PACE Engineers, Inc.
11255 Kirkland Way, Suite 300
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GO EAST LANDFILL CLOSURE PLAN

GO EAST LANDFILL
4330 108th Street SE
Everett, Washington 98208

Prepared For:
P&GE, LLC
c/o PACE Engineers, Inc.
11255 Kirkland Way, Suite 300
Kirkland, WA 98033-3417

Revised: October 28, 2015 with updates
to include 3rd party review 8/8/2016
Revised: January 2018 with updates

PACE Project #09382.00

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Revised: October 28, 2015
Third Party Review updates August 8, 2016
Snohomish County Hearing Examiner Decision Issued December 8, 2017

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GO EAST LANDFILL CLOSURE PLAN
February 8, 2012
As Proposed by P&GE, LLC, Applicant
Supplemented as of October 28, 2015
With updates to include third party review August 8, 2016, and
Snohomish County Hearing Examiner Decision Issued December 8, 2017

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1 INTRODUCTION

1.1 Purpose of Supplemental Submittal

Since 1983 the former Go East landfill has lain fallow without being formally closed under the then prevailing closure requirements promulgated by the Snohomish Health District. The purpose of this Plan (as supplemented herein) is therefore to accomplish, 32 years later, the process of closing this long inactive landfill in accordance with subsequently adopted and now current environmental standards and requirements found in WAC 173-350, as interpreted and applied by the Washington State Department of Ecology ("Ecology") and the Snohomish County Health District ("SHD").

This is a supplementation to several earlier versions of the "Go East Landfill Closure Plan" ("LFCP") dated February 8, 2012, October 28, 2015, and August 8, 2016, that further incorporates a third-party review requested in a letter dated June 14, 2016, by Snohomish County Planning and Development Services. It addresses the April 14, 2015, "Decision of the Snohomish County Hearing Examiner" and the Hearing Examiner's Final Decision dated December 8, 2017. The Hearing Examiner's April 14, 2015, decision focused on inadequacies and confusion found in the 2012 LFCP in granting the SEPA appeal and remanding the application to PDS (Snohomish County Planning & Development Services). The Hearing Examiner (HE) specifically directed that the LFCP be "revised to describe accurately [P&GE's] intended course of action (including any reasonably foreseeable alternatives) in sufficient detail and clarity so as to evaluate the probability of significant adverse environmental impacts." Further, that there be an evaluation of "any new information presented and construction activities [that] will probably cause any significant adverse environmental impacts."[1] This revised and supplemented Closure Plan answered the HE's decision and directions. It further addresses comments prepared by third party independent reviews of this plan for the purpose of evaluating any environmental impacts related to this closure plan and issues specifically requested by the HE. The third-party reviewers are included in Appendix M. Lastly, this version of the LFCP addresses the "Final Decision" of the Hearing Examiner.

This supplement addresses and incorporates the conditions of the previously issued "Conditional Approval" by Snohomish Health District of the February 8, 2012 LFCP and the decision of the Snohomish County Hearing Examiner dated December 8, 2017, to facilitate SHD's final approval. This supplement includes matters related to the relocation of existing fill within the landfill site to reshape it so that closure may be accomplished in compliance with WAC 173-351-400 for the protection of human health and the environment.

The following is a summary of the detailed analyses and discussions which address and respond to the HE's April 14 criticisms, findings, and conclusions, and the HE's final decisions. References are provided to the plan's sections where detailed information will be found with respect to these summarized closure actions and the mitigations of the probable significant adverse environmental impacts arising therefrom.

[1] "Decision Granting SEPA Appeal," p. 14 (April 14, 2015).

1.1.1 Overall Project Benefits

There are multiple benefits resulting from the official closure that are summarized and listed in Section 1.3 of this plan. Beyond those listed benefits, closing the landfill allows for the development of other portions of the property into the proposed residential community of Bakerview. This residential development will generate the substantial funds needed for the implementation of the closure plan.

1.1.2 Potential Project Impacts and Mitigation

1.1.2.1 Groundwater Impacts

This project will install six groundwater wells to monitor any impacts to the groundwater as a result of the Landfill. Monitoring is to be conducted quarterly starting at project approval for up to 20 years or until testing has shown groundwater impacts from the landfill are minimal and the Snohomish Health District agrees testing can cease. The landfill site is under laid by over 200 feet of impermeable material resulting in a very unlikely situation that the landfill impacts any groundwater. Furthermore, there are no known downstream wells that would be impacted even if such an effect was discovered by such monitoring. For a full discussion on groundwater impacts, refer to Chapter 8, Leachate Control.

<u>Mitigation</u>:
Covering the landfill is for the purpose of decreasing the possibility of impacts to the groundwater by minimizing water infiltration through the landfill and into the groundwater. Therefore, implementing the landfill closure will have a positive effect on groundwater. Testing of the six (6) wells will be done quarterly for up to 20 years, or until it is shown there are no/minimal impacts resulting from the landfill at its closure.

1.1.2.2 Surface Water Impacts

This closure plan describes the various streams and surface water that occur on the subject property including a spring that emanates at the toe of the northeast slope of the landfill. Surface water leaving the property in the spring and stream have been tested multiple times over the 30-plus years since operations ceased, without noting any significant contamination associated with the landfill. Were such contamination conditions to have existed, they would likely have been discovered prior to this date. To monitor any possible contamination, quarterly testing will be performed for up to 20 years, or until it is shown no significant impacts are occurring as discussed in the plan. No significant adverse impacts to surface water are anticipated. For additional discussion on the treatment of surface waters related to the landfill, see Chapter 5, Stormwater Improvements.

Mitigation:
Covering the landfill is also for the purpose of decreasing flow emanating from the landfill therefore reducing any environmental effects on the surface water emanating from the landfill and stream directly downstream of the landfill area. Therefore, implementing the landfill closure plan will have a positive effect on surface water conditions if there is any probability of such environmental impacts.

1.1.2.3 Methane Gas Impacts

Past testing has shown there is not significant methane gas being discharged from the Go East Landfill. Project testing showed essentially a zero level around the edge of the current landfill. This low level is explained by the fact that there is very little organic material present in the landfill that could decompose and generate gas. However, by covering the landfill as proposed with a geomembrane, the escape routes for gas that do exist will be reduced. For this reason, the gas dispersal trench as discussed in detail in the plan will be constructed around the landfill to intercept any gas escaping from under the geomembrane. Automated 24/7 testing will be done at four manhole structure places around the landfill. Furthermore, twelve (12) probes will be installed around the edge of landfill and provide access for monitoring methane levels. Should the concentration of methane exceed 5% by volume, an active forced air system will be installed to dissipate the levels as required. Testing will continue as described in the plan until the concentration is below 5% and declining and Snohomish Health District approves the discontinuing. All houses within a hundred feet around the edge of the landfill will be required to install gas mitigation in their homes construction as discussed in the plan. For a complete discussion on treatment of methane gas, refer to Chapter 7, Landfill Gas Control.

Mitigation:
Mitigation of possible environmental and public health effects due to methane gas will include monitoring to confirm levels are safe. If levels were to reach 5% by volume, a forced air system will be installed to reduce levels to below 5% until they decline naturally. Because of the nature of the landfill material it is very unlikely significant levels will be experienced. Quarterly testing will continue after the initial continuous testing phase is completed to confirm safe levels. Periodic testing beyond this will be continued until levels have stabilized below 5% and are declining. Homes constructed within one-hundred feet of the landfill will be required to install gas mitigation measures built into their house construction (see Exhibit E-1 of Appendix H).

1.1.2.4 Landfill Surface Impacts

As described in the landfill closure plan the existing surface of the landfill area is covered with trees, brush and blackberries. Portions are rutted and cratered, and portions of the northeast slope of the landfill have areas that exceed the desired

2:1 slope. The existing slope area is not easily accessible so should a fire or slide occur today, access to deal with same would be very difficult and delayed. The existing surface of the landfill was covered with about one foot of material in 1983 as required at that time for closure. In 1983 a fire broke out and burned for two (2) years before extinguishing itself. This created a crater effect on portions of the top and northeast slope area. In 1996, an attempt to replace the earthen cover for the site, for safety reasons, limited grading occurred but was halted due to lack of permit. Nothing has been done to regrade the fill area since that time. The current cover has no capabilities to prevent surface water from infiltrating directly into the landfill as current standards require. For this reason, all rainfall and runoff landing on the landfill or draining to the landfill has infiltrated down to the bottom of the landfill where the underlying impermeable layer of natural soils exists. It then discharges from the foot of the landfill at what has been referred to as the spring.

The landfill Cover 1 area surface is undulating, but generally slopes to the southeast. The proposed closure plan addresses all of the existing undulations that exist in the surface of the current landfill. The plan includes leaving the northeast landfill slope in an undisturbed and stable state. It includes covering the remaining landfill area with low permeable cover materials, as well as re-sloping the surface of the landfill to maintain a minimum 2% slope toward a detention/treatment pond that will collect surface runoff and release it at a controlled rate and vegetate the surface with grasses and small maintainable landscaping. The surface of the main landfill area will be used for the detention pond, open passive play areas, active play areas, access road and trails for the local community.

Closing the landfill to current standards will require heavy equipment to move portions of the existing landfill materials and reshape the surface. This may be done by moving materials with heavy equipment, including dozers, graders excavators, and trucks and placing the materials using compactors. In some cases, materials may be directly moved on the landfill into final position by grading and in other locations relocating the material may be done by placing excavated materials into trucks and moving it several hundred feet and placing it back on the landfill. Any hazardous materials encountered will be screened as described in the plan and placed in environmentally-secure containers onsite. This material will be hauled to facilities permitted to deal with the hazardous material. The top of the compacted subgrade (landfill) materials will be topped with 6-inches of local sands to support the geomembrane. The membrane will be protected on the top side by placing a geotextile cover as further discussed in chapter 4. Any exposed landfill material will be covered at night as discussed elsewhere. For additional information on the treatment of the landfill surface, refer to Chapter 4, Final Soil Cover System, portions of Chapter 3, Final Grading and Site Layout, and runoff mitigation included in Chapter 6, Erosion and Sedimentation Control.

Mitigation:
Landfill relocation activity will be accomplished as permitted by a County issued "Surface Disturbance Permit" and the conditions included in that permit governing working hours, dust control, and associated street use permit. Specific mitigation is summarized as follows:

- All equipment will be equipped with residential mufflers to control noise and vehicles will not be left to idle.
- Re-fueling will be done at one location onsite to control any spillage.
- Water truck and hoses will control dust as well as provide onsite fire extinguishment capabilities. Also, any piles of material and any exposed landfill material will be covered when not being work (night time) with visqueen and secured with sandbags.
- Work hours will be set to control and limit noise for the LFC work. Hours of work will be regulated by County permit requirements but would be typically 8 a.m. to 5 p.m. Additionally, a Noise Control Plan (NCP) for the LFCP will be implemented to limit noise impacts to the local residential community. The noise control plan includes the following items and will be monitored by the onsite professional overseeing the LFC activity:
    - Measuring noise levels at the property boundary to determine the actual effects of the construction equipment and operating schedule if complaints are received.
    - Using newer and/or well-maintained quieter equipment that is inspected regularly.
    - Using equipment suitable for the job that isn't over or under powered.
    - Whenever possible, using the quietest equipment alternative.
    - Scheduling louder or impulsive noise sources during mid-day hours only.
    - Locating equipment to position prominent noise sources away from the property boundary to the extent practical.
    - Limiting the use of back up beepers through truck/equipment routing or the use of flagmen.
    - Using a sound level meter to determine if the Project noise levels (for the Landfill Closure activities) are approaching limits, if construction activities need to be performed in close proximity to residences.

- Using best management practices such as enhanced muffler systems and sound barriers to prevent exceedances if construction noise is approaching unacceptable levels.

- A fire hydrant will be constructed onsite as one of the first activities. It will have a water consumption meter and backflow device as required by the District for metering water use and protection of any backflow. This will be used to fill and maintain water for onsite water trucks and hose/s for sprinkling the areas where landfill screening will take place. Furthermore, water will be available for dust control as needed. It also will be available for immediate use should it be needed for fire protection.
- To eliminate impacts of moving large quantities of landfill material offsite and through the local communities, the plan is to relocate landfill material within the current landfill area, except for any hazardous waste materials or material not permitted to be placed back into the landfill (as discussed in the plan). Cut and fill requirements will be balanced with onsite available materials to extend possible as discussed in the plan.
- Any hazardous materials if encountered, will be separated and place in confined container onsite and transported to a preapproved facility licensed to handle the particular material. All regulations protecting worker safety will be followed if such hazardous materials are encountered.
- A full time certified professional will be onsite to observe the landfill relocation activity and have oversight of this work. He will be responsible with overseeing all landfill relocation of materials. It will be his responsibility to determine if any materials being relocated need to be further tested and place in the screening area or directly into the secured containers on site. He will be tasked with preparing a daily report of the material relocated and his recommendations and direction. (The probabilities of encountering hazardous waste materials is very low given the extensive sampling, testing, and the 65 (or more) test holes dug to different depths in the landfill site without encountering any.)
- Should the Health District require relocation offsite of certain non-inert materials encountered like clean wood waste, to prevent moving large quantities offsite chipping and reuse of much of this material may occur with the chipping being used for cover in landscaped areas. This processing is in keeping with the site's original permit classifying same as a "Wood Waste Landfill."
- To minimize any exposure to dust and limit opportunities for spontaneous combustion the area of exposed landfill being worked on will be limited to one acre at a time. This area will be covered at the end of each working day with visqueen and anchored with sand bags. As soon as an area of

the landfill has the subgrade filled and compacted to final grade, it will be covered and compacted with 6-inches of onsite sands ready for the geomembrane cover. Additionally, during time of LFC work, driving speed will be limited to 15 mph, work will be curtailed during high winds, and training of onsite workers regarding limiting dust with oversite will occur. (See Chapter 4)

- To secure the site from the community during the construction activities the entry and security fencing will be reinforced and repaired. The goal will be to eliminate trespassing onto the site during these activities.

1.1.2.5 Government Oversight

Additionally, the Snohomish Health District will be providing on-going oversight of the landfill activity and attending weekly coordination meetings as they deem necessary with the owners, contractor, County, and others as work progresses. Snohomish County will be monitoring permits issued by them. Additionally, Appendix F describe the Post Closure Operation Plan and Appendix H, contains Sampling/Analysis and Monitoring Plan for the project that must be accomplished and reported to SHD.

1.1.2.6 Traffic-Related Impacts

This analysis provides an estimate of the anticipated truck traffic required to complete the Go-East Landfill Closure Plan associated with the subdivision plans for the Bakerview property. This estimate includes only those traffic volumes for various materials that are anticipated to be imported or exported from or to the site for the landfill closure and does not include truck traffic related to the subdivision construction. The exception to this is that mass grading required for the subdivision will be completed with the landfill closure such that no further significant import/export of fill material should be necessary once the closure activity is completed. For example, traffic related to street, storm, water, sewer, other utilities, or the home construction is not considered in this analysis.

This plan calls for relocating all excavated landfill materials to the top of the remaining landfill area (except any material not permitted by SHD or the onsite professional overseeing the work). There are multiple options of providing needed fill materials for the landfill closure from importing offsite materials to using onsite excavated material from the lot and street areas of the Bakerview plat. By adjusting the final grades of the Bakerview lots and streets, sufficient quantities of fill can be generated onsite to satisfy the landfill closure fill requirements as summarized below. This analysis looks at what the amount of materials that would be needed to be moved off or onto the site to successfully close the landfill in compliance with this closure plan. It is based on relocating landfill material as required to reshape the landfill and keeping all material on the landfill area except as noted. It also calls for using excavated onsite material from areas outside the landfill for needed fill for the closure. Reshaping the landfill includes the "Wedge" relocation, grading for the detention pond, materials regraded from the northeast slope, other site debris except for hazardous materials, if encountered, such as asbestos, lead paint boards, or other materials that are to be removed from the site as directed by the Snohomish County Health District. A general description and estimate of quantities of materials needed to complete the landfill closure is summarized below:

- Vegetative Materials: Trees, stumps and brush from the existing landfill area and adjacent site property to be developed will be removed. It is anticipated the marketable trees, will be removed from the site while some limbs and chippable materials maybe be chipped and stockpiled for possible ground cover. Some stumps may be left in place or trucked offsite or simply relocated to the top of the landfill to be buried as permitted. Topsoil would be stripped as needed and stockpiled and reused primarily on the top of the landfill area to remain. This operation will generate truck traffic leaving the site from both the landfill and non-landfill areas. It is estimated this logging/stripping phase of the work may take one to two months. It could generate up to 10 trucks leaving the site per hour during the peak period logs are being exported offsite.
- Wedge Area Grading: The landfill material lying in the "Wedge" area will be graded/excavated and relocated to the top of the landfill to remain. Depending on final design and actual depths of the landfill encountered, this volume is estimated to be 50,000 to 60,000 cubic yards of material. (Note: Memo updated August 1, 2016, estimates 52,000 cubic yards of "Wedge Excavation".) None of this material is planned to be removed from the site unless a hazardous material like asbestos or lead painted wood or some other material the Health District directs be removed. (Note: non-inert materials may be chipped and reused in landscape areas if it is required to be removed from the site.) The structural material for filling the "Wedge" will be excavated from non-landfill soils onsite. Therefore, the anticipated truck traffic entering or leaving the site for this work is expected to be very minimal. There is discussion that non-inert material that is not clean wood chip for landscape cover may be required to be removed to a facility permitted to accept this material. However, should this be the case the peak truck traffic should be less than 10 trucks per hour.
- Other Landfill Excavations: Landfill material relocated/removed with the construction of the detention ponds are to be relocated to the top of the remaining landfill area as previously discussed. There is no anticipated truck traffic entering or leaving the site for this work.

- Landfill Cover and Geomembrane Foundation/Bedding: It is anticipated all of the bedding for the geomembrane will be obtained either from screened landfill sands or preferably by just excavating local sands available onsite. No import of materials is anticipated for this purpose. For Cover 1 and if needed Cover 2 areas as shown in the landfill closure plan, the two (2+) plus feet of cover material over the geomembrane will also be excavated from the non-landfill areas being graded for the lots and street areas onsite. The top soil will be a mixture of top soil/strippings stockpiled during the clearing operation as previously discussed or imported from an offsite topsoil supplier. If the entire Cover 1 area was to receive one foot of topsoil, less than 5,000 cubic yards of material would be needed. (Note that the landfill top soil requirement is one foot and much of it is to be obtained using site stripping.)
- Methane Collection Trench: The Closure Plan calls for the construction of a gravel methane collection trench around the landfill area to remain as shown on the plans. The volume of gravel needing to be imported to construct this trench is estimated to be 1,000 cubic yards.

The total required volume of material that would need to be imported from offsite based on this analysis is estimated to be roughly 6,000 cubic yards. To allow for unexpected needs (such as the export of non-invert materials), conservative maximum export/import estimate of 10,000 to 23,000 cubic yards is used in this traffic analysis. If all this work was done in one construction season, this would result in no more than about 10 tandem trucks with trailer (18+ cubic yard loads) per hour on average based on an eight-hour day.

The anticipated construction traffic described above is well below the anticipated traffic generated by the Bakerview development and should therefore not be an issue. The development was granted concurrency for 106 units, (current plan is for 97 lots) which generates approximately 1,014 daily trips with 107 PM peak-hour trips. As the anticipated construction traffic is far less than the traffic that was evaluated as part of the traffic impact analysis for the Bakerview subdivision, the third-party peer reviewer stated, therefore, the landfill closure traffic is not anticipated to create a more significant impact than the proposed Bakerview residential development. (See a copy of the Gibson memo showing proposed routes in Appendix M.)

Mitigation:
Mitigation for the import/export of materials as discussed above will include the following:

- Compliance with work hours for the street use permits associated with the project.

- Flagging and traffic control as required for any heavy periods of traffic on and off the site (based on the above analysis the peak construction traffic for the landfill closure is only about 10% of the peak hourly project for the Bakerview subdivision built out).
- Wheel wash for all trucks leaving the site and maintenance of the street as needed.
- Minimizing traffic by reducing the need to import/export landfill materials as discussed elsewhere in this plan.
- Other mitigation imposed by the required street use permit to be issued for the project by the County.

1.1.2.7 No Action Alternative

Closing the Go-East Landfill is a requirement of the various permits issued starting in 1969 and continued through 1983. Not closing the landfill is not an acceptable or rational option as SHD and Ecology are requiring closure in compliance with current WAC requirements while Snohomish County is requiring closure approval by SHD as a condition of the Bakerview development project.

1.2 Guide to Supplemental Information

To aid the reviewer of this Supplemental Plan the following is an index of the additions and revisions made to the prior 2012 LFCP that was reviewed by the Snohomish County Hearing Examiner and SHD:

SECTIONS SUPPLEMENTED/ REVISED	TITLES OF SUPPLEMENTED/ REVISED SECTIONS	DESCRIPTION OF SUPPLEMENTATIONS/REVISIONS
Section 1.1	Purpose of Supplement Submittal	New Section
Section 1.1.2	Potential Project Impacts and Mitigation	New/Supplemental Section
Section 1.2	Guide to Supplemental Revisions	New Section
Section 1.3	Benefits of Closing the Landfill to Current Standards	New Section
Section 1.5	Historic Background	Revised
Section 2.1	Applicable Regulatory Requirements	Revised
Section 2.1.2	Closure Requirements	Revised and Supplemented
Section 2.2	Closure Improvements Objectives	Revised
Section 3.1	Introduction	Supplemented and Revised
Section 3.2	Existing Conditions	Revised
Section 3.3	Proposed Grading Conditions	Revised & HE New Condition Added
Section 3.4.3	Northeast Slope Area	Section Deleted
Section 3.5	Site Setbacks	Revised
Section 3.6	Waste Relocation, Oversight, and Requirements	Revised
Section 3.6.1	Landfill Debris Screening Plan	Revised and Supplemented

SECTIONS SUPPLEMENTED/ REVISED	TITLES OF SUPPLEMENTED/ REVISED SECTIONS	DESCRIPTION OF SUPPLEMENTATIONS/REVISIONS
Section 4.1	(Final Soil Cover System) Introduction	Revised
Section 4.4	Proposed Cover System Overview	Revised
Section 4.4.1 & subsections	Cover System 1	Revised
Section 4.4.2 & subsections	Cover System 2	Revised
Section 4.4.3 & subsections	Cover System 3	Section Deleted
Section 4.5	Settlement of Landfill Area	Revised
Section 5 (5.1 - 5.4.5)	Stormwater Improvements & Subsections	Revised
Section 6	Erosion and Sedimentation Control	Revised
Section 7.4	Proposed Landfill Gas Control Improvements	Revised and Supplemented
Section 8.3, 8.4 & 8.5	Leachate Control	Revised
Section 9 Revised	Construction Requirements and Sequence	New
Section 9.2	General Grading Requirements	Revised
Section 9.2.1	Temporary Construction Roads	Revised
Section 9.2.2	Waste Excavation Requirements	Revised
Section 9.2.4	Structural Fill Placement	Revised
Section 9.2.5	Interceptor Trench Bench Requirements	Revised
Section 9.2.6	Preliminary Construction Sequence	New Section
Section 9.2.7	Actual Construction Onsite	New Section
Sections, prior 9.1, 9.2, 9.3, 9.4 & 9.5	Post-Closure Operations and Maintenance Plan	Revised and moved to Section 10
Section 10	Includes prior Section 9	New section includes prior Section 9
Appendix D	Engineering Plans	Sheets Revised (include Northeast Slope)
Appendix F	Post-Closure Operation Plan	Revised Sht. 7 of 10
Appendix H	Sampling/Analysis and Monitoring Plan	Revised Sht. 7 & added exhibit F-1
Appendix I	Waste Excavation, Screening and Disposal	Revised
Appendix K	Construction Quality Assurance Plan	Revised

1.3 Benefits of Closing the Landfill to Current Standards

Closing the landfill provides multiple benefits to the local adjacent communities, the environment, and the County as a whole as summarized below:

- Provides formal closure of the landfill using current closure standards that are far more extensive than those standards required under the 1972 permit requirements initially authorizing the landfill creation and operation through 1983.
- Minimize the need for future maintenance to control or eliminate current conditions potentially posing threats to public health and the environment.

- Eliminate potential hazards to neighboring residents and their pets who currently use the site, as well as future residents of the planned Bakerview subdivision.
- Increase property values to adjacent residences resulting from a formally closed landfill.
- Provide increased stability and erosion protection for landfill surface areas.
- Provide access to the landfill surface and northeast slope areas for erosion remediation and fire extinguishment.
- Reduce environmental impacts of landfill on groundwater.
- Reduce environmental impacts of landfill on surface water.
- Increase stability of the landfill areas thereby avoiding accidents to neighboring residents who continue to use the site for recreational purposes.
- Add long term stability to the surface of the landfill by covering and sloping it for drainage and detention of surface water.
- Eliminate illegal uses currently occurring on the property.
- Provide for a high value residential community on the property.
- Provide for safe recreational use on the landfill surface.
- Increase tax basis for the entire property.

This Landfill Closure Plan engineering report gives the background of the project site and outlines the necessary requirements for closure and post-closure activities. It also details procedures to complete formal closure. In more detail, the plan describes the improvements that will be completed to the old landfill surface including grading, cover improvements, stormwater collection, and treatment. The plan also explains activities related to monitoring and controlling gas and leachate as well as inspection and maintenance activities and schedules required during the post-closure period. Completion of this closure and approval by Snohomish Health District will meet and satisfy all closure requirements imposed on the former Go-East landfill from 1983 when it ceased operations to the present.

1.4 Project Location

The property consists of the entire northwest quarter of the southeast quarter of Section 21, Township 28 N, Range 4 East, Willamette Meridian, in Snohomish County. The project consists of one parcel, tax parcel number 28052100400200, which is approximately 40.9 acres in size, according to the record survey drawings by PACE Engineers, Inc. The parcel is located east of Silver Lake on the south side of 108th Street SE at 44th Avenue SE. More precisely, the parcel is located at 4330 108th Street SE, Everett, Washington.

The property surrounding the site is residential with associated open space tracts. The northern property line is bound by The Pointe residential subdivision and an open space tract. The western property line is bound by King's Ridge Division 1 residential subdivision and an open space tract. The southern property line is bound by the Waldenwood West Division 1 and the Pinehurst at Waldenwood Division 2 open space tracts. The east side of the property is bound by an Olympic Pipeline easement, located at the bottom of the ravine, and farther east is the Pinehurst at Waldenwood Division 2 open space tract.

1.5 Historic Background

The following is a chronological background of the Go East Landfill site. Dates and events were taken from both the *Memorandum Trip Report* by George A. Brooks at Ecology and Environment, Inc., dated June 3, 1987, and the *Site Hazard Assessment: Recommendation for No Further Action*, dated May 14, 2004. Complete references of these two reports can be found in Section 10 of this report. Additional background information came from the *Snohomish County Board of Adjustment Written Order No. 14 (CU-7-72)* and the *Decision of the Hearing Examiner File No. CT 91-1125G* dated June 3, 1992, both of which are located at the Snohomish Health District's (SHD's) records office, and from the principal shareholder of the Go East Corporation, Mr. Gary W. East.

Ownership and site usage have changed over the years, dating back to 1969. In 1969, a permit was issued for excavation and sand reclamation for a two-year period, ending in 1971. In 1972 Rekoway, Inc., purchased the property and was issued a Conditional Use (CU-7-72) permit to operate the site for sand and gravel excavation and as a solid waste landfill accepting "wood, mineral, and concrete solid materials and excluding all garbage, tin cans and similar type wastes." (*See, CU-7-72, par. 6, p. 4). Rekoway began operating the site for these purposes shortly after the CU permit was issued. At some point in its operations, Rekoway accepted a large truckload of metal debris from the Boeing plant which it then had buried in the northwesterly edge of the fill site at a location approximately fifty (50) feet below the present fill surface. On August 21, 1974 a small but highly visible fire erupted with a spectacular fireball. This was the consequence of mixing metal dust and scraps with water in a defective soil cell that failed to prevent oxygen from joining the mix.

This event was short-lived as the then owner/operator, Rekoway, excavated the involved material and removed it from the site. This unusual event was never repeated because this type of fill was never thereafter permitted into the landfill. After this extinguishment a large number of enclosed cells were then placed in layers ("lifts") on, around and above the site of this eruption from 1979 to 1983 by Go East. Today the location of this fire is buried and surrounded by these multiple lifts. Since 1974 to the present- 41 years-there has not been a repeat of this event nor any indication that the source of this eruption still exists.

During the period 1975 to 1977 Rekoway accepted wood waste debris that included partially burned trees and stumps. Rekoway did not closely inspect this debris to confirm all burning had been extinguished, and it failed to adequately construct the dirt containment cells in which this debris was placed. Consequently, some of this debris spontaneously began smoldering and producing dense smoke. By 1977 Rekoway abandoned any efforts to extinguish these smoldering conditions and as a consequence the landfill permit was suspended by the

Snohomish Health District and by Snohomish County. Rekoway's fill operations therefore ceased. These conditions persisted until 1979.

In 1979 Go East Corporation agreed to purchase the entire 40-acre property including the landfill site from Rekoway on the condition the suspended CU-7-72 permit would be reinstated and fill operations permitted to resume. A meeting of the Snohomish Health District, Snohomish County Fire Marshal, Snohomish County Prosecutor, the Puget Sound Air Pollution Control Board and Go East Corporation was held in September 1979. From that meeting it was mutually agreed that conditioned on the extinguishment of the debris then smoldering in the fill site to the satisfaction of Snohomish Health District and the County Fire Marshal, the suspended CU-7-72 permit would be reinstated and Go East could reopen fill operations.

Thus, under the watchful eyes of Snohomish Health District and the Fire Marshal, as well as other governmental representatives, Go East excavated the fill site to locate all of the debris involved in the smoldering fire. Using a crane this debris was brought to the surface of the fill area and then subjected to days of water inundation, occasionally being moved and rolled about to expose all surfaces. The debris involved was all-natural wood waste. No manufactured or nonorganic materials were involved.

This water extinguishment took nearly two months to complete. Finally, the Snohomish Health District and Snohomish Fire Marshal representatives determined that all fire, embers and other sources of smoldering and smoke were completely extinguished. Go East was then permitted by Snohomish Health District to replace the water-treated debris into the newly-excavated holes within the fill area which were then sealed with dirt walls and ceilings. Then the entire fill surface was graded to level it in order to accept new fill material. The "Go East Landfill" was then opened to the public as a licensed wood waste disposal facility.

From November 1979 to July 1983 when the landfill ceased operations there never was a fire or similar event to those above described.

The Go East Landfill ceased accepting fill material in late summer 1983 and the then-required ten (10) closure steps including "capping" the landfill with a 2 foot layer of semi-permeable dirt was accomplished. Go East maintained its manager's onsite office to watch over the closed fill site as required by the Snohomish Health District's ten closure regulations.

In October 1983 a fire broke out on the steep face of the fill area in the northwest quadrant of the site. Because of the area's steepness the earth-moving equipment needed to seal off the fire in order to deprive it of oxygen could not be used. Go East after expending approximately $50,000.00 in its ultimately futile attempts to extinguish the fire by reburying it, elected to allow it to burn out its limited fuel contained within the lower "lift" cell where it had originated. The Snohomish Health District ordered Go East to suspend all closure activities until the fire was deemed extinguished.

Unfortunately, due to public pressure and contrary to good practice, the Snohomish County Fire Marshal entered the site without permission and proceeded to pour under pressure, thousands of gallons of water onto the slope area. The result was to wash away the walls of the affected cell and those cells immediately abutting it, thereby allowing the fire to spread into the fuel contained in the adjoining and now exposed cells. Over the many days and nights this damaging water treatment was conducted numerous cells were opened and the original small fire greatly increased and spread.

Fortunately, and because of the sound construction by Go East of the "lift" cells, the fire remained confined to the topmost layer of the site's cells. The fire wandered around this top layer until consuming most of the available fuel contained therein. It did not and could not penetrate the lower and subterranean “lift" cells which remained intact.

By 1985 the fire ceased burning due to lack of fuel. It left behind a cratered surface of the fill area where the process of burning wood waste in the top layer of cells resulted in subsidence and sluffing of the dirt tops and walls of the affected cells. Some of these craters were as deep as 6 to 8 feet having a circumference of approximately 10 feet. The walls between the cells were weakened by the destruction of the wood waste lateral support that had burned. These uneven surface conditions persist to this day. These surface conditions pose a hazard to the many neighbors who trespass on the site. To remedy this requires that the site be graded, leveled and the historic craters filled with materials existing elsewhere on the landfill. Since the fire burned itself out, the site has been fostering the growth of trees, grasses, native shrubbery and non-native plants such as blackberries.

1.6 Property Description and Existing Vegetative Conditions

The 40-acre property encompasses a topographically diverse area consisting of ridges and ravines, as well as some flatter areas. Within the property, the Go East Landfill is located generally in the northern half of the property in a pre-existing ravine. Landfill material (solid waste landfill – wood, mineral, and concrete solid materials) was placed in multiple cells, approximately 25 feet by 20 feet by 8 feet deep. The material was compacted as placement occurred by the weight of the moving bulldozer equipment. The limits of the landfill encompass an area of approximately 9.6 acres. The north and west portions of the landfill area generally slope towards the southeast at roughly 4 to 5 percent grade. The northwest corner of the property and the northern portion of the property generally slope down towards the landfill area. The northeast portion of the property consists of fill slopes created by landfill activities and slopes easterly down to the ravine below. The sloping hillsides in the northeast portion of the property originally conveyed the natural surface water runoff discharge from the north half of the property to the east to the bottom of the ravine that existed. The terrain on the eastern and southern property lines of the property slope down to the ravines below. The southern third of the property consists of steeply-sided incised drainage ravines which run from west to east, turn northward at the eastern edge of the property, and extend beyond the northeast corner of the property to the Snohomish River Valley. A detailed account of the proposed grading and slope conditions can be found in Chapter 3 of this report and the Appendices there referenced.

Current vegetative cover in the landfill area of the property consists of a variety of trees including red alder and black cottonwood as well as grass, native, and non-native shrubbery including Himalayan blackberry bushes.

As documented for this project in Appendix C, the *Mitigation Plan* by Wetland Resources, Inc., dated February 23, 2010, there is a Category III wetland in the northwestern portion of the property, part of which extends offsite to the west. This is the result of the construction of a pond created in 1979 for water storage and fire protection during the landfill operations in the 1980s as directed by the County Fire Marshal and SHD. A stream flows from the west into this wetland, and thence southeast to a point where it drops down a slope to intersect with another stream that flows to the east. This combined stream continues east exiting the property along its eastern boundary, before turning in a northerly direction.

An existing conditions plan is contained in Appendix A of this report and shows the existing property grades, slopes, vegetation and other attributes of the property.

1.7 Current Fill Components

Approximately 65 exploration pits have been completed on the property to assess the depth of fill and the type of material contained in the landfill. These test pits vary in depth, and are up to 25 feet deep. Associated Earth Sciences, Inc., (AESI) excavated 17 exploration pits (EP-1 through EP-17) on August 5 and 6, 2009, and four monitoring wells (borings MW-1 through MW-4) from August 11 to August 14, 2009. The pits allowed for visual observation of subsurface conditions and the borings were to assess groundwater levels below the site. Additionally, 48 exploration pits were completed by HWA in 2002. According to the logs, the fill consists of assorted construction debris including gravel, concrete, wire, woody debris, tire, brick, asphalt, plastic pipe, dimensional lumber, burned wood, metal, glass shards, and carpet. These materials are found at depths as shallow as 1 foot and ranging up to depths of over 21 feet. Fill also included loose, silty sand with gravel. Complete documentation of all explorations is contained in the *Subsurface Exploration, Geologic Hazards, and Geotechnical Engineering Report* dated October 21, 2009, by AESI and located in Appendix A of this report.

2 CLOSURE IMPROVEMENT REQUIREMENTS AND OBJECTIVES

2.1 Applicable Regulatory Requirements

The Snohomish Health District has been directed by Ecology to apply the most recent version of closure standards as applicable for a landfill closure. Ecology wrote on January 26, 2011, to SHD, *"Chapter 173-350 WAC is the regulation currently in effect for all solid waste facilities except municipal solid waste landfills and incinerators. WAC 173-350-030(1) says, 'These standards apply to all facilities upon the effective date of this chapter.' The Go East Landfill is a facility, therefore chapter 173-350 WAC applies."* This is an incorrect conclusion as the Go East landfill is not a "facility."

This landfill has not accepted waste material since 1983. The site will never be reopened for receiving waste material. The landfill is not, and has not been for over 30 years, an operating "facility" as defined by WAC 173-350-030(1). The requirements of WAC 173-350-030 relate to finalizing closure of landfills in operation as a "facility." These regulations were adopted after the initial attempts to close the Go East landfill in 1983 in accordance with SHD's then prevailing closure requirements.[2] Nonetheless, the Go East Corporation and its successor applicant, P&GE, LLC, are prepared to undertake and complete closure as set forth in this Plan under the following and applicable Code requirements as related to meeting applicable landfill closure requirements.

2.1.1 Design Standards for Landfill Closure

The Ecology letter dated January 26, 2011, highlights the following "Design standards" contained in the Washington Administrative Code (WAC).

WAC 173-350-400 (3) *Limited purpose landfills – Design standards* which include subsection (e) the *Final closure design requirements*. These standards include, among other items, the following:

- Prevent exposure of waste
- Minimize infiltration
- Prevent erosion from wind and water
- Is capable of sustaining native vegetation
- Addresses anticipated settlement, with goal of achieving no less than two to five percent slope after settlement
- Provides sufficient stability, etc.

[2] On August 26, 1983, the Snohomish Health District enunciated ten closure requirements as follows: 1. No more wood waste; 2. Any fires must be extinguished; 3. Grade the landfill surface; 4. Place two (2) feet of "clean soil" on the landfill; 5. Provide erosion control until vegetation is established; 6. Seed with grass or similar vegetation; 7. Permanently divert all surface water from the site, using detention ponds where necessary; 8. Place filter dike at base of fill slope; 9. Prepare and record maps and statement of facts regarding site and contents; 10. SHD will inspect progress and completion.

- Provides for the management of water run-on and runoff, etc.
- Minimize the need for post-closure maintenance
- Provides for collection and removal of methane and other gases
- Meets the requirements of regulations, permits and policies administered by jurisdictional air pollution control authority
- Other requirements as specifically included in this WAC section and SHD's supplemental requirements.

WAC 173-350-400 (5) Groundwater monitoring requirements

WAC 173-350-400 (6) Limited purpose landfills – Closure requirements.

WAC 173-350-400 (7) Limited purpose landfills – Post-closure requirements.

WAC 173-350-400 (8) Limited purpose landfills – Financial assurance requirements.

WAC 173-350-400 (9) Permit application contents.

WAC 173-350-400 (10) Construction records.

2.1.2 Closure Requirements

The closure performance standards for landfills are found at WAC 173-350-400 (6) *Limited purpose landfills – Closure requirements*.

Accordingly, the Go East Landfill closure will be performed in a manner that complies with this Code subsection as is feasible given that this code section is written to apply to and in anticipation of a new facility and, not a landfill where operations ceased 32 years previously,

Special Closure requirements that are required by Snohomish Health District prior to commencing closure activities onsite include the following:

- Complete all SEPA requirements as required by WAC 173-350-715(1)(e)
- Acquire all Federal, State and local permits as required to implement this landfill closure plan
- Provide to SHD the required closure plan and post closure plan "Financial Assurance" as described in Section 10.5 of this LFCP
- Plat covenant to address gas safety to be recorded on the final plat is required and included in Appendix H of this plan.
- Future landfill maintenance obligations/requirements are also included in Appendix H of this plan.
- Gas piping to be installed within the gravel gas trench and stubbed into the four manhole structures to house continuous gas monitoring equipment as discussed elsewhere in this plan. This piping is for the purpose of collecting any gas that is

formed in the landfill under the geomembrane and direct it safely to the atmosphere. Room is available in these four structures to install blowers sized accordingly as needed if an event of increased gas emissions occurs. The blowers would be connected to the piping stubbed into the manholes and piped to discharge at a location posing no threat to public health or the environment. Power to operate the blowers would be run from temporary sources installed onsite. The maximum gas limit is not expected to approach or exceed the 5% by volume permissible level. Should it do so, blowers can be sized based on actual emission amounts detected and will be promptly installed.

- Two (2) additional groundwater monitoring wells are to be installed as discussed in this LFCP and generally where shown on the project drawings near the toe of the northeast slope area. These wells will be installed (as the prior ones have been) under the direction of a licensed geologist and per state standards.
- Stormwater pond (detention pond) operating requirements including monitoring for any leaks in the liner is required and is contained in Appendix F along with a detailed checklist for post closure maintenance of the storm system and detention pond.
- The proposed LFCP does not propose any screening of landfill material but rather relocating material that needs to be moved to reshape the landfill (as described in this LFCP). However, should SHD require screening to remove any hazardous materials encountered or non-inert materials, Appendix I in addition to Section 3.5 of the LFCP includes procedures, location and requirements for screening any landfill materials excavated from the landfill that required.
- A job trailer will be required to provide a place to keep documentation, contacts, meetings, etc. Scheduled meetings will be held during the closure activity to coordinate any SHD inspections and oversight and monitor progress.

2.2 Closure Improvements Objectives

The primary objectives of the landfill closure improvements are to:

- Provide a physical barrier over the top of the waste;
- Ensure the safety of the public, protect human health, and avoid harm to the environment during construction of the closure and thereafter;
- Safely and adequately transport and vent any methane gas;
- Improve/protect surface water and ground water quality; and
- Prevent stormwater infiltration into landfill waste.
- Prevent flooding to downstream properties

The proposed design here addresses these objectives by conforming to applicable regulatory requirements, addressing operational and maintenance needs, and adhering to sound engineering principles. These objectives are addressed in Chapters 3 through 9 of this report by explaining each individual landfill closure improvement and its specific design criteria. It is understood that successfully completing this closure plan and the subsequent approval by Snohomish Health District will complete and satisfy all requirements related to the CU-7-72 permit issued in 1972 and reactivated in 1979 by the Snohomish Health District.

3 FINAL GRADING AND SITE LAYOUT

3.1 Introduction

This chapter presents the site grading design prepared for the landfill closure improvements for the subject property and criteria and methodology that were used to develop this design. The landfill closure improvements grading plan and soil cover cross-section, shown in Appendix D, are based on the design criteria presented in this chapter. Also, detailed grading, drainage, detention pond, pond monitoring drains, etc., are shown on the preliminary plat drawings for the Bakerview (the accompanying subdivision) project. A surface water TIR (Technical Information Report) with upstream and downstream analysis also accompanies these plans. It has been previously reviewed and approved for the preliminary Bakerview plat and closure activities by Snohomish County PDS. (Note: An updated preliminary Bakerview plat and updated TIR to support the latest site plans and this updated LFCP is to accompany this revised LFCP.)

3.2 Existing Conditions

In general, the 40-acre property consists of rolling plateau and ravines, with the landfill located in a pre-existing ravine in the northern half of the site. The majority of the 9.6-acre landfill area is flat, sloping towards the southeast at grades of approximately five percent. Slopes lead down to the landfill area from the north and northwest portions of the property. Portions of these slopes were manmade due to the past sand and gravel mining activities, and range from approximately 54 to 73 percent and are 10 to 40 feet high.

The southern half of the property contains naturally occurring steep slopes leading down to a ravine and stream. The east side of the property has naturally occurring slopes as well, also leading to a ravine and stream below. Slopes on the east and south side of the property are roughly 30 to 70 feet high and contain slopes ranging from 50 to 65 percent. According to the Geotechnical Engineering Report by Associated Earth Sciences, Inc., (AESI) located in Appendix A, and the Critical Areas Planning Project maps prepared for Snohomish County by GeoEngineers, Inc., (1991), slopes on the south and east sides of the property are classified as a High Landslide Hazard Area. As stated in the Geotechnical Engineering Report, “Mitigation recommendations include building setbacks from the top of steep slopes, control of filling and grading on slopes, and control of stormwater discharge.” This project is complying with these recommendations.

The northeast portion of the site also contains steep slopes at approximately 30 to 60 percent. Portions of these sloping hillsides in the northeast portion of the site are fill slopes consisting of construction debris that was transported in during the active landfill period. According to the Geotechnical Engineering Report, this area was originally the natural stormwater runoff discharge location of the site and is classified as a Landslide Hazard Area according to the SCC 30.62.015(16). The landfill closure and associated plat will comply with the steep slope mitigation recommendations of AESI as stated in Section 5 of the attached Geotechnical Engineering Report (Appendix A). More information on the steep slopes and landslide hazard areas can be found in Section 5.0 of the Geotechnical Engineering Report.

The existing access to the site is via 108th Street SE. At the northwest corner of the property there is a gravel roadway/trail leading down to the landfill area. The road works its way down the grade towards the south and then turns east between the limits of the landfill and the edge of the southern ravine. Here the roadway runs east for about 400 linear feet. The gravel roadway then turns to the north and continues between the eastern limits of the landfill and the ravine to the east. The road ends at the ravine to the north.

3.3 Proposed Grading/Reshaping the Existing Landfill

The first phase in closing the landfill will be for the trees and vegetation to be removed from an area of approximately 10 acres of the landfill plus adjacent areas that are to be developed into a residential plat to accommodate site grading and landfill cover. The balance of the property will remain in its existing and natural condition with current vegetation. It is estimated the tree removal phase will take about a month and a half to two months to log, and remove all marketable wood and grubbing from the developed portions of the site. It is anticipated the entire developed area including the landfill site and adjacent area to be graded to obtain fill material for the landfill closure (subdivision area) will be logged and grubbed as the first phase of the closure activity. Stumps and grubbing that must be removed will be loaded to be disposed of offsite. Stumps and ground cover that can be left in place will not be removed. Any top soil in the areas to be regraded will be stockpiled and covered to be used at a later time.

The northern half of the property will generally be graded to meet the appropriate landfill cover requirements as previously discussed and graded to allow for future uses of the site. Suitable onsite soil material (as defined by the geotechnical engineer) will be used to the maximum extent feasible to balance the grading efforts. This will require re-grading some areas adjacent to the landfill so onsite soils can be used in the grading efforts needed to reshape the landfill surface to minimize import of offsite materials. Only in the event there is not sufficient suitable onsite materials from outside the landfill area (as needed to reshape and close the landfill) will imported structural fill material be brought onto the site for completing the landfill closure. Current plans call for balancing the cut/fill requirement of the Bakerview project using onsite materials to the maximum extent possible. Any exposed and scattered landfill debris outside the landfill area will be cleaned up and placed on the landfill and covered per the landfill cover system requirements in Section 4 of this report. Only materials designated by SHD would be removed from the property as described elsewhere.

As a condition of plat approval, the Hearing Examiner is requiring the following testing program for the lot areas. (Note: Material from many of the lot and road areas is being excavated and used as fill of the various landfill cover requirements. This testing will coordinate with the mass site excavations.)

P&GE shall submit a test pit sampling program for PDS and third-party expert approval. The purpose of the sampling program will be to determine whether any waste lies under any of the residential lots. The sampling program should be of such depth and frequency to assure future residents that waste does not lie under their houses and yards. The results of the sampling program shall be filed with PDS and promptly provided to the Homeowners Associations. If waste is found under residential ots where it was not expected to be found based on prior explorations, additional exploration shall occur to determine the horizontal and vertical limits of the waste so discovered. Al waste found under residential lots shall be excavated, removed, and handled according to the Landfill Closure Plan as if it had been found in an expected location. The appropriateness and reasonable ness of the exploration program requires engineering judgment that should be applied not only by P&GE, but also by PDS, the Health District, and by a third-party expert.

3.4 Waste Relocation

3.4.1 Introduction

There will be three relocations of waste material within the existing landfill to accomplish the closure. These are: The detention pond area, the landfill perimeter area (so-called Wedge area), and the landfill Cover 1 area. All of the waste material to be relocated was lawfully placed on the property while CU-7-72 was in effect. None of this material was imported into the landfill since its closure in 1983. These relocations will result in the improvement of the landfill for the safety and betterment of the public that is currently and, in the future will be, using the site, the protection of the surrounding environment, and the amelioration and improvement of surface and subsurface water qualities historically associated with the prevailing conditions of the water courses over, through and under the landfill for the past 30-plus years.

This Closure Plan addresses the requirements for reshaping these three areas of the landfill to allow for the "Closure of the Landfill" to comply with WAC 173-350-400 (e) "Final closure system design" and Snohomish Health District requirements. Although the Go-East landfill has not accepted any material since 1983, SHD is requiring the closure meet the current applicable closure requirements of WAC 173-350-400. The multiple benefits of closing the landfill are included in Section 1.3 and therefore will not be repeated here.

3.4.2 Detention Pond

The current code requires the landfill be covered with a low permeable cover material meeting certain permeability requirements as discussed in Section 4. This will cause major flooding to the downstream property owners and Lowell-Larimer Road and siltation of surface waters downstream. To prevent this, a detention pond is required and being provided for flow attenuation and water treatment. The only feasible place available on site to put this pond is where shown on the project plans (Appendix D) on the landfill. It is located uphill of the NE landfill slope setback (as determined by the project geotechnical engineer), in the lowest ground to minimize runoff by-passing the pond, in the only area large enough to accommodate the pond and in the shallowest landfill area to minimize any settlement issues. It also is being dug into the landfill resulting in a 30+ year surcharge, and the pond area is being compacted using dynamic compaction further eliminating any future settlement issues with the pond. To construct this pond landfill material has to be relocated and a high level of compaction accomplished to ready the pond area for subgrade for the pond construction. The pond has to be constructed at the proper grades to collect the runoff from the majority of the landfill and be oversized to compensate for any runoff area that is not possible to drain to the pond (the northeast landfill slope area) and other site requirements. The detention pond will be graded to its final configuration during the landfill closure and the associated storm pipe conveyance systems will be installed to collect and adequately discharge stormwater runoff safely down the piped conveyance system north of the sloped landfill area. The detention and water quality treatment pond will be graded to final elevations and used as the temporary TESCP (temporary erosion sedimentation control plan) sediment pond for landfill closure activities preventing erosion from escaping off the site. The pond will be graded with gentle side slopes of 3:1 or flatter to provide a park like feel without using fences. The landfill area above the northeast fill slope will be re-graded to provide a final grade that drains to the stormwater pond for water quality treatment and controlled discharge to the downstream drainage system.

3.4.3 Northeast Slope Area

This section deleted.

3.4.4 Edges of the Landfill

To comply with covering the existing landfill area that is to remain, it is imperative that the edges be defined and graded to a uniform shape to permit the covering and edge treatment. Also, debris outside the defined landfill (if any) needs to be relocated. This requirement has been combined with the closure plan objective of reducing the size of the landfill to remain and needing to be maintained as specified in 173-350-400(e)(i)(H) “Minimize the need for post-closure maintenance”. This also coordinates the goal providing a residential subdivision to finance the closure plan adjacent to the landfill. To accomplish all of these goals, some landfill material has to be relocated from the edges. An irregular-shaped area containing site sands and landfill waste materials along the perimeter of the landfill on the west and south sides will be relocated/excavated during initial site closure grading (this area has been referred to as the “wedge area”). This area will then be backfilled with compacted structural fill material from onsite material excavated outside the landfill area to accommodate a transitional boundary and edge of the landfill cover, gravel gas trench and future land development options. These areas of earthen structural fill will be compacted to at least 95% of the modified Proctor maximum density using ASTM-D1557 (as recommended in the Geotechnical Engineering Report). This will reduce the footprint and precisely define the boundary of the landfill. This reduction will represent a reduction of area previously impacted by stormwater infiltration and thus reduces the area needing landfill closure cover mitigation and future landfill surface maintenance. The waste between the existing perimeter of the landfill (zero-foot depth line) and inward towards the landfill including the area proposed for the gravel gas trench, lying outside the area of proposed lots and streets, will be removed. The excavation may extend several more horizontal feet inward and then continue at roughly a 1½:1 slope up to meet existing grade (actual slope, as required to provide a safe working environment). It is estimated based on prior test pits the depth of this area may vary between about 0 and 20 feet, with an average depth of about 10 to 15 feet. The full time geotechnical engineer onsite will monitor the landfill closure activity and wedge removal. The type of material, density and color all will be apparent when the native material is encountered. The landfill waste is dark brown to gray in color with no bedding features and contains abundant debris. The native soils consist of tan to gray sand and gray silt with bedding features indicative of the native soils. Visual distinction between the landfill waste and the native soils will be obvious. Within this removal area, a new perimeter gravel filled methane interception trench will become the boundary of the capped landfill, an area of approximately 6.4 acres. The existing landfill area is approximately 9.6 acres. The irregular-shaped area to be excavated (between the zero-foot depth line and extend to include all areas just past the gas trench of proposed lots and streets) represents the limit of excavation of approximately 3.2 acres. It is currently estimated about 52,000 cubic yards (depending on actual depths of landfill encountered) of material will be excavated relocated on the top (subgrade of Cover System 1) of the landfill area to remain. Another roughly 10,000 cubic yards will be relocated from the creation of the detention pond. Refer to Appendix D for plans of the proposed landfill area that will remain.

3.4.5 Cover of the Remaining Landfill

To accommodate the covering of the existing landfill area to remain (Cover 1 area) as shown on the project plans in Appendix D, grading it to drain to the detention pond is required. Additionally, the top area needs to be filled and compacted to create the final subgrades as previously discussed, to allow for placement of the cover system. This regrading not only is needed to meet the code slope requirements of the WAC, but to provide grades that prevent the run-on of surface water from around the landfill area. The final grades for the landfill area must coordinate with the final grades of the land around the landfill. The final design has to take into account the balancing of cut/fill of the site that will ultimately produce final grades. Additionally, when the landfill has been permanently closed the final grades need to account for settlements, gas trench around the landfill, run-on as previously described and surface runoff. In order to create the proposed final surface grades that comply with the WAC and final project grade requirements, the landfill material is to be relocated and re-graded. It is estimated the Cover 1 area will be capped with about 55,000 to 65,000 cubic yards of landfill material from the detention pond area, slope area and wedge area. Once capped, 6 inches of onsite sand material will be placed and compacted over the compacted landfill subgrade. Any exposed landfill material will be covered each night as discussed elsewhere and the area actively being graded will be limited to no more than one acre at a time. The landfill area will be capped with a protective earthen cover supplemented by a geomembrane liner layer system described in Chapter 4 of this report. The earthen cap will provide a grassy recreation surface, with shrubs and possibly small trees, and a detention and water quality treatment pond. The main landfill area will be graded to roughly a 5 percent slope (minimum slope by code is 2%) to drain to the stormwater detention pond.

3.5 Site Setbacks

The WAC 173-350-400 requires a setback of one hundred feet between the open and active landfill areas and the property parcel boundary. That regulation does not apply as the Go East landfill is not active nor has it been since 1983. It is of interest to note that the boundary of the previous active landfill facility did generally comply with these recommendations. The existing landfill, when it was operational had a setback from the adjacent properties of 100 feet or more except for an area along the north side as previously described. No existing homes are within 100 feet of the landfill area. This will provide a functional setback area for activities related to the final landfill closure activities.

An adequate buffer between the landfill and the residential lots is provided to allow operation of the landfill management features; including vehicular access and methane gas migration trenching monitoring wells. The separation will prevent harmful impacts to the trench and liner by the residents. The development plan also proposes a pedestrian trail system surrounding the landfill. This will provide access to the methane gas migration trench, gas monitoring structures, and the installation of an active gas reduction system that could be installed in the four (4) gas monitoring structures if needed. Additionally, an access road will be constructed across the landfill for access to the detention and storm management features. No privately owned residential properties are planned to be placed on top of the landfill area.

A grading plan (revised July 2015) has been prepared for closure of the Go East Landfill and is located in Appendix D of this report. Additionally, preliminary plat drawings include detailed grading and drainage plans for the landfill and entire project area. The grading plan shows the proposed finished elevations for the top of the soil cover layer over the landfill area as well as proposed contours over the remainder of the northern half of the site.

3.6 Waste Relocation, Oversight and Requirements

3.6.1 Landfill Debris Screening Plan – If Needed

No screening of the landfill material is planned unless it is directed by SHD or the onsite professional overseeing the landfill relocation efforts. However, should screening be required it will be accomplished in compliance with this Section.

To date there have been over 65 soil test logs excavated into the landfill with depths up to and over 25 feet for the purpose of inventorying the type of debris and depths of material contained in the landfill. Individual soil logs are recorded by the geotechnical engineer observing the excavations and are all contained in Appendix A of the closure plan. There will be periodic testing of the mineral soils and materials being excavated from the landfill perimeter to provide information needed to provide proper worker protection during construction and to allow documentation of the material being relocated from the landfill perimeter to the top of the landfill. None of the excavated material is planned to be hauled offsite for disposal unless it contains asbestos or lead paint, or as may be directed by SHD for removal. Graded and excavated landfill is to be relocated and reused on the landfill to create fill grades to permit closing the landfill at slopes that meet current WAC requirements.

Only material excavated from the “Wedge” such as a tire, carpeting, and organics that are not wood waste (material not readily compactable) would be removed during excavation. This would be accomplished by the excavator setting aside any such items encountered and the material being manually separated and piled on site until a full load is obtained. At that time a dump truck shall be loaded and covered to transport the material offsite to an approved landfill site accepting the material. Any hazardous material if encountered would be placed into a container on site and stored until it is hauled and disposed of offsite at an appropriated landfill site. Of the materials encountered in past exploration including gravel, concrete, wire, woody debris, tire, brick asphalt, plastic pipe, dimensional lumber, burned wood, metal, glass shards and carpet, only the tire and carpet would not be proposed to be put back into the landfill. Unless directed by the project geotechnical engineer monitoring the landfill excavation activities, all material will be relocated directly and compacted on the portion of the landfill to remain.

Some additional materials that may be encountered in the landfill are those allowed under the “Written Order No. 76” dated September 18, 1975 by the Snohomish County Zoning Adjustor. They include “Wood, including tree stumps, logs, and demolished buildings: mineral, concrete, asphaltic products: any type of waste soils; bulk packaging materials, pallets, warehousing waste material of wood or metal components; and tires.” In addition to these items Go-East was allowed to dispose of broken glass which was used to stabilize the haul roads. Any non-inert materials not listed above would not be allowed to be relocated unless approved by SHD.

The area to the west of the proposed detention/water quality treatment pond will be used as the landfill debris screening location for materials that are required to be screened or manually separated. A note depicting this area has been added on sheet 1 of 3 as included in the Appendix D.

A full time certified professional will be on site during the times landfill material is being regraded and moved. All materials will be visually inspected for evidence of asbestos, including board and tiles, and onsite swab testing for lead paint will be performed as painted boards are identified. Representative samples of suspect materials collected and tested. A certified asbestos professional will be onsite to visually inspect excavated materials. Only materials directed by this professional or SHD to be screened will be moved to this location. All other materials will be relocated and compacted on top of the landfill to there remain. Materials with detectable levels of lead paint, chemicals, and asbestos will be handled appropriately in accordance with the current solid waste handling standards as outlined in WAC 173-350 and Snohomish Health District Sanitary Code Section XVIII, and transported offsite to an appropriate facility for disposal.

3.6.2 Preventive Measures during Relocation

The maximum area being regraded on the landfill at any one time will be limited to one acre. Any areas not covered with a minimum of 6 inches of sand cover material will be covered after work hours with Visqueen and sand bags to preclude any airborne materials and reduce fire potential. To further control and contain dust during excavation a fire hydrant with a consumption meter will be used to fulfill an onsite water truck. Materials will be sprinkled with water as needed and all runoff contained. A backflow device will be installed on the fire hydrant. Screening of asbestos materials if found, will be accomplished in compliance with applicable codes and by workers certified for handling these materials under the direction of a certified professional onsite monitor for the relocation work. This may require sprinkling the areas with water to mitigate adverse effects. The Washington State Department of Ecology Best Management Practice (BMPs) for dust control shall be followed and are found in Volume IV of the Department's 2005 Storm Water Management Manual for Western Washington (Department of Ecologies 2005, SWMMWW). This described practice may also be used for controlling dust due to disturbance of other areas. The BMP discussed other ways to control potential dust such as also covering stockpiles with a wind-resistant fabric. All BMP standards will be observed and fully complied with.

As discussed in the LFCP besides the physical requirement of needing to relocate some landfill materials to shape the landfill ready for covering (as required by the current WAC), keeping as much material onsite as possible is the most environmentally responsible way of closing the landfill. Additionally, it provides for maximum workers safety in minimizing handing the landfill materials. It reduces traffic impacts and potential of truck accidents moving landfill material offsite and safety to the local adjacent communities from needing to move materials offsite. Even though over 65 exploration holes were dug and not one found any hazardous materials, keeping material confined on site is the most efficient and responsible way to implement this closure. (As a reminder, there was a full-time operator who lived on site and oversaw all material brought on site and managed the landfill operation.) This Plan discusses the landfill testing and full-time oversight that must occur to implement the plan. The first requirement listed in WAC 173-350-400 (e)(i) is "(A) Prevents exposure of waste". The Plan for Go East complies with these requirements by not unnecessarily hauling off portions of the landfill material, when it can be simply and safely (moved) placed, compacted and covered a few feet from where it currently exists to reshape the current landfill to allow it to be closed (covered) in compliance with the current WAC requirements. Pictures showing typical landfill materials expected to be encountered are included in the following pages. A high percentage of the material consists of local sands used for covering the landfill material each day.

As previously discussed prior to construction, materials proposed to be relocated from the wedge area will be tested for contamination (see Table G-4 below, taken from Volume IV of the Department's 2005 SWMMWW) and pH levels. These materials will be sampled and analyzed at the frequency of 1 sample for every 500 cubic yards for the first 2,500 cubic yards, and then one sample taken approximately every 2,500 cubic yards thereafter. In the event that change is encountered, texture or other characteristics area observed by the onsite monitoring professional that indicate a possible different source of the materials and soil, a sample we will be collected even when the frequency exceeds 1 sample per 2,500 cubic yards. More sampling may be required if field testing indicates that additional assessment is needed due to high levels of one or more of potential contaminants.

Table G.4 – Recommended Parameters and Suggested Values for Determining Reuse and Disposal Options

Parameter	Suggested Maximum Value (MTCA) (1)	TCLP Maximum Value (2)
Arsenic, Total	20.0 mg/kg	5.0 mg/l
Cadmium, Total	2.0 mg/kg	1.0 mg/l
Chromium, Total	42 mg/kg	5.0 mg/l
Lead, total	250 mg/kg	5.0 mg/l
Nickel	100 mg/kg	Na (3)
Zinc	270 mg/kg	Na
Mercury (Inorganic)	2.0 mg/kg	0.2 mg/l
PAHs (Carcinogenic)	0.1 – 2.0 mg/kg	
TPH (Heavy Fuel Oil)	200 - 460 mg/kg	Na
TPH (Diesel)	200 – 460 mg/kg	Na
TPH (Gasoline)	100 mg/kg	Na
Benzene	0.03 mg/kg	0.5 mg/l
Ethylbenzene	6 mg/kg	Na
Toluene	7 mg/kg	Na
Xylenes (Total)	9 mg/kg	Na
pH (4)	6.5-8.5	6.5-8.5

Notes: Model Toxics Control Act Method A values for unrestricted site use or protection of terrestrial organisms.
Maximum Concentrations of Contaminants for the Toxicity Characteristic per WAC 173-303-090.
Na = No value given
pH range considered to be neutral

Results of the testing will be compared to the MTCA (Model Toxics Control Act) values listed in Table G-4 to allow the contractor to determine the level of worker protection required. Additional air monitoring may be required to determine respiratory protection if fugitive dust becomes an issue. The results of TCLP (Toxicity Characteristic Leaching Procedure) analyses will be compared to the Table G-4 limits to determine and document that dangerous is not present and not being relocated onto or into the landfill area. Should TCLP's values exceed the dangerous waste criteria listed in Table G-4, special handling and disposal requirements will be implemented. Furthermore, the contractor shall look to Labor and Industry and worker health and safety regulation should any hazardous material be encountered.

3.6.3 Air and Odor Control Activities

No odors are anticipated because of the nature of the materials being excavated. This is documented by the nearly 70 test holes that have been excavated, many to depths deeper than any proposed excavation to occur with the closure plan. No odors were encountered. Construction mitigation such as watering/sprinkling to keep dust down, etc. is included in the plan. See the prior Section 3.6.2. Besides these mitigation measures, the following best practices as recommended by the independent third party peer review will be complied with during the landfill closure activities:

- Speed limits onsite: Vehicle speed affects the disturbance of dusty road surfaces. For both safety and dust control, vehicles should limit onsite speed to 15 mph.
- High Wind Closures: Earthwork operations should be curtailed during dry, windy conditions when mitigation measures (such as watering) cannot be effectively implemented. Road dust is easily generated during dry conditions and can remain airborne for a long distance during high winds. Curtailment of dust-generating activities is a standard surface disturbance best practice when other mitigation measures are no longer effective.
- Training: The construction manager should provide training and regular debriefings of crews on the importance of implementing and maintaining fugitive dust control measures. This includes the importance of ongoing observations to determine if conditions have deteriorated or a mitigation measure is ineffective or not being used properly.
- Inspections: Onsite workers should conduct a daily inspection to ensure that mitigation measures are remaining effective and that there are no areas of inadequate dust control.

These mitigation measures represent the best practices of the industry for reducing road dust impacts from closure construction, and fugitive dust from road travel should be minimized to the extent practicable.

4 FINAL SOIL COVER SYSTEM

4.1 Introduction

The primary objectives of the landfill closure improvements are stated in Section 2.1.2 of this report. However, the objectives are restated here to emphasize that the final soil cover system for this project is ultimately the basis for accomplishing these objectives. To satisfy the landfill closure requirements, ***Final closure system design***, (WAC 173-350-400(e)), the soil cover system must:

- Prevent exposure to waste;
- Minimize infiltration;
- Prevent erosion;
- Be capable of sustaining vegetation;
- Address settlements resulting in no less than two to five percent slope after settlement;
- Provide sufficient stability and mechanical strength, and address potential freeze-thaw;
- Provide for the management of run-on and runoff;
- Minimize the need for post closure maintenance;
- Provide for the collection and venting of methane; and,
- Meet the requirements of regulations, permits, and policies of the jurisdictional air pollution control authority.

This chapter presents the existing conditions on site, the design criteria used to develop the final soil cover system, and the details of that cover system. Additionally, the final landfill grades must blend with the grades surrounding the landfill to prevent “run on” of surface water and avoid potentially dangerous transition grades.

4.2 Existing Soil Cover Conditions

The existing conditions of the landfill cover as they relate to the final soil cover design are described in Sections 1.6 and 3.2 of this report. The Geotechnical Engineering Report for this project describes the existing conditions of the waste material within the landfill, as well as presenting soil logs displaying the soil characteristics. Section 1.7 of this report summarizes these findings.

In summary, the upper landfill area is located in a ravine and covers an area of approximately 9.6 acres. It currently contains slopes ranging from zero to five percent and is currently vegetated with a variety of trees including red alder and black cottonwood as well as grass, native shrubbery, and non-native vegetation including Himalayan blackberry bushes. According to the Geotechnical Engineering Report for this project, “the exploration pits generally encountered consolidated, granular, glacial sediments overlain by fill material that varied widely in thickness and composition" including assorted construction debris.

4.3 WAC Design Cover Criteria

The presumptive design criteria to address the regulatory requirements for the landfill cover, (as stated in WAC 173-350-400) *Final closure system design,* are as follows:

- "An anti-erosion layer consisting of a minimum of two feet of earthen material of which the upper 12 inches is capable of sustaining native vegetation, seeded with grass or other shallow rooted vegetation."
- A geomembrane with a minimum of 30-mil or greater thickness is commensurate with the ability to join the membrane material and site characteristics such as slope, over a competent foundation.

4.4 Proposed Cover System Overview

The proposed cover systems will encompass a total area of approximately 6.4 acres. The presumptive final closure cover for the final landfill cover system for proper closure are stated in WAC 173-350-400(e)(ii)A&B. This project as proposed will exceed the minimal requirements in this Code Section. The cover systems are described in detail in the subsections below and shown in cross-sectional views located in Appendix D of this document.

For this project there are two separate and distinct cover systems:

- **Cover System 1:** For the larger plateau area and slopes up to 3:1, the area will be covered by a minimum 40-mil LLDPE (linear low-density polyethylene) geomembrane liner, plus a geotextile layer directly above the geomembrane, plus at least two feet of earthen material with the upper 12 inches being organic material suitable for supporting native and seed grasses. The geomembrane liner is discussed in more detail in Section 4.4.2.2 of this report.
- **Cover System 2:** For the area of the proposed stormwater detention pond and conveyance ditches, a second 40-mil LLDPE geomembrane liner layer will be provided for additional protection against water infiltration.

4.4.1 Cover System 1

Cover System 1 encompasses the largest area, approximately 4+ acres, and includes the entire "plateau area."

This cover system will require a 40-mil geomembrane liner (LLDPE or approved), plus a minimum of 2 feet of earthen material with the top 12 inches including organic material suitable for supporting native and seed grasses.

4.4.1.1 Soil Fill Material Layer

The soil fill material layer will generally range from a depth of 0 feet to 10 feet as required to achieve the proposed grades. This fill material will be generated from grading and relocation of onsite cut materials in combination with onsite mineral soils as recommended in the Geotechnical Engineering Report and as shown in the proposed grading plan in Appendix D. This material will be placed and compacted typically in one-foot lifts as directed by the project geotechnical engineer. After compacting the final lift of this layer, it should be carefully inspected for protruding objects, and they should be removed before laying down the sub-grade. Any exposed landfill material will be covered as describe elsewhere in this plan at the end of each working day.

4.4.1.2 Sub-Grade Layer

The sub-grade layer will consist of a minimum of 6 inches of foundation material. This layer is intended to serve as a flat surface (bedding), onto which the geomembrane liner will be placed, and to prevent any puncture from waste below and help minimize differential settlement of the waste. The foundation material will be compacted ready for the placement of the geomembrane on top of it. Careful inspection is required of the sub-grade layer before placement of the geomembrane. The six inches of foundation material must be a measured six inches above the soil fill material layer, in other words, foundation material that fills voids in the fill material layer is not part of the six-inch sub-grade layer.

4.4.1.3 Geomembrane Layer

Over the sub-grade layer, the geomembrane liner will provide extra protection against stormwater infiltration into the landfill. This project proposes to use a minimum 40-mil geomembrane liner (LLDPE or approved), which is commonly used for capping landfills and lining ponds. The liner membrane will be flexible and capable to elongate to accommodate any possible differential settlement that may occur over time. The liner is intended to prevent moisture penetration downwards and gas migration upwards. Directly over the top of the geomembrane will be placed a geomembrane cushion as recommended by the manufacturer of the membrane.

For further information on the geomembrane liner layer, Appendix E discusses monitoring and control activities. For testing of the geomembrane liner layer, see “Northwest Linings and Geotextile Products, Inc., Construction Quality Control Manual for Containment Membrane Field Installations” included in Appendix E of this report. The specifications and materials and installation warrantees for the geomembrane liner are included in Appendix E. This liner, as recommended by the independent third-party peer review, or approved equal, shall be used for this project.

4.4.1.4 Soil Layer

The project proposes to place a minimum 2-foot thick soil layer per geotechnical engineer recommendations on top of the geomembrane. Section 10.3 of the Geotechnical Engineering Report recommends, "This material be placed in minimum loose lift thickness of 24 inches (or as practical)", with the top 12 inches of material described in 4.4.1.5 below.

4.4.1.5 Vegetative Soil Cover Layer

The vegetative soil cover layer will be a minimum of 12 inches deep and will consist of organic soils to promote and sustain plant and/or grass growth. The vegetative soil depth may be deeper as required to develop adequate plant root systems.

4.4.2 Cover System 2

Cover System 2 is proposed in the area of the stormwater pond for additional protection against stormwater infiltrating into the landfill with use of a second geomembrane liner. Cover System 2 will extend one foot above the pond overflow level and encompassing the entire pond area (an area of approximately 0.7 acres). Cover System 2 consists of the following layers from bottom to top.

4.4.2.1 Lower Sub-Grade Layer

The lower sub-grade layer will consist of 6 inches (minimum) of compacted foundation material. This layer is intended to serve as a flat surface for placement of the lower geomembrane liner, and to prevent any puncture from waste below and help minimize differential settlement of the waste.

4.4.2.2 Lower Geomembrane Layer

Over the lower sub-grade layer, the geomembrane liner will provide protection against pond water infiltration into the landfill. This project proposes to use a geomembrane liner which is commonly used for capping landfills and lining ponds (see Appendix E for specifications for the liner). The geomembrane is flexible and able to elongate to accommodate possible differential settlement that may occur over time. These liners are intended to prevent moisture penetration downwards and gas migration upwards.

4.4.2.3 Upper Sub-Grade Layer

The upper sub-grade layer will consist of 12 inches (minimum) of foundation material (site sands) placed without compaction. This layer is intended to serve as a flat surface to place the second geomembrane liner. Monitoring pipes will be placed horizontally at the low point in this layer to convey any leakage to a daylight point on the northeast slope for on-going monitoring activities. There are four (4) such pipes include each stating at a different section under the detention pond. In this way should a leak occur, it can be easily traced to a particular area in the pond.

4.4.2.4 Upper Geomembrane Layer

Over the upper sub-grade layer, the geomembrane liner will provide additional protection against stormwater infiltration into the landfill. This layer proposes to use a second geomembrane liner with a geotextile protective layer directly above the geomembrane. Penetrations of the geomembrane for pipes will be in compliance with the manufactures recommendations.

4.4.2.5 Soil Layer

The project proposes to place a minimum 2-foot thick soil layer per geotechnical engineer recommendations on top of this upper layer. Section 10.3 of the Geotechnical Engineering Report recommends, "This material be placed in maximum loose lift thickness of 24 inches". A minimum of the top 6 inches shall be material described in section 4.4.2.6 below.

4.4.2.6 Vegetative Soil Cover Layer

The vegetative soil cover layer will be a minimum of 6 inches deep and will consist of organic soils to promote and sustain plant and/or grass growth. The vegetative soil depth may be deeper as required to develop adequate plant root systems.

4.4.3 Cover System 3

This section deleted.

4.5 Settlement of the Landfill Area

To conform to the grading plans, some soil cover system areas over the landfill may be as deep as 10 feet or more. The Geotechnical Engineering Report estimates that a minimum settlement of 1 foot could occur if 10 feet of fill soil is placed on the landfill. The 1-foot of settlement is based on modeling the waste as loose, granular soil and does not take into account decay of construction debris or collapse of potential voids within the landfill.

The landfill has 30 years of past settlement due to consolidation, decomposition, and differential settlement. With the new closure activity proposed in the closure plan, the existing surface will be proof-rolled, reshaped, added to, and excavated, depending on location. Any voids that may have occurred over the years will be eliminated with the new activity. The entire landfill area is to remain as open space. Any future possible settlements will be significantly reduced by the fact that underlying and buried material has been in place for more than 30 years, combined with the re-compaction efforts that will occur with the proposed landfill closure. The stormwater pond area will be excavated into the existing grades benefiting from a 30-year surcharge of the pond area, reducing the possibility of settlement in this area even more, and additionally, the pond area is to be dynamically compacted. The pond is being constructed in the shallower fill areas to minimize the possibility of any significant future settlement and at the lowest elevation on the landfill possible maintain the required slope setbacks.

5 STORMWATER IMPROVEMENTS

5.1 Introduction

Typically, the intent of the proposed stormwater facilities is to collect runoff from the proposed development and detain and release it at the allowable rates per the 1992 Department of Ecology's Stormwater Management Manual for the Puget Sound Basin (1992 DOE Manual), as adopted by Snohomish County. The project is vested to this manual in February 2010.

The initial application for the Closure of the Landfill was submitted in March 2010. The application was deemed complete and sufficient for review by SHD. Additionally, the Preliminary Plat plans were submitted to Snohomish County Snohomish County Planning and Development Services (PDS) and the application deemed complete prior to adoption of the 2005 NPDES standards by PDS in September 2010. Therefore, the property is vested under the 1992 Stormwater Management Manual. The property owner has met with the downstream property owner, who has been impacted by runoff from the adjacent developments around the Bakerview property. The Bakerview project has the unique opportunity to facilitate the rate of runoff leaving the site because of the landfill area which is to remain as open space, to oversize the required stormwater detention facility as required to allow for covering the landfill and potentially help reduce impacts to the downstream properties. The area on the plateau of the landfill is to remain as open space and is therefore available for increased runoff rate mitigation.

The development plan strives to improve the existing stormwater management system and will eliminate infiltration of stormwater runoff into the waste. The following sub-sections explain the current conditions of the stormwater flow as it exists today, design criteria for the stormwater facility design, and the proposed stormwater functionality and facilities.

5.2 Existing Stormwater Conditions

Surface water on the main, upper landfill portion of the site generally flows to the southeast at four to five percent grade. Runoff from the southwest portion of the flatter part of the site flows into a stream entering the site from the west and runs across this portion of the property in a southeasterly direction. As documented by Wetland Resources, Inc., (located in Appendix C of this report), this stream (Stream 1) is defined as a Category III wetland and extends offsite to the west. This stream originally flowed at the bottom of the landfill ravine before permitted landfill activity occurred about 40 years ago. Over the many years the stream has been temporarily diverted to accommodate landfill operations. Currently the plateau stream (Stream 1) is discharging down a slope to Stream 2 causing significant erosion. In a ravine in the central portion of the site, this stream meets up with another stream that runs to the east. These streams (Stream 2) then intersect a third stream (Stream 3) that runs northerly just east of the eastern property line and the flow continue north towards the Snohomish River Valley. On the east and south perimeters of the property are steep slopes and ravines. Runoff currently flows down the respective hillside towards the stream in each of the ravines. The stream (Stream 1) will be restored in a permanent alignment with planted buffers and then protected by recorded tract boundaries. The proposal related to the stream is more fully described in Section 5.4.4.

As stated previously, the landfill is located in what was previously a ravine. As explained in the Hydrogeology section of the *Hydrogeology, Groundwater, and Surface Water Quality Report* prepared by Associated Earth Sciences, Inc., dated December 15, 2009 (located in Appendix B of this report), "The shallow groundwater flow likely mimics the pre-fill topography. Shallow groundwater beneath the site appears to flow from the north, south, and west portions of the property to the center of the landfill area before turning east to follow the former ravine axis and discharging along the east face of the landfill" (what has been referred to as "the spring") into the stream at the northeast corner of the site.

5.3 Design Criteria

The applicable design criteria for flow control and water quality treatment for this project is the 1992 Department of Ecology's Stormwater Management Manual for the Puget Sound Basin (1992 DOE Manual), as adopted by Snohomish County in 1998 as well as the additional addenda and amendments. The development project is vested to the 1992 Design Manual, based on the "Determination of Completeness" of the Preliminary Plat / Subdivision Application issued by Snohomish County PDS in February of 2010. Stormwater design must also follow the requirements set forth in Snohomish County Code Chapter 30.63A "Drainage" and the 2009 Engineering Design and Development Standards (EDDS). An "Upstream and Downstream Analysis" has been completed on the stream as well as the site area. This analysis was submitted to Snohomish County PDS with the Land Use Application.

Although the landfill closure plan does not include the additional significant proposed impervious surfaces; it does provide stormwater facilities that are sized for future development of the Bakerview residential plat. The stormwater facilities will accommodate developed flows from the proposed developed impervious and pervious surface areas. The stormwater facilities will be graded to their final elevations during the landfill closure period and will be fully operable immediately after landfill closure.

Landfill closure will provide the required water quality treatment. A flow control facility will also be provided for storm events up through the post development 24-hour, 100-year storm. Allowable peak discharge rates from the site are limited to 50% of the 2-year, 24-hour existing condition peak flow rate, and up to the 10-year and 100-year, 24-hour existing condition peak flow rates, as required per Chapter I-2.9 of the 1992 DOE Manual. Surface water runoff treatment for this project is required to treat the flow volume from the 6-month, 24-hour storm event. Existing and proposed stormwater flows used for sizing the flow control and water quality treatment facility for this project were generated using the Santa Barbara Unit Hydrograph Method.

The design criteria for stormwater pollution prevention varies from the design standards for flow control and water quality treatment. Snohomish County has adopted a newer version of the Ecology Manual for its construction stormwater pollution prevention (i.e., temporary erosion and sediment control measures): Volume II of the 2005 Ecology Stormwater Management Manual for Western Washington (2005 Ecology Manual). The temporary sediment pond for the landfill closure is contained in these guidelines which are located on page 4-105 of Volume II.

Stormwater ponds are located at the lower areas of the developed property to facilitate and maximize gravity flow of water to the facility. The pond will be located as shown on the plans in Appendix D. Subsequently, in the permit approval process, once Snohomish Health District approves this closure plan, documents will be developed with detailed drawings for submittal to the Snohomish County PDS to obtain Preliminary Plat Approval, subsequently a Grading Permit to allow for the implementation of the closure plan. Several other permits may also be needed, including an Ecology NPDES Permit, WDFW, Haul Road and Route approval, associated development approvals, and possibly others. These permits will be applied for promptly.

5.4 Proposed Stormwater Improvements

(Note: The following section has been updated to account for leaving the northeast slope in its current stable and vegetated state.)

The proposed combination detention and water quality treatment pond will be located on top of a compacted low permeable soil layer as described in Section 4.4.3. This compacted low permeable soil layer will be lined by a double geomembrane liner. The pond will be graded to its final elevation during the closed and capped landfill closure period and the associated storm pipe conveyance systems will be installed to collect and adequately discharge stormwater runoff. The pond will be used as the temporary sediment pond for erosion control purposes. Runoff from the developed portion of the site above the 3:1 northeast fill slope (west of the proposed access road) will be directed to the combined detention and water quality treatment pond, where runoff will be treated and discharged at the allowable released rate. Controlled flow will travel via storm drainage pipe towards the northeast and be conveyed down the slope in a tight-lined pipe to the ravine at the bottom. Here, it will discharge to the stream that runs northerly along the east property line. The tight-lined pipe will reduce the risk of erosion that could be caused by releasing the runoff directly down the slope.

The importance of the stormwater improvements is to restrict water from infiltrating into the closed and capped landfill area to the maximum extent feasible. The soil layer in conjunction with the double geomembrane liner, as described in Chapter 4 of this report, is the primary measure in minimizing infiltration and directing runoff to the detention pond. The soil layer is graded to direct water to the pond. The pond outlets are tight-lined to the natural discharge location at the northeast corner of the property.

Prior to any landfill activities, the northeast corner of the site was the natural discharge location for runoff from the site. The stream previously discharged in this direction, but since has been diverted due to landfill activities. The spring daylights at the toe of the landfill; the same location as the original historic stream.

The project will relocate the plateau stream, Stream 1, to a permanent alignment that allows it to discharge at a location that eliminates both erosion and infiltration into the closed and capped landfill. The relocated stream alignment is proposed to continue south of the current stream location where it outlets from the historic fire storage pond, now designated as a wetland. Stream flow from the wetland travel via open channel flow towards the south for 325 feet and then cascade down the slope with energy dissipaters, where it will intersect the larger stream just upstream of its current discharge location. An alternative to the open channel flow down the slope is to tight-line the stream in a pipe to reduce the risk of erosion if erosion issues are significant. Refer to Section 5.4.4 for more details on the proposed stream.

If a storm event exceeds the 100-year design flow rate, the overflow manhole structure in the pond will convey the stormwater to the same downstream piped conveyance system as explained above. No stormwater will overflow out of the pond because the inlet for the overflow structure is set below the berm of the pond. Therefore, water will flow through the overflow structure first before topping the berm.

The following sections describe in more detail the necessity, function, and size of the proposed stormwater facilities.

5.4.1 Water Quality Treatment Pond

A combination detention and water quality treatment pond is provided for this project and designed to accommodate a future development with associated impervious areas and developed flow rates. The water quality treatment pond consists of two cells within the larger combination pond, the first cell for pre-settling and the second for sediment removal. Both cells will have a water quality depth of 3 feet, with 4 feet of detention on top, for a total depth of 7 feet. Cell one will also have an additional 12” of depth for sediment storage and cell two will have an additional 6” depth for sediment storage. The cells will be planted with vegetation that can withstand the varying depths of the detention storage. The remainder of the pond area outside the water quality cells is for detention storage and will be from 0-4 feet deep. As described in Section 4.4.3, a double geomembrane liner system will be placed beneath the combination detention and water quality treatment pond.

The basic water quality treatment volume required is approximately 33,300[3] cubic feet. In the current designed condition, approximately 33,300 cubic feet will be provided with approximately 15,300 square feet of surface area.

5.4.2 Detention Pond

The detention storage volume is located above the water quality treatment volume. The detention storage depth is 4 feet and is designed to accommodate future development with associated impervious areas and developed flow rates. The detention volume required was calculated using the existing and proposed peak flow rates. The volume of detention storage required is approximately 85,000 cubic feet. Approximately 92,000

[3] Provided water quality treatment volume, surface area and detention volume shown are based on TIR for Bakerview dated February 2013. For updated figures refer to January 2018 study for Bakerview.

cubic feet of detention storage volume is proposed. The double geomembrane liner system as described in Section 4.4.3 will be placed under the combination detention and water quality treatment pond and conveyance swale.

A monitoring system is proposed to detect any water that may infiltrate down through the two feet of earthen cover and the first layer of geomembrane to the top of the lower geomembrane layer. A series of 4-inch pipes will be installed to allow for monitoring isolated zones. In the event of any leakage, a repair plan can be developed to excavate and repair, with minimal disruption to the pond system. The monitoring system will be constructed to drain these pipes to daylight. The pipes will daylight on the slope to the east of the pond and provide for visual monitoring of any infiltration of un-wanted water significantly seeping through the bottom of the pond.

5.4.3 Temporary Sediment Pond

See Section 6.3.1 for design details.

5.4.4 Stream

The stream that enters the site from the west will continue to flow through the site in a similar direction. However, the existing stream onsite is proposed to be relocated to a new permanent alignment and drain south across the site for 325 feet at a 2% grade and will have the required buffers. This portion of the stream will be open channel flow and have a trapezoidal cross-section with a bottom width of about 2 feet, a top width of about 6 feet, and a depth of about 2 feet. The floodplain width varies due to the meandering alignment of the stream. The stream buffer width varies from about 64 feet to over 100 feet. At the south end of the stream at the crest of the hillside, the stream will traverse down the slope in an engineered channel with flow/energy dissipaters consisting of logs and boulders. These structures will create step pools that will act as a series of energy dissipaters, slowing down the stream flow and stabilizing the hillside. It is anticipated that these structures will be placed approximately 10 to 15 feet apart. This will be analyzed during the final design. The slope down to the larger stream (Stream 2) may be too great to allow for a free-flowing stream channel down the slope. If that is the case, it may be desirable that the stream to be contained within a pipe, and subsequently discharged at the toe of the slope into an energy dissipating structure. The engineered stream will intersect the larger stream at the bottom of the slope, just upstream of the stream's current discharge location. Refer to the *Mitigation Plan* in Appendix C for details on the current stream.

5.4.5 Landfill Soil Cover System Drainage

Limited amounts of precipitation that land on the closed and capped landfill portion of the property will infiltrate through the vegetative soil layer and make its way down to the top of the membrane. The surface and this layer will be sloped at approximately 5% (2% minimum) to provide for positive drainage towards the stormwater pond facility. A perforated pipe and interceptor trench will be located near the 3:1 northeast fill slope southwest of the access road to collect any runoff that is not collected is the pond. Runoff will be conveyed to the storm drainage system, combined with released pond flow and subsequently tight-lined down the slope to the northeast to the stream below.

6 EROSION AND SEDIMENTATION CONTROL

6.1 Introduction

The overall objectives for the erosion and sedimentation control measures for the closed and capped landfill closure are to minimize erosion during construction, minimize erosion of the cover system following construction, and minimize sediment transport during and following construction.

6.2 Design Criteria

For construction stormwater pollution prevention, Snohomish County adopted Volume II of the 2005 Ecology Stormwater Management Manual for Western Washington (2005 Ecology Manual). During the final phase of design, a Stormwater Pollution Prevention Plan (SWPPP) will be prepared in accordance with the 2005 Ecology Manual and will address the following:

- Implement Best Management Practices (BMPs) to prevent erosion and sedimentation, and to identify, reduce, eliminate or prevent stormwater contamination and water pollution from construction activity.
- Prevent violations of surface water quality, groundwater quality, or sediment management standards.
- Prevent, during the construction phase, adverse water quality impacts including impacts on beneficial uses of the receiving water by controlling peak flow rates and volumes of stormwater runoff at the outfalls and downstream of the outfalls.

6.3 Proposed Erosion and Sedimentation Control Facility Improvements

Best Management Practices (BMPs) per the 2005 Ecology Manual will be put in place in order to prevent or reduce pollution of stormwater runoff caused by construction activities and to minimize the amount of sediment-laden runoff leaving the project site. In order to reduce erosion of exposed soils during grading, numerous temporary cover BMPs will be implemented per the 2005 Ecology Manual. These practices include temporary seeding of stripped areas, mulching and matting, and clear plastic sheeting and sandbags.

Certain structural erosion control BMPs and sediment retention BPMs will be implemented as well during construction and include stake and wire fence, silt fence, stabilized construction entrance, wheel wash, interceptor dike and swale, rip rap, storm drain inlet protection, and temporary sediment ponds. Additional BMPs will be implemented as the project progresses and as the contractor deems necessary.

All construction debris will promptly be removed from the site to minimize demolition and construction impacts on the site. The contractor shall implement additional Best Management Practices as required and/or recommended by the county inspector and as approved and/or required by other agencies during construction to prevent construction debris, waste, material, fuel, oil, lubricants, and other fluids from entering the public right of way and the existing storm conveyance system.

6.3.1 Temporary Sediment Pond

Temporary sediment ponds are used to remove sediment from the stormwater runoff before it leaves the construction site and are required for disturbed areas larger than 3 acres. As stated in Section 6.3 above, the design criteria followed for the design of the temporary sediment pond begins on page 4-105 of the 2005 Ecology Manual, as adopted by Snohomish County.

This project proposes one temporary sediment pond which will be located in both cells one and two of the combination detention and water quality treatment pond. The developed 10-year peak flow was used in the calculations due to the large project size and to provide a greater level of protection to downstream conveyance systems.

The temporary sediment pond will remain in operation until the future lots and homes are constructed and the site is permanently stabilized. At this point, the pond will be cleaned, appropriately maintained, the control structure will be replaced or updated for final design release rates, and put in use for permanent detention and water quality treatment control. The permanent stormwater pond will then be maintained by the home owners association.

6.4 Erosion and Sedimentation Control Measures for Closure

After construction, the site will be permanently protected from possible erosion and sediment problems. The detention and water quality treatment pond will prevent sediment-laden runoff from leaving the site and the grass landscaping on the remainder of the developed portion of the site will protect the slopes from possible erosion. Permanent seeding of any disturbed slope areas will also be implemented. The runoff at the discharge location for the site, in the northeast corner, will be tight-lined down the slope to prevent erosion from occurring in that area.

7 LANDFILL GAS CONTROL

7.1 Introduction

Landfills typically produce methane (CH_4) as a bi-product of decomposing waste. Methane is not toxic however in higher concentrations (5 to 15%) may burn. The following sections describe the current methane gas levels at the site and propose mitigation improvements for the site to release the gas.

7.2 Existing Landfill Gas Conditions

The former Go East landfill contains waste consisting of inorganic materials such as concrete, wire, brick and other construction debris, which are non-decomposable, and organic materials such as wood, woody debris, charred wood, and dimensional lumber which will decompose over time. Organic materials decompose by anaerobic bacteria that produce a methane and carbon dioxide biogas product. Though wood is an organic material, it is highly unaffected by anaerobic digestion because the microorganisms cannot degrade the lignin in wood. This does explain the low levels of methane found within this limited purpose / wood waste landfill.

Associated Earth Sciences, Inc., conducted a closed and capped landfill gas monitoring with gas probes on August 7, 2009 and October 5, 2009. The results of the landfill gas measurements are found in the Geotechnical Engineering Report Section 4.4 and Table 1. The details are summarized as;

Ten gas probe monitoring devices (GS-1 through GS-10) were placed in or within close proximity to the closed and capped landfill.

- GS-1, 2, 4, 6, 7, 9, 10 – gas testing locations showed a 0.0% concentration of methane.
- GS-3 – The highest methane concentration was found in GS-3 which is located roughly in the center of the closed and capped landfill. The methane concentration was 0.0% until the probe reached a depth of 15 feet. Between 15 feet deep and 30 feet deep the methane concentrations ranged from 4.2% to 8.4 percent.
- GS-5 – located on the eastern portion of the landfill, contained methane concentrations of 1.7% to 2.7% at 30 to 50 feet deep
- GS-8 – located in the southern portion of the landfill contained a methane concentration of 0.2% at a depth of 20 feet.

7.3 Design Criteria

WAC 173-350-400(3)(e)(I) provides criteria for collection and removal of methane and other gasses for Limited Purposes Landfills. The Geotechnical Engineering Report recommends that "methane mitigation systems be provided beneath detention ponds lined with synthetic materials and around vaults or manholes when these structures are located within the landfill limits."

7.4 Proposed Landfill Gas Control Improvements

This site meets the guidelines referenced in Section 7.3 regarding methane detection at the edge of the closed and capped landfill. However, the closure plan requires a methane collection and venting system to mitigate any possible increase in methane gas released due to the covering of the landfill. Low levels of methane gas will be safely released into the environment by means of a methane vent trench system, located at the perimeter of the closed landfill. This collection and venting system incorporates a deepened gravel trench that extends down vertically to the contact point with the glacial till and landfill area; please refer to the detail in Appendix D. This system will ensure and prevent any possible gas horizontal migration beyond the capped landfill area.

The final soil cover system, as described in detail in Chapter 4 of this report, will be constructed and implemented in a manner that will greatly reduce methane gas randomly released. The proposed soil and geomembrane cover system is impenetrable, composed of vegetation rooted in topsoil, a 2 (two) feet of earthen soil layer and a geomembrane liner to fully cover the landfill area with a finish grade of 3:1 or less. As the gas rises, it will be redirected by the impenetrable surfaces via the permeable geomembrane subgrade (sand) layer, and travel horizontally to the gravel-filled methane vent trench system located at the perimeter of the landfill. This trench will be about one foot wide and extend to undisturbed native soil and filled with gravel. Methane gas will migrate upwards to the surface of the gravel trench. Four manhole structures to house monitors will be placed about every 300 feet along the trench length. Methane gas, if any, will safely escape into the air at these controlled locations around the landfill through vent piping extending at least 100 feet from the edge of the landfill (see sheet 1 in Appendix D). The third-party peer reviewer recommends these pipes be extended 10 feet above ground level. They will consist of a 4-inch galvanized pipe securely anchored. The above ground portion will be removed once it is shown that any gas discharge is insignificant and the discharge can be at ground level. Therefore, any methane gas will be diluted in the ambient air long before it would have a chance to travel underground past the trench system surrounding the closed landfill. Additionally, the design proposes to install a horizontal pipe, 2-inch diameter vent pipes, 4 feet deep, within the gravel trench that could be used as a forced air venting system should the need arise. If the concentration of methane exceeds 5% by volume at any of the venting manholes, blowers can be sized and installed to force the removal of methane until levels have dropped.

To further help detect possible methane gas, continuous field gas monitors will be installed in the manhole release structures along the west and south side of the landfill (four units total). These units will provide continuous monitoring and readouts of any gas being released at these points. Monitoring would take place for up to 6 months (three dry months and three wet season months) or until sufficient evidence exists indicating no longer safety issues are present with the release of low levels of methane gas. See Section 10.3.3 of this report for more details on the continuous field gas monitoring units. Monitoring will continue until methane levels are below 5% by volume and declining. It is not anticipated due to the 32-year history of low or non-existent methane gas generated at this site that such emissions will reach or exceed the 5% threshold level.

8 LEACHATE CONTROL

8.1 Introduction

The most recent water quality samplings for the property were taken by Associated Earth Sciences, Inc., (AESI) in August 2009. Four groundwater monitoring wells (MW-1 through MW-4) were installed on the property and the results of these tests are documented on pages four through eight of the *Hydrogeology, Groundwater, and Surface Water Quality Report* (Water Quality Report located in Appendix B) completed by AESI, note the updated report dated May 3, 2010, and in the associated tables, figures, and logs attached to that report. Surface water was also collected from springs at locations SP-1 and SP-2 (as seen in Figure 1 of the Water Quality Report). A summary of these findings is found below in Section 8.3 of this report.

8.2 Previous Water Quality Studies and Analyses

There have been many past tests on water samples taken in and around the closed and capped landfill dating from 1981 to 2004. Tests were conducted by the Snohomish Health District and the State of Washington Department of Ecology, as well as other engineering consultants. None of the testing has found significant degradation of the local ground or surface water. The following paragraphs explain a few of the most notable reports and testing results.

According to the *Memorandum Trip Report* by George A. Brooks at Ecology and Environment, Inc., dated June 3, 1987, "Representatives of the Snohomish Health District collected several water samples (landfill leachate, upstream point of receiving stream, and downstream point of receiving stream) in 1981, 1983, 1984, and 1986. The Department of Ecology analyzed these samples for certain parameters which varied per sampling event. Generally, the results of these analyses were consistent. The leachate contained elevated levels of specific conductance, chlorides, sulfates, total dissolved solids, total nitrogen, iron, and manganese. The level of these parameters was considerably higher than in the upstream receiving water and had a minor effect on the downstream receiving water. The leachate did not contain elevated levels of pH, zinc, or total organic carbon. The previous surface water sampling results indicate that the [contaminant] levels are far below the drinking water standards. Recommend that no further investigation be done at this time."

The *Surface Water Quality Testing Report* by Robert Bober from 1997 explained that surface water testing stations were established at three separate locations. The report concluded that "Surface water test results completed at the locations delineated in this study did not appear to pose any health risks. None of the test results exceeded the MCLs (minimum contaminant levels) set by the Department of Ecology." It also stated that "No evidence of significant contamination was found in the surface water."

It should be noted that no landfill activities have taken place since 1983. There have not been any significant groundwater impacts noted and the condition currently described will only improve.

8.3 Existing Water Quality Conditions

The results of the groundwater analyses are summarized in Table 2 of the Water Quality Report by AESI along with comparative standards to the Water Quality Standards for Groundwaters of Washington State (WAC 173-200). The results of the surface water analyses are found in Table 3 and are compared to the Surface Water Quality Standards for Washington State (WAC 173-201A).

To summarize the results of the Water Quality Report, wells MW-1 and MW-3 are located outside and up-gradient of the closed and capped landfill, the water quality in these locations are not affected by the landfill debris. Test results do, however, indicate that the natural groundwater in the area does not meet the State Groundwater Quality criteria. Spring SP-1, which daylights down-gradient of the landfill beneath the debris at the northeast end of site, indicates that the landfill has little impact on the groundwater quality. The general direction of water travel is from the area of MW-1 and MW-3 through the landfill to SP-1, and since SP-1 shows little increase in contaminants as compared to MW-1 and MW-3, the landfill has very little impact on the water quality in that area. MW-2 is also located outside and cross-gradient of the landfill to the southeast and the water quality at this location may have been affected by the landfill debris. MW-4 was dry at the time of testing. Spring SP-2 is located on the east side of the stream that runs eastward along the south side of the landfill at the bottom of the ravine. Samples from both SP-1 and SP-2 did not exceed any of the State Surface Water Quality criteria. Additionally, two wells will be placed at the toe of the slope and monitored routinely with the reconstruction of the northeast slope of the landfill. Also, please refer to the Monitor Report located in Appendix H for further information.

The results of the groundwater analyses indicated that some total metals and dissolved metals exceed the State Groundwater Quality criteria. However, these numbers were compared to the water quality results presented in "The Groundwater and Groundwater Quality in Western Snohomish County, Washington" USGS Water Resources Investigations Report 96-4312. The statistics presented in this publication indicated that even though some of the results for this project exceeded state criteria, they are actually still well within the maximum and minimum values exhibited elsewhere in the county. Detailed information on this analysis can be found on pages five and six of the Water Quality Report for this project.

It is the recommendation of AESI in the Water Quality Report that the proposed development will have a positive impact on the site by implementing the soil landfill cap which will prevent surface water infiltration through the landfill debris and therefore only increase the water quality of the surface and groundwater in the area.

8.4 Design Criteria

The groundwater monitoring system will comply with Water Quality Standards for Groundwater of Washington State WAC 173-200 as well as WAC 173-304-500 "Groundwater Monitoring Requirements" and WAC 173-304-407 "General Closure and Post-Closure Requirements". The monitoring well and surface water monitoring locations surrounding the landfill satisfy the recommendations of the geotechnical engineer and regulations.

8.5 Proposed Improvements

The proposed final soil cover system will be constructed with the intention of improving groundwater and surface water quality results by eliminating infiltration of surface water runoff into the landfill area and eliminate water running to the landfill from upslope areas. Groundwater in existing wells, springs, and streams will be monitored for leachate as explained in Section 10 of this report as well as Appendix H.

9 CONSTRUCTION REQUIREMENTS AND SEQUENCE

9.1 Introduction

The overall objectives for regrading the surface of the landfill to permit compliance of the current closure requirements include the following:

- Limit relocation and excavation of existing waste material;
- Eliminate water run-on from areas adjacent to and uphill of the landfill;
- Anticipate long-term settlement and develop surface grades that promote positive drainage over time and re-grade landfill for permanent cover system;
- Maximize area and ensure that surface water runoff can be conveyed via overland flow and conveyance pipes to the stormwater detention and treatment ponds and safely discharged to downstream surface waters;
- Minimize areas that are too low in elevation to drain by gravity to the detention/treatment ponds;
- Provide construction and maintenance vehicle access to landfill cover areas, detention pond, and closure monitoring facilities requiring maintenance and inspection.
- Regrade the northeast landfill slope area to maximum 2:1 slope
- Define and contain edge of landfill for installing perimeter gas trench;
- Minimize landfill area to reduce future maintenance per WAC 173-350-400/500;

9.2 General Grading Requirements

Site grading was also developed by following requirements set forth in Snohomish County Code Chapter 30.63B "Grading" and the 2004 Engineering Design and Development Standards (EDDS), as adopted by Snohomish County. In addition, the general grading for the site should:

- Provide final structurally stable and erosion-resistant cover slopes.
- Minimize landfill thereby reducing closure activities and resultant environmental issues, the effects of surface water runoff, and the needs for future maintenance of the site.
- Minimize settlement and differential settlement over the landfill area.
- Provide final grades that promote positive drainage across the site.
- Prevent stormwater infiltration.
- Provide a minimum 2% surface slope on landfill area (preferably 5%).
- Reduce erosion on landfill slope in northeast portion of landfill by planting and/or seeding (or installing alternative cover system approved by SHD).

- Convey by gravity infiltrated surface water from the cover system to the proposed stormwater conveyance system.

9.2.1 Temporary Construction Roads

The contractor shall be responsible for design and construction of temporary construction roads on the landfill surface as needed for construction access. Temporary roads shall be reinforced for stability and settlement resistance and shall support the maximum loads based on design truck loading, construction equipment and vehicles, maintenance vehicles, and emergency vehicles. Temporary construction roads shall also provide access to the landfill perimeter area and the stormwater detention pond.

9.2.2 Waste Excavation Requirements

As described in Section 3.5, none of the material to be relocated is planned to be relocated off the landfill except as directed by the onsite professional overseeing the work or if required by SHD. It is possible some waste (e.g., asbestos, lead paint, or other materials designated by SHD) will need to be removed off the site upon discovery and temporarily placed on the landfill area for manual screening and processing is possible. Once landfill material has been determined it needs to be moved off the site for any reason it typically would be screened and that portion of the material designated by SHD securely stored for future removal from the site, the remaining material if allowed will be placed in low lying areas of the landfill (Cover System 1 area) and covered per the landfill cover system requirements in Section 4 of this report. Material designated for removal by SHD will be placed in secure vessels onsite and then hauled offsite to an authorized recycling facility or other approved landfill.

9.2.3 Stockpile Area Requirements

All imported soil materials will be placed directly onto the property with minimal materials stockpiled. Material storage areas shall be located as needed to facilitate construction and minimize haul distances. Imported materials that may need to be stockpiled and used for closure improvements include, but are not limited to, quarry spalls for culvert inlet/outlet slope protection and for filling gabions or other toe of slope protection, gravel material for construction and access roads, soil cover layer material, and structural fill.

9.2.4 Structural Fill Placement

Structural fill is recommended to be placed in all areas of utility trench backfill, and waste excavation backfill in the landfill area. Structural fill will be placed in accordance with Sections 9.0 and 10.0 of the Geotechnical Engineering Report for this project. As discussed previously materials being relocated to the top of the landfill to adjust grades will be limited to one-acre areas at a time. All material relocated will be compacted in lifts of 12 inches and as directed by the project geotechnical engineer. Water may be added to achieve optimum compaction levels. Each night any exposed landfill material will be cover with visqueen and anchored with sand bags. The shaping of the landfill

(Cover 1 area) until final subgrade elevations are attained. At that point local sands from excavations outside the landfill will be placed at a minimum 6-inch depth and compacted ready for the geomembrane cover. The area of the “Wedge” being relocated to the top of the landfill will be filled and compacted using onsite soils from outside the landfill. All compaction and testing for compaction will be performed by the project geotechnical engineer.

9.2.5 Interceptor Trench Bench Requirements

The existing northeast facing slope of the landfill is required to be stripped, reconstructed and re-sloped to a maximum slope of 2:1 with intermittent interceptor trench bench drains. The interceptor trench bench drains are described on the drawings in Appendix D.

9.2.6 Preliminary Construction Sequence

The following is an anticipated sequence of work items required to complete the closure plan. This sequence is preliminary in nature as it will be the selected contractor’s responsibility to develop a final construction schedule sequence approved initially by SHD and thereafter periodically updated as work progresses. The following is a summary of the various permits, approvals and construction work as well as the likely sequencing of actions and work on the site.

- Preapproval Requirements
  - Complete the SEPA process with Snohomish County.
  - Complete the preliminary plat process thru Snohomish County including public hearing in front of the County Hearing Examiner.
- Final Permits & Approvals
  - Commence all final design drawings and specifications.
  - Obtain from Snohomish County approvals including land disturbance activity permit, street use permit, and approval of the final design drawings for the plat including surface water. Obtain SHD approval on any updated plans.
  - Obtain Washington State Fish and Game approval of the stream relocation plans (JARPA).
  - Obtain U.S. Army Corps of Engineers’ approval for stream relocation and wetland mitigation. (Note: This approval has already been obtained.)
  - Obtain Contractor bids and estimates – select general contractor.
  - Obtain any additional Snohomish Health District approvals (if any).
    - Post landfill closure security/bond per requirements.
    - Establish coordination/meeting schedule with contractor/SHD/owner etc. to coordinate the closure activities.

- Provide contractor produced projected schedules, phasing, etc. as required by Owner and Snohomish Health District.
- Provide required soil testing of material that is to be relocated by pot holing to obtain soil samples and send to testing lab per LFCP per Section 3.5.1.

- Establish a final plan of action and schedule with contractor to do the work and coordinate with all affected agencies prior to starting construction. (Host pre-construction/kickoff meeting.)

9.2.7 Actual Construction Onsite

- Commence Construction Phase (Land Disturbance Activity (LDA) for closure phase)
  - Commence the Landfill Closure work as detailed in the approved "Landfill Closure Plan".
    - Accomplish any additional desired test holes to further define the limits of the relocate landfill edge. (might want to do this during final design phase)
    - Implement TESCP (Temporary Erosion and Sediment Control Plan) and plan how to phase activities to minimize exposures (develop preliminary phase plan).
    - Coordinate with SLWSD (Silver Lake Water and Sewer District) to bring a short water line with fire hydrant onsite per design for fire protection and erosion control for landfill work.
    - Commence clearing activity in phases. Stock pile and cover any topsoils for reuse later. Log and clear entire landfill area and area outside the landfill to be graded. (Estimate 1 to 2 months to complete clearing phase.)
    - Remove vegetation from main landfill area, chip, stock pile, etc. as needed, proof roll and ready for accepting the relocated "wedge fill". Stumps in the landfill area where no excavation is to occur may be left in place.
    - Remove vegetation from areas to be excavated onsite outside landfill area.
    - Have onsite metal, leak-proof enclosures capable of being secured, in place ready to accept any contaminated materials that might be encountered such as asbestos or lead painted wood, etc. to prevent any likely environmental or public health hazards.
    - Prepare area to be used for screening landfill and stock pile any materials.

- Begin removing the "wedge" and relocating the material to the top of the landfill area per the grading plan (estimated about 52,000 in-place cubic yards, depending on final project requirements).
- Fill excavated "wedge" area with compacted structural fill from onsite per grading plan.
- Grade subgrade on landfill to final design subgrade elevations and place 6-inches of compacted sand base ready for placement of the geomembrane. Maintain minimum 2% slope toward detention pond per plan at required grade to drain. (5% slope desired) Limit working area to maximum one acres at a time and cover with visqueen in off hours.
- Rough grade area under detention pond.
- Accomplish the "Dynamic Compaction" needed for area under the detention pond and along the storm piping trenches as required. Complete excavation and grading for the detention pond including construction of the various monitoring piping, sub-grade, proof rolling, membrane placement, etc., ready for collecting runoff as the closure proceeds. Outlet piping can be temporarily laid on the surface until the final grading of the landfill is completed.
- Construct storm drainage piping as shown from discharge at toe of slope to detention pond and extend into lot area as needed to pick up site runoff. Install control structure, overflow, etc.
- Construct access to toe of northeast slope to permit construction activities, including drilling two (2) wells. Track vehicles will be required to perform this relocation work.
- Install two wells at toe of slope as required ready for sampling.
- Place any gas piping and detention pond leak detection piping ready for placing membrane. Also be sure the leak detection piping from the detention pond is in place prior to installing sand base for surface membrane.
- Construct and place membrane on top of landfill, above northeast slope area to remain undisturbed, with subgrade materials, etc., ready for final topping fill materials.
- Place minimum two feet of fill material over the membrane on the landfill, grade and include a minimum of 12 inches of topping that includes soil suitable for growing grasses, etc. (Note: Materials may be import fills or excavations as required to achieve final grades for the subdivision. Coordinate onsite cut and fill quantities with landfill cover needs to minimize any import of material.)
- Grade area around landfill and slope ground away from landfill to preclude the "run-on" of water onto the landfill.

- Construct perimeter gas collection trench with piping and monitoring manholes.
    - Construct a path or trail from the top to the bottom of the sloped face for walking access to two wells and spring.
    - Landscape top of landfill and slope area as required.
    - Construct the access road to the detention pond and emergency access across the landfill per design.
    - Construct any recreation facilities or other planned features on top of landfill including trails and also any general trails for the plat.
    - Place any settlement monitors desired for future monitoring.
    - Acquire and install four (4) gas monitors in monitoring MH's as required or contract with a person to accomplish gas monitoring.
    - Install gas probes around landfill.
  - Commence construction of stream relocation:
    - Grade for stream per design.
    - Use impermeable fill materials or line stream as required.
    - Landscape and gravel channel and final stream per design.
    - Relocate stream water after landscape has stabilized.
  - Obtain SHD approval of closure work, provide as-built and recordation of records per LFCP.
  - Note: once the landfill closure is complete the grading for the Bakerview subdivision will also be complete as the grading plan is designed to balance as much as possible using onsite materials.
  - Commence second LDA per PDS requirements for completing plat work.
  - Construct onsite plat utilities:
    - Sewer
    - Storm
    - Water
    - Gas/power/telecommunications
  - Complete subgrade for streets, sidewalks, and trails
  - Construction streets, curb, gutter, sidewalks, etc.
  - Pave and install street mons.
  - Place cover/protection around four wells for future monitoring
  - Install street lights and other site amenities
  - Final grade lots and stake ready for sales.
- Commence home construction, utilize gas protection as described in this plan.

- Commence post landfill closure activities as spelled out in LFCP-post post-closure security as required with SHD:
  - Quarterly monitoring six wells and two surface water locations.
  - Continuous monitoring six months at four locations for gas, quarterly thereafter.
  - Quarterly monitoring using approximately 12 gas probes.
  - Monitor detention pond for leakage, etc.
  - Monitor slope for sloughing.
  - Monitor landfill top for large settlements.
  - Use forms in LFCP for checklist and comply with requirements for post closure activities.

10 POST-CLOSURE OPERATIONS AND MAINTENANCE PLAN

10.1 Introduction

During the post-closure period, there are many activities that must take place in order to protect and ensure the environmental safety of the site and future residents. The post-closure period is a period of at least 20 years after the landfill has been closed during which the site must be monitored and facilities must be maintained or until the site becomes stabilized (i.e., little or no settlement and little or no gas or leachate production) and is deemed as such by the Snohomish Health Department (SHD). Post-closure period activities include groundwater monitoring, surface water monitoring, gas monitoring, and maintenance of any associated monitoring facilities and structures. Additionally, it requires maintaining the surface of the closed landfill. Below is a description of these activities. It should be noted that the last landfill activities took place over 30 years ago (1983) when the previous owners believed the landfill and initial closure was closed. Since then, over a period of more than 20 years, the landfill site has been periodically monitored for gas and leachate as described previously in Sections 7 and 8 above. There have not been any significant findings of gas generation or leachate contamination reported for more than the 20 years.

10.2 Post-Closure Operations and Maintenance Plan

The Post Closure Operations and Maintenance Plan has been prepared and is included in the document, labeled as Appendix H.

10.2.1 Requirements

Appendix H details the required maintenance activities and provides checklists to assist. The property owner is responsible to implement this plan and retain qualified professionals as required.

10.3 Gas Monitoring, Groundwater, Leachate Monitoring, and Control Activities

10.3.1 Overview

The P&GE LLC, Closure Plan proposed design addresses the methane gas, groundwater and surface water levels as well as the monitoring system. The site has been monitored for over 30 years. Recordkeeping will continue as proposed herein of the previously installed monitoring wells as well as future installations, accordingly.

The landfill gas monitoring strategy will comply with; WAC 173-350-400(3)(e)(I) Final Closure System Design – collection and removal.

The groundwater monitoring strategy will comply with; WAC 173-350-500; sampling and analysis plan, & WAC 173-350-500; data analysis, notification, and reporting.

The surface water monitoring strategy will comply with WAC 173-350-500.

10.3.2 Schedule

Please refer to Appendix H.

10.3.3 Monitoring Agency

The contractor shall retain a monitoring agency (Professional Engineer) that is qualified to complete the appropriate management, monitoring and testing activities outlined in Appendix H.

10.3.4 Documentation

Please refer to Appendix H.

10.4 Detention and Water Quality Treatment Pond Maintenance and Control Activities

10.4.1 Schedule

During the construction phase, the detention/water quality treatment pond will be maintained by the contractor on a regular basis to ensure the construction stormwater pollution prevention requirements are being met per the design criteria of Section 6.2 of this report. Following construction of the proposed residential development, the pond shall be maintained once annually in accordance with the Pond Maintenance Manual located in Appendix F.

10.4.2 Monitoring Agency

The property owner is responsible for pond maintenance and will contract with a qualified contractor or professional engineer, as necessary during the construction phase. After home build-out is complete, all pond maintenance will become the responsibility of the HOA Maintenance can be conducted by either the HOA or by an agency with appropriate pond maintenance qualifications.

10.4.3 Documentation

During construction, Stormwater Pollution Prevention Plan (SWPPP) monitoring will likely be required and will therefore be documented in the Inspection Log tables located within the SWPPP report. After home build-out is complete, the annual pond maintenance operations shall be documented on an appropriate data sheet and kept on file with the HOA president per Snohomish County requirements. A copy of these reports can be furnished to Snohomish County as required by county standards and another copy can be sent to SHD upon request.

10.4.4 Pond Liner Monitoring and Repair Responsibility

After the residential development is built out, it is anticipated that the Home Owners Association (HOA) will be responsible to the county for meeting the on-going maintenance for the detention pond. This can include checking for excessive leaking being detected by monitoring water flowing from the monitoring system consisting of piping on top of the lower geo-membrane that is day lighted. Should excess leaking occur, the area of the 2 feet of cover material can be removed, repairs can be completed or a new geomembrane liner can be placed, and the 2 feet of material can be re-installed on the geomembrane liner. Rupture of the geomembrane liners would be a very unlikely, low probability event as the wet portion of the pond will have been created by excavating down into the landfill which was effectively surcharged for over 25 years. The pond area will be proof-rolled and compacted using dynamic compaction techniques prior to placing the geomembrane system. Additionally, the pond area is located on the shallower area of the landfill. Post-closure funding can be placed into an account to cover the repair cost should a leak in the pond liner occur. The fund would be transferred to the HOA or responsible party to maintain the pond. A fund of $25,000 is proposed to be set aside to cover a future leak in the pond liner should one occur.

10.5 Financial Assurance Plan

As a preliminary matter it should be noted that the financial assurance as contained in the WAC 173-350-400(8) addresses an active landfill and provides for appropriate set asides allocated to insure funds are available for closure. The prior owner attempted to close the landfill under WAC 173-301, and this earlier regulation did not require financial assurances. Ecology in an October 8, 2015 letter states that it "sees no need to Financial Assurance for the closure because (it) understand(s) the landfill closure is planned to occur soon after the owner obtains the required permits…the owner should be required to demonstrate Financial Assurance for the entire post-closure that SHD determines is appropriate". Furthermore, because the "Closure" is being funded by the associated subdivision which by County permit process can only be accomplished after the closure of the landfill, there is great incentive to complete the landfill closure as quickly as possible. Nonetheless, P&GE, LLC, is prepared to provide the appropriate financial assurance measure, for post-closure maintenance and monitoring to follow upon the completion of the proposed final closure pan herein.

The financial mechanism used for post-closure assurance will be a surety bond as described in WAC 173-350-600(3)(c). The bond amount will be established under the criteria set forth in WAC 173-350-600(6) upon approval and issuance of the various permits and authorizations for the project to proceed.

11 REFERENCES

1. The *Memorandum Trip Report* by George A. Brooks at Ecology and Environment, Inc., dated June 3, 1987. It is contained in the *Final Site Inspection Report for Reckoway Landfill* by George A. Brooks dated June 30, 1987, which is contained in the letter from Bill Glasser at The Environmental Protection Agency (EPA) to Gary East of Go East Corporation stamped “Received XX 9, 1987”. (The XX is not legible in the stamp.)
2. Washington Administrative Code (WAC) Chapter 173-350-400 “Limited purpose landfills – design standards” as adopted by the Snohomish Health District (SHD); last update: March 9, 2004
3. *Site Hazard Assessment – Recommendation for No Further Action* assumed to be written by Geoffrey Crofoot at the Snohomish Health District, dated May 14, 2004
4. *Go East Landfill Closure Mitigation Plan* prepared by Wetland Resources, Inc., dated February 23, 2010
5. *Subsurface Exploration, Geologic Hazards, and Geotechnical Engineering Report for the Former Go East Landfill* prepared by Associated Earth Sciences, Inc., dated October 21, 2009, updated May 26, 2011
6. *Hydrogeology, Groundwater, and Surface Water Quality Report for the Former Go East Landfill* prepared by Associated Earth Sciences, Inc., updated May 3, 2011
7. *Surface Water Quality Testing Report* for Go East Landfill (Leachate) prepared by Robert G. Bober Jr., P.E., Civil Engineering Consultant dated October 29, 1997
8. *Hydraulic Evaluation of Landfill Performance Model, HELP*, prepared by Associated Earth Sciences, Inc., updated May 31, 2011
9. *1992 Stormwater Management Manual for the Puget Sound Basin,* prepared by the Washington State Department of Ecology
10. *2005 Stormwater Management Manual for Western Washington*, prepared by the Washington State Department of Ecology

GO EAST
LANDFILL CLOSURE PLAN
Snohomish County, Washington

Appendix A
Geotech Report
Associated Earth Sciences, October 21 2009
Rev. February 28, 2013

Associated Earth Sciences, Inc.

Serving the Pacific Northwest Since 1981

October 21, 2009
Revised February 28, 2013
Project No. KE090231A

PACE Engineers, Inc.
11255 Kirkland Way, Suite 300
Kirkland, Washington 98033

Attention: Mr. Marty Penhallegon, P.E.

Subject: Subsurface Exploration, Geologic Hazards, and Geotechnical Engineering Report
Former Go East Landfill
4330 108th Street SE
Snohomish County, Washington

Dear Mr. Penhallegon:

We are pleased to present the enclosed copies of the referenced report. This report summarizes the results of our subsurface exploration and geotechnical engineering studies and offers recommendations for the preliminary design and development of the proposed project. Our recommendations are preliminary in that project plans are still under development at the time of this report. This report has been revised from the original report dated October 21, 2009 based on additional new information acquired for the site after issuance of the original report.

We have enjoyed working with you on this study and are confident that the recommendations presented in this report will aid in the successful completion of your project. If you should have any questions or if we can be of additional help to you, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

Jon N. Sondergaard, L.G., L.E.G.
Principal Engineering Geologist

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Subsurface Exploration, Geologic Hazards,
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FORMER GO EAST LANDFILL

Snohomish County, Washington

Prepared for

PACE Engineers, Inc.

Project No. KE090231A
October 21, 2009
Revised February 28, 2013

APPENDIX A

SUBSURFACE EXPLORATION, GEOLOGIC HAZARDS, AND GEOTECHNICAL ENGINEERING REPORT

FORMER GO EAST LANDFILL

Snohomish County, Washington

Prepared for:
PACE Engineers, Inc.
11255 Kirkland Way, Suite 300
Kirkland, Washington 98033

Prepared by:
Associated Earth Sciences, Inc.
911 5th Avenue, Suite 100
Kirkland, Washington 98033
425-827-7701
Fax: 425-827-5424

October 21, 2009
Revised February 28, 2013
Project No. KE090231A

APPENDIX A

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I. PROJECT AND SITE CONDITIONS

1.0 INTRODUCTION

This report presents the results of our subsurface exploration, geologic hazard, and geotechnical engineering study for the proposed new residential development. The location of the site is shown on the "Vicinity Map," Figure 1. The approximate locations of the subsurface explorations accomplished for this study are presented on the "Site and Exploration Plan," Figure 2. If there are any substantial changes in the nature, design, or location of the proposed improvements, the conclusions and recommendations contained in this report should be reviewed and modified, or verified, as necessary.

1.1 Purpose and Scope

The purpose of this study was to provide subsurface data to be used in the design of the residential subdivision project. Our study included a review of selected geologic literature, excavating seventeen exploration pits, advancing four exploration borings with monitoring well installations, conducting landfill gas probe measurements, and performing geologic studies to assess the type, thickness, distribution, and physical properties of the subsurface sediments and shallow ground water conditions. Geotechnical engineering studies were completed to formulate our recommendations for site preparation, site grading, lot construction, and drainage. This report summarizes our current fieldwork and offers preliminary development recommendations based on our present understanding of the project. Our recommendations are preliminary because project plans have not been finalized at the time this report was prepared. We recommend that we be allowed to review project plans prior to construction to verify that our geotechnical recommendations have been correctly interpreted and incorporated into the design. Additional exploration or design modifications/review may be required to finalize project documentation.

1.2 Authorization

Written authorization to proceed with this study was granted by PACE Engineers, Inc. (PACE) on July 7, 2009. Our study was accomplished in general accordance with our scope of work letter dated June 29, 2009. This report has been prepared for the exclusive use of PACE and their agents for specific application to this project.

Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted geotechnical engineering and engineering geology practices in effect in this area at the time our report was prepared. No other warranty, express or implied, is made.

2.0 PROJECT AND SITE DESCRIPTION

This report was completed with an understanding of the project based on a topographic survey and proposed lot layout provided to us by PACE. The project site is a square-shaped, approximate 40-acre parcel, extending approximately ¼ mile north-south and east-west. The northern portion of the subject parcel contains the 5- to 6-acre, former Go East Landfill. Site topography includes steep slopes leading down into the subject site from the north and west. Portions of the steep bank near to the western property line appear to include relict excavation faces, which may be the result of past surface mining activities. The northern two-thirds of the subject site is generally flat-lying to gently sloping, while the southern, roughly one-third of the property is comprised of a large steeply-sided drainage ravine. This ravine turns northward east of the subject site and extends beyond the northeast corner of the subject site toward the floor of the Snohomish River valley and Lowell-Larimer Road. The site is bounded on the north and west by existing residential subdivisions, to the south by the steeply-incised drainage, and to the east by the Olympic Pipeline Easement and the steeply-sided drainage. Site vegetation consists of small to large, second-growth deciduous and coniferous trees and moderate to dense undergrowth. The former landfill area is vegetated predominantly with blackberry brambles. A small stream, delineated by others, was observed to the south of the former landfill area. A spring emanates from the base of the steeply-sided ravine to the northeast of the landfill area.

The proposed project consists of developing portions of the subject 40-acre parcel with single-family residences, along with associated roadways and utilities. A conceptual site plan, presented on Figure 3, illustrates the currently-proposed project. As stated above, a portion of the subject parcel contains the 5- to 6-acre, former Go East Landfill. According to the Snohomish County Health District (SCHD), closure of the former landfill would require the following elements in accordance with *Washington Administrative Code* (WAC) 173-350 and a conditional use permit (CUP) for the site issued in 1977: 1) a closure plan approved by SCHD, 2) placement of a minimum of 2 feet of low-permeability soil over the landfill graded to no steeper than 2H:1V (Horizontal:Vertical) and seeded with natural grass, 3) a leachate monitoring and control program, 4) a landfill gas monitoring and control program, 5) inspections by SCHD and certification by the engineer that the closure plan has been properly implemented, 6) maps and statement of fact regarding the landfill recorded as part of the deed for the property, and 7) review of the completed closure one year after completion to determine if continued compliance with SCHD Article 4.04M is required.

A report by HWA Geosciences, Inc. (HWA), completed for the subject property on June 21, 2002, was obtained from the client for our review. The scope of work accomplished for the HWA report included the excavation of 47 exploration pits to depths of up to 27 feet below ground surface (bgs). The locations of the HWA explorations are shown on the "Site and

Exploration Plan," Figure 2, and the logs of the HWA explorations are presented in Appendix A.

3.0 SUBSURFACE EXPLORATION

Our field study included excavating 17 exploration pits, drilling four exploration borings, and completing six cone penetrometers to gain additional subsurface information about the site. We also completed a total of ten gas probes around and within the landfill to explore for the presence of methane. The various types of sediments, as well as the depths where characteristics of the sediments changed, are indicated on the exploration logs presented in Appendix A. The depths indicated on the logs where conditions changed may represent gradational variations between sediment types.

The conclusions and recommendations presented in this report are based on the explorations completed for this study, and subsurface data from previous site explorations by others. The number and locations of the explorations were determined based on the site size and development type. Because of the nature of exploratory work below ground, extrapolation of subsurface conditions between field explorations is necessary. It should be noted that differing subsurface conditions may sometimes be present due to the random nature of deposition and the alteration of topography by past grading and/or filling, particularly on sites where surface mining and landfill operations occurred. The nature and extent of any variations between the field explorations may not become fully evident until construction. If variations are observed at that time, it may be necessary to re-evaluate specific recommendations in this report and make appropriate changes.

3.1 Exploration Pits

The exploration pits were excavated on August 5 and 6, 2009, with a subcontracted, track-mounted excavator. The pits permitted direct, visual observation of subsurface conditions. Materials encountered in the exploration pits were studied and classified in the field by a geologist from our firm. All exploration pits were backfilled immediately after examination and logging. Selected samples were then transported to our laboratory for further visual classification and testing, as necessary.

3.2 Exploration Borings/Monitoring Wells

The exploration borings were completed on August 11 through 14, 2009, by a subcontracted driller using a portable drill rig advancing a 4.25-inch, inside-diameter, hollow-stem auger. Exploration borings MW-1 through MW-4 were completed as 2-inch-diameter monitoring wells to assess ground water levels below the site. During the drilling process, samples were obtained at 5-foot-depth intervals. The borings were continuously observed and logged by an engineering geologist from our firm. The attached exploration logs are based on the field logs, drilling action, and inspection of the samples collected.

Disturbed, but representative samples were obtained by using the Standard Penetration Test (SPT) procedure in accordance with *American Society for Testing and Materials* (ASTM):D 1586. This test and sampling method consists of driving a standard 2-inch, outside-diameter, split-barrel sampler a distance of 18 inches into the soil with a 140-pound hammer free-falling a distance of 30 inches. The number of blows for each 6-inch interval is recorded, and the number of blows required to drive the sampler the final 12 inches is known as the Standard Penetration Resistance ("N") or blow count. If a total of 50 is recorded within one 6-inch interval, the blow count is recorded as the number of blows for the corresponding number of inches of penetration. The resistance, or N-value, provides a measure of the relative density of granular soils or the relative consistency of cohesive soils; these values are plotted on the attached boring logs.

The samples obtained from the split-barrel sampler were classified in the field and representative portions placed in watertight containers. The samples were then transported to our laboratory for further visual classification.

3.3 Cone Penetrometers

Six cone penetrometer (CPT) explorations were completed by In Situ Engineering of Snohomish, Washington on April 26, 2011. The original intent was to complete one deep cone penetrometer through the landfill debris to characterize the physical properties of this material. Upon attempting to complete the cone penetrometer exploration, the penetrometer met with refusal at depth within the landfill debris. Six attempts (CPT-01 through CPT-06) to penetrate the landfill debris at the approximate location shown on Figure 2. The depths of CPT penetration ranged from approximately 2 to 20 feet. CPT-01 and CPT-04 were the deepest at approximately 20.7 and 17.8 feet, respectively. Logs of the CPT explorations are presented in Appendix A.

3.4 Landfill Gas Monitoring

Measurements of landfill gas parameters were performed using a GEM 2000 landfill gas monitor. The gas probes performed on August 7, 2009 were generally completed using $^{3}/_{16}$-inch, inside-diameter plastic tubing and were purged using the GEM 2000 monitor capable of pumping 0.5 liters per minute (0.018 cubic feet per minute). Measurements were recorded once the parameters stabilized for at least 2 minutes. At 25 feet bgs at GS-1, the tubing became clogged, and the $^{5}/_{8}$-inch, inside-diameter drill rod was used for sampling. After more than 30 minutes of purge time, the gas levels measured were similar to those measured at 5 feet, suggesting a possible leakage in the "drill rod"-based sampling system.

The gas probes performed on October 5, 2009 were completed using the $^{5}/_{8}$-inch, inside-diameter drill rod and purged with a "geopump" capable of pumping 1 gallon per minute (0.134 cubic feet per minute). The threads on the drill rods during the October 5, 2009 sampling were sealed with Teflon tape. The results of our landfill gas measurements are summarized in Section 4.4 of this report, and presented in Table 1, attached to this report.

4.0 SUBSURFACE CONDITIONS

Subsurface conditions at the project site were inferred from the field explorations accomplished for this study, visual reconnaissance of the site, and previous exploration data collected by others. As shown on the exploration logs, the exploration pits generally encountered consolidated, granular, glacial sediments overlain by fill material that varied widely in thickness and composition. The following section presents more detailed subsurface information organized from the shallowest (youngest) to the deepest (oldest) sediment types.

4.1 Stratigraphy

4.1.1 Fill

Fill soils (soils not naturally placed) were encountered at the locations of exploration pits EP-1 through EP-8, EP-11 through EP-17, and CPT explorations CPT-01 through CPT-06. Fill encountered at the locations of these exploration pits generally consisted of loose silty sand with gravel with various types and amounts of assorted construction debris. Portions of the fill at these locations contained organic material. Where encountered, the fill ranged in thickness from approximately 1 foot (EP-11) to greater than 21 feet (EP-6). The fill extended below the depths explored at exploration pits EP-2, EP-6, EP-8, EP-14, and EP-17, as well as at exploration pit EP-13 and CPT-01 through CPT-06, which met refusal at various depths likely due to the presence of abundant debris. The depth and location of the fill, combined with the absence of a discernable topsoil layer beneath the fill, suggests that the area was excavated prior to filling, possibly as a borrow pit. Excavated and filled areas can vary greatly in quality, thickness/depth, and extent over short distances. Fill is also expected in unexplored areas of the site, such as within the limits of the former landfill and its associated access roads. Due to their variable density and organic debris content, the existing fill soils are not suitable for foundation support.

4.1.2 Vashon Advance Outwash

Sediments encountered directly below the fill, or at the ground surface at exploration pits EP-9 and EP-10 and exploration borings MW-1 through MW-4, generally consisted of medium dense to very dense sand, with silt lenses, interbeds, and variable silt and gravel content. We interpret these sediments to be representative of Vashon advance outwash (Qva). The Qva sediments were deposited by meltwater streams that emanated from the advancing glacial ice during the Vashon Stade of Fraser Glaciation approximately 12,500 to 15,000 years ago. The high relative density of these sediments is due to their consolidation by the massive weight of the glacial ice that overrode these materials subsequent to their deposition. At the locations of exploration borings MW-1 through MW-4, the Qva sediments extended to depths of approximately 28 to 73 feet bgs.

