GRAVEL CO. 645 7TH NW SALEM OR 97304		W		65.00	19.0		02/16/1967	07/31/1967	MILLER, HARLAN R MILLER-ROBINSON & WEST			√														
MARI 8145	7.00S-3.00W-32 -				RIVER BEND SAND AND GRAVEL CO. 645 7TH NW SALEM OR 97304		W		28.00	15.0		02/22/1967	07/31/1967	MILLER, HARLAN R MILLER-ROBINSON & WEST			√														
MARI 8146	7.00S-3.00W-32 NW-NW				SANITARY SERVICE INC. 496 FERRY ST SE SALEM OR 97301		W					05/31/1973	04/10/1974	JANNSEN, EDWARD W A M JANNSEN DRILLING CO.			√														
MARI 8147	7.00S-3.00W-32 NW-NW				SANITARY SERVICE INC. 496 FERRY ST SE SALEM OR 97301		W	35.00	65.00	35.0		04/25/1973	04/10/1974	JANNSEN, EDWARD W A M JANNSEN DRILLING CO.			√														
MARI 8148	7.00S-3.00W-32 SW-NW				SANITARY SERVICE INC. 496 FERRY ST SE SALEM OR 97301		W	31.00	51.00	31.0		05/21/1973	04/10/1974	JANNSEN, EDWARD W A M JANNSEN DRILLING CO.			√														
MARI 8149	7.00S-3.00W-32 NW-SE				SALEM GOLF CLUB R 3 SALEM OR 97302		W		46.00	18.0	350.0	08/26/1958	10/01/1958	SNEED, R F J A SNEED & SONS			√						√								
MARI 8150	7.00S-3.00W-32 SW-SW			JENSEN, HAROLD RT 3 SALEM OR 97302			W		30.00								√					√									
MARI 52304	7.00S-3.00W-32 NW-NW		BROWNS ISLAND DEMOLITION LANDFILL		COUNTY OF MARION; SOLID WASTE 388 STATE ST SUITE 735 SALEM OR 97301		M		47.00	30.4		09/23/1997	10/03/1997	MACK, EUGENE MACK DRILLING CO.	106832	19766				√											
MARI 52305	7.00S-3.00W-32 NW-NW		BROWNS ISLAND DEMOLITION LANDFILL		COUNTY OF MARION; SOLID WASTE 388 STATE ST SUITE 735 SALEM OR 97301		M		41.00	30.2		09/23/1997	10/03/1997	MACK, EUGENE MACK DRILLING CO.	106833	15810				√											

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Township: 7 S, Range: 3 W, Sections: 32

Well Log	T-R-S/ QQ-Q	Taxlot	Street of Well	Owner	Company	Special Standards	Well Type	First Water	Completed Depth	Static Water Level	Yield	Completed Date	Received Date	Bonded Constructor	Startcard	Well Id #	New	Abandon	Deepen	Alteration	Conversion	Domestic	Irrigation	Community	Livestock	Industrial	Injection	Thermal	Dewatering	Piezometer	Latitude/ Longitude
MARI 52298	7.00S-3.00W-32 NE-SE		BROWNS ISLAND DEMOLITION LANDFILL		COUNTY OF MARION; SOLID WASTE 388 STATE ST SUITE 735 SALEM OR 97301		M		34.00	6.0		09/23/1997	10/03/1997	MACK, EUGENE MACK DRILLING CO.	106247	19771				√											
MARI 52299	7.00S-3.00W-32 NW-SW		BROWNS ISLAND DEMOLITION LANDFILL		COUNTY OF MARION; SOLID WASTE 388 STATE ST SUITE 735 SALEM OR 97301		M		22.00	19.8		09/23/1997	10/03/1997	MACK, EUGENE MACK DRILLING CO.	106246	19770				√											
MARI 52300	7.00S-3.00W-32 NW-NW		BROWNS ISLAND DEMOLITION LANDFILL		COUNTY OF MARION; SOLID WASTE 388 STATE ST SUITE 735 SALEM OR 97301		M		58.00	39.0		09/30/1997	10/03/1997	MACK, EUGENE MACK DRILLING CO.	106835	19769				√											
MARI 52301	7.00S-3.00W-32 NW-NW		BROWNS ISLAND DEMOLITION LANDFILL		COUNTY OF MARION; SOLID WASTE 388 STATE ST SUITE 735 SALEM OR 97301		M		42.00	37.4		09/30/1997	10/03/1997	MACK, EUGENE MACK DRILLING CO.	106834	19768				√											
MARI 52302	7.00S-3.00W-32 NW-NW		BROWNS ISLAND DEMOLITION LANDFILL		COUNTY OF MARION; SOLID WASTE 388 STATE ST SUITE 735 SALEM OR 97301		M		51.00	34.8		09/23/1997	10/03/1997	MACK, EUGENE MACK DRILLING CO.	106831	19767				√											
MARI 52509	7.00S-3.00W-32 NW-SW				COUNTY OF MARION; SOLID WASTE 388 STATE ST SUITE 735 SALEM OR 97301		M		33.00	25.6		10/14/1997	11/04/1997	MACK, EUGENE MACK DRILLING CO.	106837	19783	√														
MARI 52510	7.00S-3.00W-32 NW-SW				COUNTY OF MARION; SOLID WASTE 388 STATE ST SUITE 735 SALEM OR 97301		M		43.00	28.0		10/14/1997	11/04/1997	MACK, EUGENE MACK DRILLING CO.	106836	19782				√											
MARI 52511	7.00S-3.00W-32 NW-SW				COUNTY OF MARION; SOLID WASTE 388 STATE ST SUITE 735 SALEM OR 97301		M		54.00	28.3		10/14/1997	11/04/1997	MACK, EUGENE MACK DRILLING CO.	106838	19784				√											
MARI 53661	7.00S-3.00W-32 NW-NW	100	2895 FARAGATE ST; BROWNS ISLND DEMOLITION LANDFILL		COUNTY OF MARION 388 STATE ST SUITE 735 SALEM OR 97301		M	12.00	40.00	12.6		11/10/1998	12/02/1998	MCINNIS, GREG GEO TECH EXPLORATIONS INC.	117226	29714	√														
MARI 53662	7.00S-3.00W-32 NW-NW	100	2895 FARAGATE ST; BROWNS ISLND DEMOLITION LANDFILL		COUNTY OF MARION 388 STATE ST SUITE 735 SALEM OR 97301		M	13.00	46.00	13.2		11/11/1998	12/02/1998	MCINNIS, GREG GEO TECH EXPLORATIONS INC.	117227	29715	√														

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Township: 7 S, Range: 3 W, Sections: 32

Well Log	T-R-S/ QQ-Q	Taxlot	Street of Well	Owner	Company	Special Standards	Well Type	First Water	Completed Depth	Static Water Level	Yield	Completed Date	Received Date	Bonded Constructor	Startcard	Well Id #	New	Abandon	Deepen	Alteration	Conversion	Domestic	Irrigation	Community	Livestock	Industrial	Injection	Thermal	Dewatering	Piezometer	Latitude/ Longitude
MARI 54242	7.00S-3.00W-32 NW-NW		BROWNS ISLAND DEMOLITION LANDFILL		COUNTY OF MARION; SOLID WASTE 388 STATE ST SALEM OR 97301		M		0.00			08/02/1999	08/19/1999	MACK, EUGENE MACK DRILLING CO.	124260			√													
MARI 56623	7.00S-3.00W-32 SE-NE	100	MINTO BROWN ISLAND PARK		CITY OF SALEM; DEPARTMENT OF COMMUNITY SERVICES 1460 20TH ST SE SALEM OR 97302		W		0.00	28.0		06/26/2002	06/27/2002	SIPPEL, FLOYD G SIPPEL WELL DRILLING INC.	137212			√					√								
MARI 20803	7.00S-3.00W-32 -			BEEGLE, ROBERT RT 3 BOX 918 SALEM OR 97301			W		35.00	8.0	300.0	05/20/1967	07/31/1967	MILLER, HARLAN R MILLER ROBINSON AND WEST			√						√								
MARI 20804	7.00S-3.00W-32 -			SCHINDLER, LEONARD 1885 ORCHARD HEIGHTS RD SALEM OR 97304			W		65.00	21.0	20.0	08/24/1968	08/29/1968	SNEED, RICHARD F DECEASED 10-9 -1996/R F SNEED WELL DRILLING			√					√									

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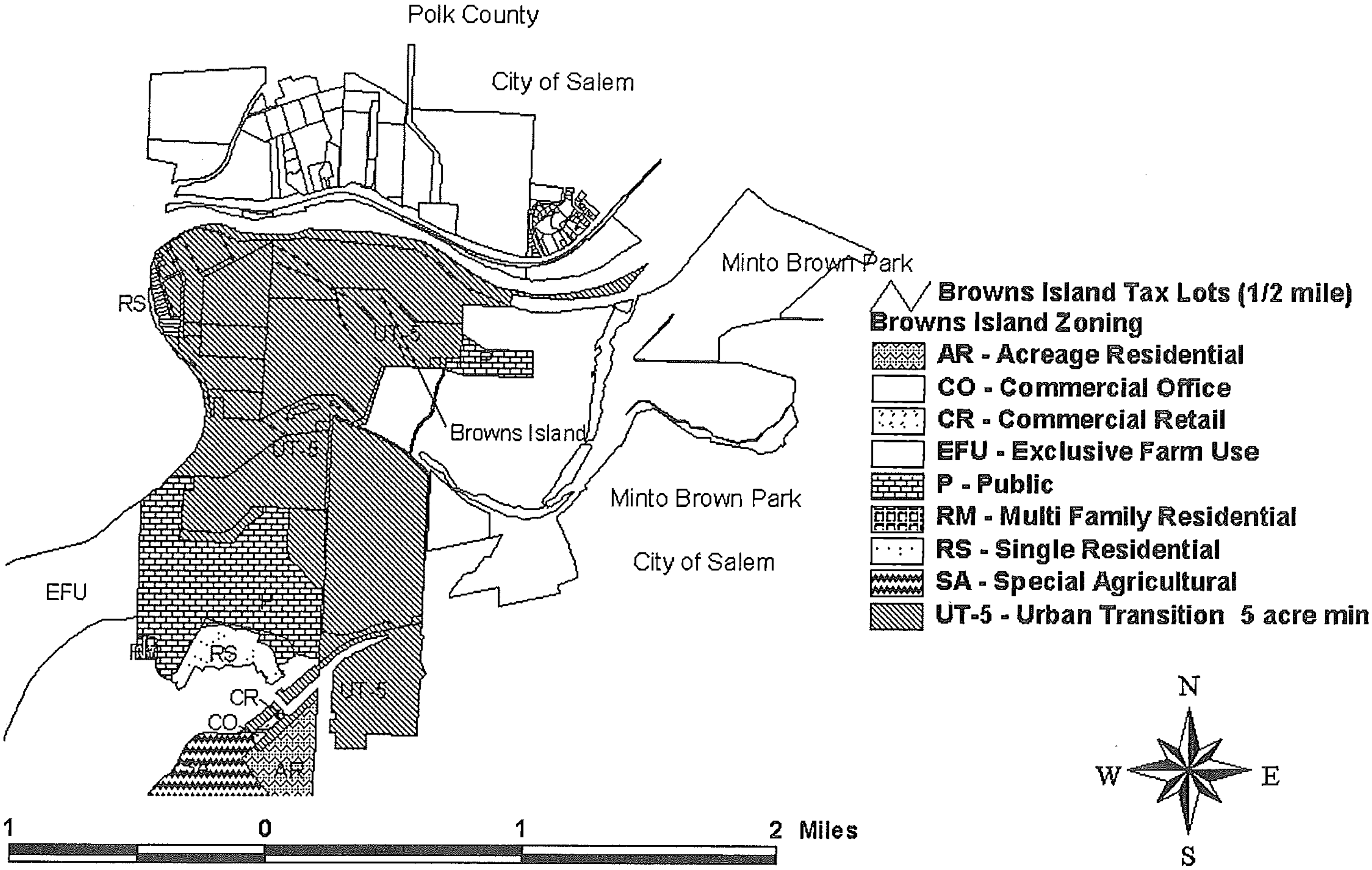
APPENDIX D

Property Owners and Zoning within ½-mile of the Site

Browns Island Tax Lots and Zoning
1/2 mile radius



2013 BROWN'S ISLAND ADJACENT PROPERTY OWNERS - MARION COUNTY

TAXLOT	STREET	OWNERNAME	OWNERADD	CITY	ST	ZIP
073W3200100		CITY OF SALEM	555 LIBERTY ST SE	SALEM	OR	97301
073W3000500		SIMONSON,DAVID A & DONNA	6455 NE COLUMBIA BLVD	PORTLAND	OR	97220
073W3000400		HEYDEN,DEREK ALLEN 25% &	33849 TERRA CIRCLE DR SE	CORVALLIS	OR	97330
073W3000100	2895 FARAGATE AV S	MARION COUNTY-SOLID WASTE	PO BOX 14500	SALEM	OR	97309
073W3100400		SIMONSON,DAVID A & DONNA	6455 NE COLUMBIA BLVD	PORTLAND	OR	97218
073W3000200		HEYDEN,DEREK ALLEN 25% &	33849 TERRA CIRCLE DR SE	CORVALLIS	OR	97330
073W3000599		SIMONSON,DAVID A & DONNA	6455 NE COLUMBIA BLVD	PORTLAND	OR	97218
073W3100300	3221 FARAGATE AV S	HEYDEN,ROGER-ETAL	33849 TERRA CIRCLE DR SE	CORVALLIS	OR	97330
073W3000100	2895 FARAGATE AV S	MARION COUNTY-SOLID WASTE	PO BOX 14500	SALEM	OR	97309
073W3100300	3221 FARAGATE AV S	HEYDEN,ROGER-ETAL	33849 TERRA CIRCLE DR SE	CORVALLIS	OR	97330
073W3000100	2895 FARAGATE AV S	MARION COUNTY-SOLID WASTE	PO BOX 14500	SALEM	OR	97309
073W3100200		MARION COUNTY-SOLID WASTE	PO BOX 14500	SALEM	OR	97309
073W3100300	3221 FARAGATE AV S	HEYDEN,ROGER-ETAL	33849 TERRA CIRCLE DR SE	CORVALLIS	OR	97330
073W3200100		CITY OF SALEM	555 LIBERTY ST SE	SALEM	OR	97301
073W3100200		MARION COUNTY-SOLID WASTE	PO BOX 14500	SALEM	OR	97309
073W3000100	2895 FARAGATE AV S	MARION COUNTY-SOLID WASTE	PO BOX 14500	SALEM	OR	97309
073W3100600		HEYDEN,DEREK ALLEN 25% &	33849 TERRA CIRCLE DR SE	CORVALLIS	OR	97330
073W3200200		MARION COUNTY	PO BOX 14500	SALEM	OR	97309
073W3100700		HEYDEN,DEREK ALLEN 25% &	33849 TERRA CIRCLE DR SE	CORVALLIS	OR	97330
073W3200400		MARION COUNTY-SOLID WASTE	PO BOX 14500	SALEM	OR	97309
073W3200500		MARION COUNTY-SOLID WASTE	PO BOX 14500	SALEM	OR	97309
073W3200100		CITY OF SALEM	555 LIBERTY ST SE	SALEM	OR	97301
073W3200100		CITY OF SALEM	555 LIBERTY ST SE	SALEM	OR	97301
073W3100801		SIMONSON,DAVID A & DONNA	6455 NE COLUMBIA BLVD	PORTLAND	OR	97218
073W3100301	3225 FARAGATE AV S	KJD PROPERTIES LLC	4131 IMPERIAL DR	WEST LINN	OR	97068
073W3200100		CITY OF SALEM	555 LIBERTY ST SE	SALEM	OR	97301
073W3300300	2025 GOLF COURSE RD S	SALEM GOLF CLUB INC	2025 GOLF COURSE RD S	SALEM	OR	97302
073W3101100	3410 FARAGATE AV S	MILLER FORESTS INC	PO BOX 12395	SALEM	OR	97309
073W3100900		MILLER FORESTS INC	PO BOX 12395	SALEM	OR	97309
073W3102000		MILLER FORESTS INC	PO BOX 12395	SALEM	OR	97309
073W3101900	3221 FARAGATE AV S	KJD PROPERTIES LLC	4131 IMPERIAL DR	WEST LINN	OR	97068
073W3200100		CITY OF SALEM	555 LIBERTY ST SE	SALEM	OR	97301
073W3101800		MILLER FORESTS INC	PO BOX 12395	SALEM	OR	97309
073W3200100		CITY OF SALEM	555 LIBERTY ST SE	SALEM	OR	97301
073W3200600	2806 HOMESTEAD RD S	CITY OF SALEM	555 LIBERTY ST SE	SALEM	OR	97301
073W3200101	2025 GOLF COURSE RD S	SALEM GOLF CLUB INC	2025 GOLF COURSE RD S	SALEM	OR	97302

2013 BROWN'S ISLAND ADJACENT PROPERTY OWNERS - POLK COUNTY

TAXLOT	STREET	OWNERNAME	OWNERADD2	CITY	ST	ZIP
073W30A1300	DALLAS HWY.	FURSMAN OLIVER C	3371 DALLAS HWY NW	SALEM	OR	97304
073W30A1400	DALLAS HWY.	GLAZE GREGORY C & SUSAN D	3375 DALLAS HWY NW	SALEM	OR	97304
073W30A1600	DALLAS HWY.	LEOPOLD MARJORIE S	3455 DALLAS HWY NW	SALEM	OR	97304
073W29600	DALLAS HWY.	U S NATIONAL BANK OF OREGON	P O BOX 3168 (PL-6)	PORTLAND	OR	97208
073W29600	DALLAS HWY.	U S NATIONAL BANK OF OREGON	P O BOX 3168 (PL-6)	PORTLAND	OR	97208
073W30A1500	DALLAS HWY.	"EVERETT TRUST"	P O BOX 5421	SALEM	OR	97304
073W30A1700		KELLY ROBERT J & BETTY M	3545 DALLAS HWY NW	SALEM	OR	97304
073W30202	DALLAS HWY.	GWYNN DENNIS W & KWANG NIM	3255 DALLAS HWY NW	SALEM	OR	97304
073W30801		PARK STATE HIGHWAY COMMISSION	525 TRADE ST SE	SALEM	OR	97310
073W30A2000		PARK STATE HIGHWAY COMMISSION	STATE HWY BLDG	SALEM	OR	97310
073W30A2100		PARK STATE HIGHWAY COMMISSION	STATE HWY BLDG	SALEM	OR	97310
073W30A2700	DALLAS HWY.	LECOMPTE ANDREW C	3475 DALLAS HWY NW	SALEM	OR	97304
073W30A2200	DALLAS HWY.	WILLSON MARGE	3605 DALLAS HWY NW	SALEM	OR	97304
073W291600		HUT DEVELOPMENT CORP	4800 DALLAS HWY NW #A	SALEM	OR	97304
073W30A2600	DALLAS HWY.	O'NEIL EDWARD D & STEPHANIE L	3505 DALLAS HWY NW	SALEM	OR	97304
073W30A2400	DALLAS HWY.	KELLY ROBERT J & BETTY M	3545 DALLAS HWY NW	SALEM	OR	97304
073W30A2300		WIDMER NATHAN & PATRICIA ET AL	3575 DALLAS HWY NW	SALEM	OR	97304
073W30A2500	DALLAS HWY.	JAMES WYATT & JENNIFER L	3515 DALLAS HWY NW	SALEM	OR	97304
073W29DB1300	COLLEGE	WILLAMETTE CHRISTIAN FELLOWSHP	255 COLLEGE DR NW	SALEM	OR	97304
073W30205		FAGAN DENNIS M & MARY E	3253 DALLAS HWY NW	SALEM	OR	97304
073W301800		HUT DEVELOPMENT CORP	4800 DALLAS HWY NW #A	SALEM	OR	97304
073W30203		GWYNN DENNIS W & KWANG NIM	3255 DALLAS HWY NW	SALEM	OR	97304
073W30201	DALLAS HWY.	FAGAN DENNIS M & MARY E	3253 DALLAS HWY NW	SALEM	OR	97304
073W30204		GWYNN DENNIS W & KWANG NIM	3255 DALLAS HWY NW	SALEM	OR	97304
073W30206		FAGAN DENNIS M & MARY E	3253 DALLAS HWY NW	SALEM	OR	97304
073W29DB1301		SMITH LOWELL A	1630 HILLWOOD CT S	SALEM	OR	97302
073W29700		BONNEVILLE POWER SUB-STATION	P O BOX 3621	PORTLAND	OR	97208
073W29DB4600	COLLEGE	COLLEGE PARK, LLC	7585 STATE ST	SALEM	OR	97301
073W29DB5300	COLLEGE DR NW	COLLEGE PARK, LLC	7585 STATE ST	SALEM	OR	97301
073W29DB5200	COLLEGE DR NW	COLLEGE PARK, LLC	7585 STATE ST	SALEM	OR	97301
073W29DB4700	COLLEGE DR NW	COLLEGE PARK, LLC	7585 STATE ST	SALEM	OR	97301
073W302100		HUT DEVELOPMENT CORP	4800 DALLAS HWY NW #A	SALEM	OR	97304
073W29DB1501	COLLEGE DR NW	COLLEGE PARK, LLC	7585 STATE ST	SALEM	OR	97301
073W29DB4800	COLLEGE DR NW	COLLEGE PARK, LLC	7585 STATE ST	SALEM	OR	97301
073W29DB1601	COLLEGE DR NW	COLLEGE PARK, LLC	7585 STATE ST	SALEM	OR	97301

2013 BROWN'S ISLAND ADJACENT PROPERTY OWNERS - POLK COUNTY

TAXLOT	STREET	OWNERNAME	OWNERADD2	CITY	ST	ZIP
073W29DB1500		RAWLINS M DUANE, INC	7085 BATTLECREEK RD SE	SALEM	OR	97301
073W29DB5100	COLLEGE DR NW	COLLEGE PARK, LLC	7585 STATE ST	SALEM	OR	97301
073W30900	DALLAS HWY.	WILLIAMS TRUST ET AL	395 LEFELLE ST S	SALEM	OR	97302
073W29DB3100	1/2 STONEWAY	PRATT LAWRENCE A & VALRIE	1320 OAK GROVE RD NW	SALEM	OR	97304
073W29DB1600		RAWLINS M DUANE, INC	7085 BATTLECREEK RD SE	SALEM	OR	97301
073W29800	DALLAS HWY.	VOIGT DANIEL E, RVCBL LVNG TR	3574 EOLA DR NW	SALEM	OR	97304
073W29DB4900	COLLEGE DR NW	COLLEGE PARK, LLC	7585 STATE ST	SALEM	OR	97301
073W29DB3700	DALLAS HWY.	A F G CORPORATION ET AL	2401 DALLAS HWY NW	SALEM	OR	97304
073W29701		BONNEVILLE POWER SUB-STATION	P O BOX 3621	PORTLAND	OR	97208
073W29DB5000		RAWLINS M DUANE, INC	7085 BATTLECREEK RD SE	SALEM	OR	97301
073W29600	DALLAS HWY.	U S NATIONAL BANK OF OREGON	P O BOX 3168 (PL-6)	PORTLAND	OR	97208
073W29DB1700	COLLEGE	SMITH LOWELL A & MAUREEN E, LI	1630 HILLWOOD CT S	SALEM	OR	97302
073W29DB3000	DALLAS HWY.	DALKE LIVING TRUST ET AL	2920 BRECKENRIDGE ST NW	SALEM	OR	97304
073W29DB3500	DALLAS HWY.	KIMBALL DARWIN B	2275 ELECTRIC AVE	SALEM	OR	97302
073W29DB5400		RAWLINS M DUANE, INC	7085 BATTLECREEK RD SE	SALEM	OR	97301
073W29DB2500	COLLEGE	D M P INVESTMENTS	P O BOX 5517	SALEM	OR	97304
073W29DB2600	DALLAS HWY.	ERB LESTER W & VONNIE K	P O BOX 5400	SALEM	OR	97304
073W29DB5500		RAWLINS M DUANE, INC	7085 BATTLECREEK RD SE	SALEM	OR	97301
073W29DB2900	DALLAS HWY.	SIMPSON JOHN A & FERNANDEZ R E	P O BOX 5268	SALEM	OR	97302
073W29DB3601		CITY OF SALEM	555 LIBERTY ST SE	SALEM	OR	97301
073W29DB2701	DALLAS HWY.	WILLIS GERALD	791 ORCHARD HEIGHTS RD N	SALEM	OR	97304
073W29DB3001	DALLAS HWY.	SIMPSON JOHN A & FERNANDEZ R E	P O BOX 5268	SALEM	OR	97302
073W29DB1800	COLLEGE	BATHURST THOMAS H & LYNN R	165 COLLEGE DR NW	SALEM	OR	97304
073W29DB3201		CITY OF SALEM	555 LIBERTY ST SE	SALEM	OR	97301
073W29DB2601	DALLAS HWY.	ERB LESTER W & VONNIE K	P O BOX 5400	SALEM	OR	97304
073W29DB1900	COLLEGE	ANDERSON KAMI JOENE	155 COLLEGE DR NW	SALEM	OR	97304
073W29DB2700	DALLAS HWY.	WILLIS GERALD	791 ORCHARD HEIGHTS RD N	SALEM	OR	97304
073W29DB2000	COLLEGE	WYNIA DENNIS E	145 COLLEGE DR NW	SALEM	OR	97304
073W29DB2400	COLLEGE	VANWORMER RAYMOND	1509 BIG VALLEY RD	RENO	NV	80511
073W29DB2100	DALLAS HWY.	DALKE HERBERT, REVOCABLE TRUST	1099 MANZANITA ST NE	KEIZER	OR	97303
073W29DB2300	COLLEGE	GRANNER EDNA B & GRANNER DENNI	125 COLLEGE DR NW	SALEM	OR	97304
073W29DB2200	DALLAS HWY.	BRILL LIVING TRUST	2625 DALLAS HWY NW	SALEM	OR	97304

APPENDIX E

Nitrate Investigation – 2007 and 2008

From 2008 Browns Island Landfill Annual Water Quality Monitoring Report

2.4 NITRATE INVESTIGATION

Nitrate is generally detected above its primary standard in a least one groundwater sample collected from the site each year. These detections usually only occur in shallow wells and primarily at well MW-8a. Elevated nitrate concentrations have also occurred at background well MW-15 and at cross-gradient wells MW-9a/b. Based on the location of the nitrate detections, the source has been considered to be related to agricultural activities (fertilizer application) occurring adjacent to and up-gradient of the wells showing elevated concentrations and not from the landfill. Elevated nitrate concentrations are typically observed in Fall event samples.

To ascertain if the source of nitrate is related to nearby agricultural activities (fertilizer application) an investigation was performed as part of the Fall 2007 sampling event. At that time, groundwater samples from wells MW-8a, MW-9b and MW-15 were also analyzed for stable nitrogen and oxygen isotope signatures of nitrate, and surface soil samples collected from adjacent crop land were analyzed for nitrate (as nitrogen), ammonia (as nitrogen) and total kjeldahl nitrogen.

Results of the Fall 2007 groundwater nitrate isotope data indicated the presence of two signature types. The isotope signature of samples collected from wells MW-9b and MW-15 were consistent with a fertilizer source. In contrast, the sample from MW-8a showed a waste type signature, possibly affected by denitrification. There were also indications that dissolved organic nitrogen was present at MW-8a.

The occurrence of elevated nitrate at well MW-8a in samples collected during the fall events appeared to be due to transformation of reduced nitrogen species (e.g. oxidation of ammonia or nitrification of organic nitrogen) to nitrate near the water table. The waste-type isotope signature of nitrate in MW-8a suggests that the reduced nitrogen species originate from the landfill rather than agricultural activities. It was noted that inactive well MW-10a is similar to MW-8a, a shallow screen located across the water table, but that elevated nitrate concentrations were not observed at MW-10a.

In a letter dated May 6, 2008, the DEQ indicated that based on site specific conditions, the concentrations of nitrate at MW-8a do not appear to adversely affect the beneficial uses of groundwater and as such, a corrective action was not warranted. However, in an effort to confirm the Fall 2007 results interpretation, additional sampling activities were proposed. The following additional sample activities were completed in 2008 in an attempt to fingerprint the nitrogen source specifically observed at MW-8a:

1. Exploration sampling: Inactive wells MW-2a and MW-6a were sampled on April 9th. These two wells appear to be located either in or adjacent to waste fill. Samples from the well were analyzed for ammonia and TKN to obtain nitrogen information associated with the landfill's leachate.

2. Spring event: Based on exploration sample results, wells MW-2a and MW-6a were sampled again during the Spring 2008 along with MW-8a, MW-9a, and MW-15 for isotope ammonia.

3. Fall event: Samples from wells MW-6a, MW-8a, MW-9b, and MW-15 were analyzed for isotope ammonia and nitrate. Well MW-2a was dry and could not be sampled.

The objective of this additional sampling and analysis was to determine whether ammonia and/or organic nitrogen concentrations were sufficient to explain the observed elevated nitrate concentrations typically observed in the Fall samples. Results of these investigation activities are presented and discussed in Section 4.5.

Table 9: Nitrate Investigation Summary Results
2008 Annual Water Quality Monitoring Report
Brown's Island Landfill

Samples Collected in 2007

Sample Location	Sample Matrix	Sample Date	Nitrate-N	Ammonia-N	Total Kjeldahl Nitrogen	$^{15}N/^{14}N$ (nitrate)	^{18}O (oxygen)	Initial Dissolved Oxygen	Sample Dissolved Oxygen	Depth to Water Level (feet)
MW-8a	groundwater	5/24/2007	0.650	0.535	na	na	na	1.39	4.73	15.80
MW-8a	groundwater	9/27/2007	15.7	0.730	na	17.7	-0.9	2.34	3.46	18.68
40 ft S of MW-8a @ 1.5 ft	soil	9/26/2007	1.19	< 0.60	520	na	na	na	na	-
40 ft S of MW-8a @ 4.0 ft	soil	9/26/2007	1.07	< 0.60	420	na	na	na	na	-
150 ft SW of MW-8a @ 1.5 ft	soil	9/26/2007	0.893	< 0.60	360	na	na	na	na	-
150 ft SW of MW-8a @ 1.5 ft	soil	9/26/2007	0.862	< 0.60	550	na	na	na	na	-
MW-9b	groundwater	5/24/2007	1.78	< 0.0500	na	na	na	2.52	2.84	14.57
MW-9b	groundwater	9/27/2007	6.19	< 0.0500	na	2.2	0.0	3.2	5.10	17.10
SW of MW-9b @ 1.5 ft	soil	9/26/2007	6.43	0.62 est	500	na	na	na	na	-
SW of MW-9b @ 4.0 ft	soil	9/26/2007	3.44	< 0.60	410	na	na	na	na	-
MW-15	groundwater	5/24/2007	3.88	< 0.0500	na	na	na	3.00	4.08	16.45
MW-15	groundwater	9/27/2007	4.12	< 0.0500	na	9.8	13.0	2.3	1.39	20.59
S of MW-15 @ .75 ft	soil	9/26/2007	0.270	0.83 est	600	na	na	na	na	-
S of MW-15 @ 1.0 ft	soil	9/26/2007	< 0.050	1.1 est	770	na	na	na	na	-

Notes:
Groundwater concentrations of 15N and 18O are in units of 0/00.
Groundwater concentrations of nitrate-n are in units of mg/l.
Soil concentrations are in units of mg/Kg.
Intitial DO is the first reading recorded during purging. Sample DO is the reading recorded during sample collection.
na - indicates not analyzed.

Samples Collected in 2008

Sample Location	Sample Matrix	Sample Date	Nitrate-N	Ammonia-N	Total Kjeldahl Nitrogen	$^{15}N/^{14}N$ (nitrate)	$^{15}N/^{14}N$ (ammonia)	Initial Dissolved Oxygen	Sample Dissolved Oxygen	Depth to Water Level (feet)
MW-2a	groundwater	4/9/2008	<0.100	22.7	16.8	na	na	na	na	34.72
MW-6a	groundwater	4/9/2008	0.120	35.4	29.0	na	na	na	na	27.61
MW-2a	groundwater	5/22/2008	na	15.3	14.4	na	n/a	1.28	2.52	32.94
MW-6a	groundwater	5/22/2008	na	30.5	28.6	na	5.8	0.72	1.22	26.22
MW-8a	groundwater	5/22/2008	0.420	< 0.0500	<0.0500	na	3.0	5.68	6.12	9.80
MW-9a	groundwater	5/22/2008	1.02	< 0.0500	na	na	-2.6	7.56	2.31	9.67
MW-9b	groundwater	5/22/2008	3.73	< 0.0500	na	na	n/a	2.64	2.21	9.74
MW-15	groundwater	5/22/2008	3.86	< 0.0500	na	na	2.8	1.2	1.87	14.89
MW-6a	groundwater	10/21/2008	<0.100	33.7	32.5	n/a	n/a	0.76	0.76	31.84
MW-8a	groundwater	10/20/2008	10.7	0.489	<0.500	17.4	n/a	0.0	0.0	16.52
MW-9a	groundwater	10/21/2008	0.110	< 0.0500	na	na	n/a	1.47	0.0	16.10
MW-9b	groundwater	10/21/2008	1.86	< 0.0500	<0.500	3.8	n/a	4.01	3.09	16.18
MW-15	groundwater	10/21/2008	2.61	< 0.0500	<0.500	7.9	n/a	1.23	0.0	19.75

Notes:
na - not analyzed.
n/a - Isotope lab indicated dissolved ammonia or nitrate in sample was reportedly very low or there was inadequate sample and thus not reported.
MW-2a did not contain enough water to sample during October sample event.

