Environmental Monitoring Plan
Olympic View Sanitary Landfill
Port Orchard, WA

Prepared for

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Certification

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1 INTRODUCTION

This Environmental Monitoring Plan (EMP or "Plan") has been prepared to address the requirement of Task 3 (Paragraph IV C 1) of the Agreed Order pursuant to the Model Toxics Control Act (MTCA) (Chapter 173-340 WAC) for Olympic View Sanitary Landfill (No. DE 00SWFPNR-1729). Specifically this plan describes the environmental monitoring to be conducted in conjunction with implementation of corrective actions to be undertaken at the Olympic View Sanitary Landfill (OVSL or the "Site") in Port Orchard, Washington (Figure 1). As required by MTCA (WAC 173-340-400 (4)(b)(viii) and (4)(c)(x)) this monitoring plan includes a Sampling and Analysis Plan (Appendix A) (WAC 173-340-820). This EMP also addresses the environmental monitoring requirements established pursuant to the Solid Waste Regulations (WAC 173-351-400).

1.1 Regulatory Background

The Site is a solid waste landfill that is subject to requirements under the Criteria for Municipal Solid Waste Landfills (Chapter 173-351 WAC, "the solid waste regulations"). The Site consists of two closed landfill cells including an older, unlined landfill cell (Old Barney White Landfill) and a newer lined landfill (Figure 2). Both the older and newer landfill cells are covered with a geosynthetic membrane overlain by drainage and vegetative layers. The Site includes leachate collection from both cells (Figure 3). The collected leachate is accumulated in a double lined leachate pond from which it is currently either sent to an evaporator or is hauled to a local publicly-owned treatment works (POTW). Landfill gas is collected from both cells (Figure 4) and used to evaporate leachate or is burned in a landfill gas flare system.

Groundwater, leachate, and soil gas monitoring at the Site has been performed on a quarterly basis in accordance with the requirements of the Agreed Order and the solid waste regulations. Exhibit A to the Agreed Order details the monitoring and reporting requirements for the Site that were previously in effect. Prior monitoring results have been reported in quarterly and annual monitoring reports. Task 3 of the Agreed Order required a new EMP be developed for the Site.

The MTCA regulations describe specific requirements for compliance monitoring (WAC173-340-410) and cleanup standards. The assessment monitoring requirements of the solid waste regulations (WAC 173-351-440) are consistent with the MTCA groundwater monitoring requirements.

As the Site is subject to a MTCA Order, this EMP has been prepared to address the requirements of the Agreed Order, the compliance monitoring requirements of MTCA and the monitoring requirements of the solid waste regulations. Upon demonstration that the cleanup standards established for the Site have been achieved and the requirements of the Agreed Order have been met, this EMP will be revised to address the continuation of the post-closure monitoring requirements of the solid waste regulations.

1.2 Purpose of Monitoring Program

The purpose of the monitoring program described in this Plan is to address the requirement for a new EMP set forth under Task 3 of the Agreed Order. This EMP addresses the monitoring requirements established under MTCA and the monitoring requirements established under the solid waste regulations.

MTCA (WAC 173-340-120) requires that cleanup actions include compliance monitoring to ensure the long-term effectiveness of the cleanup action. As specified by MTCA (WAC 173-340-410), the purpose of compliance monitoring is to:

1. Confirm that human health and the environment are adequately protected during implementation of the corrective actions,

2. Assess the performance of the corrective actions to be implemented at the Site in terms of attainment of cleanup standards and, if appropriate, other performance standards (in this case, those defined by the solid waste regulations); and

3. Confirm the long-term effectiveness of the corrective actions.

The Site is also subject to the groundwater monitoring requirements established pursuant to the solid waste regulations. The site is currently subject to assessment groundwater monitoring under the solid waste regulations (WAC 173-351-440). Groundwater monitoring conducted to meet the MTCA requirements will also meet the groundwater assessment monitoring requirements of the solid waste regulations.

Monitoring of leachate quality and landfill (soil) gas is required to meet the requirements of the solid waste regulations. Stormwater monitoring is also conducted at the Site pursuant to a stormwater discharge permit issued by the Department of Ecology.

1.3 Scope of Monitoring Program

This plan addresses environmental monitoring of the following media at the Site:

- Groundwater
- Leachate
- Soil gas

Stormwater runoff at the Site is accumulated in detention ponds (Figure 5) and is monitored in accordance with an existing stormwater pollution prevention plan (Waste Management, 2008) and Industrial Stormwater Baseline General Permit (Facility Number SO3-002538C, October 15, 2008) through Ecology's Water Quality Program. Stormwater discharge sampling points were previously established through discussions with the Department of Ecology and Kitsap County Health District. Details regarding the

stormwater sampling requirements, visual inspection procedures, and other requirements of the General Permit are provided in the SAP (Appendix A).

This plan is organized around the various environmental media to be monitored at the Site. The locations of the existing environmental monitoring points (groundwater monitoring wells, leachate monitoring points, soil gas monitoring probes, and stormwater outfalls) are shown on Figure 6.

This EMP describes the following components, as appropriate, for the monitoring programs for each of the environmental media at the Site:

- Cleanup or performance standards
- Point of compliance
- Monitoring network
- Monitoring parameters or analytes
- Monitoring frequency
- Data analysis and evaluation procedures

Reporting of the monitoring results is discussed in Section 5 of this Plan. This EMP is accompanied by a Sampling and Analysis Plan (Appendix A) prepared pursuant to WAC 173-340-820 and WAC 137-351-410.

Please note that the corrective actions for the Site have not been selected at the time this Plan was prepared. Therefore, this Plan may be modified at a later date, if necessary, to address criteria specific to the implementation and operation of the selected corrective actions.

2 GROUNDWATER

This section provides a general description of the occurrences of groundwater and the nature and extent of contamination at the Site. This section also describes the proposed cleanup standards and the point of compliance where the cleanup standards are to be met. The monitoring wells that will be sampled pursuant to this Plan (monitoring network), the groundwater quality monitoring parameters for which the samples will be analyzed (analyte list), and the frequency of groundwater sample collection and analysis are also described in this section. Lastly, the data analysis and evaluation procedures to be used to demonstrate compliance with the cleanup standards are described.

2.1 Groundwater Occurrence and Nature and Extent of Contamination

The subsurface at the Site is dominated by poorly graded to well graded sands and gravels associated with coarse-grained Vashon recessional and advance outwash deposits and intervening, lenses of silty sands, silts and clays associated with Vashon recessional lacustrine deposits. The outwash deposits and the interbedded recessional lacustrine deposits overlay thick deposits of silts and clays associated with the Vashon advance lacustrine deposits. Detailed information regarding the geologic conditions at the Site is presented in the Remedial Investigation (RI) report (Parametrix, 2007).

Groundwater is present in all of the units beneath the Site with the primary groundwater system composed of the Vashon recessional and advance outwash deposits which have been interpreted to act as one continuous unconfined aquifer extending from the water table to the underlying fine-grained deposits of the Vashon advance lacustrine deposits. This continuous unconfined aquifer is considered the regional aquifer. The regional aquifer overlies the Vashon advance lacustrine unit which has been interpreted to be present beneath the entire OVSL Site.

The groundwater flow direction of the regional aquifer is generally to the west or west-northwest extending from the highland areas along the eastern and southeastern portions of the Site to the wetlands and Union River valley to the west and west-northwest of the Site. Figure 7 presents a recent water level contour map of the groundwater elevations at the Site. Additional details regarding groundwater occurrence and flow can be found in the RI report (Parametrix, 2007).

Based on the results of the RI and past and ongoing groundwater monitoring activities at the Site, groundwater contamination at the Site has been characterized as consisting of low levels of volatile organic compounds (VOCs) and trace metals present within the regional aquifer. Specifically, comparison of the results of the 2005 through 2007 groundwater monitoring data to the *Water Quality Standards for Groundwater of the State of Washington* (Chapter 173-200 WAC), State/Federal primary and secondary Maximum Contaminant Levels (MCLs), and the MTCA Method B values has identified eight analytes that exceed one of these standards in at least one well. These eight

analytes include pH, specific conductivity, arsenic, iron, manganese, 1,1-dichloroethane, trichloroethene, and vinyl chloride.

Other trace metals that have been detected in groundwater include barium, chromium, cobalt, copper, nickel, vanadium and zinc although with the exception of barium, occurrences of these metals are isolated and infrequent. Where and when they have been detected, the levels of all of these metals have been below the State and Federal standards and the MTCA Method B Cleanup Levels for Groundwater. The compound cis-1,2-dichloroethene has also been detected in groundwater beneath the Site but at levels below the State and Federal standards and MTCA Method B Levels. Freon compounds, ethyl ether, benzene, toluene, and dichlorobenzene have also been detected in groundwater samples. These detections have only been reported in isolated wells and have generally occurred infrequently over time and in every case have been reported at concentrations below the State and Federal standards and the MTCA Method B Levels. Additional information regarding groundwater quality and the results of past groundwater monitoring can be found in the RI report (Parametrix, 2007) and the various annual monitoring reports (SCS, 2006, 2007, 2008 and 2009).

Information regarding how these monitoring results compare to groundwater standards and health-based criteria can be found in the Human Health Risk Assessment (HHRA) (Arcadis, 2008). The HHRA identified eight chemicals of concern for the Site including arsenic, iron, manganese, cis-1,2-dichloroethene, ethyl ether, trichloroethene, vinyl chloride and ammonia. Groundwater cleanup levels have been developed for these same eight chemicals as described further below.

2.2 Groundwater Cleanup Standards and Point of Compliance

Proposed groundwater cleanup standards for the chemicals of concern at the Site are presented on Table 1. These cleanup standards were developed in accordance with MTCA guidance (Ecology 2005a) based on the following:

- The most stringent applicable state and federal drinking water quality standards for potable groundwater (40 CFR Parts 141 and 143 and WAC 246-290-310)

- Water Quality Standards for Ground Waters of the State of Washington (WAC 173-200) and related guidance (Ecology, 2005b);

- Model Toxics Control Act (MTCA) Method B (WAC 173-340-720) standard formula risk-based values for potential carcinogenic and non-carcinogenic health effects based on information obtained from the Cleanup Levels and Risk Calculations (CLARC) database (Ecology, 2008); and

- Background concentration for dissolved inorganic constituents in groundwater in the area of the Site.

The groundwater cleanup standards provided on Table 1 are considered to be preliminary as final groundwater cleanup standards will be determined by the Department of Ecology as part of the selection of corrective actions for the Site.

A background arsenic level of 0.0039 mg/l was previously developed based on the upper prediction limit calculated using all of the historical data obtained from the Site's upgradient monitoring wells MW-13, MW-13A, MW-13B, and MW-35. This value has previously been used as the background value for arsenic. Ecology recently determined that a background value based only on the results of the low-level detection limit (EPA Method 200.8) data obtained from the upgradient wells will be used at the Site. Evaluation of only the low-level detection limit method results from the more recent (2005 through 2008) arsenic data from the upgradient wells results in a background value of 0.00046 mg/l. As part of the Human Health Risk Assessment (HHRA) (Geomatrix, 2008) an evaluation of the arsenic data obtained from water supply wells located in the Union River watershed upgradient of the Site was performed and resulted in identification of a regional background arsenic concentration of 0.0085 mg/l.

The solid waste regulations state that for groundwater the "Point of compliance means the point located on land owned by the owner of the MSWLF unit, and is no more than one hundred fifty meters (four hundred ninety two feet) from the waste management unit boundary." The point of compliance for OVSL is established as a line of wells located downgradient of the landfill within 150 meters of the landfill boundary (see discussion below regarding compliance monitoring wells).

2.3 Groundwater Monitoring Well Network

The groundwater monitoring well network has been developed to address three distinct criteria;

1. Evaluation of compliance with the groundwater cleanup standards at the point of compliance,
2. Evaluation of the protectiveness of the site, and
3. Evaluation of the effectiveness of the corrective actions implemented at the Site.