4.1.3 Pre-Vashon Glacial Lacustrine

Underlying the Vashon advance outwash sediments, exploration borings MW-1 through MW-4 encountered sediments interpreted to be pre-Vashon glacial lacustrine silts. These sediments consisted of very stiff to hard, moist to wet, bluish gray silt, with a few very fine sand partings and fine sand beds. These lake sediments were deposited prior to the Vashon-age glaciation. These sediments were subsequently overridden by several thousand feet of glacial ice that compressed the sediments into their present, very stiff to hard state. The deposit is suitable for foundation support when prepared as recommended in the "Site Preparation" section of this report. The deposit contains a large proportion of fine-grained material making it highly susceptible to disturbance when wet.

4.2 Geologic Mapping

Review of the United States Geological Survey (USGS) *Distribution and Description of the Geologic Units in the Everett Quadrangle, Washington* by Minard, dated 1981, indicates that the area is underlain by Vashon advance outwash in the western portions of the property, with Vashon glacial to pre-Fraser nonglacial deposits, undifferentiated, exposed along the eastern portions of the site and the eastern slope. Our interpretations of the sediments encountered during our study are in general agreement with this regional geologic map; however, the silt unit underlying the sandy Vashon advance outwash is interpreted to be glacial lacustrine (which fits into the broad, undifferentiated category described on the map).

4.3 Hydrology

Ground water seepage was encountered in exploration pits EP-1, EP-3, and EP-4, as well as exploration borings MW-1 through MW-4. The observed ground water probably represents a perched aquifer in the advance outwash sediments above the underlying silt. We installed

2-inch-diameter monitoring wells in exploration borings MW-1 through MW-4 to allow measurement of ground water levels after drilling was completed. Observed depth to ground water after drilling is included on the exploration logs in Appendix A. Ground water levels should be expected to change in response to seasonal weather changes, on- and off-site land usage changes, and other factors. Additional ground water level measurements should be completed to monitor these seasonal influences. Due to possible ground water confinement, soil fracture patterns, disturbance related to drilling and installation of the standpipe, and other factors, ground water level measurements made in the piezometers may not be representative of a static ground water surface that is laterally extensive. A more detailed discussion of the hydrogeology and ground water quality will be provided under separate cover.

4.4 Landfill Gas Measurements

Results of the landfill gas measurements are summarized in Table 1 attached to this report. The highest methane (CH_4) concentrations (between 4.2 and 8.4 percent) were measured in GS-3 completed within the landfill. Lower concentrations of methane (less than 2.7 percent) were also detected in GS-5 and GS-8. Methane was not detected in probes (GS-1, GS-2, and GS-4) completed outside of the landfill.

Oxygen concentrations were near or below detection levels in probes completed within the landfill (GS-3, GS-6, and GS-8) and variable outside the landfill. The highest oxygen concentrations (20.6 to 21.5 percent) were detected in GS-1, GS-2, and GS-10.

The carbon dioxide concentrations ranged from less than 1 percent to 4 percent in GS-1, GS-2, GS-4, GS-9, and GS-10, and from approximately 7 percent to 23 percent in GS-3, GS-5, GS-6, GS-7, and GS-8.

Table 2 presents a summary of applicable regulations related to methane exposure. Based on the regulations, the site meets the WAC 173-351-200(4)(a)(ii) requirement for less than 5 percent methane at the property line. Since no methane was detected outside of the landfill limits and no habitable structures are planned to be constructed over landfill debris, the site should also meet the WAC 173-351-200(4)(a)(i) requirement of 1.25 percent methane within on-site structures. We do recommend that methane mitigation systems be provided beneath detention ponds lined with synthetic materials and around vaults or manholes when these structures are located within the landfill limits.

II. GEOLOGIC HAZARDS AND MITIGATIONS

The following discussion of potential geologic hazards is based on the geologic, slope, and shallow ground water conditions as observed and discussed herein and review of the *Snohomish County Code* (SCC).

5.0 STEEP SLOPE/LANDSLIDE HAZARDS AND MITIGATION

Steep slopes at the site can be grouped into three categories: 1) natural slopes on the south and east sides of the property, 2) slopes on the north-northeast end of the site created by dumping of landfill debris, and 3) slopes on the north-northwest and west sides of the property created by past mining of sand and gravel.

5.1 Natural Slopes

On the south and east sides of the property, existing natural slopes range from around 50 percent to 65 percent inclination and are approximately 30 to 70 feet high. The steep slopes on the south side of the property are formed by a stream valley and those on the east side are part of a larger slope that occurs above the Snohomish River valley that lies to the east.

Snohomish County has designated the natural slopes on the south and east sides of the site as a High Landslide Hazard Area (LH) according to Critical Areas Planning Project maps prepared for Snohomish County by GeoEngineers, Inc. (1991). The near-surface soil underlying much of the site consists of medium dense to dense advance outwash sand that is underlain by stiff to hard pre-Vashon glacial lacustrine silts and clayey silts. We performed a slope reconnaissance along the south and east site slopes for indications of slope instability, such as bowed or tilted trees, naturally occurring terraced topography, tension cracks, reversed drainage gradients, and unvegetated soil exposures. We observed several coniferous trees with curved trunks and terraced topography (the lower benches along the eastern slope), both of which are characteristic of past shallow earth movement typical of steep slopes in the Puget Sound area. Mitigation recommendations include building setbacks from the top of the steep slopes, control of filling and grading on slopes, and control of storm water discharge. Recommended slope mitigations are discussed in Section 5.3.

5.1.1 Slope Stability Assessment

To evaluate the stability of the existing slopes located on the south and east sides of the site, we modeled slope stability under static and seismic conditions using the computer program Slope W, Version 5 by Geo-Slope International. The model used the Morgenstern-Price

Method of a rotational failure mechanism. Input parameters for the analysis consisted of slope geometry, geology, and ground water conditions of the slope interpreted from our explorations and estimated soil strength parameters based on the CPT explorations and our experience with similar soils. The slope geometry was developed from a topographic map of the site provided to us by PACE.

In general, the calculated factor of safety is the ratio between the available soil shear resistance and the gravitational forces that tend to produce a slide. When the soil strength is equal to the slide-producing forces, a factor of safety of 1.0 would exist. An acceptable factor of safety would depend on the level of risk deemed acceptable by the owner and the County. A static factor of safety of 1.5 and a dynamic factor of safety of 1.1 during short-term seismic loading are specified in SCC 30.62B.340(3)(b) as the minimum acceptable..

The soil stratigraphy for the stability model is based on the borings completed for this project and our slope reconnaissance. The location of the cross section modeled is shown on Figure 2. The soil properties used in the slope stability analysis employ the Mohr-Coulomb model, and are presented in Table 3. The soil densities are based on SPT blow counts obtained from the boring. The internal angle of friction for the waste was estimated based upon the approximate relative density of the waste and peak friction angle determined from the CPT data and Schmertman (1978), the overburden pressure and applying a factor of safety of 1.5. The soil cohesion values are estimated based on our experience with similar soils and correlation with published information. The cohesion for the silt and clay of the pre-Vashon sediments is based on laboratory data obtained from other geotechnical studies that performed tests on similar, glacially consolidated soils (Converse, 1981). The site conditions modeled are presented in Appendix B in Section A-A' and Section B-B'.

Table 3
Soil Properties Used in Slope Stability Model

Soil Type	Unit Weight (pcf)	Cohesion (psf)	Phi (degrees)
Landfill Waste	115	50	25
Advance Outwash	130	0	40
Advance Lacustrine	120	1500	17

pcf = pounds per cubic foot.
psf = pounds per square foot.

A ground water table existing within the advance outwash above the advance lacustrine silt and clay was also included in the modeling. Results of the stability analysis are presented in Appendix B.

The stability analysis included both static and dynamic (seismic) conditions. For the native slopes depicted on Section A-A, for the static condition, the lowest factor of safety for the largest critical failure was 1.6. For the dynamic condition, with a seismic force of 0.16g applied to the slope, the lowest factor of safety for the largest critical failure was 1.2. The seismic load applied was based on a peak horizontal ground acceleration for the site, as determined from the USGS Earthquake Hazards Reduction Program and consistent with the 2006 *International Building Code* (IBC). Factors of safety for static and dynamic conditions are above those specified in SCC 30.62B.340(3)(b).

5.1.2 Discussion

In general, the factors of safety determined by the computer model are likely conservative when compared to actual field conditions. This conservatism comes from the compounding of "worst-case-conditions" (i.e., slope angle, unit weight, phi angle, and ground water) in the computer model, and the inability to model the positive effects of weak soil cementing, tree roots, established drainage channels, and other features and the low probability of these events occurring concurrently. Finally, based on our reconnaissance, the slopes in question show no obvious indications of incipient, deep-seated instability.

5.2 Man-Made Slopes

Steep slopes at the north-northeast end of the property are comprised of landfill debris that was deposited at the site during active operation of the construction debris landfill. The landfill debris was placed within a former stream valley after diversion of the stream around the west side of the site. This slope is about 120 feet high with the upper 40 to 50 feet of the slope inclined at about 30 percent, while the lower 70 to 80 feet is inclined at about 57 percent. At this time, no specific development activities are planned for this area other than construction of the landfill cap. Portions of the waste around the perimeter of the landfill away from the slope may be regraded to facilitate site development. These slopes would classify as Landslide Hazard Areas according to the SCC 30.62.015(16).

The existing slope on the north side of the landfill is currently well vegetated, and does not exhibit indications of slope instability. The existing slope has experienced past seismic events such as the 2001, 6.8 magnitude earthquake.

A similar slope stability model, as discussed above, was completed for Section B-B' that runs through the north side of the landfill, as shown on Figure 2. The results of the modeling are presented in Appendix B. For the static condition, the factor of safety for the largest rotational failure at the face of the landfill that falls within the 85-foot setback from the top of the slope was 2.0. Under dynamic conditions during a seismic event that imposes a 0.16g (½ the estimated peak horizontal ground acceleration) seismic load on the slope, the lowest factor of safety for critical circles that fall within the 85-foot setback from the top of the slope is 1.3. The factors of safety for the static and dynamic conditions are at or above 1.5 for static and 1.1 for dynamic conditions specified in SCC 30.62B.340(3)(b). No habitable structures are planned for this area. We recommend that other structures, such as ponds, utility corridors, or emergency access roads, be set back a minimum of 85 feet from the top of the steep slope along the north side of the landfill.

In general, the factors of safety determined by the computer model are likely conservative when compared to actual field conditions. This conservatism comes from the compounding of "worst case conditions" (i.e., slope angle, unit weight, phi angle, and ground water) in the computer model, and the inability to model the positive effects of weak soil cementing, tree roots, established drainage channels, and other features. Finally, based on our reconnaissance, the slopes in question appear to be stable in their current configuration and show no obvious indications of incipient, deep-seated instability.

Steep man-made slopes also occur at the north-northwest and west sides of the site due to past sand and gravel mining activities. These slopes range in inclination from about 54 to 73 percent and are approximately 10 to 40 feet in height. Some of these slopes may be regraded to flatter inclinations during development. If these slopes remain, they are subject to the steep slope mitigation recommendations provided in Section 5.3 below.

5.3 Steep Slope Mitigation Recommendations

In accordance with Snohomish County Critical Area Regulations (SCC) 30.62.B.340(2)(a), the standard minimum setback for steep slopes at the site is the slope height divided by 3 or 50 feet, whichever is greater. For the subject site, this would result in top of slope setbacks equal to 50 feet. However, per Section 30.62B.340(2)(b), deviations from the standard minimum setbacks may be allowed if a geotechnical report demonstrates that the proposed alternative setbacks provide protection that is equal to that provided by the standard minimum setback and the proposal meets the requirements of SCC 30.62B.320.

Based on the subsurface explorations, slope stability analysis, and site reconnaissance, Associated Earth Sciences, Inc. (AESI) recommends a minimum top and toe of slope building setback of 25 feet for the steep natural slopes located on the property. As described in Section 5.1 of this report, slope stability analyses demonstrate that the proposed 25-foot setback is protective of the proposed structures and meets the minimum factors of safety for both static and dynamic stability.

We also recommend a minimum top of slope setback for non-habitable structures of 85 feet from the top of the man-made steep slope on the north side of the landfill. The proposed setback exceeds the standard minimum required of 50 feet for the 120-foot-tall slope. Site development, grading, and drainage plans should be reviewed by AESI as the design proceeds to verify or modify slope setbacks and mitigations.

Discharge of storm water onto steep slopes may cause erosion and slope instability. We therefore recommend that site storm water be directed away from steep slopes. All site storm water should be directed to an on-site storm water collection system or, if necessary, conveyed via tightline to the streams at the bottom of the steep slopes. Direct discharge of storm water onto or above steep slopes should not be allowed.

6.0 SEISMIC HAZARDS AND MITIGATION

Earthquakes occur in the Puget Lowland with great regularity. Most of these events are small and are usually not felt. However, large earthquakes do occur, as evidenced by the 1949, 7.2-magnitude event; the 1965, 6.5-magnitude event; and the 2001, 6.8-magnitude event. The 1949 earthquake appears to have been the largest in this area during recorded history. Evaluation of return rates indicates that an earthquake of a magnitude between 6.0 and 7.0 is likely every 25 to 40 years in the Puget Sound area.

Generally, there are four types of potential geologic hazards associated with large seismic events: 1) surficial ground rupture, 2) seismically induced landslides, 3) liquefaction, and 4) ground motion. The potential for each of these hazards to adversely impact the proposed project is discussed below.

6.1 Surficial Ground Rupture

The nearest known fault trace to the project site is the South Whidbey Island-Lake Alice Fault located approximately 6 miles to the southwest. No surficial faulting or earth rupture associated with this fault has been documented to date in the vicinity of the site.

6.2 Seismically Induced Landslides

It is our opinion that the risks of seismically induced, deep-seated landslides and surficial, debris flow-type failures are similar to the risks under static conditions, and the mitigations discussed in Section 5.0 are applicable.

6.3 Liquefaction

The encountered stratigraphy across the site has a low potential for liquefaction due to the over-consolidated nature of the advance outwash and the glacial lacustrine silt, and high silt content of the pre-Vashon glacial lacustrine deposit underlying the site. Therefore, no liquefaction mitigation efforts are required, in our opinion.

6.4 Ground Motion

It is our opinion that earthquake damage to the proposed structures, when founded on suitable bearing strata in accordance with the recommendations contained herein, will be caused by the intensity and acceleration associated with the event. Structural design of the proposed buildings should follow the 2006 IBC. Information presented by the USGS Earthquake Hazards Reduction Program indicates a spectral acceleration for the project area for short periods (0.2 seconds) of $S_S = 1.17$ and for a 1-second period of $S_1 = 0.41$. Based on the results of subsurface exploration and on an estimation of soil properties at depth utilizing available geologic data, Site Class "C", in conformance with Table 1613.5.2 of the IBC, may be used.

7.0 EROSION HAZARDS AND MITIGATION

According to the SCC, Erosion Hazard Areas are those that have soils defined by the United States Soil Conservation Service as having a high risk of water erosion. At the subject property, the upland areas are classified as Alderwood gravelly sandy loam on 2 to 8 percent slopes with a slight erosion hazard. The sloping areas to the south and east are classified as Alderwood gravelly sandy loam on 25 to 70 percent slopes with a high erosion hazard. Based on these definitions, the steep slopes to the south and east of the property are classified as Erosion Hazard Areas.

As of October 1, 2008, the Washington State Department of Ecology (Ecology) Construction Storm Water General Permit (also known as the National Pollutant Discharge Elimination System [NPDES] permit) requires weekly Temporary Erosion and Sedimentation Control (TESC) inspections and turbidity monitoring of site runoff for all sites 1 or more acres in size that discharge storm water to surface waters of the state. The TESC inspections and turbidity monitoring of runoff must be completed by a Certified Erosion and Sediment Control Lead (CESCL) for the duration of the construction. The weekly TESC reports do not need to be sent to Ecology, but should be logged into the project Storm Water Pollution Prevention Plan (SWPPP). Ecology requires a monthly summary report of the turbidity monitoring results signed by the NPDES permit holder. If the monitored turbidity equals or exceeds 25 nephelometric turbidity units (NTU) (Ecology benchmark standard), the project best management practices (BMPs) should be modified to decrease the turbidity of storm water leaving the site. Changes and upgrades to the BMPs should be documented in the weekly TESC reports and continued until the weekly turbidity reading is 25 NTU or lower. If the monitored turbidity exceeds 250 NTU, the results must be reported to Ecology via phone within 24 hours and corrective actions should be implemented as soon as possible. Daily turbidity monitoring is continued until the corrective actions lower the turbidity to below 25 NTU, or until the discharge stops. This description of the sampling benchmarks and reporting requirements is a brief summary of the Construction Storm Water General Permit conditions. The general permit is available on the internet[1].

In order to meet the current Ecology requirements, a properly developed, constructed, and maintained erosion control plan consistent with local standards and best management erosion control practices will be required for this project. AESI is available to assist the project civil engineer in developing site-specific erosion control plans. Based on past experience, it will be necessary to make adjustments and provide additional measures to the TESC plan in order to optimize its effectiveness. Ultimately, the success of the TESC plan depends on a proactive approach to project planning and contractor implementation and maintenance.

Maintaining cover measures atop disturbed ground provides the greatest reduction to the potential generation of turbid runoff and sediment transport. During the local wet season (October 1st through March 31st), exposed soil should not remain uncovered for more than 2 days unless it is actively being worked. Ground-cover measures can include erosion control matting, plastic sheeting, straw mulch, crushed rock or recycled concrete, or mature hydroseed.

Surface drainage control measures are also essential for collecting and controlling the site runoff. Flow paths across slopes should be kept to less than 50 feet in order to reduce the erosion and sediment transport potential of concentrated flow. Ditch/swale spacing will need to be shortened with increasing slope gradient. Ditches and swales that exceed a gradient of about 7 to 10 percent, depending on their flow length, should have properly constructed check dams installed to reduce the flow velocity of the runoff and reduce the erosion potential within the ditch. Flow paths that are required to be constructed on gradients between 10 to 15 percent should be placed in a riprap-lined swale with the riprap properly sized for the anticipated flow conditions. Flow paths constructed on slope gradients steeper than 15 percent should be placed in a pipe slope drain. AESI is available to assist the project civil engineer in developing a suitable erosion control plan with proper flow control.

Ground cover prior to rain events is one of the most important and effective means to maintain water quality. Once very fine sediment is suspended in water, the settling times of the smallest particles are on the order of weeks and months. Therefore, the typical retention times of sediment traps or ponds will not reduce the turbidity of highly turbid site runoff to the benchmark turbidity of 25 NTU. Temporary sediment traps and ponds are necessary to control the release rate of the runoff and to provide a catchment for sand-sized and larger soil particles, but are not effective at reducing the turbidity of the runoff.

[1] http://www.ecy.wa.gov/programs/wq/stormwater/construction/constructionfinalpermit.pdf

Silt fencing should be utilized as buffer protection and not as a flow-control measure. Silt fencing should be placed parallel with topographic contours to prevent sediment-laden runoff from leaving a work area or entering a sensitive area. Silt fences should not be placed to cross contour lines without separate flow control in front of the silt fence. A swale/berm combination should be constructed to provide flow control rather than let the runoff build up behind the silt fence and utilize the silt fence as the flow-control measure. Runoff flowing in front of a silt fence will cause additional erosion and usually will cause a failure of the silt fence. Silt fencing should be limited to protect sensitive areas, and swales should be used to provide flow control.

7.1 Erosion Hazard Mitigation

To mitigate the erosion hazards and the potential for off-site sediment transport, we recommend the following:

1. Construction activity should be scheduled or phased as much as possible to reduce the amount of earthwork activity that is performed during the winter months.

2. The winter performance of a site is dependent on a well-conceived plan for control of site erosion and storm water runoff. The project TESC should include ground-cover measures, access roads, and staging areas. The contractor must implement and maintain the required measures. A site maintenance plan should be in place in the event storm water turbidity measurements are greater than the Ecology standards.

3. TESC measures for a given area to be graded or otherwise worked should be installed soon after ground clearing or timber harvesting. The recommended sequence of construction within a given area after clearing/timber harvesting would be to install sediment traps and/or ponds and establish perimeter flow control prior to starting mass grading.

4. During the wetter months of the year, or when large storm events are predicted during the summer months, each work area should be stabilized so that if showers occur, the work area can receive the rainfall without excessive erosion or sediment transport. The required measures for an area to be "buttoned-up" will depend on the time of year and the duration the area will be left un-worked. During the winter months, areas that are to be left un-worked for more than 2 days should be mulched or covered with plastic. During the summer months, stabilization will usually consist of seal-rolling the subgrade. Such measures will aid in the contractor's ability to get back into a work area after a storm event. The stabilization process also includes establishing temporary storm water conveyance channels through work areas to route runoff to the approved treatment facilities.

5. All disturbed areas should be revegetated as soon as possible. If it is outside of the growing season, the disturbed areas should be covered with mulch, as recommended in the erosion control plan. Straw mulch provides a cost-effective cover measure and can be made wind-resistant with the application of a tackifier after it is placed.

6. Surface runoff and discharge should be controlled during and following development. Uncontrolled discharge may promote erosion and sediment transport. Under no circumstances should concentrated discharges be allowed to flow over the top of steep slopes.

7. Soils that are to be reused around the site should be stored in such a manner as to reduce erosion from the stockpile. Protective measures may include, but are not limited to, covering with plastic sheeting, the use of low stockpiles in flat areas, or the use of silt fences around pile perimeters. During the period between October 1st and March 31st, these measures are required.

8. On-site erosion control inspections and turbidity monitoring (if required) should be performed in accordance with Ecology requirements. Weekly and monthly reporting to Ecology should be performed on a regularly scheduled basis. Temporary and permanent erosion control and drainage measures should be adjusted and maintained, as necessary, for the duration of project construction.

It is our opinion that with the proper implementation of the TESC plans and by field-adjusting appropriate mitigation elements (BMPs) throughout construction, as recommended by the erosion control inspector, the potential adverse impacts from erosion hazards on the project may be mitigated.

III. PRELIMINARY DESIGN RECOMMENDATIONS

8.0 INTRODUCTION

Our exploration indicates that, from a geotechnical standpoint, the parcel is suitable for the proposed development provided the recommendations contained herein are properly followed. Foundations bearing on either the medium dense to very dense, natural outwash sediments or on structural fill placed over these sediments are capable of providing suitable building support.

We encountered significant fill thicknesses in most of our exploration pits, which were completed within or near the edges of the landfill. We understand that the current plan includes the removal of existing landfill debris, where less than 15 feet in depth, and the replacement of this material with structural fill to provide foundation support for the proposed residences. The attached Figure 2 shows both the approximate extent of landfill debris and the existing debris greater than 15 feet in depth. Based on our observations and exploration, we expect that the localized depth, content, or condition of the materials in the area of the landfill will vary widely, particularly if past surface mining activities took place at the property prior to the site's use as a landfill.

For the areas with existing landfill debris depths less than 15 feet, we recommend that the existing debris be removed from below areas of planned foundations to expose underlying, undisturbed native sediments, followed by restoration of the planned foundation grade with structural fill. Removal of existing fill should extend laterally beyond the building footprint by a distance equal to the depth of overexcavation. For example, if existing fill is removed to a depth of 12 feet below a planned footing area, the excavation should also extend laterally at least 12 feet beyond the building footprint in that area. Where existing debris is removed and replaced with structural fill, conventional shallow foundations may be used for building support. The required depth of removal should be determined in the field based on actual conditions encountered during excavation.

Typically, deep foundation systems, such as pipe piles (described in Section 11.2 of this report), are used to reach bearing soil below loose fill areas. However, based on our explorations at this project site, it is our opinion that driven piles may get "hung up" in buried wood or construction debris and not reach the bearing soil strata. We anticipate that most obstructions could be removed with a large excavator, and that deepened footings or overexcavation and backfill with structural fill can be used to reach bearing soil where the unsuitable fill zone is relatively thin. However, in areas underlain by significant fill thicknesses, overexcavation and backfill may not be practical. In these areas, a deep foundation system may be needed to provide support to planned structures, with the understanding that the risk remains of piles getting "hung up" in buried wood or construction debris and not reaching the bearing soil strata.

For all proposed structures, paved areas, grade-sensitive utility locations, or other features that are considered as "settlement-sensitive," we recommend that existing unsuitable landfill debris be removed and replaced with structural fill. Long-term consolidation and ground surface settlement should be expected wherever the existing landfill debris is not removed. It should be understood that the risk of excessive, post-construction differential settlement will remain between mitigated areas and non-mitigated landfill debris areas. The magnitude of anticipated settlement is discussed in Section 10.4.

9.0 SITE PREPARATION

Site preparation should include removal of all trees, brush, and any other deleterious material. Additionally, any organic forest duff, sod, topsoil, and stumps should be removed and the remaining roots grubbed. Areas where loose soils exist due to previous grading, filling, or grubbing operations should be considered as uncontrolled fill to the depth of disturbance and treated as subsequently recommended for structural fill placement. Where existing loose fill or natural sediments are relatively free of organics or debris and near their optimum moisture content for compaction, they can be segregated for reuse as structural fill. Since the density of the soil is variable, random soft pockets may exist, and the depth and extent of stripping can best be determined in the field by the geotechnical engineer or their representative.

9.1 Permanent Cut and Fill Slopes

Permanent cut and structural fill slopes should be graded no steeper than 2H:1V. Slopes should be hydroseeded, landscaped, or otherwise protected as soon as possible after grading. Cut slopes in natural, undisturbed soils that must be steeper than 2H:1V should be protected by retaining walls or rockeries.

9.2 Temporary Cut Slopes

In our opinion, stable construction slopes should be the responsibility of the contractor and should be determined during construction based on the local conditions encountered at that time. For planning purposes, we anticipate that temporary, unsupported cut slopes in the existing landfill debris or loose to medium dense, weathered sediments can be made at a maximum slope of 1.5H:1V. For temporary cut slopes within the dense to very dense, unweathered sediments, up to a 1H:1V inclination may be planned. As is typical with earthwork operations, some sloughing and raveling may occur, and cut slopes may have to be adjusted in the field. Flatter, temporary cut slopes should be anticipated in areas of ground water seepage. In addition, WISHA/OSHA regulations should be followed at all times.

9.3 Site Disturbance

The pre-Vashon glacial lacustrine deposit, along with lenses and interbeds within the Vashon advance outwash, contains a high percentage of fine-grained material (silt and clay-sized particles), which makes it moisture-sensitive and subject to disturbance when wet. Most of the soils encountered in our explorations were judged to be at or above their optimum moisture content for compaction at the time of our study. The contractor must use care during site preparation and excavation operations so that the underlying soils are not softened, particularly during wet weather conditions. If disturbance occurs, the softened soils should be removed and the area brought to grade with structural fill. Because of the moisture-sensitive nature of the soils, we anticipate that wet weather construction would significantly increase the earthwork costs over dry season and dry site construction. It is also likely that even during the dry season, soil moisture conditioning and/or imported granular soils may be required to achieve proper compaction of structural fill areas.

10.0 STRUCTURAL FILL

Structural fill will be necessary to establish desired grades and for utility trench backfill. All references to structural fill in this report refer to subgrade preparation, fill type, placement, and compaction of materials, as discussed in this section. In those areas where existing uncontrolled fill is present, we recommend that it be removed and, where suitable, set aside for reuse. Our recommendations for the placement of structural fill are presented in the following sections.

10.1 Fill Placement

After stripping, planned excavation, and any required overexcavation have been performed to the satisfaction of the geotechnical engineer or their representative, the upper 12 inches of exposed ground should be compacted to a firm and unyielding condition. If the subgrade contains too much moisture, adequate recompaction may be difficult or impossible to obtain and should probably not be attempted. In lieu of compaction, the area to receive fill should be blanketed with washed rock, quarry spalls, or crushed recycled concrete to act as a capillary break between the new fill and the wet subgrade. Structural fill should be placed and compacted within 2 percent of the optimum moisture content.

After compaction of the exposed ground is approved, or a free-draining rock course is laid, possibly in conjunction with engineering stabilization fabric, structural fill may be placed to attain desired grades. Structural fill is defined as non-organic soil, acceptable to the geotechnical engineer, placed in maximum 8-inch loose lifts, with each lift being compacted to at least 95 percent of the modified Proctor maximum density using ASTM:D 1557 as the standard.

The contractor should note that any proposed fill soils should be evaluated by AESI prior to their use in fills. This would require that we have a sample of the material 72 hours in advance of filling activities to perform a Proctor test and determine its field compaction standard. Soils in which the amount of fine-grained material (smaller than the U.S. No. 200 sieve) is greater than approximately 5 percent (measured on the minus U.S. No. 4 sieve size) should be considered moisture-sensitive. Use of moisture-sensitive soils in structural fills should be limited to favorable dry weather and near-optimum subgrade moisture conditions.

The on-site sandy advance outwash soils may be used for structural fill, provided that soil moisture is within 2 percent of optimum. The pre-Vashon glacial lacustrine soils observed in our explorations to underlie the sandy advance outwash contained significant amounts of silt and clay and are considered moisture-sensitive. Construction equipment traversing the site when the soils are wet can cause considerable disturbance. If fill is placed during wet weather or if proper compaction cannot be obtained due to wet subgrade or soil conditions, a select material consisting of a clean, free-draining gravel and/or sand should be used. Free-draining fill consists of non-organic soil with the amount of fine-grained material limited to 5 percent by weight when measured on the minus U.S. No. 4 sieve fraction and at least 25 percent greater than the No. 4 sieve.

All planned fills on slopes steeper than 5H:1V should be analyzed by AESI during design and prior to construction. If fill is to be placed on slopes steeper than 5H:1V, the base of the fill should be tied to firm, stable subsoil by appropriate keying and benching, which would be established in the field to suit the particular soil conditions at the time of grading. The keyway will embed the toe of the new fill into the hillside enhancing stability of the fill. Generally, the keyway for hillside fills should be at least 8 feet wide and cut into the medium dense to very dense, natural outwash sediments. Level benches would then be cut horizontally across the hill following the contours of the slope. No specific width is required for the benches, although they are usually a few feet wide, such as those produced by a large excavator bucket. If persistent ground water seepage is encountered, gravel interceptor drains should be constructed on the benches prior to filling. Again, all fills proposed for the steep site slopes should be reviewed by our office prior to construction.

10.2 Construction Monitoring

A representative from our firm should observe the stripped subgrades and be present during placement of structural fill to observe the work and perform a representative number of in-place density tests. In this way, the adequacy of the earthwork may be evaluated as filling progresses and problem areas may be corrected at that time. It is important to understand that taking random compaction tests on a part-time basis will not ensure uniformity or acceptable performance of a fill. As such, we are available to aid in developing a suitable monitoring and testing frequency.

10.3 Landfill Cap

As per the SCHD, the landfill portion of the property is subject to the closure requirements of WAC 173-304, Minimal Functional Standards for Solid Waste Handling. The regulations require that the landfill be covered with a minimum of 2 feet of compacted, low-permeability (less than 1×10^{-6} cm/sec) soil. We recommend that this material be placed in maximum loose lift thicknesses of 8 inches and compacted to a minimum of 95 percent of its maximum dry density, as determined by ASTM:D 1557. We also recommend that the cap material contain a minimum of 20 percent passing the U.S. No. 200 sieve size and a maximum particle size of 3 inches. Prior to placement of the soil cap, the area to be filled should be prepared as recommended in Section 9.0 of this report. Soil cap placed on a slope should be placed as recommended in Section 10.1 of this report.

For non-structural, protective soil layers that are placed over cover membranes and do not require low permeability, we recommend that the soil be compacted to a minimum of 90 percent of its maximum dry density as determined by ASTM:D 1557. We recommend that the lower foot of soil placed directly on top of the membrane have a maximum particle size of 2 inches, that the gravel content consist of rounded rock (not crushed/fractured), and be free of other deleterious material, such as concrete debris, wood, etc. Soil cover placed above the lower foot may consist of general purpose fill soil that can be compacted to the above recommended density.

10.4 Site Settlement

Presented below is a description of the proposed plat development with respect to the former Go East construction debris/solid waste landfill location, history, and composition. This information is followed by a discussion of our settlement analysis and estimated settlements.

As discussed earlier, we understand that the proposed residential plat project consists of developing portions of the subject 40-acre parcel with 97+ single-family residences, along with associated roadways, utilities, and storm water detention and water quality pond. The home sites and roadways will be constructed around the perimeter of the 5- to 6-acre, former Go East Landfill. The footprint and boundary of the landfill will be reduced. The reduced areas of the landfill will be reclaimed for plat development by excavation of the existing construction debris fill extending to depths ranging from 0 to 15+ feet, and replacement with compacted, structural fill. The excavated material will be relocated to within the boundary of the remaining landfill. All waste fill would be removed from lot footprints and right-of-way alignments. However, the storm water pond, pond access road, emergency access road, and approximately 1 to 2 acres of park area will be located above areas underlain by landfill debris. Design of the pond will include use of double layers of 30-mil, polyvinyl chloride (PVC) (or equal) geomembrane liner. A single layer will be used outside the pond area. In accordance with the SCHD, the landfill area, including the pond and park areas, will be capped by placement of a minimum of 2 feet of low-permeability soil cover over the landfill, graded to no steeper than 2H:1V and seeded with turf native on 2:1 slope grass. A conceptual site plan, presented on Figure 3, illustrates the currently-proposed project.

Presented below is a brief history of the former Go East Landfill development and usage.

- 1969 - The site was first used as a permitted sand excavation pit, permitted per Snohomish County.
- 1971 - Sand excavation pit was closed.
- 1972 - Rekoway, Inc. purchased the site, received a CUP for sand and gravel excavation, and later as a solid waste landfill accepting wood, mineral, and concrete solid materials, placed in sealed cells and compacted.
- 1978 - The Rekoway site was closed.
- 1979 - The Go East Corporation acquired the site, SCHD permitted for a wood waste landfill, placed in sealed earthen cells and compacted.
- 1983 - SCHD permit expired; Go East Landfill closed and was capped with fill material.

The landfill waste fill has been inventoried in 65 exploration pits with depths up to about 25 feet. An additional 6 cone penetrometer soundings extending to a maximum depth of 20 feet were completed to further characterize the waste fill. Additionally, a series of ground water monitor wells and temporary gas probes have also been installed. The exploration pits, cone penetrometer soundings, and ground water monitor wells and gas probe locations are surveyed and mapped as shown on Figure 2. Where the exploration pits and soundings did not penetrate the fill, the fill depth has been estimated by comparing the pre- and post-landfill site topography survey data (contained with the owners files), as shown on the site plan and cross sections provided by PACE. Below the storm water pond, the maximum fill depths are estimated to range from 15 to 30 feet deep. The deepest portions of the landfill are located approximately 100 feet north of the pond, and are estimated to extend to depths of 48 to

68 feet. Regrading of the landfill required to achieve desired grades will result in removing 5 to 12 feet of fill from the pond area, and adding 3 to 25 feet of structural fill to the remaining park areas of the landfill. This regrading includes the proposed landfill cap.

Based on the landfill debris exposed within the exploration pits, the material consists of gravel, concrete, wire, woody debris, stumps, tires, brick, asphalt, plastic pipe, lumber, burned wood, burn ash, metal, glass, and carpet. It is our understanding from the landfill owner (Mr. Gary East) that during each day of operation, approximately 6 to 8 feet of waste debris was placed in landfill cells. The fill was spread and "cat walked" using a dozer to flatten and compact the material. The fill was subsequently capped with approximately 1 foot of soil fill. The exploration logs validate that the cap fill soil consists of loose, silty sand with gravel.

10.5 Settlement Analysis

As discussed above, the proposed residences and associated roadways and utilities will be located outside the modified existing landfill, and settlement of structures supported on natural soil or structural fill is not a concern when prepared as discussed in Section 9.0. However, the proposed storm water pond, pond access road, and emergency access road will be located above areas underlain by landfill debris. Furthermore, the remaining portions of the landfill will be used as park areas. Thus, both the pond and park areas will be located over landfill debris and may experience some long-term settlement. To develop estimates of this potential settlement, we have utilized the following analysis method.

Total settlement (S_t) of the landfill soils has four components, or

$$S_t = S_i + S_c + S_s + S_b$$

Where: S_i = the immediate or elastic settlement of the soil skeleton;
S_p = settlement due to primary soil consolidation;
S_s = settlement due to secondary soil consolidation; and,
S_b = settlement due to biodecomposition of organic materials.

Immediate settlement S_i occurs when a soil is placed as fill or is surcharged with new soil fills or foundation loads. The added stress is transferred to the soil skeleton, resulting in a deformation. This process occurs immediately upon application of the load and is partially an elastic process. We have estimated the immediate settlements for various waste fill depths and loadings using Schmertmann's method based on *"Settlement Analysis," Technical Engineering & Design Guides as Adapted from the US Army Corps of Engineers*, No. 9, ASCE Press, 1994. The cone penetrometer soundings provided equivalent SPT blow count numbers for use in the analysis.

Primary soil consolidation settlement S_p occurs when a soil is loaded and the air and water voids are partially squeezed out of the soil mass. This portion of the consolidation process is where the bulk of the settlement will be observed. Once the air and moisture voids are removed from the soil mass, a second form of settlement occurs, and as the sequence implies, is known as secondary or long-term consolidation settlement S_s. Secondary consolidation occurs as the result of a buildup of stress on the soil skeleton (increased effective stress), which results in the breaking down and reorientation of soil particles. Although this process of secondary consolidation is not well understood, rough estimates of secondary settlement can be made. The amount and rate of both primary and secondary settlement are dependent primarily upon, fill thickness, permeability, and drainage provided by adjacent soils. Loads applied to the fill, such as soil stockpiles, and compaction can create pre-consolidation stresses, which also significantly affect primary and secondary settlement.

In order to estimate the settlement of the landfill waste soil, Terzaghi's method of consolidation theory (Holtz and Kovacs, 1981) was applied. This method allows estimation of primary consolidation, the time to reach the end of primary consolidation, and the long-term secondary consolidation. Engineering properties for the landfill waste have been estimated, since no laboratory data was available. The exploration pits noted that the soil component of the landfill debris typically consists of loose, silty sand with gravel. However the cone penetrometer data indicates that the waste fill behaves generally similar to silty clay, clayey silt, and sandy silt. This is likely due to the presence of organic material and woody debris, which cause the debris to exhibit cone sleeve friction values more similar to soils with greater cohesive properties. Thus, we have characterized the landfill waste soil as organic silt, and selected associated engineering indices for modified compression index $C_{c\varepsilon}$, modified recompression index $C_{r\varepsilon}$, coefficient of consolidation C_v, and modified secondary compression index $C_{\alpha\varepsilon}$ for use in our settlement analyses. It is our opinion that this is a conservative approach, and will likely overestimate predicted settlement.

In addition to settlement of the waste fill soils due to immediate and consolidation settlements, it is possible that additional settlement could be realized due to the biological decomposition of the organic component of the fill. No specific means of calculating this potential type of consolidation was available at the time this report was prepared. However, a literature search and review was conducted. Based on papers by J.A. Micales and K.E. Skog, *The Decomposition of Forest Products in Landfills*, contained in International Biodeterioration & Biodegradation Vol. 39, No. 2-3, 145-158 (1997); and by F.A. Ximenes, W.D. Gardener, and A.L. Cowie, *The Decomposition of Wood Products in Landfills in Sydney, Australia*, contained in Waste Management (2008), it has been found that 3 to 9.1 percent of the carbon from buried wood waste are decomposed and emitted as landfill gas. In the case of the Australian study, these values were determined by evaluation of wood debris buried in separate landfills for 19, 29, and 46 years. These papers also state that landfills develop anaerobic conditions in a short time period, which inhibits fungi and bacterial decomposition of the organic material. Thus, decomposition of buried wood, which forms the majority of organic material within the Go East Landfill waste, should be very slow and the resulting settlement should not be excessive.

Although an accurate estimate of the biological decomposition settlement S_b that may result from decay of organic materials within the landfill waste is not possible at this time, we have employed a simplified method to estimate this settlement component as follows:

S_b = waste fill depth x 50 percent x 9.1 percent

This equation assumes that 50 percent of the waste fill depth is organic debris and that 9.1 percent of that debris will decompose over the next 30 years. The 50 percent value was estimated from dense zones of soil indicated on the cone penetrometer sounding log of CPT-6. Dense soil zones are speculated to be larger waste debris. This estimate is assumed to be conservative in that:

- Less than 50 percent of the estimated debris thickness would be organic due to the presence of hard materials such as concrete, asphalt, brick, metal, and glass.
- The waste has already been in place for 30 years and the majority of biological decomposition has likely occurred.

10.6 Settlement Estimates and Discussion

Based on the landfill site characterization and settlement analyses methods discussed in Sections 10.4 and 10.5, AESI estimates that the total maximum amount of settlement S_t estimated beneath the future storm water pond is 10 to 18 inches, with maximum differential settlement of about 8 inches. North of the pond additional structural fill material will be placed in lifts, then rolled and compacted. The maximum amount of settlement estimated elsewhere on the landfill (about 1 to 2 acres of parkland) where structural fill will be placed over the waste is about 3.0 to 6.6 feet, with maximum differential settlement of up to 3.5 feet. We understand the surface of the landfill with deeper fills will be graded with an undulating grade such that settlements may not be even noticeable minimizing future regrading. Estimated settlements for the pond location are smaller than for the park areas because the underlying landfill debris is less thick in the pond location, and excavation of the pond will remove soil and reduce loads on the underlying landfill debris. Whereas, adding structural fill to the park areas will increase loading on the existing landfill debris, and induce new settlement to occur.

As mentioned previously, no habitable structures will be constructed over the landfill, but the storm water detention pond, access road, emergency access road, and park area will be constructed atop the landfill. These facilities should be designed to accommodate potential total and differential settlements estimated to occur within the landfill over the life of the project. The detention pond, and any relocated streams or pipelines should be constructed to prevent the infiltration of water into the landfill debris. Infiltration of concentrated water flow into the landfill debris could result in additional settlement.

Potential settlements due to collapse of possible voids within the debris materials are not predictable. Sinkholes typically develop due to decay of thick zones of organic materials, collapse of voids within nested material due to soil overburden pressure, or piping of soil particles into void spaces due to ground water flow. Observations and recent topographic field survey mapping indicates limited settlement has occurred at the shallower fill areas located at the edges of the site. Moderate settlement has occurred at the center of the site, where deeper fills are located. Engineers have not located any specific sinkholes or abrupt changes to the landfill surface. The landfill waste has been in place for the past 30 years, which in our opinion, should be sufficient time for some potential sinkhole development. Prior to adding any new fill, the existing surface will be proof-rolled to expose any voids within the existing fill that may have occurred or exist due to the 30+ years of the fills history. Further, if a void were to collapse, it would not be of sufficient size to propagate to the surface and form a significant sinkhole, but more likely, a depression would develop. Therefore, it is our opinion that the risk of formation of future sinkholes is low.

The current pond design utilizes a double PVC liner with an elongation capacity of over 300 percent. Given the liner's large elongation capacity, the estimated total maximum settlement and development of an isolated sinkhole depression is expected to be well within the capacity of the liner, and a puncture or rip is not likely to occur.

11.0 FOUNDATIONS

11.1 Shallow Foundations

11.1.1 Allowable Soil Bearing Pressure

Spread footings may be used for building support when founded either directly on the medium dense to very dense, natural glacial sediments, or on structural fill placed over these materials, as described under the "Site Preparation" and "Structural Fill" sections of this report. For footings founded either directly upon the medium dense to very dense glacial sediments, or on structural fill as described above, we recommend that an allowable bearing pressure of 2,500 pounds per square foot (psf) be used for design purposes, including both dead and live loads. An increase of one-third may be used for short-term wind or seismic loading.

11.1.2 Footing Depths

Perimeter footings for the proposed buildings should be buried a minimum of 18 inches into the surrounding soil for frost protection. No minimum burial depth is required for interior footings; however, all footings must penetrate to the prescribed strata, and no footings should be founded in or above loose, organic, or existing fill soils. Sediments suitable for foundation support were generally encountered in our explorations at depths of approximately 2 to greater than 21 feet, but may be deeper elsewhere, particularly in previously disturbed graded areas or where the landfill debris extends deeper.

11.1.3 Footings Adjacent to Cuts

The area bounded by lines extending downward at 1H:1V from any footing must not intersect another footing or intersect a filled area that has not been compacted to at least 95 percent of ASTM:D 1557. In addition, a 1.5H:1V line extending down from any footing must not daylight because sloughing or raveling may eventually undermine the footing. Thus footings should not be placed near the edges of steps or cuts in the bearing soils.

11.1.4 Footing Settlement

Anticipated settlement of footings founded on undisturbed, medium dense to dense native soils or structural fill as described above should be on the order of 1 inch or less. However, disturbed soil not removed from footing excavations prior to footing placement could result in increased settlements.

11.1.5 Footing Subgrade Bearing Verification

All footing areas should be observed by AESI prior to placing concrete to verify that the exposed soils can support the design foundation bearing capacity and that construction conforms with the recommendations in this report. Foundation bearing verification may also be required by the governing municipality.

11.1.6 Foundation Drainage

Perimeter footing drains should be provided, as discussed under the "Drainage Considerations" section of this report. If gravity drainage is not possible, the portion of the structure below the drain level must be designed for combined soil and hydrostatic/buoyant forces.

11.2 Deep Foundations

11.2.1 Pipe Piles

A deep foundation system consisting of small-diameter driven steel pipe piles can be used for foundation support in areas where landfill debris underlies the structure. However, by placing the foundation of the buildings on piles, a rigid structure is created, while the area surrounding the buildings could still settle. Therefore, accommodations must be made to allow for the differential settlement between the structural, pile-supported areas and the parking area pavement, utilities, patios, and sidewalks. This may include extending the deep foundation elements out beyond the perimeter of the buildings to include the sidewalks and other concrete elements, surcharge loading of the building perimeter, hinged connections of the utilities and exterior building components, or preloading parking areas.

Pipe piles should consist of 3-, 4-, or 6-inch-diameter pipe depending on the required structural loads. The piles should be steel pipe, driven with a suitable hydraulic hammer to the refusal criteria shown in Table 4. The following table provides required minimum hammer weights, refusal criteria, and allowable loads for pipe piles. The length of driven piles required will depend upon the thickness of the fill through which they must be driven and the depths to pile refusal in the native sediments. We anticipate that piles would reach refusal within 20 feet of penetrating the fill, but refusal depths are difficult to predict in sandy soils and may exceed this depth. Actual pipe pile depths may not be determined until after initial pile installation.

Table 4
Pipe Pile Design Parameters

Pipe Diameter (inches)	Wall Thickness	Minimum Hammer Size (pounds)	Refusal Criteria[1] (seconds)	Allowable Load[1] (kips)
3	Schedule 40	400	25	10
4	Schedule 40	650	20	20
6	Schedule 40	1,500	15	20-30

[1] Refusal is defined as less than 1 inch of penetration in "X" seconds under constant driving.
[2] Allowable load to be verified by 200 percent load tests in accordance with ASTM:D 1145 "quick load test."

Anticipated settlement of pile-supported foundations should be less than ½ inch. Pile installation must be observed by AESI to verify that the design bearing capacity of the piles has been attained and that construction conforms to the recommendations contained herein. Snohomish County may also require such inspections.

Lateral resistance can be derived from passive soil resistance against the buried portion of the foundation (i.e., the grade beam) or from the installation of batter piles. A passive equivalent fluid of 200 pounds per cubic foot (pcf) can be used to account for lateral resistance. Lateral resistance for batter piles should be taken as the horizontal component of the axial pile load. Batter piles are typically installed at 1H:4V inclination.

11.2.2 Driving Obstructions

Driven piles may not be able to penetrate the woody debris, asphalt, or other landfill debris encountered in our explorations. This debris is not considered to be suitable for support of the structures. Therefore, it may be necessary to pre-excavate in areas planned for piles to remove debris in the fill.

11.2.3 Augercast Piles

In lieu of driven piles, augercast piles may be better able to penetrate landfill debris, although they also may be subject to being stopped short of planned bearing depth by large debris. Augercast piles are formed by drilling to the required depth with a continuous-flight, hollow-stem auger. Fluid grout is then pumped down the hollow stem under pressure as the auger is withdrawn. Reinforcing steel cages are then lowered into the unset grout. A central reinforcing bar is installed for the full length of the pile for transfer of uplift loads. Since the grout is placed under pressure, actual grout volumes used are typically 15 to 50 percent greater than the theoretical volume of the pile. Actual grout volumes for piles constructed through some types of fill and soft, yielding soils can be much more. The pile contractor should be required to provide a pressure gauge and a calibrated pump stroke counter so that the actual grout volume for each pile can be determined. Typically, a nine-sack, minimum 4,000 pounds per square inch (psi) grout mix is used for augercast piles.

Pile Capacity

The proposed augercast piles would gain support primarily from end bearing with some contribution from skin friction. The piles should penetrate a minimum of 6 feet into the bearing soils to develop the capacities shown in Table 5 below. Based on the borings completed for this project, the bearing soils consist of medium dense to dense sand or stiff to hard silt. Pile installation depths should be anticipated to vary depending upon the depth of landfill debris penetrated and should be determined in the field by the geotechnical engineer or their representative. The design capacities presented in this report require the minimum embedment into bearing soil and a minimum pile spacing of 3 pile diameters for full axial capacities. The number and spacing of the piles should be determined by a structural engineer.

Table 5
Preliminary Augercast Pile Recommendations

Depth of Landfill Debris (feet)	Pile Diameter (inches)	Estimated Total Pile Length (feet)	Recommended Embedment into Bearing Soil (feet)	Allowable Vertical Pile Capacity (tons)[1]	Allowable Lateral Capacity[2] (tons)	Depth to Fixity (feet)	Allowable Uplift Capacity (tons)
10	24	16	6	40	9	14	16
20	24	26	6	45	9	23	25
30	24	36	6	45	9	24	36

(1) Requires minimum 6 feet embedment into bearing soils and minimum 3D spacing for full axial capacity.
(2) Lateral capacity assumes a fixed-head condition, suitable reinforcement, and up to ½ inch lateral deflection at ground surface.

Allowable design loads may be increased by one-third for short-term wind or seismic loading. Anticipated settlements of pile-supported structures will generally be on the order of ½ inch.

Depth to Fixity

The depth of fixity for various pile depths are shown in Table 5. The depth of fixity does not include the code-required 20 percent increase for reinforcing cage design.

Drilling Obstructions

Based on the loose conditions of the landfill debris through which the augercast piles are to be excavated, care should be taken in construction planning to allow grout time to set prior to drilling adjacent piles. The landfill debris may contain concrete, wood, metal, or other debris that could obstruct drilling. AESI should be consulted immediately if obstructions in the bearing layer are encountered. If shallow obstructions are encountered, they should be removed with an excavator. If obstructions cannot be removed, AESI and the structural engineer should be consulted to provide recommendations for installation of replacement piling.

Group Effects

Where piles are installed in groups and subject to lateral loading, reductions in lateral capacity to account for group effects should be included in design. The effects of group performance should be considered where piles are spaced closer than 6 pile diameters center-to-center and are aligned in the direction of loading. Piles should not be spaced closer than 3 pile diameters center-to-center to achieve full vertical and uplift capacity.

For the determination of individual capacities for load application parallel to the line of spacing, the following spacing and reduction factors presented in Table 6 should apply. The last pile in a row can be assumed to develop the full lateral capacity.

Table 6
Lateral Reduction Factors

Pile Spacing	Reduction Factor
8 diameters	1.0
5 diameters	0.7
4 diameters	0.4
3 diameters	0.25

12.0 CAST-IN-PLACE RETAINING WALLS AND BASEMENT WALLS

All backfill behind retaining walls or around foundation units should be placed as per our recommendations for structural fill and as described in this section of the report. Horizontally backfilled retaining walls that are free to yield laterally at least 0.1 percent of their height may be designed using an equivalent fluid equal to 35 pcf. Fully restrained, horizontally backfilled, rigid walls that cannot yield should be designed for an equivalent fluid of 50 pcf. If roadways, parking areas, or other areas subject to vehicular traffic are adjacent to retaining walls, a surcharge equivalent to 2 feet of soil should be added to the wall height in determining lateral design forces. Retaining walls that retain sloping backfill at a maximum angle of 2H:1V should be designed using an equivalent fluid pressure of 55 pcf for yielding conditions or 75 pcf for fully restrained conditions.

In accordance with the 2006 IBC, retaining wall design should include seismic design parameters. Based on the site soils and assumed wall backfill materials, we recommend a seismic surcharge pressure in addition to the equivalent fluid pressures presented above. A rectangular pressure distribution of 4H and 8H psf (where H is the height of the wall in feet) should be included in design for "active" and "at-rest" loading conditions, respectively. The resultant of the rectangular seismic surcharge should be applied at the midpoint of the walls.

The lateral pressures presented above are based on the conditions of a uniform backfill consisting of imported sand and gravel compacted to 90 percent of ASTM:D 1557. A higher degree of compaction is not recommended, as this will increase the pressure acting on the wall.

Footing drains must be provided for all retaining walls, as discussed under the "Drainage Considerations" section of this report. It is imperative that proper drainage be provided so that hydrostatic pressures do not develop against the walls. This would involve installation of a minimum, 1-foot-wide, blanket drain to within 1 foot of the ground surface using imported, washed gravel against the walls placed to be continuous with the footing drain.

12.1 Passive Resistance and Friction Factor

Retaining wall footings/keyways cast directly against undisturbed dense soils in a trench may be designed for passive resistance against lateral translation using an allowable equivalent fluid equal to 200 pcf. The passive equivalent fluid pressure diagram begins at the top of the footing; however, total lateral resistance should be summed only over the depth of the actual key. We recommend an allowable coefficient of base friction of 0.30 for structures with conventional foundations; for structures to be pile-supported, we do not recommend using base friction for resistance to lateral loads.

13.0 FLOOR SUPPORT CONSIDERATIONS

Slab-on-grade floors may be constructed either directly on the medium dense to very dense, natural sediments, or on structural fill placed over these materials. Areas of the slab subgrade that are disturbed (loosened) during construction should be recompacted to an unyielding condition prior to placing the pea gravel, as described below. Floors that are placed over existing landfill debris should be pile-supported.

If moisture intrusion through slab-on-grade floors is to be limited, the floors should be constructed atop a capillary break consisting of a minimum thickness of 4 inches of washed pea gravel, washed crushed rock, or other suitable material approved by the geotechnical engineer. The capillary break should be overlain by a 10-mil (minimum thickness) plastic vapor retarder.

14.0 DRAINAGE CONSIDERATIONS

All retaining and perimeter foundation walls should be provided with a drain at the base of the footing elevation. Drains should consist of rigid, perforated, polyvinyl chloride (PVC) pipe surrounded by washed pea gravel. The level of the perforations in the pipe should be set at or slightly below the bottom of the footing grade beam, and the drains should be constructed with sufficient gradient to allow gravity discharge away from the buildings. In addition, all retaining walls should be lined with a minimum, 12-inch-thick, washed gravel blanket that extends to within 1 foot of the surface and is continuous with the foundation drain. Roof and surface runoff should not discharge into the foundation drain system, but should be handled by a separate, rigid, tightline drain. In planning, exterior grades adjacent to walls should be sloped downward away from the structures to achieve surface drainage.

15.0 PROJECT DESIGN AND CONSTRUCTION MONITORING

At the time of this report, site grading, structural plans, and construction methods have not been finalized. We are available to provide additional geotechnical consultation as the project design develops and possibly changes from that upon which this report is based. We recommend that AESI perform a geotechnical review of the plans prior to final design completion. In this way, our earthwork and foundation recommendations may be properly interpreted and implemented in the design. This plan review is not included in the current scope of work or budget.

We are also available to provide geotechnical engineering and monitoring services during construction. The integrity of the foundations and other site improvements depends on proper site preparation and construction procedures. In addition, engineering decisions may have to be made in the field in the event that variations in subsurface conditions become apparent. Construction monitoring services are not part of the current scope of work. If these services are desired, please let us know, and we will prepare a cost proposal.

We have enjoyed working with you on this study and are confident that these recommendations will aid in the successful completion of your project. If you should have any questions or require further assistance, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

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16.0 REFERENCES

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Table 1
Landfill Gas Probe Data

Probe	Date	Sample depth below ground surface (feet)	O_2 (%)	CO_2 (%)	CH_4 (%)
GS-1	8/7/09	5	21.5	0.1	0.0
GS-1	8/7/09	10	8.3	1.8	0.0
GS-1	8/7/09	15	8.2	1.8	0.0
GS-1	8/7/09	20	8.0	1.6	0.0
GS-1	8/7/09	25 (a)	21.3	0.1	0.0
GS-2	8/7/09	5	20.7	0.8	0.0
GS-2	8/7/09	10	20.6	0.9	0.0
GS-2	8/7/09	15	12.8	2.2	0.0
GS-2	8/7/09	20	11.9	2.9	0.0
GS-2	8/7/09	25	11.7	3.1	0.0
GS-3	8/7/09	5	9.8	10.1	0.0
GS-3	8/7/09	10	3.2	14.7	0.0
GS-3	8/7/09	15	0.0	21.0	6.4
GS-3	8/7/09	20	0.0	18.3	4.2
GS-3	8/7/09	25	0.0	19.9	4.8
GS-3	8/7/09	30	0.0	22.8	8.4
GS-4	8/7/09	5	14.6	4.1	0.0
GS-4	8/7/09	10	14.9	4.2	0.0
GS-4	8/7/09	15	14.8	4.0	0.0
GS-4	8/7/09	20	14.8	3.9	0.0
GS-4	8/7/09	25	14.6	3.9	0.0
GS-5	10/5/09	30	0.6	18.2	2.7
GS-5	10/5/09	40	2.2	15.6	2.4
GS-5	10/5/09	50	0.5	18.1	1.7
GS-6	10/5/09	15	0.0	21.4	0.0
GS-6	10/5/09	30	13.1	7.8	0.0
GS-7	10/5/09	10	1.1	19.5	0.0
GS-7	10/5/09	20	5.6	13.3	0.0
GS-8	10/5/09	10	0.0	19.1	0.0
GS-8	10/5/09	20	0.0	17.5	0.2
GS-9	10/5/09	10	19.4	1.6	0.0
GS-9	10/5/09	20	19.7	1.5	0.0
GS-10	10/5/09	5	21.0	0.3	0.0
GS-10	10/5/09	10	21.2	0.1	0.0

a = Purged 5/8-inch, inside-diameter pipe. Concentrations may be diluted with ambient air due to leakage in sampling system.

Table 2
Summary of Relevant/Applicable Regulations for Methane Exposure

Law	Code Citation	Regulatory Agency	Applies to:	Applicable location:	Maximum Allowable Methane Concentration 5% vol 100% LEL 50,000 ppm	1.25% vol 25% LEL 12,500 ppm	0.5% vol 10% LEL 5,000 ppm	0.1% vol 2% LEL 1,000 ppm	0.01% vol 0.2% LEL 100 ppm
RCW	WAC 173-351-200(4)(a)(ii)	SHD	Owner/Operator of Landfill	in soil at property boundary	X				
RCW	WAC 173-351-200(4)(a)(i)	SHD	Owner/Operator of Landfill	in on-site structures		X			
RCW	WAC 173-351-200(4)(a)(iii)	SHD	Owner/Operator of Landfill	in off-site structures					X
MTCA	WAC 173-340-300	Ecology	Owner of Contaminated Site	in soils, ambient air, or indoor air			X		
		ACGIH	Employer	in workplace				X*	

Reference: SCS Engineers, 2009

RCW = Revised Code of Washington
MTCA = Model Toxics Control Act
WAC = Washington Administrative Code
SHD = Snohomish Health District
Ecology = Washington State Department of Ecology
ACGIH = American Conference of Governmental Industrial Hygienists
* recommended exposure limit, currently not regulated

% vol = percent by volume
% LEL = percent of lower explosive limit
ppm = parts per million
lower explosive limit of methane = 5% vol in air
= unit of measure as cited in regulation

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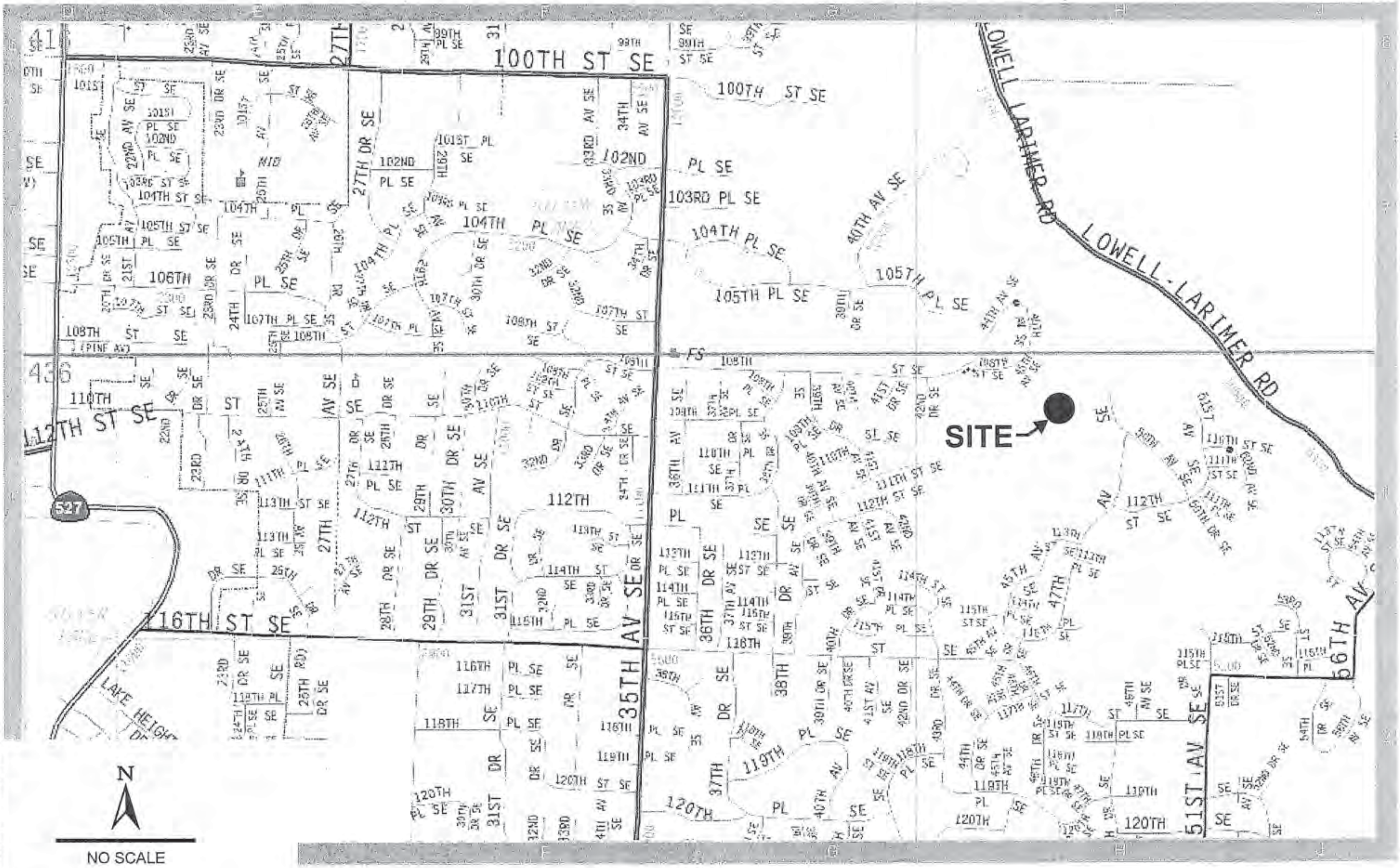
APPENDIX A



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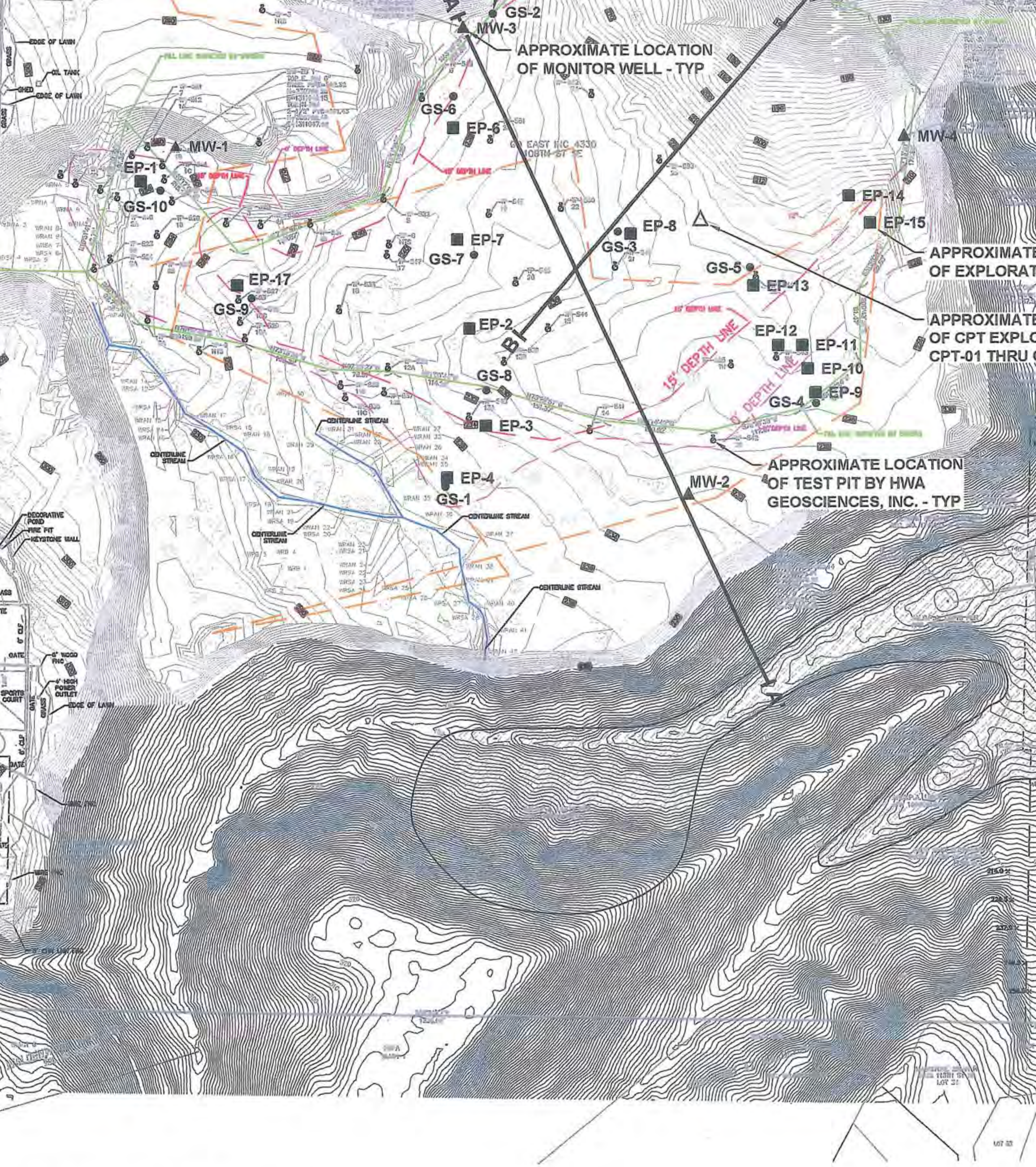
VICINITY MAP

GO EAST LANDFILL DEVELOPMENT
SNOHOMISH COUNTY, WASHINGTON

FIGURE 1
DATE 9/09
PROJ. NO. KE090231A

090231 Go East Landfill Development | 090231 Vicinity.cdr

APPENDIX A



NOTE: FILL AND DEPTH OF FILL LINES
SHOWN ARE APPROXIMATE

APPENDIX A

N

0 100 200

FEET

REFERENCE: PACE

NOTE: BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION.

Associated Earth Sciences, Inc.

CONCEPTUAL SITE PLAN

GO EAST LANDFILL DEVELOPMENT

SNOHOMISH COUNTY, WASHINGTON

FIGURE 3

DATE 2/13

PROJECT NO. KE090231A

090231 Go East Landfill Development \ 09231 submit 2-13.dwg LAYOUT: aesi 2-13

APPENDIX A

APPENDIX A

Exploration Logs

Major Divisions			Symbol	Description
Coarse-Grained Soils - More than 50%[1] Retained on No. 200 Sieve	Gravels - More than 50%[1] of Coarse Fraction Retained on No. 4 Sieve	≤5% Fines[5]	GW	Well-graded gravel and gravel with sand, little to no fines
			GP	Poorly-graded gravel and gravel with sand, little to no fines
		≥15% Fines[5]	GM	Silty gravel and silty gravel with sand
			GC	Clayey gravel and clayey gravel with sand
	Sands - 50%[1] or More of Coarse Fraction Passes No. 4 Sieve	≤5% Fines[5]	SW	Well-graded sand and sand with gravel, little to no fines
			SP	Poorly-graded sand and sand with gravel, little to no fines
		≥15% Fines[5]	SM	Silty sand and silty sand with gravel
			SC	Clayey sand and clayey sand with gravel
Fine-Grained Soils - 50%[1] or More Passes No. 200 Sieve	Silts and Clays Liquid Limit Less than 50		ML	Silt, sandy silt, gravelly silt, silt with sand or gravel
			CL	Clay of low to medium plasticity; silty, sandy, or gravelly clay, lean clay
			OL	Organic clay or silt of low plasticity
	Silts and Clays Liquid Limit 50 or More		MH	Elastic silt, clayey silt, silt with micaceous or diatomaceous fine sand or silt
			CH	Clay of high plasticity, sandy or gravelly clay, fat clay with sand or gravel
			OH	Organic clay or silt of medium to high plasticity
Highly Organic Soils			PT	Peat, muck and other highly organic soils

Terms Describing Relative Density and Consistency

	Density	SPT[2] blows/foot
Coarse-Grained Soils	Very Loose	0 to 4
	Loose	4 to 10
	Medium Dense	10 to 30
	Dense	30 to 50
	Very Dense	>50

	Consistency	SPT[2] blows/foot
Fine-Grained Soils	Very Soft	0 to 2
	Soft	2 to 4
	Medium Stiff	4 to 8
	Stiff	8 to 15
	Very Stiff	15 to 30
	Hard	>30

Test Symbols

- G = Grain Size
- M = Moisture Content
- A = Atterberg Limits
- C = Chemical
- DD = Dry Density
- K = Permeability

Component Definitions

Descriptive Term	Size Range and Sieve Number
Boulders	Larger than 12"
Cobbles	3" to 12"
Gravel	3" to No. 4 (4.75 mm)
Coarse Gravel	3" to 3/4"
Fine Gravel	3/4" to No. 4 (4.75 mm)
Sand	No. 4 (4.75 mm) to No. 200 (0.075 mm)
Coarse Sand	No. 4 (4.75 mm) to No. 10 (2.00 mm)
Medium Sand	No. 10 (2.00 mm) to No. 40 (0.425 mm)
Fine Sand	No. 40 (0.425 mm) to No. 200 (0.075 mm)
Silt and Clay	Smaller than No. 200 (0.075 mm)

[3] Estimated Percentage

Component	Percentage by Weight
Trace	<5
Few	5 to 10
Little	15 to 25
With	- Non-primary coarse constituents: ≥ 15% - Fines content between 5% and 15%

Moisture Content

- Dry - Absence of moisture, dusty, dry to the touch
- Slightly Moist - Perceptible moisture
- Moist - Damp but no visible water
- Very Moist - Water visible but not free draining
- Wet - Visible free water, usually from below water table

Symbols

Sampler Type

Blows/6" or portion of 6"

2.0" OD Split-Spoon Sampler (SPT)

Bulk sample

Grab Sample

Sampler Type Description

- 3.0" OD Split-Spoon Sampler
- 3.25" OD Split-Spoon Ring Sampler
- 3.0" OD Thin-Wall Tube Sampler (including Shelby tube)
- Portion not recovered

Cement grout surface seal

Bentonite seal

Filter pack with blank casing section

Screened casing or Hydrotip with filter pack

End cap

(1) Percentage by dry weight
(2) (SPT) Standard Penetration Test (ASTM D-1586)
(3) In General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)
(4) Depth of ground water
- ATD = At time of drilling
- Static water level (date)

(5) Combined USCS symbols used for fines between 5% and 15%

Classifications of soils in this report are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D-2487 and D-2488 were used as an identification guide for the Unified Soil Classification System.

Associated Earth Sciences, Inc.

EXPLORATION LOG KEY

blocks\log_key.dwg LAYOUT: Layout2

LOG OF EXPLORATION PIT NO. EP-1

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. **DESCRIPTION**
	Fill
1	Loose, moist, brownish gray, silty SAND, with gravel, roots, woody debris, plastic, brick.
2	
3	
4	Loose, moist, bluish gray, silty fine to medium SAND, with organics and woody debris, and dimensional lumber.
5	
6	
7	
8	
9	
10	**Vashon Advance Outwash**
11	Loose to medium dense, moist to wet, rust-stained brown to brownish gray, silty fine to medium SAND, with trace organics.
12	
13	
14	Bottom of exploration pit at 13 feet. Slight seepage at 11'. Caving from 7' to 12'.
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	

Go East Landfill Development
Snohomish County, WA

Associated Earth Sciences, Inc.

Logged by: JPL

Approved by:

Project No. KE090231A

8/5/09

APPENDIX A

LOG OF EXPLORATION PIT NO. EP-2

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplfication of actual conditions encountered. **DESCRIPTION**
	Fill
1	Loose, moist, brownish gray, silty SAND, with gravel, woody debris, plastic, and oxide fragment glass brick.
2	
3	
4	Loose, moist, dark brown to brown, silty SAND, with organic, woody debris, wire, burned wood fragments, brick, metal fragments and pipe, cloth (some wood with creosote odor), concrete, carpet.
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	Bottom of exploration pit at 19 feet. No seepage or caving.
21	
22	
23	
24	
25	

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8/5/09

LOG OF EXPLORATION PIT NO. EP-3

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. **DESCRIPTION**
	Fill
1	Loose, moist, brownish gray, silty SAND, with gravel, concrete, wire, and woody debris.
2	
3	Loose, moist, dark brown to brown, silty SAND, with organics and assorted debris (woody, metal, plastic, concrete, tire, railroad tie (dimensional wood), fabric, brick.
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	**Vashon Advance Outwash (Qva)**
17	Medium dense, moist to wet, rust-stained brownish gray, fine to medium SAND, with silty zones and trace gravel.
18	Bottom of exploration pit at 16.5 feet. Slight seepage at 5' in south extension. No caving. 15-foot depth stake located adjacent to north end of exploration pit. Contact between fill and Qva slopes upward (approximately 2H:1V [Horizontal:Vertical]) toward the south.
19	
20	

Go East Landfill Development
Snohomish County, WA

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APPENDIX A

LOG OF EXPLORATION PIT NO. EP-4

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplfication of actual conditions encountered.

Depth (ft)	DESCRIPTION
	Fill
1	Loose, moist, brownish gray, silty SAND, with gravel, roots, and a brick fragment.
2	
3	**Vashon Advance Outwash (Qva)**
4	Medium dense to dense, moist, slightly rust-stained brownish gray, fine to medium SAND, with trace gravel.
5	
6	
7	
8	Bottom of exploration pit at 7 feet. Seepage at 5'. Caving 2' to 7'.
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	

Go East Landfill Development
Snohomish County, WA

Associated Earth Sciences, Inc.

Logged by: JPL

Approved by:

Project No. KE090231A

8/5/09

LOG OF EXPLORATION PIT NO. EP-5

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. **DESCRIPTION**
	Fill
1	Loose, moist, dark brown to brownish gray, silty SAND, with roots, gravel, organics, concrete, woody debris, and brick fragments.
2	
3	**Vashon Advance Outwash (Qva)**
4	Medium dense, moist, reddish brown to brownish gray, fine to medium SAND, with roots and trace gravel.
5	
6	
7	
8	
9	Bottom of exploration pit at 8 feet. No seepage or caving. Base of slope located at west end of exploration pit. Contact between fill and Qva slopes downward (approximately 2 1/2H:1V) toward the east.
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	

Go East Landfill Development
Snohomish County, WA

Associated Earth Sciences, Inc.

Logged by: JPL

Approved by:

Project No. KE090231A

8/5/09

LOG OF EXPLORATION PIT NO. EP-6

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. **DESCRIPTION**
	Fill
1	Brown, silty SAND, with gravel, roots, and assorted debris (wood, metal, glass, plastic, fabric, brick, tire, stumps), more "general refuse" - not as much woody debris percentage as other pits.
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	Dense, moist, slightly rust-stained bluish gray, silty fine to medium SAND, with gravel, asphalt, and plastic pipe (bricks and woody debris below 18').
14	
15	
16	
17	
18	
19	
20	
21	
22	Bottom of exploration pit at 21 feet. No seepage. Caving 3' to 10'.
23	
24	
25	

Go East Landfill Development
Snohomish County, WA

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Project No. KE090231A

8/5/09

APPENDIX A

LOG OF EXPLORATION PIT NO. EP-7

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. **DESCRIPTION**
	Fill
1	Loose, moist, dark brown to brown, silty SAND, with gravel, organics, and associated debris (woody debris, dimensional lumber, brick, glass, plastic, stumps, burned wood,, asphalt, concrete, metal,
2	burn ash [orange and white], carpet.
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	**Vashon Advance Outwash (Qva)**
15	Medium dense to dense, moist, rust-stained brownish gray, fine to medium SAND, with lenses of bluish gray to gray, SILT (lenses between 14" and 15").
16	
17	
18	
19	
20	
21	Bottom of exploration pit at 20 feet. No seepage or caving.
22	
23	
24	
25	

Go East Landfill Development
Snohomish County, WA

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Project No. KE090231A

8/5/09

LOG OF EXPLORATION PIT NO. EP-8

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

Depth (ft)	DESCRIPTION
	Fill
1	Dark brown to brown, silty SAND, with gravel, organics and assorted debris (woody debris, metal, concrete, asphalt, plastic, burned wood, brownish ash, wire, brick, stumps, dimensional lumber, cinder blocks).
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	Bottom of exploration pit at 19 feet. No seepage. Cave below 15'.
21	
22	
23	
24	
25	

Go East Landfill Development
Snohomish County, WA

Associated Earth Sciences, Inc.

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Project No. KE090231A

8/5/09

LOG OF EXPLORATION PIT NO. EP-9

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. **DESCRIPTION**
	Vashon Advance Outwash (Qva)
1	Hard, moist, bluish gray, bedded SILT.
2	
3	Dense, moist, brownish gray, fine to medium SAND.
4	
5	
6	Bottom of exploration pit at 5.5 feet. No seepage or caving.
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	

KCTP3 090231A.GPJ September 10, 2009

Go East Landfill Development
Snohomish County, WA

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Project No. KE090231A

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APPENDIX A

LOG OF EXPLORATION PIT NO. EP-10

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. DESCRIPTION
	Vashon Advance Outwash (Qva)
1	Loose, moist, brownish gray, silty SAND, with gravel and roots.
2	Hard, moist, rust-stained tan to bluish gray, SILT.
3	Dense, moist, brownish gray, fine to medium SAND, with trace gravel.
4	
5	
6	
7	Bottom of exploration pit at 5.5 feet. No seepage or caving.
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
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APPENDIX A

LOG OF EXPLORATION PIT NO. EP-11

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplfication of actual conditions encountered. **DESCRIPTION**
	Fill
1	Loose, moist, dark brown to brown, silty SAND, with gravel, organics and assorted debris (similar).
	Vashon Advance Outwash (Qva)
2	Dense, moist, brownish gray, fine to medium SAND, slight rust staining.
3	
4	Bottom of exploration pit at 3 feet. No seepage or caving.
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	

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Snohomish County, WA

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Project No. KE090231A

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LOG OF EXPLORATION PIT NO. EP-12

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplfication of actual conditions encountered. **DESCRIPTION**
	Fill
1	Loose, moist, dark brown to brown, silty SAND, with gravel, organics, and assorted debris (similar).
2	
3	
4	
5	Loose, moist, bluish gray, silty SAND, with gravel.
6	Loose, moist, dark brown to brown, silty SAND, with gravel, organics, and assorted debris (similar).
7	
8	
9	
10	
11	
	Vashon Advance Outwash (Qva)
12	Dense, moist, brownish gray, fine to medium SAND.
13	
14	
15	
16	
17	Bottom of exploration pit at 16 feet. No seepage or caving.
18	
19	
20	
21	
22	
23	
24	
25	

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Snohomish County, WA

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Project No. KE090231A

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APPENDIX A

LOG OF EXPLORATION PIT NO. EP-13

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. **DESCRIPTION**
	Fill
1	Loose, moist, dark brown to brown, silty SAND, with gravel, organics, and assorted debris (similar).
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	Bottom of exploration pit at 17 feet. Refusal on debris. No seepage or caving.
19	
20	
21	
22	
23	
24	
25	

Go East Landfill Development
Snohomish County, WA

Associated Earth Sciences, Inc.

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Project No. KE090231A

8/5/09

LOG OF EXPLORATION PIT NO. EP-14

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

Depth (ft)	DESCRIPTION
	Fill
1	Loose, moist, dark brown to brown, silty SAND, with gravel, organics, and assorted debris, abundant burned woody debris.
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	Bottom of exploration pit at 18 feet. No seepage or caving. Hard digging through layers of burned wood.
20	
21	
22	
23	
24	
25	

Go East Landfill Development
Snohomish County, WA

Associated Earth Sciences, Inc.

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Project No. KE090231A

8/5/09

LOG OF EXPLORATION PIT NO. EP-15

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

Depth (ft)	DESCRIPTION
	Fill
1	Loose, moist, dark brown to brown, silty sAND, with gravel, organics, and assorted debris
2	
3	
4	
5	
6	
7	
8	
9	**Vashon Advance Outwash**
10	Dense, moist, slightly rust-stained brownish gray, fine to medium SAND.
11	
12	
13	
14	Bottom of exploration pit at 12.5 feet. No seepage or caving.
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	

Go East Landfill Development
Snohomish County, WA

Associated Earth Sciences, Inc.

Logged by: JPL

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Project No. KE090231A

8/5/09

LOG OF EXPLORATION PIT NO. EP-16

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. **DESCRIPTION**
	Fill
1	Loose, moist, brownish gray, silty SAND, with gravel, trace organics and woody debris.
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	Loose, moist, bluish gray, silty SAND, with gravel, woody debris, asphalt.
13	
14	
15	
16	
17	
18	**Vashon Advance Outwash (Qva)**
19	Medium dense to dense, moist, bluish gray to brownish gray (slightly rust-stained) fine to medium SAND.
20	
21	Bottom of exploration pit at 20 feet. No seepage or caving. Much less debris than other pits. More like typical fill with some debris.
22	
23	
24	
25	

LOG OF EXPLORATION PIT NO. EP-17

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. **DESCRIPTION**
	Fill
1	Loose, moist, dark brown to brown, silty SAND, with gravel, organics, and assorted debris, abundant glass shards.
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	Bottom of exploration pit at 19.5 feet. No seepage or caving.
21	
22	
23	
24	
25	

Go East Landfill Development
Snohomish County, WA

Associated Earth Sciences, Inc.

Logged by: JPL
Approved by:

Project No. KE090231A

8/5/09

Associated Earth Sciences, Inc.

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
KE090231A	MW-1	1 of 3

Project Name	Go East Landfill	Location	Snohomish County, WA
Elevation (Top of Well Casing)	~262'	Surface Elevation (ft)	~259'
Water Level Elevation	~211'	Date Start/Finish	8/11/09,8/12/09
Drilling/Equipment	Cascade CME 75	Hole Diameter (in)	6 1/4" I.D.
Hammer Weight/Drop	140# / 30"		

Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
		Well monument (aboveground) Concrete				**Vashon Advance Outwash**
5		Bentonite chips		8 12 28		Moist, slightly rust-stained brownish gray, fine to medium SAND, with trace gravel.
10				14 28 40		Moist, brownish gray, fine to medium SAND, with silty zones and coarse sand beds.
15				10 15 25		Wet, slightly rust-stained brownish gray, fine to medium SAND, with trace gravel.
20		Bentonite grout		8 18 21		Moist, bluish gray, SILT.
25				50/6"		Moist, brownish gray, fine to medium SAND.
30				25 50/5"		Moist, slightly rust-stained brownish gray, fine to medium SAND, with a silt lens containing trace charcoal.
35				18 33 34		Moist, brownish gray, fine to medium SAND, with siltier zones.

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture

Water Level (8/19/09)

Water Level at time of drilling (ATD)

Logged by: JPL

Approved by:

NWWELL 090231A.GPJ BORING.GDT 9/10/09

APPENDIX A

Associated Earth Sciences, Inc.	Geologic & Monitoring Well Construction Log		
	Project Number: KE090231A	Well Number: MW-1	Sheet: 2 of 3

Project Name: Go East Landfill
Elevation (Top of Well Casing): ~262'
Water Level Elevation: ~211'
Drilling/Equipment: Cascade CME 75
Hammer Weight/Drop: 140# / 30"

Location: Snohomish County, WA
Surface Elevation (ft): ~259'
Date Start/Finish: 8/11/09 8/12/09
Hole Diameter (in): 6 1/4" I.D.

Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
				36 50/5"		Moist, bluish gray, fine to medium SAND, with siltier zones.
						Driller reports significant water.
45				50/6"		Above bottom 6": Same as above (filled sampler [heave?]). Bottom 6": Moist, bluish gray, SILT, with a few light gray, very fine sand partings.
	▽					
50				24 27 41		Moist, bluish gray, silty very fine SAND interbedded with sandy SILT.
55				14 17 32		Moist, bluish gray, SILT.
60		Bentonite chips		10 23 26		Moist to wet, bluish gray, fine SAND.
		Silica sand 2/12				
65				18 28 39		Wet, same.
70		2" I.D. Schedule 40 PVC machine slotted well screen with 0.010" slots (65' to 75')		16 24 36		Wet, bluish gray, silty very fine SAND interbedded with SILT, with fine sand.
						Pre-Vashon Glacial Lacustrine
75		Threaded end cap		10 22 27		Wet, bluish gray, SILT, with very fine sand, a few very fine sand partings and beds of fine to medium sand.

Sampler Type (ST):

2" OD Split Spoon Sampler (SPT)	No Recovery	M - Moisture
3" OD Split Spoon Sampler (D & M)	Ring Sample	▽ Water Level (8/19/09)
Grab Sample	Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

Logged by: JPL
Approved by:

Associated Earth Sciences, Inc.

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
KE090231A	MW-1	3 of 3

Project Name: Go East Landfill
Elevation (Top of Well Casing): ~262'
Water Level Elevation: ~211'
Drilling/Equipment: Cascade CME 75
Hammer Weight/Drop: 140# / 30"

Location: Snohomish County, WA
Surface Elevation (ft): ~259'
Date Start/Finish: 8/11/09, 8/12/09
Hole Diameter (in): 6 1/4" I.D.

Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
				14 22 28		Moist, bluish gray, SILT, with scattered white sand-sized grains.
85				18 23 24		Moist, bluish gray, SILT, with a few very fine sand partings.
90				15 21 25		Moist, bluish gray, SILT.
95				9 17 30		Moist, bluish gray, SILT, with a few very fine sand partings and a fine sand bed.
100				12 19 26		Moist, bluish gray, SILT, with a few very fine sand partings.
						Boring terminated at 101.5 feet on 8/12/09
105						
110						
115						

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture
Water Level (8/19/09)
Water Level at time of drilling (ATD)

Logged by: JPL
Approved by:

Associated Earth Sciences, Inc.

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
KE090231A	MW-2	1 of 2

Project Name: Go East Landfill
Elevation (Top of Well Casing): ~234'
Water Level Elevation: ~183'
Drilling/Equipment: Cascade CME 75
Hammer Weight/Drop: 140# / 30"

Location: Snohomish County, WA
Surface Elevation (ft): ~232'
Date Start/Finish: 8/12/09,8/12/09
Hole Diameter (in): 6 1/4" I.D.

Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
		Well monument (aboveground) Concrete				**Vashon Advance Outwash**
5		Bentonite chips		10 12 14		~4" moist, rust-stained brownish gray, fine to medium SAND over moist, brownish gray to bluish gray (with depth), SILT.
10				11 11 13		Moist, brownish gray, fine SAND.
15				9 19 29		Moist, brownish gray, fine SAND interbedded with brownish gray, SILT, rust staining at contacts.
20		Bentonite grout		8 12 17		Moist to wet, brownish gray, silty fine SAND, with a medium sand bed, interbedded with brownish gray, SILT.
25				5 14 22		Moist, brownish gray, fine SAND.
30				13 21 33		Wet, same, with slight rust staining.
35				21 26 33		Wet, same with siltier zones.

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture
Water Level (8/19/09)
Water Level at time of drilling (ATD)

Logged by: JPL
Approved by:

Associated Earth Sciences, Inc.

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
KE090231A	MW-2	2 of 2

Project Name: Go East Landfill
Elevation (Top of Well Casing): ~234'
Water Level Elevation: ~183'
Drilling/Equipment: Cascade CME 75
Hammer Weight/Drop: 140# / 30"

Location: Snohomish County, WA
Surface Elevation (ft): ~232'
Date Start/Finish: 8/12/09,8/12/09
Hole Diameter (in): 6 1/4" I.D.

Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
				11 21 21		Moist to wet, brownish gray, SILT, with fine sand beds.
45		Bentonite chips		12 26 37		Moist to wet, brownish gray to bluish gray, silty very fine SAND interbedded with SILT, with fine sand.
	∇	Silica sand 2/12				
50		2" I.D. Schedule 40 PVC machine slotted well screen with 0.010" slots (50' to 60')		11 19 22		Wet, bluish gray, fine SAND, medium sand laminae with organics at 50.5'.
55				12 20 24		Wet, bluish gray, silty very fine SAND.
						Pre-Vashon Glacial Lacustrine
60		Threaded end cap		7 19 22		Moist, bluish gray, SILT.
						Boring terminated at 61.5 feet on 8/12/09
65						
70						
75						

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture
∇ Water Level (8/19/09)
▼ Water Level at time of drilling (ATD)

Logged by: JPL
Approved by:

Associated Earth Sciences, Inc.

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
KE090231A	MW-3	1 of 2

Project Name	Go East Landfill	Location	Snohomish County, WA
Elevation (Top of Well Casing)	~245'	Surface Elevation (ft)	~243'
Water Level Elevation	~214'	Date Start/Finish	8/13/09,8/13/09
Drilling/Equipment	Cascade CME 75	Hole Diameter (in)	6 1/4" I.D.
Hammer Weight/Drop	140# / 30"		

Depth (ft)	Water Level	WELL CONSTRUCTION	Blows/ 6"	DESCRIPTION
0		Well monument (aboveground) Concrete		**Vashon Advance Outwash**
5		Bentonite chips	2 4 6	Wet, slightly rust-stained brownish gray, fine to medium SAND.
10			6 11 13	Moist, rust-stained bluish gray, bedded SILT.
				Bottom 3": Moist, brownish gray, fine to medium SAND, with trace gravel.
15			10 16 21	Moist, brownish gray, fine to medium SAND, with trace gravel.
20		Bentonite grout	8 13 13	Moist, brownish gray, fine to medium SAND.
25			10 13 16	Moist, same.
	▽			
30			20 29 22	Wet, brownish gray, fine SAND, with siltier zones.
35			11 18 29	Top 4": Wet, rust-stained brownish gray, fine to medium SAND, with silt. Wet, bluish gray, silty very fine SAND interbedded with SILT, with fine sand.

Sampler Type (ST):

2" OD Split Spoon Sampler (SPT)	No Recovery	M - Moisture	Logged by: JPL
3" OD Split Spoon Sampler (D & M)	Ring Sample	▽ Water Level (8/19/09)	Approved by:
Grab Sample	Shelby Tube Sample	▼ Water Level at time of drilling (ATD)	

NWWELL 090231A.GPJ BORING.GDT 9/10/09

APPENDIX A

Associated Earth Sciences, Inc.

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
KE090231A	MW-3	2 of 2

Project Name Go East Landfill
Elevation (Top of Well Casing) ~245'
Water Level Elevation ~214'
Drilling/Equipment Cascade CME 75
Hammer Weight/Drop 140# / 30"

Location Snohomish County, WA
Surface Elevation (ft) ~243'
Date Start/Finish 8/13/09 8/13/09
Hole Diameter (in) 6 1/4" I.D.

Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
				12 20 26		Moist, bluish gray, SILT.
45		Bentonite chips		12 21 29		Wet, bluish gray, fine SAND, with silt.
		Silica sand 2/12				
50		2" I.D. Schedule 40 PVC machine slotted well screen with 0.010" slots (50' to 60')		14 18 21		Wet, same.
55				12 24 30		Moist to wet, bluish gray, laminated SILT, with very fine sand.
						Pre-Vashon Glacial Lacustrine
60		Threaded end cap		14 24 28		Moist, bluish gray, SILT, with a few very fine sand partings and a bed of fine sand.
						Boring terminated at 61.5 feet on 8/13/09
65						
70						
75						

Sampler Type (ST):

2" OD Split Spoon Sampler (SPT)
3" OD Split Spoon Sampler (D & M)
Grab Sample
No Recovery
Ring Sample
Shelby Tube Sample
M - Moisture
Water Level (8/19/09)
Water Level at time of drilling (ATD)

Logged by: JPL
Approved by:

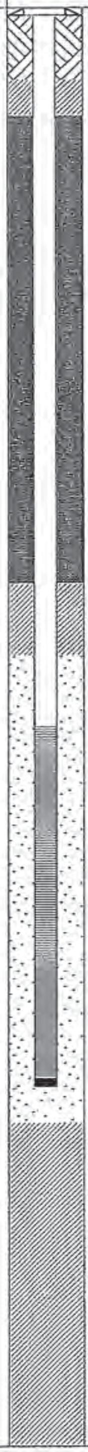
Associated Earth Sciences, Inc.

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
KE090231A	MW-4	1 of 2

Project Name: Go East Landfill
Elevation (Top of Well Casing):
Water Level Elevation: No water (8/19/09)
Drilling/Equipment: Cascade CME 75
Hammer Weight/Drop: 140# / 30"

Location: Snohomish County, WA
Surface Elevation (ft): ~206'
Date Start/Finish: 8/14/09, 8/14/09
Hole Diameter (in): 6 1/4" I.D.



Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
		Locking cap				**Vashon Advance Outwash**
		Concrete				
		Bentonite chips				
5		Bentonite grout		6 8 10		Moist, grayish brown, fine SAND, little silt (SM).
10		2" I.D. Schedule 40 PVC blank		7 9 10		Moist, grayish brown, fine SAND, few silt (SP).
15				7 11 12		Becomes slightly more gray, trace silt, trace rust mottling.
		Bentonite chips				
		#2/12 silica sand				Moist to very moist, grayish tan, silty fine SAND (SM).
20				9 15 18		
		2" I.D. Schedule 40 PVC machine slotted well screen with 0.010" slots (20' to 30')				
25				6 14 19		
						Pre-Vashon Glacial Lacustrine
30		Threaded end cap		6 8 16		Wet, grayish tan, SILT (ML); non-plastic, contains dilatant zones.
35		Bentonite chips		5 9 11		Becomes blue-gray and very moist to wet.

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture
Water Level ()
Water Level at time of drilling (ATD)

Logged by: TJP
Approved by:

NWWELL 090231A.GPJ BORING.GDT 9/10/09

Associated Earth Sciences, Inc.

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
KE090231A	MW-4	2 of 2

Project Name: Go East Landfill
Location: Snohomish County, WA
Elevation (Top of Well Casing):
Surface Elevation (ft): ~206'
Water Level Elevation: No water (8/19/09)
Date Start/Finish: 8/14/09 8/14/09
Drilling/Equipment: Cascade CME 75
Hole Diameter (in): 6 1/4" I.D.
Hammer Weight/Drop: 140# / 30"

Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
				11 13 17		
45				9 12 18		
						Boring terminated at 46.5 feet on 8/14/09
50						
55						
60						
65						
70						
75						

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

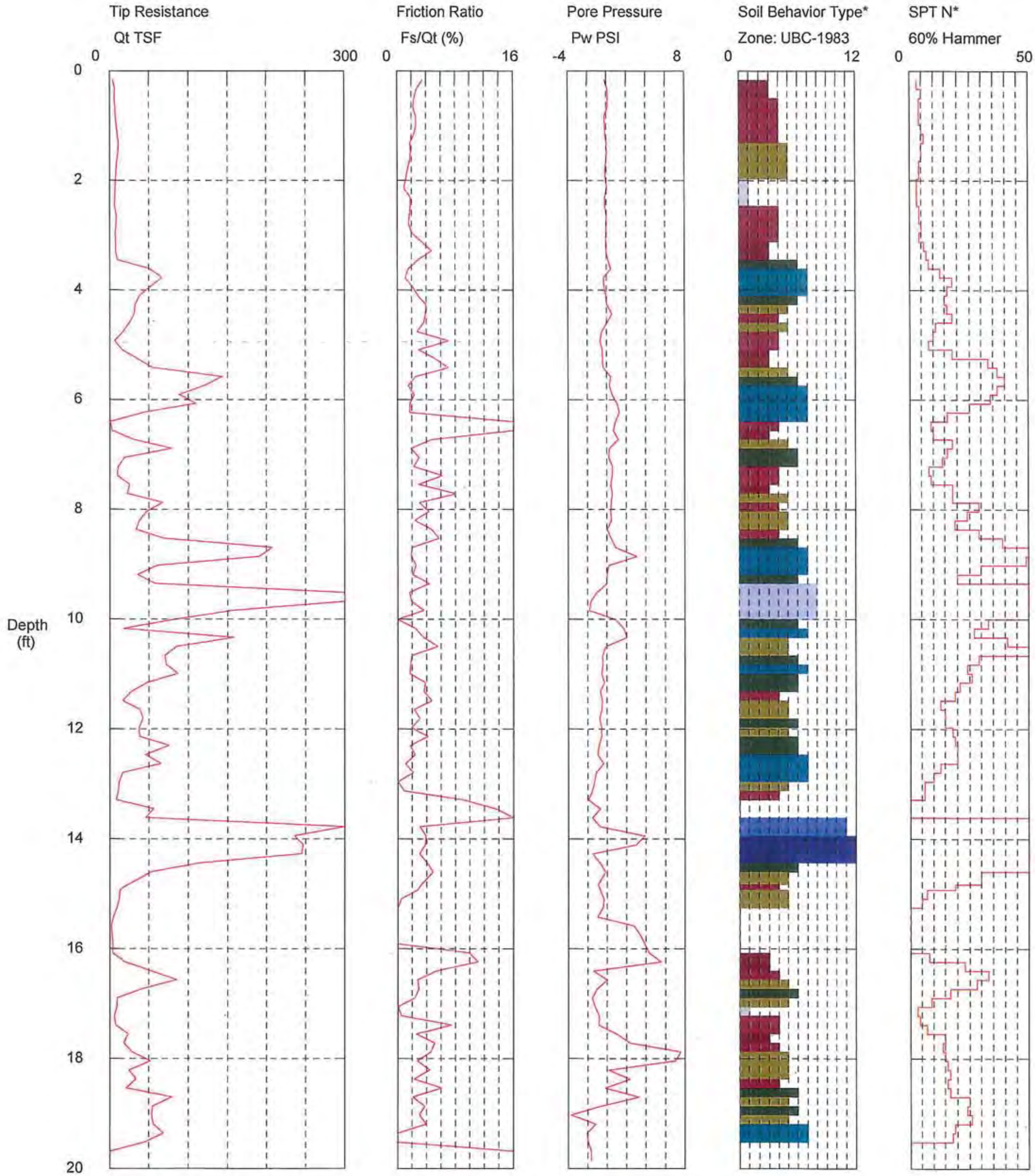
M - Moisture
Water Level ()
Water Level at time of drilling (ATD)

Logged by: TJP
Approved by:

AESI

Operator: Brown
Sounding: CPT-01
Cone Used: DSG1079

CPT Date/Time: 4/26/2011 10:58:38 AM
Location: Go East
Job Number: KE090231A



Maximum Depth = 20.67 feet

Depth Increment = 0.164 feet

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

*Soil behavior type and SPT based on data from UBC-1983

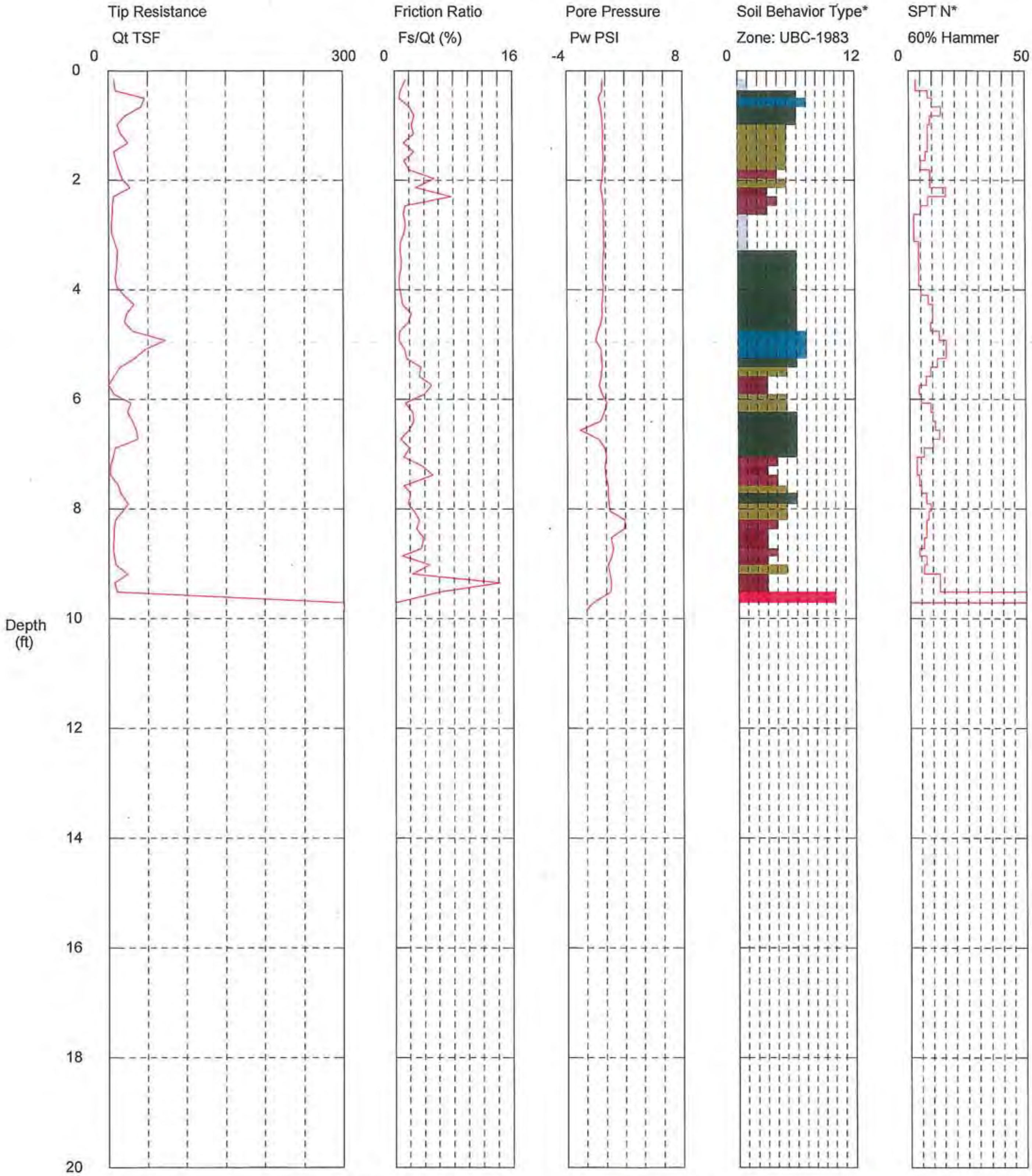
In Situ Engineering

APPENDIX A

AESI

Operator: Brown
Sounding: CPT-02
Cone Used: DSG1079

CPT Date/Time: 4/26/2011 11:33:00 AM
Location: Go East
Job Number: KE090231A



Maximum Depth = 9.84 feet

Depth Increment = 0.197 feet

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*Soil behavior type and SPT based on data from UBC-1983

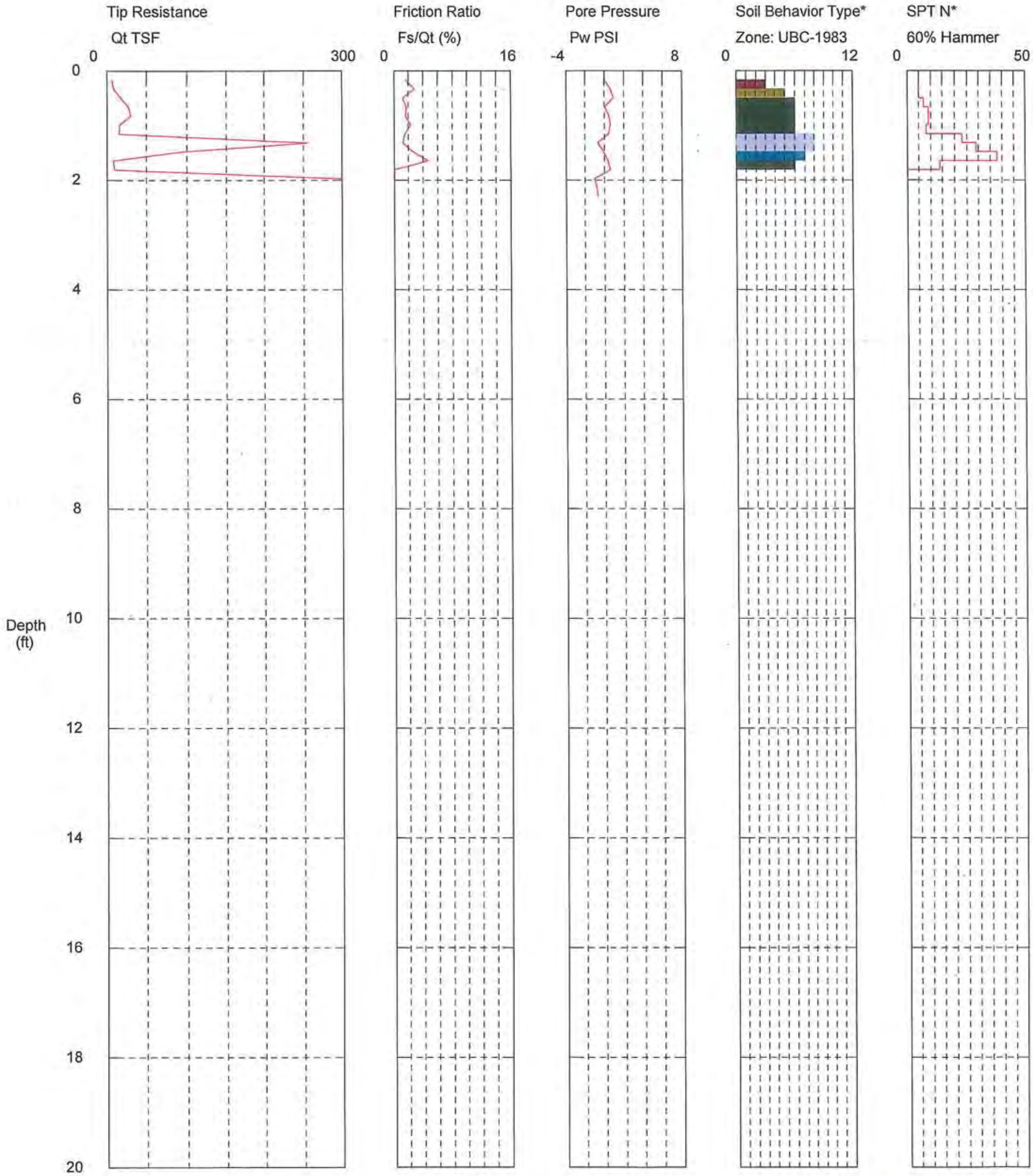
In Situ Engineering

APPENDIX A

AESI

Operator: Brown
Sounding: CPT-03
Cone Used: DSG1079

CPT Date/Time: 4/26/2011 11:45:04 AM
Location: Go East
Job Number: KE090231A



Maximum Depth = 2.30 feet

Depth Increment = 0.164 feet

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

*Soil behavior type and SPT based on data from UBC-1983

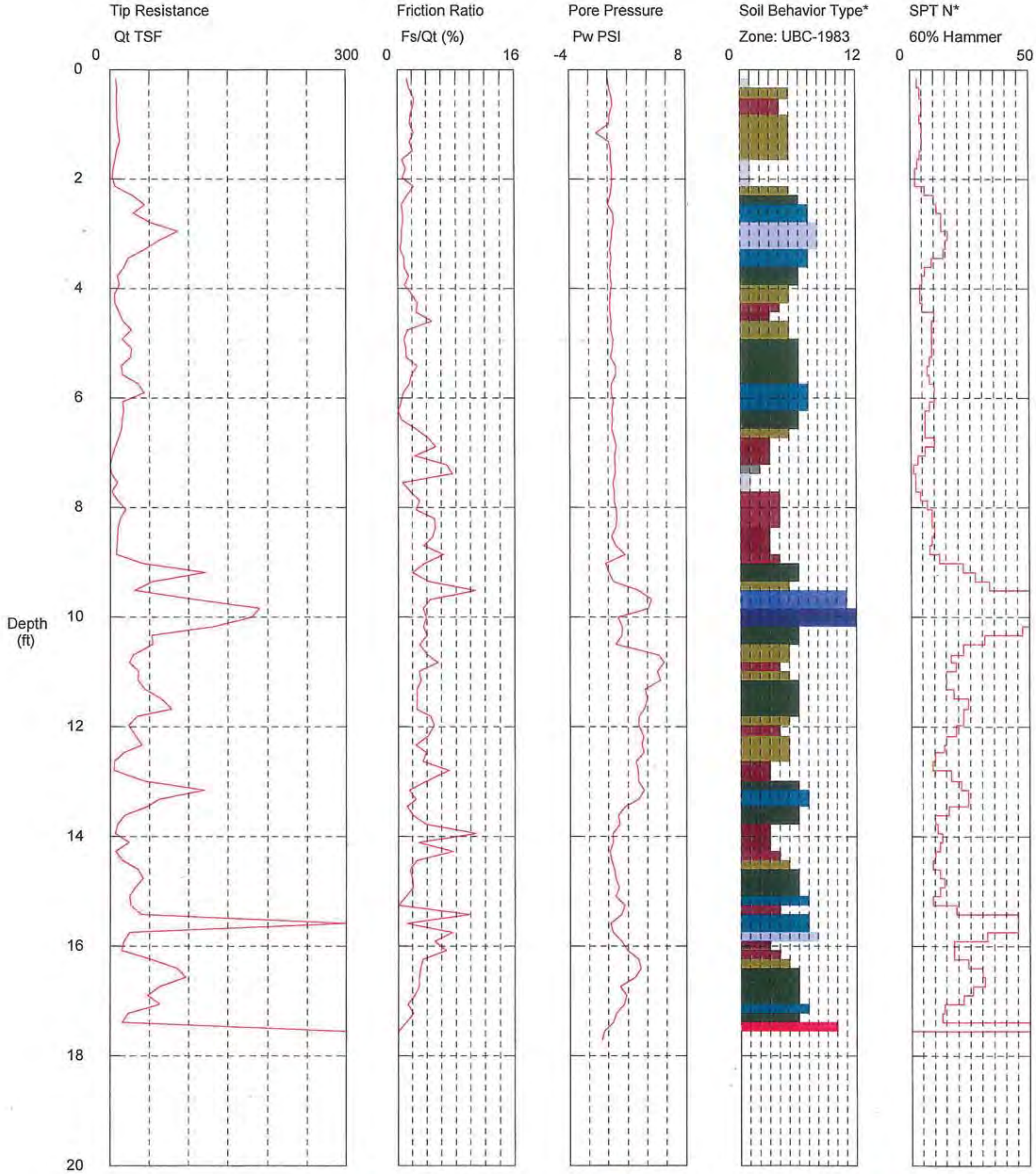
In Situ Engineering

APPENDIX A

AESI

Operator: Brown
Sounding: CPT-04
Cone Used: DSG1079

CPT Date/Time: 4/26/2011 11:52:51 AM
Location: Go East
Job Number: KE090231A



Maximum Depth = 17.72 feet
Depth Increment = 0.164 feet

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

*Soil behavior type and SPT based on data from UBC-1983

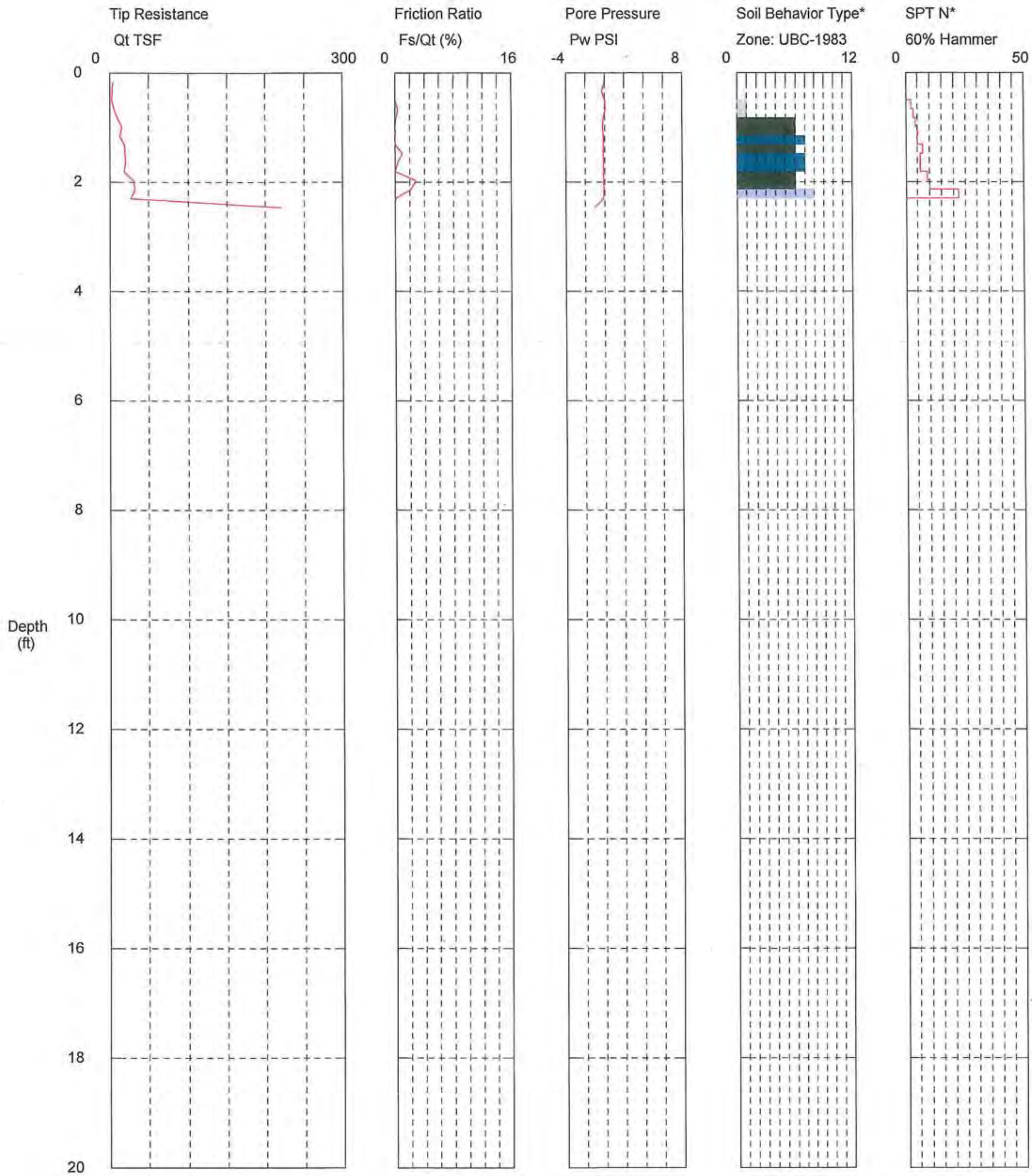
In Situ Engineering

APPENDIX A

AESI

Operator: Brown
Sounding: CPT-05
Cone Used: DSG1079

CPT Date/Time: 4/26/2011 12:12:30 PM
Location: Go East
Job Number: KE090231A



Maximum Depth = 2.46 feet

Depth Increment = 0.164 feet

1	sensitive fine grained
2	organic material
3	clay
4	silty clay to clay
5	clayey silt to silty clay
6	sandy silt to clayey silt
7	silty sand to sandy silt
8	sand to silty sand
9	sand
10	gravelly sand to sand
11	very stiff fine grained (*)
12	sand to clayey sand (*)

*Soil behavior type and SPT based on data from UBC-1983

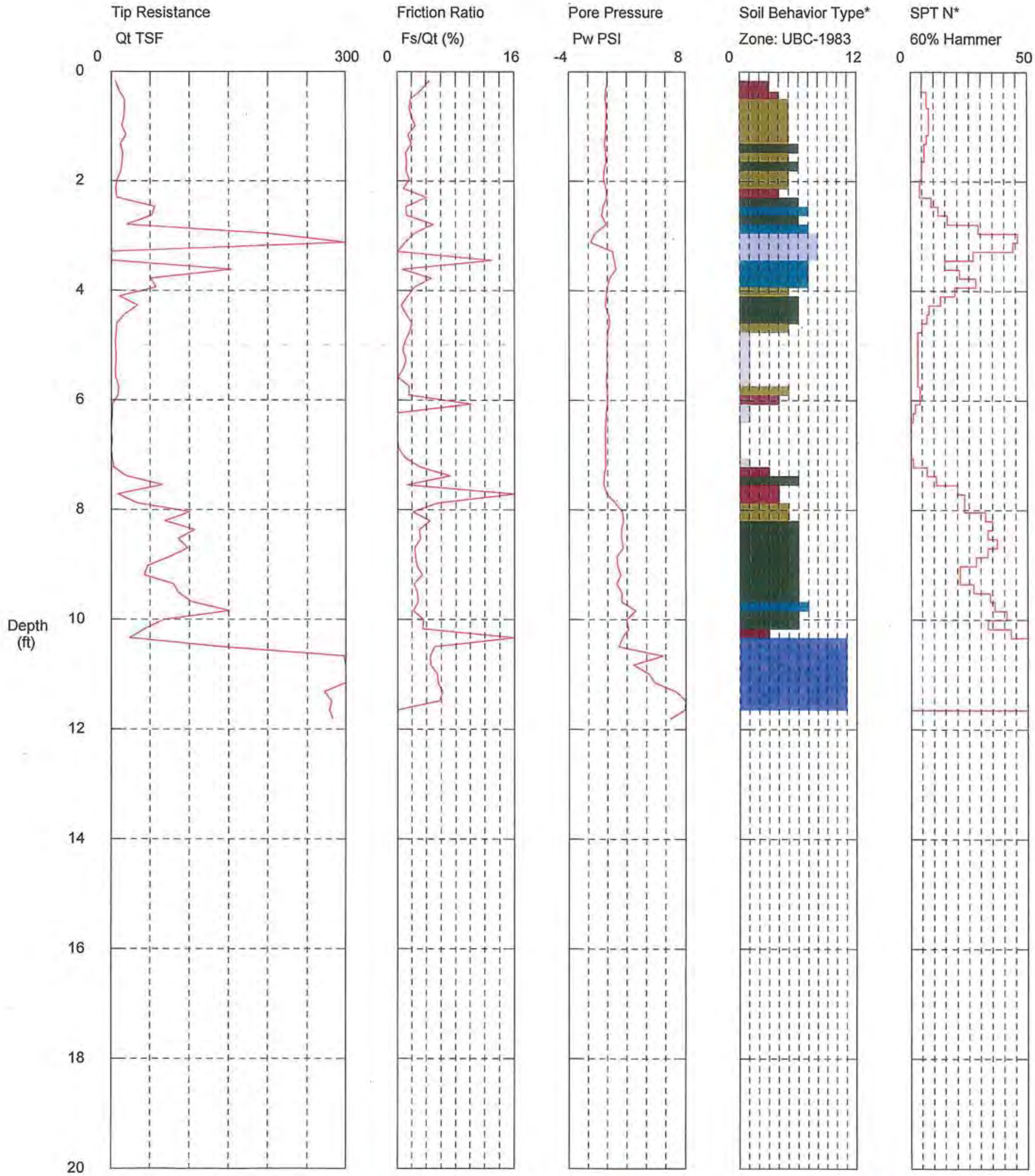
In Situ Engineering

APPENDIX A

AESI

Operator: Brown
Sounding: CPT-06
Cone Used: DSG1079

CPT Date/Time: 4/26/2011 12:20:42 PM
Location: Go East
Job Number: KE090231A



Maximum Depth = 11.81 feet

Depth Increment = 0.197 feet

1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*Soil behavior type and SPT based on data from UBC-1983

In Situ Engineering

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP SM	Light brown, poorly graded SAND with some silt, loose, dry, (Earthen Fill)					
3.5		SW	Yellowish brown, well graded SAND with some gravel, medium dense, dry to moist, fine to coarse sand, (Glacial Outwash) 1" horizon of black organic soil at 3.5'					
5		SP	Light gray brown poorly graded GRAVELLY SAND, dense, moist, fine sand, (Glacial Outwash)					

SKETCH OF East SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 2, 4, 6, 8, 10

DEPTH (feet): 0, 2, 4, 6, 8, 10

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-1-A
PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT10 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0–2		SP	Yellowish brown, poorly graded SAND, medium dense, dry (Glacial Outwash)					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 2 4 6 8 10

DEPTH (feet)

0 2 4 6 8 10

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-1-B

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT10 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0–2		SP	Yellowish brown, poorly graded SAND, medium dense, dry. (Glacial Outwash)					

Depth scale: 0, 2, 4, 6, 8, 10

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 2, 4, 6, 8, 10

DEPTH (feet): 0, 2, 4, 6, 8, 10

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-1-C

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT10 2002071.GPJ 6/25/02

APPENDIX A

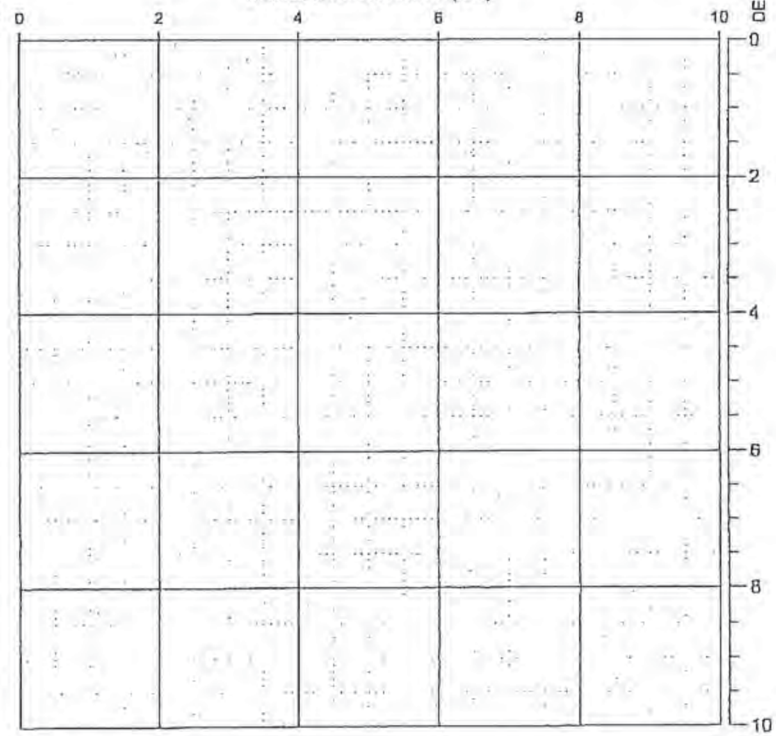
EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Light brown, GRAVELLY SAND, medium dense, dry (Earthen Fill)					
		SP	Olive gray, poorly graded SAND, loose, moist, fine sand, intermixed bricks and dimensional timber, (Demolition waste)					
2		SP	Olive gray, poorly graded SAND, loose, moist, fine sand, intermixed tree limbs (Earthen Fill)					
6		SP	Olive gray, poorly graded SAND, moist to wet, fine to medium grained, with trace roots (Glacial Outwash)					
10								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-1-D
PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT10 2002071.GPJ 6/25/02

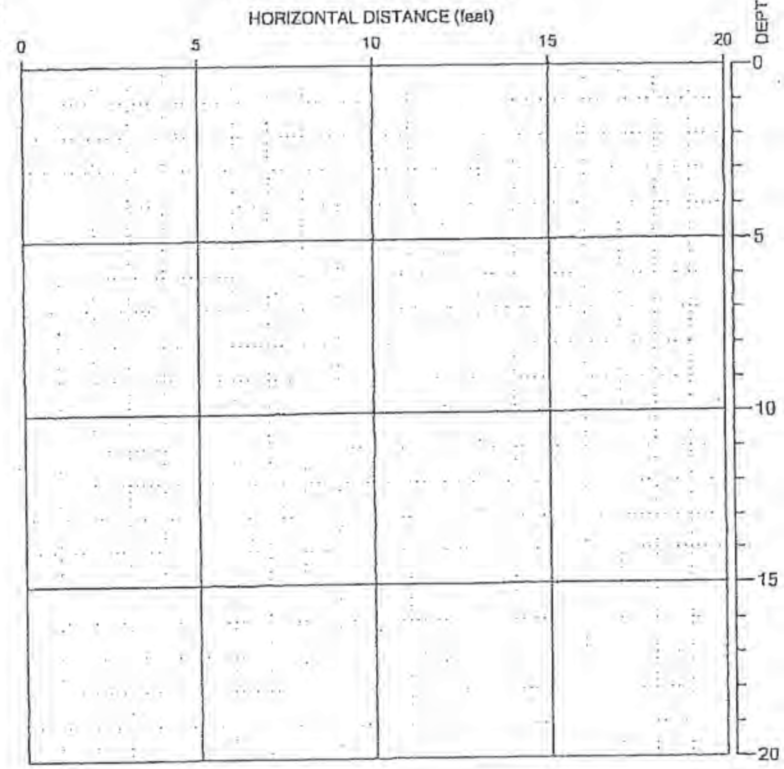
APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Gray brown, poorly graded SAND, loose, fine sand, some roots (Earthen Fill)					
		SP	Brown, poorly graded SAND, loose, fine sand (Earthen Fill)					
5		SP	Gray, poorly graded SAND, loose, fine sand, some wood and plastic (Earthen Fill)					
10								
15								
20								

SKETCH OF SIDE OF PIT



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-2-A

PAGE: 1 of 1

PROJECT NO.: 2002071

FIGURE:

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, SAND with some gravel, fine sand (Earthen Fill)					
		SP SM	Gray, poorly graded SAND, with silt and gravel, moist, loose, with intermixed tree branches (Earthen Fill)					
		SP	Yellowish brown, poorly graded SAND, trace gravel, very moist, medium dense (Glacial Outwash)					

DEPTH (feet): 0, 5, 10, 15, 20

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 5, 10, 15, 20

DEPTH (feet): 0, 5, 10, 15, 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-2-B

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, SAND, trace plastic, bricks and tree branches (Earthen Fill)					
		SP	Gray, poorly graded SAND, loose, moist, fine sand, with intermixed tree branches (Earthen Fill)					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet) 0 5 10 15 20

DEPTH (feet) 0 5 10 15 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-2-C

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, poorly graded SAND, moist, fine sand, some roots (Earthen Fill)					
		SP	Gray, poorly graded SAND, moist to wet, loose, fine sand, intermixed wood and branches (Earthen Fill) Wet below 5' Strong seepage at 9'					
10		SP	Yellowish brown, SAND, wet					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 5, 10, 15, 20

DEPTH (feet): 0, 5, 10, 15, 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-2-D

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX A

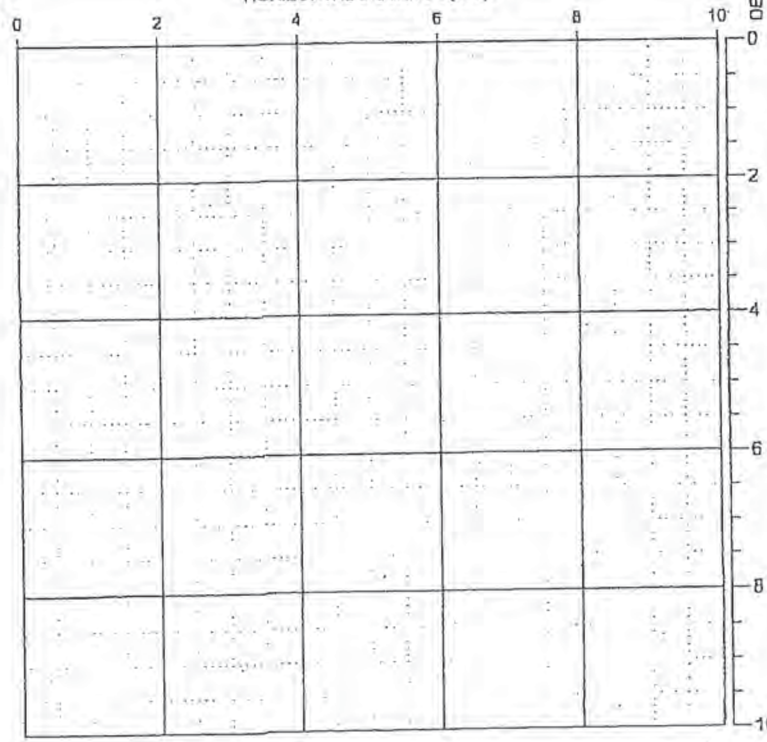
EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 8/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, SAND, moist to wet, some roots (Earthen Fill - Topsoil)					
		SP	Gray, poorly graded SAND, wet, loose, fine sand, intermixed tree branches (Earthen Fill) Seepage at 3'					
4		SP	Yellowish bown, poorly graded SAND, wet, fine to medium sand (Glacial Outwash)					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-2-E

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT10 2002071.GPJ 8/25/02

APPENDIX A

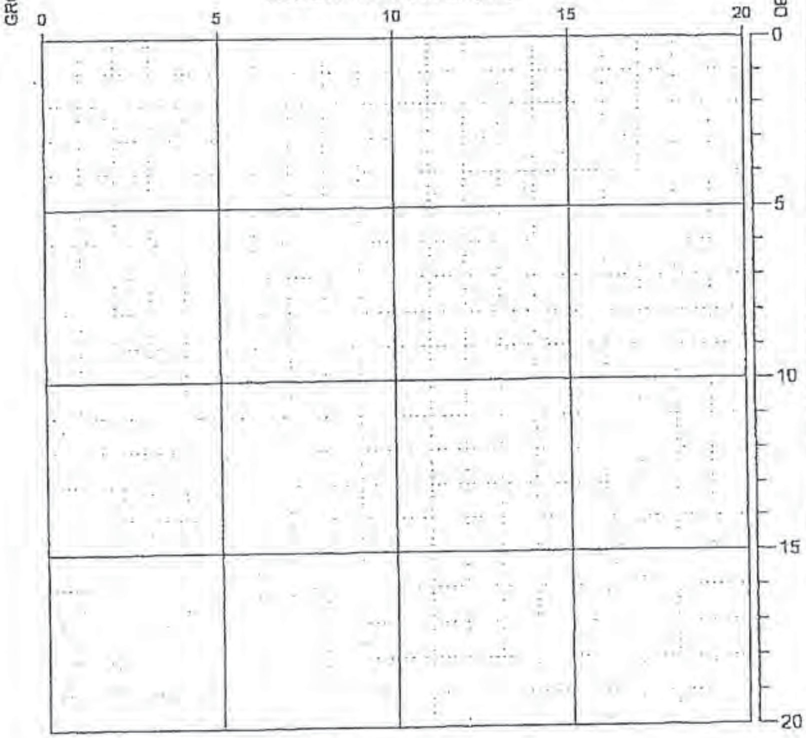
EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/5/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0			Dark brown, SILTY SAND, loose, intermixed wood, steel, bricks concrete and plastic (Demolition Waste)					
5		SM	Light brown, SILTY SAND, dry to moist, fine sand (Glacial Outwash)					
10								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-30

PAGE: 1 of 1

PROJECT NO.: 2002071

FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/5/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0–6			Brown, SILTY SAND with some gravel, loose, fine sand, intermixed bricks, concrete, logs and some carpet (Demolition Waste)					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 2 4 6 8 10

DEPTH (feet)

0 2 4 6 8 10

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-31
PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT10 2002071.GPJ 6/25/02