Field Report

DATE 4-9-08	JOB NO. 275-2063-007
PROJECT Browns Island	
LOCATION	
CONTRACTOR PMX	OWNER
WEATHER overcast/raining	TEMP 50-60 ° at AM ° at PM
PRESENT AT SITE A. Somes	

TO

Browns Island
Pre-Spring 2008 Sampling
Event (MW-2a, MW-6a)

THE FOLLOWING WAS NOTED:

1130 Onsite @ MW-2A. 1138 purging MW-2A
1153 Collect [MW-2a] (NO_3, TKN, Ammonia) 2 containers (250 H_2SO_4 250 unp)
1200 proceed to MW-6a. 1210 purging MW-6a
1225 Collect [MW-6a] 2 containers (NO_3, Amm., TKN)
1230 Proceed to MW-8a to tag total depth and stick-up.

- MW-8a: SWL = 13.34, TD = 20.32 both from Top of PVC
  PVC is 0.44 feet below top of monument. Monument is 1.12' above concrete pad. Feeling for screen interval ⇒ tool caught up @ 5-feet above bottom apparently @ screen/PVC joint, also feeling it hitting slots on well screen ceases at around 5 ~~ft~~ feet ~~[illegible]~~ off bottom.
- MW-10a: SWL = 9.75' btopvc. TD = 15.25' btopvc.
  Feeling for screen interval: hitting slots ceases @ 10' below PVC ⇒ 5' screen interval, also caught on PVC joint @ 10' bgln

1400 depart site for the day.

[signature]

Parametrix, Inc.

Browns Island

Well #: MW-2A

Sample #: ________

Groundwater Sampling Field Data Sheet

2008 - Pre- Spring Sampling Event

Project Number		Date	4-9-08
Project Name	NMC - Browns Island	Location	
Project Address		Sampled By	AS
Client Name		Purged By	AS

Casing Diameter: 2" X 4" ____ 6" ____ Other ________

Depth to Water (feet)	34.72	Purge Volume Measurement Method	5-g bucket
Depth of Well (feet)	41.1	Date Purged	4-9-08
Water Column (feet)	6.38 = 1.0	Purge Time (from/to)	1138
Reference Point (TOC)	notch - north	Date/Time Sampled	4-9-08/ 1153

TIME (2400 hr)	Cumulative Volume (gal)	pH (units)	Temp.	EC	DO (mg/L)	DTW (btoc)	ORP
–	initial	6.33	–	–	–	–	–
–	1.0	6.33	12.8	521	–	–	-37.5
1143	2.0	6.39	12.8	744	–	–	-48.8
	3.0	6.40	12.8	749	–	–	-49.8
1153	sample	6.40	12.8	748	–	–	-49.7

Purge Equipment: disposable bailer   Sampling Equipment: disposable bailer

Laboratory		Date Sent to Lab	
Chain-of-Custody (yes/no)	yes	Field QC Sample Number	
Shipment Method		Split with (name(s)/organization)	

Well Integrity: good   key # 2126

Remarks:

Analyses: NO_3, Ammonia, TKN

Signature: AS   Page 1 of 1

Parametrix, Inc.

Well #: MW-6a

Sample #:

Browns Island

Groundwater Sampling Field Data Sheet

Pre-Spring 2008 Sampling

Project Number	275-2063-007	Date	4-9-08
Project Name	Browns Island	Location	
Project Address	Browns Island	Sampled By	AS
Client Name	Marion County	Purged By	AS

Casing Diameter: 2" X 4" ___ 6" ___ Other ___

Depth to Water (feet)	27.61	Purge Volume Measurement Method	5-g bucket
Depth of Well (feet)	43.15	Date Purged	4-9-08
Water Column (feet)	15.54 x 0.16 = 2.6 g	Purge Time (from/to)	1210/
Reference Point (TOC)	notch - north	Date/Time Sampled	4-9-08/ 1225

TIME (2400 hr)	Cumulative Volume (gal)	pH (units)	Temp.	EC	DO (mg/L)	DTW (btoc)	ORP
–	initial	7.01	13.7	433	–	–	51.0
1214	2.6	6.54	13.4	980	–	–	-78.0
1218	5.2	6.53	13.4	1253	–	–	-80.2
1222	7.8	6.56	13.4	1260	–	–	-78.1
1225	sample	6.56	13.4	1261	–	–	-73.7

Purge Equipment	disp. bailer	Sampling Equipment	disp. bailer

Laboratory		Date Sent to Lab	
Chain-of-Custody (yes/no)	yes	Field QC Sample Number	
Shipment Method		Split with (name(s)/organization)	

Well Integrity: good

Remarks:

Analyses: NO_3, TKN, Ammonia

Signature: AS

Page 1 of 1

TestAmerica
ANALYTICAL TESTING CORPORATION

11720 North Creek Pkwy N Suite 400, Bothell, WA 98011-8244 425-420-9200 FAX 420-9210
11922 E. First Ave, Spokane, WA 99206-5302 509-924-9200 FAX 924-9290
9405 SW Nimbus Ave, Beaverton, OR 97008-7145 503-906-9200 FAX 906-9210
2000 W International Airport Rd Ste A10, Anchorage, AK 99502-1119 907-563-9200 FAX 563-9210

CHAIN OF CUSTODY REPORT

Work Order #:

CLIENT: Parametrix

INVOICE TO: Rick Malin

REPORT TO: Rick Malin
ADDRESS: 700 NE Mult, #1000
PDX OR 97232

PHONE: FAX:

P.O. NUMBER:

PROJECT NAME: Browns' Island Landfill
PROJECT NUMBER: 27
SAMPLED BY: A. Somes

TURNAROUND REQUEST in Business Days *
Organic & Inorganic Analyses: 10 (STD.) 7 5 4 3 2 1 <1
Petroleum Hydrocarbon Analyses: 5 (STD.) 4 3 2 1 <1
OTHER Specify:
* Turnaround Requests less than standard may incur Rush Charges.

	CLIENT SAMPLE IDENTIFICATION	SAMPLING DATE/TIME	Nitrate	Ammonia (H_2SO_4)	TKN (H_2SO_4)											MATRIX (W, S, O)	# OF CONT.	LOCATION / COMMENTS	TA WO ID
1	MW-2a	4-9-08/1153	X	X	X											W	2		
2	MW-6a	4-9-08/1225	X	X	X											W	2		
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			

RELEASED BY: [signature] DATE: 4-10-08
PRINT NAME: Andrew Somes FIRM: PMX TIME: 1411
RECEIVED BY:
PRINT NAME: [signature] FIRM: TAP DATE: 4-10-08 TIME: 1411

RELEASED BY: DATE:
PRINT NAME: FIRM: TIME:
RECEIVED BY:
PRINT NAME: FIRM: DATE: TIME:

ADDITIONAL REMARKS:

TEMP:

PAGE OF

COC REV 05/2006

Note: By relinquishing samples to TestAmerica, client agrees to pay for the services requested on this chain of custody form and for any additional analyses performed on this project. Payment for services is due within 30 days from the date of invoice unless otherwise contracted. Sample(s) will be disposed of after 30 days unless otherwise contracted.

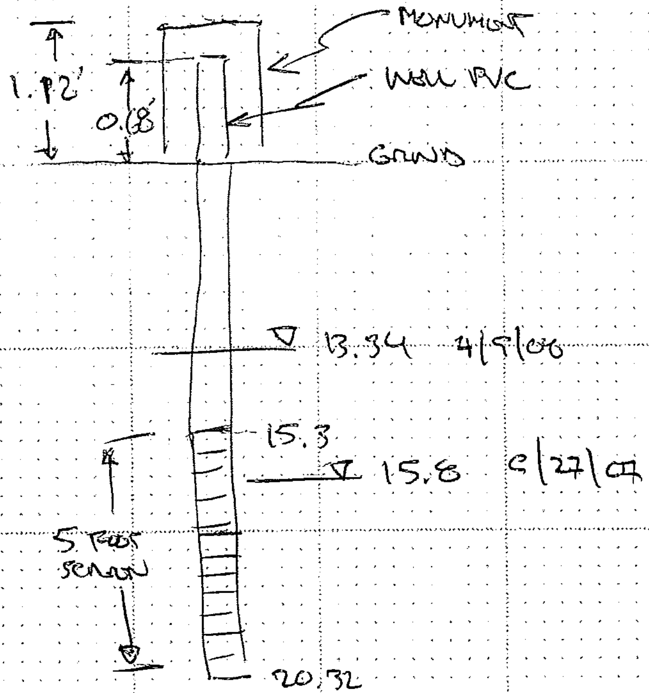
Parametrix

PROJECT ______ SHEET ____ OF ____

BY ______ DATE ______ CHECKED ______ DATE ______

SUBJECT ______ JOB NO. ______ PHASE ____ TASK ____

MW-8A



TOTAL PVC LENGTH 20.32 FT

PVC STICK UP -

Rick Malin

From: River He [riverhe@zymaxusa.com]
Sent: Tuesday, July 08, 2008 3:52 PM
To: Rick Malin
Subject: data report!
Attachments: 41085Ammonia.pdf

Hi Rick,

Here is the report of your ammonia samples. Except sample # 2, the concentrations of ammonia in the other samples seem lower than what you told me. We didn't get any ammonia at the end for the sample #1 (MW-02A). The final isotope data of the samples were corrected for isotope fractionation against the standard solutions with the similar ammonia concentration. For example, the last three samples were corrected against ammonia std solution with concentration about 0.5 mg/L. Please send me email if you have any question about the data. Regards,

River He, Ph.D.
ZymaX Forensics, a DPRA Copmany

REPORT OF ANALYTICAL RESULTS

ZymaX FORENSICS

Client:	Rick Malin Parametrix 700 NE Multnomah #1000 Portland, Or 97232	Lab Number:	41085
		Received:	5/23/2008
		Matrix:	Water
Project:	Browns Island	Sample Description:	See Below
Project Number:	275-2063-007	Analyzed:	7/7/2008
Collected by:	Andrew Somes	Method:	CF-IRMS

$\delta^{15}N$ (ammonia)

LAB NUMBER	SAMPLE DESCRIPTION	$\delta^{15}N$ ‰
41085-1*	**MW-02A**	n/a
41085-2	MW-06A	5.8
41085-3	MW-08A	3.0
41085-4	MW-09A	-2.6
41085-5	MW-15	2.8
Analytical Precision (1-sigma)		0.3

*** Note: dissolved ammonia is very low in this sample and thus not reported.***

Submitted by,
Zymax Forensics, a DPRA company

River He, PhD
Isotope Lab Manager

41085-1d15n.xls
RH

Rick Malin

From: Jaime Lopez [Jaime.Lopez@dpra.com]
Sent: Tuesday, January 13, 2009 5:05 PM
To: Rick Malin
Subject: RE: Browns island Landfill ammonia

Sorry Rick,

I am not sure how Shan-Tan wanted you to contact River but his email address is shantan@zymaxusa.com

Thank you,

Jaime Lopez
Administrative Assistant
DPRA/Zymax Forensics
71 Zaca Lane STE 100
SLO, CA 93401
ph: 805-544-4696
fax: 805-544-8226
jaimelopez@xymaxusa.com

From: Rick Malin [mailto:RMalin@parametrix.com]
Sent: Tue 1/13/2009 6:34 PM
To: Jaime Lopez
Subject: RE: Browns island Landfill ammonia

Thanks. How do I contact River or Shan-Tan? Is River still with Zymax?

From: Jaime Lopez [mailto:Jaime.Lopez@dpra.com]
Sent: Tuesday, January 13, 2009 4:30 PM
To: Rick Malin
Subject: Browns island Landfill ammonia

Rick,

I talked to Shan-Tan he wanted me to advise you that for N isotope on ammonia, we sub-contracted it to University of California at Berkley. They were unable to get the data due to an inadequate sample. They only charged the basic cost for running the samples which amounted to $56(14/sample). If you any further questions please contact River or Shan-Tan.

Best regards,

Jaime Lopez
Administrative Assistant
DPRA/Zymax Forensics
71 Zaca Lane STE 100
SLO, CA 93401
ph: 805-544-4696
fax: 805-544-8226
jaimelopez@xymaxusa.com

REPORT OF ANALYTICAL RESULTS

ZymaX FORENSICS

Client:	Rick Malin Parametrix 700 NE Multnomah #1000 Portland, Or 97232
Lab Number:	41340
Received:	10/27/2008
Matrix:	Water
Project:	Browns Island Landfill
Project Number:	275-2063-007/03/03A
Collected by:	Andrew Somes
Sample Description:	See Below
Analyzed:	11/10/2008
Method:	CF-IRMS

$\delta^{15}N$ (nitrate)

LAB NUMBER	SAMPLE DESCRIPTION	$\delta^{15}N$ ‰
41340-1*	MW-6A	n/a
41340-2	MW-8A	17.4
41340-3	MW-9B	3.8
41340-4	MW-15	7.9
Analytical Precision (1-sigma)		0.3

Note: * #1 was not analyzed for isotope because not much was recovered.

Submitted by,
Zymax Forensics, a DPRA company

River He, PhD
Isotope Lab Manager

41340-1d15n.xls
RH

From 2007 Browns Island Landfill Annual Water Quality Monitoring Report

2.4 NITRATE INVESTIGATION

As described in Section 4.5 of the BI 2006 AWQMR, nitrate is generally detected above its primary standard in a least one groundwater sample collected from the site each year. These detections usually only occur in shallow wells and primarily at well MW-8a. Elevated nitrate concentrations (above 10 mg/l) have also occurred at background well MW-15 and at cross-gradient wells MW-9a/b. Based on the location of the nitrate detections, the source has been considered to be related to agricultural activities (fertilizer application) adjacent to and up-gradient of the wells showing elevated concentrations and not from the landfill. Elevated nitrate concentrations are typically observed in Fall event samples.

As indicated the DEQ's May 2, 2007 letter presenting the review comments to the BI 2005 and 2006 AWQMRs, the spatial distributions of nutrient in groundwater at the site appears to indicate agricultural fertilizer applications adjacent to the facility are greater than agronomic rates for the area. To help verify this observation the following nitrate investigation activities were completed during 2007:

- During the Spring event, inactive well MW-2b was sampled for total dissolved solids and nitrate to provide information on nitrate concentrations beneath the landfill.
- During the Fall event wells MW-8a, MW-9b, and MW-15, in addition to permit required monitoring, samples, were also analyzed for stable nitrogen and oxygen isotope signatures of nitrate in order to asses potential sources.
- During the Fall event shallow soil samples were collected from fields adjacent and generally upgradient of the wells MW-8a, MW-9b, and MW-15 by the Oregon Department of Agriculture (ODA) to provide data regarding the potential that over fertilization on the adjacent lands was occurring. Soil samples collected by ODA were analyzed by the DEQ Laboratory.
- During the Fall event surface water samples were collected from the slough south and east of the landfill to determine the level of nitrate present in these surface water bodies.

The approximate locations of the soil samples and slough water samples are shown on Figure 3. The approximate location of monitoring wells MW-8a, MW-9b, and MW-15 are also shown on Figure 3. Results of these investigation activities are presented and discussed in Section 4.5.

4.5 NITRATE INVESTIGATION RESULTS

As described in Section 2.3, nitrate is usually detected above its primary drinking water standard in a least one groundwater sample collected from the site each year. This exceedance most frequently occurs in shallow well MW-8a. Due to the locations where exceedances occur, the source of nitrate has been considered to be associated with agricultural-related activities (fertilizer application) adjacent to and up-gradient of the wells showing elevated concentrations and not from the landfill. Elevated nitrate concentrations are typically occur in Fall event samples. The results of sampling completed during 2007, the interpretation of the results, and activities proposed for 2008 to fingerprint the nitrate source is presented below.

4.5.1 Sample Results

In order to confirm this suspected source, additional analyses of groundwater samples and surface soil sampling on adjacent agricultural properties were performed during the Fall 2007 sampling event. In addition to the standard site monitoring program analysis, groundwater samples from wells MW-8a, MW-9b, and MW-15 were also analyzed for stable nitrogen and oxygen isotope signatures of nitrate. This additional analysis was performed by Zymax laboratories located in San Luis Obispo, California. Surface table during both events. Similarly, the 20-foot screen interval at MW-15 was below the water table during the two sample events completed in 2007.

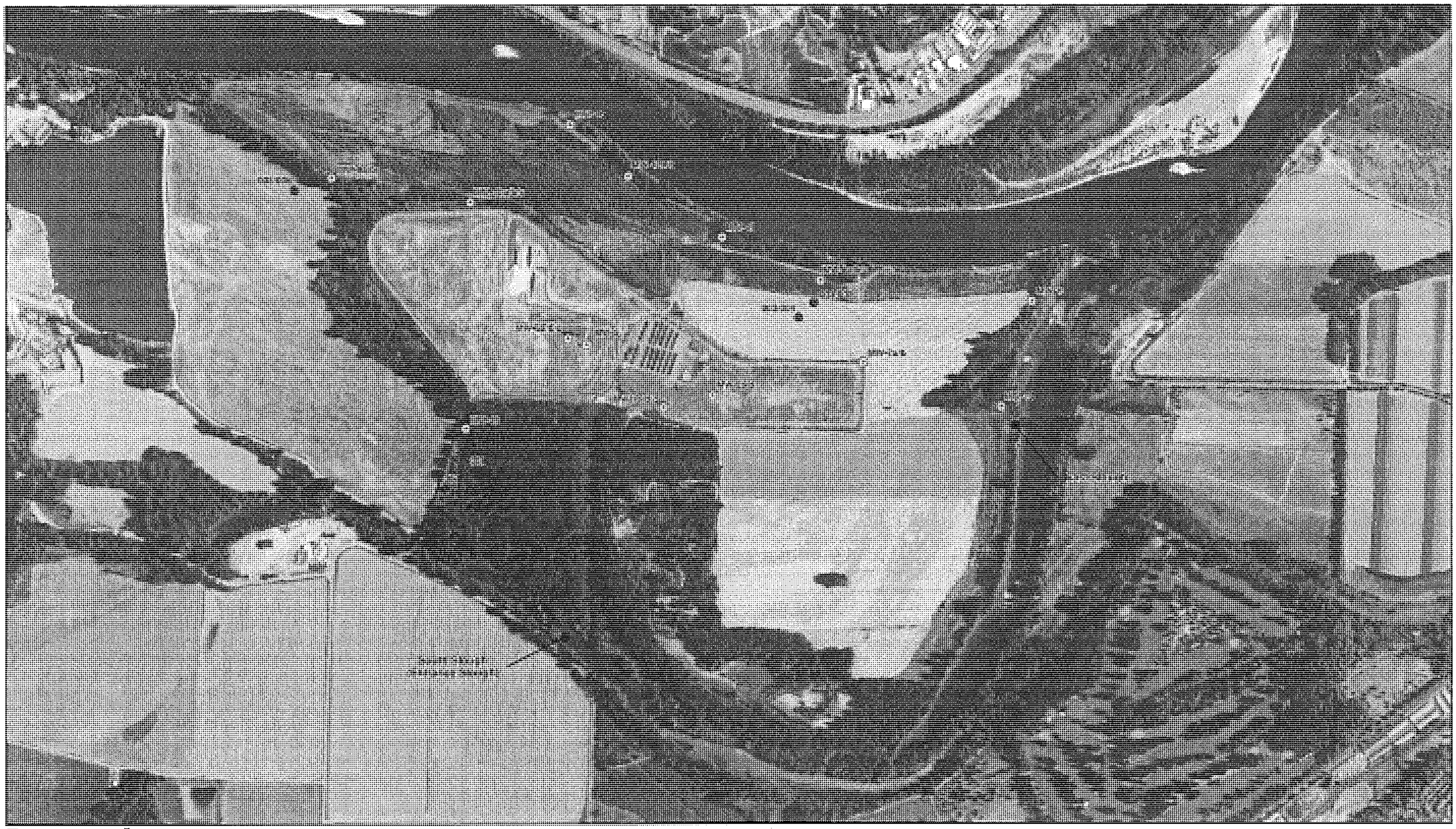
The occurrence of elevated nitrate at well MW-8a in samples collected during the fall events appears to be due to transformation of reduced nitrogen species (e.g. oxidation of ammonia or nitrification of organic nitrogen) to nitrate near the water table. The waste-type isotope signature of nitrate in MW-8a suggests that these reduced nitrogen species originate from the landfill rather than agricultural activities. It should be noted that the inactive well MW-10a is similar to MW-8a; shallow screen located across the water table. However, elevated nitrate concentrations were not observed in samples form MW-10a.

4.5.3 Proposed Actions

Based on findings of activities completed during 2007 as described above the following activities are proposed for 2008 to confirm result interpretations.

1. Exploration sampling: An attempt will be made to sample inactive wells MW-2a and MW-6a in April. These two wells appear to be located either in or adjacent to waste fill. If samples can be obtained they will be analyzed for ammonia and TKN. The purpose of this analysis is to obtain ammonia and organic nitrogen information associated with landfill leachate.
2. Spring event: If MW-2a and MW-6a can be sampled and dependent upon their results, wells MW-2a and MW-6a will be sampled again during the Spring 2008 along with MW-8a, MW-9a, and MW-15 for isotope ammonia and total nitrogen. Wells MW-8a, MW-9a, and MW-15 will also be sampled for standard scheduled parameters.
3. Fall event: Wells MW-2a, MW-6a, MW-8a, MW-9a, and MW-15 will again, if possible, be sampled and analyzed for isotope ammonia and total nitrogen. Standard scheduled analysis will also be completed on active wells MW-8a, MW-9a, and MW-15 during this event.

The objective for the above activities is to fingerprint the nitrogen source. Organic nitrogen will be determined as difference between TKN and ammonia. This additional sampling and analysis will provide a mass and isotope balance on nitrogen species in groundwater from the wells which will be used to determine whether ammonia and/or organic nitrogen concentrations are sufficient to explain the observed elevated nitrate concentrations typically observed in the Fall samples. The isotope signatures will also be used to evaluate whether the detected ammonia and/or organic nitrogen is the source of the nitrate.



Parametrix File:GIS/Projects/275_BrownsIslandLandfill/MXD_PDF/BrownsIsland_SiteLocation.mxd Date: March 5, 2008

0 500 1,000 1,500 Feet

- Monitoring Well
- ODA/DEQ Soil Sample Point
- Surface Water Sample Point

Figure 3
Nitrate Investigation
Sample Locations
2007 Annual Water Quality
Monitoring Report
Brown's Island Landfill

Parametrix ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES

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MEMORANDUM

Date: **December 31, 2007**

To: **Scot Tenza**
Don Alexander

From: **Rick Malin**

Subject: **Fall 2007 Event Nitrate Results and Interpretation**

cc: **Dimitri Vlassopoulos**

Project Number: **275-2063-008**

Project Name: **Brown's Island Landfill**

This memorandum presents findings and our interpretation of the nitrate investigation completed at the Brown's Island Landfill during 2007. To help confirm our interpretation, select additional analysis is proposed for well MW-8a during 2008.

Background

As described in Section 4.5 of the Brown's Island Landfill (BI) 2006 Annual Water Quality Monitoring Report (AWQMR), nitrate is generally detected above its primary standard in a least one groundwater sample collected from the site each year. These detections usually only occur in shallow wells and primarily at well MW-8a. Elevated nitrate concentrations (above 10 mg/l) have also occurred at background well MW-15 and at cross-gradient wells MW-9a/b. Based on the location of the nitrate detections, the source has been considered to be related to agricultural activities (fertilizer application) that have occurred adjacent to and up-gradient of the wells showing elevated concentrations and not from the landfill. Elevated nitrate concentrations are typically observed in Fall event samples.

As indicated the DEQ's May 2, 2007 letter presenting the review comments to the BI 2005 and 2006 AWQMRs, the spatial distributions of nutrient in groundwater at the site appears to indicate agricultural fertilizer applications adjacent to the facility are greater than agronomic rates for the area. To help verify this observation, during the Fall 2007 event, in addition to permit required monitoring, samples from wells MW-8a, MW-9b, and MW-15 were also analyzed for the stable nitrogen and oxygen isotope signatures of nitrate in order to asses potential sources. As part of this investigation, the DEQ with cooperation from the Oregon Department of Agriculture (ODA) looked into the potential that over fertilization on the adjacent lands was occurring. During the Fall 2007 event, ODA collected shallow soil samples from fields adjacent and generally upgradient of the three wells. The soil samples collected by ODA were analyzed by the DEQ Laboratory. The approximate location of the soil samples are shown on Figure 1.

Results

Groundwater samples collected from wells MW-8a, MW-9b, and MW-15 during 2007 showed the pattern previously observed; higher nitrate concentrations in the fall particularly at MW-8a.

Soil sample results indicate that the highest nitrate concentrations were detected in the samples collected from the field south of MW-9b. Notably lower concentration of nitrate was reported in soil samples collected from fields south of MW-8a. Ammonia was generally not detected in soil samples, with the highest concentrations detected in soil samples collected south of MW-15. Detected TKN concentrations ranged from 360 mg/kg up to 770 mg/kg. The highest TKN concentrations were detected in the soil sample collected south of MW-15. The lowest TKN concentrations were detected in soil samples collected southwest of MW-8a. TKN concentrations collected south of MW-8a and southwest of MW-9b were similar.

Interpretation

The detected TKN concentrations reported in the soil samples are at levels consistent with the description of the soil. The detections are considered to reflect the nitrogen content of natural organic matter present in the soil. Sample results indicate that the soils do have nitrate present, but not in excessive amounts.

Nitrate isotope data for groundwater show two signature types. The isotope signatures of the samples collected from MW-9b and MW-15 are consistent with a fertilizer source. In contrast, the sample from MW-8a shows a waste type signature, possibly affected by denitrification. There is an indication that dissolved organic nitrogen is present at MW-8a.

Wells MW-8a and MW-9b have the shallowest well screens of the active monitoring well network. The following table presents well screen information as measured from the top of the well's PVC casing.

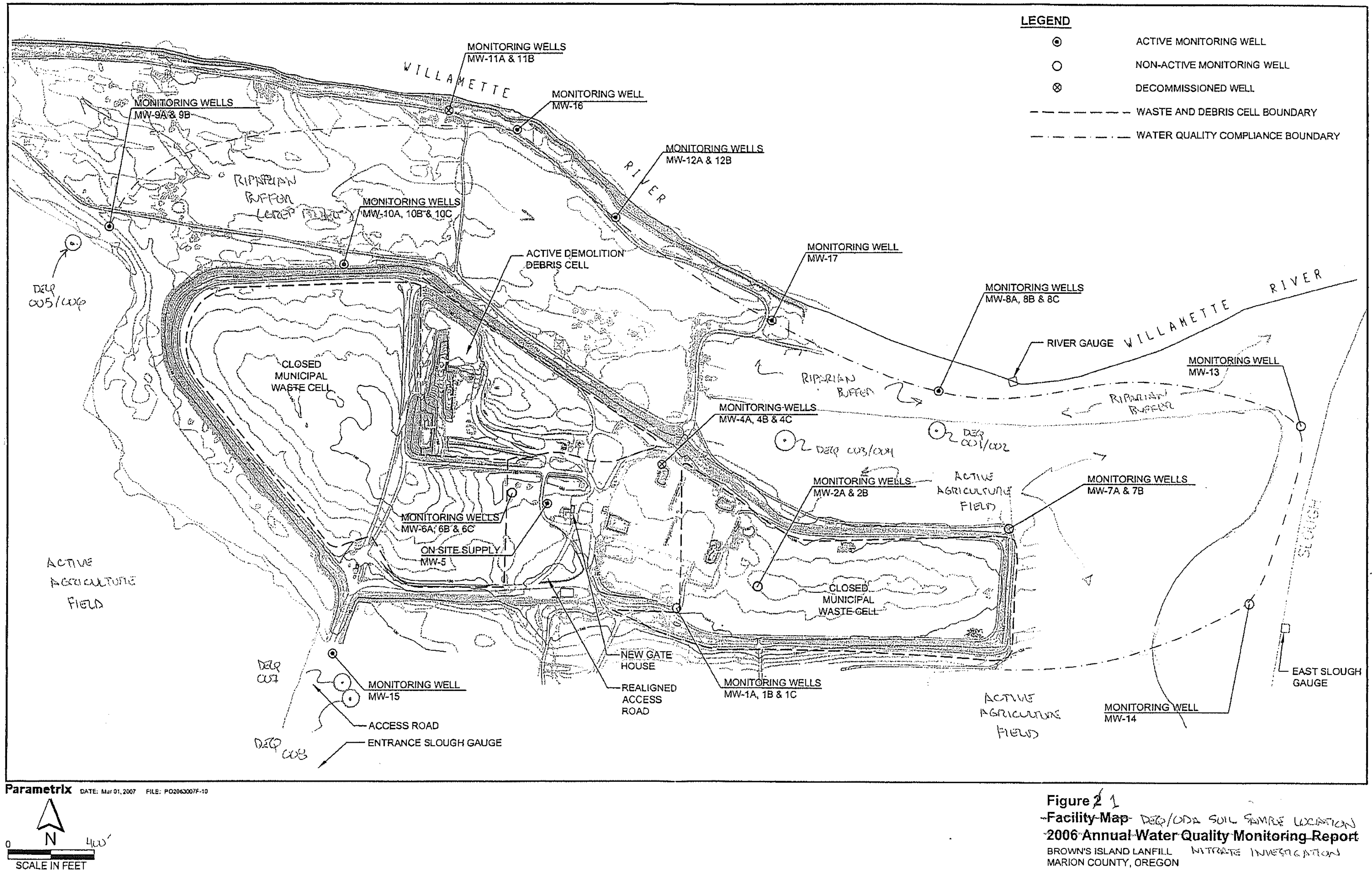
Well	Top of Screen (feet)	Bottom of screen (feet)	Total depth of well (feet)
MW-8a	15	20	20.47
MW-9b	18.8	23.9	25.53
MW-15	20	40	44.36

Consistent with the site monitoring program, wells are purged of three casing volumes and sample the following day. During the sample event completed on 5/24/07, there was 4.7 foot water column in well MW-8a. Three casing volumes were purged from the well. During the sample event completed on 9/27/07, there was a 1.8-foot water column in the well. One half (0.5) gallon was purged from the well before it was bailed dry. During both events a portion of the MW-8a well screen was above the water table. Comparatively at MW-9b there was 10.9-foot water column in the well during the 5/24/07 event and an 8.4-foot water column during the 9/26/07 event. The well screen at MW-9b was below the water table in during both events. Similarly, the 20-foot screen interval at MW-15 was below the water table during the two sample events completed in 2007.

The occurrence of elevated nitrate at well MW-8a in samples collected during the fall events appears to be due to transformation of reduced nitrogen species (e.g. oxidation of ammonia or nitrification of organic nitrogen) to nitrate near the water table. The waste-type isotope signature of nitrate in MW-8a indicates that these reduced nitrogen species originate from the landfill rather than agricultural activities.