To this end, four distinct groups of wells have been included in the monitoring well network. These four groups of wells include the following:

1. Compliance monitoring wells;
2. Performance monitoring wells;
3. Downgradient monitoring wells; and
4. Upgradient monitoring wells.

2.3.1 Compliance Monitoring Wells

Six wells located downgradient of the landfill mass have been identified for use in evaluation of compliance with the groundwater cleanup standards. These six wells include:

- MW-39
- MW-15R
- MW-34 A and C
- MW-42
- MW-43.

These six wells provide coverage on approximately 300 to 800 ft spacing perpendicular to the groundwater flow direction downgradient of the landfill.

2.3.2 Performance Monitoring Wells

It is expected that it will take time for both implementation of corrective actions and for such actions to result in any demonstrable improvement in water quality at the point of compliance. Therefore, six wells located downgradient of the landfill mass inside of the point of compliance have been identified for use in evaluation of the effectiveness of the corrective measures. These six wells include:

- MW-24
- MW-23A
- MW-2B1
- MW-20
- MW-19 C
- MW-4

Water quality monitoring of these six wells will provide an early indication of the anticipated effectiveness of the corrective actions.

2.3.3 Downgradient Monitoring Wells

As groundwater contamination at levels above the cleanup standards has been detected downgradient of the point of compliance, six additional monitoring wells have been included in the monitoring network to provide water quality data to confirm that human health and the environment are adequately protected during the period of time required to achieve the cleanup standards at the point of compliance. These six wells include:

- MW-36A
- MW-33A and C
- MW-32

- MW-29A.
- MW-9 (for at least as long as it takes to sample compliance well MW-43 a minimum of four times at which time the need to continue sampling MW-9 will be re-evaluated)

These wells are spaced at intervals of approximately 300 to 600 ft perpendicular to the downgradient groundwater flow direction from the landfill.

2.3.4 Upgradient Monitoring Wells

Background water quality data will be collected from four upgradient wells including:

- MW-13A
- MW-13B
- MW-35
- MW-16

2.3.5 Completion of Corrective Action

Compliance with the cleanup standards has been achieved when the concentrations have not exceeded the cleanup standards for a period of three consecutive years using appropriate statistical procedures in both the downgradient and compliance wells.

2.3.6 Modifications to Groundwater Network

The rationale for including the 22 monitoring wells listed above in the monitoring network is presented on Table 2 along with a rationale for why other wells were not included in the well network. A summary of the construction of the 19 existing monitoring wells included in the network and three proposed additional monitoring wells, including the depths and elevations of the screened intervals of these wells, is provided on Table 3. The locations of these wells are provided on Figure 8.

The above network is considered to be dynamic as it will be subject to ongoing evaluation relative to its ability to detect potential releases and migration and also relative to possible redundancies in the monitoring network. For example, existing or possibly additional new wells that are not currently included in the monitoring network may be added to the network in the future in response to changes in Site conditions. Such changes that could trigger a re-evaluation and possible future additions to the groundwater monitoring network could include occurrences of elevated levels of landfill gas in a gas monitoring probe located near a well or location that is not currently part of the groundwater monitoring network. Another example of a change in Site conditions that could trigger a re-evaluation of the monitoring network would be new occurrences of contaminants or increased levels of contaminants in a downgradient or deeper well.

Alternatively, the absence of contamination in a downgradient well over a prolonged period of time could trigger re-evaluation of the need for continued sampling of the downgradient well. Similarly, once compliance with the groundwater cleanup standards is achieved in the downgradient and compliance monitoring wells, the need for continued monitoring of the downgradient and/or performance wells may be subject to re-evaluation.

2.4 Groundwater Monitoring Parameters

The solid waste regulations (WAC 173-351-430 (1)) require monitoring for trace metals and volatile organic compounds (listed in Appendix I to the solid waste regulations and referred to as the Appendix I constituents). The solid waste regulations also require monitoring for Groundwater Quality Parameters including field parameters, geochemical indicator parameters (major ions, iron and manganese), and leachate indicators (ammonia, total organic carbon and total dissolved solids) as specified in Appendix II to the solid waste regulations (referred to as the Appendix II constituents).

In the event that any of the Appendix I constituents are found at levels determined to represent a statistically significant increase above background, the Site triggers into assessment monitoring. The solid waste regulations then require monitoring for additional metal parameters, semivolatile organic compounds and pesticides (listed in Appendix III to the solid waste regulations and referred to as Appendix III constituents) unless it can be demonstrated that the levels of Appendix III constituents are below background values. If an Appendix III constituent exceeds a ground water quality standard, a facility is in corrective action and continues assessment monitoring.

In order to provide ongoing verification that SVOCs, pesticides and herbicides continue to not be a concern in groundwater, a subset of the compliance monitoring wells and performance monitoring wells will be sampled on a periodic basis for the full Appendix III constituents. If an Appendix III constituent is detected, it will be added to the monitoring program. The wells to be sampled for full Appendix III constituents include the following:

Compliance Monitoring Wells for Appendix III analyses

- MW-15R
- MW-34C
- MW-32 (initially but eventually to be replaced by either well MW-42 or MW-43, selection of which will be based on the results of the first four rounds of water quality sampling from these wells)

Performance Monitoring Wells for Appendix III analyses

- MW-24
- MW-19C
- MW-2B1

Together, these six wells provide a line of wells located at an approximately 370 ft spacing (ranging from a minimum of 120 ft to a maximum of approximately 630 ft) perpendicular to the groundwater flow direction.

In addition to collection of samples for water quality monitoring, the depth to water will be obtained from all monitoring wells in the monitoring network and any other unobstructed monitoring wells that may be present at the Site. Water levels will be obtained in conjunction with each water quality monitoring event.

2.5 Groundwater Monitoring Frequency

MTCA does not contain a required monitoring frequency but requires that the monitoring frequency be identified and justified. The solid waste regulations require quarterly monitoring for sites in assessment or corrective action.

Operational modifications and corrective actions are currently being implemented at the Site with the intent of reducing impacts to groundwater. In order to obtain as early an indication of the effectiveness of these modifications and actions, quarterly groundwater monitoring for the Appendix I, II and any Appendix III parameters detected as part of the Appendix III monitoring (see discussion below) will be performed for the performance, compliance, and upgradient monitoring wells listed above. Once it is determined that the effects of these modifications and actions on groundwater quality have stabilized, a semiannual groundwater monitoring frequency for these wells may be proposed. If a reduction in the monitoring frequency is considered appropriate, an amendment to this Plan providing the rationale for the revised monitoring frequency and addressing the requirements for alternative groundwater monitoring programs set forth in the solid waste regulations (WAC 173-351-450) will be prepared and submitted to the agencies for review and approval.

The downgradient monitoring wells MW-33A, MW-29A, and MW-9 will be sampled for the Appendix I and II parameters and any Appendix III parameters that are detected as part of the Appendix III monitoring (see below) on a semiannual basis as the water quality in these wells has remained relatively consistent over the last three years. Note that sampling of MW-9 will only be conducted until such time as sufficient water quality data (minimum of four quarters) is obtained from newly installed well MW-43 to verify that it is a suitable replacement for MW-9. As downgradient monitoring well MW-32 contains iron, manganese, trichloroethene and vinyl chloride at concentrations greater than the groundwater cleanup levels, this well will continue to be monitored on a quarterly basis. Downgradient monitoring wells MW-36A and MW-33C will be monitored quarterly until such time as sufficient data (12 quarters) are available to determine whether these wells need to continue to be sampled on a quarterly basis or if the frequency of sampling for these wells can be reduced to semiannual. In the event that new contaminants or an increase in the concentrations of contaminants in any wells that are being sampled on a semiannual basis is identified, the frequency of sampling for such

wells may be increased on a contingent basis to quarterly sampling until such time as sufficient data are available to assess the cause and significance of such changes.

As discussed above, less frequent monitoring for the Appendix III parameters will be performed on a subset of the compliance and performance monitoring wells to provide ongoing verification that the landfill does not cause an increase in the occurrence of concentrations of Appendix III constituents in groundwater. Samples will be obtained for Appendix III analyses every three years from the three performance monitoring wells identified for Appendix III analyses (MW-24, MW-2B1, and MW-19C). Samples will be obtained every five years for Appendix III analyses from the three compliance wells (MW-15R, MW34C, and MW-32). Note that sampling of MW-32 for Appendix III parameters will only be conducted until such time as sufficient water quality data (minimum of four quarters) is obtained from the newly installed compliance wells MW-42 and MW-43 at which point a determination will be made as to whether the location for sampling and analysis of the Appendix III parameter should be changed from MW-32 to either MW-42 or MW-43. Initial collection of samples for Appendix III parameters will be conducted during the first or second monitoring event performed after this EMP is approved by Ecology.

Table 4 presents a summary of the analytical requirements and sampling frequencies for each monitoring well included in the groundwater monitoring network.

2.6 Groundwater Data Evaluation and Analysis

This section describes the intended uses of the monitoring data and a description of the evaluations to be performed.

2.6.1 Evaluation of Water Level Data

The intended use of the water level monitoring data is to provide an ongoing basis to verify the relative locations (i.e., upgradient or downgradient) of the various monitoring wells relative to the landfill mass. The water level data will also be examined to determine if a significant increase or decrease in water levels at a particular location may have occurred that could affect the representativeness of the water quality results from such a location.

Results of the groundwater level monitoring will be tabulated. Hydrographs will be prepared for the wells subject to water quality monitoring to identify any changes in water levels that may occur over time. In addition, potentiometric surface maps will be prepared for each water level monitoring event. The potentiometric surface maps will be inspected to identify any changes that may occur in the overall direction of the hydraulic gradient to provide ongoing verification that the water quality monitoring network contains wells suitably located to detect any contaminant releases or migration from the Site.

2.6.2 Upgradient Water Quality Data

The intended use of water quality data obtained from the upgradient monitoring wells is to provide information on background water quality in the area of the landfill. Data obtained from the upgradient monitoring wells is used as part of the detection monitoring program pursuant to the Solid Waste Regulations (WAC 173-351-430) which requires statistical-based comparison of water quality data to background values.

With the exception of arsenic, background levels of Appendix I and II parameters inorganic compounds will be re-evaluated on a yearly basis through re-calculation of the upper prediction limit at a 99% confidence level based on incorporation of the prior years monitoring results into the historical data set from the upgradient monitoring wells. Background for organic parameters are assumed to be zero so no prediction limits will be calculated.

With the exception of the earlier arsenic data that was not obtained using the low-level detection limit method currently in use, all of the available data from the upgradient wells will be used to calculate the upper prediction limit. In the event that a potential outlier is identified, the potential outlier will be identified to Ecology and KCHD in the text of the report. Calculation of the prediction limit may be performed both with and without the potential outlier to assess the effect of including the potential outlier in the calculations. Sen's Test would also be applied to the upgradient wells to look for increasing or decreasing trends that could affect calculation of the prediction limit. In the event a significant trend is identified, Ecology and KCHD will be consulted on how to proceed with calculation of the prediction limit.]

The Department of Ecology has determined that the background value for arsenic will be based on the upper prediction limit at a 99% confidence level calculated using only the arsenic results obtained using EPA test method 200.8 from upgradient wells (previously MW-13, MW-13A, MW-13B, and MW-35 but in the future to include MW-13A, MW-13B, MW-16 and MW-35). The calculated 99% confidence upper prediction limit for the EPA Method 200.8 analytical results obtained from the upgradient wells through the end of 2008 is presented on Table 2.

2.6.3 Compliance and Downgradient Water Quality Monitoring Data

There are two intended uses for groundwater quality monitoring data obtained from the compliance monitoring wells. The first is to demonstrate that water quality downgradient of the landfill does not exceed background levels (detection monitoring). The second is for parameters and locations where water quality downgradient of the landfill does exceed background levels, monitoring data obtained from the compliance monitoring wells will be used to demonstrate compliance with the groundwater cleanup standards (compliance monitoring).