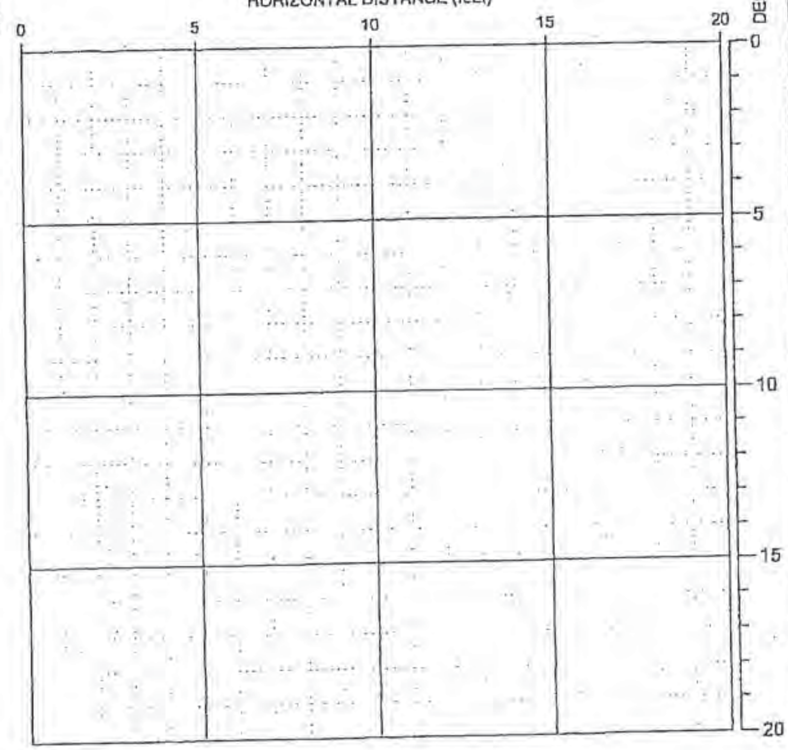
APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, poorly graded GRAVELLY SAND, medium dense, fine to medium sand (Earthen Fill)					
			Black/brown, GRAVELLY SAND with glass, aphalt and bricks, dry, loose (Demolition Waste)					
5			Gray, SAND, dry to moist, loose, fine to medium sand, intermixed wood, boulders, concrete pipe (Demolition Waste)					
10								
			Increasing amounts of plastic and concrete at 12'					
15			Becoming moist below 16'					
20								

SKETCH OF SIDE OF PIT



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-3-A

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

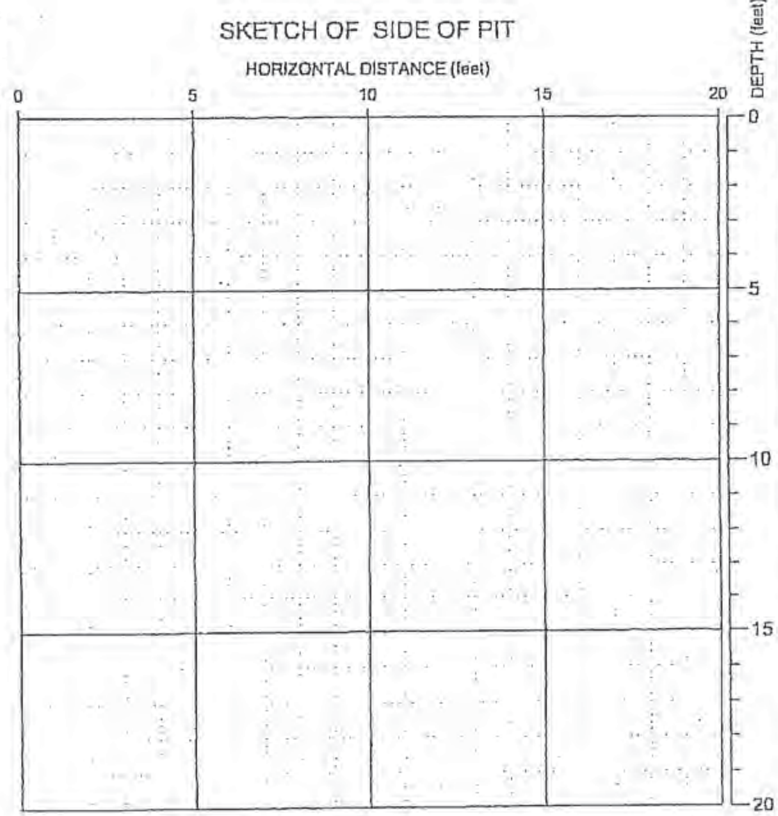
TPIT20 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SM	Dark brown, SILTY SAND with some gravel, medium dense, fine sand (Earthen Fill)					
			Brown, SAND, dry, loose, intermixed steel pipes, plastic and concrete (Demolition Waste)					
11		SP	Yellowish brown, poorly graded SAND, moist, dense, fine sand, with gray SILT laminations (Glacial Outwash)					



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-4-A

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SM	Dark brown, SILTY SAND with some gravel, medium dense, fine sand (Earthen Fill)					
			Gray, SAND, dry to moist, loose, fine to medium sand, intermixed wood, steel, concrete pipe (Demolition Waste)					
5		SP	Yellowish bown, poorly graded SAND, medium dense, fine to medium sand, (Glacial Outwash)					
10								
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 5, 10, 15, 20

DEPTH (feet): 0, 5, 10, 15, 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-4-B

PAGE: 1 of 1

PROJECT NO.: 2002071

FIGURE:

TPIT20 2002071.GPJ 8/25/02

APPENDIX A

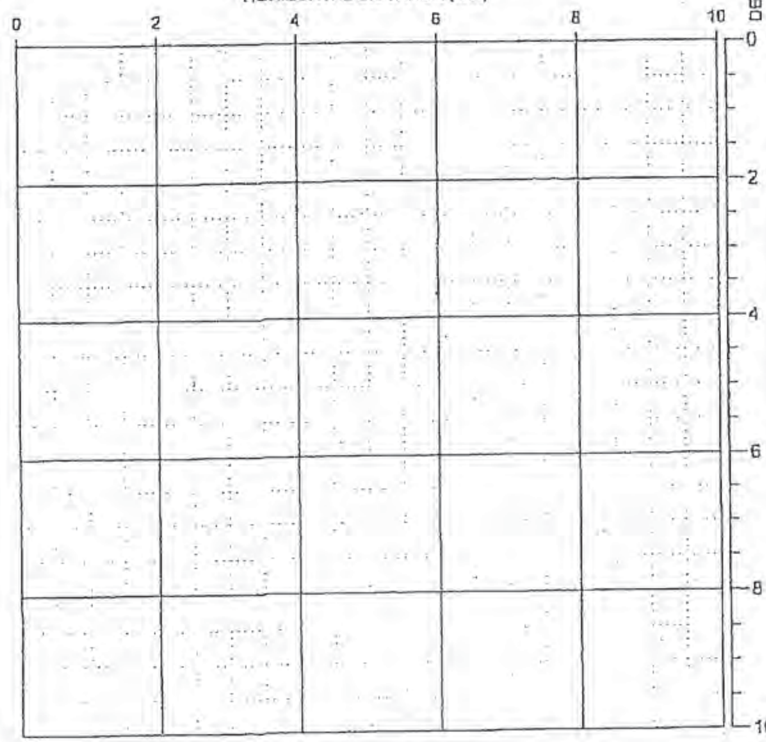
EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, SAND, loose, fine sand, some roots (Earthen Fill - Topsoil)					
			Dark brown, SILTY SAND, intermixed wood and glass, (Demolition Waste)					
2		SP	Yellowish bown, poorly graded SAND, fine to medium sand, (Glacial Outwash)					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-5-A

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Grayish light brown, GRAVELLY SAND, loose, fine to coarse sand (Earthen Fill)					
			Dark brown/black, SAND, organic, with dimensional timber (Demolition Waste)					
4		SP	Yellowish bown, poorly graded SAND, fine to medium sand, (Glacial Outwash)					

DEPTH (feet): 0, 2, 4, 6, 8, 10

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 2, 4, 6, 8, 10

DEPTH (feet): 0, 2, 4, 6, 8, 10

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-6

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT10 2002071.GPJ 6/25/02

APPENDIX A

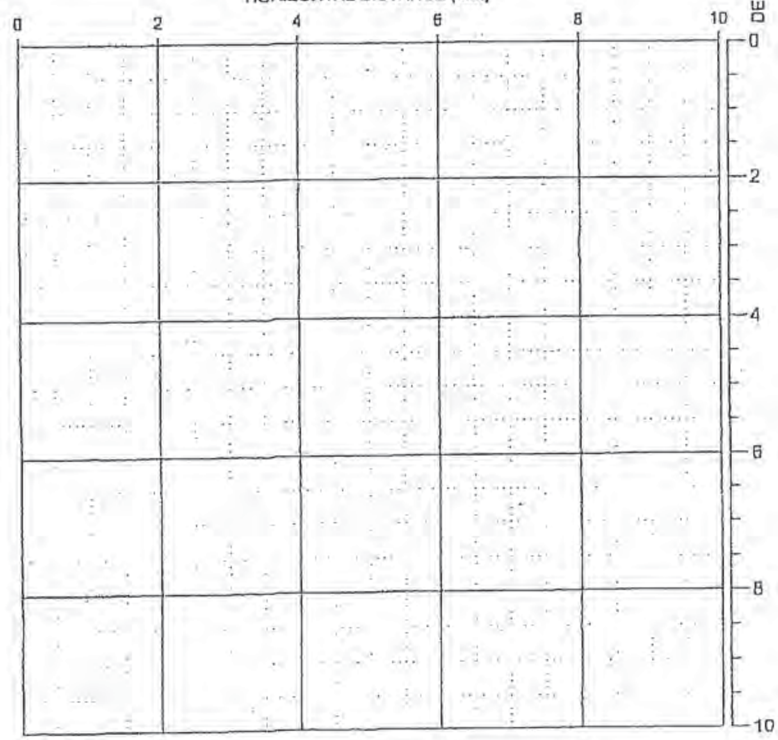
EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, SAND, loose, dry to moist, medium sand (Earthen Fill)					
		SP	Dark brown, SAND with some gravel, medium dense with trace wood (Earthen Fill)					
		SP	Gray, SAND, loose, slightly moist, with intermixed wood (Earthen Fill)					
4		SP	Yellowish bown, poorly graded SAND, fine to medium sand, (Glacial Outwash)					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-7

PAGE: 1 of 1

PROJECT NO.: 2002071

FIGURE:

APPENDIX A

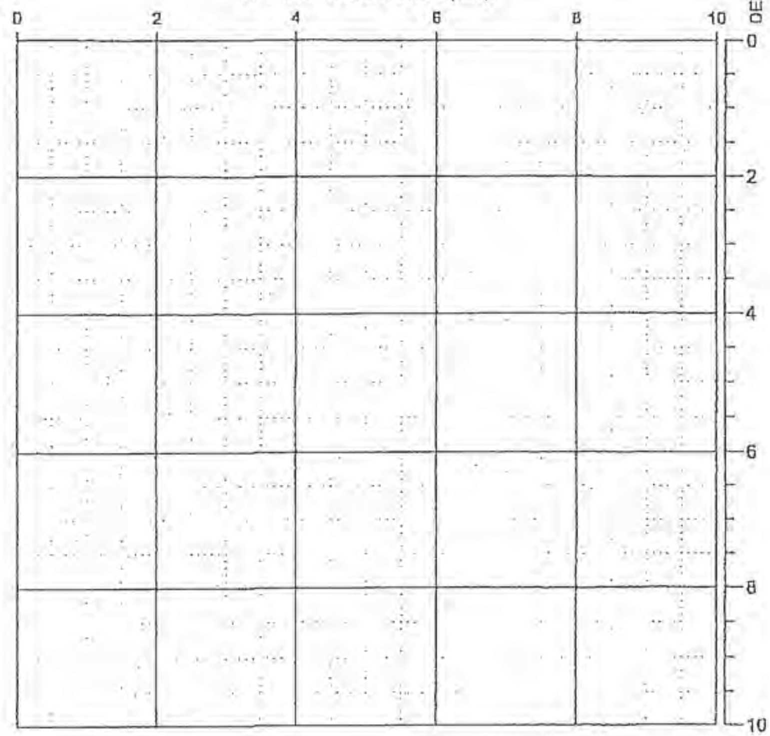
EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, SAND, loose, dry to moist, medium sand (Earthen Fill)					
		SP	Yellowish brown, poorly graded SAND, bedded with gray poorly graded SAND, moist to wet (Glacial Outwash)					
2								
			Strong seepage at 3'					
4								
6								
8								
10								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-8-A

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT10 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, SAND, loose, dry to moist, medium sand (Earthen Fill)					
5		SP	Gray, SAND, loose, slightly moist, fine to medium sand with intermixed wood (Earthen Fill)					
10		SP	Yellowish brown, poorly graded SAND, bedded with gray poorly graded SAND, loose, moist to wet (Glacial Outwash) Wet below 8' Strong seepage at 10'					
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 5 10 15 20

DEPTH (feet)

0 5 10 15 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-8-B

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Dark brown, poorly graded SAND, fine sand (Topsoil - Fill)					
		SP	Yellowish bown, poorly graded SAND, fine sand, (Glacial Outwash)					
		SP	Gray brown, poorly graded SAND, wet, fine to medium grained (Glacial Outwash) Strong seepage at 5'					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 5, 10, 15, 20

DEPTH (feet): 0, 5, 10, 15, 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-9-A

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, poorly graded GRAVELLY SAND, fine to medium sand, dry to moist (Earthen Fill)					
			Dark brown, GRAVELLY SAND, with intermixed glass, bricks and some steel (Demolition Waste)					
		SP	Gray, SAND, loose, slightly moist, fine to medium sand with intermixed wood (Earthen Fill)					
5		SP	Yellowish bown, poorly graded SAND, fine sand (Glacial Outwash)					
10								
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 5 10 15 20

DEPTH (feet)

0 5 10 15 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

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HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-9-B

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0			Dark brown, poorly graded SILTY SAND, loose, moist, fine sand, organic (Topsoil - Fill)					
		SP	Yellowish brown, poorly graded SAND with trace gravel, loose, moist, fine sand (Glacial Outwash)					
		SP	Gray brown, poorly graded SAND, moist, fine sand (Glacial Outwash)					

Depth scale (feet): 0, 2, 4, 6, 8, 10

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 2, 4, 6, 8, 10

DEPTH (feet): 0, 2, 4, 6, 8, 10

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-10-A

PAGE: 1 of 1

PROJECT NO.: 2002071

FIGURE:

TPIT10 2002071.GPJ 6/25/02

APPENDIX A

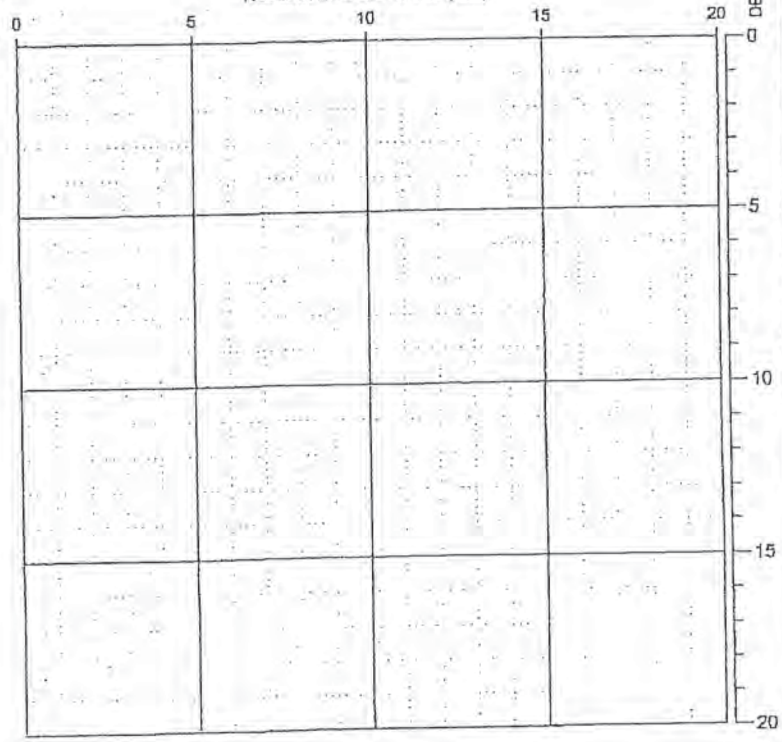
EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		ML	Gray, GRAVELLY SILT, medium dense, moist (Fill)					
			Brown, poorly graded SILTY SAND, loose, moist with intermixed glass, dimensional timber, steel and some plastic (Demolition Waste)					
14		SP	Yellowish brown/gray, poorly graded SAND, wet, fine sand, bedded (Glacial Outwash)					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-10-B

PAGE: 1 of 1

PROJECT NO.: 2002071

FIGURE:

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP SM	Brown, poorly graded GRAVELLY SAND with some silt, medium dense, dry (Fill)					
			Brown, poorly graded SILTY SAND, dry, loose, fine sand with intermixed dimensional timber (Demolition Waste)					
10		SP	Yellowish brown/gray, poorly graded SAND, moist, fine sand (Glacial Outwash)					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet) 0 5 10 15 20

DEPTH (feet) 0 5 10 15 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-10-C

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Dark brown, poorly graded SAND, moist, fine sand, organic, (Topsoil - Fill)					
		SP	Brown, poorly graded SAND, dry, loose, fine sand, some intermixed wood (Earthen Fill)					
		SP	Gray, poorly graded SAND, moist, fine sand, intermixed wood (Earthen Fill)					
5		SP	Yellowish brown, poorly graded SAND, loose, fine sand (Glacial Outwash)					
		ML	Gray, SILT, dry, medium plasticity, dense					
10								
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-11-A
PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

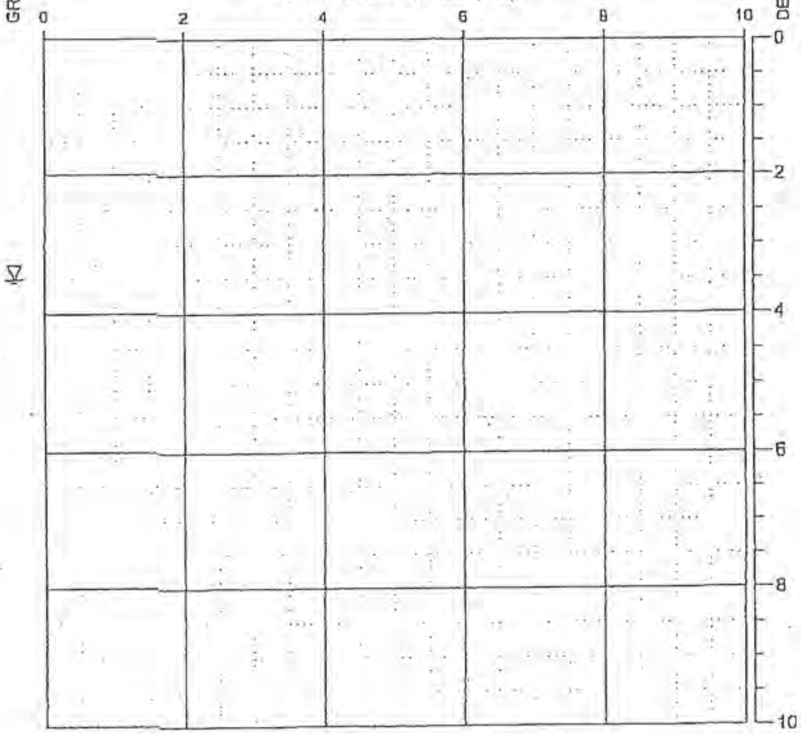
APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0			Brown, SAND, loose, moist, organic, (Topsoil - Fill)					
		SP	Gray brown, poorly graded SAND, moist, loose, fine sand (Glacial Outwash)					
2		SP	Gray/yellowish brown, poorly graded SAND, moist to wet, fine sand, bedded, (Glacial Outwash) Seepage at 3.5'					∇
4								
6								
8								
10								

SKETCH OF SIDE OF PIT



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-11-B

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT10 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, poorly graded GRAVELLY SAND, dry to moist, loose, fine sand, some roots (Fill)					
		SP	Yellowish brown/gray, poorly graded SAND, moist, medium dense, fine sand (Glacial Outwash)					
2								
4								
6								
8								
10								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0 2 4 6 8 10

DEPTH (feet): 0 2 4 6 8 10

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA
HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-11-C

PAGE: 1 of 1

PROJECT NO.: 2002071

FIGURE:

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, poorly graded GRAVELLY SAND, dry to moist, loose, fine sand, some roots (Fill)					
			Charcoal and partially burnt wood					
5			Brown, poorly graded SAND, dry, loose, intermixed bricks, (Demolition waste)					
			Gray brown, poorly graded SAND, moist, loose, fine to medium sand, intermixed wood and steel, with some hoses (Demolition Waste)					
10								
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 5, 10, 15, 20

DEPTH (feet): 0, 5, 10, 15, 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-12-A

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

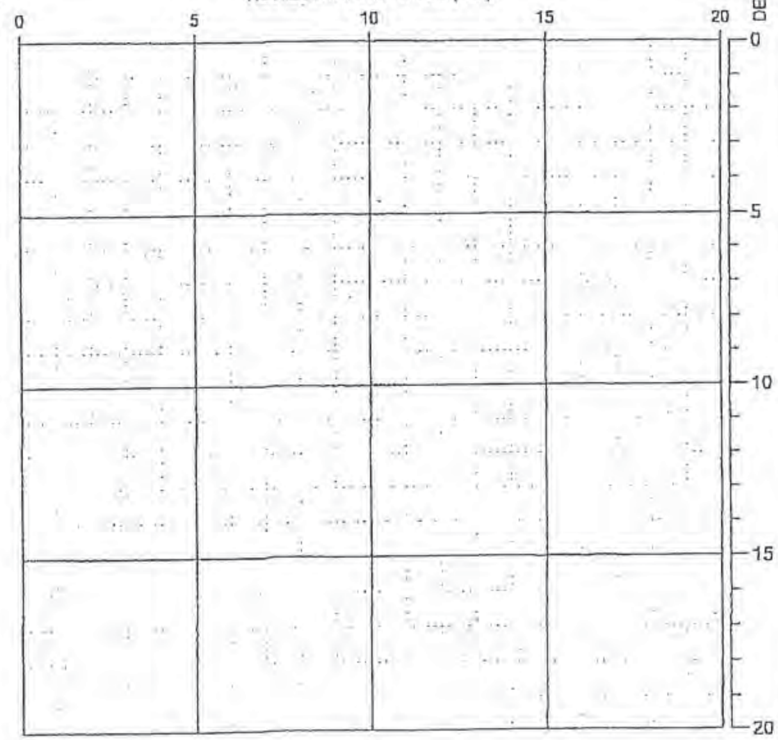
APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, poorly graded GRAVELLY SAND, moist to dry, loose, fine to medium sand (Fill)					
			Gray brown, poorly graded SAND, moist, loose, fine to medium sand, intermixed with wood (Demolition waste)					

SKETCH OF SIDE OF PIT



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-12-B
PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

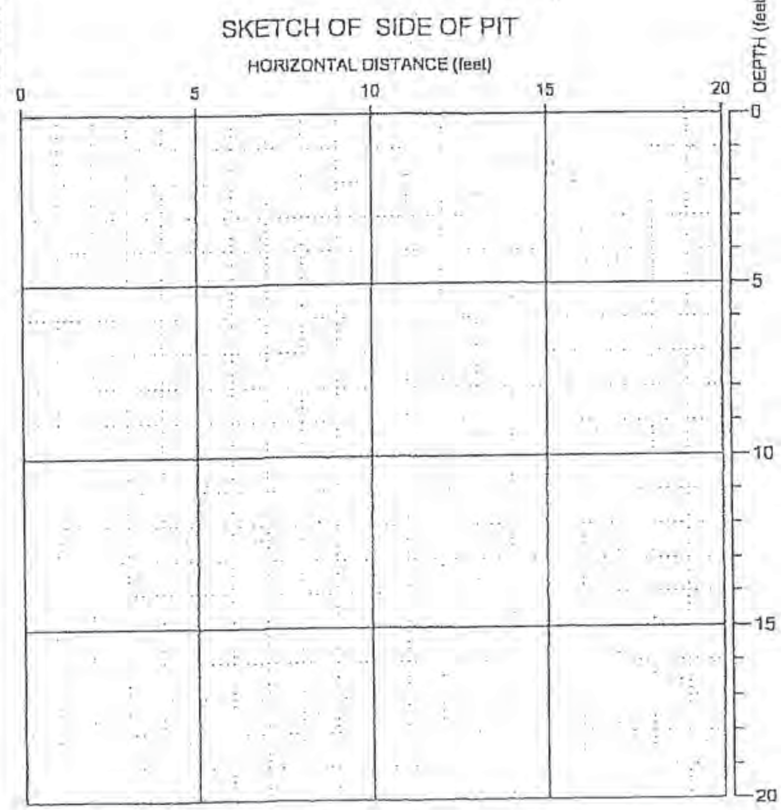
TPIT20 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, poorly graded GRAVELLY SAND, moist to dry, loose, fine to medium sand (Fill)					
			Gray brown, poorly graded SAND, dry, loose, fine sand, intermixed wood, tires, metal, carpet, steel pipes (Refuse)					



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-13-A
PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/4/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, poorly graded GRAVELLY SAND, moist to dry, loose, fine to medium sand (Fill)					
			Dark gray brown, poorly graded SAND, dry to moist, loose, intermixed dimensional timber, bricks, steel pipes (Demolition Waste)					
5								
10								
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 5 10 15 20

DEPTH (feet)

0 5 10 15 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-13-B

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/4/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Gray, poorly graded GRAVELLY SAND, dry, fine sand (Fill)					
			Gray brown, poorly graded SAND, dry to moist, loose, fine to medium sand, intermixed dimensional lumber (Demolition Waste)					
5								
10								
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 5, 10, 15, 20

DEPTH (feet): 0, 5, 10, 15, 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA
HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-14-A
PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/4/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, poorly graded GRAVELLY SAND, dry, medium dense, fine sand, with some steel and pockets of crushed glass (Fill)					
5			Dark gray brown, poorly graded SAND, moist, loose, fine sand, intermixed dimensional timber (Fill)					
10								
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 5, 10, 15, 20

DEPTH (feet): 0, 5, 10, 15, 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-15

PAGE: 1 of 2

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/4/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
20								
25								
30								
35								
40								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 5 10 15 20

DEPTH (feet)

20 25 30 35 40

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-15

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 8/4/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, poorly graded GRAVELLY SAND, moist to dry, loose, fine to medium sand with some wood (Earthen Fill)					
5			Dark brown, poorly graded SAND, dry to moist, fine sand, with intermixed wood and plastic (Demolition Waste)					
			Pocket of pink packing foam and plastic at 8 feet					
10			Pocket of crushed glass at 10 feet					
			No plastic in demolition waste below 13 feet					
15								
		SP	Gray, poorly graded SAND, moist, fine sand, (Glacial Outwash - Fill)					
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 5 10 15 20 DEPTH (feet)

0 5 10 15 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA
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GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-16

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/4/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SM	Gray brown, SILTY SAND with some gravel, fine sand, with intermixed wood, some steel and plastic (Demolition Waste)					
			Brown, poorly graded GRAVELLY SAND, with intermixed wood, bricks, steel and cardboard (Demolition Waste)					
5			Crushed glass					
		SP	Yellowish brown, poorly graded SAND, dry, loose, fine to medium sand (Earthen Fill)					
10			Dark brown, SILTY SAND, moist, loose, fine sand, intermixed wood (Demolition Waste)					
15								
		SM	Gray/yellow, SANDY SILT, moist, medium plasticity, medium stiff, dark brown concretions					
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 5 10 15 20

DEPTH (feet) 0 5 10 15 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-17

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 5900 Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/4/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		ML	Gray, SANDY SILT with some gravel, dry, medium plasticity, (Earthen Fill)					
5			Brown, poorly graded SILTY SAND, moist, loose, fine to medium sand, intermixed with tires, bricks, plastic and large pieces of wood (Demolition Waste)					
			Intermixed with wood only below 8'					
10								
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 5, 10, 15, 20

DEPTH (feet): 0, 5, 10, 15, 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-18

PAGE: 1 of 2

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 5900 Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 8/4/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
20								
25								
30								
35								
40								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 5 10 15 20

DEPTH (feet): 20 25 30 35 40

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA
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GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-18

PAGE: 2 of 2

PROJECT NO.: 2002071 FIGURE:

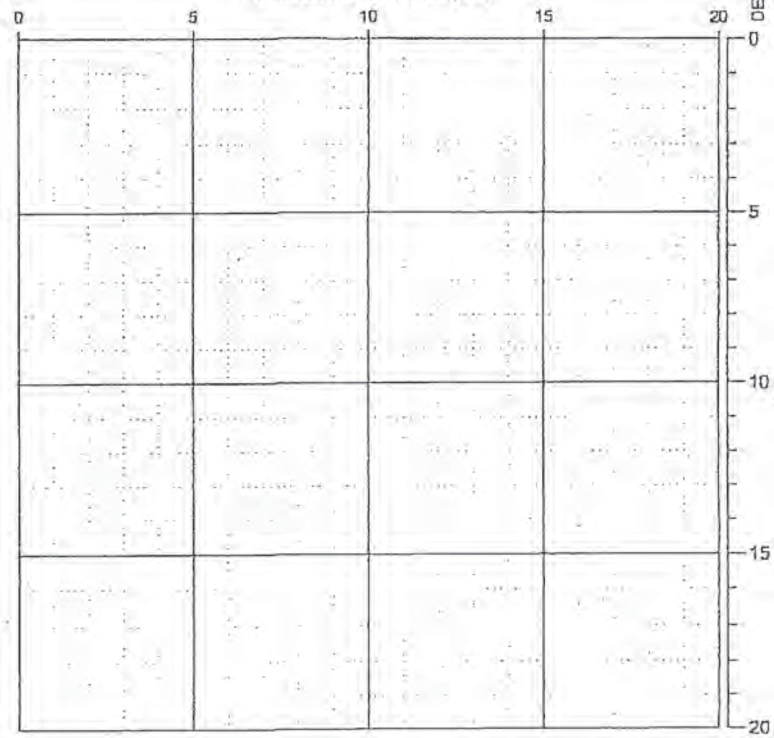
EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/5/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, poorly graded GRAVELLY SAND, dry, medium dense, (Earthen Fill)					
			Black/brown, GRAVELLY SAND with glass, aphalt and bricks, dry, loose (Fill)					
			Crushed glass (Fill)					
5			Gray, poorly graded SAND, dry, loose, fine sand, with intermixed plastic and PVC pipes (Demolition Waste)					
			Dark brown, poorly graded SAND, dry to moist, loose, intermixed plywood, PVC pipes and some steel (Demolition Waste					
10								
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-19

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/5/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SM	Dark brown, SILTY SAND with some gravel, moist (Earthen Fill)					
		SM	Brown, SILTY SAND, dry to moist, loose, fine to medium sand, intermixed plywood, bricks, plastic sheeting, steel and occasional tire (Demolition Waste)					
5								
		SP	Olive grey, poorly graded SAND, loose, moist, fine to medium sand					
10								
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 5, 10, 15, 20

DEPTH (feet): 0, 5, 10, 15, 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA

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GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP20

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/5/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SM	Dark brown, SILTY SAND with some gravel, moist (Earthen Fill)					
		SM	Brown, SILTY SAND, moist, loose, fine to medium sand (Demolition Waste) Some plastic at 3' Burnt wood at 4' Tyres and PVC piping at 6' to 8'					
5								
		SP	Dark brown, SAND, moist, loose, with intermixed plywood and dimensional timber (Demolition waste)					
10								
		ML	Blue gray, SANDY SILT, moist, with intermixed plywood, tires and concrete (Demolition waste)					
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 5, 10, 15, 20

DEPTH (feet): 0, 5, 10, 15, 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP21

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/5/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		ML	Dark brown, SANDY SILT, low plasticity, moist (Earthen Fill)					
		SM	Orange brown, SILTY SAND, dry, loose, with intermixed glass and steel (Demolition waste)					
			Charcoal and partially burnt wood					
5		SM	Dark brown, SILTY SAND, dry to moist, loose, intermixed concrete and dimensional timber, with some carpet (Demolition Waste)					
10								
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 5, 10, 15, 20

DEPTH (feet): 0, 5, 10, 15, 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP22

PAGE: 1 of 1

PROJECT NO.: 2002071

FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX A

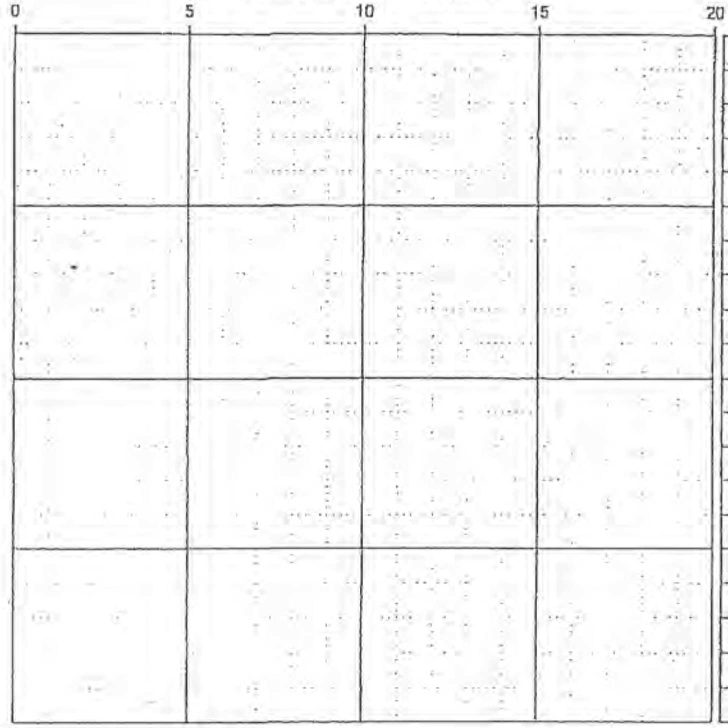
EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/5/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SM	Brown, SILTY SAND with gravel (Earthen Fill					
			Brown, SILTY SAND, loose, with intermixed plastic sheeting, plywood, foam rubber insulation, glass (Demolition Waste)					
5			Burnt wood and charcoal					
			Branches and pine needles (Wood waste)					
10			Dark brown, SILTY SAND, with intermixed dimensional timber and concrete (Demolition Waste)					
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP23

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/5/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, poorly graded SAND with some gravel					
			Dark brown, SILTY SAND, dry to moist, with intermixed bricks, linoleum, insulation and some steel and wire (Demolition Waste)					
			Crushed glass					
5			Dark brown, SILTY SAND, dry to moist, with intermixed bricks, insulation and some steel and wire (Demolition Waste)					
10								
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 5 10 15 20

DEPTH (feet) 0 5 10 15 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-24
PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/5/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SM	Dark brown, SILTY SAND					
		SM	Orange, poorly graded SILTY SAND, dry, fine to medium sand, some steel and bricks (Demolition Waste)					
			Burnt wood/charcoal					
5			Brown, SILTY SAND, dry to moist, with intermixed dimensional timber, steel, concrete, carpet and some plastic (Demolition Waste) Pocket of crushed glass at 7' Large stumps from 8' to 12'					
10								
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 5 10 15 20

DEPTH (feet) 0 5 10 15 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-25

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/5/02
LOGGED BY: B. Robinson

DEPTH (feet)	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0	SM	Brown, SILTY SAND with gravel (Earthen Fill)					
		Dark gray, GRAVELLY SAND with silt, some steel and plastic (Demolition Waste)					
		Charcoal					
5		Dark gray, SILTY SAND, with intermixed plywood, dimensional timber, trace concrete (Demolition Waste) Large pieces of dimensional timber at 8'					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-26

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/5/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0			Dark brown, SILTY SAND with some gravel, fine sand, with intermixed bricks, glass, plywood and steel (Demolition Waste)					
3.5		SM	Gray, SILTY SAND, moist to dry, some wood, (Earthen Fill)					
4.5		SP SM	Light brown, poorly graded SAND with some silt, fine sand, (Glacial Outwash)					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 2 4 6 8 10

DEPTH (feet)

0 2 4 6 8 10

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-27
PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT10 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/5/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0			Dark brown, SILTY SAND, moist, with some wood and glass, occasional concrete (Topsoil - Demolition Waste)					
		SM	Light brown, SAND, moist, fine sand, with veins of gray SILTY SAND					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 2 4 6 8 10

DEPTH (feet) 0 2 4 6 8 10

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-28

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT10 2002071.GPJ 6/25/02

APPENDIX A

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/5/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0			Dark brown, SILTY SAND, moist, with some wood and glass, occasional concrete (Topsoil - Demolition Waste)					
		SM	Light brown, SAND, moist, fine sand, with veins of gray SILTY SAND					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 2 4 6 8 10

DEPTH (feet) 0 2 4 6 8 10

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-29

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

APPENDIX B

Slope Stability Models

Description:
Comments:
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Last Saved Date: 5/11/2011
Last Saved Time: 8:27:52 AM
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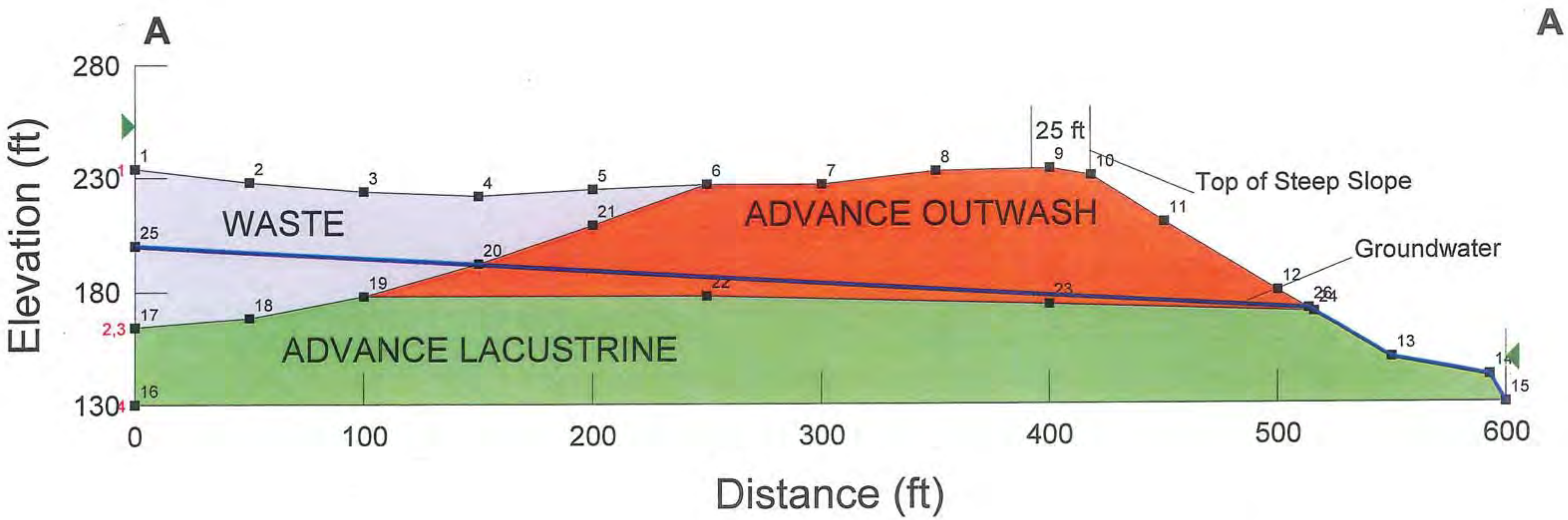
P.W.P. Option: Piezometric lines with Ru
Tension Crack Option: (none)
Seismic Coefficient: Horizontal

SITE CONDITIONS



APPENDIX A

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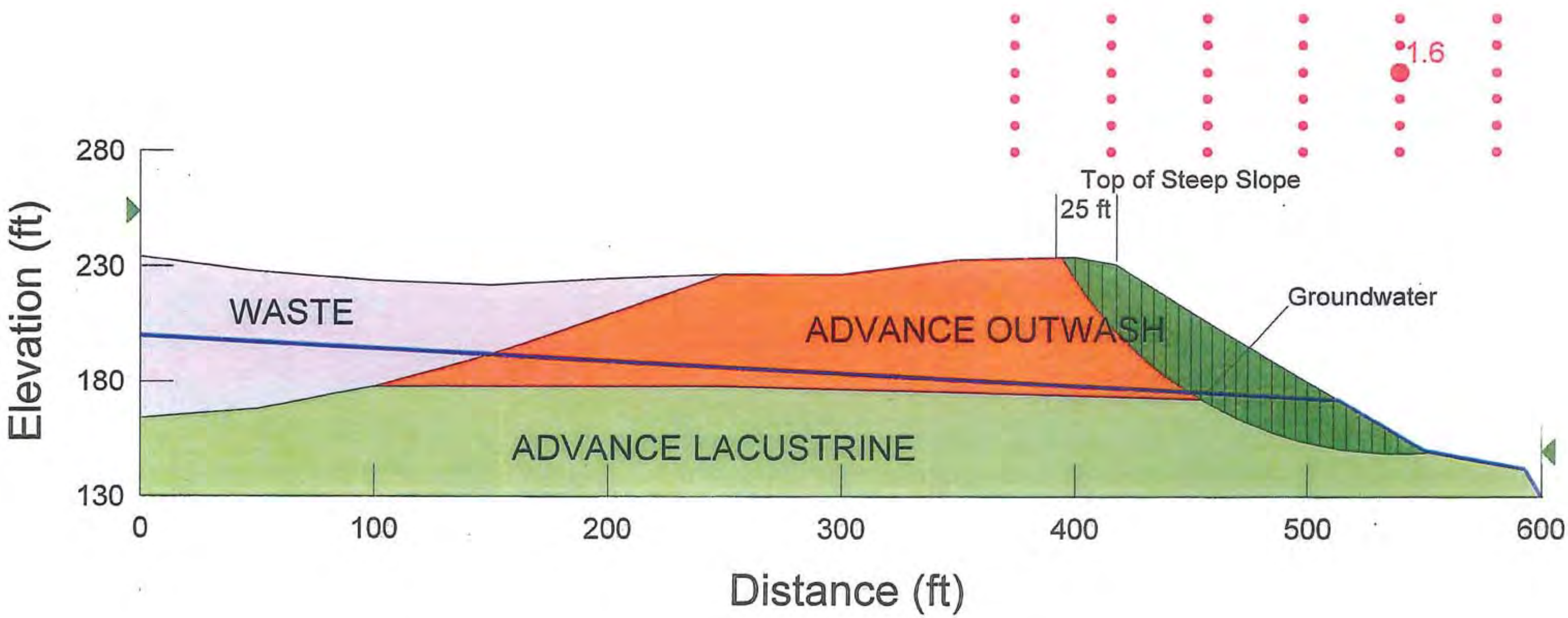

APPENDIX A

Description:
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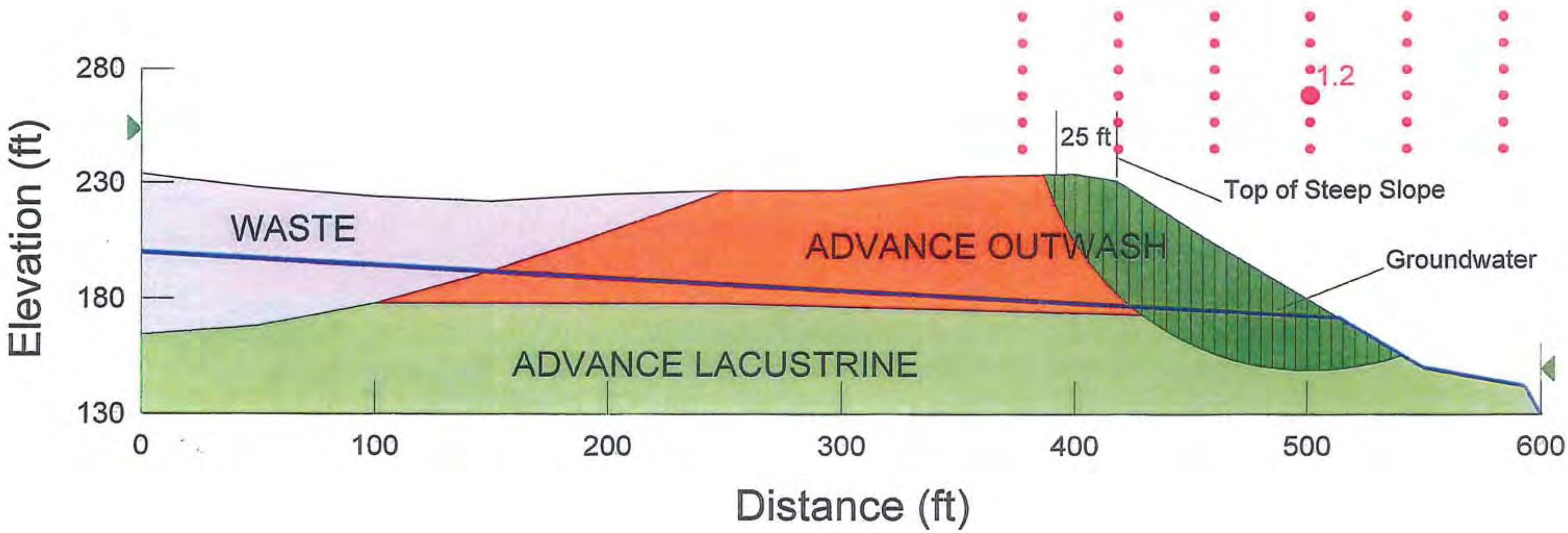
SEISMIC (0.16g)



APPENDIX A

SITE CONDITIONS

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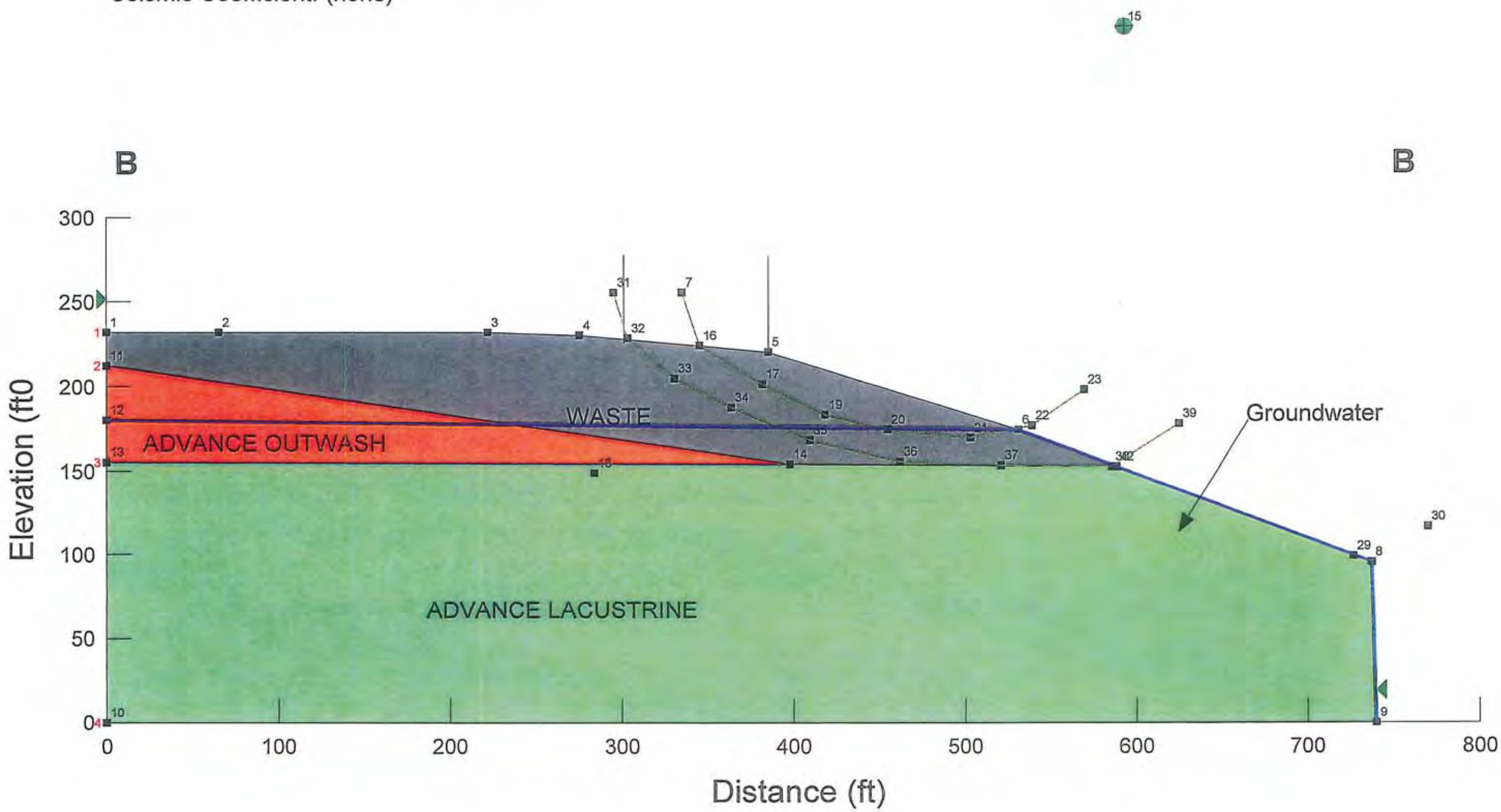

APPENDIX A

SITE CONDITIONS

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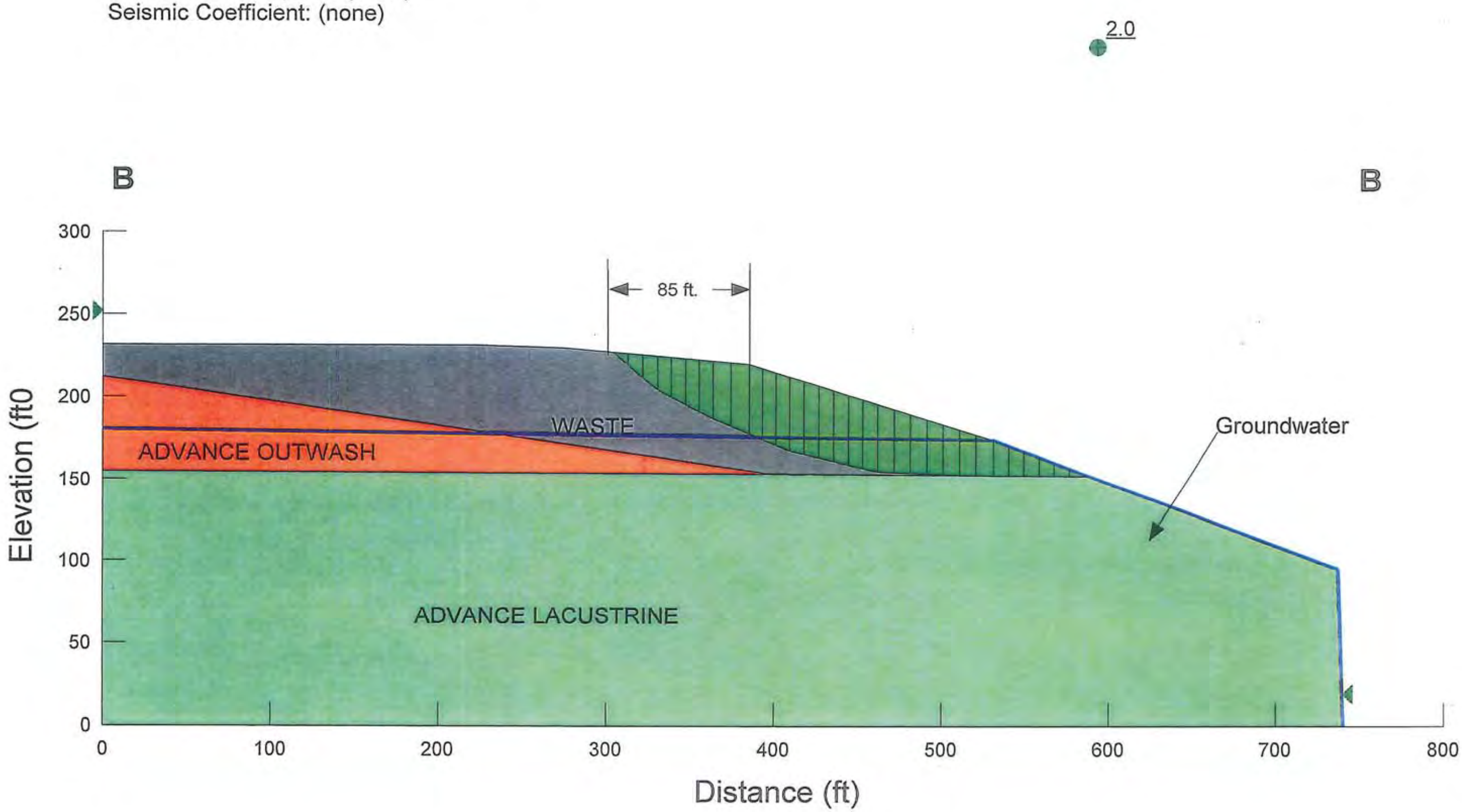

APPENDIX A

SITE CONDITIONS

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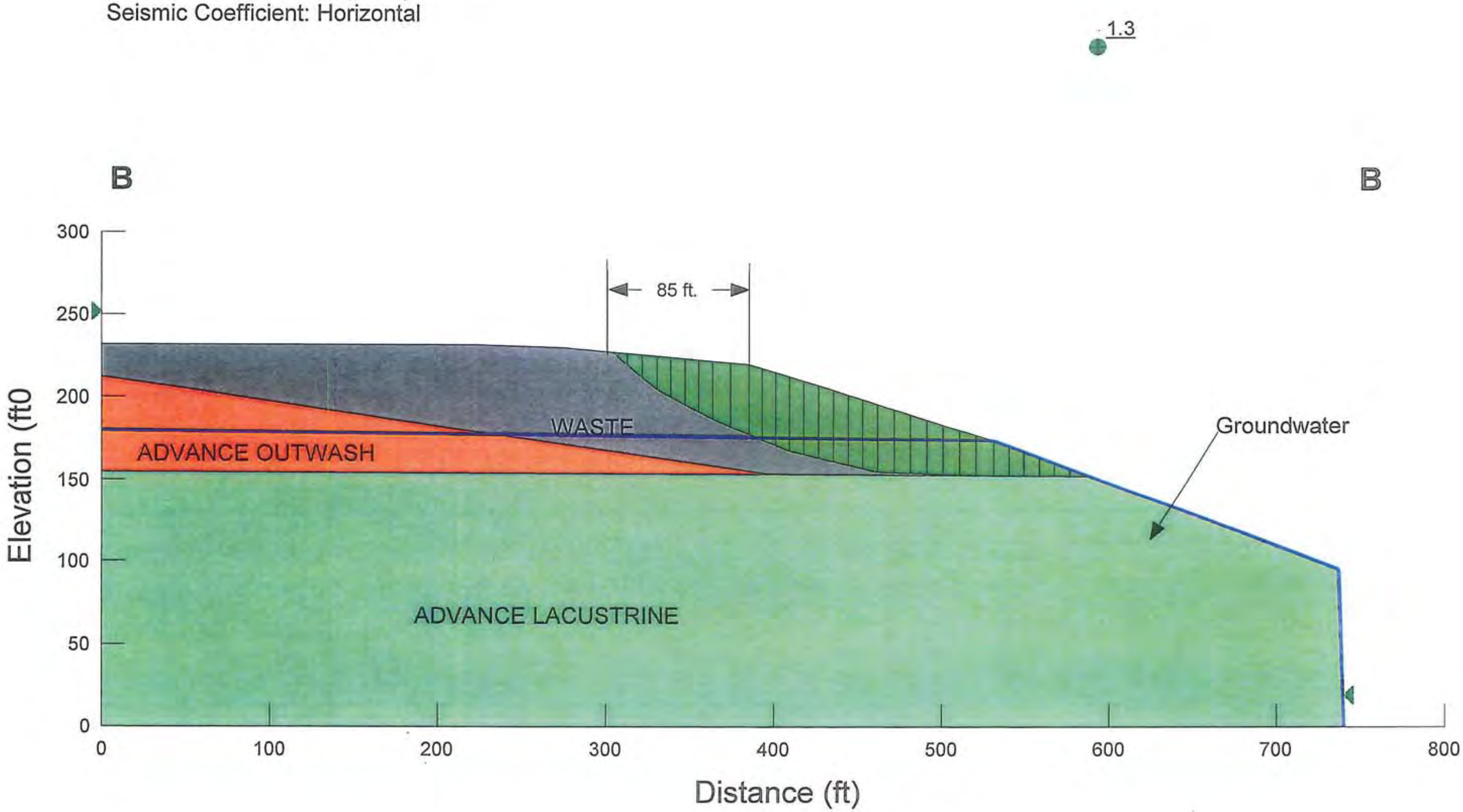
Seismic Coefficient: Horizontal



APPENDIX A

SITE CONDITIONS

Go East Landfill KE090231A:
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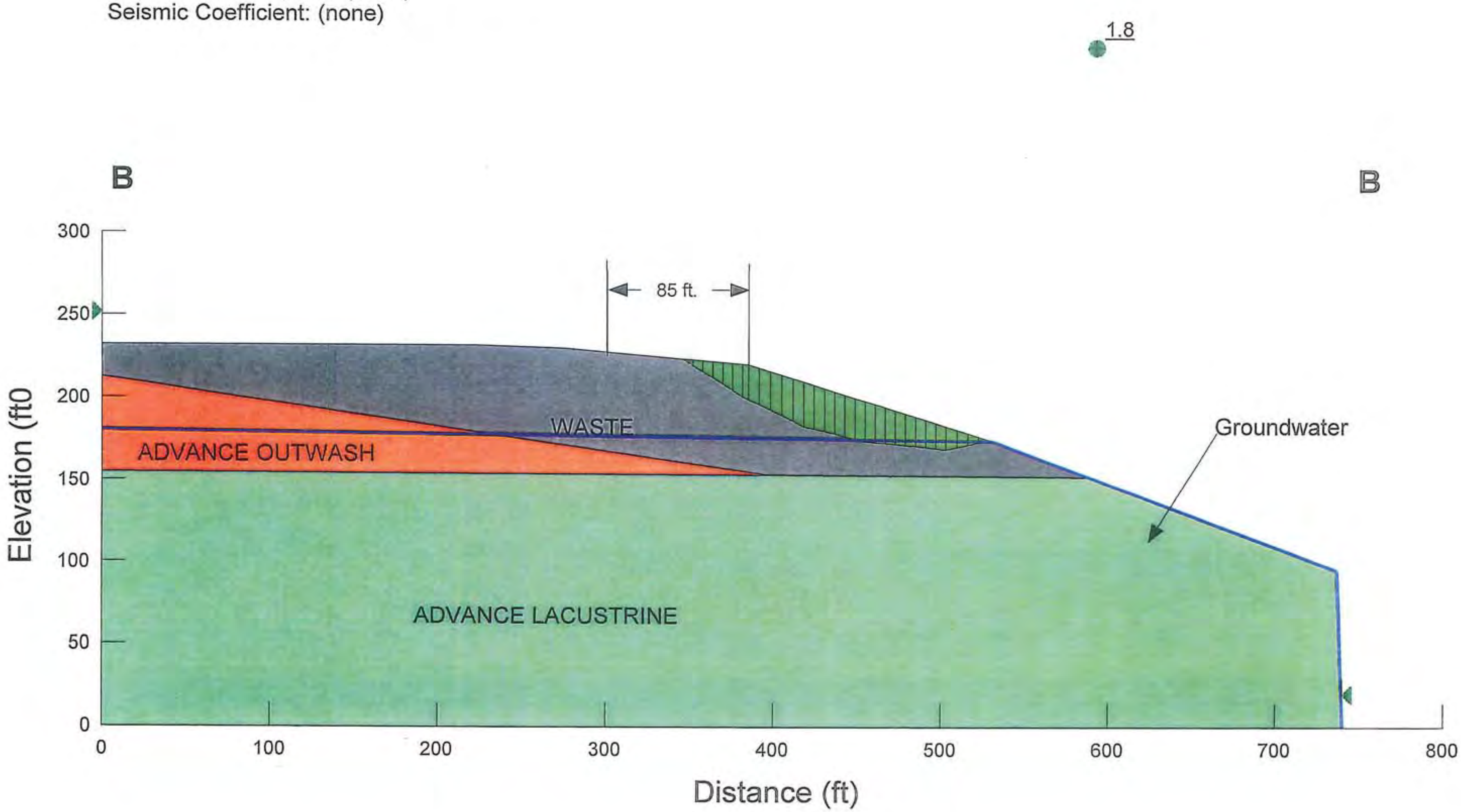
Seismic Coefficient: (none)



APPENDIX A

SITE CONDITIONS

Go East Landfill KE090231A:
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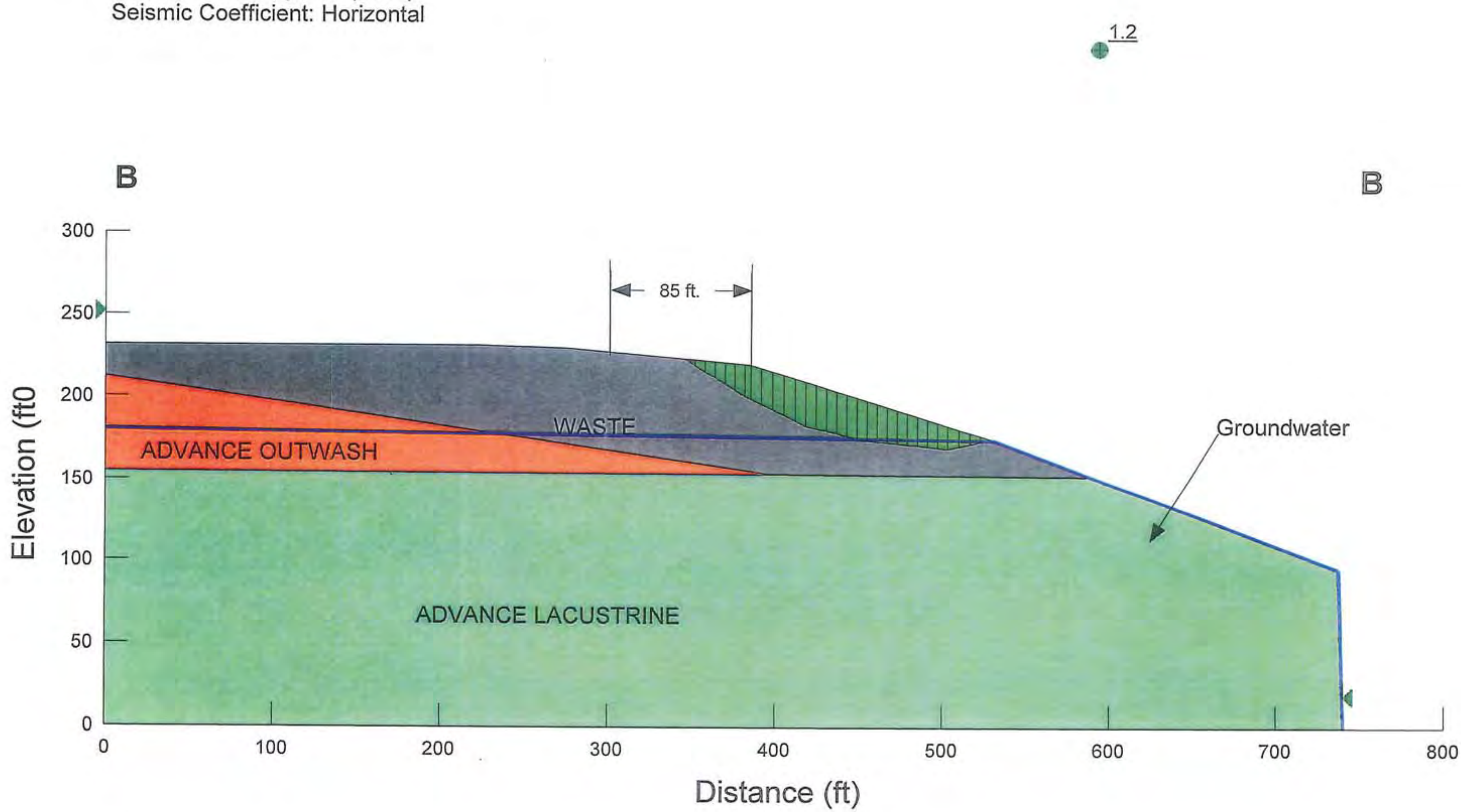
Seismic Coefficient: Horizontal



APPENDIX A

Appendix B
Hydrogeology Report
Associated Earth Sciences, Inc., December 2009
Rev. October 26, 2011

December 15, 2009
Revised October 26, 2011
Project No. KE090231A

PACE Engineers, Inc.
11255 Kirkland Way, Suite 300
Kirkland, Washington 98033

Attention: Mr. Marty Penhallegon, P.E.

Subject: Revised Hydrogeology, Ground Water, and Surface Water Quality Report
Former Go East Landfill
Snohomish County, Washington

Dear Mr. Penhallegon:

Associated Earth Sciences, Inc. (AESI) is pleased to provide this letter-report presenting our interpretation of the hydrogeology and the results of ground water and surface water quality testing. This letter-report has been prepared for the exclusive use of PACE Engineers and their agents for specific application to this project. Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted geology and hydrogeology practices in effect in this area at the time our letter-report was prepared. No other warranty, express or implied, is made. Our observations, findings, and opinions are a means to identify and reduce the inherent risks to the owner.

AESI's original hydrogeologic report was dated December 15, 2009. At that time, the project was being regulated under Chapter 173-304 of WAC. Since the original report was prepared, the Snohomish Health District (SHD) has determined that the project should be regulated under Chapter 173-350 of WAC.

This revised report is intended to partially meet the requirements of Chapter 173-350 of WAC. Other reports prepared by AESI (Subsurface Exploration and Geotechnical Study, dated October 21, 2009 and HELP Model Evaluations, in progress) along with this report when reviewed together are intended to fully meet the hydrogeologic characterization requirements of Chapter 173-350 of WAC.

The original report has been revised to provide additional data required by Chapter 173-350 of WAC and some of the interpretations in the original report have been revised based on new information reviewed or collected during preparation of this document.

INTRODUCTION

The project site is a square-shaped, approximate 40-acre parcel, extending approximately ¼ mile north-south and east-west (Figure 1). The northern portion of the subject parcel contains the 5- to 6-acre, former Go East Landfill. Site topography includes steep slopes leading down into the subject site from the north and west. Portions of the steep bank near the western property line appear to include relict excavation faces, which may be the result of past surface mining activities. The northern two-thirds of the subject site is generally flat-lying to gently sloping, while the southern, roughly one-third of the property is comprised of a large, steeply sided drainage ravine. This ravine turns northward east of the subject site and extends beyond the northeast corner of the subject site toward the floor of the Snohomish River valley and Lowell-Larimer Road. The site is bounded on the north and west by existing residential subdivisions, to the south by the steeply incised drainage, and to the east by the Olympic Pipeline Easement and the steeply sided drainage. Site vegetation consists of small to large, second-growth deciduous and coniferous trees and moderate to dense undergrowth. The former landfill area is vegetated predominantly with blackberry brambles. A small stream, delineated by others, was observed to the south of the former landfill area. A spring emanates from the base of the steeply sided ravine to the northeast of the landfill area.

SURFACE WATERS

Surface waters within 1 mile of the landfill site include three streams, whose locations are shown on Figure 2, "Ground Water Flow Map."

- Stream 1 flows across the west side of the property and eventually flows into Stream 2 that runs along the base of the steep slope south of the landfill area. Prior to being used as a construction debris landfill, the area beneath the current landfill footprint consisted of a ravine that was occupied by a stream channel as shown on Figure 3, "Pre-Filling Ravine Location." Subsequent mining of sand and then backfilling with landfill debris resulted in the stream (Stream 1) being routed around the landfill area. The current Stream 1 channel (Figure 2) is reportedly the result of temporary relocation of the stream during landfill operations and possibly damming of the channel by local residents. The Stream 1 channel begins in the central-western portion of the site and flows in a southeasterly direction where it discharges into Stream 2.

- Stream 2 originates off-site to the south of the property and flows east across the property and eventually across the Olympic Pipeline corridor, then downslope to the Snohomish River valley (Figure 2).

- Stream 3 originates from ground water seepage at the east end of the landfill and flows east within the pre-landfill ravine and across the Olympic Pipeline corridor (Figure 1).

SURROUNDING LAND USE/WATER SUPPLY WELLS

Water Supply Wells

Land use surrounding the landfill includes single-family residential development and undeveloped land. An Olympic pipeline easement is located adjacent to the east of the landfill. The Washington State Department of Ecology (Ecology) on-line water well report database was reviewed to identify recorded potential water supply wells within 2,000 feet of the landfill boundary. Information in the database for a 2,000-foot search radius included well reports for 34 resource protection wells and one water well report. The water well report has notation of "abandoned backfilled with bentonite" indicating the well is not in use for water supply.

Water Rights

Water right information in the Ecology database indicates three water right claims exist within 2,000 feet of the Go East site boundaries. Two of the water rights are surface water rights with water use for irrigation. The third water right is a ground water right. On the water right claim form for the ground water right, the use of the water is listed under "other" and not specified. The use options on the water right form include domestic, stockwatering, irrigation, and "other."

Table 1
Summary of Water Rights Within 2,000 Feet of the Go East Property Boundaries

Record	Right Holder	Type	Date of Claim	Use	Amount
S1-005837CL	Stecher	Surface Water	1971	Irrigation	4 acre-feet/year
S1-036523CL	Stecher	Surface Water	1973	Irrigation	Not listed
G1-099852CL	Chovanak	Ground Water	1975	Other	Not listed

GEOLOGY

Our field study included excavating 17 exploration pits and drilling 4 exploration borings to gain additional subsurface information about the site. We also completed a total of 10 gas probes around and within the landfill to explore for the presence of methane. The various types of sediments, as well as the depths where characteristics of the sediments changed, are indicated on the exploration logs presented in Attachment A. The depths indicated on the logs where conditions changed may represent gradational variations between sediment types. In addition to the recent AESI work, previous work by HWA Geosciences (HWA) resulted in the completion of 46 additional exploration pits at the site. The locations of the explorations completed by AESI are shown on Figures 1 and 2, and the locations of the exploration pits completed by HWA are shown on Figure 4, "HWA Exploration Locations." Geologic cross sections of the site are presented on Figure 5, "Geologic Cross Sections." Logs of the AESI and HWA explorations are included in Attachment A.

Fill

Fill soils (soils not naturally placed) were encountered at the locations of exploration pits EP-1 through EP-8, and EP-11 through EP-17, and in gas probes GS-3 and GS-5 through GS-10. Fill encountered at the locations of these exploration pits generally consisted of loose silty sand with gravel with various types and amounts of assorted construction debris. Portions of the fill at these locations contained organic material. Where encountered, the fill ranged in thickness from approximately 1 foot (EP-11) to greater than 21 feet (EP-6). The fill extended below the depths explored at exploration pits EP-2, EP-6, EP-8, EP-14, and EP-17, as well as at exploration pit EP-13, which met refusal at 17 feet due to the presence of abundant debris. The depth and location of the fill, combined with the absence of a discernable topsoil layer beneath the fill, suggests that the area was excavated prior to filling, possibly as a borrow pit. Excavated and filled areas can vary greatly in quality, thickness/depth, and extent over short distances. Fill is also expected in unexplored areas of the site, such as within the limits of the former landfill and its associated access roads. Due to their variable density and organic debris content, the existing fill soils are not suitable for foundation support.

Vashon Advance Outwash

Sediments encountered directly below the fill, or at the ground surface at exploration pits EP-9 and EP-10 and exploration borings MW-1 through MW-4, generally consisted of medium dense to very dense sand, with silt lenses, interbeds, and variable silt and gravel content. We interpret these sediments to be representative of Vashon advance outwash (Qva). The Qva sediments were deposited by meltwater streams that emanated from the advancing glacial ice during the Vashon Stade of Fraser Glaciation approximately 12,500 to 15,000 years ago. The high relative density of these sediments is due to their consolidation by the massive weight of the glacial ice that overrode these materials subsequent to their deposition. At the locations of exploration borings MW-1 through MW-4, the Qva sediments extended to depths of approximately 28 to 73 feet below ground surface.

Pre-Vashon Glacial Lacustrine

Underlying the Vashon advance outwash sediments, exploration borings MW-1 through MW-4 encountered sediments interpreted to be pre-Vashon glacial lacustrine silts. These sediments consisted of very stiff to hard, moist to wet, bluish gray silt, with a few very fine sand partings and fine sand beds. These lake sediments were deposited prior to the Vashon-age glaciation. These sediments were subsequently overridden by several thousand feet of glacial ice that compressed the sediments into their present, very stiff to hard state.

Geologic Mapping

Review of the United States Geological Survey (USGS) *Distribution and Description of the Geologic Units in the Everett Quadrangle, Washington*, by Minard, dated 1981, indicates that the area is underlain by Vashon advance outwash in the western portions of the property, with Vashon glacial to pre-Fraser nonglacial deposits, undifferentiated, exposed along the eastern portions of the site and the eastern slope. Our interpretations of the sediments encountered during our study are in general agreement with this regional geologic map; however, the silt unit underlying the sandy Vashon advance outwash is interpreted to be glacial lacustrine (which fits into the broad, undifferentiated category described on the map).

HYDROGEOLOGY

AESI completed four ground water monitoring wells (MW-1 through MW-4) at the site. When measured in August 2009, February 2011, and April 2011, three of the wells contained water and one well (MW-4) was dry. Details of the well installations and ground water elevations are presented in Table 2.

- Depths to ground water varied between about 31 and 51 feet with ground water occurring within the granular advance outwash deposits above the fine-grained, lower-permeability, pre-Vashon glacial lacustrine deposits.

- In addition to the wells, ground water discharge is evident in a spring (SP-1) that daylights at the toe of the slope from beneath the landfill debris on the east end of the site at the head of Stream 3. This spring is an expression of shallow ground water discharging from the old, prefill ravine that underlies the landfill. Soils exposed at the spring and below the landfill debris consist of the pre-Vashon glacial lacustrine deposits.

- The water table in the advance outwash deposits appears to be unconfined to semi-confined depending upon the location at the site and the nature of the underlying sediments.

- The ground water in the vicinity of wells MW-1 and MW-3 appears to be semi-confined due to the occurrence of interbedded silt that provides a confining layer(s) near the bottom of the advance outwash. Where these interbedded silt layers are absent (MW-2), the ground water is unconfined.

- Based on the ground water elevations in wells MW-1, MW-2, and MW-3, ground water flow in the shallow ground water system beneath the site generally flows to the east toward the Snohomish River valley (Figure 1). There is a component of southerly flow in the northern potion of the site.

- Recharge to the ground water system in advance outwash deposits is likely from infiltration of precipitation.

- Discharge from the ground water system in the advance outwash deposits is to seeps and springs in the eastern portion of the site where the contact between the advance outwash deposits and underlying fine-grained pre-Vashon-age lacustrine deposits and the ground water system daylights on the steep slopes east and southeast of the landfill footprint.

- Slug testing was conducted in wells MW-1 and MW-2 at the site to estimate the hydraulic conductivity of the ground water system in the advance outwash deposits. We were not able to conduct slug testing in MW-3 as the casing was off-plumb and the slug bar could not be lowered to the level of the well where the well screen and ground water is present.

- The hydraulic conductivity of the advance outwash aquifer was estimated to be about 1 to 3 feet/day. The aquifer material consists of fine sand to silty very fine sand in MW-1 and MW-2. The hydraulic conductivity estimate derived from the slug test of 1 to 3 feet/day is consistent with published hydraulic conductivity values for silty fine sand (Heath, 1991).

- Ground water flow rate was evaluated based on our interpretation of ground water flow direction, as shown on Figure 2. The estimated flow rate is from the center of the landfill to the northeast toward the discharge point. A ground water flow rate of approximately 0.4 feet per day was estimated using a hydraulic conductivity value of 3 feet/day, an effective porosity of 0.15, and a hydraulic gradient of 0.02.

WATER QUALITY

Summary of Previously Collected Water Quality Data: Surface Water

Based on the data set of previously collected water quality data provided by PACE Engineering, surface water quality sample collection dates back to 1981. Ecology collected surface water samples from Stream 3, which emanates from seepage near SP-1, and is termed the "leachate stream" (Sampling ID GE-1). Ecology also collected surface water samples from the stream to which Stream 3 is tributary at a location upstream of the confluence with Stream 3 (Sample ID GE-2) and a location downstream of the confluence with Stream 3 (Sample ID GE-3). The surface water samples were tested for pH, specific conductivity, chloride, sulfate, total dissolved solids, nitrate, zinc, iron, manganese, and tannin and lignins. Based on sample data sheets, Ecology conducted the surface water sampling from January 1981 through March 1986. Ecology water quality sample data sheets with analytical results are included in Attachment B.

The SHD collected samples at what appear to be the same surface water locations as the Ecology sampling locations described above in May 1989, November 1991, and December 1996.

- Samples collected in May 1989 were analyzed for dissolved iron, dissolved manganese, dissolved zinc, chemical oxygen demand, chloride, sulfate, nitrate, nitrite, ammonia nitrogen, phosphate, total organic carbon, pH, and conductivity.

- Samples collected in November 1991 were analyzed for dissolved iron, dissolved manganese, dissolved zinc, chemical oxygen demand, chloride, sulfate, nitrate, nitrite, ammonia nitrogen, pH, and conductivity.

- Samples collected in January 1997 were analyzed for electrical conductivity, hydrogen ion, total organic carbon, calcium, magnesium, manganese, potassium, sodium, zinc, chemical oxygen demand, chloride, fluoride, nitrate, nitrite, ortho-phosphate, sulfate, tannins, and ammonia.

In September 1997, Robert G. Bober Jr., P.E. collected surface water samples at what appears to be the same Ecology sampling locations.

- Samples collected by Mr. Bober were analyzed for calcium, iron, magnesium, manganese, potassium, sodium, zinc, pH, fluoride, ammonia-nitrogen, chemical oxygen demand, total organic carbon, specific conductivity, chloride, nitrate, nitrite, orthophosphate, orthophosphate-phosphorus, sulfate, and tannins and lignins.

In May 2002, HWA collected what appears to be a surface water sample (SW-1-0502) from the site. The sample location is unknown.

- The surface water sample collected by HWA was analyzed for TPH-G/BETX, TPH-Diesel, priority pollutant metals, volatile organic compounds, semi-volatile organic compounds, pesticides, polychlorinated biphenyls (PCBs), total iron, total manganese, nitrate, chloride, sulfate, bicarbonate alkalinity, carbonate alkalinity, hydroxide alkalinity, total alkalinity, total dissolved solids, total suspended solids, total organic carbon, total coliform, and fecal coliform.

In March 2004, the SHD collected a surface water sample from a seep and a stream in the area of the landfill. These sample locations may correspond with the previous Ecology sampling locations for the "leachate seep" and receiving stream.

- The surface water samples were analyzed for carcinogenic polynuclear aromatic hydrocarbons (PAHs), nitrate, sulfate, priority pollutant metals, and total organic carbon.

A summary of previous surface water sampling is presented in Table 3. The results presented in Table 3 were compared to the *Water Quality Standards for Surface Waters of the State of Washington* (WAC 173-201A). Based on the data we reviewed, all of the analyte concentrations for surface water are below their respective surface water quality criteria.

Recent Surface Water Sampling

Surface water samples were collected by AESI from the spring (SP-1) at the head of Stream 3 that exits the east face of the landfill and from location SP-2 in Stream 2 that flows across the east side of the property (Figure 1). The SP-1 location is downgradient of the landfill and the quality of samples collected at this location is likely representative of the impacts of the landfill debris on the shallow ground water.

The samples were submitted to a subcontract analytical laboratory for water quality testing. Each of the water samples were analyzed for RCRA 8 metals (ground water for both total and dissolved), iron, manganese, chloride, sulfate, pH, specific conductivity, and semi-volatile organics. The laboratory test certificates are included in Attachment C.

The results of the surface water analyses are summarized in Table 4. The analytical results were compared to the *Water Quality Standards for Surface Waters of the State of Washington* (WAC 173-201A). The analytical testing indicates the following:

- All of the analyte concentrations from both surface water samples are below their respective surface water quality criteria.

Ground Water

Samples of ground water were collected from each well that contained ground water (MW-1, MW-2, and MW-3). The samples were submitted to a subcontract analytical laboratory for water quality testing. Each of the water samples were analyzed for RCRA 8 metals (ground water for both total and dissolved), iron, manganese, chloride, sulfate, pH, specific conductivity, and semi-volatile organics. The laboratory test certificates are included in Attachment C.

Wells MW-1, MW-2, and MW-3 are located outside of the landfill limits and are screened within the native advance outwash soils that underlie at least portions of the landfill. Wells MW-1 and MW-3 are also upgradient of the landfill and the quality of the water in these wells is likely not impacted by the landfill debris. Well MW-2 is crossgradient of the landfill and water collected from this well may have been impacted by the landfill debris.

The results of the ground water analyses are summarized in Table 5. The analytical results were compared to the *Water Quality Standards for Ground Waters of Washington State* (WAC 173-200; Surface Water Criteria [SWC]), and the *State Maximum Contaminant Levels* (MCLs) for drinking water. The analytical testing indicates the following:

- For the total metals arsenic, chromium, iron, and manganese, ground water collected from wells MW-1, MW-2, and MW-3 exceeds the SWC. Ground water from wells MW-1 and MW-2 exceeds the SWC for total lead.

- Ground water collected from wells MW-1, MW-2, and MW-3 exceeds the MCLs for total iron and manganese. Ground water collected from well MW-3 exceeds the MCLs for total arsenic. Ground water collected from wells MW-1 and MW-2 exceeds the MCLs for total chromium and lead.

- Concentrations of dissolved metals arsenic and manganese exceed the SWC in wells MW-1, MW-2, and MW-3. The ground water collected from well MW-1 exceeds the SWC for dissolved iron.

- The ground water collected from well MW-1 exceeds the MCLs for dissolved arsenic and iron. The ground water collected from wells MW-1, MW-2, and MW-3 exceeds the MCLs for dissolved manganese.

- The ground water collected from well MW-3 exceeds the SWC and the MCLs for specific conductivity.

For comparison, the results of the ground water quality analyses were also referenced to the water quality results presented in *The Ground-Water System and Ground-Water Quality in Western Snohomish County, Washington*, USGS Water-Resources Investigations Report 96-4312. This publication presents statistics for the results of ground water quality analyses of dissolved constituents for 297 samples for common constituents (calcium, iron, manganese, etc.) and 68 samples for trace elements (arsenic, chromium, etc.). The publication provides the minimum, maximum, and median values for numerous ground water quality parameters that presents a general, widespread picture of the natural ground water quality in western Snohomish County. The statistics presented in this publication indicate the following:

- The dissolved arsenic concentrations (0.0064 to 0.021 milligrams per liter [mg/L]) in ground water at the subject site are higher than the median value (0.002 mg/L) for western Snohomish County, but well within the maximum (0.280 mg/L) and minimum (<0.001 mg/L) values exhibited elsewhere in the county.

- The dissolved iron concentrations (<0.2 to 0.47 mg/L) in ground water at the subject site are less than the median value (0.038 mg/L) for western Snohomish County in wells MW-2 and MW-3 and higher than the median value in MW-1. The concentrations in well MW-1 are well within the maximum (26 mg/L) and minimum (<0.003 mg/L) values exhibited elsewhere in the county.

- The dissolved manganese concentrations (0.064 to 0.12 mg/L) in ground water at the subject site are higher than the median value (0.038 mg/L) for western Snohomish County, but well within the maximum (0.91 mg/L) and minimum (<0.001 mg/L) values exhibited elsewhere in the county.

- The dissolved chromium and lead concentrations in ground water at the subject site are consistent with the minimum and median values for western Snohomish County.

CONCLUSIONS

Ground water beneath the site occurs at depths ranging between approximately 31 and 51 feet below existing site grades when measured in August 2009, February 2011, and April 2011. The ground water appears to flow generally to the east and discharges to the east in springs that daylight in the ravine and southeast side of the site via a spring that daylights beneath the landfill debris into an east-northeast flowing stream.

Ground water quality results of samples collected from monitoring wells MW-1 and MW-3, which are upgradient of the landfill, indicate that the natural quality of the ground water in the area does not meet the State Ground Water Quality criteria. Spring sample SP-1, collected from water that discharges directly from beneath the landfill, indicates that the landfill has little impact on the quality of the ground water with the possible exception of semivolatile organic compounds (SVOCs), which were only detected in this sample. The two SVOC compounds detected in sample SP-1 (fluorene and acenaphthene) do not have State Ground Water Quality standards. However, the concentrations of these compounds observed in Sample SP-1 (fluorene = 0.68 parts per billion [ppb] and acenaphthene = 1.3 ppb) are well below the Environmental Protection Agency (EPA) Human Health Water Quality criteria of 1,100 ppb for fluorene and 670 ppb for acenaphthene.

Surface water samples were collected from the spring that emanates from the base of the landfill on the east side and from a stream that runs parallel to the south side of the property. These samples did not exceed any of the State Surface Water Quality criteria.

The proposed development plan includes the construction of a soil cap over the existing landfill to inhibit the downward migration of precipitation into the landfill debris. The cap will also prevent direct contact with the landfill debris by neighborhood residents. The proposed project will also utilize the public water supply and not rely upon ground water beneath the site for domestic or irrigation use. In our opinion, the proposed development will have a positive impact on the site by preventing surface water infiltration through the landfill debris and by isolating the landfill debris from direct contact and erosion by wind and water.

We appreciate the opportunity to be of service to you on this project. Should you have any questions regarding this letter-report or other geotechnical or hydrogeologic aspects of the site, please call us at your earliest convenience.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

State of Washington
Hydrogeologist
1079
Licensed Geologist
David J. Baumgarten
10/27/11

State of Washington
Engineering Geologist
704
Licensed Geologist
Jon N. Sondergaard
10/27/11

David J. Baumgarten, L.G., L.Hg.
Senior Hydrogeologist

Jon N. Sondergaard, L.G., L.E.G.
Principal Engineering Geologist

Attachments:

Table 1: Summary of Water Rights
Table 2: Ground Water Elevation Data
Table 3: Surface Water Quality: Previous Collected Samples
Table 4: Surface Water Quality Results: Current Samples
Table 5: Ground Water Quality Results

Figure 1: Site Plan
Figure 2: Ground Water Flow Map
Figure 3: Pre-Filling Ravine Location
Figure 4: HWA Exploration Locations
Figure 5: Geologic Cross Sections

Attachment A: Exploration Logs AESI/HWA
Attachment B: Previous Surface Water Quality Data
Attachment C: Surface Water and Ground Water Analytical Data

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APPENDIX B

Table 2: Go East Landfill: Ground Water Elevation Data

	MW-1	MW-2	MW-3	MW-4	Spring
Top of Casing Elevation (ft)	261.43	234.53	244.10	209.22	--
Top of Screen Elevation (ft)	196.43	184.53	194.10	189.22	--
Bottom of Screen Elevation (ft)	186.43	174.53	184.10	179.22	--
Depth to Ground Water					
8-19-2009	51.15	51.14	30.95	dry	--
2-21-2011	50.60	50.35	39.31	dry	--
4-15-2011	50.36	50.13	38.91	dry	--
Ground Water Elevation					
8-19-2009	210.28	183.39	213.15	--	110.5
2-21-2011	210.83	184.18	204.79	--	
4-15-2011	211.07	184.40	205.19	--	

Table 3 Summary of Previously Collected Water Quality Data: Leachate Spring/Surface Water

Results presented as a range of measured parameters

Sampling Agency/Event	pH	Specific Concuctance (umhos/cm)	Iron (mg/l)	Manganese (mg/l)	Zinc (mg/l)	Chloride (mg/l)	Sulfate (mg/l)	Nitrate (mg/l)	Nitrite (mg/l)	Ammonia Nitrogen (mg/l)	Total organic carbon (mg/l)	Tanins and Lignins (mg/l)	Phosphate (mg.l)	Chemical Oxygen Demand (mg/l)	Sodium (mg/l)	Fluoride (mg/l)	Potassium (mg/l)	Calcium (mg/l)
Ecology Sampling 1981 to 1986																		
"Leachate Spring"	6.5 - 8.3	510 - 979	0.12 - 24[1]	2.0 - 2.8	0.01 - 0.04	23 - 220	85 - 180	0.05 - 0.75	0.05 - 0.25	2.8 - 7.2	13-31	4.1 - 14	NT[3]	NT	NT	NT	NT	NT
Stream No. 3 Samples	6.5 - 7.8	116 - 199	0.02 - 2.1[1]	0.02 - 0.25	0.01 - 0.08	1 - 64	6 - 23	2.6 - 4.2	0.01 - 0.05	0.01 - 0.48	3 - 5	0.41 - 1.0	NT	NT	NT	NT	NT	NT
Snohomish County Sampling 1989 to 1996																		
"Leachate Spring"	6.6 -7.8	200 - 949	<0.01 - 6.5[2]	1.5 - 1.63[2]	<0.002 - 0.013[2]	14 - 20	<4.0 - 34.9	<0.01 - 0.206	<0.01 - 0.036	0.07 - 4.1	34.9 - 65.3	2.9 - 3.2	<0.1 - 0.193	59 - 80.4	33	<0.05	NT	NT
Stream No. 3 Samples	7.6 - 8.0	160 - 450	0.05 - 0.81[2]	0.005 - 0.40[2]	<0.002 - 0.90[2]	3.8 - 5.7	<4.0 - 16.6	2.0 - 2.5	0.002 - 0.01	0.07 - 0.32	3.9 - 12	0.4 - 0.7	0.107 - 0.117	5.8 - 33.9	6.0 - 14.7	<0.5	NT	NT
Robert Bober Single Event (September 1997)																		
Ground Water Seepage Samples (three sampling stations)	7.6 - 7.7	174 - 212	0.198[1]	<0.005[1]	<0.02[1]	4.67 - 6.48	7.30 - 9.57	2.42 - 3.37	<0.05	<0.10	1.05 - 1.78	<0.250	<0.10	<10	6.53 - 7.28	NS	2.05 - 2.39	10.3 - 15.0
HWA GeoSciences Single Event (May 2002)[5]																		
Surface Water Sample	NT	NT	21	1.5	NT	8.95	1.83	<0.200	NT	NT	29.8	NT	NT	NT	NT	NT	NT	NT
Snohomish County Sampling Single Event March 2004[6]																		
Seepage Sample	NT	NT	NT	NT	0.01	NT	5	1.72	NT	NT	9.93	NT	NT	NT	NT	NT	NT	NT
Surface Water Sample	NT	NT	NT	NT	ND[4]	NT	ND	ND	NT	NT	3.63	NT	NT	NT	NT	NT	NT	NT

Notes

(1) Total Metals

(2) Dissolved Metals

(3) Not Tested

(4) Non Detect

(5) HWA sample also analyzed for total dissolved solids, total suspended solids, total coliform, fecal coliform, TPH-G/BETX, TPH-Diesel, Total metals (priority pollutant metals), volatile organic compounds (VOCs), semi-volatile organic compounds SVOCs, Pesticides, and PCBs. Non-detect was reported for TPH-G/BETX and TPH-Diesel. Priority Pollutant Metals were all Non-Detect except for lead which was 0.002 mg/l. VOCs were all Non-Detect, SVOCs were Non-Detect except for acenaphthene which was 0.0011 mg/l, fluorene which was 0.00072 mg/l, flouranthene which was 0.00015 mg/l, benzo(a) anthracene which was 0.00001 mg/l, and chyrsene which was 0.00001 mg/l. Pesticides were all Non-Detect. PCBs were all Nor
Fecal coliforms were detected at 11 MPN/100 mg/l, and Total coliforms were detected at 4.0 MPN/mg/l.

(6) Snohomish County 2004 samples were also analyzed for proirity pollutant metals and carcinogenic polyaromatic hydrocarbons (PAHs). PAHs were not detected. Arsenic was detected at a concentration of 0.003mg/l in the seepage sample and 0.
in the surface water sample. Chromium was detected at 0.002 mg/l in the seepage sample. Lead was detected at 0.001 in the seepage sample. Nickel was detected at 0.004 mg/l in the seepage sample and 0.002 mg/l in the surface water sample.

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Table 4. Surface Water Quality Results
Go East Landfill

Total Metals (mg/L)(1)

Sample No.	Date	Arsenic	Barium	Cadmium	Chromium	Lead	Selenium	Silver	Mercury	Iron	Manganese
SP-1	8/26/2009	<0.002	0.42	<0.002	0.0057	<0.002	<0.002	<0.002	<0.0002	110	1.4
SP-2	8/26/2009	<0.002	0.017	<0.002	0.0034	<0.002	<0.002	<0.002	<0.0002	0.43	0.026
SWQ(3)		0.36		0.166(5)	0.015(5)	0.276(5)	0.02	2.3(5)	0.0021		

Sample No.	Date	Chloride (mg/L)	Sulfate (mg/L)	pH	Spec. Cond. umhos/cm	SVOC (ug/L)(2)	
						Fluorene	Acenaphthene
SP-1	8/26/2009	5.8	<1.2	6.49	580	0.68	1.3
SP-2	8/26/2009	6.1	9.6	7.96	280	<0.31	<0.52
SWQ		860					

Note:
1) mg/L = milligrams per liter
2) ug/L = micrograms per liter
3) SWQ = State Surface Water Quality Criteria per WAC 173-201A
4) **Bold** = Exceeds SWC
5) SWQ at hardness = 100

APPENDIX B

KE090231A

Table 5. Ground Water Quality Results
Go East Landfill

Groundwater

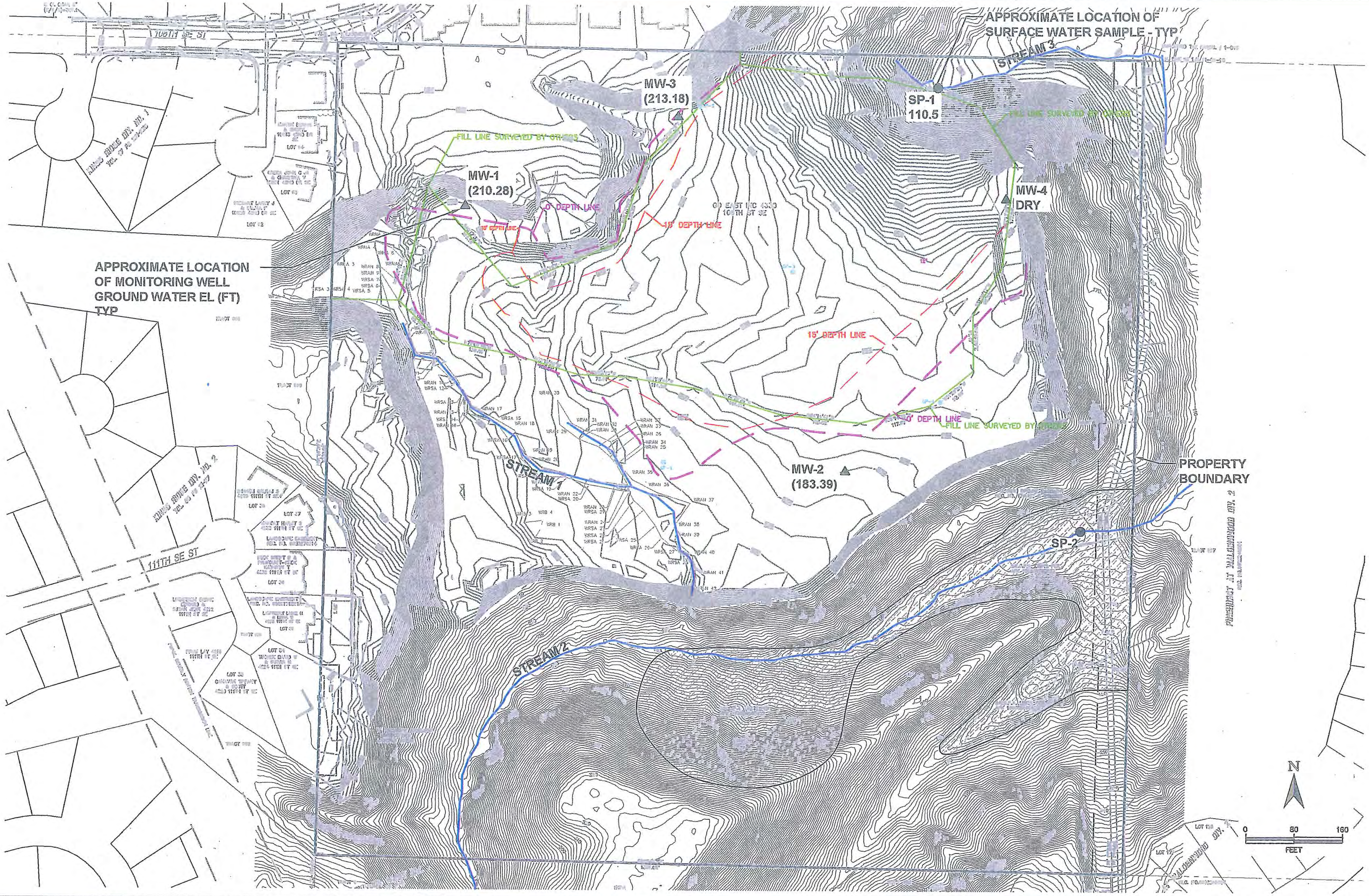
Metals (mg/L)[1]

		Arsenic		Barium	Cadmium	Chromium		Lead		Selenium	Silver	Mercury	Iron		Manganese	
Well No.	**Date**	Total	Dissolved	Total	Total	Total	Dissolved	Total	Dissolved	Total	Total	Total	Total	Dissolved	Total	Dissolved
MW-1	8/19/2009	**0.045**	**0.021**	0.62	<0.002	**0.23**	<0.002	**0.058**	<0.002	0.003	<0.002	<0.0002	**120**	**0.47**	**3.2**	**0.073**
MW-2	8/19/2009	**0.076**	**0.0096**	0.99	<0.002	**0.6**	<0.002	**0.084**	<0.002	0.0055	<0.002	0.00062	**240**	<0.2	**5.9**	**0.12**
MW-3	8/19/2009	**0.0082**	**0.0064**	0.13	<0.002	**0.054**	<0.002	0.0075	<0.002	<0.002	<0.002	0.00025	**22**	<0.2	**0.51**	**0.064**
SWC[2]		0.00005		1	0.005	0.05		0.05		0.01	0.05	0.002	0.3		0.005	
MCL		0.01		2	0.005	0.1				0.05	0.1	0.002	0.3		0.05	

Well No.	**Date**	Chloride (mg/L)	Sulfate (mg/L)	pH	Spec. Cond. umhos/cm	SVOC (ug/L)[2]
MW-1	8/19/2009	61	27	8.47	470	ND
MW-2	8/19/2009	78	24	8.24	630	ND
MW-3	8/19/2009	170	31	8.25	**780**	ND
SWC		250	250	6.5-8.5	700	
MCL		250	250		700	

Note: 1) mg/L = milligrams per liter
2) ug/L = micrograms per liter
3) SWC = State Groundwater Quality Criteria per WAC 173-200
4) **Bold** = Exceeds SWC
5) MCL = State Drinking Water Standard

APPENDIX B



REFERENCE: PACE

Associated Earth Sciences, Inc.

SITE PLAN

GO EAST LANDFILL

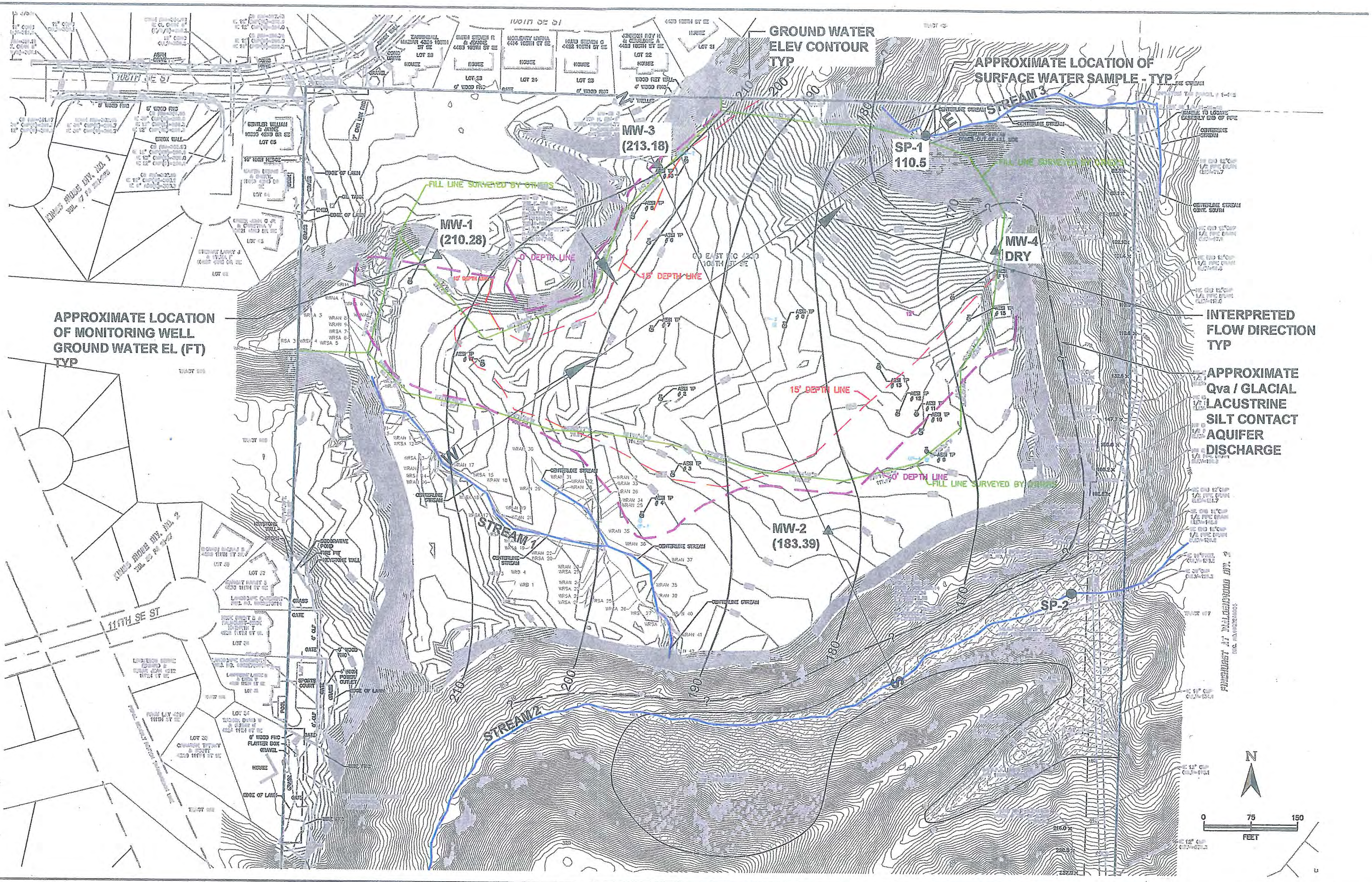
SNOHOMISH COUNTY, WASHINGTON

FIGURE 1

DATE 5/11

PROJECT NO. KE090231A

APPENDIX B



REFERENCE: PACE

Associated Earth Sciences, Inc.

GROUND WATER FLOW MAP
GO EAST LANDFILL
SNOHOMISH COUNTY, WASHINGTON

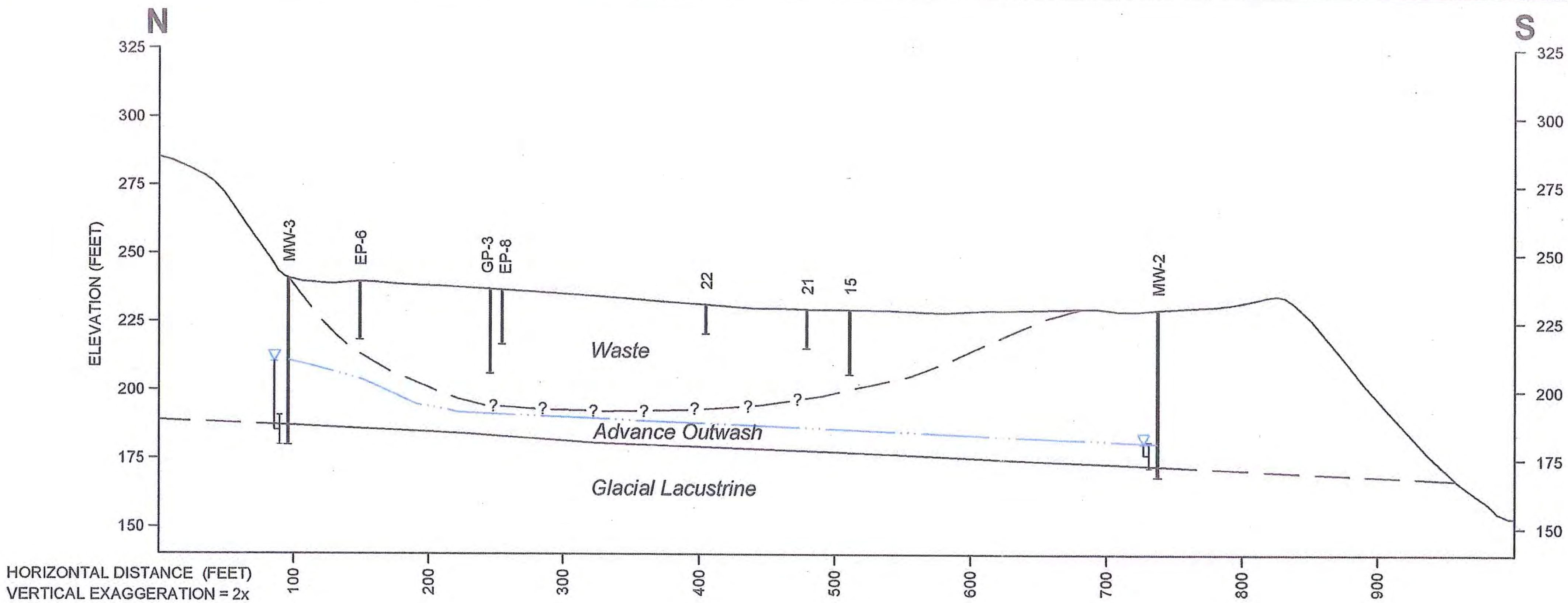
FIGURE 2

DATE 5/11

PROJECT NO. KE090231A

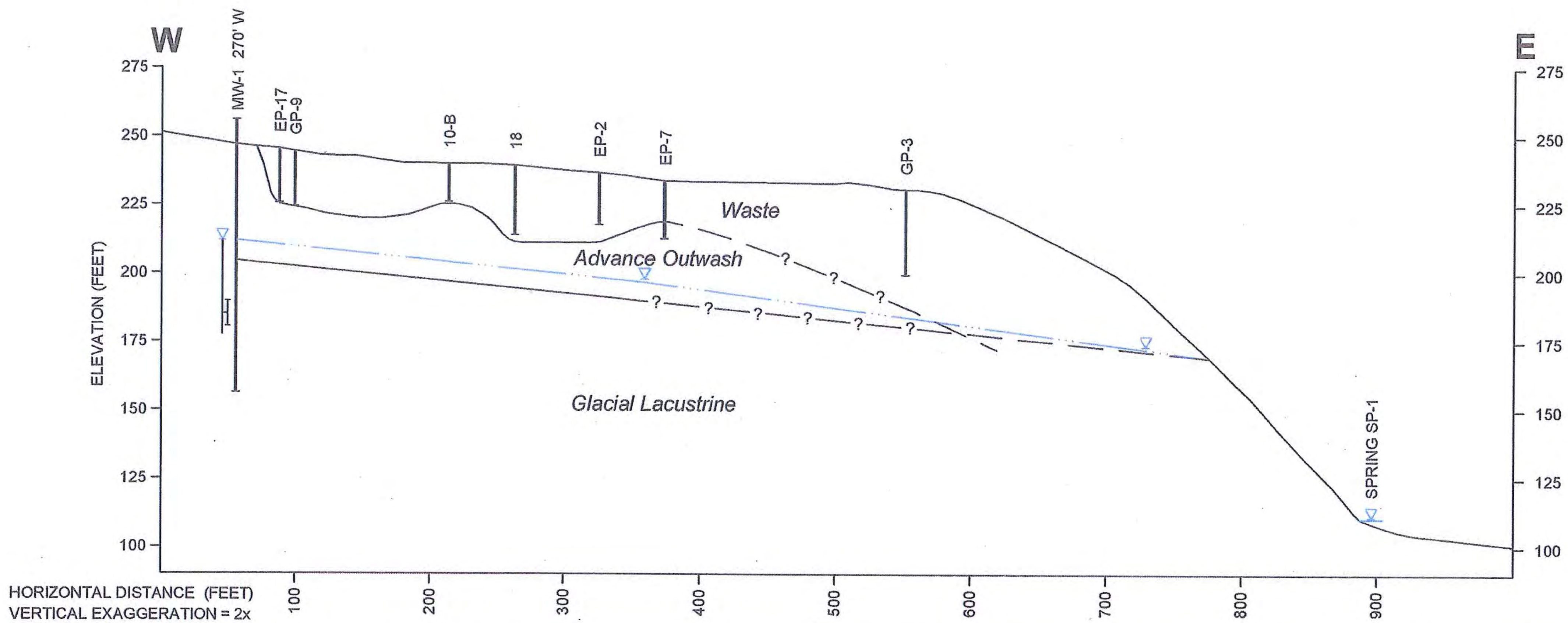
APPENDIX B

090231 Go East Landfill Development \090231 GW Flow Map 5-11.dwg LAYOUT: AESI 1



LEGEND:

GP	GAS PROBE BY AESI
MW	MONITORING WELL BY AESI
EP	EXPLORATION PIT BY AESI
18	EXPLORATION PIT BY HWA
▽	WATER LEVEL - DATE PROVIDED IN LOG
ǀ I	MONITOR WELL SCREEN ZONE
?	GEOLOGIC CONTACT - '?' INDICATES APPROXIMATE



090231 Go East Landfill Development \ 090231 Geo Sects 12-11.dwg LAYOUT: Sections

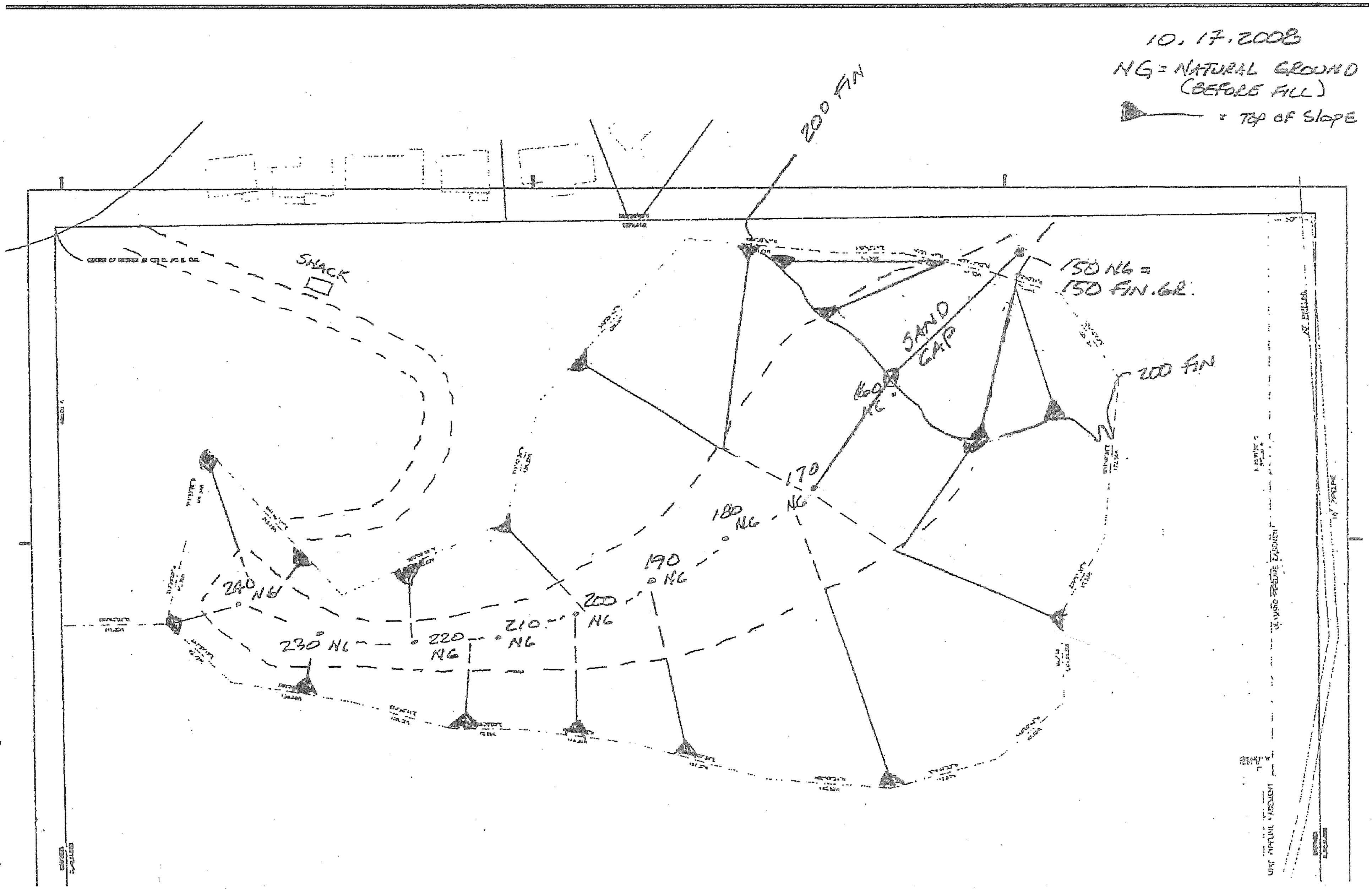
Associated Earth Sciences, Inc.

GEOLOGIC CROSS-SECTIONS

GO EAST LANDFILL
SNOHOMISH COUNTY, WASHINGTON

FIGURE 5
DATE 12/11
PROJECT NO. KE090231A

APPENDIX B



REFERENCE: HWA GEOSCIENCES, INC.

Associated Earth Sciences, Inc.

PRE-FILLING RAVINE LOCATION

GO EAST LANDFILL DEVELOPMENT
SNOHOMISH COUNTY, WASHINGTON

FIGURE 3
DATE 5/11
PROJ. NO. KE090231A

090231 Go East Landfill Development \ 090231 HWA Figures 4-11.cdr PAGE 2

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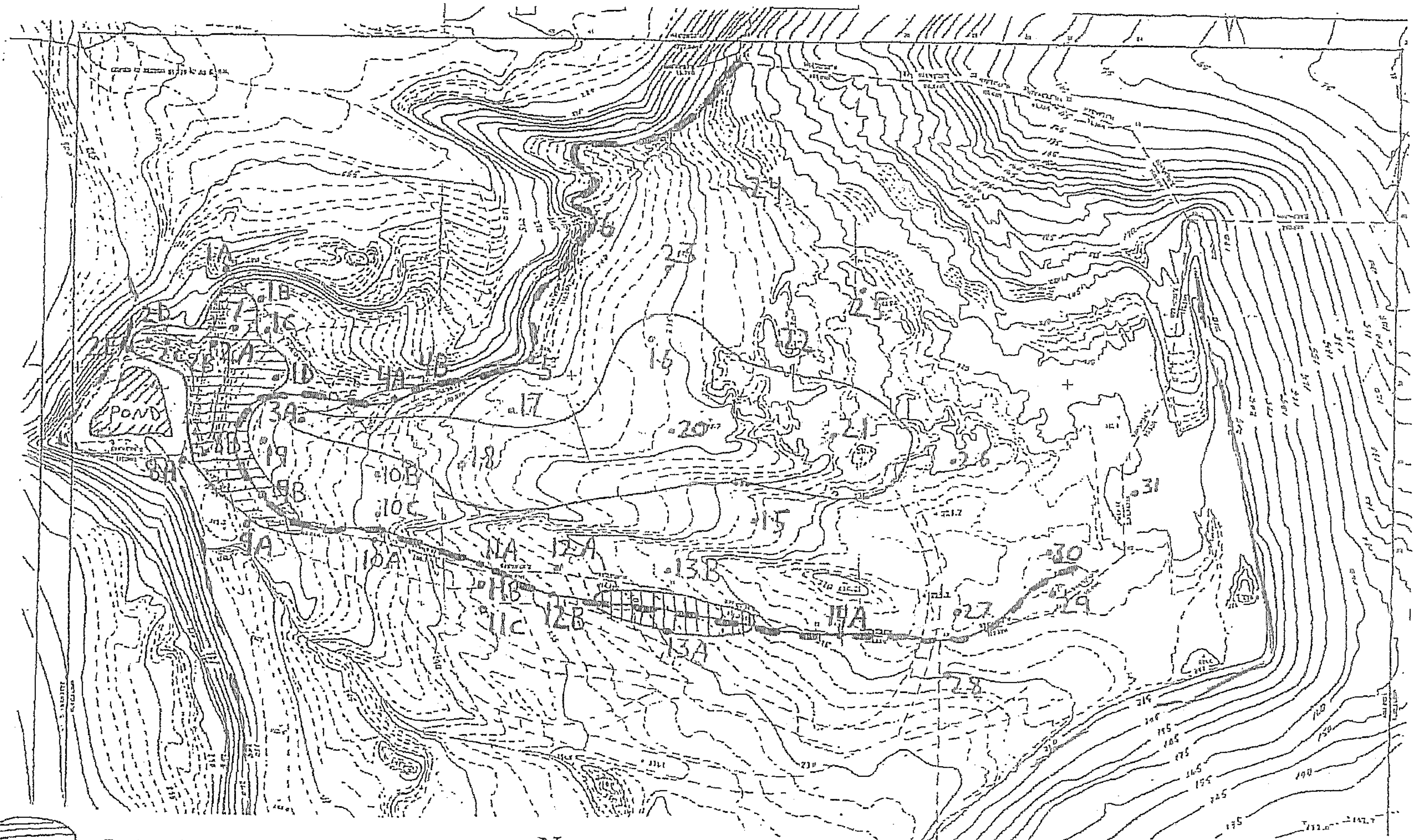

Earthen Fill

Demolition Waste

Demolition Waste with Occasional tires, plastic, etc.

Waste including tires, plastic, etc.

N

REFERENCE: HWA GEOSCIENCES, INC.

Associated Earth Sciences, Inc.

HWA EXPLORATION LOCATIONS

GO EAST LANDFILL DEVELOPMENT

SNOHOMISH COUNTY, WASHINGTON

FIGURE 4

DATE 5/11

PROJ. NO. KE090231A

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APPENDIX B

ATTACHMENT A

Exploration Logs AESI/HWA

Major Divisions		Fines	Symbol	Description
Coarse-Grained Soils - More than 50%[1] Retained on No. 200 Sieve	Gravels - More than 50%[1] of Coarse Fraction Retained on No. 4 Sieve	≤5% Fines[5]	GW	Well-graded gravel and gravel with sand, little to no fines
			GP	Poorly-graded gravel and gravel with sand, little to no fines
		≥15% Fines[5]	GM	Silty gravel and silty gravel with sand
			GC	Clayey gravel and clayey gravel with sand
	Sands - 50%[1] or More of Coarse Fraction Passes No. 4 Sieve	≤5% Fines[5]	SW	Well-graded sand and sand with gravel, little to no fines
			SP	Poorly-graded sand and sand with gravel, little to no fines
		≥15% Fines[5]	SM	Silty sand and silty sand with gravel
			SC	Clayey sand and clayey sand with gravel
Fine-Grained Soils - 50%[1] or More Passes No. 200 Sieve	Silts and Clays Liquid Limit Less than 50		ML	Silt, sandy silt, gravelly silt, silt with sand or gravel
			CL	Clay of low to medium plasticity; silty, sandy, or gravelly clay, lean clay
			OL	Organic clay or silt of low plasticity
	Silts and Clays Liquid Limit 50 or More		MH	Elastic silt, clayey silt, silt with micaceous or diatomaceous fine sand or silt
			CH	Clay of high plasticity, sandy or gravelly clay, fat clay with sand or gravel
			OH	Organic clay or silt of medium to high plasticity
Highly Organic Soils			PT	Peat, muck and other highly organic soils

Terms Describing Relative Density and Consistency

	Density	SPT[2] blows/foot
Coarse-Grained Soils	Very Loose	0 to 4
	Loose	4 to 10
	Medium Dense	10 to 30
	Dense	30 to 50
	Very Dense	>50

	Consistency	SPT[2] blows/foot
Fine-Grained Soils	Very Soft	0 to 2
	Soft	2 to 4
	Medium Stiff	4 to 8
	Stiff	8 to 15
	Very Stiff	15 to 30
	Hard	>30

Test Symbols

G = Grain Size
M = Moisture Content
A = Atterberg Limits
C = Chemical
DD = Dry Density
K = Permeability

Component Definitions

Descriptive Term	Size Range and Sieve Number
Boulders	Larger than 12"
Cobbles	3" to 12"
Gravel	3" to No. 4 (4.75 mm)
Coarse Gravel	3" to 3/4"
Fine Gravel	3/4" to No. 4 (4.75 mm)
Sand	No. 4 (4.75 mm) to No. 200 (0.075 mm)
Coarse Sand	No. 4 (4.75 mm) to No. 10 (2.00 mm)
Medium Sand	No. 10 (2.00 mm) to No. 40 (0.425 mm)
Fine Sand	No. 40 (0.425 mm) to No. 200 (0.075 mm)
Silt and Clay	Smaller than No. 200 (0.075 mm)

(3) Estimated Percentage

Component	Percentage by Weight
Trace	<5
Few	5 to 10
Little	15 to 25
With	- Non-primary coarse constituents: ≥ 15% - Fines content between 5% and 15%

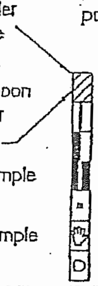
Moisture Content

Dry - Absence of moisture, dusty, dry to the touch
Slightly Moist - Perceptible moisture
Moist - Damp but no visible water
Very Moist - Water visible but not free draining
Wet - Visible free water, usually from below water table

Symbols

Sampler Type

Blows/6" or portion of 6"

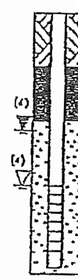


2.0" OD Split-Spoon Sampler (SPT)

Bulk sample

Grab Sample

Sampler Type Description
3.0" OD Split-Spoon Sampler
3.25" OD Split-Spoon Ring Sampler
3.0" OD Thin-Wall Tube Sampler (including Shelby tube)
Portion not recovered



Cement grout surface seal
Bentonite seal
Filter pack with blank casing section
Screened casing or Hydrotip with filler pack
End cap

(1) Percentage by dry weight
(2) (SPT) Standard Penetration Test (ASTM D-1586)
(3) In General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)
(4) Depth of ground water
ATD = At time of drilling
Static water level (date)
(5) Combined USCS symbols used for fines between 5% and 15%

Classifications of soils in this report are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D-2487 and D-2488 were used as an identification guide for the Unified Soil Classification System.

Associated Earth Sciences, Inc.

EXPLORATION LOG KEY

APPENDIX B

LOG OF EXPLORATION PIT NO. EP-1

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. DESCRIPTION
	Fill
1	Loose, moist, brownish gray, silty SAND, with gravel, roots, woody debris, plastic, brick.
2	
3	
4	Loose, moist, bluish gray, silty fine to medium SAND, with organics and woody debris, and dimensional lumber.
5	
6	
7	
8	
9	
10	**Vashon Advance Outwash**
11	Loose to medium dense, moist to wet, rust-stained brown to brownish gray, silty fine to medium SAND, with trace organics.
12	
13	
14	Bottom of exploration pit at 13 feet. Slight seepage at 11'. Caving from 7' to 12'.
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	

Go East Landfill Development
Snohomish County, WA

Associated Earth Sciences, Inc.

Logged by: JPL

Approved by:

Project No. KE090231A

8/5/09

APPENDIX B

LOG OF EXPLORATION PIT NO. EP-2

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. DESCRIPTION
	Fill
1	Loose, moist, brownish gray, silty SAND, with gravel, woody debris, plastic, and oxide fragment glass brick.
2	
3	
4	Loose, moist, dark brown to brown, silty SAND, with organic, woody debris, wire, burned wood fragments, brick, metal fragments and pipe, cloth (some wood with creosote odor), concrete, carpet.
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	Bottom of exploration pit at 19 feet. No seepage or caving.
21	
22	
23	
24	
25	

Go East Landfill Development
Snohomish County, WA

Associated Earth Sciences, Inc.

Logged by: JPL
Approved by:

Project No. KE090231A
8/5/09

KCTP3 090231A.GPJ September 10, 2009

LOG OF EXPLORATION PIT NO. EP-3

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

Depth (ft)	DESCRIPTION
	Fill
1	Loose, moist, brownish gray, silty SAND, with gravel, concrete, wire, and woody debris.
2	
3	Loose, moist, dark brown to brown, silty SAND, with organics and assorted debris (woody, metal, plastic, concrete, tire, railroad tie (dimensional wood), fabric, brick.
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	**Vashon Advance Outwash (Qva)**
17	Medium dense, moist to wet, rust-stained brownish gray, fine to medium SAND, with silty zones and trace gravel.
18	Bottom of exploration pit at 16.5 feet. Slight seepage at 5' in south extension. No caving. 15-foot depth stake located adjacent to north end of exploration pit. Contact between fill and Qva slopes upward (approximately 2H:1V [Horizontal:Vertical]) toward the south.
19	
20	

Go East Landfill Development
Snohomish County, WA

Associated Earth Sciences, Inc.

Project No. KE090231A

8/5/09

Logged by: JPL

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LOG OF EXPLORATION PIT NO. EP-4

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. DESCRIPTION
	Fill
1	Loose, moist, brownish gray, silty SAND, with gravel, roots, and a brick fragment.
2	
3	**Vashon Advance Outwash (Qva)**
4	Medium dense to dense, moist, slightly rust-stained brownish gray, fine to medium SAND, with trace gravel.
5	
6	
7	
8	Bottom of exploration pit at 7 feet. Seepage at 5'. Caving 2' to 7'.
9	
10	
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KCTP3 090231A.GPJ September 10, 2009

Go East Landfill Development
Snohomish County, WA

Associated Earth Sciences, Inc.

Project No. KE090231A

8/5/09

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APPENDIX B

LOG OF EXPLORATION PIT NO. EP-5

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

Depth (ft)	DESCRIPTION
	Fill
1	Loose, moist, dark brown to brownish gray, silty SAND, with roots, gravel, organics, concrete, woody debris, and brick fragments.
2	
3	**Vashon Advance Outwash (Qva)**
4	Medium dense, moist, reddish brown to brownish gray, fine to medium SAND, with roots and trace gravel.
5	
6	
7	
8	
9	Bottom of exploration pit at 8 feet. No seepage or caving. Base of slope located at west end of exploration pit. Contact between fill and Qva slopes downward (approximately 2 1/2H:1V) toward the east.
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Go East Landfill Development
Snohomish County, WA

Associated Earth Sciences, Inc.

Project No. KE090231A

8/5/09

Logged by: JPL

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LOG OF EXPLORATION PIT NO. EP-6

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. DESCRIPTION
	Fill
1	Brown, silty SAND, with gravel, roots, and assorted debris (wood, metal, glass, plastic, fabric, brick, tire, stumps), more "general refuse" - not as much woody debris percentage as other pits.
2	
3	
4	
5	
6	
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9	
10	
11	
12	
13	Dense, moist, slightly rust-stained bluish gray, silty fine to medium SAND, with gravel, asphalt, and plastic pipe (bricks and woody debris below 18').
14	
15	
16	
17	
18	
19	
20	
21	
22	Bottom of exploration pit at 21 feet. No seepage. Caving 3' to 10'.
23	
24	
25	

Go East Landfill Development
Snohomish County, WA

Associated Earth Sciences, Inc.

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Project No. KE090231A

8/5/09

LOG OF EXPLORATION PIT NO. EP-7

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. DESCRIPTION
	Fill
1	Loose, moist, dark brown to brown, silty SAND, with gravel, organics, and associated debris (woody debris, dimensional lumber, brick, glass, plastic, stumps, burned wood,, asphalt, concrete, metal, burn ash [orange and white], carpet.
2	
3	
4	
5	
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8	
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10	
11	
12	
13	
14	**Vashon Advance Outwash (Qva)**
15	Medium dense to dense, moist, rust-stained brownish gray, fine to medium SAND, with lenses of bluish gray to gray, SILT (lenses between 14" and 15").
16	
17	
18	
19	
20	
21	Bottom of exploration pit at 20 feet. No seepage or caving.
22	
23	
24	
25	

Go East Landfill Development
Snohomish County, WA

Associated Earth Sciences, Inc.

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Project No. KE090231A

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LOG OF EXPLORATION PIT NO. EP-8

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. **DESCRIPTION**
	Fill
1	Dark brown to brown, silty SAND, with gravel, organics and assorted debris (woody debris, metal, concrete, asphalt, plastic, burned wood, brownish ash, wire, brick, stumps, dimensional lumber, cinder blocks).
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	Bottom of exploration pit at 19 feet. No seepage. Cave below 15'.
21	
22	
23	
24	
25	

Go East Landfill Development
Snohomish County, WA

Associated Earth Sciences, Inc.

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Project No. KE090231A
8/5/09

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APPENDIX B

LOG OF EXPLORATION PIT NO. EP-9

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. DESCRIPTION
	Vashon Advance Outwash (Qva)
1	Hard, moist, bluish gray, bedded SILT.
2	
3	Dense, moist, brownish gray, fine to medium SAND.
4	
5	
6	Bottom of exploration pit at 5.5 feet.
7	No seepage or caving.
8	
9	
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24	
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Go East Landfill Development
Snohomish County, WA

Associated Earth Sciences, Inc.

Logged by: JPL
Approved by:

Project No. KE090231A
8/5/09

LOG OF EXPLORATION PIT NO. EP-10

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

Depth (ft)	DESCRIPTION
	Vashon Advance Outwash (Qva)
1	Loose, moist, brownish gray, silty SAND, with gravel and roots.
2	Hard, moist, rust-stained tan to bluish gray, SILT.
3	Dense, moist, brownish gray, fine to medium SAND, with trace gravel.
4	
5	
6	Bottom of exploration pit at 5.5 feet. No seepage or caving.
7	
8	
9	
10	
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12	
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Go East Landfill Development
Snohomish County, WA

Associated Earth Sciences, Inc.

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Project No. KE090231A
8/5/09

LOG OF EXPLORATION PIT NO. EP-11

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. DESCRIPTION
	Fill
1	Loose, moist, dark brown to brown, silty SAND, with gravel, organics and assorted debris (similar).
	Vashon Advance Outwash (Qva)
2	Dense, moist, brownish gray, fine to medium SAND, slight rust staining.
3	
4	Bottom of exploration pit at 3 feet. No seepage or caving.
5	
6	
7	
8	
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10	
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Snohomish County, WA

Associated Earth Sciences, Inc.

Project No. KE090231A

8/5/09

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APPENDIX B

LOG OF EXPLORATION PIT NO. EP-12

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. DESCRIPTION
	Fill
1	Loose, moist, dark brown to brown, silty SAND, with gravel, organics, and assorted debris (similar).
2	
3	
4	
5	Loose, moist, bluish gray, silty SAND, with gravel.
6	Loose, moist, dark brown to brown, silty SAND, with gravel, organics, and assorted debris (similar).
7	
8	
9	
10	
11	**Vashon Advance Outwash (Qva)**
12	Dense, moist, brownish gray, fine to medium SAND.
13	
14	
15	
16	
17	Bottom of exploration pit at 16 feet. No seepage or caving.
18	
19	
20	
21	
22	
23	
24	
25	

Go East Landfill Development
Snohomish County, WA

Associated Earth Sciences, Inc.

Project No. KE090231A

8/5/09

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APPENDIX B

LOG OF EXPLORATION PIT NO. EP-13

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

Depth (ft)	DESCRIPTION
	Fill
1	Loose, moist, dark brown to brown, silty SAND, with gravel, organics, and assorted debris (similar).
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	Bottom of exploration pit at 17 feet. Refusal on debris. No seepage or caving.
19	
20	
21	
22	
23	
24	
25	

Go East Landfill Development
Snohomish County, WA

Associated Earth Sciences, Inc.

Project No. KE090231A

8/5/09

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KCTP3 090231A.GPJ September 10, 2009

APPENDIX B

LOG OF EXPLORATION PIT NO. EP-14

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. DESCRIPTION
	Fill
1	Loose, moist, dark brown to brown, silty SAND, with gravel, organics, and assorted debris, abundant burned woody debris.
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	Bottom of exploration pit at 18 feet. No seepage or caving. Hard digging through layers of burned wood.
20	
21	
22	
23	
24	
25	

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Snohomish County, WA

Associated Earth Sciences, Inc.

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Project No. KE090231A

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LOG OF EXPLORATION PIT NO. EP-15

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. DESCRIPTION
	Fill
1	Loose, moist, dark brown to brown, silty sAND, with gravel, organics, and assorted debris.
2	
3	
4	
5	
6	
7	
8	
9	**Vashon Advance Outwash**
10	Dense, moist, slightly rust-stained brownish gray, fine to medium SAND.
11	
12	
13	Bottom of exploration pit at 12.5 feet. No seepage or caving.
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	

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Snohomish County, WA

Associated Earth Sciences, Inc.