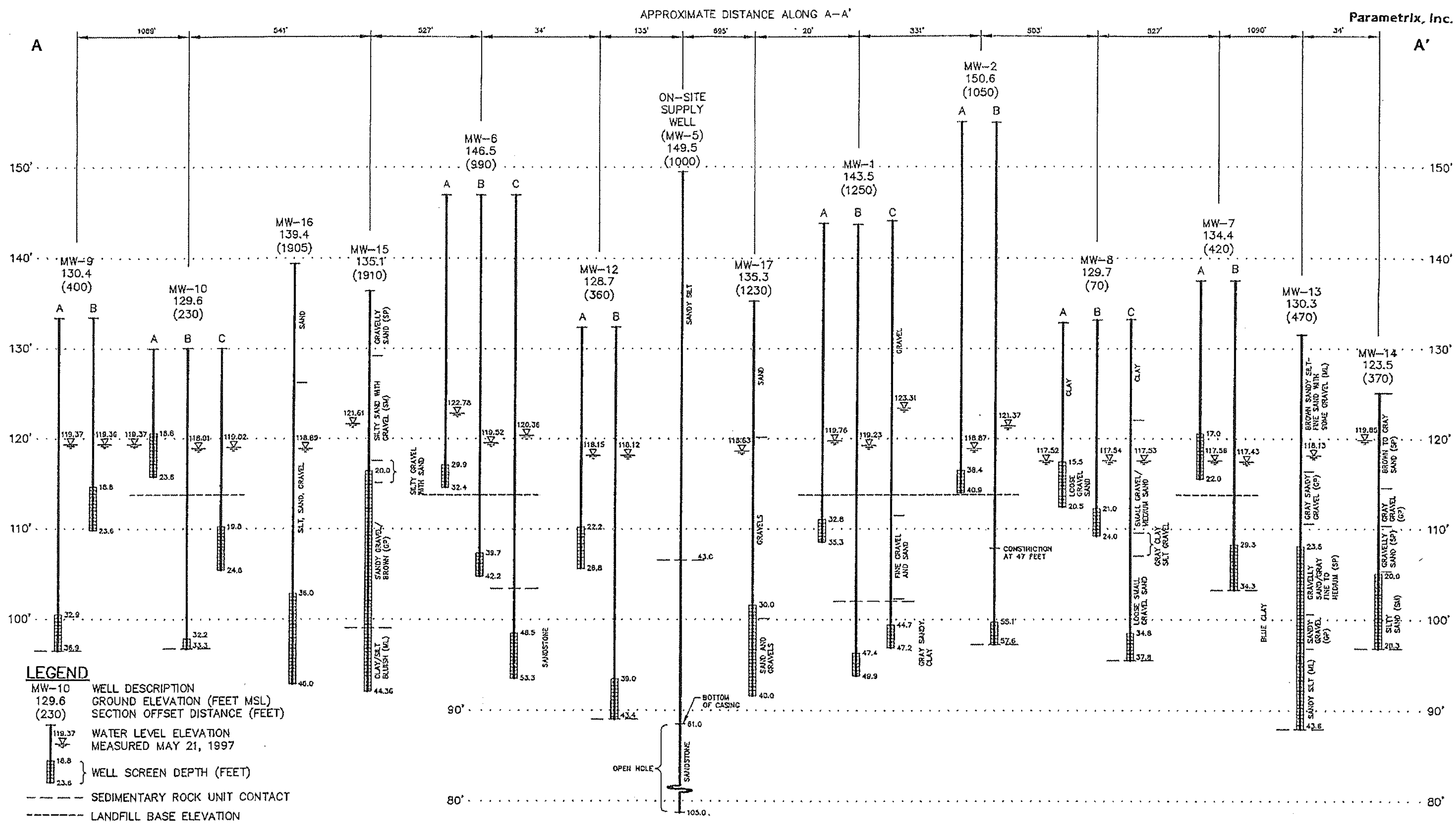
Proposed Action

Analyze well MW-8a for ammonia, organic nitrogen (determined as difference between TKN and ammonia) and nitrate concentrations and nitrogen isotope ratios of TKN, ammonia, and nitrate during the Spring and Fall 2008 monitoring events. This additional sampling and analysis will provide a mass and isotope balance on nitrogen species in groundwater which will be used to determine whether ammonia and/or organic nitrogen concentrations are sufficient to explain the observed elevated nitrate concentrations typically observed in the fall samples. The isotope signatures will be used to evaluate whether the detected ammonia and/or organic nitrogen is the source of the nitrate.



Parametrix DATE: Mar 01, 2007 FILE: PO2063007F-10

Figure ~~2~~ 1
~~Facility Map~~ DEQ/ODA SOIL SAMPLE LOCATION
~~2006 Annual Water Quality Monitoring Report~~
BROWN'S ISLAND LANFILL NITRATE INVESTIGATION
MARION COUNTY, OREGON



FILE: 20630550
DATE: 04/18/01

SCALE: VERT 1"=10'
HORIZ NONE

Figure 4
Well Cross-Section A-A'
Environmental Monitoring Plan Update
BROWN'S ISLAND LANDFILL
MARION COUNTY, OREGON

ZymaX FORENSICS

REPORT OF ANALYTICAL RESULTS

Client:	Rick Malin Parametrix 700 NE Multnomah #1000 Portland, Or 97232	Lab Number:	40706
		Received:	9/28/2007
		Matrix:	Water
Project:	Browns Island	Sample Description:	See Below
Project Number:	275-2063-007-02	Analyzed:	10/31/2007
Collected by:	Andrew Somes	Method:	CF-IRMS

$\delta^{15}N$ $\delta^{18}O$

LAB NUMBER	SAMPLE DESCRIPTION	$\delta^{15}N$ ‰	$\delta^{18}O$ ‰
40706-1	MW-8A	17.7	-0.9
40706-2	MW-9B	2.2	0.0
40706-3	MW-15	9.8	13.0
Analytical Precision (1-sigma)		0.4	0.2

Submitted by,
Zymax Forensics, a DPRA company

River He, PhD
Isotope Lab Manager

40706-1NO3.xls
RH

ZymaX
71 Zaca Lane
San Luis Obispo CA 93401
vox 805.544.4696
fax 805.544.8226

CHAIN of CUSTODY

CLIENT EDD ☐ LUFT EDF ☐ DW EDT ☐

report to: Rick Malin
company: Parametrix
address: 700 NE Multnomah #1000, PDX OR 97232
vox: 503 233 2400
fax:
proj: Browns Island
proj #: 275-2063-007-02
sampler: Andrew Somes

ANALYSIS REQUESTED: $\delta^{15}N$ and $\delta^{18}O$ of dissolved Nitrate

Turnaround Time: ASAP ☐ 48 hr ☐ 12 hr ☐ 72 hr ☐ 24 hr ☐ std ☒

ZymaX use only	SAMPLE DESCRIPTION	Date Sampled	Time	Matrix	Preserve	$\delta^{15}N$ and $\delta^{18}O$ of dissolved Nitrate	# of containers	Remarks
40706-1	MW-8A	9-27-07	0930	W	ice	X	1	
-2	MW-9B		1155	W	ice	X	1	
-3	MW-15		1355	W	ice	X	1	

Comments: delivered via Fed-Ex overnite

Sample integrity upon receipt:
- Samples received intact ☐
- Samples received cold ☐
- Custody seals ☐
- Correct container types ☐

Bill 3rd party:
PO#:
Quote: yes / no

Relinquished by:
Signature: [signature]
Print: Andrew Somes
Company: Parametrix
Date: 9-27-07 Time: 1530

Received by:
Signature:
Print:
Company:
Date: Time:

Relinquished by:
Signature:
Print:
Company:
Date: Time:

Received by ZymaX envirotechnology, inc:
Signature: [signature]
Print: Jon Holt
Company: Zymax
Date: 9/28/07 Time:

email: login@ZymaXusa.com

FACSIMILE TRANSMITTAL SHEET

Subject:

Zymax#40706 Attn: Rick Malin

Message:

Please contact me at jonathan.holt@dpra.com for a PDF or hard copy of this report

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

PORTLAND, OR 9405 S.W. NIMBUS AVENUE
BEAVERTON, OR 97008-7132
ph: (503) 906.9200 fax: (503) 906.9210

Draft Report

Parametrix, Inc.-(PMX)	Project Name: **BROWN'S ISLAND LANDFILL**	
700 NE Multnomah, Suite 1000	Project Number: 275-2063-007-02-03A	Report Created:
Portland, OR 97232	Project Manager: Rick Malin	10/03/07 10:38

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
MW-8A	PQI0996-01	Water	09/27/07 09:30	09/28/07 11:20
MW-8B	PQI0996-02	Water	09/27/07 10:00	09/28/07 11:20
MW-8C	PQI0996-03	Water	09/27/07 10:15	09/28/07 11:20
MW-17	PQI0996-04	Water	09/27/07 10:40	09/28/07 11:20
MW-12A	PQI0996-05	Water	09/27/07 11:00	09/28/07 11:20
MW-12B	PQI0996-06	Water	09/27/07 11:15	09/28/07 11:20
MW-16	PQI0996-07	Water	09/27/07 11:25	09/28/07 11:20
MW-9A	PQI0996-08	Water	09/27/07 11:45	09/28/07 11:20
MW-9B	PQI0996-09	Water	09/27/07 11:55	09/28/07 11:20
MW-10B	PQI0996-10	Water	09/27/07 12:25	09/28/07 11:20
MW-10C	PQI0996-11	Water	09/27/07 12:35	09/28/07 11:20
SW- EAST SLOUGH	PQI0996-12	Water	09/27/07 13:00	09/28/07 11:20
MW-5	PQI0996-13	Water	09/27/07 13:40	09/28/07 11:20
MW-15	PQI0996-14	Water	09/27/07 13:55	09/28/07 11:20
FD-0927	PQI0996-15	Water	09/27/07 08:00	09/28/07 11:20
SW-BRIDGE	PQI0996-16	Water	09/27/07 14:15	09/28/07 11:20

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Draft Report

Parametrix, Inc.-(PMX)	Project Name:	BROWN'S ISLAND LANDFILL	
700 NE Multnomah, Suite 1000	Project Number:	275-2063-007-02-03A	Report Created:
Portland, OR 97232	Project Manager:	Rick Malin	10/03/07 10:38

DRAFT: Anions per EPA Method 300.0

TestAmerica - Portland, OR

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PQI0996-01 (MW-8A)		**Water**			**Sampled: 09/27/07 09:30**					
Nitrate-Nitrogen	EPA 300.0	15.7	-----	1.00	mg/l	10x	7091203	09/28/07 14:46	10/01/07 22:15	H2
Sulfate	"	1.31	-----	1.00	"	1x	"	"	09/28/07 22:09	
PQI0996-02 (MW-8B)		**Water**			**Sampled: 09/27/07 10:00**					
Nitrate-Nitrogen	EPA 300.0	0.150	-----	0.100	mg/l	1x	7091203	09/28/07 14:46	09/28/07 22:25	
Sulfate	"	ND	-----	1.00	"	"	"	"	"	
PQI0996-03 (MW-8C)		**Water**			**Sampled: 09/27/07 10:15**					
Nitrate-Nitrogen	EPA 300.0	ND	-----	0.100	mg/l	1x	7091203	09/28/07 14:46	09/28/07 22:41	
Sulfate	"	ND	-----	1.00	"	"	"	"	"	
PQI0996-04 (MW-17)		**Water**			**Sampled: 09/27/07 10:40**					
Nitrate-Nitrogen	EPA 300.0	ND	-----	0.100	mg/l	1x	7091203	09/28/07 14:46	09/28/07 22:57	
Sulfate	"	16.7	-----	1.00	"	"	"	"	"	
PQI0996-05 (MW-12A)		**Water**			**Sampled: 09/27/07 11:00**					
Nitrate-Nitrogen	EPA 300.0	ND	-----	0.100	mg/l	1x	7091203	09/28/07 14:46	09/28/07 23:13	
Sulfate	"	39.5	-----	1.00	"	"	"	"	"	
PQI0996-06 (MW-12B)		**Water**			**Sampled: 09/27/07 11:15**					
Nitrate-Nitrogen	EPA 300.0	ND	-----	0.100	mg/l	1x	7091203	09/28/07 14:46	09/29/07 00:01	
Sulfate	"	134	-----	10.0	"	10x	"	"	09/29/07 04:50	
PQI0996-07 (MW-16)		**Water**			**Sampled: 09/27/07 11:25**					
Nitrate-Nitrogen	EPA 300.0	ND	-----	0.100	mg/l	1x	7091203	09/28/07 14:46	09/29/07 00:17	
Sulfate	"	5.80	-----	1.00	"	"	"	"	"	
PQI0996-08 (MW-9A)		**Water**			**Sampled: 09/27/07 11:45**					
Nitrate-Nitrogen	EPA 300.0	1.18	-----	0.100	mg/l	1x	7091203	09/28/07 14:46	09/29/07 00:34	
Sulfate	"	11.7	-----	1.00	"	"	"	"	"	

PORTLAND, OR 9405 S.W. NIMBUS AVENUE
BEAVERTON, OR 97008-7132
ph: (503) 906.9200 fax: (503) 906.9210

Parametrix, Inc.-(PMX)	Project Name:	BROWN'S ISLAND LANDFILL	
700 NE Multnomah, Suite 1000	Project Number:	275-2063-007-02-03A	Report Created:
Portland, OR 97232	Project Manager:	Rick Malin	10/03/07 10:38

DRAFT: Anions per EPA Method 300.0

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Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PQI0996-09 (MW-9B)		**Water**			**Sampled: 09/27/07 11:55**					
Nitrate-Nitrogen	EPA 300.0	6.19	-----	0.100	mg/l	1x	7091203	09/28/07 14:46	09/29/07 00:50	
Sulfate	"	14.0	-----	1.00	"	"	"	"	"	
PQI0996-10 (MW-10B)		**Water**			**Sampled: 09/27/07 12:25**					
Nitrate-Nitrogen	EPA 300.0	ND	-----	0.100	mg/l	1x	7091203	09/28/07 14:46	09/29/07 01:22	
Sulfate	"	4.51	-----	1.00	"	"	"	"	"	
PQI0996-11 (MW-10C)		**Water**			**Sampled: 09/27/07 12:35**					
Nitrate-Nitrogen	EPA 300.0	ND	-----	0.100	mg/l	1x	7091203	09/28/07 14:46	09/29/07 01:38	
Sulfate	"	9.57	-----	1.00	"	"	"	"	"	
PQI0996-12 (SW- EAST SLOUGH)		**Water**			**Sampled: 09/27/07 13:00**					
Nitrate-Nitrogen	EPA 300.0	ND	-----	0.100	mg/l	1x	7091203	09/28/07 14:46	09/29/07 01:54	
PQI0996-13 (MW-5)		**Water**			**Sampled: 09/27/07 13:40**					
Nitrate-Nitrogen	EPA 300.0	ND	-----	0.100	mg/l	1x	7091203	09/28/07 14:46	09/29/07 02:10	
Sulfate	"	ND	-----	1.00	"	"	"	"	"	
PQI0996-14 (MW-15)		**Water**			**Sampled: 09/27/07 13:55**					
Nitrate-Nitrogen	EPA 300.0	4.12	-----	0.100	mg/l	1x	7091203	09/28/07 14:46	09/29/07 02:26	
Sulfate	"	10.0	-----	1.00	"	"	"	"	"	
PQI0996-15 (FD-0927)		**Water**			**Sampled: 09/27/07 08:00**					
Nitrate-Nitrogen	EPA 300.0	ND	-----	0.100	mg/l	1x	7091203	09/28/07 14:46	09/29/07 03:14	
Sulfate	"	ND	-----	1.00	"	"	"	"	"	
PQI0996-16 (SW-BRIDGE)		**Water**			**Sampled: 09/27/07 14:15**					
Nitrate-Nitrogen	EPA 300.0	0.130	-----	0.100	mg/l	1x	7091203	09/28/07 14:46	09/29/07 03:30	

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ANALYTICAL TESTING CORPORATION

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BEAVERTON, OR 97008-7132
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Parametrix, Inc.-(PMX)	Project Name:	BROWN'S ISLAND LANDFILL	
700 NE Multnomah, Suite 1000	Project Number:	275-2063-003	Report Created:
Portland, OR 97232	Project Manager:	Rick Malin	06/08/07 11:22

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
MW-2B	PQE0963-01	Water	05/24/07 14:20	05/24/07 16:30

Richard D. Reid, Project Manager

PORTLAND, OR 9405 S.W. NIMBUS AVENUE
BEAVERTON, OR 97008-7132
ph: (503) 906.9200 fax: (503) 906.9210

Parametrix, Inc.-(PMX)	Project Name:	BROWN'S ISLAND LANDFILL	
700 NE Multnomah, Suite 1000	Project Number:	275-2063-003	Report Created:
Portland, OR 97232	Project Manager:	Rick Malin	06/08/07 11:22

Conventional Chemistry Parameters per APHA/EPA Methods

TestAmerica - Portland, OR

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PQE0963-01 (MW-2B)		Water			Sampled: 05/24/07 14:20					
Total Dissolved Solids	EPA 160.1	473	----	10.0	mg/l	1x	7051348	05/29/07 09:00	05/29/07 13:38	

Richard D. Reid, Project Manager

TestAmerica
ANALYTICAL TESTING CORPORATION

PORTLAND, OR 9405 S.W. NIMBUS AVENUE
BEAVERTON, OR 97008-7132
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Parametrix, Inc.-(PMX)	Project Name:	BROWN'S ISLAND LANDFILL	
700 NE Multnomah, Suite 1000	Project Number:	275-2063-003	Report Created:
Portland, OR 97232	Project Manager:	Rick Malin	06/08/07 11:22

Anions per EPA Method 300.0

TestAmerica - Portland, OR

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PQE0963-01 (MW-2B)		**Water**			**Sampled: 05/24/07 14:20**					
Nitrate-Nitrogen	EPA 300.0	ND	-----	0.100	mg/l	1x	7051295	05/25/07 10:51	05/25/07 19:01	

TestAmerica - Portland, OR

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report shall not be reproduced except in full, without the written approval of the laboratory.

Richard D. Reid, Project Manager

TestAmerica
ANALYTICAL TESTING CORPORATION

PORTLAND, OR 9405 S.W. NIMBUS AVENUE
BEAVERTON, OR 97008-7132
ph: (503) 906.9200 fax: (503) 906.9210

Parametrix, Inc.-(PMX)	Project Name:	**BROWN'S ISLAND LANDFILL**	
700 NE Multnomah, Suite 1000	Project Number:	275-2063-003	Report Created:
Portland, OR 97232	Project Manager:	Rick Malin	06/27/07 16:15

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
MW-8A	PQE0962-01	Water	05/24/07 10:50	05/24/07 16:30
MW-8B	PQE0962-02	Water	05/24/07 10:58	05/24/07 16:30
MW-8C	PQE0962-03	Water	05/24/07 11:05	05/24/07 16:30
MW-17	PQE0962-04	Water	05/24/07 11:35	05/24/07 16:30
MW-12A	PQE0962-05	Water	05/24/07 12:10	05/24/07 16:30
MW-12B	PQE0962-06	Water	05/24/07 12:00	05/24/07 16:30
MW-16	PQE0962-07	Water	05/24/07 12:30	05/24/07 16:30
MW-10B	PQE0962-08	Water	05/24/07 13:30	05/24/07 16:30
MW-10C	PQE0962-09	Water	05/24/07 13:20	05/24/07 16:30
FD-5/24	PQE0962-10	Water	05/24/07 12:00	05/24/07 16:30
MW-15	PQE0962-11	Water	05/24/07 14:40	05/24/07 16:30
MW-5	PQE0962-12	Water	05/24/07 13:55	05/24/07 16:30
MW-9B	PQE0962-13	Water	05/24/07 13:05	05/24/07 16:30
MW-9A	PQE0962-14	Water	05/24/07 12:55	05/24/07 16:30
Trip Blank	PQE0962-15	Water	05/24/07 00:00	05/24/07 16:30

TestAmerica - Portland, OR

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report shall not be reproduced except in full, without the written approval of the laboratory.

Richard D. Reid, Project Manager

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Portland, OR 97232	Project Manager: Rick Malin	06/27/07 16:15

Anions per EPA Method 300.0

TestAmerica - Portland, OR

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PQE0962-01 (MW-8A)		**Water**			**Sampled: 05/24/07 10:50**					
Chloride	EPA 300.0	22.8	-----	0.500	mg/l	1x	7051295	05/25/07 10:51	05/25/07 13:56	
Nitrate-Nitrogen	"	0.650	-----	0.100	"	"	"	"	"	
Sulfate	"	2.61	-----	1.00	"	"	"	"	"	
PQE0962-02 (MW-8B)		**Water**			**Sampled: 05/24/07 10:58**					
Chloride	EPA 300.0	21.2	-----	0.500	mg/l	1x	7051295	05/25/07 10:51	05/25/07 14:12	
Nitrate-Nitrogen	"	ND	-----	0.100	"	"	"	"	"	
Sulfate	"	2.97	-----	1.00	"	"	"	"	"	
PQE0962-03 (MW-8C)		**Water**			**Sampled: 05/24/07 11:05**					
Chloride	EPA 300.0	23.9	-----	0.500	mg/l	1x	7051295	05/25/07 10:51	05/25/07 14:28	
Nitrate-Nitrogen	"	ND	-----	0.100	"	"	"	"	"	
Sulfate	"	ND	-----	1.00	"	"	"	"	"	
PQE0962-04 (MW-17)		**Water**			**Sampled: 05/24/07 11:35**					
Chloride	EPA 300.0	17.0	-----	0.500	mg/l	1x	7051295	05/25/07 10:51	05/25/07 19:33	
Nitrate-Nitrogen	"	ND	-----	0.100	"	"	"	"	"	
Sulfate	"	28.4	-----	1.00	"	"	"	"	05/25/07 14:44	
PQE0962-05 (MW-12A)		**Water**			**Sampled: 05/24/07 12:10**					
Chloride	EPA 300.0	100	-----	5.00	mg/l	10x	7051295	05/25/07 10:51	05/26/07 04:06	
Nitrate-Nitrogen	"	0.180	-----	0.100	"	1x	"	"	05/25/07 15:00	
Sulfate	"	107	-----	10.0	"	10x	"	"	05/26/07 04:06	
PQE0962-06 (MW-12B)		**Water**			**Sampled: 05/24/07 12:00**					
Chloride	EPA 300.0	119	-----	5.00	mg/l	10x	7051295	05/25/07 10:51	05/26/07 04:23	
Nitrate-Nitrogen	"	ND	-----	0.100	"	1x	"	"	05/25/07 15:48	
Sulfate	"	172	-----	10.0	"	10x	"	"	05/26/07 04:23	
PQE0962-07 (MW-16)		**Water**			**Sampled: 05/24/07 12:30**					
Chloride	EPA 300.0	43.3	-----	5.00	mg/l	10x	7051295	05/25/07 10:51	05/26/07 04:39	
Nitrate-Nitrogen	"	ND	-----	0.100	"	1x	"	"	05/25/07 16:04	
Sulfate	"	1.45	-----	1.00	"	"	"	"	"	

Richard D. Reid, Project Manager

PORTLAND, OR 9405 S.W. NIMBUS AVENUE
BEAVERTON, OR 97008-7132
ph: (503) 906.9200 fax: (503) 906.9210

Parametrix, Inc.-(PMX)	Project Name: BROWN'S ISLAND LANDFILL	
700 NE Multnomah, Suite 1000	Project Number: 275-2063-003	Report Created:
Portland, OR 97232	Project Manager: Rick Malin	06/27/07 16:15

Anions per EPA Method 300.0

TestAmerica - Portland, OR

Analyte	Method	Result	MDL*	MRL	Units	Dil	Batch	Prepared	Analyzed	Notes
PQE0962-08 (MW-10B)		**Water**			**Sampled: 05/24/07 13:30**					
Chloride	EPA 300.0	49.9	-----	5.00	mg/l	10x	7051295	05/25/07 10:51	05/26/07 04:55	
Nitrate-Nitrogen	"	ND	-----	0.100	"	1x	"	"	05/25/07 16:20	
Sulfate	"	ND	-----	1.00	"	"	"	"	"	
PQE0962-09 (MW-10C)		**Water**			**Sampled: 05/24/07 13:20**					
Chloride	EPA 300.0	62.4	-----	5.00	mg/l	10x	7051295	05/25/07 10:51	05/26/07 05:11	
Nitrate-Nitrogen	"	ND	-----	0.100	"	1x	"	"	05/25/07 16:36	
Sulfate	"	ND	-----	1.00	"	"	"	"	"	
PQE0962-10 (FD-5/24)		**Water**			**Sampled: 05/24/07 12:00**					
Chloride	EPA 300.0	40.3	-----	5.00	mg/l	10x	7051295	05/25/07 10:51	05/26/07 05:27	
Nitrate-Nitrogen	"	ND	-----	0.100	"	1x	"	"	05/25/07 16:52	
Sulfate	"	ND	-----	1.00	"	"	"	"	"	
PQE0962-11 (MW-15)		**Water**			**Sampled: 05/24/07 14:40**					
Chloride	EPA 300.0	6.46	-----	0.500	mg/l	1x	7051295	05/25/07 10:51	05/25/07 17:08	
Nitrate-Nitrogen	"	3.88	-----	0.100	"	"	"	"	"	
Sulfate	"	10.5	-----	1.00	"	"	"	"	"	
PQE0962-12 (MW-5)		**Water**			**Sampled: 05/24/07 13:55**					
Chloride	EPA 300.0	40.3	-----	5.00	mg/l	10x	7051295	05/25/07 10:51	05/26/07 05:43	
Nitrate-Nitrogen	"	ND	-----	0.100	"	1x	"	"	05/25/07 17:41	
Sulfate	"	ND	-----	1.00	"	"	"	"	"	
PQE0962-13 (MW-9B)		**Water**			**Sampled: 05/24/07 13:05**					
Chloride	EPA 300.0	8.10	-----	0.500	mg/l	1x	7051295	05/25/07 10:51	05/25/07 17:57	
Nitrate-Nitrogen	"	1.78	-----	0.100	"	"	"	"	"	
Sulfate	"	11.7	-----	1.00	"	"	"	"	"	
PQE0962-14 (MW-9A)		**Water**			**Sampled: 05/24/07 12:55**					
Chloride	EPA 300.0	6.21	-----	0.500	mg/l	1x	7051295	05/25/07 10:51	05/25/07 18:13	
Nitrate-Nitrogen	"	5.55	-----	0.100	"	"	"	"	"	
Sulfate	"	13.8	-----	1.00	"	"	"	"	"	

Richard D. Reid, Project Manager

20070908

Analytical Report

Brown's Island Landfill, soil sampling

Sampling Event: 20070908

Report to: Arendt, Jack, Oregon Department of Environmental Quality

Print Date: 11/05/2007

DEQ

State of Oregon
Department of
Environmental
Quality

Laboratory Division
1712 SW 11th Avenue
Portland, OR 97201
Phone: (503) 229-5983
(800) 452-4011
Fax: (503) 229-6924

www.deq.state.or.us

Final Report Approved by:

Greg Pettit, Laboratory Administrator

Ron Doughten, Laboratory Quality Assurance Officer

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY LABORATORY

Analytical Report

Sampling Event: 20070908 Brown's Island Landfill, soil sampling

Att: Request for Analysis

cc: Measeles, Paul, Oregon Department of Agriculture - Salem Lab
DEQ Laboratory File

Sample Collector:
Paul Measeles, Oregon Department of Agriculture - Salem Lab

Analytical Laboratory:
Oregon Department of Environmental Quality

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY LABORATORY

Analytical Report

Sampling Event: 20070908 Brown's Island Landfill, soil sampling

Sampling Event Summary

Sampling Subproject:

136 (27406) Brown's Island Landfill

Sample Summary

Item	QA	Station	Sample Matrix	Sample Date / Time
001	S	34552 Brown's Island Landfill 40' S of field Edge by MW-8 moist silty loam (grass seed)	Solid/soil	26-Sep-2007 10:33:00
002	S	34552 Brown's Island Landfill 40' S of field Edge by MW-8 brown clayey silt moist	Solid/soil	26-Sep-2007 10:40:00
003	S	34553 Brown's Island Landfill 150 ft from N Edge of Field by MW-8 silty loam	Solid/soil	26-Sep-2007 10:47:00
004	S	34553 Brown's Island Landfill 150 ft from N Edge of Field by MW-8 silty loam	Solid/soil	26-Sep-2007 10:52:00
005	S	34554 Brown's Island Landfill Dry Damp Silty Loam Grass Seed Field dry-damp silty loam grass s	Solid/soil	26-Sep-2007 11:26:00
006	S	34554 Brown's Island Landfill Dry Damp Silty Loam Grass Seed Field damp silty loam new grass s	Solid/soil	26-Sep-2007 11:30:00
007	S	34555 Brown's Island Landfill Slough Sample Near MW-15 wet, moist black, brown, w/ rootlet	Solid/soil	26-Sep-2007 12:11:00
008	S	34557 Brown's Island Landfill Slough Sample B near MW-15 wet brn/blk silty loam w/ roots	Solid/soil	26-Sep-2007 12:16:00

Key to QA/QC Types

S = Sample

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY LABORATORY

Analytical Report

Sampling Event: 20070908 Brown's Island Landfill, soil sampling

Item	Parameter	Method	MRL	Result	Unit	Notes

001 S (Grab) 34552 - Brown's Island Landfill 40' S of field Edge by MW-8 moist silty loam (grass seed), 09/26/2007 10:33:00

Parameter	Method	MRL	Result	Unit	Notes
Field parameters					
Field Sample Depth	MOM grab	0	**1.5**	ft	
General Chemistry					
Ammonia as N	4500-NH3 G	0.02	<0.60	mg/Kg wet	
Nitrate/nitrite as N	4500-NO3 F	0.0050	**1.19**	mg/Kg wet	
Percent Solids	2540 G	1	**76.8**	%	
Total Kjeldahl Nitrogen	4500-Norg D	0.2	**520**	mg/Kg wet	

002 S (Grab) 34552 - Brown's Island Landfill 40' S of field Edge by MW-8 brown clayey silt moist, 09/26/2007 10:40:00

Parameter	Method	MRL	Result	Unit	Notes
Field parameters					
Field Sample Depth	MOM grab	0	**4.0**	ft	
General Chemistry					
Ammonia as N	4500-NH3 G	0.02	<0.60	mg/Kg wet	
Nitrate/nitrite as N	4500-NO3 F	0.0050	**1.07**	mg/Kg wet	
Percent Solids	2540 G	1	**72.3**	%	
Total Kjeldahl Nitrogen	4500-Norg D	0.2	**420**	mg/Kg wet	

003 S (Grab) 34553 - Brown's Island Landfill 150 ft from N Edge of Field by MW-8 silty loam, 09/26/2007 10:47:00

Parameter	Method	MRL	Result	Unit	Notes
Field parameters					
Field Sample Depth	MOM grab	0	**1.5**	ft	
General Chemistry					
Ammonia as N	4500-NH3 G	0.02	<0.60	mg/Kg wet	
Nitrate/nitrite as N	4500-NO3 F	0.0050	**0.893**	mg/Kg wet	
Percent Solids	2540 G	1	**83.4**	%	
Total Kjeldahl Nitrogen	4500-Norg D	0.2	**360**	mg/Kg wet	

004 S (Grab) 34553 - Brown's Island Landfill 150 ft from N Edge of Field by MW-8 silty loam, 09/26/2007 10:52:00

Parameter	Method	MRL	Result	Unit	Notes
Field parameters					
Field Sample Depth	MOM grab	0	**4.0**	ft	
General Chemistry					
Ammonia as N	4500-NH3 G	0.02	<0.60	mg/Kg wet	
Nitrate/nitrite as N	4500-NO3 F	0.0050	**0.862**	mg/Kg wet	
Percent Solids	2540 G	1	**79.2**	%	

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY LABORATORY

Analytical Report

Sampling Event: 20070908 Brown's Island Landfill, soil sampling

Item	Parameter	Method	MRL	Result	Unit	Notes

004 S (Grab) 34553 - Brown's Island Landfill 150 ft from N Edge of Field by MW-8 silty loam, 09/26/2007 10:52:00

Total Kjeldahl Nitrogen	4500-Norg D	0.2	**550**	mg/Kg wet	

005 S (Grab) 34554 - Brown's Island Landfill Dry Damp Silty Loam Grass Seed Field dry-damp silty loam grass s, 09/26/2007 11:26:00

Field parameters					
Field Sample Depth	MOM grab	0	**1.5**	ft	
General Chemistry					
Ammonia as N	4500-NH3 G	0.02	**0.62 est**	mg/Kg wet	1
Nitrate/nitrite as N	4500-NO3 F	0.0050	**6.43**	mg/Kg wet	
Percent Solids	2540 G	1	**86.6**	%	
Total Kjeldahl Nitrogen	4500-Norg D	0.2	**500**	mg/Kg wet	

006 S (Grab) 34554 - Brown's Island Landfill Dry Damp Silty Loam Grass Seed Field damp silty loam new grass s, 09/26/2007 11:30:00

Field parameters					
Field Sample Depth	MOM grab	0	**4.0**	ft	
General Chemistry					
Ammonia as N	4500-NH3 G	0.02	<0.60	mg/Kg wet	
Nitrate/nitrite as N	4500-NO3 F	0.0050	**3.44**	mg/Kg wet	
Percent Solids	2540 G	1	**76.4**	%	
Total Kjeldahl Nitrogen	4500-Norg D	0.2	**410**	mg/Kg wet	

007 S (Grab) 34555 - Brown's Island Landfill Slough Sample Near MW-15 wet, moist black, brown, w/ rootlet, 09/26/2007 12:11:00

Field parameters					
Field Sample Depth	MOM grab	0	**1.0**	ft	
General Chemistry					
Ammonia as N	4500-NH3 G	0.02	**1.1 est**	mg/Kg wet	2
Nitrate/nitrite as N	4500-NO3 F	0.0050	<0.050	mg/Kg wet	
Percent Solids	2540 G	1	**61.2**	%	
Total Kjeldahl Nitrogen	4500-Norg D	0.2	**770**	mg/Kg wet	

008 S (Grab) 34557 - Brown's Island Landfill Slough Sample B near MW-15 wet brn/blk silty loam w/ roots, 09/26/2007 12:16:00

Field parameters					
Field Sample Depth	MOM grab	0	**0.75**	ft	

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY LABORATORY

Analytical Report

Sampling Event: 20070908 Brown's Island Landfill, soil sampling

Item	Parameter	Method	MRL	Result	Unit	Notes

008 S (Grab) 34557 - Brown's Island Landfill Slough Sample B near MW-15 wet brn/blk silty loam w/ roots, 09/26/2007 12:16:00

General Chemistry

Parameter	Method	MRL	Result	Unit	Notes
Ammonia as N	4500-NH3 G	0.02	**0.83 est**	mg/Kg wet	3
Nitrate/nitrite as N	4500-NO3 F	0.0050	**0.270**	mg/Kg wet	
Percent Solids	2540 G	1	**64.9**	%	
Total Kjeldahl Nitrogen	4500-Norg D	0.2	**600**	mg/Kg wet	

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY LABORATORY

Analytical Report

Sampling Event: 20070908 Brown's Island Landfill, soil sampling

Sample / Result Comments

1) Analyte found in method blank
2) Analyte found in method blank
3) Analyte found in method blank

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY LABORATORY

Analytical Report

Sampling Event: 20070908 Brown's Island Landfill, soil sampling

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY
Request for Analysis
Timecenter: 27406-LM

Sampling Event # 20070908

Site: Brown's Island Landfill, soil sampling

Collected by: Paul Meeuwlas & Shan Alr

Date Sampled: 08-26-07

Site Hydro: [illegible]

DATE RECEIVED: 08/26/07

RECEIVED BY: HC

DATE RELEASED:

Item #	LASAR #	Sample Point Name (Lat/Long)	Split Y/N	Nutrients		Time (HH MM)	Sample Depth (ft)	Lab Analyses	
1	34552	Soil Sample' Moist Silty loam (Grass, Seed) 40' Sor Field Edge by MW-8 N44.92531 W 123.08254 10:33AM	N	L 6016		10.33	1.5 ft	Nitrate, Ammonia TKN	% Solids
2	34552	As above - Bos more silty ish Brown Clay Silt Moist	N	L 6017		10:40	4.0 ft	Nitrate, Ammonia, TKN	% Solids
3	34553	Soil Sample (50 ft from Edge of Field By MW-8 Silty loam N 44.92499 W 123.08298	N	L 6018		10:47	1.5 ft	Nitrate, Ammonia, TKN	% Solids
4	34553	As Above Silty loam	N	L 6019		10:52	4.0 ft	Nitrate, Ammonia, TKN	% Solids
5	34554	Soil Sample Dry - Damp Silty loam, Grass Seed N 44.92737 W 123.09832	N	L 6020		11:26	1.5 ft	Nitrate, Ammonia, TKN	% Solids
6	34554	As Above Near Grass Seed Field Damp Silty Loam	N	L 6021		11:30	4.0 ft	Nitrate, Ammonia, TKN	% Solids
7	34555	Wet - Moist Black - Brn w/ Rootlets Silty loam Slough Sample Near MW-15 N 44.92147 W 123.09290	N	L 6023		12:11	1.0 ft	Nitrate, Ammonia, TKN	% Solids
8	34557	Wet Brn - Blk silty loam w/ Roots 8 → Slough Sample Near MW-15 N 44.92154 W 123.09286	N	L 6024		12:16	0.75 ft	Nitrate, Ammonia, TKN	% Solids
				L				Nitrate, Ammonia, TKN	% Solids
				L				Nitrate, Ammonia, TKN	% Solids
				L				Nitrate, Ammonia, TKN	% Solids

Weather: Clear - Warm

Comments:

End Report
11/05/2007 12:53

ATTACHMENT A

Sampling and Analysis Plan

Sampling and Analysis Plan
Browns Island Landfill
Marion County, Oregon

Prepared for

Marion County Department of Public Works
Environmental Services
5155 Silverton Road NE
Salem, OR 97305

Prepared by

Parametrix
700 NE Multnomah, Suite 1000
Portland, OR 97232-4110
T. 503.233.2400 T. 360.694.5020 F. 503.233.4825
www.parametrix.com

March 18, 2013 | 275-2063-007

CITATION

Parametrix. 2013. Sampling and Analysis Plan
Browns Island Landfill
Marion County, Oregon. Prepared by Parametrix,
Portland, Oregon. March 18, 2013.