Detection monitoring data will be evaluated in accordance with the requirements of the solid waste regulations (Chapter 173-351 WAC). Waste Management has previously conducted the detection monitoring evaluations using a computer program (DUMPSTAT) to conduct the various statistical analyses in accordance with the requirements of the solid waste regulations.

Data obtained from the compliance monitoring wells for which the results for specific parameters are found to be above the groundwater cleanup standard will be evaluated in accordance with the MTCA regulations [WAC 173-340-720(9)(d), (e) and (f)] using MTCAStat.

The intended use of the water quality data obtained from the downgradient monitoring wells is to provide data to verify that the calculated risks from the occurrences of site-related chemicals in groundwater do not increase but instead remain stable or decline over time. Therefore, results obtained from the downgradient monitoring wells will also be compared to the groundwater cleanup standards in accordance with the MTCA regulations [WAC 173-340-720(9)(d), (e) and (f)] using MTCAStat.

For a well to be found to be in compliance with the groundwater cleanup levels, the 95% upper confidence limit (UCL) values must be less than the groundwater cleanup levels for a period of three years.

Changes in water quality over time can be indicative of improvements in water quality as a result of implementation of operational modifications and/or corrective actions or alternatively of a potential new release or increase in the rate or magnitude of chemical migration. The presence of temporal trends in the compliance or downgradient monitoring results would invalidate use of some standard statistical techniques. Therefore, the potential for temporal trends in the compliance monitoring and downgradient water quality data will also be evaluated to identify the presence of statistically significant increasing or decreasing trends using Sen's Slope Estimate test (Sen's test).

2.6.4 Performance Well Monitoring Data

The intended use of water quality data obtained from the performance monitoring wells is to provide an early indication of the potential effectiveness of corrective actions implemented at the Site. Therefore, water quality data obtained from these wells will be evaluated to identify potential temporal trends (i.e., increases or decreases in chemical concentrations over time) in the water quality in these wells. Water quality results from the performance monitoring wells will be evaluated for the presence of temporal trends using Sen's test.

In the event that increasing trends are identified, further evaluation and interpretation of the monitoring results will need to be conducted to determine if the increase is potentially due to the effects of implementation of corrective measures. For example, it is anticipated that some corrective measures could result in a reduction in infiltration into

the landfill thereby reducing dilution of leachate resulting in increases in leachate concentrations; however, this effect may be offset by the overall reduction in the volume of leachate generated as a result of the corrective measures. Alternatively, some corrective measures could result in a temporary increase in landfill gas generation or migration which could cause a temporary increase in the concentrations of gas-to-water contamination. Potential increases in chemical concentrations as a result of implementation of corrective measures are anticipated to occur relatively soon after implementation of the corrective measures and consequently, these types of effects are not expect to affect longer term monitoring results.

3 LEACHATE

Leachate monitoring is required pursuant to the solid waste regulations (WAC 173-351-415). Leachate quality data may also be useful in evaluation of the source of any fluids found to be present in the leak detection system of the leachate pond. Operation and monitoring of the leachate pond are discussed in Section 3.6 below.

3.1 Leachate Occurrences and Quality

As discussed above, leachate is collected from the lined portion of the landfill and pumped from leachate risers through a force main to the leachate pond (Figure 3). Leachate is also collected along the toe of Old Barney White Landfill via gravity flow to a sump at the leachate evaporator from which it is pumped to the leachate pond. The majority of the leachate flow occurs through the force main. This flow has been sampled in the past with the samples designated as L-INF.

Samples of the leachate influent have been analyzed for Appendix I (trace metals and VOCs), Appendix II (Groundwater Quality Parameters) and Appendix IV (Leachate Parameters) parameters as specified in the solid waste regulations. Samples of the leachate influent were also collected on a quarterly basis in 2001 and 2002 and again in 2005 and analyzed for Appendix III parameters (SVOCs, pesticides, herbicides and PCBs). In other years, samples of the leachate influent have been collected annually during the fourth quarter and analyzed for SVOCs, pesticides, herbicides and PCBs. Samples have also been obtained from the leachate pond (L-POND) and analyzed for parameters specified by the receiving POTW.

Review of the leachate influent monitoring results indicates that leachate contains VOCs, trace metals and elevated levels of major ions, and total dissolved solids. Pesticides and phthalate esters have been detected at trace levels (generally below 1 ug/l) in some of the prior leachate samples. Naphthalene and 1,4-dichlorobenzene have been detected in some of the previous samples of the leachate influent. These two compounds can also be quantified as part of the VOC analyses. The most recent (2007) sample of the leachate influent did not detect any priority pollutant SVOCs, pesticides, herbicides or PCBs. The 2006 sample reportedly contained a trace (less than 0.1 ug/l) level of the pesticide aldrin. No other SVOCs, pesticides, herbicides or PCBs were detected in this sample.

3.2 Leachate Monitoring Points

Leachate samples will continue to be collected from the force main discharge to the pond (L-INF). Ecology has requested that the discharge from the Old Barney White Landfill leachate toe drain collection system discharge into the pond also be sampled. Previously, there was no point from which the Old Barney White Landfill toe drain system could be directly accessed to provide for collection of such a sample. Leachate collected by the Old Barney White Landfill toe drain previously flowed by gravity into a sump located

adjacent to the leachate evaporator. This sump also collected the landfill gas condensate and runoff from the leachate evaporator pad. These combined flows were then pumped from the sump into the leachate pond. Waste Management recently reconstructed this sump as part of installation of flow meters to measure Old Barney White Landfill toe drain and landfill gas condensate flows into the pond. Construction of the new sump vault allows for collection of a sample of leachate flow from the Old Barney White Landfill toe drain system when flow is present and as such samples will be collected from this location pursuant to this Plan when flow is present at the time of sample collection.

Although not a subject of this Plan, samples will also be collected from the leachate pond itself and analyzed for parameters required by the receiving POTW and as specified in the State Waste Discharge Permit issued by Ecology's Water Quality Program (permit no. No. ST-7271 modified June 5, 2008).

3.3 Leachate Monitoring Parameters

Samples collected from the leachate force main (L-INF) and Old Barney White Landfill toe drain (OBWL-TD) flows into the leachate pond will be analyzed for Appendix I, II and IV parameters as specified in the solid waste regulations. In addition, samples of leachate flow to the pond will be analyzed for the Appendix III parameters every three years.

3.4 Leachate Monitoring Frequency

In the past, sampling of leachate inflow to the pond was performed on a quarterly basis in accordance with the Agreed Order and the solid waste regulations with annual samples collected for Appendix III parameters. These data are not used to assess compliance with cleanup standards, the effectiveness or performance of corrective actions or protection of public health and the environment. As discussed below, these data will be used to assess the adequacy of the groundwater monitoring parameter list and the potential for leakage from the leachate pond. Annual monitoring of leachate influent from the leachate collection system (L-INF) and the Old Barney White Landfill Toe Drain (OBWL-TD), if flow is present, will be performed during the fourth quarter. Sampling during the fourth quarter should provide sufficient data to address these objectives.

3.5 Leachate Data Evaluation and Analysis

In the past, data obtained from the leachate influent samples has not been used for any specific purpose other than to provide information regarding the overall site conditions. The quality of leachate influent does not have any bearing on the effectiveness of the corrective actions being undertaken, compliance with cleanup standards, or the operation of the leachate pond or leachate evaporator. Leachate quality data does provide a check on the adequacy of the groundwater monitoring analyte list.

3.6 Leachate Pond Operation and Monitoring

Operation and monitoring of the leachate pond is subject to the operating standards for surface impoundment (WAC 173-350-330(4)). These regulations require leak detection monitoring for impoundments such as the OVSL leachate pond that are equipped with a leak detection system.

The presence of fluid in the leak detection system of the leachate pond has been checked on a weekly basis. In the event that fluid is present in the leak detection system, it is pumped out and the volume of fluid removed is recorded. Pursuant to this Plan, in the future when pumping occurs, a sample will be collected for water quality analysis. In the event that leachate is removed from the sump on more than one occasion in a quarter, only one sample need be collected during each quarter.

Samples collected from the leak detection system will be analyzed for the Appendix II parameters. The results of the sample analyses will be qualitatively compared to the water quality data obtained from the leachate influent and OBWL-TD (if sufficient flow is present to allow for collection of a sample) samples to assess the possible source of the fluid (condensation, rainwater infiltration, or pond leakage) present in the leak detection system. If it is determined that the fluid present in the leak detection system could be a result of leakage from the pond, Waste Management will prepare a work plan to present operational modifications proposed to address such leakage and/or additional investigations to assess the source of such leakage.

4 SOIL GAS

Monitoring for the presence of landfill gas outside of the waste management unit (hereafter referred to as soil gas) is required pursuant to the solid waste regulations (WAC 173-351-200(4)) to assess the protectiveness of the Site. Collection and containment of landfill gas to restrict gas migration from the waste management unit is performed through operation of the landfill gas extraction and collection system. Upgrades and operational modifications were recently implemented to improve the performance of the landfill gas extraction and collection system. Soil gas monitoring provides data related to the effectiveness of these activities in restricting migration of landfill gas from the waste management unit. In addition, to the extent that groundwater contamination at the Site is a result of gas-to-water migration, soil gas monitoring may provide information on possible sources of groundwater contamination.

4.1 Soil Gas Occurrences and Quality

Landfill gas (methane and carbon dioxide) is present within the landfill mass as a result of decomposition of the waste materials. A landfill gas extraction system was installed and is operated within the landfill to reduce the potential for gas accumulation and migration. The extracted gas is used in the leachate evaporator or is destroyed in the flare system.

Although the landfill gas system has been in operation during the period of active landfill operation and subsequently after closure of the landfill, based on monitoring results it has not eliminated gas migration from the landfill mass. Specifically, landfill gas has been detected in gas probes located to the north and west of the landfill, in particular gas probe GP-15. Repairs, modifications and improvements to the landfill gas extraction system and related operations were implemented in 2007 and 2008 to reduce the potential for migration. The most recent monitoring data (fourth quarter 2008) obtained from probe GP-15 indicate that gas levels have declined significantly in this area and are now below performance standards.

4.2 Soil Gas Performance Standards and Point of Compliance

The solid waste regulations (WAC 173-351-200(4)(a)) require the following:

1. The concentration of methane gas cannot exceed 25% of the lower explosive limit (LEL) in facility structures;

2. The concentration of methane gas cannot exceed the LEL at the property boundary or beyond; and

3. The concentration of methane gas cannot exceed 100 parts per million (ppm) by volume in any offsite structures.

4.3 Soil Gas Monitoring Points

A total of 17 gas monitoring probes, installed around the landfill mass, are used to monitor for the presence of landfill gas (Figure 6). Many of these probes consist of clustered probes completed at varying depths at the same location (Table 5). Soil gas monitoring will continue to be performed from these 17 gas probes.

The potential for occurrences of explosive gases within the various facility structures (all of which were unoccupied) was evaluated by performance of regular monitoring of these structures. The seven buildings that have been checked and the sample locations within each include the

- Maintenance Building (MB-Of, MB-Ba, and MB-Sh)
- Weld Shop (WS-R1, WS-Of, and WS-R2)
- Old Toll Booth (OldTB)
- Scale House (SH-SS, SH-NS, and SH-In)
- Main Pump House (MN-Wh)
- South Slope Pump House (SS-Wh)
- Wash Rack Shed (WR-Sh)

With the exception of the Scale House and the South Slope Pump House, the remainder of these structures were recently demolished. Therefore, monitoring will only be performed at the Scale House and the South Slope Pump House in the future, unless and until these buildings are removed.