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Project No. KE090231A
8/5/09

LOG OF EXPLORATION PIT NO. EP-16

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

Depth (ft)	DESCRIPTION
	Fill
1	Loose, moist, brownish gray, silty SAND, with gravel, trace organics and woody debris.
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	Loose, moist, bluish gray, silty SAND, with gravel, woody debris, asphalt.
13	
14	
15	
16	
17	
18	**Vashon Advance Outwash (Qva)**
19	Medium dense to dense, moist, bluish gray to brownish gray (slightly rust-stained) fine to medium SAND.
20	
21	Bottom of exploration pit at 20 feet. No seepage or caving. Much less debris than other pits. More like typical fill with some debris.
22	
23	
24	
25	

Go East Landfill Development
Snohomish County, WA

Associated Earth Sciences, Inc.

Project No. KE090231A

8/5/09

Logged by: JPL

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KCTP3 090231A.GPJ September 10, 2009

APPENDIX B

LOG OF EXPLORATION PIT NO. EP-17

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. **DESCRIPTION**
	Fill
1	Loose, moist, dark brown to brown, silty SAND, with gravel, organics, and assorted debris, abundant glass shards.
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	Bottom of exploration pit at 19.5 feet. No seepage or caving.
21	
22	
23	
24	
25	

Go East Landfill Development
Snohomish County, WA

Associated Earth Sciences, Inc.

Logged by: JPL
Approved by:

Project No. KE090231A
8/5/09

Associated Earth Sciences, Inc.

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
KE090231A	MW-1	1 of 3

Project Name: Go East Landfill
Elevation (Top of Well Casing): ~262'
Water Level Elevation: ~211'
Drilling/Equipment: Cascade CME 75
Hammer Weight/Drop: 140# / 30"

Location: Snohomish County, WA
Surface Elevation (ft): ~259'
Date Start/Finish: 8/11/09 8/12/09
Hole Diameter (in): 6 1/4" I.D.

Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
		Well monument (aboveground) Concrete				Vashon Advance Outwash
5		Bentonite chips		8 12 28		Moist, slightly rust-stained brownish gray, fine to medium SAND, with trace gravel.
10				14 28 40		Moist, brownish gray, fine to medium SAND, with silty zones and coarse sand beds.
15				10 15 25		Wet, slightly rust-stained brownish gray, fine to medium SAND, with trace gravel.
20		Bentonite grout		8 18 21		Moist, bluish gray, SILT.
25				50/6"		Moist, brownish gray, fine to medium SAND.
30				25 50/5"		Moist, slightly rust-stained brownish gray, fine to medium SAND, with a silt lens containing trace charcoal.
35				18 33 34		Moist, brownish gray, fine to medium SAND, with siltier zones.

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture
Water Level (8/19/09)
Water Level at time of drilling (ATD)

Logged by: JPL
Approved by:

APPENDIX B

Associated Earth Sciences, Inc.

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
KE090231A	MW-1	1 of 3

Project Name: Go East Landfill
Elevation (Top of Well Casing): ~262'
Water Level Elevation: ~211'
Drilling/Equipment: Cascade CME 75
Hammer Weight/Drop: 140# / 30"

Location: Snohomish County, WA
Surface Elevation (ft): ~259'
Date Start/Finish: 8/11/09 8/12/09
Hole Diameter (in): 6 1/4" I.D.

Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
		Well monument (aboveground) Concrete				**Vashon Advance Outwash**
5		Bentonite chips		8 12 28		Moist, slightly rust-stained brownish gray, fine to medium SAND, with trace gravel.
10				14 28 40		Moist, brownish gray, fine to medium SAND, with silty zones and coarse sand beds.
15				10 15 25		Wet, slightly rust-stained brownish gray, fine to medium SAND, with trace gravel.
20		Bentonite grout		8 18 21		Moist, bluish gray, SILT.
25				50/6"		Moist, brownish gray, fine to medium SAND.
30				25 50/5"		Moist, slightly rust-stained brownish gray, fine to medium SAND, with a silt lens containing trace charcoal.
35				18 33 34		Moist, brownish gray, fine to medium SAND, with siltier zones.

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture
Water Level (8/19/09)
Water Level at time of drilling (ATD)

Logged by: JPL
Approved by:

NWWELL 090231A.GPJ BORING.GDT 9/10/09

Associated Earth Sciences, Inc.

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
KE090231A	MW-1	2 of 3

Project Name: Go East Landfill
Elevation (Top of Well Casing): ~262'
Water Level Elevation: ~211'
Drilling/Equipment: Cascade CME 75
Hammer Weight/Drop: 140# / 30"

Location: Snohomish County, WA
Surface Elevation (ft): ~259'
Date Start/Finish: 8/11/09 8/12/09
Hole Diameter (in): 6 1/4" I.D.

Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
				36 50/5"		Moist, bluish gray, fine to medium SAND, with siltier zones.
						Driller reports significant water.
45				50/6"		Above bottom 6": Same as above (filled sampler [heave?]). Bottom 6": Moist, bluish gray, SILT, with a few light gray, very fine sand partings.
	∇					
50				24 27 41		Moist, bluish gray, silty very fine SAND interbedded with sandy SILT.
55				14 17 32		Moist, bluish gray, SILT.
60		Bentonite chips		10 23 26		Moist to wet, bluish gray, fine SAND.
		Silica sand 2/12				
65				18 28 39		Wet, same.
70		2" I.D. Schedule 40 PVC machine slotted well screen with 0.010" slots (65' to 75')		16 24 36		Wet, bluish gray, silty very fine SAND interbedded with SILT, with fine sand.
						Pre-Vashon Glacial Lacustrine
75		Threaded end cap		10 22 27		Wet, bluish gray, SILT, with very fine sand, a few very fine sand partings and beds of fine to medium sand.

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture
∇ Water Level (8/19/09)
▼ Water Level at time of drilling (ATD)

Logged by: JPL
Approved by:

APPENDIX B

Associated Earth Sciences, Inc.

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
KE090231A	MW-1	3 of 3

Project Name: Go East Landfill
Elevation (Top of Well Casing): ~262'
Water Level Elevation: ~211'
Drilling/Equipment: Cascade CME 75
Hammer Weight/Drop: 140# / 30"

Location: Snohomish County, WA
Surface Elevation (ft): ~259'
Date Start/Finish: 8/11/09 8/12/09
Hole Diameter (in): 6 1/4" I.D.

Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
				14 22 28		Moist, bluish gray, SILT, with scattered white sand-sized grains.
85				18 23 24		Moist, bluish gray, SILT, with a few very fine sand partings.
90				15 21 25		Moist, bluish gray, SILT.
95				9 17 30		Moist, bluish gray, SILT, with a few very fine sand partings and a fine sand bed.
100				12 19 26		Moist, bluish gray, SILT, with a few very fine sand partings.
						Boring terminated at 101.5 feet on 8/12/09
105						
110						
115						

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture
Water Level (8/19/09)
Water Level at time of drilling (ATD)

Logged by: JPL
Approved by:

NWWELL 090231A.GPJ BORING.GDT 9/10/09

Associated Earth Sciences, Inc.

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
KE090231A	MW-2	1 of 2

Project Name: Go East Landfill
Elevation (Top of Well Casing): ~234'
Water Level Elevation: ~183'
Drilling/Equipment: Cascade CME 75
Hammer Weight/Drop: 140# / 30"

Location: Snohomish County, WA
Surface Elevation (ft): ~232'
Date Start/Finish: 8/12/09 8/12/09
Hole Diameter (in): 6 1/4" I.D.

Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
		Well monument (aboveground) Concrete				Vashon Advance Outwash
5		Bentonite chips		10 12 14		~4" moist, rust-stained brownish gray, fine to medium SAND over moist, brownish gray to bluish gray (with depth), SILT.
10				11 11 13		Moist, brownish gray, fine SAND.
15				9 19 29		Moist, brownish gray, fine SAND interbedded with brownish gray, SILT, rust staining at contacts.
20		Bentonite grout		8 12 17		Moist to wet, brownish gray, silty fine SAND, with a medium sand bed, interbedded with brownish gray, SILT.
25				5 14 22		Moist, brownish gray, fine SAND.
30				13 21 33		Wet, same, with slight rust staining.
35				21 26 33		Wet, same with siltier zones.

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture
Water Level (8/19/09)
Water Level at time of drilling (ATD)

Logged by: JPL
Approved by:

NWWELL 090231A.GPJ BORING.GDT 9/10/09

APPENDIX B

Associated Earth Sciences, Inc.

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
KE090231A	MW-2	2 of 2

Project Name: Go East Landfill
Elevation (Top of Well Casing): ~234'
Water Level Elevation: ~183'
Drilling/Equipment: Cascade CME 75
Hammer Weight/Drop: 140# / 30"

Location: Snohomish County, WA
Surface Elevation (ft): ~232'
Date Start/Finish: 8/12/09 8/12/09
Hole Diameter (in): 6 1/4" I.D.

Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
				11 21 21		Moist to wet, brownish gray, SILT, with fine sand beds.
45		Bentonite chips		12 26 37		Moist to wet, brownish gray to bluish gray, silty very fine SAND interbedded with SILT, with fine sand.
	▽	Silica sand 2/12				
50				11 19 22		Wet, bluish gray, fine SAND, medium sand laminae with organics at 50.5'.
		2" I.D. Schedule 40 PVC machine slotted well screen with 0.010" slots (50' to 60')				
55				12 20 24		Wet, bluish gray, silty very fine SAND.
						Pre-Vashon Glacial Lacustrine
60		Threaded end cap		7 19 22		Moist, bluish gray, SILT.
						Boring terminated at 61.5 feet on 8/12/09
65						
70						
75						

48'

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture
▽ Water Level (8/19/09)
▼ Water Level at time of drilling (ATD)

Logged by: JPL
Approved by:

NWWELL 090231A.GPJ BORING.GDT 9/10/09

APPENDIX B

Associated Earth Sciences, Inc.

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
KE090231A	MW-3	1 of 2

Project Name: Go East Landfill
Elevation (Top of Well Casing): ~245'
Water Level Elevation: ~214'
Drilling/Equipment: Cascade CME 75
Hammer Weight/Drop: 140# / 30"

Location: Snohomish County, WA
Surface Elevation (ft): ~243'
Date Start/Finish: 8/13/09 8/13/09
Hole Diameter (in): 6 1/4" I.D.

Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
0		Well monument (aboveground) Concrete				**Vashon Advance Outwash**
5		Bentonite chips		2 4 6		Wet, slightly rust-stained brownish gray, fine to medium SAND.
10				6 11 13		Moist, rust-stained bluish gray, bedded SILT. Bottom 3": Moist, brownish gray, fine to medium SAND, with trace gravel.
15				10 16 21		Moist, brownish gray, fine to medium SAND, with trace gravel.
20		Bentonite grout		8 13 13		Moist, brownish gray, fine to medium SAND.
25				10 13 16		Moist, same.
~28	∇					
30				20 29 22		Wet, brownish gray, fine SAND, with siltier zones.
35				11 18 29		Top 4": Wet, rust-stained brownish gray, fine to medium SAND, with silt. Wet, bluish gray, silty very fine SAND interbedded with SILT, with fine sand.

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture
∇ Water Level (8/19/09)
▼ Water Level at time of drilling (ATD)

Logged by: JPL
Approved by:

NWWELL 090231A.GPJ BORING.GDT 9/10/09

APPENDIX B

Associated Earth Sciences, Inc.

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
KE090231A	MW-3	2 of 2

Project Name: Go East Landfill
Elevation (Top of Well Casing): ~245'
Water Level Elevation: ~214'
Drilling/Equipment: Cascade CME 75
Hammer Weight/Drop: 140# / 30"

Location: Snohomish County, WA
Surface Elevation (ft): ~243'
Date Start/Finish: 8/13/09 8/13/09
Hole Diameter (in): 6 1/4" I.D.

Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
				12 20 26		Moist, bluish gray, SILT.
45		Bentonite chips		12 21 29		Wet, bluish gray, fine SAND, with silt.
		Silica sand 2/12				
50		2" I.D. Schedule 40 PVC machine slotted well screen with 0.010" slots (50' to 60')		14 18 21		Wet, same.
55				12 24 30		Moist to wet, bluish gray, laminated SILT, with very fine sand.
						Pre-Vashon Glacial Lacustrine
60		Threaded end cap		14 24 28		Moist, bluish gray, SILT, with a few very fine sand partings and a bed of fine sand.
						Boring terminated at 61.5 feet on 8/13/09
65						
70						
75						

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture
Water Level (8/19/09)
Water Level at time of drilling (ATD)

Logged by: JPL
Approved by:

APPENDIX B

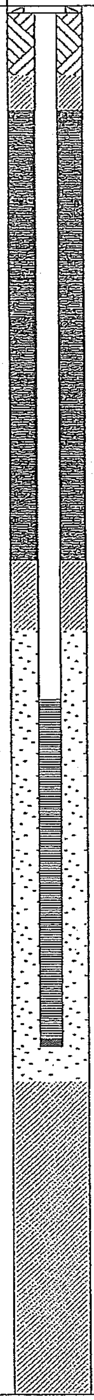
Associated Earth Sciences, Inc.

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
KE090231A	MW-4	1 of 2

Project Name: Go East Landfill
Elevation (Top of Well Casing):
Water Level Elevation: No water (8/19/09)
Drilling/Equipment: Cascade CME 75
Hammer Weight/Drop: 140# / 30"

Location: Snohomish County, WA
Surface Elevation (ft): ~206'
Date Start/Finish: 8/14/09 8/14/09
Hole Diameter (in): 6 1/4" I.D.



Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
		Locking cap				**Vashon Advance Outwash**
		Concrete				
		Bentonite chips				
5		Bentonite grout		6 8 10		Moist, grayish brown, fine SAND, little silt (SM).
10		2" I.D. Schedule 40 PVC blank		7 9 10		Moist, grayish brown, fine SAND, few silt (SP).
15				7 11 12		Becomes slightly more gray, trace silt, trace rust mottling.
		Bentonite chips				
		#2/12 silica sand				Moist to very moist, grayish tan, silty fine SAND (SM).
20				9 15 18		
		2" I.D. Schedule 40 PVC machine slotted well screen with 0.010" slots (20' to 30')				
25				6 14 19		
						Pre-Vashon Glacial Lacustrine
30		Threaded end cap		6 8 16		Wet, grayish tan, SILT (ML); non-plastic, contains dilatant zones.
35		Bentonite chips		5 9 11		Becomes blue-gray and very moist to wet.

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture
Water Level ()
Water Level at time of drilling (ATD)

Logged by: TJP
Approved by:

NWWELL 090231A.GPJ BORING.GDT 9/10/09

APPENDIX B

Associated Earth Sciences, Inc.

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
KE090231A	MW-4	2 of 2

Project Name: Go East Landfill
Elevation (Top of Well Casing):
Water Level Elevation: No water (8/19/09)
Drilling/Equipment: Cascade CME 75
Hammer Weight/Drop: 140# / 30"

Location: Snohomish County, WA
Surface Elevation (ft): ~206'
Date Start/Finish: 8/14/09 8/14/09
Hole Diameter (in): 6 1/4" I.D.

Depth (ft)	Water Level	WELL CONSTRUCTION	S T	Blows/ 6"	Graphic Symbol	DESCRIPTION
				11 13 17		
45				9 12 18		
						Boring terminated at 46.5 feet on 8/14/09
50						
55						
60						
65						
70						
75						

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture
Water Level ()
Water Level at time of drilling (ATD)

Logged by: TJP
Approved by:

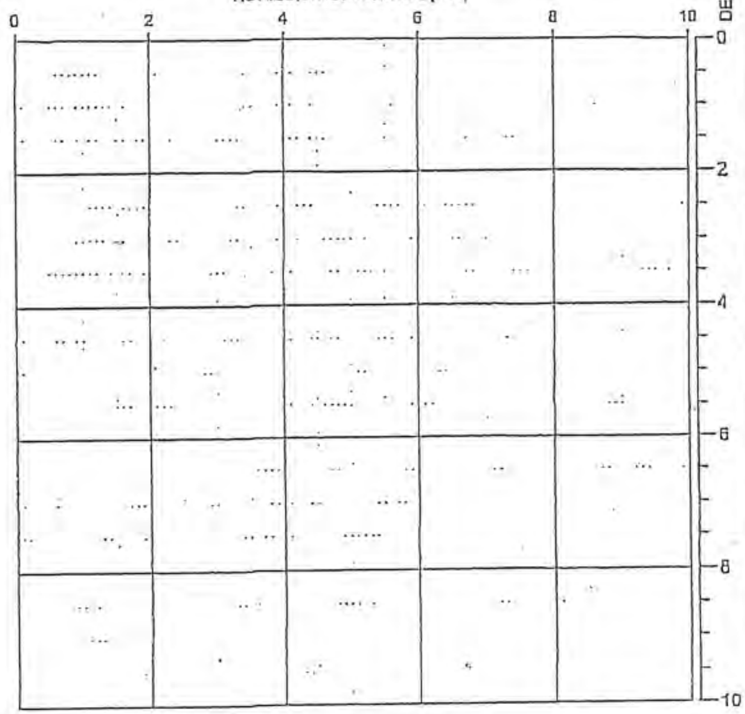
NWWELL 090231A.GPJ BORING.GDT 9/10/09

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0	SP SM	Light brown, poorly graded SAND with some silt, loose, dry. (Earthen Fill)					
	SW	Yellowish brown, well graded SAND with some gravel, medium dense, dry to moist, fine to coarse sand. (Glacial Outwash) 1" horizon of black organic soil at 3.5'					
	SP	Light gray brown poorly graded GRAVELLY SAND, dense, moist, fine sand. (Glacial Outwash)					

SKETCH OF East SIDE OF PIT



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-1-A
PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT10 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett-Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0–2		SP	Yellowish brown, poorly graded SAND, medium dense, dry (Glacial Outwash)					

DEPTH (feet): 0, 2, 4, 6, 8, 10

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 2, 4, 6, 8, 10

DEPTH (feet): 0, 2, 4, 6, 8, 10

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-1-B
PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT10 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0–2		SP	Yellowish brown, poorly graded SAND, medium dense, dry, (Glacial Outwash)					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 2, 4, 6, 8, 10

DEPTH (feet): 0, 2, 4, 6, 8, 10

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-1-C
PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT10 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Light brown, GRAVELLY SAND, medium dense, dry (Earthen Fill)					
		SP	Olive gray, poorly graded SAND, loose, moist, fine sand, intermixed bricks and dimensional timber, (Demolition waste)					
2		SP	Olive gray, poorly graded SAND, loose, moist, fine sand, intermixed tree limbs (Earthen Fill)					
6		SP	Olive gray, poorly graded SAND, moist to wet, fine to medium grained, with trace roots (Glacial Outwash)					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 2 4 6 8 10

DEPTH (feet)

0 2 4 6 8 10

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-1-D

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT10 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Gray brown, poorly graded SAND, loose, fine sand, some roots (Earthen Fill)					
		SP	Brown, poorly graded SAND, loose, fine sand (Earthen Fill)					
5		SP	Gray, poorly graded SAND, loose, fine sand, some wood and plastic (Earthen Fill)					
10								
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 5 10 15 20

DEPTH (feet)

0 5 10 15 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-2-A

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

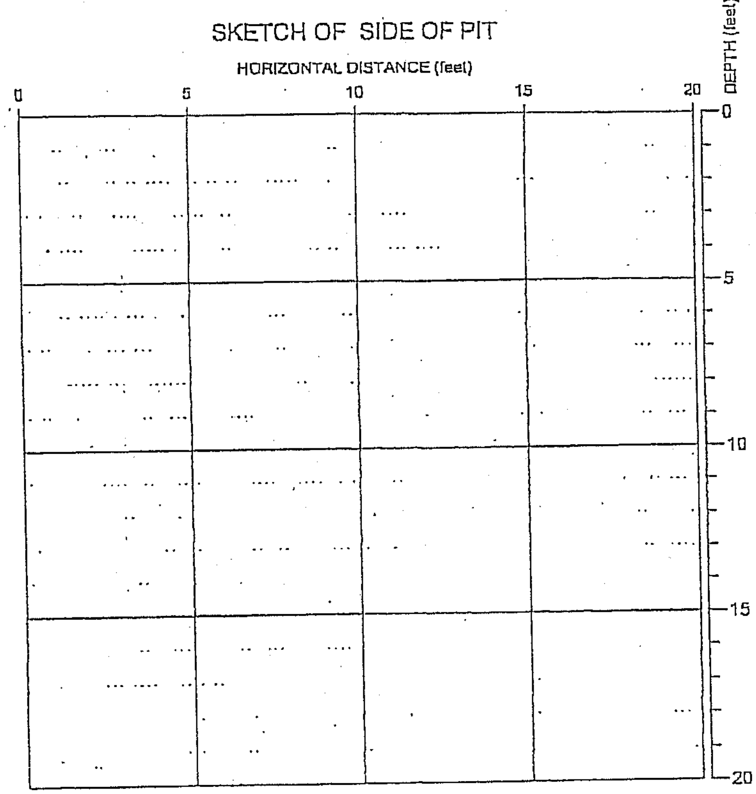
TPIT20 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, SAND with some gravel, fine sand (Earthen Fill)					
		SP SM	Gray, poorly graded SAND, with silt and gravel, moist, loose, with intermixed tree branches (Earthen Fill)					
		SP	Yellowish brown, poorly graded SAND, trace gravel, very moist, medium dense (Glacial Outwash)					



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-2-B
PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, SAND, trace plastic, bricks and tree branches (Earthen Fill)					
		SP	Gray, poorly graded SAND, loose, moist, fine sand, with intermixed tree branches (Earthen Fill)					
5								
10								
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 5 10 15 20

DEPTH (feet)

0 5 10 15 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-2-C

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TP/T20 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, poorly graded SAND, moist, fine sand, some roots (Earthen Fill)					
		SP	Gray, poorly graded SAND, moist to wet, loose, fine sand, intermixed wood and branches (Earthen Fill) Wet below 5' Strong seepage at 9'					
10		SP	Yellowish brown, SAND, wet					
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 5, 10, 15, 20

DEPTH (feet): 0, 5, 10, 15, 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-2-D

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 8/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, SAND, moist to wet, some roots (Earthen Fill - Topsoil)					
		SP	Gray, poorly graded SAND, wet, loose, fine sand, intermixed tree branches (Earthen Fill) Seepage at 3'					
4		SP	Yellowish bown, poorly graded SAND, wet, fine to medium sand (Glacial Outwash)					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 2, 4, 6, 8, 10'

DEPTH (feet): 0, 2, 4, 6, 8, 10

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-2-E

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT10 2002071.GPJ 9/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/5/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0–6			Dark brown, SILTY SAND, loose, intermixed wood, steel, bricks concrete and plastic (Demolition Waste)					
6–10		SM	Light brown, SILTY SAND, dry to moist, fine sand (Glacial Outwash)					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 5, 10, 15, 20

DEPTH (feet): 0, 5, 10, 15, 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-30

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/5/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0–6			Brown, SILTY SAND with some gravel, loose, fine sand, intermixed bricks, concrete, logs and some carpet (Demolition Waste)					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 2, 4, 6, 8, 10

DEPTH (feet): 0, 2, 4, 6, 8, 10

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-31

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT10 2002071.GPJ 8/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, poorly graded GRAVELLY SAND, medium dense, fine to medium sand (Earthen Fill)					
			Black/brown, GRAVELLY SAND with glass, aphalt and bricks, dry, loose (Demolition Waste)					
5			Gray, SAND, dry to moist, loose, fine to medium sand, intermixed wood, boulders, concrete pipe (Demolition Waste)					
10								
			Increasing amounts of plastic and concrete at 12'					
15			Becoming moist below 16'					
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 5 10 15 20

DEPTH (feet)

0 5 10 15 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-3-A

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TP/T20 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SM	Dark brown, SILTY SAND with some gravel, medium dense, fine sand (Earthen Fill)					
			Brown, SAND, dry, loose, intermixed steel pipes, plastic and concrete (Demolition Waste)					
		SP	Yellowish brown, poorly graded SAND, moist, dense, fine sand, with gray SILT laminations (Glacial Outwash)					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 5, 10, 15, 20

DEPTH (feet): 0, 5, 10, 15, 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-4-A
PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

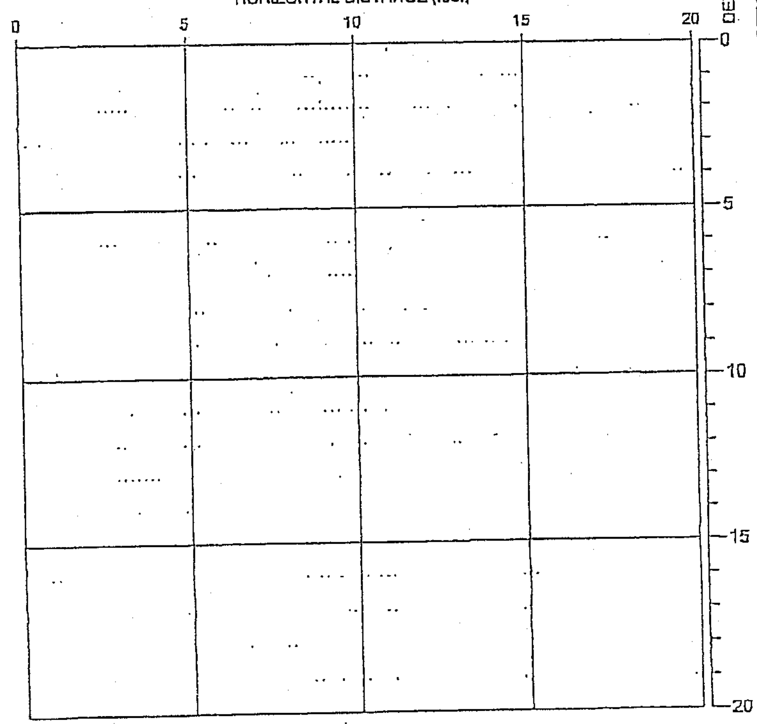
APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 5900 Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SM	Dark brown, SILTY SAND with some gravel, medium dense, fine sand (Earthen Fill)					
			Gray, SAND, dry to moist, loose, fine to medium sand, intermixed wood, steel, concrete pipe (Demolition Waste)					
		SP	Yellowish bown, poorly graded SAND, medium dense, fine to medium sand, (Glacial Outwash)					
5								
10								
15								
20								

SKETCH OF SIDE OF PIT



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-4-B

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, SAND, loose, fine sand, some roots (Earthen Fill - Topsoil)					
			Dark brown, SILTY SAND, intermixed wood and glass. (Demolition Waste)					
2		SP	Yellowish bown, poorly graded SAND, fine to medium sand, (Glacial Outwash)					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 2 4 6 8 10

DEPTH (feet)

0 2 4 6 8 10

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-5-A

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT10 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Grayish light brown, GRAVELLY SAND, loose, fine to coarse sand (Earthen Fill)					
			Dark brown/black, SAND, organic, with dimensional timber (Demolition Waste)					
4		SP	Yellowish bown, poorly graded SAND, fine to medium sand, (Glacial Outwash)					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-6

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT10 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, SAND, loose, dry to moist, medium sand (Earthen Fill)					
2.5		SP	Dark brown, SAND with some gravel, medium dense with trace wood (Earthen Fill)					
3		SP	Gray, SAND, loose, slightly moist, with intermixed wood (Earthen Fill)					
4		SP	Yellowish bown, poorly graded SAND, fine to medium sand, (Glacial Outwash)					

Depth scale (feet): 0, 2, 4, 6, 8, 10

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 2, 4, 6, 8, 10

DEPTH (feet): 0, 2, 4, 6, 8, 10

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

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HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-7

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT10 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, SAND, loose, dry to moist, medium sand (Earthen Fill)					
		SP	Yellowish brown, poorly graded SAND, bedded with gray poorly graded SAND, moist to wet (Glacial Outwash) Strong seepage at 3'					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0 2 4 6 8 10

DEPTH (feet): 0 2 4 6 8 10

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-8-A

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT10 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 5900 Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, SAND, loose, dry to moist, medium sand (Earthen Fill)					
		SP	Gray, SAND, loose, slightly moist, fine to medium sand with intermixed wood (Earthen Fill)					
5								
		SP	Yellowish brown, poorly graded SAND, bedded with gray poorly graded SAND, loose, moist to wet (Glacial Outwash) Wet below 8' Strong seepage at 10'					
10								
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 5 10 15 20

DEPTH (feet) 0 5 10 15 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-8-B

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Dark brown, poorly graded SAND, fine sand (Topsoil - Fill)					
		SP	Yellowish bown, poorly graded SAND, fine sand, (Glacial Outwash)					
		SP	Gray brown, poorly graded SAND, wet, fine to medium grained (Glacial Outwash) Strong seepage at 5'					
5								
10								
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 5 10 15 20

DEPTH (feet)

0 5 10 15 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-9-A

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, poorly graded GRAVELLY SAND, fine to medium sand, dry to moist (Earthen Fill)					
			Dark brown, GRAVELLY SAND, with intermixed glass, bricks and some steel (Demolition Waste)					
		SP	Gray, SAND, loose, slightly moist, fine to medium sand with intermixed wood (Earthen Fill)					
5		SP	Yellowish bown, poorly graded SAND, fine sand (Glacial Outwash)					
10								
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 5, 10, 15, 20

DEPTH (feet): 0, 5, 10, 15, 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-9-B

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0			Dark brown, poorly graded SILTY SAND, loose, moist, fine sand, organic (Topsoil - Fill)					
		SP	Yellowish brown, poorly graded SAND with trace gravel, loose, moist, fine sand (Glacial Outwash)					
3		SP	Gray brown, poorly graded SAND, moist, fine sand (Glacial Outwash)					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 2, 4, 6, 8, 10

DEPTH (feet): 0, 2, 4, 6, 8, 10

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-10-A

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT10 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		ML	Gray, GRAVELLY SILT, medium dense, moist (Fill)					
			Brown, poorly graded SILTY SAND, loose, moist with intermixed glass, dimensional timber, steel and some plastic (Demolition Waste)					
5								
10								
		SP	Yellowish brown/gray, poorly graded SAND, wet, fine sand, bedded (Glacial Outwash)					
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 5 10 15 20

DEPTH (feet)

0 5 10 15 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

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HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-10-B

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP SM	Brown, poorly graded GRAVELLY SAND with some silt, medium dense, dry (Fill)					
			Brown, poorly graded SILTY SAND, dry, loose, fine sand with intermixed dimensional timber (Demolition Waste)					
10		SP	Yellowish brown/gray, poorly graded SAND, moist, fine sand (Glacial Outwash)					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 5 10 15 20

DEPTH (feet)

0 5 10 15 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-10-C

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 5900 Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Dark brown, poorly graded SAND, moist, fine sand, organic, (Topsoil - Fill)					
		SP	Brown, poorly graded SAND, dry, loose, fine sand, some intermixed wood (Earthen Fill)					
		SP	Gray, poorly graded SAND, moist, fine sand, intermixed wood (Earthen Fill)					
5		SP	Yellowish brown, poorly graded SAND, loose, fine sand (Glacial Outwash)					
		ML	Gray, SILT, dry, medium plasticity, dense					
10								
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 5, 10, 15, 20

DEPTH (feet): 0, 5, 10, 15, 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-11-A

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0			Brown, SAND, loose, moist, organic, (Topsoil - Fill)					
		SP	Gray brown, poorly graded SAND, moist, loose, fine sand (Glacial Outwash)					
2		SP	Gray/yellowish brown, poorly graded SAND, moist to wet, fine sand, bedded, (Glacial Outwash)					
			Seepage at 3.5'					▽
4								
6								
8								
10								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 2, 4, 6, 8, 10

DEPTH (feet): 0, 2, 4, 6, 8, 10

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-11-B

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT10 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, poorly graded GRAVELLY SAND, dry to moist, loose, fine sand, some roots (Fill)					
		SP	Yellowish brown/gray, poorly graded SAND, moist, medium dense, fine sand (Glacial Outwash)					
2								
4								
6								
8								
10								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 2 4 6 8 10

DEPTH (feet)

0 2 4 6 8 10

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-11-C
PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT10 2002071.GPJ 6/25/02

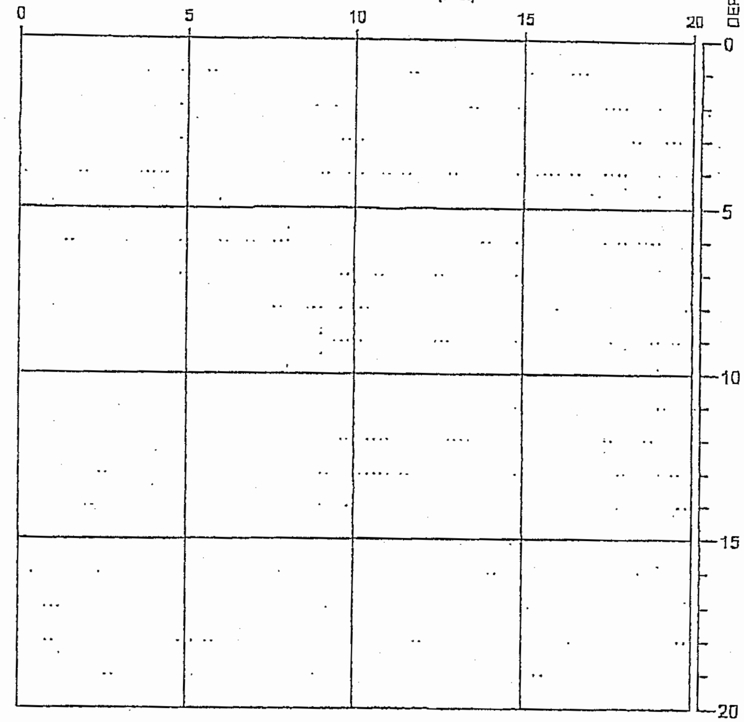
APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, poorly graded GRAVELLY SAND, dry to moist, loose, fine sand, some roots (Fill)					
			Charcoal and partially burnt wood					
5			Brown, poorly graded SAND, dry, loose, intermixed bricks, (Demolition waste)					
			Gray brown, poorly graded SAND, moist, loose, fine to medium sand, intermixed wood and steel, with some hoses (Demolition Waste)					
10								
15								
20								

SKETCH OF SIDE OF PIT



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HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-12-A
PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, poorly graded GRAVELLY SAND, moist to dry, loose, fine to medium sand (Fill)					
			Gray brown, poorly graded SAND, moist, loose, fine to medium sand, intermixed with wood (Demolition waste)					
5								
10								
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 5 10 15 20

DEPTH (feet)

0 5 10 15 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-12-B

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

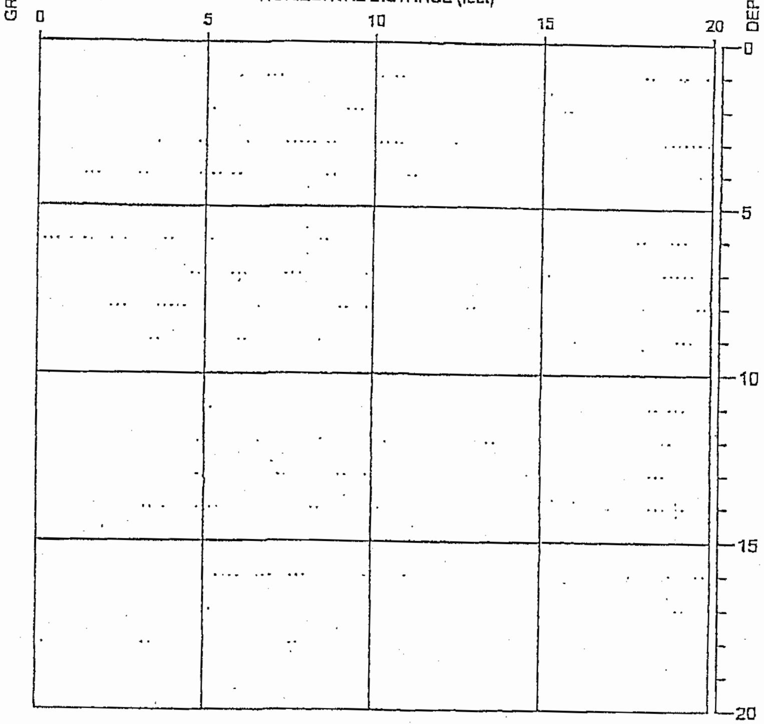
APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/3/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, poorly graded GRAVELLY SAND, moist to dry, loose, fine to medium sand (Fill)					
			Gray brown, poorly graded SAND, dry, loose, fine sand, intermixed wood; tires, metal, carpet, steel pipes (Refuse)					
5								
10								
15								
20								

SKETCH OF SIDE OF PIT



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-13-A
PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/4/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, poorly graded GRAVELLY SAND, moist to dry, loose, fine to medium sand (Fill)					
			Dark gray brown, poorly graded SAND, dry to moist, loose, intermixed dimensional timber, bricks, steel pipes (Demolition Waste)					
5								
10								
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 5, 10, 15, 20

DEPTH (feet): 0, 5, 10, 15, 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-13-B

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

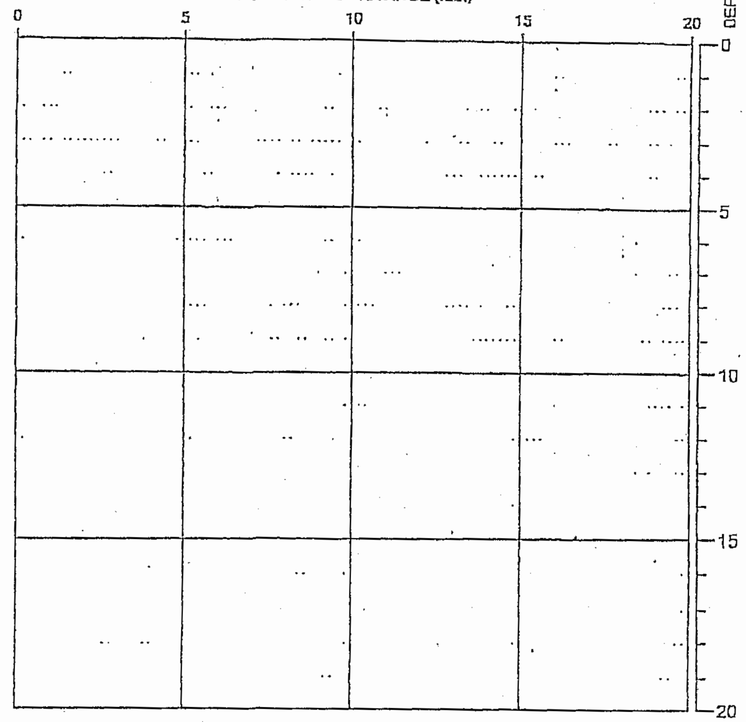
APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 5900 Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/4/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Gray, poorly graded GRAVELLY SAND, dry, fine sand (Fill)					
			Gray brown, poorly graded SAND, dry to moist, loose, fine to medium sand, intermixed dimensional lumber (Demolition Waste)					

SKETCH OF SIDE OF PIT



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-14-A
PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/4/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, poorly graded GRAVELLY SAND, dry, medium dense, fine sand, with some steel and pockets of crushed glass (Fill)					
4			Dark gray brown, poorly graded SAND, moist, loose, fine sand, intermixed dimensional timber (Fill)					
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 5, 10, 15, 20

DEPTH (feet): 0, 5, 10, 15, 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-15
PAGE: 1 of 2

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/4/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
20								
25								
30								
35								
40								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

DEPTH (feet)	0	5	10	15	20
20					
25					
30					
35					
40					

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-15

PROJECT NO.: 2002071 FIGURE:

APPENDIX B

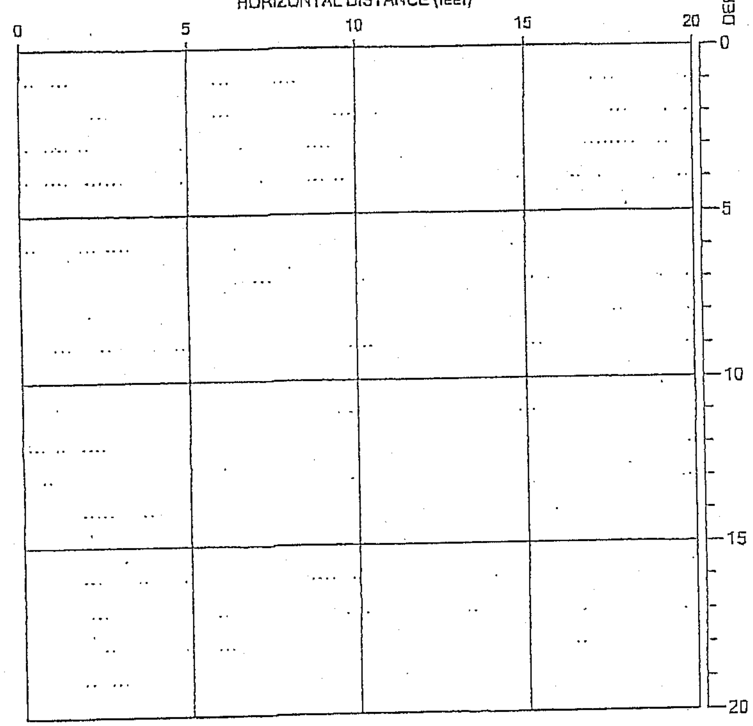
EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/4/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, poorly graded GRAVELLY SAND, moist to dry, loose, fine to medium sand with some wood (Earthen Fill)					
5			Dark brown, poorly graded SAND, dry to moist, fine sand, with intermixed wood and plastic (Demolition Waste)					
			Pocket of pink packing foam and plastic at 8 feet					
10			Pocket of crushed glass at 10 feet					
			No plastic in demolition waste below 13 feet					
15								
		SP	Gray, poorly graded SAND, moist, fine sand, (Glacial Outwash - Fill)					
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-16

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/4/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SM	Gray brown, SILTY SAND with some gravel, fine sand, with intermixed wood, some steel and plastic (Demolition Waste)					
			Brown, poorly graded GRAVELLY SAND, with intermixed wood, bricks, steel and cardboard (Demolition Waste)					
5			Crushed glass					
		SP	Yellowish brown, poorly graded SAND, dry, loose, fine to medium sand (Earthen Fill)					
10			Dark brown, SILTY SAND, moist, loose, fine sand, intermixed wood (Demolition Waste)					
15		SM	Gray/yellow, SANDY SILT, moist, medium plasticity, medium stiff, dark brown concretions					
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 5, 10, 15, 20

DEPTH (feet): 0, 5, 10, 15, 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-17
PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX B

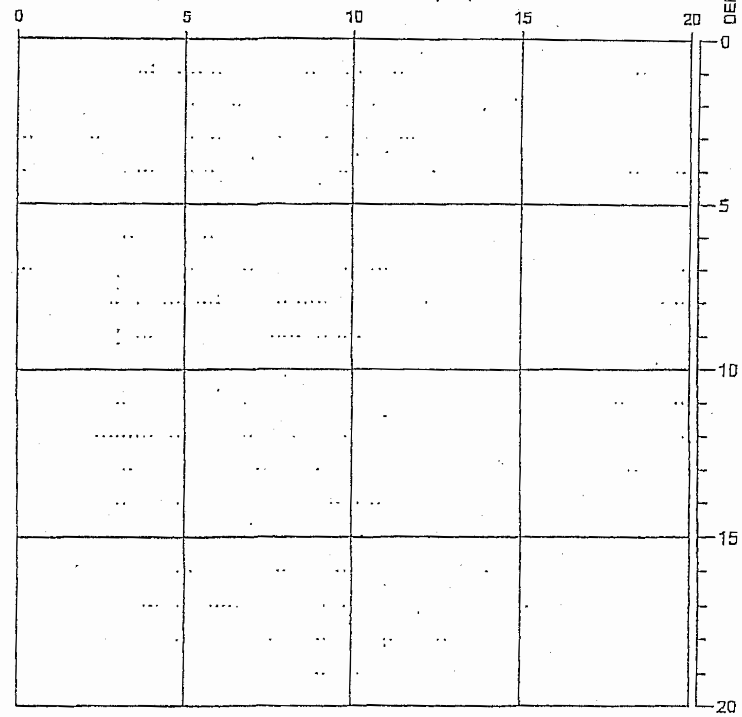
EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/4/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		ML	Gray, SANDY SILT with some gravel, dry, medium plasticity. (Earthen Fill)					
4			Brown, poorly graded SILTY SAND, moist, loose, fine to medium sand, intermixed with tires, bricks, plastic and large pieces of wood (Demolition Waste)					
8			Intermixed with wood only below 8'					
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-18
PAGE: 1 of 2

PROJECT NO.: 2002071 FIGURE:

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/4/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
20								
25								
30								
35								
40								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 5 10 15 20

DEPTH (feet)

20 25 30 35 40

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-18
PAGE: 2 of 2

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/5/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, poorly graded GRAVELLY SAND, dry, medium dense, (Earthen Fill)					
			Black/brown, GRAVELLY SAND with glass, aphalt and bricks, dry, loose (Fill)					
			Crushed glass (Fill)					
5			Gray, poorly graded SAND, dry, loose, fine sand, with intermixed plastic and PVC pipes (Demolition Waste)					
			Dark brown, poorly graded SAND, dry to moist, loose, intermixed plywood, PVC pipes and some steel (Demolition Waste					
10								
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 5 10 15 20

DEPTH (feet) 0 5 10 15 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-19

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/5/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SM	Dark brown, SILTY SAND with some gravel, moist (Earthen Fill)					
		SM	Brown, SILTY SAND, dry to moist, loose, fine to medium sand, intermixed plywood, bricks, plastic sheeting, steel and occasional tire (Demolition Waste)					
10		SP	Olive grey, poorly graded SAND, loose, moist, fine to medium sand					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 5, 10, 15, 20

DEPTH (feet): 0, 5, 10, 15, 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP20

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/5/02
LOGGED BY: B. Robinson

DEPTH (feet)	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0	SM	Dark brown, SILTY SAND with some gravel, moist (Earthen Fill)					
	SM	Brown, SILTY SAND, moist, loose, fine to medium sand (Demolition Waste) Some plastic at 3' Burnt wood at 4' Tyres and PVC piping at 8' to 8'					
	SP	Dark brown, SAND, moist, loose, with intermixed plywood and dimensional timber (Demolition waste)					
	ML	Blue gray, SANDY SILT, moist, with intermixed plywood, tires and concrete (Demolition waste)					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet): 0, 5, 10, 15, 20

DEPTH (feet): 0, 5, 10, 15, 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP21

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 0/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 5900 Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/5/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		ML	Dark brown, SANDY SILT, low plasticity, moist (Earthen Fill)					
		SM	Orange brown, SILTY SAND, dry, loose, with intermixed glass and steel (Demolition waste)					
			Charcoal and partially burnt wood					
		SM	Dark brown, SILTY SAND, dry to moist, loose, intermixed concrete and dimensional timber, with some carpet (Demolition Waste)					
5								
10								
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

DEPTH (feet)	0–5	5–10	10–15	15–20
0				
5				
10				
15				
20				

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP22

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/6/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SM	Brown, SILTY SAND with gravel (Earthen Fill					
			Brown, SILTY SAND, loose, with intermixed plastic sheeting, plywood, foam rubber insulation, glass (Demolition Waste)					
5			Burnt wood and charcoal					
			Branches and pine needles (Wood waste)					
10			Dark brown, SILTY SAND, with intermixed dimensional timber and concrete (Demolition Waste)					
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 5 10 15 20

DEPTH (feet) 0 5 10 15 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP23
PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/5/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SP	Brown, poorly graded SAND with some gravel					
			Dark brown, SILTY SAND, dry to moist, with intermixed bricks, linoleum, insulation and some steel and wire (Demolition Waste)					
			Crushed glass					
5			Dark brown, SILTY SAND, dry to moist, with intermixed bricks, insulation and some steel and wire (Demolition Waste)					
10								
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 5 10 15 20

DEPTH (feet) 0 5 10 15 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-24

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

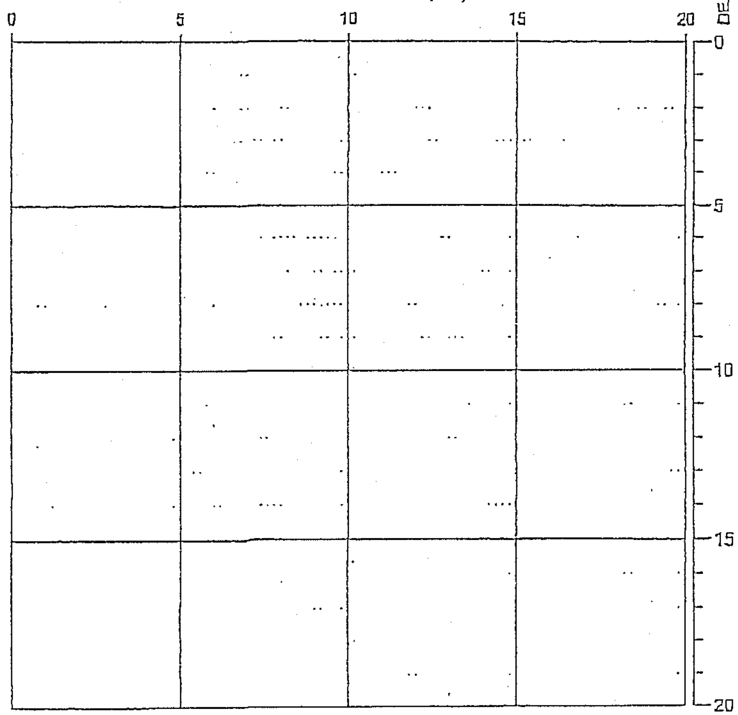
APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 5900 Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/5/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SM	Dark brown, SILTY SAND					
		SM	Orange, poorly graded SILTY SAND, dry, fine to medium sand, some steel and bricks (Demolition Waste)					
			Burnt wood/charcoal					
5			Brown, SILTY SAND, dry to moist, with intermixed dimensional timber, steel, concrete, carpet and some plastic (Demolition Waste) Pocket of crushed glass at 7' Large stumps from 8' to 12'					
15								

SKETCH OF SIDE OF PIT



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-25
PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/5/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0		SM	Brown, SILTY SAND with gravel (Earthen Fill)					
			Dark gray, GRAVELLY SAND with silt, some steel and plastic (Demolition Waste)					
			Charcoal					
5			Dark gray, SILTY SAND, with intermixed plywood, dimensional timber, trace concrete (Demolition Waste) Large pieces of dimensional timber at 8'					
10								
15								
20								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 5 10 15 20

DEPTH (feet)

0 5 10 15 20

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-26

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT20 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 5900 Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/5/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0 – 3.5			Dark brown, SILTY SAND with some gravel, fine sand, with intermixed bricks, glass, plywood and steel (Demolition Waste)					
3.5 – 4.5		SM	Gray, SILTY SAND, moist to dry, some wood. (Earthen Fill)					
4.5 – 6		SP SM	Light brown, poorly graded SAND with some silt, fine sand, (Glacial Outwash)					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 2 4 6 8 10

DEPTH (feet)

0 2 4 6 8 10

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-27

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT10 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 590D Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/5/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0			Dark brown, SILTY SAND, moist, with some wood and glass, occasional concrete (Topsoil - Demolition Waste)					
		SM	Light brown, SAND, moist, fine sand, with veins of gray SILTY SAND					
2								
4								
6								
8								
10								

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 2 4 6 8 10

DEPTH (feet) 0 2 4 6 8 10

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-28

PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

TPIT10 2002071.GPJ 6/25/02

APPENDIX B

EXCAVATION COMPANY: Best Way Excavation, Inc.
EXCAVATING EQUIPMENT: 5900 Track Hoe
SURFACE ELEVATION: ± Feet

LOCATION: Go East Landfill, Everett Washington
DATE COMPLETED: 6/5/02
LOGGED BY: B. Robinson

DEPTH (feet)	SYMBOL	USCS SOIL CLASS.	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT (%)	OTHER TESTS	GROUNDWATER
0			Dark brown, SILTY SAND, moist, with some wood and glass, occasional concrete (Topsoil - Demolition Waste)					
		SM	Light brown, SAND, moist, fine sand, with veins of gray SILTY SAND					

SKETCH OF SIDE OF PIT

HORIZONTAL DISTANCE (feet)

0 2 4 6 8 10

DEPTH (feet) 0 2 4 6 8 10

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

GO EAST LANDFILL
EVERETT, WASHINGTON

LOG OF TEST PIT
TP-29
PAGE: 1 of 1

PROJECT NO.: 2002071 FIGURE:

ATTACHMENT B

Previous Surface Water Quality Data

State of Washington
Department of Ecology

ORIGINAL TO: LAB FILES
COPIES TO:
David Wright NWRO

ENVIRONMENTAL LABORATORY DATA SUMMARY METALS

SOURCE Snohomish County Landfill PROGRAM NUMBER 954

DATE COLLECTED 3/20/86 RECEIVED ________ COLLECTED BY ________

Sample (Log) Number	Units	Standard Deviation ± %	12 7776	12 7777	12 7778	12 7779	12 7780	12 7781	12 7782	12 7783
Station:			GE 1	GE 2	GE 3	LS 3	LS 4	LS 5	LS 6	LS 9
Cu										
Zn T	µg/L	ppb	2	<1	<1	<1	46	8	65	174
Fe T	µg/L		14,520	572	1785	216	592	666	206	7280
Ni										
Cr										
Cd										
Pb										
Mn T	µg/L		2,123	37	259	93	4	128	152	305

RECEIVED
JUN 30 1986
DEPARTMENT OF ECOLOGY
NORTHWEST REGION

NOTE: Dissolved Metals: Those that will pass through a 0.45 µ membrane filter
Suspended Metals: Those retained by a 0.45 µ membrane filter
Total Metals: Those found in the unfiltered, rigorously acid digested sample
mg/L = ppm = µg/ml
µg/L = ppb = ng/ml
mg/kg = ppm - µg/gm
µg/kg = ppb = ng/gm
"<" is "less than" and ">" is "greater than

SUMMARIZED BY [signature] DATE 6/26/86

REVIEWED BY P. Crily DATE 6/27/86

ECY 040-2-32 (a)
Rev. 8/81

APPENDIX B

State of Washington Department of Ecology

OLYMPIA ENVIRONMENTAL LABORATORY

DATA SUMMARY

ORIGINAL TO: LAB FILES

COPIES TO: Dave Wright

SOURCE Snohomish Co. Landfill

DATE COLLECTED 3/20/86

COLLECTED BY Dave Wright

Sample (Log) Number 12	7776	7777	7778	7779	7780	7781	7782	7783	7784	7785
Station:	GE 1	GE 2	GE 3	LS 3	LS 4	LS 5	LS 6	LS 9	LS 10	LS 11
pH (units)	6.5	6.6	6.8	7.3	5.4	5.5	7.3	6.8	7.3	7.6
Turbidity (NTU)										
Sp. Conductivity (umhos/cm)	979	192	262	330	59	60	273	202	223	210
COD										
BOD (5 day)										
Fecal Coliform (Col./100 ml)										
NO3-N										
NO2-N										
NH3-N										
T.Kjeldahl-N										
O-PO4-P										
Total Phos.-P										
Total Solids (Dissolved)	620	110	98	160	68	49	55	140	120	120
Total Non Vol. Solids										
Total Suspended Solids										
Total Non Vol. Sus. Solids										
TOC as C	13	14	0.5	0.7	10	6.8	17	21	6.6	14
Tannin & Lignin	4.6	2.0	2.0							

RECEIVED APR 1 0 1986 DEPARTMENT OF ECOLOGY NORTHWEST REGION

NOTE: All results are in mg/L(ppm) unless otherwise specified. ND is "None Detected"
"<" is "Less Than" and ">" is "Greater Than"

SUMMARIZED BY Pam Covey DATE 4/1/86

REVIEWED BY DATE

ECY 040-2-32
Rev. 9/81

APPENDIX B

Washington Department of Ecology

RE... ND ENVIRONMENTAL LABORA...

DATA SUMMARY

LAB FILES

COPIES TO: D. E. Wright

SOURCE Go East Landfill

PROGRAM NUMBER 41414

DATE SAMPLED 1-18-84 DATE RECEIVED 1-19-84 COLLECTED BY Sno. H. D.

Sample (Log) Number	Standard Deviation ±%	24 0178		24 0178		24 0180			
Station:		GE-1		GE-2		GE-3			
pH (units)	10	6.7		7.2		7.3			
Turbidity (NTU)									
Sp. Conductivity (umhos/cm) @ 16°C	10	800.		135.		199.			
COD									
BOD (5 day)									
Fecal Coliform (Col./100 ml)									
Chloride as Cl									
Sulfate as SO_4	10	120.		15.		19.			
Total Hardness as $CaCO_3$									
Total Organic Carbon (TOC)	10	31.		4.		4.			
Total Solids									
Total Non Vol. Solids									
Total Suspended Solids									
Total Dissolved Solids	10	680.		150.		190.			
Tannin and Lignin as Tannin	10	14.		<1		1.			

65° 21b.

NOTE: All results are reported as mg/L(ppm) unless otherwise specified.
"<" is "less than" and ">" is "greater than"
est = estimate

2/219 SUMMARIZED BY Miles M. Kemp DATE 1-26-84

REVIEWED BY [signature] DATE 2/29/1984

ECY 040-2-32(b)
Rev. 5/82

APPENDIX B

State of Washington
Department of Ecology

ORIGINAL TO: LAB FILES
COPIES TO: D.E. WRIGHT

'VIRONMENTAL LABORATORY
DATA SUMMARY
METALS

SOURCE GO Dast Landfill PROGRAM NUMBER 444

DATE COLLECTED 1/18/84 RECEIVED 1/19/84 COLLECTED BY SHD

Sample (Log) Number	Units	Standard Deviation ± %	240	240	240					
Station:			178	179	180					
Cu										
Zn - TOTAL	mg/L	10	0.03	0.02	0.02					
Fe - TOTAL	mg/L	10	15	0.62	1.6					
Ni										
Cr										
Cd										
Pb										
Mn - TOTAL	mg/L	10	2.8	0.05	0.32					

NOTE: Dissolved Metals: Those that will pass through a 0.45 μ membrane filter
Suspended Metals: Those retained by a 0.45 μ membrane filter
Total Metals: Those found in the unfiltered, rigorously acid digested sample
mg/L = ppm = μg/ml
μg/L = ppb = ng/ml
mg/kg = ppm - μg/gm
μg/kg = ppb = ng/gm
"<" is "less than" and ">" is "greater

2/23 SUMMARIZED BY [signature] DATE 1/27/84

REVIEWED BY [signature] DATE 1/27/1984

APPENDIX B

ECY 040-2-32 (a)
Rev. 8/81

Washington Department of Ecology

OLYMPIA ENVIRONMENTAL LABORATORY

ORIGINAL TO: LAB FILES

COPIES TO: Laurence Ashley

DATA SUMMARY

SOURCE GO East Landfill, Snohomish County

DATE COLLECTED 1-18-84 COLLECTED BY SHD

Sample (Log) Number 24	0178	0179	0180							
Station:	1	2	3							
pH (units)										
Turbidity (NTU)										
Sp. Conductivity (umhos/cm)										
COD										
BOD (5 day)										
Fecal Coliform (Col./100 ml)										
NO3-N	0.75	4.2	4.0							
NO2-N	<0.25	<0.01	<0.01							
NH3-N	7.2	0.04	0.48							
T. Kjeldahl-N										
O-PO4-P										
Total Phos.-P										
Total Solids										
Total Non Vol. Solids										
Total Suspended Solids										
Total Non Vol. Sus. Solids										

NOTE: All results are in mg/L(ppm) unless otherwise specified. ND is "None Detected"
"<" is "Less Than" and ">" is "Greater Than"

SUMMARIZED BY G Freeman DATE 2-1-84

REVIEWED BY A. Pollo DATE 2-7-84

ECY 040-2-32
Rev. 9/81

APPENDIX B

Washington Department of Ecology

REDMONL ENVIRONMENTAL LABORATORY

DATA SUMMARY

LAB FILES

COPIES TO: D. Wright March

OURCE GO East Woodwaste Landfill PROGRAM NUMBER 4141 4

ATE RECEIVED 3/12/1984 Date Sampled 3/12/84 COLLECTED BY SCHD 3-12-84

	Standard Deviation ±%								
ample (Log) Number			240-565		566		567		
ation:			GE-1		GE-2		GE-3		
H (units)			6.6		7.3		7.1		
urbidity (NTU)									
p. Conductivity (umhos/cm) @17°C			666.		116.		156.		
OD									
OD (5 day)									
ecal Coliform (Col./100 ml)									
hloride as Cl	10		35.		4.		6.		
S as SO_4	10		180.		13.		23.		
Total Hardness as $CaCO_3$									
Total Organic Carbon (TOC)									
Total Solids									
Total Non Vol. Solids									
Total Suspended Solids									
Total Dissolved Solids	10		580.		120.		150.		
Tannin + Lignin as Tannin	10		6.6		0.8		1.0		
N-NH_3-N	10		5.8		0.04		0.30		

NOTE: All results are reported as mg/L(ppm) unless otherwise specified.
"<" is "less than" and ">" is "greater than"
est = estimate

2/243 SUMMARIZED BY Miles M. Kuntz DATE 3-26-1984

REVIEWED BY [signature] DATE 3/26/1984

APPENDIX B

ECY 040-2-32(b)
Rev. 10/80

State of Washington Department of Ecology

ENVIRONMENTAL LABORATORY DATA SUMMARY METALS

ORIGINAL TO: LAB FILES
COPIES TO: D.E. WRIGHT

SOURCE Go East Landfill Woodwaste

PROGRAM NUMBER 444

DATE COLLECTED 3/12/84 RECEIVED 3/12/84 COLLECTED BY S HD

Sample (Log) Number	Units	Standard Deviation ±%	240	240	240						
Station:			565	566	567						
Cu											
Zn-TOTAL	mg/L	10	0.02	0.02	0.02						
Fe-"	"	"	18.	0.92	1.9						DU. limit 0.3 mg/L
Ni											
Cr											
Cd											
Pb											
Mn-"	"	"	2.5	0.02	0.25						.05 DU limit

Note: Dissolved Metals: Those that will pass through a 0.45 μ membrane filter
Suspended Metals: Those retained by a 0.45 μ membrane filter
Total Metals: Those found in the unfiltered, rigorously acid digested sample
mg/L = ppm = μg/ml
μg/L = ppb = ng/ml

mg/kg = ppm = μg/gm
μg/kg = ppb = ng/gm
"<" is "less than" and ">" is "greater than"

ECY 040-2-32 (a)
Rev. 8/81

3/33 SUMMARIZED BY Gary D Bruno DATE 3/20/84

APPENDIX B

State of Washington Department of Ecology

— REQUEST FOR ANALYSIS

Date 5-23-84

SOURCE Go East Landfill REQUESTED BY D.E. Wright

LOCATION Snohomish COUNTY COLLECTED BY J. Diefenbach / (4D

DATE WERE (WILL BE) COLLECTED 5-24-84 APPROVED BY

SAMPLES WILL ARRIVE: DATE 5-24-84 APPROXIMATE TIME CARRIER

PRIORITY: REASONABLY SOON ✓ AS SOON AS POSSIBLE EMERGENCY

ROUTE DATA SUMMARY TO: D.E. Wright

PROGRAM CODE 4 - 4 - 4 ☐ Amb. Mon. ☐ Compliance ☐ Inspection ☐ Class, #

☐ Investigation ☒ Survey ☐ Spill ☐ Complaint ☐ Other (describe)

OTHER INFORMATION: Surface waters below landfill - some contaminated with leachate from burning woodwaste L.F.

Type of Analyses Required	Number of Samples	Approx. Range	Preservative Type-Vol.	For Lab Use Only Laboratory Number	Analyst	Date	Notes
				Rec'd 5-24-84 MWK			
✓ pH	3		ice				
✓ Cond				241050			
~~TDS~~ deleted 7/24/84				to			
✓ Cl⁻				241052			
✓ $SO_4^=$							
Tannin & Lignin			To Oly 6-1-84				
NH_3-N			H_2SO_4 via SR/JK				
✓ Fe			HNO_3				
✓ Mn							
✓ Zn							

Fill out as completely as possible. Some Analyses (bacteriological, biological, BOD, etc.) and large n bers of samples must be scheduled ahead of time. Specific questions should be directed to the Ana supervising the particular analysis desired.

APPENDIX B

ECY 040-1-61

State of Washington
Department of Ecology

ENVIRONMENTAL LABORATORY
DATA SUMMARY
METALS

ORIGINAL TO: LAB FILES
COPIES TO: D.E. WRIGHT

SOURCE GO EAST LANDFILL PROGRAM NUMBER 444

DATE COLLECTED 5/24/84 RECEIVED 5/24/84 COLLECTED BY J. DEFENBACH/SHD

Sample (Log) Number	Units	Standard Deviation ± %	241	241	241					
Station:			650	051	052					
Cu										
Zn - TOTAL	mg/L	10	0.01	<0.01	<0.01					
Fe - TOTAL	"	"	0.12	<0.02	0.22					
Ni										
Cr										
Cd										
Pb										
Mn - TOTAL	"	"	2.4	0.02	0.30					

NOTE: Dissolved Metals: Those that will pass through a 0.45 μ membrane filter
Suspended Metals: Those retained by a 0.45 μ membrane filter
Total Metals: Those found in the unfiltered, rigorously acid digested sample
mg/L = ppm = μg/ml
μg/L = ppb = ng/ml
mg/kg = ppm - μg/gm
μg/kg = ppb = ng/gm
"<" is "less than" and ">" is "greate

ECY 040-2-32 (a)
Rev. 8/81

SUMMARIZED BY [signature] DATE 6/.../84

REVIEWED BY DATE

APPENDIX B

State of Washington Department of Ecology

LAB FILES

REDMOND ENVIRONMENTAL LABORATORY

DATA SUMMARY

COPIES TO: D.E. Wright

SOURCE Go East Landfill

PROGRAM NUMBER 4,4,4

DATE RECEIVED 5-24-1984

COLLECTED BY J. Defenbach/SHD on 5-24-1984

Sample (Log) Number	Standard Deviation ±%	24 1050		24 1051		24 1052			
Station:		GE 1		GE 2		GE 3			
pH (units)	10	6.9		7.1		7.1			
Turbidity (NTU)									
Sp. Conductivity (umhos/cm) @25°C	10	600.		119.		168.			
COD									
BOD (5 day)									
Fecal Coliform (Col./100 ml)									
Chloride as Cl	10	33.		5.		7.			
Sulfate as SO_4	10	100.		12.		22.			
Total Hardness as $CaCO_3$									
Total Organic Carbon (TOC)									
Total Solids									
Total Non Vol. Solids									
Total Suspended Solids									
Total Dissolved Solids									

NOTE: All results are reported as mg/L(ppm) unless otherwise specified.
"<" is "less than" and ">" is "greater than"
est = estimate

2/261 SUMMARIZED BY [signature] DATE 7/10/84

REVIEWED BY ______ DATE ______

ECY 040-2-32(b)
Rev. 10/80

APPENDIX B

State of Washington Department of Ecology

OLYMPIA ENVIRONMENTAL LABORATORY

DATA SUMMARY

ORIGINAL TO: LAB FILES

COPIES TO: Laurence Ashley

SOURCE Go East Landfill, Snohomish County

DATE COLLECTED 5-24-84

COLLECTED BY J. Defenbach, SHD

Sample (Log) Number 24	1050	1051	1052							
Station: GE-	1	2	3							
pH (units)										
Turbidity (NTU)										
Sp. Conductivity (umhos/cm)										
COD										
BOD (5 day)										
Fecal Coliform (Col./100 ml)										
NO3-N										
NO2-N										
NH3-N	4.0	0.10	0.45							
T.Kjeldahl-N										
O-PO4-P										
Total Phos.-P										
Total Solids										
Total Non Vol. Solids										
Total Suspended Solids										
Total Non Vol. Sus. Solids										
Tannin and Lignin as Tannin	6.1	0.53	0.96							

NOTE: All results are in mg/L(ppm) unless otherwise specified. ND is "None Detected"
"<" is "Less Than" and ">" is "Greater Than"

SUMMARIZED BY G. Freeman DATE 6-25-84

REVIEWED BY L. Bell DATE 6-26-

ECY 040-2-32
Rev. 9/81

APPENDIX B

Washington Department of Ecology

REQUEST FOR ANALYSIS

Date 6-28-84

SOURCE GO East Landfill REQUESTED BY D. E. Wright

LOCATION S Snohomish COUNTY COLLECTED BY

DATE WERE (WILL BE) COLLECTED 6-28-84 APPROVED BY

SAMPLES WILL ARRIVE: DATE 6-28-84 APPROXIMATE TIME CARRIER

PRIORITY: REASONABLY SOON ✓ AS SOON AS POSSIBLE EMERGENCY

ROUTE DATA SUMMARY TO:

PROGRAM CODE 4 - 4 - 4 ☐ Amb. Mon. ☐ Compliance ☐ Inspection ☐ Class, #

☐ Investigation ☐ Survey ☐ Spill ☐ Complaint ☑ Other (describe)

OTHER INFORMATION:

Rec'd 6/28/1984 LA

Type of Analyses Required	Number of Samples	Approx. Range	Preservative Type-Vol.	For Lab Use Only: Laboratory Number	Analyst	Date	Notes
✓ pH				241420	LA	6/28	
✓ Cond				241421	LA	6/28	
✓ TOC				241422	LB	7/17	
Terminal Hygro							
NH_3-N		1 o	O/4 6/29				
NO_3-N							
✓ Fe							
✓ Mn							
✓ Zn							

Fill out as completely as possible. Some Analyses (bacteriological, biological, BOD, etc.) and large nu bers of samples must be scheduled ahead of time. Specific questions should be directed to the Anal supervising the particular analysis desired.

ECY 040-2-62

APPENDIX B

State of Washington
Department of Ecology

ORIGINAL TO: LAB FILES
COPIES TO: D.E. WRIGHT

ENVIRONMENTAL LABORATORY
DATA SUMMARY
METALS

SOURCE Go East Landfill PROGRAM NUMBER 444

DATE COLLECTED 6/28/84 RECEIVED 6/28/84 COLLECTED BY DE Wright

Sample (Log) Number	Units	Standard Deviation ± %	241	241	241					
Station:			420	421	422					
Cu										
Zn - TOTAL	mg/L	10	0.02	0.03	0.08					
Fe - TOTAL	mg/L	10	24.	0.55	2.1					
Ni										
Cr										
Cd										
Pb										
Mn - TOTAL	mg/L	10	2.2	0.05	0.25					

NOTE: Dissolved Metals: Those that will pass through a 0.45 μ membrane filter
Suspended Metals: Those retained by a 0.45 μ membrane filter
Total Metals: Those found in the unfiltered, rigorously acid digested sample
mg/L= ppm = μg/ml
μg/L= ppb = ng/ml

mg/kg = ppm - μg/gm
μg/kg = ppb = ng/gm
"<" is "less than" and ">" is "greater

7/16 SUMMARIZED BY Greg D Burns DATE 7/6/84

REVIEWED BY [illegible] DATE 7/9/1984

ECY 040-2-32 (a)
Rev. 8/81

APPENDIX B

State of Washington Department of Ecology

ORIGINAL TO: LAB FILES

COPIES TO: D. Wright

REDMOND ENVIRONMENTAL LABORATORY

DATA SUMMARY

SOURCE GoEast Landfill / Snohomish C.   PROGRAM NUMBER 4, 4, 4

DATE RECEIVED 6/28/84 / Date Sampled 6/28/84   COLLECTED BY SCHD

Sample (Log) Number	Standard Deviation ±%		14-1420	1421	1422				
Station:			GE-1	GE-2	GE-3				
pH (units) @22°C	10		6.8	7.1	7.1				
Turbidity (NTU)									
Sp. Conductivity (umhos/cm)	10		620	140	180				
COD									
BOD (5 day)									
Fecal Coliform (Col./100 ml)									
Chloride as Cl									
.fate as SO_4									
Total Hardness as $CaCO_3$									
Total Organic Carbon (TOC)	10		17.	3.	5.				
Total Solids									
Total Non Vol. Solids									
Total Suspended Solids									
Total Dissolved Solids									

E: All results are reported as mg/L(ppm) unless otherwise specified.
" <" is "less than" and " >" is "greater than"
est = estimate

SUMMARIZED BY [signature] DATE 7/24/1984

REVIEWED BY ______ DATE ______

APPENDIX B

Washington Department of Ecology

O IPIA ENVIRONMENTAL LABORAT

DATA SUMMARY

ORIGINAL TO: LAB FILES

COPIES TO: Laurence Ashley

SOURCE Go East Landfill, Snohomish County

DATE COLLECTED 6-28-84

COLLECTED BY SCHD

Sample (Log) Number 24	1420	1421	1422								
Station: GE	1	2	3								
pH (units)											
Turbidity (NTU)											
Sp. Conductivity (umhos/cm)											
COD											
BOD (5 day)											
Fecal Coliform (Col./100 ml)											
NO3-N	<0.25	3.4	3.6								
NO2-N	<0.25	<0.05	<0.05								
'H3-N	3.5	0.35	0.80								
T.Kjeldahl-N											
O-P04-P											
Total Phos.-P											
Total Solids											
Total Non Vol. Solids											
Total Suspended Solids											
Total Non Vol. Sus. Solids											
Tannin and Lignin as Tannin	5.8	0.41	0.79								

NOTE: All results are in mg/L(ppm) unless otherwise specified. ND is "None Detected"
"<" is "Less Than" and ">" is "Greater Than"

SUMMARIZED BY G. Treems DATE 7-23-84

REVIEWED BY [illegible] DATE 7-23-84

ECY 040-2-32
Rev. 9/81

State of Washington Department of Ecology

OLYMPIA ENVIRONMENTAL LABORATORY

DATA SUMMARY

ORIGINAL TO: LAB FILES

COPIES TO: Laurence Ash

SOURCE Go East Landfill, Snohomish County

DATE COLLECTED 8-7-84

COLLECTED BY SCHD

Sample (Log) Number 14	3522	3523	2524						
Station: 24	1573 1	1574 2	1575 3						
pH (units)									
Turbidity (NTU)									
Sp. Conductivity (umhos/cm)									
COD									
BOD (5 day)									
Fecal Coliform (Col./100 ml)									
NO3-N									
NO2-N									
NH3-N	2.8	0.01	0.18						
T.Kjeldahl-N									
O-PO4-P									
Total Phos.-P									
Total Solids									
Total Non Vol. Solids									
Total Suspended Solids									
Total Non Vol. Sus. Solids									
Tannin and Lignin as Tannin	6	<1	<1						

NOTE: All results are in mg/L(ppm) unless otherwise specified. ND is "None Detected"
"<" is "Less Than" and ">" is "Greater Than"

SUMMARIZED BY H Freeman DATE 8-29-84

APPENDIX B

R. Cu... DATE 8-29-84

ECY 040-2-32

PAGE ______ OF ______

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State of Washington Department of Ecology

ENVIRONMENTAL LABORATORY DATA SUMMARY METALS

SOURCE Go East

PROGRAM NUMBER 449

DATE COLLECTED 8/7/1984 RECEIVED 8/7/1984 COLLECTED BY SCHD

Sample (Log) Number	Units	Standard Deviation ± %		24-1573		-1574		-1575		
Station:				GE#1		GE#2		GE#3		
Cu										
Zn TOTAL	mg/l	10		<0.01		<0.01		<0.01		
Fe TOTAL	mg/l	10		11.		0.5		0.9		
Ni										
Cr										
Cd										
Pb										
Mn TOTAL	mg/l	10		2.3		0.05		0.20		

NOTE: Dissolved Metals: Those that will pass through a 0.45 μ membrane filter
Suspended Metals: Those retained by a 0.45 μ membrane filter
Total Metals: Those found in the unfiltered, rigorously acid digested sample
mg/L= ppm = μg/ml
μg/L= ppb = ng/ml
mg/kg = ppm - μg/gm
μg/kg = ppb = ng/gm
"<" is "less than" and ">" is "greater th

SUMMARIZED BY [illegible] DATE 8/10/84 APPENDIX B

ECY 040-2-32 (a)
Rev. 8/81

State of Washington Department of Ecology

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REDMOND ENVIRONMENTAL LABORATORY

DATA SUMMARY

SOURCE Go East Landfill/Snohomish Co. PROGRAM NUMBER 2, 4, 4

DATE RECEIVED 8/7/1984 Date Sample 8/7/84 COLLECTED BY: SCHD

Sample (Log) Number	Standard Deviation ±%		24-1573		-1574		-1575		
Station:			GE#1		GE#2		GE#3		
pH (units)	10		8.3		7.8		7.9		
Turbidity (NTU)									
Sp. Conductivity (umhos/cm) @ 16°C	10		510.		137.		172.		
COD									
BOD (5 day)									
Fecal Coliform (Col./100 ml)									
Chloride as Cl	10		220.		64		56.		
Sulfate as SO_4	10		85.		6.		8.		
Total Hardness as $CaCO_3$									
Total Organic Carbon (TOC)									
Total Solids									
Total Non Vol. Solids									
Total Suspended Solids									
Total Dissolved Solids									

NOTE: All results are reported as mg/L(ppm) unless otherwise specified.
" <" is "less than" and " >" is "greater than"
est = estimate

SUMMARIZED BY [signature] DATE 8/10/1984

REVIEWED BY [signature] DATE 8-10-84

APPENDIX B

State of Washington Department of Ecology

REQUEST FOR ANALYSIS

Date 8/9/1984

SOURCE GoEast · REQUESTED BY D. Wright

LOCATION Snohomish COUNTY COLLECTED BY SCHD

DATE WERE (WILL BE) COLLECTED 8/7/1984 APPROVED BY

SAMPLES WILL ARRIVE: DATE 8/7/1984 APPROXIMATE TIME PM CARRIER SCHD

PRIORITY: REASONABLY SOON ...... AS SOON AS POSSIBLE ...... EMERGENCY ......

ROUTE DATA SUMMARY TO: D.Wright

PROGRAM CODE 2-4-4 ☐ Amb. Mon. ☐ Compliance ☐ Inspection ☐ Class, #

☐ Investigation ☒ Survey ☐ Spill ☐ Complaint ☐ Other (describe)

OTHER INFORMATION:

Rec'd 8/7/84 LD

Type of Analyses Required	Number of Samples	Approx. Range	Preservative Type-Vol.	For Lab Use Only: Laboratory Number	Analyst	Date	Notes
pH	3			241573	LA	8/9	
Cond				241574	LA	8/9	
Cl^-				241575	SC	8/9	
$SO_4^=$					SC	8/9	
Tannin & Lignin		O/c	8/9/1984				
NH_3-N							
Fe					LA	8/10	
Mn					LA	8/10	
Zn					LA	8/10	

Fill out as completely as possible. Some Analyses (bacteriological, biological, BOD, etc.) and large numbers of samples must be scheduled ahead of time. Specific questions should be directed to the Analyst supervising the particular analysis desired.

APPENDIX B

State of Washington
Department of Ecology

REDMOND ENVIRONMENTAL LABORATORY

DATA SUMMARY

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LAB FILES
COPIES TO: DE Wright

SOURCE Go East Landfill
PROGRAM NUMBER 4, 5, 4
DATE RECEIVED 9/18/1984 Date sampled 9/18/1984
COLLECTED BY SCHD

Sample (Log) Number	Standard Deviation ±%		24-1813	-1814	-1815		
Station:			GE-1	GE-2	GE-3		
pH (units)	10		6.9	7.2	7.1		
Turbidity (NTU)							
Sp. Conductivity (umhos/cm) @22°C	10		560.	164.	198.		
COD							
BOD (5 day)							
Fecal Coliform (Col./100 ml)							
loride as Cl	10		26	<1	10		
Sulfate as SO_4	10		120.	11.	15.		
Total Hardness as $CaCO_3$							
Total Organic Carbon (TOC)							
Total Solids							
Total Non Vol. Solids							
Total Suspended Solids							
Total Dissolved Solids	10		420	132.	157.		

NOTE: All results are reported as mg/L(ppm) unless otherwise specified.
"<" is "less than" and ">" is "greater than"
est = estimate

SUMMARIZED BY [signature] DATE 9/21/1984

REVIEWED BY Susan Clinn DATE 9-21-84

APPENDIX B

State of Washington
Department of Ecology

ENVIRONMENTAL LABORATORY
DATA SUMMARY
METALS

ORIGINAL TO: LAB FILES
COPIES TO: D.E. WRIGHT

SOURCE Go East Landfill PROGRAM NUMBER 494

DATE COLLECTED 9/18/84 RECEIVED 9/18/84 COLLECTED BY SCHD

Sample (Log) Number	Units	Standard Deviation ± %	GE-1 241	GE-2 241	GE-3 241					
Station:			813	814	815					
Cu										
Zn - Total	mg/L	10	<0.01	0.01	<0.01					
Fe - "	"	"	18	0.55	1.4					
Ni										
Cr										
Cd										
Pb										
Mn - "	"	"	2.2	0.02	0.18					

NOTE: Dissolved Metals: Those that will pass through a 0.45 μ membrane filter
Suspended Metals: Those retained by a 0.45 μ membrane filter
Total Metals: Those found in the unfiltered, rigorously acid digested sample
mg/L = ppm = μg/ml mg/kg = ppm - μg/gm
μg/L = ppb = ng/ml μg/kg = ppb = ng/gm
"<" is "less than" and ">" is "greater

ECY 040-2-32 (2)
Rev. 8/81

2/54 SUMMARIZED BY [signature] DATE 9/20/84

APPENDIX B

[signature] DATE 9/20/1984

State of Washington
Department of Ecology

ORIGINAL TO:
LAB FILES
COPIES TO:
D. Wright

REDMOND ENVIRONMENTAL LABORATORY

DATA SUMMARY

SOURCE Go East Landfill/Snohomish Co. PROGRAM NUMBER 4 1 5 1 4

DATE RECEIVED 8/29/1984 Date sampled 8/29/1984 COLLECTED BY: SCHD'

Sample (Log) Number	Standard Deviation ±%		24-1722	-1723	-1724				
Station:			GE-1	GE-2	GE-3				
pH (units)	10		6.7	6.7	6.6				
Turbidity (NTU)									
Sp. Conductivity (umhos/cm) @ 20°C	10		543.	146.	180.				
COD									
BOD (5 day)									
Fecal Coliform (Col./100 ml)									
'oride as Cl	10		23.	6.	9.				
Sulfate as SO_4	10		106.	11.	10.				
Total Hardness as $CaCO_3$									
Total Organic Carbon (TOC)									
Total Solids									
Total Non Vol. Solids									
Total Suspended Solids									
Total Dissolved Solids									

NOTE: All results are reported as mg/L(ppm) unless otherwise specified.
" <" is "less than" and " >" is "greater than"
est = estimate

SUMMARIZED BY [signature] DATE 9/4/1984

REVIEWED BY DATE

APPENDIX B

State of Washington Department of Ecology

PAGE ____ OF ____

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COPIES TO: D. E. WRIGHT

ENVIRONMENTAL LABORATORY DATA SUMMARY METALS

SOURCE Go East Landfill PROGRAM NUMBER 454

DATE COLLECTED 8/29/84 RECEIVED 8/29/84 COLLECTED BY SCHO

Sample (Log) Number	Units	Standard Deviation ± %	241 722	241 723	241 724					
Station:			GE-1	GE-2	GE-3					
Cu										
Zn - Total	mg/L	10	0.04	0.03	0.02					
Fe - "	"	"	12.5	0.60	1.2					
Ni										
Cr										
Cd										
Pb										
Mn - "	"	"	2.0	0.02	0.18					

NOTE: Dissolved Metals: Those that will pass through a 0.45 μ membrane filter
Suspended Metals: Those retained by a 0.45 μ membrane filter
Total Metals: Those found in the unfiltered, rigorously acid digested sample
mg/L = ppm = μg/ml mg/kg = ppm - μg/gm
μg/L = ppb = ng/ml μg/kg = ppb = ng/gm "<" is "less than" and ">" is "great

APPENDIX B

ECY 040-2-32 (a) %, SUMMARIZED BY [signature] DATE 9/4/84

State of Washington Department of Ecology

(MPIA ENVIRONMENTAL LABORAT Y

DATA SUMMARY

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COPIES TO: Laurence Ashley

SOURCE Go East Landfill, Snohomish County

DATE COLLECTED 8-29-84

COLLECTED BY SCHD

Sample (Log) Number 24	1722	1723	1724						
Station:	GE-1	GE-2	GE-3						
pH (units)									
Turbidity (NTU)									
Sp. Conductivity (umhos/cm)									
COD									
BOD (5 day)									
Fecal Coliform (Col./100 ml)									
NO3-N									
NO2-N									
NH3-N	2.7	0.01	0.31						
T.Kjeldahl-N									
O-PO4-P									
Total Phos.-P									
Total Solids									
Total Non Vol. Solids									
Total Suspended Solids									
Total Non Vol. Sus. Solids									
Tannin and Lignin as Tannin	4.1	<1	<1						

NOTE: All results are in mg/L(ppm) unless otherwise specified. ND is "None Detected"
"<" is "Less Than" and ">" is "Greater Than"

SUMMARIZED BY [signature] DATE 9-28-8

REVIEWED BY [signature] DATE 9-28-8

ECY 040-2-32
Rev. 9/81

APPENDIX B-8

State of Washington Department of Ecology

[?]MPIA ENVIRONMENTAL LABORA[?]RY

DATA SUMMARY

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SOURCE Cathcart Landfill

DATE COLLECTED

COLLECTED BY

Sample (Log) Number 24	1813	1814	1815	1816	1817	1818	1819	1820	1821	18..
Station:	GE1	GE2	GE3	C5	C17	C18	C19	C20	C21	C2..
pH (units)										
Turbidity (NTU)										
Sp. Conductivity (umhos/cm)										
COD										
BOD (5 day)										
Fecal Coliform (Col./100 ml)										
NO3-N	0.05	3.4	3.2	0.05	0.01	1.2	1.1	0.40	4.4	0..
NO2-N	0.05	0.05	0.05	<0.01	<0.01	0.05	0.05	0.01	0.10	0..
NH3-N	2.8	0.02	0.14	0.11	0.04	0.02	0.06	<0.01	0.04	1..
T.Kjeldahl-N										
O-PO4-P										
Total Phos.-P										
Total Solids										
Total Non Vol. Solids										
Total Suspended Solids										
Total Non Vol. Sus. Solids										

NOTE: All results are in mg/L(ppm) unless otherwise specified. ND is "None Detected"
"<" is "Less Than" and ">" is "Greater Than".

SUMMARIZED BY G Freeman DATE 9-21-8[?]

REVIEWED BY [illegible] DATE 9-26-[?]

ECY 040-2-32

APPENDIX B

Analytical Results of the Sampling are listed as follows.

Table 1
Surface Water Sampling Analytical Results
March 4, 2004

Analysis	MTCA Method A for Ground Water	MTCA Method B for Surface Water	Go-East # 1 Seep	Go-East # 2 Surface Water	DW S
Nitrate-N			1.72	ND	
Sulfate			5	ND	
TOC			9.93	3.63	
Antimony		1,040	ND	ND	
Arsenic	.005	.0177	.003	.055	* 0.01 (0.05)
Beryllium			ND	ND	
Cadmium	.005	.0203	ND	ND	
Chromium	.05		.002	ND	0.1
Copper		2,660	ND	ND	
Lead	.015	NA	.001	ND	
Mercury	.002	NA	ND	ND	
Nickel		1.1	.004	.002	0. [illegible]
Selenium			ND	ND	
Silver		25.9	ND	ND	
Thallium			ND	ND	
Zinc		16.5	.010	ND	5.0

All results are noted in Mg/l unless otherwise noted.
Black outline indicates non-metal sample

Carcinogenic Polynuclear Aeromatic Hydrocarbon (PAH) analysis was conducted. Results indicate non-detect for all PAHs on both samples. PAHs were sampled because of fire at the site. Elevated arsenic level may be attributed to natural background, however, no sampling confirms this.

Historical Activities

Ecology and Environment Inc. prepared a report for the United States Environmental Protection Agency (USEPA) Region X in June of 1987. The report and assessment were carried out under the provisions of Section 3012 of the Resource Conservation and Recovery Act (RCRA). The report recognized: Leachate is present at the site, several fires have occurred at the site and small amounts of metal dusts were deposited at one time. The report recommends no further action under Superfund for the following reasons: Small volume of hazardous waste was ever delivered to the site, contaminants found in surface water were below Primary Drinking water

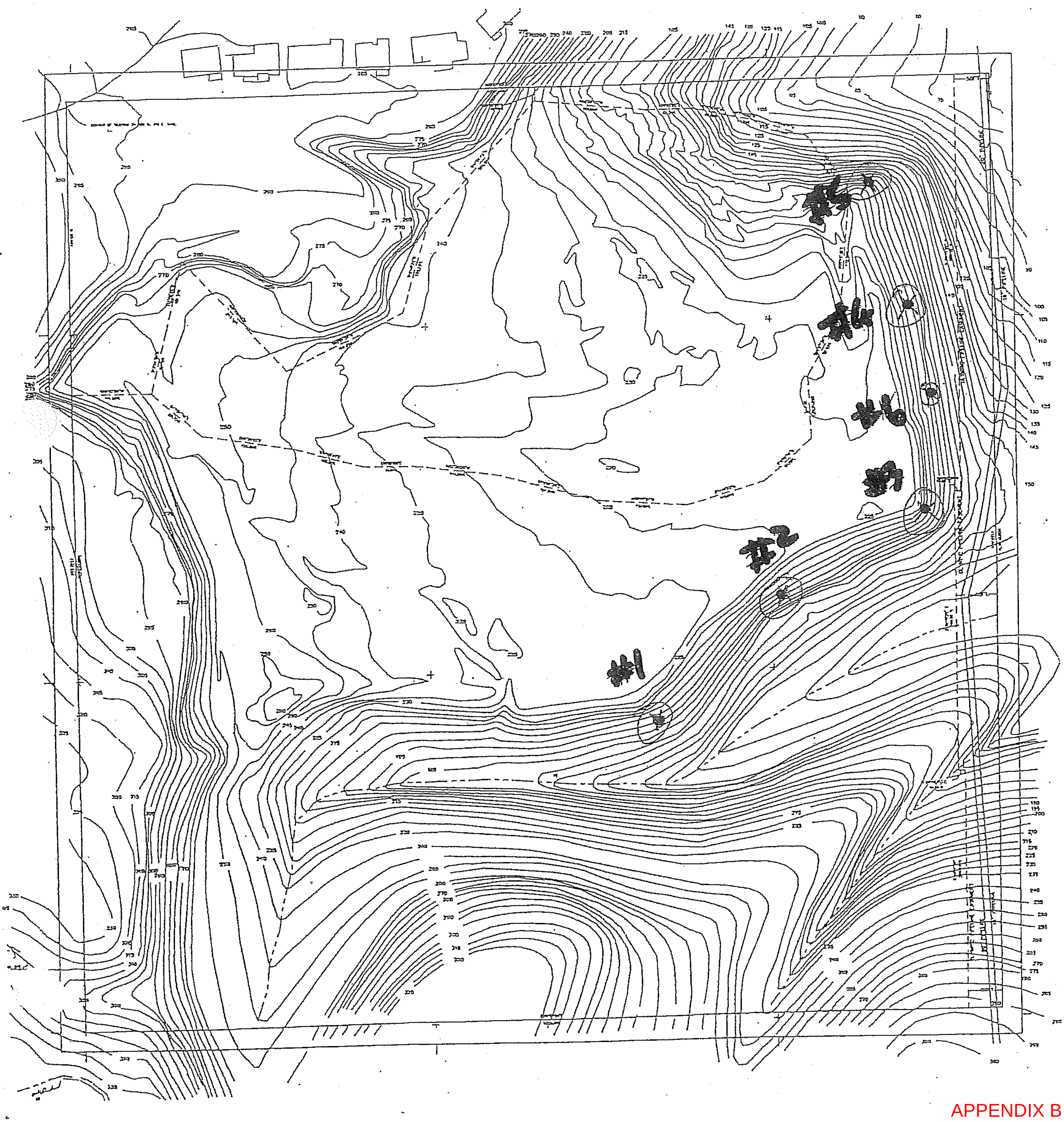
Drinking water Std.
* old Std = 0.05
current = 0.01

→ Go-East Landfill Ground water Sampling

→ 3/3/04 -

→ 6 sample site all @ 190'-200' above Sealevel.

Sample sites will be @ springs exiting The hillside.



APPENDIX B

EDGE ANALYTICAL

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March 22, 2004

Geoffrey Crofoot
Snohomish Health District
3020 Rucker Ave Ste 104
Everett, WA 98201

RE: 04-1319 - SHD15017/Go-East

Dear Geoffrey Crofoot,

Your project: SHD15017/Go-East, was received on Thursday March 04, 2004.
All samples were analyzed within the accepted holding times, were appropriately preserved and were analyzed according to approved analytical protocols. The quality control data was within laboratory acceptance limits.

If you have questions phone me at 800 755-9295.

Respectfully Submitted,

L. J. Henderson, PhD
Laboratory Director

Enclosure Data Report
QC Reports
Chain of Custody

Reference Number: 04-1319
Report Date: 3/15/2004

Data Report

Collected By:

Date Received: 3/4/2004

Analyte	Result	PQL	MDL	Units	DF	Method	Analyzed	Analyst	Batch	Comments
SELENIUM	ND	0.005	0.00009	mg/L	1.0	200.8/200.2	3/11/2004	MVP	200.8D040311	
SILVER	ND	0.001	0.00003	mg/L	1.0	200.8/200.2	3/11/2004	MVP	200.8D040311	
THALLIUM	ND	0.001	0.00003	mg/L	1.0	200.8/200.2	3/11/2004	MVP	200.8D040311	
ZINC	ND	0.005	0.00006	mg/L	1.0	200.8/200.2	3/11/2004	MVP	200.8D040311	

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PQL = Practical Quantitation Limit is the lowest level that can be acheived within specified limits of precision and accuracy during routine laboratory operating conditions.
ND = Not detected above the listed practical quantitation limit (PQL)
D.F. - Dilution Factor

WSDOE Lab C057
WSDOH Lab 046

APPENDIX B

FORM: Multi RESULT

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WSDOE Lab C057

DATA REPORT

Client Name: Snohomish Health District
3020 Rucker Ave Ste 104
Everett, WA 98201

Reference Number: 04-1319
Project: SHD15017/Go-East

Lab Number: 2607
Field ID: G1
Sample Description: Seap
Matrix: Water
Collect Date: 3/3/2004
Extraction Date: 3/9/2004
Extraction Method: 3510C

Report Date: 3/22/2004
Date Analyzed: 3/17/2004
Analyst: CHM
Review:
Analytical Method: 8270C

Carcinogenic PAHs

CAS ID#	COMPOUNDS	RESULT*	Units	PQL	MDL	D.F.	Batch	COMMENT
	- Polynuclear Aromatic Hydrocarbons (PAHs)							
56-55-3	BENZ[A]ANTHRACENE	ND	ug/L	0.1		1.0	8270_040309	
50-32-8	BENZO[A]PYRENE	ND	ug/L	0.1		1.0		
205-99-2	BENZO[B]FLUORANTHENE	ND	ug/L	0.1		1.0		
207-08-9	BENZO[K]FLUORANTHENE	ND	ug/L	0.1		1.0		
218-01-9	CHRYSENE	ND	ug/L	0.1		1.0		
53-70-3	DIBENZO[A,H]ANTHRACENE	ND	ug/L	0.1		1.0		
39-5	INDENO[1,2,3,C,D]PYRENE	ND	ug/L	0.1		1.0		

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Result of: NA - indicates the compound was not analyzed.
Alpha chacters following a numeric value are data qualifiers. If there are data qualifiers on your report definitions can be found on an accompanying sheet.
ND - indicates the compound was not detected above the PQL or MDL.

PQL = Practical Quantitation Limit is the lowest level that can be acheived within specified limits of precision and accuracy during routine laboratory operating conditions.
D.F. - Dilution Factor.

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WSDOE Lab C057

DATA REPORT

Client Name: Snohomish Health District
3020 Rucker Ave Ste 104
Everett, WA 98201

Reference Number: 04-1319
Project: SHD15017/Go-East

Lab Number: 2608
Field ID: G-2
Sample Description: stream
Matrix: Water
Collect Date: 3/3/2004
Extraction Date: 3/9/2004
Extraction Method: 3510C

Report Date: 3/22/2004
Date Analyzed: 3/17/2004
Analyst: CHM
Review: TW
Analytical Method: 8270C

Carcinogenic PAHs

CAS ID#	COMPOUNDS	RESULT*	Units	PQL	MDL	D.F.	Batch	COMMENT
	Polynuclear Aromatic Hydrocarbons (PAHs)							
56-55-3	BENZ[A]ANTHRACENE	ND	ug/L	0.1		1.0	8270_040309	
50-32-8	BENZO[A]PYRENE	ND	ug/L	0.1		1.0		
205-99-2	BENZO[B]FLUORANTHENE	ND	ug/L	0.1		1.0		
207-08-9	BENZO[K]FLUORANTHENE	ND	ug/L	0.1		1.0		
218-01-9	CHRYSENE	ND	ug/L	0.1		1.0		
-3-70-3	DIBENZO[A,H]ANTHRACENE	ND	ug/L	0.1		1.0		
-39-5	INDENO[1,2,3,C,D]PYRENE	ND	ug/L	0.1		1.0		

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Result of: NA - indicates the compound was not analyzed.
Alpha chacters following a numeric value are data qualifiers. If there are data qualifiers on your report definitions can be found on an accompanying sheet.
ND - indicates the compound was not detected above the PQL or MDL.

PQL = Practical Quantitation Limit is the lowest level that can be acheived within specified limits of precision and accuracy during routine laboratory operating conditions.
D.F. - Dilution Factor.

EDGE ANALYTICAL

QUALITY CONTROL REPORT
SURROGATE REPORT

Reference Number: 04-1319
Report Date: 03/22/04

Lab No	Analyte	Result	Units	Method	Limit
8270_040309 2607	2 - FLUOROBIPHENYL (Surr)	91	%	8270C	Acceptance Limits 28-130%
	d5-NITROBENZENE (Surr)	93	%		Acceptance Limits 43-127%
	p-TERPHENYL-d14 (Surr)	86	%		Acceptance Limits 66-138%
8270_040309 2608	2 - FLUOROBIPHENYL (Surr)	95	%	8270C	Acceptance Limits 28-130%
	d5-NITROBENZENE (Surr)	93	%		Acceptance Limits 43-127%
	p-TERPHENYL-d14 (Surr)	90	%		Acceptance Limits 66-138%

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*Notation:

A surrogate is a pure compound added to a sample in the laboratory just before processing so that the overall efficiency of a method can be determined.

The Acceptance Limits (or Control Limits) approximate a 99% confidence interval around the mean recovery.

APPENDIX B

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QUALITY CONTROL REPORT
BLANK REPORT

Reference Number: 04-1319
Report Date: 03/22/04

Batch	Analyte	Result	Units	Limit	QC Qualifier	Method	Type*	Comments
200.8D040311	BERYLLIUM	ND	mg/L	0.00		200.8	LRB	
	CHROMIUM	ND	mg/L	0.00		200.8	LRB	
	NICKEL	ND	mg/L	0.00		200.8	LRB	
	COPPER	ND	mg/L	0.01		200.8	LRB	
	ZINC	ND	mg/L	0.02		200.8	LRB	
	ARSENIC	ND	mg/L	0.01		200.8	LRB	
	SELENIUM	ND	mg/L	0.00		200.8	LRB	
	SILVER	ND	mg/L	0.00		200.8	LRB	
	CADMIUM	ND	mg/L	0.00		200.8	LRB	
	ANTIMONY	ND	mg/L	0.00		200.8	LRB	
	THALLIUM	ND	mg/L	0.00		200.8	LRB	
	LEAD	ND	mg/L	0.00		200.8	LRB	
Hg_040308	MERCURY	ND	mg/L	0.00		245.1	LRB	
I040304A	NITRATE-N	ND	mg/L	0.10		300.0	LRB	
	SULFATE	ND	mg/L	0.10		300.0	LRB	
TOC_040304	TOTAL ORGANIC CARBON	ND	mg/L	0.50		SM5310 B	LRB	
200.8D040311	BERYLLIUM	ND	mg/L	0.00		200.8	MB	
	BERYLLIUM	ND	mg/L	0.00		200.8	MB	
	CHROMIUM	ND	mg/L	0.00		200.8	MB	
	CHROMIUM	ND	mg/L	0.00		200.8	MB	
	NICKEL	ND	mg/L	0.00		200.8	MB	
	NICKEL	ND	mg/L	0.00		200.8	MB	
	COPPER	ND	mg/L	0.00		200.8	MB	
	COPPER	ND	mg/L	0.00		200.8	MB	
	ZINC	ND	mg/L	0.00		200.8	MB	
	ZINC	0.001	mg/L	0.00		200.8	MB	
	ARSENIC	ND	mg/L	0.00		200.8	MB	
	ARSENIC	ND	mg/L	0.00		200.8	MB	
	SELENIUM	ND	mg/L	0.00		200.8	MB	
	SELENIUM	ND	mg/L	0.00		200.8	MB	
	SILVER	ND	mg/L	0.00		200.8	MB	
	SILVER	ND	mg/L	0.00		200.8	MB	
	CADMIUM	ND	mg/L	0.00		200.8	MB	
	CADMIUM	ND	mg/L	0.00		200.8	MB	

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*Notation:

LRB: Laboratory Reagent Blanks are used to determine the background level of the analytes in a laboratory batch. Therefore, this report may include analytes not requested for your submitted samples.

MB: Method Blanks are used to determine background levels of analytes in digested and extracted laboratory reagent water.

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QUALITY CONTROL REPORT
BLANK REPORT

Reference Number: 04-1319
Report Date: 03/22/04

Batch	Analyte	Result	Units	Limit	QC Qualifier	Method	Type*	Comments
200.8D040311	ANTIMONY	ND	mg/L	0.00		200.8	MB	
	ANTIMONY	ND	mg/L	0.00		200.8	MB	
	THALLIUM	ND	mg/L	0.00		200.8	MB	
	THALLIUM	ND	mg/L	0.00		200.8	MB	
	LEAD	ND	mg/L	0.00		200.8	MB	
	LEAD	ND	mg/L	0.00		200.8	MB	
8270_040309	BENZ[A]ANTHRACENE	ND	ug/L	0.02		8270C	MB	
	BENZO[A]PYRENE	ND	ug/L	0.02		8270C	MB	
	BENZO[B]FLUORANTHENE	ND	ug/L	0.02		8270C	MB	
	BENZO[K]FLUORANTHENE	ND	ug/L	0.02		8270C	MB	
	CHRYSENE	ND	ug/L	0.02		8270C	MB	
	DIBENZO[A,H]ANTHRACENE	ND	ug/L	0.02		8270C	MB	
	INDENO[1,2,3,C,D]PYRENE	ND	ug/L	0.02		8270C	MB	
	2 - FLUOROBIPHENYL (Surr)	67	%			8270C	MB	
	p-TERPHENYL-d14 (Surr)	127	%			8270C	MB	

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MB: Method Blanks are used to determine background levels of analytes in digested and extracted laboratory reagent water.

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QUALITY CONTROL REPORT
QCS/LFB REPORT

Reference Number: 04-1319
Report Date: 03/22/04

Batch	Analyte	Result	True Value	Units	Method	% Recovery	Limits	QC Qualifier	Type*	Comment
200.8D040311	BERYLLIUM	0.039	0.040	mg/L	200.8	98	85-115		LFB	
	CHROMIUM	0.040	0.040	mg/L	200.8	100	85-115		LFB	
	NICKEL	0.039	0.040	mg/L	200.8	98	85-115		LFB	
	COPPER	0.040	0.040	mg/L	200.8	100	85-115		LFB	
	ZINC	0.0406	0.040	mg/L	200.8	102	85-115		LFB	
	ARSENIC	0.039	0.040	mg/L	200.8	98	85-115		LFB	
	SELENIUM	0.039	0.040	mg/L	200.8	98	85-115		LFB	
	SILVER	0.039	0.040	mg/L	200.8	98	85-115		LFB	
	CADMIUM	0.039	0.040	mg/L	200.8	98	85-115		LFB	
	ANTIMONY	0.038	0.040	mg/L	200.8	95	85-115		LFB	
	THALLIUM	0.040	0.040	mg/L	200.8	100	85-115		LFB	
	LEAD	0.040	0.040	mg/L	200.8	100	85-115		LFB	
).8D040311	BERYLLIUM	0.042	0.040	mg/L	200.8	105	85-115		LFB	
	CHROMIUM	0.043	0.040	mg/L	200.8	108	85-115		LFB	
	NICKEL	0.042	0.040	mg/L	200.8	105	85-115		LFB	
	COPPER	0.043	0.040	mg/L	200.8	108	85-115		LFB	
	ZINC	0.042	0.040	mg/L	200.8	105	85-115		LFB	
	ARSENIC	0.041	0.040	mg/L	200.8	103	85-115		LFB	
	SELENIUM	0.041	0.040	mg/L	200.8	103	85-115		LFB	
	SILVER	0.042	0.040	mg/L	200.8	105	85-115		LFB	
	CADMIUM	0.042	0.040	mg/L	200.8	105	85-115		LFB	
	ANTIMONY	0.040	0.040	mg/L	200.8	100	85-115		LFB	
	THALLIUM	0.041	0.040	mg/L	200.8	103	85-115		LFB	
	LEAD	0.043	0.040	mg/L	200.8	108	85-115		LFB	
8270_040309	BENZ[A]ANTHRACENE	8.3	10	ug/L	8270C	83	33-143		LFB	
	BENZO[A]PYRENE	8.6	10	ug/L	8270C	86	17-163		LFB	
	BENZO[B]FLUORANTHENE	9.3	10	ug/L	8270C	93	24-159		LFB	
	BENZO[K]FLUORANTHENE	8.5	10	ug/L	8270C	85	11-162		LFB	
	CHRYSENE	8.8	10	ug/L	8270C	88	17-168		LFB	
	DIBENZO[A,H]ANTHRACENE	8.5	10	ug/L	8270C	85	1-227		LFB	
	INDENO[1,2,3,C,D]PYRENE	8.6	10	ug/L	8270C	86	1-171		LFB	
	2 - FLUOROBIPHENYL (Surr)	108		%	8270C	NA	NA		LFB	
	p-TERPHENYL-d14 (Surr)	130		%	8270C	NA	NA		LFB	
Hg_040308	MERCURY	0.00196	0.0020	mg/L	245.1	98	80-120		LFB	

›tation:

% Recovery = (Result of Analysis)/(True Value) * 100

NA = Indicates % Recovery could not be calculated.

QCS: Quality Control Sample, a solution containing known concentrations of method analytes which is used to fortify an aliquot of reagent matrix. The QCS is obtained from an externa source and is used to check lab performance.

LFB: Laboratory Fortified Blank, an aliquot of reagent matrix to which known quantities of method analytes are added in the lab. The LFB is analyzed exactly like a sample, and its purpose is to determine whether method performance is within accepted control limits.

APPENDIX B

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QUALITY CONTROL REPORT
QCS/LFB REPORT

Reference Number: 04-1319
Report Date: 03/22/04

Batch	Analyte	Result	True Value	Units	Method	% Recovery	Limits	QC Qualifier	Type*	Comment
TOC_040304	TOTAL ORGANIC CARBON	0.98	1.0	mg/L	SM5310 B	98	90-110		LFB	
200.8D040311	BERYLLIUM	0.040	0.040	mg/L	200.8	100	85-115		QCS	
	CHROMIUM	0.040	0.040	mg/L	200.8	100	85-115		QCS	
	NICKEL	0.039	0.040	mg/L	200.8	98	85-115		QCS	
	COPPER	0.040	0.040	mg/L	200.8	100	85-115		QCS	
	ZINC	0.040	0.040	mg/L	200.8	100	85-115		QCS	
	ARSENIC	0.039	0.040	mg/L	200.8	98	85-115		QCS	
	SELENIUM	0.039	0.040	mg/L	200.8	98	85-115		QCS	
	SILVER	0.040	0.040	mg/L	200.8	100	85-115		QCS	
	CADMIUM	0.039	0.040	mg/L	200.8	98	85-115		QCS	
	ANTIMONY	0.038	0.040	mg/L	200.8	95	85-115		QCS	
	THALLIUM	0.040	0.040	mg/L	200.8	100	85-115		QCS	
	LEAD	0.040	0.040	mg/L	200.8	100	85-115		QCS	
Hg_040308	MERCURY	0.00259	0.0025	mg/L	245.1	104	80-120		QCS	
I040304A	NITRATE-N	2.55	2.50	mg/L	300.0	102	80-120		QCS	
	SULFATE	29	30	mg/L	300.0	97	80-120		QCS	
TOC_040304	TOTAL ORGANIC CARBON	1.67	1.65	mg/L	SM5310 B	101	90-110		QCS	

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otation:

% Recovery = (Result of Analysis)/(True Value) * 100

NA = Indicates % Recovery could not be calculated.

QCS: Quality Control Sample, a solution containing known concentrations of method analytes which is used to fortify an aliquot of reagent matrix. The QCS is obtained from an externa source and is used to check lab performance.

LFB: Laboratory Fortified Blank, an aliquot of reagent matrix to which known quantities of method analytes are added in the lab. The LFB is analyzed exactly like a sample, and its purpose is to determine whether method performance is within accepted control limits.

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QUALITY CONTROL REPORT
Duplicate Report

Reference Number: 04-1319
Report Date: 03/22/04

Batch	Duplicate Sample	Analyte	Result	Duplicate Result	Units	Method	%RPD	Limits	QC Qualifier
200.8D040311	2477	COPPER	13	13	ug/L	200.8	0.0	0-45	
		CADMIUM	ND	ND	ug/L	200.8	NA	0-45	
		LEAD	2.0	2.0	ug/L	200.8	0.0	0-45	
	2546	BERYLLIUM	ND	ND	ug/L	200.8	NA	0-45	
		CHROMIUM	4.1	4.4	ug/L	200.8	7.1	0-45	
		NICKEL	5.1	5.6	ug/L	200.8	9.3	0-45	
		COPPER	96	97	ug/L	200.8	1.0	0-45	
		ZINC	264	264	ug/L	200.8	0.0	0-45	
		ARSENIC	1.8	1.6	ug/L	200.8	11.8	0-45	
		SELENIUM	1.7	2.1	ug/L	200.8	21.1	0-45	
		SILVER	3.3	3.7	ug/L	200.8	11.4	0-45	
		CADMIUM	0.6	0.6	ug/L	200.8	0.0	0-45	
		THALLIUM	ND	ND	ug/L	200.8	NA	0-45	
		LEAD	6.3	6.3	ug/L	200.8	0.0	0-45	
	2635	BERYLLIUM	ND		ug/L	200.8		0-45	
		CHROMIUM	4.4	4.3	ug/L	200.8	2.3	0-45	
		NICKEL	5.0	5.2	ug/L	200.8	3.9	0-45	
		COPPER	79	77	ug/L	200.8	2.6	0-45	
		ZINC	163	164	ug/L	200.8	0.6	0-45	
		ARSENIC	1.5	1.4	ug/L	200.8	6.9	0-45	
		SELENIUM	1.2	1.2	ug/L	200.8	0.0	0-45	
		SILVER	3.4	3.3	ug/L	200.8	3.0	0-45	
		CADMIUM	0.4	0.4	ug/L	200.8	0.0	0-45	
		THALLIUM	ND	ND	ug/L	200.8	NA	0-45	
		LEAD	5.4	5.2	ug/L	200.8	3.8	0-45	
HG_040308	2468	MERCURY	ND	ND	mg/L	245.1	NA	0-45	
	2551	MERCURY	ND	ND	mg/L	245.1	NA	0-45	
	2610	MERCURY	ND	ND	mg/L	245.1	NA	0-45	
	2651	MERCURY	ND	ND	mg/L	245.1	NA	0-45	
I040304A	2587	NITRATE-N	1.51	1.49	mg/L	300.0	1.3	0-45	
		SULFATE	25	25	mg/L	300.0	0.0	0-45	
	2610	NITRATE-N	ND	ND	mg/L	300.0	NA	0-45	
		SULFATE	15	15	mg/L	300.0	0.0	0-45	
TOC_040304	2608	TOTAL ORGANIC CARBON	3.63	3.60	mg/L	SM5310 B	0.8	0-50	

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%RPD = Relative Percent Difference
NA = Indicates %RPD could not be calculated

Duplicate analysis is used to validate all samples processed in a laboratory batch. Therefore, the duplicate analysis results in this report may not have come from the samples you submitted or may include analytes not requested.

APPENDIX B

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QUALITY CONTROL REPORT

Matrix Spike/Matrix Spike Duplicate Report

Reference Number: 04-1319
Report Date: 3/22/2004

Batch	Sample	Analyte	Result	Spike Result	Duplicate Spike Result	Spike Conc	Units	Percent Recovery MS	Percent Recovery MSD	Limits	%RPD	Limits	QC Qualifier	Comments
200.8D040311	2477	COPPER	13	23		10	ug/L	100		70-130	NA	0-60		
		CADMIUM	ND	9.7		10	ug/L	97		70-130	NA	0-60		
		LEAD	2.0	12		10	ug/L	100		70-130	NA	0-60		
	2546	BERYLLIUM	ND	40		40	ug/L	100		70-130	NA	0-60		
		CHROMIUM	4.1	44		40	ug/L	100		70-130	NA	0-60		
		NICKEL	5.1	40.5		40	ug/L	89		70-130	NA	0-60		
		COPPER	96	129		40	ug/L	83		70-130	NA	0-60		
		ZINC	264	288		40	ug/L	60		70-130	NA	0-60	S	SPIKE <1:5 COMPARED TO BACKGROUND
		ARSENIC	1.8	40		40	ug/L	96		70-130	NA	0-60		
		SELENIUM	1.7	35		40	ug/L	83		70-130	NA	0-60		
		SILVER	3.3	40		40	ug/L	92		70-130	NA	0-60		
		CADMIUM	0.6	39		40	ug/L	96		70-130	NA	0-60		
		THALLIUM	ND	39		40	ug/L	98		70-130	NA	0-60		
		LEAD	6.3	45		40	ug/L	97		70-130	NA	0-60		
	2635	BERYLLIUM	ND	41.6		40	ug/L	104		70-130	NA	0-60		
		CHROMIUM	4.4	46		40	ug/L	104		70-130	NA	0-60		
		NICKEL	5.0	42		40	ug/L	93		70-130	NA	0-60		
		COPPER	79	114		40	ug/L	88		70-130	NA	0-60		
		ZINC	163	193		40	ug/L	75		70-130	NA	0-60		
		ARSENIC	1.5	41.6		40	ug/L	100		70-130	NA	0-60		
		SELENIUM	1.2	40		40	ug/L	97		70-130	NA	0-60		
		SILVER	3.4	42.6		40	ug/L	98		70-130	NA	0-60		
		CADMIUM	0.4	40		40	ug/L	99		70-130	NA	0-60		
		THALLIUM	ND	40.9		40	ug/L	102		70-130	NA	0-60		
		LEAD	5.4	46		40	ug/L	102		70-130	NA	0-60		

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APPENDIX B

%RPD = Relative Percent Difference
NA = Indicates %RPD could not be calculated

Matrix Spike (M[illegible] Matrix Spike Duplicate (MSD) analyses are used to determine the accuracy (MS) and precisi[illegible] MSD) of a analytical method in a given sample matrix. Therefore, the usefulness of this report is limited to samples of similar matrice[illegible] yzed in the same analytical batch.

Batch	Sample	Analyte	Result	Spike Result	Duplicate Spike Result	Spike Conc	Units	Percent Recovery MS	MSD	Limits	%RPD	Limits	QC Qualifier	Comments
8270_040309	2537	BENZ[A]ANTHRACENE	ND	7.2		10	ug/L	72	NA	33-143	NA	0-60		
		BENZO[A]PYRENE	ND	7.8		10	ug/L	78	NA	17-163	NA	0-60		
		BENZO[B]FLUORANTHENE	ND	8.6		10	ug/L	86	NA	24-159	NA	0-60		
		BENZO[K]FLUORANTHENE	ND	7.4		10	ug/L	74	NA	11-162	NA	0-60		
		CHRYSENE	ND	8.4		10	ug/L	84	NA	17-168	NA	0-60		
		DIBENZO[A,H]ANTHRACENE	ND	7.7		10	ug/L	77	NA	1-227	NA	0-60		
		INDENO[1,2,3,C,D]PYRENE	ND	7.2		10	ug/L	72	NA	1-171	NA	0-60		
		2 - FLUOROBIPHENYL (Surr)	107	107			%		NA		NA			
		p-TERPHENYL-d14 (Surr)	126	119			%		NA		NA			
HG_040308	2468	MERCURY	ND	0.00195	0.00194	0.0020	mg/L	98	97	80-120	1.0	0-60		
	2551	MERCURY	ND	0.00201	0.00199	0.0020	mg/L	101	100	80-120	1.0	0-60		
	2610	MERCURY	ND	0.00204	0.00204	0.0020	mg/L	102	102	80-120	0.0	0-60		
	2651	MERCURY	ND	0.00178	0.00170	0.0020	mg/L	89	85	80-120	4.6	0-60		
I040304A	2587	NITRATE-N	1.51	2.61		1.00	mg/L	110	NA	80-120	NA	0-60		
	2610	NITRATE-N	ND	1.24		1.00	mg/L	124	NA	80-120	NA	0-60		
		SULFATE	15	17		2.00	mg/L	100	NA	80-120	NA	0-60		
	2639	NITRATE-N	0.2	1.22		1.00	mg/L	102	NA	80-120	NA	0-60		
TOC_040304	2344	TOTAL ORGANIC CARBON	1.16	2.09	2.14	1.0	mg/L	93	98	70-130	5.2	0-50		

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APPENDIX B

%RPD = Relative Percent Difference

NA = Indicates %RPD could not be calculated

Matrix Spike (MS)/Matrix Spike Duplicate (MSD) analyses are used to determine the accuracy (MS) and precision (MSD) of a analytical method in a given sample matrix. Therefore, the usefulness of this report is limited to samples of similar matrices analyzed in the same analytical batch.

EDGE ANALYTICAL

Qualifier Definitions

Reference Number: 04-1319
Report Date: 03/22/04

Qualifier	Definition
S	Spiking amount was lower than the 5:1 spike to background (sample amount) basis for performance criteria. The reported criteria does not apply due to increased errors in measurement of both sample and spike concentration. The results are reported for prec

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Note: Some qualifier definitions found on this page may pertain to results or QC data which are not printed with this report.

04-1514

CHAIN OF CUSTODY RECORD

EDGE ANALYTICAL
11525 KNUDSON ROAD
BURLINGTON, WA 98233
PHONE 360 757-1400
800 755-9295
FAX 360 757-1402

SUBMIT REPORT TO:

NAME Geoffrey Crofoot
ADDRESS 3020 Rucker
Everett WA 98201
PROJECT NAME Go-East
PHONE/FAX 425-339-5250
JOB/P.O. NO. — CONTACT
SAMPLER (SIGNATURE) GWC

BILLING INFO

NAME Gary Honda
ADDRESS 3020 Rucker
Suite 104. Everett WA 98201
ATTN:
VISA ☐ MC ☐ CARDHOLDER
CARD # EXP / /

JCN
PAGE 1 OF 1
DATE 3/3/04

2003 Udder Health Systems, Inc.
Refer to this number in inquires
15017
Bottle Number

INSTRUCTIONS

1. USE ONE LINE PER SAMPLE
2. BE SPECIFIC IN TEST REQUESTS
3. CHECK OFF TESTS TO BE PERFORMED FOR EACH SAMPLE

TURN AROUND REQUEST

☐ STANDARD
☐ 5 DAYS (50% SURCHARGE)
☐ 1 - 2 DAYS (100% SURCHARGE)
☐ OTHER

TESTS TO PERFORM

NO.	SAMPLE ID	DESCRIPTION	GRAB/COMP.	MATRIX	DATE	TIME	Carcinogenic PAH	Phthalates / Sulfates	PP metals	TOC						NO. OF CONTAINERS	PRESERVATIVE	OBSERVATIONS, COMMENTS, SPECIAL INSTRUCTIONS
1	G-1	Seep	X	H2O	3/2/04	12:10	X	X	X	X								
2	G-2	Stream	X	H2O	〃	12:15	X	X	X	X								TOC bottle labeled
3																		Seep has field
4																		ID G-2 written
5																		
6																		
7																		
8																		
9																		
10																		
11																		
12																		
13																		
14																		

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TOTAL NO. OF CONTAINERS

RELINQUISHED BY (SIGN AND PRINT)	DATE / TIME	RECEIVED BY (SIGN AND PRINT)	DATE / TIME
Geoffrey W. Crofoot GWC	2:15 / 3/3/04	Mary E. Morehart	3-3-04 2:15 pm
Marilyn McKim	3/4/04 / 10:25	Tim Fowler / Tim Fowler	3-4-04 10:25 AM

recd Mary [illegible] 3/4/05 12:??

CHAIN OF CUSTODY SEALS ☐ YES ☐ NO ☐ NA

SHIPPED VIA ☐ UPS ☐ FED EX ☐ OTHER

APPENDIX B

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Burlington, WA 98233
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Snohomish Health District Environmental Health

Data Report

Client Name: Snohomish Health District
3020 Rucker Ave Ste 104
Everett, WA 98201

Report Date: 3/15/2004
Reference Number: 04-1319
Project: SHD15017/Go-East

Collected By:

Date Received: 3/4/2004
Supervisor: YM

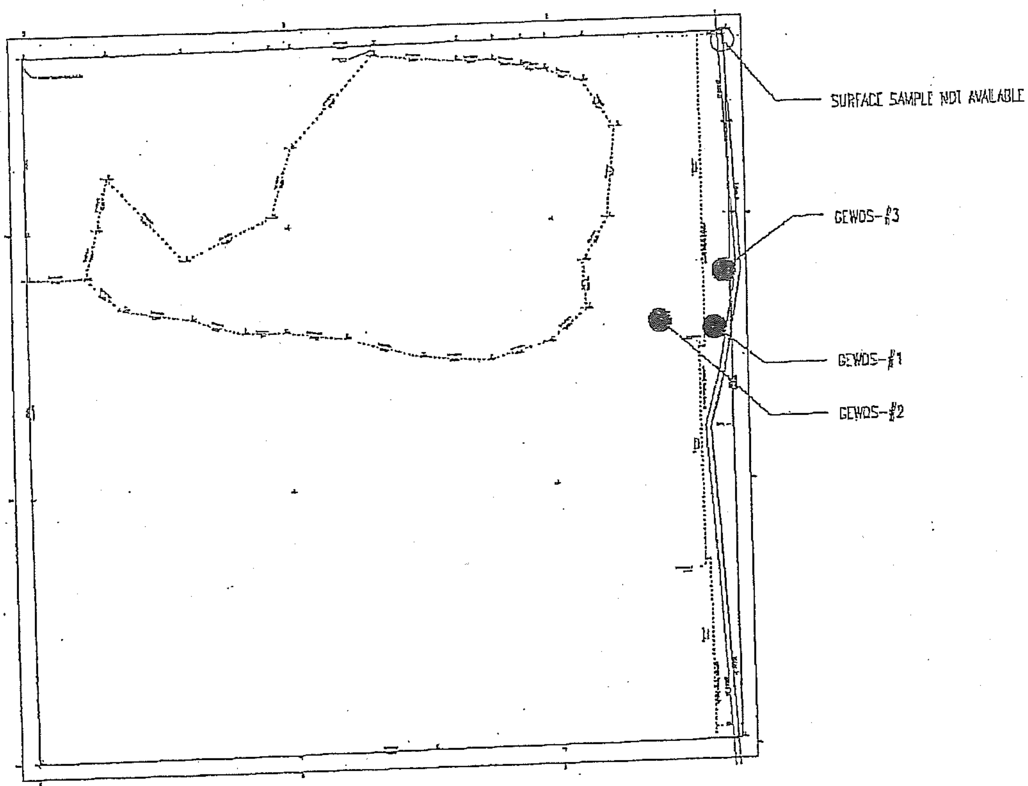
Analyte	Result	PQL	MDL	Units	DF	Method	Analyzed	Analyst	Batch	Comments
Lab Number: 2607	Sample Description: G1 - Seap						Sample Date: 3/3/2004			
NITRATE-N	1.72	0.1	0.015	mg/L	1.0	300.0	3/4/2004	MVP	I040304A	
SULFATE	5	1	0.04	mg/L	1.0	300.0	3/4/2004	MVP	I040304A	
TOTAL ORGANIC CARBON	9.93	0.5	0.06	mg/L	1.0	SM5310 B	3/4/2004	TW	TOC_040304	
ANTIMONY	ND	0.001	0.00004	mg/L	1.0	200.8/200.2	3/11/2004	MVP	200.8D040311	
ARSENIC	0.003	0.001	0.00003	mg/L	1.0	200.8/200.2	3/11/2004	MVP	200.8D040311	
BERYLLIUM	ND	0.001	0.00005	mg/L	1.0	200.8/200.2	3/11/2004	MVP	200.8D040311	
CADMIUM	ND	0.001	0.00002	mg/L	1.0	200.8/200.2	3/11/2004	MVP	200.8D040311	
CHROMIUM	0.002	0.005	0.0001	mg/L	1.0	200.8/200.2	3/11/2004	MVP	200.8D040311	
COPPER	ND	0.005	0.00004	mg/L	1.0	200.8/200.2	3/11/2004	MVP	200.8D040311	
LEAD	0.001	0.001	0.00002	mg/L	1.0	200.8/200.2	3/11/2004	MVP	200.8D040311	
MERCURY	ND	0.0005	0.0005	mg/L	1.0	245.1	3/8/2004	SV	Hg_040308	
NICKEL	0.004	0.001	0.00005	mg/L	1.0	200.8/200.2	3/11/2004	MVP	200.8D040311	
SELENIUM	ND	0.005	0.00009	mg/L	1.0	200.8/200.2	3/11/2004	MVP	200.8D040311	
SILVER	ND	0.001	0.00003	mg/L	1.0	200.8/200.2	3/11/2004	MVP	200.8D040311	
THALLIUM	ND	0.001	0.00003	mg/L	1.0	200.8/200.2	3/11/2004	MVP	200.8D040311	
ZINC	0.010	0.005	0.00006	mg/L	1.0	200.8/200.2	3/11/2004	MVP	200.8D040311	
Lab Number: 2608	Sample Description: G-2 - stream						Sample Date: 3/3/2004			
NITRATE-N	ND	0.1	0.015	mg/L	1.0	300.0	3/4/2004	MVP	I040304A	
SULFATE	ND	1	0.04	mg/L	1.0	300.0	3/4/2004	MVP	I040304A	
TOTAL ORGANIC CARBON	3.63	0.5	0.06	mg/L	1.0	SM5310 B	3/4/2004	TW	TOC_040304	
ANTIMONY	ND	0.001	0.00004	mg/L	1.0	200.8/200.2	3/11/2004	MVP	200.8D040311	
ARSENIC	0.055	0.001	0.00003	mg/L	1.0	200.8/200.2	3/11/2004	MVP	200.8D040311	
BERYLLIUM	ND	0.001	0.00005	mg/L	1.0	200.8/200.2	3/11/2004	MVP	200.8D040311	
CADMIUM	ND	0.001	0.00002	mg/L	1.0	200.8/200.2	3/11/2004	MVP	200.8D040311	
CHROMIUM	ND	0.005	0.0001	mg/L	1.0	200.8/200.2	3/11/2004	MVP	200.8D040311	
COPPER	ND	0.005	0.00004	mg/L	1.0	200.8/200.2	3/11/2004	MVP	200.8D040311	
LEAD	ND	0.001	0.00002	mg/L	1.0	200.8/200.2	3/11/2004	MVP	200.8D040311	
MERCURY	ND	0.0005	0.0005	mg/L	1.0	245.1	3/8/2004	SV	Hg_040308	
NICKEL	0.002	0.001	0.00005	mg/L	1.0	200.8/200.2	3/11/2004	MVP	200.8D040311	

PQL = Practical Quantitation Limit is the lowest level that can be acheived within specified limits of precision and accuracy during routine laboratory operating conditions.
ND = Not detected above the listed practical quantitation limit (PQL)
D.F. - Dilution Factor

WSDOE Lab C057
WSDOH Lab 046

APPENDIX B

GO-EAST SURFACE WATER TESTS
FOR
LANDFILL LEACHATE



NORTH CREEK ANALYTICAL
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SPOKANE ▫ (509) 924-9200 ▫ FAX 924-9290
PORTLAND ▫ (503) 643-9200 ▫ FAX 644-2202

Bober, Robert G. Jr. 11818 Military Road South Seattle, WA 98168	Project: Go-East Landfill Project Number: #970501 Project Manager: Robert G. Bober	Sampled: 9/29/97 Received: 9/29/97 Reported: 10/24/97 16:53

ANALYTICAL REPORT FOR SAMPLES:

Sample Description	Laboratory Sample Number	Sample Matrix	Date Sampled
GEWQS #1	B709601-01	Water	9/29/97
GEWQS #2	B709601-02	Water	9/29/97
GEWQS #3	B709601-03	Water	9/29/97

North Creek Analytical, Inc.

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Rebecca Wood
Rebecca Wood, Project Manager

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Bober, Robert G. Jr. 11818 Military Road South Seattle, WA 98168	Project: Go-East Landfill Project Number: #970501 Project Manager: Robert G. Bober	Sampled: 9/29/97 Received: 9/29/97 Reported: 10/24/97 16:53

Total Metals by EPA 6000/7000 Series Methods
North Creek Analytical - Bothell

Analyte	Batch Number	Date Prepared	Date Analyzed	Specific Method	Reporting Limit	Result	Units	Notes*
			B709601-01				Water	
GEWOS #1								
Calcium	1070194	10/8/97	10/10/97	EPA 6010A	0.250	10.7	mg/l	
Iron	"	"	"	EPA 6010A	0.150	0.198	"	
Magnesium	"	"	"	EPA 6010A	0.100	10.6	"	
Manganese	1070564	10/22/97	10/23/97	EPA 6010A	0.00500	ND	"	
Potassium	1070194	10/8/97	10/9/97	EPA 6010A	0.200	2.69	"	
Sodium	"	"	"	EPA 6010A	0.500	6.89	"	
Zinc	"	"	10/10/97	EPA 6010A	0.0200	ND	"	
			B709601-02				Water	
GEWOS #2								
Calcium	1070194	10/8/97	10/10/97	EPA 6010A	0.250	10.3	mg/l	
Iron	"	"	"	EPA 6010A	0.150	ND	"	
Magnesium	"	"	"	EPA 6010A	0.100	10.4	"	
Manganese	1070564	10/22/97	10/23/97	EPA 6010A	0.00500	ND	"	
Potassium	1070194	10/8/97	10/9/97	EPA 6010A	0.200	2.39	"	
Sodium	"	"	"	EPA 6010A	0.500	6.53	"	
Zinc	"	"	10/10/97	EPA 6010A	0.0200	ND	"	
			B709601-03				Water	
GEWOS #3								
Calcium	1070194	10/8/97	10/10/97	EPA 6010A	0.250	15.0	mg/l	
Iron	"	"	"	EPA 6010A	0.150	ND	"	
Magnesium	"	"	"	EPA 6010A	0.100	11.7	"	
Manganese	1070564	10/22/97	10/23/97	EPA 6010A	0.00500	ND	"	
Potassium	1070194	10/8/97	10/9/97	EPA 6010A	0.200	2.05	"	
Sodium	"	"	"	EPA 6010A	0.500	7.28	"	
Zinc	"	"	10/10/97	EPA 6010A	0.0200	ND	"	

**Refer to end of report for text of notes and definitions.*

North Creek Analytical, Inc.

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Bober, Robert G. Jr.
11818 Military Road South
Seattle, WA 98168

Project: Go-East Landfill
Project Number: #970501
Project Manager: Robert G. Bober

Sampled: 9/29/97
Received: 9/29/97
Reported: 10/24/97 16:53

Conventional Chemistry Parameters by APHA/EPA Methods
North Creek Analytical - Bothell

Analyte	Batch Number	Date Prepared	Date Analyzed	Specific Method	Reporting Limit	Result	Units	Notes*
GEWOS #1			B709601-01				Water	
pH	1070003	9/30/97	9/30/97	EPA 150.1		7.55	pH Units	
Fluoride	1070148	10/6/97	10/6/97	EPA 340.2	0.100	ND	mg/l	
Ammonia-Nitrogen	1070166	10/7/97	10/7/97	EPA 350.3	0.100	ND	"	
Chemical Oxygen Demand	1070157	10/6/97	"	EPA 410.4	10.0	ND	"	
Total Organic Carbon	1070612	10/23/97	10/23/97	EPA 415.1	1.00	1.40	"	
Specific Conductivity	1070002	9/30/97	9/30/97	SM 2510B	1.00	174	uS/cm	
GEWOS #2			B709601-02				Water	
pH	1070003	9/30/97	9/30/97	EPA 150.1		7.63	pH Units	
Fluoride	1070148	10/6/97	10/6/97	EPA 340.2	0.100	ND	mg/l	
Ammonia-Nitrogen	1070166	10/7/97	10/7/97	EPA 350.3	0.100	ND	"	
Chemical Oxygen Demand	1070157	10/6/97	"	EPA 410.4	10.0	ND	"	
Total Organic Carbon	1070612	10/23/97	10/23/97	EPA 415.1	1.00	1.05	"	
Specific Conductivity	1070002	9/30/97	9/30/97	SM 2510B	1.00	177	uS/cm	
GEWOS #3			B709601-03				Water	
pH	1070003	9/30/97	9/30/97	EPA 150.1		7.66	pH Units	
Fluoride	1070148	10/6/97	10/6/97	EPA 340.2	0.100	ND	mg/l	
Ammonia-Nitrogen	1070166	10/7/97	10/7/97	EPA 350.3	0.100	ND	"	
Chemical Oxygen Demand	1070157	10/6/97	"	EPA 410.4	10.0	ND	"	
Total Organic Carbon	1070612	10/23/97	10/23/97	EPA 415.1	1.00	1.78	"	
Specific Conductivity	1070002	9/30/97	9/30/97	SM 2510B	1.00	212	uS/cm	

*Refer to end of report for text of notes and definitions.