CERTIFICATION

The technical material and data contained in this document were prepared under the supervision and direction of the undersigned, whose seal, as a professional hydrogeologist licensed to practice as such, is affixed below.

Approved by Rick Malin, R.G.

TABLE OF CONTENTS

LIST OF FIGURES

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ATTACHMENTS

1. INTRODUCTION

This March 18, 2013 Sampling and Analysis Plan (SAP) is presented as Attachment A to the March 18, 2013 Environmental Monitoring Plan Update (EMP) for the Browns Island Landfill (BI). This SAP describes the procedures recommended for obtaining, preparing, documenting, preserving, and shipping water quality samples collected at the BI site. This plan addresses water quality monitoring requirements set forth in the BI Solid Waste Disposal Site Closure Permit Number 255 (closure permit) issued on May 4, 2006 and presented in the March 18, 2013 EMP. The EMP considers site-specific conditions to provide a monitoring program that addresses closure permit requirements while being protective of human health, welfare and safety, and the environment.

This SAP establishes Quality Assurance/Quality Control (QA/QC) requirements for sample acquisition and handling. This SAP has been updated to reflect changes to the site's groundwater monitoring program that have occurred since development of the September 22, 2005 BI SAP update. The EMP identifies changes that have occurred resulting in updates to the SAP.

This SAP provides site information so it can function as a stand along document. The BI EMP provides additional site information, detail, and history and should be used as the primary reference for this SAP. The most recent BI Annual Water Quality Monitoring Report should also be referenced for any recent site monitoring-related issues or changes.

1.1 SITE LOCATION

The BI site is located approximately 1.5 miles west of Salem, Oregon (Figure 1). The landfill complex occupies approximately 87 acres. The site is bordered by the Willamette River on its north and west sides and by unnamed interconnecting sloughs on its south and east sides. Adjacent to the site is active or former croplands that have been planted with native trees and shrubs.

The BI site can be reached by heading west on River Road South from Salem and turning north on to Homestead Road or a bit further west on to Browns Island Road South. River Road South can be reached from Highway 99 East (also known as Commercial Street) in Salem by turning west onto Owens Street.

Figure 2 is a site area map showing area topography, the waste fill boundary, and monitoring well locations. Figure 2 is based on a photogrammetric map generated from a May 8, 2012, aerial photograph of the site. Figure 3 is an aerial photo of the BI site that also shows well locations. As indicated on Figure 3, with exception of the western side, BI is surrounded by the Eola Bend and Minto-Browns Island park complex.

1.2 SITE DESCRIPTION

The Browns Island Landfill operated as the municipal solid waste disposal facility for the City of Salem and the surrounding Marion County area from April 1967 to September 1986. Landfilling began in the central portion of the site in 1967 and expanded onto City and County land in the mid to late 1970s. From 1979 through 1986, landfill expansion was toward the west onto adjacent private (former Trussell) property. The approximate fill thickness is 35 feet in the older eastern portion of the site and 40 feet in the western area of the landfill.

When the use of the site as a municipal landfill was terminated, there remained an unfilled area (a former gravel pit) of approximately eight acres near the central portion of the landfill site. This unfilled area is currently being filled with construction and demolition debris and is referred to as the Browns Island Demolition Landfill. A composting facility also operates at the site. The site is owned and operated by Marion County.

The site is situated on a young river terrace consisting of stratified sands with well-rounded pebbles, gravels, and cobbles. The aggregate quarry located to the west of BI is mining this material. Underlying the young alluvium deposits are older marine sedimentary rock deposits consisting of tuffaceous siltstone and sandstone. Groundwater flow at the site is primarily toward the northeast, toward the river, with the Willamette River functioning primarily as a discharge boundary, but occasional as a recharge boundary dependent upon river stage. The base of the uppermost aquifer at the site is at the top of the older marine sedimentary rock unit.

1.3 SITE MONITORING PROGRAM

The site groundwater quality monitoring network consists of 13 monitoring wells (MW-5, MW-8a/b/c, MW-9a/b, MW-10b/c, MW-12a/b, MW-15, MW-16, and MW-17). There are also 13 inactive monitoring wells (MW-1a/b/c, MW-2a/b, MW-6a/b/c, MW-7a/b, MW-10a, MW-13, and MW-14) at the site. The locations of these wells are shown on Figures 2 and 3. Well MW-5 is an on-site water supply well. Static water levels are collected from both active and inactive wells.

The first monitoring well at the site was installed in 1973 and additional wells have been installed over time as the groundwater quality monitoring program has been modified and adjusted. Monitoring wells installed prior to 1980 were completed as single, double, or triple installations. All active monitoring wells are equipped with dedicated bladder sampling pumps. As described in Section 5.5.2, low-flow sampling methodology is used to collect groundwater quality samples with the exception of MW-5. All active wells at the site can be accessed by either gravel roads or dirt access paths.

Site monitoring development, history, and water quality conditions are presented in Section 2 of the EMP. Additional detail on site operations, geology, and hydrogeology are presented in Section 1.4 of the EMP.

2. WATER QUALITY MONITORING LOCATIONS

This section describes the established water quality monitoring and water level measurement locations at the site.

The existing groundwater quality monitoring network consists of 13 wells. One of these wells (MW-5) is an on-site water supply well. There are also 13 inactive monitoring wells. Table 1 presents a site well summary identifying active, inactive, and abandoned wells. The locations of the wells listed on Table 1 are shown on Figure 2. With the exception of well MW-5, all wells are two-inch diameter PVC monitoring wells.

Table 2 presents a monitoring schedule for the BI. Semi-annual monitoring is completed at the site. Table 2 identifies the frequency of analysis for the DEQ-approved parameter groups. All 13 active monitoring wells are sampled during a compliance monitoring event. Table 3 identifies the analytes included in each of the parameter groups identified in Table 2.

Static water level measurements are collected from both the active and inactive wells listed in Table 2 during each semi-annual compliance monitoring event. Compliance periods are indicated on Table 2.

Three surface water level measurement points (entrance slough, east slough, and Willamette River) are also measured at the site to evaluate surface water/groundwater interaction. The locations of these surface water level measurement points are shown on Figures 2 and 3. The on-site Willamette River measurement point was used to determine the difference between Willamette River stage elevations and at the site. The Willamette River stage elevations are measured at the U.S. Geological Survey (USGS) staff gage at the Marion (Center) Street Bridge (station 14191000, located 2.5 miles downstream of the site). Through a series of comparative measurements, the vertical difference between the two river stage measurement locations was determined to be approximately 6.01 feet (i.e., the elevation of the on-site river stage measurement location is approximately 6.01 feet higher than the Center Street USGS gage location).The readings from the entrance slough and east slough points are collected during each semi-annual monitoring event along with monitoring well static water level measurements. Willamette River stage level associated with a semi-annual monitoring event is determined as described above.

3. SAMPLING DATES

This section identifies the compliance sampling periods for the site. Table 2 provides a summary of the information presented in this section.

Groundwater quality samples, to be submitted for analytical laboratory testing, are to be collected at the frequency identified on Table 2. The sampling frequency of the 13 monitoring wells is semi-annual. The compliance groundwater quality sampling periods for the site are:

- Spring: March 1st through May 31st.
- Fall: September 1st through October 31st.

The locations and analytical requirements for the groundwater quality sampling events at the site are also presented in Table 2 and shown on Figure 2.

The collection of water level measurements at the site will also be completed during each semi-annual compliance sampling event. Static water level measurements are to be collected from the active and inactive wells listed in Table 2. Surface water stage readings from the two established staff gauges are also to be collected during each semi-annual monitoring event.

4. SAMPLING PARAMETERS

The chemical parameters to be analyzed for in the groundwater quality monitoring program at BI are identified in Table 3. Table 3 also presents the method of analysis and the laboratory method reporting level for each parameter. Table 2 identifies which parameter groups are to be analyzed at what location for a given compliance sampling event.

The facility's long-term water quality monitoring program was optimized in 2011. The optimized list of parameters considered the site's historic analysis schedule and list of parameters, site groundwater quality conditions, site-specific contaminants of interest, closure permit requirements, and most probable beneficial use that could be impacted by groundwater conditions at the site. This analysis resulted in the BI Indicator Parameters listed on Table 2. The BI Permit Parameters, which are also presented on Table 2, represent a more extensive (full sweep) list of parameters originally referenced in the facility's closure permit. BI Indicator Parameters were utilized beginning with the fall 2011 event consistent with Table 2. As indicated on Table 2, analysis is completed on BI Indicator Parameters except during even year (i.e., 2014, 2016, etc.) fall events.

Table 4 presents a list of the volatile organic constituents (VOCs) that are identified under EPA Test Method 8260, the MRL of each analyte, the Numerical Groundwater Reference Levels (based on OAR 340-40-020), and the EPA Drinking Water Standard maximum contaminant levels (MCLs). The proposed MRL of a given constituent should be no greater than ten-percent of the constituent's state/federal water quality standard, if such a standard exists.

5. SAMPLING PREPARATION

This section describes activities that need to be completed prior to a sampling event. These activities include communication with the laboratory, notifying the DEQ, establishing a sampling schedule, and site access preparation.

5.1 LABORATORY NOTIFICATION

The current designated laboratory for water quality analysis of samples collected at the site is:

Apex Laboratories
12232 SW Garden Place
Tigard, Oregon 97223
(503) 718-2323 Fax (503) 718-0333

The designated laboratory should be contacted at least one week prior to sampling and notified of an upcoming sample event. The laboratory will provide, upon request, sample cooler(s), appropriate sample bottles with preservatives, sample labels, chain of custody forms, and custody seals.

Table 2 identifies the locations to be sampled, the parameter groups to be analyzed, and the sampling schedule. Table 3 identifies the parameters and chemicals present in each parameter group identified in Table 2. Table 4 lists the analytes and the maximum contaminant levels for VOCs by EPA Method 8260.

Table 5 presents appropriate sample containers, preservatives, holding times, and applicable comments. Note that nitrate has the shortest hold time of 2 days.

The laboratory needs to be informed of the following:

- The specific parameters/analytes requiring analysis as identified on Table 3. Table 2 presents the parameter groups to be analyzed, sampling frequency and schedule.
- The number of samples to be collected. Currently 14 samples will be collected during a groundwater quality monitoring event. This includes a sample from each well (13 samples total) plus one additional field duplicate sample set as described in Section 6.1. A field duplicate sample is to be collected for each day of sampling and analyzed for the same parameters as the associated field sample.
- Common anions and cations are to be field filtered for dissolved species analysis. Dissolved trace metal species analysis, if scheduled, may also be necessary if the total suspended solids concentration of the sample is greater than 100 mg/L.
- The need for a laboratory-prepared VOC transport (trip) blank to accompany each set of VOC samples to and from the laboratory, if analysis for VOCs is scheduled. VOC transport blank specifics are discussed in Section 6.1.
- If VOCs (by EPA Method 8260) are scheduled, the laboratory needs to also complete a tentatively identified compound (TIC) analysis for the samples submitted. Analysis for TICs needs to be indicated on the chain-of-custody. The TIC analysis represents a library search of detections not on the Method 8260 standard analyte list.

5.2 DEQ SAMPLING NOTIFICATION

As indicated in Section 10.2 of the closure permit, the Salem office of the DEQ Solid Waste Program needs to be notified in writing at least ten (10) working days prior to a water quality monitoring sampling event at the site. The address of the DEQ Western Region Solid Waste Program is:

Western Region Solid Waste Program
Department of Environmental Quality
750 Front Street Northeast, Suite 120
Salem, Oregon 97301-1039
Ph. 503/378-8240

An email to the DEQ project hydrogeologist assigned to the BI site also serves as an acceptable form of written sampling event notification.

5.3 DEQ SPLIT SAMPLING EVENTS

As indicated in Section 10.3 of the closure permit, the County must split samples with the DEQ when requested, and must schedule all requested split-sampling events with the DEQ Laboratory at least 45 days prior to the sampling event. There are no split sampling events scheduled at this time.

As noted in Section 10.5 of the closure permit, the DEQ reserves the right to add to or delete from the scheduled sampling events, sample locations, parameters to be sample for, and to conduct unscheduled samplings or split sampling. In the event of changes to the split sampling schedule, the DEQ is to notify the County at least 30 days prior to the sampling event.

5.4 SITE ACCESS

The site access gate remains unlocked during facility operation hours, which are 8:00 a.m. to 5:00 p.m., Monday through Friday.

The BI on-site operations telephone number is (503) 588-5064.

With the exception of monitoring wells MW-5 and MW-15, all wells are located in areas serviced by gravel access roads or dirt paths. Inclement weather conditions can reduce vehicle access to these monitoring well locations, potentially requiring the use of four-wheel drive. Weather conditions prior to and during a sampling event should be taken into consideration and planned for accordingly.

5.5 SAMPLING METHODOLOGY

The goal of groundwater quality sampling is to collect samples that are representative of the water present in the water-bearing zone screened by the monitoring well. This objective is obtained by purging the well such that water representative of formation (water-bearing zone) conditions is obtained.

5.5.1 Dedicated Sampling Pumps

Dedicated bladder pumps were installed in the 12 active monitoring wells prior to the fall 2008 sampling event. The on-site water supply well (MW-5) is purged and sampled at a spigot. The installed bladder pumps are Well Wizard dedicated monitoring systems manufactured by QED Environmental Systems. Each dedicated sampling pump consists of a Teflon bladder housed in a PVC tube equipped with an inlet screen. The pumps are suspended in the well from polyethylene twin tubing that provides an airline and a sample line. A well cap provides protection and connection points for air and sample discharge lines. The pumps can be powered by a portable air compressor or a pressured gas bottle and require a QED pump controller.

The dedicated sampling pumps were installed to limit the potential for cross-contamination while increasing sample collection efficiency and representativeness. Historically samples from monitoring wells were purged and sampled using a dedicated PVC bailer stored (suspended) in each active well. Typically all wells were purged three well casing volumes the first day of a sample event with samples collected the following day. With installation of the dedicated bladder pumps, each well was purged three well casing volumes and then sampled. The collection of samples from the 13 monitoring wells using this method takes two days to complete. As described below, low-flow sampling methodology is now used. Two days should still be scheduled to complete a sampling event.

5.5.2 Low-Flow Sampling Method

Use of low-flow sampling methodology was proposed at BI prior to the fall 2011 event. Low stress (low-flow) purging is used to reduce stress on the water column and minimize drawdown inside the well in order to limit alterations to the water chemistry and the mobilization of solids. Low stress purge rates should be from 0.2 to 0.5 liters per minute (L/min), with less than 1-foot of drawdown. Sampling should occur when the water column and other parameter measurements have stabilized.

An evaluation of dedicated sample pump discharge rates and resulting water level drawdowns determined that performance of BI monitoring wells are suited for low flow sampling. Total drawdowns in BI monitoring wells were observed to be less than one foot and typically less than 0.1 feet. Due to a portion of the screen interval at shallow well MW-8a typically being above the water table, this well was determined not to meet the low flow criteria of maintaining water level above the well screen. The DEQ approved low flow sampling methodology at BI in a letter dated August 18, 2011. The approved low-flow sampling for BI is as follows.

5.5.2.1 Materials

The following materials are used during low stress groundwater sampling:

- Water level indicator
- Bladder pump controller [MP10 MicroPurge Digital Controller]
- 0.25-inch (OD) polyethylene tubing
- Air compressor or nitrogen tank and regulator
- Power source (generator or field vehicle power outlet)
- Graduated cylinder (used to measure pumping flow rate)
- Two graduated 5-gallon plastic buckets

- pH meter
- Specific conductance meter
- Redox meter
- Temperature meter
- Dissolved oxygen meter
- Flow through cell [volume 250 mL] for water quality meters
- Field data sheets
- Sample containers with labels and appropriate preservatives
- Personal Protective Equipment (PPE)
- Decontamination supplies

Table 6 provides an equipment checklist.

5.5.2.2 Sampling Procedure

1. Open monitoring well monument and remove protective cap situated over top of bladder pump wellhead plate. Remove dedicated polyethylene discharge tubing from the pump plate storage access hole. Use the water level indicator to measure and record depth to water to the nearest 0.01 feet from the surveyed measuring point (top of pump plate water level access hole used to store discharge tube).
2. Connect the air compressor (connected to power source) or nitrogen tank to the pump controller and the controller to the pump connection on the wellhead plate.
3. Connect the dedicated polyethylene tubing to the pump effluent line on the wellhead plate. Run the effluent end of the tubing to the flow through cell containing water quality meter probes. Direct overflow from the flow through cell into the graduated 5-gallon bucket.
4. Start compressor or open nitrogen tank control valve and begin purging via the pump controller.
5. Adjust pump controller to achieve drawdown stabilization and optimum groundwater flow rate (0.2 to 0.5 L/min). Record depth to water measurements on the field data sheet every 3 to 5 minutes.
6. Collect water quality indicator parameters every 3 to 5 minutes [representing a full flush of water in the flow through cell]. The water quality indicators include: dissolved oxygen, specific conductance, pH, oxidation-reduction potential, and temperature. Groundwater is considered stable and representative of groundwater in the formation when three consecutive water-quality indicator readings are within the following criteria:

Groundwater Quality Parameters	Stabilization Criteria
Water level	+/- 1.00 foot
pH	+/- 0.1 pH units
Specific conductance	+/- 5% S/cm
Oxidation-reduction potential	+/- 10 millivolts
Dissolved oxygen	+/- 10 milligrams per liter

Temperature	+/- 1 Degree Celsius

7. Once the groundwater quality parameter stabilization criteria are met, sample collection can take place. Collect sample from the effluent line of the wellhead, not from the discharge of the flow-through cell.

8. After sampling is completed, disconnect the air compressor or nitrogen tank from the pump controller and the pump controller from the well. Disconnect the polyethylene tubing connecting the pump effluent line on the wellhead and place back in the wellhead pump plate storage access hole. Reinstall protective cap situated over the top of the pump wellhead plate. Replace monument cover and lock.

Site monitoring well purging and sampling techniques are also discussed in Section 8.3.

6. QUALITY CONTROL PROCEDURES

Quality control procedures are designed to ensure that all samples collected at the site are: (1) consistent with project objectives; (2) identified, handled, and transported in a manner that ensures the data are representative of actual site conditions; and (3) processed so that information is not lost in sample transferal. This section details QC procedures that are to be used at the site.

6.1 FIELD QA/QC

To ensure QA/QC of water quality sample data collected at the BI site, the following documentation procedures and field duplicate and blank methodology will be employed:

- Documentation - All sample collection and equipment handling procedures will be documented, including the calibration of field measurement equipment. Field measurement equipment shall be calibrated at the beginning of each day. A calibration check should be completed during the middle of each day or within 4 hours of calibration and at the end of the field day to determine if instrument drift has occurred. If drift has occurred, the instrument shall be recalibrated. Calibration of field measurement equipment will be documented in the field report form or sampling notebook. Documentation of water quality sample collection and associated sampling equipment will be recorded on the site field sampling forms (Attachment 1). Sampling field data sheets will be used to document sample collection at each water quality monitoring location.
- Transport (trip) Blank – Water quality sampling events that include the analysis of VOCs will employ a VOC transport blank to accompany sample shipment. The VOC transport blank will be prepared by the laboratory and will accompany the laboratory prepared sampling kit (laboratory-provided bottles and coolers) to and from the site. The transport blank will be preserved in the same manner as the other VOC samples. All VOC samples collected during a specific sampling period are to be stored in the cooler that contains the VOC blank.
- Equipment Blank - An equipment blank will be collected on a daily basis only when nondedicated pumps or bailers are used for the collection of a water quality sample. Wells at the site are equipped with dedicated sampling pumps that will be used for the collection of water quality samples.
- Field Duplicate - A field duplicate "blind" sample will be collected. The purpose of the field duplicate is to evaluate the precision associated with sample collection, preservation, and storage, as well as with laboratory procedures. Field duplicate samples will be collected at a minimum frequency of one every sampling day or one for each subsequent 10 samples, whichever is greater. The "blind" field duplicate sample will be collected immediately following collection of the original sample (e.g., VOC sample collection followed by field duplicate VOC sample collection, etc.). The field duplicate will be submitted for the same analysis as the original sample it is duplicating. The identity of the field duplicate (commonly designated FD) and the sampling date (e.g., FD-4/22 is a blind field duplicate collected on April 22nd) will be recorded on the site sampling field data form for the location from which it was collected. On the field duplicate sample containers and the chain-of-custody form, the blind field duplicate will be labeled in the manner described.

6.2 LABORATORY QA/QC

Water quality samples collected from the BI will be submitted for analysis to the designated contracted analytical laboratory. A copy of the current designated analytical laboratories Quality Assurance Plan/Program (QAP) is presented in Attachment 2. Included in the QAP are laboratory procedures regarding: routine equipment calibration to standards of known concentrations; the analysis and reporting of results of laboratory method blanks, duplicates, and matrix spikes for all analytes on schedules appropriate for the analytical methods used; the reporting of the accuracy and the precision data for the analysis period; and the reporting of the percent recovery of surrogate spikes in each sample analyzed for organic analytes. The contracted analytical laboratory report shall include a Quality Control Data Report which presents method blank and surrogate standard results.

The contracted analytical laboratory should implement a data validation policy that requires all data generated by the laboratory to be subjected to at least three levels of review before being released. This data generation, validation, and review process should be included in the contracted laboratory's QAP. During preparation of the draft report, the laboratory's information management system should be programed to automatically check for and list any sample results involving out-of-control QC samples, modified analyte lists, or any special flags which may have been assigned by the primary or secondary reviewers. Generation of the final report is accomplished when the laboratory Project Manager generates and saves the electronic version of the draft report to a centralized electronic archive and then prints the file on laboratory letterhead. In order to ensure consistency between the different formats of analytical data, electronic data files electronic data deliveries (EDDs) are produced from the laboratory information management system at the same time the hard-copy final report is generated.

The existing BI groundwater quality database is in Microsoft Access format and includes groundwater quality data, dating back to April 1985. As new site water quality data is obtained, EDDs from the laboratory are directly transferred into the database. This database update methodology increases data transfer efficiency and reduces data entry errors. The existing database provides various types of data reports and formats.

7. SITE SAMPLING FIELD DATA DOCUMENTATION

Site sampling documentation will be completed using a field report form and a sampling field data form (sampling form). Copies of these sampling forms should be reproduced on water-proof paper. A copy of the sampling form is presented in Attachment 1.

Field Report Form - The field report form is used to record general information including field instrumentation calibration results, site conditions, and other relevant information associated with the sampling event. Examples of site condition comments include observations of odors from a source other than a sampling point, smoke, and visible ash fallout.

Sampling Form - The sampling form, to be completed at each water quality location during each sampling event, provides a format to document sample acquisition information. A copy of the sampling form will be submitted with each water quality monitoring event report.

The following information will be recorded during each water quality sampling event:

- General sampling information (i.e., semi-annual sampling event, field sampling personnel and other relevant specifics). This information should be recorded on both the field report and sampling forms.
- Weather conditions at the time of the sampling event (temperature, precipitation, and wind). This information should be recorded on the field report form and/or in the site sampling field notebook.
- Field instrument calibration documentation noting the time and measured value of a known standard. Field equipment to be calibrated includes: pH, specific conductivity, dissolved oxygen, and reduction/oxidation potential (ORP) meters. Calibration information will be recorded on the field report form or on a separate calibration sheet.
- Well purging actions will be recorded on the sampling form for each monitoring well sampling location, and should include: depth to groundwater prior to and during purging; time and date of well purging; and the actual volume purged from the well prior to sample collection.
- Field parameter measurements noted during water quality sampling at a given location. Field parameter measurement information will include the time of measurement, the amount of water removed at the time of the measurement (at monitoring well locations), temperature, pH, specific conductivity, dissolved oxygen readings, and ORP. Included with field measurement data will be notations of the appearance of the sample (e.g., color, turbidity, and other observations). This information will be recorded on the sampling form. Field parameter monitoring is discussed in Section 5.2.2.
- Type of purging and sampling equipment used at each well location will be recorded on the sampling form.
- Sampling deviations, problems, or other pertinent information at a water quality monitoring location will be documented in the remarks section of the sampling form.
- The name and location of the laboratory, the use of chain-of-custody documentation, shipment method, and documentation of any split samples collected will also be noted on the sampling form.

Errors made on the sampling form or on the field report form will be crossed out with a single line and initialed by the field representative. Necessary corrections will be entered next to the error.

8. WATER QUALITY SAMPLING PROCEDURES

The goal of water quality sampling is to collect samples that are representative of a water-bearing formation or a surface water location. Specific monitoring well sampling procedures are organized as follows:

- Description of the sample location
- Water level measurement
- Well purging
- Field parameter measurements and instrumentation calibration
- Sample collection

The sampling form, presented in Attachment 1, provides a format on which to record and document the collection of water quality samples at the site.

The field report form will identify the facility name (BI), the type of sampling event being completed (semi, verifications, etc.), the weather conditions, the name of the sampling crew and their association, and any comments on site conditions (i.e., odors coming from a source other than a sampling point, smoke, and visible fallout).

8.1 DESCRIPTION OF SAMPLE LOCATIONS

The condition of the well will be documented. Details will include the condition of the protective casing and its cap, the condition of the well casing, the well's security (i.e., is it locked), and the condition of the concrete pad, if present. Visual damage or impeded access to the well will be detailed in the remark section of the site sampling field form. Gaseous odor in or around the well, if present, needs to be noted and described.

8.2 WATER LEVEL MEASUREMENT

Depth to groundwater in all monitoring wells at the site will be measured within a period of 4 hours to limit the possible effects of diurnal and barometric pressure. These water levels will form a data set used to construct a potentiometric map of the site and evaluate groundwater flow direction. The water level measurement reference point is the top of the exterior casing on all wells and piezometers. Reference point elevations are identified in Table 1.

Water level measurements will be collected prior to disturbing or purging the well. The depth of water in each well will be measured with an electric water level indicator from the top of the PVC well casing to the nearest 0.01 foot. The water level indicator will be rinsed with deionized water before use in each well, and will be washed with a non-phosphate detergent and then fully rinsed prior to and at the end of each field day. Section 10 discusses decontamination procedures to be used at the site. All water level measurements will be recorded on the appropriate field sampling forms.

8.3 MONITORING WELL PURGING

Purging methodology for the active monitoring wells is described in Section 5.5.2.

Well MW-5, the on-site supply well, is purged by opening the hose bib tap located on the east exterior side of the pump house. This is the closest discharge point to the well head. A hose needs to be attached to the tap to direct water away from the pump house. The minimum discharge period from the exterior east pump house tap is 10 minutes. The average measured discharge rate at the tap is 10 gallons per minute. This period of time will remove at least one well casing volume based on well depth and its static water level. At minimum, the pump in the supply well should come on during discharge from the tap. The operation of the pump can be heard outside the well house located on the north side of the pump house. During purging of well MW-5, field parameters and discharge rate will be measured. Measurement of field parameters should be completed at start of purging, at around 5 minutes, and during sample collection. Following completion of MW-5 purging, the hose shall be removed from the tap, the flow rate from the tap reduced to a slow steady flow, and the sample collection from the tap can proceed.

8.4 MONITORING OF FIELD PARAMETERS

Monitoring of field parameters during purging is described in Section 5.2.2.

All field parameter measurement equipment will be portable such that measurements are collected at the sampling location.

8.5 SAMPLING PROCEDURE

Water quality samples will be collected from the established monitoring points by the following procedures.

Groundwater sampling procedures for monitoring wells is described in Section 5.2.2.