4.4 Soil Gas Monitoring Parameters

Landfill gas probes are monitored for barometric pressure, methane, carbon dioxide, and oxygen. In addition, the presence of water, and if present, the depth to water are measured at each probe location. Facility structures are monitored for barometric pressure, methane, carbon dioxide and oxygen.

4.5 Soil Gas Monitoring Frequency

Soil gas monitoring is performed on a quarterly basis in accordance with the solid waste regulations (WAC 173-351-200(4)(b)(i)).

4.6 Soil Gas Data Evaluation and Analysis

Results of the soil gas monitoring are tabulated and compared to the operational standards set forth in the solid waste regulations as described above. If the results of the soil gas monitoring indicated that the levels of landfill gases present in the soil gas probes and buildings meet the standards set forth in the solid waste regulations (described above), then it can be concluded that the landfill gas extraction and collection system operation is effective in restricting gas migration from the waste management unit.

In the event that landfill gas components are detected in one or more of the gas probes or in one or more of the buildings at levels above the standards set forth in the solid waste regulations, additional evaluations will be conducted. These additional evaluations may include examination of the applied vacuum and gas flow rate from the gas extraction wells located in the area of the gas probe or building containing gas levels above the standards, re-sampling of the gas probe or building, or other activities. As most of the gas probes are not located at the property boundary, the presence of gas in one or more of the gas probes at levels above the standard does not necessarily result in a condition of non-compliance with the solid waste regulations. The magnitude of the gas occurrence combined with the distance between the subject gas probe and the property boundary will be evaluated to assess the potential for gas occurrences at levels above the standard to occur at the property boundary. Depending upon the severity of the gas levels and proximity to the property boundary, an additional gas probe(s) may be installed along the property boundary to provide data for assessment of compliance with the solid waste standards.

5 REPORTING

The results of the monitoring activities will be presented in periodic (quarterly or semi-annual) monitoring reports to be prepared upon receipt of the laboratory analytical results for each monitoring event. Reporting will include the requirements set forth in the Solid Waste Regulations (WAC 173-351-415).

Quarterly reports will include the following information:

1. Dates of monitoring activities;
2. Summary of monitoring wells, leachate sampling points, and soil gas probe conditions;
3. Tabulated depth to water measurements and calculated water level elevations for each groundwater monitoring well;
4. Potentiometric surface map;
5. Overall rate(s) and direction(s) of groundwater flow beneath the Site;
6. Isopleth maps initially for specific conductance, iron, manganese, cis-1,2-dichloroethene, and vinyl chloride but subject to change each year based on Ecology's review of the prior year annual report;
7. Tabulated summary of analytical results for parameters detected above the method detection limit in each groundwater monitoring well including data qualifiers as appropriate;
8. Tabular summary of analytical results reportedly detected in any groundwater monitoring well at a concentration greater than the cleanup standard;
9. Tabular summary of prediction limit exceedances for both Appendix I and II inorganics and trace metals;
10. Cation-anion balance;
11. Trilinear/Stiff diagrams;
12. Tabular summary of leachate influent monitoring results;
13. Tabular summary of the dates and volumes of fluid removed from the leachate pond leak detection system;
14. Tabular summary of the results of samples, if any, obtained from fluid removed from the leachate pond leak detection system;
15. Copies of field data sheets (e.g., well purge records);
16. Copy of the analytical laboratory reports; and
17. Tabular summary of landfill gas monitoring (gas probe and building) results obtained during the quarter.

An annual monitoring report will be also prepared that presents the above items for the last monitoring event of the preceding year and includes the following additional items:

1. A brief summary of groundwater flow rates and directions for the year, noting any trends or changes;

2. Discussion of landfill gas occurrences detected outside of the landfill footprint (soil gas) if any, evaluation of possible correlation, if any, of VOC occurrences in groundwater with report occurrences of soil gas;
3. A summary geochemical evaluation noting any changes or trends in the cation-anion balances, trilinear diagrams and general water chemistry for each well;
4. Discussion on how natural attenuation is observed;
5. Report of annual leachate volumes and discussion of leachate volume trends over time;
6. Updated calculations of background prediction limits for Appendix I and II inorganic parameters and trace metals;
7. Results of statistical comparisons of groundwater quality results to background levels and cleanup standards;
8. Summary tables including tabulations of the following:
    a. Groundwater well construction details for all wells monitored,
    b. Summary of groundwater and leachate influent analytical parameters by quarterly or semi-annual monitoring event,
    c. Summary tabulation of all groundwater elevation measurements performed during the year,
    d. Groundwater and leachate influent analytical results and field parameters,
    e. Groundwater and leachate influent volatile organic compound detections,
    f. Tabular summary of groundwater analytical results for Appendix I and II inorganic parameters and trace metals that exceed the background prediction limits,
    g. Tabular summary of groundwater analytical results that exceed WAC 173-200, Federal MCLs or the MTCA groundwater cleanup levels by monitoring event,
    h. Summary table of wells and parameters for which increasing or decreasing trends are identified,
    i. Tabular summary of quarterly landfill gas monitoring results,
    j. Tabular summary of storm water analytical results and field parameters,
9. Figures including the following:
    a. Potentiometric maps for each set of site-wide water level data obtained during the year;
    b. Graph of leachate volume over time, and
10. Appendices including the following:
    a. Well hydrographs updated to include the water level measurement data obtained over the preceding year,
    b. Groundwater Sampling Instrument Calibration Documentation Forms and Records of Water Level Readings for the year's monitoring event (except for those provide in the quarterly monitoring reports),
    c. Storm Water Visual Inspection/Sampling Forms, Field Information Forms and Instrument Calibration Documentation,
    d. Final yearly monitoring event (fourth quarter or second semi-annual event) Groundwater Geochemical Results (Cation/Anion Balances, Piper Diagrams, and Stiff Diagrams), and
    e. Statistical evaluations to include the following:

i. Updated background prediction limit calculations for inorganics and trace metals based on the years monitoring results,
ii. Summary comparison of the years analytical results to the updated prediction limit values showing which locations and parameters exceeded background prediction limits,
iii. Water quality time series graphs for constituents that exceed a cleanup standard, prediction limit or a groundwater standard, for which a statistical meaningful trend is identified (separate graphs for each parameter and well), and
iv. Results of MTCAStat evaluations of compliance and downgradient monitoring well water quality results to the groundwater cleanup levels.

f. Other items and documentation as necessary to support the text, tables or figures of the report.

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Tables

Table 1: Groundwater Cleanup Standards (Preliminary)

Chemical [1]	Units [2]	Federal and State MCL [3]	Groundwater Quality Standards [4]	MTCA Methd B Levels [5]		Background Prediction Limit [6]	Groundwater Cleanup Standard [7]
				1×10^{-6} Cancer Risk	Noncancer Risk (HQ = 1)		
Trace metals							
Arsenic	mg/l	0.010	0.00005	0.000058	0.0048	0.00046 *	0.00046
Iron	mg/l	0.3	0.30	N.E.	N.E.	0.23	0.3
Manganese	mg/l	0.05	0.050	N.E.	2.2	0.031	0.05
Volatile Organic Compounds							
cis-1,2-dichloroethene	ug/l	70	70	N.E.	80	NA	70
ethyl ether	ug/l	N.E.	N.E.	N.E.	1600	NA	1600
trichloroethene	ug/l	5	3	0.49	2.4	NA	0.49
vinyl chloride	ug/l	2	0.02	0.029	24	NA	0.02
Other							
Ammonia	mg/l	N.E.	N.E.	N.E.	N.E.	0.19	0.19

Notes:

1 Only those chemicals identified as Indicator Hazardous Substances in the Human Health Risk Assessment are listed. In the event that other chemicals are detected, cleanup standards will be developed for such chemicals using the same approach presented above.

2 mg/l = milligrams per liter ug/l = micrograms per liter

3 MCL = maximum contaminant level as either a primary or secondary drinking water standard.

4 Per W.A.C. 173-200

5 MTCA Method B Levels based on values calculated using CLARC Database 2008

6 Background values are based on 95% upper prediction limt as presented in the 2008 Annual Monitoring Report, Olympic View Sanitary Landfill prepared by SCS Engineers March 26, 2009.

7 Cleanup standard represents the most restrictive (lowest) of the values presented.

* Site background calculated at 0.00046 mg/l based on using only low-level detection limit (EPA Method 200.8) data from upgradient wells.

N.E. Not established

NA Not applicable; background for volatile organics is assumed to be zero, therefore no prediction limits are calculated.

Table 2: Summary of Rationale for Inclusion or Exclusion of Existing Monitoring Wells in the Groundwater Monitoring Network

Well ID	Total Depth (ft-bgs)	Top of Screen Elevation (ft-msl)	Screen Length (ft)	Hydraulic Location Relative to the Landfill [1]	Current Use [2]	Prior Water Quality Results [3]	Include in Network ?	Intended Use for Monitoring Data [4]	Rationale for Inclusion or Exclusion [5]
MW-1	180	NA	NA	NA	Supply well	pH, As*	No	-	Located within waste unit boundary
MW-2A1	38	143	10	downgradient	GW Level	not sampled	No	-	Shallower well at same location included in network
MW-2B1	18	163	10	downgradient	GW Quality	pH, As, Fe, Mn, VC, VOC	Yes	Performance	Downgradient of Phase I/OBWL; prior water quality
MW-4	34	149	10	downgradient	GW Quality	pH, As, VC, VOC	Yes	Performance	Downgradient of /OBWL; prior water quality
MW-5	14	159.5	10	downgradient	GW Level	not sampled	No	-	Located in same area as MW-20
MW-9	24	140	5	downgradient	GW Quality	As, Fe	Yes	Downgradient	To be replaced by new downgradient well
MW-10	17.5	142	5	downgradient	GW Level	not sampled	No	-	Located in same area as MW-29A and MW-32
MW-11	22	137	5	downgradient	GW Level	not sampled	No	-	Located in same area as MW-29A and MW-32
MW-12	70	183	20	downgradient	GW Level	not sampled	No	-	Well is not downgradient of landfill
MW-13	40	256	10	upgradient	GW Quality	pH	No	-	Shallow with very high water level possibly reflective of local recharge rather than regional conditions
MW-13A	155	141	10	upgradient	GW Quality	As	Yes	Background	Existing upgradient (background) well
MW-13B	260	36	10	upgradient	GW Quality	As	Yes	Background	Existing upgradient (background) well
MW-14	80	151	5	crossgradient	GW Level	not sampled	No	-	Sufficient other background wells available
MW-15R	33	157	10	downgradient	GW Quality	pH, As, VC, VOC	Yes	Compliance	Downgradient of MW-24; prior water quality
MW-16	70	178	10	crossgradient	GW Level	not sampled	Yes	Background	Included to increase background spatial coverage
MW-17	54	163	10	crossgradient	GW Level	not sampled	No	-	Well is not downgradient of landfill
MW-18	75	199	15	crossgradient	GW Level	not sampled	No	-	Well is not downgradient of landfill
MW-19A	45.5	165	15	downgradient	GW Level	not sampled	No		Downgradient of Phase I/OBWL; prior water quality
MW-19B	59.5	146	10	downgradient	GW Level	not sampled	No	-	Shallower well at same location included in network
MW-19C	90	111	5	downgradient	GW Quality	pH, As, Mn, VC, VOC	Yes	Performance	Downgradient of Phase I/OBWL; prior water quality
MW-19D	143	61	10	downgradient	GW Quality	pH, As, VOC	No	-	Shallower well at same location included in network
MW-20	49	165	15	downgradient	GW Quality	pH, As, Mn, VC, VOC	Yes	Performance	Downgradient of Phase I and OBWL
MW-21	15	150	10	downgradient	GW Quality	not sampled	No	-	Downgradient of Phase I and OBWL
MW-23A	23	172	15	downgradient	GW Quality	pH, As, Fe, Mn, VC, VOC	Yes	Performance	Downgradient of Phase II; prior water quality
MW-23B	60	130	10	downgradient	GW Quality	pH, As, VC	No	-	Shallower well at same location included in network
MW-23C	114	76	10	downgradient	GW Quality	pH, As	No	-	Shallower well at same location included in network
MW-24	42	176	15	downgradient	GW Quality	pH, As, Fe, Mn, VC, 1,1-DCA, VOC	Yes	Performance	Downgradient of Phase II; prior water quality
MW-26	25.5	178	15	crossgradient	GW Level	not sampled	No	-	Well is not downgradient of landfill