North Creek Analytical, Inc.

Rebecca Wood

Rebecca Wood, Project Manager

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PORTLAND ▪ (503) 643-9200 ▪ FAX 644-2202

Bober, Robert G. Jr.
11818 Military Road South
Seattle, WA 98168

Project: Go-East Landfill
Project Number: #970501
Project Manager: Robert G. Bober

Sampled: 9/29/97
Received: 9/29/97
Reported: 10/24/97 16:53

Anions by EPA Method 300.0
North Creek Analytical - Bothell

Analyte	Batch Number	Date Prepared	Date Analyzed	Specific Method	Reporting Limit	Result	Units	Notes*
			B709601-01				Water	
GEWOS #1								
Chloride	1070476	10/17/97	10/17/97	EPA 300.0	2.00	5.15	mg/l	
Nitrate-Nitrogen	1070004	9/30/97	9/30/97	EPA 300.0	0.0500	2.53	"	
Nitrite-Nitrogen	"	"	"	EPA 300.0	0.0500	ND	"	
Orthophosphate-phosphorus	"	"	"	EPA 300.0	0.100	ND	"	
Sulfate	1070476	10/17/97	10/17/97	EPA 300.0	1.00	7.50	"	
			B709601-02				Water	
GEWOS #2								
Chloride	1070476	10/17/97	10/17/97	EPA 300.0	0.400	4.67	mg/l	
Nitrate-Nitrogen	1070004	9/30/97	9/30/97	EPA 300.0	0.0500	2.42	"	
Nitrite-Nitrogen	"	"	"	EPA 300.0	0.0500	ND	"	
Orthophosphate-phosphorus	"	"	"	EPA 300.0	0.100	ND	"	
Sulfate	1070476	10/17/97	10/17/97	EPA 300.0	0.200	7.30	"	
			B709601-03				Water	
GEWOS #3								
Chloride	1070476	10/17/97	10/17/97	EPA 300.0	0.400	6.48	mg/l	
Nitrate-Nitrogen	1070004	9/30/97	9/30/97	EPA 300.0	0.0500	3.37	"	
Nitrite-Nitrogen	"	"	"	EPA 300.0	0.0500	ND	"	
Orthophosphate-phosphorus	"	"	"	EPA 300.0	0.100	ND	"	
Sulfate	1070476	10/17/97	10/17/97	EPA 300.0	0.200	9.57	"	

*Refer to end of report for text of notes and definitions.

North Creek Analytical, Inc.

Rebecca Wood, Project Manager

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SPOKANE ▪ (509) 924-9200 ▪ FAX 924-9290
PORTLAND ▪ (503) 643-9200 ▪ FAX 644-2202

Bober, Robert G. Jr.
11818 Military Road South
Seattle, WA 98168

Project: Go-East Landfill
Project Number: #970501
Project Manager: Robert G. Bober

Sampled: 9/29/97
Received: 9/29/97
Reported: 10/24/97 16:53

Conventional Chemistry Parameters per APHA/EPA Methods
North Creek Analytical - Portland

Analyte	Batch Number	Date Prepared	Date Analyzed	Specific Method	Reporting Limit	Result	Units	Notes*
GEWOS #1			B709601-01				Water	
Tannins & Lignins	0970743	10/1/97	10/1/97	SM 5550B	0.250	ND	mg/l	
GEWOS #2			B709601-02				Water	
Tannins & Lignins	0970743	10/1/97	10/1/97	SM 5550B	0.250	ND	mg/l	
GEWOS #3			B709601-03				Water	
Tannins & Lignins	0970743	10/1/97	10/1/97	SM 5550B	0.250	ND	mg/l	

*Refer to end of report for text of notes and definitions.

North Creek Analytical, Inc.

Rebecca Wood

Rebecca Wood, Project Manager

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APPENDIX B

NORTH CREEK ANALYTICAL
Environmental Laboratory Services

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Bober, Robert G. Jr.	Project: Go-East Landfill	Sampled: 9/29/97
11818 Military Road South	Project Number: #970501	Received: 9/29/97
Seattle, WA 98168	Project Manager: Robert G. Bober	Reported: 10/24/97 16:53

Total Metals by EPA 6000/7000 Series Methods/Quality Control
North Creek Analytical - Bothell

Analyte	Date Analyzed	Spike Level	Sample Result	QC Result	Units	Reporting Limit Recov. Limits	Recov. %	RPD Limit	RPD %	Notes*
Batch: 1070194	Date Prepared: 10/8/97				Extraction Method: EPA 3010					
Blank	1070194-BLK1									
Calcium	10/10/97			ND	mg/l	0.250				
Iron	"			ND	"	0.150				
Magnesium	"			ND	"	0.100				
Potassium	10/9/97			ND	"	0.200				
Sodium	"			0.815	"	0.500				3
Zinc	10/10/97			ND	"	0.0200				
LCS	1070194-BS1									
Calcium	10/10/97	1.00		0.975	mg/l	80.0-120	97.5			
Iron	"	1.00		0.977	"	80.0-120	97.7			
Magnesium	"	1.00		0.904	"	80.0-120	90.4			
Potassium	10/9/97	10.0		10.0	"	80.0-120	100			
Sodium	"	2.50		2.68	"	80.0-120	107			
Zinc	10/10/97	1.00		0.938	"	80.0-120	93.8			
Duplicate	1070194-DUP1		B709601-01							
Calcium	10/10/97		10.7	10.4	mg/l			20.0	2.84	
Iron	"		0.198	ND	"			20.0		
Magnesium	"		10.6	10.2	"			20.0	3.85	
Potassium	10/9/97		2.69	2.64	"			20.0	1.88	
Sodium	"		6.89	6.60	"			20.0	4.30	
Zinc	10/10/97		ND	ND	"			20.0		
Matrix Spike	1070194-MS1		B709601-01							
Calcium	10/10/97	1.00	10.7	12.2	mg/l	80.0-120	150			
Iron	"	1.00	0.198	0.960	"	80.0-120	76.2			
Magnesium	"	1.00	10.6	11.8	"	80.0-120	120			
Potassium	10/9/97	10.0	2.69	12.0	"	80.0-120	93.1			
Sodium	"	2.50	6.89	8.88	"	80.0-120	79.6			4
Zinc	10/10/97	1.00	ND	0.902	"	80.0-120	90.2			
Matrix Spike Dup	1070194-MSD1		B709601-01							
Calcium	10/10/97	1.00	10.7	12.7	mg/l	80.0-120	200	20.0	28.6	
Iron	"	1.00	0.198	1.04	"	80.0-120	84.2	20.0	9.98	
Magnesium	"	1.00	10.6	12.1	"	80.0-120	150	20.0	22.2	
Potassium	10/9/97	10.0	2.69	12.4	"	80.0-120	97.1	20.0	4.21	
Sodium	"	2.50	6.89	9.21	"	80.0-120	92.8	20.0	15.3	

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PORTLAND ▪ (503) 643-9200 ▪ FAX 644-2202

Bober, Robert G. Jr. 11818 Military Road South Seattle, WA 98168	Project: Go-East Landfill Project Number: #970501 Project Manager: Robert G. Bober	Sampled: 9/29/97 Received: 9/29/97 Reported: 10/24/97 16:53

Total Metals by EPA 6000/7000 Series Methods/Quality Control
North Creek Analytical - Bothell

Analyte	Date Analyzed	Spike Level	Sample Result	QC Result	Units	Reporting Limit Recov. Limits	Recov. %	RPD Limit	RPD %	Notes*
Matrix Spike Dup (continued)	1070194-MSD1		B709601-01							
Zinc	10/10/97	1.00	ND	0.921	mg/l	80.0-120	92.1	20.0	2.08	
	Date Prepared: 10/22/97				Extraction Method: EPA 3010					
Batch: 1070564										
Blank	1070564-BLK1									
Manganese	10/23/97			ND	mg/l	0.00500				
LCS	1070564-BS1									
Manganese	10/23/97	1.00		1.00	mg/l	80.0-120	100			
Duplicate	1070564-DUP1		B709601-02							
Manganese	10/23/97		ND	ND	mg/l			20.0		
Matrix Spike	1070564-MS1		B709601-02							
Manganese	10/23/97	1.00	ND	0.946	mg/l	80.0-120	94.6			
Matrix Spike	1070564-MS2		B709601-02							
Manganese	10/23/97	2.00	ND	1.96	mg/l	80.0-120	98.0			
Matrix Spike Dup	1070564-MSD1		B709601-02							
Manganese	10/23/97	1.00	ND	0.927	mg/l	80.0-120	92.7	20.0	2.03	

*Refer to end of report for text of notes and definitions.

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Bober, Robert G. Jr. 11818 Military Road South Seattle, WA 98168	Project: Go-East Landfill Project Number: #970501 Project Manager: Robert G. Bober	Sampled: 9/29/97 Received: 9/29/97 Reported: 10/24/97 16:53

Conventional Chemistry Parameters by APHA/EPA Methods/Quality Control
North Creek Analytical - Bothell

Analyte	Date Analyzed	Spike Level	Sample Result	QC Result	Units	Reporting Limit Recov. Limits	Recov. %	RPD Limit	RPD %	Notes*
Batch: 1070002	Date Prepared: 9/30/97				Extraction Method: General Preparation					
Blank	1070002-BLK1									
Specific Conductivity	9/30/97			ND	uS/cm	1.00				
LCS	1070002-BS1									
Specific Conductivity	9/30/97	102		103	uS/cm	95.0-104	101			
Duplicate	1070002-DUP1		B709507-01							
Specific Conductivity	9/30/97		571	569	uS/cm			4.00	0.351	
Batch: 1070003	Date Prepared: 9/30/97				Extraction Method: General Preparation					
Duplicate	1070003-DUP1		B709601-01							
pH	9/30/97		7.55	7.61	pH Units			10.0	0.792	
Batch: 1070148	Date Prepared: 10/6/97				Extraction Method: General Preparation					
Blank	1070148-BLK1									
Fluoride	10/6/97			ND	mg/l	0.100				
LCS	1070148-BS1									
Fluoride	10/6/97	5.00		4.94	mg/l	78.0-113	98.8			
Duplicate	1070148-DUP1		B709408-01							
Fluoride	10/6/97		ND	ND	mg/l			25.0		
Batch: 1070157	Date Prepared: 10/6/97				Extraction Method: General Preparation					
Blank	1070157-BLK1									
Chemical Oxygen Demand	10/7/97			ND	mg/l	10.0				
LCS	1070157-BS1									
Chemical Oxygen Demand	10/7/97	100		102	mg/l	83.0-119	102			
Duplicate	1070157-DUP1		B709601-01							
Chemical Oxygen Demand	10/7/97		ND	ND	mg/l			25.0		
Matrix Spike	1070157-MS1		B709601-01							
Chemical Oxygen Demand	10/7/97	100	ND	97.3	mg/l	80.0-120	97.3			

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PORTLAND ▪ (503) 643-9200 ▪ FAX 644-2202

Bober, Robert G. Jr. 11818 Military Road South Seattle, WA 98168	Project: Go-East Landfill Project Number: #970501 Project Manager: Robert G. Bober	Sampled: 9/29/97 Received: 9/29/97 Reported: 10/24/97 16:53

Conventional Chemistry Parameters by APHA/EPA Methods/Quality Control
North Creek Analytical - Bothell

Analyte	Date Analyzed	Spike Level	Sample Result	QC Result	Units	Reporting Limit Recov. Limits	Recov. %	RPD Limit	RPD %	Notes*
Batch: 1070166	Date Prepared: 10/7/97					Extraction Method: General Preparation				
Blank	1070166-BLK1									
Ammonia-Nitrogen	10/7/97			ND	mg/l	0.100				
LCS	1070166-BS1									
Ammonia-Nitrogen	10/7/97	5.00		5.19	mg/l	89.0-110	104			
Duplicate	1070166-DUP1		B710047-03							
Ammonia-Nitrogen	10/7/97		1.21	1.20	mg/l			17.0	0.830	
Batch: 1070612	Date Prepared: 10/23/97					Extraction Method: General Preparation				
Blank	1070612-BLK1									
Total Organic Carbon	10/23/97			ND	mg/l	1.00				
LCS	1070612-BS1									
Total Organic Carbon	10/23/97	5.00		5.28	mg/l	95.0-111	106			
Duplicate	1070612-DUP1		B709601-01							
Total Organic Carbon	10/23/97		1.40	1.42	mg/l			15.0	1.42	

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Bober, Robert G. Jr.
11818 Military Road South
Seattle, WA 98168

Project: Go-East Landfill
Project Number: #970501
Project Manager: Robert G. Bober

Sampled: 9/29/97
Received: 9/29/97
Reported: 10/24/97 16:53

Anions by EPA Method 300.0/Quality Control
North Creek Analytical - Bothell

Analyte	Date Analyzed	Spike Level	Sample Result	QC Result	Units	Reporting Limit Recov. Limits	Recov. %	RPD Limit	RPD %	Notes*
					Extraction Method: General Preparation					
Batch: 1070004	Date Prepared: 9/30/97									
Blank	1070004-BLK1									
Nitrate-Nitrogen	9/30/97			ND	mg/l	0.0500				
Nitrite-Nitrogen	"			ND	"	0.0500				
Orthophosphate-phosphorus	"			ND	"	0.100				
LCS	1070004-BS1									
Nitrate-Nitrogen	9/30/97	0.900		0.855	mg/l	90.0-110	95.0			
Orthophosphate-phosphorus	"	1.94		1.82	"	90.0-110	93.8			
LCS	1070004-BS2									
Nitrite-Nitrogen	9/30/97	2.00		1.85	mg/l	90.0-110	92.5			
Duplicate	1070004-DUP1		B709601-01							
Nitrate-Nitrogen	9/30/97		2.53	2.73	mg/l			8.00	7.60	
Nitrite-Nitrogen	"		ND	ND	"			25.0		
Orthophosphate-phosphorus	"		ND	ND	"			25.0		
Matrix Spike	1070004-MS1		B709601-01							
Nitrate-Nitrogen	9/30/97	0.900	2.53	3.66	mg/l	77.0-117	126			4
Orthophosphate-phosphorus	"	1.94	ND	1.79	"	75.0-125	92.3			
Matrix Spike	1070004-MS2		B709601-01							
Nitrite-Nitrogen	9/30/97	2.00	ND	1.96	mg/l	72.0-134	98.0			
					Extraction Method: General Preparation					
Batch: 1070476	Date Prepared: 10/17/97									
Blank	1070476-BLK1									
Chloride	10/17/97			ND	mg/l	0.200				
Sulfate	"			ND	"	0.100				
LCS	1070476-BS1									
Chloride	10/17/97	2.00		2.02	mg/l	90.0-110	101			
Sulfate	"	4.00		4.04	"	90.0-110	101			
Duplicate	1070476-DUP1		B709601-01							
Chloride	10/17/97		5.15	4.62	mg/l			16.0	10.8	
Sulfate	"		7.50	7.57	"			8.00	0.929	

Refer to end of report for text of notes and definitions.

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Bober, Robert G. Jr. 11818 Military Road South Seattle, WA 98168	Project: Go-East Landfill Project Number: #970501 Project Manager: Robert G. Bober	Sampled: 9/29/97 Received: 9/29/97 Reported: 10/24/97 16:53

Anions by EPA Method 300.0/Quality Control
North Creek Analytical - Bothell

Analyte	Date Analyzed	Spike Level	Sample Result	QC Result	Units	Reporting Limit Recov. Limits	Recov. %	RPD Limit	RPD %	Notes*
<u>Duplicate</u>	<u>1070476-DUP2</u>		<u>B710300-01</u>							
Chloride	10/17/97			ND	mg/l			16.0		
Sulfate	"			ND	"			8.00		
<u>Matrix Spike</u>	<u>1070476-MS1</u>		<u>B709601-01</u>							
Chloride	10/17/97	20.0	5.15	26.3	mg/l	56.0-140	106			
Sulfate	"	40.0	7.50	47.7	"	57.0-134	101			

*Refer to end of report for text of notes and definitions.

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Bober, Robert G. Jr.
11818 Military Road South
Seattle, WA 98168

Project: Go-East Landfill
Project Number: #970501
Project Manager: Robert G. Bober

Sampled: 9/29/97
Received: 9/29/97
Reported: 10/24/97 16:53

Conventional Chemistry Parameters per APHA/EPA Methods/Quality Control
North Creek Analytical - Portland

Analyte	Date Analyzed	Spike Level	Sample Result	QC Result	Units	Reporting Limit Recov. Limits	Recov. %	RPD Limit	RPD %	Notes*
Batch: 0970743	Date Prepared: 10/1/97				Extraction Method: Wet Chem					
Blank	0970743-BLK1									
Tannins & Lignins	10/1/97			ND	mg/l	0.250				
LCS	0970743-BS1									
Tannins & Lignins	10/1/97	2.00		1.62	mg/l	75.0-125	81.0			
Duplicate	0970743-DUP1		B709601-01							
Tannins & Lignins	10/1/97		ND	ND	mg/l			20.0		
Matrix Spike	0970743-MS1		B709601-01							
Tannins & Lignins	10/1/97	2.00	ND	ND	mg/l	75.0-125	NR			5

*Refer to end of report for text of notes and definitions.

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Bober, Robert G. Jr. 11818 Military Road South Seattle, WA 98168	Project: Go-East Landfill Project Number: #970501 Project Manager: Robert G. Bober	Sampled: 9/29/97 Received: 9/29/97 Reported: 10/24/97 16:53

Notes and Definitions

#	Note
1	Analyses are not controlled on RPD values from sample concentrations less than 5 times the reporting limit.
2	Analyses are not controlled on matrix spike RPD and/or percent recoveries when the sample concentration is significantly higher than the spike level.
3	
4	The spike recovery for this QC sample is outside of established control limits. Review of associated batch QC indicates the recovery for this analyte does not represent an out-of-control condition for the batch.
5	The spike recovery for this QC sample is outside of established control limits due to sample matrix interference.
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
Recov.	Recovery
RPD	Relative Percent Difference

North Creek Analytical, Inc.

Rebecca Wood

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CHAIN OF CUSTODY REPORT

Work Order # B709601

REPORT TO: Robert G. Bober Jr., PE
ATTENTION: BOB
ADDRESS: 11818 Military Road South
Seattle, WA 98168-1232
PHONE: (206) 244-8133 FAX: 241-8152
PROJECT NAME: GO-EAST LANDFILL
PROJECT NUMBER: #970501
SAMPLED BY: R. G. Bober Jr.

INVOICE TO: GO EAST INC
ATTENTION: Doug Lageson
ADDRESS: 155 NE 100th, Ste 304
Seattle, WA 98125
P.O. NUMBER:
NCA QUOTE #: SN0090817.m pf

Analysis Request:

TURNAROUND REQUEST in Business Days*
Organic & Inorganic Analyses: ☒ 10 (Standard) ☐ 7 ☐ 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1 ☐ Same Day
Fuels & Hydrocarbon Analyses: ☐ 5 (Standard) ☐ 3-4 ☐ 2 ☐ 1 ☐ Same Day
OTHER Specify:
*Turnaround Requests less than standard may incur Rush Charges.

	CLIENT SAMPLE IDENTIFICATION	SAMPLING DATE/TIME	NCA SAMPLE ID (Laboratory Use Only)	Analysis Request	MATRIX (W, S, A, O)	# OF CONTAINERS	COMMENTS
1.	GEWQS #1	9/29/97 10:40 AM	B709601-01	← 19 Analytes		5	
2.	GEWQS #2	9/29/97 11:30 AM	-02	← " "		5	
3.	GEWQS #3	9/29/97 12:50 PM	-03	← " "		5	
4.				See Attached Sheet			
5.				for analytes.			
6.							
7.							
8.							
9.							
10.							

RELINQUISHED BY (Signature): Robert G Bober Jr DATE: 9/29/97
PRINT NAME: Robert G Bober Jr, PE FIRM: SAME TIME: 2:45 PM
RECEIVED BY (Signature): Dana H DATE: 9/29/97
PRINT NAME: D. HEINZ FIRM: NCA-B TIME: 1445

RELINQUISHED BY (Signature): DATE:
PRINT NAME: FIRM: TIME:
RECEIVED BY (Signature): DATE:
PRINT NAME: FIRM: TIME:

ADDITIONAL REMARKS:

PAGE OF

COC Rev 8 /94

APPENDIX B

ANALYSIS REPORT AM TEST

Snohomish Health District
Mike Young

Date Received: 11/22/91
Date Reported: 12/20/91

WATER SAMPLES

AM TEST Identification Number 91-A013248
Client Identification GE3
Sampling Date 11/21/91

PARAMETER	Result	Q	D.L.
Conventionals			
pH	7.6		
Total Organic Carbon (mg/l)	11.		0.5
Chemical Oxygen Demand (mg/l)	< 10		10
Chloride (mg/l)	4.3		1.0
Conductivity (umhos/cm)	160		0.5
Ammonia Nitrogen (mg/l)	0.017		0.005
Nitrate + Nitrite Nitrogen (mg/l)	2.4		0.01
Nitrite Nitrogen (mg/l)	< 0.01		0.001
Sulfate (mg/l)	16.		1.0
Dissolved Metals			
Dissolved Iron (mg/l)	0.05		0.01
Dissolved Manganese (mg/l)	0.005		0.002
Dissolved Zinc (mg/l)	0.014		0.002

Upstream of landfill on Creek.

APPENDIX B

EDGE A[illegible]tical, Inc.
1151 Kn[illegible]on Rd.
Burlington, WA 98233
(360) 757-1400 - FAX (360) 757-1402

Data Report

Client Name: Snohomish Health District
3020 Rucker Ave Ste 102
Everett, WA 98201

Report Date: 1/14/97
Reference Number: 96-3260
Project: Go East & Lake Stevens

Analyst: MVP
Date Sampled: 12/16/96
Date Recieved: 12/17/96

Lab Number	Sample Description	Analyte	Result	MDL	Units	Method	Comments
5338.0	GED - downstream	ELECTRICAL CONDUCTIVITY	450	10	uS/cm	SM2510 B	
5338.1		HYDROGEN ION	8.0		pH Units	SM4500-H+ B	
5338.2		TOTAL ORGANIC CARBON	11.96	0.50	mg/L	SM5310 B	
5338.3		CALCIUM	40.0	0.5	mg/L	SM3500-Ca B	
5338.3		IRON	0.39	0.05	mg/L	SM3500-FE B	
5338.3		MAGNESIUM	14.6	0.5	mg/L	SM3500-Mg B	
5338.3		MANGANESE	0.40	0.01	mg/L	200.8	
5338.3		POTASSIUM	5.7	1.0	mg/L	SM3500-K B	
5338.3		SODIUM	14.7	1.0	mg/L	SM3500-Na B	
5338.3		ZINC	ND	0.05	mg/L	200.8	
5338.4		CHEMICAL OXYGEN DEMAND	33.9	5.0	mg/L	SM5220 B	
5338.5		CHLORIDE	ND	20	mg/L	300.0	
5338.5		FLUORIDE	ND	0.5	mg/L	300.0	
[illegible]		NITRATE-N	2.0	0.5	mg/L	300.0	
5[illegible]		NITRITE-N	ND	0.5	mg/L	300.0	
5338.5		ORTHO-PHOSPHATE	ND	0.1	mg/L	300.0	
5338.5		SULFATE	16.4	10	mg/L	300.0	
5338.6		TANNINS	0.7	0.1	mg/L	SM5550	
5338.7		AMMONIA	0.25	0.25	mg/L	SM4500-NH3 F	

RECEIVED
JAN 16 1997
Snohomish
Health District

MDL = Method detection limit
ND = Not detected above the listed method detection limit (MDL)

WSDOE Lab
C057WSDOH Lab

Supervisor

APPENDIX B

ANALYSIS REPORT AM TEST

Snohomish Health District
Mike Young

Date Received: 11/22/91
Date Reported: 12/20/91

WATER SAMPLES

AM TEST Identification Number 91-A013247
Client Identification GE2
Sampling Date 11/21/91

PARAMETER	Result	Q	D.L.
Conventionals			
pH	7.7		
Total Organic Carbon (mg/l)	14.		0.5
Chemical Oxygen Demand (mg/l)	< 10		10
Chloride (mg/l)	5.2		1.0
Conductivity (umhos/cm)	200		0.5
Ammonia Nitrogen (mg/l)	0.068		0.005
Nitrate + Nitrite Nitrogen (mg/l)	2.3		0.01
Nitrite Nitrogen (mg/l)	< 0.01		0.001
Sulfate (mg/l)	15.		1.0
Dissolved Metals			
Dissolved Iron (mg/l)	0.05		0.01
Dissolved Manganese (mg/l)	0.032		0.002
Dissolved Zinc (mg/l)	0.90		0.002

Down stream of landfill on Creek.

APPENDIX B

EDGE ANALYTICAL

EDGE Analytical, Inc.
1151 [illegible] Rd.
Burlington, WA 98233
(360) 757-1400 - FAX (360) 757-1402

Data Report

Client Name: Snohomish Health District
3020 Rucker Ave Ste 102
Everett, WA 98201

Report Date: 1/14/97
Reference Number: 96-3260
Project: Go East & Lake Stevens

Analyst: MVP
Date Sampled: 12/16/96
Date Recieved: 12/17/96

Lab Number	Sample Description	Analyte	Result	MDL	Units	Method	Comments
5337.0	GEU - upstream	ELECTRICAL CONDUCTIVITY	174	10	uS/cm	SM2510 B	
5337.1		HYDROGEN ION	8.0		pH Units	SM4500-H+ B	
5337.2		TOTAL ORGANIC CARBON	3.88	0.50	mg/L	SM5310 B	
5337.3		CALCIUM	10.4	0.5	mg/L	SM3500-Ca B	
5337.3		IRON	0.21	0.05	mg/L	SM3500-FE B	
5337.3		MAGNESIUM	7.7	0.5	mg/L	SM3500-Mg B	
5337.3		MANGANESE	0.03	0.01	mg/L	200.8	
5337.3		POTASSIUM	2.0	1.0	mg/L	SM3500-K B	
5337.3		SODIUM	6.0	1.0	mg/L	SM3500-Na B	
5337.3		ZINC	ND	0.05	mg/L	200.8	
5337.4		CHEMICAL OXYGEN DEMAND	11.6	5.0	mg/L	SM5220 B	
5337.5		CHLORIDE	ND	20	mg/L	300.0	
5337.5		FLUORIDE	ND	0.5	mg/L	300.0	
[illegible]5		NITRATE-N	2.5	0.5	mg/L	300.0	
[illegible]		NITRITE-N	ND	0.5	mg/L	300.0	
5337.5		ORTHO-PHOSPHATE	ND	0.1	mg/L	300.0	
5337.5		SULFATE	ND	10	mg/L	300.0	
5337.6		TANNINS	0.4	0.1	mg/L	SM5550	
5337.7		AMMONIA	ND	0.25	mg/L	SM4500-NH3 F	

RECEIVED
JAN 16 1997
Snohomish
Health District

M[illegible] Method detection limit
ND = Not detected above the listed method detection limit (MDL)

WSDOE Lab
C057WSDOH Lab

Supervisor

APPENDIX B

AM EST

CLIENT: Snohomish Health District

REPORT TO: Jeffrey R. Defenbach

DATE RECEIVED: 5/26/89

DATE REPORTED: 6/30/89

Laboratory Sample Number	908237	908238	908239	908240
Client Identification	LS-9	GO EAST #1	GO EAST #2	GO EAST #3
Dissolved Iron (mg/l)	2.2	6.5	0.31 0.27]	0.81
Dissolved Manganese (mg/l)	0.109	1.63	0.033 0.032]	0.170
Dissolved Zinc (mg/l)	0.137	<0.002	0.003 <0.002]	<0.002
Chemical Oxygen Demand (mg/l)	<5.0	59.	5.8	9.9
Chloride (mg/l)	1.9	20.	3.8	5.7
Sulfate (mg/l)	4.0	<4.0	<4.0	<4.0
Nitrate Nitrogen (mg/l)	<0.010	0.206	2.03	2.11 2.12]
Nitrite Nitrogen (mg/l)	0.001 0.001]	0.036	0.002	0.010
Ammonia Nitrogen (mg/l)	0.024	0.070	0.318	0.272
Phosphate (mg/l)	0.104	0.193	0.117	0.107
Total Organic Carbon (mg/l)	11.3	65.3	11.9	9.55 10.5]
pH	7.85	7.50	7.95	7.90
Conductivity (umhos/cm)	218.	810.	185.	235.
Tannin & Lignin (mg/l)	-	3.22 2.95]	-	0.483

< = Less than
] denotes duplicate analysis

APPENDIX B

CLIENT: Snohomish Health District

DATE RECEIVED: 5/26/89

REPORT TO: Jeffrey R. Defenbach

DATE REPORTED: 6/30/89

Laboratory Sample Number	908233	908234	908235	908236
Client Identification	DL-1	DL-2	LS-6	LS-8
Dissolved Iron (mg/l)	0.13 0.13]	<0.01	0.09	0.03
Dissolved Manganese (mg/l)	0.005 0.005]	<0.002	0.133	0.076
Dissolved Zinc (mg/l)	0.009 0.009]	0.022	0.015	0.045
Chemical Oxygen Demand (mg/l)	<5.0	6.4	<5.0 <5.0]	<5.0
Chloride (mg/l)	<1.0	<1.0	1.9	1.9
Sulfate (mg/l)	<4.0	<4.0	<4.0	<4.0 <4.0]
Nitrate Nitrogen (mg/l)	0.119	<0.010 <0.010	<0.010	<0.010
Nitrite Nitrogen (mg/l)	<0.001 <0.001]	<0.001	<0.001	<0.001
Ammonia Nitrogen (mg/l)	<0.005	<0.005	0.710	0.550 0.610]
Phosphate (mg/l)	0.024	0.026	0.686 0.665]	0.497 0.493]
Total Organic Carbon (mg/l)	3.43	3.27	11.8	8.53
pH	7.20	6.75	7.55	7.85 7.95]
Conductivity (umhos/cm)	68.5	33.0	255.	220. 220.]

< = Less than
] denotes duplicate analysis

AMTEST

AmTest Inc.

Professional
Analytical
Services

14603 N.E. 87th S
Redmond, WA
98052

Fax: 206 883 3495

Tel: 206 885 1664

METHODOLOGY REPORT

ANALYTE	METHOD	METHOD REFERENCE	DETECTION LIMIT	DATE ANALYZED
AM TEST IDENTIFICATION NUMBER 91-A013246 CLIENT ID GE1				
pH	150.1	EPA		11/27/91
Total Organic Carbon	415.2	EPA	0.50	11/26/91
Chemical Oxygen Demand	410.4	EPA	10	12/ 9/91
Chloride	325.2	EPA	1.0	11/25/91
Conductivity	120.1	EPA	0.10	11/27/91
Ammonia Nitrogen	350.1	EPA	0.005	11/26/91
Nitrate + Nitrite	353.2	EPA	0.010	12/ 4/91
Nitrite Nitrogen	354.1	EPA	0.001	11/22/91
Sulfate	375.4	EPA	1.0	12/13/91
Dissolved Iron	200.7	EPA	0.01	12/ 6/91
Dissolved Manganese	200.7	EPA	0.002	12/ 6/91
D olved Zinc	200.7	EPA	0.002	12/ 6/91
Ac d Dig. (Diss Metals)	3010	EPA		12/ 3/91

APPENDIX B

AMTEST

nohomish Health District

Mike Young

Date Received: 11/22/91
Date Reported: 12/23/91
Project Name: Cathcart Lake Stevens

QUALITY CONTROL - DUPLICATE ANALYSIS

ANALYTE/SAMPLE NOS.	DUPLICATE #1 (mg/l)	DUPLICATE #2 (mg/l)	RELATIVE PERCENT DIFFERENCE (%)
Sulfate			
91-A013098	27.	28.	3.6
91-A013251	<10.	<10.	-
Chemical Oxygen Demand			
91-A013098	<10.	<10.	-
91-A013370	<10.	<10.	-
Chloride			
91-A013098	6.3	5.7	10.
91-A013370	<10.	<10.	-
mmonia			
91-A013098	0.057	0.060	5.1
91-A013251	0.070	0.068	2.0
pH			
91-A013098	7.4	7.3	1.4
91-A013251	6.4	6.5	1.5
Conductivity			
91-A013098	200.	200.	0.
91-A013251	690.	690.	0.
Nitrate + Nitrite Nitrogen			
91-A013098	0.23	0.23	0.
91-A013370	<0.01	<0.01	-
Nitrite Nitrogen			
91-A013250	<0.001	<0.001	-
91-A013376	<0.001	<0.001	-
Total Organic Carbon			
91-A013098	6.92	5.99	14.
91-A013251	18.9	18.1	4.3

< = less than

APPENDIX B

AMTEST

nohomish Health District

Mike Young

Date Received: 11/22/91
Date Reported: 12/23/91
Project Name: Cathcart Lake Stevens

QUALITY CONTROL - SPIKE RECOVERY DATA

ANALYTE/SAMPLE NOS.		SPIKED ADDED (mg/l)	RECOVERY (%)
Sulfate			
	91-A013099	100.	117.
	91-A013250	100.	114.
Chloride			
	91-A013099	50.	94.
	91-A013369	50.	97.
Ammonia			
	91-A013099	0.1	125.
	91-A013250	0.1	94.
Nitrate + Nitrite Nitrogen			
	91-A013099	5.	112.
	91-A013369	5.	100.
Nitrite			
	91-A013099	0.05	94.
	91-A013375	0.05	98.
Total Organic Carbon			
	91-A013099	25.	85.
	91-A013250	25.	95.

REPORTED BY ______________________
Jeff Buystedt

JB/pb

APPENDIX B

AMTEST

CLIENT: Snohomish Health District

REPORT TO: Jeffrey R. Defenbach

DATE RECEIVED: 5/26/89

DATE REPORTED: 6/30/89

Laboratory Sample Number Client Identification	EPA METHOD	DETECTION LIMIT
Dissolved Iron (mg/l)	200.7	0.01
Dissolved Manganese (mg/l)	200.7	0.002
Dissolved Zinc (mg/l)	200.7	0.002
Chemical Oxygen Demand (mg/l)	410.4	5.0
Chloride (mg/l)	325.3	1.0
Sulfate (mg/l)	375.4	4.0
Nitrate Nitrogen (mg/l)	353.2	0.010
Nitrite Nitrogen (mg/l)	353.2	0.010
Ammonia Nitrogen (mg/l)	350.1	0.005
Phosphate (mg/l)	365.2	0.005
Total Organic Carbon (mg/l)	415.1	0.05
pH	150.1	-
Conductivity (umhos/cm)	120.1	0.1

< = Less than
] denotes duplicate analysis

CLIENT: Snohomish Health District DATE RECEIVED: 5/26/89

REPORT TO: Jeffrey R. Defenbach DATE REPORTED: 6/30/89

SPIKE RECOVERY DATA

Laboratory Sample Number Client Identification	SAMPLE NUMBER	SPIKE ADDED (mg/l)	RECOVERY (%)
Dissolved Iron (mg/l)	908224	1.0	100.
Dissolved Manganese (mg/l)	908224	1.0	100.
Dissolved Zinc (mg/l)	908224	1.0	86.
Chloride (mg/l)	910228	10.	110.
Sulfate (mg/l)	910236	10.	107.
Nitrate Nitrogen (mg/l)	908214	0.100	116.
Nitrite Nitrogen (mg/l)	908222	0.100	98.
Ammonia Nitrogen (mg/l)	908216	0.100	125.
Phosphate (mg/l)	908223	0.100	113.
Total Organic Carbon (mg/l)	908220	1.0	99.1

< = Less than
] denotes duplicate analysis

OnSite Environmental Inc.

Analytical Testing and Mobile Laboratory Services

RECEIVED
JUN 14 2002
HWA GeoSciences Inc.

June 12, 2002

Arnie Sugar
HWA GeoSciences, Inc.
19730 64th Avenue West
Lynnwood, WA 98036

Re: Analytical Data for Project 2002071
Laboratory Reference No. 0205-223

Dear Arnie:

Enclosed are the analytical results and associated quality control data for samples submitted on May 31, 2002.

The standard policy of OnSite Environmental Inc. is to store your samples for 30 days from the date of receipt. If you require longer storage, please contact the laboratory.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning the data, or need additional information, please feel free to call me.

Sincerely,

David Baumeister
Project Manager

Enclosures

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

Case Narrative

Samples were collected on May 31, 2002. Samples were maintained at the laboratory at 4°C and followed SW846 analysis and extraction methods.

NWTPH Gx/BTEX Analysis

Any QA/QC issues associated with this extraction and analysis will be indicated with a footnote reference and discussed in detail on the Data Qualifier page.

NWTPH Dx Analysis

Any QA/QC issues associated with this extraction and analysis will be indicated with a footnote reference and discussed in detail on the Data Qualifier page.

Priority Pollutant Metals EPA 200.8/7470A Analysis

Any QA/QC issues associated with this extraction and analysis will be indicated with a footnote reference and discussed in detail on the Data Qualifier page.

Volatiles EPA 8260B Analysis

Any QA/QC issues associated with this extraction and analysis will be indicated with a footnote reference and discussed in detail on the Data Qualifier page.

Semivolatile EPA 8270C/SIM Analysis

The percent recovery for the surrogate, 2-Fluorophenol (19%), in sample SW-1-0502 (05-223-01) was less than the lower control limit of 21%. All other surrogates for this sample were within quality control limits. One surrogate in each fraction is allowed to be out of control as long as it is greater than 10%.

Any other QA/QC issues associated with this extraction and analysis will be indicated with a footnote reference and discussed in detail on the Data Qualifier page.

Organochlorine Pesticides/PCB's by EPA 8081A/ 8082 Analysis

Any QA/QC issues associated with this extraction and analysis will be indicated with a footnote reference and discussed in detail on the Data Qualifier page.

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

NWTPH-Gx/BTEX

Date Extracted: 6-3-02
Date Analyzed: 6-3-02

Matrix: Water
Units: ug/L (ppb)

Client ID: SW-1-0502
Lab ID: 05-223-01

	Result	Flags	PQL
Benzene	ND		1.0
Toluene	ND		1.0
Ethyl Benzene	ND		1.0
m,p-Xylene	ND		1.0
o-Xylene	ND		1.0
TPH-Gas	ND		100

Surrogate Recovery:
Fluorobenzene 89%

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

NWTPH-Gx/BTEX
METHOD BLANK QUALITY CONTROL

Date Extracted: 6-3-02
Date Analyzed: 6-3-02

Matrix: Water
Units: ug/L (ppb)

Lab ID: MB0603W1

	Result	Flags	PQL
Benzene	ND		1.0
Toluene	ND		1.0
Ethyl Benzene	ND		1.0
m,p-Xylene	ND		1.0
o-Xylene	ND		1.0
TPH-Gas	ND		100

Surrogate Recovery:
Fluorobenzene 90%

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

NWTPH-Gx/BTEX
DUPLICATE QUALITY CONTROL

Date Extracted: 6-3-02
Date Analyzed: 6-3-02

Matrix: Water
Units: ug/L (ppb)

Lab ID:	05-219-02 Original	05-219-02 Duplicate	RPD	Flags
Benzene	ND	ND	NA	
Toluene	ND	ND	NA	
Ethyl Benzene	ND	ND	NA	
m,p-Xylene	ND	ND	NA	
o-Xylene	ND	ND	NA	
TPH-Gas	ND	ND	NA	
Surrogate Recovery:				
Fluorobenzene	90%	90%		

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

NWTPH-Gx/BTEX
MS/MSD QUALITY CONTROL

Date Extracted: 6-3-02
Date Analyzed: 6-3-02

Matrix: Water
Units: ug/L (ppb)

Spike Level: 50.0 ppb

Lab ID:	05-219-02 MS	Percent Recovery	05-219-02 MSD	Percent Recovery	RPD	Flags
Benzene	47.2	94	47.7	95	1.1	
Toluene	49.0	98	49.5	99	1.0	
Ethyl Benzene	49.5	99	50.0	100	1.0	
m,p-Xylene	49.6	99	50.1	100	0.92	
o-Xylene	49.3	99	49.7	100	0.85	

Surrogate Recovery:		
Fluorobenzene	93%	93%

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

NWTPH-Dx

Date Extracted:	6-4-02
Date Analyzed:	6-4-02
Matrix:	Water
Units:	mg/L (ppm)
Client ID:	SW-1-0502
Lab ID:	05-223-01
Diesel Range:	ND
PQL:	0.25
Identification:	---
Lube Oil Range:	ND
PQL:	0.40
Identification:	---
Surrogate Recovery	
o-Terphenyl:	68%
Flags:	Y

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

NWTPH-Dx
METHOD BLANK QUALITY CONTROL

Date Extracted:	6-4-02
Date Analyzed:	6-4-02
Matrix:	Water
Units:	mg/L (ppm)
Lab ID:	MB0604W1
Diesel Range:	ND
PQL:	0.25
Identification:	---
Lube Oil Range:	ND
PQL:	0.40
Identification:	---
Surrogate Recovery	
o-Terphenyl:	89%
Flags:	Y

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

NWTPH-Dx
DUPLICATE QUALITY CONTROL

Date Extracted: 6-4-02
Date Analyzed: 6-4-02

Matrix: Water
Units: mg/L (ppm)

Lab ID:	06-001-04	06-001-04 DUP
Diesel Range:	ND	ND
PQL:	0.25	0.25
RPD:	N/A	
Surrogate Recovery		
o-Terphenyl:	102%	112%
Flags:	Y	Y

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

PRIORITY POLLUTANT METALS
EPA 200.8/7470A

Date Extracted: 6-3&5-02
Date Analyzed: 6-3,4&5-02

Matrix: Water
Units: ug/L (ppb)

Lab ID: 05-223-01
Client ID: SW-1-0502

Analyte	Method	Result	PQL
Antimony	200.8	ND	5.6
Arsenic	200.8	ND	3.3
Beryllium	200.8	ND	11
Cadmium	200.8	ND	4.4
Chromium	200.8	ND	11
Copper	200.8	ND	11
Lead	200.8	2.0	1.1
Mercury	7470A	ND	.50
Nickel	200.8	ND	22
Selenium	200.8	ND	5.6
Silver	200.8	ND	11
Thallium	200.8	ND	1.1
Zinc	200.8	ND	28

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

PRIORITY POLLUTANT METALS
EPA 200.8
METHOD BLANK QUALITY CONTROL

Date Extracted: 6-3&5-02
Date Analyzed: 6-3,4&5-02

Matrix: Water
Units: ug/L (ppb)

Lab ID: MB0603W1

Analyte	Method	Result	PQL
Antimony	200.8	ND	5.6
Arsenic	200.8	ND	3.3
Beryllium	200.8	ND	11
Cadmium	200.8	ND	4.4
Chromium	200.8	ND	11
Copper	200.8	ND	11
Lead	200.8	ND	1.1
Nickel	200.8	ND	22
Selenium	200.8	ND	5.6
Silver	200.8	ND	11
Thallium	200.8	ND	1.1
Zinc	200.8	ND	28

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

PRIORITY POLLUTANT METALS
EPA 7470A
METHOD BLANK QUALITY CONTROL

Date Extracted:	6-3&5-02
Date Analyzed:	6-3,4&5-02
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	MB0605W1

Analyte	Method	Result	PQL
Mercury	7470A	ND	.50

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

PRIORITY POLLUTANT METALS
EPA 200.8
DUPLICATE QUALITY CONTROL

Date Extracted: 6-3&5-02
Date Analyzed: 6-3,4&5-02

Matrix: Water
Units: ug/L (ppb)

Lab ID: 05-221-02

Analyte	Sample Result	Duplicate Result	RPD	PQL	Flags
Antimony	6.22	ND	NA	5.6	
Arsenic	6.97	6.12	13	3.3	
Beryllium	ND	ND	NA	11	
Cadmium	ND	ND	NA	4.4	
Chromium	ND	ND	NA	11	
Copper	ND	ND	NA	11	
Lead	ND	ND	NA	1.1	
Nickel	ND	ND	NA	22	
Selenium	ND	ND	NA	5.6	
Silver	ND	ND	NA	11	
Thallium	ND	ND	NA	5.6	
Zinc	ND	ND	NA	28	

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

PRIORITY POLLUTANT METALS
EPA 7470A
DUPLICATE QUALITY CONTROL

Date Extracted: 6-3&5-02
Date Analyzed: 6-3,4&5-02

Matrix: Water
Units: ug/L (ppb)

Lab ID: 05-204-03

Analyte	Sample Result	Duplicate Result	RPD	PQL	Flags
Mercury	ND	ND	NA	0.50	

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

PRIORITY POLLUTANT METALS
EPA 200.8
MS/MSD QUALITY CONTROL

Date Extracted: 6-3&5-02
Date Analyzed: 6-3,4&5-02

Matrix: Water
Units: ug/L (ppb)

Lab ID: 05-221-02

Analyte	Spike Level	MS	Percent Recovery	MSD	Percent Recovery	RPD	Flags
Antimony	110	117	101	120	103	2.0	
Arsenic	110	114	97	114	97	0	
Beryllium	110	106	96	106	96	0	
Cadmium	110	108	98	107	98	0.78	
Chromium	110	110	100	107	97	2.5	
Copper	110	103	94	103	94	0	
Lead	110	112	102	111	101	0.86	
Nickel	110	104	95	103	93	1.5	
Selenium	110	101	92	101	92	0	
Silver	110	83.6	76	95.2	87	13	
Thallium	110	115	105	114	103	1.2	
Zinc	110	109	99	104	94	4.8	

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

PRIORITY POLLUTANT METALS
EPA 7470A
MS/MSD QUALITY CONTROL

Date Extracted: 6-3&5-02
Date Analyzed: 6-3,4&5-02

Matrix: Water
Units: ug/L (ppb)

Lab ID: 05-204-03

Analyte	Spike Level	MS	Percent Recovery	MSD	Percent Recovery	RPD	Flags
Mercury	5.0	4.81	96	4.57	91	5.1	

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

VOLATILES by EPA 8260B
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Date Extracted: 6-4-02
Date Analyzed: 6-4-02

Matrix: Water
Units: ug/L (ppb)

Lab ID: 05-223-01
Client ID: SW-1-0502

Compound	Results	Flags	PQL
Dichlorodifluoromethane	ND		0.20
Chloromethane	ND		0.20
Vinyl Chloride	ND		0.20
Bromomethane	ND		0.20
Chloroethane	ND		0.20
Trichlorofluoromethane	ND		0.20
1,1-Dichloroethene	ND		0.20
Acetone	ND		5.0
Iodomethane	ND		1.0
Carbon Disulfide	ND		0.20
Methylene Chloride	ND		1.0
(trans) 1,2-Dichloroethene	ND		0.20
Methyl t-Butyl Ether	ND		0.20
1,1-Dichloroethane	ND		0.20
Vinyl Acetate	ND		1.0
2,2-Dichloropropane	ND		0.20
(cis) 1,2-Dichloroethene	ND		0.20
2-Butanone	ND		5.0
Bromochloromethane	ND		0.20
Chloroform	ND		0.20
1,1,1-Trichloroethane	ND		0.20
Carbon Tetrachloride	ND		0.20
1,1-Dichloropropene	ND		0.20
Benzene	ND		0.20
1,2-Dichloroethane	ND		0.20
Trichloroethene	ND		0.20
1,2-Dichloropropane	ND		0.20
Dibromomethane	ND		0.20
Bromodichloromethane	ND		0.20
2-Chloroethyl Vinyl Ether	ND		1.0
(cis) 1,3-Dichloropropene	ND		0.20
Methyl Isobutyl Ketone	ND		2.0
Toluene	ND		0.20
(trans) 1,3-Dichloropropene	ND		0.20

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

VOLATILES by EPA 8260B
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Lab ID: 05-223-01
Client ID: SW-1-0502

Compound	Results	Flags	PQL
1,1,2-Trichloroethane	ND		0.20
Tetrachloroethene	ND		0.20
1,3-Dichloropropane	ND		0.20
2-Hexanone	ND		2.0
Dibromochloromethane	ND		0.20
1,2-Dibromoethane	ND		0.20
Chlorobenzene	ND		0.20
1,1,1,2-Tetrachloroethane	ND		0.20
Ethylbenzene	ND		0.20
m,p-Xylene	ND		0.40
o-Xylene	ND		0.20
Styrene	ND		0.20
Bromoform	ND		1.0
Isopropylbenzene	ND		0.20
Bromobenzene	ND		0.20
1,1,2,2-Tetrachloroethane	ND		0.20
1,2,3-Trichloropropane	ND		0.20
n-Propylbenzene	ND		0.20
2-Chlorotoluene	ND		0.20
4-Chlorotoluene	ND		0.20
1,3,5-Trimethylbenzene	ND		0.20
tert-Butylbenzene	ND		0.20
1,2,4-Trimethylbenzene	ND		0.20
sec-Butylbenzene	ND		0.20
1,3-Dichlorobenzene	ND		0.20
p-Isopropyltoluene	ND		0.20
1,4-Dichlorobenzene	ND		0.20
1,2-Dichlorobenzene	ND		0.20
n-Butylbenzene	ND		0.20
1,2-Dibromo-3-chloropropane	ND		1.0
1,2,4-Trichlorobenzene	ND		0.20
Hexachlorobutadiene	ND		0.20
Naphthalene	ND		1.0
1,2,3-Trichlorobenzene	ND		0.20

Surrogate	Percent Recovery	Control Limits
Dibromofluoromethane	*94*	*71-133*
Toluene, d8	102	80-151
4-Bromofluorobenzene	91	75-139

APPENDIX B

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

VOLATILES by EPA 8260B
METHOD BLANK QUALITY CONTROL
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Date Extracted: 6-4-02
Date Analyzed: 6-4-02

Matrix: Water
Units: ug/L (ppb)

Lab ID: MB0604W1

Compound	Results	Flags	PQL
Dichlorodifluoromethane	ND		0.20
Chloromethane	ND		0.20
Vinyl Chloride	ND		0.20
Bromomethane	ND		0.20
Chloroethane	ND		0.20
Trichlorofluoromethane	ND		0.20
1,1-Dichloroethene	ND		0.20
Acetone	ND		5.0
Iodomethane	ND		1.0
Carbon Disulfide	ND		0.20
Methylene Chloride	ND		1.0
(trans) 1,2-Dichloroethene	ND		0.20
Methyl t-Butyl Ether	ND		0.20
1,1-Dichloroethane	ND		0.20
Vinyl Acetate	ND		1.0
2,2-Dichloropropane	ND		0.20
(cis) 1,2-Dichloroethene	ND		0.20
2-Butanone	ND		5.0
Bromochloromethane	ND		0.20
Chloroform	ND		0.20
1,1,1-Trichloroethane	ND		0.20
Carbon Tetrachloride	ND		0.20
1,1-Dichloropropene	ND		0.20
Benzene	ND		0.20
1,2-Dichloroethane	ND		0.20
Trichloroethene	ND		0.20
1,2-Dichloropropane	ND		0.20
Dibromomethane	ND		0.20
Bromodichloromethane	ND		0.20
2-Chloroethyl Vinyl Ether	ND		1.0
(cis) 1,3-Dichloropropene	ND		0.20
Methyl Isobutyl Ketone	ND		2.0
Toluene	ND		0.20
(trans) 1,3-Dichloropropene	ND		0.20

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
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Project: 2002071

VOLATILES by EPA 8260B
METHOD BLANK QUALITY CONTROL
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Lab ID: MB0604W1

Compound	Results	Flags	PQL
1,1,2-Trichloroethane	ND		0.20
Tetrachloroethene	ND		0.20
1,3-Dichloropropane	ND		0.20
2-Hexanone	ND		2.0
Dibromochloromethane	ND		0.20
1,2-Dibromoethane	ND		0.20
Chlorobenzene	ND		0.20
1,1,1,2-Tetrachloroethane	ND		0.20
Ethylbenzene	ND		0.20
m,p-Xylene	ND		0.40
o-Xylene	ND		0.20
Styrene	ND		0.20
Bromoform	ND		1.0
Isopropylbenzene	ND		0.20
Bromobenzene	ND		0.20
1,1,2,2-Tetrachloroethane	ND		0.20
1,2,3-Trichloropropane	ND		0.20
n-Propylbenzene	ND		0.20
2-Chlorotoluene	ND		0.20
4-Chlorotoluene	ND		0.20
1,3,5-Trimethylbenzene	ND		0.20
tert-Butylbenzene	ND		0.20
1,2,4-Trimethylbenzene	ND		0.20
sec-Butylbenzene	ND		0.20
1,3-Dichlorobenzene	ND		0.20
p-Isopropyltoluene	ND		0.20
1,4-Dichlorobenzene	ND		0.20
1,2-Dichlorobenzene	ND		0.20
n-Butylbenzene	ND		0.20
1,2-Dibromo-3-chloropropane	ND		1.0
1,2,4-Trichlorobenzene	ND		0.20
Hexachlorobutadiene	ND		0.20
Naphthalene	ND		1.0
1,2,3-Trichlorobenzene	ND		0.20

Surrogate	Percent Recovery	Control Limits
Dibromofluoromethane	88	71-133
Toluene, d8	101	80-151
4-Bromofluorobenzene	92	75-139

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

VOLATILES by EPA 8260B
SB/SBD QUALITY CONTROL

Date Extracted: 6-4-02
Date Analyzed: 6-4-02

Matrix: Water
Units: ug/L (ppb)

Lab ID: SB0604W1

Compound	Spike Amount	SB	Percent Recovery	SBD	Percent Recovery	RPD	Flags
1,1-Dichloroethene	10.0	7.66	77	7.98	80	4.1	
Benzene	10.0	12.3	123	11.8	118	3.9	
Trichloroethene	10.0	9.73	97	10.0	100	3.0	
Toluene	10.0	11.4	114	11.8	118	3.5	
Chlorobenzene	10.0	8.96	90	9.34	93	4.1	

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

SEMIVOLATILES by EPA 8270C/SIM
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Date Extracted:	6-7-02
Date Analyzed:	6-10&11-02
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	05-223-01
Client ID:	SW-1-0502

Compound:	Results	Flags	PQL
Aniline	ND		1.0
bis(2-Chloroethyl)ether	ND		1.0
Phenol	ND		1.0
2-Chlorophenol	ND		1.0
1,3-Dichlorobenzene	ND		1.0
1,4-Dichlorobenzene	ND		1.0
1,2-Dichlorobenzene	ND		1.0
Benzyl alcohol	ND		1.0
bis(2-chloroisopropyl)ether	ND		1.0
2-Methylphenol	ND		1.0
Hexachloroethane	ND		1.0
N-Nitroso-di-n-propylamine	ND		1.0
4-Methylphenol	ND		1.0
Nitrobenzene	ND		1.0
Isophorone	ND		1.0
2-Nitrophenol	ND		1.0
2,4-Dimethylphenol	ND		1.0
bis(2-Chloroethoxy)methane	ND		1.0
2,4-Dichlorophenol	ND		1.0
Benzoic acid	ND		25
1,2,4-Trichlorobenzene	ND		1.0
Naphthalene	ND		0.10
4-Chloroaniline	ND		1.0
Hexachlorobutadiene	ND		1.0
4-Chloro-3-methylphenol	ND		1.0
2-Methylnaphthalene	ND		0.10
1-Methylnaphthalene	ND		0.10

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

SEMIVOLATILES by EPA 8270C/SIM
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Lab ID: 05-223-01
Client ID: SW-1-0502

Compound:	Results	Flags	PQL
Hexachlorocyclopentadiene	ND		25
2,4,6-Trichlorophenol	ND		1.0
2,4,5-Trichlorophenol	ND		1.0
2-Chloronaphthalene	ND		10
2-Nitroaniline	ND		1.0
Acenaphthylene	ND		0.10
Dimethylphthalate	ND		1.0
2,6-Dinitrotoluene	ND		1.0
Acenaphthene	1.1		0.10
3-Nitroaniline	ND		1.0
2,4-Dinitrophenol	ND		10
Dibenzofuran	ND		10
2,4-Dinitrotoluene	ND		1.0
4-Nitrophenol	ND		10
Fluorene	0.72		0.10
4-Chlorophenyl-phenylether	ND		10
Diethylphthalate	ND		10
4-Nitroaniline	ND		10
4,6-Dinitro-2-methylphenol	ND		25
n-Nitrosodiphenylamine	ND		10
4-Bromophenyl-phenylether	ND		1.0
Hexachlorobenzene	ND		1.0
Pentachlorophenol	ND		10
Phenanthrene	ND		0.10
Anthracene	ND		0.10
Carbazole	ND		10
Di-n-butylphthalate	ND		1.0
Fluoranthene	0.15		0.10
Benzidine	ND		10
Pyrene	ND		0.10

APPENDIX B

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

SEMIVOLATILES by EPA 8270C/SIM
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Lab ID: 05-223-01
Client ID: SW-1-0502

Compound:	Results	Flags	PQL
Butylbenzylphthalate	ND		1.0
3,3'-Dichlorobenzidine	ND		25
Benzo[a]anthracene	0.011		0.010
Chrysene	0.010		0.010
bis(2-Ethylhexyl)phthalate	ND		1.0
Di-n-octylphthalate	ND		1.0
Benzo[b]fluoranthene	ND		0.010
Benzo[k]fluoranthene	ND		0.010
Benzo[a]pyrene	ND		0.010
Indeno[1,2,3-cd]pyrene	ND		0.010
Dibenz[a,h]anthracene	ND		0.010
Benzo[g,h,i]perylene	ND		0.010

Surrogate :	Percent Recovery		Control Limits
2-Fluorophenol	19	Q	21 - 100
Phenol-d6	15		10 - 94
Nitrobenzene-d5	54		35 - 114
2-Fluorobiphenyl	63		43 - 116
2,4,6-Tribromophenol	97		10 - 123
Terphenyl-d14	65		33 - 144

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

SEMIVOLATILES by EPA 8270C/SIM
METHOD BLANK QUALITY CONTROL
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Date Extracted: 6-7-02
Date Analyzed: 6-10&11-02

Matrix: Water
Units: ug/L (ppb)

Lab ID: MB0607W1

Compound:	Results	Flags	PQL
Aniline	ND		1.0
bis(2-Chloroethyl)ether	ND		1.0
Phenol	ND		1.0
2-Chlorophenol	ND		1.0
1,3-Dichlorobenzene	ND		1.0
1,4-Dichlorobenzene	ND		1.0
1,2-Dichlorobenzene	ND		1.0
Benzyl alcohol	ND		1.0
bis(2-chloroisopropyl)ether	ND		1.0
2-Methylphenol	ND		1.0
Hexachloroethane	ND		1.0
N-Nitroso-di-n-propylamine	ND		1.0
4-Methylphenol	ND		1.0
Nitrobenzene	ND		1.0
Isophorone	ND		1.0
2-Nitrophenol	ND		1.0
2,4-Dimethylphenol	ND		1.0
bis(2-Chloroethoxy)methane	ND		1.0
2,4-Dichlorophenol	ND		1.0
Benzoic acid	ND		25
1,2,4-Trichlorobenzene	ND		1.0
Naphthalene	ND		0.10
4-Chloroaniline	ND		1.0
Hexachlorobutadiene	ND		1.0
4-Chloro-3-methylphenol	ND		1.0
2-Methylnaphthalene	ND		0.10
1-Methylnaphthalene	ND		0.10

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

SEMIVOLATILES by EPA 8270C/SIM
METHOD BLANK QUALITY CONTROL
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Lab ID: MB0607W1

Compound:	Results	Flags	PQL
Hexachlorocyclopentadiene	ND		25
2,4,6-Trichlorophenol	ND		1.0
2,4,5-Trichlorophenol	ND		1.0
2-Chloronaphthalene	ND		10
2-Nitroaniline	ND		1.0
Acenaphthylene	ND		0.10
Dimethylphthalate	ND		1.0
2,6-Dinitrotoluene	ND		1.0
Acenaphthene	ND		0.10
3-Nitroaniline	ND		1.0
2,4-Dinitrophenol	ND		10
Dibenzofuran	ND		10
2,4-Dinitrotoluene	ND		1.0
4-Nitrophenol	ND		10
Fluorene	ND		0.10
4-Chlorophenyl-phenylether	ND		10
Diethylphthalate	ND		10
4-Nitroaniline	ND		10
4,6-Dinitro-2-methylphenol	ND		25
n-Nitrosodiphenylamine	ND		10
4-Bromophenyl-phenylether	ND		1.0
Hexachlorobenzene	ND		1.0
Pentachlorophenol	ND		10
Phenanthrene	ND		0.10
Anthracene	ND		0.10
Carbazole	ND		10
Di-n-butylphthalate	ND		1.0
Fluoranthene	ND		0.10
Benzidine	ND		10
Pyrene	ND		0.10

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

SEMIVOLATILES by EPA 8270C/SIM
METHOD BLANK QUALITY CONTROL
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Lab ID: MB0607W1

Compound:	Results	Flags	PQL
Butylbenzylphthalate	ND		1.0
3,3'-Dichlorobenzidine	ND		25
Benzo[a]anthracene	ND		0.010
Chrysene	ND		0.010
bis(2-Ethylhexyl)phthalate	ND		1.0
Di-n-octylphthalate	ND		1.0
Benzo[b]fluoranthene	ND		0.010
Benzo[k]fluoranthene	ND		0.010
Benzo[a]pyrene	ND		0.010
Indeno[1,2,3-cd]pyrene	ND		0.010
Dibenz[a,h]anthracene	ND		0.010
Benzo[g,h,i]perylene	ND		0.010

Surrogate :	Percent Recovery	Control Limits
2-Fluorophenol	21	21 - 100
Phenol-d6	15	10 - 94
Nitrobenzene-d5	49	35 - 114
2-Fluorobiphenyl	58	43 - 116
2,4,6-Tribromophenol	92	10 - 123
Terphenyl-d14	72	33 - 144

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

SEMIVOLATILES by EPA 8270C/SIM
SB/SBD QUALITY CONTROL

Date Extracted: 6-7-02
Date Analyzed: 6-11-02

Matrix: Water
Units: ug/L (ppb)

Lab ID: SB0607W1

Compound:	Sample Amount	Spike Amount	SB	Percent Recovery	SBD	Percent Recovery	RPD	Flags
Phenol	ND	90.6	20.0	22	19.0	21	5.0	
2-Chlorophenol	ND	95.5	52.3	55	55.0	58	5.1	
1,4-Dichlorobenzene	ND	33.3	18.4	55	17.9	54	2.8	
N-Nitroso-di-n-propylamine	ND	50.1	32.3	64	32.4	65	0.27	
1,2,4-Trichlorobenzene	ND	45.0	27.0	60	25.8	57	4.5	
4-Chloro-3-methylphenol	ND	95.4	65.2	68	73.2	77	12	
Acenaphthene	ND	56.8	40.4	71	40.5	71	0.29	
2,4-Dinitrotoluene	ND	47.6	31.3	66	32.0	67	2.3	
4-Nitrophenol	ND	118	47.4	40	43.5	37	8.5	
Pentachlorophenol	ND	91.7	74.7	81	75.1	82	0.48	
Pyrene	ND	46.4	40.6	88	40.4	87	0.48	

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

ORGANOCHLORINE PESTICIDES by EPA 8081A

Date Extracted: 6-6-02
Date Analyzed: 6-8-02

Matrix: Water
Units: ug/L (ppb)

Lab ID: 05-223-01
Client ID: SW-1-0502

Analyte	Result	PQL	Flags
alpha-BHC	ND	0.0050	
gamma-BHC	ND	0.0050	
Heptachlor	ND	0.0050	
Aldrin	ND	0.0050	
beta-BHC	ND	0.0050	
delta-BHC	ND	0.0050	
Heptachlor epoxide	ND	0.0050	
Endosulfan I	ND	0.0050	
4,4'-DDE	ND	0.0050	
Dieldrin	ND	0.0050	
Endrin	ND	0.0050	
Endosulfan II	ND	0.0050	
4,4'-DDD	ND	0.0050	
4,4'-DDT	ND	0.0050	
Endrin Aldehyde	ND	0.0050	
Endosulfan Sulfate	ND	0.0050	
Methoxychlor	ND	0.0050	
Endrin ketone	ND	0.0050	
Toxaphene	ND	0.050	
Chlordane (Technical)	ND	0.050	

Surrogate	Percent Recovery	Control Limits
2,4,5,6-Tetrachloro-m-xylene	53	40 - 116
Decachlorobiphenyl	62	8 - 108

APPENDIX B

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

ORGANOCHLORINE
PESTICIDES by EPA 8081A
METHOD BLANK QUALITY CONTROL

Date Extracted: 6-6-02
Date Analyzed: 6-8-02

Matrix: Water
Units: ug/L (ppb)

Lab ID: MB0606W1

Analyte	Result	PQL	Flags
alpha-BHC	ND	0.0050	
gamma-BHC	ND	0.0050	
Heptachlor	ND	0.0050	
Aldrin	ND	0.0050	
beta-BHC	ND	0.0050	
delta-BHC	ND	0.0050	
Heptachlor epoxide	ND	0.0050	
Endosulfan I	ND	0.0050	
4,4'-DDE	ND	0.0050	
Dieldrin	ND	0.0050	
Endrin	ND	0.0050	
Endosulfan II	ND	0.0050	
4,4'-DDD	ND	0.0050	
4,4'-DDT	ND	0.0050	
Endrin Aldehyde	ND	0.0050	
Endosulfan Sulfate	ND	0.0050	
Methoxychlor	ND	0.0050	
Endrin ketone	ND	0.0050	
Toxaphene	ND	0.050	
Chlordane (Technical)	ND	0.050	

Surrogate	Percent Recovery	Control Limits
2,4,5,6-Tetrachloro-m-xylene	69	40 - 116
Decachlorobiphenyl	73	8 - 108

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

ORGANOCHLORINE
PESTICIDES by EPA 8081A
MS/MSD QUALITY CONTROL

Date Extracted: 6-6-02
Date Analyzed: 6-8-02

Matrix: Water
Units: ug/L (ppb)

Lab ID: 05-223-01

Analyte	Spike Level	MS	Percent Recovery	MSD	Percent Recovery	RPD
gamma-BHC	0.050	0.0311	62	0.0312	62	0.32
Heptachlor	0.050	0.0388	78	0.0346	69	11
Aldrin	0.050	0.0347	69	0.0348	70	0.29
Dieldrin	0.125	0.0974	78	0.0966	77	0.82
Endrin	0.125	0.105	84	0.105	84	0.0
4,4'-DDT	0.125	0.129	103	0.132	106	2.3

Surrogate	Percent Recovery	Percent Recovery	Control Limits
2,4,5,6-Tetrachloro-m-xylene	57	55	40 - 116
Decachlorobiphenyl	61	68	8 - 108

Flags:

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

ORGANOCHLORINE PESTICIDES by EPA 8081A SPIKE BLANK QUALITY CONTROL

Date Extracted: 6-6-02
Date Analyzed: 6-8-02

Matrix: Water
Units: ug/L (ppb)

Lab ID: SB0606W1

Analyte	Spike Level	Result	Percent Recovery
gamma-BHC	0.050	0.0407	81
Heptachlor	0.050	0.0449	90
Aldrin	0.050	0.0410	82
Dieldrin	0.125	0.125	100
Endrin	0.125	0.127	102
4,4'-DDT	0.125	0.159	127

Surrogate	Percent Recovery	Control Limits
2,4,5,6-Tetrachloro-m-xylene	65	40 - 116
Decachlorobiphenyl	94	8 - 108

Flags:

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

PCBs by EPA 8082

Date Extracted:	6-6-02
Date Analyzed:	6-10-02
Matrix:	Water
Units:	ug/L (ppb)
Lab ID:	05-223-01
Client ID:	SW-1-0502

	Result	PQL
Aroclor 1016:	ND	0.050
Aroclor 1221:	ND	0.050
Aroclor 1232:	ND	0.050
Aroclor 1242:	ND	0.050
Aroclor 1248:	ND	0.050
Aroclor 1254:	ND	0.050
Aroclor 1260:	ND	0.050

Surrogate	Percent Recovery	Control Limits
Decachlorobiphenyl	66	14 - 135

Flags:

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

PCBs by EPA 8082
METHOD BLANK QUALITY CONTROL

Date Extracted: 6-6-02
Date Analyzed: 6-10-02

Matrix: Water
Units: ug/L (ppb)

Lab ID: MB0606W1

	Result	PQL
Aroclor 1016:	ND	0.050
Aroclor 1221:	ND	0.050
Aroclor 1232:	ND	0.050
Aroclor 1242:	ND	0.050
Aroclor 1248:	ND	0.050
Aroclor 1254:	ND	0.050
Aroclor 1260:	ND	0.050

Surrogate	Percent Recovery	Control Limits
Decachlorobiphenyl	61	14 - 135

Flags:

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

PCBs by EPA 8082
MS/MSD QUALITY CONTROL

Date Extracted: 6-6-02
Date Analyzed: 6-10-02

Matrix: Water
Units: ug/L (ppb)

Lab ID: 05-223-01

Spike Level: 1.00

	MS	Percent Recovery	MSD	Percent Recovery	RPD
Aroclor 1260:	0.731	73	0.787	79	7.4
PQL	0.050		0.050		

Surrogate	Percent Recovery	Percent Recovery	Control Limits
Decachlorobiphenyl	68	77	14 - 135

Flags:

Date of Report: June 12, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

PCBs by EPA 8082
SPIKE BLANK QUALITY CONTROL

Date Extracted: 6-6-02
Date Analyzed: 6-10-02

Matrix: Water
Units: ug/L (ppb)

Lab ID: SB0606W1

Spike Level: 1.00

	Result	Percent Recovery
Aroclor 1260:	0.818	82

Surrogate	Percent Recovery	Control Limits
Decachlorobiphenyl	87	14 - 135

Flags:

OnSite Environmental Inc.

DATA QUALIFIERS AND ABBREVIATIONS

A - Due to a high sample concentration, the amount spiked is insufficient for meaningful MS/MSD recovery data.

B - The analyte indicated was also found in the blank sample.

C - The duplicate RPD is outside control limits due to high result variability when analyte concentrations are within five times the quantitation limit.

D - Data from 1:____ dilution.

E - The value reported exceeds the quantitation range, and is an estimate.

F - Surrogate recovery data is not available due to the high concentration of coeluting target compounds.

G - Insufficient sample quantity for duplicate analysis.

H - The analyte indicated is a common laboratory solvent and may have been introduced during sample preparation, and be impacting the sample result.

I - Compound recovery is outside of the control limits.

J - The value reported was below the practical quantitation limit. The value is an estimate.

K - Sample duplicate RPD is outside control limits due to sample inhomogeniety. The sample was re-extracted and re-analyzed with similar results.

L - The RPD is outside of the control limits.

M - Hydrocarbons in the gasoline range (toluene-napthalene) are present in the sample.

O - Hydrocarbons outside the defined gasoline range are present in the sample.

P - The RPD of the detected concentrations between the two columns is greater than 40.

Q - Surrogate recovery is outside of the control limits.

S - Surrogate recovery data is not available due to the necessary dilution of the sample.

T - The sample chromatogram is not similar to a typical ____________.

U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

V - Matrix Spike/Matrix Spike Duplicate recoveries are outside control limits due to matrix effects.

W - Matrix Spike/Matrix Spike Duplicate RPD are outside control limits due to matrix effects.

X - Sample extract treated with a silica gel cleanup procedure.

Y - Sample extract treated with an acid cleanup procedure.

Z -

ND - Not Detected at PQL
MRL - Method Reporting Limit
PQL - Practical Quantitation Limit
RPD - Relative Percent Difference

OnSite Environmental Inc.
Analytical Testing and Mobile Laboratory Services

RECEIVED
JUN 19 2002
HWA GeoSciences Inc.

June 17, 2002

Arnie Sugar
HWA GeoSciences, Inc.
19730 64th Avenue West
Lynnwood, WA 98036

Re: Analytical Data for Project 2002071
Laboratory Reference No. 0205-223

Dear Arnie:

Enclosed are the analytical results and associated quality control data for samples submitted on May 31, 2002.

The standard policy of OnSite Environmental Inc. is to store your samples for 30 days from the date of receipt. If you require longer storage, please contact the laboratory.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning the data, or need additional information, please feel free to call me.

Sincerely,

David Baumeister
Project Manager

Enclosures

14648 NE 95th Street, Redmond, WA 98052 • (425) 883-3881 • Fax (425) 885-4603

APPENDIX B

Date of Report: June 17, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

Case Narrative

Samples were collected on May 31, 2002. Samples were maintained at the laboratory at 4°C and followed SW846 analysis and extraction methods.

Total Metals EPA 6010B Analysis

Any QA/QC issues associated with this extraction and analysis will be indicated with a footnote reference and discussed in detail on the Data Qualifier page.

Date of Report: June 17, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

TOTAL METALS
EPA 6010B

Date Extracted: 6-3-02
Date Analyzed: 6-12&13-02

Matrix: Water
Units: ug/L (ppb)

Lab ID: 05-223-01
Client ID: SW-1-0502

Analyte	Method	Result	PQL
Iron	6010B	21000	110
Manganese	6010B	1500	11

Date of Report: June 17, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

TOTAL METALS
EPA 6010B
METHOD BLANK QUALITY CONTROL

Date Extracted: 6-3-02
Date Analyzed: 6-12&13-02

Matrix: Water
Units: ug/L (ppb)

Lab ID: MB0603W1

Analyte	Method	Result	PQL
Iron	6010B	ND	110
Manganese	6010B	ND	11

Date of Report: June 17, 2002
Samples Submitted: May 31, 2002
Lab Traveler: 05-223
Project: 2002071

TOTAL METALS
EPA 6010B
DUPLICATE QUALITY CONTROL

Date Extracted: 6-3-02
Date Analyzed: 6-12&13-02

Matrix: Water
Units: ug/L (ppb)

Lab ID: 05-221-02

Analyte	Sample Result	Duplicate Result	RPD	PQL	Flags
Iron	ND	ND	NA	110	
Manganese	ND	ND	NA	11	

OnSite Environmental Inc.

DATA QUALIFIERS AND ABBREVIATIONS

A - Due to a high sample concentration, the amount spiked is insufficient for meaningful MS/MSD recovery data.

B - The analyte indicated was also found in the blank sample.

C - The duplicate RPD is outside control limits due to high result variability when analyte concentrations are within five times the quantitation limit.

D - Data from 1:____ dilution.

E - The value reported exceeds the quantitation range, and is an estimate.

F - Surrogate recovery data is not available due to the high concentration of coeluting target compounds.

G - Insufficient sample quantity for duplicate analysis.

H - The analyte indicated is a common laboratory solvent and may have been introduced during sample preparation, and be impacting the sample result.

I - Compound recovery is outside of the control limits.

J - The value reported was below the practical quantitation limit. The value is an estimate.

K - Sample duplicate RPD is outside control limits due to sample inhomogeniety. The sample was re-extracted and re-analyzed with similar results.

L - The RPD is outside of the control limits.

M - Hydrocarbons in the gasoline range (toluene-napthalene) are present in the sample.

O - Hydrocarbons outside the defined gasoline range are present in the sample.

P - The RPD of the detected concentrations between the two columns is greater than 40.

Q - Surrogate recovery is outside of the control limits.

S - Surrogate recovery data is not available due to the necessary dilution of the sample.

T - The sample chromatogram is not similar to a typical ____________.

U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

V - Matrix Spike/Matrix Spike Duplicate recoveries are outside control limits due to matrix effects.

W - Matrix Spike/Matrix Spike Duplicate RPD are outside control limits due to matrix effects.

X - Sample extract treated with a silica gel cleanup procedure.

Y - Sample extract treated with an acid cleanup procedure.

Z -

ND - Not Detected at PQL
MRL - Method Reporting Limit
PQL - Practical Quantitation Limit
RPD - Relative Percent Difference

HWA GEOSCIENCES INC.
19730 64th Ave. W., Suite 200, Lynnwood, WA 98036 (425)774-0106
4500 Kruse Way, Suite 300, Lake Oswego, OR 97035 (503)675-2424

Chain of Custody and Laboratory Analysis Request

DATE: 5/31/02
PAGE: 1 of 1

PROJECT NAME: G. East LF # 2002071
SITE CODE:
SAMPLERS NAME: B. Robinson PHONE: 206 774 3128
SAMPLERS SIGNATURE: [signature]
HWA CONTACT: Arnie Sugar PHONE: 425 774 0106

05-223

ANALYSIS REQUESTED

HWA SAMPLE ID	DATE	TIME	MATRIX	LAB ID	# OF BOTTLE	TPH-G/BTEX	TPH-Diesel/oil	Total Metals (PP Mets:)	VOC	SVOC	Pesticides/PCB									REMARKS
SW-1-0502	5/31/02	1600	W	1	14	X	X	X	X	X	X									Acid/silica gel extract for metals

	PRINT NAME	SIGNATURE	COMPANY	DATE	TIME	REMARKS
Relinquished by:	B. Robinson	[signature]	HWA Geosciences	5/31/02	1740	
Received by:	[signature]	Kathryn M Speirs	OSE	5/31/02	1740	
Relinquished by:						
Received by:						

DISTRIBUTION: WHITE - Return to HWA; YELLOW - Retain by Lab; PINK - Retain by Sampler

APPENDIX B

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HWA GeoSciences Inc. 19730 64th Ave W, Suite 200 Lynnwood WA/USA, 98067	Project: GO EAST LF Project Number: 2002071 Project Manager: Arnie Sugar	Reported: 06/13/02 14:55

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
SW-1-0502	B2E0795-01	Water	05/31/02 14:00	05/31/02 16:50

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HWA GeoSciences Inc. 19730 64th Ave W, Suite 200 Lynnwood WA/USA, 98067	Project: GO EAST LF Project Number: 2002071 Project Manager: Arnie Sugar	Reported: 06/13/02 14:55

Conventional Chemistry Parameters by APHA/EPA Methods

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
;W-1-0502 (B2E0795-01) Water	**Sampled: 05/31/02 14:00**	**Received: 05/31/02 16:50**							
Bicarbonate Alkalinity	396	5.00	mg/L as CaCO3	1	2F10027	06/10/02	06/10/02	SM 2320B	
Carbonate Alkalinity	ND	5.00	"	"	"	"	"	"	
Hydroxide Alkalinity	ND	5.00	"	"	"	"	"	"	
Total Alkalinity	396	5.00	"	"	"	"	"	"	
Total Dissolved Solids	460	10	mg/l	"	2F06055	06/06/02	06/12/02	EPA 160.1	
Total Suspended Solids	60	4.0	"	"	2F06053	"	06/11/02	EPA 160.2	
Total Organic Carbon	29.8	20.0	"	10	2F06007	06/05/02	06/05/02	EPA 415.1	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Jeanne Garthwaite

eanne Garthwaite, Project Manager

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HWA GeoSciences Inc. 19730 64th Ave W, Suite 200 Lynnwood WA/USA, 98067	Project: GO EAST LF Project Number: 2002071 Project Manager: Arnie Sugar	Reported: 06/13/02 14:55

Anions by EPA Method 300.0
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
SW-1-0502 (B2E0795-01) Water	**Sampled: 05/31/02 14:00**		**Received: 05/31/02 16:50**						
Chloride	8.95	0.800	mg/l	2	2F03001	06/01/02	06/01/02	EPA 300.0	
Nitrate-Nitrogen	ND	0.200	mg/l as N	1	"	"	"	"	
Sulfate	1.83	0.400	mg/l	"	"	"	"	"	

Anne Garthwaite

Jeanne Garthwaite, Project Manager

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HWA GeoSciences Inc. 19730 64th Ave W, Suite 200 Lynnwood WA/USA, 98067	Project: GO EAST LF Project Number: 2002071 Project Manager: Arnie Sugar	Reported: 06/13/02 14:55

Microbiological Parameters by APHA Standard Methods
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
SW-1-0502 (B2E0795-01) Water	**Sampled: 05/31/02 14:00**	**Received: 05/31/02 16:50**							
Fecal Coliforms	11	2.0	MPN/100 ml	1	2F07050	05/31/02	06/04/02	SM 9221	
Total Coliforms	4.0	2.0	"	"	"	"	"	"	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Jeanne Garthwaite

Jeanne Garthwaite, Project Manager

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HWA GeoSciences Inc. 19730 64th Ave W, Suite 200 Lynnwood WA/USA, 98067	Project: GO EAST LF Project Number: 2002071 Project Manager: Arnie Sugar	Reported: 06/13/02 14:55

Conventional Chemistry Parameters by APHA/EPA Methods - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 2F06007: Prepared 06/05/02 Using General Preparation										
Blank (2F06007-BLK1)										
Total Organic Carbon	ND	2.00	mg/l							
LCS (2F06007-BS1)										
Total Organic Carbon	20.3	2.00	mg/l	20.0		102	90-110			
LCS Dup (2F06007-BSD1)										
Total Organic Carbon	20.9	2.00	mg/l	20.0		104	90-110	2.91	20	
Duplicate (2F06007-DUP1)					Source: B2E0697-01					
Total Organic Carbon	7.20	2.00	mg/l		9.12			23.5	25	
Matrix Spike (2F06007-MS1)					Source: B2E0697-01					
Total Organic Carbon	19.3	2.00	mg/l	10.0	9.12	102	70-125			
tch 2F06053: Prepared 06/06/02 Using General Preparation										
Blank (2F06053-BLK1)										
Total Suspended Solids	ND	4.0	mg/l							
Duplicate (2F06053-DUP1)					Source: B2E0766-01					
Total Suspended Solids	ND	4.0	mg/l		ND			0.0	19	
Batch 2F06055: Prepared 06/06/02 Using General Preparation										
Blank (2F06055-BLK1)										
Total Dissolved Solids	ND	10	mg/l							

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HWA GeoSciences Inc.	Project: GO EAST LF	
19730 64th Ave W, Suite 200	Project Number: 2002071	Reported:
Lynnwood WA/USA, 98067	Project Manager: Arnie Sugar	06/13/02 14:55

Conventional Chemistry Parameters by APHA/EPA Methods - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 2F06055: Prepared 06/06/02 Using General Preparation										
Duplicate (2F06055-DUP1)					Source: B2E0766-03					
Total Dissolved Solids	160	10	mg/l		160			0.0	17	
Batch 2F10027: Prepared 06/10/02 Using General Preparation										
Blank (2F10027-BLK1)										
Bicarbonate Alkalinity	ND	5.00	mg/L as CaCO3							
Carbonate Alkalinity	ND	5.00	"							
Hydroxide Alkalinity	ND	5.00	"							
Total Alkalinity	ND	5.00	"							
LCS (2F10027-BS1)										
Total Alkalinity	50.4	5.00	mg/L as CaCO3	50.0		101	90-110			
LCS Dup (2F10027-BSD1)										
Total Alkalinity	50.2	5.00	mg/L as CaCO3	50.0		100	90-110	0.398	20	
Duplicate (2F10027-DUP1)					Source: B2E0766-01					
Bicarbonate Alkalinity	74.6	5.00	mg/L as CaCO3		74.4			0.268	6	
Carbonate Alkalinity	ND	5.00	"		74.4				6	
Hydroxide Alkalinity	ND	5.00	"		ND				6	
Total Alkalinity	74.6	5.00	"		ND				6	

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HWA GeoSciences Inc. 19730 64th Ave W, Suite 200 Lynnwood WA/USA, 98067	Project: GO EAST LF Project Number: 2002071 Project Manager: Arnie Sugar	Reported: 06/13/02 14:55

Anions by EPA Method 300.0 - Quality Control
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 2F03001: Prepared 06/01/02 Using General Preparation										
Blank (2F03001-BLK1)										
Chloride	ND	0.400	mg/l							
Nitrate-Nitrogen	ND	0.200	mg/l as N							
Sulfate	ND	0.400	mg/l							
LCS (2F03001-BS1)										
Chloride	2.07	0.400	mg/l	2.00		104	90-110			
Nitrate-Nitrogen	0.997	0.200	mg/l as N	1.00		99.7	90-110			
Sulfate	6.11	0.400	mg/l	6.00		102	90-110			
LCS Dup (2F03001-BSD1)										
Chloride	2.06	0.400	mg/l	2.00		103	90-110	0.484	20	
Nitrate-Nitrogen	1.00	0.200	mg/l as N	1.00		100	90-110	0.300	20	
[illegible]e	6.16	0.400	mg/l	6.00		103	90-110	0.815	20	
Duplicate (2F03001-DUP1)					Source: B2E0506-07					
Chloride	6.15	0.800	mg/l		6.25			1.61	25	
Sulfate	12.3	0.800	"		12.5			1.61	25	
Duplicate (2F03001-DUP2)					Source: B2E0795-01					
Nitrate-Nitrogen	ND	0.200	mg/l as N		ND				25	
Sulfate	1.76	0.400	mg/l		1.83			3.90	25	
Duplicate (2F03001-DUP3)					Source: B2E0642-04					
Sulfate	12.1	0.800	mg/l		12.2			0.823	25	
Matrix Spike (2F03001-MS1)					Source: B2E0506-07					
Chloride	16.4	2.00	mg/l	10.0	6.25	102	54-124			
Sulfate	43.0	2.00	"	30.0	12.5	102	75-125			

Jeanne Garthwaite

Jeanne Garthwaite, Project Manager

North Creek Analytical, Inc.
Environmental Laboratory Network

APPENDIX B

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HWA GeoSciences Inc.
19730 64th Ave W, Suite 200
Lynnwood WA/USA, 98067

Project: GO EAST LF
Project Number: 2002071
Project Manager: Arnie Sugar

Reported:
06/13/02 14:55

Anions by EPA Method 300.0 - Quality Control

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 2F03001: Prepared 06/01/02 Using General Preparation										
Matrix Spike (2F03001-MS2)					Source: B2E0795-01					
Nitrate-Nitrogen	0.996	0.200	mg/l as N	1.00	ND	90.6	60-130			
Sulfate	7.67	0.400	mg/l	6.00	1.83	97.3	75-125			
Matrix Spike (2F03001-MS3)					Source: B2E0642-04					
Sulfate	42.7	2.00	mg/l	30.0	12.2	102	75-125			

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HWA GeoSciences Inc. 19730 64th Ave W, Suite 200 Lynnwood WA/USA, 98067	Project: GO EAST LF Project Number: 2002071 Project Manager: Arnie Sugar	Reported: 06/13/02 14:55

Notes and Definitions

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
RPD	Relative Percent Difference

North Creek Analytical - Bothell

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Jeanne Garthwaite

Jeanne Garthwaite, Project Manager

North Creek Analytical, Inc.
Environmental Laboratory Network

APPENDIX B

HWA GEOSCIENCES INC.

19730 64th Ave. W., Suite 200, Lynnwood, WA 98036 (425)774-0106
4500 Kruse Way, Suite 300, Lake Oswego, OR 97035 (503)675-2424

Chain of Custody and Laboratory Analysis Request

DATE: 5/31/02
PAGE: 1 of 1

PROJECT NAME: Go East LF #: 2002071
SITE CODE:
SAMPLERS NAME: B. Robinson PHONE: 206 794 3125
SAMPLERS SIGNATURE: [signature]
HWA CONTACT: Arnie Sugar PHONE: 425 774 0106

ANALYSIS REQUESTED

HWA SAMPLE ID	DATE	TIME	MATRIX	LAB ID	# OF BOTTLE	Nitrate	Chloride	Sulfate	Alkalinity/Carb/Bicarb	TDS	TSS	TOC	Total Coliform	Fecal Coliform						REMARKS
SW-1-0502	5/31/02	1400	W		7	X	X	X	X	X	X	X	X	X						B2E0795-01

	PRINT NAME	SIGNATURE	COMPANY	DATE	TIME	REMARKS
Relinquished by:	B. Robinson	[signature]	HWA Geosciences	5/31/02	4:50pm	
Received by:	K. KACZOROWSKI	[signature]	NCA	5/31/02	16:50	
Relinquished by:						
Received by:						

DISTRIBUTION: WHITE - Return to HWA; YELLOW - Retain by Lab; PINK - Retain by Sampler

APPENDIX B

HWA GEOSCIENCES INC.

19730 64th Ave. W., Suite 200, Lynnwood, WA 98036 (425)774-0106
4500 Kruse Way, Suite 300, Lake Oswego, OR 97035 (503)675-2424

Chain of Custody and Laboratory Analysis Request

DATE: 5/31/02
PAGE: 1 of 1

PROJECT NAME: G. East LF #: 2002071
SITE CODE:
SAMPLERS NAME: B. Robinson PHONE: 206 776 3128
SAMPLERS SIGNATURE: [signature]
HWA CONTACT: Arnie Sugar PHONE: 425 774 0106

05-223

ANALYSIS REQUESTED

HWA SAMPLE ID	DATE	TIME	MATRIX	LAB ID	# OF BOTTLE	TPH - G/BTEX	TPH - Diesel/oil	Total Metals (pp Mets - 13)	VOC	SVOC	Pesticides/PCB		Total Metals Fe, Mn							REMARKS
SW-1-0502	5/31/02	1600	W	1	14	X	X	X	X	X	X		X							Acid/silica gel extract for metals
																				X Added 6/13/02 BR

PRINT NAME	SIGNATURE	COMPANY	DATE	TIME	REMARKS
Relinquished by: B. Robinson	[signature]	HWA Geosciences	5/31/02	1740	
Received by: [signature]	Kathryn M Spears	OSE	5/31/02	1740	
Relinquished by:					
Received by:					

DISTRIBUTION: WHITE - Return to HWA; YELLOW - Retain by Lab; PINK - Retain by Sampler

APPENDIX B

ATTACHMENT C

Surface Water and Ground Water Analytical Data

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

Job Number: 580-15041-2

Job Description: Go East

For:
Associated Earth Sciences
911 5th Avenue
Suite 100
Kirkland, WA 98033

Attention: Jon Sondergaard

Approved for release.
Curtis Armstrong
Project Manager I
9/23/2009 12:03 PM

Curtis Armstrong
Project Manager I
curtis.armstrong@testamericainc.com
09/23/2009

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This report shall not be reproduced except in full, without prior express written approval by the laboratory. The results relate only to the item(s) tested and the sample(s) as received by the laboratory.

The results included in this report have been reviewed for compliance with the laboratory QA/QC plan and meet all requirements of NELAC. All data have been found to be compliant with laboratory protocol, with the exception of any items noted in the case narrative.

Table of Contents

METHOD SUMMARY

Client: Associated Earth Sciences

Job Number: 580-15041-2

Description	Lab Location	Method	Preparation Method
Matrix Water			
Metals (ICP)	TAL TAC	SW846 6010B	
Sample Filtration	TAL TAC		FILTRATION
Preparation, Total Recoverable or Dissolved Metals	TAL TAC		SW846 3005A
Metals (ICP/MS)	TAL TAC	SW846 6020	
Sample Filtration	TAL TAC		FILTRATION
Preparation, Total Recoverable or Dissolved Metals	TAL TAC		SW846 3005A

Lab References:

TAL TAC = TestAmerica Tacoma

Method References:

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

SAMPLE SUMMARY

Client: Associated Earth Sciences

Job Number: 580-15041-2

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
580-15041-1	MW2S181909	Water	08/19/2009 1205	08/19/2009 1320
580-15041-2	MW1S181909	Water	08/19/2009 1206	08/19/2009 1320
580-15041-3	MW3S181909	Water	08/19/2009 1140	08/19/2009 1320

Client: Associated Earth Sciences

Job Number: 580-15041-2

Client Sample ID:	**MW2S181909**
Lab Sample ID:	580-15041-1
Client Matrix:	Water

Date Sampled: 08/19/2009 1205
Date Received: 08/19/2009 1320

6010B Metals (ICP)-Dissolved

Method:	6010B	Analysis Batch: 580-50597		Instrument ID:	SEA027
Preparation:	3005A	Prep Batch: 580-50492		Lab File ID:	N/A
Dilution:	1.0			Initial Weight/Volume:	50 mL
Date Analyzed:	09/21/2009 1110			Final Weight/Volume:	50 mL
Date Prepared:	09/18/2009 1047				

Analyte	Result (mg/L)	Qualifier	RL
Iron	ND		0.20
Manganese	0.12		0.020

6020 Metals (ICP/MS)-Dissolved

Method:	6020	Analysis Batch: 580-50621		Instrument ID:	SEA026
Preparation:	3005A	Prep Batch: 580-50492		Lab File ID:	N/A
Dilution:	5.0			Initial Weight/Volume:	50 mL
Date Analyzed:	09/21/2009 1329			Final Weight/Volume:	50 mL
Date Prepared:	09/18/2009 1047				

Analyte	Result (mg/L)	Qualifier	RL
Arsenic	0.0096		0.0020
Chromium	ND	^	0.0020
Lead	ND		0.0020

Analytical Data

Client: Associated Earth Sciences | Job Number: 580-15041-2

Client Sample ID: MW1S181909

Lab Sample ID: 580-15041-2
Client Matrix: Water

Date Sampled: 08/19/2009 1206
Date Received: 08/19/2009 1320

6010B Metals (ICP)-Dissolved

Method:	6010B	Analysis Batch: 580-50597		Instrument ID:	SEA027
Preparation:	3005A	Prep Batch: 580-50492		Lab File ID:	N/A
Dilution:	1.0			Initial Weight/Volume:	50 mL
Date Analyzed:	09/21/2009 1123			Final Weight/Volume:	50 mL
Date Prepared:	09/18/2009 1047				

Analyte	Result (mg/L)	Qualifier	RL
Iron	0.47		0.20
Manganese	0.073		0.020

6020 Metals (ICP/MS)-Dissolved

Method:	6020	Analysis Batch: 580-50621		Instrument ID:	SEA026
Preparation:	3005A	Prep Batch: 580-50492		Lab File ID:	N/A
Dilution:	5.0			Initial Weight/Volume:	50 mL
Date Analyzed:	09/21/2009 1334			Final Weight/Volume:	50 mL
Date Prepared:	09/18/2009 1047				

Analyte	Result (mg/L)	Qualifier	RL
Arsenic	0.021		0.0020
Chromium	ND	^	0.0020
Lead	ND		0.0020

Analytical Data

Client: Associated Earth Sciences

Job Number: 580-15041-2

Client Sample ID: **MW3S181909**

Lab Sample ID: 580-15041-3
Client Matrix: Water

Date Sampled: 08/19/2009 1140
Date Received: 08/19/2009 1320

6010B Metals (ICP)-Dissolved

Method:	6010B	Analysis Batch: 580-50597		Instrument ID:	SEA027
Preparation:	3005A	Prep Batch: 580-50492		Lab File ID:	N/A
Dilution:	1.0			Initial Weight/Volume:	50 mL
Date Analyzed:	09/21/2009 1128			Final Weight/Volume:	50 mL
Date Prepared:	09/18/2009 1047				

Analyte	Result (mg/L)	Qualifier	RL
Iron	ND		0.20
Manganese	0.064		0.020

6020 Metals (ICP/MS)-Dissolved

Method:	6020	Analysis Batch: 580-50621		Instrument ID:	SEA026
Preparation:	3005A	Prep Batch: 580-50492		Lab File ID:	N/A
Dilution:	5.0			Initial Weight/Volume:	50 mL
Date Analyzed:	09/21/2009 1339			Final Weight/Volume:	50 mL
Date Prepared:	09/18/2009 1047				

Analyte	Result (mg/L)	Qualifier	RL
Arsenic	0.0064		0.0020
Chromium	ND	^	0.0020
Lead	ND		0.0020

DATA REPORTING QUALIFIERS

Client: Associated Earth Sciences

Job Number: 580-15041-2

Lab Section	Qualifier	Description
Metals		
	^	ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA, DLCK or MRL standard: Instrument related QC exceeds the control limits.

APPENDIX B

Quality Control Results

Client: Associated Earth Sciences

Job Number: 580-15041-2

Method Blank - Batch: 580-50492

Method: 6010B
Preparation: 3005A
Total Recoverable

Lab Sample ID: MB 580-50492/19-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 09/21/2009 1032
Date Prepared: 09/18/2009 1047

Analysis Batch: 580-50597
Prep Batch: 580-50492
Units: mg/L

Instrument ID: SEA027
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Result	Qual	RL
Iron	ND		0.20
Manganese	ND		0.020

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 580-50492

Method: 6010B
Preparation: 3005A
Total Recoverable

LCS Lab Sample ID: LCS 580-50492/20-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 09/21/2009 1036
Date Prepared: 09/18/2009 1047

Analysis Batch: 580-50597
Prep Batch: 580-50492
Units: mg/L

Instrument ID: SEA027
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

LCSD Lab Sample ID: LCSD 580-50492/21-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 09/21/2009 1040
Date Prepared: 09/18/2009 1047

Analysis Batch: 580-50597
Prep Batch: 580-50492
Units: mg/L

Instrument ID: SEA027
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	% Rec. LCS	% Rec. LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Iron	97	98	80 - 120	2	20		
Manganese	98	99	80 - 120	1	20		

Calculations are performed before rounding to avoid round-off errors in calculated results.

Client: Associated Earth Sciences

Job Number: 580-15041-2

Method Blank - Batch: 580-50492

Method: 6020
Preparation: 3005A
Total Recoverable

Lab Sample ID:	MB 580-50492/19-A	Analysis Batch:	580-50621	Instrument ID:	SEA026
Client Matrix:	Water	Prep Batch:	580-50492	Lab File ID:	N/A
Dilution:	5.0	Units:	mg/L	Initial Weight/Volume:	50 mL
Date Analyzed:	09/21/2009 1117			Final Weight/Volume:	50 mL
Date Prepared:	09/18/2009 1047				

Analyte	Result	Qual	RL
Arsenic	ND		0.0020
Chromium	ND	^	0.0020
Lead	ND		0.0020

LCS-Standard Reference Material - Batch: 580-50492

Method: 6020
Preparation: 3005A
Total Recoverable

Lab Sample ID:	LCSSRM 580-50492/22-A	Analysis Batch:	580-50621	Instrument ID:	SEA026
Client Matrix:	Water	Prep Batch:	580-50492	Lab File ID:	N/A
Dilution:	50	Units:	mg/L	Initial Weight/Volume:	50 mL
Date Analyzed:	09/21/2009 1204			Final Weight/Volume:	50 mL
Date Prepared:	09/18/2009 1047				

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Arsenic	4.00	3.85	96	80 - 120	
Chromium	0.400	0.387	97	80 - 120	^
Lead	1.00	1.05	105	80 - 120	

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quality Control Results

Client: Associated Earth Sciences

Job Number: 580-15041-2

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 580-50492

Method: 6020
Preparation: 3005A
Total Recoverable

LCS Lab Sample ID:	LCS 580-50492/20-A	Analysis Batch:	580-50621	Instrument ID:	SEA026
Client Matrix:	Water	Prep Batch:	580-50492	Lab File ID:	N/A
Dilution:	50	Units:	mg/L	Initial Weight/Volume:	50 mL
Date Analyzed:	09/21/2009 1154			Final Weight/Volume:	50 mL
Date Prepared:	09/18/2009 1047				

LCSD Lab Sample ID:	LCSD 580-50492/21-A	Analysis Batch:	580-50621	Instrument ID:	SEA026
Client Matrix:	Water	Prep Batch:	580-50492	Lab File ID:	N/A
Dilution:	50	Units:	mg/L	Initial Weight/Volume:	50 mL
Date Analyzed:	09/21/2009 1159			Final Weight/Volume:	50 mL
Date Prepared:	09/18/2009 1047				

	% Rec.						
Analyte	LCS	LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Arsenic	92	94	80 - 120	2	20		
Chromium	95	97	80 - 120	3	20	^	^
Lead	101	104	80 - 120	2	20		

Calculations are performed before rounding to avoid round-off errors in calculated results.

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Tacoma
5755 8th Street E.
Tacoma, WA 98424
Tel. 253-922-2310
Fax 253-922-5047
www.testamericainc.com

Chain of Custody Record

15041

Client: AEST
Project Manager: Jon Sondergaard
Date: 8-19-09
Chain of Custody Number: 5034
Address: 911 5th Avenue
Telephone Number (Area Code)/Fax Number: (425) 827-7701
Lab Number:
Page 1 of 1
City: Kirkland State: WA Zip Code: 98033
Site Contact:
Lab Contact:
Analysis (Attach list if more space is needed)
Project Name and Location (State): Go East
Carrier/Waybill Number:
Contract/Purchase Order/Quote No.: KE090231A

Sample I.D. and Location/Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil	Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/NaOH	None	Special Instructions/ Conditions of Receipt
MW2S181909	8-19-09	1205		X					1				3	1
MW1S181909	8-19-09	1206		X					1				3	2
MW3S181909	8-19-09	1140		X					1				3	3

Cooler: ☐ Yes ☐ No Cooler Temp:

Possible Hazard Identification: ☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal: ☐ Return To Client ☐ Disposal By Lab ☐ Archive For ____ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required (business days): ☐ 24 Hours ☐ 48 Hours ☐ 5 Days ☐ 10 Days ☐ 15 Days ☐ Other Normal

QC Requirements (Specify)

1. Relinquished By: Emily Cressman Emily Cressman	Date: 8/19/09	Time: 1120	1. Received By: [signature]	Date: 8/19/09	Time: 1:20
2. Relinquished By	Date	Time	2. Received By	Date	Time
3. Relinquished By	Date	Time	3. Received By	Date	Time

Comments: w/rec @ lab 8/20 @ 10:00 - Ice Packs 6.0°
TB = 4.2

DISTRIBUTION: WHITE – Stays with the Samples; CANARY – Returned to Client with Report; PINK – Field Copy

TAL-8274-580 (0508)

Login Sample Receipt Check List

Client: Associated Earth Sciences

Job Number: 580-15041-2

Login Number: 15041
Creator: Armstrong, Curtis
List Number: 1

List Source: TestAmerica Tacoma

Question	T / F/ NA	Comment
Radioactivity either was not measured or, if measured, is at or below background	True	
The cooler's custody seal, if present, is intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
There are no discrepancies between the sample IDs on the containers and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
VOA sample vials do not have headspace or bubble is <6mm (1/4") in diameter.	N/A	
If necessary, staff have been informed of any short hold time or quick TAT needs	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Is the Field Sampler's name present on COC?	True	
Sample Preservation Verified	True	

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

Job Number: 580-15041-1

Job Description: Go East

For:
Associated Earth Sciences
911 5th Avenue
Suite 100
Kirkland, WA 98033

Attention: Jon Sondergaard

Approved for release.
Curtis Armstrong
Project Manager I
9/4/2009 11:39 AM

Curtis Armstrong
Project Manager I
curtis.armstrong@testamericainc.com
09/04/2009

TestAmerica Tacoma is a part of TestAmerica Laboratories, Inc.

The results included in this report have been reviewed for compliance with the laboratory QA/QC plan and meet all requirements of NELAC. All data have been found to be compliant with laboratory protocol, with the exception of any items noted in the case narrative.

Table of Contents

METHOD SUMMARY

Client: Associated Earth Sciences

Job Number: 580-15041-1

Description	Lab Location	Method	Preparation Method
Matrix Water			
Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)	TAL TAC	SW846 8270C	
Liquid-Liquid Extraction (Continuous)	TAL TAC		SW846 3520C
Metals (ICP)	TAL TAC	SW846 6010B	
Preparation, Total Recoverable or Dissolved Metals	TAL TAC		SW846 3005A
Metals (ICP/MS)	TAL TAC	SW846 6020	
Preparation, Total Recoverable or Dissolved Metals	TAL TAC		SW846 3005A
Mercury (CVAA)	TAL TAC	SW846 7470A	
Preparation, Mercury	TAL TAC		SW846 7470A
Conductivity, Specific Conductance	TAL TAC	MCAWW 120.1	
pH (Electrometric)	TAL TAC	MCAWW 150.1	
Anions, Ion Chromatography	TAL TAC	MCAWW 300.0	

Lab References:

TAL TAC = TestAmerica Tacoma

Method References:

MCAWW = "Methods For Chemical Analysis Of Water And Wastes", EPA-600/4-79-020, March 1983 And Subsequent Revisions.

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

SAMPLE SUMMARY

Client: Associated Earth Sciences

Job Number: 580-15041-1

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
580-15041-1	MW2S181909	Water	08/19/2009 1205	08/19/2009 1320
580-15041-2	MW1S181909	Water	08/19/2009 1206	08/19/2009 1320
580-15041-3	MW3S181909	Water	08/19/2009 1140	08/19/2009 1320

Client: Associated Earth Sciences | Job Number: 580-15041-1

Client Sample ID: MW2S181909

Lab Sample ID: 580-15041-1 | Date Sampled: 08/19/2009 1205
Client Matrix: Water | Date Received: 08/19/2009 1320

8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method:	8270C	Analysis Batch: 580-49207		Instrument ID:	TAC002
Preparation:	3520C	Prep Batch: 580-49001		Lab File ID:	AT11843.D
Dilution:	1.0			Initial Weight/Volume:	1010 mL
Date Analyzed:	08/27/2009 1529			Final Weight/Volume:	10 mL
Date Prepared:	08/24/2009 1902			Injection Volume:	1.0 uL

Analyte	Result (ug/L)	Qualifier	RL
Phenol	ND		3.0
Bis(2-chloroethyl)ether	ND		2.0
2-Chlorophenol	ND		2.0
1,3-Dichlorobenzene	ND		2.0
1,4-Dichlorobenzene	ND		2.0
Benzyl alcohol	ND		2.0
1,2-Dichlorobenzene	ND		2.0
2-Methylphenol	ND		2.0
3 & 4 Methylphenol	ND		4.0
N-Nitrosodi-n-propylamine	ND		2.0
Hexachloroethane	ND		3.0
Nitrobenzene	ND		2.0
Isophorone	ND		2.0
2-Nitrophenol	ND		2.0
2,4-Dimethylphenol	ND		5.0
Benzoic acid	ND		9.9
Bis(2-chloroethoxy)methane	ND		2.0
2,4-Dichlorophenol	ND		2.0
1,2,4-Trichlorobenzene	ND		2.0
Naphthalene	ND		2.0
4-Chloroaniline	ND		2.0
Hexachlorobutadiene	ND		3.0
4-Chloro-3-methylphenol	ND		2.0
2-Methylnaphthalene	ND		0.99
Hexachlorocyclopentadiene	ND	*	9.9
2,4,6-Trichlorophenol	ND		3.0
2,4,5-Trichlorophenol	ND		2.0
2-Chloronaphthalene	ND		0.30
2-Nitroaniline	ND		2.0
Dimethyl phthalate	ND		2.0
Acenaphthylene	ND		0.40
2,6-Dinitrotoluene	ND		2.0
3-Nitroaniline	ND		2.0
Acenaphthene	ND		0.50
2,4-Dinitrophenol	ND		25
4-Nitrophenol	ND		9.9
Dibenzofuran	ND		2.0
2,4-Dinitrotoluene	ND		2.0
Diethyl phthalate	ND		2.0
4-Chlorophenyl phenyl ether	ND		2.0
Fluorene	ND		0.30
4-Nitroaniline	ND		3.0
4,6-Dinitro-2-methylphenol	ND		20
N-Nitrosodiphenylamine	ND		2.0
4-Bromophenyl phenyl ether	ND		2.0
Hexachlorobenzene	ND		2.0

APPENDIX B

Client: Associated Earth Sciences

Job Number: 580-15041-1

Client Sample ID: MW2S181909

Lab Sample ID: 580-15041-1

Client Matrix: Water

Date Sampled: 08/19/2009 1205

Date Received: 08/19/2009 1320

8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method:	8270C	Analysis Batch: 580-49207		Instrument ID:	TAC002
Preparation:	3520C	Prep Batch: 580-49001		Lab File ID:	AT11843.D
Dilution:	1.0			Initial Weight/Volume:	1010 mL
Date Analyzed:	08/27/2009 1529			Final Weight/Volume:	10 mL
Date Prepared:	08/24/2009 1902			Injection Volume:	1.0 uL

Analyte	Result (ug/L)	Qualifier	RL
Pentachlorophenol	ND		3.5
Phenanthrene	ND		0.40
Anthracene	ND		0.20
Di-n-butyl phthalate	ND		2.0
Fluoranthene	ND		0.25
Pyrene	ND		0.30
Butyl benzyl phthalate	ND		3.0
3,3'-Dichlorobenzidine	ND		9.9
Benzo[a]anthracene	ND		0.30
Chrysene	ND		0.20
Bis(2-ethylhexyl) phthalate	ND		15
Di-n-octyl phthalate	ND		2.0
Benzo[a]pyrene	ND		0.20
Indeno[1,2,3-cd]pyrene	ND		0.30
Dibenz(a,h)anthracene	ND		0.30
Benzo[g,h,i]perylene	ND		0.30
Carbazole	ND		2.0
1-Methylnaphthalene	ND		0.30
Benzo[b]fluoranthene	ND		0.40
Benzo[k]fluoranthene	ND		0.30
2,2'-oxybis[1-chloropropane]	ND		2.0

Surrogate	%Rec	Qualifier	Acceptance Limits
2-Fluorophenol	99		50 - 120
Phenol-d5	89		50 - 120
Nitrobenzene-d5	95		50 - 120
2-Fluorobiphenyl	100		50 - 120
2,4,6-Tribromophenol	90		50 - 120
Terphenyl-d14	91		50 - 120

Client: Associated Earth Sciences

Job Number: 580-15041-1

Client Sample ID: **MW1S181909**

Lab Sample ID: 580-15041-2
Client Matrix: Water

Date Sampled: 08/19/2009 1206
Date Received: 08/19/2009 1320

8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method:	8270C	Analysis Batch: 580-49207		Instrument ID:	TAC002
Preparation:	3520C	Prep Batch: 580-49001		Lab File ID:	AT11844.D
Dilution:	1.0			Initial Weight/Volume:	1020 mL
Date Analyzed:	08/27/2009 1550			Final Weight/Volume:	10 mL
Date Prepared:	08/24/2009 1902			Injection Volume:	1.0 uL

Analyte	Result (ug/L)	Qualifier	RL
Phenol	ND		2.9
Bis(2-chloroethyl)ether	ND		2.0
2-Chlorophenol	ND		2.0
1,3-Dichlorobenzene	ND		2.0
1,4-Dichlorobenzene	ND		2.0
Benzyl alcohol	ND		2.0
1,2-Dichlorobenzene	ND		2.0
2-Methylphenol	ND		2.0
3 & 4 Methylphenol	ND		3.9
N-Nitrosodi-n-propylamine	ND		2.0
Hexachloroethane	ND		2.9
Nitrobenzene	ND		2.0
Isophorone	ND		2.0
2-Nitrophenol	ND		2.0
2,4-Dimethylphenol	ND		4.9
Benzoic acid	ND		9.8
Bis(2-chloroethoxy)methane	ND		2.0
2,4-Dichlorophenol	ND		2.0
1,2,4-Trichlorobenzene	ND		2.0
Naphthalene	ND		2.0
4-Chloroaniline	ND		2.0
Hexachlorobutadiene	ND		2.9
4-Chloro-3-methylphenol	ND		2.0
2-Methylnaphthalene	ND		0.98
Hexachlorocyclopentadiene	ND	*	9.8
2,4,6-Trichlorophenol	ND		2.9
2,4,5-Trichlorophenol	ND		2.0
2-Chloronaphthalene	ND		0.29
2-Nitroaniline	ND		2.0
Dimethyl phthalate	ND		2.0
Acenaphthylene	ND		0.39
2,6-Dinitrotoluene	ND		2.0
3-Nitroaniline	ND		2.0
Acenaphthene	ND		0.49
2,4-Dinitrophenol	ND		25
4-Nitrophenol	ND		9.8
Dibenzofuran	ND		2.0
2,4-Dinitrotoluene	ND		2.0
Diethyl phthalate	ND		2.0
4-Chlorophenyl phenyl ether	ND		2.0
Fluorene	ND		0.29
4-Nitroaniline	ND		2.9
4,6-Dinitro-2-methylphenol	ND		20
N-Nitrosodiphenylamine	ND		2.0
4-Bromophenyl phenyl ether	ND		2.0
Hexachlorobenzene	ND		2.0

Client: Associated Earth Sciences

Job Number: 580-15041-1

Client Sample ID: MW1S181909

Lab Sample ID: 580-15041-2

Client Matrix: Water

Date Sampled: 08/19/2009 1206

Date Received: 08/19/2009 1320

8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method:	8270C	Analysis Batch: 580-49207		Instrument ID:	TAC002
Preparation:	3520C	Prep Batch: 580-49001		Lab File ID:	AT11844.D
Dilution:	1.0			Initial Weight/Volume:	1020 mL
Date Analyzed:	08/27/2009 1550			Final Weight/Volume:	10 mL
Date Prepared:	08/24/2009 1902			Injection Volume:	1.0 uL

Analyte	Result (ug/L)	Qualifier	RL
Pentachlorophenol	ND		3.4
Phenanthrene	ND		0.39
Anthracene	ND		0.20
Di-n-butyl phthalate	ND		2.0
Fluoranthene	ND		0.25
Pyrene	ND		0.29
Butyl benzyl phthalate	ND		2.9
3,3'-Dichlorobenzidine	ND		9.8
Benzo[a]anthracene	ND		0.29
Chrysene	ND		0.20
Bis(2-ethylhexyl) phthalate	ND		15
Di-n-octyl phthalate	ND		2.0
Benzo[a]pyrene	ND		0.20
Indeno[1,2,3-cd]pyrene	ND		0.29
Dibenz(a,h)anthracene	ND		0.29
Benzo[g,h,i]perylene	ND		0.29
Carbazole	ND		2.0
1-Methylnaphthalene	ND		0.29
Benzo[b]fluoranthene	ND		0.39
Benzo[k]fluoranthene	ND		0.29
2,2'-oxybis[1-chloropropane]	ND		2.0

Surrogate	%Rec	Qualifier	Acceptance Limits
2-Fluorophenol	101		50 - 120
Phenol-d5	94		50 - 120
Nitrobenzene-d5	91		50 - 120
2-Fluorobiphenyl	93		50 - 120
2,4,6-Tribromophenol	101		50 - 120
Terphenyl-d14	56		50 - 120

Analytical Data

Client: Associated Earth Sciences

Job Number: 580-15041-1

Client Sample ID: MW3S181909

Lab Sample ID: 580-15041-3

Client Matrix: Water

Date Sampled: 08/19/2009 1140

Date Received: 08/19/2009 1320

8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method:	8270C	Analysis Batch: 580-49207		Instrument ID:	TAC002
Preparation:	3520C	Prep Batch: 580-49001		Lab File ID:	AT11845.D
Dilution:	1.0			Initial Weight/Volume:	1030 mL
Date Analyzed:	08/27/2009 1610			Final Weight/Volume:	10 mL
Date Prepared:	08/24/2009 1902			Injection Volume:	1.0 uL

Analyte	Result (ug/L)	Qualifier	RL
Phenol	ND		2.9
Bis(2-chloroethyl)ether	ND		1.9
2-Chlorophenol	ND		1.9
1,3-Dichlorobenzene	ND		1.9
1,4-Dichlorobenzene	ND		1.9
Benzyl alcohol	ND		1.9
1,2-Dichlorobenzene	ND		1.9
2-Methylphenol	ND		1.9
3 & 4 Methylphenol	ND		3.9
N-Nitrosodi-n-propylamine	ND		1.9
Hexachloroethane	ND		2.9
Nitrobenzene	ND		1.9
Isophorone	ND		1.9
2-Nitrophenol	ND		1.9
2,4-Dimethylphenol	ND		4.9
Benzoic acid	ND		9.7
Bis(2-chloroethoxy)methane	ND		1.9
2,4-Dichlorophenol	ND		1.9
1,2,4-Trichlorobenzene	ND		1.9
Naphthalene	ND		1.9
4-Chloroaniline	ND		1.9
Hexachlorobutadiene	ND		2.9
4-Chloro-3-methylphenol	ND		1.9
2-Methylnaphthalene	ND		0.97
Hexachlorocyclopentadiene	ND	*	9.7
2,4,6-Trichlorophenol	ND		2.9
2,4,5-Trichlorophenol	ND		1.9
2-Chloronaphthalene	ND		0.29
2-Nitroaniline	ND		1.9
Dimethyl phthalate	ND		1.9
Acenaphthylene	ND		0.39
2,6-Dinitrotoluene	ND		1.9
3-Nitroaniline	ND		1.9
Acenaphthene	ND		0.49
2,4-Dinitrophenol	ND		24
4-Nitrophenol	ND		9.7
Dibenzofuran	ND		1.9
2,4-Dinitrotoluene	ND		1.9
Diethyl phthalate	ND		1.9
4-Chlorophenyl phenyl ether	ND		1.9
Fluorene	ND		0.29
4-Nitroaniline	ND		2.9
4,6-Dinitro-2-methylphenol	ND		19
N-Nitrosodiphenylamine	ND		1.9
4-Bromophenyl phenyl ether	ND		1.9
Hexachlorobenzene	ND		1.9

Client: Associated Earth Sciences

Job Number: 580-15041-1

Client Sample ID: **MW3S181909**

Lab Sample ID: 580-15041-3
Client Matrix: Water

Date Sampled: 08/19/2009 1140
Date Received: 08/19/2009 1320

8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method:	8270C	Analysis Batch: 580-49207		Instrument ID:	TAC002
Preparation:	3520C	Prep Batch: 580-49001		Lab File ID:	AT11845.D
Dilution:	1.0			Initial Weight/Volume:	1030 mL
Date Analyzed:	08/27/2009 1610			Final Weight/Volume:	10 mL
Date Prepared:	08/24/2009 1902			Injection Volume:	1.0 uL

Analyte	Result (ug/L)	Qualifier	RL
Pentachlorophenol	ND		3.4
Phenanthrene	ND		0.39
Anthracene	ND		0.19
Di-n-butyl phthalate	ND		1.9
Fluoranthene	ND		0.24
Pyrene	ND		0.29
Butyl benzyl phthalate	ND		2.9
3,3'-Dichlorobenzidine	ND		9.7
Benzo[a]anthracene	ND		0.29
Chrysene	ND		0.19
Bis(2-ethylhexyl) phthalate	ND		15
Di-n-octyl phthalate	ND		1.9
Benzo[a]pyrene	ND		0.19
Indeno[1,2,3-cd]pyrene	ND		0.29
Dibenz(a,h)anthracene	ND		0.29
Benzo[g,h,i]perylene	ND		0.29
Carbazole	ND		1.9
1-Methylnaphthalene	ND		0.29
Benzo[b]fluoranthene	ND		0.39
Benzo[k]fluoranthene	ND		0.29
2,2'-oxybis[1-chloropropane]	ND		1.9

Surrogate	%Rec	Qualifier	Acceptance Limits
2-Fluorophenol	93		50 - 120
Phenol-d5	95		50 - 120
Nitrobenzene-d5	94		50 - 120
2-Fluorobiphenyl	97		50 - 120
2,4,6-Tribromophenol	99		50 - 120
Terphenyl-d14	86		50 - 120

Client: Associated Earth Sciences — Job Number: 580-15041-1

Client Sample ID: MW2S181909

Lab Sample ID: 580-15041-1 — Date Sampled: 08/19/2009 1205
Client Matrix: Water — Date Received: 08/19/2009 1320

6010B Metals (ICP)-Total Recoverable

Method:	6010B	Analysis Batch: 580-49028		Instrument ID:	SEA027
Preparation:	3005A	Prep Batch: 580-48943		Lab File ID:	N/A
Dilution:	1.0			Initial Weight/Volume:	50 mL
Date Analyzed:	08/24/2009 2024			Final Weight/Volume:	50 mL
Date Prepared:	08/24/2009 1049				

Analyte	Result (mg/L)	Qualifier	RL
Iron	240		0.20
Manganese	5.9		0.020

6020 Metals (ICP/MS)-Total Recoverable

Method:	6020	Analysis Batch: 580-49473		Instrument ID:	SEA026
Preparation:	3005A	Prep Batch: 580-49434		Lab File ID:	N/A
Dilution:	5.0			Initial Weight/Volume:	50 mL
Date Analyzed:	08/31/2009 1921			Final Weight/Volume:	50 mL
Date Prepared:	08/31/2009 1247				

Analyte	Result (mg/L)	Qualifier	RL
Arsenic	0.076		0.0020
Barium	0.99		0.0060
Cadmium	ND		0.0020
Chromium	0.60		0.0020
Lead	0.084		0.0020
Selenium	0.0055		0.0020
Silver	ND		0.0020

7470A Mercury (CVAA)

Method:	7470A	Analysis Batch: 580-49462		Instrument ID:	SEA029
Preparation:	7470A	Prep Batch: 580-49427		Lab File ID:	N/A
Dilution:	1.0			Initial Weight/Volume:	50 mL
Date Analyzed:	08/31/2009 1444			Final Weight/Volume:	50 mL
Date Prepared:	08/31/2009 1149				

Analyte	Result (mg/L)	Qualifier	RL
Mercury	0.00062		0.00020

Client: Associated Earth Sciences

Job Number: 580-15041-1

Client Sample ID: **MW1S181909**

Lab Sample ID: 580-15041-2
Client Matrix: Water

Date Sampled: 08/19/2009 1206
Date Received: 08/19/2009 1320

6010B Metals (ICP)-Total Recoverable

Method:	6010B	Analysis Batch: 580-49028		Instrument ID:	SEA027
Preparation:	3005A	Prep Batch: 580-48943		Lab File ID:	N/A
Dilution:	1.0			Initial Weight/Volume:	50 mL
Date Analyzed:	08/24/2009 2029			Final Weight/Volume:	50 mL
Date Prepared:	08/24/2009 1049				

Analyte	Result (mg/L)	Qualifier	RL
Iron	120		0.20
Manganese	3.2		0.020

6020 Metals (ICP/MS)-Total Recoverable

Method:	6020	Analysis Batch: 580-49473		Instrument ID:	SEA026
Preparation:	3005A	Prep Batch: 580-49434		Lab File ID:	N/A
Dilution:	5.0			Initial Weight/Volume:	50 mL
Date Analyzed:	08/31/2009 1925			Final Weight/Volume:	50 mL
Date Prepared:	08/31/2009 1247				

Analyte	Result (mg/L)	Qualifier	RL
Arsenic	0.045		0.0020
Barium	0.62		0.0060
Cadmium	ND		0.0020
Chromium	0.23		0.0020
Lead	0.058		0.0020
Selenium	0.0030		0.0020
Silver	ND		0.0020

7470A Mercury (CVAA)

Method:	7470A	Analysis Batch: 580-49462		Instrument ID:	SEA029
Preparation:	7470A	Prep Batch: 580-49427		Lab File ID:	N/A
Dilution:	1.0			Initial Weight/Volume:	50 mL
Date Analyzed:	08/31/2009 1448			Final Weight/Volume:	50 mL
Date Prepared:	08/31/2009 1149				

Analyte	Result (mg/L)	Qualifier	RL
Mercury	ND		0.00020

Client: Associated Earth Sciences

Job Number: 580-15041-1

Client Sample ID: MW3S181909

Lab Sample ID: 580-15041-3

Client Matrix: Water

Date Sampled: 08/19/2009 1140

Date Received: 08/19/2009 1320

6010B Metals (ICP)-Total Recoverable

Method:	6010B	Analysis Batch: 580-49028		Instrument ID:	SEA027
Preparation:	3005A	Prep Batch: 580-48943		Lab File ID:	N/A
Dilution:	1.0			Initial Weight/Volume:	50 mL
Date Analyzed:	08/24/2009 2051			Final Weight/Volume:	50 mL
Date Prepared:	08/24/2009 1049				

Analyte	Result (mg/L)	Qualifier	RL
Iron	22		0.20
Manganese	0.51		0.020

6020 Metals (ICP/MS)-Total Recoverable

Method:	6020	Analysis Batch: 580-49473		Instrument ID:	SEA026
Preparation:	3005A	Prep Batch: 580-49434		Lab File ID:	N/A
Dilution:	5.0			Initial Weight/Volume:	50 mL
Date Analyzed:	08/31/2009 1913			Final Weight/Volume:	50 mL
Date Prepared:	08/31/2009 1247				

Analyte	Result (mg/L)	Qualifier	RL
Arsenic	0.0082		0.0020
Barium	0.13		0.0060
Cadmium	ND		0.0020
Chromium	0.054		0.0020
Lead	0.0075		0.0020
Selenium	ND		0.0020
Silver	ND		0.0020

7470A Mercury (CVAA)

Method:	7470A	Analysis Batch: 580-49462		Instrument ID:	SEA029
Preparation:	7470A	Prep Batch: 580-49427		Lab File ID:	N/A
Dilution:	1.0			Initial Weight/Volume:	50 mL
Date Analyzed:	08/31/2009 1453			Final Weight/Volume:	50 mL
Date Prepared:	08/31/2009 1149				

Analyte	Result (mg/L)	Qualifier	RL
Mercury	0.00025		0.00020

Client: Associated Earth Sciences

Job Number: 580-15041-1

General Chemistry

Client Sample ID: **MW2S181909**

Lab Sample ID: 580-15041-1
Client Matrix: Water

Date Sampled: 08/19/2009 1205
Date Received: 08/19/2009 1320

Analyte	Result	Qual	Units	RL	Dil	Method
Chloride	78		mg/L	4.5	5.0	300.0
Analysis Batch: 580-49693	Date Analyzed: 09/03/2009 1102					
Sulfate	24		mg/L	1.2	1.0	300.0
Analysis Batch: 580-49693	Date Analyzed: 09/03/2009 0332					

Analyte	Result	Qual	Units	Dil	Method
pH	8.24	HF	SU	1.0	150.1
Analysis Batch: 580-48871	Date Analyzed: 08/21/2009 1320				

Analyte	Result	Qual	Units	RL	Dil	Method
Specific Conductance	630		umhos/cm	10	1.0	120.1
Analysis Batch: 580-49109	Date Analyzed: 08/26/2009 1038					

Client: Associated Earth Sciences

Job Number: 580-15041-1

General Chemistry

Client Sample ID: MW1S181909

Lab Sample ID: 580-15041-2

Client Matrix: Water

Date Sampled: 08/19/2009 1206

Date Received: 08/19/2009 1320

Analyte	Result	Qual	Units	RL	Dil	Method
Chloride	61		mg/L	4.5	5.0	300.0
Analysis Batch: 580-49693	Date Analyzed: 09/03/2009 1121					
Sulfate	27		mg/L	1.2	1.0	300.0
Analysis Batch: 580-49693	Date Analyzed: 09/03/2009 0352					

Analyte	Result	Qual	Units	Dil	Method
pH	8.47	HF	SU	1.0	150.1
Analysis Batch: 580-48871	Date Analyzed: 08/21/2009 1320				

Analyte	Result	Qual	Units	RL	Dil	Method
Specific Conductance	470		umhos/cm	10	1.0	120.1
Analysis Batch: 580-49109	Date Analyzed: 08/26/2009 1038					

Client: Associated Earth Sciences

Job Number: 580-15041-1

General Chemistry

Client Sample ID: **MW3S181909**

Lab Sample ID: 580-15041-3
Client Matrix: Water

Date Sampled: 08/19/2009 1140
Date Received: 08/19/2009 1320

Analyte	Result	Qual	Units	RL	Dil	Method
Chloride	170		mg/L	4.5	5.0	300.0
Analysis Batch: 580-49693	Date Analyzed: 09/03/2009 1139					
Sulfate	31		mg/L	1.2	1.0	300.0
Analysis Batch: 580-49693	Date Analyzed: 09/03/2009 0410					

Analyte	Result	Qual	Units	Dil	Method
pH	8.25	HF	SU	1.0	150.1
Analysis Batch: 580-48871	Date Analyzed: 08/21/2009 1320				

Analyte	Result	Qual	Units	RL	Dil	Method
Specific Conductance	780		umhos/cm	10	1.0	120.1
Analysis Batch: 580-49109	Date Analyzed: 08/26/2009 1038					

DATA REPORTING QUALIFIERS

Client: Associated Earth Sciences

Job Number: 580-15041-1

Lab Section	Qualifier	Description
GC/MS Semi VOA		
	*	LCS or LCSD exceeds the control limits
	X	Surrogate exceeds the control limits
General Chemistry		
	HF	Field parameter with a holding time of 15 minutes

Quality Control Results

Client: Associated Earth Sciences

Job Number: 580-15041-1

Method Blank - Batch: 580-49001

Method: 8270C
Preparation: 3520C

Lab Sample ID:	MB 580-49001/1-A	Analysis Batch:	580-49207	Instrument ID:	TAC002
Client Matrix:	Water	Prep Batch:	580-49001	Lab File ID:	AT11841.D
Dilution:	1.0	Units:	ug/L	Initial Weight/Volume:	1000 mL
Date Analyzed:	08/27/2009 1449			Final Weight/Volume:	10 mL
Date Prepared:	08/24/2009 1902			Injection Volume:	1.0 uL

Analyte	Result	Qual	RL
Phenol	ND		3.0
Bis(2-chloroethyl)ether	ND		2.0
2-Chlorophenol	ND		2.0
1,3-Dichlorobenzene	ND		2.0
1,4-Dichlorobenzene	ND		2.0
Benzyl alcohol	ND		2.0
1,2-Dichlorobenzene	ND		2.0
2-Methylphenol	ND		2.0
3 & 4 Methylphenol	ND		4.0
N-Nitrosodi-n-propylamine	ND		2.0
Hexachloroethane	ND		3.0
Nitrobenzene	ND		2.0
Isophorone	ND		2.0
2-Nitrophenol	ND		2.0
2,4-Dimethylphenol	ND		5.0
Benzoic acid	ND		10
Bis(2-chloroethoxy)methane	ND		2.0
2,4-Dichlorophenol	ND		2.0
1,2,4-Trichlorobenzene	ND		2.0
Naphthalene	ND		2.0
4-Chloroaniline	ND		2.0
Hexachlorobutadiene	ND		3.0
4-Chloro-3-methylphenol	ND		2.0
2-Methylnaphthalene	ND		1.0
Hexachlorocyclopentadiene	ND		10
2,4,6-Trichlorophenol	ND		3.0
2,4,5-Trichlorophenol	ND		2.0
2-Chloronaphthalene	ND		0.30
2-Nitroaniline	ND		2.0
Dimethyl phthalate	ND		2.0
Acenaphthylene	ND		0.40
2,6-Dinitrotoluene	ND		2.0
3-Nitroaniline	ND		2.0
Acenaphthene	ND		0.50
2,4-Dinitrophenol	ND		25
4-Nitrophenol	ND		10
Dibenzofuran	ND		2.0
2,4-Dinitrotoluene	ND		2.0
Diethyl phthalate	ND		2.0
4-Chlorophenyl phenyl ether	ND		2.0
Fluorene	ND		0.30

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quality Control Results

Client: Associated Earth Sciences

Job Number: 580-15041-1

Method Blank - Batch: 580-49001

Method: 8270C
Preparation: 3520C

Lab Sample ID:	MB 580-49001/1-A	Analysis Batch:	580-49207	Instrument ID:	TAC002
Client Matrix:	Water	Prep Batch:	580-49001	Lab File ID:	AT11841.D
Dilution:	1.0	Units:	ug/L	Initial Weight/Volume:	1000 mL
Date Analyzed:	08/27/2009 1449			Final Weight/Volume:	10 mL
Date Prepared:	08/24/2009 1902			Injection Volume:	1.0 uL

Analyte	Result	Qual	RL
4-Nitroaniline	ND		3.0
4,6-Dinitro-2-methylphenol	ND		20
N-Nitrosodiphenylamine	ND		2.0
4-Bromophenyl phenyl ether	ND		2.0
Hexachlorobenzene	ND		2.0
Pentachlorophenol	ND		3.5
Phenanthrene	ND		0.40
Anthracene	ND		0.20
Di-n-butyl phthalate	ND		2.0
Fluoranthene	ND		0.25
Pyrene	ND		0.30
Butyl benzyl phthalate	ND		3.0
3,3'-Dichlorobenzidine	ND		10
Benzo[a]anthracene	ND		0.30
Chrysene	ND		0.20
Bis(2-ethylhexyl) phthalate	ND		15
Di-n-octyl phthalate	ND		2.0
Benzo[a]pyrene	ND		0.20
Indeno[1,2,3-cd]pyrene	ND		0.30
Dibenz(a,h)anthracene	ND		0.30
Benzo[g,h,i]perylene	ND		0.30
Carbazole	ND		2.0
1-Methylnaphthalene	ND		0.30
Benzo[b]fluoranthene	ND		0.40
Benzo[k]fluoranthene	ND		0.30
2,2'-oxybis[1-chloropropane]	ND		2.0

Surrogate	% Rec		Acceptance Limits
2-Fluorophenol	106		50 - 120
Phenol-d5	92		50 - 120
Nitrobenzene-d5	91		50 - 120
2-Fluorobiphenyl	97		50 - 120
2,4,6-Tribromophenol	77		50 - 120
Terphenyl-d14	122	X	50 - 120

Calculations are performed before rounding to avoid round-off errors in calculated results.