Groundwater quality samples will be collected using the following guidelines:

- Water will be discharged directly into the bottle that has been specifically prepared for a specific constituent or set of constituents. Water will be discharged slowly down the inside of the container to reduce aeration.
- Field-filtered samples include common anion and cation parameters and trace metals as listed in Table 3. Field-filtered samples will be collected using a Gelman Sciences or similarly designed in-line disposable 0.45-micron copolymer high capacity filter. A new filter will be used at each sampling location.
- 40-mL vials used for volatile organic analysis (VOA) will be filled using a low-flow filling technique. This technique making sure water flow into the bottle is under low pressure and controlled to reduce agitation, bubbling, and potential lost of preservative. The Teflon-lined screw lid will be placed on the VOA vial so that no air bubbles are trapped in the vial. When the lid is secure, the vial will be inverted and tapped to evaluate the presence of bubbles. If bubbles are present, the lid will be removed and additional sample volume added. The lid will be secured and checked for air bubbles, as before.
- Plastic bottles without preservatives should be filled completely to minimize air contact. Glass bottles, other than total organic carbon containers, should be filled only seven-eighths full to allow room for liquid expansion.
- Appropriate sample containers and preservatives for each constituent or group of constituents are listed in Table 5. Sample containers will be supplied by the laboratory with the appropriate preservative. The laboratory will certify that the provided containers were prepared according to appropriate EPA protocol. Containers will be placed into coolers containing ice or Blue Ice immediately after the samples have been collected.

- Samples preserved with acid should be spot-checked in the field to determine if the pH is less than 2, as required. A few drops of the preserved sample can be poured onto a low-range pH test strip to check the pH. Additional acid preservative should be available to adjust the pH, if needed. VOC samples cannot be checked in this manner, due to the zero head space requirement. VOC vials are assumed to have sufficient preservative in them, as supplied by the laboratory.
- To limit potential contamination from outside sources, a new pair of latex, vinyl, or nitrile surgical-type gloves should be donned at each sampling location.
- Each sample container will be labeled in a water proof manner indicating sample location, date, and time. The sample containers should be pre-labeled with sampling location and type of analysis to be completed. If regular ice is used, labels on the containers should be covered with clear shipping tape to reduce label illegibility or removal.

9. DECONTAMINATION

Decontamination procedures are required to remove contaminants from equipment that comes into contact with the sample matrix (sample contacting equipment) and from ancillary equipment that has not contacted the portion of sample to be analyzed (non-sample contacting equipment). The decontamination procedure methods to be employed at BI are based on standard practices as presented in ASTM Standard D-5088-90, Decontamination of Field Equipment Used at Nonradioactive Waste Sites.

Sample collection at the BI involves the use of dedicated or disposable sampling equipment including dedicated sampling pumps. All sampling equipment employed at BI is either dedicated, removed prior to sample collection, or used once and disposed after use.

Sample contacting equipment are those items that come into direct contact with the sample or a portion of the sample that will undergo chemical analysis or physical testing. Non-sample contacting equipment are those items associated with the sampling effort that do not directly contact the sample.

Decontamination of sample contacting equipment, if used, will receive a non-phosphate detergent wash followed by rinse with deionized water and then allowed to air dry.

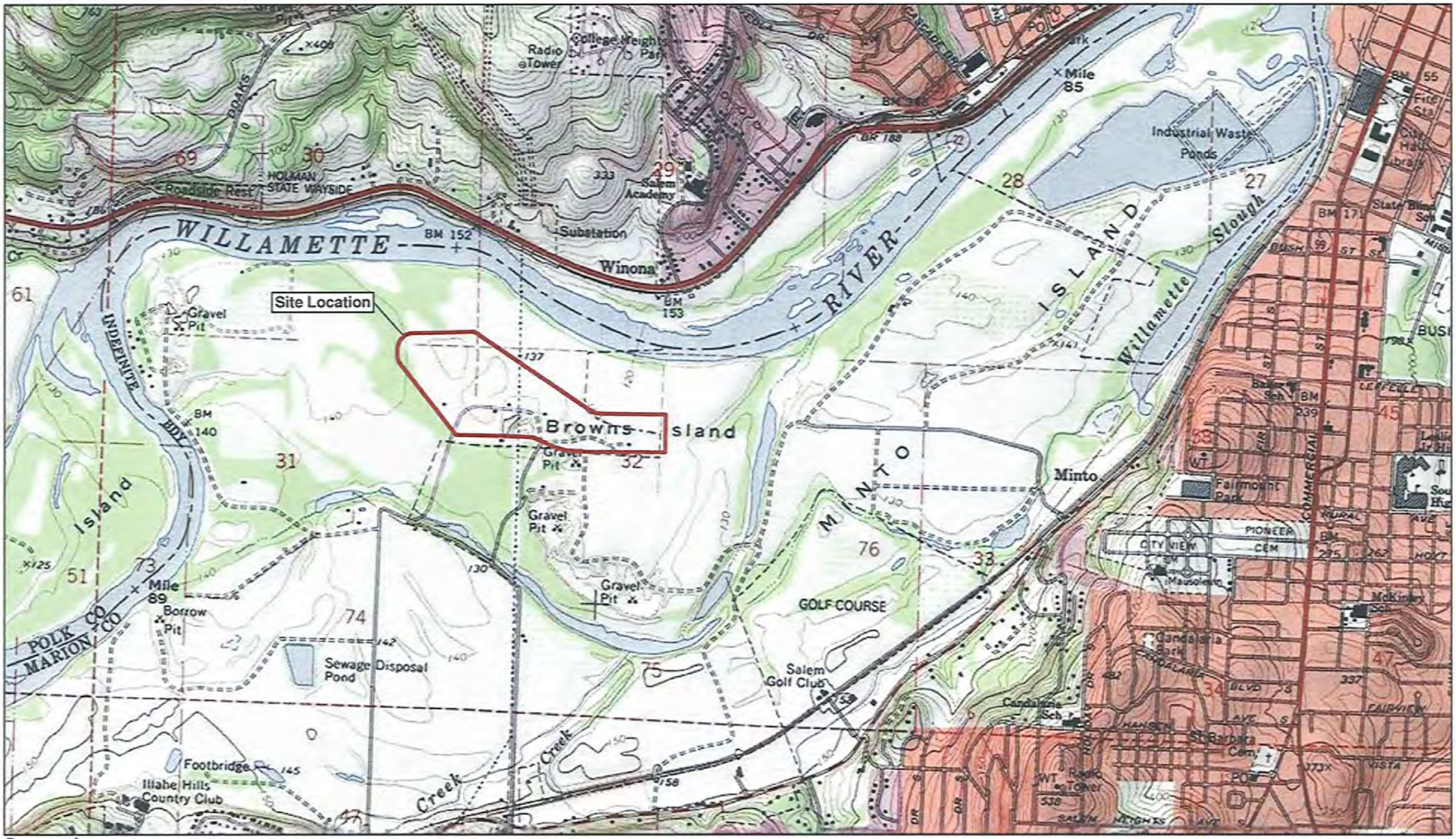
Decontamination of non-sample contacting equipment will receive a non-phosphate detergent wash and rinsed with deionized water.

Control rinse water will be obtained from a water system of known chemical composition. The non-phosphate detergent will be Alquinox, Liquinox, or a similar solution. Deionized water shall be organic-free reagent grade.

10. SAMPLE PACKAGING AND SHIPMENT

Chain-of-custody procedures will be followed. The following procedures for sample packing and shipment will be followed:

- Double-check that the sample label sticker on the sample bottle has been completed and that the label identification matches the chain-of-custody form.
- Roll up or contain glass containers with bubble-pack and tape, taking care that there is no glass-to-glass contact. (Plastic bottles do not have to be wrapped with bubble pack.)
- Pack the sample bottles in coolers, preferably keeping all the samples from one sample location together. Use additional bubble-pack material to provide cushioning and support between and below sample bottles, especially the large glass bottles.
- Use Blue Ice or ice sealed inside two Ziploc bags to cool the samples. Do not use ice for packing between bottles.
- Complete the chain-of-custody form, listing the number of sample bottles in the cooler. Indicate on the chain-of-custody form which analyses are to be performed (as indicated in Table 3). Seal the top chain-of-custody sheet in a Ziploc bag and tape it to the inside lid of the cooler.
- Close the cooler and tape it shut by making one complete wrap of banding tape on each end of the cooler and seal the opening with a custody seal.
- Transport the coolers to the laboratory or use the laboratory courier service. Chain-of-custody forms are to be signed upon sample relinquishment.



Parametrix DATE: March 1, 2011 FILE: BrownIsland_SiteLocation.mxd

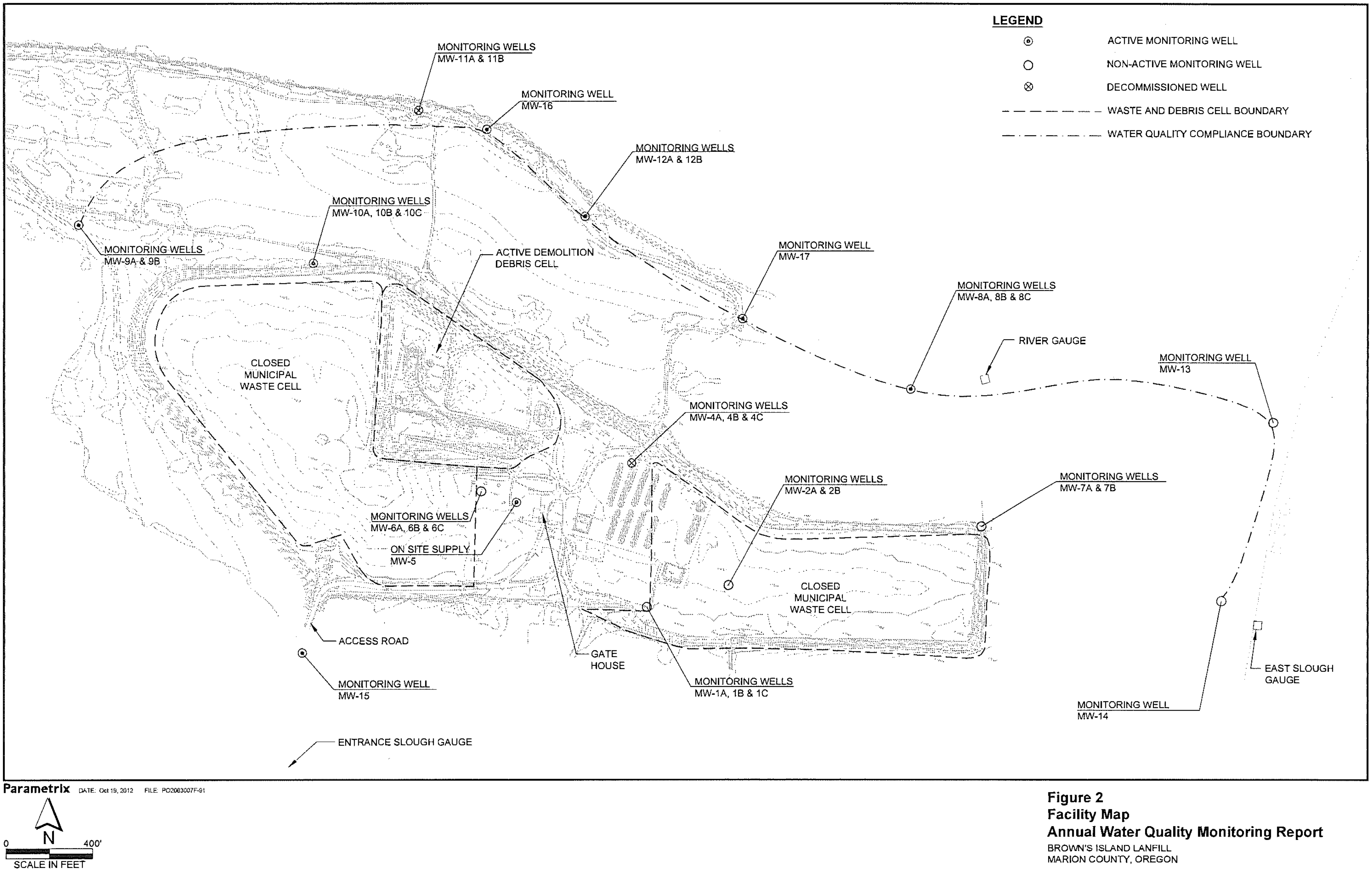
N

0 0.5 1

Miles

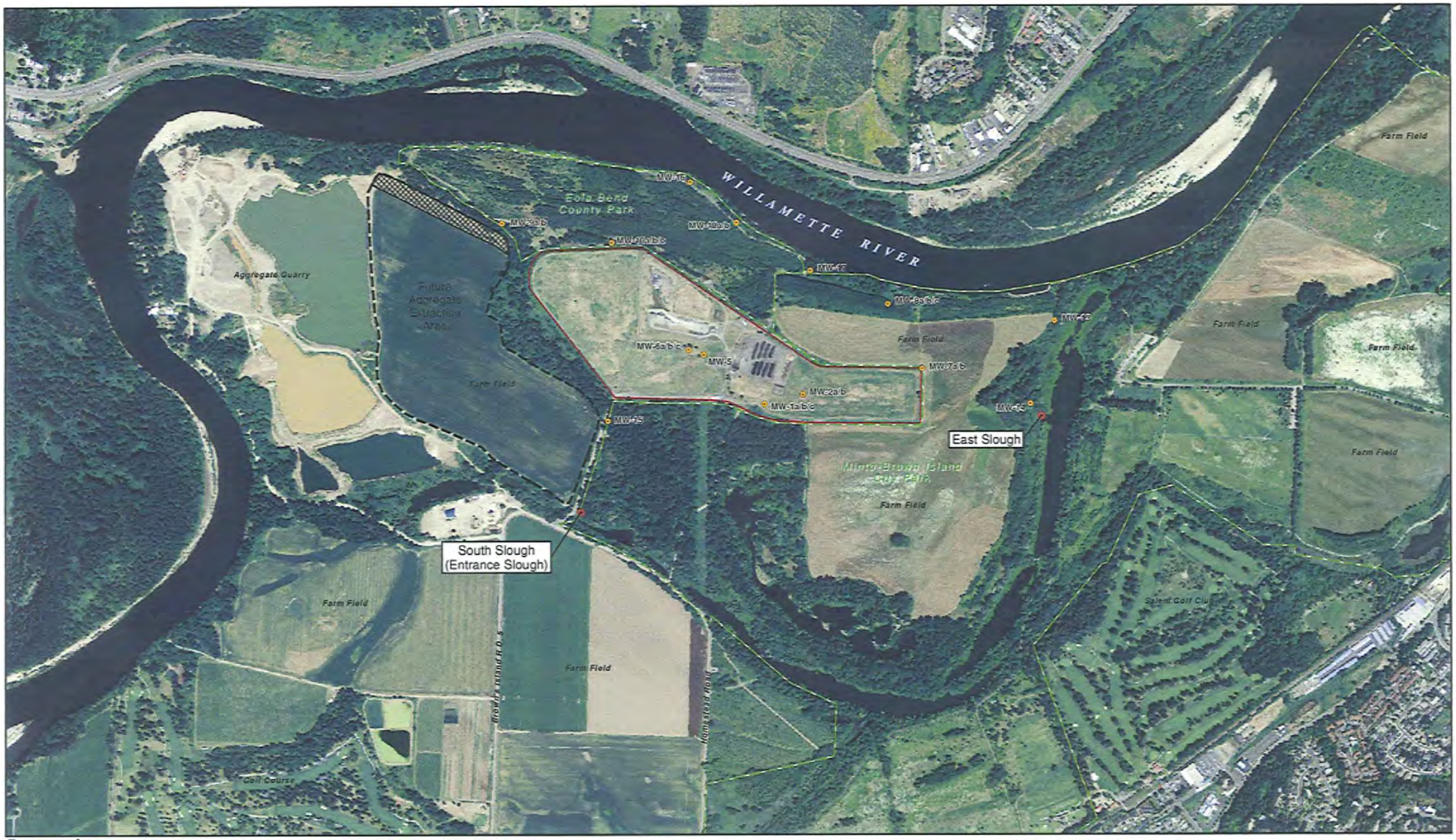
Figure 1
Site Location

Annual Water Quality
Monitoring Report
Brown's Island Landfill



Parametrix DATE: Oct 19, 2012 FILE: PO2063007F-01

Figure 2
Facility Map
Annual Water Quality Monitoring Report
BROWN'S ISLAND LANFILL
MARION COUNTY, OREGON



Parametrix DATE: March 3, 2011 FILE: BrownIsland_AerialSiteMap.mxd

N

0 0.25 0.5
Miles

Site Location
Future Aggregate Extraction Area
Recent Excavated Area
Monitoring Well
Surface Water Elevation Monitoring Point
Park Boundary

Figure 3
Aerial Site Map

Annual Water Quality
Monitoring Report
Browns Island Landfill

Table 1: Monitoring Well Summary Data
Sampling and Analysis Plan
Browns Island Landfill

Active Monitoring Wells

Well ID	Date Installed	Well Log	Construction Type	Well Depth (from top of PVC - ft)	Top of PVC Casing Elevation (ft)	Screen Length (ft)	Screen interval (ft below top of PVC)
MW-5	1/5/1969	yes	supply	105	153.84	none	61-105
MW-8a	10/16/1975	yes	single	20.47	136.72	5	15.3 - 20.3
MW-8b/c	10/15/1975	yes	double	23.90/37.72	136.88/136.62	3/3	23-26/32-35
MW-9a/b	3/76-7/79	no	double	37.08/23.78	136.98/137.02	4.0/4.9	32.9-36.9/18.8-23.9
MW-10b/c	3/76-7/79	no	double	33.42/24.70	134.78/134.94	1.1/4.8	32.2-33.3/19.8-24.6
MW-12a/b	3/76-7/79	no	double	26.90/43.51	136.17/135.83	4.6/4.4	22.2-26.8/39.0-43.4
MW-15	10/31/1986	yes	single	44.36	140.24	20	20-40
MW-16	11/11/1998	yes	single	48.77	141.92	10	36/46
MW-17	11/10/1998	yes	single	42.38	137.81	10	30/40

Inactive Monitoring Wells

Well ID	Date Installed	Well Log	Construction Type	Well Depth (ft)	Top of PVC Casing Elevation (ft)	Screen Length (ft)	Screen interval (ft below top of PVC
MW-1a/b/c	5/8-5/21/73	yes	triple	40.67/47.17/51.33	151.75/152.01/152.16	2.5/2.5/2.5	38.2-40.6/44.7-47.1/48.8-51.3
MW-2a/b	5/22-23/73	yes	double	41.75/57.5	158.63/158.68	2.5/2.5	39.2-41.7/55.0-57.5
MW-6a/b/c	5/23-5/31/73	yes	triple	33.3/43.33/54.3	151.89/151.89/151.90	5/5/4	28.3-33.3/38.3-43.3/50.3-54.3
MW-7a	10/13/1973	yes	single	22.0	141.36	5	15-20
MW-7b	10/8/1973	yes	single	34.3	141.90	5	30-35
MW-10a	3/76-7/79	no	single	14.32	134.78	4.8	9.4-14.2
MW-13	10/29/1986	yes	single	43.55	135.31	20	21/41
MW-14	10/30/1986	yes	single	28.25	128.85	5	21/26

Abandoned Monitoring Wells

Well ID	Date Installed	Well Log	Construction Type	Well Depth (ft)	Date Abandoned
MW-4a/b/c	4/16-5/7/73	yes	triple	40/48/62	7/29/99-8/2/99
MW-11a/b	3/76-7/79	no	double	15.08/21.31	9/8/1997

TABLE 2: WATER QUALITY SAMPLE LOCATIONS, FREQUENCY, AND SCHEDULE
SAMPLING AND ANALYSIS PLAN
BROWNS ISLAND LANDFILL

Locations	Analytes *	Frequency	Schedule
Alluvium wells: Shallow: MW-8a. Intermediate: MW-8b, MW-9b, MW-10c, MW-12a, and MW-15. Deep: MW-8c, MW-9a, MW-10b, MW-12b, MW-16, and MW-17.	Group 1a Group 1b Group 2a	Semi-annual	Spring and Fall
	Group 2b Group 3	Bi-annual	Every two years in Fall beginning in 2006
Marine Sedimentary Rock wells: MW-5 (on-site supply well)	Group 1a Group 1b Group 2a	Semi-annual	Spring and Fall
	Group 2b Group 3	Bi-annual	Every two years in Fall beginning in 2006
Piezometers: MW-1a/b/c, MW-2a/b, MW-6a/b/c, MW-7a/b, MW-10a, MW-13, and MW-14.	Water levels	Semi-annual: all monitoring wells	Spring and Fall

NOTES:

* See Table 3, Water Quality Monitoring Parameters, for analytes/parameters included in each parameter group. BI Indicator Parameter list is applied except during even year Fall events (i.e., Fall 2012, Fall 2014, etc.) when the BI Permit Parameter list is applied.

The semi-annual compliance monitoring periods are:

Spring: March 1st through May 31st.

Fall: September 1st through October 31st.

TABLE 3: WATER QUALITY MONITORING PARAMETERS
SAMPLING AND ANALYSIS PLAN
BROWNS ISLAND LANDFILL

BI INDICATOR PARAMETERS	BI PERMIT PARAMETERS	METHOD	METHOD DESCRIPTION	METHOD REPORTING LEVEL (mg/L)	DEQ REFERENCE LEVELS[d] (mg/L)	DEQ GUIDANCE LEVELS[e] (mg/L)	EPA DRINKING WATER STD[f] (mg/L)
GROUP 1a: FIELD INDICATOR PARAMETERS							
ELEVATION OF WATER LEVEL	ELEVATION OF WATER LEVEL	FIELD	Electric Probe				
pH	pH	FIELD	Reference Electrode Probe			6.5 to 8.5 su	
TEMPERATURE	TEMPERATURE	FIELD	Temperature Probe				
SPECIFIC CONDUCTANCE	SPECIFIC CONDUCTANCE	FIELD	Conductivity Probe				
DISSOLVED OXYGEN	DISSOLVED OXYGEN	FIELD	Metal Cathode Probe				
REDOX POTENTIAL (Eh)	REDOX POTENTIAL (Eh)	FIELD	Platinum Band Sensor Probe				
GROUP 1b: LABORATORY INDICATOR PARAMETERS							
	HARDNESS (as $CaCO_3$)	6020[a]	ICP-MS	2.00			
TOTAL ALKALINITY (as $CaCO_3$)	TOTAL ALKALINITY (as $CaCO_3$)	310.1[b]	Titrimetric	20.0			
TOTAL DISSOLVED SOLIDS (TDS)	TOTAL DISSOLVED SOLIDS (TDS)	160.1[b]	Gravimetric	10.0		500	
TOTAL SUSPENDED SOLIDS (TSS)	TOTAL SUSPENDED SOLIDS (TSS)	160.1[b]	Gravimetric	5.00			
	CHEMICAL OXYGEN DEMAND (COD)	410.4[b]	Spectrophotometric	5.00			
	TOTAL ORGANIC CARBON (TOC)	415.1[b]	UV, Persulfate Oxidation-IR	1.00			
GROUP 2a: COMMON ANIONS AND CATIONS[c]							
CALCIUM (Ca)	CALCIUM (Ca)	200.7[b]	ICP-MS	0.500			
	MAGNESIUM (Mg)	200.7[b]	ICP-MS	0.002			
	SODIUM (Na)	200.7[b]	ICP-MS	1.00			
	POTASSIUM (K)	200.7[b]	ICP-MS	1.00			
IRON (Fe)	IRON (Fe)	200.7[b]	ICP-MS	0.100		0.3	
MANGANESE (Mn)	MANGANESE (Mn)	200.8[b]	ICP-MS	1.00		0.05	
AMMONIA-NITROGEN (NH_3-N)	AMMONIA-NITROGEN (NH_3-N)	350.3[b]	Electrode	0.0200			
	BICARBONATE ALKALINITY (HCO_3)	310.1[b]	Titrimetric	10.0			
SULFATE (SO_4)	SULFATE (SO_4)	300.0[b]	Ion Chromotography	1.00		250	
CHLORIDE (Cl)	CHLORIDE (Cl)	325.3[b]	Ion Chromotography	1.00		250	
NITRATE (NO_3-N)	NITRATE (NO_3-N)	353.3[b]	Ion Chromotography	0.250	10.0		10
	SILICA (Si)	370.1[b]	Spectrophotometric Reduction	0.250			
GROUP 2b: TRACE METALS							
	ARSENIC (As)	6020[a]	ICP-MS	0.00100	0.05		0.05
	BARIUM (Ba)	6020[a]	ICP-MS	0.00100	1.0		2
	CADMIUM (Cd)	6020[a]	ICP-MS	0.00100	0.01		0.005
	CHROMIUM (Cr)	6020[a]	ICP-MS	0.00200	0.05		0.1
	COBALT (Co)	6020[a]	ICP-MS	0.00100			
	LEAD (Pb)	6020[a]	ICP-MS	0.00100	0.05		0.015***
	NICKEL (Ni)	6020[a]	ICP-MS	0.00200			
	SELENIUM (Se)	6020[a]	ICP-MS	0.00100	0.01		0.05
	SILVER (Ag)	6020[a]	ICP-MS	0.00100	0.05		0.1
GROUP 3: VOLATILE ORGANIC CONSTITUENTS							
	VOLATILE ORGANIC CONSTITUENTS	8260[a]	Gas Chromotography/Mass Spect.	0.50-1.0 ug/L			

[c] DISSOLVED CONCENTRATIONS. SAMPLES MUST BE FIELD-FILTERED.
[a] TEST METHODS FOR EVALUATING SOLID WASTE - PHYSICAL/CHEMICAL METHODS. 3rd edition. EPA SW-846 (November 1990).
[b] METHODS FOR CHEMICAL ANALYSIS OF WATER AND WASTES. EPA-600/4-79-020 (revised March 1983).
[d] DEQ NUMERICAL GROUNDWATER QUALITY REFERENCE LEVELS (HEALTH BASED). OAR 340-040-080 (January 1990).
[e] DEQ NUMERICAL GROUNDWATER QUALITY GUIDANCE LEVELS (NONHEALTH BASED). OAR 340-040-080 (January 1990).
[f] EPA NATIONAL PRIMARY DRINKING WATER STANDARDS. EPA 816-F-02-013 July 2002.
*** EPA ACTION LEVELS.
ICP-MS: Inductively Coupled Plasma-Mass Spectrometry
TRACE METALS - TOTAL CONCENTRATIONS IF TSS <100 mg/L; BOTH TOTAL AND DISSOLVED CONCENTRATIONS IF TSS >100 mg/L.

TABLE 4: VOLATILE ORGANIC CONSTITUENTS - EPA METHOD 8260
BROWNS ISLAND LANDFILL
SAMPLING AND ANALYSIS PLAN

ANALYTE	EPA DW STD. & HEALTH ADVISORY (ug/L)	DEQ-GW QUALITY LEVELS (ug/L)	METHOD REPORT LEVEL (ug/L)
Acetone		NEL	10.0
Benzene	5	5	0.500
Bromobenzene		NEL	0.500
Bromochloromethane		NEL	0.500
Bromodichloromethane (THM)	100	NEL	0.500
Bromoform (THM)	100	NEL	1.00
Bromomethane		NEL	5.00
2-Butanone		NEL	10.0
n-Butylbenzene		NEL	5.00
sec-Butylbenzene		NEL	0.500
tert-Butylbenzene		NEL	1.00
Carbon Tetrachloride	5	5	1.00
Chlorobenzene	100	NEL	0.500
Chloroethane		NEL	1.00
Chloroform (TMH)	100	NEL	0.500
Chloromethane		NEL	5.00
2-Chlorotoluene		NEL	0.500
4-Chlorotoluene		NEL	0.500
1,2-Dibromo-3-chloropropane	0.2	NEL	5.00
Dibromochloromethane		NEL	0.500
1,2-Dibromoethane		NEL	0.500
Dibromomethane		NEL	0.500
1,2-Dichlorobenzene	600	NEL	0.500
1,3-Dichlorobenzene	600	NEL	0.500
1,4-Dichlorobenzene	75	75	0.500
Dichlorodifluoromethane		NEL	5.00
1,1-Dichloroethane		NEL	0.500
1,2-Dichloroethane (EDC)	5	5	0.500
1,1-Dichloroethene	7	7	0.500
cis-1,2-Dichloroethene	70	NEL	0.500
trans-1,2-Dichloroethene	100	NEL	0.500
1,2-Dichloropropane (1,2-DCP)	5	NEL	0.500
1,3-Dichloropropane		NEL	0.500
2,2-Dichloropropane		NEL	0.500
1,1-Dichloropropene		NEL	1.00
Ethylbenzene	700	NEL	0.500
Hexachlorobutadiene		NEL	2.000
2-Hexanone		NEL	10.0
Isopropylbenzene		NEL	2.00
p-Isopropyl toluene		NEL	2.00
4-Methyl-2-pentanone		NEL	5.00
Methylene Chloride		NEL	5.00
Napthalene		NEL	2.00
n-Propylbenzene		NEL	0.500
Styrene	100	NEL	0.500
1,1,1,2-Tetrachloroethane		NEL	0.500
1,1,2,2-Tetrachloroethane		NEL	0.500
Tetrachloroethene (PCE)	5	NEL	0.500
Toluene	1000	NEL	0.500
1,2,3-Trichlorobenzene		NEL	1.00
1,2,4-Trichlorobenzene	70	NEL	1.00
1,1,1-Trichloroethane (1,1,1-TCA)	200	200	1.00
1,1,2-Trichloroethane	5	NEL	0.500
Trichloroethene (TCE)	5	5	0.500
Trichlorofluoromethane		NEL	0.500
1,2,3-Trichloropropane		NEL	0.500
1,2,4-Trimethylbenzene		NEL	1.00
1,3,5-Trimethylbenzene		NEL	0.500
Vinyl chloride	2	2	0.500
o-xylenes		NEL	0.500
m,p-xylenes	10,000	NEL	1.00

NOTES:
NEL = NO ESTABLISHED MCL.
* TOTALS FOR ALL THM'S COMBIND CANNOT EXCEED 0.008 mg/L.

TABLE 5: Water Quality Sample Containers, Preservatives, and Holding Times
Browns Island Landfill
Sampling and Analysis Plan

Parameter	Analytical Method	Volume Required (mL)	Container Type	Preservative	Holding Time
Indicator Parameters (Group 1b)					
Total Alkalinity	310.1	250	Plastic	Cool, 4°C	14 days
Total Dissolved Solids (TDS)	160.1	1,000	Plastic	Cool, 4°C	7 days
Total Suspended Solids (TSS)	160.2	1,000	Plastic	Cool, 4°C	7 days
Chemical Oxygen Demand (COD)	410.4	1,000	Plastic	H_2SO_4 to pH <2; Cool, 4°C	28 days
Total Organic Carbon (TOC)	415.1	100	Glass	H_2SO_4 to pH <2; Cool, 4°C	28 days
Common Anions and Cations (Group 2a)					
Calcium	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
Iron	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
Potassium	200.7/6010	500	Plastic	HNO_3 to pH <2	6 months
Ammonia-Nitrogen	350.1/350.3	500	Plastic	H_2SO_4 to pH <2; Cool, 4°C	28 days
Nitrate-Nitrogen	300.0	500	Plastic	Cool, 4°C	48 hours
Bicarbonate (HCO_3)	SM2320B	500	Plastic	None	14 days
Sulfate	300.0	500	Plastic	Cool, 4°C	28 days
Chloride	300.0	500	Plastic	None	28 days
Dissolved and Total Trace Metals (Group 2b)					
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
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
Nickel	200.8/6020	500	Plastic	HNO_3 to pH <2	6 months
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
Volatile Organic Compounds (VOCs) (Group 3)					
	8260/524.2	3/40-mL vials	Glass with Teflon-lined septum caps	HCL to pH <2; Cool, 4°C	14 days
NOTE: Information from U.S. EPA "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods" (SW-846).					

TABLE 6
BROWNS ISLAND LANDFILL - MARION COUNTY
EQUIPMENT CHECKLIST

Monitoring Wells
☐Keys (unlock wells)
☐5-gallon bucket (track purge volume)
☐Cell phone and contact numbers
☐Map of boring locations

Field Parameter Measurements
☐Water level indicator (reads to 0.01 ft)
☐pH meter with buffers
☐Conductivity meter with standards
☐Dissolved oxygen meter
☐Thermometer
☐Oxidation/Reduction meter
☐Spare meter batteries
☐Distilled decon rinse water

Documentation
☐Adhesive labels for sample containers (from lab)
☐Ball point pen, pencil, and indelible ink pen
☐Clipboard
☐Sampling field notebook (water-proof paper)
☐Sampling data sheets (on water-proof paper)
☐Custody sheets (from lab)
☐Custody seals (from lab)
☐Sampling and analysis plan
☐Meter operation manuals

Decontamination
☐Alconox or trisodium phosphate detergent
☐Distilled water
☐Plastic tarp
☐Medium-side wash brushes
☐Surgical gloves
☐Rubber boots

Shipping
☐Sample containers (from lab)
☐Covers (from lab)
☐Ice or blue ice
☐Zip-loc and/or bubble bags
☐Strapping tape

Miscellaneous
☐Paper towels
☐Small sledge hammer
☐Watch with stopwatch
☐Knife
☐Safety glasses
☐Duct tape
☐Rain gear
☐Heavy rubber outer gloves

Monitoring Well Sampling
☐Power source (generator or battery)
☐Air compressor or tank w/ regulator
☐Bladder pump controller
☐0.25-inch polyethylene tubing
☐Flow through cell for meters
☐Graduated cylinder
☐Disposable 0.45 micron filter

ATTACHMENT 1

Water Quality Monitoring Sampling Field Data Sheet

Parametrix, Inc.