Table 2: Summary of Rationale for Inclusion or Exclusion of Existing Monitoring Wells in the Groundwater Monitoring Network

Well ID	Total Depth (ft-bgs)	Top of Screen Elevation (ft-msl)	Screen Length (ft)	Hydraulic Location Relative to the Landfill [1]	Current Use [2]	Prior Water Quality Results [3]	Include in Network ?	Intended Use for Monitoring Data [4]	Rationale for Inclusion or Exclusion [5]
MW-27	32.5	182	15	crossgradient	GW Level	not sampled	No	-	Well is not downgradient of landfill
MW-28	15	174.5	10	crossgradient	GW Level	not sampled	No	-	Well is not downgradient of landfill
MW-29A	25	140	5	downgradient	GW Quality	pH, As, Fe, Mn	Yes	Downgradient	Downgradient of MW-19 cluster; prior water quality
MW-29B	65	110	15	downgradient	GW Level	not sampled	No	-	Shallower well at same location included in network
MW-29C	50	111	5	downgradient	GW Quality	pH, As, Mn	No	-	Shallower well at same location included in network
MW-30A	35	136	5	downgradient	GW Quality	pH, As	No	-	Downgradient of MW-19A and -29A which are in the network
MW-30B	86	84	5	downgradient	GW Level	not sampled	No	-	Downgradient of MW-19A and -29A which are in the network
MW-31	20	136	10	downgradient	GW Level	not sampled	No	-	Downgradient of MW-32
MW-32	21	135	5	downgradient	GW Quality	pH, As, Fe, Mn, VC, VOC	Yes	Downgradient	Downgradient of MW-19 and -20; prior water quality
MW-33A	20	140	15	downgradient	GW Quality	pH, As, Fe, Mn	Yes	Downgradient	Downgradient of MW-19, -20 & -32; prior water quality
MW-33B	40	114	10	downgradient	GW Level	not sampled	No	-	Shallower well at same location included in network
MW-33C	65	89	10	downgradient	GW Quality	not sampled	Yes	Downgradient	Shallower well at same location included in network
MW-34A	48	168	20	downgradient	GW Quality	pH, As, VC	Yes	Compliance	Deeper well at same location contains higher levels of VOCs
MW-34B	208	-1	10	downgradient	GW Quality	pH, As	No	-	Deeper well at same location included in network
MW-34C	98	114	15	downgradient	GW Quality	pH, As, Fe, Mn, VC, VOC	Yes	Compliance	Downgradient of MW-2 cluster; prior water quality
MW-35	149	161	10	upgradient	GW Quality	As	Yes	Background	Existing upgradient (background) well
MW-36	100	96	9	downgradient	GW Quality	As	No	-	New well at same location to be included in network
MW-36A	33	159.43	5	downgradient	new well		Yes	Downgradient	Shallow well downgradient of Phase I and II cells and OBWL
MW-37	9	139	5	downgradient	GW Quality	pH, As, Fe, Mn, VOC	No	-	Very shallow well; water quality reflects wetlands VOCs have only been detected infrequently at levels below GW standards
MW-38	47	110	10	downgradient	GW Quality	As, Fe, Mn	No	-	Located in the same area as MW-32
MW-39	25	174	10	downgradient	GW Quality	pH, As, Fe, Mn,	Yes	Compliance	Downgradient of Phase II; prior water quality
MW-40A	24.4	160	5	crossgradient	GW Quality	pH	No	-	Well is not downgradient of landfill
MW-40B	67	118	5	crossgradient	GW Quality	pH, As, Mn	No	-	Well is not downgradient of landfill
MW-40C	103.7	82	5	crossgradient	GW Quality	pH, As	No	-	Well is not downgradient of landfill
MW-41A	35.7	168	5	crossgradient	GW Quality	pH, Mn	No	-	Well is not downgradient of landfill
MW-41B	79	126	5	crossgradient	GW Quality	pH, As	No	-	Well is not downgradient of landfill

Table 2: Summary of Rationale for Inclusion or Exclusion of Existing Monitoring Wells in the Groundwater Monitoring Network

Well ID	Total Depth (ft-bgs)	Top of Screen Elevation (ft-msl)	Screen Length (ft)	Hydraulic Location Relative to the Landfill [1]	Current Use [2]	Prior Water Quality Results [3]	Include in Network ?	Intended Use for Monitoring Data [4]	Rationale for Inclusion or Exclusion [5]
MW-41C	117	87	5	crossgradient	GW Quality	pH, As	No	-	Well is not downgradient of landfill
MW-42	30	161.42	5	downgradient	new well		Yes	Compliance	Shallow well downgradient of OBWL
MW-43	50	147.68	5	downgradient	new well		Yes	Compliance	Shallow well downgradient of OBWL
P-1	57.5	231.50	7.5	upgradient	GW Level	not sampled	No	-	Sufficient other upgradient wells available
P-9	36	179	5	crossgradient	GW Level	not sampled	No	-	Well is not downgradient of landfill

Notes:

1 Hydraulic location relative to the landfill refers to whether the well is located upgradient, downgradient, or cross-gradient (lateral) of the landfill mass.

2 Current use refers to whether the well is currently being used for water quality monitoring, for only water level monitoring or for water supply.

3 Summary of prior water quality data is based on results obtained from the twelve quarters of monitoring obtained in 2005, 2006, and 2007.
Parameters listed in this column represent those parameters reported to be present at concentrations greater than the Federal Maximum Contaminant Levels or the W.A.C. 173-200 Groundwater Quality Standards or MTCA Method B levels or represent reported detections of other volatile organic compounds (VOCs) at levels below MCLs and W.A.C. 173-200 standards.
Only those compounds that were reported at concentrations greater than MCLs or W.A.C. 173-200 standards at least twice over the 12 quarters of monitoring are listed. In the case of other VOCs, the VOC identifier is applied in instances where other VOCs were reportedly detected at least twice over the 12 quarters of monitoring.

- pH pH (acidity)
- As arsenic
- Fe iron
- Mn managanese
- VC vinyl chloride
- VOC other volatile organic compounds reportedly detected at least twice but at levels below MCLs and W.A.C. 173-200 stnadards.
- * well was only sampled once over the last 12 quarters.

4 Intended use of the water quality data to be obtained from wells included in the monitoirng network
- Compliance - data to be used to assess compliance with groundwater cleanup standards
- Performance - data to be used to assess the performance (effectiveness) of corrective measures implemented at the Site.
- Downgradient - data to be used to assess changes in downgradient groundwater quality and compliance with cleanup standards
- Upgradient - data to be used to assess upgradient (background) groundwater quality

5 Rationale for inclusion or exclusion of specific wells
- OBWL Old Barney White Landfill

Table 3: Summary of Well Construction Information for Groundwater Monitoring Well Network

Well ID	Northing	Easting	Reference Elevation (ft-msl)	Total Depth (ft-bgs)	Top of Screen Elevation (ft-msl)	Bottom of Screen Elevation (ft-msl)	Screen Length (ft)
Compliance Monitoring Wells							
MW-15R	189905.03	1157711.29	180.66	33	157	147	10
MW-34A	189391.16	1156929.63	197.95	48	168	148	20
MW-34C	189391.16	1156943.77	199.89	98	114	99	15
MW-39	190362.60	1158325.32	189.92	25	174	164	10
MW-42	188407.6	1156636.6	186.42	30	161.42	156.42	5
MW-43	189754.1	1156935.2	192.68	50	147.68	142.68	5
Performance Monitoring Wells							
MW-2B1	189232.23	1157544.63	172.94	18	163	153	10
MW-4	188298.52	1156887.57	175.78	34	149	139	10
MW-19C	188520.03	1157025.96	196.96	90	111	106	5
MW-20	188850.01	1157062.68	198.41	49	165	150	15
MW-23A	189485.84	1158085.12	182.28	23	172	157	15
MW-24	189795.14	1158383.22	208.24	42	176	161	15
Downgradient Monitoirng Wells							
MW-9	188298.84	1156337.75	160.34	24	140	135	5
MW-29A	188570.27	1156121.60	160.21	25	140	135	5
MW-32	188908.88	1156388.52	152.36	21	135	130	5
MW-33A	189304.18	1155636.34	147.68	20	140	125	15
MW-33C	189284.18	1155636.34	147.59	65	89	79	10
MW-36A	188690.5	1156617.9	187.43	33	189.43	154.43	5
Upgradient Wells							
MW-13A	188233.33	1159346.53	288.74	155	141	131	10
MW-13B	188223.33	1159346.53	288.66	260	36	26	10
MW-16 *	190804.53	1159350.37	240.01	70	178	168	10
MW-35	188917.42	1159762.03	302.69	149	161	151	10

tbd - to be determined as this is a new well that has not yet been drilled.

* subject to inspection of well condition; alternatively MW-26, -27, or -28 may be used instead.

Table 4: Summary of Monitoring Well Sampling Frequency and Analytical Testing

Well/Leachate	Appendix I and II and Appdx III adds*	Appendix III	Appendix IV
Compliance			
39	Quarterly		
15R	Quarterly	5 years	
34A	Quarterly		
34C	Quarterly	5 years	
42	Quarterly	**	
43	Quarterly	**	
Performance			
24	Quarterly	3 years	
23A	Quarterly		
2B1	Quarterly	3 years	
20	Quarterly		
19C	Quarterly	3 years	
4	Quarterly		
Downgradient			
36A	Quarterly		
33A	Semi-annual		
33C	Quarterly		
32	Quarterly	[Initial sampling until new POC wells MW-42 and MW-43 have enough data to select one as a replacement for MW-32]	
29A	Semi-annual		
9	Semi-annual***		
Upgradient			
13A	Quarterly		
13B	Quarterly		
35	Quarterly		
16	Quarterly		
Leachate			
Influent (L-INF)	Annually	3 years	Annually
OBWL-TD	Annually	3 years	Annually
Leak Detection	Quarterly****		

* The routine (quarterly and semi-annual) sampling will also include any additional constituents detected by the Appendix III analyses.

** One of the new wells will be selected for appendix III testing once enough data are available to select one

*** Well MW-9 will be sampled until such time as new well MW-43 has been installed and sampled enough times (minimum four) to provide sufficient data to determine if it is a suitable replacement for well MW-9.

**** If the amount of liquid removed from the leak detection system is sufficient to allow for collection of a sample for Appendix II analyses.