Client: Associated Earth Sciences

Job Number: 580-15041-1

Lab Control Sample - Batch: 580-49001

Method: 8270C
Preparation: 3520C

Lab Sample ID:	LCS 580-49001/2-A	Analysis Batch: 580-49207		Instrument ID:	TAC002
Client Matrix:	Water	Prep Batch: 580-49001		Lab File ID:	AT11842.D
Dilution:	1.0	Units: ug/L		Initial Weight/Volume:	1000 mL
Date Analyzed:	08/27/2009 1509			Final Weight/Volume:	10 mL
Date Prepared:	08/24/2009 1902			Injection Volume:	1.0 uL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Phenol	10.0	9.69	97	60 - 140	
Bis(2-chloroethyl)ether	9.98	10.7	107	60 - 140	
2-Chlorophenol	9.99	10.3	103	60 - 140	
1,3-Dichlorobenzene	9.83	7.72	79	60 - 140	
1,4-Dichlorobenzene	9.96	7.79	78	60 - 140	
Benzyl alcohol	9.78	9.82	100	60 - 140	
1,2-Dichlorobenzene	9.96	8.64	87	60 - 140	
2-Methylphenol	10.4	10.7	103	60 - 140	
3 & 4 Methylphenol	10.2	10.1	99	60 - 140	
N-Nitrosodi-n-propylamine	9.99	10.5	105	60 - 140	
Hexachloroethane	10.1	7.87	78	60 - 140	
Nitrobenzene	9.97	9.81	98	60 - 140	
Isophorone	9.92	9.73	98	60 - 140	
2-Nitrophenol	10.0	9.73	97	60 - 140	
2,4-Dimethylphenol	9.99	9.70	97	60 - 140	
Benzoic acid	49.9	39.7	80	60 - 140	
Bis(2-chloroethoxy)methane	10.0	11.9	119	60 - 140	
2,4-Dichlorophenol	9.93	9.97	100	60 - 140	
1,2,4-Trichlorobenzene	10.0	9.52	95	60 - 140	
Naphthalene	10.0	10.2	102	60 - 140	
4-Chloroaniline	10.0	9.32	93	60 - 140	
Hexachlorobutadiene	9.99	8.94	90	60 - 140	
4-Chloro-3-methylphenol	9.90	9.99	101	60 - 140	
2-Methylnaphthalene	10.0	11.6	116	60 - 140	
Hexachlorocyclopentadiene	10.0	ND	55	60 - 140	*
2,4,6-Trichlorophenol	9.93	10.6	107	60 - 140	
2,4,5-Trichlorophenol	9.81	10.8	110	60 - 140	
2-Chloronaphthalene	9.99	10.8	108	60 - 140	
2-Nitroaniline	10.0	10.2	102	60 - 140	
Dimethyl phthalate	10.0	11.1	111	60 - 140	
Acenaphthylene	10.0	10.4	104	60 - 140	
2,6-Dinitrotoluene	10.1	11.2	111	60 - 140	
3-Nitroaniline	10.0	11.6	116	60 - 140	
Acenaphthene	10.0	11.0	110	60 - 140	
2,4-Dinitrophenol	49.9	32.4	65	60 - 140	
4-Nitrophenol	49.8	40.7	82	60 - 140	
Dibenzofuran	9.76	10.8	110	60 - 140	
2,4-Dinitrotoluene	10.0	10.8	108	60 - 140	
Diethyl phthalate	9.99	10.9	109	60 - 140	
4-Chlorophenyl phenyl ether	10.0	11.8	118	60 - 140	
Fluorene	10.0	11.1	111	60 - 140	

Calculations are performed before rounding to avoid round-off errors in calculated results.

Client: Associated Earth Sciences

Job Number: 580-15041-1

Lab Control Sample - Batch: 580-49001

Method: 8270C
Preparation: 3520C

Lab Sample ID:	LCS 580-49001/2-A	Analysis Batch:	580-49207	Instrument ID:	TAC002
Client Matrix:	Water	Prep Batch:	580-49001	Lab File ID:	AT11842.D
Dilution:	1.0	Units:	ug/L	Initial Weight/Volume:	1000 mL
Date Analyzed:	08/27/2009 1509			Final Weight/Volume:	10 mL
Date Prepared:	08/24/2009 1902			Injection Volume:	1.0 uL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
4-Nitroaniline	10.0	12.3	123	60 - 140	
4,6-Dinitro-2-methylphenol	50.1	42.7	85	60 - 140	
N-Nitrosodiphenylamine	10.0	10.9	109	60 - 140	
4-Bromophenyl phenyl ether	9.98	11.9	120	60 - 140	
Hexachlorobenzene	9.99	11.6	116	60 - 140	
Pentachlorophenol	9.99	9.94	99	60 - 140	
Phenanthrene	10.0	11.0	110	60 - 140	
Anthracene	10.0	10.7	106	60 - 140	
Di-n-butyl phthalate	10.0	11.1	111	60 - 140	
Fluoranthene	10.0	11.5	115	60 - 140	
Pyrene	10.0	11.4	113	60 - 140	
Butyl benzyl phthalate	10.0	10.9	109	60 - 140	
3,3'-Dichlorobenzidine	20.2	22.1	110	60 - 140	
Benzo[a]anthracene	10.0	10.8	107	60 - 140	
Chrysene	10.0	11.2	112	60 - 140	
Bis(2-ethylhexyl) phthalate	10.0	ND	116	60 - 140	
Di-n-octyl phthalate	10.0	11.5	114	60 - 140	
Benzo[a]pyrene	10.0	11.2	112	60 - 140	
Indeno[1,2,3-cd]pyrene	10.0	9.71	97	60 - 140	
Dibenz(a,h)anthracene	10.0	9.51	95	60 - 140	
Benzo[g,h,i]perylene	10.0	9.97	99	60 - 140	
Carbazole	9.99	11.5	115	60 - 140	
1-Methylnaphthalene	10.0	10.7	106	60 - 140	
Benzo[b]fluoranthene	10.0	11.9	118	60 - 140	
Benzo[k]fluoranthene	10.0	12.3	123	60 - 140	
2,2'-oxybis[1-chloropropane]	9.99	11.5	115	60 - 140	

Surrogate	% Rec	Acceptance Limits
2-Fluorophenol	104	50 - 120
Phenol-d5	96	50 - 120
Nitrobenzene-d5	94	50 - 120
2-Fluorobiphenyl	97	50 - 120
2,4,6-Tribromophenol	105	50 - 120
Terphenyl-d14	109	50 - 120

Calculations are performed before rounding to avoid round-off errors in calculated results.

Client: Associated Earth Sciences

Job Number: 580-15041-1

Method Blank - Batch: 580-48943

Method: 6010B
Preparation: 3005A
Total Recoverable

Lab Sample ID:	MB 580-48943/20-A	Analysis Batch:	580-49028	Instrument ID:	SEA027
Client Matrix:	Water	Prep Batch:	580-48943	Lab File ID:	N/A
Dilution:	1.0	Units:	mg/L	Initial Weight/Volume:	50 mL
Date Analyzed:	08/24/2009 1846			Final Weight/Volume:	50 mL
Date Prepared:	08/24/2009 1049				

Analyte	Result	Qual	RL
Iron	ND		0.20
Manganese	ND		0.020

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 580-48943

Method: 6010B
Preparation: 3005A
Total Recoverable

LCS Lab Sample ID:	LCS 580-48943/21-A	Analysis Batch:	580-49028	Instrument ID:	SEA027
Client Matrix:	Water	Prep Batch:	580-48943	Lab File ID:	N/A
Dilution:	1.0	Units:	mg/L	Initial Weight/Volume:	50 mL
Date Analyzed:	08/24/2009 1924			Final Weight/Volume:	50 mL
Date Prepared:	08/24/2009 1049				

LCSD Lab Sample ID:	LCSD 580-48943/22-A	Analysis Batch:	580-49028	Instrument ID:	SEA027
Client Matrix:	Water	Prep Batch:	580-48943	Lab File ID:	N/A
Dilution:	1.0	Units:	mg/L	Initial Weight/Volume:	50 mL
Date Analyzed:	08/24/2009 1929			Final Weight/Volume:	50 mL
Date Prepared:	08/24/2009 1049				

	% Rec.						
Analyte	LCS	LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Iron	90	91	80 - 120	2	20		
Manganese	101	103	80 - 120	2	20		

Calculations are performed before rounding to avoid round-off errors in calculated results.

Client: Associated Earth Sciences

Job Number: 580-15041-1

Method Blank - Batch: 580-49434

Method: 6020
Preparation: 3005A
Total Recoverable

Lab Sample ID: MB 580-49434/15-A
Client Matrix: Water
Dilution: 5.0
Date Analyzed: 08/31/2009 1809
Date Prepared: 08/31/2009 1247

Analysis Batch: 580-49473
Prep Batch: 580-49434
Units: mg/L

Instrument ID: SEA026
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Result	Qual	RL
Arsenic	ND		0.0020
Barium	ND		0.0060
Cadmium	ND		0.0020
Chromium	ND		0.0020
Lead	ND		0.0020
Selenium	ND		0.0020
Silver	ND		0.0020

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 580-49434

Method: 6020
Preparation: 3005A
Total Recoverable

LCS Lab Sample ID: LCS 580-49434/16-A
Client Matrix: Water
Dilution: 50
Date Analyzed: 08/31/2009 1835
Date Prepared: 08/31/2009 1247

Analysis Batch: 580-49473
Prep Batch: 580-49434
Units: mg/L

Instrument ID: SEA026
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

LCSD Lab Sample ID: LCSD 580-49434/17-A
Client Matrix: Water
Dilution: 50
Date Analyzed: 08/31/2009 1839
Date Prepared: 08/31/2009 1247

Analysis Batch: 580-49473
Prep Batch: 580-49434
Units: mg/L

Instrument ID: SEA026
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

	% Rec.						
Analyte	LCS	LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Arsenic	101	100	80 - 120	2	20		
Barium	101	99	80 - 120	1	20		
Cadmium	96	97	80 - 120	2	20		
Chromium	106	105	80 - 120	1	20		
Lead	109	109	80 - 120	0	20		
Selenium	107	102	80 - 120	5	20		
Silver	102	103	80 - 120	2	20		

Calculations are performed before rounding to avoid round-off errors in calculated results.

Client: Associated Earth Sciences

Job Number: 580-15041-1

Method Blank - Batch: 580-49427

Method: 7470A
Preparation: 7470A

Lab Sample ID: MB 580-49427/16-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 08/31/2009 1325
Date Prepared: 08/31/2009 1149

Analysis Batch: 580-49462
Prep Batch: 580-49427
Units: mg/L

Instrument ID: SEA029
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Result	Qual	RL
Mercury	ND		0.00020

LCS-Standard Reference Material - Batch: 580-49427

Method: 7470A
Preparation: 7470A

Lab Sample ID: LCSSRM 580-49427/19-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 08/31/2009 1338
Date Prepared: 08/31/2009 1149

Analysis Batch: 580-49462
Prep Batch: 580-49427
Units: mg/L

Instrument ID: SEA029
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Mercury	0.00200	0.00198	99	75 - 125	

Calculations are performed before rounding to avoid round-off errors in calculated results.

Client: Associated Earth Sciences | Job Number: 580-15041-1

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 580-49427

Method: 7470A
Preparation: 7470A

LCS Lab Sample ID:	LCS 580-49427/17-A	Analysis Batch:	580-49462	Instrument ID:	SEA029
Client Matrix:	Water	Prep Batch:	580-49427	Lab File ID:	N/A
Dilution:	1.0	Units:	mg/L	Initial Weight/Volume:	50 mL
Date Analyzed:	08/31/2009 1330			Final Weight/Volume:	50 mL
Date Prepared:	08/31/2009 1149				

LCSD Lab Sample ID:	LCSD 580-49427/18-A	Analysis Batch:	580-49462	Instrument ID:	SEA029
Client Matrix:	Water	Prep Batch:	580-49427	Lab File ID:	N/A
Dilution:	1.0	Units:	mg/L	Initial Weight/Volume:	50 mL
Date Analyzed:	08/31/2009 1334			Final Weight/Volume:	50 mL
Date Prepared:	08/31/2009 1149				

Analyte	% Rec. LCS	% Rec. LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Mercury	105	98	75 - 125	6	20		

Calculations are performed before rounding to avoid round-off errors in calculated results.

Client: Associated Earth Sciences

Job Number: 580-15041-1

Method Blank - Batch: 580-49109

Method: 120.1
Preparation: N/A

Lab Sample ID:	MB 580-49109/1	Analysis Batch:	580-49109	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	N/A
Dilution:	1.0	Units:	umhos/cm	Initial Weight/Volume:	
Date Analyzed:	08/26/2009 1038			Final Weight/Volume:	1.0 mL
Date Prepared:	N/A				

Analyte	Result	Qual	RL
Specific Conductance	ND		10

Lab Control Sample - Batch: 580-49109

Method: 120.1
Preparation: N/A

Lab Sample ID:	LCS 580-49109/2	Analysis Batch:	580-49109	Instrument ID:	No Equipment Assigned
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	N/A
Dilution:	1.0	Units:	umhos/cm	Initial Weight/Volume:	
Date Analyzed:	08/26/2009 1038			Final Weight/Volume:	1.0 mL
Date Prepared:	N/A				

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Specific Conductance	98.4	96.5	98	80 - 120	

Calculations are performed before rounding to avoid round-off errors in calculated results.

Client: Associated Earth Sciences

Job Number: 580-15041-1

Method Blank - Batch: 580-49693

Method: 300.0
Preparation: N/A

Lab Sample ID:	MB 580-49693/2	Analysis Batch:	580-49693	Instrument ID:	IS 2000 Ion Chromatograph
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	N/A
Dilution:	1.0	Units:	mg/L	Initial Weight/Volume:	5 mL
Date Analyzed:	09/02/2009 2030			Final Weight/Volume:	5 mL
Date Prepared:	N/A				

Analyte	Result	Qual	RL
Chloride	ND		0.90
Sulfate	ND		1.2

Lab Control Sample - Batch: 580-49693

Method: 300.0
Preparation: N/A

Lab Sample ID:	LCS 580-49693/1	Analysis Batch:	580-49693	Instrument ID:	IS 2000 Ion Chromatograph
Client Matrix:	Water	Prep Batch:	N/A	Lab File ID:	N/A
Dilution:	1.0	Units:	mg/L	Initial Weight/Volume:	5 mL
Date Analyzed:	09/02/2009 2011			Final Weight/Volume:	5 mL
Date Prepared:	N/A				

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Chloride	10.0	9.92	99	90 - 110	
Sulfate	10.0	9.41	94	90 - 110	

Calculations are performed before rounding to avoid round-off errors in calculated results.

APPENDIX B

PAGE 01/01

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Tacoma
5755 8th Street E.
Tacoma, WA 98424
Tel. 253-922-2310
Fax 253-922-5047
www.testamericainc.com

Attens: Curtis Armstrong

Chain of Custody Record

15041

Client: AEST	Project Manager: Jon Sondergaard	Date: 8-19-09	Chain of Custody Number: 5034
Address: 911 5th Avenue	Telephone Number (Area Code)/Fax Number: (425) 827-7701	Lab Number:	Page 1 of 1
City: Kirkland; State: WA; Zip Code: 98033	Site Contact:	Lab Contact:	
Project Name and Location (State): Go East	Carrier/Waybill Number:		
Contract/Purchase Order/Quote No.: KE0902311A			

Sample I.D. and Location/Description (Containers for each sample may be combined on one line)	Date	Time	Air	Aqueous	Sed.	Soil	Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/NaOH	None	chloride	iron	Manganese	Sulfate	pH	Conductivity	SVO	RCRA 8 Metals	Special Instructions/ Conditions of Receipt
MW25181909	8-19-09	1205		X					1				3	X	X	X	X	X	X	X	X	
MW15181909	8-19-09	1206		X					1				3	X	X	X	X	X	X	X	X	
MW35181909	8-19-09	1140		X					1				3	X	X	X	X	X	X	X	X	

Cooler: ☐ Yes ☐ No Cooler Temp: ______

Possible Hazard Identification: ☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal: ☐ Return To Client ☐ Disposal By Lab ☐ Archive For ______ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required (business days): ☐ 24 Hours ☐ 48 Hours ☐ 5 Days ☐ 10 Days ☐ 15 Days ☐ Other Normal

QC Requirements (Specify)

1. Relinquished By: Emily Cressman Emily Cressman	Date: 8/19/09	Time: 1:20	1. Received By: [signature]	Date: 8/19/09	Time:
2. Relinquished By	Date	Time	2. Received By	Date	Time
3. Relinquished By	Date	Time	3. Received By	Date	Time

Comments

DISTRIB: WHITE – Stays with the Samples; CANARY – Returned to Client with Report; PINK – Field Copy

TAL-8274-580

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4258277701 13:41 08/19/2009 09/04/2009

APPENDIX B

Login Sample Receipt Check List

Client: Associated Earth Sciences

Job Number: 580-15041-1

Login Number: 15041
Creator: Armstrong, Curtis
List Number: 1

List Source: TestAmerica Tacoma

Question	T / F/ NA	Comment
Radioactivity either was not measured or, if measured, is at or below background	True	
The cooler's custody seal, if present, is intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
There are no discrepancies between the sample IDs on the containers and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
VOA sample vials do not have headspace or bubble is <6mm (1/4") in diameter.	N/A	
If necessary, staff have been informed of any short hold time or quick TAT needs	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Is the Field Sampler's name present on COC?	True	
Sample Preservation Verified	True	

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

Job Number: 580-15143-1

Job Description: Go East

For:
Associated Earth Sciences
911 5th Avenue
Suite 100
Kirkland, WA 98033

Attention: Jon Sondergaard

H Curbow

Approved for release.
Heather Curbow
Project Manager I
9/16/2009 11:57 AM

Designee for
Curtis Armstrong
Project Manager I
curtis.armstrong@testamericainc.com
09/16/2009

TestAmerica Tacoma is a part of TestAmerica Laboratories, Inc.

The results included in this report have been reviewed for compliance with the laboratory QA/QC plan and meet all requirements of NELAC. All data have been found to be compliant with laboratory protocol, with the exception of any items noted in the case narrative.

TestAmerica Laboratories, Inc.
TestAmerica Tacoma 5755 8th Street East, Tacoma, WA 98424
Tel (253) 922-2310 Fax (253) 922-5047 www.testamericainc.com

ACCREDITED IN ACCORDANCE WITH nelac

Job Narrative
580-J15143-1

Comments
No additional comments.

Receipt
All samples were received in good condition within temperature requirements.

GC/MS Semi VOA
Method(s) 8270C:
Reanalysis(re-extraction) of the following samples was performed outside of the analytical holding time: 15143-01 and 15143-02. The original extraction batch 49413 was within extraction holding time.

The laboratory control sample (LCS) for batch 49413 (8270 analytical batch 49879) exceeded lower control limits. Affected samples are re-extracted.

No other analytical or quality issues were noted.

Metals
No analytical or quality issues were noted.

General Chemistry
No analytical or quality issues were noted.

Organic Prep
No analytical or quality issues were noted.

METHOD SUMMARY

Client: Associated Earth Sciences

Job Number: 580-15143-1

Description	Lab Location	Method	Preparation Method
Matrix: Water			
Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)	TAL TAC	SW846 8270C	
Liquid-Liquid Extraction (Separatory Funnel)	TAL TAC		SW846 3510C
Metals (ICP)	TAL TAC	SW846 6010B	
Preparation, Total Recoverable or Dissolved Metals	TAL TAC		SW846 3005A
Metals (ICP/MS)	TAL TAC	SW846 6020	
Preparation, Total Recoverable or Dissolved Metals	TAL TAC		SW846 3005A
Mercury (CVAA)	TAL TAC	SW846 7470A	
Preparation, Mercury	TAL TAC		SW846 7470A
Conductivity, Specific Conductance	TAL TAC	MCAWW 120.1	
pH (Electrometric)	TAL TAC	MCAWW 150.1	
Anions, Ion Chromatography	TAL TAC	MCAWW 300.0	

Lab References:

TAL TAC = TestAmerica Tacoma

Method References:

MCAWW = "Methods For Chemical Analysis Of Water And Wastes", EPA-600/4-79-020, March 1983 And Subsequent Revisions.

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

SAMPLE SUMMARY

Client: Associated Earth Sciences

Job Number: 580-15143-1

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
580-15143-1	SP-1	Water	08/26/2009 0000	08/27/2009 1000
580-15143-2	SP-2	Water	08/26/2009 0000	08/27/2009 1000

Client: Associated Earth Sciences

Job Number: 580-15143-1

Client Sample ID: SP-1

Lab Sample ID: 580-15143-1
Client Matrix: Water

Date Sampled: 08/26/2009 0000
Date Received: 08/27/2009 1000

8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method:	8270C	Analysis Batch:	580-49879	Instrument ID:	TAC002
Preparation:	3510C	Prep Batch:	580-49413	Lab File ID:	AT12073.D
Dilution:	1.0			Initial Weight/Volume:	1005 mL
Date Analyzed:	09/09/2009 1600			Final Weight/Volume:	10 mL
Date Prepared:	08/31/2009 1058			Injection Volume:	1.0 uL

Analyte	Result (ug/L)	Qualifier	RL
Phenol	ND		3.0
Bis(2-chloroethyl)ether	ND		2.0
2-Chlorophenol	ND		2.0
1,3-Dichlorobenzene	ND		2.0
1,4-Dichlorobenzene	ND		2.0
Benzyl alcohol	ND		2.0
1,2-Dichlorobenzene	ND		2.0
2-Methylphenol	ND		2.0
3 & 4 Methylphenol	ND		4.0
N-Nitrosodi-n-propylamine	ND		2.0
Hexachloroethane	ND		3.0
Nitrobenzene	ND		2.0
Isophorone	ND		2.0
2-Nitrophenol	ND		2.0
2,4-Dimethylphenol	ND		5.0
Benzoic acid	ND		10
Bis(2-chloroethoxy)methane	ND		2.0
2,4-Dichlorophenol	ND		2.0
1,2,4-Trichlorobenzene	ND		2.0
Naphthalene	ND		2.0
4-Chloroaniline	ND	*	2.0
Hexachlorobutadiene	ND		3.0
4-Chloro-3-methylphenol	ND		2.0
2-Methylnaphthalene	ND		1.0
Hexachlorocyclopentadiene	ND		10
2,4,6-Trichlorophenol	ND		3.0
2,4,5-Trichlorophenol	ND		2.0
2-Chloronaphthalene	ND		0.30
2-Nitroaniline	ND		2.0
Dimethyl phthalate	ND		2.0
Acenaphthylene	ND		0.40
2,6-Dinitrotoluene	ND		2.0
3-Nitroaniline	ND	*	2.0
Acenaphthene	1.3		0.50
2,4-Dinitrophenol	ND		25
4-Nitrophenol	ND	*	10
Dibenzofuran	ND		2.0
2,4-Dinitrotoluene	ND		2.0
Diethyl phthalate	ND		2.0
4-Chlorophenyl phenyl ether	ND		2.0
Fluorene	0.68		0.30
4-Nitroaniline	ND		3.0
4,6-Dinitro-2-methylphenol	ND		20
N-Nitrosodiphenylamine	ND	*	2.0
4-Bromophenyl phenyl ether	ND		2.0
Hexachlorobenzene	ND		2.0

Client: Associated Earth Sciences

Job Number: 580-15143-1

Client Sample ID: SP-1

Lab Sample ID: 580-15143-1
Client Matrix: Water

Date Sampled: 08/26/2009 0000
Date Received: 08/27/2009 1000

8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method:	8270C	Analysis Batch: 580-49879		Instrument ID:	TAC002
Preparation:	3510C	Prep Batch: 580-49413		Lab File ID:	AT12073.D
Dilution:	1.0			Initial Weight/Volume:	1005 mL
Date Analyzed:	09/09/2009 1600			Final Weight/Volume:	10 mL
Date Prepared:	08/31/2009 1058			Injection Volume:	1.0 uL

Analyte	Result (ug/L)	Qualifier	RL
Pentachlorophenol	ND		3.5
Phenanthrene	ND		0.40
Anthracene	ND		0.20
Di-n-butyl phthalate	ND		2.0
Fluoranthene	ND		0.25
Pyrene	ND		0.30
Butyl benzyl phthalate	ND		3.0
3,3'-Dichlorobenzidine	ND		10
Benzo[a]anthracene	ND		0.30
Chrysene	ND		0.20
Bis(2-ethylhexyl) phthalate	ND		15
Di-n-octyl phthalate	ND		2.0
Benzo[a]pyrene	ND		0.20
Indeno[1,2,3-cd]pyrene	ND		0.30
Dibenz(a,h)anthracene	ND		0.30
Benzo[g,h,i]perylene	ND		0.30
Carbazole	ND	*	2.0
1-Methylnaphthalene	ND		0.30
Benzo[b]fluoranthene	ND		0.40
Benzo[k]fluoranthene	ND		0.30
2,2'-oxybis[1-chloropropane]	ND		2.0

Surrogate	%Rec	Qualifier	Acceptance Limits
2-Fluorophenol	54		10 - 120
Phenol-d5	24		10 - 102
Nitrobenzene-d5	79		34 - 146
2-Fluorobiphenyl	83		35 - 143
2,4,6-Tribromophenol	76		29 - 151
Terphenyl-d14	76		35 - 166

Client: Associated Earth Sciences

Job Number: 580-15143-1

Client Sample ID: SP-2

Lab Sample ID: 580-15143-2
Client Matrix: Water

Date Sampled: 08/26/2009 0000
Date Received: 08/27/2009 1000

8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method:	8270C	Analysis Batch: 580-49879		Instrument ID:	TAC002
Preparation:	3510C	Prep Batch: 580-49413		Lab File ID:	AT12074.D
Dilution:	1.0			Initial Weight/Volume:	962 mL
Date Analyzed:	09/09/2009 1620			Final Weight/Volume:	10 mL
Date Prepared:	08/31/2009 1058			Injection Volume:	1.0 uL

Analyte	Result (ug/L)	Qualifier	RL
Phenol	ND		3.1
Bis(2-chloroethyl)ether	ND		2.1
2-Chlorophenol	ND		2.1
1,3-Dichlorobenzene	ND		2.1
1,4-Dichlorobenzene	ND		2.1
Benzyl alcohol	ND		2.1
1,2-Dichlorobenzene	ND		2.1
2-Methylphenol	ND		2.1
3 & 4 Methylphenol	ND		4.2
N-Nitrosodi-n-propylamine	ND		2.1
Hexachloroethane	ND		3.1
Nitrobenzene	ND		2.1
Isophorone	ND		2.1
2-Nitrophenol	ND		2.1
2,4-Dimethylphenol	ND		5.2
Benzoic acid	ND		10
Bis(2-chloroethoxy)methane	ND		2.1
2,4-Dichlorophenol	ND		2.1
1,2,4-Trichlorobenzene	ND		2.1
Naphthalene	ND		2.1
4-Chloroaniline	ND	*	2.1
Hexachlorobutadiene	ND		3.1
4-Chloro-3-methylphenol	ND		2.1
2-Methylnaphthalene	ND		1.0
Hexachlorocyclopentadiene	ND		10
2,4,6-Trichlorophenol	ND		3.1
2,4,5-Trichlorophenol	ND		2.1
2-Chloronaphthalene	ND		0.31
2-Nitroaniline	ND		2.1
Dimethyl phthalate	ND		2.1
Acenaphthylene	ND		0.42
2,6-Dinitrotoluene	ND		2.1
3-Nitroaniline	ND	*	2.1
Acenaphthene	ND		0.52
2,4-Dinitrophenol	ND		26
4-Nitrophenol	ND	*	10
Dibenzofuran	ND		2.1
2,4-Dinitrotoluene	ND		2.1
Diethyl phthalate	ND		2.1
4-Chlorophenyl phenyl ether	ND		2.1
Fluorene	ND		0.31
4-Nitroaniline	ND		3.1
4,6-Dinitro-2-methylphenol	ND		21
N-Nitrosodiphenylamine	ND	*	2.1
4-Bromophenyl phenyl ether	ND		2.1
Hexachlorobenzene	ND		2.1

Client: Associated Earth Sciences

Job Number: 580-15143-1

Client Sample ID: **SP-2**

Lab Sample ID: 580-15143-2
Client Matrix: Water

Date Sampled: 08/26/2009 0000
Date Received: 08/27/2009 1000

8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method: 8270C
Preparation: 3510C
Dilution: 1.0
Date Analyzed: 09/09/2009 1620
Date Prepared: 08/31/2009 1058

Analysis Batch: 580-49879
Prep Batch: 580-49413

Instrument ID: TAC002
Lab File ID: AT12074.D
Initial Weight/Volume: 962 mL
Final Weight/Volume: 10 mL
Injection Volume: 1.0 uL

Analyte	Result (ug/L)	Qualifier	RL
Pentachlorophenol	ND		3.6
Phenanthrene	ND		0.42
Anthracene	ND		0.21
Di-n-butyl phthalate	ND		2.1
Fluoranthene	ND		0.26
Pyrene	ND		0.31
Butyl benzyl phthalate	ND		3.1
3,3'-Dichlorobenzidine	ND		10
Benzo[a]anthracene	ND		0.31
Chrysene	ND		0.21
Bis(2-ethylhexyl) phthalate	ND		16
Di-n-octyl phthalate	ND		2.1
Benzo[a]pyrene	ND		0.21
Indeno[1,2,3-cd]pyrene	ND		0.31
Dibenz(a,h)anthracene	ND		0.31
Benzo[g,h,i]perylene	ND		0.31
Carbazole	ND	*	2.1
1-Methylnaphthalene	ND		0.31
Benzo[b]fluoranthene	ND		0.42
Benzo[k]fluoranthene	ND		0.31
2,2'-oxybis[1-chloropropane]	ND		2.1

Surrogate	%Rec	Qualifier	Acceptance Limits
2-Fluorophenol	45		10 - 120
Phenol-d5	22		10 - 102
Nitrobenzene-d5	74		34 - 146
2-Fluorobiphenyl	75		35 - 143
2,4,6-Tribromophenol	68		29 - 151
Terphenyl-d14	73		35 - 166

Analytical Data

Client: Associated Earth Sciences

Job Number: 580-15143-1

Client Sample ID: SP-1

Lab Sample ID: 580-15143-1
Client Matrix: Water

Date Sampled: 08/26/2009 0000
Date Received: 08/27/2009 1000

6010B Metals (ICP)-Total Recoverable

Method: 6010B
Preparation: 3005A
Dilution: 1.0
Date Analyzed: 09/08/2009 1821
Date Prepared: 09/08/2009 0955

Analysis Batch: 580-49900
Prep Batch: 580-49799

Instrument ID: SEA027
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Result (mg/L)	Qualifier	RL
Iron	110		0.20
Manganese	1.4		0.020

6020 Metals (ICP/MS)-Total Recoverable

Method: 6020
Preparation: 3005A
Dilution: 5.0
Date Analyzed: 09/09/2009 0908
Date Prepared: 09/08/2009 0955

Analysis Batch: 580-49910
Prep Batch: 580-49799

Instrument ID: SEA026
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Result (mg/L)	Qualifier	RL
Arsenic	ND		0.0020
Barium	0.42		0.0060
Cadmium	ND		0.0020
Chromium	0.0057		0.0020
Lead	ND		0.0020
Selenium	ND		0.0020
Silver	ND		0.0020

7470A Mercury (CVAA)

Method: 7470A
Preparation: 7470A
Dilution: 1.0
Date Analyzed: 08/31/2009 1435
Date Prepared: 08/31/2009 1149

Analysis Batch: 580-49462
Prep Batch: 580-49427

Instrument ID: SEA029
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Result (mg/L)	Qualifier	RL
Mercury	ND		0.00020

Client: Associated Earth Sciences

Job Number: 580-15143-1

Client Sample ID: SP-2

Lab Sample ID: 580-15143-2
Client Matrix: Water

Date Sampled: 08/26/2009 0000
Date Received: 08/27/2009 1000

6010B Metals (ICP)-Total Recoverable

Method: 6010B
Preparation: 3005A
Dilution: 1.0
Date Analyzed: 09/08/2009 1826
Date Prepared: 09/08/2009 0955

Analysis Batch: 580-49900
Prep Batch: 580-49799

Instrument ID: SEA027
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Result (mg/L)	Qualifier	RL
Iron	0.43		0.20
Manganese	0.026		0.020

6020 Metals (ICP/MS)-Total Recoverable

Method: 6020
Preparation: 3005A
Dilution: 5.0
Date Analyzed: 09/09/2009 0912
Date Prepared: 09/08/2009 0955

Analysis Batch: 580-49910
Prep Batch: 580-49799

Instrument ID: SEA026
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Result (mg/L)	Qualifier	RL
Arsenic	ND		0.0020
Barium	0.017		0.0060
Cadmium	ND		0.0020
Chromium	0.0034		0.0020
Lead	ND		0.0020
Selenium	ND		0.0020
Silver	ND		0.0020

7470A Mercury (CVAA)

Method: 7470A
Preparation: 7470A
Dilution: 1.0
Date Analyzed: 08/31/2009 1439
Date Prepared: 08/31/2009 1149

Analysis Batch: 580-49462
Prep Batch: 580-49427

Instrument ID: SEA029
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Result (mg/L)	Qualifier	RL
Mercury	ND		0.00020

General Chemistry

Client Sample ID: SP-1

Lab Sample ID: 580-15143-1   Date Sampled: 08/26/2009 0000
Client Matrix: Water   Date Received: 08/27/2009 1000

Analyte	Result	Qual	Units	RL	Dil	Method
Chloride	5.8		mg/L	0.90	1.0	300.0
Analysis Batch: 580-50152			Date Analyzed: 09/11/2009 2138			
Sulfate	ND		mg/L	1.2	1.0	300.0
Analysis Batch: 580-50152			Date Analyzed: 09/11/2009 2138			

Analyte	Result	Qual	Units	Dil	Method
pH	6.49	HF	SU	1.0	150.1
Analysis Batch: 580-49243			Date Analyzed: 08/27/2009 1315		

Analyte	Result	Qual	Units	RL	Dil	Method
Specific Conductance	580		umhos/cm	10	1.0	120.1
Analysis Batch: 580-49875			Date Analyzed: 09/08/2009 1939			

Analytical Data

Client: Associated Earth Sciences

Job Number: 580-15143-1

General Chemistry

Client Sample ID: SP-2

Lab Sample ID: 580-15143-2
Client Matrix: Water

Date Sampled: 08/26/2009 0000
Date Received: 08/27/2009 1000

Analyte	Result	Qual	Units	RL	Dil	Method
Chloride	6.1		mg/L	0.90	1.0	300.0
Analysis Batch: 580-50152	Date Analyzed: 09/11/2009 2156					
Sulfate	9.6		mg/L	1.2	1.0	300.0
Analysis Batch: 580-50152	Date Analyzed: 09/11/2009 2156					

Analyte	Result	Qual	Units	Dil	Method
pH	7.96	HF	SU	1.0	150.1
Analysis Batch: 580-49243	Date Analyzed: 08/27/2009 1315				

Analyte	Result	Qual	Units	RL	Dil	Method
Specific Conductance	280		umhos/cm	10	1.0	120.1
Analysis Batch: 580-49875	Date Analyzed: 09/08/2009 1939					

Quality Control Results

Client: Associated Earth Sciences

Job Number: 580-15143-1

Method Blank - Batch: 580-49413

Method: 8270C
Preparation: 3510C

Lab Sample ID: MB 580-49413/1-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 09/09/2009 1519
Date Prepared: 08/31/2009 1058

Analysis Batch: 580-49879
Prep Batch: 580-49413
Units: ug/L

Instrument ID: TAC002
Lab File ID: AT12071.D
Initial Weight/Volume: 1000 mL
Final Weight/Volume: 10 mL
Injection Volume: 1.0 uL

Analyte	Result	Qual	RL
Phenol	ND		3.0
Bis(2-chloroethyl)ether	ND		2.0
2-Chlorophenol	ND		2.0
1,3-Dichlorobenzene	ND		2.0
1,4-Dichlorobenzene	ND		2.0
Benzyl alcohol	ND		2.0
1,2-Dichlorobenzene	ND		2.0
2-Methylphenol	ND		2.0
3 & 4 Methylphenol	ND		4.0
N-Nitrosodi-n-propylamine	ND		2.0
Hexachloroethane	ND		3.0
Nitrobenzene	ND		2.0
Isophorone	ND		2.0
2-Nitrophenol	ND		2.0
2,4-Dimethylphenol	ND		5.0
Benzoic acid	ND		10
Bis(2-chloroethoxy)methane	ND		2.0
2,4-Dichlorophenol	ND		2.0
1,2,4-Trichlorobenzene	ND		2.0
Naphthalene	ND		2.0
4-Chloroaniline	ND		2.0
Hexachlorobutadiene	ND		3.0
4-Chloro-3-methylphenol	ND		2.0
2-Methylnaphthalene	ND		1.0
Hexachlorocyclopentadiene	ND		10
2,4,6-Trichlorophenol	ND		3.0
2,4,5-Trichlorophenol	ND		2.0
2-Chloronaphthalene	ND		0.30
2-Nitroaniline	ND		2.0
Dimethyl phthalate	ND		2.0
Acenaphthylene	ND		0.40
2,6-Dinitrotoluene	ND		2.0
3-Nitroaniline	ND		2.0
Acenaphthene	ND		0.50
2,4-Dinitrophenol	ND		25
4-Nitrophenol	ND		10
Dibenzofuran	ND		2.0
2,4-Dinitrotoluene	ND		2.0
Diethyl phthalate	ND		2.0
4-Chlorophenyl phenyl ether	ND		2.0
Fluorene	ND		0.30

Calculations are performed before rounding to avoid round-off errors in calculated results.

APPENDIX B

Quality Control Results

Client: Associated Earth Sciences

Job Number: 580-15143-1

Method Blank - Batch: 580-49413

Method: 8270C
Preparation: 3510C

Lab Sample ID: MB 580-49413/1-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 09/09/2009 1519
Date Prepared: 08/31/2009 1058

Analysis Batch: 580-49879
Prep Batch: 580-49413
Units: ug/L

Instrument ID: TAC002
Lab File ID: AT12071.D
Initial Weight/Volume: 1000 mL
Final Weight/Volume: 10 mL
Injection Volume: 1.0 uL

Analyte	Result	Qual	RL
4-Nitroaniline	ND		3.0
4,6-Dinitro-2-methylphenol	ND		20
N-Nitrosodiphenylamine	ND		2.0
4-Bromophenyl phenyl ether	ND		2.0
Hexachlorobenzene	ND		2.0
Pentachlorophenol	ND		3.5
Phenanthrene	ND		0.40
Anthracene	ND		0.20
Di-n-butyl phthalate	ND		2.0
Fluoranthene	ND		0.25
Pyrene	ND		0.30
Butyl benzyl phthalate	ND		3.0
3,3'-Dichlorobenzidine	ND		10
Benzo[a]anthracene	ND		0.30
Chrysene	ND		0.20
Bis(2-ethylhexyl) phthalate	ND		15
Di-n-octyl phthalate	ND		2.0
Benzo[a]pyrene	ND		0.20
Indeno[1,2,3-cd]pyrene	ND		0.30
Dibenz(a,h)anthracene	ND		0.30
Benzo[g,h,i]perylene	ND		0.30
Carbazole	ND		2.0
1-Methylnaphthalene	ND		0.30
Benzo[b]fluoranthene	ND		0.40
Benzo[k]fluoranthene	ND		0.30
2,2'-oxybis[1-chloropropane]	ND		2.0

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quality Control Results

Client: Associated Earth Sciences

Job Number: 580-15143-1

Lab Control Sample - Batch: 580-49413

Method: 8270C
Preparation: 3510C

Lab Sample ID:	LCS 580-49413/2-A	Analysis Batch:	580-49879	Instrument ID:	TAC002
Client Matrix:	Water	Prep Batch:	580-49413	Lab File ID:	AT12072.D
Dilution:	1.0	Units:	ug/L	Initial Weight/Volume:	1000 mL
Date Analyzed:	09/09/2009 1539			Final Weight/Volume:	10 mL
Date Prepared:	08/31/2009 1058			Injection Volume:	1.0 uL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Phenol	10.0	ND	19	10 - 70	
Bis(2-chloroethyl)ether	9.98	6.95	70	53 - 128	
2-Chlorophenol	9.99	6.22	62	52 - 122	
1,3-Dichlorobenzene	9.83	7.64	78	58 - 129	
1,4-Dichlorobenzene	9.96	8.05	81	62 - 132	
Benzyl alcohol	9.78	4.51	46	20 - 100	
1,2-Dichlorobenzene	9.96	7.95	80	60 - 126	
2-Methylphenol	10.4	5.22	50	35 - 106	
3 & 4 Methylphenol	10.2	4.36	43	21 - 102	
N-Nitrosodi-n-propylamine	9.99	6.74	67	47 - 142	
Hexachloroethane	10.1	8.64	86	60 - 125	
Nitrobenzene	9.97	8.74	88	66 - 131	
Isophorone	9.92	8.16	82	62 - 122	
2-Nitrophenol	10.0	7.82	78	55 - 131	
2,4-Dimethylphenol	9.99	6.61	66	47 - 127	
Benzoic acid	49.9	ND	18	0 - 35	
Bis(2-chloroethoxy)methane	10.0	7.83	78	65 - 126	
2,4-Dichlorophenol	9.93	7.00	71	66 - 122	
1,2,4-Trichlorobenzene	10.0	7.82	78	59 - 130	
Naphthalene	10.0	7.89	79	49 - 130	
4-Chloroaniline	10.0	6.89	69	75 - 171	*
Hexachlorobutadiene	9.99	8.00	80	54 - 135	
4-Chloro-3-methylphenol	9.90	6.30	64	56 - 121	
2-Methylnaphthalene	10.0	8.49	85	64 - 125	
Hexachlorocyclopentadiene	10.0	ND	51	45 - 126	
2,4,6-Trichlorophenol	9.93	6.86	69	62 - 127	
2,4,5-Trichlorophenol	9.81	6.83	70	64 - 124	
2-Chloronaphthalene	9.99	7.61	76	70 - 125	
2-Nitroaniline	10.0	7.41	74	65 - 130	
Dimethyl phthalate	10.0	8.13	81	47 - 147	
Acenaphthylene	10.0	7.29	73	71 - 126	
2,6-Dinitrotoluene	10.1	9.63	95	66 - 131	
3-Nitroaniline	10.0	8.35	83	90 - 176	*
Acenaphthene	10.0	7.72	77	65 - 130	
2,4-Dinitrophenol	49.9	ND	48	15 - 140	
4-Nitrophenol	49.8	ND	9	10 - 135	*
Dibenzofuran	9.76	7.69	79	71 - 121	
2,4-Dinitrotoluene	10.0	9.07	91	57 - 128	
Diethyl phthalate	9.99	8.14	81	54 - 135	
4-Chlorophenyl phenyl ether	10.0	7.78	78	66 - 127	
Fluorene	10.0	8.01	80	69 - 129	

Calculations are performed before rounding to avoid round-off errors in calculated results.

Client: Associated Earth Sciences

Job Number: 580-15143-1

Lab Control Sample - Batch: 580-49413

Method: 8270C
Preparation: 3510C

Lab Sample ID: LCS 580-49413/2-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 09/09/2009 1539
Date Prepared: 08/31/2009 1058

Analysis Batch: 580-49879
Prep Batch: 580-49413
Units: ug/L

Instrument ID: TAC002
Lab File ID: AT12072.D
Initial Weight/Volume: 1000 mL
Final Weight/Volume: 10 mL
Injection Volume: 1.0 uL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
4-Nitroaniline	10.0	8.77	88	58 - 143	
4,6-Dinitro-2-methylphenol	50.1	35.2	70	36 - 127	
N-Nitrosodiphenylamine	10.0	7.83	78	90 - 150	*
4-Bromophenyl phenyl ether	9.98	8.10	81	66 - 131	
Hexachlorobenzene	9.99	8.07	81	67 - 128	
Pentachlorophenol	9.99	6.97	70	43 - 118	
Phenanthrene	10.0	7.27	72	62 - 128	
Anthracene	10.0	7.69	77	73 - 128	
Di-n-butyl phthalate	10.0	7.37	74	72 - 132	
Fluoranthene	10.0	7.16	72	64 - 124	
Pyrene	10.0	7.25	72	58 - 140	
Butyl benzyl phthalate	10.0	7.71	77	70 - 141	
3,3'-Dichlorobenzidine	20.2	16.3	81	67 - 157	
Benzo[a]anthracene	10.0	7.09	71	70 - 126	
Chrysene	10.0	7.87	79	70 - 126	
Bis(2-ethylhexyl) phthalate	10.0	ND	78	69 - 154	
Di-n-octyl phthalate	10.0	7.58	75	49 - 149	
Benzo[a]pyrene	10.0	7.66	76	72 - 128	
Indeno[1,2,3-cd]pyrene	10.0	7.24	72	58 - 139	
Dibenz(a,h)anthracene	10.0	7.32	73	61 - 146	
Benzo[g,h,i]perylene	10.0	7.12	71	59 - 144	
Carbazole	9.99	7.84	78	90 - 155	*
1-Methylnaphthalene	10.0	7.92	79	47 - 148	
Benzo[b]fluoranthene	10.0	8.49	85	64 - 140	
Benzo[k]fluoranthene	10.0	7.58	76	62 - 142	
2,2'-oxybis[1-chloropropane]	9.99	7.12	71	50 - 135	

Calculations are performed before rounding to avoid round-off errors in calculated results.

Client: Associated Earth Sciences

Job Number: 580-15143-1

Method Blank - Batch: 580-49799

Method: 6010B
Preparation: 3005A
Total Recoverable

Lab Sample ID: MB 580-49799/20-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 09/08/2009 1717
Date Prepared: 09/08/2009 0955

Analysis Batch: 580-49900
Prep Batch: 580-49799
Units: mg/L

Instrument ID: SEA027
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Result	Qual	RL
Iron	ND		0.20
Manganese	ND		0.020

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 580-49799

Method: 6010B
Preparation: 3005A
Total Recoverable

LCS Lab Sample ID: LCS 580-49799/21-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 09/08/2009 1747
Date Prepared: 09/08/2009 0955

Analysis Batch: 580-49900
Prep Batch: 580-49799
Units: mg/L

Instrument ID: SEA027
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

LCSD Lab Sample ID: LCSD 580-49799/22-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 09/08/2009 1750
Date Prepared: 09/08/2009 0955

Analysis Batch: 580-49900
Prep Batch: 580-49799
Units: mg/L

Instrument ID: SEA027
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

	% Rec.						
Analyte	LCS	LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Iron	100	102	80 - 120	1	20		
Manganese	98	101	80 - 120	2	20		

Calculations are performed before rounding to avoid round-off errors in calculated results.

Client: Associated Earth Sciences

Job Number: 580-15143-1

Method Blank - Batch: 580-49799

Method: 6020
Preparation: 3005A
Total Recoverable

Lab Sample ID: MB 580-49799/20-A
Client Matrix: Water
Dilution: 5.0
Date Analyzed: 09/09/2009 0811
Date Prepared: 09/08/2009 0955

Analysis Batch: 580-49910
Prep Batch: 580-49799
Units: mg/L

Instrument ID: SEA026
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Result	Qual	RL
Arsenic	ND		0.0020
Barium	ND		0.0060
Cadmium	ND		0.0020
Chromium	ND		0.0020
Lead	ND		0.0020
Selenium	ND		0.0020
Silver	ND		0.0020

Lab Control Sample - Batch: 580-49799

Method: 6020
Preparation: 3005A
Total Recoverable

Lab Sample ID: LCS 580-49799/21-A
Client Matrix: Water
Dilution: 50
Date Analyzed: 09/09/2009 0838
Date Prepared: 09/08/2009 0955

Analysis Batch: 580-49910
Prep Batch: 580-49799
Units: mg/L

Instrument ID: SEA026
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Arsenic	4.00	3.95	99	80 - 120	
Barium	4.00	4.01	100	80 - 120	
Cadmium	0.100	0.104	104	80 - 120	
Chromium	0.400	0.413	103	80 - 120	
Lead	1.00	1.06	106	80 - 120	
Selenium	4.00	4.01	100	80 - 120	
Silver	0.600	0.614	102	80 - 120	

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quality Control Results

Client: Associated Earth Sciences

Job Number: 580-15143-1

Method Blank - Batch: 580-49427

Method: 7470A
Preparation: 7470A

Lab Sample ID: MB 580-49427/16-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 08/31/2009 1325
Date Prepared: 08/31/2009 1149

Analysis Batch: 580-49462
Prep Batch: 580-49427
Units: mg/L

Instrument ID: SEA029
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Result	Qual	RL
Mercury	ND		0.00020

LCS-Standard Reference Material - Batch: 580-49427

Method: 7470A
Preparation: 7470A

Lab Sample ID: LCSSRM 580-49427/19-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 08/31/2009 1338
Date Prepared: 08/31/2009 1149

Analysis Batch: 580-49462
Prep Batch: 580-49427
Units: mg/L

Instrument ID: SEA029
Lab File ID: N/A
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Mercury	0.00200	0.00198	99	75 - 125	

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quality Control Results

Client: Associated Earth Sciences

Job Number: 580-15143-1

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 580-49427

Method: 7470A
Preparation: 7470A

LCS Lab Sample ID:	LCS 580-49427/17-A	Analysis Batch:	580-49462	Instrument ID:	SEA029
Client Matrix:	Water	Prep Batch:	580-49427	Lab File ID:	N/A
Dilution:	1.0	Units:	mg/L	Initial Weight/Volume:	50 mL
Date Analyzed:	08/31/2009 1330			Final Weight/Volume:	50 mL
Date Prepared:	08/31/2009 1149				

LCSD Lab Sample ID:	LCSD 580-49427/18-A	Analysis Batch:	580-49462	Instrument ID:	SEA029
Client Matrix:	Water	Prep Batch:	580-49427	Lab File ID:	N/A
Dilution:	1.0	Units:	mg/L	Initial Weight/Volume:	50 mL
Date Analyzed:	08/31/2009 1334			Final Weight/Volume:	50 mL
Date Prepared:	08/31/2009 1149				

	% Rec.						
Analyte	LCS	LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Mercury	105	98	75 - 125	6	20		

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quality Control Results

Client: Associated Earth Sciences | Job Number: 580-15143-1

Method Blank - Batch: 580-49875

Method: 120.1
Preparation: N/A

Lab Sample ID: MB 580-49875/1
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 09/08/2009 1939
Date Prepared: N/A

Analysis Batch: 580-49875
Prep Batch: N/A
Units: umhos/cm

Instrument ID: No Equipment Assigned
Lab File ID: N/A
Initial Weight/Volume:
Final Weight/Volume: 1.0 mL

Analyte	Result	Qual	RL
Specific Conductance	ND		10

Lab Control Sample - Batch: 580-49875

Method: 120.1
Preparation: N/A

Lab Sample ID: LCS 580-49875/2
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 09/08/2009 1939
Date Prepared: N/A

Analysis Batch: 580-49875
Prep Batch: N/A
Units: umhos/cm

Instrument ID: No Equipment Assigned
Lab File ID: N/A
Initial Weight/Volume:
Final Weight/Volume: 1.0 mL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Specific Conductance	98.4	96.6	98	80 - 120	

Duplicate - Batch: 580-49875

Method: 120.1
Preparation: N/A

Lab Sample ID: 580-15143-1
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 09/08/2009 1939
Date Prepared: N/A

Analysis Batch: 580-49875
Prep Batch: N/A
Units: umhos/cm

Instrument ID: No Equipment Assigned
Lab File ID: N/A
Initial Weight/Volume:
Final Weight/Volume: 1.0 mL

Analyte	Sample Result/Qual	Result	RPD	Limit	Qual
Specific Conductance	580	577	0	20	

Calculations are performed before rounding to avoid round-off errors in calculated results.

Client: Associated Earth Sciences

Job Number: 580-15143-1

Method Blank - Batch: 580-50152

Method: 300.0
Preparation: N/A

Lab Sample ID: MB 580-50152/4
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 09/11/2009 1129
Date Prepared: N/A

Analysis Batch: 580-50152
Prep Batch: N/A
Units: mg/L

Instrument ID: IS 2000 Ion Chromatograpl
Lab File ID: N/A
Initial Weight/Volume: 5 mL
Final Weight/Volume: 5 mL

Analyte	Result	Qual	RL
Chloride	ND		0.90
Sulfate	ND		1.2

Lab Control Sample - Batch: 580-50152

Method: 300.0
Preparation: N/A

Lab Sample ID: LCS 580-50152/1
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 09/11/2009 0902
Date Prepared: N/A

Analysis Batch: 580-50152
Prep Batch: N/A
Units: mg/L

Instrument ID: IS 2000 Ion Chromatograpl
Lab File ID: N/A
Initial Weight/Volume: 5 mL
Final Weight/Volume: 5 mL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Chloride	10.0	10.1	101	90 - 110	
Sulfate	10.0	9.17	92	90 - 110	

Calculations are performed before rounding to avoid round-off errors in calculated results.

DATA REPORTING QUALIFIERS

Client: Associated Earth Sciences | Job Number: 580-15143-1

Lab Section	Qualifier	Description
GC/MS Semi VOA		
	*	LCS or LCSD exceeds the control limits
General Chemistry		
	HF	Field parameter with a holding time of 15 minutes

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Tacoma
5755 8th Street E.
Tacoma, WA 98424
Tel. 253-922-2310
Fax 253-922-5047
www.testamericainc.com

Chain of Custody Record

15143

Client: Associated Earth Sciences Inc	Project Manager: Jon Sondergaard	Date: 8/27/09	Chain of Custody Number: 5088
Address: 911 Fifth Avenue	Telephone Number (Area Code)/Fax Number	Lab Number	Page 1 of 1
City: Kirkland / State: WA / Zip Code: 98033	Site Contact / Lab Contact: Curtis Armstrong	Analysis (Attach list if more space is needed)	
Project Name and Location (State): Go East KE090231A	Carrier/Waybill Number		Special Instructions/ Conditions of Receipt
Contract/Purchase Order/Quote No.: [redacted]			Will Fax Analytes to Curtis Armstrong

Sample I.D. and Location/Description (Containers for each sample may be combined on one line)	Date	Time	Air	Aqueous	Sed.	Soil	Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/NaOH	Special Instructions/ Conditions of Receipt
SP-1	8/26/09												1
SP-2	8/26/09												2

Matrix: Air, Aqueous, Sed., Soil — Containers & Preservatives: Unpres., H2SO4, HNO3, HCl, NaOH, ZnAc/NaOH

@ Lab 8/27 10:00 Temp 0.1° TB 0.1°
Cooler Dsc Red Blu Wht Wet/Packs
Packing Bubble wrap w/Cp

Page 24 of 26

Cooler: ☒ Yes ☐ No Cooler Temp: ______

Possible Hazard Identification: ☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal: ☐ Return To Client ☒ Disposal By Lab ☐ Archive For ______ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required (business days): ☐ 24 Hours ☐ 48 Hours ☐ 5 Days ☐ 10 Days ☐ 15 Days ☐ Other ______

QC Requirements (Specify)

	Date	Time		Date	Time
1. Relinquished By: Jon Sondergaard	8/27/09	08:20	1. Received By		
2. Relinquished By			2. Received By		
3. Relinquished By			3. Received By	8/27/09	8:25

Comments

DISTRIBUTION: WHITE – Stays with the Samples; CANARY – Returned to Client with Report; PINK – Field Copy

TAL-8274 (0508)

APPENDIX B

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Tacoma
5755 8th Street E.
Tacoma, WA 98424
Tel. 253-922-2310
Fax 253-922-5047
www.testamericainc.com

Chain of Custody Record

15145

Client: Associated Earth Sciences Inc	Project Manager: Jon Sondergaard	Date: 8/27/09	Chain of Custody Number: 5088
Address: 911 Fifth Avenue	Telephone Number (Area Code)/Fax Number:	Lab Number:	Page 1 of 1
City: Kirkland State: WA Zip Code: 98033	Site Contact: Lab Contact: Curtis Armstrong		
Project Name and Location (State): Go East KE090231A	Carrier/Waybill Number:		
Contract/Purchase Order/Quote No.: [redacted]			

Special Instructions/ Conditions of Receipt: Will Fax Analytes to Curtis Armstrong

Sample I.D. and Location/Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Aqueous	Sed.	Soil	Containers & Preservatives: Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/NaOH	Chloride	Iron	Manganese	Sulfate	pH	Conductivity	Semi Volatiles	RCRA 8 Metals	Special Instructions/ Conditions of Receipt
SP-1	8/26/09			X									X	X	X	X	X	X	X	X	1
SP-2	8/26/09			X									X	X	X	X	X	X	X	X	2

Cooler: ☒ Yes ☐ No Cooler Temp: ____

Possible Hazard Identification: ☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal: ☐ Return To Client ☒ Disposal By Lab ☐ Archive For ____ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required (business days): ☐ 24 Hours ☐ 48 Hours ☒ 5 Days ☐ 10 Days ☐ 15 Days ☐ Other ____

QC Requirements (Specify):

	Date	Time		Date	Time
1. Relinquished By: Jon Sondergaard	8/27/09	08:20	1. Received By:		
2. Relinquished By:			2. Received By:		
3. Relinquished By:			3. Received By: [signature] / Cathy Gamble	8/27/09 / 8/27/09	8 A / 10:00

Comments:

DISTRIBUTION: WHITE – Stays with the Samples; CANARY – Returned to Client with Report; PINK – Field Copy

TAL-0274-5RD (0508)

APPENDIX B

Login Sample Receipt Check List

Client: Associated Earth Sciences

Job Number: 580-15143-1

Login Number: 15143
Creator: Gamble, Cathy
List Number: 1

List Source: TestAmerica Tacoma

Question	T / F/ NA	Comment
Radioactivity either was not measured or, if measured, is at or below background	True	
The cooler's custody seal, if present, is intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
There are no discrepancies between the sample IDs on the containers and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
ppropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
VOA sample vials do not have headspace or bubble is <6mm (1/4") in diameter.	N/A	
If necessary, staff have been informed of any short hold time or quick TAT needs	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Is the Field Sampler's name present on COC?	False	
Sample Preservation Verified	True	

Appendix C
Landfill Closure Mitigation
Wetland Resources, Inc., September 1, 2010

Wetland Resources, Inc.

Delineation / Mitigation / Restoration / Habitat Creation / Permit Assistance

9505 19th Avenue S.E.
Suite 106
Everett, Washington 98208
(425) 337-3174
Fax (425) 337-3045

LANDFILL CLOSURE MITIGATION PLAN

For

BAKERVIEW

Wetland Resources, Inc. Project #09058

Prepared By:

Wetland Resources, Inc.
9505 19th Ave. SE
Suite 106
Everett, WA 98208
(425) 337-3174

For:

PACE Engineers
Attn: Marty Penhallegon
11255 Kirkland Way
Kirkland, WA 98033

September 1, 2010

Table of Contents

Site Description

On May 4, 2009 *Wetland Resources, Inc.* conducted a site investigation to locate jurisdictional wetlands and streams on and adjacent to the 40-acre site located at 4330 108th Street SE in Snohomish County, Washington. The property is further located as a portion of Section 21, Township 28N, Range 5E, W.M.

Access to this undeveloped site is from a gravel road that enters the northwest corner via 108th Street SE. From the north this site has a general southeast aspect to a steep ravine that runs along the southern portion of the property. From 1972 to 1983, the subject site was operated as a solid waste landfill, accepting wood, mineral, and concrete solid materials. Large concrete blocks and other evidence of this period are still visible on the site. Since 1983, the property has re-vegetated with typical vegetation is comprised of red alder, black cottonwood, and Himalayan blackberry. Two wetlands (Wetlands A and B) and an associated Type Np stream (Stream C) are located on the western portion of the site. Stream C flows south where it drains to Stream A (Type Np) located in the ravine. Stream A flows east where it is joined by Stream B (Type Np) in the southeast corner of site. From here the stream flows off-site and drains north along the eastern property line.

In Snohomish County, Category III wetlands receive standard 60-foot protective buffers while Type Np streams receive 50-foot standard buffers.

Project Description and Conceptual Mitigation Plan

This project is proposed to occur in two phases and is proposed to be submitted as two projects with two separate applications. The first project is to properly close the old landfill and restore the site to its pre-disturbance condition. To close the landfill, the site will be graded and unsuitable or hazardous material will be removed. After grading and waste removal or recycling, the area will be capped with a geomembrane layer and fill soil. During grading for the landfill closure, Stream C (Type Np) which at some point in the past was re-routed to its current location, will be re-aligned to flow south and drain to Stream A. Due to the extensive grading necessary for the landfill closure, portions of Wetland A as well as Wetland B will be graded or adversely affected. It is anticipated that 8,159 square feet (0.18 acres) of wetland will be impacted. Mitigation for wetland impacts is offered through a combination of wetland creation adjacent to the restored stream and the purchase of mitigation credits at an established wetland mitigation bank. There are two approved wetland mitigation banks in the Snohomish River basin (WRIA 7), one of which will be utilized for this project. The proposed project will meet required wetland and stream mitigation ratios for Snohomish County and the Army Corps of Engineers. The new stream will have a sinuous channel and will be sized to convey the 100-year storm flow as calculated by an engineer. Flow at the southern end of the restored stream channel will flow over the steep slope to Stream A. The wetland creation area will be adjacent to both sides of the restored stream channel. This will serve to assure adequate hydrology to the wetland, provide the stream with a high flow channel during storm events, which will reduce flow velocities and the potential for downstream flooding, as well as increase habitat complexity and edge and improve wildlife habitat. All slopes from the wetland creation area will be a maximum of 3:1. A final mitigation plan which meats all of the requirements of SCC 30.62A will be submitted as part of the grading permits for the landfill closure.

The second project will be to construct a residential development on the property. Because this portion of the project has been designed with the restored stream in mind, no critical areas impacts will occur with this portion of the project.

WETLAND AND STREAM CLASSIFICATIONS - COWARDIN SYSTEM

According to the Cowardin System, as described in Classification of Wetlands and Deepwater Habitats of the United States, the classifications for the on-site wetlands and streams are as follows:

Wetland A, Category III: Palustrine, Forested Wetland, Broad-leaved Deciduous, Permanently flooded.

Wetland B, Category III: Palustrine, Forested Wetland, Broad-leaved Deciduous, Seasonally flooded/ Saturated.

Streams A, B, and C, Type Np: Riverine, Upper Perennial, Streambed.

WETLAND AND STREAM CLASSIFICATIONS - SNOHOMISH COUNTY

Under the Snohomish County Critical Areas Regulations (CAR), Chapter 30.62A, the on-site wetlands and streams are classified as follows:

Wetland A - Category III: This wetland is located in the western portion of the site and is associated with Stream C. This depressional wetland received a score of 44 with a habitat score of 18 on the DOE *Wetland Rating Form for Western Washington* (Version 2). Typically, wetlands with scores between 30 to 50 points for all functions, with habitat scores of less than 20, are classified as Category III wetlands per SCC 30.62A.230. In Snohomish County, Category III wetlands with habitat scores of less than 20 typically receive 60-foot protective buffers.

Wetland B - Category III: This is a small depressional wetland, located in the western portion of the site, west of Wetland A. This wetland received a score of 44 with a habitat score of 14 on the DOE *Wetland Rating Form for Western Washington* (Version 2). Typically, wetlands with scores between 30 to 50 points for all functions, with habitat scores of less than 20, are classified as Category III wetlands per SCC 30.62A.230. In Snohomish County, Category III wetlands with habitat scores of less than 20 typically receive 60-foot protective buffers.

Streams A and B - Type Np: Both of these streams are unnamed. Stream A flows west across the southern portion of the site. Near the eastern border of the subject property, Stream A is joined by Stream B, and both flow north to the Snohomish River basin. All available resources including Snohomish County Snoscape maps, Washington Department of Fish and Wildlife, and the Washington Department of Natural Resources, indicate that fish do not utilize the on-site streams. This conclusion appears accurate, as fish access to these streams is blocked by a pump station located adjacent to the Snohomish River and by poor water quality in the downstream ditches of the Marshlands Drainage District. In Snohomish County, Type Np streams typically receive 50-foot standard buffers.

Stream C - Type Np: This unnamed stream originates to the west of the subject site, flows east through Wetland A, and finally drains over a steep slope, south to Stream A. This is a perennial stream that does not support fish. In Snohomish County, Type Np streams typically receive 50-foot standard buffers.

In Snohomish County, regulated streams, wetlands, and their buffers are designated collectively as Critical Area Protection Areas (CAPAs). Critical Area Protection Areas are subject to the following conditions:

> *"Critical Area Protection Area (CAPA) means an area which is to be left permanently undisturbed in a substantially natural state and in which no clearing, grading, filling, building construction or placement, or road construction of any kind is allowed except the following:*
>
> *(1) Crossings for underground utility lines and drainage discharge swales which utilize the shortest alignment possible and for which no alignment that would avoid such a crossing is feasible;*
> *(2) Removal of hazardous trees by the property owner;*
> *(3) Fences, only if the critical area and its buffer are not detrimentally affected;*
> *(4) Other uses and development activity as allowed by chapter 30.62 SCC; and*
> *(5) In rural cluster subdivisions approved pursuant to chapter 30.41C SCC, buffer plantings as required by SCC 30.41C.200 and passive recreational uses limited to non-motorized trails, exercise pathways, and wildlife viewing areas."*

Wetland Determination Report

Methodology

On-site, the routine methodology described in the Washington State Wetlands Identification and Delineation Manual (Washington State Department of Ecology Publication #96-94, March 1997) was used to make a determination, as required by Snohomish County. Under this method, the process for making a wetland determination is based on three sequential steps:

1.) Examination of the site for hydrophytic vegetation (species present and percent cover);

2.) If hydrophytic vegetation is found, then the presence of hydric soils is determined.

3.) The final step is determining if wetland hydrology exists in the area examined under the first two steps.

The following criteria descriptions were used in the boundary determination:

Wetland Vegetation Criteria:

The 1997 edition of the Washington State Wetlands Identification and Delineation Manual defines hydrophytic vegetation as "the sum total of macrophytic plant life that occurs in areas where the frequency and duration of inundation or soil saturation produce permanently or periodically saturated soils of sufficient duration to exert a controlling influence on the plant species present." Field indicators were used to determine whether the vegetation meets the definition for hydrophytic vegetation.

Wetland Soils Criteria and Mapped Description:

The 1997 edition of the Washington State Wetlands Identification and Delineation Manual defines hydric soils as "soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part." Field indicators were used to determine whether a given soil meets the definition for hydric soils.

The soils underlying the subject site are mapped in the Soil Survey of Snohomish County Area Washington as Adlerwood gravelly sandy loam 2 to 8 percent slopes on the terraces, and Alderwood -Everett gravelly sandy loams, 25 to 70 percent slopes in the ravines.

Alderwood gravelly sandy loam is described as a moderately well drained soil on till plains. It is moderately deep over a hardpan. This soil formed in glacial till. Typically, the surface layer is very dark grayish brown gravelly sandy loam about 7 inches thick. The upper part of the subsoil is dark yellowish brown and dark brown very gravelly sandy loam about 23 inches thick. Included in this unit are small areas of soils that have a stony of bouldery surface layer and areas of McKenna soils, Norma soils, and Terric Medisaprists in drainageways on plains. Also included are small areas of Everett, Indianola, and Ragnar soils on terraces and outwash plains. Included areas make up about 15 percent of the total acreage. Permeability of this soil is moderately rapid above the hardpan and very slow through it. Available water capacity is low. Soils sampled on site appear similar to the description for Alderwood gravelly sandy loam.

Alderwood- Everett gravelly sandy loams, 25 to 75 percent slopes is on till plains, terraces, and outwash plains. This unit is about 60 percent Alderwood gravelly sandy loam and about 25 percent Everett gravelly sandy loam. Included in this unit are small areas of Ragnar, Indianola, Mckenna, and Norma soils and Terric Medisaprists in depressional areas and drainageways on plains. Also included are colluvial soils, slump areas, and escarpments. Included areas make up about 15 percent of the total acreage. The Alderwood soil is moderately deep over a hardpan and is moderately well drained. It formed in glacial till. Typically, the surface layer is very dark grayish brown gravelly sandy loam about 7 inches thick. The upper part of the subsoil is dark yellowish brown and dark brown very gravelly sandy loam about 23 inches thick. A weakly cemented hardpan is at a depth of about 35 inches. Depth to the hardpan ranges from 20 to 40 inches. Permeability of the Alderwood soil is moderately rapid above the hardpan and very slow through it. Available water capacity is low. A seasonal perched water table is at a depth of 18 to 36 inches from January to March. Springs or seep areas are common.

Hydrology Criteria

The Washington State Wetlands Identification and Delineation Manual, 1997 edition, states that "areas which are seasonally inundated and/or saturated to the surface for a consecutive number of days ≥12.5 percent of the growing season are wetlands, provided the soil and vegetation parameters are met. Areas inundated or saturated between 5 and 12.5 percent of the growing season in most years may or may not be wetlands. Areas saturated to the surface for less than 5 percent of the growing season are non-wetlands." Field indicators are used for determining whether wetland hydrology parameters are met.

BOUNDARY DETERMINATION FINDINGS

Wetland A, Category III: This depressional wetland is located in the western portion of the subject property, and is associated with Stream C. Vegetation in this wetland is represented by a canopy of red alder (*Alnus rubra*, Fac) and Black cottonwood (*Populus balsamifera*, Fac), with salmonberry (*Rubus spectabilis,* Fac+), Himalayan blackberry (*Rubus armeniacus*, FacU), lady fern (*Athyrium filix-femina,* Fac), reed canarygrass (*Phalaris arundinacea*, FacW), climbing nightshade (*Solanum dulcamara*, Fac+), and duckweed (*Lemma minor,* Obl). Soils in this wetland have a Munsell color of dark gray (10 YR 4/1) with a texture of loamy sand from 0 to 18 inches below the surface. Soils were ponded to six inches through much of this wetland during our May 2009 field work.

Wetland B, Category III: Wetland B is located in a small depression, west of Wetland A. Vegetation in this wetland is comprised of red alder (*Alnus rubra*, Fac), salmonberry (*Rubus spectabilis,* Fac+), lady fern (*Athyrium filix-femina,* Fac), and field horsetail (*Equisetum arvense*, Fac). Soils in this wetland have a Munsell color of very dark grayish brown (10 YR 3/2) with a texture of loamy sand from 0 to 5 inches below the surface. From 5 to 18 inches, soils have a Munsell color of dark gray (10 YR 4/1) with a texture of sandy loam. Soils were saturated to the surface during our May 2009 site investigation.

Non-Wetland: Vegetation over the majority of the site is represented by a sparse canopy of red alder (*Alnus rubra*, Fac) and Black cottonwood (*Populus balsamifera*, Fac), with Himalayan blackberry (*Rubus armeniacus*, FacU) in the uderstory. Portions of the site in the west and in the ravine are less disturbed and contain red alder (*Alnus rubra*, Fac), big leaf maple (*Acer macrophyllum*, FacU), Western hemlock (*Tsuga heterophylla*, FacU-), salmonberry (*Rubus spectabilis,* Fac+), sword fern (*Polystichum munitum,* FacU), filaree (*Erodium cicutarium*, Nol/Upl), and piggy-back plant (*Tolmiea menziesii*, Fac). Typical soils in the upland areas of the site have a Munsell color of dark brown (10 YR 3/3) with textures of gravelly sandy loam to loamy sand from 0 to 18 inches below the surface. Soils were dry during our May 2009 site investigation.

Wetland Functions and Values Assessment

Methodology

The methodology for this functions and values assessment is based on professional opinion developed through past field analyses and interpretation. This assessment pertains specifically to this site, but is typical for assessments of similar systems common to western Washington. In addition, the *2000 Wetland and Buffer Functions and Semi-quantitative Performance Assessment* was conducted for this site (please see attached).

Functions and Values – Professional Opinion

Wetlands in western Washington perform a variety of ecosystem functions. Included among the most important functions provided by wetlands are stormwater control, water quality improvement, fish and wildlife habitat, aesthetic value, recreational opportunities, and education. Assessments of these functions for the project site are provided below.

Existing Conditions

The on-site wetlands provide a moderate level of functions for all values. As these wetlands contain dense vegetation they are able to contribute to flood flow attenuation and storm water control. Densely vegetated wetlands containing plants greater than six feet tall are better able to control stormwater flows than areas dominated by low growing vegetation. As a result, these wetlands have the potential to create high quality, natural water retention systems.

The subject wetlands also aid in water quality functions. As water flows through these features it is slowed by vegetation, and any suspended sediment is able to settle out of the water column, thus improving water quality. Retention of sediments and stormwater also helps to control erosion.

Given the location of these wetlands in the landscape, their proximity to forested buffer, the on-site forested ravine, and to some extent the Snohomish River basin, it is likely that they are utilized for extended periods of time by a variety of wildlife. The associated edge habitat between the wetlands, streams, and upland buffers, provides protected wildlife movement corridors, as well as forage and cover opportunities. This habitat becomes increasingly important as urban areas become more densely populated. Wetlands often contain resources such as food, water, thermal cover and hiding cover in close proximity, which wildlife species need to thrive.

The level of functions provided by these wetland are limited by their relatively small size, the prevalence of invasive species in the wetlands and adjacent buffers, and the extent of disturbance. Examples of disturbance include historic uses such as filling and grading, as well as current and ongoing uses such as camping and dog walking. Functions on this site could be improved through control of invasive species and by limiting human intrusion to the wetlands and buffers.

Functions and Values - SAM Assessment

Information provided by the *2000 Wetland and Buffer Functions and Semi-quantitative Performance Assessment (SAM)* was used to further evaluate wetland conditions. This assessment can be found in Appendix B of this document.

Overall, the subject wetlands provide a moderate level of functions and values, with scores of 87 and 78 out of a possible 132. Many of the factors that resulted in the scores not being higher are unalterable, such as the size and location of these wetlands in the landscape, soil types, and the hydrogeomorphic classifications.

Use Of This Report

This Critical Area Study is supplied to PACE Engineers as a means of determining on-site wetland conditions and mitigating for impacts, as required by Snohomish County during the permitting process. This report is based largely on readily observable conditions and, to a lesser extent, on readily ascertainable conditions. No attempt has been made to determine hidden or concealed conditions.

The laws applicable to wetlands are subject to varying interpretations and may be changed at any time by the courts or legislative bodies. This report is intended to provide information deemed relevant in the applicant's attempt to comply with the laws now in effect.

The work for this report has conformed to the standard of care employed by wetland ecologists. No other representation or warranty is made concerning the work or this report and any implied representation or warranty is disclaimed.

Wetland Resources, Inc.

Louis Emenhiser
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Professional Wetland Scientist #1680

References

Cooke, Sarah S. 2000. Wetland and Buffer Functions Semi-Quantitative Assessment Methodology (SAM). Cooke Scientific Services. February 2000.

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Soil Survey of Snohomish County Area Washington. U.S.D.A. Soil Conservation Service. July 1983.

Washington State Wetlands Identification and Delineation Manual. Washington State Department of Ecology. Publication #96-94. March 1997.

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Field Data Sheet
BAKERVIEW - WRI # 09058
Investigation Date: May 4, 2009

Pit	Depth	Texture	Color	Moisture	Species	%	Status	Strata
S1	0-18"	Gravelly Sandy Loam	10YR 4/4	moist	*Acer macrophyllum*	60	FacU	Tree
Non-Wetland					*Tsuga heterophylla*	10	FacU-	Tree
					Corylus cornuta	30	FacU	Shrub
					Sambucus racemosa	20	FacU	Shrub
					Vaccinium parvifolium	10	FacU	Shrub
					Rubus spectabilis	10	Fac+	Shrub
					Polystichum munitum	10	FacU	Herb
Conclusion: Non-Wetland - Parameters for hydrophytic vegetation, hydric soils, and wetland hydrology are not met.								
S2	0-18"	Loamy Sand	10YR 4/1	Ponded to 6"	*Alnus rubra*	60	Fac	Tree
Wetland					*Populus balsamifera*	10	Fac	Tree
					Rubus spectabilis	70	Fac+	Shrub
					Rubus armeniacus	10	FacU	Shrub
					Athyrium filix-femina	20	Fac	Herb
					Phalaris arundinacea	20	FacW	Herb
					Solanum dulcamara	tr	Obl	Herb
					Lemma minor	30	FacW	Aquatic
Conclusion: Wetland - Parameters for hydrophytic vegetation, hydric soils, and wetland hydrology are met.								
S3	0-18"	Sandy Loam	10YR 4/3	dry	*Alnus rubra*	50	Fac	Tree
Non-Wetland					*Tsuga heterophylla*	5	FacU-	Tree
					Rubus spectabilis	60	Fac+	Shrub
					Polystichum munitum	30	FacU	Herb
					Erodium cicutarium	tr	Nol/Upl	Herb
					Tolmiea menziesii	tr	Fac	Herb
Conclusion: Non-Wetland - Parameters for hydrophytic vegetation, hydric soils, and wetland hydrology are not met.								
S4	0-5"	Loamy Sand	10YR 3/2	sat	*Alnus rubra*	40	Fac	Tree
Wetland			redox		*Rubus spectabilis*	60	Fac+	Shrub
B	5-18"	Sandy Loam	10YR 4/1	sat	*Athyrium filix-femina*	20	Fac	Herb
					Equisetum arvense	15	Fac	Herb
Conclusion: Wetland - Parameters for hydrophytic vegetation, hydric soils, and wetland hydrology are met.								
S5	0-18"	Loamy Sand	2.5Y 3/3	dry	*Populus balsamifera*	50	Fac	Tree
Non-Wetland					*Rubus armeniacus*	80	FacU	Shrub
					Sambucus racemosa	5	FacU	Shrub
					Oemleria cerasiformis	5	FacU	Shrub
					Polystichum munitum	tr	FacU	Herb
Conclusion: Non-Wetland - Parameters for hydrophytic vegetation, hydric soils, and wetland hydrology are not met.								
S6	0-18"	Loamy Sand	2.5Y 3/3	dry	*Alnus rubra*	30	Fac	Tree
Non-Wetland					*Populus balsamifera*	30	Fac	Tree
					Rubus armeniacus	80	FacU	Shrub
					Phalaris arundinacea	10	FacW	Herb
Conclusion: Non-Wetland - Parameters for hydrophytic vegetation, hydric soils, and wetland hydrology are not met.								

Field Data Sheet
BAKERVIEW - WRI # 09058
Investigation Date: May 4, 2009

Pit	Depth	Texture	Color	Moisture	Species	%	Status	Strata
S7 Non-Wetland	0-18"	Silt Loam	10YR 3/3	dry	*Rubus armeniacus*	100	FacU	Shrub

Conclusion: Non-Wetland - Parameters for hydrophytic vegetation, hydric soils, and wetland hydrology are not met.

Pit	Depth	Texture	Color	Moisture	Species	%	Status	Strata
S8	0-18"	Loamy Sand	2.5Y 3/3	dry	*Populus balsamifera*	20	Fac	Tree
Non-Wetland					*Acer macrophyllum*	20	FacU	Tree
					Robinia pseudoacacia	20	Nol/Upl	Shrub
					Rubus armeniacus	10	FacU	Shrub
					Polygonum cuspidatum	80	FacU	Herb

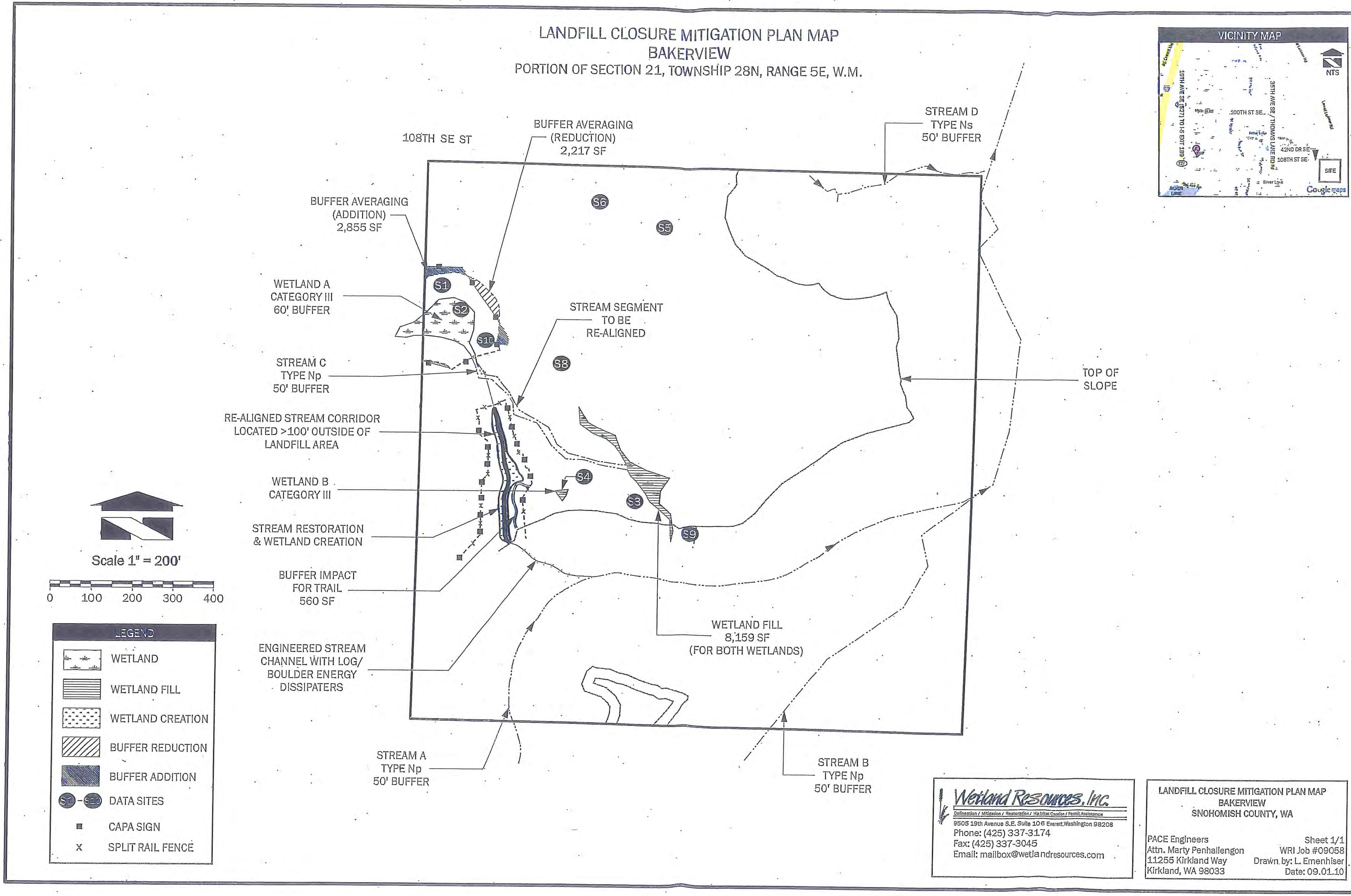
Conclusion: Non-Wetland - Parameters for hydrophytic vegetation, hydric soils, and wetland hydrology are not met.

Pit	Depth	Texture	Color	Moisture	Species	%	Status	Strata
S9	0-4"	Gravelly Sandy Loam	2.5Y 3/2	dry	*Alnus rubra*	60	Fac	Tree
Non-Wetland	4-18"	Gravelly Sandy Loam	2.5Y 3/3	dry	*Populus balsamifera*	20	Fac	Tree
					Rubus armeniacus	60	FacU	Shrub
					Phalaris arundinacea	30	FacW	Herb

Conclusion: Non-Wetland - Parameters for hydrophytic vegetation, hydric soils, and wetland hydrology are not met.

Pit	Depth	Texture	Color	Moisture	Species	%	Status	Strata
S10	0-18"	Sandy Loam	2.5Y 5/2	dry	*Salix Scouleriana*	60	Fac	Tree
Non-Wetland			redox		*Phalaris arundinacea*	10	FacW	Herb
					Anthoxanthum odoratum	5	FacU+	Herb
					Juncus effusus	5	FacW	Herb
					Equisetum arvense	5	Fac	Herb
					Taraxacum officinale	tr	FacU	Herb

Conclusion: Non-Wetland - Parameters for hydrophytic vegetation, hydric soils, and wetland hydrology are not met.


LANDFILL CLOSURE MITIGATION PLAN MAP
BAKERVIEW
PORTION OF SECTION 21, TOWNSHIP 28N, RANGE 5E, W.M.
VICINITY MAP
NTS
100TH ST SE
42ND DR SE
108TH ST SE
SITE
108TH SE ST
BUFFER AVERAGING (REDUCTION) 2,217 SF
STREAM D TYPE Ns 50' BUFFER
BUFFER AVERAGING (ADDITION) 2,855 SF
WETLAND A CATEGORY III 60' BUFFER
STREAM SEGMENT TO BE RE-ALIGNED
STREAM C TYPE Np 50' BUFFER
TOP OF SLOPE
RE-ALIGNED STREAM CORRIDOR LOCATED >100' OUTSIDE OF LANDFILL AREA
WETLAND B CATEGORY III
STREAM RESTORATION & WETLAND CREATION
BUFFER IMPACT FOR TRAIL 560 SF
ENGINEERED STREAM CHANNEL WITH LOG/ BOULDER ENERGY DISSIPATERS
WETLAND FILL 8,159 SF (FOR BOTH WETLANDS)
STREAM A TYPE Np 50' BUFFER
STREAM B TYPE Np 50' BUFFER
S1
S2
S3
S4
S5
S6
S8
S9
S10
Scale 1" = 200'
0 100 200 300 400
LEGEND
WETLAND
WETLAND FILL
WETLAND CREATION
BUFFER REDUCTION
BUFFER ADDITION
S1 - S10 DATA SITES
CAPA SIGN
X SPLIT RAIL FENCE
Wetland Resources, Inc.
Delineation / Mitigation / Restoration / Habitat Creation / Permit Assistance
9505 19th Avenue S.E. Suite 106 Everett, Washington 98208
Phone: (425) 337-3174
Fax: (425) 337-3045
Email: mailbox@wetlandresources.com
LANDFILL CLOSURE MITIGATION PLAN MAP
BAKERVIEW
SNOHOMISH COUNTY, WA
PACE Engineers
Attn. Marty Penhallengon
11255 Kirkland Way
Kirkland, WA 98033
Sheet 1/1
WRI Job #09058
Drawn by: L. Emenhiser
Date: 09.01.10

ATTACHMENT A

Washington State Department of Ecology Rating Forms

WETLAND RATING FORM – WESTERN WASHINGTON

Version 2 - Updated July 2006 to increase accuracy and reproducibility among users
Updated Oct 2008 with the new WDFW definitions for priority habitats

Name of wetland (if known): PACE 108th Wet A Date of site visit: 5.05.09

Rated by L. Emenhiser Trained by Ecology? Yes ☑ No ☐ Date of training 10.11.06

SEC: 21 TWNSHP: 28 RNGE: 5 Is S/T/R in Appendix D? Yes ☐ No ☑

Map of wetland unit: Figure 2/2 Estimated size 30,000 sf

SUMMARY OF RATING

Category based on FUNCTIONS provided by wetland

I___ II___ III ✓ IV___

Category I = Score >=70	
Category II = Score 51-69	
Category III = Score 30-50	
Category IV = Score < 30	

Score for Water Quality Functions	20
Score for Hydrologic Functions	6
Score for Habitat Functions	18
TOTAL score for Functions	44

Category based on SPECIAL CHARACTERISTICS of wetland

I___ II___ Does not Apply ✓

Final Category (choose the "highest" category from above) III

Summary of basic information about the wetland unit

Wetland Unit has Special Characteristics		Wetland HGM Class used for Rating	
Estuarine		Depressional	✓
Natural Heritage Wetland		Riverine	
Bog		Lake-fringe	
Mature Forest		Slope	
Old Growth Forest		Flats	
Coastal Lagoon		Freshwater Tidal	
Interdunal			
None of the above	✓	Check if unit has multiple HGM classes present	

Does the wetland unit being rated meet any of the criteria below?

If you answer YES to any of the questions below you will need to protect the wetland according to the regulations regarding the special characteristics found in the wetland.

Check List for Wetlands That May Need Additional Protection (in addition to the protection recommended for its category)	YES	NO
SP1. *Has the wetland unit been documented as a habitat for any Federally listed Threatened or Endangered animal or plant species (T/E species)?* For the purposes of this rating system, "documented" means the wetland is on the appropriate state or federal database.		✓
SP2. *Has the wetland unit been documented as habitat for any State listed Threatened or Endangered animal species?* For the purposes of this rating system, "documented" means the wetland is on the appropriate state database. Note: Wetlands with State listed plant species are categorized as Category I Natural Heritage Wetlands (see p. 19 of data form).		✓
SP3. *Does the wetland unit contain individuals of Priority species listed by the WDFW for the state?*		✓
SP4. *Does the wetland unit have a local significance in addition to its functions?* For example, the wetland has been identified in the Shoreline Master Program, the Critical Areas Ordinance, or in a local management plan as having special significance.		✓

To complete the next part of the data sheet you will need to determine the Hydrogeomorphic Class of the wetland being rated.

The hydrogeomorphic classification groups wetlands into those that function in similar ways. This simplifies the questions needed to answer how well the wetland functions. The Hydrogeomorphic Class of a wetland can be determined using the key below. See p. 24 for more detailed instructions on classifying wetlands.

Classification of Wetland Units in Western Washington

If the hydrologic criteria listed in each question do not apply to the entire unit being rated, you probably have a unit with multiple HGM classes. In this case, identify which hydrologic criteria in questions 1-7 apply, and go to Question 8.

1. Are the water levels in the entire unit usually controlled by tides (i.e. except during floods)?
[✓] NO – go to 2 [ ] YES – the wetland class is **Tidal Fringe**

If yes, is the salinity of the water during periods of annual low flow below 0.5 ppt (parts per thousand)? [ ] YES – **Freshwater Tidal Fringe** [ ] NO – **Saltwater Tidal Fringe (Estuarine)**

*If your wetland can be classified as a Freshwater Tidal Fringe use the forms for **Riverine** wetlands. If it is Saltwater Tidal Fringe it is rated as an **Estuarine** wetland.* Wetlands that were called estuarine in the first and second editions of the rating system are called Salt Water Tidal Fringe in the Hydrogeomorphic Classification. Estuarine wetlands were categorized separately in the earlier editions, and this separation is being kept in this revision. To maintain consistency between editions, the term "Estuarine" wetland is kept. Please note, however, that the characteristics that define Category I and II estuarine wetlands have changed (see p.).

2. The entire wetland unit is flat and precipitation is the only source (>90%) of water to it. Groundwater and surface water runoff are NOT sources of water to the unit.
[✓] NO – go to 3 [ ] YES – The wetland class is **Flats**

If your wetland can be classified as a "Flats" wetland, use the form for **Depressional** wetlands.

3. Does the entire wetland unit **meet both** of the following criteria?
___The vegetated part of the wetland is on the shores of a body of permanent open water (without any vegetation on the surface) at least 20 acres (8 ha) in size;
___At least 30% of the open water area is deeper than 6.6 ft (2 m)?
[✓] NO – go to 4 [ ] YES – The wetland class is **Lake-fringe (Lacustrine Fringe)**

4. Does the entire wetland unit **meet all** of the following criteria?
___The wetland is on a slope (*slope can be very gradual*),
___The water flows through the wetland in one direction (unidirectional) and usually comes from seeps. It may flow subsurface, as sheetflow, or in a swale without distinct banks.
___The water leaves the wetland **without being impounded**?
NOTE: *Surface water does not pond in these type of wetlands except occasionally in very small and shallow depressions or behind hummocks (depressions are usually <3ft diameter and less than 1 foot deep).*
[✓] NO - go to 5 [ ] YES – The wetland class is **Slope**

5. Does the entire wetland unit **meet all** of the following criteria?
____The unit is in a valley, or stream channel, where it gets inundated by overbank flooding from that stream or river
____The overbank flooding occurs at least once every two years.
NOTE: The riverine unit can contain depressions that are filled with water when the river is not flooding.
[✓] NO - go to 6 [ ] YES – The wetland class is **Riverine**

6. Is the entire wetland unit in a topographic depression in which water ponds, or is saturated to the surface, at some time during the year. *This means that any outlet, if present, is higher than the interior of the wetland.*
[ ] NO – go to 7 [✓] YES – The wetland class is **Depressional**

7. Is the entire wetland unit located in a very flat area with no obvious depression and no overbank flooding. The unit does not pond surface water more than a few inches. The unit seems to be maintained by high groundwater in the area. The wetland may be ditched, but has no obvious natural outlet.
[✓] NO – go to 8 [ ] YES – The wetland class is **Depressional**

8. Your wetland unit seems to be difficult to classify and probably contains several different HGM clases. For example, seeps at the base of a slope may grade into a riverine floodplain, or a small stream within a depressional wetland has a zone of flooding along its sides. GO BACK AND IDENTIFY WHICH OF THE HYDROLOGIC REGIMES DESCRIBED IN QUESTIONS 1-7 APPLY TO DIFFERENT AREAS IN THE UNIT (make a rough sketch to help you decide). Use the following table to identify the appropriate class to use for the rating system if you have several HGM classes present within your wetland. NOTE: Use this table only if the class that is recommended in the second column represents 10% or more of the total area of the wetland unit being rated. If the area of the class listed in column 2 is less than 10% of the unit; classify the wetland using the class that represents more than 90% of the total area.

HGM Classes within the wetland unit being rated		*HGM Class to Use in Rating*	
Slope + Riverine		Riverine	
Slope + Depressional		Depressional	
Slope + Lake-fringe		Lake-fringe	
Depressional + Riverine along stream within boundary	✓	Depressional	✓
Depressional + Lake-fringe		Depressional	
Salt Water Tidal Fringe and any other class of freshwater wetland		Treat as ESTUARINE under wetlands with special characteristics	

If you are unable still to determine which of the above criteria apply to your wetland, or if you have more than 2 HGM classes within a wetland boundary, classify the wetland as **Depressional** for the rating.

Wetland name or number Wet A

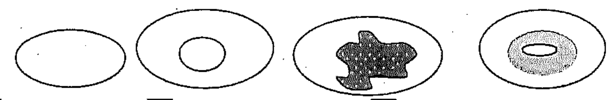
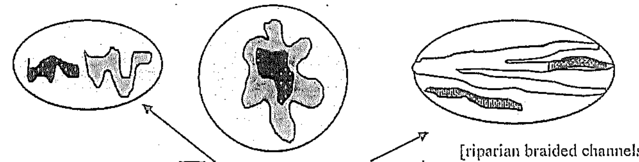
D	Depressional and Flats Wetlands WATER QUALITY FUNCTIONS - Indicators that the wetland unit functions to improve water quality	Points (only 1 score per box)
D	**D 1. Does the wetland unit have the potential to improve water quality?**	(see p.38)
D	D 1.1 Characteristics of surface water flows out of the wetland: ☐ Unit is a depression with no surface water leaving it (no outlet) points = 3 ☐ Unit has an intermittently flowing, OR highly constricted permanently flowing outlet points = 2 ☑ Unit has an unconstricted, or slightly constricted, surface outlet *(permanently flowing)* points = 1 ☐ Unit is a "flat" depression (Q. 7 on key), or in the Flats class, with permanent surface outflow and **no obvious natural outlet** and/or outlet is a man-made ditch points = 1 *(If ditch is not permanently flowing treat unit as "intermittently flowing")* Provide photo or drawing	Figure ___ 1
D	S 1.2 The soil 2 inches below the surface (or duff layer) is clay or organic *(use NRCS definitions)* ☐ YES points = 4 ☑ NO points = 0	0
D	D 1.3 Characteristics of persistent vegetation (emergent, shrub, and/or forest Cowardin class) ☑ Wetland has persistent, ungrazed, vegetation >= 95% of area points = 5 ☐ Wetland has persistent, ungrazed, vegetation >= 1/2 of area points = 3 ☐ Wetland has persistent, ungrazed vegetation >= 1/10 of area points = 1 ☐ Wetland has persistent, ungrazed vegetation <1/10 of area points = 0 Map of Cowardin vegetation classes	Figure ___ 5
D	D1.4 Characteristics of seasonal ponding or inundation. *This is the area of the wetland unit that is ponded for at least 2 months, but dries out sometime during the year. Do not count the area that is permanently ponded. Estimate area as the average condition 5 out of 10 yrs.* ☑ Area seasonally ponded is > ½ total area of wetland points = 4 ☐ Area seasonally ponded is > ¼ total area of wetland points = 2 ☐ Area seasonally ponded is < ¼ total area of wetland points = 0 Map of Hydroperiods	Figure ___ 4
D	**Total for D 1** *Add the points in the boxes above*	10
D	**D 2. Does the wetland unit have the opportunity to improve water quality?** Answer YES if you know or believe there are pollutants in groundwater or surface water coming into the wetland that would otherwise reduce water quality in streams, lakes or groundwater downgradient from the wetland. *Note which of the following conditions provide the sources of pollutants. A unit may have pollutants coming from several sources, but any single source would qualify as opportunity.* ☐ Grazing in the wetland or within 150 ft ☑ Untreated stormwater discharges to wetland ☐ Tilled fields or orchards within 150 ft of wetland ☑ A stream or culvert discharges into wetland that drains developed areas, residential areas, farmed fields, roads, or clear-cut logging ☐ Residential, urban areas, golf courses are within 150 ft of wetland ☐ Wetland is fed by groundwater high in phosphorus or nitrogen ☐ Other________ ☑ YES multiplier is 2 ☐ NO multiplier is 1	(see p. 44) multiplier 2
D	**TOTAL - Water Quality Functions** Multiply the score from D1 by D2 *Add score to table on p. 1*	20

Wetland name or number Wet A

D	Depressional and Flats Wetlands HYDROLOGIC FUNCTIONS - Indicators that the wetland unit functions to reduce flooding and stream degradation	Points (only 1 score per box)
	D 3. Does the wetland unit have the potential to reduce flooding and erosion?	(see p.46)
D	D 3.1 Characteristics of surface water flows out of the wetland unit ☐ Unit is a depression with no surface water leaving it (no outlet) points = 4 ☐ Unit has an intermittently flowing, OR highly constricted permanently flowing outlet points = 2 ☐ Unit is a "flat" depression (Q. 7 on key), or in the Flats class, with permanent surface outflow and **no obvious natural outlet** and/or outlet is a man-made ditch points = 1 *(If ditch is not permanently flowing treat unit as "intermittently flowing")* ☑ Unit has an unconstricted, or slightly constricted, surface outlet *(permanently flowing)* points = 0	0
D	D 3.2 Depth of storage during wet periods *Estimate the height of ponding above the bottom of the outlet. For units with no outlet measure from the surface of permanent water or deepest part (if dry).* ☐ Marks of ponding are 3 ft or more above the surface or bottom of outlet points = 7 ☐ The wetland is a "headwater" wetland" points = 5 ☐ Marks of ponding between 2 ft to < 3 ft from surface or bottom of outlet points = 5 ☑ Marks are at least 0.5 ft to < 2 ft from surface or bottom of outlet points = 3 ☐ Unit is flat (yes to Q. 2 or Q. 7 on key) but has small depressions on the surface that trap water points = 1 ☐ Marks of ponding less than 0.5 ft points = 0	3
D	D 3.3 Contribution of wetland unit to storage in the watershed *Estimate the ratio of the area of upstream basin contributing surface water to the wetland to the area of the wetland unit itself.* ☐ The area of the basin is less than 10 times the area of unit points = 5 ☐ The area of the basin is 10 to 100 times the area of the unit points = 3 ☑ The area of the basin is more than 100 times the area of the unit points = 0 ☐ Entire unit is in the FLATS class points = 5	0
D	**Total for D 3** *Add the points in the boxes above*	3
D	**D 4. Does the wetland unit have the opportunity to reduce flooding and erosion?** Answer YES if the unit is in a location in the watershed where the flood storage, or reduction in water velocity, it provides helps protect downstream property and aquatic resources from flooding or excessive and/or erosive flows. Answer NO if the water coming into the wetland is controlled by a structure such as flood gate, tide gate, flap valve, reservoir etc. OR you estimate that more than 90% of the water in the wetland is from groundwater in areas where damaging flooding does not occur. *Note which of the following indicators of opportunity apply.* ☐ Wetland is in a headwater of a river or stream that has flooding problems ☑ Wetland drains to a river or stream that has flooding problems ☐ Wetland has no outlet and impounds surface runoff water that might otherwise flow into a river or stream that has flooding problems ☐ Other________ ☑ YES multiplier is 2 ☐ NO multiplier is 1	(see p. 49) multiplier 2
D	**TOTAL - Hydrologic Functions** Multiply the score from D 3 by D 4 *Add score to table on p. 1*	6

These questions apply to wetlands of all HGM classes. HABITAT FUNCTIONS - Indicators that unit functions to provide important habitat	**Points** (only 1 score per box)
H 1. Does the wetland unit have the potential to provide habitat for many species?	
H 1.1 Vegetation structure *(see p. 72)* *Check the types of vegetation classes present (as defined by Cowardin)- Size threshold for each class is ¼ acre or more than 10% of the area if unit is smaller than 2.5 acres.* [ ] Aquatic bed [ ] Emergent plants [ ] Scrub/shrub (areas where shrubs have >30% cover) [✓] Forested (areas where trees have >30% cover) *If the unit has a forested class check if:* [✓] The forested class has 3 out of 5 strata (canopy, sub-canopy, shrubs, herbaceous, moss/ground-cover) that each cover 20% within the forested polygon *Add the number of vegetation structures that qualify. If you have:* [ ] 4 structures or more points = 4 Map of Cowardin vegetation classes [ ] 3 structures points = 2 [✓] 2 structures points = 1 [ ] 1 structure points = 0	Figure ___ 1
H 1.2. Hydroperiods *(see p. 73)* *Check the types of water regimes (hydroperiods) present within the wetland. The water regime has to cover more than 10% of the wetland or ¼ acre to count. (see text for descriptions of hydroperiods)* [✓] Permanently flooded or inundated [ ] 4 or more types present points = 3 [ ] Seasonally flooded or inundated [ ] 3 types present points = 2 [ ] Occasionally flooded or inundated [✓] 2 types present point = 1 [✓] Saturated only [ ] 1 type present points = 0 [ ] Permanently flowing stream or river in, or adjacent to, the wetland [ ] Seasonally flowing stream in, or adjacent to, the wetland [ ] *Lake-fringe wetland* = 2 points [ ] *Freshwater tidal wetland* = 2 points Map of hydroperiods	Figure ___ 1
H 1.3. Richness of Plant Species *(see p. 75)* Count the number of plant species in the wetland that cover at least 10 ft^2. *(different patches of the same species can be combined to meet the size threshold)* *You do not have to name the species.* *Do not include Eurasian Milfoil, reed canarygrass, purple loosestrife, Canadian Thistle* If you counted: [ ] > 19 species points = 2 *List species below if you want to:* [✓] 5 - 19 species points = 1 [ ] < 5 species points = 0	1

Total for page 3

H 1.4. Interspersion of habitats *(see p. 76)* Decide from the diagrams below whether interspersion between Cowardin vegetation classes (described in H 1.1), or the classes and unvegetated areas (can include open water or mudflats) is high, medium, low, or none.  [✓] None = 0 points [ ] Low = 1 point [✓] Moderate = 2 points  [riparian braided channels] [ ] High = 3 points NOTE: If you have four or more classes or three vegetation classes and open water the rating is always "high". Use map of Cowardin vegetation classes	Figure ___ 0
H 1.5. Special Habitat Features: *(see p. 77)* *Check the habitat features that are present in the wetland. The number of checks is the number of points you put into the next column.* [✓] Large, downed, woody debris within the wetland (>4in. diameter and 6 ft long). [✓] Standing snags (diameter at the bottom > 4 inches) in the wetland [✓] Undercut banks are present for at least 6.6 ft (2m) and/or overhanging vegetation extends at least 3.3 ft (1m) over a stream (or ditch) in, or contiguous with the unit, for at least 33 ft (10m) [ ] Stable steep banks of fine material that might be used by beaver or muskrat for denning (>30degree slope) OR signs of recent beaver activity are present *(cut shrubs or trees that have not yet turned grey/brown)* [✓] At least ¼ acre of thin-stemmed persistent vegetation or woody branches are present in areas that are permanently or seasonally inundated. *(structures for egg-laying by amphibians)* [ ] Invasive plants cover less than 25% of the wetland area in each stratum of plants *NOTE: The 20% stated in early printings of the manual on page 78 is an error.*	4
H 1. TOTAL Score - potential for providing habitat *Add the scores from H1.1, H1.2, H1.3, H1.4, H1.5*	7

Comments

Wetland name or number Wet A

H 2. Does the wetland unit have the opportunity to provide habitat for many species?	
H 2.1 Buffers *(see p. 80)* *Choose the description that best represents condition of buffer of wetland unit. The highest scoring criterion that applies to the wetland is to be used in the rating. See text for definition of "undisturbed."* ☐ 100 m (330ft) of relatively undisturbed vegetated areas, rocky areas, or open water >95% of circumference. No structures are within the undisturbed part of buffer. (relatively undisturbed also means no-grazing, no landscaping, no daily human use) **Points = 5** ☐ 100 m (330 ft) of relatively undisturbed vegetated areas, rocky areas, or open water > 50% circumference. **Points = 4** ☐ 50 m (170ft) of relatively undisturbed vegetated areas, rocky areas, or open water >95% circumference. **Points = 4** ☐ 100 m (330ft) of relatively undisturbed vegetated areas, rocky areas, or open water > 25% circumference, . **Points = 3** ☐ 50 m (170ft) of relatively undisturbed vegetated areas, rocky areas, or open water for > 50% circumference. **Points = 3** **If buffer does not meet any of the criteria above** ☑ No paved areas (except paved trails) or buildings within 25 m (80ft) of wetland > 95% circumference. Light to moderate grazing, or lawns are OK. **Points = 2** ☐ No paved areas or buildings within 50m of wetland for >50% circumference. Light to moderate grazing, or lawns are OK. **Points = 2** ☐ Heavy grazing in buffer. **Points = 1** ☐ Vegetated buffers are <2m wide (6.6ft) for more than 95% of the circumference (e.g. tilled fields, paving, basalt bedrock extend to edge of wetland **Points = 0.** ☐ Buffer does not meet any of the criteria above. **Points = 1** Aerial photo showing buffers	Figure ___ 2
H 2.2 Corridors and Connections *(see p. 81)* H 2.2.1 Is the wetland part of a relatively undisturbed and unbroken vegetated corridor (either riparian or upland) that is at least 150 ft wide, has at least 30% cover of shrubs, forest or native undisturbed prairie, that connects to estuaries, other wetlands or undisturbed uplands that are at least 250 acres in size? *(dams in riparian corridors, heavily used gravel roads, paved roads, are considered breaks in the corridor).* ☐ YES = **4 points** *(go to H 2.3)* ☐ NO = go to H 2.2.2 H 2.2.2 Is the wetland part of a relatively undisturbed and unbroken vegetated corridor (either riparian or upland) that is at least 50ft wide, has at least 30% cover of shrubs or forest, and connects to estuaries, other wetlands or undisturbed uplands that are at least 25 acres in size? OR a Lake-fringe wetland, if it does not have an undisturbed corridor as in the question above? ☑ YES = **2 points** *(go to H 2.3)* ☐ NO = H 2.2.3 H 2.2.3 Is the wetland: ☐ within 5 mi (8km) of a brackish or salt water estuary OR ☐ within 3 mi of a large field or pasture (>40 acres) OR ☐ within 1 mi of a lake greater than 20 acres? ☐ YES = **1 point** ☐ NO = **0 points**	2

Total for page 4

Wetland name or number Wet A

H 2.3 Near or adjacent to other priority habitats listed by WDFW *(see new and complete descriptions of WDFW priority habitats, and the counties in which they can be found, in the PHS report http://wdfw.wa.gov/hab/phslist.htm)* Which of the following priority habitats are within 330ft (100m) of the wetland unit? *NOTE: the connections do not have to be relatively undisturbed.* ☐ **Aspen Stands:** Pure or mixed stands of aspen greater than 0.4 ha (1 acre). ☐ **Biodiversity Areas and Corridors:** Areas of habitat that are relatively important to various species of native fish and wildlife *(full descriptions in WDFW PHS report p. 152).* ☐ **Herbaceous Balds:** Variable size patches of grass and forbs on shallow soils over bedrock. ☐ **Old-growth/Mature forests:** (Old-growth west of Cascade crest) Stands of at least 2 tree species, forming a multi-layered canopy with occasional small openings; with at least 20 trees/ha (8 trees/acre) > 81 cm (32 in) dbh or > 200 years of age. (Mature forests) Stands with average diameters exceeding 53 cm (21 in) dbh; crown cover may be less that 100%; crown cover may be less that 100%; decay, decadence, numbers of snags, and quantity of large downed material is generally less than that found in old-growth; 80 - 200 years old west of the Cascade crest. ☐ **Oregon white Oak:** Woodlands Stands of pure oak or oak/conifer associations where canopy coverage of the oak component is important *(full descriptions in WDFW PHS report p. 158).* ☑ **Riparian:** The area adjacent to aquatic systems with flowing water that contains elements of both aquatic and terrestrial ecosystems which mutually influence each other. ☐ **Westside Prairies:** Herbaceous, non-forested plant communities that can either take the form of a dry prairie or a wet prairie *(full descriptions in WDFW PHS report p. 161).* ☑ **Instream:** The combination of physical, biological, and chemical processes and conditions that interact to provide functional life history requirements for instream fish and wildlife resources. ☐ **Nearshore:** Relatively undisturbed nearshore habitats. These include Coastal Nearshore, Open Coast Nearshore, and Puget Sound Nearshore. *(full descriptions of habitats and the definition of relatively undisturbed are in WDFW report: pp. 167-169 and glossary in Appendix A).* ☐ **Caves:** A naturally occurring cavity, recess, void, or system of interconnected passages under the earth in soils, rock, ice, or other geological formations and is large enough to contain a human. ☐ **Cliffs:** Greater than 7.6 m (25 ft) high and occurring below 5000 ft. ☐ **Talus:** Homogenous areas of rock rubble ranging in average size 0.15 - 2.0 m (0.5 - 6.5 ft), composed of basalt, andesite, and/or sedimentary rock, including riprap slides and mine tailings. May be associated with cliffs. ☑ **Snags and Logs:** Trees are considered snags if they are dead or dying and exhibit sufficient decay characteristics to enable cavity excavation/use by wildlife. Priority snags have a diameter at breast height of > 51 cm (20 in) in western Washington and are > 2 m (6.5 ft) in height. Priority logs are > 30 cm (12 in) in diameter at the largest end, and > 6 m (20 ft) long. ☑ If wetland has **3 or more** priority habitats = **4 points** ☐ If wetland has 2 priority habitats = **3 points** ☐ If wetland has 1 priority habitat = **1 point** ☐ No habitats = 0 points *Note: All vegetated wetlands are by definition a priority habitat but are not included in this list. Nearby wetlands are addressed in question H 2.4)*	4

H 2.4 Wetland Landscape *(choose the one description of the landscape around the wetland that best fits) (see p. 84)* ☐ There are at least 3 other wetlands within ½ mile, and the connections between them are relatively undisturbed (light grazing between wetlands OK, as is lake shore with some boating, but connections should NOT be bisected by paved roads, fill, fields, or other development. points = 5 ☐ The wetland is Lake-fringe on a lake with little disturbance and there are 3 other lake-fringe wetlands within ½ mile points = 5 ☑ There are at least 3 other wetlands within ½ mile, BUT the connections between them are disturbed points = 3 ☐ The wetland is Lake-fringe on a lake with disturbance and there are 3 other lake-fringe wetland within ½ mile points = 3 ☐ There is at least 1 wetland within ½ mile. points = 2 ☐ There are no wetlands within ½ mile. points = 0	3
H 2. TOTAL Score - opportunity for providing habitat *Add the scores from H2.1,H2.2, H2.3, H2.4*	11
TOTAL for H 1 from page 14	7
Total Score for Habitat Functions – add the points for H 1, H 2 and record the result on p. 1	18

CATEGORIZATION BASED ON SPECIAL CHARACTERISTICS

Please determine if the wetland meets the attributes described below and circle the appropriate answers and Category.

Wetland Type *Check off any criteria that apply to the wetland. Circle the Category when the appropriate criteria are met.*	**Category**
SC 1.0 Estuarine wetlands *(see p. 86)* Does the wetland unit meet the following criteria for Estuarine wetlands? ☐ The dominant water regime is tidal, ☐ Vegetated, and ☐ With a salinity greater than 0.5 ppt. ☐ YES = Go to SC 1.1 NO ☑ = Go to SC 2.0	
SC 1.1 Is the wetland unit within a National Wildlife Refuge, National Park, National Estuary Reserve, Natural Area Preserve, State Park or Educational, Environmental, or Scientific Reserve designated under WAC 332-30-151? ☐ YES = Category I ☐ NO go to SC 1.2	Cat. I ☐
SC 1.2 Is the wetland unit at least 1 acre in size and meets at least two of the following three conditions? ☐ YES = Category I ☐ NO = Category II ☐ The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing, and has less than 10% cover of non-native plant species. If the non-native *Spartina* spp. are the only species that cover more than 10% of the wetland, then the wetland should be given a dual rating (I/II). The area of Spartina would be rated a Category II while the relatively undisturbed upper marsh with native species would be a Category I. Do not, however, exclude the area of Spartina in determining the size threshold of 1 acre. ☐ At least ¾ of the landward edge of the wetland has a 100 ft buffer of shrub, forest, or un-grazed or un-mowed grassland. ☐ The wetland has at least 2 of the following features: tidal channels, depressions with open water, or contiguous freshwater wetlands.	☐ **Cat. I** ☐ **Cat. II** ☐ **Dual rating I/II**

SC 2.0 Natural Heritage Wetlands *(see p. 87)* Natural Heritage wetlands have been identified by the Washington Natural Heritage Program/DNR as either high quality undisturbed wetlands or wetlands that support state Threatened, Endangered, or Sensitive plant species. SC 2.1 Is the wetland unit being rated in a Section/Township/Range that contains a Natural Heritage wetland? *(this question is used to screen out most sites before you need to contact WNHP/DNR)* S/T/R information from Appendix D ☑ or accessed from WNHP/DNR web site ☐ YES ☐ – contact WNHP/DNR (see p. 79) and go to SC 2.2 NO ☑ SC 2.2 Has DNR identified the wetland as a high quality undisturbed wetland or as or as a site with state threatened or endangered plant species? ☐ YES = Category I NO ☑ not a Heritage Wetland	☐ Cat. I
SC 3.0 Bogs *(see p. 87)* Does the wetland unit **(or any part of the unit)** meet both the criteria for soils and vegetation in bogs? *Use the key below to identify if the wetland is a bog. **If you answer yes you will still need to rate the wetland based on its functions.*** 1. Does the unit have organic soil horizons (i.e. layers of organic soil), either peats or mucks, that compose 16 inches or more of the first 32 inches of the soil profile? (See Appendix B for a field key to identify organic soils)? Yes - go to Q. 3 ☐ ☑ No - go to Q. 2 2. Does the unit have organic soils, either peats or mucks that are less than 16 inches deep over bedrock, or an impermeable hardpan such as clay or volcanic ash, or that are floating on a lake or pond? ☐ Yes - go to Q. 3 ☑ No - Is not a bog for purpose of rating 3. Does the unit have more than 70% cover of mosses at ground level, AND other plants, if present, consist of the "bog" species listed in Table 3 as a significant component of the vegetation (more than 30% of the total shrub and herbaceous cover consists of species in Table 3)? ☐ Yes – Is a bog for purpose of rating ☐ No - go to Q. 4 NOTE: If you are uncertain about the extent of mosses in the understory you may substitute that criterion by measuring the pH of the water that seeps into a hole dug at least 16" deep. If the pH is less than 5.0 and the "bog" plant species in Table 3 are present, the wetland is a bog. 1. Is the unit forested (> 30% cover) with sitka spruce, subalpine fir, western red cedar, western hemlock, lodgepole pine, quaking aspen, Englemann's spruce, or western white pine, WITH any of the species (or combination of species) on the bog species plant list in Table 3 as a significant component of the ground cover *(> 30% coverage of the total shrub/herbaceous cover)?* 2. ☐ YES = Category I No ☐ Is not a bog for purpose of rating	☐ Cat. I

SC 4.0 Forested Wetlands *(see p. 90)* Does the wetland unit have at least 1 acre of forest that meet one of these criteria for the Department of Fish and Wildlife's forests as priority habitats? *If you answer yes you will still need to rate the wetland based on its functions.* ☐ **Old-growth forests:** (west of Cascade crest) Stands of at least two tree species, forming a multi-layered canopy with occasional small openings; with at least 8 trees/acre (20 trees/hectare) that are at least 200 years of age OR have a diameter at breast height (dbh) of 32 inches (81 cm) or more. NOTE: The criterion for dbh is based on measurements for upland forests. Two-hundred year old trees in wetlands will often have a smaller dbh because their growth rates are often slower. The DFW criterion is and "OR" so old-growth forests do not necessarily have to have trees of this diameter. ☐ **Mature forests:** (west of the Cascade Crest) Stands where the largest trees are 80 – 200 years old OR have average diameters (dbh) exceeding 21 inches (53cm); crown cover may be less that 100%; decay, decadence, numbers of snags, and quantity of large downed material is generally less than that found in old-growth. ☐ YES = Category I NO ☑ not a forested wetland with special characteristics	Cat. I ☐
SC 5.0 Wetlands in Coastal Lagoons *(see p. 91)* Does the wetland meet all of the following criteria of a wetland in a coastal lagoon? ☐ The wetland lies in a depression adjacent to marine waters that is wholly or partially separated from marine waters by sandbanks, gravel banks, shingle, or, less frequently, rocks ☐ The lagoon in which the wetland is located contains surface water that is saline or brackish (> 0.5 ppt) during most of the year in at least a portion of the lagoon *(needs to be measured near the bottom)* ☐ YES = Go to SC 5.1 NO ☑ not a wetland in a coastal lagoon SC 5.1 Does the wetland meets all of the following three conditions? ☐ The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing), and has less than 20% cover of invasive plant species (see list of invasive species on p. 74). ☐ At least ¾ of the landward edge of the wetland has a 100 ft buffer of shrub, forest, or un-grazed or un-mowed grassland. ☐ The wetland is larger than 1/10 acre (4350 square feet) ☐ YES = Category I ☐ NO = Category II	☐ Cat. I ☐ Cat. II

SC 6.0 Interdunal Wetlands *(see p. 93)*	
Is the wetland unit west of the 1889 line (also called the Western Boundary of Upland Ownership or WBUO)? ☐ YES - go to SC 6.1 NO ☑ not an interdunal wetland for rating ***If you answer yes you will still need to rate the wetland based on its functions.*** In practical terms that means the following geographic areas: ☐ Long Beach Peninsula- lands west of SR 103 ☐ Grayland-Westport- lands west of SR 105 ☐ Ocean Shores-Copalis- lands west of SR 115 and SR 109 SC 6.1 Is the wetland one acre or larger, or is it in a mosaic of wetlands that is once acre or larger? ☐ YES = Category II ☐ NO – go to SC 6.2	**Cat. II** ☐
SC 6.2 Is the unit between 0.1 and 1 acre, or is it in a mosaic of wetlands that is between 0.1 and 1 acre? ☐ YES = Category III	**Cat. III** ☐
Category of wetland based on Special Characteristics *Choose the "highest" rating if wetland falls into several categories, and record on p. 1.* If you answered NO for all types enter "Not Applicable" on p.1	☐ Cat. I ☐ Cat. II ☐ Cat. III ☑ N/A

WETLAND RATING FORM – WESTERN WASHINGTON

Version 2 - Updated July 2006 to increase accuracy and reproducibility among users
Updated Oct 2008 with the new WDFW definitions for priority habitats

Name of wetland (if known): PACE 108th Wet B Date of site visit: 5.05.09

Rated by L. Emenhiser Trained by Ecology? Yes☑ No☐ Date of training 10.11.06

SEC: 21 TWNSHP: 28 RNGE: 5 Is S/T/R in Appendix D? Yes☐ No☑

Map of wetland unit: Figure 2/2 Estimated size 4,000 sf

SUMMARY OF RATING

Category based on FUNCTIONS provided by wetland

I___ II___ III ✓ IV___

Category I = Score >=70 Category II = Score 51-69 Category III = Score 30-50 Category IV = Score < 30	

Score for Water Quality Functions	16
Score for Hydrologic Functions	14
Score for Habitat Functions	14
TOTAL score for Functions	44

Category based on SPECIAL CHARACTERISTICS of wetland

I___ II___ Does not Apply ✓

Final Category (choose the "highest" category from above) III

Summary of basic information about the wetland unit

Wetland Unit has Special Characteristics		Wetland HGM Class used for Rating	
Estuarine		Depressional	✓
Natural Heritage Wetland		Riverine	
Bog		Lake-fringe	
Mature Forest		Slope	
Old Growth Forest		Flats	
Coastal Lagoon		Freshwater Tidal	
Interdunal			
None of the above	✓	Check if unit has multiple HGM classes present	

Does the wetland unit being rated meet any of the criteria below?

If you answer YES to any of the questions below you will need to protect the wetland according to the regulations regarding the special characteristics found in the wetland.

Check List for Wetlands That May Need Additional Protection (in addition to the protection recommended for its category)	YES	NO
SP1. *Has the wetland unit been documented as a habitat for any Federally listed Threatened or Endangered **animal or plant** species (T/E species)?* For the purposes of this rating system, "documented" means the wetland is on the appropriate state or federal database.		✓
SP2. *Has the wetland unit been documented as habitat for any State listed Threatened or Endangered **animal** species?* For the purposes of this rating system, "documented" means the wetland is on the appropriate state database. Note: Wetlands with State listed plant species are categorized as Category I Natural Heritage Wetlands (see p. 19 of data form).		✓
SP3. *Does the wetland unit contain individuals of Priority species listed by the WDFW for the state?*		✓
SP4. *Does the wetland unit have a local significance in addition to its functions?* For example, the wetland has been identified in the Shoreline Master Program, the Critical Areas Ordinance, or in a local management plan as having special significance.		✓

To complete the next part of the data sheet you will need to determine the Hydrogeomorphic Class of the wetland being rated.

The hydrogeomorphic classification groups wetlands into those that function in similar ways. This simplifies the questions needed to answer how well the wetland functions. The Hydrogeomorphic Class of a wetland can be determined using the key below. See p. 24 for more detailed instructions on classifying wetlands.

Classification of Wetland Units in Western Washington

If the hydrologic criteria listed in each question do not apply to the entire unit being rated, you probably have a unit with multiple HGM classes. In this case, identify which hydrologic criteria in questions 1-7 apply, and go to Question 8.

1. Are the water levels in the entire unit usually controlled by tides (i.e. except during floods)?
☑ NO – go to 2 ☐ YES – the wetland class is **Tidal Fringe**

If yes, is the salinity of the water during periods of annual low flow below 0.5 ppt (parts per thousand)? **YES – Freshwater Tidal Fringe NO – Saltwater Tidal Fringe (Estuarine)**

*If your wetland can be classified as a Freshwater Tidal Fringe use the forms for **Riverine** wetlands. If it is Saltwater Tidal Fringe it is rated as an **Estuarine** wetland.* Wetlands that were called estuarine in the first and second editions of the rating system are called Salt Water Tidal Fringe in the Hydrogeomorphic Classification. Estuarine wetlands were categorized separately in the earlier editions, and this separation is being kept in this revision. To maintain consistency between editions, the term "Estuarine" wetland is kept. Please note, however, that the characteristics that define Category I and II estuarine wetlands have changed (see p.).

2. The entire wetland unit is flat and precipitation is the only source (>90%) of water to it. Groundwater and surface water runoff are NOT sources of water to the unit.
☑ NO – go to 3 ☐ YES – The wetland class is **Flats**

If your wetland can be classified as a "Flats" wetland, use the form for **Depressional** wetlands.

3. Does the entire wetland unit **meet both** of the following criteria?
___The vegetated part of the wetland is on the shores of a body of permanent open water (without any vegetation on the surface) at least 20 acres (8 ha) in size;
___At least 30% of the open water area is deeper than 6.6 ft (2 m)?
☑ NO – go to 4 ☐ YES – The wetland class is **Lake-fringe (Lacustrine Fringe)**

4. Does the entire wetland unit **meet all** of the following criteria?
____The wetland is on a slope (*slope can be very gradual*),
____The water flows through the wetland in one direction (unidirectional) and usually comes from seeps. It may flow subsurface, as sheetflow, or in a swale without distinct banks.
____The water leaves the wetland **without being impounded?**
NOTE: *Surface water does not pond in these type of wetlands except occasionally in very small and shallow depressions or behind hummocks (depressions are usually <3ft diameter and less than 1 foot deep).*
☑ NO - go to 5 ☐ YES – The wetland class is **Slope**

5. Does the entire wetland unit **meet all** of the following criteria?
____The unit is in a valley, or stream channel, where it gets inundated by overbank flooding from that stream or river
____The overbank flooding occurs at least once every two years.
NOTE: The riverine unit can contain depressions that are filled with water when the river is not flooding.
☑ NO - go to 6 ☐ YES – The wetland class is **Riverine**

6. Is the entire wetland unit in a topographic depression in which water ponds, or is saturated to the surface, at some time during the year. *This means that any outlet, if present, is higher than the interior of the wetland.*
☐ NO – go to 7 ☑ YES – The wetland class is **Depressional**

7. Is the entire wetland unit located in a very flat area with no obvious depression and no overbank flooding. The unit does not pond surface water more than a few inches. The unit seems to be maintained by high groundwater in the area. The wetland may be ditched, but has no obvious natural outlet.
☑ NO – go to 8 ☐ YES – The wetland class is **Depressional**

8. Your wetland unit seems to be difficult to classify and probably contains several different HGM classes. For example, seeps at the base of a slope may grade into a riverine floodplain, or a small stream within a depressional wetland has a zone of flooding along its sides. GO BACK AND IDENTIFY WHICH OF THE HYDROLOGIC REGIMES DESCRIBED IN QUESTIONS 1-7 APPLY TO DIFFERENT AREAS IN THE UNIT (make a rough sketch to help you decide). Use the following table to identify the appropriate class to use for the rating system if you have several HGM classes present within your wetland. NOTE: Use this table only if the class that is recommended in the second column represents 10% or more of the total area of the wetland unit being rated. If the area of the class listed in column 2 is less than 10% of the unit; classify the wetland using the class that represents more than 90% of the total area.

HGM Classes within the wetland unit being rated		*HGM Class to Use in Rating*	
Slope + Riverine	☐	Riverine	☐
Slope + Depressional	☐	Depressional	☐
Slope + Lake-fringe	☐	Lake-fringe	☐
Depressional + Riverine along stream within boundary	☐	Depressional	☐
Depressional + Lake-fringe	☐	Depressional	☐
Salt Water Tidal Fringe and any other class of freshwater wetland	☐	Treat as ESTUARINE under wetlands with special characteristics	☐

If you are unable still to determine which of the above criteria apply to your wetland, or if you have more than 2 HGM classes within a wetland boundary, classify the wetland as **Depressional** for the rating.