Well/Sample #: ______________

Groundwater Sampling Field Data Sheet
Sampling Event

Project Number ____________________ Date ____________________
Project Name ____________________ Event ____________________
Client Name ____________________ Sampled by ____________________

Casing Diameter: 2" ____ 4" ____ ____ Other ________

Depth to Water (feet) ____________________ Purge Volume Measurement Method ________
Depth of Well (feet) ____________________ Date Purged ________
Water Column (feet) ____________________ Purge Time (from/to) ________
1 Purge Volume (g) ____________________ Date/Time Sampled ________

Time (2400 hr)	Cumulative Volume (gal)	Depth to Water (feet)	pH (units)	Temp. (°C)	EC (μS)	DO (mg/L)	Redox (mV)	Turb. (visual)

Purge Equipment ____________________ Sampling Equipment ____________________

Laboratory ____________________ Date Sent to Lab ____________________
Chain-of-Custody (yes/no) ____________________ Field QC Sample Number ____________________
Shipment Method ____________________ Split with (name(s)/organization) ____________________

Well Integrity ____
Remarks: ____

Signature ____

Field Report

Date	Job No.
Project/Location	
Weather am:	pm:
Present at Site	

The following was noted:

ATTACHMENT 2

Designated Analytical Laboratory Quality Assurance Program
(Please see attached CD)

Apex Laboratories, LLC
12232 SW Garden Place
Tigard, Oregon 97223
503-718-2323

QUALITY ASSURANCE MANUAL
JUNE 2011

Approval signatures:

Rochelle Aman   6/30/11
for David Jack, Technical/Operations Manager

Evan Holloway   6-29-11
Evan Holloway, Quality Assurance Manager

Philip Nerenberg   6/29/11
Philip Nerenberg, Laboratory Director

Clarifications & Definitions

This document is footnoted to reference applicable sections of the 2003 National Environmental Laboratory Accreditation Conference (NELAC) Standard and the corresponding items on the NELAC 2003 Quality Systems checklist.

Element: refers to Apex's laboratory information management system. *Element* is the brand name of the software marketed by Prōmium.

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Table of Contents

Figures

1. Quality Assurance Policy Statement

This Quality Assurance (QA) Manual summarizes the overall quality system in place at Apex Laboratories, LLC. The signatures on the front cover serve to document laboratory management's commitment to upholding the tenets of this QA Manual and the related documents that support the quality system.[1] The objectives and policies laid out in this manual are issued under the authority of the Laboratory Director, and Apex assumes legal responsibility for compliance with them.[2]

1.1. The objectives of Apex's quality system are summarized as follows:[3]

a) Produce data that are scientifically valid, defensible, reproducible, accurate and timely.

b) Report data of known quality, representative of the submitted sample and most appropriate to the end-use of the data.

c) Provide a framework for effective communication of, and adherence to, all applicable method and regulatory guidelines and client requirements. [4]

d) Provide a mechanism for continuous improvement and minimize departures from the quality system.

e) Document the means by which the laboratory's quality objectives (items a-d above) are achieved.

f) Ensure that personnel uphold the laboratory's quality objectives and are fully empowered to do so.[5]

1.2. [6]The protocols of the laboratory's quality system fall into two categories: (1) those specific to the analytical method sources referenced in section 9.1, and (2) those applicable to the laboratory's operations in general as regulated by the standards of accrediting bodies, including Washington Department of Ecology (WA DOE) and Oregon Environmental Laboratory Accreditation Program (ORLAP). Whichever format presents the most stringent QA/Quality Control (QC) requirements takes precedence, unless specifically excluded.[7]

a) Analytical procedure and QA/QC requirements specific to an analytical method are included in the laboratory's standard operating procedure (SOP) for the method. An SOP may cover more than one analytical method.

b) QA protocols applicable to the laboratory's operations in general are documented as one or more of the following:
- **i** The QA Manual - references further detailed documentation when applicable and copies may be footnoted to reference the 2003 National Environmental Laboratory Accreditation Conference (NELAC) Standard.
- **ii** Apex SOPs - categorized by department, including QA administrative SOPs.
- **iii** Laboratory Policies – address issues applicable to multiple SOPs, usually short enough to not warrant being a full SOP.

1.3. [8]It is the QA Department's duty, with the support of the rest of the management team, to integrate the quality system into the daily operations of the laboratory. Requirements of the quality systems are informally communicated through the normal day-to-day interactions of laboratory status and department meetings, data review, training, addressing analytical problems, etc. For Apex, it is imperative that the quality system is the framework of the laboratory's function, not a separate aspect of it. Formal periodic documentation of each employee's knowledge of the aspects of the quality system relevant to their job and their agreement to implement them is achieved by the following:

a) Each employee reads the QA Manual as part of their initial orientation, and each new revision of it thereafter.

b) A training session on the QA Manual and relevant QA SOPs and policies is given by a member of the QA department at least once a year.

c) New policies are communicated via email and are made available electronically.

d) Analysts review their method SOPs against current published methods annually.

2. Laboratory Ethics and Data Integrity[9]

Apex Laboratories, LLC, has an internal program in place to create an ethically sound culture and ensure data integrity. Apex's ethics program is described in detail in Apex SOP Q-101 Code of Ethics.

2.1. Ethics Training

Apex's ethics program is supported by many components of the quality system and includes annual ethics training for all employees that covers:

a) Detection, evaluation and remediation of any improper, unethical or illegal actions.

b) Management's responsibility to provide personnel with the resources and authority to carry out their work in accordance with the quality system and ethics program.

c) Prevention of any undue pressures or influences (internal or external) that may adversely affect the quality of work. [10]

d) The agreement of personnel, and the laboratory as a whole, to not participate in any business or activity that could:[11]
i Pose a conflict of interest,
ii Compromise the integrity of the data generated by the laboratory or client confidentiality, or
iii Undermine the laboratory's compliance with safety and/or hazardous waste disposal regulations.

e) Each new employee receives ethics training as part of their orientation. A signed ethics agreement is kept in each employees training file. Lab-wide refresher training for the ethics program is given annually by the QA department. This training is documented by dated signatures of those attending the training session. Training signature sheets are kept on file in the QA department.

2.2. Documentation and Tracking

Data integrity issues are documented in order to track any further investigation or follow-up that may be required and to provide a historical record in case of further incidents.

a) Documentation may include:
i Data review or internal audit findings and subsequent corrective action,

- **ii** A non-conformance report with subsequent corrective action, or
- **iii** In cases where confidentiality is an issue, and/or the ethical concern is not directly associated with any specific data, documentation as a Code of Ethics Non-Conformance Report may be kept by human resources in the appropriate personnel file.

b) In order to track the occurrence of data integrity and/or ethical concern issues for periodic assessment of the Quality System, (the annual QA Report to Management, etc), the QA department keeps a record of all Code of Ethics Non-Conformance Reports kept in personnel files.

c) Apex maintains that the greatest deterrent for inappropriate action is a corporate climate of personal accountability and commitment to the highest degree of integrity in all actions of the laboratory and its staff members.

3. Client Services

3.1. Acceptance of Work[12] - The Project Manager is responsible for reviewing the technical and service requirements of any request to provide analytical testing prior to accepting the work. This includes a review of the capacity and capability of each department involved, taking into consideration factors such as laboratory accreditation, instrumentation, methodology, staffing, turn around times, reporting levels and specialized project requirements. The laboratory will not accept samples for in-house analysis where capability or capacity is exceeded.

a) A client's request for work is documented, at a minimum, by a submitted chain of custody (COC) and may be include further documentation such as a Quality Assurance Project Plan (QAPP) or Sampling and Analysis Plan (SAP) from the client.

b) Apex makes every effort to clarify and document project requirements and provide the most appropriate analytical support:

- **i** If impropriety of sample handling or sample containers is significant enough to potentially compromise data integrity, the client is notified for the option of re-sampling or qualification of the data.
- **ii** If samples are of an atypical matrix, Apex has a protocol in place to ensure appropriate sample preparation and analytical methods are applied and thoroughly documented.
- **iii** Any incongruities between a client's request for work and the laboratory's ability to perform the analyses are resolved prior to commencing work.

c) Review of any request for work is documented in the project file, at a minimum as review of the COC and sample receipt confirmation sent to the client. More extensive requests that include a contact or QAPP, etc., entail further documentation and approval signatures.

3.2. Apex's Statement of Qualifications includes a list all test methods the laboratory is able to perform and the extent of accreditation for each test method and applicable matrix.[13] The laboratory's protocol for development and validation of alternative methodologies is documented as Apex SOP Q-108.

3.3. Amendments, Deviations & Complaints – Pertinent client communications during routine samples analyses may be documented as notes in the project file or retained electronically as emails or entries in *Element*.[14]

a) Amendments to a client's request for work (whether a COC or QAPP, etc.) are reviewed as above and are communicated to the appropriate personnel and documented accordingly.[15]

b) If there are changes in Apex's accreditation status relevant to a client's work or the laboratory deviates from the agreed upon protocols during performance of the work, such changes are communicated to the client for timely resolution and are documented accordingly.[16]

3.4. Apex is amenable to client's request to monitor laboratory performance through project specific QC, split samples, performance test samples, and/or client audits.[17]

3.5. Any complaint a client has against the laboratory's service or reported data will be handled by the appropriate management or QA personnel. The extent of corrective action and documentation warranted will be determined by the nature of the compliant and may include an amended Analytical Report, a non-conformance report and/or inclusion in the annual QA report to management.[18]

4. Organization & Responsibility

4.1. Apex is an independently owned and operated laboratory and is not part of a larger organization. The laboratory does not perform business activities other than those associated with environmental testing, therefore the potential for conflict of interest in the roles of key personnel is minimal.[19] The laboratory's management team consists of the Laboratory Director, the Technical Manager, the Business Director and the QA Manager. The laboratory management and quality systems cover all work conducted by Apex personnel at the laboratory facility or on behalf of the laboratory at a client location.[20]

Employees may fill multiple roles in the laboratory in order to provide coverage in all areas at all times. Each employee is fully trained in any new tasks they are assigned, and must demonstrate proficiency before being allowed to work independently on client samples. Where applicable, the organizational chart (Figure 1.) shows an employee's secondary responsibilities in parentheses under the appropriate department.

4.2. Organizational Structure

The organizational chart (Figure 1.) depicts the structure of the laboratory organized per department and the independent relationship of quality assurance, technical operations and business development.[21] Personnel responsible for supervising the work of a department are bolded on the organizational chart. No name bolded for a department indicates that all personnel are at an equivalent experience level sufficient that supervision other than by the Technical Manager is not required.[22]

The organizational chart and position descriptions below, in conjunction with the Code of Ethics (Apex SOP Q-101), define the responsibility, authority and interrelationship of personnel responsible for data integrity.[23]

4.3. Job descriptions of key positions[24]

A brief job description for key positions within the laboratory are given below. The names of personnel filling these positions are given in the organizational chart (Figure 1.) and Apex's Statement of Qualifications (SOQ) contains detailed descriptions of their relevant experience. Deputies assigned in the absence of the key positions (Laboratory Director, Technical Manager, Business Development Manager and QA Manager) are indicated on the organizational chart (Figure 1.)[25]

a) **Laboratory Director** - Responsible for the overall laboratory functions, including daily laboratory operations and adherence to technical standards. The Laboratory Director works in conjunction with the Technical Manager and Quality Assurance Manager to ensure that adequate technical and staffing resources are available for the work being performed. Responsibilities also include project management and reporting, as well as purchasing, facilities management and supervision of laboratory employees.

b) **Quality Assurance (QA) Manager** - The Quality Assurance Manager role will be filled by someone who meets the minimum requirements of the 2003 NELAC standard Section 5.4.1.5.i, including general knowledge of analytical methods performed by the laboratory and documented quality assurance training.

Responsible for developing, implementing and maintaining the laboratory's Quality System. Ensures that the Quality System is relevant to laboratory operations and complies with analytical methods and applicable standards.[26]

Duties: [27]

i Oversees the auditing of laboratory and system operations, and any necessary corrective actions.
ii Oversight of QA/QC data review & assessment of compliance with laboratory quality objectives, independent of any outside influences.
iii Works in conjunction with the Technical Manager to determine the minimum qualifications for all technical positions.
iv Ensures that personnel are appropriately trained and that training is documented. Maintains training records.
v Maintains laboratory accreditations, including proficiency testing[22, 32]and communicates with state and federal agencies regarding all accreditation matters.
vi Communicates the ongoing status of Quality System compliance to management, including the Annual Quality Report to Management referenced in Section 19.3 of this manual.
vii Maintains current revisions of controlled documents including the Quality Assurance Manual and SOPs.[28]
viii Maintains method development and validation documentation, including MDL studies.

c) **Technical Manager** - The Technical Manager role will be filled by someone who meets the minimum requirements of the 2003 NELAC standard Section 4.1.1.1[29]

Responsible for managing the technical functions of laboratory operations, including monitoring analytical capabilities, ensuring adequate resources, performing technical project assessments and monitoring the validity of analyses performed and data generated to assure reliable data. The Technical Manager oversees method development and manages laboratory data systems, including the LIMS system and electronic infrastructure, along with report and deliverable design. The Technical Manager works in conjunction with the Quality Assurance Manger to determine the minimum qualifications for all technical positions and ensure adequate training.[30] The Technical Manager also works closely with the Quality Assurance team to implement and maintain the quality system, and ensure adherence to it.[31]

d) **Business Development Manager** - Responsible for business development and client relations, including determination of the laboratory's ability to meet project specifications. In conjunction with the Laboratory Director, the Business Development Manager performs client project management and reporting activities. Other responsibilities include overseeing sample receipt and courier operations.

e) **Project Manager (PM)** – Responsible for primary contact with the client. The PM is responsible for clarifying client requests and monitoring the laboratory's performance in relation to the work performed. The PM advises clients of any subcontracting of work whether because of unforeseen reasons or on a continuing basis and gain approval from the client for such work, preferably in writing. Produces and reviews final reports for completeness and accuracy. The PM must also ensure client confidentiality.

f) **Sample Receiving Supervisor** - Reports to the Business Development Manager. Supervises sample control technicians who are responsible for sample receipt and login, including the completeness of all sample receipt documentation for incoming samples and projects. Sample Control Technicians also prepare sample bottles, fill client bottle requests and coordinate delivery of sample containers for client sampling and subsequent sample pick-up.

g) **Laboratory Analyst** - Responsible for preparation and/or analysis of samples in accordance with the relevant SOP and published method(s). Depending on their documented level of experience, analysts may also be responsible for training other analysts, data entry and review, instrument maintenance, preparation of analytical standards, and initiation of non-confromance reports. Analysts may be assigned additional secondary roles, such as serving on the safety committee, coordinating waste disposal activities, or working in a different department in the laboratory. In all aspects of work conducted, analysts are responsible for compliance with Apex's quality system, including the Code of Ethics' right of refusal and full disclosure *(SOP Q-101 4.2.4 and 4.2.7)*

Personnel in key positions and lines of authority are depicted on the organizational chart in Figure 1 at the end of this document.

5. Training[32]

The selection of well-qualified personnel, based upon education and experience, is critical to the success and quality of the laboratory. In order to maintain a qualified staff and provide for personnel advancement within the laboratory, Apex follows a thorough program of orientation and training as detailed in Apex SOP Q-103.

5.1. Apex's training protocol is designed to provide a mechanism to document the competence of personnel and set appropriate goals for individual training.

5.2. Each new employee receives an orientation that includes familiarization with the Apex Orientation & Training SOP Q-103 and Training Record, the Quality Assurance Manual, the Safety Manual & Chemical Hygiene Plan (SOP SMO-001) and the Code of Ethics (SOP Q-101).

5.3. The level of experience upon hire, and the continuous training of each employee, is documented in an individual's Training Record by both the trainer and trainee initialing and dating the appropriate methods and level of training.

a) Training is conducted as one-on one instruction by an experienced analyst on the specific analytical procedure to be performed. Employees are provided with the appropriate SOPs and reference methods, and are fully trained in all aspects appropriate to the training level of the procedure, including quality control and safety.

b) Prior to preparing or analyzing any client samples without direct supervision, an analyst must demonstrate proficiency in the task through successful completion of a Demonstration of Capability

(DOC) (Refer to Apex SOP Q-107).

c) Original Training Records are retained in each department for ease of access.

5.4. An individual training file is kept for each employee in the QA department. Each employee training file contains:

a) A completed *Initial Training Signature Sheet* to document initial orientation and certify understanding and agreement to comply with Apex's QA Manual.

b) A completed *Training Record Documentation Agreement* to certify understanding and agreement to comply with Apex's training protocol.

c) A completed *Apex Laboratories Safety & Environmental Orientation* form to document initial safety training.

d) A completed *Ethics Agreement and Training Form* to document initial ethics training and agreement to comply with Apex's Code of Ethics.

e) A copy of the individual's Training Record.

f) A signed hard copy of the individual's annual *Demonstration of Capability of Certification Statement.*

g) Certificates of any training obtained from external sources.

6. Laboratory Responsibilities

6.1. Lines of Authority **-** The Laboratory Director is responsible for nominating deputies in the case of the absence of personnel in management or supervisory positions. The Business Development Manager assumes this responsibility in the absence of the Laboratory Director.

6.2. Approved Signatories - Apex Laboratories, LLC, provides environmental data for a variety of clientele. Management level positions are approved signatories for all reported data and controlled laboratory documents. Alternate signatories may be assigned in the case of an extended absence or leave to ensure normal work flow.

6.3. Independence of QA - The QA Department has a high degree of independence and authority in the laboratory's organization. The QA Department reports directly to the Laboratory Director to review the work of groups and individuals, and is independent of production pressures that associated with generating or compiling data.

7. Facilities, Equipment & Supplies[33]

7.1. Facility

Apex Laboratories, LLC is a 7800 square foot main facility, with a 6000 square foot secondary facility dedicated to environmental analytical services and divided into separate areas for sample receipt and laboratory departments. The floor plan is organized in such a manner as to minimize cross contamination between analytical procedures and maximize work flow efficiency. The laboratory's floor plan is depicted in Figure 2 at the end of this document.

Apex does not have mobile laboratory facilities. [34]

7.2. Equipment[35]

Apex analysts operate and maintain a wide variety of state-of-the-art analytical instrumentation and equipment for the performance of a variety of chemical analysis. All instruments and analytical equipment are subject to service and preventative maintenance procedures per manufacturer instruction to minimize the occurrence of failure or malfunction. Each instrument used for testing is uniquely identified and has it's own instrument logbook which is kept near the instrument. All maintenance is documented in the appropriate instrument logbooks. A detailed list of instrumentation is maintained in Apex's Statement of Qualifications for accurate assessment of the laboratory's capabilities.

7.3. Procurement of supplies

Apex purchases all supplies associated with samples analyses, such as gases, chemicals and sample containers, from reputable suppliers and maintains records of lot numbers when applicable. Chemicals, bottles and standards are tested prior to use in the laboratory. Volumetric dispensing devices, such as glass microliter syringes, must be procured from vendors with ISO 9001 certification, or otherwise be certified to meet the requirements for Class A glassware.

8. Sample Management

Most samples submitted to Apex Laboratories are sampled by our clients, either directly or through the use of third party sampling services. Apex provides limited sampling services for storm water monitoring and other projects. Prior to sampling, clients receive appropriate sampling containers with preservatives from the laboratory. This service is extended to our clients to ensure that the proper containers are used for the requested analyses, and that the containers used are clean and contain the appropriate preservative. At login, sample container information is recorded and Apex may qualify results from samples received in containers that were not provided by the lab or were sampled in improper containers.

8.1. Analysis Requests

Analytical methods used by Apex are those specified by regulatory agencies such as the U.S. Environmental Protection Agency (USEPA), including SW-846 methodologies and the Code of Federal Register Guidelines, ASTM, Standard Methods or state agencies. Any deviations from these methods are documented in the related Standard Operating Procedures.

Ideally, clients coordinate with the Laboratory Director, Business Development Manager and/or designated Project Manager prior to sampling to ensure that correct sampling procedures, containers and preservatives are employed for the analytical method best suited to the matrix and end use of the analytical data. Chain of Custody (COC) forms accompany all bottle orders to be completed at the time of sampling, and are provided to clients in bulk for unscheduled projects. If prior planning is not possible, analysis requests may be made by the client and documented at the time of sample receipt.

Figure 3 at the end of this document is an example of an Apex COC.

8.2. Sample receipt [36]

a) The Sample Control department is responsible for receiving samples from the clients or their designees. Samples are routinely delivered to the laboratory by the client or sampler, commercial courier or delivery service (UPS/Fed Ex/DHL), or may be picked up by Apex courier. The COC is signed by both the client and the sample control personnel or Apex courier upon receipt, documenting transfer of custody to the laboratory. Commercial delivery services are not required to sign COCs as long as the cooler has remained sealed while in custody.

b) When samples arrive at the laboratory, the COC accompanying the samples is reviewed to confirm that all pertinent information is filled out, including client name and address, project name and number, sample name and matrix, number of containers, required turnaround time and date /time sampled. Sample control personnel verify the following parameters:

- **i** Sample containers received correspond to those on the COC, and containers are intact.
- **ii** Sample volume, container, preservation and temperature are correct for requested analyses.
- **iii** Adequate time is allowed to meet holding time requirements for the requested analyses.
- **iv** Samples are not visibly damaged or compromised.

c) Sample conditions as received are documented using the Apex Cooler Receipt Form form during cooler receipt and inspection. Once custody is taken, cooler and sample conditions are recorded on the Cooler Receipt Form, the COC information is checked and entered into *Element,* Apex sample labels are printed. Samples are labeled with their unique container identifiers (labels) and placed into the appropriate storage location prior to analysis. When sample control personnel enter all pertinent sample information into *Element*, a work order number is assigned to the sample delivery group, unique individual sample and container identifiers are created, and the samples are placed into extraction and analysis queues. Project specific information pertaining to the samples and requested analyses is also entered into *Element* when applicable.

d) If there are any inconsistencies in the chain of custody or problems with sample receipt or login, they are noted on the Cooler Receipt Form and the Apex project manager is notified immediately and the client contacted. Detailed descriptions of protocols for all aspects of sample control, including handling, tracking, acceptance, and storage are contained in Apex SOP L-001 R0 - *Sample Receipt, Login, Subsampling, and Subcontracting, and* L-003 – *Sample Management Tracking and Storage.*

Figure 4 at the end of this document is an example of an Apex Cooler Receipt Form.

8.3. Subcontracting of samples[37]

a) When clients request an analysis not performed in-house by Apex employees or exceeds laboratory capacity, sample control personnel will arrange for the samples to be delivered to and analyzed by a laboratory with the appropriate certification.

b) Client notification and approval is required prior to subcontracting of any samples. The certifications and Quality Assurance Manuals of all subcontract laboratories utilized by Apex should be maintained by the QA Department. A subcontract COC is prepared to accompany the samples and document transfer of custody to the subcontract laboratory. Subcontract custody documentation is retained with the project folder. Apex assumes responsibility for coordinating all reporting and QC requirements between the client and subcontracting laboratory, along with the release of final data.

c) Subcontracted data is received either electronically or in hardcopy form. The full subcontractor's report is included with our Apex report to the client. When possible, the subcontracted data is included in the text of the Apex report and identified as subcontracted data.

See also Apex SOP L-001 - Sample Receipt, Login, Subsampling and Subcontracting, Section 6.1.

8.4. Sample Handling

a) Storage

Samples are stored in accordance with conditions listed in the individual methods. All soil samples and all water samples, except acid preserved samples for metals analysis only, are refrigerated and maintained at less than 6°C, but not frozen. Acid preserved polyethylene bottles for metals analyses only are stored at ambient temperature in a designated storage location. Samples stored away from all standards, reagents, food and other potentially contaminating sources. Client sample storage location is documented in *Element*.

b) Tracking

Prior to commencing work on a set of samples, the extractionist or analyst will create a bench sheet in *Element* and add the desired samples to the batch by selecting the bottle to be used. The bench sheet is used to track information relating to all aspects of extraction including sample amount, date and time of extraction, person performing the work, spike standard IDs and amounts, along with any comments relevant to the sample or samples in the batch. Sample analysis may be tracked by creating an analytical sequence in *Element* for organics analyses including GC and GC/MS techniques. Analytical batches and sequences are assigned unique identification numbers by *Element*.

c) Disposal

Refrigerated samples are kept at 6^{o}C for the remainder of the month in which they are received and the following month. Samples are retained for at least two full months after receipt. Samples are then disposed of according to laboratory determined disposal procedures which meet DEQ guidelines. Samples deemed hazardous may be returned to the client.

9. Environmental Test Method Selection, Validation & Documentation

Apex Selects methods for environmental testing which meet the needs of the client and which are appropriate for the environmental tests it undertakes.

9.1. Method Sources

Most of the analytical methods used by Apex are those specified by regulatory agencies such as the U.S. Environmental Protection Agency (USEPA), or the Code of Federal Register (CFR) Guidelines. The following is a partial list of method references used by Apex:

a) Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, U.S. Environmental Protection Agency, SW-846, 3rd Edition, September 1986, Update I, July 1992 and Update II, September 1994.

b) Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, Revised 1983.

c) Standard Methods for the Examination of Water and Wastewater, American Public Health Association, American Water Works Association, and Water Pollution Control Federation, 20th Edition (1999).

d) Guidelines Establishing Procedures for the Analysis of Pollutants Under the Clean Water Act, 40 CFR, Part 136.

e) Oregon Department Of Environmental Quality, test methods as contained in OAR 340-122.

f) Washington Department of Ecology, test methods as defined in WAC 173-300 – 173-340

g) ASTM Standards

9.2. Standard Operating Procedures[38]

Apex Laboratory maintains SOPs that accurately reflect all phases of current laboratory activities including Quality Assurance, General Laboratory Procedures, and Test Methods. All SOPs are internally written documents with adequate detail to allow someone (with similar qualifications to the analyst), other than the analyst, to reproduce the procedures used to generate the test result.

9.3. Method detection limits (MDL)

Method Detection Limit studies are performed in accordance with 40CFR part 136 Appendix B, MDL Study specifications, upon introduction of any new analyte, matrix type, instrument, technique or following significant changes to any one of these. The MDL is verified annually for each matrix, method and analyte. MDL studies are not performed for some methods where spiking standards are not available or the reporting scale is not determined by low-level sensitivity or precision, such as pH, Solids, Temperature, or Turbidity.

9.4. Method reporting limits

Method reporting limits are usually set at two to five times the method detection limit (MDL) above. Documentation of an acceptable MDL study and demonstrated method reporting limit capability for each analytical instrument must be in place prior to analysis of client samples. When applicable, MRL values are adjusted for sample dilution and percent dry weight of solid samples.

10. Calibration & Maintenance

10.1. Instrument calibration[39]

a) Apex calibrates all instrumentation using certified traceable reference materials. Calibration procedures for routine analyses are performed in accordance with approved appropriate analytical methods and documented in the relevant analytical SOPs. No points may be deleted between the high and low points of an initial calibration curve in order to meet QC criteria, however points at the high or low ranges of the curve may be deleted to improve the curve fit as long as the minimum number of points is retained and the limitation in analytical range and/or reporting limit are not detrimental to the data quality objectives. Method specific guidelines for calibrations are followed when available, and Apex specifies preferred calibration criteria when they are not. At a minimum, Apex analysts prepare calibration curves in accordance with the following criteria:

- **i** Calibration is comprised of at least three points.
- **ii** Calibration is verified by a second source, if available.
- **iii** Lowest point of the calibration curve must be at or below the MRL.
- **iv** Internal calibration point or level cannot be deleted.

b) All calibration standard preparations are entered in to the *Element* data system. Information such as concentration of the standard used, dilution volumes, solvent, date prepared, manufacturer's lot number, and the name of the analyst is recorded to ensure the calibration may be reconstructed if necessary. To assure that calibration standards are prepared correctly, an external quality control standard from a secondary source is analyzed each time a new calibration is prepared.

c) Initial calibration curves are verified by continuing calibration standards every twelve hours for organic methods or every ten samples for inorganic methods. Sample analysis is not performed until the calibration has been verified. If the continuing instrument calibration verification results obtained are outside established acceptance criteria, corrective actions are performed. If routine corrective action procedures fail to produce a second consecutive calibration verification within acceptable limits, then the analyst must demonstrate acceptable performance after corrective action with two consecutive calibration verifications or a new initial instrument calibration must be performed.

d) If samples are analyzed with an unacceptable calibration, all associated samples will be reanalyzed. If reanalysis is not possible, data associated with an unacceptable initial instrument calibration shall be reported with appropriate data qualifiers.[40] Data associated with an unacceptable continuing calibration verification (CCV) may be fully useable under the following special conditions:

- **i** When the acceptance criteria for the CCV are exceeded high, and there are associated samples that are non-detects, then those non-detects may be reported.
- **ii** When the acceptance criteria for the CCV are exceeded low, those sample results may be reported if they exceed the applicable maximum regulatory limit level.

e) Sample data is traceable to the calibration source through unique method (calibration) names recorded on all hard copy data. Instrument calibration curves can be entered into *Element* for most analyses utilizing analytical sequences.

10.2. Instrument Maintenance[41,42]

a) Apex's instrument preventive maintenance program complies with instrument manufacturer recommendations and is designed to maximize instrument performance and minimize downtime. Maintenance schedules for instrumentation are included in the related analytical SOPs. All maintenance carried out on an instrument is documented in the instrument logbook kept with the instrument, and is followed by the appropriate calibration and/or calibration verification procedures.

b) Instrument logbooks must include the following information:

- **i** The identity of the item of equipment and it's software.
- **ii** The manufacturer's name, type identification, and and serial number or other unique identification.
- **iii** Current location.
- **iv** The manufacturer's instructions, or reference to their location.
- **v** All maintenance carried out to date (documentation on all routine and non-routine maintenance activities).

vi Any damage, malfunction, modification or repair to the equipment.
vii Date received and date placed in service (if available).
viii Condition when received if available (used, new, reconditioned).

c) In the event a problem arises which cannot be corrected in-house, manufacturer trained service technicians are contracted and brought on-site (service calls are also documented in the instrument logbooks.

10.3. Reference standards[43]

In general, unless a higher grade is required per method or instrument sensitivity, all chemicals used are reagent grade or higher, and all standards traceable to ACS or NIST reference standards. Whenever possible, Apex maintains independent source standards for each analysis to allow for verification of calibration standards. All reference materials are assigned a unique identification number upon receipt that is retained with the traceability certification and entered into *Element*. Records of all stock and intermediate standard solutions prepared, including information on reagent and solvent purity, lot numbers, analyst's initials and preparation dates are maintained in *Element*. All standard solutions are validated prior to use. The validation procedure is typically verification of concentration using a standard prepared at a different time or obtained from a second source. All standards are labeled with an expiration date.

10.4. Support equipment[44]

Support equipment includes any devices for weighing, measuring, heating or cooling standards or samples. Support equipment includes, but is not limited to the following: analytical balances, ovens, refrigerators, freezers, water baths, thermometers, rotary extractors, water purifying systems, and volumetric dispensing devices.

a) Quantitative results of analyses are highly dependent on the accuracy and reliability of support equipment, therefore, all support equipment is maintained in proper working order and calibration verified on a regular basis. The results of such calibration or verification shall be within the specifications required of the application for which this equipment is used or it shall be removed from service until repaired. Equipment which has been removed from service must be clearly labeled as such, or physically removed from the laboratory.

b) Apex maintains ASTM class I certified reference weights for all analytical balances bracketing their range of use for analysis. Partial immersion and total immersion NIST traceable thermometers are maintained for thermometer calibration. Prior to use on a daily basis the calibration of each balance, oven, refrigerator, freezer and water bath is verified and documented. On a quarterly basis the calibrations of rotary extractors, and volumetric dispensing devices are verified. All other support equipment either has the calibration verified or is recalibrated at least on an annual basis. If operational conditions change or the instrument is moved, calibration verification must be performed before use.

c) Glass microliter syringes are purchased from an ISO 9001-2000 certified vendor, such as Hamilton Company. Such syringes are manufactured to be accurate withing +/- 1% of nominal volume, with precision within 1% when measured at 80% of total scale volume.

d) The Laboratory uses type 1 Deionized (ASTM (D1193-91)) water for all extractions and solutions. The system is checked weekly and preventative maintenance is performed bi-monthly.