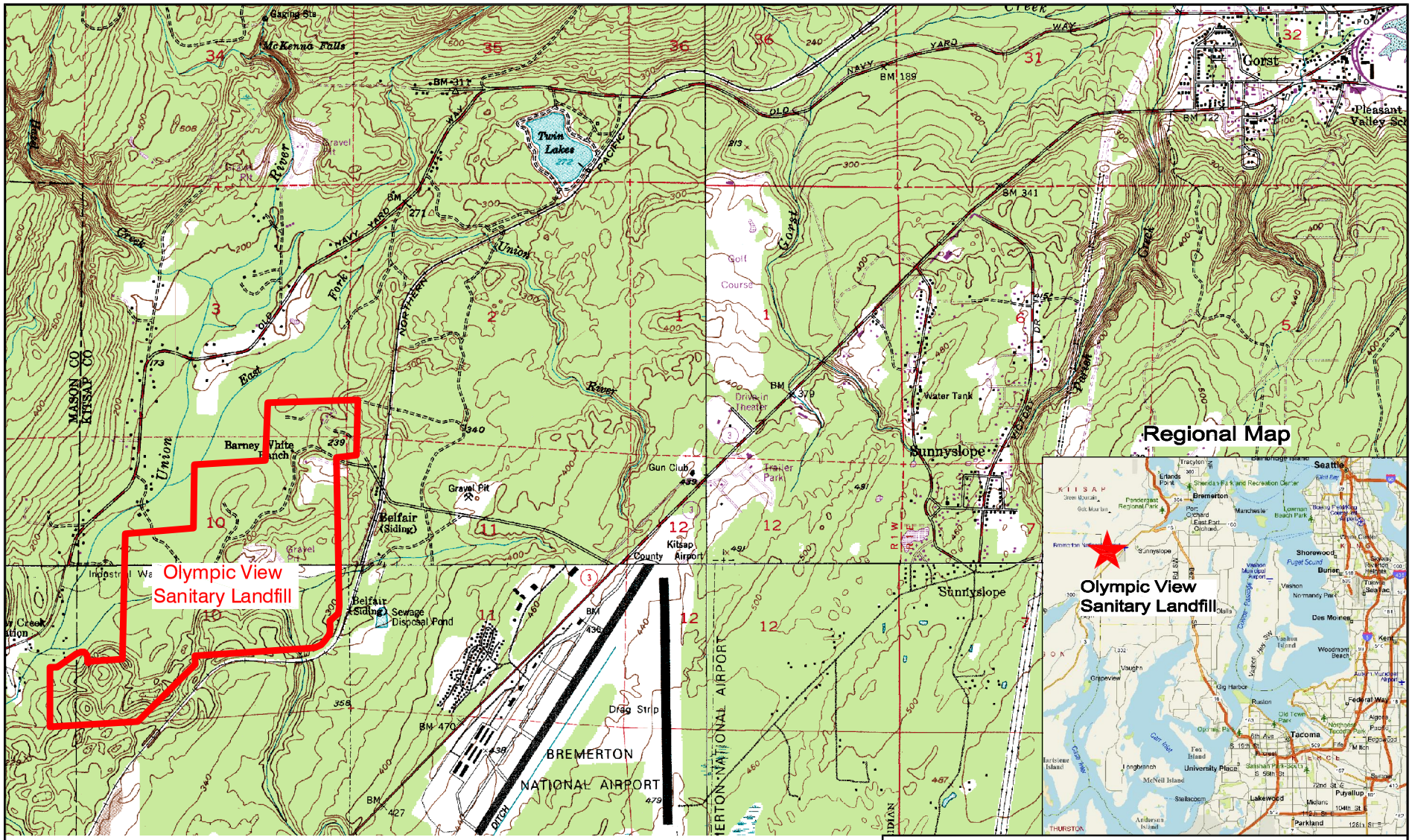
Table 5: Summary of Gas Probe Construction Information

Probe Name	October 2005 Survey Data				TD	TOS	TOSE	BOS	BOSE
	East	North	TOCE	GSE	(btoc)	(btoc)		(btoc)	
GP-7	1156086.18	188579.45	166.70	163.2	15.6	10.6	156.1	15.6	151.1
GP-7B	1156257.18	188531.93	NA	165	NA	NA	NA	NA	NA
GP-8	1156888.30	188346.45	184.16	183.9	17.8	12.8	171.4	17.8	166.4
GP-8B	1156890.48	188160.04	NA	172	NA	NA	NA	NA	NA
GP-9s	1157909.88	187872.26	208.75	206.5	16.5	11.5	197.3	16.5	192.3
GP-9d	1157909.88	187872.26	209.13	206.5	31.3	26.3	182.8	31.3	177.8
GP-10s	1158789.55	187762.91	272.59	269.7	18.0	13.0	259.6	18.0	254.6
GP-10d	1158789.55	187762.91	272.84	269.7	29.1	24.1	248.7	29.1	243.7
GP-11s	1159385.58	188231.10	292.34	289.8	15.3	10.3	282.0	15.3	277.0
GP-11d	1159385.58	188231.10	292.82	289.8	30.3	25.3	267.5	30.3	262.5
GP-12s	1159422.17	189223.78	259.80	258.4	16.4	11.4	248.4	16.4	243.4
GP-12m	1159422.17	189223.78	259.84	258.4	36.6	31.6	228.2	36.6	223.2
GP-12d	1159422.17	189223.78	260.48	258.4	50.4	45.4	215.1	50.4	210.1
GP-13s	1159229.63	190199.58	230.93	229.0	17.1	12.1	218.8	17.1	213.8
GP-13m	1159229.63	190199.58	231.01	229.0	38.5	33.5	197.5	38.5	192.5
GP-13d	1159229.63	190199.58	231.35	229.0	55.2	50.2	181.1	55.2	176.1
GP-14	1158375.85	190514.41	193.44	190.9	15.4	10.4	183.0	15.4	178.0
GP-14B	1158318.34	190495.29	NA	180	NA	NA	NA	NA	NA
GP-15	1158179.88	189689.74	191.91	188.6	15.4	10.4	181.5	15.4	176.5
GP-16	1157099.67	188944.73	180.45	177.8	15.2	10.2	170.3	15.2	165.3

s shallow probe
m intermediate probe
d deep probe
TOCE top of PVC elevation (feet)
GSE ground surface elevation (feet)
TD total depth of boring (feet)
btoc below top of PVC
TD total depth (feet)
TOS depth to top of screen (feet)
TOSE top of screen elevation (feet)
BOS depth to bottom of screen (feet)
BOSE bottom of screen elevation (feet)

Figures

M:\clients\EMSI\Waste-Man-OVSL\Parametrix\BL2982003P06T04F2-1 11-9-07\Site-Fig-1.dwg plotted: 01/06/2009



WASHINGTON

Vicinity Map

Figure 1

Site Location Map
Kitsap County, Washington

Olympic View Sanitary Landfill

EMSI Engineering Management Support, Inc.

EAST FORK UNION RIVER

UNION RIVER

STORMWATER DETENTION POND A

STORMWATER DETENTION POND B/C

WETLAND B

WETLAND C

WETLAND D

FORMER NORTH BORROW

FORMER LEACHATE LAGOONS

DETENTION POND D

TRUCK LOADOUT HUT

OLD BARNEY WHITE LANDFILL (UNLINED BOTTOM)

PHASE II STAGE B3

PHASE II STAGE B1

PHASE II STAGE B2

PHASE II STAGE A

PHASE I STAGE B1

PHASE I STAGE A

PHASE I STAGE B

PHASE I STAGE C

BARNEY WHITE REGIONAL INFILTRATION/DETENTION FACILITY

TRANSFER STATION

TRANSFER AND STORAGE WAREHOUSES

WEST BORROW

OLD PUMP STATION

LEACHATE AERATION LAGOON

FLARE FACILITY AND LEACHATE EVAPORATOR

SOUTH BORROW

TRIBUTARY 512

FORMER LEACHATE SPRAY IRRIGATION

SOUTH SLOPE WELL PUMP HOUSE

PORT OF BREMERTON WASTEWATER PONDS

LANDFILL DEVELOPMENT PHASE BOUNDARY

Plan Area

Property Line

KEY MAP

NO SCALE

NOTES:

1. Contour data based on topographic survey data supplied by Space Imaging LLC & Kitsap County GIS Aerial Imagery, June 2001.
2. Additional property to south (see Key Map).

N

600 0 600

SCALE IN FEET

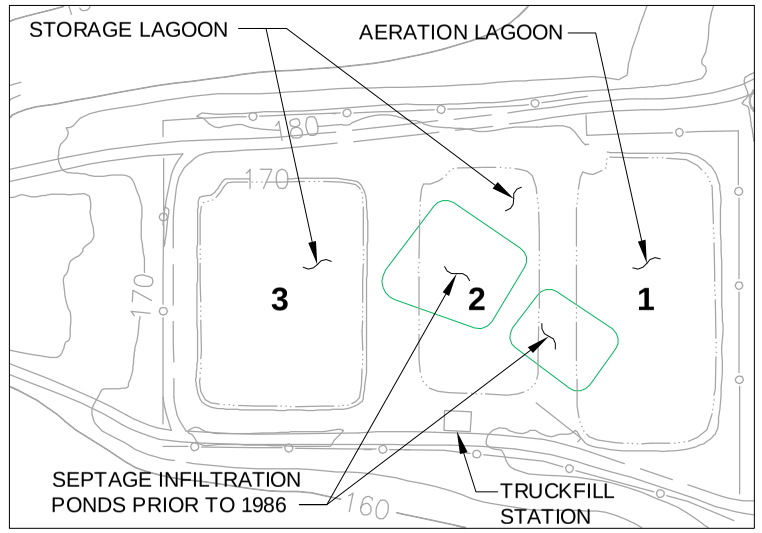
Figure 2

Overall Site Plan

Olympic View Sanitary Landfill

EMSI Engineering Management Support, Inc.

M:\CLIENTS\EMSI\WASTE-MAN-OVSL\PARAMETRIX\BL2982003P06T04F2-1 11-9-07\OVSL-FIG-2_8-09.DWG-11X17 FIGURE 08/27/2009 9:27AM

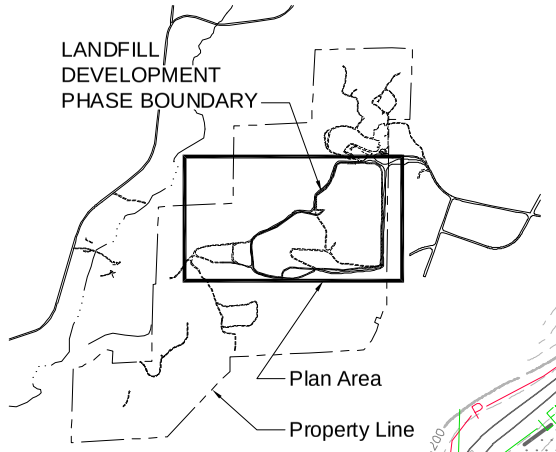


LEACHATE LAGOON AREA 1986 TO 1997

NOTES:

1. LeachateTransmission Pipe (LTP) was abandoned as part of the installation of Leachate Forcemain (LFM) HDPE system; however, the Leachate Toe Slope Collector System (LC) was connected to a new 2-inch HDPE pipe that was slipped with the LTP and leachate manholes and discharges at LM-5. As part of LFM and leachate manholes system, Leachate manholes (LM) No.1, 2, 3, and 4 were abandoned. Phase 1 Leachate was diverted around LM-1 to the new pump station.