D	Depressional and Flats Wetlands WATER QUALITY FUNCTIONS - Indicators that the wetland unit functions to improve water quality	Points (only 1 score per box)
D	**D 1. Does the wetland unit have the potential to improve water quality?**	(see p.38)
D	D 1.1 Characteristics of surface water flows out of the wetland: [✓] Unit is a depression with no surface water leaving it (no outlet) points = 3 [ ] Unit has an intermittently flowing, OR highly constricted permanently flowing outlet points = 2 [ ] Unit has an unconstricted, or slightly constricted, surface outlet *(permanently flowing)* points = 1 [ ] Unit is a "flat" depression (Q. 7 on key), or in the Flats class, with permanent surface outflow and no obvious natural outlet and/or outlet is a man-made ditch points = 1 *(If ditch is not permanently flowing treat unit as "intermittently flowing")* Provide photo or drawing	Figure ___ 3
D	S 1.2 The soil 2 inches below the surface (or duff layer) is clay or organic *(use NRCS definitions)* [ ] YES points = 4 [✓] NO points = 0	0
D	D 1.3 Characteristics of persistent vegetation (emergent, shrub, and/or forest Cowardin class) [✓] Wetland has persistent, ungrazed, vegetation > = 95% of area points = 5 [ ] Wetland has persistent, ungrazed, vegetation > = 1/2 of area points = 3 [ ] Wetland has persistent, ungrazed vegetation > = 1/10 of area points = 1 [ ] Wetland has persistent, ungrazed vegetation <1/10 of area points = 0 Map of Cowardin vegetation classes	Figure ___ 5
D	D 1.4 Characteristics of seasonal ponding or inundation. *This is the area of the wetland unit that is ponded for at least 2 months, but dries out sometime during the year. Do not count the area that is permanently ponded. Estimate area as the average condition 5 out of 10 yrs.* [ ] Area seasonally ponded is > ½ total area of wetland points = 4 [ ] Area seasonally ponded is > ¼ total area of wetland points = 2 [✓] Area seasonally ponded is < ¼ total area of wetland points = 0 Map of Hydroperiods	Figure ___ 0
D	**Total for D 1** *Add the points in the boxes above*	8
D	**D 2. Does the wetland unit have the opportunity to improve water quality?** Answer YES if you know or believe there are pollutants in groundwater or surface water coming into the wetland that would otherwise reduce water quality in streams, lakes or groundwater downgradient from the wetland. *Note which of the following conditions provide the sources of pollutants. A unit may have pollutants coming from several sources, but any single source would qualify as opportunity.* [ ] Grazing in the wetland or within 150 ft [✓] Untreated stormwater discharges to wetland [ ] Tilled fields or orchards within 150 ft of wetland [ ] A stream or culvert discharges into wetland that drains developed areas, residential areas, farmed fields, roads, or clear-cut logging [ ] Residential, urban areas, golf courses are within 150 ft of wetland [ ] Wetland is fed by groundwater high in phosphorus or nitrogen [ ] Other___ [✓] YES multiplier is 2 [ ] NO multiplier is 1	(see p. 44) multiplier 2
D	**TOTAL - Water Quality Functions** Multiply the score from D1 by D2 *Add score to table on p. 1*	16

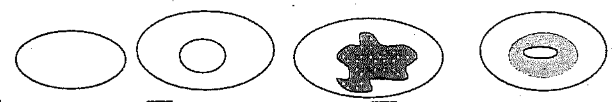
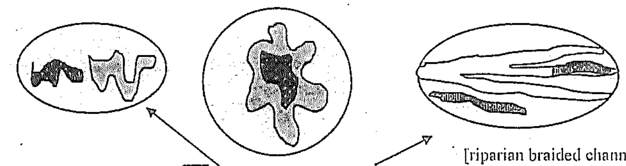
D	Depressional and Flats Wetlands HYDROLOGIC FUNCTIONS - Indicators that the wetland unit functions to reduce flooding and stream degradation	Points (only 1 score per box)
	D 3. Does the wetland unit have the potential to reduce flooding and erosion?	(see p.46)
D	D 3.1 Characteristics of surface water flows out of the wetland unit [✓] Unit is a depression with no surface water leaving it (no outlet) points = 4 [ ] Unit has an intermittently flowing, OR highly constricted permanently flowing outlet points = 2 [ ] Unit is a "flat" depression (Q. 7 on key), or in the Flats class, with permanent surface outflow and no obvious natural outlet and/or outlet is a man-made ditch points = 1 *(If ditch is not permanently flowing treat unit as "intermittently flowing")* [ ] Unit has an unconstricted, or slightly constricted, surface outlet *(permanently flowing)* points = 0	4
D	D 3.2 Depth of storage during wet periods *Estimate the height of ponding above the bottom of the outlet. For units with no outlet measure from the surface of permanent water or deepest part (if dry).* [ ] Marks of ponding are 3 ft or more above the surface or bottom of outlet points = 7 [ ] The wetland is a "headwater" wetland" points = 5 [ ] Marks of ponding between 2 ft to < 3 ft from surface or bottom of outlet points = 5 [ ] Marks are at least 0.5 ft to < 2 ft from surface or bottom of outlet points = 3 [ ] Unit is flat (yes to Q. 2 or Q. 7 on key) but has small depressions on the surface that trap water points = 1 [✓] Marks of ponding less than 0.5 ft points = 0	0
D	D 3.3 Contribution of wetland unit to storage in the watershed *Estimate the ratio of the area of upstream basin contributing surface water to the wetland to the area of the wetland unit itself.* [ ] The area of the basin is less than 10 times the area of unit points = 5 [✓] The area of the basin is 10 to 100 times the area of the unit points = 3 [ ] The area of the basin is more than 100 times the area of the unit points = 0 [ ] Entire unit is in the FLATS class points = 5	3
D	**Total for D 3** *Add the points in the boxes above*	7
D	**D 4. Does the wetland unit have the opportunity to reduce flooding and erosion?** Answer YES if the unit is in a location in the watershed where the flood storage, or reduction in water velocity, it provides helps protect downstream property and aquatic resources from flooding or excessive and/or erosive flows. Answer NO if the water coming into the wetland is controlled by a structure such as flood gate, tide gate, flap valve, reservoir etc. OR you estimate that more than 90% of the water in the wetland is from groundwater in areas where damaging groundwater flooding does not occur. *Note which of the following indicators of opportunity apply.* [ ] Wetland is in a headwater of a river or stream that has flooding problems [ ] Wetland drains to a river or stream that has flooding problems [✓] Wetland has no outlet and impounds surface runoff water that might otherwise flow into a river or stream that has flooding problems [ ] Other___ [✓] YES multiplier is 2 [ ] NO multiplier is 1	(see p. 49) multiplier 2
D	**TOTAL - Hydrologic Functions** Multiply the score from D 3 by D 4 *Add score to table on p. 1*	14

Wetland name or number Wet B

These questions apply to wetlands of all HGM classes. HABITAT FUNCTIONS - Indicators that unit functions to provide important habitat	**Points** (only 1 score per box)
H 1. Does the wetland unit have the potential to provide habitat for many species?	
H 1.1 Vegetation structure *(see p. 72)* *Check the types of vegetation classes present (as defined by Cowardin)- Size threshold for each class is ¼ acre or more than 10% of the area if unit is smaller than 2.5 acres.* ☐ Aquatic bed ☐ Emergent plants ☐ Scrub/shrub (areas where shrubs have >30% cover) ☑ Forested (areas where trees have >30% cover) *If the unit has a forested class check if:* ☐ The forested class has 3 out of 5 strata (canopy, sub-canopy, shrubs, herbaceous, moss/ground-cover) that each cover 20% within the forested polygon *Add the number of vegetation structures that qualify. If you have:* ☐ 4 structures or more points = 4 Map of Cowardin vegetation classes ☐ 3 structures points = 2 ☐ 2 structures points = 1 ☑ 1 structure points = 0	Figure ___ 0
H 1.2. Hydroperiods *(see p. 73)* *Check the types of water regimes (hydroperiods) present within the wetland. The water regime has to cover more than 10% of the wetland or ¼ acre to count. (see text for descriptions of hydroperiods)* ☐ Permanently flooded or inundated ☐ 4 or more types present points = 3 ☐ Seasonally flooded or inundated ☐ 3 types present points = 2 ☐ Occasionally flooded or inundated ☐ 2 types present point = 1 ☑ Saturated only ☑ 1 type present points = 0 ☐ Permanently flowing stream or river in, or adjacent to, the wetland ☐ Seasonally flowing stream in, or adjacent to, the wetland ☐ *Lake-fringe wetland* = 2 points ☐ *Freshwater tidal wetland* = 2 points Map of hydroperiods	Figure ___ 0
H 1.3. Richness of Plant Species *(see p. 75)* Count the number of plant species in the wetland that cover at least 10 ft². *(different patches of the same species can be combined to meet the size threshold)* *You do not have to name the species.* *Do not include Eurasian Milfoil, reed canarygrass, purple loosestrife, Canadian Thistle* If you counted: ☐ > 19 species points = 2 *List species below if you want to:* ☑ 5 - 19 species points = 1 ☐ < 5 species points = 0	1

Total for page 1

Wetland name or number Wet B

H 1.4. Interspersion of habitats *(see p. 76)* Decide from the diagrams below whether interspersion between Cowardin vegetation classes (described in H 1.1), or the classes and unvegetated areas (can include open water or mudflats) is high, medium, low, or none.  ☑ None = 0 points ☐ Low = 1 point ☑ Moderate = 2 points  [riparian braided channels] ☐ High = 3 points NOTE: If you have four or more classes or three vegetation classes and open water the rating is always "high". Use map of Cowardin vegetation classes	Figure ___ 0
H 1.5. Special Habitat Features: *(see p. 77)* *Check the habitat features that are present in the wetland. The number of checks is the number of points you put into the next column.* ☑ Large, downed, woody debris within the wetland (>4in. diameter and 6 ft long). ☐ Standing snags (diameter at the bottom > 4 inches) in the wetland ☐ Undercut banks are present for at least 6.6 ft (2m) and/or overhanging vegetation extends at least 3.3 ft (1m) over a stream (or ditch) in, or contiguous with the unit, for at least 33 ft (10m) ☐ Stable steep banks of fine material that might be used by beaver or muskrat for denning (>30degree slope) OR signs of recent beaver activity are present *(cut shrubs or trees that have not yet turned grey/brown)* ☐ At least ¼ acre of thin-stemmed persistent vegetation or woody branches are present in areas that are permanently or seasonally inundated.*(structures for egg-laying by amphibians)* ☑ Invasive plants cover less than 25% of the wetland area in each stratum of plants *NOTE: The 20% stated in early printings of the manual on page 78 is an error.*	2
H 1. TOTAL Score - potential for providing habitat *Add the scores from H1.1, H1.2, H1.3, H1.4, H1.5*	3

Comments

H 2. Does the wetland unit have the opportunity to provide habitat for many species?	
H 2.1 Buffers *(see p. 80)* *Choose the description that best represents condition of buffer of wetland unit. The highest scoring criterion that applies to the wetland is to be used in the rating. See text for definition of "undisturbed."* ☐ 100 m (330ft) of relatively undisturbed vegetated areas, rocky areas, or open water >95% of circumference. No structures are within the undisturbed part of buffer. (relatively undisturbed also means no-grazing, no landscaping, no daily human use) **Points = 5** ☐ 100 m (330 ft) of relatively undisturbed vegetated areas, rocky areas, or open water > 50% circumference. **Points = 4** ☐ 50 m (170ft) of relatively undisturbed vegetated areas, rocky areas, or open water >95% circumference. **Points = 4** ☐ 100 m (330ft) of relatively undisturbed vegetated areas, rocky areas, or open water > 25% circumference, . **Points = 3** ☐ 50 m (170ft) of relatively undisturbed vegetated areas, rocky areas, or open water for > 50% circumference. **Points = 3** **If buffer does not meet any of the criteria above** ☑ No paved areas (except paved trails) or buildings within 25 m (80ft) of wetland > 95% circumference. Light to moderate grazing, or lawns are OK. **Points = 2** ☐ No paved areas or buildings within 50m of wetland for >50% circumference. Light to moderate grazing, or lawns are OK. **Points = 2** ☐ Heavy grazing in buffer. **Points = 1** ☐ Vegetated buffers are <2m wide (6.6ft) for more than 95% of the circumference (e.g. tilled fields, paving, basalt bedrock extend to edge of wetland **Points = 0.** ☐ Buffer does not meet any of the criteria above. **Points = 1** Aerial photo showing buffers	Figure ___ 2
H 2.2 Corridors and Connections *(see p. 81)* H 2.2.1 Is the wetland part of a relatively undisturbed and unbroken vegetated corridor (either riparian or upland) that is at least 150 ft wide, has at least 30% cover of shrubs, forest or native undisturbed prairie, that connects to estuaries, other wetlands or undisturbed uplands that are at least 250 acres in size? *(dams in riparian corridors, heavily used gravel roads, paved roads, are considered breaks in the corridor).* ☐ YES = 4 points *(go to H 2.3)* ☐ NO = go to H 2.2.2 H 2.2.2 Is the wetland part of a relatively undisturbed and unbroken vegetated corridor (either riparian or upland) that is at least 50ft wide, has at least 30% cover of shrubs or forest, and connects to estuaries, other wetlands or undisturbed uplands that are at least 25 acres in size? **OR** a **Lake-fringe** wetland, if it does not have an undisturbed corridor as in the question above? ☑ YES = **2 points** *(go to H 2.3)* ☐ NO = H 2.2.3 H 2.2.3 Is the wetland: ☐ within 5 mi (8km) of a brackish or salt water estuary OR ☐ within 3 mi of a large field or pasture (>40 acres) OR ☐ within 1 mi of a lake greater than 20 acres? ☐ YES = **1 point** ☐ NO = **0 points**	2

Total for page 4

H 2.3 Near or adjacent to other priority habitats listed by WDFW *(see new and complete descriptions of WDFW priority habitats, and the counties in which they can be found, in the PHS report http://wdfw.wa.gov/hab/phslist.htm)* Which of the following priority habitats are within 330ft (100m) of the wetland unit? *NOTE: the connections do not have to be relatively undisturbed.* ☐ **Aspen Stands:** Pure or mixed stands of aspen greater than 0.4 ha (1 acre). ☐ **Biodiversity Areas and Corridors:** Areas of habitat that are relatively important to various species of native fish and wildlife *(full descriptions in WDFW PHS report p. 152).* ☐ **Herbaceous Balds:** Variable size patches of grass and forbs on shallow soils over bedrock. ☐ **Old-growth/Mature forests:** (Old-growth west of Cascade crest) Stands of at least 2 tree species, forming a multi-layered canopy with occasional small openings; with at least 20 trees/ha (8 trees/acre) > 81 cm (32 in) dbh or > 200 years of age. (Mature forests) Stands with average diameters exceeding 53 cm (21 in) dbh; crown cover may be less that 100%; crown cover may be less that 100%; decay, decadence, numbers of snags, and quantity of large downed material is generally less than that found in old-growth; 80 - 200 years old west of the Cascade crest. ☐ **Oregon white Oak:** Woodlands Stands of pure oak or oak/conifer associations where canopy coverage of the oak component is important *(full descriptions in WDFW PHS report p. 158).* ☑ **Riparian:** The area adjacent to aquatic systems with flowing water that contains elements of both aquatic and terrestrial ecosystems which mutually influence each other. ☐ **Westside Prairies:** Herbaceous, non-forested plant communities that can either take the form of a dry prairie or a wet prairie *(full descriptions in WDFW PHS report p. 161).* ☑ **Instream:** The combination of physical, biological, and chemical processes and conditions that interact to provide functional life history requirements for instream fish and wildlife resources. ☐ **Nearshore:** Relatively undisturbed nearshore habitats. These include Coastal Nearshore, Open Coast Nearshore, and Puget Sound Nearshore. *(full descriptions of habitats and the definition of relatively undisturbed are in WDFW report: pp. 167-169 and glossary in Appendix A).* ☐ **Caves:** A naturally occurring cavity, recess, void, or system of interconnected passages under the earth in soils, rock, ice, or other geological formations and is large enough to contain a human. ☐ **Cliffs:** Greater than 7.6 m (25 ft) high and occurring below 5000 ft. ☐ **Talus:** Homogenous areas of rock rubble ranging in average size 0.15 - 2.0 m (0.5 - 6.5 ft), composed of basalt, andesite, and/or sedimentary rock, including riprap slides and mine tailings. May be associated with cliffs. ☑ **Snags and Logs:** Trees are considered snags if they are dead or dying and exhibit sufficient decay characteristics to enable cavity excavation/use by wildlife. Priority snags have a diameter at breast height of > 51 cm (20 in) in western Washington and are > 2 m (6.5 ft) in height. Priority logs are > 30 cm (12 in) in diameter at the largest end, and > 6 m (20 ft) long. ☑ If wetland has **3 or more** priority habitats = **4 points** ☐ If wetland has 2 priority habitats = **3 points** ☐ If wetland has 1 priority habitat = **1 point** ☐ No habitats = 0 points *Note: All vegetated wetlands are by definition a priority habitat but are not included in this list. Nearby wetlands are addressed in question H 2.4)*	4

H 2.4 Wetland Landscape (choose the one description of the landscape around the wetland that best fits) (see p. 84)	
☐ There are at least 3 other wetlands within ½ mile, and the connections between them are relatively undisturbed (light grazing between wetlands OK, as is lake shore with some boating, but connections should NOT be bisected by paved roads, fill, fields, or other development. points = 5 ☐ The wetland is Lake-fringe on a lake with little disturbance and there are 3 other lake-fringe wetlands within ½ mile points = 5 ☑ There are at least 3 other wetlands within ½ mile, BUT the connections between them are disturbed points = 3 ☐ The wetland is Lake-fringe on a lake with disturbance and there are 3 other lake-fringe wetland within ½ mile points = 3 ☐ There is at least 1 wetland within ½ mile. points = 2 ☐ There are no wetlands within ½ mile. points = 0	3
H 2. TOTAL Score - opportunity for providing habitat *Add the scores from H2.1,H2.2, H2.3, H2.4*	11
TOTAL for H 1 from page 14	3
Total Score for Habitat Functions – add the points for H 1, H 2 and record the result on p. 1	14

CATEGORIZATION BASED ON SPECIAL CHARACTERISTICS

Please determine if the wetland meets the attributes described below and circle the appropriate answers and Category.

Wetland Type *Check off any criteria that apply to the wetland. Circle the Category when the appropriate criteria are met.*	**Category**
SC 1.0 Estuarine wetlands *(see p. 86)* Does the wetland unit meet the following criteria for Estuarine wetlands? ☐ The dominant water regime is tidal, ☐ Vegetated, and ☐ With a salinity greater than 0.5 ppt. ☐ YES = Go to SC 1.1 NO ☑ = Go to SC 2.0	
SC 1.1 Is the wetland unit within a National Wildlife Refuge, National Park, National Estuary Reserve, Natural Area Preserve, State Park or Educational, Environmental, or Scientific Reserve designated under WAC 332-30-151? ☐ YES = Category I ☐ NO go to SC 1.2	Cat. I ☐
SC 1.2 Is the wetland unit at least 1 acre in size and meets at least two of the following three conditions? ☐ YES = Category I ☐ NO = Category II ☐ The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing, and has less than 10% cover of non-native plant species. If the non-native *Spartina* spp. are the only species that cover more than 10% of the wetland, then the wetland should be given a dual rating (I/II). The area of Spartina would be rated a Category II while the relatively undisturbed upper marsh with native species would be a Category I. Do not, however, exclude the area of Spartina in determining the size threshold of 1 acre. ☐ At least ¾ of the landward edge of the wetland has a 100 ft buffer of shrub, forest, or un-grazed or un-mowed grassland. ☐ The wetland has at least 2 of the following features: tidal channels, depressions with open water, or contiguous freshwater wetlands.	☐ **Cat. I** ☐ **Cat. II** ☐ **Dual rating I/II**

SC 2.0 Natural Heritage Wetlands *(see p. 87)*	
Natural Heritage wetlands have been identified by the Washington Natural Heritage Program/DNR as either high quality undisturbed wetlands or wetlands that support state Threatened, Endangered, or Sensitive plant species. SC 2.1 Is the wetland unit being rated in a Section/Township/Range that contains a Natural Heritage wetland? *(this question is used to screen out most sites before you need to contact WNHP/DNR)* S/T/R information from Appendix D [✓] or accessed from WNHP/DNR web site [ ] YES [ ] – contact WNHP/DNR (see p. 79) and go to SC 2.2 NO [✓] SC 2.2 Has DNR identified the wetland as a high quality undisturbed wetland or as or as a site with state threatened or endangered plant species? [ ] YES = Category I NO [✓] not a Heritage Wetland	[ ] Cat. I
SC 3.0 Bogs *(see p. 87)* Does the wetland unit **(or any part of the unit)** meet both the criteria for soils and vegetation in bogs? *Use the key below to identify if the wetland is a bog. If you answer yes you will still need to rate the wetland based on its functions.* 1. Does the unit have organic soil horizons (i.e. layers of organic soil), either peats or mucks, that compose 16 inches or more of the first 32 inches of the soil profile? (See Appendix B for a field key to identify organic soils)? Yes - go to Q. 3 [ ] [✓] No - go to Q. 2 2. Does the unit have organic soils, either peats or mucks that are less than 16 inches deep over bedrock, or an impermeable hardpan such as clay or volcanic ash, or that are floating on a lake or pond? [ ] Yes - go to Q. 3 [✓] No - Is not a bog for purpose of rating 3. Does the unit have more than 70% cover of mosses at ground level, AND other plants, if present, consist of the "bog" species listed in Table 3 as a significant component of the vegetation (more than 30% of the total shrub and herbaceous cover consists of species in Table 3)? [ ] Yes – Is a bog for purpose of rating [ ] No - go to Q. 4 NOTE: If you are uncertain about the extent of mosses in the understory you may substitute that criterion by measuring the pH of the water that seeps into a hole dug at least 16" deep. If the pH is less than 5.0 and the "bog" plant species in Table 3 are present, the wetland is a bog. 4. Is the unit forested (> 30% cover) with sitka spruce, subalpine fir, western red cedar, western hemlock, lodgepole pine, quaking aspen, Englemann's spruce, or western white pine, WITH any of the species (or combination of species) on the bog species plant list in Table 3 as a significant component of the ground cover *(> 30% coverage of the total shrub/herbaceous cover)?* 2. [ ] YES = Category I No [ ] Is not a bog for purpose of rating	[ ] Cat. I

SC 4.0 Forested Wetlands *(see p. 90)*	
Does the wetland unit have at least 1 acre of forest that meet one of these criteria for the Department of Fish and Wildlife's forests as priority habitats? *If you answer yes you will still need to rate the wetland based on its functions.* [ ] **Old-growth forests:** (west of Cascade crest) Stands of at least two tree species, forming a multi-layered canopy with occasional small openings; with at least 8 trees/acre (20 trees/hectare) that are at least 200 years of age OR have a diameter at breast height (dbh) of 32 inches (81 cm) or more. NOTE: The criterion for dbh is based on measurements for upland forests. Two-hundred year old trees in wetlands will often have a smaller dbh because their growth rates are often slower. The DFW criterion is and "OR" so old-growth forests do not necessarily have to have trees of this diameter. [ ] **Mature forests:** (west of the Cascade Crest) Stands where the largest trees are 80 – 200 years old OR have average diameters (dbh) exceeding 21 inches (53cm); crown cover may be less that 100%; decay, decadence, numbers of snags, and quantity of large downed material is generally less than that found in old-growth. [ ] YES = Category I NO [✓] not a forested wetland with special characteristics	Cat. I [ ]
SC 5.0 Wetlands in Coastal Lagoons *(see p. 91)* Does the wetland meet all of the following criteria of a wetland in a coastal lagoon? [ ] The wetland lies in a depression adjacent to marine waters that is wholly or partially separated from marine waters by sandbanks, gravel banks, shingle, or, less frequently, rocks [ ] The lagoon in which the wetland is located contains surface water that is saline or brackish (> 0.5 ppt) during most of the year in at least a portion of the lagoon *(needs to be measured near the bottom)* [ ] YES = Go to SC 5.1 NO [✓] not a wetland in a coastal lagoon SC 5.1 Does the wetland meets all of the following three conditions? [ ] The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing), and has less than 20% cover of invasive plant species (see list of invasive species on p. 74). [ ] At least ¾ of the landward edge of the wetland has a 100 ft buffer of shrub, forest, or un-grazed or un-mowed grassland. [ ] The wetland is larger than 1/10 acre (4350 square feet) [ ] YES = Category I [ ] NO = Category II	[ ] Cat. I [ ] Cat. II

Wetland name or number Wet B

SC 6.0 Interdunal Wetlands *(see p. 93)*	
Is the wetland unit west of the 1889 line (also called the Western Boundary of Upland Ownership or WBUO)? ☐ YES - go to SC 6.1 NO ☑ not an interdunal wetland for rating ***If you answer yes you will still need to rate the wetland based on its functions.*** In practical terms that means the following geographic areas: ☐ Long Beach Peninsula- lands west of SR 103 ☐ Grayland-Westport- lands west of SR 105 ☐ Ocean Shores-Copalis- lands west of SR 115 and SR 109 SC 6.1 Is the wetland one acre or larger, or is it in a mosaic of wetlands that is once acre or larger? ☐ YES = Category II ☐ NO – go to SC 6.2	**Cat. II** ☐
SC 6.2 Is the unit between 0.1 and 1 acre, or is it in a mosaic of wetlands that is between 0.1 and 1 acre? ☐ YES = Category III	**Cat. III** ☐
Category of wetland based on Special Characteristics *Choose the "highest" rating if wetland falls into several categories, and record on p. 1.* If you answered NO for all types enter "Not Applicable" on p.1	☐ Cat. I ☐ Cat. II ☐ Cat. III ☑ N/A

ATTACHMENT B

SAM 2000 Rating Forms

2000 Wetland and Buffer Functions and Semi-quantitative Performance Assessment updated 8/04

Wetland # Pace Wet A Staff LE/SB Date May 4, 2009

Location S 21 T 28N R 5E N/A = Not Applicable, N/I = No information available

Table 1: Determining Wetland Size in Landscape Context

Attribute	Low (1 pt.)	Medium (2 pts.)	High (3 pts.)	Total
Absolute Size	<5 acres [1]	5-10 acres [ ]	> 10 acres [ ]	[1]
Wetland Loss in Basin	< 20 % [ ]	20 – 60 % [2]	> 60 % [ ]	[2]
Size Relative to Other Wetlands in Basin (on NWI maps)	< 100% of average size [1]	100 – 200 % of average size [ ]	> 200% of average size [ ]	[1]
Buffer Size	< 75 feet [1]	75 to 200 feet [ ]	> 200 feet [ ]	[1]
Buffer Condition	> 60% disturbed [ ]	20-60% disturbed [2]	< 20% disturbed [ ]	[2]
Relative Size	If score is ≤1.4 then score the question as 1 If score is 1.5 to 2.4 then score the question as 2 If score is 2.5 to 3 then score the question as 3			7 ÷ 5 = 1.4 Score= [2]

Function	Criteria Group 1 1 pt	Group 2 2 pts	Group 3 3 pts
Flood/ Storm Water Control Points = 12 (max 15)	__ size cumulative score (see Table 1) __ riverine or shallow depression __ < 10 % forested cover 1 unconstrained outlet __ located in lower 1/3 of the drainage	2 size cumulative score (see Table 1) __ mid-sloped wetland __ 10 - 30 % forested cover __ semi-constrained outlet __ located in middle 1/3 of the drainage	__ size cumulative score (see Table 1) 3 lake, depressions, headwaters, bogs 3 > 30 % forested cover __ culvert/bermed outlet 3 located in upper 1/3 of the drainage
Base Flow/ Ground Water Support Points = 11 (max 15)	__ Size cumulative score (see Table 1) __ riverine or shallow depression __ located in lower 1/3 of the drainage __ temporally flooded or saturated 1 vegetation < 20 % OBL species	2 Size cumulative score (see Table 1) __ mid-sloped wetland __ located in middle 1/3 of the drainage 2 seasonally or semi-permanently flooded or saturated __ vegetation 20 to 40 % OBL species	__ Size cumulative score (see Table 1) 3 lake,depressions, headwaters,bogs 3 located in upper 1/3 of the drainage __ permanently flooded or saturated, or intermittently exposed __ vegetation > 40 % OBL species
Erosion/ Shoreline Protection Points = 5 (max 9)	__ sparse grass/herbs or no veg along OHWM 1 wetland extends < 30 m from OHWM 1 <20% shoreline developed	__ sparse wood or veg along OHWM __ wetland extends 30 - 60 m from OHWM __ 20 to 60% shoreline developed	3 dense wood or veg along OHWM __ wetland extends > 200 m from OHWM __ >60% shoreline developed
Water Quality Improvement Points = 11 (max 15)	__ rapid flow through site __ < 50 % veg cover __ <20% of basin upstream from wetland is developed __ result from Table 2 1 Soil coarse -gravel, Sand, sandyloam	2 moderate flow through site __ 50 - 80 % cover __ 20 to 50% of basin upstream from wetland is developed 2 result from Table 2 __ Soil organic mineral mix	__ slow flow through site 3 > 80 % veg cover 3 > 50% of basin upstream from wetland is developed __ result from Table 2 __ Soil heavy organic muck and peat

Wetland # Pace Wet A Staff LE/SB Date May 4, 2009

Table 2: Overland Flow Contained in Wetland

Attribute	Low (1 pt.)	Medium (2 pts.)	High (3 pts.)	Total
Configuration	Plate-shaped ☐	Shallow bowl-shaped 2	Deep Bowl-shaped ☐	2
Drainage Basin Size	< 2 acres ☐	2-5 acres ☐	> 5 acres 3	3
Outlet	Unconstrained 1	Semi-constrained ☐	Constrained ☐	1
Input	Groundwater only ☐	Surface flow and groundwater 2	Surface flow ☐	2
Basin Condition	< 20% impervious ☐	20-40 % impervious ☐	>40% impervious 3	3
Flow Contained				11 ÷ 5 = 2.2 Score= 2

Natural Biological Support Points = 25 (max 36)	__ size cumulative score (see Table 1) __ low connectivity to veg'd buffers __ ag land, low veg structure __ seasonal surface water __ one habitat type PAB ☐ POW ☐ PEM ☐ PSS ☐ PFO ☐ EST ☐ __ low plant diversity (< 6 species) __ > 50 % invasive species __ low organic accumulation 1 low organic export __ few habitat features __ buffers very disturbed __ isolated from upland habitats	2 size cumulative score (see Table 1) __ mod connectivity to veg'd buffers __ 2 layers of vegetation 2 permanent surface water 2 two habitat types PAB ☐ POW ☐ PEM ☐ PSS ☑ PFO ☑ EST ☐ 2 moderate plant diversity (7-15 spp) 2 10 to 50 % invasive species 2 moderate organic accumulation __ moderate organic export 2 some habitat features 2 buffers slightly disturbed 2 partially connected to upland habitats	__ size cumulative score (see Table 1) 3 high connectivity to veg'd buffers 3 high veg structure __ open water pools through summer __ ≥ 3 habitat types PAB ☐ POW ☐ PEM ☐ PSS ☐ PFO ☐ EST ☐ __ high plant diversity (> 15 spp) __ < 10% invasive species __ high organic accumulation __ high organic export __ many habitat features __ buffers not disturbed __ well connected to upland habitats
Overall Habitat Functions Points = 6 (max 9)	__ size cumulative score (see Table 1) __ low habitat diversity __ low sanctuary or refuge	2 size cumulative score (see Table 1) 2 moderate habitat diversity 2 moderate sanctuary or refuge	__ size cumulative score (see Table 1) __ high habitat diversity __ high sanctuary or refuge
Specific Habitat Functions Points = 11 (max 15)	__ low invertebrate habitat __ low amphibian habitat 1 low fish habitat __ low mammal habitat __ low bird habitat	__ moderate invertebrate habitat __ moderate amphibian habitat __ moderate fish habitat 2 moderate mammal habitat 2 moderate bird habitat	3 high invertebrate habitat 3 high amphibian habitat __ high fish habitat __ high mammal habitat __ high bird habitat

2000 Wetland and Buffer Functions and Semi-quantitative Performance Assessment updated 8/04

Wetland # Pace Wet A Staff LE/SB Date May 4, 2009

Cultural/ Socioeconomic Points = 7 (max 18)	1 low educational opportunities __ low aesthetic value 1 lacks commercial fisheries, agriculture, renewable resources 1 lacks historical or archeological resources 1 lacks passive and active recreational opportunities 1 privately owned	__ moderate educational opportunities 2 moderate /aesthetic value __ moderate commercial fisheries, agriculture, renewable resources __ historical or archeological site __ some passive and active recreational opportunities __ privately owned, some public access	__ high educational opportunities __ high aesthetic value __ high commercial fisheries, agriculture, renewable resources __ important historical or archeological site __ many passive and active recreational opportunities __ unrestricted public access

Total Points = 87

(max 132)

Dominant Vegetation:

Wildlife:

Notes:

2000 Wetland and Buffer Functions and Semi-quantitative Performance Assessment updated 8/04

Wetland # Pace Wet B Staff LE/SB Date May 4, 2009

Location S 21 T 28N R 5E N/A = Not Applicable, N/I = No information available

Table 1: Determining Wetland Size in Landscape Context

Attribute	Low (1 pt.)	Medium (2 pts.)	High (3 pts.)	Total
Absolute Size	<5 acres [1]	5-10 acres [ ]	> 10 acres [ ]	[1]
Wetland Loss in Basin	< 20 % [ ]	20 – 60 % [2]	> 60 % [ ]	[2]
Size Relative to Other Wetlands in Basin (on NWI maps)	< 100% of average size [1]	100 – 200 % of average size [ ]	> 200% of average size [ ]	[1]
Buffer Size	< 75 feet [1]	75 to 200 feet [ ]	> 200 feet [ ]	[1]
Buffer Condition	> 60% disturbed [ ]	20-60% disturbed [2]	< 20% disturbed [ ]	[2]
Relative Size	If score is ≤1.4 then score the question as 1 If score is 1.5 to 2.4 then score the question as 2 If score is 2.5 to 3 then score the question as 3			7 ÷ 5 = 1.4 Score= [2]

Function	Criteria Group 1 1 pt	Group 2 2 pts	Group 3 3 pts
Flood/ Storm Water Control Points = 13 (max 15)	__ size cumulative score (see Table 1) __ riverine or shallow depression __ < 10 % forested cover __ unconstrained outlet __ located in lower 1/3 of the drainage	2 size cumulative score (see Table 1) __ mid-sloped wetland __ 10 - 30 % forested cover __ semi-constrained outlet 2 located in middle 1/3 of the drainage	__ size cumulative score (see Table 1) 3 lake, depressions, headwaters, bogs 3 > 30 % forested cover 3 culvert/bermed outlet __ located in upper 1/3 of the drainage
Base Flow/ Ground Water Support Points = 9 (max 15)	__ Size cumulative score (see Table 1) __ riverine or shallow depression __ located in lower 1/3 of the drainage 1 temporally flooded or saturated 1 vegetation < 20 % OBL species	2 Size cumulative score (see Table 1) __ mid-sloped wetland 2 located in middle 1/3 of the drainage __ seasonally or semi-permanently flooded or saturated __ vegetation 20 to 40 % OBL species	__ Size cumulative score (see Table 1) 3 lake,depressions, headwaters,bogs __ located in upper 1/3 of the drainage __ permanently flooded or saturated, or intermittently exposed __ vegetation > 40 % OBL species
Erosion/ Shoreline Protection Points = 5 (max 9)	__ sparse grass/herbs or no veg along OHWM 1 wetland extends < 30 m from OHWM 1 <20% shoreline developed	__ sparse wood or veg along OHWM __ wetland extends 30 - 60 m from OHWM __ 20 to 60% shoreline developed	3 dense wood or veg along OHWM __ wetland extends > 200 m from OHWM __ >60% shoreline developed
Water Quality Improvement Points = 11 (max 15)	__ rapid flow through site __ < 50 % veg cover __ <20% of basin upstream from wetland is developed __ result from Table 2 1 Soil coarse -gravel, Sand, sandyloam	__ moderate flow through site __ 50 - 80 % cover 2 20 to 50% of basin upstream from wetland is developed 2 result from Table 2 __ Soil organic mineral mix	3 slow flow through site 3 > 80 % veg cover __ > 50% of basin upstream from wetland is developed __ result from Table 2 __ Soil heavy organic muck and peat

2000 Wetland and Buffer Functions and Semi-quantitative Performance Assessment updated 8/04

Wetland # Pace Wet B Staff LE/SB Date May 4, 2009

Table 2: Overland Flow Contained in Wetland

Attribute	Low (1 pt.)	Medium (2 pts.)	High (3 pts.)	Total
Configuration	Plate-shaped ☐	Shallow bowl-shaped ☐	Deep Bowl-shaped 3	3
Drainage Basin Size	< 2 acres 1	2-5 acres ☐	> 5 acres ☐	1
Outlet	Unconstrained ☐	Semi-constrain ☐	Constrained 3	3
Input	Groundwater only ☐	Surface flow and groundwater 2	Surface flow ☐	2
Basin Condition	< 20% impervious ☐	20-40 % impervious 2	>40% impervious ☐	2
Flow Contained				11 ÷ 5 = 2.2 Score= 2

Natural Biological Support Points = 22 (max 36)	__ size cumulative score (see Table 1) __ low connectivity to veg'd buffers __ ag land, low veg structure 1 seasonal surface water 1 one habitat type PAB ☐ POW ☐ PEM ☐ PSS ☑ PFO ☐ EST ☐ __ low plant diversity (< 6 species) __ > 50 % invasive species __ low organic accumulation 1 low organic export __ few habitat features __ buffers very disturbed __ isolated from upland habitats	2 size cumulative score (see Table 1) __ mod connectivity to veg'd buffers 2 2 layers of vegetation __ permanent surface water __ two habitat types PAB ☐ POW ☐ PEM ☐ PSS ☐ PFO ☐ EST ☐ 2 moderate plant diversity (7-15 spp) 2 10 to 50 % invasive species 2 moderate organic accumulation __ moderate organic export 2 some habitat features 2 buffers slightly disturbed 2 partially connected to upland habitats	__ size cumulative score (see Table 1) 3 high connectivity to veg'd buffers __ high veg structure __ open water pools through summer __ ≥ 3 habitat types PAB ☐ POW ☐ PEM ☐ PSS ☐ PFO ☐ EST ☐ __ high plant diversity (> 15 spp) __ < 10% invasive species __ high organic accumulation __ high organic export __ many habitat features __ buffers not disturbed __ well connected to upland habitats
Overall Habitat Functions Points = 6 (max 9)	__ size cumulative score (see Table 1) __ low habitat diversity __ low sanctuary or refuge	2 size cumulative score (see Table 1) 2 moderate habitat diversity 2 moderate sanctuary or refuge	__ size cumulative score (see Table 1) __ high habitat diversity __ high sanctuary or refuge
Specific Habitat Functions Points = 7 (max 15)	1 low invertebrate habitat 1 low amphibian habitat 1 low fish habitat __ low mammal habitat __ low bird habitat	__ moderate invertebrate habitat __ moderate amphibian habitat __ moderate fish habitat 2 moderate mammal habitat 2 moderate bird habitat	__ high invertebrate habitat __ high amphibian habitat __ high fish habitat __ high mammal habitat __ high bird habitat

2000 Wetland and Buffer Functions and Semi-quantitative Performance Assessment updated 8/04

Wetland # Pace Wet B Staff LE/SB Date May 4, 2009

Cultural/ Socioeconomic Points = 6 (max 18)	1 low educational opportunities 1 low aesthetic value 1 lacks commercial fisheries, agriculture, renewable resources 1 lacks historical or archeological resources 1 lacks passive and active recreational opportunities 1 privately owned	__ moderate educational opportunities __ moderate /aesthetic value __ moderate commercial fisheries, agriculture, renewable resources __ historical or archeological site __ some passive and active recreational opportunities __ privately owned, some public access	__ high educational opportunities __ high aesthetic value __ high commercial fisheries, agriculture, renewable resources __ important historical or archeological site __ many passive and active recreational opportunities __ unrestricted public access

Total Points = 78

(max 132)

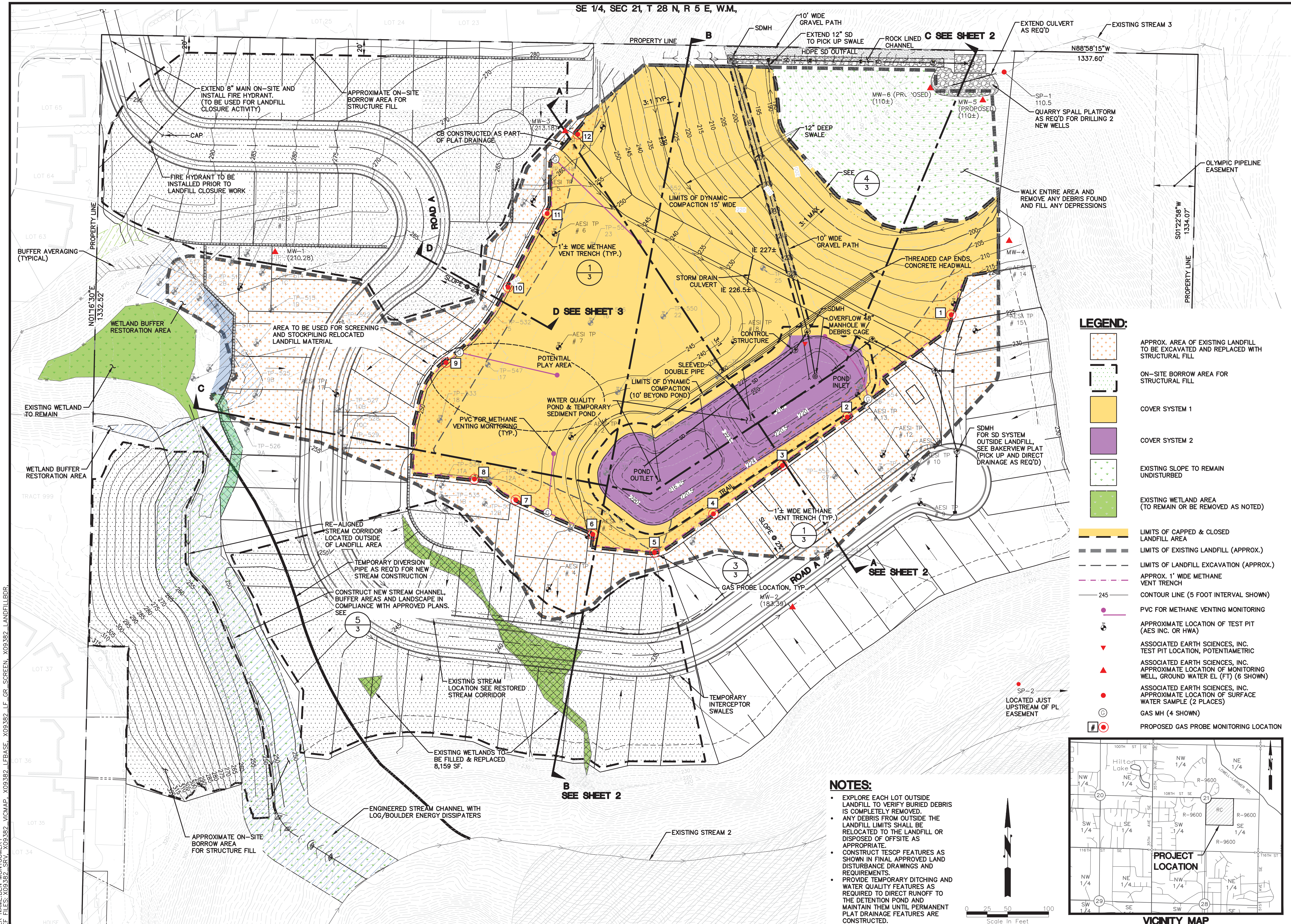
Dominant Vegetation:

Wildlife:

Notes:

GO EAST
LANDFILL CLOSURE PLAN
Snohomish County, Washington

Appendix D
Landfill Closure Engineering Plans
PACE Engineers, January 2018



NOTES:

- EXPLORE EACH LOT OUTSIDE LANDFILL TO VERIFY BURIED DEBRIS IS COMPLETELY REMOVED.
- ANY DEBRIS FROM OUTSIDE THE LANDFILL LIMITS SHALL BE RELOCATED TO THE LANDFILL OR DISPOSED OF OFFSITE AS APPROPRIATE.
- CONSTRUCT TESCP FEATURES AS SHOWN IN FINAL APPROVED LAND DISTURBANCE DRAWINGS AND REQUIREMENTS.
- PROVIDE TEMPORARY DITCHING AND WATER QUALITY FEATURES AS REQUIRED TO DIRECT RUNOFF TO THE DETENTION POND AND MAINTAIN THEM UNTIL PERMANENT PLAT DRAINAGE FEATURES ARE CONSTRUCTED.

SYM	REVISION	DATE
	REVISED GRADING	12/05/13
1	REVISED GRADING	1/26/18

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11255 Kirkland Way, Suite 300
Kirkland, WA 98033
p. 425.827.2014 | f. 425.827.5043
Civil | Structural | Planning | Survey
paceengrs.com

MARTIN J. PENHALLEGON, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER

GO EAST LANDFILL CLOSURE

GRADING & DRAINAGE PLAN

SCALE: 1"=50'
DATE: 1/26/2018
DESIGNED BY: SC
CHECKED BY: MP
JOB NUMBER P09382.00
DWG NAME: P09382_LF-DR
SHEET 1 OF 3

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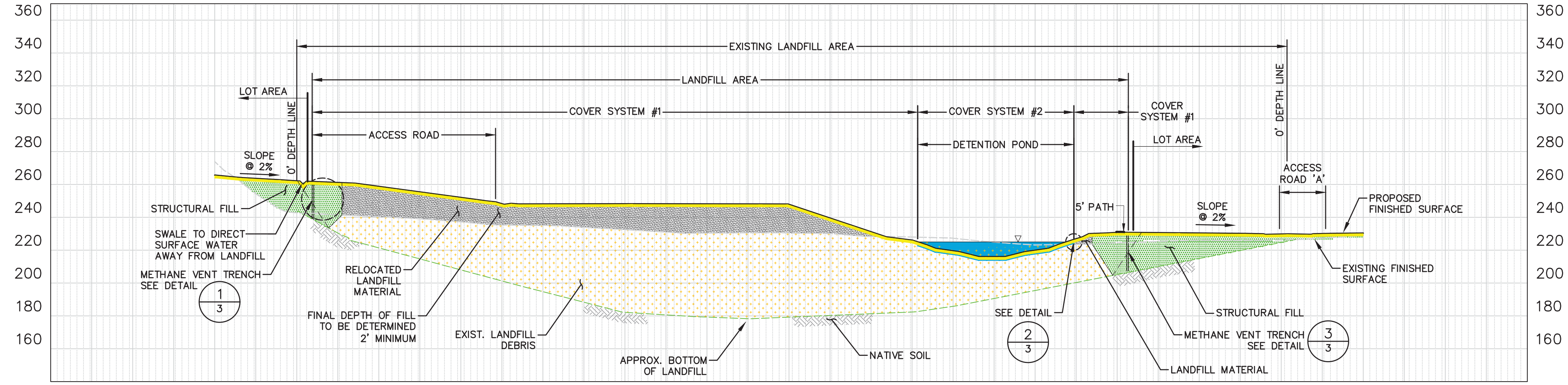
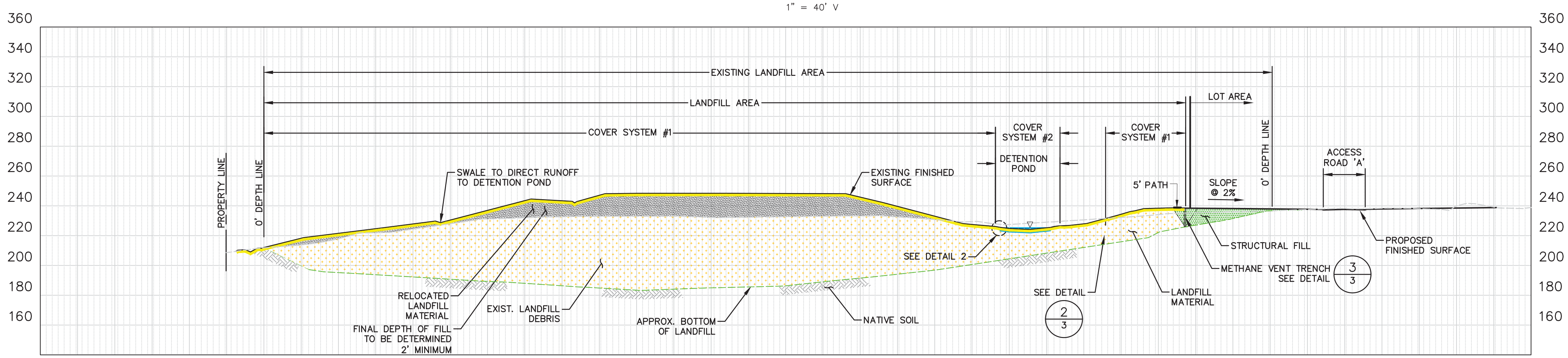
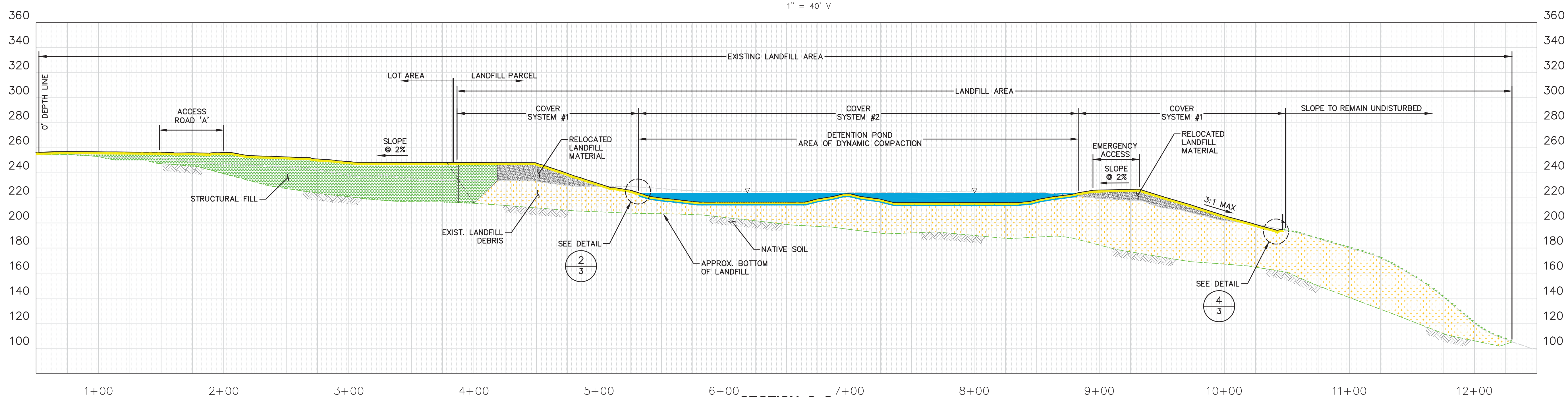


SECTION A-A
SCALE: 1" = 40' H
1" = 40' V



SECTION B-B
SCALE: 1" = 40' H
1" = 40' V



SECTION C-C
SCALE: 1" = 40' H
1" = 40' V

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SYM	REVISION	DATE
1	REVISED GRADING	1/26/18
	REVISED GRADING	12/05/13

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GO EAST
LANDFILL CLOSURE

CROSS SECTIONS

SCALE: AS SHOWN	DATE: 1/26/2018
DESIGNED BY: MP	CHECKED BY: MP

JOB NUMBER P09382.00
DWG NAME: P09382_LF-XS
SHEET 2 OF 3

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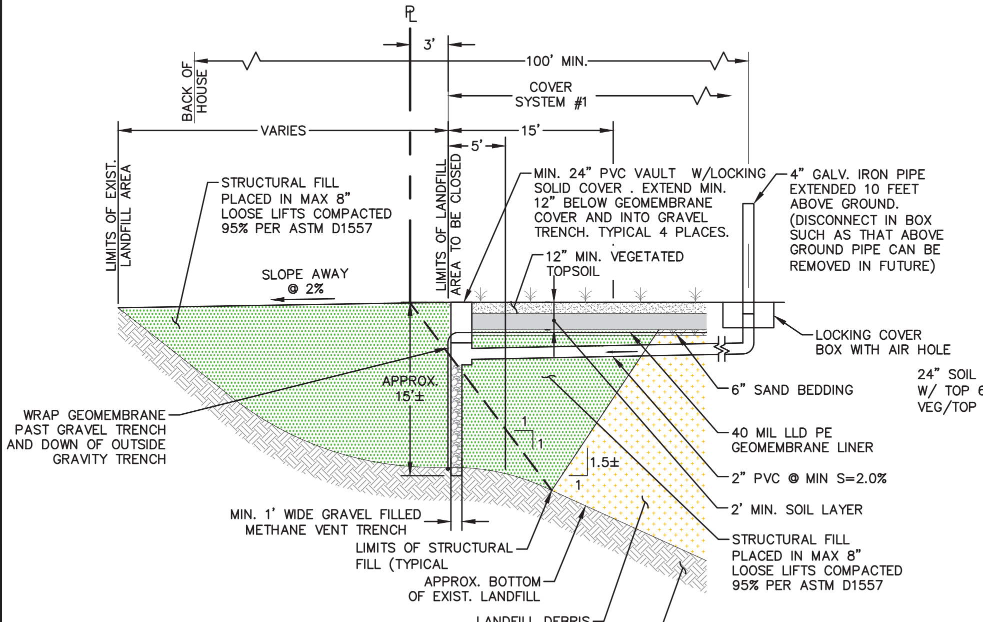
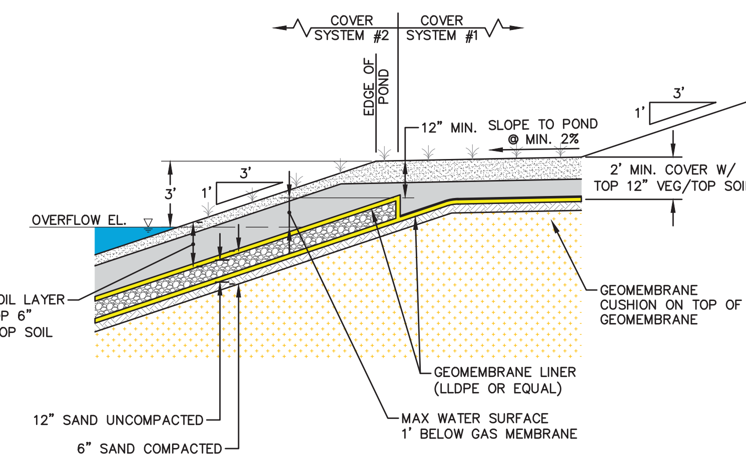


TYPICAL METHANE VENT TRENCH AND VENT

DETAIL 1

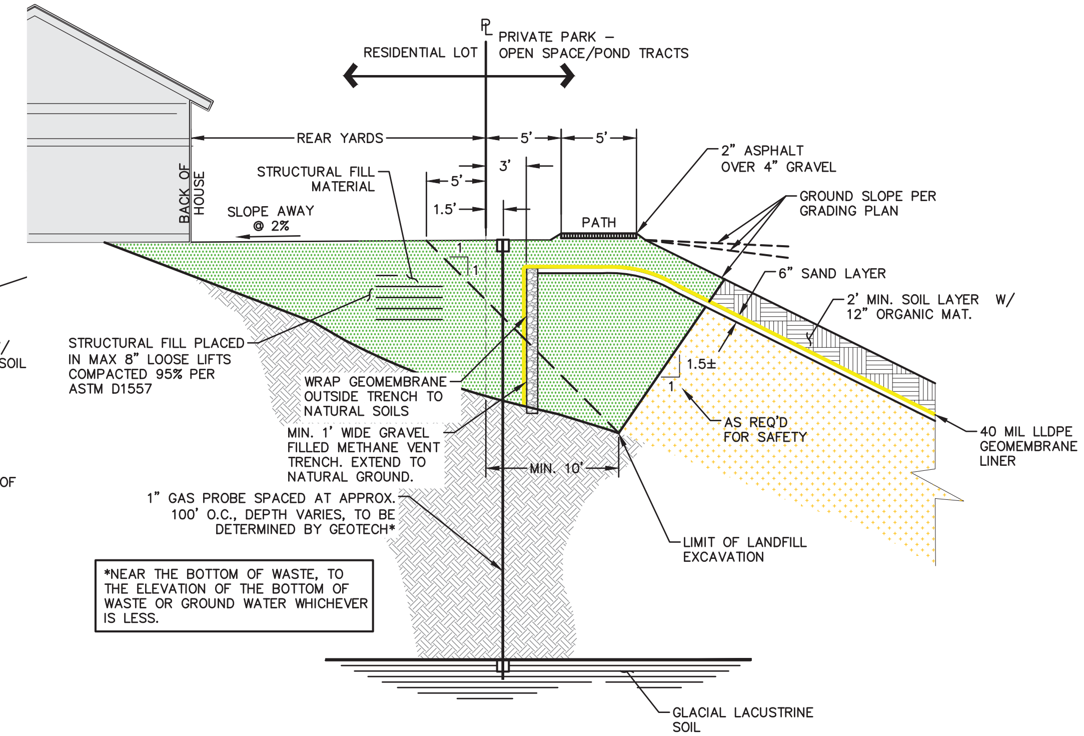
NOT TO SCALE



TRANSITION - COVER 1 TO COVER 2

DETAIL 2

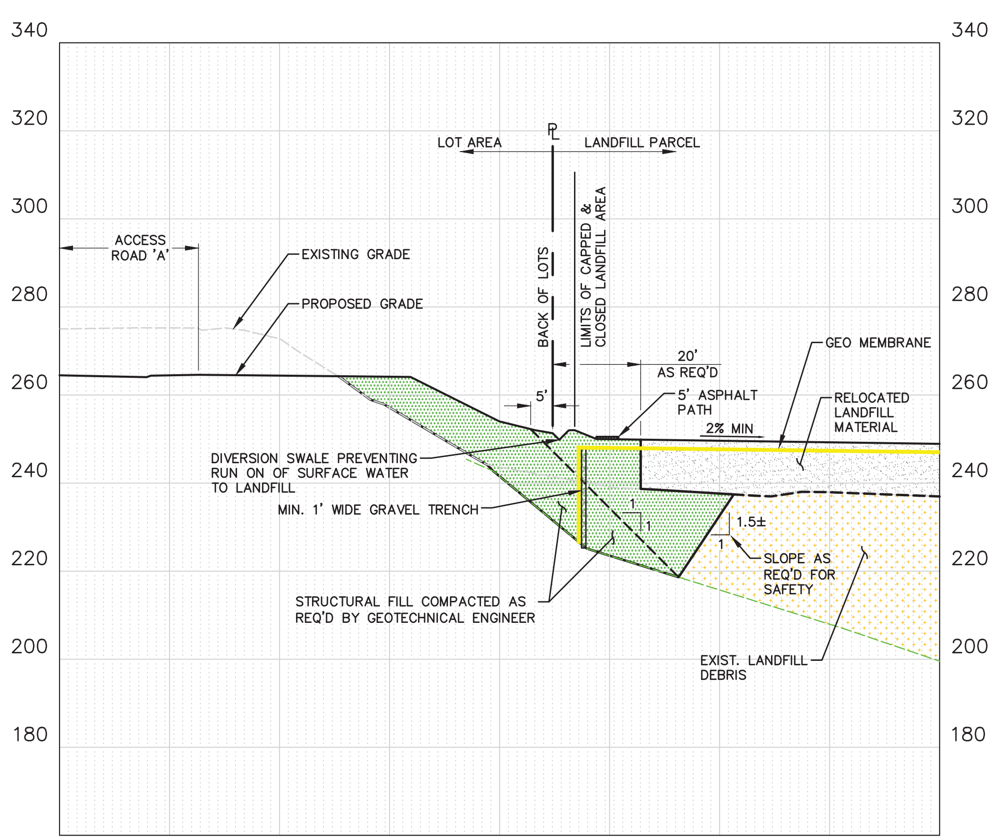
NOT TO SCALE



TYPICAL EDGE OF LANDFILL/LOTS

DETAIL 3

NOT TO SCALE



SECTION D-D

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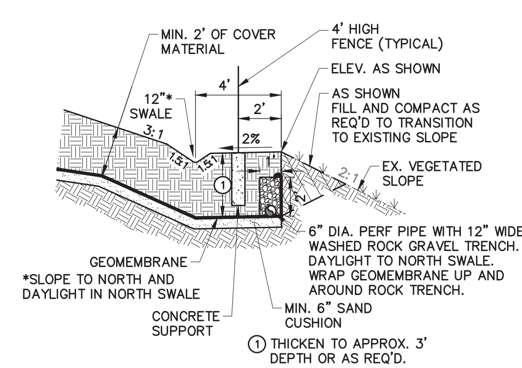

TOP OF EXISTING 2:1

DETAIL 4

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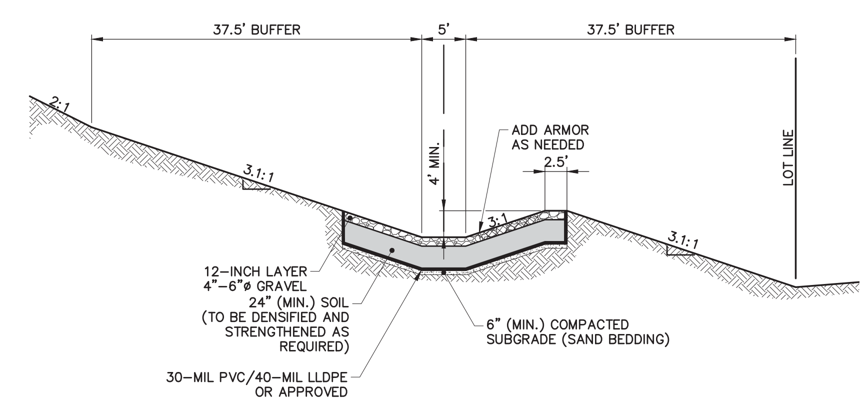

TYPICAL STREAM SECTION

DETAIL 5

NOT TO SCALE

SYM	REVISION	DATE
1	REVISED GRADING	1/26/18
	REVISED GRADING	12/05/13

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MARTIN L. PENHALLEGON, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER

GO EAST LANDFILL CLOSURE

DETAILS

SCALE:	DATE:
AS SHOWN	1/26/2018
DESIGNED BY: MP	CHECKED BY: MP

JOB NUMBER P09382.00

DWG NAME: P09382_LF-XS

SHEET 3 OF 3

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Appendix E
Geomembrane Liner Manual
Northwest Linings & Geotextile Products, Inc.

**NORTHWEST LININGS &
GEOTEXTILE PRODUCTS, Inc.**
"Helping to Protect the Environment"
21000 77th Avenue South
Kent, WA 98032
(253) 872-0244 • (800) 729-6954
FAX: (253) 872-0245
www.northwestlinings.com

LLDPE Textured Specifications

PROPERTY	Frequency[1]	TEST METHOD	LDT40 mil	LDT60 mil	LDT80 mil	LDT100 mil
Thickness- (nominal) (mils)			40	60	80	100
Thickness- (min. avg.) (mils)	per roll	D5994	38	57	76	100
• Lowest indiv. of 8 of 10 values			36	54	72	
• Lowest indiv. of 10 values			34	51	68	90
Asperity Heights, mils		GRI GM12	16	16	16	16
Sheet Density, g/cc(max.)		ASTM D 1505/D 792 GRI GM17	0.939	0.939	0.939	0.939(max.)
TENSILE PROPERTIES [1](min. avg.)	50,000 SF	D638 Type IV (Specimen @ 2 in./min.)				
•Break Strength (lb/in)			112	168	224	280
•Break Elongation (%)			400	400	400	400
2% Modulus, lb/in.		ASTM 5323	60,000	60,000	60,000	
Tear Resistance (min. avg.) (lb)	50,000 SF	D1004	25	36	50	60
Puncture Resistance (min. avg.) (lb)	50,000 SF	D4833	50	70	90	115
Axi-Symetric Break Strain, %		D 5617	30	30	30	30
Carbon Black Content[2] (range) (%)	50,000 SF	D1603	2.0-3.0	2.0-3.0	2.0-3.0	2.0-3.0
Carbon Black Dispersion[3]	50, 000 SF	D5596	Cat. 1 or 2	Cat. 1 or 2	Cat. 1 or 2	A1,A2,B1(D3015)
Oxidative Induction Time(OIT) Standard OIT, minutes		D 3895	100	100	100	0.940
Oven Aging at 150°C, 500PSI O2 Standard OIT-% retained after 90 days		D5721 D 5885	60	60	60	60
UV Resistance[4] High Pressure OIT[5]-% retained after 1600 hrs		GRI GM 11 D 5885	35	35	35	35
Seam Properties 1. Shear Strength, lb/in 2. Peel Strength, lb/in		D4437	53 44 & FTB	79 66 & FTB	105 88 & FTB	130 100(min) & FTB[6,7]

1 = Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction. Break elongation is calculated using gauge length of 2.0 inches.
2 = Other methods such as ASTM D 4218 or microwave methods are acceptable if an appropriate correlation can be established.
3.= Carbon black dispersion for 10 different views: All 10 in Categories 1 and 2.
4.= The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.
5.= UV resistance is based on percent retained value regardless of the original HP-OIT value.
6.= If peel strength exceeds ultimate tensile strength of the sheet but the sample fails FTB, the test will be considered pass.
7.= Federal Test Method Standards.

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NORTHWEST LININGS & GEOTEXTILES PRODUCTS, INC.
CONSTRUCTION QUALITY CONTROL MANUAL
FOR HDPE AND LLDPE CONTAINMENT MEMBRANE
FIELD INSTALLATIONS

ASTM D5641, D5820, D6365, D6392, GRI GM19

NORTHWEST LININGS AND GEOTEXTILES
HDPE/LLDPE-FIELD QUALITY CONTROL MANUAL

I. INTRODUCTION

A. This manual describes the Quality Control Procedures utilized by Northwest Linings (NWL) Installation Personnel to assure quality workmanship and installation integrity of HDPE/LLDPE Geomembranes.

B. Geosynthetic components of lining systems which are addressed in this manual are HDPE/LLDPE Geomembranes. NWL recognizes that specific documentation of the specific installation is required to substantiate this Quality Control Program.

II. HDPE/LLDPE GEOMEMBRANE INSTALLATION

A. Earth Work

1. The general and/or earthwork contractor shall be responsible for preparing and maintaining the subgrade in a condition suitable for liner installation unless agreed otherwise.

2. Surfaces to be lined shall be smooth and free of debris, roots, and angular or sharp rocks to a depth of four (4) inches. All fill shall consist of well-graded material free of organics, trash, clayballs or other harmful matter. No sharp edged stones, stones larger than one (1) inch diameter or hard objects shall be allowed within the top four (4) inches of the subgrade. The surface shall be compacted in accordance with project specifications but in no event below the minimum required to provide a firm unyielding foundation sufficient to permit the movement of vehicles and welding equipment over the surface without causing rutting or other harmful effects. The subgrade shall have no sudden sharp or abrupt changes in grade.

3. The earthwork contractor shall protect the subgrade from becoming too dry, flooding and freezing. Protection, if required, may consist of a thin plastic protective cover (or other material as approved by the engineer) installed over the subgrade until the placement of the liner begins. Subgrade found to have cracks greater than 1/2 inch in width or depth or which exhibit swelling, heaving or other similar conditions shall be reworked by the general contractor to remove these defects.

4. Surface acceptance: Upon request, NWL will provide the Owner's Representative with a written acceptance of the surface to be lined. This acceptance will be limited to an amount of area that NWL is capable of lining in a particular work shift. Subsequent repairs to the subgrade and the surface shall remain the responsibility of the earthwork contractor.

B. Crest Anchorage System

1. The anchor trench shall be excavated by the earthwork contractor to lines and widths shown on the design drawings prior to geomembrane placement.

2. Anchor trenches excavated in clay soils susceptible to desiccation cracks should be excavated only the distance required for that days liner placement to minimize the potential for cracking of the clay soils.

3. Corners in the anchor trench shall be slightly rounded where the geomembrane enters the trench to minimize sharp bends in the liner.

C. Preparation for Geomembrane Deployment

1. Panel Layout: Prior to liner deployment, layout drawings shall be produced to indicate the panel configuration and location of seams.

2. Identification: Each panel used shall be given a numeric or alpha-numeric identifier consistent with the layout drawing. This identification number shall be related to a manufacturing roll number.

D. Field Panel Placement

1. Location: NWL will attempt to install field panels at the location indicated on the layout drawing. If panels are positioned in a location other than that indicated on the layout drawings, the revised location shall be noted in the field on a layout drawing which will be modified at the completion of the project to reflect actual panel locations.

2. Weather Conditions: Geomembrane deployment shall not be done during any precipitation, in the presence of excessive moisture (i.e. fog, dew), in an area of standing or ponded water, or during high winds.

3. Method of Deployment:

    1. The method and equipment used to deploy the panels must not damage the geomembrane or the supporting subgrade surface. The supporting sub-grade must be prepared and maintained in a condition to support the equipment needed for the installation.

    2. The rolls of liner will be deployed from a spreader bar apparatus supported by a fork lift, loader or other piece of heavy equipment that can safely lift and move the rolls. Heavy equipment will not be allowed to operate directly on geomembrane.

    3. No personnel working on the liner will smoke, wear shoes that can damage the geomembrane, or engage in actions which could result in damage to the geomembrane.

    4. Adequate temporary ballast and/or anchoring, (i.e. sandbags,) which will not damage the geomembrane, will be placed to prevent uplift of the liner by wind.

    5. The geomembrane will be deployed in a manner to minimize wrinkles.

    6. Rubber tired and tracked ATV's and similar equipment are acceptable to operate on the geomembrane with ground pressure less than 8 psi. Tires and tracks will be checked for sharp edges, rocks or debris that may damage the liner before operating on the geomembrane. Driving paths will be as straight as possible avoiding sharp turns, sudden stops and starts.

    7. Any damage to a panel of geomembrane will be repaired in accordance with Section IV. Any area of a panel seriously damaged (torn, twisted, or crimped) will be marked, cut out, and removed from the work area with resulting seaming and/or repairs performed in accordance with Section IV of this document.

E. Field Seaming

1. General Requirements:

    1. Layout: In general, seams shall be oriented parallel to the slope, (down hill) not across the slope. Whenever possible, horizontal seams should be located not less than five (5) feet from the toe of the slope. Each seam shall be numbered in a manner compatible with the panel layout drawing for documentation of seam testing results.

    2. Personnel: All personnel performing seaming operations shall be trained in the operation of the equipment being used and will qualify by successfully welding a test seam as described herein. The project foreman will provide direct supervision of all personnel seaming to verify proper welding procedures are followed.

F. Equipment:

1. Fusion Welding: Fusion Welding consists of placing a heated wedge, mounted on a self propelled vehicular unit, between two (2) overlapped sheets such that both sheets are heated to temperatures ranging from 600 degrees F. to 950 degrees F. After being heated by the wedge, the overlapped edges pass through a set of preset pressure rollers which compress the panels together forming a continuous homogenous fusion weld. The fusion welder is equipped with a temperature readout device which continuously monitors the temperature of the wedge.

2. Extrusion Fillet Welding: Extrusion welding consists of introducing a ribbon of molten resin along the edge of the seam overlap to the two sheets to be welded. The molten polymer causes some of the material of each sheet to be liquefied resulting in a homogeneous bond between the molten weld bead and the surfaces of the sheets. The extrusion welder is equipped with gauges giving the temperature in the apparatus and the preheat temperature at the nozzle.

G. Seam Preparation:

1. Fusion Welding:

    1. Overlap the panels approximately four (4) inches.

    2. Clean the seam area prior to seaming to assure the area is clean and free of moisture, dust, dirt and debris.

    3. No grinding is required for fusion welding.

    4. Adjust the panels so that seams are aligned with the fewest possible number of wrinkles and "fishmouths".

2. Extrusion Welding:

    1. Overlap the panels a minimum of three (3) inches.

    2. Temporarily bond the panels to be welded taking care not to damage the geomembrane.

    3. Grind seam overlap prior to welding within 15 minutes of welding operation in manner that does not damage the geomembrane.

    4. Clean the seam area prior to seaming to assure the area is clean and free of moisture, dust dirt and debris of any kind.

    5. Purge the extruder prior to beginning the seam to remove all heat-degraded Extrudate from the barrel.

    6. Keep welding rod clean and off the ground.

H. Test Seams:

Test seams shall be performed at the beginning of each seaming period and at least once each five hours for each seaming apparatus used that day. Test seams shall be made on fragment pieces of the liner and under the same conditions as actual seams.

1. Test Seam Length:

    The test seam shall be at least three feet long, made by joining 2 pieces at least 9" in width.

2. Sample Procedures:

    1. Visually inspect the seam for squeeze out, footprint, pressure and general appearance.

    2. Two samples one inch wide shall be cut from the test seam. The samples shall then be tested in peel and shall not fail in the seam. Failure shall be a film tear bond (FTB). If a sample fails, the entire procedure shall be repeated. ASTM D6392 will be method of testing samples GRI GM19 will be used for strength and locus of break.

    3. If any of the second set of samples fail, the machine shall not be accepted and used for seaming until the problem is corrected and 2 passing tests are achieved.

4. After completion of the test the remaining portion of the test seam shall be discarded. Documentation of the test seams will be maintained by listing machine I.D. number, operators name, temperature control setting and test results.

5. Passing test results records shall be maintained on NWL's test weld report form.

6. If test samples are to act as destructive samples then the sample shall be marked, logged and saved. If samples are to be cut from the actual finished seam for Lab Testing, the test seams shall be discarded per above.

I. General Seaming Procedures:

1. Seaming shall extend to the outside edge of panels to be placed in the anchor trench.

2. While welding a seam, monitor and maintain the proper overlap.

3. Inspect seam area to assure area is clean and free of moisture, dust, dirt and debris of any kind.

4. While welding a seam, monitor temperature gauges to assure proper settings are maintained and that the machine is operating properly.

5. Align wrinkles at the seam overlap to allow welding through a wrinkle.

6. Fishmouths or wrinkles at seam overlaps that cannot be welded through shall be cut along the ridge in order to achieve a flat overlap. The cut area shall be seamed. Any portion where the overlap is inadequate shall be patched with an oval or round patch extending six inches beyond the cut in all directions.

7. All cross/butt seams between two rows of seamed panels shall be welded during the coolest time of the day to allow for contraction of the geomembrane.

8. All "T" joints shall have the overlap from the wedge welder seam trimmed back to allow an extrusion fillet weld. Then grind two inches on either side of the seam and extrusion weld all of the area prepared by grinding.

J. Weather Conditions:

NWL relies on the experience of the Project Superintendent and the results of test seams to determine seaming restriction by weather. Many factors, such as ambient temperature, humidity, wind, sunshine, etc., can effect the integrity of field seams and must be taken into account when deciding whether or not seaming should proceed. Test seams are required prior to daily production seaming to determine if the weather conditions will effect NWL's ability to produce quality seams. Additional non-destructive and destructive testing of production seams substantiate the decision made by the Project Superintendent to seam on any given day.

SECTION III Seam Testing-Quality & Control-Geomembranes

A. Concept:

NWL installation crews will non-destructively test all field seams over their full length using air pressure testing, vacuum testing or other approved method, to verify the continuity and integrity of the seams.

B. Air Pressure Testing:

The weld seam created by the fusion welding process is composed of two welded seams separated by an unwelded channel approximately 3/8 of an inch wide. This channel permits seams to be tested by inflating the sealed channel with air to a predetermined pressure and observing the stability of the pressurized channel over time. Method of test ASTM D5820 Practice for Pressurized Air Channel Eval of Dual Seamed Geomembranes.

C. **Equipment for air testing:**

1. An air pump (manual or motor driven) capable of generating and sustaining a pressure of 30 PSI.
2. A rubber hose with fittings and connections.
3. A sharp hollow needle with a pressure gauge capable of reading and sustaining a pressure of 30 PSI.
4. Procedure for air testing:
5. Seal both ends of the seam to be tested.
6. Insert needle in the sealed channel.
7. Inflate the test channel to a pressure between 25 to 30 PSI, in accordance with the following schedule, close valve, and allow 2 minutes for the injected air to come into equilibrium in the channel. Observe <u>initial</u> pressure after approximately 2 minutes.

INITIAL PRESSURE SCHEDULE*				MAX. PRESSURE DIFF.
MATERIAL	(MIL)	MIN. PSI	MAX. PSI	AFTER 5 MINUTES
	40	25	30	4
	50	26	30	4
	60	27	30	4
	80	30	30	4
	100	30	30	4

* Initial pressure settings are read after a two minute relaxing period. The purpose of this period is to permit the air temperature and pressure to stabilize.

8. Observe and record the air pressure five minutes after the relaxing period ends. If loss of pressure exceeds the value above or if the pressure does not stabilize, locate the faulty area and repair.
9. Upon completion of the pressure test the end of the seam opposite the pressure gauge is cut. A decrease in gauge pressure must be observed or the air channel will be considered blocked and the test will be repeated after the blockage is corrected.
10. Remove needle and seal resulting hole by extrusion welding.
11. Record test results on non-destructive test form
12. In the event of a Non-Complying Air pressure test, the following procedure shall be followed.
13. Check seam-end seals and retest seams.
14. If non-compliance reoccurs, cut one inch samples from each end of the seam and additional samples at the distance specified.
15. Perform destructive field peel test on the samples.
16. If all samples pass destructive testing remove the overlap left by the wedge welder and perform an Air Pressure/Soap Test or vacuum test.
17. If a leak is detected by the air pressure/soap or the vacuum test, repair by extrusion welding. Test repair by vacuum testing.

18. If no leak is discovered air pressure/soap testing, the seam will pass non-destructive testing.

19. If no leak is discovered by vacuum testing, the seam will pass non-destructive testing.

20. If one or more samples fail the peel test, additional samples will be taken.

21. When two passing samples are located, the seam between these two locations will be considered complying. The area outside of this length will be considered non-complying and the entire length extrusion welded.

22. Test the entire length of the repaired seam by vacuum testing.

D. Air Pressure Testing/Soap Testing:

This test is used when the seam fails the air pressure test due to slow pressure loss. The procedure is to constantly supply pressure to the seam air channel while spraying the length with a soap and water solution and visually examining the seam for bubbles. Note: This option is not recommended during high wind conditions.

1. Equipment for Air Pressure/Soap Testing:

    1. The same equipment as the air pressure test.

    2. A soap solution and means to apply the solution.

2. Procedure for Air Pressure/Soap Testing:

    1. Trim excess overlap material off at edge of seam

    2. Insert needle gauge assembly in opposite ends of the seam to be tested to show that pressure is continuous throughout the channel.

    3. Maintain 30 psi

    4. Apply soap solution to the weld edge and visually examine for bubbles.

    5. If no bubbles appear the problem is with the inside track "secondary weld". This seam is acceptable providing it has passed peel tests.

    6. If any bubbles appear on the outside track "Primary weld", repair defect by extrusion welding and vacuum test the repair.

E. Vacuum Testing:

This test is used when the geometry of the weld makes air pressure testing impossible or impractical or when attempting to locate the precise location of a defect believed to exist after air pressure testing. Method of testing is based on ASTM D5641 Practice for Geomembrane Seam Eval by Vacuum Chamber.

1. Equipment for vacuum testing:

    1. Vacuum box consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom, port hole or valve assembly and a vacuum gauge.

    2. Vacuum pump assembly or compressor with a venturi equipped with a pressure controller and pipe connections.

    3. A rubber pressure/vacuum hose with fittings and connections.

4. A soap solution with a means to apply the solution.

2. Procedure for Vacuum Testing:

   1. Trim excess overlap from seam.

   2. Apply soap solution to the area to be tested.

   3. Place the vacuum box over the area and apply sufficient downward pressure to seal the box against the liner.

   4. Open the vacuum valve and apply a minimum of 5 in. Hg vacuum to the area as indicated by the gauge on the box.

   5. Ensure that a leak-tight seal is created.

   6. For a period of not less than five seconds, examine the geomembrane through the viewing window for the presence of soap bubbles.

   7. If no bubbles appear after five to ten seconds, close the valve and move overlap and repeat the process.

3. Procedure for non-complying test:

   1. Mark all areas where soap bubbles appear and repair the marked areas.

   2. Retest repaired areas.

4. Procedure for non-destructive testing of extrusion welds that are not on flat surfaces or accessible for the equipment: ASTM D6365 Practice for Nondestructive Testing of Geomembranes Seams using the Spark Test.

F. Destructive Testing:

The purpose of destructive testing is to determine and evaluate seam strength. These tests require direct sampling and thus subsequent patching. Therefore destructive testing should be held to a minimum to reduce the amount of repairs required.

1. Procedure for Destructive Testing:

   1.1. Destructive test samples shall be marked and cut out randomly at a minimum average frequency of one test location every 700 feet of seam length.

   1.2. Additional test may be taken in areas of contamination, offset welds, visible crystallinity or other potential cause of faulty welds.

   1.3. ASTM D6392 will be method of testing samples GRI GM19 will be used for strength and locus of break standards.

1) Sample Size:

   a) The sample should be twelve inches wide with a seam fourteen inches long centered lengthwise in the sample. The sample may be increased in size to accommodate independent lab testing by the owner or by specific project specifications.

   b) A one inch sample shall be cut from each end of the test seam for field testing on a calibrated field tensiometer.

2) The one inch wide samples shall be tested in the field for peel. If any field sample fails to pass FTB, it will be assumed the sample fails destructive testing. The procedures outlined in Section 2 shall be followed to locate passing samples to send to the laboratory.

   i) If the sample passes the field test, the remaining portion of the sample test strip may be sent to Northwest Linings for laboratory testing to evaluate seam strength and confirm field testing.

1. Procedure in the event of Destructive Test Failure:

   1. Cut additional field samples for testing. In the case of a field production seam, the samples must lay a minimum of ten feet in each direction from the location of the failed sample. Perform a field test with the tensiometer for peel strength. and confirm field testing.

   2. If the laboratory samples pass, then reconstruct the seam up to the two passing sample locations.

      1. Heat tack the overlap along the length of the seam to be reconstructed and extrusion weld.

      2. Vacuum test the extrusion weld.

      3. If either of the samples fails then additional samples are taken in accordance with the above procedure until two passing samples are found to establish the zone in which the seam should be reconstructed.

      4. All passing seams must be bounded by two locations from which samples passing destructive test have been taken.

      5. In the case of reconstructed seams exceeding 150 feet, a sample must be taken and pass destructive testing.

      6. All destructive seam samples sent to Northwest Linings shall be numbered and recorded on a destructive seam test form.

   3. Northwest Linings Quality Assurance Laboratory Testing:

      The remaining destructive sample will be sent to a qualified laboratory and will be tested in "Seam Strength" and "Peel Adhesion" (ASTM D6392 will be method of testing samples GRI GM19 will be used for strength and locus of break). Five specimens shall be tested for each test method with data recorded. Four out of the five specimens must pass for each test in order for the seam to pass the destructive test.

SECTION IV Defects and Repairs

A. Inspection

1. Northwest Linings Project Superintendent shall conduct a detailed walk through and visually check all seams and non-seam areas of the geomembrane for defects, holes, blisters and signs of damage during installation.

2. All other NWL installation personnel shall at all times be on the lookout for any damaged areas. Damaged areas shall be marked and repaired.

B. Procedure

1. Repair procedures: Any portion of the geomembrane showing a flaw, or failing destructive or non-destructive test shall be repaired. Several methods exist for repairs, and the decision as to the appropriate method shall be made by NWL's Project Superintendent. Methods available for repair:

1. Patching - used to repair large holes, tears and destructive sample locations. All patches shall extend at least six inches beyond the defect and all corners of patches shall be rounded.

2. Grinding and welding - used to repair sections of extruded seams.

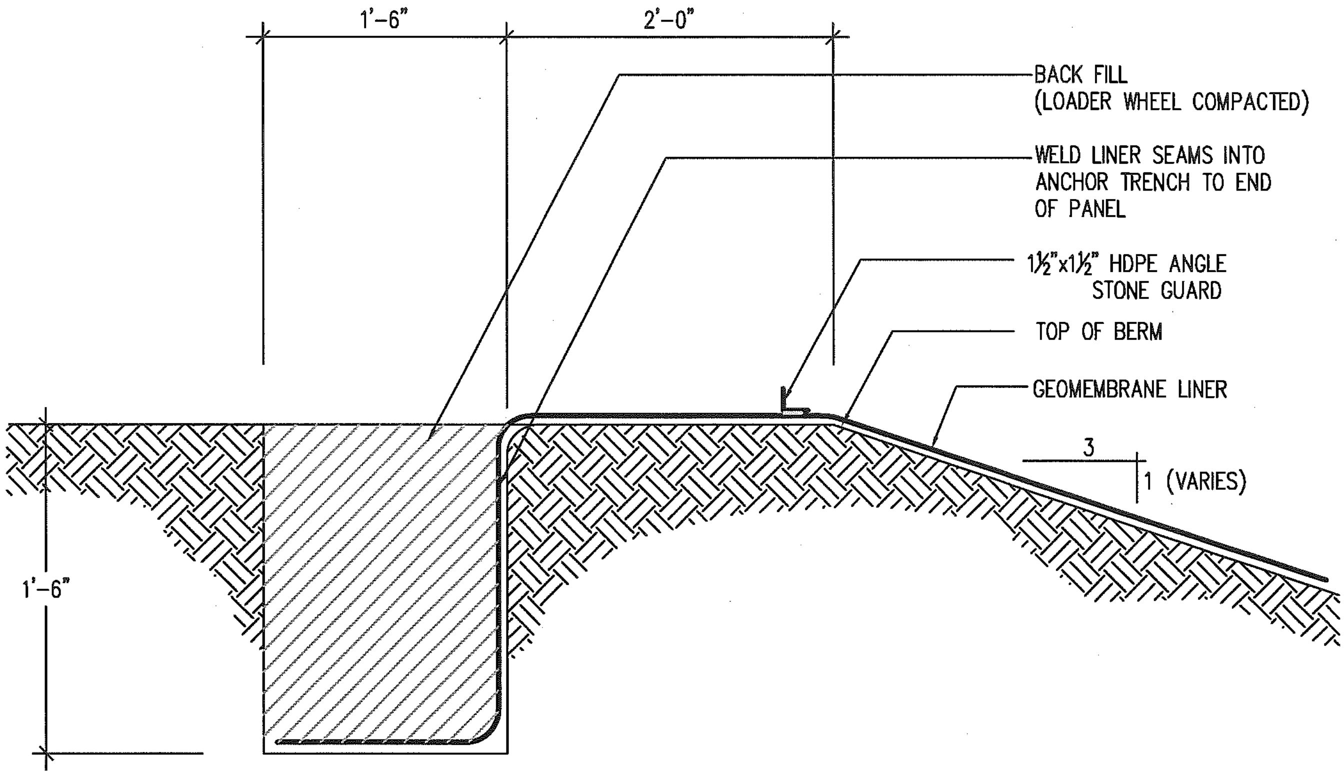
3. Spot welding or seaming - used to repair small tears, pinholes or other minor localized flaws.

4. Capping - used to repair lengths of failed extruded areas.

5. Removal of a bad seam and replacement with a strip of new material seamed into place.

C. Verification of Repairs:

1. Every repair shall be non-destructively tested using the methods set out in this manual Repairs which pass the non-destructive test shall be deemed adequate. Large repairs may require a destructive test. Repair test results shall be logged on a repair report form. The repair location shall be recorded on a record drawing.

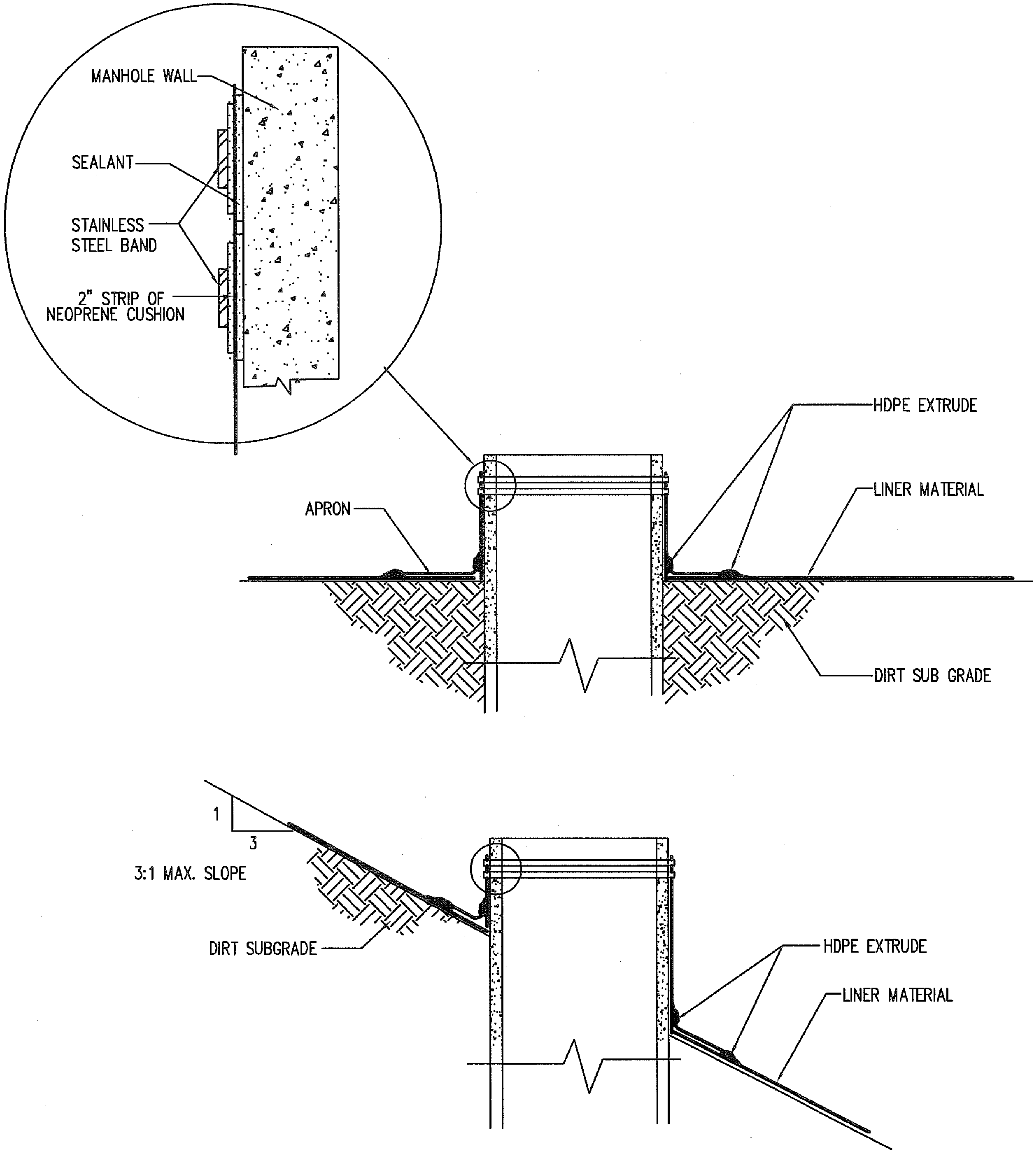


TYPICAL ANCHOR TRENCH

EXPOSED LINING SYSTEM — NTS

H.D.P.E – POLYPROPELENE – URETHANE – COOLGUARD – XR 5

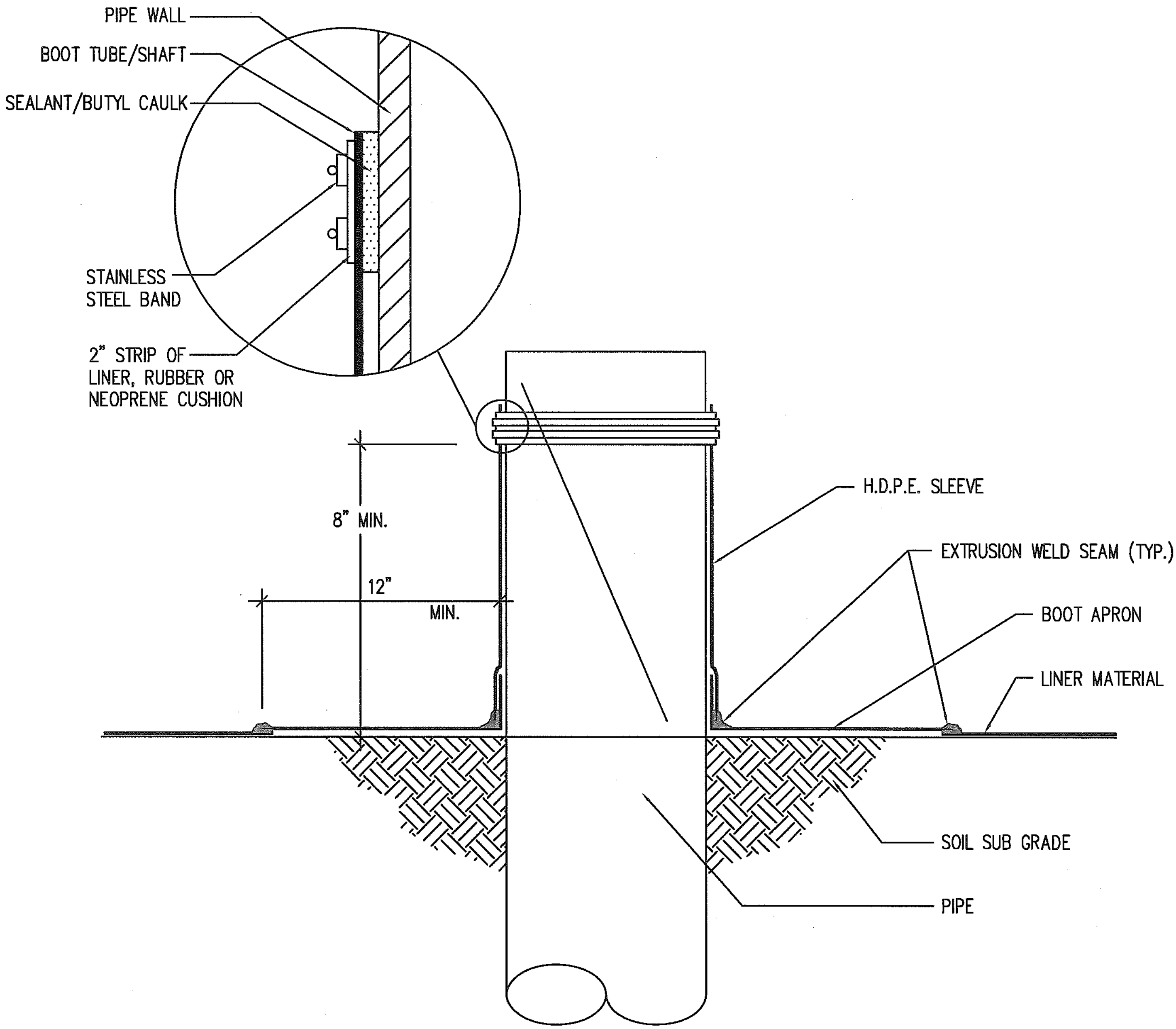
SHEET NO.	DETAIL	NORTHWEST LININGS & GEOTEXTILE PRODUCTS, Inc.	JOB NAME:			
		www.northwestlinings.com	JOB NO.			
		21000 77TH AVE. SOUTH	DATE:		CHECKED:	
		KENT, WA. 98032 (253) 872-0244 (253) 872-0245 FAX	BY:		SCALE:	N T S



MANHOLE BOOT DETAIL

NTS

SHEET NO.	DETAIL	NORTHWEST LININGS & GEOTEXTILE PRODUCTS, Inc. www.northwestlinings.com 21000 77TH AVE. SOUTH KENT, WA. 98032 (253) 872-0244 (253) 872-0245 FAX	JOB NAME:			
			JOB NO.			
			DATE:	2 17 04	CHECKED:	
			BY:		SCALE:	

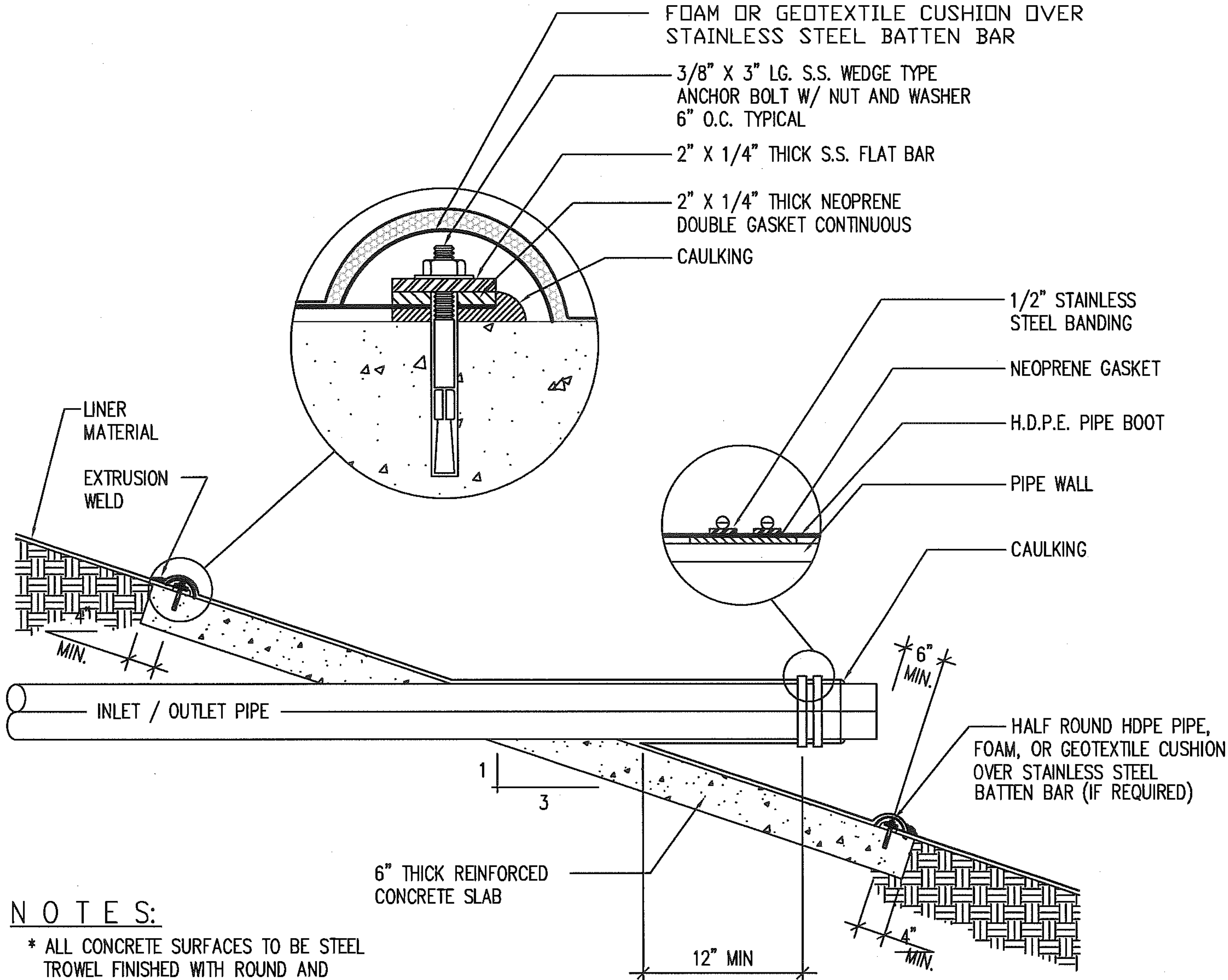


H.D.P.E. / L.L.D.P.E. 90° PIPE BOOT DETAIL

NTS

SHEET NO.	DETAIL	NORTHWEST LININGS & GEOTEXTILE PRODUCTS, Inc.
		www.northwestlinings.com 21000 77TH AVE. SOUTH KENT, WA. 98032 (253) 872-0244 (253) 872-0245 FAX

JOB NAME:			
JOB NO.			
DATE:	3 23 04	CHECKED:	
BY:		SCALE:	



N O T E S:

* ALL CONCRETE SURFACES TO BE STEEL TROWEL FINISHED WITH ROUND AND SMOOTH EDGES
* SLOPES STEEPER THAN 3 : 1 SHOULD BE AVOIDED
* FOR EXISTING CONCRETE ONLY
* IF POURING NEW CONCRETE– HD SEAL LOCK CAN BE USED IN PLACE OF BATTEN BAR

P I P E B O O T D E T A I L–OPTION 2

WITH BATTEN ATTACHMENT

N T S

SHEET NO.

DETAIL

NORTHWEST LININGS &
GEOTEXTILE PRODUCTS, Inc.
www.northwestlinings.com
21000 77TH AVE. SOUTH
KENT, WA. 98032
(253) 872-0244 (253) 872-0245 FAX

JOB NAME:			
JOB NO.			
DATE:		CHECKED:	
BY:		SCALE:	

GO EAST
LANDFILL CLOSURE PLAN
Snohomish County, Washington

Appendix F
Post-Closure Operation Plan
PACE Engineers, January 2018

Appendix F

POST-CLOSURE OPERATION PLAN

Overview of Post-Closure Operation Plan

This document presents the plan for operation, inspection, and maintenance of; the Go East Landfill limited purpose / wood waste landfill following completion of landfill closure event. The Go East Landfill has not accepted waste since 1983. The final requirements for closure are now proposed to be completed in accordance with the applicable regulation for a limited purpose landfill as per the Solid Waste Handling Standards, Washington Administrative Code (WAC) Chapter 173-350.

This Operation Plan specifically addresses:

- Operation
- Maintenance
- Inspection
- Monitoring
- Repairs

Closure Sequence of Landfill

Closure of the landfill is being performed in two phases. The first phase was completed in the 1980’s by the Go East Corporation. Subsequently, the ownership sold the property to P&GE LLC in 2009. These phases are as follows:

- **Completed:** Phase 1: Re-grading of the waste surface and placement of 1 foot of cover fill over the landfill surface, completed in 1983,
- **Proposed:** Phase 2: Placement of a geomembrane liner and 2 foot (minimum) of additional fill over the surface. Please refer to the Closure Plan for specifics.

Purpose of the Post-Closure Operation Plan

The purpose of the Post-Closure Plan is to ensure the post-closure procedures are completed in accordance with acceptable standard practices and testing protocol for the owner and agencies expectations. Assurance will be achieved via site observations, photographic records, sampling and laboratory test analysis and summary of results as required and described in this section of the Landfill Closure Plan. The owner of the Landfill, or its successors, will retain a qualified person to oversee and insure the post-closure activities are completed timely.

Summary of Closure Operation

The proposed landfill closure cover design includes at least a 2-foot protective cover of soil fill (non-structural) and a geomembrane layer (two layers in specific locations) with a protective layer of soil over the landfill waste. Impacts on the environment from the landfill going forward will be greatly reduced from the current condition, now in place for nearly 30 years. Potential impacts to ground water from precipitation infiltrating through the waste will be reduced. Following completion of this Final Closure Plan, ground water flows at the base of the landfill will be reduced with the installation of this design. The landfill closure design will meet the design standard of WAC 173-350-400 (6) Limited purpose landfills – Closure requirements.

The Go East Landfill is an above-grade landfill completed in a ravine between two existing slopes. The base of the ravine is underlain by about 200 feet of impermeable glacial lacustrine silt and clay, therefore infiltrated water has historically migrated through the waste material to the bottom of the ravine and then conveyed via a gravel and pipe conveyance system to the northeast, where the flow daylights at the toe of the slope. The existing groundwater monitoring network wells will be used into the future for groundwater monitoring. Since the sale of the property by Go East Corporation to P&GE LLC, in 2009, P&GE LLC or its successors will be responsible for the property for final closure of the landfill. This responsibility includes completion of closure, permitting, and long-term operation and maintenance of the property. Specifically this includes installation of the additional ground water monitoring system points, monitoring of ground water and future sampling, and analysis of gas, ground water, and surface water. All of these features require post-closure follow-up!

Objectives of Post-Closure Operation Plan

The P&GE LLC, Post-Closure Operation Plan addresses the intent and strategies for Operation, Maintenance, Inspection, Monitoring, and Repairs Programs for the property. The primary objective is to strive to;

1. Prevent exposure of waste,
2. Minimize infiltration of rain water into the material,
3. Prevent erosion from wind and water,
4. Provide for sustaining vegetation,
5. Address possible settlement,
6. Provide slope stability,
7. Provide management of run-on and run-off of surface waters,
8. Minimize the need for post-closure maintenance,
9. Provide for collection, testing and documentation of Ground Water,
10. Provide for collection, testing and documentation of Surface Water,
11. Provide for collection, testing and documentation of methane gas.

Preparation of Post-Closure Operation Plan

This plan has been prepared under the direction of Mr. Ken Nilsen, Professional Engineer registered in Washington. Mr. Nilsen's Washington Professional Engineer registration number is 25427. Signature and professional stamp are located on the last page.

Geo-Physical Setting of Go East Landfill

The landfill generally occupies the northerly 9.6 acres of the 40-acre property.

The property consists of rolling plateaus and ravines with the landfill located in a pre-existing ravine in the northern half of the site. The majority of the 9.6-acre landfill area is relatively flat, sloping toward the southeast at grades of about five percent. Slopes lead down to the landfill area from the north and northwest portions of the property.

The southern half of the 40-acre property contains naturally occurring slopes leading down to a ravine and stream. The east side of the property has naturally occurring slopes as well, also leading to a ravine and stream below. These slopes on the east and south sides of the property are roughly 30 to 70 feet high and contain slopes ranging from 50 to 65 percent according to the Geotechnical Engineering Report by Associated Earth Sciences, Inc. Further details of the Hydrogeology prepared by AESI for the site is located in Appendix B of the Closure Report.

Topsoil and cover material consists of loose, silty sand and gravel. Sediments directly below the fill generally consist of medium dense to very dense sand, with silt lenses interpreted as Vashon advance outwash (Qva) or pre-Vashon glacial lacustrine silt and clay (Qpv). Please refer to the AESI report, “Hydrogeology, Ground Water, and Surface Water Quality Report,” located in Appendix B.

OPERATION PLAN

Given the operation of the plan terminated in 1983 and the facility is not to be re-opened. "Operation" of the property is limited to monitoring and management of the property and equipment. The goal of the Operation Plan is to protect human health and the environment by ensuring the safety of the closed landfill. The owners recognize and value the use of current highly accurate electronic technology and continuous monitoring capabilities. Additionally the operation plan strives to reduce exposure of potentially harmful waste, manage erosion issues, and provide public education to achieve this goal.

1. Maintenance of the landfill cap.

It is vital to protect the soil cap by repairing areas of erosion, re-grading, reseeding and covering as needed, as well as establishing and maintaining healthy vegetative cover. This routine maintenance may also include additional soil to fill in areas of subsidence and depressions to prevent ponding of water on top of the landfill.

Mowing the vegetative cover on the landfill is a key step in maintenance. The owners shall mow the landfill once per month during the growing season. This will enable the owner to see when problems with the landfill cap are beginning, allowing simpler and cheaper corrective actions to be implemented to address the problem(s).

2. Monitoring of surface water, ground water/leachate, and methane gas venting system for the landfill.

The landfill will be closed with environmental monitor control systems in place. The landfill owner is required to keep the systems operating and in good working condition, thereby ensuring the on-site control of surface water, ground water/leachate and methane gas control system and prevent or reduce an impact to the public and the environment. The owners will maintain monitoring systems in place at the landfill to identify any problems, until they are no longer required. Sampling and analysis of all wells will continue at the required frequency and all results submitted to SHD as described in more detail in the following sections. Please see Appendix H for requirement for testing the wells.

3. Routine Quarterly Visually Inspection

Maintaining surface water storm drainage systems, such as detention and sedimentation ponds, is needed to prevent erosion. The landfill owners will visually inspect collection ponds to ensure the slopes, banks, and berms are structurally sound. They will be mowed and checked for damage caused through age, exposure to the elements, infestation by rodents, or other degradation. If basins fill in with vegetation or sediment, they must be drained and cleaned to ensure they maintain sufficient storage capacity to contain surface water as designed.

A landfill maintenance inspection checklist is included at the end of this document to guide owners when they check the landfill’s condition.

REPAIR PLAN

The owner or its successors will maintain the integrity of the cap, monitoring wells, and gas venting system to prevent any damage, malfunction, or substandard performance until they are no longer needed. Damage and associated repairs will be reported to SHD in an annual report during the post-closure care period. Repairs will be contracted directly by the owner or its successors based upon the estimated cost of post-closure care performed by a third party.

OPERATIONAL COST / FINANCIAL UNDERWRITING

Permitting for the Landfill Closure and Post-Closure activities will be allowed by Snohomish County by issuing separate land use permits. All landfill closure and related activities must be completed by the owner and approved by the Snohomish Health District (SHD) prior to issuance of any development/construction permit for the associated subdivision. As a condition for approval of the completed closure and related activities by SHD, the following described financial assurance for post-closure activity shall be in place. The owners will provide financial assurance to support the costs associated to complete the monitoring and potential repair activities of this plan (see below).

One of the unique features of this plan is that after the landfill closure is completed and approved by SHD, the owner, after supplying the described financial assurances, will then be allowed to proceed with the development of the associated plat and construction of homes. This closure and associated plat development and house construction will take several years at the minimum to complete. During this time the owner will remain the responsible agency for accomplishing all post-closure activities and making any repairs or taking other corrective actions needed due to erosion and other causes. Funding for such activities during this period is all part of the project budget for the subdivision development. Further, because of the associated plat, the ongoing maintenance related to key features of the landfill area, such as the emergency access road across the landfill, detention pond, stormwater system on the landfill, recreation features like play area, trails, open space, etc., will all be a requirement of the plat approval process and permitting. These features are, therefore, not landfill-related, but are requirements of the approved subdivision. Once the plat is built out, the future ownership of the landfill and open space tracts will be turned over to an HOA. The HOA, as the caretaker of the closure site, has the ability to provide the income stream needed to maintain all the features of the landfill closure site at the level and condition specified in the Closure Plan. Additionally, by this stage of completion, it is probable the monitoring requirements for the landfill will be reduced as there will already have been monitoring of the landfill by then for over 35 years. It is expected the planned monitoring for gas, surface water, and groundwater will eventually be eliminated once testing has verified there is no significant residual potential effect or conditions that pose any danger to human health and the environment as a whole. Nonetheless, the post-closure budget set forth below is based on a twenty-year projection for such post-closure monitoring.

A repair fund account required by SHD and established for post-closure detention pond repair activities may be transferred to the future HOA once an HOA is established and has assumed responsibility of the landfill and common ownership property.

A surety bond will be used as the instrument for financial assurance for the post-closure activities. This will be furnished after completion of the landfill closure and as a condition of its approval by SHD. The associated subdivision activity cannot proceed until this assurance has been provided and closure approved. This surety will comply with the requirements of WAC 173-350-600. The surety company will be one listed by the U.S. Department of the Treasury on its Circular 570. A standby trust account Trustee will be set up as required in the same WAC chapter.

Estimated post closure activity costs not related to or required as a part of the subdivision approval are set forth below.

1. Annual monitoring:

• Groundwater and Surface Monitoring (quarterly)	$ 15,000
• Monitoring Gas Probes (quarterly)	$ 5,000
• Monitor Detention Pond Pipes and Landfill Surface Area	$ 2,000
• Prepare Yearly Report	$ 3,000
• Annual SHD Permit Cost	$ 1,000
	$ 26,000/year
20 years of Monitoring	**$ 520,000**

Note: The bond can be reduced as SHD determines monitoring is no longer needed, and as the monitoring period remaining is reduced.

2. Repair Fund of $25,000 (as a separate fund immediately available for pond liner repair).

Notes: Review the post-closure cost estimate by April 1st of each calendar year. the cost estimate shall be adjusted for inflation by multiplying the total estimated cost by an approved inflation factor. If other factors affecting the cost estimate have changed, the estimate shall be adjusted correspondingly. The new estimate shall be submitted to the Health District for approval.

INSPECTION CHECKLIST

Cap Maintenance

Has the landfill been mowed at least once a month during growing season? ☐ Yes ☐ No
Dates:_______________ and _______________

Are there any eroded areas that need to be repaired? ☐ Yes ☐ No
If yes, placed additional soil, re-graded, reseeded and mulched on:
Date:_______________

Are there any depressions or areas of subsidence on the landfill or does water collect and pond on areas of the landfill after a rainfall? ☐ Yes ☐ No
If yes, placed additional soil, re-graded, reseeded and mulched on:
Date:_______________

Is a thick stand of grassy vegetation established? ☐ Yes ☐ No
If no, reseeded and mulched on: Date:_______________

Are there bare spots or areas of dead vegetation? ☐ Yes ☐ No
If yes, placed additional soil, re-graded, reseeded and mulched on:
Date:_______________

Is there unwanted vegetation present that could compromise the integrity of the liner system? ☐ Yes ☐ No

Detention Pond Maintenance

Has the pond been mowed at least twice a year? ☐ Yes ☐ No
Dates:_______________ and _______________

Are there any eroded areas that need to be repaired? ☐ Yes ☐ No
If yes, placed additional soil, re-graded, reseeded and mulched on:
Date:_______________

Are there any depressions or areas of subsidence on the pond areas of the landfill after a rainfall and after the detention pond has drained? ☐ Yes ☐ No
If yes, placed additional soil, re-graded, reseeded and mulched on:
Date:_______________

Is a thick stand of grassy vegetation established? ☐ Yes ☐ No
If no, reseeded and mulched on: Date:_______________

Are there bare spots or areas of dead vegetation? ☐ Yes ☐ No
If yes, placed additional soil, re-graded, reseeded and mulched on:
Date:_______________

Is there any water draining from the pond leak detection system? ☐ Yes ☐ No
If yes, what is the estimated flow? Greater than 1/2 GPM? Determine source of leakage and repair.
Date:_______________

Is there pond outfall conveyance system functioning as designed? ☐ Yes ☐ No
If no, check piping for breaks and leaks?
Determine source of failure, schedule repair.
Date:_______________

Environmental Monitoring Systems Maintenance

Ground Water / Leachate System

Date of Quarterly Sampling and location:_______________

If yes, how many? _______________

If yes, note required actions and dates you performed the required actions:

Date:_______________Action:____

Surface Water Collection System

Date of Quarterly Sampling and location:_______________

If yes, how many? _______________

If yes, note required actions and dates you performed the required actions:

Date:_______________Action:____

Methane Gas Venting System

Date of Quarterly Sampling ____________________

Probe #	**Tested**	**Result**	**Probe #**	**Tested**	**Result**
#1	☐Yes ☐No		#7	☐Yes ☐No	
#2	☐Yes ☐No		#8	☐Yes ☐No	
#3	☐Yes ☐No		#9	☐Yes ☐No	
#4	☐Yes ☐No		#10	☐Yes ☐No	
#5	☐Yes ☐No		#11	☐Yes ☐No	
#6	☐Yes ☐No		#12	☐Yes ☐No	

*Note: Add a line for each sampling station for #, and testing performed.

____

Kenneth H. Nilsen, Washington Professional Engineer
Registration Number 25427

DETENTION PONDS

Maintenance Component	Defect or Problem	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	Any trash and debris which exceed 1 cubic foot per 1,000 square feet (this is about equal to the amount of trash it would take to fill up one standard size office garbage can). In general, there should be no visual evidence of dumping.	Trash and debris cleared from site.
	Poisonous Vegetation or Noxious Weeds	Any poisonous or nuisance vegetation which may constitute a hazard to the public.	No danger of poisonous vegetation where the public might normally be. Coordination with Snohomish Health District.
	Contaminants and Pollution	Oil, gasoline, or other contaminants of one gallon or more, or any amount found that could: 1)cause damage to plant, animal, or marine life; 2)constitute a fire hazard; or 3) be flushed downstream during rain storms.	No contaminants present other than a surface film. (Coordination with Snohomish Health District)
	Unmowed Grass/Ground Cover	If facility is located in private residential area, mowing is needed when grass exceeds 18 inches in height. In other areas, the general policy is to make the pond site match adjacent ground cover and terrain as long as there is no interference with the function of the facility.	When mowing is needed, grass/ground cover should be mowed to 2 inches in height. Mowing of selected higher use areas rather than the entire slope may be acceptable for some situations.
	Rodent Holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes or other causes.	Rodents destroyed and dam or berm repaired. (Coordination with Snohomish Health District)
	Insects	When insects such as wasps and hornets interfere with maintenance activities. Mosquito complaints accompanied by presence of high mosquito larvae concentrations (aquatic phase).	Insects destroyed or removed from site. Mosquito control: Swallow nesting boxes or approved larvicide applied.
	Tree Growth	Tree growth threatens integrity of berms acting as dams, does not allow maintenance access, or interferes with maintenance activity (i.e., slope mowing, silt removal, vactoring, or equipment movements). If trees are a threat to berm integrity or not interfering with access, leave trees alone.	Trees do not hinder maintenance activities. Harvested trees should be recycled into mulch or other beneficial uses (e.g., alders for firewood).
Side Slopes of Pond	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted berm embankment.	Slopes should be stabilized by using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction. If erosion is occurring on compacted berms a licensed civil engineer should be consulted to resolve source of erosion.
Storage Area	Sediment	Accumulated sediment that exceeds 10% of the designed pond depth.	Sediment cleaned out to designed pond shape and depth; pond reseeded if necessary to control erosion.
	Liner Damage (If Applicable)	Liner is visible and has more than three 1/4-inch holes in it.	Liner repaired or replaced.
Pond Berms (Dikes)	Settlement	Any part of berm that has settled 4 inches lower than the design elevation. Settling can be an indication of more severe problems with the berm or outlet works. A licensed civil engineer should be consulted to determine the source of the settlement.	Dike should be built back to the design elevation.
Emergency Overflow/Spillway and Berms over 4 feet in height.	Tree Growth	Tree growth on emergency spillways create blockage problems and may cause failure of the berm due to uncontrolled overtopping. Tree growth on berms over 4 feet in height may lead to piping through the berm which could lead to failure of the berm.	Trees should be removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. A licensed civil engineer should be consulted for proper berm/spillway restoration.
Emergency Overflow/Spillway	Rock Missing	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil at the top of out flow path of spillway. Rip-rap on inside slopes need not be replaced.	Replace rocks to design standards.

WATER QUALTIY TREATMENT PONDS

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
Pond Area	Water Level	First cell empty, doesn't hold water.	Line the first cell to maintain at least 4 feet of water. Although the second cell may drain, the first cell must remain full to control turbulence of the incoming flow and reduce sediment resuspension.
	Defective Vegetation	Vegetation such as grass and weeds need to be mowed when it starts to impede aesthetics of pond. Mowing is generally required when height exceeds 18 inches. Mowed vegetation should be removed from areas where it could enter the pond, either when the pond level rises, or by rainfall runoff.	Vegetation should be mowed to 4 to 5 inches in height. Trees and bushes should be removed where they are interfering with pond maintenance activities; that is, at the inlet, outlet and near engineered structures.
	Algae Mats	When algae mats develop over more than 10% of the water surface, they should be removed. Excessive algae mats interfere with dissolved oxygen content in the water and pose a threat to downstream lakes if excess nutrients are released.	Algae mats that cover more than 10% of the surface of any cell should be removed. A rake or mechanical device should be used to remove the algae. Removed algae can be left to dry on the pond slope above the 100-year water surface.
	Trash and Debris	Accumulation that exceeds 1 cubic foot per 1000 square foot of pond area.	Trash and debris removed from pond.
	Sediment Accumulation	Sediment accumulations in pond bottom that exceeds the depth of sediment zone plus 6 inches, usually in the first cell.	Removal of sediment from pond bottom.
	Oil Sheen on Water	Prevalent and visible oil sheen.	Remove oil from water by use of oil-absorbent pads or by vactor truck. Refer problem to locate source and correct. If chronic low levels of oil persist, plant wetland plants such as *Juncus effusus* (soft rush) which can uptake small concentrations of oil.
	Erosion	Erosion of the pond's side slopes and/or scouring of the pond bottom, that exceeds 6 inches, or where continued erosion is prevalent.	Slopes should be stabilized by using proper erosion control measures, and repair methods.
Pond Dike/Berm	Settlement	Any part of these components that has settled 4 inches or lower than the design elevation, or inspector determines dike/berm is unsound.	Dike/berm is repaired to specifications.
Internal Berm	Concentrated Flow	Berm dividing cells should be level.	Build up low areas of berm or lower high areas so that the berm surface is level and water flows evenly over the entire length of the berm from the first cell to the second.
Inlet/Outlet Pipe	Sediment and Debris	Inlet/Outlet pipe clogged with sediment and/or debris material.	No clogging or blockage in the inlet and outlet piping.
Overflow Spillway	Rock Missing	Rock is missing and soil is exposed at top of spillway or outside slope.	Replace rocks to specifications.

Appendix G
HELP Model

Associated Earth Sciences, Inc., May 31, 2011

Associated Earth Sciences, Inc.

Celebrating Over 25 Years of Service

May 31, 2011
Project No. KE090231A

PACE Engineers, Inc.
11255 Kirkland Way, Suite 300
Kirkland, Washington 98033

Attention: Mr. Marty Penhallegon, P.E.

Subject: Hydraulic Evaluation of Landfill Performance (HELP) Model
Water Balance Evaluation of Proposed Landfill Cover System
Former Go East Landfill
Snohomish County, Washington

Dear Mr. Penhallegon:

Associated Earth Sciences, Inc. (AESI) is pleased to provide this letter-report presenting our water balance evaluation of the proposed landfill cover system for the former Go East Landfill. The location of the project site is shown on the "Vicinity Map," Figure 1. Our water balance evaluation was completed using the U.S. Environmental Protection Agency (EPA) landfill cover design and the hydraulic evaluation of landfill performance HELP model to evaluate changes in recharge to the ground water system through the proposed landfill cover system. This letter-report has been prepared for the exclusive use of PACE Engineers, Inc. (PACE) and their agents for specific application to this project. The proposed landfill cover configuration is presented on the "Landfill Cover Plan," Figure 2. Details of each of the proposed cover systems are presented on the "Cover System Detail," Figure 3. This letter-report is intended to meet the requirements of WAC 173-350-400(3)(f).

INTRODUCTION

The Go East project site is a square-shaped, approximate 40-acre parcel, extending approximately ¼ mile north-south and east-west (Figure 1). The northern portion of the subject parcel contains the approximately 7-acre, former Go East Landfill. Site topography includes steep slopes leading down into the subject site from the north and west. Portions of the steep bank near the western property line appear to include relict excavation faces, which may be the result of past surface mining activities. The northern two-thirds of the subject site is generally flat-lying to gently sloping, while the southern, roughly one-third of the property is comprised of a large, steeply sided drainage ravine. This ravine turns northward east of the subject site and extends beyond the northeast corner of the subject site toward the floor of the Snohomish River valley and Lowell-Larimer Road. The site is bound on the north and west by existing residential subdivisions, to the south by the steeply incised drainage, and to the east by the Olympic Pipeline Easement and the steeply sided drainage. Site vegetation consists of small to large, second-growth deciduous and coniferous trees and moderate to dense undergrowth. The former landfill area is vegetated predominantly with blackberry brambles. A small stream (Existing Stream 2, Figure 2), delineated by others, was observed to the south of the former landfill area. A spring emanates from the base of the steeply sided ravine to the northeast of the landfill area, which feeds Existing Stream 3 (Figure 2).

GEOLOGY/HYDROGEOLOGY

This summary of the geology and hydrogeology of the Go East Landfill site is based on the subsurface explorations, subsurface interpretations, and ground water level monitoring data detailed in our report entitled "Revised Hydrogeology, Ground Water, and Surface Water Quality Report, Former Go East Landfill, Snohomish County, Washington," dated May 3, 2011.

Geology

Geologic conditions at the site include surficial topsoils underlain by greater than 21 feet of landfill fill. The landfill fill is underlain by medium dense to very dense sand, with silt lenses, interbeds, and variable silt and gravel content, interpreted to be Vashon advance outwash deposits. Underlying the Vashon advance outwash sediments are sediments interpreted to be pre-Vashon glacial lacustrine silts. The lacustrine silts consisted of very stiff to hard, moist to wet, bluish gray silt, with a few very fine sand partings and fine sand beds.

Ground Water

A ground water system is present in the advance outwash sand deposits beneath the landfill fill. Depths to ground water varied between about 31 and 51 feet with ground water occurring within the granular advance outwash deposits above the fine-grained, lower-permeability, pre-Vashon glacial lacustrine deposits. The ground water system in the advance outwash deposits appears to be unconfined to semi-confined depending upon the location at the site and the nature of the underlying sediments. Ground water flow in the shallow ground water system beneath the site generally flows to the east toward the Snohomish River valley. There is also a component of southerly flow in the northern potion of the site. Discharge from the ground water system in the advance outwash deposits is to seeps and springs in the eastern portion of the site where the contact between the advance outwash deposits and underlying fine-grained pre-Vashon-age lacustrine deposits and the ground water system daylights on the steep slopes east and southeast of the landfill footprint. Recharge to the ground water system in advance outwash deposits in the vicinity of the site is likely from infiltration of precipitation.

HYDRAULIC EVALUATION OF LANDFILL PERFORMANCE (HELP) MODEL: WATER BALANCE

General

A water balance of an area is a rough quantitative description of the relationship between the input of water (precipitation) and the loss of water (mainly by evapotranspiration, surface water runoff, and ground water recharge). As precipitation falls on permeable ground surfaces, a portion will infiltrate into the soil. The infiltrated water is held in the soil as soil moisture by capillary forces. The precipitation that does not infiltrate remains on the surface, filling small depressions and eventually running downslope as overland flow. When the soil moisture content is high, such as what would generally occur during the winter and spring months of the year, water will migrate downward and eventually recharge the perched unconfined aquifer. As the water infiltrates, a portion is used by plants as evapotranspiration. During periods of low precipitation, such as the months of May through September, not only is all of the infiltrated precipitation generally lost to evapotranspiration beneath vegetated areas, but the plants actually utilize the water stored in the upper soil column creating a soil moisture deficit situation.

The HELP model was used to develop a water balance for the proposed landfill cap design. The HELP model allows the input of a proposed landfill cap profile with the individual layers which comprise the landfill cap. HELP model layers can include vertical percolation layers, lateral drainage layers, barrier soil layers, and geotextiles and geonets.

Three cover systems (Cover System 1, Cover System 2, and Cover System 3) are included in the proposed approximately 7.25-acre landfill cap (Figure 2). A HELP model profile was developed for each proposed cover system and corresponding area of each cover to assess water balances under each cover system type in relation to the existing condition. A cumulative water balance of the entire landfill cap area was also developed which integrated each cover system. A discussion of individual cover system water balances and the integrated complete landfill cover system are presented in the following sections of this letter-report. A permeability of 1 x 10-6 cm/sec was used for all “barrier soil liners” per WAC 173-350.

Cover System 1

Cover System 1 will comprise 5.21 acres of the proposed 7.25-acre landfill cap. Details of Cover System 1 as input into the HELP model are presented in Table 1.

Table 1
Cover System 1 HELP Model Input

Layer	Layer Thickness (inches)	Layer Depth (inches)	HELP Layer Designation	HELP Layer Material
Vegetated Topsoil	6	0 to 6	Vertical Percolation Layer	Fine Sandy Loam
Compacted Soil	24	6 to 30	Barrier Soil Liner	Silt Loam Compacted
PVC Liner	30-mil	30	Geomembrane Liner	PVC
Compacted Subgrade	6	30 to 36	Vertical Percolation Layer	Sandy Loam

Cover System 2

Cover System 2 will comprise 0.87 acres of the proposed 7.25-acre landfill cap. Details of Cover System 2 as input into the HELP model are presented in Table 2.

Table 2
Cover System 2 HELP Model Input

Layer	Layer Thickness (inches)	Layer Depth (inches)	HELP Layer Designation	HELP Layer Material
Vegetated Topsoil	6	0 to 6	Vertical Percolation Layer	Fine Sandy Loam
Compacted Soil	24	6 to 30	Barrier Soil Liner	Silty Loam Compacted
PVC Liner	30-mil	30	Geomembrane Liner	PVC
Compacted Soil	12	30 to 42	Vertical Percolation Layer	Silty Loam
PVC Liner	30-mil	42	Geomembrane Liner	PVC
Compacted Soil	6	42 to 48	Vertical Percolation Layer	Loamy Fine Sand

Cover System 3

Cover System 3 will comprise 1.17 acres of the proposed 7.25-acre landfill cap. Details of Cover System 3 as input into the HELP model are presented in Table 3.

Table 3
Cover System 3 HELP Model Input

Layer	Layer Thickness (inches)	Layer Depth (inches)	HELP Layer Designation	HELP Layer Material
Vegetated Topsoil	6	0 to 6	Vertical Percolation Layer	Fine Sandy Loam
Compacted Soil	24	6 to 30	Barrier Soil Liner	Silty Loam Compacted

Water Balance: HELP MODEL

The "weather generator" in the HELP model was used to generate 30 years of weather data for the water balance analysis. The water balances for the existing condition and landfill cover system can be described with the following equation:

$$RCH = PPT - RO - ET$$

Where RCH is ground water recharge at the site, PPT is natural precipitation, RO is surface water runoff, and ET is actual evapotranspiration of natural precipitation.

Existing Condition Water Balance

The 7.25-acre landfill cover area was modeled under the existing vegetated condition with no engineered landfill cover system to estimate an average annual ground water recharge rate for the 30-year simulated weather data. The existing condition water balance was also run for the individual areas occupied by the three proposed engineered landfill cover types (Cover System 1, Cover System 2, and Cover System 3). A breakdown of the acreages proposed for the three cover systems is summarized in Table 4.

Table 4
Cover Systems Acreage Areas

Cover System	Acres
Cover System 1	5.21
Cover System 2	0.87
Cover System 3	1.17
Total	**7.25**

Results of the existing condition average annual recharge volumes, rates, and minimum and maximum annual recharge rates for each proposed cover system area are presented in Table 5.

Table 5
Existing Condition HELP Model
Annual Average Recharge and Precipitation

Cover System Area	Annual Average Recharge Volume (acre-feet)	Average Annual Precipitation (inches/year)
Cover System 1	6.4	34.37
Cover System 2	1.1	34.37
Cover System 3	1.9	34.37
Total	**9.4**	--

Landfill Cover System Water Balance

The HELP model was used to evaluate the water balance for each of the three proposed landfill cover types under the same 30-year simulated weather data derived from the HELP model weather generator.

The HELP water balance was run for the individual areas occupied by the three proposed engineered landfill cover types (Cover System 1, Cover System 2, and Cover System 3) based on each cover system's design and acreage breakdown presented above.

Results of the HELP water balance model for each proposed cover system area are presented below in Table 6.

Table 6
Landfill Cover Systems HELP Model Annual Average Recharge and Runoff

Cover System Area	Annual Average Recharge Volume (acre-feet)	Annual Average Recharge Rate (inches/year)	Annual Average Runoff Volume (acre-feet/year)	Annual Average Runoff Rate (inches/year)
Cover System 1	0.10	0.23	5.18	11.9
Cover System 2	0.02	0.27	0.97	13.3
Cover System 3	0.69	7.02	0.85	8.72
Total	**0.81**	--	**7.00**	--

HELP Water Balance: Existing Conditions versus Landfill Cover Systems

Entire Landfill Area

The HELP model results show an average annual recharge volume for the 7.25-acre landfill cover area of approximately 9.4 acre-feet under the existing conditions. HELP model results under the proposed landfill cover systems show an average annual recharge volume of 0.81 acre-feet. The placement of the proposed landfill cover system will result in a decrease in average annual ground water recharge volume of 8.59 acre-feet (91 percent). A majority of the reduced average annual recharge volume is runoff from the landfill cover systems which will be collected and conveyed to an outfall on the slope below the northeast portion of the landfill.

Individual Cover Systems

Existing recharge volumes versus landfill cover recharge volumes are presented in Table 7.

Table 7
Average Annual Recharge: Existing Conditions versus Landfill Cover Systems HELP Model

Cover System Area	Annual Average Recharge Volume Existing Conditions (acre-feet)	Annual Average Recharge Volume Landfill Cover System (acre-feet)	Recharge Change (acre-feet)	Recharge Percent Decrease
Cover System 1	6.4	0.10	- 6.30	98
Cover System 2	1.1	0.02	- 1.08	98
Cover System 3	1.9	0.69	- 1.21	64

The greatest volume and percent decrease in recharge from the HELP model results occurred beneath Cover Systems 1 and 2. The large decrease in recharge under Cover Systems 1 and 2 is likely strongly influenced by the presence of very low permeability geomembranes.

SUMMARY

AESI completed a water balance assessment of the Go East Landfill site to assess changes in recharge volumes with the placement of a landfill cover system. The assessment included a review of existing geologic and hydrogeologic publications of the site vicinity and the proposed landfill cover systems which will occupy approximately 7.25 acres.

Our HELP model water balance simulations of the existing and landfill cover conditions indicated average annual recharge volumes of approximately 9.4 acre-feet under the existing condition and approximately 0.81 acre-feet under the landfill cover condition. The decrease in the average annual recharge of approximately 8.6 acre-feet represents a decrease in recharge of 91 percent under the landfill cover system. A majority of the decrease in recharge is due to conveyance of precipitation as runoff from the landfill cover system. The greatest decrease in average annual recharge of approximately 98 percent occurred in the areas of the landfill where Cover Systems 1 and 2 are proposed. Cover Systems 1 and 2 include at least one geomembrane liner as part of the landfill cover system profile, which increases runoff from theses cover systems versus the existing conditions. Runoff from the landfill cover systems will be routed to a discharge outlet which will convey runoff to Stream 3, located at the northeast corner of the landfill. The construction of the proposed landfill covers will significantly reduce the amount of water entering the landfill due to precipitation and significantly reduce the amount of water available for production of leachate.

LIMITATIONS

We have prepared this letter-report for PACE for use in regard to the Go East Landfill. The conclusions and interpretations presented in this letter-report should not be construed as a warranty of the subsurface conditions. Our conclusions and recommendations are based on a baseline of on-site information provided by various other consultants.

This letter-report is issued with the understanding that the information and recommendations contained herein are brought to the attention of the appropriate design team personnel and incorporated into the project plans and specifications, and the necessary steps are taken to see that the contractor and subcontractor carry out such recommendations in the field.

Within the limitations of scope, schedule, and budget, AESI attempted to execute these services in accordance with generally accepted professional principles in the fields of engineering geology and hydrogeology at the time this letter-report was prepared. No warranty, express or implied, is made.

We have enjoyed working with you on this study and are confident that these recommendations will aid in the successful completion of your project. If you should have any questions or require further assistance, please do not hesitate to call.

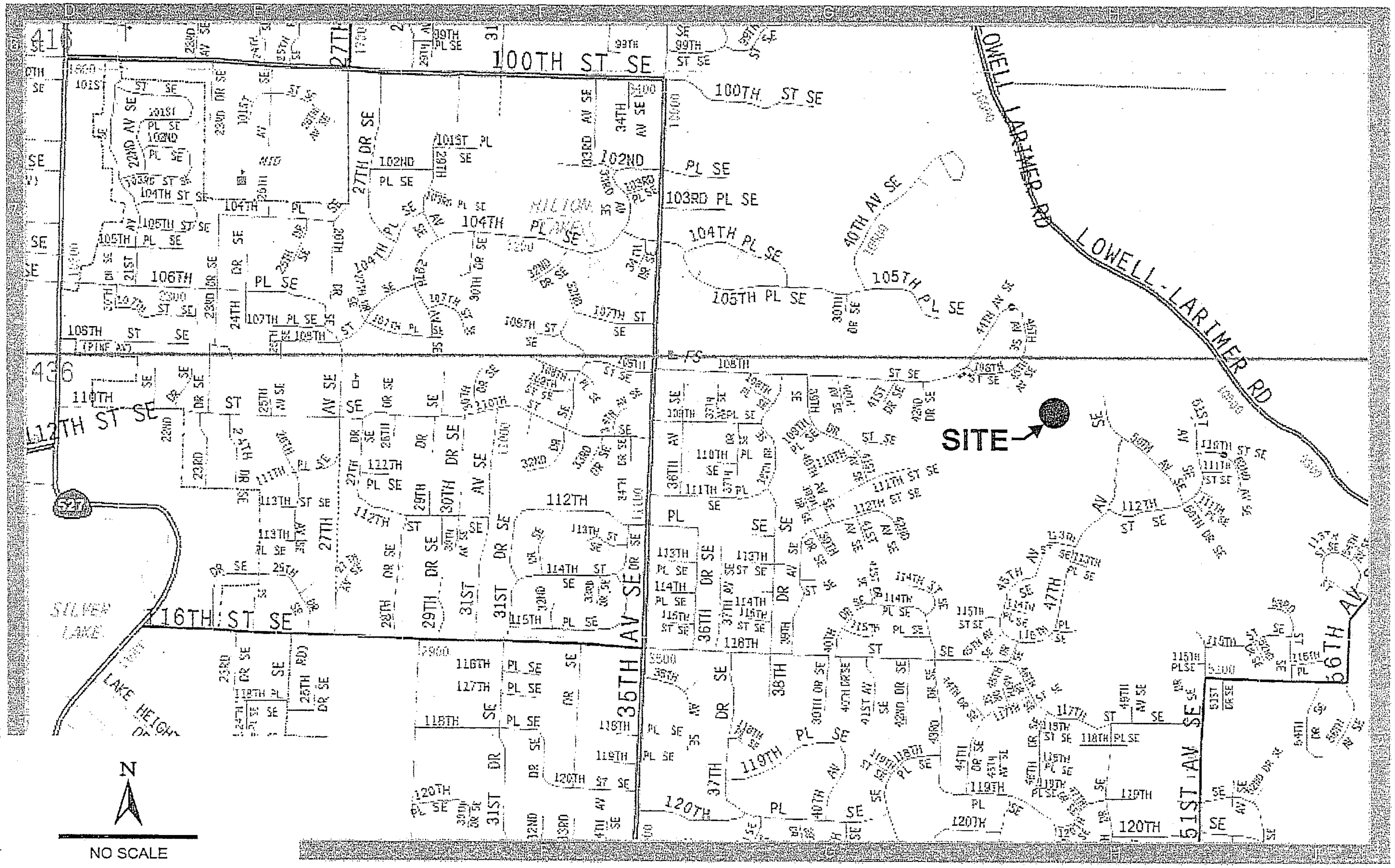
Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

5/31/2011

Jon N. Sondergaard, L.G., L.E.G.
Principal Geologist

David J. Baumgarten, L.G., L.Hg.
Senior Hydrogeologist

Attachments: Figure 1: Vicinity Map
Figure 2: Landfill Cover Plan
Figure 3: Cover System Detail



Associated Earth Sciences, Inc.