11. Data Quality Objectives

11.1. Definitions

The quality of data generated is always the top priority at Apex. The quality of the data generated is confirmed by assuring the data is accurate, precise, representative, complete, comparable and defensible as defined below.

a) **Accurate-** The degree of accuracy is determined by the agreement between an observed value and an accepted reference or true value. Accuracy is ensured by adherence to analytical quality protocols and use of dual source certified reference materials for all possible methodologies. Accuracy is monitored through the performance of quality control check samples, matrix spikes, laboratory quality control spikes, and surrogate/internal standard spikes

b) **Precise** - The degree of precision is determined by the difference in resultant value of two identically prepared items. Precision is ensured by adherence to protocols for replicate analyses. Precision is monitored by the performance of sample and/or field duplicates, matrix spike and control spike duplicates, and the subsequent calculation of relative standard deviation (RSD) or relative percent difference (RPD).

c) **Representative** - The degree of representation is expressed by how accurately and precisely a point defines the mean characteristics of a population, parameter variations at a specific sampling point, or an environmental condition within a defined boundary. Proper representation is ensured by adherence to proper sample treatment protocol including appropriate analytical approved methodologies, adherence to holding times and analysis of field duplicate samples.

d) **Complete** - The degree of completion is determined by the amount of valid data returned from any sampling set compared to the expected amount under normal conditions. Completeness is ensured by adherence to all quality protocols for every sample received. Apex makes a concerted effort to provide the most complete resultant data possible for every sampling set by minimizing laboratory error and instrument or electronic failure.

e) **Comparable** - The degree of comparability is determined by the precision of one data set to another. Comparability is ensured by adherence to appropriate analytical methods and SOPs and consistent detection levels for each method routinely performed by Apex. Detection levels are evaluated annually to provide documented proof of limit appropriateness. External comparability is ensured by the use of common reporting units and general reporting protocols.

f) **Defensible** - The degree of defensibility of a specific data set is measured by the completeness of documentation and traceability to certified standards for comparison. Apex will provide expert witness testimony regarding environmental analyses performed at Apex, if required. In order to provide the best quality for our clients, Apex maintains laboratory operating conditions such that all data associated with sample analysis can withstand scrutiny for legal purposes.

The following definitions are found in the TNI Standard, Volume 1, Management and Technical Requirements for Laboratories Performing Environmental Analysis. They are included here for easy reference. Changes or additions to the TNI definition are included in italics. For further definitions, see the appropriate TNI section.

g) **Analyst:** The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.

h) **Audit:** A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives.

i) **Batch:** Environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one (1) to twenty (20) environmental samples of the same quality systems matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be twenty-four (24) hours. An **analytical batch** is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various quality system matrices and can exceed twenty (20) samples.

j) **Bias:** The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value).

k) **Blank:** A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. Blanks include:

Method Blank: A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.

l) **Certified Reference Material (CRM):** Reference material, accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability chain to a national metrology institute. *Also includes Standard Reference Material (SRM)*

m) **Chain of Custody Form:** Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and types of containers; the mode of collection; the collector; time of collection; preservation; and requested analyses.

n) **Holding Times:** The maximum time that can elapse between two (2) specified activities.

o) **Internal Standard:** A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical method.

p) **Limit(s) of Detection (LOD):** A laboratory's estimate of the minimum amount of an analyte in a given matrix that an analytical process can reliably detect in their facility.

q) **Limit(s) of Quantitation (LOQ):** The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence.

r) **Matrix:** The substrate of a test sample.

s) **Matrix Duplicate:** A replicate matrix prepared in the laboratory and analyzed to obtain a measure of precision.

t) **Matrix Spike (spiked sample or fortified sample):** A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which an independent test result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

u) **Matrix Spike Duplicate (spiked sample or fortified sample duplicate):** A replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte.

v) **Quality System:** A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required quality assurance (QA) and quality control (QC) activities.

w) **Quality System Matrix:** These matrix definitions are to be used for purposes of batch and quality control requirements:

Aqueous: Any aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine. Includes surface water, ground water effluents, and TCLP or other extracts.

Chemical Waste: A product or by-product of an industrial process that results in a matrix not previously defined.

Drinking Water: Any aqueous sample that has been designated a potable or potential potable water source.

Non-Aqueous Liquid: Any organic liquid with <15% settleable solids.

Solids: Includes soils, sediments, sludges and other matrices with >15% settleable solids.

The options available in the Element LIMS for matrix types tested at Apex are: Cartridge, Digest, Liquid, Oil, Paint Chip, Pore Water, Sediment, Soil, Solid, Transformer Oil, Water, and Wipe. Liquid may refer to aqueous or non-aqueous liquid that does not meet the definition of Water. Some of these Apex matrices may be combined for the purposes of an extraction batch. The above TNI definitions are generally used to establish extraction batches.

x) ***Reference Standard:*** *Standard used for the calibration of working measurement standards in a* given organization or at a given location.

11.2. Criteria[45]

Data Quality Objectives (DQOs) are defined as the goals of accuracy and precision established for a data set to demonstrate freedom from bias. Apex's data quality objectives are assigned from one of three sources: 1) EPA method specified criteria or published guidance such as Contract Laboratory Program (CLP), Functional Guidelines or the Department of Defense QSM; 2) internally derived criteria from control charts of analytical data; and 3) client mandated project specific criteria. EPA method specified criteria are included in Apex's analytical SOPs when available and serve as the minimum requirements. All data quality objectives are maintained in *Element* and included in analytical reports. Client specific DQOs are coordinated between Apex and the client prior to commencement of work and are documented as a Quality Assurance Project Plan (QAPP) provided by the client. Data quality objectives are comprised of the internal and reportable quality control checks described below.

11.3. Instrument QC

a) **Calibration Verification Standards -** At the start of each analytical sequence, a Calibration Verification Standard (CCV) is run to verify the continued applicability of the initial calibration. The standard or set of standards contains all of the analytes to be measured along with any internal standards or surrogates used. In most cases the calibration verification standard is from the same source as the initial calibration standard. Calibration verification standard acceptance criteria are established by the related analytical methods, or determined by Apex based on instrument and method limitations. These criteria are stated in the relevant analytical SOP. In general, if a calibration check standard does not pass the acceptance criteria, reanalysis of the standard is permitted if there is a reasonable cause for the initial failure. Potential reasons for failure of a CCV include: need for instrument maintenance, tuning, or conditioning; incorrect or degraded standard analyzed; sample introduction error; or instrument performance drift requiring recalibration. Corrections can be made for any of these conditions (except instrument drift) and a second CCV analyzed <u>if</u> the instrument operating parameters are not modified. For example, if a dirty GC injection liner causes a CCV failure, the liner can be replaced with an identical liner, conditioned as necessary, and a second CCV analyzed. If standards analyzed after corrections are made fail to match the current calibration, a new calibration curve must be run.

   i Conditioning runs and response checks are standard solutions analyzed to condition and test the system during and after maintenance. Conditioning runs/response checks and CCVs cannot be used interchangeably, and the intended use of any standards analyzed should be clear from the information contained in the analytical data.

   ii It is not acceptable to analyze repeated CCVs with the intention of accepting data based on a passing CCV without a reasonable cause for the initial failure. Repeated runs of any standard are only acceptable if instrument conditions have been corrected to match those of the current calibration curve.

   iii Calibration must be re-verified again every 20 samples for organic methods (except GC/MS) and every 10 samples for inorganic methods. Samples should be run using the same conditions as CCVs. For example, if a sequence of dirty samples requires repeated instrument blanks to be run prior to the CCV, then instrument blanks should be run between each sample as well. If sequences with multiple CCVs are used to analyze samples, failing CCVs will mean that data not bracketed by acceptable QC is not reportable. However, the failure of subsequent CCVs in a sequence (e.g. when a sequence runs overnight) will not automatically force recalibration, and the rules stated above for determining and correcting CCV failure still apply.

b) **Instrument Performance Standards -** Instrument performance criteria must be demonstrated when running GC/MS, GC/ECD, ICP or ICP/MS methods, and may include mass spectral tunes, analyte breakdown and tailing check standards, and interference check standards. At the beginning of every twelve-hour period, the instrument must pass the performance criteria defined in the respective analytical method and related Apex analytical SOP.

c) **Instrument Blanks -** Prior to sample analysis, an instrument or extraction blank must be analyzed to assure that the analytical system is free of contamination. Analytes should not be detected above one-half the Method Reporting Limit (MRL) in the instrument or extraction blank for some analyses. See Apex Laboratory Policy #091016A, "Data assessment and qualification for blank detections" for further clarification. If it is determined that the blank is not free of contamination, corrective action must be taken to eliminate the source of contamination. Affected samples may be either reextracted and reanalyzed or the data appropriately qualified as specified below for method blanks, depending on the end use of the data.

d) **Internal Standards -** A known concentration of Internal Standard is added to every standard, blank and sample being analyzed for organic parameters by GC/MS or metals by ICP/MS. Internal Standard calibrations compensate for minor fluctuations in instrument response by adjusting target analyte results based on Internal Standard responses. If fluctuations in the Internal Standard are more than the acceptance criteria, corrective action must be taken to solve the problem. Effected samples must be reanalyzed or the data reported as Estimated.

11.4. Extraction Batch QC

a) **Batch QC Source Selection –** Matrix Spikes and Sample Duplicates that are performed on client samples should be analyzed on a systematic random basis, such as selecting the first and tenth sample assigned to the batch. Alternately, client samples that are known from historical analysis to be likely to provide useful information may be selected as the QC source. (e.g. Selecting a sample as the duplicate source that is suspected to have detections above the reporting level, or deliberately not selecting a sample that is suspected to have such severe matrix effects or high native analyte concentration as to preclude calculation of spike recovery.)

b) **Laboratory Control and Matrix Spikes -** Laboratory Control Samples (LCS) and Matrix Spikes and Spike Duplicates (MS/MSD) are performed by spiking laboratory blanks or client samples, respectively, with a spiking solution containing some or all of the analytes of interest for the analysis. Laboratory control spikes are performed on matrix specific, analyte free media, while matrix spikes are performed on sample media. These analyses are a measure of method performance and accuracy and are done at a frequency of one out of every twenty samples, or one per extraction batch for all applicable methods. Accuracy data are expressed as percent recovery and acceptance criteria for laboratory spike recovery are derived from the appropriate analytical methods or listed sources, from internal control charts, or from client specified DQOs. If recoveries for the Laboratory Control Sample fall outside of acceptance limits, corrective action and reanalysis must be performed if possible. If reextraction and reanalysis are not possible, data will be qualified appropriately, or not reported at all. Out of control matrix spike recoveries, from batches with in-control LCSs, are usually indicative of some form of matrix interference. Apex will qualify the reported data accordingly and inform the client of the sample matrix interference.

c) **Sample Duplicate Analyses –** A percentage of all samples are analyzed in duplicate as a measure of analytical precision, expressed as relative percent difference (RPD). Sample Matrix Duplicates are performed on replicate (separately extracted) aliquots of actual samples. Sample Matrix

Duplicates are run at minimum rate of one per batch of twenty samples or less for all methods. Duplicate Matrix and/or Laboratory Control Spikes may also be run to demonstrate method precision. If RPD values for an LCS/LCS Duplicate pair do not fall within acceptance limits, corrective action and reanalysis must be performed, if possible. If reextraction and reanalysis are not possible, data will be qualified appropriately, or not reported at all. The rules for allowing marginal exceedences of LCS compounds is not used and all results are qualified when LCS componds are outside of control limits. Out- of- control Sample Duplicate or Matrix Spike RPD values, associated with in-control LCS RPDs, are usually indicative of interference with the specific sample matrix. Apex will qualify the reported data accordingly and inform the client of the suspected sample matrix interference.

d) **Method Blanks –** One method blank is processed with each batch of samples to assure that the equipment and reagents being used are free of contamination. Analytes should not be detected above one half the Method Reporting Limit (MRL) in the method blank. If it is determined that the blank is not free of contamination, corrective action must be taken to determine the source of contamination. The affected samples must either be reanalyzed, or the data appropriately qualified. If an analyte is detected in a method blank at a concentration greater than one half of the MRL, the associated data is flagged in *Element*. Final qualification of the data is determined by analyst review and end use of the data; non-detected sample results are not qualified, sample concentrations less than five to 10 times the concentration detected in the method blank are qualified based on the client's end use of the data. See Apex Laboratory Policy #091016A - “Data assessment and qualification for blank detections” for further clarification.

e) **Surrogate Standards -** Surrogates are compounds closely related to the compounds of interest, but not expected to be found in real world samples. All samples and QC are spiked with a known concentration of the surrogates before extraction for all GC and GC/MS methods. Surrogate recovery limits for each matrix are established in the same way as Lab Control Sample limits. For methods with multiple surrogates, only a certain number of surrogate recoveries may need to meet QC criteria, as reflected in the SOP. Samples should be reanalyzed if surrogate recoveries do not meet acceptance criteria and no interferences or matrix effects are suspected. Data with failing surrogates will be qualified based on the client's end use of the data.

12. Calculations

Accuracy Measurements
(Percent Recovery = P)

Method Standards:

$$P = \frac{100 \text{ x observed recovery}}{\text{true concentration}}$$

Matrix Spikes:

$$P = \frac{100 \text{ x (observed - background)}}{\text{spike concentration}}$$

Average Recovery (P):

$$\overline{P} = \frac{\sum P}{n}$$

Standard Deviation of Recovery:

$$SD = \sqrt{\frac{\sum (P - \overline{P})^2}{(n - 1)}}$$

Upper and Lower Control Limits (Recovery):

$$UCL_p = \overline{P} + 3SD$$

$$LCL_p = \overline{P} - 3SD$$

<u>Precision Measurements</u>

Relative Percent Difference: $$RPD = 100\ x\ \frac{|X_1 - X_2|}{(X_1 + X_2)/2}$$

Mean RPD: $$\overline{R} = \frac{\sum RPD}{n}$$

UCL for Mean RPD: $$\overline{R_c} = 3.27x\overline{R}$$

13. Data Reduction, Validation and Reporting

13.1. Data reduction and primary analytical review

a) An extractionist or analyst initiates the sample preparation process by querying *Element* for samples requiring the analysis to be performed. A bench sheet is created with a unique batch identification number for the samples to be extracted or digested. The bench sheet is printed out and used to document the sample preparation procedure, including the extractionist, date and time, sample amounts used, standards IDs and amounts and any comments relevant to the samples. Bench sheets are considered raw data and are retained in each department.

b) Following analysis, instrument raw data is reviewed using the instrument software and all relevant reports are generated. Each analyst is responsible for the primary data review, including checking instrument performance criteria such as mass spectral tunes, blank evaluation and initial/continuing calibration checks prior to sample analysis.

c) Whenever possible, instrument data is automatically acquired by commercially available software designed by the instrument manufacturers specifically for this purpose. Hard copy printouts of all instrument QC and sample data are generated at the time of acquisition or prior to any manual integrations or edits. For GC and GC/MS methods, each data file of an analytical sequence is reviewed electronically by the analyst for correct analyte identification and integrations and acceptable QC results. During this process, chromatograms for any necessary manual integrations are printed and added to the raw data packet for that sample. Following review, edited quantitation reports are reprinted, if necessary, and the sample raw data packet is initialed and dated by the analyst. The analyst then uploads the electronic data for the samples into *Element* using the companion DataTool instrument interface software, which allows for direct data uploads without the need for manual entry.

d) Metals data generated by ICP or ICP/MS and Wet Chem data generated by IC is also captured by manufacturer designed software specific direct acquisition software and printed out at the time of acquisition. Following the primary analyst's electronic review, the raw data for the sequence is similarly uploaded into *Element*.

e) Wet chemistry data that is not electronically captured is manually entered into *Element* following primary review.

f) Sample data is then queried from *Element* and undergoes the first level of review in *Element*. The analyst adds appropriate qualifiers, initiates reextraction or reanalysis if necessary, and updates the sample analysis status to “needs review”.

13.2. Secondary data review

a) All hard copy sequence data is secondarily reviewed by a person qualified to perform the analysis, or who is trained in the specifics of data review of the particular analysis. Instrument data is reviewed against the electronic data in *Element*, and the package is evaluated against stated Data Quality Objectives. The appropriate corrective action is implemented and documented if a problem is found at any stage in the review process.

b) The analyst and secondary reviewer similarly review GC and GC/MS calibration sequence data. Metals and wet chemistry calibrations are reviewed with the associated sample data.

13.3. Tertiary data review and reporting

a) Tertiary review of all data for a given project is performed when the report is generated through the *Element* data system by project management. The report format includes sample and batch QC results (blanks, blank spikes, duplicates and matrix spikes) and analysis information such as analysis date and batch identification. Project narration, calibration data, instrument QC data, or client-specified component data packages are also available upon request. Once the project manager approves the data, a final report is generated electronically in Adobe .pdf format with the project manager’s electronic signature attached. Safeguards against unauthorized use of the electronic signature include password authentication and user specific privileges. The original Chain of Custody, Cooler Receipt Form, documentation of vital client correspondence and/or non-conformance issues are retained in the project file. Electronic Final Report and a snapshot of the table data used in the report is archived at the time of reporting so subsequent requests for EDDs or other report variations will come from the same subset of data, and include any modifications done in the original report.

Figure 5 at the end of this document is an example of an Apex Analytical Report.

14. Naming conventions used by *Element*

Element Naming Schemes (auto-assigned):

Work Orders:	LYYMNNN	A10A001
Samples:	AN	-01
Container:	A-Z	A
Standards:	LYYMNNN	A10H001
Batch Numbers:	YYMNNNN	10H0001
Sequence Numbers:	YMDDNNN	0H01001
Calibration IDs:	LYMDDNN	A0H0101

L	Lab Code	**A**
Y	Year	**0**
YY	Year	**10**
MM	Month (Num)	**08** (Aug)
M	Month (Alpha)	**A– L** (Jan-Dec)
N	Sequential Number	**0-9**
DD	Day	**01-31**

Batch QC/Instrument QC/Sample Naming:

Batch QC: (Batch Number - QC Type - Number)

10A80001-BLK1	Batch QC Blank
10A80001-BS1	Batch QC Lab Control Sample
10A80001-Dup1	Batch Duplicate
10A80001-MS1	Batch QC Matrix Spike
10A80001-MSD1	Batch QC Matrix Spike Dup
10A80001-PS1	Batch QC Post Spike (ICPMS)

Instrument QC: (Sequence Number - QC Type - Number)

0H01001-TUN1	MS Tune Sample
0H01001-CCV1	Continuing Cal Std
0H01001-CCB1	Continuing Cal Blank
0H01001-ICV1	Initial Cal Verification
0H01001-CAL1	Calibration Standard
0H01001-IBL1	Instrument Blank
0H01001- etc…	

Samples:

A10A001-01	Work Order A10A001, Sample -01

15. Control of Nonconformance and Corrective Action[46]

15.1. Any aspect of the environmental testing work conducted by the laboratory that fails to comply with the standards of the laboratory's quality system, agreed upon client requirements, and/or accepted regulatory guidelines constitutes a nonconformance event. Appropriate documentation and corrective action steps must be taken in a timely manner for all noncomformances as detailed below. Documentation and corrective action steps, as well as the level of responsibility at which they are dealt with, are dependent upon the type of noncomformance, the extent of deviation and its impact on data.

a) Types of nonconformance documentation and guidelines for timely resolution in ascending order of severity are listed below and explained in detail in Section 15.8. More than one type of documentation may be applied to a nonconformance event.

- **i** Documentation in the data and qualification of results – immediately upon data entry.
- **ii** Case Narrative on the Analytical Report – before final report issued.
- **iii** Nonconformance Form retained by the QA department – completed/finalized within 2 weeks of nonconformance event.
- **iv** Amended Analytical Report – issued within 1 week after the nonconformance form finalized.

- **v** Client notification/data recall – completed within 2 weeks after the nonconformance form finalized.

b) Apex's system to accurately and consistently assess the impact of any nonconformance event on data quality and useability is based on potential known bias and the type of nonconformance. Types of deviations and the corresponding appropriate documentation and corrective action are characterized in Sections 15.2 through 15.5 below.[47] Criteria for assessment of impact on data is covered in Section 15.8

c) Lines of authority and responsibilities for implementing corrective action, tracking nonconformance events, follow-up, and preventative measures are outlined in Section 15.6. and 15.8.

15.2. Laboratory & Sample Quality Control Nonconformance

Problems related to QC data commonly identified by an analyst at the time of analysis, or during data review, are categorized below as pertaining to either laboratory QC issues or sample QC issues. Such issues are usually recognized prior to reporting results and are dealt with at the analyst level by either reanalysis or qualification of the data. Apex analytical SOPs and QC policies address specific QA for each noncoformance.

a) Laboratory QC Nonconformance

- **i Initial Calibration -** Corrective action is initiated if the initial calibration criteria specified in the analytical method and related Apex SOP are not met. Identification of the cause of failure is essential. Routine corrective actions are to verify standard concentrations, perform instrument maintenance, and reanalyze the calibration curve. The cause of failure is identified and corrected prior to proceeding with curve reanalysis.
- **ii Continuing Calibration -** Corrective action is initiated if continuing calibration criteria are not met. Routine corrective actions are to reanalyze the continuing calibration standard, perform instrument maintenance, or run a new calibration curve if necessary. All samples analyzed with a continuing calibration standard outside acceptance limits are reanalyzed or adequately qualified.
- **iii Laboratory Control Sample (LCS) Recoveries –** Laboratory policy *Spike Policy 091112A* describes in detail the protocol followed when an LCS recovery falls outside acceptance limits. Corrective action is initiated if LCS recoveries are found to be outside acceptance limits. Poor recoveries could be due to extraction inefficiency, analyst error or instrument problems. The LCS may be reanalyzed to verify an out-of control situation. Corrective action requires re-extraction and re-analysis of the associated samples, or appropriate qualification of the sample data if reanalysis is not possible.
- **iv Method or Instrument Blanks -** Laboratory policy *Blank Policy 091016A* describes in detail the protocol followed when analyte is detected in a blank. Method and instrument blanks should have analyte concentrations less than one-half of the Method Reporting Limit in order to avoid bias of sample results near the MRL. The source of any significant blank contamination is determined and eliminated. If the contamination is related to instrument contamination or carryover, maintenance can be performed and the blank and any samples reanalyzed. If the source is determined to be from the sample preparation steps or from the reagents, the samples should be reextracted or the data qualified appropriately.
- **v Instrument Performance Standards -** Corrective action is initiated when a GC/ECD, GC/MS, ICP or ICP/MS does not pass the method instrument performance criteria such as tune, breakdown and response factors. Normal corrective actions include cleaning or retuning the mass spectrometer, cleaning the GC inlet, or changing the cones on the ICP/MS.

b) Sample QC nonconformance

When laboratory QC data are within acceptance limits, sample QC exceedances such as Sample Duplicate RPD, Matrix Spike recovery, Internal Standard response, Surrogate recovery and Post-digestion Spike recoveries are usually indicative of some form of sample matrix interference with the chosen methodology.

- **i** Corrective action for a sample QC exceedance may include reextraction and/or reanalysis of the sample to eliminate the possibility of analytical or preparation error. If the results of reanalysis are consistent with the initial results, the data is qualified accordingly.
- **ii** Significant sample QC deviations may warrant a Case Narrative on the Analytical Report written by the Technical Manager or QA Department.

c) Issuance of a Nonconformance Form for laboratory and sample QC nonconfromances is not usually warranted, unless a laboratory QC deviation begins to occur frequently or the QC deviation is discovered after the data has been issued without qualification.

- **i** If a QC deviation is discovered after the data has been issued as a final report without qualification, documentation should include an amended Analytical Report and a Nonconformance Form noting the root cause and corrective action for the QC deviation and for reporting the data unqualified.
- **ii** Continued occurrence of a laboratory QC nonconformance requires documentation on a Nonconformance Form so that the root cause of the deviation can be investigated and resolved with the appropriate corrective action.

15.3. Procedural Nonconformance

Unexpected occurrences of procedural errors during sample preparation or analysis, such as a sample going to dryness during concentration, should be documented in the raw data and the results qualified accordingly by the analyst. Qualification of results may also extend to a Case Narrative on the Analytical Report written by the Technical Manager or QA Department. Frequently occurring procedural errors warrant the use of a nonconformance form and a corrective action plan as described in section 15.2.

15.4. Expected Nonconformance[48]

The laboratory has protocols in place for accepting and performing work that does not fall within the usual scope of normal sample preparation and analytical methods. Apex's *Weird Sample Plan* and New Method Development and Validation SOP Q-108, provide the frame work to ensure that permitted deviations from and/or modifications of standard policies and procedures are thoroughly documented and data are accurately qualified and reported.

15.5. Technical Operations or Quality System Nonconformance[49]

Noncompliance issues that are not directly associated with analytical QC data may also arise; such deviations are considered operational noncompliances. When it is discovered that an aspect of the laboratory's normal operation deviates from laboratory policy and/or regulatory requirements, the QA department assumes responsibility for initiating corrective action. Examples of such a deviation might be: a refrigerator temperature exceedance during sample storage, or a balance used past its certification date.

a) Operational deviations, including root cause and corrective action, are documented initially on a

Nonconformance Form and followed through to a level commensurate with the seriousness of the nonconformance. Technical and QA management assess the potential impact of a noncompliance on all associated reported results.

b) Response to operational nonconformance issues that are recognized as a result of a client or regulatory agency audit are the responsibility of the QA department. Corrective action in such cases is documented as a formal audit response.

15.6. Responsibilities & Authority for Nonconforming Work[50]

The level of authority required to resolve a nonconformance issue is dependent upon the extent of the nonconformance as noted in the descriptions in Sections 15.2 through 15.5.

a) Procedural, laboratory QC, and sample QC nonconformances are generally addressed at the analyst level by data qualification during data entry or data review.

b) Extenuating procedural nonconformances, expected nonconformances for atypical samples, technical operations and quality system nonconformances need to be addressed at the management level (by the Technical Manager, QA Department and/or Laboratory Director) and require more extensive documentation than qualification of affected results. This usually involves a case narrative added at the beginning of the analytical report.

c) Apex's nonconformance policy is to empower analysts to be directly responsible for any noncompliance of data they generate. In accordance with Apex's Code of Ethics SOP Q-101- "All analysts have the right to, and are expected to, initiate a stop work investigation in the event that work fails to comply with the standards of the laboratory's quality system and/or accepted regulatory guidelines. Each analyst is responsible for collaborating with QA and the Technical Manager to investigate any situation that could potentially compromise data integrity and take the corrective actions necessary to resolve the nonconformance."

d) Resolution of extenuating nonconformances is considered a collaborative effort between the analyst, Technical Manager, QA, project management and the Laboratory Director. However, because the Laboratory Director is ultimately responsible for all reported test results, corrective action steps that involve stopping and/or resuming production or withholding or amending results are enacted under the final authority of the Laboratory Director.[51] If the analyst, Technical Manager and/or QA Manager disagree with the Laboratory Director's corrective action decision, dissent is documented.

15.7. Response Time

a) Corrective action is initiated as soon as possible after a nonconformance is discovered. If the corrective action involves more than documentation in the data and qualification of results, the entire corrective action process, including root cause analysis and data assessment, may take several weeks to complete. In such cases:

i An electronic Nonconformance Form is initiated and management notified immediately to begin the corrective action and assessment of impact on data process.[52] The QA department controls the amount of time a nonconformance case is open by monitoring each electronic Nonconformance Form on the X:\ drive to closure, as indicated by the signed Nonconformance Form in pdf format in the same location.

ii If data submitted to a client could potentially be significantly affected by the nonconformance, the client is promptly notified via email that their data is under review and that further information will be forthcoming.[53] The QA department is responsible for ensuring that resolution of the nonconformance is completed with the client.

15.8. Assessment of Impact

a) For laboratory and sample QC nonconformances, assessment of the impact of the nonconformance on data is done at the analyst level. The assessment, and corresponding data qualification, is then incorporated into the data review process.

b) Impact is usually limited to an analytical batch or sequence.

c) For nonconformance events that are deviations from the quality system or technical operations policies (section 15.5), the impact on data is initially assessed by the analyst in conjunction with the Technical Manager to determine the amount of data affected and to what extent data integrity has been compromised. After the initial assessment by the analyst and Technical Manager, QA and the Laboratory Director are consulted to discuss possible courses of corrective action and compliance requirements.[54] *Element* is used to determine all data potentially effected by a non conformance event. The following points outline criteria for assessment of impact on data quality for potential data recall.

d) if the nonconformance event is a correctable error, such as a quantitation, transposition or transcription error, the data are corrected and reissued as an amended report with appropriate documentation.

e) If the nonconformance event causes results to change from nondetect to detected, or vice versa, an amended Analytical Report with Case Narrative is issued.

f) If the nonconformance event causes a specific known bias in the data and the amount of error introduced to the final results is significant in comparison to the level of the reported result and/or the error inherent in the analysis, results may be reissued as estimated and qualified for the potential bias.

g) If there is no known bias associated with the nonconformance event, and/or the amount of error introduced to the final results is not significant in comparison to the level of the reported result or error inherent in the analysis, corrective action will entail internal documentation rather than reissuing data.

15.9. Corrective Actions, Preventative Measures and Follow up[55]

a) Corrective actions applicable to various types of nonconformances are given in Section 15.2. In general, the criteria for an acceptable corrective action are as follows:[56]
- **i** The investigation must start with a determination of the root cause of the nonconformance and identification of potential corrective actions.
- **ii** The corrective action chosen must be the most likely to eliminate the noncompliance and prevent recurrence.
- **iii** The extent of the corrective action must be appropriate to the magnitude and associated risk of the nonconformance.
- **iv** If the nonconformance casts doubt on the lab's compliance with it's own policies, the lab must ensure that the appropriate areas of activity are audited as soon as possible.

v Changes implemented as a result of corrective action should be documented and measurable for appropriate follow up.

b) Documentation of corrective action is critical to ensuring that the changes implemented as a result of corrective actions are maintained and that nonconformance events are able to be tracked to assess laboratory performance.[57]

i Corrective actions for nonconformances that have minimal data impact, and are able to be executed to completion immediately, do not need to be documented further. For example, a blank spike recovery outside control limits may be resolved with re-extraction/reanalysis of the samples, documentation in the raw data and\or qualification of results, and does not require a nonconformance Form.

ii A Nonconformance Form is used to document any nonconformance event that cannot be remedied immediately and fully documented as such in the data.

iii Nonconformance forms should include:

- The responsible analyst and an explanation of the nonconformance and root cause
- data effected.
- Initial and subsequent corrective actions, target completion dates and date of reissued reports.
- QA, Technical Manager and Laboratory Director comments and approval.

iv Documentation of changes implemented as a result of corrective action may include a laboratory policy or an SOP revision.

v Nonconformance events and subsequent corrective actions are summarized and documented annually in the QA Report to Management for overall assessment of laboratory performance.

Figure 6 at the end of this document is an example of an Apex Nonconformance form.

c) The laboratory has the following measures in place in order to prevent the occurrence of nonconformances and to be able to readily identify them when they do occur:[58]

i The Apex Code of Ethics sets a standard for continuous improvement.

ii There is an established policy for review of SOPs and most current methods.

iii Regularly scheduled laboratory-wide and department specific status meetings provide a forum for identifying potential problems and preventing nonconformance.

d) The effectiveness of corrective actions taken for nonconformance issues pertaining to the Quality System, technical operations and/or regulatory compliance is assessed by incorporating the issues into the next scheduled internal audit for the appropriate department(s).[59]

16. Documentation[60]

The laboratory maintains record keeping systems applicable to the scope of work conducted and sufficient to meet the regulatory requirements under which the work is conducted.[61] Records are organized and stored to ensure easy retrieval and prevent loss or damage during retention.[62] After the allotted retention time, hard copy records and data are disposed of in such a way that maintains client confidentiality.[63]

Types of records retained fall into two main categories; analytical data, and documentation supporting the quality system (including health & safety and hazardous waste disposal).