2. Design Areas:
   - OLD - 20 Acres
   - PHASE I - 25 Acres
   - PHASE II - 20 Acres



KEY MAP
NO SCALE

LR-01
LR-02
LR-03
LR-04
ABANDONED LEACHATE PUMP STATION
PHASE II STAGE B3 [NA]
PHASE II STAGE B1 [NA]
PHASE II STAGE B2 [NA]
PHASE II STAGE A [187]
PHASE I STAGE BI [225]
PHASE I STAGE A [202]
PHASE I STAGE C [233]
PHASE I STAGE B [225]
OLD BARNEY WHITE LANDFILL (UNLINED BOTTOM) [190]
LCO-11
LCO-10
LCO-9
LCO-8
LCO-7
LCO-6
LCO-5
LCO-4
LCO-3
LCO-2
LCO-1
PROPERTY LINE, TYP.
POWER LINE (TYP.)
LM-1
LM-2
LM-3
LM-4
LM-5
L-INF
LEACHATE TRANSMISSION PIPE 1
LEACHATE MANHOLE, TYP. 1
LEACHATE TOE SLOPE COLLECTOR
LEACHATE AERATION LAGOON
TRUCKFILL STATION
PREVIOUS TRUCKFILL STATION
SEE INSET PLAN ABOVE FOR HISTORIC LEACHATE MANAGEMENT FACILITIES
FLARE FACILITY AND LEACHATE EVAPORATOR, SEE FIGURE 2-3
6"

LEGEND:

◎LM-5	Leachate Manhole	LC	Leachate Toe Slope Collection Pipe
○LM-2	Decommissioned Leachate Manhole	LCP	Leachate Collection Pipe
• LCO-1	Leachate Cleanout	LTP	Leachate Transmission Pipe (Decommissioned-In-Place)
[202]	Approximate Bottom Elevation	LFM	Leachate Force Main Pipe
P	Power Utility Vault	P	Underground Power Line
♦ L-INF	Leachate Influent Monitoring Station and Flow Meter		
◇ LR	Leachate Riser		
	Landfill Development Phase Boundary		
	Bottom Liner System		

N

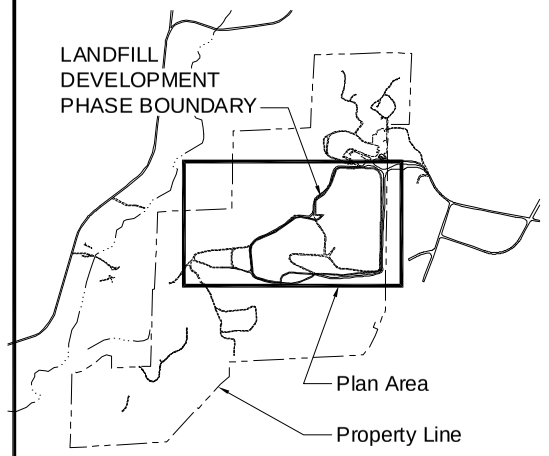
240 0 240

SCALE IN FEET

Figure 3
Leachate Collection System
Olympic View Sanitary Landfill

EMSI Engineering Management Support, Inc.

M:\CLIENTS\EMSI\WASTE-MAN-0\SL\PARAMETRIX\BL2982003P06T04F2-1 11-9-07\SITE-FIG-3.DWG-LAYOUT1 01/06/2009 2:38PM



KEY MAP

NO SCALE

LEACHATE AERATION LAGOON, SEE FIGURE 3

FLARE FACILITY AND LEACHATE EVAPORATOR

OLD BARNEY WHITE LANDFILL (UNLINED BOTTOM)

PHASE II STAGE B3

PHASE II STAGE B1

PHASE II STAGE B2

PHASE II STAGE A

PHASE I STAGE BI

PHASE I STAGE A

PHASE I STAGE B

PHASE I STAGE C

PROPERTY LINE, TYP.

LEGEND:

- GW-5 — Well Location
- LCO-2 (HC-7) — Horizontal Trench/LCO Location
- Condensate Knockout
- Isolation Valve
- LFG — Landfill Gas HDPE Pipe
- Flow Direction
- Landfill Development Phase Boundary
- Bottom Liner System

NOTES:

1. Landfill Gas System based on as-built data provided by Shaw Emcon/OWT, Issued August 2004.

Filenames: 2003asblts01.dwg, 2003asblts02.dwg, & 2003asblts16.dwg.

240 0 240

SCALE IN FEET

N

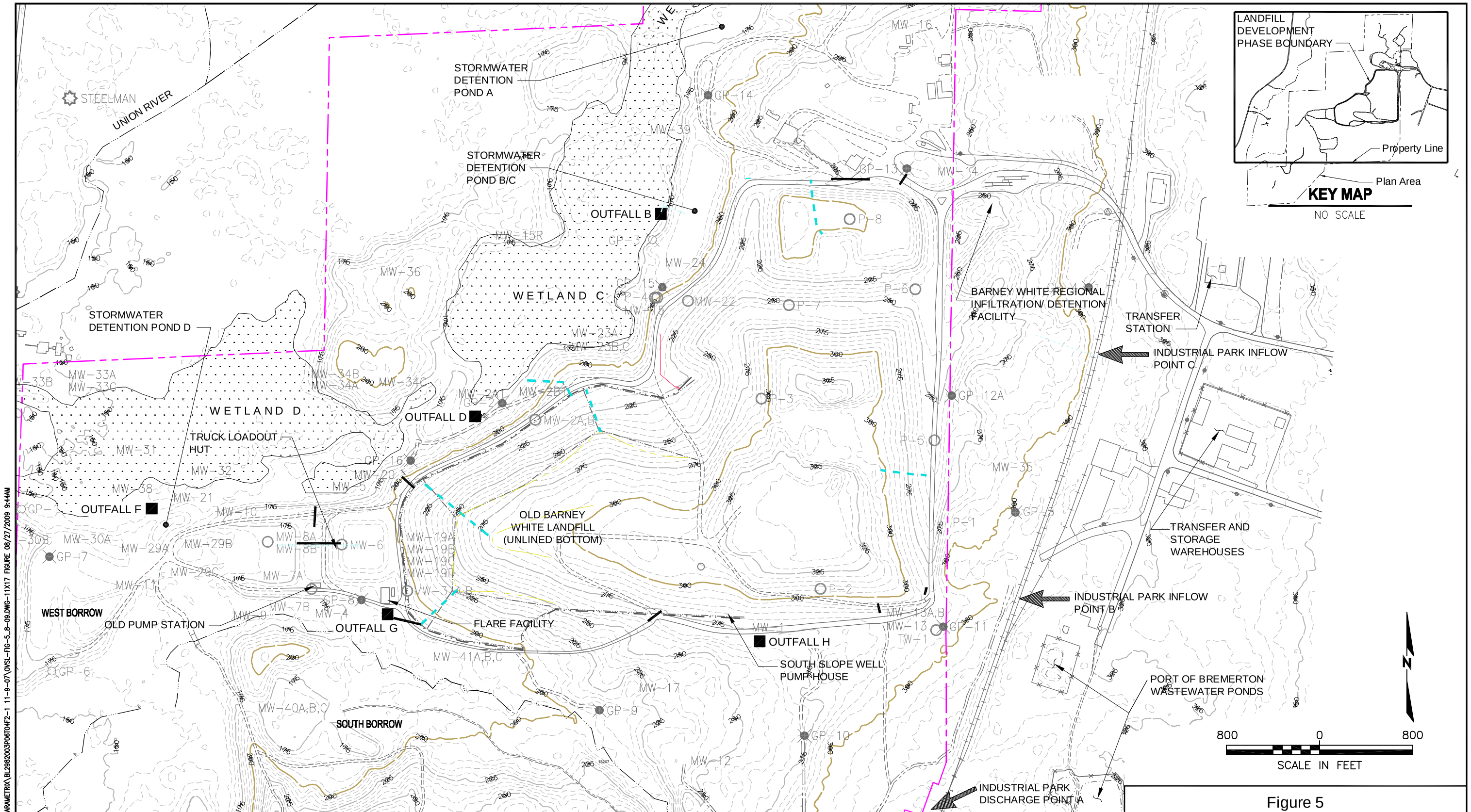
Figure 4

Landfill Gas Extraction System

Olympic View Sanitary Landfill

EMSI Engineering Management Support, Inc.

M:\CLIENTS\EMSI\WASTE-MAN-OVSL\PARAMETRIX\BL2982003P06T04F2-1 11-9-07\SITE-FIG-4.DWG-11X17 FIGURE 01/06/2009 2:56PM



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LEGEND:

MW-32	Monitoring Well or Piezometer
MW-15	Decommissioned Monitoring Well or Piezometer
SCOTT	Offsite Private Well
GP-15	Gas Probe
GP-6	Decommissioned Gas Probe
OUTFALL B	Stormwater Monitoring Outfall
	Off-Site Point Discharge
	Downchutes
	Ditch
	Conveyance Channels
	Culverts
	Property Line
	Landfill Development Phase Boundary
	Stream
	Access Road
	Railroad

NOTES:

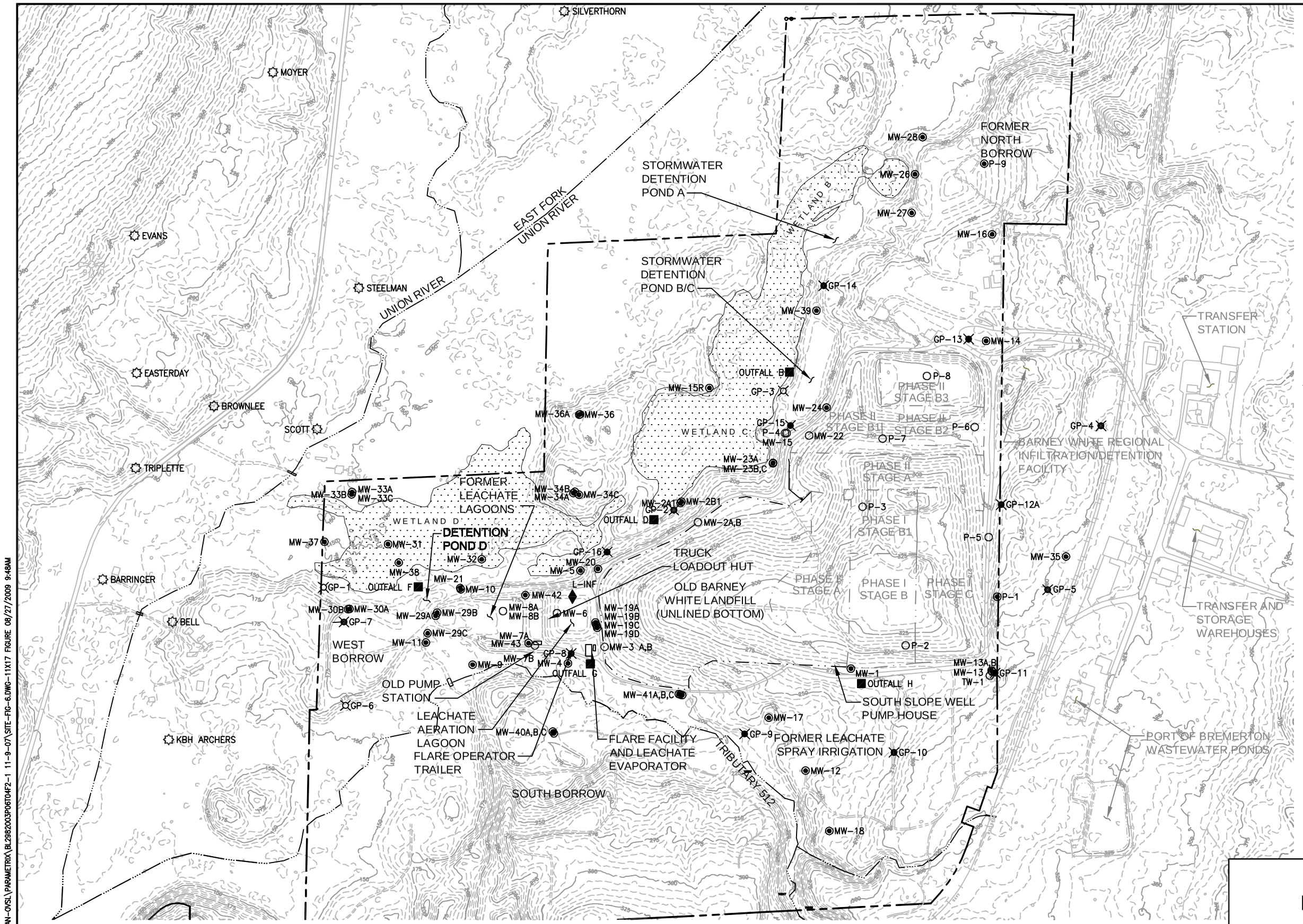
1. Contour data based on topographic survey data supplied by Space Imaging LLC & Kitsap County GIS Aerial Imagery, June 2001.
2. Additional property to south (see Key Map).

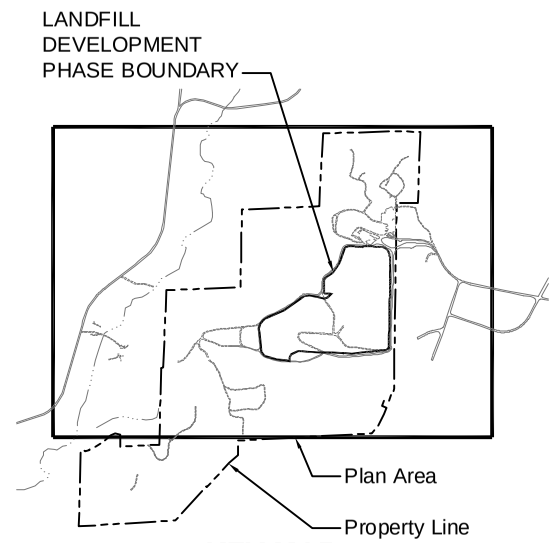
Figure 5

Stormwater Management Systems

Olympic View Sanitary Landfill

EMSI Engineering Management Support, Inc.





KEY MAP

NO SCALE

NOTES:

1. Contour data based on topographic survey data supplied by Space Imaging LLC & Kitsap County GIS Aerial Imagery, June 2001.
2. Additional property to south (see Key Map).

LEGEND:

MW-32	Monitoring Well or Piezometer
SCOTT	Offsite Private Well
MW-15	Decommissioned Monitoring Well or Piezometer
L-INF	Leachate Influent Monitoring Station
GP-15	Gas Probe
OUTFALL B	Stormwater Monitoring Outfall
	Property Line
	Landfill Development Phase Boundary
	Stream
	Access Road
	Railroad

Figure 6

Enviromental Monitoring Locations

Olympic View Sanitary Landfill

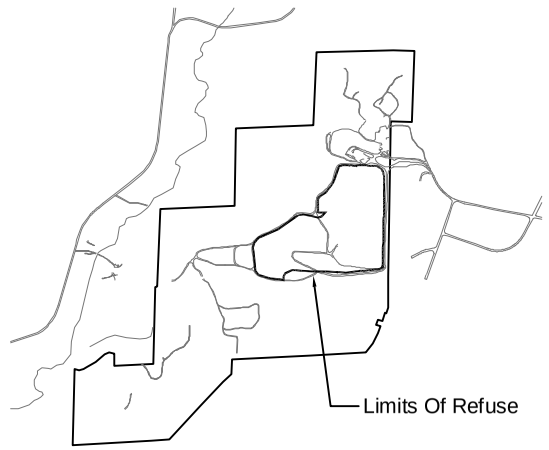
EMSI Engineering Management Support, Inc.

M:\CLIENTS\SMSI\WASTE-MAN-OVSL\PARAMETRIX\BL298200309T04F2-1 11-9-07\SITE-FIG-6.DWG-11X17 FIGURE 08/27/2009 9:48AM

Note:

Water level contours were generated using depth to water and measuring point elevation data from wells screened between 89 and 200 ft-msl and one stream gauge. The water level elevations for twelve wells have not been used to generate contours for the following reasons:

- Wells MW-13, MW-13B, MW-19D, MW-23C, MW-30B, MW-33C, MW-34B, MW-40C, MW-41C, and P-1 have screen elevations outside the 89 to 200 ft-msl range.
- Water levels were omitted for MW-11, and P-9.



KEY MAP

NO SCALE

LEGEND

- SG-UR 140.19 — STREAM GAUGE — WATER LEVEL ELEVATION, FT-MSL, DECEMBER 2007
- MW-17 173.63 — MONITORING WELL — WATER LEVEL ELEVATION, FT-MSL, DECEMBER 2007
- 180 — ESTIMATED GROUNDWATER ELEVATION CONTOUR IN FEET-MSL CONTOUR INTERVAL = 5 FT
- STORM WATER SAMPLING POINT
- GROUNDWATER FLOW DIRECTION

N

600 0 600

SCALE IN FEET

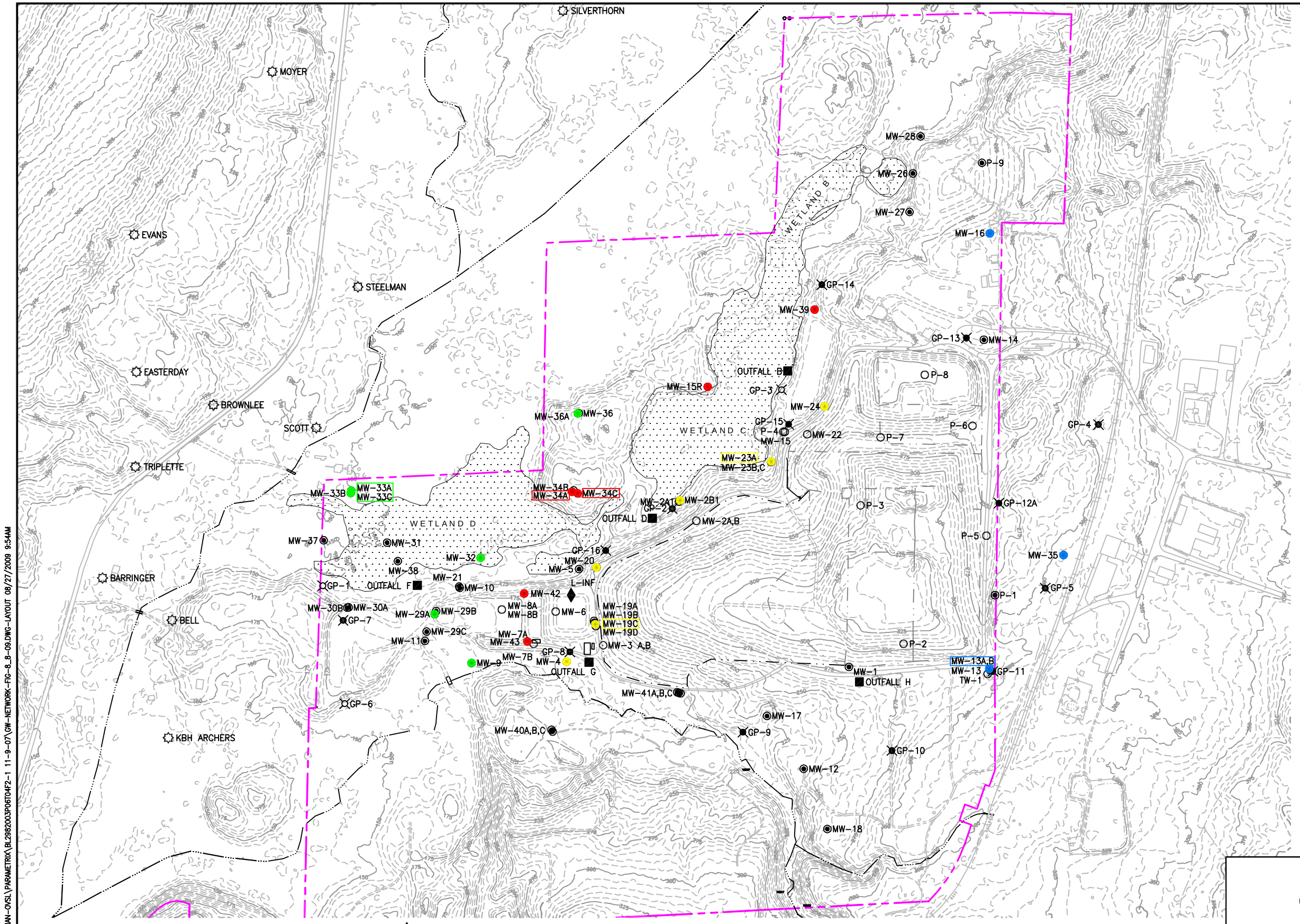
Figure 7

Water Level Contour Map
December 2007

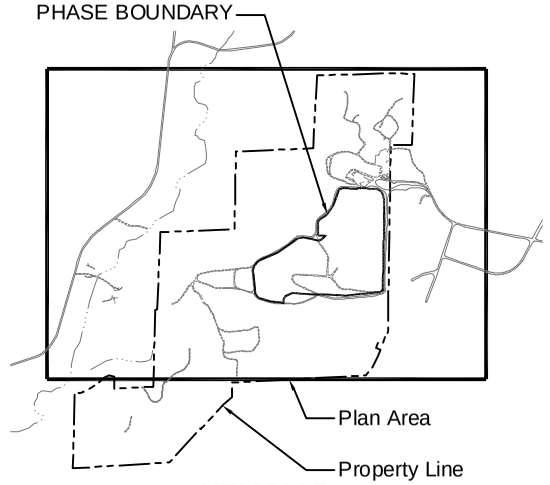
Olympic View Sanitary Landfill

EMSI Engineering Management Support, Inc.

M:\CLIENTS\EMSI\WASTE-MAN-OVSL\PARAMETRIX\BL2982003P06T04F2-1 11-9-07\OME-1207-FIG-7.DWG-LAYOUT 01/06/2009 3:02PM



LANDFILL DEVELOPMENT PHASE BOUNDARY



KEY MAP

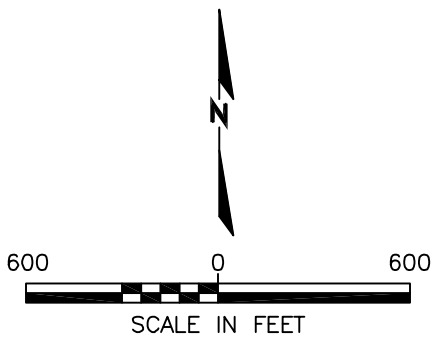
NO SCALE

NOTES:

1. Contour data based on topographic survey data supplied by Space Imaging LLC & Kitsap County GIS Aerial Imagery, June 2001.
2. Additional property to south (see Key Map).

MONITORING WELL KEY

- Compliance Monitoring Well
- Performance Monitoring Well
- Downgradient Monitoring Well
- Upgradient (background) Monitoring Well



LEGEND:

MW-32	Monitoring Well or Piezometer	L-INF	Leachate Influent Monitoring Station		Property Line
SCOTT	Offsite Private Well	GP-15	Gas Probe		Landfill Development Phase Boundary
MW-15	Decommissioned Monitoring Well or Piezometer	GP-6	Decommissioned Gas Probe		Stream
		GP-7B	Decommissioned Gas Probe Boring		Access Road
		OUTFALL B	Stormwater Monitoring Outfall		Railroad

Figure 8

Groundwater Monitoring Well Network

Olympic View Sanitary Landfill

EMSI Engineering Management Support, Inc.

M:\CLIENTS\EMSI\WASTE-MAN-OVSL\PARAMETRIX\BL2982003P06T04F2-1 11-9-07\OM-NETWORK-FIG-8_8-09.DWG-LAYOUT 08/27/2009 9:54AM

WETLAND B
WETLAND C
WETLAND D
GP-2
GP-4
GP-5
GP-7
GP-8
GP-9
GP-10
GP-11
GP-12A
GP-13
GP-14
GP-15
GP-16
9S10
LANDFILL DEVELOPMENT PHASE BOUNDARY
Plan Area
Property Line
KEY MAP
NO SCALE
NOTES:
1. Contour data based on topographic survey data supplied by Space Imaging LLC & Kitsap County GIS Aerial Imagery, June 2001.
2. Additional property to south (see Key Map).
N
600 0 600
SCALE IN FEET
LEGEND:
GP-15 Gas Probe
Figure 9
Landfill Gas Monitoring Probe Network
Olympic View Sanitary Landfill
EMSI Engineering Management Support, Inc.
M:\CLIENTS\EMSI\WASTE-MAN-OVSL\PARAMETRIX\BL2982003P06T04F2-1 11-9-07\GASPROBE-NETWORK-FIG-9.DWG-1-6-09 01/06/2009 2:26PM

Appendix A:

Sampling and Analysis Plan