16.1. Analytical Data[64]

All laboratory activities that contribute to generating analytical results are documented promptly, legibly, and in ink, in the appropriate place to indicate the task with the person's initials and the date the task was performed.[65] Any corrections to raw data are made in such a manner that the original data are still legible. The correction is initialed and dated by the person making the correction.[66] A note must be added if necessary to clarify the reason for the correction. Electronic documentation, including an audit trail of changes, is maintained in *Element* as the initials/date of the analyst responsible for the data.[67]

All analytical data necessary to reconstruct sample results and ensure traceability of all measurements are retained by the laboratory for a minimum of two years in hard copy and five years in electronic format[68]. Such data include, but are not limited to[69]:

a) Chain of custody forms and sample receipt and tracking documentation.[70]

b) Standard preparation records, including reference material certificates of purity.

c) Handwritten bench sheets completed with relevant information pertaining to sample preparation/ analysis, including standard/reagent IDs and any analyst notes.

d) Support equipment data such as balance checks and refrigerator temperature logs.

e) Instrument calibration data.

f) Instrument data from the analysis of all samples, and instrument and batch QC samples, including:
- **i** Sample ID.
- **ii** Instrument & calibration ID.
- **iii** Any manual manipulations such as calculations or integrations.
- **iv** Documentation of data review.

g) Analysis sequence logs.

h) Instrument maintenance logs.

i) Analytical reports (including sample results, sample preparation and analysis methods, QC results and acceptance criteria) & project specific client correspondence.

16.2. Analytical Data Storage

Sample analyses are organized by preparation batch and analytical sequence. Each batch and analytical sequence is assigned a unique identification number in *Element*. (Please refer to Section 14 of this manual for *Element* naming conventions.[71]) Data are organized for storage by sequence number, except conventional chemistry parameter tests that do not involve an analytical sequence run on an instrument. Data for such tests are organized per batch.

a) Data Storage by Sequence - For each successful analytical sequence run on an instrument, the laboratory prints out a hard copy packet of data and the electronic data is uploaded from the instrument software into *Element*. Upon completion and review, the sequence data packet, including the Element sequence log, is scanned into the data warehouse on the laboratory's network. Hard copy sequence data packets are stored chronologically in each department and periodically boxed and placed in the laboratory's main storage area.

b) Data Storage by Batch - Benchsheets for batches are scanned into the data warehouse on the laboratory's network. Analytical data organized by batch only are retained as hard copies per department.

16.3. Supporting Data Storage[72]

Data that is not stored by either sequence or batch is organized for retention and retrieval as outlined below.

a) Traceability records for standards and reagents are kept in a binder by the department using the material. Standard preparation records are maintained in *Element.*

b) Instrument maintenance logs are assigned a unique identification number entered into the log book of log books for tracking purposes. Completed log books are stored chronologically with other support data in the laboratory's main storage area.

c) Loose leaf data such as balance checks and temperature logs are kept in a binder by the equipment. A full binder is transferred to a labeled folder and archived chronologically with other support data in the laboratory's main storage area.

d) Infrequent support data, such as pipet and thermometer calibration records are kept in the QA department or in the department responsible for maintaining the calibration.

16.4. Quality System Documentation[73]

All records and data important in documenting the Quality System are retained by the laboratory in either electronic or hard copy format for a minimum of five years. The QA department maintains the following records including all previous and current versions:

a) Analyst training records, including qualifications, education and experience including Demonstration of Capability (DOC) records for each analyst.

b) Log of names and initials of all personnel who make logbook entries.

c) Proficiency Testing results.

d) Audit findings and corrective actions reports.

e) Information & correspondence pertaining to accreditations.

f) Method Detection Limit (MDL) studies.

g) Annual Reports to Management.

h) Nonconformance Reports, and all other documentation of data integrity.

i) Standard operating procedures.

j) Lab policies.

k) Quality assurance manual and Statement of Qualifications.

16.5. Accessibility[74]

a) Access to active and archived data and records is controlled for hard copy data by limited access to the laboratory facility, and through computer log-in restrictions for electronic records. Retrieval of archived information is documented as the end product of the reason for the retrieval, for example as a data package or nonconformance report, etc.[75]

b) All data and records are made available for audits by regulatory agencies. To maintain client confidentiality[76], audits by clients are limited to data and reports for the client's samples, and general data and records pertaining to Apex's QA system, such as SOPs and MDL, DOC and PT sample data.

c) If ownership of the laboratory is transferred, all data and records, and the obligation to retain them, would be included in the transfer. In the event of business closure or bankruptcy, the applicable regulatory and state legal requirements will be met.[77]

17. Document Control[78]

17.1. Description and Explanation

Documents that are fundamental to the laboratory's quality system are issued as either controlled or regulated documents, according to Apex Policy 100928A Document Control[79]. Documents considered fundamental to the quality system include: the Quality Assurance Manual, standard operating procedures, laboratory policies, non-conformance reports, Analytical Reports, audit finding reports, audit response reports, Apex Change Memos, QA Reports to Management, etc.

a) For a controlled document, the generation, distribution and period of use is controlled. This process is applicable to documents where periodic revision is mandated to ensure continuing suitability and compliance with applicable requirements.[80]
- **i** Controlled documents are assigned a unique controlled document number, revision number, and effective date to clearly identify the time period a document is in force. Each page of a controlled document contains the document number, page number and total number of pages.[81]
- **ii** The QA department maintains distribution records of all controlled documents and current revision status to ensure that a document is retracted at the end of the enforcement period.[82]
- **iii** The original of each non-current revision is marked as obsolete and archived to document changes per revision.[83]
- **iv** Apex's QA Manual and SOPs are maintained as controlled documents. Binders of hard copies of the current QA Manual and relevant SOPs are maintained in the QA department only; the most recent revisions of all SOPs are accessible to the laboratory electronically in read-only format.[84]

b) The generation of regulated documents is controlled, but distribution is not controlled to the extent that the number copies distributed is known. With the exception of laboratory policies (see Section 17.3 below), regulated documents are not expected to be revised.

c) Controlled and regulated documents are assigned unique identification numbers for tracking.

17.2. Approval and Revision

Controlled and regulated documents require the dated signature(s) of authorized personnel necessary to review and approve the document prior to use.[85] A regulated document such as an Analytical Report only requires the signature of the project manager, where as a technical standard operating procedure requires the approval of the Technical Manager, QA Management and/or an appropriate representative from the analytical department.

a) Review for an approval signature on a controlled document includes pertinent background information such as the applicable analytical method and/or changes made to the previous revision of the document being reviewed.[86]

b) Revisions of a controlled document require the same level of approval signatures as the original version and are re-issued as soon as practicable to incorporate necessary changes.[87]

17.3. Laboratory Policy Process

The laboratory policy process was created as a means to document aspects of laboratory operation that are applicable to multiple SOPs or brief enough to not warrant an entire SOP.

a) In order to keep the policy process efficient and flexible, policies are issued and maintained electronically.

b) A hard copy of approval signatures for each policy is kept separately from the electronic format to allow for flexibility. Modifications that do not alter the intent of the policy do not require further approval signatures. Modifications that do alter the intent of the policy require the signature of one of the original signatories. Policy modifications are tracked by the date noted in the document footer.[88]

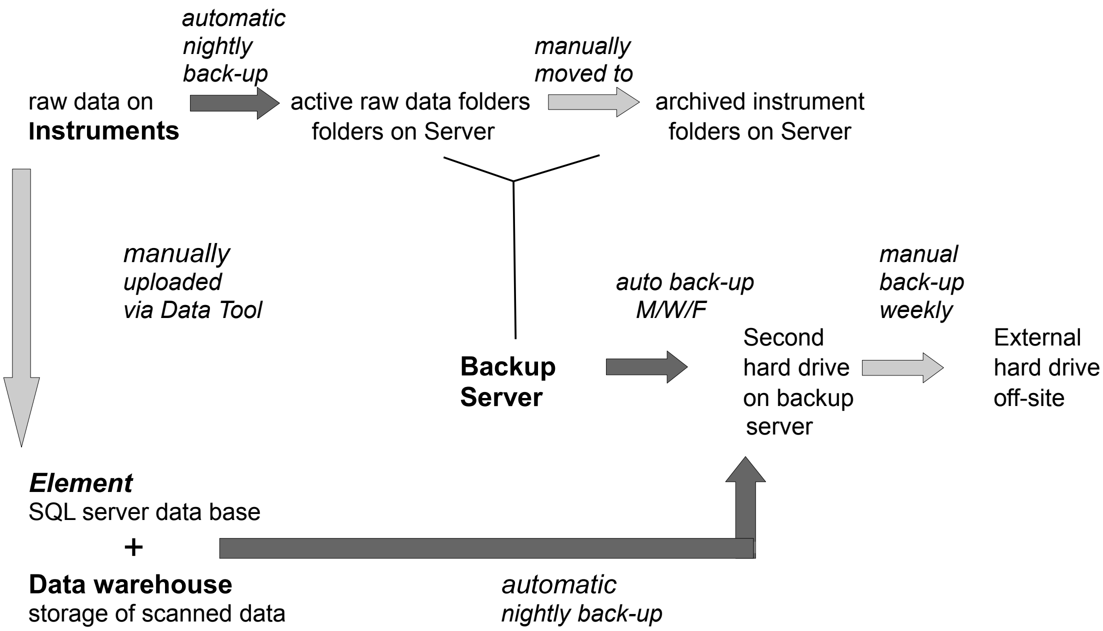
18. Computer Hardware, Software, Validation and Back-up

Apex uses only commercially available computer hardware from reputable sources and software designed specially for analytical instrumentation such as Agilent Technologies *ChemStation* Software. The Laboratory Information Management System, *Element*, is developed by Promium, LLC and maintained internally by the Technical Manager and externally by a service contract with the manufacturer. The integrity of *Element* and instrumentation software is tracked in the related audit trails which document changes made in the system; and is verified by review of the raw data against the uploaded data, and review of the final report.

18.1. Back-up[89]

The laboratory's electronic data and documents are organized to facilitate easy retrieval by authorized personnel. To guard against potential loss, electronic records are stored in multiple locations, including an external hard drive kept off site. The Technical Manager assumes responsibility for ensuring that electronic records are kept in a format supported by the hardware/software necessary for retrieval.[90]

The diagram below illustrates the extensive electronic backup systems in place.[91]



19. Performance and System Audits[92]

In order to maintain accreditation and meet contractual qualifications Apex is subject to audits conducted by regulatory agencies and private clients. In addition to these external audits, Apex performs internal audits to support the Quality System and continuous improvement. The three types of audits outlined below are conducted according to a predetermined schedule by the QA department.[93] The QA Manager may also delegate auditing tasks to qualified personnel independent of the activity to be audited.[94]

19.1. Performance audits are qualitative evaluations to assure that the Quality System requirements are being followed in the day-to-day analytical operations of the laboratory.

a) Performance audits may include:

- **i** Determining whether the current SOP meets the most up to date regulatory requirements and whether the SOP is being followed in the laboratory.
- **ii** Assessing analyst training and documentation of training.
- **iii** Evaluation of record keeping systems.
- **iv** Ensuring that adequate equipment, supplies and personnel are available for the audited analysis.
- **v** Auditing data as instrument data, in *Element* and as the final analytical report.
- **vi** Ensuring that corrective actions implemented for previous audit findings are in place.[95]

b) Performance audit reports include the department, method(s) and analyst(s) audited, any findings and subsequent corrective actions and date of implementation. Performance audit reports are retained by the QA department.[96]

c) Corrective action for audit findings should be implemented as soon as possible. The time frame for completion of such corrective action will be determined by the QA Manager and included in the audit report (usually 30 days).[97] In the event that audit findings warrant data recall, effected clients will be notified in writing within 45 days of the audit report.[98]

d) Internal performance audits should be performed at least annually per department, or more often as needed at the discretion of the Laboratory Director or QA Manager.[45]

19.2. Proficiency Testing[99]

Proficiency tests (PT) are quantitative evaluations of laboratory performance to assure the accuracy of data being generated. PT samples are an integral part of maintaining the laboratory's accreditations.[100] PT samples are purchased and analyzed by the laboratory for all analytes and matrices for which the laboratory reports results, except in cases where a PT is not available for a particular analysis. PT samples are prepared according to the manufacturers instructions and analyzed using the same procedures and QC requirements as normal samples including the following:[101]

a) PT samples are logged in to *Element* and assigned a work order number. The project manager role is assigned to a QA department representative.

b) PT samples are prepared (extracted/ digested) and analyzed by the same analyst that usually performs the analysis, using the same methodology.

c) The organization (per batch /sequence) and extent of analysis of the PT sample and associated batch QC and instrument QC are the same as for routine environmental samples. The PT sample should not be singled out as the source for batch QC. Batch QC for PT batches should be selected using the same criteria as non-PT batches. [102]

d) PT sample results are entered into *Element* and the analytical data are retained the same as for routine environmental samples[103]. An Analytical Report is generated and retained with the electronic report sent from the PT provider.

e) PT results are reported according to the PT provider's instructions, by either transcribing the results from Apex's Analytical Report onto the PT provider's reporting sheets and manually submitting them via fax or mail, or entering the results on the PT provider's web site.[104]

f) PT sample results submitted to maintain Apex's accreditation status will be generated from analyses performed only by the laboratory; the analyses cannot be subcontracted. Apex may send specifically designated PT samples to subcontract laboratories in order to assess their analytical capability. Such results may be submitted to the PT provider for assessment criteria, but not to maintain Apex's accreditation status.[105]

g) Apex may receive PT samples from a client as part of the client's QA protocol, but Apex will not knowingly analyze PT samples to support a client's own accreditation for an analysis.[106]

h) Prior to submission of PT results, Apex will not make any attempt to obtain PT result information from the PT provider or other laboratories participating in the PT study. If circumstances arise that compromise the integrity of Apex's participation in a PT study, Apex will withdraw from the study.[107]

i) Once PT results are submitted by the laboratory, the PT provider reports results and acceptance or failure to the laboratory and any listed accrediting agencies.[22] If a parameter does not pass, corrective action is taken to find the source of the problem. Analysis of a remedial PT may be part of the corrective action. Generally, accreditation is based on successful completion of two out of three PT studies for each matrix and analyte. Certification is generally downgraded to “Provisional” for an analyte/matrix upon failure of that analyte in a single PT sample. Subsequent failure will likely result in suspension of certification until corrective action has been sufficiently completed and two successful PT sample analyses are completed. PTs are analyzed at least 2 times per year for each method and matrix analyzed in the laboratory. PT sample results and supporting data are readily available for review by any client or regulatory agency upon request.

19.3. Quality System Audits[108]

At least once per year the QA department conducts a review of the Quality System as a whole to determine any necessary revisions or additions to ensure the maintenance of a properly functioning and adapting system.

a) The Quality System review should incorporate:
- **i** An assessment of the Quality Assurance Manual and any necessary revisions.
- **ii** New policies implemented.
- **iii** Examination of non-conformance issues and corrective actions, including any issues pertaining to non-compliance with Apex Code of Ethics SOP Q-101.
- **iv** Results of PT studies for the year and any remedial action.
- **v** Findings of performance audits and corrective actions.
- **vi** Client feedback and/or complaints.
- **vii** Changes in workload volume, instrumentation and analyses.
- **viii** Any external assessments/ audits, findings and responses.

b) Quality System audit findings and proposed corrective actions are formally documented and submitted to the Laboratory Director and management team as an annual QA Report to Management.
- **i** The report is initiated as an open document and is finalized with documentation of the corrective action, usually within 90 days. (Substantial actions that require system changes may take longer, in which case the QA Report to Management is finalized with a proposed completion date for the corrective action.)
- **ii** The QA Report to Management is dated with the initiation date and is finalized by the management team signing and dating the final hard copy report.
- **iii** Signed final QA management reports are retained in hard copy or electronic format by the QA department for a minimum of 5 years.

Figure 1 – Organization Chart

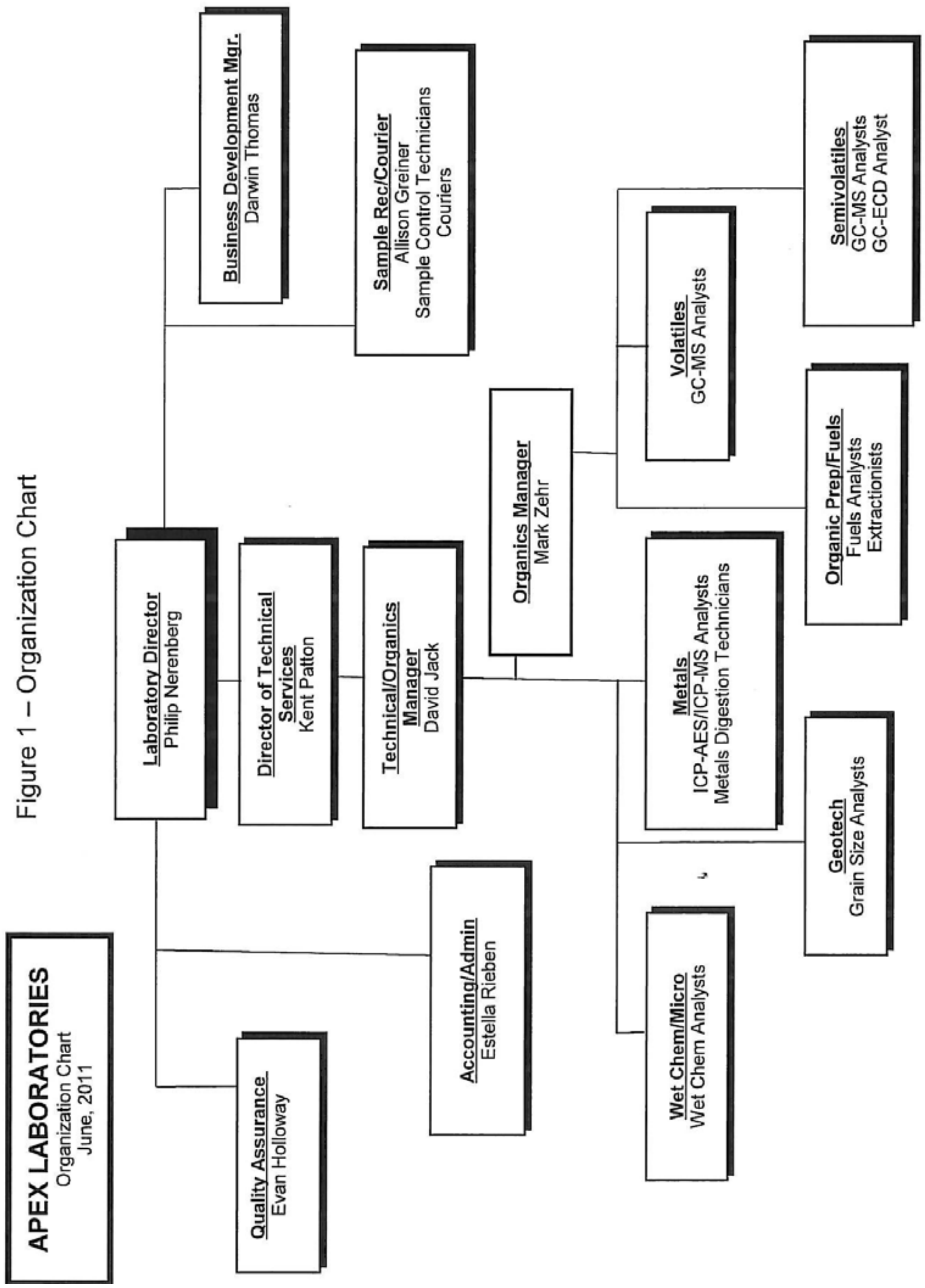


Figure 2 – Floor Plan

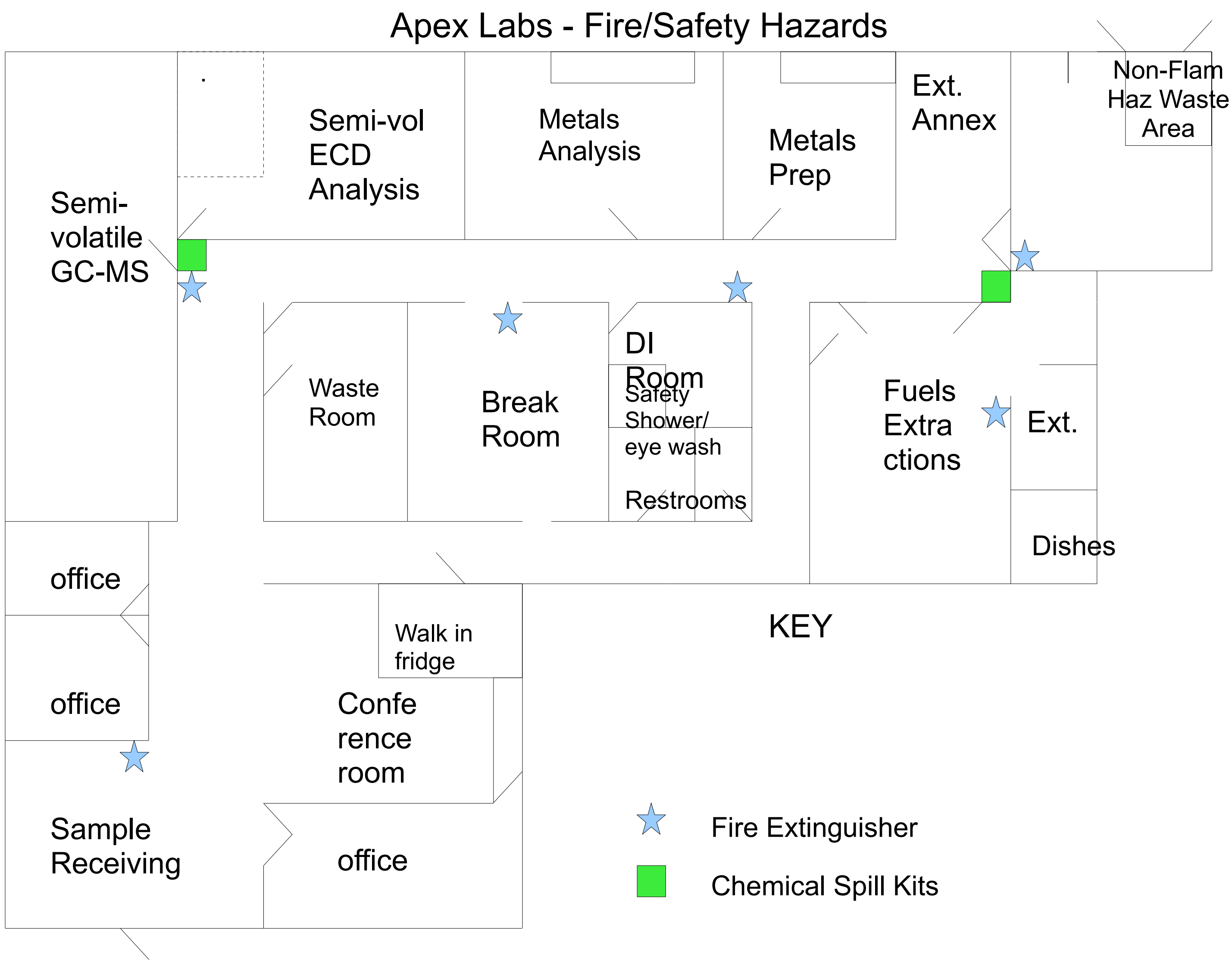


Figure 3 – Chain of Custody

The next page is an example of an Apex Laboratories Chain of Custody.

APEX LABS **CHAIN OF CUSTODY** Lab # ____________ COC ___of___

12232 S.W. Garden Place, Tigard, OR 97223 Ph: 503-718-2323 Fax: 503-718-0333

Company:	Project Mgr:	Project Name:	Project #
Address:	Phone:	Fax:	Email:
Sampled by:	ANALYSIS REQUEST		

Site Location: OR WA

Other: ________

	SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	NWTPH-HCID	NWTPH-Dx	NWTPH-Gx	BTEX	8260 RBDM VOCs	8260 Halo VOCs	8260 VOCs	8270 SIM PAHs	8082 PCBs	8081 Chlor. Pest	RCRA Metals (8)	Priority Metals (13)	Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Hg, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Tl, V, Zn	TCLP Metals (8)	1200- COLS	1200-Z						
1																												
2																												
3																												
4																												
5																												
6																												
7																												
8																												
9																												
10																												

Normal Turn Around Time (TAT) = 7-10 Business Days **YES** **NO**

TAT Requested (circle) **1 Day** **2 Day** **3 Day** **4 DAY** **5 DAY** **Other:** ________

SAMPLES ARE HELD FOR 30 DAYS

SPECIAL INSTRUCTIONS:

RELINQUISHED BY:		**RECEIVED BY:**		**RELINQUISHED BY:**		**RECEIVED BY:**	
Signature:	Date:	Signature:	Date:	Signature:	Date:	Signature:	Date:
Printed Name:	Time:	Printed Name:	Time:	Printed Name:	Time:	Printed Name:	Time:
Company:		Company:		Company:		Company:	

Figure 4 – Cooler Receipt Form

APEX LABS COOLER RECEIPT FORM

Client: ____Element WO#: A11_________

Project/Project #: ____

Delivery info:

Date/Time Received: __________@____________ By: _________________________

Delivered by: Apex Courier___Client___FedEx___UPS___Senvoy ___SDS___Other___

Cooler Inspection Inspected by: ________________________@___________

Chain of Custody:

Included? Yes ___ No ___ Signed/Dated by Client? Yes ___ No ___

Signed/Dated by Apex Personnel? Yes ___ No ___

Coolers: No. of Coolers: ________

	Cooler #1	Cooler #2	Cooler #3	Cooler #4
Temperature (deg. C)	________	________	________	________
Received on Ice? (Y/N)	________	________	________	________
Temp. Blanks? (Y/N)	________	________	________	________
Ice Type: (Gel/Real/Other)	________	________	________	________
Condition:	________	________	________	________

Cooler out of temp? (Y/N) Possible reason why:______________________________

Samples Inspection: Inspected by: ________________________@_________

All Samples Intact? Yes ___ No ___ Comments:______________________________

____

Bottle Labels/COCs agree? Yes ___ No ___ Comments: ________________________

____Containers

Appropriate for Analysis? Yes ___ No ___ Comments: _______________

____

Do VOA Vials have Visible Headspace? Yes ___ No ___ NA ____

Comments____ Water Samples:

pH Checked and Appropriate (except VOAs): Yes___No___NA______

Comments: ____

Additional Information: ____

____

____

Labeled by:_____________________________ **See Client Contact Form: Y**_____

Figure 5 – Sample Report

The next six pages are an example of a report generated out of *Element* by Apex Laboratories.

Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

Wednesday, August 4, 2010

Philip Nerenberg
Apex Labs
12232 S.W. Garden Place
Tigard, OR 97223

RE: Performance Evaluation / Spring 2010 Water Remedial P

Enclosed are the results of analyses for work order A10F200, which was received by the laboratory on 6/17/2010 at 3:51:00PM.

Thank you for using Apex Labs. We appreciate your business and strive to provide the highest quality services to the environmental industry.

If you have any questions concerning this report or the services we offer, please feel free to contact me by email at: EHolloway@Apex-Labs.com, or by phone at 503-718-2323.

Apex Laboratories

Evan Holloway, Quality Assurance Manager

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

Apex Labs	Project: **Performance Evaluation**	
12232 S.W. Garden Place	Project Number: Spring 2010 Water Remedial	**Reported:**
Tigard, OR 97223	Project Manager: Philip Nerenberg	08/04/10 16:16

ANALYTICAL REPORT FOR SAMPLES

SAMPLE INFORMATION

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
Trace Metals 1	A10F200-01	Water	06/17/10 00:00	06/17/10 15:51

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

Apex Labs	Project: **Performance Evaluation**	
12232 S.W. Garden Place	Project Number: Spring 2010 Water Remedial	**Reported:**
Tigard, OR 97223	Project Manager: Philip Nerenberg	08/04/10 16:16

ANALYTICAL SAMPLE RESULTS

Total Metals by EPA 6010C (ICP-AES)

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
Trace Metals 1 (A10F200-01)			**Matrix: Water**		**Batch: 1006383**			
Copper	**0.363**	---	0.0100	mg/L	1	06/23/10 17:24	EPA 6010C	

Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

Apex Labs	Project: **Performance Evaluation**	
12232 S.W. Garden Place	Project Number: Spring 2010 Water Remedial	**Reported:**
Tigard, OR 97223	Project Manager: Philip Nerenberg	08/04/10 16:16

QUALITY CONTROL (QC) SAMPLE RESULTS

Total Metals by EPA 6010C (ICP-AES)

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 1006383 - EPA 3015A							**Water**					
Blank (1006383-BLK2)						Prepared: 06/23/10 14:07 Analyzed: 06/23/10 17:18						
EPA 6010C												
Copper	ND	---	0.0100	mg/L	1	---	---	---	---	---	---	
LCS (1006383-BS2)						Prepared: 06/23/10 14:07 Analyzed: 06/23/10 17:21						
EPA 6010C												
Copper	0.0543	---	0.0100	mg/L	1	0.0556	---	98	80-120%	---	---	

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

Apex Labs	Project: **Performance Evaluation**	
12232 S.W. Garden Place	Project Number: Spring 2010 Water Remedial	**Reported:**
Tigard, OR 97223	Project Manager: Philip Nerenberg	08/04/10 16:16

SAMPLE PREPARATION INFORMATION

Total Metals by EPA 6010C (ICP-AES)

Prep: EPA 3015A

Lab Number	Matrix	Method	Sampled	Prepared	Sample Initial/Final	Default Initial/Final	RL Prep Factor
Batch: 1006383							
A10F200-01	Water	EPA 6010C	06/17/10 00:00	06/23/10 14:07	45mL/50mL	45mL/50mL	1.00

Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

Apex Labs	Project:	**Performance Evaluation**	
12232 S.W. Garden Place	Project Number:	Spring 2010 Water Remedial	**Reported:**
Tigard, OR 97223	Project Manager:	Philip Nerenberg	08/04/10 16:16

Notes and Definitions

Qualifiers:

Notes and Conventions:

DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis. Results listed as 'wet' or without 'dry'designation are not dry weight corrected.
RPD	Relative Percent Difference
MDL	If MDL is not listed, data has been evaluated to the Method Reporting Limit only.
WMSC	Water Miscible Solvent Correction has been applied to Results and MRLs for volatiles soil samples per EPA 8000C.
Batch QC	Unless specifically requested, this report contains only results for Batch QC derived from client samples included in this report. All analyses were performed with the appropriate Batch QC (including Sample Duplicates, Matrix Spikes and/or Matrix Spike Duplicates) in order to meet or exceed method and regulatory requirements. Any exceptions to this will be qualified in this report. Complete Batch QC results are available upon request. In cases where there is insufficient sample provided for Sample Duplicates and/or Matrix Spikes, a Lab Control Sample Duplicate (LCS Dup) is analyzed to demonstrate accuracy and precision of the extraction and analysis.
Blank Policy	Apex assesses blank data for potential high bias down to a level equal to ½ the method reporting limit (MRL), except for conventional chemistry and HCID analyses which are assessed only to the MRL. Sample results flagged with a B or B-02 qualifier are potentially biased high if they are less than ten times the level found in the blank for inorganic analyses or less than five times the level found in the blank for organic analyses. For accurate comparison of volatile results to the level found in the blank; water sample results should be divided by the dilution factor, and soil sample results should be divided by 1/50 of the sample dilution to account for the sample prep factor. Results qualified as reported below the MRL may include a potential high bias if associated with a B or B-02 qualified blank. B and B-02 qualifications are not applied to J qualified results reported below the MRL.

Figure 6 – Nonconformance Report Form

APEX LABORATORIES NONCONFORMANCE FORM

Severity (circle one): 1 2 3

1 - Needs signatures of analyst and one QA/QC/TD person w/ documentation of decision.
2 - Needs QA/QC review (discussion among QA/QC/TD) w/ initials of all involved, documentation of decision and possible system modifications.
3 - Needs actions indicated in level 2 with signature of laboratory manager and follow-up to verify that system changes have been implemented.

Levels 1 & 2 need only 1st page, level 3 needs 2 pages.

Notification of Nonconformance:

Date:	
Analyst/Department:	
Nonconformance:	
Root Cause:	
Initial Corrective Action:	
Samples Affected:	(List Client(s), Work Order(s) and Sample(s) Affected)
QC Affected:	(List Batch and Instrument QC Affected)
Reviewed By / Date:	(Quality Assurance Department or Technical Manager / Date of review)
Comments:	(Comments from QA Department or Technical Manager)

Figure 6 – Nonconformance Report Form

Follow-up to Corrective Action:	(List further steps to be completed to remedy Nonconformance, only if a level 3 nonconformance)
Target Completion Date:	

Project Management Notification:

Project Manager Comments:	(Comments from Project Manager, including documentation of client notification, if applicable)
Subsequent Actions to be Taken:	(if applicable)
Date of Reissued Report	(Date Amended Report sent to Client, if applicable)

Quality Assurance Approval:

QA Comments:	(Comments from Quality Assurance Department)	
Subsequent Actions to be Taken:	(if applicable)	
Corrective Action Completed?		
QA Approval:		**Date:**

Laboratory Manager Approval:

Laboratory Manager:	**Date:**

Additional Comments:

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