VICINITY MAP
GO EAST LANDFILL DEVELOPMENT
SNOHOMISH COUNTY, WASHINGTON

FIGURE 1
DATE 9/09
PROJ. NO. KE090231A

090231 Go East Landfill Development \ 090231 Vicinity.cdr

GO EAST
LANDFILL CLOSURE PLAN
Snohomish County, Washington

Appendix H

Sampling / Analysis and Monitoring Plan

PACE Engineers, Inc., June 2015

Rev. April 30, 2018

SAMPLING/ANALYSIS AND MONITORING PLAN

1. Overview

This document presents the plan for sampling, analysis, and monitoring of methane gas, groundwater, and surface water at the Go East Landfill solid waste/wood waste landfill following completion of landfill closure. The Go East Landfill had been closed since 1983. The final requirements for closure are now being completed in accordance with the applicable regulation for a limited purpose landfill as per the Solid Waste Handling Standards, Washington Administrative Code (WAC) Chapter 173-350.

These regulations require post closure monitoring of:

- Landfill Gas
- Groundwater Quality
- Surface Water Quality

Preparation of this Plan

This plan has been prepared under the direction of Mr. Ken Nilsen, Professional Engineer, registered in the State of Washington. Mr. Nilsen's Washington Professional Engineer registration number is 25427. Signature and professional stamp are located on the last page.

Objectives of Monitoring Program

The P&GE, LLC, Closure Plan design addresses the methane gas, groundwater, and surface water levels as well as the monitoring system. The site has been monitored for nearly 30 years. Recordkeeping will continue as proposed herein and will include the previously installed monitoring wells as well as future installations, accordingly;

- The landfill gas monitoring strategy will comply with; WAC 173-350-400(3)(e)(I) Final Closure System Design – collection and venting.
- The groundwater monitoring strategy will comply with; WAC 173-350-500(4); sampling and analysis plan, & WAC 173-350-500(5); data analysis, notification and reporting
- The surface water monitoring analysis will comply with; WAC 173-201A

The purpose of this monitoring system would be to provide a basis for evaluating the effectiveness of the implemented closure and to provide a history of pertinent data that would determine when the landfill is stabilized and when post-closure monitoring may cease. The landfill monitoring program is designed to:

- Identify the horizontal direction of groundwater flow and groundwater/surface water quality around the landfill;
- Monitor the presence and migration of methane gas on site;
- Perform intrawell and interwell comparisons to determine if the landfill is impacting groundwater quality;
- On a yearly basis following collection of new quarterly baseline data, evaluate the significance of similarities or differences in groundwater data and groundwater flow information from the monitoring wells and gas collection points, and determine if

continued monitoring is necessary or if the monitoring program may be reduced or eliminated.

Information Included in This Monitoring Plan

Section 2 of this plan includes general background information on the landfill and the existing site conditions.

Section 3 presents the plan for groundwater monitoring that will be initiated following Phase 2 of the landfill closure project.

Attachments to this plan include:

Attachment A – WAC 173-350-500 Groundwater Monitoring WAC Requirements

Attachment B – Groundwater Sampling Surface Water Quality Methodology

Attachment C – Quality Assurance Plan

Attachment D – Portable Landfill Gas Analyzer Specifications

Attachment E – Residential Methane Mitigation Design

2. Monitoring Methodology

Landfill Gas Monitoring

Following is a brief summary of the current know occurrence of Landfill Gas at the site. This is more fully described in Section 7 of the Go East Landfill Closure Plan.

The former Go East Landfill contains waste consisting of inorganic materials and wood. The wood is unaffected by anaerobic digestion because the microorganisms cannot degrade the lignin in wood. This may explain the low levels of methane found within this wood waste landfill.

Associated Earth Sciences, Inc., conducted monitoring with temporary gas probes on August 7, 2009, and October 5, 2009. The results of the landfill gas measurements are found in the Geotechnical Engineering Report Section 4.4 and Table 1. The details are summarized as;

Ten temporary gas probe monitoring devices (GS-1 through GS-10) were placed in and within close proximity to the existing landfill which had been previously closed and capped prior to the implementation of WAC 173-350

- GS-1, 2, 4, 6, 7, 9, 10 – gas-testing locations showed a 0.0 percent concentration of methane.
- GS-3 – Methane concentration was found in GS-3, which is located roughly in the center of the closed and capped landfill. The methane concentration was 0.0 percent until the probe reached a depth of 15 feet. Between 15 feet deep and 30 feet deep, the methane concentrations ranged from 4.2 to 8.4 percent.
- GS-5 – located on the eastern portion of the landfill, contained methane concentrations of 1.7% to 2.7% at 30 to 50 feet deep
- GS-8 – located in the southern portion of the landfill contained a methane concentration of 0.2% at a depth of 20 feet.

Appendix H

Table 1: Gas Probe Summary Table:

Site ID	Evaluation Date	Concentration % by Volume	Depth to Sample
GS-1	2009	0.0%	N.A.
GS-2	2009	0.0%	N.A.
GS-3	2009	4.2% to 8.4	15' – 30'
GS-4	2009	0.0%	N.A.
GS-5	2009	1.7% to 2.7%	30 to 50
GS-6	2009	0.0%	N.A.
GS-7	2009	0.0%	N.A.
GS-8	2009	0.2%	20'
GS-9	2009	0.0%	N.A.
GS-10	2009	0.0%	N.A.

Design Criteria

The Washington Administrative Code (WAC) Chapter 173-350-400(3)(e)(I) provides criteria for collection and removal of methane gas and other gasses for Limited Purposes Landfills. The Geotechnical Engineering Report recommends that "methane mitigation systems be provided beneath detention ponds lined with synthetic materials and around vaults or manholes when these structures are located within the landfill limits."

Proposed Landfill Methane Gas Control Monitoring

Overview – A small amount of gas was present during the gas probe testing in 2009, and gas monitoring performed by the Snohomish Health District has documented a decreasingly low level of gas detected at the site over the last 30 years since the landfill was active. The past testing demonstrated that the existing landfill meets the requirements of WAC 173-351-400(4)(a)(i). However landfill gas monitoring is proposed to continue during the post-closure period, per WAC 173-304-407(7).

This site meets the guidelines for a methane collection and venting system. The low levels of methane gas will be safely released in a controlled manner into the air by means of a methane vent trench system, located at the perimeter of the closed landfill. This should prevent gas migration beyond the landfill area. Additionally, automatic, continuous gas monitoring equipment will be installed within the methane collection system. Monitoring points will be placed generally 300' apart. Please refer to Appendix D, Sheet 2 of 2, detail 1.

Methane Vent Trench Design – The final soil cover system will be constructed and managed in a manner that will greatly reduce random venting of gases. The proposed cover system is impenetrable, constructed of a combination of 2 feet (minimum) of earthen soil layer placed over a geomembrane liner to fully cover the landfill area. As the gas rises, it will encounter the impenetrable surfaces and travel horizontally to the gravel-filled methane vent trench system located at the perimeter of the closed landfill. This trench will be about one foot wide and about 15-20 feet deep (or to the depth of contact to the undisturbed native soil) and filled with gravel. At the perimeter low levels, gases will be self-venting. Therefore, any methane gas will be diluted in the air long before it would have a chance to travel underground past the trench system surrounding the closed landfill. Additionally, the design proposes to install a 2 inch diameter horizontal vent pipe within the gravel trench that could be used as a forced air venting system should the situation arise.

Continuous Monitoring of Gas Levels – Monitor probes will be located approximately every 300 feet along the trench, where 4-inch diameter vertical pipes will be located. Continuous field gas monitors will be installed in the **structures attached to** the vertical pipes along the west and south side of the landfill (four unit's total). These units will provide continuous monitoring and readouts of any gas being released at these points. **Continuous** monitoring would take place for three (3) months of dry season and three (3) months of wet season during the first year following closure. This monitoring could extend longer, **per SHD discretion,** if any unsafe issues with the low levels of methane gas are found.

Methane gas measurements would also be collected on a quarterly basis for two years, subsequent to removal of the continuous monitoring equipment, from the monitoring well points, located on the landfill perimeter, using the portable gas detector, described in Attachment D.

Home Protection – the homebuilder will be required to provide gas migration barriers beneath each home located within 1,000 feet of the landfill. Please refer to Attachment F, Residential Methane Mitigation Design for detail of prototypical barrier solution for single-family residential properties. Alternative design solutions may be considered.

Monitoring Responsibility – The owner shall retain a qualified professional to oversee the completion of the appropriate gas monitoring testing.

Documentation – The weekly readouts of the continuous field gas monitoring devices will be furnished to the SHD for the 6 months monitoring period, indicated above. Documentation shall be consistent with the Snohomish Health District Sanitary Code, Chapter 3.1, Section XXXVI, E and shall demonstrate that levels at the perimeter are below the lower explosive limits of 5%.

If threshold levels of 5%, at the landfill edge are exceeded, then necessary actions may be taken to mitigate for this higher gas level. This is consistent with the Snohomish Health District Sanitary Code, Chapter 3.1, Section XXXVI, and E. Mitigation actions may include modifying the gas collection system to an active forced air system, additional monitoring or additional gas mitigation. Additionally monitoring of the sampling locations associated with greater than 5% thresholds levels, will continue for two years after construction or until the methane, levels are determined to be safe, and trending downward, in accordance to SHD standards. **However, in the event SHD determines additional monitoring for a longer period is warranted an extension will be negotiated.**

The quarterly gas monitoring observations reports and results of field tests shall be documented on an appropriate data sheet and kept on file for two years following the construction finish date. A copy of these annual reports will be furnished to Snohomish Health District (SHD).

Appendix H

Remediation Plan Where Methane Gas is Measured Above Sate Limit – If detection of explosive gases exceed the following limits a remediation plan will be implemented:

- Twenty-five percent of the lower explosive limit for the gases in facility structures (excluding the gas control or recover system components);
- The lower explosive limit in soil gases or in ambient air for the gases at the property boundary or beyond; and
- One hundred parts per million by volume of hydrocarbons (expressed as methane) in offsite structures.

Typically for methane this is 5% by volume which is the limit for this project. Any amount beyond this level is referred to hereafter as “High Levels.”

The remediation plan for this landfill closure is as follows:

- The gas mitigation plan for the closure has be discussed earlier. Gas generated within the closed landfill is being directed to and collected in the gravel gas trench surrounding the upper portions of the landfill and directed by piping to 100 feet away from the landfill boundary to the interior of the landfill in a common, uninhabited space where it is released via several vents. This will allow for an easy way to monitor methane discharge levels.
- Methane is being monitored 24/7 for a 6-month period or longer as determined appropriate by SHD. Methane recorders will be located inside four manhole structures installed along the gravel trench at locations of maximum concentrations prior to being released directly to the atmosphere thru piping directing it at least 100 feet from inhabited structures.
- Should levels increase above 5% by volume (“High Levels”) a force air ventilation system can be sized and installed to help dissipate the High Levels.
- SHD will be promptly notified of events of High Levels. Within 7 calendar days of High Level detection a written report will be provided to SHD to include remediation steps to be employed to protect human health.
- Any homes constructed within 100 feet of the landfill will be monitored as set forth in this plan.
- Any homes found with High Levels will be immediately notified and evacuated until levels drop to safe levels.
- Within 60 calendar days of detection the remediation plan describing nature and extent of High Level problem and its remediation will be undertaken.
- Monitoring of the probes will be increased to weekly from quarterly, until level are confirmed to drop below 5%.
- Monitoring of the home installed gas monitoring systems will be checked to see they are in working order and in place.
- Results of all testing including the 24/7, results of the probes, and any issues with the home monitoring systems will be recorded and reported quarterly to SHD. After the limits have been confirmed to be below 5% and declining, the reporting period will be reduced to yearly.
- After it has been determined that methane gas levels are not a concern, the probes will be decommissioned per state requirements.

Proposed Groundwater Monitoring System

Overview – The purpose of this monitoring system is to understand the horizontal and vertical groundwater flow relationships, to collect groundwater samples for water quality measurements, and to evaluate the impact of the landfill on the groundwater.

The landfill groundwater monitoring program is designed to:

- Identify the horizontal direction of groundwater flow and groundwater/surface water quality around the landfill.
- Perform comparisons to determine if the landfill is impacting groundwater quality when compared to the gradient well, and,
- On a yearly basis following collection of new quarterly data, evaluate the significance of similarities or differences of groundwater quality and groundwater flow information from the monitoring wells relative to the site data collected from previous years, and determine if continued groundwater monitoring is necessary or if the groundwater monitoring program may be reduced or eliminated.

Location of Existing Well Network

The existing monitoring well network is listed below (Table 2) and mapped in Figure 1. The four original wells (MW-1 through MW-4) were installed in 2009 to determine the depth to water and direction of groundwater flow.

Table 2: Go East Landfill Groundwater Monitoring Well Character and Data

Site ID	Evaluation Date	Casing at Ground Elevation (feet)	Top of Screen	Depth to Bottom of Screen	Depth to Groundwater (feet)	Groundwater Elevation (feet)
MW-1	8/19/2009	261.43	196.43	186.43	51.15	210.28
MW-1	2/21/2011	261.43	196.43	186.43	50.60	210.83
MW-1	4/15/2011	261.43	196.43	186.43	50.36	211.07
MW-2	8/192009	234.53	184.53	174.53	51.40	183.39
MW-2	2/21/2011	234.53	184.53	174.53	50.35	184.18
MW-2	4/15/2011	234.53	184.53	174.53	50.13	184.40
MW-3	8/192009	244.10	194.10	184.10	30.95	213.15
MW-3	2/21/2011	244.10	194.10	184.10	39.31	204.79
MW-3	4/15/2011	244.10	194.10	184.10	38.91	205.19

Site ID	Evaluation Date	Casing at Ground Elevation (feet)	Top of Screen	Depth to Bottom of Screen	Depth to Groundwater (feet)	Groundwater Elevation (feet)
MW-4	0/0/2009	209.22	189.22	179.22	dry	0.00
SP-1 (Spring)	0/0/2009	110.50		—	—	110.50
Proposed Additional Monitoring Wells						
MW-5	0/0/2012	—	—	—	—	—
MW-6	0/0/2012	—	—	—	—	—

All elevations relative to NGVD29 datum.

Monitoring – Ongoing monitoring of wells (MW-1 through MW-4) and the newly proposed additional monitoring wells (MW-5 & MW-6) will continue on a quarterly basis. The particulars regarding the location and construction of the proposed new wells will be presented in a work plan to be reviewed and approved by the SHD. The work plan will be presented to SHD once the closure plan has been approved and prior to the start of construction of the landfill cover.

Given the difficulty of access to the base of the landfill northeasterly slope, two (2) additional groundwater monitoring wells will be installed on the northeast side of the landfill. Due to the current difficult site access to this location, these additional monitoring wells will be installed during landfill cap construction using either limited access drilling equipment or man portable drive points. These additional monitoring wells will provide ongoing opportunity to monitor groundwater upslope of where groundwater daylights at the SP-1 spring location.

Schedule – Per WAC 173-350-500, monitoring will continue on a quarterly basis following closure of the landfill until SHD deems the site is stabilized and permits monitoring to stop, or a maximum of 20 years.

Monitoring Responsibility – The owner shall retain a qualified Professional Engineer to complete the following groundwater monitoring.

Documentation – The results of each quarterly monitoring event will be compiled into an annual data report that will be submitted to SHD each year. Quarterly logs, results of field tests, and laboratory test results shall be summarized and analyzed in an annual report submitted to SHD the year following the monitoring activities and kept on file for two years following the construction finish date. Evaluation of data will be discussed per requirements of WAC 173-350-500(5).

Proposed Surface Water Monitoring

Overview – Surface water monitoring will follow the requirements of WAC 173-201A, which includes testing for parameters such as pH, sulfate, nitrates, and per table located in C-1.

Appendix H

Location & Sampling Procedures – Monitoring in Stream 3 (see Appendix D, Sheet 1) at the northeast corner of the site where the stream exits the site, and spring SP-2 in Stream 2 at the central portion of the eastern property line. Samples will be collected and placed in a suitable container and transported to a subcontracted analytical laboratory for water quality testing. Each sample will be analyzed for RCRA 8 metals, iron, manganese, chloride, sulfate, pH, specific conductivity, and semi-volatile organics. Laboratory certificates will be provided to SHD quarterly.

Schedule – Per WAC monitoring and analysis will occur and be provided to SHD quarterly and be summarized and evaluated in an annual report. Once the closure plan has been approved, quarterly monitoring will begin. Surface water monitoring has taken place periodically for the 28 years since the landfill operations stopped in 1983. Subsequent surface water monitoring will continue on a quarterly basis through construction and for two years following closure of the landfill. However, in the event SHD deems the site is stabilized at an earlier date monitoring will terminate. Similarly, in the event SHD determines additional monitoring for a longer period is warranted, an extension will be negotiated. An extension request will be based on recent data; results of field tests, and results of laboratory tests. The actual post-activity monitoring period will have exceeded 30 years after the initial closure activity was completed.

Monitoring Responsibility – The owner shall retain a qualified professional to complete the appropriate surface water testing.

Documentation – The results of each quarterly monitoring event will be compiled into an annual data report that will be submitted to SHD each year. Quarterly logs, results of field tests, and laboratory results shall be summarized and analyzed in an annual report submitted to SHD the year following the monitoring activities and kept on file for two years following the construction finish date.

Kenneth H. Nilsen, Washington Professional Engineer
Registration Number 25427

Attachment A
WAC 173-350-500 Groundwater Monitoring

Attachment A
WAC 173-350-500 Groundwater Monitoring

I. *Groundwater monitoring - Professional qualifications.*

All reports, plans, procedures, and design specifications required by this section shall be prepared under the guidance of a licensed professional in accordance with the requirements of Chapter 18.220 *Revised Code of Washington* (RCW)•

II. *Groundwater monitoring - Site characterization.*

A site proposed for solid waste activities shall be characterized for its geologic and hydrogeologic properties and suitability for constructing, operating, and monitoring a solid waste facility in accordance with all applicable requirements of this chapter. The site characterization report shall be submitted with the permit application and shall include at a minimum the following:

A. A summary of local and regional geology and hydrology, including:

1. Faults;
2. Zones of joint concentrations;
3. Unstable slopes and subsidence areas on-site;
4. Areas of groundwater recharge and discharge;
5. Stratigraphy; and
6. Erosional and depositional environments and facies interpretation(s).

B. A site-specific borehole program, including description of lithology, soil/bedrock types and properties, preferential groundwater flow paths or zones of higher hydraulic conductivity, the presence of confining unit(s) and geologic features, such as fault zones, cross-cutting structures, etc., and the target hydrostratigraphic unit(s) to be monitored. Requirements of the borehole program include:

1. Each boring will be of sufficient depth below the proposed grade of the bottom liner to identify soil, bedrock, and hydrostratigraphic unit(s);
2. Boring samples shall be collected from 5-foot intervals at a minimum and at changes in lithology. Representative samples shall be described using the Unified Soil Classification System following *American Society for Testing and Materials* (ASTM):D 2487-85 and tested for the following, if appropriate:
   a. Particle size distribution by sieve and hydrometer analyses in accordance with approved ASTM methods (D 422 and D 1120); and
   b. Atterburg limits following approved ASTM Method D 4318.
3. Each lithologic unit on-site will be analyzed for:
   a. Moisture content sufficient to characterize the unit using ASTM Method D 2216; and
   b. Hydraulic conductivity by an in situ field method or laboratory method. All samples collected for the determination of permeability shall be collected by standard ASTM procedures.

4. All boring logs shall be submitted with the following information:
   a. Soil and rock descriptions and classifications;
   b. Method of sampling;
   c. Sample depth, interval, and recovery;
   d. Date of boring;
   e. Water level measurements;
   f. Standard penetration number following approved ASTM Method D:1586-67;
   g. Boring location; and
   h. Soil test data.
5. All borings not converted to monitoring wells or piezometers shall be carefully backfilled, plugged, and recorded in accordance with *Washington Administrative Code* (WAC) 173-160-420;
6. During the borehole drilling program, any on-site drilling and lithologic unit identification shall be performed under the direction of a licensed professional in accordance with the requirements of Chapter 18.220 RCW who is trained to sample and identify soils and bedrock Ethology;
7. An on-site horizontal and vertical reference datum shall be established during the site characterization. The standards for land boundary surveys and geodetic control surveys and guidelines for the preparation of land descriptions shall be used to establish borehole and monitoring well coordinates and casing elevations from the reference datum;
8. Other methods, including geophysical techniques, may be used to supplement the borehole program to ensure that a sufficient hydrogeologic site characterization is accomplished.
   a. A site-specific flow path analysis that includes:
      i. The depths to groundwater and hydrostratigraphic unit(s), including transmissive and confining units; and
      ii. Potentiometric surface elevations and contour maps, direction and rate of horizontal and vertical groundwater flow.
   b. Identification of the quantity, location, and construction (where available) of private and public wells within a two thousand-foot radius, measured from the site boundaries.
   c. Tabulation of all water rights for groundwater and surface water within a two thousand-foot (610-meter) radius, measured from site boundaries.
   d. Identification and description of all surface waters within a 1-mile (1.6-kilometer) radius, measured from site boundaries.
   e. A summary of all previously collected site groundwater and surface water analytical data, and for expanded facilities, identification of impacts of the existing facility upon ground and surface waters from landfill leachate discharges to date.
   f. Calculation of a site water balance:

i. Conceptual design of groundwater and surface water monitoring systems, and where applicable a vadose zone monitoring system, including proposed construction and installation methods for these systems.

g. Description of land use in the area, including nearby residences.

h. A topographic map of the site and drainage patterns, including an outline of the waste management area, property boundary, the proposed location of groundwater monitoring wells, and township and range designations.

i. Geologic cross sections.

III. *Groundwater monitoring - System design.*

A. The groundwater monitoring system design and report shall be submitted with the permit application and shall meet the following criteria:

1. A sufficient number of monitoring wells shall be installed at appropriate locations and depths to yield representative groundwater samples from those hydrostratigraphic units which have been identified in the site characterization as the earliest potential contaminant flow paths;

2. Represent the quality of groundwater at the point of compliance, and include at a minimum:

a. A groundwater flow path analysis which supports why the chosen hydrostratigraphic unit is capable of providing an early warning detection of any groundwater contamination;

B. Documentation and calculations of all of the following information:

1. Hydrostratigraphic unit thickness, including confining units and transmissiveunits;

2. Vertical and horizontal groundwater flow directions, including seasonal, man-made, or other short-term fluctuations in groundwater flow;

3. Stratigraphy and lithology;

4. Hydraulic conductivity; and

5. Porosity and effective porosity.

C. Upgradient monitoring wells (background wells) shall meet the following performance criteria:

1. Shall be installed in groundwater that has not been affected by leakage from a landfill unit; or

2. If hydrogeologic conditions do not allow for the determination of an upgradient monitoring well, then sampling at other monitoring wells which provide representative background groundwater quality may be allowed.

D. Downgradient monitoring wells (compliance wells) shall meet the following performance criteria:

1. Represent the quality of groundwater at the point of compliance;

2. Be installed as close as practical to the point of compliance;

3. When physical obstacles preclude installation of groundwater monitoring wells at the relevant point of compliance at the landfill unit or solid waste facility, the downgradient monitoring system may be installed at the closest practical distance

hydraulically downgradient from the relevant point of compliance that ensures detection of groundwater contamination in the chosen hydrostratigraphic unit.

E. All monitoring wells shall be constructed in accordance with Chapter 173-160 WAC, Minimum standards for construction and maintenance of wells, and Chapter 173-162 WAC, Regulation and licensing of well contractors and operators.

F. The owner or operator shall notify the jurisdictional health department and the department of any proposed changes to the design, installation, development, and decommission of any monitoring wells, piezometers, and other measurement, sampling, and analytical devices. Proposed changes shall not be implemented prior to the jurisdictional health department's written approval. Upon completing changes, all documentation, including date of change, new monitoring well location maps, boring logs, and monitoring well diagrams, shall be submitted to the jurisdictional health department and shall be placed in the operating record.

1. All monitoring wells, piezometers, and other measurement, sampling, and analytical devices shall be operated and maintained so that they perform to design specifications throughout the life of the monitoring program.

IV. *Groundwater monitoring - Sampling and analysis plan.*

A. The groundwater monitoring program shall include consistent sampling and analysis procedures that are designed to provide monitoring results that are representative of groundwater quality at the upgradient and downgradient monitoring wells. In addition to monitoring wells, facilities with hydraulic gradient control and/or leak detection systems will provide representative groundwater samples from those systems. The owner or operator shall submit a compliance sampling and analysis plan as part of the permit application. The plan shall include procedures and techniques for:

1. Sample collection and handling;
2. Sample preservation and shipment;
3. Analytical procedures;
4. Chain-of-custody control;
5. Quality assurance and quality control;
6. Decontamination of drilling and sampling equipment;
7. Procedures to ensure employee health and safety during well installation and monitoring; and
8. Well operation and maintenance procedures.

B. Facilities collecting leachate shall include leachate sampling and analysis as part of compliance monitoring.

C. The groundwater monitoring program shall include sampling and analytical methods that are appropriate for groundwater samples. The sampling and analytical methods shall provide sufficient sensitivity, precision, selectivity, and limited bias such, that changes in groundwater quality, can be detected and quantified. All samples shall be sent to an accredited laboratory for analyses in accordance with Chapter 173-50 WAC, Accreditation of environmental laboratories.

D. Groundwater elevations shall be measured in each monitoring well immediately prior to purging, each time groundwater is sampled. The owner or operator shall determine the rate and direction of groundwater flow each time groundwater is sampled. All groundwater elevations shall be determined by a method that ensures measurement to the one hundredth of a foot (3 millimeters) relative to the top of the well casing.

E. Groundwater elevations in wells that monitor the same landfill unit shall be measured within a period of time short enough to avoid any groundwater fluctuations which could preclude the accurate determination of groundwater flow rate and direction.

F. The owner or operator shall establish background groundwater quality in each upgradient and downgradient monitoring well. Background groundwater quality shall be based upon a minimum of eight independent samples. Samples shall be collected for each monitoring well and shall be analyzed for parameters required in the permit for the first year of groundwater monitoring. Each independent sampling event shall be no less than 1 month after the previous sampling event.

G. Groundwater quality shall be determined at each monitoring well at least quarterly during the active life of the solid waste facility, including closure and the post-closure period. More frequent monitoring may be required to protect downgradient water supply wells. Groundwater monitoring shall begin after background groundwater quality has been established. The owner or operator may propose an alternate groundwater monitoring frequency. Groundwater monitoring frequency must be no less than semiannually. The owner or operator must apply for a permit modification or must apply during the renewal process for changes in groundwater monitoring frequency making a demonstration based on the following information:

1. A characterization of the hydrostratigraphic unit(s), including the unsaturated zone, transmissive and confining units, and include the following:

    a. Hydraulic conductivity; and

    b. Groundwater flow rates,

2. Minimum distance between upgradient edge of the solid waste handling unit and downgradient monitoring wells (minimum distance of travel); and

3. Contaminant fate and transport characteristics.

4. All facilities shall test for the following parameters:

    a. Field parameters:

        i. pH;

        ii. ii. Specific conductance;

        iii. Temperature;

        iv. Static water level.

    b. Geochemical indicator parameters:

        i. Alkalinity (as $CaCO_3$);

        ii. Bicarbonate (HCO_3);

        iii. Calcium (Ca);

        iv. Chloride (Cl);

        v. Iron (Fe);

        vi. Magnesium (Mg);

vii. Manganese (Mn);

viii. Nitrate (NO3);

ix. Sodium (Na);

x. Sulfate (804).

c. Leachate indicators:

i. Ammonia (NH3-N);

ii. Total organic carbon (TOC);

iii. Total dissolved solids (TDS).

H. Based upon the site-specific waste profile and also the leachate characteristics for lined facilities, the owner or operator shall propose additional constituents to include in the monitoring program. The jurisdictional health department shall specify the additional constituents in the solid waste permit.

I. Testing shall be performed in accordance with *"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,"* U.S. Environmental Protection Agency (EPA) Publication SW-846, or other testing methods approved by the jurisdictional health department.

J. Maximum contaminant levels (MCL) for groundwater are those specified in Chapter 173-200 WAC, Water quality standards for groundwaters of the state of Washington.

V. *Groundwater monitoring - Data analysis, notification and reporting.*

A. The results of monitoring well sample analyses as required by Subsection (4)(h) and

1. of this section shall be evaluated using an appropriate statistical procedure(s), as approved by the jurisdictional health department during the permitting process, to determine if a significant increase over background has occurred. The statistical procedure(s) used shall be proposed in the sampling and analysis plan and be designed specifically for the intended site,

2. or prescriptive statistical procedures from appropriate state and federal guidance may be used,

B. If statistical analyses determine a significant increase over background:

1. The owner or operator shall:

a. Notify the jurisdictional health department and the department of this finding within thirty days of receipt of the sampling data. The notification shall indicate what parameters or constituents have shown statistically significant increases;

b. Immediately resample the groundwater for the parameter(s)showing statistically significant increase in the monitoring well(s) where the statistically significant increase has occurred;

c. Establish a groundwater protection standard using the groundwater quality criteria of Chapter 173-200 WAC, Water quality standards for groundwaters of the state of Washington. Constituents for which the background concentration level is higher than the protection standard, the owner or operator shall use background concentration for constituents established in the facility's monitoring record.

2. The owner or operator may demonstrate that a source other than a landfill unit or solid waste facility caused the contamination, or the statistically significant increase resulted from error in sampling, analyses, statistical evaluation, or natural variation in groundwater quality. If such a demonstration cannot be made and the concentrations or levels of the constituents:

   a. Meet the criteria established by Chapter 173-200 WAC, Water quality standards for groundwaters of the state of Washington, the owner or operator shall:

      i. Assess and evaluate sources of contamination; and

      ii. Implement remedial measures in consultation with the jurisdictional health department and the department.

   b. Exceed the criteria established by Chapter 173-200 WAC, Water quality standards for groundwaters of the state of Washington, the owner or operator shall:

      i. Characterize the chemical composition of the release and the contaminant fate and transport characteristics by installing additional monitoring wells;

      ii. Assess and, if necessary, implement appropriate intermediate measures to remedy the release. The measures shall be approved by the jurisdictional health department and the department; and

      iii. Evaluate, select, and implement remedial measures as required by Chapter 173-340 WAG, the Model Toxics Control Act cleanup regulation, where applicable. The roles of the jurisdictional health department and the department in remedial action are further defined by WAC 173-350-900.

   c. The owner or operator shall submit a copy of an annual report to the jurisdictional health department and the department by April 30 of each year. The jurisdictional health department may require more frequent reporting based on the results of groundwater monitoring. The annual report shall summarize and interpret the following information:

      i. All groundwater monitoring data, including laboratory and field data for the sampling periods;

      ii. Statistical results and/or any statistical trends including any findings of any statistical increases for the year and time/concentration series plots;

      iii. A summary of concentrations above the maximum contaminant levels of Chapter 173-200 WAC;

      iv. Static water level readings for each monitoring well for each sampling event;

      v. Potentiometric surface elevation maps depicting groundwater flow rate and direction for each sampling event, noting any trends or changes during the year;

      vi. Geochemical evaluation, including cation-anion balancing and trilinear and/or stiff diagramming for each sampling event noting any changes or trends in water chemistry for each well during the year; and

      vii. Leachate analyses where appropriate for each sampling event.

Attachment B
Groundwater Sampling Methodology

Attachment B
Groundwater Sampling Methodology

Groundwater samples will be collected from the monitoring well network at periodic intervals, as described in the Groundwater Monitoring Plan. Groundwater samples may be collected from any of the original wells (see Appendix C) or from the new monitoring network. Groundwater sampling will be performed in accordance with the following methodology:

A. Static water level measurements will be performed using an electronic water level meter. The meter will be decontaminated by washing in Alconox detergent and rinsing with distilled water prior to measuring each well.

B. A total of three casing volumes of water will be purged from each well prior to sampling. Wells less than 25 feet deep would be purged using a peristaltic pump, and wells deeper than 25 feet would be purged using a hand bailer. Purged groundwater will be dumped onto the ground near each well.

C. Following purging, and after the water levels have recovered to at least 90 percent of the static water level, field measurements for pH, temperature, specific conductivity, and dissolved oxygen would be performed using a portable gauge.

D. Wells less than 25 feet deep would be sampled using a peristaltic pump with clean polyethylene tubing used for each well. Wells deeper than 25 feet would be sampled using a clean, disposable bailer and rope for each sample. Water from the sampling tool would be decanted into the appropriate laboratory-prepared sample container and stored in a chilled cooler for transport to the laboratory.

E. Collected groundwater samples would be transported under chain of custody to North Creek Analytical in Bothell, Washington for laboratory testing of the analytes presented in the Groundwater Monitoring Plan.

Attachment C
Quality Assurance Plan

Attachment C
Quality Assurance Plan

The purpose of this Quality Assurance Plan (QAP) is to specifically define the quality assurance (QA) and quality control (QC) objectives, procedures and activities associated with the sampling and analysis of groundwater during monitoring of the groundwater quality at Go East.

Analytical Procedures

Analysis of groundwater for the various parameters identified in the Groundwater Monitoring Plan will be performed in accordance with the methods identified in Table F-1. Collected groundwater samples will be transported to North Creek Analytical or other licensed laboratory for analysis.

The reporting limits (RL) listed in Table C-1 are typical for the proposed analytes. The RL is defined as the lowest reproducible concentration at which a chemical can be accurately and reproducibly quantified for a given sample. The RL can vary from sample to sample depending upon the sample size, matrix interferences, moisture content and other sample specific conditions. The RLs typically correspond to the lowest calibration standard and generally reflect the lowest concentration at which an analyte can be accurately and reproducibly detected by the analytical method used.

Data Quality Indicators

Data Quality Indicators (DQI) are established by the data quality objectives and includes precision, accuracy, representativeness and completeness. The data must be of sufficient technical quality to determine whether contaminants are present and whether the pose a threat to human health and the environment. An assessment of data quality is based upon quantitative (precision, accuracy and completeness) and qualitative (representativeness and completeness) indicators. Definitions of these indicators and the applicable QC procedures are described below.

Precision

Precision measures the reproducibility of measurements under a given set of conditions. Specifically it is a quantitative measurement of the variability of a group of measurements compared to their average values. Analytical precision is measured through matrix spike/matrix spike duplicate samples and laboratory control samples/laboratory control sample duplicates for organic analyses and through duplicate samples for inorganic analyses. Analytical precision is expressed at the relative percent difference (RPD) between matrix spike/matrix spike duplicates, laboratory control samples/laboratory control sample duplicates and duplicates. Analytical precision measurements will be performed at a minimum of one per each group of analyses. Field duplicates will be collected and analyzed at a minimum frequency of 5 percent per group of analyses. Laboratory precision will be evaluated against laboratory quantitative RPD criteria listed below.

Accuracy

Accuracy indicates how close the measured value is to the true value. The accuracy of chemical tests results in assessed by “spiking” samples with known concentrations of standards (surrogates, blank spikes or matrix spikes) and establishing an average recovery of that standard. Accuracy measurements on matrix spike samples will be performed at a minimum of one in twenty samples per matrix analyzed. Blank spikes will also be analyzed at a minimum of one in twenty samples per matrix analyzed. Surrogate recoveries will be determined for every sample analyzed for organics. Laboratory accuracy will be evaluated against quantitative matrix spike and surrogate spike recovery criteria presented below.

Representativeness

Representativeness measures how closely the measured results reflect the actual concentration or distribution of the analytes in the matrix sampled. The sampling plan, sampling techniques and sampling handling procedures have been developed to ensure representative samples are collected.

Completeness

Completeness is defined as the percentage of measurements made that are judged to be valid measurements. Results will be considered to be valid if all the precision, accuracy and representiveness objectives are met and if the RLs are sufficient for the intended use of the data. The target completeness goal for the Landfill groundwater monitoring is 95 percent.

Quality Control Procedures

The following quality control procedures will be followed.

Field Quality Control

Field QC for the groundwater monitoring sampling will include the following:

- Field duplicates will be collected at a minimum of 5 percent per matrix sampled
- Temperature blanks will be included with each shipped cooler

Laboratory Quality Control

The laboratories designated QC personnel are responsible for ensuring that the laboratory implements all routine internal QA/QC procedures. At a minimum, the laboratory QC procedures for the groundwater monitoring will include the following:

- Instrument calibration and standards as defined in the laboratory standard operating procedures
- Data Valadation
- Laboratory blank measurements at a minimum of 5 percent or one per twenty samples
- Accuracy and precision measurements as defined above at a minimum of 5 percent or one in twenty per matrix.

Corrective Actions

If routine QC audits by the laboratory result in discovering unacceptable conditions or data, actions specified in the laboratory standard operating procedures will be taken. Specific corrective actions should include but are not limited to:

- Identifying the source of the violation
- Reanalyzing samples if holding time criteria permit
- Resampling and reanalyzing

- Evaluating and amending sampling and analytical procedures
- Accepting data and flagging to indicate the level of uncertainty

If unacceptable conditions occur, the laboratory will contact the AESI project manager to discuss the issues and determine the appropriate corrective action. All corrective actions taken by the laboratory will be documented in writing by the laboratory and included in the data package submitted.

Table C-1 Analytical Methods for Groundwater

Analyte	Water Quality Standard for the State of Washington WAC173-200	PQL (mg/l)	Method Detection Limit (mg/l)	Analytical Method
pH	6.5-8.5	NA	NA	EPA Method 150.1
Specific Conductivity	700 umhos/cm	1 us/cm	____	EPA Method 120.1
Absorbable organic halogens	____			EPA Method 650B
Total Organic Carbon	____	2	0.303	EPA Method 415.1
Calcium	____	0.25	0.036	EPA Method 200.7
Magnesium	____	0.5	0.018	EPA Method 200.7
Sodium	20 mg/L	0.25	0.25	EPA Method 200.7
Potassium	____	2	0.255	EPA Method 200.7
Iron	0.30 mg/L	0.15	0.062	EPA Method 200.7
Manganese	50 ug/L	0.01	0.0011	EPA Method 200.7
Arsenic	0.05 ug/L	____	0.00005	EPA Method 6020
Chromium Total	50 ug/L	0.001	0.00015	EPA Method 200.8
Zinc	5 mg/L	0.01	0.00313	EPA Method 200.8
Chloride	250 mg/L	0.4	____	EPA Method 300
Sulfate	250 mg/L	0.4	____	EPA Method 300
Nitrate	10 mg/L	0.2	____	EPA Method 300
Nitrite	1 mg/L	0.2	____	EPA Method 300
Ammonia	____	0.1	____	EPA Method 350.3
Alkalinity	____	5	____	Standard Method 2320B
Total Dissolved Solids	500 mg/L	1	____	Standard Method 2540C
Bicarbonate	____	1	____	Standard Method 2320B

Note: 1) Secondary Standard

Attachment D

Portable Landfill Gas Analyzer Specifications

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Landfill Gas Monitor

Landtec GEM™ 2000

The GEM™ 2000 is designed for analyzing LFG composition and calculating flow. The GEM™ 2000 combines the capabilities of the now discontinued GA-90 for monitoring gas migration probes and the GEM™ 500 for monitoring gas extraction systems. The GEM™ 2000 is certified intrinsically safe and offers improved speed and accuracy.

FEATURES

- **Diverse Field Applications** – Monitors migration control systems, gas extraction systems, flares, migration probes, and more.
- **Gas Extraction Monitor Mode** – Provides automatic sampling and analysis of gas composition % by volume CH_4, CO_2, O_2 and balance gas, % LEL CH_4, temperature (with optional probe), static pressure, differential pressure, and barometric pressure. Calculates gas flow rates (SCFM) as well as BTU content.
- **Landfill Gas Analyzer Mode** – Provides automatic sampling and analysis of gas composition % by volume CH_4, CO_2, O_2 and % balance gas, % LEL CH_4, temperature (with optional probe), barometric pressure and relative pressure. Can be used for data logging, with user programmed intervals.
- **Easy to Read Display** – Extra large backlit LCD shows up to five gases, atmospheric and gas vacuum pressure, temperature, ID code – all at the same time.
- **Quick Analysis** – Completes sampling and displays gas analysis and flow results in less than one minute.
- **Infrared Gas Analyzer** – Provides accurate measurements of methane (CH_4), and carbon dioxide (CO_2).
- **Gas Temperature** – Read when using optional temperature probe or can be entered manually.
- **Durable Oxygen Sensor** – Provided by the galvanic cell principle, not influenced by other gases (i.e. CH_4, CO_2, CO, SO_2 or H_2S).
- **User Friendly On-Screen Menu** – In each mode the user performs most operations in just two screens.
- **PC Data Downloading** – Provided by RS232 interface with DataField CS software (Release 3.0 or later).
- **Data Storage/Retrieval** – Stores prior measurements taken for each monitoring point, 900 monitoring points total.
- **Date/Time Stamp** – Recorded for all stored data.
- **Prior Data Recall** – Allows user to view prior data for each monitoring point.
- **Methane Analysis** – Displayed as either % CH_4 by volume or LEL CH_4 (Landfill Gas Analyzer Mode only).
- **Durable Construction** – Built of strong, durable plastic material suitable for harsh landfill environments.
- **All Weather Use** – Designed to operate in extremes from 32°F to 104°F. Sealed, weather-tight case.
- **Built-in Adjustable Alarms** – Allows user to set alarm limits for CH_4 and O_2.
- **Rechargeable Batteries** – Internal, rechargeable nickel metal hydride batteries are standard.
- **Operating Time** – Approximately 8 hours with normal pump usage (approximately 10 hours without pump running).
- **Fast Recharge Time** – Approximately 3 hours from complete discharge.
- **Battery Check** – Battery life is continuously displayed.
- **Monitoring Point ID Codes** – Provides alphanumeric identification of monitoring points for data storage and recall.
- **ID Comments** – Allows user to answer up to 3 questions with a list of 9 potential answers each.
- **Imperial vs. SI Units** – Can display measurements in Imperial (USA) or SI (metric) units.
- **Interfaces to DataField Management Software** – Which provides statistical analysis and reporting of LFG data.

SPECIFICATIONS

SENSOR

	Range	Resolution
Methane – CH4	0-70%	0.1%
Carbon Dioxide – CO_2	0-40%	0.1%
Oxygen – O_2	0-25%	0.1%
Pressures		
(diff.)	0-10" W.C.	0.001" W.C.
(static)	0-100" W.C.	0.1" W.C.

Pump Flow Rate – 500 cc/min at nominal flow, 250 cc/min at 80" W.C.

Vacuum – up to 80" W.C.

UL Certified to Class 1, Zone 1, AEx ib d iia T4

TYPICAL ACCURACY

Concentration	% CH_4 by Volume	% CO_2 by Volume	% O_2 by Volume
5% (Lel, CH_4)	±0.3%	±0.3%	±1.0%
Full Scale	±3.0% (70%)	±3.0% (40%)	±1.0% (25%)

CALL GEOTECH TODAY (800) 833-7958

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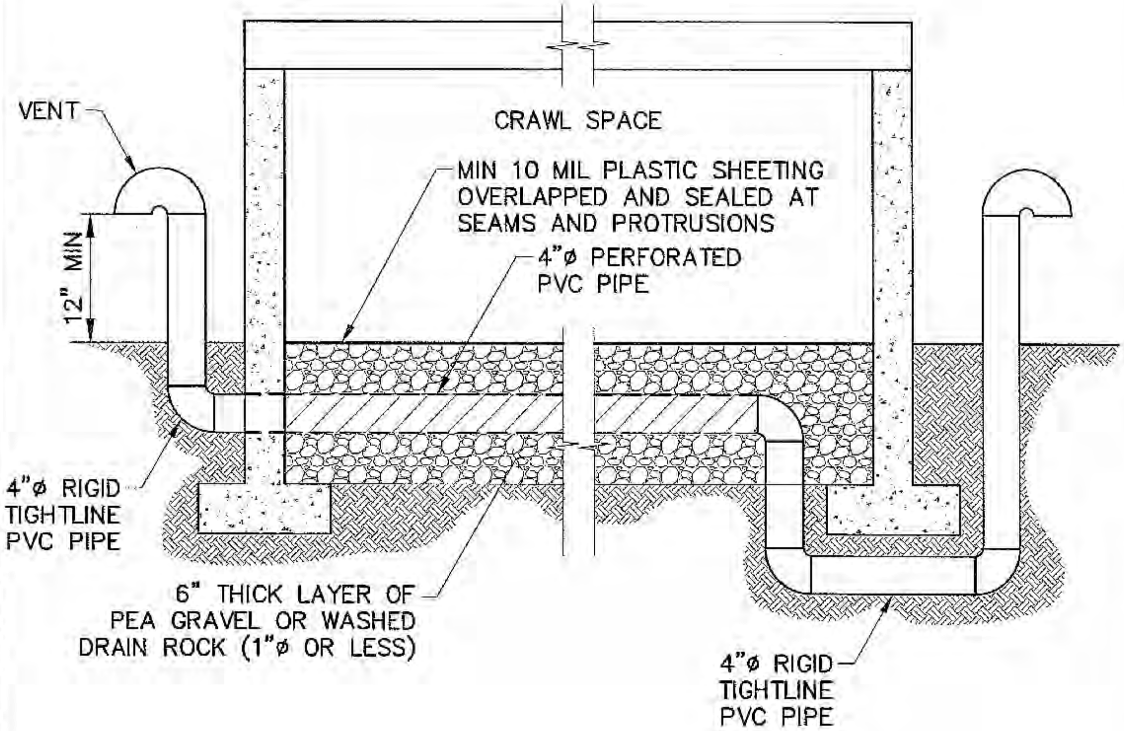
email: sales@geotechenv.com website: www.geotechenv.com

Landtec GEM 2000.indd 01/18/09

Attachment E

Residential Methane Mitigation Design



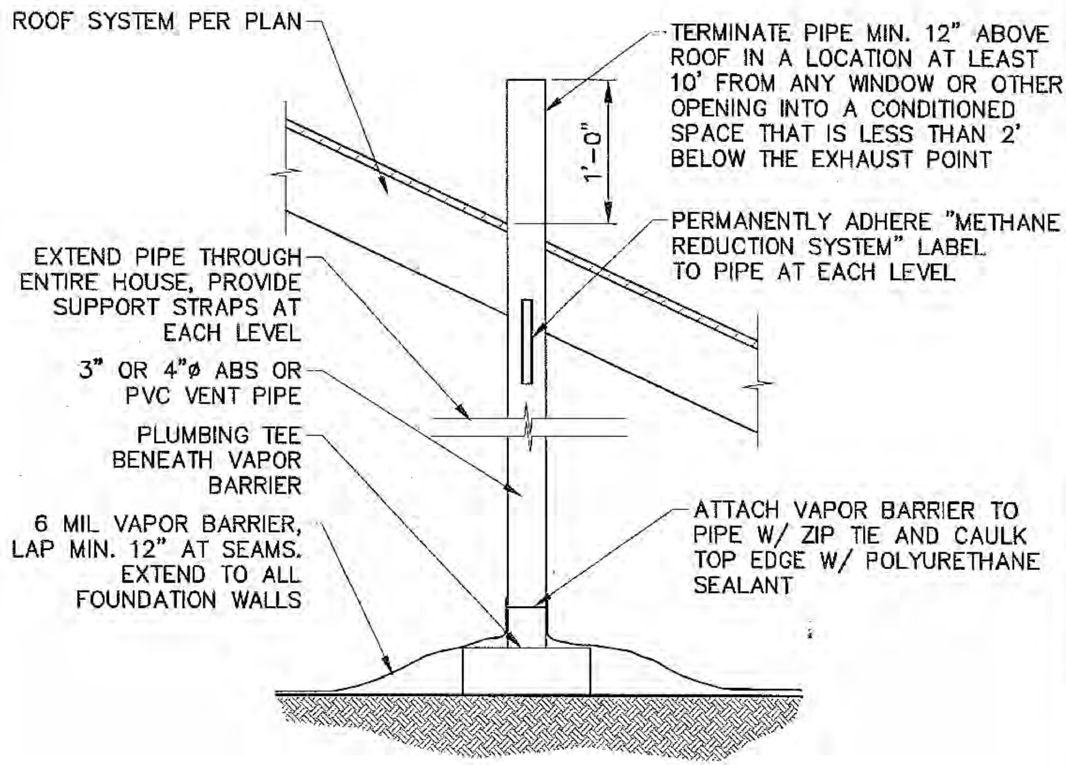
RESIDENTIAL METHANE MITIGATION DESIGN

OPTION 1 N.T.S.

APPENDIX H

DESIGNED MP DRAWN TS CHECKED SC DATE 7/8/15 SCALE N.T.S.	**GO EAST** **ATTACHMENT E** PACE An Engineering Services Company 11255 Kirkland Way, Suite 300 Kirkland, WA 98033 p. 425.827.2014 | f. 425.827.5043 Civil | Structural | Planning | Survey paceengrs.com	JOB NUMBER **09382.00** SHEET NAME SHEET **1** OF **2**

XREF FILES: 11362-SRV IMBUSA 2025SITE2010H



RESIDENTIAL METHANE MITIGATION DESIGN
OPTION 2 N.T.S.

APPENDIX H
ATTACHMENT E

DESIGNED MP DRAWN TS CHECKED SC DATE 7/8/15 SCALE N.T.S.	**GO EAST** **ATTACHMENT E** PACE An Engineering Services Company 11255 Kirkland Way, Suite 300 Kirkland, WA 98033 p. 425.827.2014 f. 425.827.5043 Civil | Structural | Planning | Survey paceengrs.com	JOB NUMBER **09382.00** SHEET NAME SHEET **2** OF **2**

Attachment F

Proposed Plat Covenant

F-1 of Appendix H

Proposed plat covenant to be recorded with final Bakerview Plat.

Tract 999 as shown on the plat contains a former wood waste landfill that operated under the name of Go East Landfill from 1979 to 1983. The Go East Landfill stopped taking landfill material in 1983. This landfill has been formally closed as described in the Go East Landfill Closure Plan available at Snohomish County Health District.

All homes constructed within 100 feet from tract 999 shall include “Residential Methane Mitigation” as shown in “Attachment E” of Appendix H of the closure plan or an approved alternative design by Snohomish Health District.

Appendix I
Waste Excavation, Screening, and Disposal

PACE Engineers, Inc., June 10, 2015

Rev. May 1, 2018

WASTE EXCAVATION, SCREENING, AND DISPOSAL PLAN

Overview

In accordance with the conditions set forth below and to the maximum allowed by SHD's representative, all excavated landfill material is to be relocated to the top of the remaining landfill. This document presents the plan for Waste Excavation, Screening, and Disposal Plan at the Go East Landfill during completion of landfill closure, if and as required. The Go East Landfill has not accepted waste since 1983. The final requirements for closure are now being completed in accordance with the applicable regulation for a limited purpose landfill as per the Solid Waste Handling Standards, Washington Administrative Code (WAC) Chapter 173.

Preparation of Waste Excavation & Disposal Plan

This plan has been prepared under the direction of Mr. Ken Nilsen, Professional Engineer registered in the State of Washington. Mr. Nilsen's Washington Professional Engineer registration number is 25427. Signature and professional stamp are located on the last page.

Overview of the Excavation

An irregular-shaped area containing waste materials along the perimeter of the landfill will be excavated during site closure grading. To the extent possible, the excavated waste[1] material will be relocated to the top of the remaining landfill. However, any hazardous waste and possibly some sand material may be screened and removed from the material prior to placing on top of the landfill. The excavated area will then be backfilled with structural fill material to accommodate future land development options. These areas of earthen structural fill will be compacted to 95% of the modified Proctor maximum density using ASTM-D1557 (per the Geotechnical Engineering Report). The footprint and boundary of the landfill will be reduced and therefore will represent a reduction of area previously impacted by storm water infiltration. The waste between the existing perimeter of the landfill (0 foot depth line) and inward toward the landfill to a waste depth of about 15 feet, or all landfill material as or may be required to be removed from the developed area (lots/street areas), will be removed and replaced with structural fill. The excavation may extend several more horizontal feet inward and then continue at roughly a 1½:1 slope up to meet existing grade (actual slope may vary to ensure a safe working environment). A new perimeter gravel-filled trench will become the boundary of the capped landfill, about 6.4 acres. The existing landfill area is approximately 9.6 acres. The irregular-shaped area to be excavated (between the 0 foot depth line and the limit of excavation) represents approximately 3.2 acres. Roughly 52,000 cubic yards of material will be excavated and located onto the landfill area. Refer to Appendix D for plans of the proposed landfill area.

To date there have been over 65 soil test logs excavated into the landfill with depths to over 25 feet deep for the purpose of inventorying the type of debris and depths of material contained in the landfill. Individual soil logs are recorded by the geotechnical engineer observing the

[1] There is nothing in the WAC or RLW precluding a landfill owner from relocating landfill waste as needed to complete a landfill closure.

excavations and are all contained in Appendix A of the closure plan. There are no reports of hazardous materials encountered in any of these soil logs. Any hazardous materials that may be encountered will be separated out by the screening operation and safely stored in a container on-site until disposed of appropriately.

Existing Material and Debris Screening

Portions of waste material that are excavated will be temporarily placed on the landfill area for manual sifting and processing to separate hazardous waste or to reclaim sand material that may be used for foundation material under the geomembrane. Once the debris has been screened and the acceptable materials inspected, tested, and verified as non-contaminated these materials shall be placed in non-structural fill areas on the remaining landfill and covered per the landfill cover system requirements in Section 4 of this report.

The area to the west of the proposed detention/water quality treatment pond will be used as the landfill debris screening location for any materials needing to be screened. .

All excavated “wedge” materials will be visually inspected for any asbestos, including board and tiles, and on-site swab testing for lead paint will be performed on painted boards. A certified asbestos professional will be on-site to visually inspect excavated materials, as needed. Any materials with detectable levels of lead and asbestos or any organic materials will be handled appropriately in accordance with the current solid waste handling standards as outlined in WAC 173-350. These items will be temporarily stored in a separate container on-site and then bagged in plastic if required before being transported off-site for proper disposal at an off-site licensed solid waste disposal facility.

To control and contain dust during excavation materials can be sprinkled with water from an on-site hydrant or water tank. The Washington State Department of Ecology (DOE) best management practice (BMP) for dust control shall be followed and can be found in Volume IV of the DOE’s 2005 Stormwater Management Manual for Western Washington (DOE’s 2005 SWMMWW). This BMP can also be used for controlling dust due to disturbance of other areas. The BMP also discusses other ways to control potential dust such as covering stockpiles with a wind-resistant fabric.

Subject to the foregoing provisions and restriction, landfill materials will be relocated to the top of the remaining landfill to the maximum extent feasible. Burned and unburned wood, untreated wood debris including stumps, limbs, or other wood excavated from the landfill will be replaced back into the landfill if testing shows it contains no contaminants, preservatives, and carcinogens, and its pH is within acceptable range. All newly logged or cut wood (trees) will be hauled offsite and disposed of. Newly cut wood including tree branches, etc., that can be chipped may be reused onsite for surface stabilization and ground covering.

Excavated mineral soils will be tested for contamination (see Table G-4 in Closure Plan Report, as taken from Volume IV of the DOE’s 2005 SWMMWW) and pH level and if acceptable, will be reused and placed back on the landfill. Suitable excavated mineral soils from areas outside the landfill in combination with imported structural fill material, if needed, will be placed and compacted back into the excavated areas in accordance with Section 3.5.5 of this report and the Geotechnical Engineering Report. These replaced mineral soils will be tested for the seven heavy metals (lead, arsenic, iron, etc.) at the following rate: one sample for every 500 cubic yards for the first 2,500 cubic yards of soil and then one sample approximately every 2,500 cubic yards thereafter. If in the event changes in color, texture, or other characteristics are observed that indicate a possible different source of the soil, a sample will be taken even when the frequency exceeds the one per 2,500 cubic yards. More sampling may be required if field testing indicates that additional assessment is needed due to high levels of one or more of the seven metals.

Stockpile Area Requirements

All imported soil materials will typically be placed directly into the designated location. Material storage areas may be located as needed to facilitate construction and minimize haul distances. Imported materials that may need to be stockpiled and used for closure improvements include, but are not limited to, quarry spalls for culvert inlet/outlet slope protection and for filling gabions or other toe-of-slope protection, gravel material for construction and access roads, soil cover layer material, and structural fill. In areas where future settlements are critical, stockpiles of soil may be used for pre-loading purposes. More information on pre-loading the landfill area can be found in Section 4.5 of the report.

Structural Fill Placement

Structural fill is recommended in areas of utility trench backfill, and in “wedge areas” of waste excavation. Structural fill will be placed in accordance with Sections 9.0 and 10.0 of the Geotechnical Engineering Report for this project. Loose fill will be removed to the depth of disturbance and the upper 12 inches of exposed ground will be compacted to a firm and unyielding condition. If the sub-grade contains too much moisture to adequately re-compact, the area to receive fill should be blanketed with gravel or quarry spalls to act as a capillary break between the new fill and the existing subgrade.

Monitoring & Documentation

The owner shall retain a qualified professional engineer to oversee the excavation program. The results of excavation event will be compiled into a data report that will be submitted to SHD, quarterly.

____
Kenneth H. Nilsen, Washington Professional Engineer
Registration Number 25427

Appendix J
Construction Estimate
PACE Engineers, Inc., July 28, 2015
Rev. August 11, 2016

ENGINEER'S CONSTRUCTION COST ESTIMATE

Overview

PACE Engineers has prepared a preliminary Cost Estimate related exclusively to the events to support the Closure of the Landfill, in accordance with WAC 173.350 regulations. The final costs will be determined at a later date, based on the Final Construction Plans, Approved Construction Specifications of the pending Closure Report, as well as Contractor Bidding. Generally, this preliminary estimate captures the major events required to close the landfill.

General Sequence of Construction Milestone Events;

- Access to and Protection of the Site
- Clearing, Grubbing, and Rough Grading
- Storm Water Management
- Screening, Excavation, and Disposal of Materials
- Finish Grading and Placement of Cap Systems
- Landscaping and Hydro-seeding

Cost Estimate

Preliminary Engineers Cost Estimate: $650,000

GO EAST
LANDFILL CLOSURE PLAN
Snohomish County, Washington

Appendix K
Construction Quality Assurance Plan

PACE Engineers, Inc., June 10, 2015

Rev. January 26, 2018

Rev. June 25, 2018

APPENDIX K
CONSTRUCTION QUALITY ASSURANCE PLAN

TABLE OF CONTENTS

LIST OF TABLES

ACRONYMS

ASTM	American Society for Testing and Materials
CQA	Construction Quality Assurance
CQC	Construction Quality Control
EPA	United States Environmental Protection Agency

FORWARD AND ACKNOWLEDGEMENT

- This CQA plan has been developed specifically for the Go East Landfill closure. The document draws upon information presented in the United States Environmental Protection Agency (EPA) Technical Guidance Document "Quality Assurance and Quality Control for Waste Containment Facilities" (EPA/600/R-93/182, September 1993). The EPA document provides information and guidance for developing comprehensive quality assurance plans and for carrying out quality control procedures at waste containment sites. Additionally, the document has benefited from guidance received from Solid Waste Handling Standards, Washington Administrative Code (WAC) 173-350.

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1. CONSTRUCTION QUALITY ASSURANCE CONCEPTS AND OVERVIEW

1.1 Introduction

This construction quality assurance (CQA) plan is for the Go East Landfill closure. It has been prepared by PACE Engineers for P&GE, LLC. This CQA plan describes the actions the owner will undertake to assure and to document that the project is constructed in general accordance with the project plans and specifications.

1.2 Preparation of Construction Assurance Quality Plan

This plan has been prepared under the direction of Mr. Kenneth H. Nilsen, Professional Engineer, registered in Washington. Mr. Nilsen's Washington Professional Engineer registration number is 25427. Signature and professional stamp are located on the last page.

1.3 Project Description

The proposed final closure construction for the landfill includes the construction and placement of a geomembrane and soil layer for the final cover of the Go East Landfill. The current landfill is to be reduced in size by relocating landfill material from the edges and placing it on the top of the remaining landfill. This will reduce the size of the remaining landfill to about 6 acres. The steeper northeast slope below approximate elevation 190 feet is to be left undisturbed. At the conclusion of the grading operation, the site will receive an application of Hydro seed to stabilize the surface of the landfill. A detention pond, emergency access, trails, pathway and recreation facilities are to be constructed on the closed landfill.

1.4 Scope

Construction quality assurance is widely recognized as a critically factor in overall quality management for waste containment facilities.

This CQA plan provides guidance:

- For specific inspections, observations, and tests;
- For documentation of the observed quality of materials and work; and
- Serves as a reference source for personnel performing and monitoring construction of the closure of the Go East Landfill.

The inspections, observations, testing, and documentation will be performed by the owner's CQA team.

This CQA plan does not establish construction requirements. Construction requirements are established by the LFCP and resulting plans and specifications and are not restated here. The criteria for acceptance will be as defined in these documents.

This CQA plan does not establish procedures to control or guide the operations of the manufacturer of materials or the contractor or relieve them of their contractual responsibility to set up the necessary procedures and controls within their organizations to produce the quality of work called for in the plans and specifications.

This CQA plan is not intended to function as or to replace the contractor's quality control program.

1.5 Definitions

It is critical to define and understand the differences between construction quality control (CQC) and CQA and to counterpoint where the different activities contrast and/or complement one another. The following definitions are made to add clarity:

CQC: A planned system of inspections that is used by the contractor to directly monitor and control the quality of the construction project. CQC for installation of the lining, for example, is normally performed by the geosynthetics installer, or by the earthwork contractor for soil materials, to insure the necessary quality in the constructed or installed system is achieved. CQC refers to measures taken by the installer or contractor to determine compliance with the requirements for materials and workmanship as stated in the plans and specifications for the project.

CQA: A planned system of activities that provides the owner and permitting agency assurance that the facility was constructed as specified in the design. CQA includes inspections, verifications, audits, and evaluations of materials and workmanship necessary to determine and document the quality of the constructed facility. CQA refers to measures taken by the CQA organization to assess if the installer or contractor is in compliance with the plans and specifications for the project.

CQA is performed independently from CQC. Although CQA and CQC are separate activities, they have similar objectives, and in a smoothly running construction project, the processes will complement one another. Conversely, an effective CQA program can lead to identification of deficiencies in the CQC process, but a CQA program by itself (in complete absence of a CQC program) is unlikely to lead to acceptable quality management. Quality is best ensured with effective CQC and CQA programs.

1.6 Responsibility and Authority

Permitting Agency: The permitting agency for this project is Snohomish Health District (SHD). SHD is supported by the Washington State Department of Ecology. It is the responsibility of the permitting agency to review the owner's permit application, including the site-specific CQA plan, for compliance with the agency's regulations and to make a decision to issue or ask for additional information. The permitting agency also has the authority to review all CQA documentation during or after construction of a facility, possibly including visits to the construction site to observe the CQC and CQA practices, to confirm that the approved CQA plan was followed and that the facility was constructed as specified in the design.

Owner: This is the organization that will own the facility. The current owner is P&GE, LLC. The owner is responsible for the closure of the facility. This responsibility includes complying with the requirements of the permitting agency, the submission of CQA documentation, and assuring the permitting agency that the facility was constructed as specified in the construction plans and specifications and as approved by the permitting agency. The owner has the authority to select and dismiss organizations charged with design, construction, and CQA.

Owner's Representative: The owner's representative, or construction manager, is responsible to administer the construction program for the owner. This responsibility includes communications to other members in the owner's organization, permitting agency, general contractor, and CQA engineer who, in this case, needs to be professionally certified in identifying hazardous waste and landfill closures.

Design Engineer: PACE Engineers is the design engineer. The design engineer's primary responsibility is to design the facility so that it fulfills the operational requirements of the owner, complies with accepted design practices for waste containment facilities, and meets or exceeds the minimum requirements of the permitting agency. The design engineer may be requested to change some aspects of the design if unexpected conditions are encountered during construction (e.g., a change in site conditions, unanticipated logistical problems during construction, or lack of availability of certain materials). Because design changes during construction are not uncommon, the design engineer is a major and essential part of the CQA process.

Manufacturer: The manufacturer is responsible for the manufacture of its materials and for quality control during manufacture. The manufacturer is responsible for certifying that its materials conform to the plans and specifications. The quality control steps taken by a manufacturer are critical to overall quality management in construction of waste containment facilities. Such activities often take the form of process quality control, computer-aided quality control, and the like. As requested, the manufacturer should provide information to the owner, permitting agency, design engineer, fabricator, installer, or CQA engineer that describes the quality control steps that are taken during the manufacturing of the product. In addition, the manufacturer should be willing to allow the owner, permitting agency, design engineer, fabricator, installer, and CQA engineer to observe the manufacturing process and quality control procedures if they so desire.

Fabricator: Some materials are fabricated from manufactured components. For example, certain geomembranes are fabricated by seaming together smaller, manufactured geomembrane sheets at the fabricator's facility. The fabricator is responsible for certifying that its materials conform to the plans and specifications. The quality control steps taken by a fabricator are critical to overall quality in construction of waste containment facilities. As requested, the fabricator should provide information to the owner, permitting agency, design engineer, installer, or CQA engineer that describes the quality control steps that are taken during the fabrication of the product. In addition, the fabricator should be willing to allow the owner, permitting agency, design engineer, installer, or CQA engineer to observe the fabrication process and quality control procedures if they so desire.

General Contractor: The general contractor has overall responsibility for construction of the project and for CQC during construction. The general contractor arranges for purchase of materials that meet specifications, enters into a contract with one or more fabricators (if fabricated materials are needed) to supply those materials, contracts with an installer (if separate from the general contractor's organization), and has overall control over the construction operations, including scheduling and CQC. The general contractor has the primary responsibility for ensuring that a facility is constructed in accord with the plans and specifications that have been developed by the design engineer and approved by the permitting agency. The general contractor is also responsible for informing the owner's representative of the scheduling and occurrence of all construction activities.

Installation Contractor: Manufactured products (such as geosynthetics) are placed and installed in the field by an installation contractor who is the general contractor or a subcontractor to the general contractor. The installer's personnel may be employees of the manufacturer or fabricator, or they may work for an independent installation company hired by the general contractor. The installer is responsible for handling, storage, placement, and installation of manufactured and/or fabricated materials. The installer will have a CQC plan to detail the proper manner that materials are handled, stored, placed, and installed.

Earthwork Contractor: The earthwork contractor is responsible for grading the site to elevations and grades shown on the plans and for constructing earthen components of the project (e.g., compacted soil liners, granular drainage layers, and embankments) according to the specifications. In this case, the earthwork contractor is responsible for excavation, relocation, placement and compaction of the "wedge areas" landfill being relocated. The earthwork contractor may be hired by the general contractor. In some cases, the general contractor's personnel may serve as the earthwork contractor. The earthwork contractor is responsible not only for grading the site to proper elevations but also for obtaining suitable earthen materials, transport and storage of those materials, preprocessing of materials (if necessary), placement and compaction of materials, and protection of materials during and (in some cases) after placement. Earthwork functions must be carried out in accord with plans and specifications approved by the permitting agency. The earthwork contractor should have a CQC plan and is responsible for CQC operations aimed at controlling materials and placement of those materials to conform with project specifications.

CQC Personnel: Construction quality control personnel are individuals who work for the general contractor, installation contractor, or earthwork contractor and whose job it is to ensure that construction is taking place in accord with the plans and specifications.

CQA Engineer: The CQA professional has overall responsibility for construction quality assurance. For this landfill closure, the individual also needs to be certified and experienced in identifying hazardous waste material such as asbestos, lead paint and other substances. (Alternatively, a person working under the Engineer could have such certifications.) The engineer is an individual experienced in a variety of activities, although particular specialists in soil placement, hazardous waste determinations and mitigation, polymeric materials, and geosynthetic placement may be involved with the project. The CQA engineer is responsible for reviewing the CQA plan as well as general plans and specifications for the project so that the CQA plan can be implemented with no contradictions or unresolved discrepancies. Other responsibilities of the CQA engineer include education of inspection personnel on CQA requirements and procedures, scheduling and coordinating of CQA inspection activities, ensuring that proper procedures are followed, ensuring that testing laboratories are conforming to CQA requirements and procedures, confirming that test data are accurately reported and that test data are maintained for later reporting, and preparation or oversight of all reports. The CQA engineer will review all documentation on a daily basis.

The most important duty of the CQA engineer is overall responsibility for confirming that the facility was constructed in general accord with plans and specifications approved by the permitting agency. In the event of nonconformance with the project specifications or CQA plan, the CQA engineer should notify the owner as to the details and, if appropriate, recommend work stoppage and possibly remedial actions. The CQA engineer is an authorized representative of the owner. The CQA engineer will be on the construction site on a regular basis during all major construction operations. This person is required to be onsite and overseeing all landfill excavation and relocation activities.

The CQA engineer is responsible for certifying to the owner and permitting agency that, in his or her opinion, that the compacted soil layer has been constructed in general accord with plans and specifications and CQA plan approved by the permitting agency. The certification statement is accompanied by a final CQA report that contains all the appropriate documentation, including daily observation reports, sampling locations, test results, drawings of record, and other relevant data.

Geotechnical Engineer: The natural soil components require specialized geotechnical expertise for observing excavation to native ground (of landfill material). placement and testing. This will be provided by a qualified geotechnical engineer for the placement of the compacted soil layer.

CQA Personnel: Construction quality assurance personnel are responsible for making observations and performing field tests to ensure that a facility is constructed in general accord with the plans and specifications approved by the permitting agency. CQA personnel shall not revoke, alter, or relax the provisions of the plans and specifications. CQA personnel report to the CQA engineer.

Testing Laboratory: Many CQA tests are performed by commercial laboratories. The testing laboratory should have its own internal quality control plan to ensure that laboratory procedures conform to the appropriate American Society for Testing and Materials (ASTM) standards or other applicable testing standards. The testing laboratory is responsible for ensuring that tests are performed in accordance with applicable methods and standards, for following internal quality control procedures, and for reporting data. The testing laboratory must be willing to allow the owner, permitting agency, design engineer, installer, or CQA engineer to observe the sample preparation and testing procedures or record-keeping procedures, if they so desire.

1.7 Personnel Qualifications

The key individuals involved in CQA and their minimum qualifications are listed in Table 1-1.

Table 1-1. Personnel Qualifications

Individual	**Minimum Qualifications**
Design Engineer	Registered Professional Engineer
Owner's Representative	The specific individual designated by the owner with knowledge of the project, its plans, specifications, and **CQA** documents
CQA Engineer/Professional	Employed by an organization that operates separately from the contractor and owner (consultant hired by the owner), who is a registered Professional Engineer who has shown competency and experience in similar projects

1.8 Written CQA Plan

Quality assurance begins with a quality assurance plan. This CQA plan is the owner's written plan for CQA activities. This CQA plan has been tailored to this specific project and coordinated with the project plans and specifications. It includes a detailed description of all CQA activities that will be used during construction to manage the installed quality of the facility.

A copy of the plans and specifications, CQA plan, and CQA documentation will be retained at the project site during the project. The plans, specifications, and CQA documents may be reviewed during a site inspection by the permitting agency and will be the chief means for the facility owner to demonstrate to the permitting agency that CQA objectives for this project are being met.

1.9 Documentation

A major purpose of the CQA process is to provide documentation for those individuals who were unable to observe the entire construction process (e.g., representatives of the permitting agency) so that those individuals can make informed judgments about the quality of construction for this project. CQA procedures and results must be thoroughly documented.

A. Inspection Reports

Routine reporting and documentation procedures are required. Inspectors will prepare written daily inspection reports that will ultimately be included in the final CQA document. The reports will include information about work that was accomplished, tests and observations that were made, and descriptions of the adequacy of the work that was performed. As a minimum, the reports will contain the following:

- Date, project name, location, personnel involved in major activities, and other relevant identification information.
- Description of weather conditions, including temperature, cloud cover, and precipitation.
- Summaries of any meetings held and actions recommended or taken.
- Specific work units and locations of construction underway during that particular day.
- Equipment and personnel being utilized in each work task, including subcontractors.
- Identification of areas or units of work being inspected.
- Unique identifying sheet number of geomembranes for cross referencing and document control.
- Description of offsite materials received, including any quality control data provided by the supplier.
- Calibrations or recalibrations of test equipment, including actions taken as a result of recalibration.

- Decisions made regarding approval of units of material or of work and/or corrective actions to be taken in instances of substandard or suspect quality.
- Unique identifying sheet numbers of inspection data sheets and/or problem reporting and corrective measures used to substantiate any CQA decisions described in the previous item.
- Pictures showing progress and key elements.
- Signature of the CQA engineer or designated representative.

B. Inspection and Testing Reports

All observations, results of field tests, and results of laboratory tests performed on site or off site will be recorded on a suitable data sheet. Recorded observations may take the form of notes, charts, sketches, photographs, or any combination of these. Where possible, a checklist may be useful to ensure that pertinent factors are not overlooked.

As a minimum, the inspection data sheets will include the following information:

- Description or title of the inspection activity.
- Location of the inspection activity or location from which the sample was obtained.
- Type of inspection activity and procedure used.
- Unique identifying geomembrane sheet number for cross-referencing and document control.
- Recorded observation or test data.
- Results of the inspection activity (e.g., pass/fail); comparison with specification requirements.
- Personnel involved in the inspection besides the individual preparing the data sheet.
- Signature of the CQA inspector.

C. Problem Identification and Corrective Measures Reports

A problem is defined as material or workmanship that does not meet the requirements of the plans, specifications, or CQA plan for the project or any obvious defect in material or workmanship. Problem identification and corrective measures reports will contain the following information:

- Location of the problem.
- Description of the problem (in sufficient detail and with supporting sketches or photographic information where appropriate) to adequately describe the problem.
- When and by whom the problem was located (reference to inspection data sheet or daily summary report).
- Corrective measure(s) as developed by the contractor.
- Who approved the corrective measure(s)?

- Documentation of correction if corrective action was taken and completed prior to finalization of the problem and corrective measures report (reference to inspection data sheet, where applicable).
- Signature of the CQA inspector and review signature of the CQA engineer.

D. Drawings of Record

Drawings of record (also called "as-built" drawings) will be prepared to document the actual lines and grades and conditions of each component of the project and to specify the source of the information (i.e. contractor redlines, field observation, survey, etc.).

E. Final Documentation and Certification

At the completion of a project, the owner will submit a final report to the permitting agency. This report will include all of the contractor's submittals, daily inspection reports, inspection data sheets, problem identification and corrective measures reports, and other documentation such as quality control data provided by manufacturers or fabricators, laboratory test results, photographs, record drawings, internal CQA memoranda or reports with data interpretation or analyses, and design changes made by the design engineer during construction. The document will be certified by the CQA engineer as follows:

> *In accordance with project CQA Plan, the undersigned professional engineer states that:*
>
> *A designated representative under the supervision of a licensed professional engineer was present during construction to observe construction activities, and that person has reviewed the results of the field testing of materials, and to the best of the person knowledge, and belief, the following project, Go East Landfill was constructed in accordance with the approved construction documents and the materials used in construction were in general conformance with the specifications. Based on the forgoing, the project can begin post-closure requirements.*

F. Document Control

Original documents and digital copy (scanned) will be kept and indexed for all CQA and CQC documents. This will allow easy access to all documents and will enable a reviewer to identify and retrieve submittals, inspection reports, or data sheets for any completed work element.

G. Storage of Records

During construction, the CQA engineer will be responsible for all CQA documents. This includes a copy of the design criteria, plans, specifications, CQA plan, and originals of all data sheets and reports. Duplicate records will be kept at another location to avoid loss of this valuable information if the originals are destroyed.

Once construction is complete, the document originals will be stored by the owner in a manner that will allow for easy access while still protecting them from damage (digitally stored). An additional copy will be forwarded to SHD for their future reference use. All documentation is to be maintained through the operating and post-closure monitoring periods of the facility by the owner and the SHD agency in an agreed-upon format (hard copy and digital copy).

1.10 Meetings and Site Visits

Periodic meetings of all parties involved with the construction of various elements of the Project are required to establish work schedules, resolve problems, and generally maintain good lines of communication. An onsite trailer/office is to be available onsite to maintain records and host meetings. These meetings are outlined in the following sections.

1.10.1 Preconstruction Meeting

The Preconstruction meeting is held in advance of the start of construction to introduce all parties, confirm responsibilities and lines of communication, resolve any particular issues prior to the commencement of work, and clarify the requirements for CQA. The CQA Plan shall be made available to all parties, and the particular requirements for testing of the geosynthetics shall be noted. In addition, the following points shall be discussed.

- The lines of authority and communication.
- The standards for QC procedures used for the geosynthetics in the context of the CQA Plan and a methodology for review and acceptance agreed between the CQA Engineer and the Contractor.
    - Review of the requirements for seaming, testing, monitoring, and documenting installation and repairs and the repair procedures that will be required for different types of flaws or damages.
    - Review of the precautions to be taken to protect the subgrade during installation, and exposure to weather conditions prior to placement of the liner materials.
    - Manufacturer material submittals, including samples taken at the manufacturer's plant, required from the Contractor **PRIOR** to items being shipped to the site.
- The Contractor's schedule and critical path items.
- Assignment of the responsibilities to each party, and confirmation that the personnel provided shall be sufficient to meet these requirements.
- Confirmation of the timing and distribution of reports for both work schedules and CQA documentation.
- Sensitivity to local residents, both around the landfill and located along roads to the landfill.
- The time and place of the first Progress Meeting.

Either as part of the Preconstruction Meeting or separately, additional topics pertinent to the CQA Program should be discussed and agreed upon by the CQA Engineer.

- A site walk to determine the status of condition of the landfill and to review potential material storage and soil stockpiles locations on site.
- The specific methods of deployment to be used for the geomembrane material and pipe materials.
- The standards for QC procedures used for the CQA Plan and a method for review and acceptance agreed between the CQA Engineer and the Contractor.
- Confirmation of equipment laydown areas and construction worker parking.
- Review Contractor's Traffic Control Plan and anticipated variations throughout the term of the Contract.
- Review the list documents Contractor will need to produce per technical specifications.

This meeting shall be fully documented by the CQA Engineer and meeting minutes will be circulated to all parties present at, or affected by, the meeting.

1.10.2 Progress Meetings and Reports

The CQA Engineer shall conduct regularly scheduled Progress Meetings, a minimum of once per week, to review the status of the schedule, problem issues, and measures for resolution of problems related to the CQA Program. These meetings shall be documented, as required, and the decisions reached shall be circulated to all affected parties. The frequency of Progress Meetings may be modified by the Snohomish Health District (SHD), if considered warranted by the CQA Engineer, based on the performance of the Contractor.

The time of the first Progress Meeting shall be determined during the Preconstruction Meeting. During each Progress Meeting, the time of the next Progress Meeting shall be confirmed. The Progress Meetings shall be designated as Progress Meeting 1, Progress Meeting 2, and so on.

The CQA Engineer shall prepare Field Inspection Daily Reports documenting the activities of the Contractor for each day worked. In addition, the CQA Engineer shall prepare for SHD meeting minutes of a weekly Progress Meeting, summarizing progress, problems, and resolutions. Areas of concern and potential future problems shall also be identified and then addressed at the next planned Progress Meeting, unless it is of sufficient importance or urgency as to warrant an *ad hoc* meeting.

1.10.3 Site Visits

The CQA Engineer is to be on site at all times that the Contractor is performing work to review the progress and methodology of the construction. A Design Engineer and the SHD Representative, at a minimum, should attend the weekly Progress Meeting at the site to be informed of the progress, problems, and resolutions. While at the site, the Design Engineer shall review any aspects of the Project that are particularly critical to the performance of the system being constructed. If the CQA Engineer has any issues arise that cannot be easily resolved or which impacts the design, the Design Engineer and/or geotechnical engineer shall make an *ad hoc* site visit to review the issue and provide resolution. A professional qualified in detecting hazardous waste shall be on site when landfill waste is being relocated. This professional may be different than the CQA Engineer.

1.10.4 Weather

The contractor or installer is responsible for complying with the LFCP requirement and contract plans and specifications. It is the responsibility of the CQA personnel to make sure that the weather restrictions are observed during construction. Maximum onsite driving speeds while landfill activity is ongoing is 15mph. The landfill closure activity will be shut down during any type of high winds.

1.10.5 Work Stoppages

The CQA engineer should notify the general contractor during stoppages for their evaluation to determine (1) whether in-place materials are covered and protected from damage (e.g., lifting of a geomembrane by wind or premature hydration of geosynthetic clay liners); (2) whether partially covered materials are protected from damage (e.g., desiccation of a compacted soil liners); and (3) whether manufactured materials are properly stored and properly or adequately protected (e.g., whether geotextiles are protected from ultraviolet exposure). The cessation of construction should not mean the cessation of CQA inspection and documentation. Failure to notify the general contractor does not relieve the general contractor of the responsibility of protecting all construction activities and materials.

Note: the maximum area of landfill that can be uncovered at any one time is one (1) acre. Any uncovered landfill area that is not covered with at least 6 inches of cover sands must be covered with visqueen and anchored to prevent wind from dislodging the visqueen.

2. LANDFILL CLOSURE AND ESTIMATED SCHEDULE

These activities and associated schedule are developed by the engineer as a general outline of the sequence of construction activities. The final construction schedule will be the responsibility of, and developed in detail by, the contractor at a later date.

The landfill closure construction work may be closely correlated to the preliminary plat construction work. Construction can not start until all necessary permits are in place, including an SHD Landfill Closure permit, LDA (Land Disturbance Activity) permit, DOE NPDES Permit, Haul Road and Route approval, and other environmental development permits such as the WDFW HPA and JARPA. The applicant will closely communicate with SHD regarding updates as more certain information is available. It is anticipated that the following general landfill closure construction sequence may be completed within a year after the site permits and approvals have been issued. The general sequence of landfill closure activity is presented as follows:

- Place filter fabric fencing and construction limit fencing.
- Mobilize equipment on site and install TESC measures.
- Excavate the proposed stormwater detention pond and drainage swales to finished depth as shown on the plans and install Cover Systems 2 to serve as the enclosure for the TESC pond.
- Clearing and grubbing of site.
- Rough grading of remainder of landfill area and remainder of developable property (i.e., fill and/or excavate as required to reach proposed sub-grade elevations).
- Excavate areas of landfill "wedge area" as shown on plans.
- Stockpile landfill debris items and classify as re-use, recycle, or solid waste.
- Construction of soil cover systems over closed landfill areas.
- Construct new stream bed and landscape; direct flow to new stream at appropriate time.
- Seed (hydro seed) and landscape disturbed areas; protect steep slopes until vegetation establishes.
- Finish landfill closure construction.
- Provide required construction records and Engineers Certification of Compliance to Closure Plan.

For more detailed proposed schedule refer to Chapter 9 "Construction Requirements and Sequence" of the LFCP.

3. GRADING & EXCAVATION

3.1 Proposed Grading Conditions

Trees and vegetation will be removed from an area of approximately 8.4 acres of the landfill surface to accommodate the site grading and landfill cover area. A total of about 20 acres of site will be cleared and the balance of the 41-acre property will remain in its existing and natural condition with current vegetation.

The northern half of the property will generally be graded to meet the appropriate landfill cover requirements and graded to allow for future uses. Suitable onsite soil material will be used for fill and landfill cover material to the maximum extent feasible. This will require re-grading of areas adjacent to the landfill so onsite soils can be used in the grading effort to minimize imports. The goal is to minimize the imported structural fill material to be used so the grading plan has been designed to nearly balance cut an fill quantities on site. Exposed and scattered landfill debris will be cleaned up, placed in low-lying areas of the landfill and covered per the landfill cover system requirements in Section 4 of this report, or removed from the property.

The landfill area will be capped with a protective earthen cover supplemented by a geomembrane liner layer system described in Chapter 4 of this report. The earthen cap will include the top 12 inches of vegetated material so support a grassy recreation area, with shrubs and possibly small trees, and a detention and water quality treatment pond. The main landfill area will be graded to roughly a 5% slope to drain to the stormwater detention pond. The detention pond will be graded to its final configuration during the landfill closure and the associated storm pipe conveyance systems will be installed to collect and adequately discharge stormwater run-off safely down the piped conveyance system north of the sloped landfill area. The detention and water quality treatment pond will be graded to final elevations and used as the temporary sediment pond for landfill closure erosion control purposes. The pond will be graded with gentle side slopes of 3:1 or flatter to provide a park feel with four-foot-high fences, only provided for safety. The landfill area above the northeast slope will be sloped to drain to the stormwater pond for water quality treatment and controlled discharge to the downstream drainage system.

Residential lots will be placed around the perimeter of the landfill except for the northeast corner of the landfill. The LFCP requires that the lot area outside the landfill have a program to verify no hidden materials exist. See pages 22 and 23 of LFCP for specific requirements to be accomplished. This portion of the property contains slopes that extend down into the north east facing ravine to the toe of slope.

3.2 Waste Removal Area

An irregular-shaped area containing waste materials along the perimeter of the landfill will be excavated during initial site closure grading. This area, referred to as the "wedge area," will then be backfilled with structural fill material to accommodate future land development options. These areas of earthen structural fill will be compacted to 95% of the modified Proctor maximum density using ASTM-D1557 (per the Geotechnical Engineering Report). The footprint and boundary of the landfill will be reduced and therefore will represent a reduction of area previously impacted by storm water infiltration. The waste between the existing perimeter of the landfill (0 foot depth line) and inward towards the landfill, including the area to be developed with lots and roads, will be removed ("wedge area"). The excavation may extend several more horizontal feet inward and then continue at roughly a 1½:1 slope up to meet existing grade (actual slope, as required to provide a safe working environment). A new perimeter gravel filled trench will become the boundary of the capped landfill, about 5.1 acres. The northeast slope about 1.3 acres will be left undisturbed. The existing landfill area is approximately 9.6 acres. The irregular-shaped area to be excavated ("wedge area"), represents the limit of excavation of approximately 3.2 acres. 46,000-60,000 cubic yards of material is estimated to be excavated and relocated onto the landfill area. The excavated area will be filled with suitable structural compacted material. Refer to the LDA plans that provide details on the landfill closure plans.

3.3 Landfill Debris Screening Plan

To date there have been over 65 soil test logs excavated into the landfill with depths up to and over 25 feet for the purpose of inventorying the type of debris and depths of material contained in the landfill. Individual soil logs are recorded by the geotechnical engineer observing the excavations and are all contained in Appendix A of the closure plan. There is a requirement to test landfill material (see page 29 of 60 of the LFCP) prior to being excavated and relocated from the landfill "wedge area" to provide information to allow proper worker protection during construction. This will allow documentation of the material being relocated from the landfill "wedge area" to the center of the landfill. None of the excavated material will be hauled off site for disposal unless it contains asbestos, lead paint, or hazardous material (see LDA drawing sheet 9 for testing and relocation requirements) in which case these materials will be placed in covered containers and disposed of offsite at an approved facility.

The area to the west of the proposed detention/water quality treatment pond will be used as the landfill debris screening location. Materials will be visually inspected for evidence of asbestos, including board and tiles, and onsite swab testing for lead paint on painted boards that are located in that area. Representative samples of suspect materials will be collected and tested. A certified asbestos professional will be on site to visually inspect excavated materials. Materials with detectable levels of lead paint and asbestos will be handled appropriately in accordance with the current solid waste handling standards as outlined in WAC 173-350 and transported offsite to an appropriate facility for disposal.

In an effort to further control and contain dust during excavation, a fire hydrant/meter, to be located onsite, will be used for an onsite water truck. Materials shall be sprinkled with water and the runoff contained as needed. The Washington State Department of Ecology (WA DOE) best management practice (BMP) for dust control shall be followed and can be found in Volume IV of the DOE's 2005 Stormwater Management Manual for Western Washington (DOE's 2005 SWMMWW). This BMP can also be used for controlling dust due to disturbance of other areas. The BMP also discusses other ways to control potential dust such as covering stockpiles with a wind-resistant fabric. Also see Section 3.6.2 and 3.6.3 for specific requirements.

Prior to excavation and relocation of the wedge area, materials will be tested for contamination (see Table G-4, as taken from Volume IV of the DOE's 2005 SWMMWW) and pH level. These materials will be sampled and analyzed at the following frequency of one sample for every 500 cubic yards for the first 2,500 cubic yards of soil and then one sample approximately every 2,500 cubic yards thereafter.

In the event that changes in color, texture, or other characteristics are observed that indicate a possible different source of the soil, a sample will be collected even when the frequency exceeds one sample per 2,500 cubic yards. More sampling may be required if field testing indicates that additional assessment is needed due to high levels of one or more of the potential contaminants. The results of the testing will be compared to the MTCA values listed in Table 3-1 to allow the contractor to determine the level of worker protection required. Additional air monitoring may be required to determine respiratory protection if fugitive dust is an issue. The results of TCLP analyses will be compared to the TCLP values in Table 3-1 to document that dangerous waste is not present and not being relocated onto the landfill area. Should TCLP values exceed the dangerous waste criteria listed in Table 3-1, special handling and disposal requirements will be implemented.

Table 3-1: Recommended Parameters and Suggested Values for Determining Reuse and Disposal Options

Parameter	Suggested Maximum Value (MTCA) [1]	TCLP Maximum Value [2]
Arsenic, Total	20.0 mg/kg	5.0 mg/l
Cadmium, Total	2.0 mg/kg	1.0 mg/l
Chromium, Total	42 mg/kg	5.0 mg/l
Lead, total	250 mg/kg	5.0 mg/l
Nickel	100 mg/kg	Na [3]
Zinc	270 mg/kg	Na
Mercury (Inorganic)	2.0 mg/kg	0.2 mg/l
PAHs (Carcinogenic)	0.1 – 2.0 mg/kg	
TPH (Heavy Fuel Oil)	200 - 460 mg/kg	Na
TPH (Diesel)	200 – 460 mg/kg	Na
TPH (Gasoline)	100 mg/kg	Na
Benzene	0.03 mg/kg	0.5 mg/l
Ethylbenzene	6 mg/kg	Na
Toluene	7 mg/kg	Na
Xylenes (Total)	9 mg/kg	Na
pH [4]	6.5-8.5	6.5-8.5

Notes: [1]Model Toxics Control Act Method A values for unrestricted site use or protection of terrestrial organisms.
[2]Maximum Concentrations of Contaminants for the Toxicity Characteristic per WAC 173-303-090.
[3]Na = No value given
[4]pH range considered to be neutral

4. LANDFILL CAP COVER SYSTEMS

4.1 Overview

The proposed cover systems will encompass a total area of approximately 5 acres (Cover Systems 1 and 2). The minimum requirements for the final landfill cover system for proper closure are stated in WAC 173-350-400(e)(ii)A&B. This project is proposing to exceed the minimal requirements as described by the WAC 173-350-400. The cover systems are described in the main report. This text provides an overview of each system. Additionally, plans, cross-sectional views, and details are provided in the LDA drawings prepared for the landfill closure.

For this project there are two separate cover systems. Cover Systems 1 and 2 both incorporate a geomembrane layer covered with earthen (non-compacted) material.

Cover System 1: For the larger plateau area and slopes up to 3:1, the area will be covered by a 40-mil LLDPE geomembrane liner, plus two feet of earthen material and 6 to 12 inches of organic material suitable for supporting native and seed grasses. The geomembrane liner is discussed in detail in Appendix F of the LFCP and the LDA drawings.

Cover System 2: For the area of the proposed stormwater detention pond and conveyance ditches, a second 40-mil LLDPE geomembrane liner layer will be provided for additional protection against water infiltration. See LDA drawings for details.

Cover System 3: This cover system has been deleted.

4.2 Earthen Cap Layer and Geomembrane (Cover Systems 1 and 2)

Cover System 1 encompasses the largest area, approximately 5 acres.

This cover system will require a geomembrane liner, plus a minimum of 2 feet of earthen material and 6 to 12 inches of organic material suitable for supporting grasses. The geomembrane liner is discussed in more detail in Section 4.2C of this Appendix E of the LFCP.

A. Soil Fill Material Layer
The soil cover material layer will consist of about 2 feet of local sands and organic soils as required to achieve the proposed grades. This fill material will be generated from areas of onsite cut materials in combination with possible imported soils as recommended in the Geotechnical Engineering Report and as shown on the grading plans contained in the LDA drawings.

B. Sub-Grade Layer
The sub-grade layer will consist of 6 inches of compacted foundation material. This layer is intended to serve as a flat surface, onto which the geomembrane liner will be placed, and to prevent any puncture from waste below and help minimize differential settlement of the waste.

C. Geomembrane Layer
Over the sub-grade layer, the geomembrane liner will provide extra protection against stormwater infiltration into the landfill. This project proposes to use a minimum 40-mil LLDPE geomembrane liner which is commonly used for capping landfills and lining ponds. The liner membrane will be flexible and

capable to elongate to accommodate any possible differential settlement that may occur over time. The liner is intended to limit or minimize moisture penetration downwards and gas migration upwards.

For further information on the geomembrane liner layer, see Appendix E. For testing of the geomembrane liner layer, see "Northwest Linings and Geotextile Products, Inc., Construction Quality Control Manual for Containment Membrane Field Installations" included in Appendix E of this report. The sample specifications and materials and installation warrantees for the geomembrane liner are included in Appendix E. This liner, or equal, shall be used for this project. Directly on the membrane will be placed a geotextile cushion material.

D. Soil Cover Layer
A 2-foot thick soil layer of soil is to be placed over the geotextile cushion per geotechnical engineer recommendations. Section 10.3 of the Geotechnical Engineering Report recommends, "This material be placed in maximum loose lift thickness of 12 inches." The top 12 inches will be as described in Appendix E below.

E. Vegetative Soil Cover Layer
The vegetative soil cover layer will be about 12 inches deep and will consist of organic soils to promote and sustain plant and/or grass growth. The vegetative soil depth may be deeper as required to develop adequate plant root systems.

4.3 Critical CQA Issues

The CQA processes for soil layers are intended to accomplish three objectives:

A. Ensure that soil layer materials are suitable.

B. Ensure that soil layer materials are properly placed and compacted.

C. Ensure that the completed layers are properly protected.

Some of these issues, such as protection of the soil layer from desiccation after completion, simply require application of common-sense procedures. Other issues, such as preprocessing of materials, are potentially much more complicated because, depending on the material, many construction steps may be involved. Furthermore, tests alone will not adequately address many of the critical CQA issues—visual observations by qualified personnel, supplemented by intelligently selected tests, provide the best approach to ensure quality in the constructed soil layer.

As discussed in Chapter 1 of the plan, the objective of CQA is to ensure that the final product meets specifications. A detailed program of tests and observations (CQC and CQA) is necessary to accomplish this objective. As a result of historic practices and procedures, CQC and CQA activities are very closely linked for compacted soil layer. In some instances, CQA testing information will be used directly by the Contractor (as CQC information) to perform his work.

4.4 Sampling Patterns

Sampling locations on compacted layers for water content/density tests and for laboratory permeability samples will be based on a pre-established grid pattern. The proposed grid pattern and test sampling locations is to be positioned on a drawing of the site prior to construction and will be a guide to the CQA personnel. The CQA personnel will adjust the pattern and/or perform additional testing to verify any suspect areas. (Provide copy of test locations on a marked plan.)

4.5 Repair From Any Destruction of Geomembrane

A number of tests (e.g., nuclear density tests) require that a penetration be made into a lift of compacted soil. Penetrations be repaired in accordance with the specifications. Approximately, 20 percent of all repairs will be inspected and documented. Inspection will include observation of the backfill procedure.

All density fill compaction testing is to be completed prior to placing geomembrane.

4.6 Corrective Action

If it is determined that materials in an area do not conform with the specifications, with allowance for outliers as discussed above, the area will be repaired. The area repaired will be the area that extends from the failing test out to the boundaries defined by passing tests. Additional testing may be performed to identify and reduce the area that requires repair.

Corrective action will depend on the specific problem. If the water content is incorrect, the action will be to moisten or dry the loose lift of soil in place. Water must be added uniformly, which requires mixing the soil with a disc or rototiller. If the soil contains oversized material, oversized particles will be removed from the material. If clods are too large, clods may be pulverized in the loose lift. If the soil lacks adequate plasticity, contains inadequate fines, or contains too much gravel, the material will be excavated and replaced. If the soil is inadequately compacted, additional passes of the compactor may be required. If the soil desiccates or freezes, it may be disked and processed to adjust water content or to reduce clod size and recompacted.

When repairs are required, the corrective action must be approved by the CQA engineer and recorded on a Problem Identification and Corrective Measures Report form.

4.7 Final Approval

Upon completion, the soil layers must be accepted and approved by the CQA engineer prior to deployment or construction of the next overlying layer. Acceptance and approval will be based on all the CQC and CQA observations, data, and test results.

5. QUALITY ASSURANCE RESPONSE REQUIREMENTS

To assure proper level of follow up is conducted, the following procedures shall be used.

5.1 Submittal Review

The CQA Engineer has ten (10) working days to review and return submittals plus an additional one week for submittals that deviate from the Contract Documents. The CQA Engineer will review only those items required by the Contract Documents. Information submitted by the Contractor not required will be returned marked "Information Only." In the event a single submittal contains both required and ono-required information, only the required information is subject to CQA Engineer review.

Submittal will be marked to indicate the result of CQA Engineer review, as follows.

- "NO EXCEPTION TAKEN" – Revision of drawing or data will not be required.
- "MAKE CORRECTION NOTED" – Contractor shall revise the drawing or data, as indicated. Resubmittal is not required.
- "REVISE AND RESUBMIT" - Contractor shall revise the drawing or data and shall resubmit the revised drawing or data to the CQA Engineer for review and acceptance.
- "REJECTED" - Submittal does not conform to Contract Documents. Contractor shall resubmit in a form that conforms to Contract Documents to the CQA Engineer for review and acceptance.

Copies marked "NO EXCEPTION TAKEN" or "MAKE CORRECTION NOTED" authorizes the Contractor to proceed with construction or fabrication covered by those Design Drawings or data sheets with corrections, if any, incorporated.

5.2 Summary of Quality Assurance Functions

Table 5-1 provides a summary of QA functions to assure proper oversight. Sections not listed typically provide for general oversight responsibilities.

Table 5-1 - CQA Response Requirements Summary.			
Action Item	**Action for CQA**	**Item**	**Notes**
Measurement and Payment Procedures	Review	Contractor progress estimates – lump sum	Per contract
Measurement and Payment Procedures	Review	Contractor time and material documentation – measurement by allowance	
Administrative Requirements	Review	Draft forms	Review and approve
	Schedule	Preconstruction meeting	Provide agenda and list of required items for Contractor to submit or present at the meeting. Prepare and distribute meeting minutes.
	Schedule	Weekly project meetings	Prepare, coordinate, convene, arrange, and direct. Provide direction to the contractor for preparation of weekly meetings. Prepare and distribute meeting minutes.
	Schedule	RFI Meetings	Direct and lead meetings. Provide direction to the contractor for preparation of meeting including ensuring required individuals are present and prepared to discuss RFIs in detail. Prepare and distribute meeting minutes.
Project Schedule	Review	Baseline schedule	
	Review	Schedule monthly updates	
Quality Assurance and Quality Control	Testing	Laboratories	Approval of lab.
Surveying	Execution	Completed Work Verification Survey	Review
Temporary Facilities and Utilities	Execution	Temp facilities	Available space
		On-site parking limitations	Available space
		Signage	Review and approve graphic design, colors, style of lettering and sign drawing prior to manufacture. Approve installation location, other signs, and removal of signs.
Traffic Controls	Plan review	Traffic Control Plan	Review (based on SC permit)
	Execution	Flagger cards	Prior to commencing work
		Coordinate with landfill operations	Ongoing
		Inspect, maintain, remove and replace signage	As necessary
Product Requirements	Execution	Products (all)	Review, as necessary
		Product substitutions	Review Substitution Request Form
Closeout Procedures	Execution	Red-line record document coordination	Weekly
Removal of Hazardous Materials and Dangerous Waste	Plan review	Pollution Prevention Site Plan	Approve prior to mobilizing to site
	Execution	Identify dangerous waste by sampling	Observe excavation, and sample as necessary during excavation, or when notification of potential by others
		Inform Contractor of the presence of Dangerous Waste	Instruct Contractor on how to proceed
		Direct additional Dangerous Waste characterization by Contractor	As required
		Provide Waste Profile form and/or HWM information to the Contractor	As required
		Temporary Dangerous Waste storage location	Identify available space/containers
		Lead and asbestos	Direct proper action for cleanup
		Cleanup	Approve alternative methods for cleanup. Inform Contractor when clean-up is adequate
		Equipment and vehicle decontamination	Inform Contractor when clean-up is adequate
		Collect Hazardous Waste Manifests	Within 30 days of disposal

Table 5-1 - CQA Response Requirements Summary (cont.)			
Action Item	**Action for CQA**	**Item**	**Notes**
Geotextiles	Review	Results of geotextile manufacturer's source quality control tests for all rolls of geotextile shipped to site	Review
	Product	Notification 10 working days prior to shipping date by Contractor	Acceptance
		Review product specs and manufacturer test results – conformance test	Acceptance
		Conformance testing	Perform, specify locations to collect samples
	Execution	Installation	Acceptance
		Installation other than machine direction down slope	Approve
		Sandbags or other methods	Approve
		Installation completion	Acceptance, as appropriate
Linear Low-Density Polyethylene (LLDPE) Geomembrane	Plan review	Installation and Sequencing Plan	Acceptance
	Product	Review product specs and manufacturer test results	Acceptance
		Conformance test – pre-shipment samples	Acceptance
		Notification 10 working days prior to shipping	Acceptance
		Shipment	Verify and check bills of lading against sample submittals
		Delivery of rolls	Inspect and determine if damaged
		Materials produced outside of North America	Acceptance
	Submittal review	Review product specs and manufacturer test results	Acceptance
		Certification of installation in accordance with Contract Documents	Acceptance
	Execution	Placement of electric generations on geomembrane	Approve
		Rounding and chamfering of edges of anchor trenches, other excavations, and grade changes other than specified	Approve
		Periodic verification, checking, or testing	Observe and document
		Connections to bottom liner	Survey Acceptance
		Subgrade	Observe daily
		Installation at ambient temperature other than between 50 and 70 degrees Fahrenheit	Approve in writing
		Trial welds greater than 2 per day	Direct as appropriate
		Working day QC documentation	Acceptance prior to commencing next day's work
		Panel identification	Coordinate coding with Contractor
		Horizontal seams less than 6 feet away from toe or crest of slope	Approve
		Seam numbering system	Coordinate coding with Contractor

Table 5-1 - CQA Response Requirements Summary (cont.)			
Action Item	**Action for CQA**	**Item**	**Notes**
Linear Low-Density Polyethylene (LLDPE) Geomembrane (cont.)	Execution (cont.)	Seam welding accessories	Approve apparatus
		Solvent and adhesive use	Approve in writing
		Extension of EGC and final cover to tie-in location	Review
		Welding and cap stripping	Observe
		Destructive testing locations and numbering	Select
		Destructive testing	Retain portion for archive storage
		Welded seams	Acceptance
		Repairs	Approve
		Record Drawings	Acceptance
		Material and seam test results, weld test summary report and installation completeness	Acceptance, as appropriate
		Installation completeness	Acceptance
Trenching, Backfilling, and Compacting for Utilities	Execution	Unauthorized excavation	Provide direction
		Material part vegetation soil, surfacing, pavement or cover system storage	Provide direction
		Underground piping and utilities	Provide all available information to Contractor
		Unsuitable conditions	Approve excavation below grade
		Plan for controlling site water during trench excavation	Review
		Excavation by machinery	Approve
		Backfilling existing utilities	Acceptance
		Field survey notes	Maintain at the job site throughout the Work
		Grade and alignment control during excavation	Provide to Contractor
		Grade control device	Provide
		Testing	In-place density and moisture content
		Installation completeness	Acceptance, as appropriate
Earthwork	Plan review	Construction Plan	Approve prior to any earthwork
		Moisture conditioning methodology	Acceptance
	Review	Surface preparation	Review prior to commencement of proof-rolling
		Compaction equipment for proof rolling	Approve
		Unsuitable screenings	Designate stockpile location
	Product	Preliminary testing, Request for Approval of Material Source form	Perform and provide, respectively
		Trench Backfill	Determine if unsuitable. Direct the use of screened embankment used in place of excavated materials where appropriate
		Blending	Approve area for blending and verify blending prior to hauling of material for final placement
		Correction of excessively wrinkled geosynthetic products	Approve
		Conformance test	Perform as appropriate
		Imported materials delivery to site	Written acceptance
		Testing for final acceptance	Approve
		Preconstruction material quality evaluations	Review prior to incorporation
		Vegetative soil blending	Verified prior to hauling for final placement

Table 5-1 - CQA Response Requirements Summary (cont.)			
Action Item	**Action for CQA**	**Item**	**Notes**
Earthwork (cont.)	Execution	Excavations allowed within 5 feet horizontally of geomembrane edge using methods other than hand tools	Written acceptance
		Excavation limits	Direct
		Refuse excavation	Approve
		Unsuitable materials excavation and placement	Written approval
		Fill material placement	Approve suitable condition of underlying surface
		Stop fill placement temporarily other than unsuitable weather conditions	Approve
		Compaction methods	Approve
		Fill low spots with screened Embankment material and minimally grade high spots of summer cover	Approve
		Finish grade compaction for hydroseeding	Verify Visually
		Condition of underlying geosynthetic products prior to placement of soil	Approve
		Excavate soft or loose zones	Approve depth of excavation
		Riprap and quarry spall placement	Approve
		Backfill material for structures other than native material	Approve
		Earthwork completeness	Written acceptance, as appropriate
Refuse Excavation and Handling	Submittal review	Refuse relocation meetings: preconstruction meeting, weekly coordination meetings, repair meetings (as necessary)	Coordinate
	Execution	Prohibited wastes	Verify
Erosion and Sedimentation Control	Plan review	Temporary Erosion and Sedimentation Control Plan that includes Dust Control Plan	Approve prior to commencement of work (updated weekly)
		Temporary enhanced surface water treatment systems plan	Approve
	Product	Dust palliative	Approve
	Execution	Surface water runoff monitoring	Monitor pH and turbidity at monitoring points identified in the Contract drawings
		Installation limits of sedimentation controls	Stake
		Removal of sediment from detention pond and outlet chamber	Direct removal
		Sewing of geotextile at location other than point of manufacture	Approve
		Silt Fence Locations	Acceptance
		Gravel Filter Berms	Approve locations
		Rock Silt/Check Dams	Approve locations

Table 5-1 - CQA Response Requirements Summary (cont.)			
Action Item	**Action for CQA**	**Item**	**Notes**
Erosion and Sedimentation Control (cont.)	Execution (cont.)	No inclusion of wood cellulose fiber in the hydroseeding process	Approve
		Application of straw mulch as temporary stabilization method	Direct use in areas with slopes 4:1 or steeper
		Areas outside the Limits of Construction	Approve
		Dust control	Acceptance
		Application of water for dust control	Request where appropriate
		Street sweeping disposal	Acceptance
		Application and reapplication of temporary soil stabilization for turbidity control in stormwater	Direct application when appropriate
		Straw mulch application in areas with Temporary Soil Stabilization cover	Direct use where appropriate
		Concrete wash water residue disposal	Approve
		Plastic sheeting (visqueen) installed on erodible embankment slopes	Provide direction when required and approve installation
		Location of stockpile for sandbags not currently in use	Approve
Rolled Erosion Control Products (RCEP)	Execution	RECP edge subject to wind- or water-related instability	Require securing, as needed
		RCEP installation	Approve
Vegetative Soil and Hydroseed	Plan review	Topsoil Testing analysis report	Acceptance
	Product	Soil amendment supplier's material certification	Acceptance
	Execution	Completion of subgrade preparation	Observe
		Completion of topsoil preparation	Observe
		Completion of finish grade prior to seeding	Observe
		Seeding and other work has been completed	Observe
		Conclusion of one-year Guarantee Period	Observe
		Areas where has erosion has washed seed and soil away	Review and provide solution
		Filling of stormwater pond as watering technique	Approve, after plants have grown to sufficient height to withstand flooding
		Onsite water source	Approve
		Finish grade of seeded areas	Acceptance prior to seeding
		Seeding at times of year other than between March 15 and May 15	Written approval
		Seed beds	Acceptance
		Monthly inspection during maintenance period	Written notice of failure, as necessary
		Final inspection 30 days before end of landscape maintenance period	Provide direction
		Final acceptance	Acceptance
Precast Concrete Utility Structures	Execution	Samples for conformance testing	Obtain, when required
		Pipe placement	Approve
		Backfilling	Review and approve all pipe in place as to line, grade, bedding, and proper joint construction
		Solid pipe leak tests	Observe and signed acceptance
		Completion and required documentation from material supplier and Contractor	Acceptance

Table 5-1 - CQA Response Requirements Summary (cont.)			
Action Item	**Action for CQA**	**Item**	**Notes**
High Density Polyethylene Pipe and Fittings	Submittal review	Sample of each solid and perforated pipe	Acceptance, prior to fabricating pipe
		Testing Plan	Approve
	Product	1-foot long sample of each solid and perforated pipe	Acceptance
		Joints and connections other than thermal butt-fusion or electro fusion other than shown in drawings	Approve
		Mechanical couplings not shown in drawings in permanent above-grade or temporary applications	Approve
	Execution	Samples	Obtain
		Placement of piping in suitable trench and weather conditions	Determine
		Backfill	Approve that all pipes are place as to line, grade, bedding, and proper joint construction
		Changes to grade and alignment from design	Approve
		Solid Pipe Leak Test	Observe and written acceptance
		Completion	Written acceptance
Piping Systems	Execution	Alternate pipe installation grade or line	Direct, based on settlement, as needed
		Notice of intent to cover a pipe or structure	Observe within 1 working day of request
		Final acceptance	Acceptance
		Inspection of new pipes and culverts after installation and during connection of pipe joints and fittings	Observe
Solid Wall PVC Piping	Submittal Review	Testing plan	Approval
	Execution	Testing	Monitor
		Repair leakage	Approve
		Inspection	Acceptance
Piping/Perforated PVC pipe	Submittal review	1-foot long sample of each solid and perforated pipe	Acceptance
		Testing Plan	Approve
	Execution	Testing	Monitor
		Repair leakage	Approve
		Inspection	Acceptance
Corrugated Polyethylene Pipe	Submittal Review	1-foot long sample of each solid and perforated pipe	Acceptance
		Testing Plan	Approve
		Splitting or snapping of CPE pipe joints and connection	Approve if not in accordance with specifications
	Execution	Testing	Monitor
		Repair leakage	Approve
		Inspection	Acceptance
Landfill Gas Collection System	Submittal review	Testing Plan	Approve
		Landfill Gas System Construction Plan and Schedule	Approve prior to disconnection of existing piping
	Product	Pipe support reuse and storage	Approve
	Execution	Any needs for isolating, disconnecting, or otherwise disrupting normal LFG operations.	Notify at least 3 working days in advance
		LFG System Construction Plan form	Approve
		LFG pipe labeling	Designate
		Final as-built pipeline information	Measure and record
		Required documentation from field and laboratory testing laboratories	Acceptance
		Completion	Acceptance

6. LINEAR LOW AND HIGH-DENSITY POLYETHYLENE GEOMEMBRANE

This Section presents information regarding QA for the Linear Low-Density Polyethylene (LLDPE) and High-Density Polyethylene (HDPE) geomembrane products associated with the Work. The geomembrane material, consisting of polyethylene resin is manufactured in 40-mil thick sheets for the LLDPE, textured on both sides, and delivered to the site in rolls. The rolls are typical 500 to 700 feet long and 20 to 25 feet wide. This section provides additional QA procedures supplementing those contained in Appendix E of the LFCP.

6.1 Geomembrane Manufacturing

The CQA Engineer shall review all geomembrane manufacturer QC certificates and other submittals required by the Specifications and provided by the contractor for conformance with the Specifications prior to material shipment to the site. This includes samples taken at the place of manufacture and tested locally.

Once conformance is confirmed and the materials have arrived at the site, the CQA Engineer shall certify that the materials on site correspond to the materials for which the manufacturing documentation has been prepared.

Any discrepancies shall be reported to SHD and contractor with details of the Discrepancies and the nature of the materials actually on site. Conformance certifications shall be included in the Final CQA Report.

6.2 Geomembrane Conformance Testing

Conformance testing is required to be completed by the Manufacturer to confirm that the geomembrane that the Contractor intends to ship to the site has the appropriate physical and mechanical properties.

6.2.1 Sampling Procedures

Geomembrane samples for pre-shipment conformance testing shall be sent from the geomembrane manufacturer's facility to the Contractor, at the minimum rate of one per 100,000 square feet of geomembrane supplied. Samples shall only be collected from material that will be delivered to the site. Geomembrane samples for conformance testing shall be in accordance with the Specifications and sufficiently large as to provide enough material to meet the test requirements. The samples shall not include material from the outermost wrapping of the roll.

The Contractor will be responsible for ensuring that the manufacturer's documentation and sample preparation conforms to the Specifications. Upon receipt, the Contractor shall trace a pattern of each sample and submit to the CQA Engineer along with the required manufacturer's documentation. The Contractor shall forward the samples to the laboratory for testing. Upon receipt of acceptable test results, the CQA Engineer may authorize shipment.

Upon delivery of the materials to the site, the CQA Engineer shall verify the shipment and check bills of lading against sample submittals. The Contractor shall provide access for the CQA Engineer to the sampled ends of the geomembrane for CQA Engineer verification that the patterns made from the samples match the actual cuts in the geomembrane.

6.2.2 Conformance Test Procedures

Testing shall be carried out by the Laboratory in accordance with the ASTM test methods indicated in Table 6-1.

Table 6-1. Conformance Tests for LLDPE and HDPE Geomembrane

Test	Test Designation
Sheet Thickness	ASTM D5994
Density	ASTM D1505
Tensile Strength at Break	ASTM D6693
Elongation at Break	ASTM D6693
Tear Resistance	ASTM D1004
Puncture Resistance	ASTM D4833
Carbon Black Content	ASTM D1603
Carbon Black Dispersion	ASTM D5596

6.2.3 Conformance Test Results

Conformance test results shall be reported to the CQA Engineer who shall review the results for conformance with the Specifications. Conformance test results shall be reported to the County and the Contractor.

Non-conformance test results will require re-sampling for re-testing. Geomembranes represented by non-conformance test results may not be deployed until conformance with the Specifications has been demonstrated. If a second round of tests confirms non-conformance of the sample, the roll from which the sample was taken shall be rejected, as well as any other rolls represented by that sample. CQA personnel shall determine which rolls are represented by the sample from a review of the geosynthetic material manufacturer's QC testing and certification.

Additional sampling and testing may be conducted on unsampled rolls represented by the non-conforming sample. Additional sampling and testing will be conducted at the expense of the Contractor to determine conformance of those rolls with the Specifications.

The CQA Engineer shall include the results of all conformance testing in the Final CQA Report.

6.3 Geomembrane Receiving, Handling, and Storage

The CQA Engineer shall perform receiving inspection on all geomembrane material in compliance with procedures described in the Specifications. The CQA Engineer shall also confirm that transportation, handling, and storage of geomembrane materials are performed in accordance with the Specifications, and shall determine the condition of rolls of geomembrane upon delivery to the site.

The CQA Engineer shall verify that the rolls delivered match the lot numbers of those included in the conformance testing.

6.4 Geomembrane Liner System Installation

CQA personnel shall monitor and document all aspects of geomembrane liner system installation. The CQA Engineer shall document that geomembrane placement and seaming activities are performed in accordance with the

Specifications, particularly that required materials, methods, and testing procedures are employed. The CQA Engineer shall also review documentation submitted by the geomembrane installer, testing laboratories, and other parties, as listed in the Specifications. Seams or repaired areas that do not pass the tests shall be repaired and retested, as described in the Specifications, until a passing result is achieved. Requirements for geomembrane installation and testing are described in detail in the Specifications and are summarized in the following subsections.

6.4.1 Subgrade Surface Inspection

Immediately prior to geomembrane deployment, the CQA Engineer and installer shall confirm that the surface upon which the geomembrane will be installed is suitably prepared and will not damage the geomembrane.

Details of required observations are presented in the Specifications. In general, the geomembrane subgrade surface shall be free of clods, rocks, sticks, abrupt changes in grade, ruts, protrusions not to exceed ⅜ inch, standing water, frozen material, sharp objects, and other conditions that could damage the geomembrane. The CQA Engineer shall observe the geomembrane subgrade daily to the appropriate lines and grades and the thickness of material.

6.4.2 Deployment

The CQA Engineer shall monitor and document geomembrane deployment. Installation shall not begin until Contractor has submitted the previous day's quality control documentation to the CQA Engineer. Deployment shall be in accordance with the Specifications and the accepted seam and panel layout drawing submitted prior to construction. The CQA Engineer shall document the time and location of material placement and make note of any damage to the materials. The CQA Engineer shall record weather, ambient temperature, temperature of the geomembrane, and subgrade conditions to ensure conformance with the Specifications.

For any damage to the materials, the Specifications define the repair method to be used, based on the nature and size of the damage. All repairs shall be performed in accordance with the Specifications.

6.4.3 Seaming/Welding

All field seaming shall conform to the accepted seam and panel layout. Field seaming operations must be completely monitored and documented by the CQA Engineer to ensure conformance with the Specifications.

- Verify that only seaming methods and equipment that have been previously accepted are used, and that equipment and gages are in current calibration, as applicable. Obtain copies of calibration certificates for project files.
- Observe trial seaming procedure and record test results. If questions arise concerning seam failure or other aspects of the trial seam, the CQA Engineer will make the final determination as to whether the seam is acceptable.
- Monitor weather conditions, measure ambient temperature, and notify the installer if conditions are outside of the acceptable limits or if conditions have changed so that new trial seams are required.
- Verify that the geomembrane installer superintendent or lead welder foreman is present during all seaming operations.

- Prior to seaming, verify that panels have been prepared in accordance with the Specifications and are clean and dry.
- During seaming, monitor and record nozzle, preheat extrudate, wedge, or other temperatures, as appropriate for the particular apparatus. For automated apparatus, record seaming apparatus speed.

Documentation shall include (as a minimum):

- A record of the trial seams, including date, time, welder identification (ID), machine ID and settings, and associated test results.
- The seam number, based on a seam numbering system agreed to by the CQA Engineer and Contractor.
- Date, time, welder ID, machine ID and settings for each seam.
- The ambient temperature and temperature of the material.

6.4.4 Seam Testing

For seam testing, the CQA Engineer shall perform the following activities.

- Verify that test equipment is suitable and in working order and that gages are in current calibration, as applicable. Obtain copies of calibration certificates for project files.
- Continuously monitor and record the results of all non-destructive testing.
- Determine locations for destructive test samples, based on the required sampling frequency and seaming observations. Destructive samples will not be taken from critical areas, such as areas that could be expected to be under a leachate head for extended periods of time, or from places that would be hard to patch. The Installer shall not be informed in advance of the locations where the seam samples will be taken.
- Observe removal of destructive test samples. Assign a number to each sample, and record the sample number and location on the layout drawings.
- The Contractor shall send the destructive test sample to QA testing laboratory. The results of the Laboratory destructive testing shall be made available to the CQA Engineer and Contractor not more than two (2) working days after the samples have been received by the laboratory.
- Observe all repair procedures and non-destructive testing of sample locations.
- Determine whether additional sampling and testing is required, such as in tie-in areas, or when there is cause to suspect the presence of excess crystallinity, contamination, offset welds, or any other potential defect. Notify the CQA Engineer of the need and location for extra tests.
- Document all actions taken in conjunction with destructive test failures.

6.4.4.1 Nondestructive Seam Testing

The purpose of nondestructive testing is to detect discontinuities or holes that may exist in the seams, and to indicate whether a seam is continuous or has non-welded sections. Nondestructive tests for geomembrane include vacuum testing and air pressure testing. Fusion welded seams that, in the opinion of the CQA Engineer cannot be pressure tested shall be vacuum tested. Nondestructive testing must be performed over the entire length of all seams, in accordance with the Specifications. The Contractor shall perform non-destructive seam testing.

CQA personnel shall observe and document the testing to verify compliance with the Specifications and document any seam defects and necessary repairs. Documentation shall include, at a minimum, the date, time, location, and pass or fail for each test. CQA personnel shall identify the failed areas by marking the area with a waterproof marker compatible with the geomembrane, notify the Contractor of any required repairs, and record the repair needed.

6.4.4.2 Destructive Seam Testing

Destructive seam tests will be performed at an initial interval as directed by SHD for geomembrane seams. CQA personnel may require additional tests if there are seams that do not appear to meet Specification requirements. At the Preconstruction Meeting, the Contractor, CQA Engineer, and SHD will agree to this minimum testing frequency of seam length.

Reasons for selecting test locations may include, but are not limited to:

- Wrinkling in seam area
- Excess crystallinity
- Suspect seaming equipment or techniques
- Weld contamination
- Insufficient overlap
- Adverse weather conditions
- Possibility of moisture, dust, dirt, debris, or other foreign material in the seam
- Failing tests

CQA personnel will select locations where seam samples will be cut for destructive testing, as follows.

- The minimum testing frequency as directed by SHD of seam length is an average frequency for the entire installation. Individual samples may be taken at greater or lesser intervals.
- If the number of failed samples exceeds five (5) percent of the tested samples, this frequency may be increased solely at the discretion of the CQA personnel. Samples taken as a result of failed tests do not count toward the total number of required tests.

CQA personnel shall not inform the Contractor in advance of destructive sample locations.

The Contractor shall collect samples in accordance with the Specifications. CQA personnel shall:

- Observe the sample cutting operations.

- Mark each sample with an identifying number that contains the seam number, destructive test number, welder ID, machine ID, date and time.
- Record the sample location and reason for taking the sample.

Destructive testing must be performed concurrently with seaming operations, not at the completion of the entire installation.

6.4.5 Laboratory Testing

CQA personnel shall forward one part of all samples for destructive testing to the laboratory to verify seam quality. Testing includes bonded seam strength (shear) and peel adhesion (peel). Both tests shall be completed in accordance with the Specification. The purpose of peel and shear tests is to evaluate seam strength and to evaluate long-term performance. Shear strength measures the continuity of tensile strength through the seam and into the parent material. Peel strength addresses weld quality. At least five (5) specimens from each sample must be tested in each method used. Minimum test values are presented in the Specifications. The Laboratory must provide test results to the CQA personnel within 24 hours of receipt. Certified test results shall be provided within five (5) days. The CQA Engineer must immediately notify the Contractor in the event of a calibration discrepancy or failed test results.

CQA personnel must record the results of the laboratory testing on a destructive seam test form, the panel/seam log, and the panel layout drawing.

If the laboratory test fails in either peel or shear, the Contractor shall follow the failed weld procedures outlined in the Specifications. This process shall be repeated until passing tests bracket the failed seam section. All seams must be bounded by locations from which passing laboratory tests have been taken. Laboratory testing governs seam acceptance. In no case can field testing of repaired seams be used for final acceptance.

6.4.6 Anchorage

CQA personnel shall monitor anchor trench backfilling and compaction to ensure that the anchorage is constructed in accordance with the Design Drawings and Specifications and the geomembrane is not damaged during backfilling.

Downslope anchor trenches for exposed geomembrane cover shall be excavated following subgrade preparation (compaction) per Specifications. The CQA Engineer shall observe contractor methods for excavation trenches and verify that the lines and grades conform to the Design Details. Following installation, backfilling, and compaction of anchor trenches, the CQA Engineer shall provide QA testing per Specifications.

6.4.7 Repairs

Any portion of the geomembrane with a flaw that fails a nondestructive or destructive test, where destructive tests were cut, or where nondestructive tests left cuts or holes, must be repaired in accordance with the Specifications. CQA personnel must locate and record all repairs on the Record Drawings. CQA personnel shall monitor and document all repairs to ensure that they are completed in accordance with the Specifications.

6.5 Post-Seaming

After field seaming operations have been completed, CQA personnel shall perform the following activities.

- Upon completion of work in any given area, examine that area to determine whether all waste and extraneous materials have been removed and that the area has been left in a satisfactorily clean condition to allow placement of materials on top of the geomembrane.
- Monitor ambient weather conditions to verify that materials above the geomembrane are placed only within the acceptable temperature limits as defined in the Specifications.
- If soil materials are placed over the geomembrane, verify that the type of equipment meets Specification requirements.
- If soil materials are placed over the geomembrane, observe the placement operations to verify that minimum thickness is maintained, and that placement is done in a manner which will not cause wrinkles in, or damage to, the geomembrane.
- Review the Contractor's Record Drawings for the liner system.

6.6 Geomembrane Boots

CQA personnel shall observe and photo-document that all geomembrane boots are constructed per details on the Design Drawings and:

- Where pipes penetrate geomembrane, include hydrated bentonite pellets.
- Where boots penetrate GCL, place dry bentonite pellets around the pipe.
- Form a watertight and airtight seal.
- Do not pull or cause stress on the geomembrane material.

6.7 Geomembrane Lined Ditches

CQA personnel shall observe construction of geomembrane ditches, associated anchor trenches, and geomembrane connection between lifts and:

- Verify that ditch slopes are uniform and conform to the grades (slopes) shown on the Construction Drawings. CQA personnel shall verify that the contractor's ditch layout in the vicinity of the CSW inlets meets the requirements shown on the plans relative to change in slope and locally increased berm height.
- Ensure that existing cross-slope anchor trenches are not damaged during removal of existing CSW ditch in preparation for the next lift of refuse.

Observe the contractor's installation of the soil bentonite plug as well as seaming of LLDPE cover at the connection to the existing anchor trench per Construction Drawings.

6.8 Construction Hold Points

Internal hold points for the polyethylene geomembrane component of the Project are identified in Table 6-2. At these points, the Contractor, manufacturer, or installer shall cease work on the affected activity until it has been reviewed and accepted by the CQA Engineer. The schedule for hold points will be determined when the Contractor develops his procurement and construction schedule for the Project. The Contractor shall update and submit the schedule to the CQA Engineer on a weekly basis.

Table 6-1. Construction Hold Points for Geomembrane Components.

Feature	Inspection Point	Inspection Activity
Subgrade for Final Cover	Prior to deployment	Manufacturer's/Installer's documentation Refer to GCL Construction Hold Points
Subgrade for Cover 1 and 2	Prior to Deployment of 6" foundation material	Observe proof-rolling subgrade free of deleterious material, protrusions greater than 3/8 inch, and other conditions that could damage the Geomembrane. CQA Compaction testing for anchor trenches and subgrade
Subgrade for Interim Cover 1 and 2	Before Deployment of Geomembrane	Manufacturer's/Installer's documentation CQA Review of compaction testing Installer's panel layout Observe proof-rolling subgrade free of deleterious material, protrusions greater than 3/8 inch, and other conditions that could damage the Geomembrane.

7. EARTHWORK

Earthwork for the Project includes excavation, dewatering, fill, backfill, compaction, grading, processing, stockpiling, disposal of unsuitable materials, aggregates, embankment, and subgrade preparation. Prior to the start of earthwork activities, the Contractor shall submit a Preconstruction Plan and schedule to CQA personnel for acceptance. This plan shall include a description of the methods to be used for all material processing, excavation, backfilling, soil placement, compaction, and grading operations. CQA personnel shall review this plan for conformance with Specification requirements.

Note that contours shown within landfill areas on the Design Drawings reflect surface conditions at the time field topography was accomplished. Over the course of time, differential settlement of the landfill will occur. If at any time during construction any CQA personnel detect a significant difference between actual and design grades, immediately notify the CQA Engineer.

7.1 Excavation for Construction Activities

Equipment and tools used in the performance of this work shall be approved by the CQA Engineer prior to commencement of work. During excavation, CQA personnel shall generally observe the excavated material and subgrade conditions and shall perform the following activities.

- Observe stripping and excavation to document that there are no moisture seeps and that all soft, organic, and otherwise undesirable materials are removed to the appropriate stockpile.
- Observe construction activities near existing wells, LFG facilities, and during exposure of existing geomembrane. Photograph and otherwise document any observed damage and secure an appropriate and documented repair.
- Immediately notify the CQA Engineer of any damage to LFG systems.
- Review the Contractor's work and confirm that the depth and slope of the excavations, sumps, ramps, trenches, surface water drainage ditches, roadways, and other pertinent features meet design requirements. The extent of confirmation surveying performed by the CQA Engineer may be modified as the work progresses.

Observations shall be recorded on daily field monitoring report forms, including Record Drawings or photographs, as appropriate.

7.2 Stockpile Excavation

During excavation of stockpiles for haul or for processing, the CQA Engineer shall generally observe the excavated material and subgrade conditions and shall perform the following activities.

- Observe stripping and excavation to document that there are no moisture seeps and that all soft, organic, and otherwise undesirable materials are removed to the appropriate stockpile.
- Observe the material for changes in moisture content or material properties (e.g., clay, glacial till, color, etc.). Refer to LFCP and Geotechnical Report for testing requirements.

7.3 Soil Materials Selection

Any imported soil materials require the review and written acceptance of the CQA Engineer prior to shipment. Final acceptance by the CQA Engineer shall be based on tests made on samples of material taken from the completed and compacted course. Laboratory test results and samples shall be prepared by the CQA Engineer. The CQA Engineer and the Design Engineer will determine if the material is in conformance with the Specifications and either accept or reject. Specific testing requirements are detailed in the Specifications.

7.4 Placement and Compaction

The CQA Engineer shall perform the following activities.

- Prior to placement of any structural backfill, drain sand, topsoil, screened embankment, or roadway materials, verify that the subgrade has been prepared (scarified, moisture-conditioned and compacted to the densities specified) in accordance with Geotechnical Report requirements.
- Review soil testing data to verify that materials satisfy Specification requirements.
- Visually observe soils for unwanted debris or deleterious material.
- During placement of fill, embankment, select embankment, and roadway materials, conduct tests and observations to document that the quality of compacted material meets the Project Specifications. This will include visual observation, measurement of lift thickness, verification of grain size analysis, determination of moisture-compaction characteristics, measurement of in-place density and moisture content, and other tests identified in the Specifications.
- Verify that final lines and grades conform to design requirements and that minimum thicknesses have been achieved prior to placing overlying layers. Verify gravel gas trench material is placed to the depths indicated on the plans.
- Monitor and inspect all soil material placement, track walking, and compaction to verify compliance with the Specifications. This is critical during placement of soil above the geosynthetic components of the liner system to avoid damage to these materials.
- Compaction effort and moisture control are critical in achieving required compaction within the exposed geomembrane anchor trenches. If adjustments are deemed necessary, the Contractor shall modify his technique in order to achieve the required density for backfilled materials.
- Visually observe to detect any damage to underlying geosynthetics, if present. Ensure that cover materials within trenches are not folded or wrinkled.
- After placement of soils, check required final grades to ensure that design surface grades, ditch lines, etc., conform to the Design Drawings.

At locations where *in situ* testing indicates moisture contents or densities are outside acceptable Specification limits, the failing area shall be reworked or removed and replaced. These areas shall be retested and the repair process repeated, as necessary, until passing results are achieved.

Observations shall be recorded on daily field monitoring report forms, Record Drawings, and test data forms.

7.5 Soil Testing

Soil testing shall be completed in both a laboratory and/or the field, as appropriate, for the purpose of materials selection and CQA. All testing shall be done in accordance with the associated ASTM standard or other procedures as listed in this CQA Plan and the Specifications (Geotechnical Report, Appendix A of LFCD). Quality Assurance testing will be performed by the CQA Engineer. For on-site borrow or recovered material, the CQA Engineer is to perform those tests as specified.

7.5.1 Laboratory Soil Testing

Laboratory testing of the soil materials to be used shall be carried out for the purpose of materials selection QA during construction operations. All equipment shall be in current calibration, traceable to nationally recognized standards. CQA personnel shall obtain copies of calibration certificates for the Project records.

The CQA Engineer shall be responsible for collection of samples for conformance testing from materials delivered to the site. The CQA Engineer shall be responsible for shipping of samples to the laboratory responsible for conformance testing of soil materials. Prior to the start of construction, the Contractor, the CQA Engineer, and the County shall evaluate test results.

Additional testing will be performed during construction for QA purposes. This testing ensures that the materials do not vary significantly or adversely during the course of the Work and that the materials consistently meet the Specifications.

It should be noted that in all cases at least one test shall be carried out regardless of the quantity of materials placed and compacted, where relevant. The CQA Engineer shall review all laboratory test results and forward an evaluation of all testing to the County.

7.5.2 Laboratory Soil Testing

CQA personnel shall monitor the Contractor who shall be responsible for providing *in situ* testing of soils to determine appropriate moisture conditioning for compaction. After placement and compaction, CQA personnel shall verify conformance with the Specifications using *in situ* moisture and density measurements and Proctor Compaction test results.

Additional testing will be performed during construction for QA purposes to ensure that the materials do not vary significantly or adversely during the course of the Work and that the materials consistently meet the Specifications.

Kenneth H. Nilsen, Washington Professional Engineer
Registration Number 25427

GO EAST
LANDFILL CLOSURE PLAN
Snohomish County, Washington

Appendix L
Agency Comments and Responses

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
Northwest Regional Office • 3190 160th Ave SE • Bellevue, WA 98008-5452 • 425-649-7000
711 for Washington Relay Service • Persons with a speech disability can call 877-833.6341

November 23, 2011

Mr. Mike Young, M.S., R.S.
Snohomish Health District
3020 Rucker Avenue, Suite 104
Everett, WA 98201-3900

Dear Mr. Young:

Subject: Go East Landfill

As you requested, Ecology reviewed the revised closure plan for the Go East Landfill, dated October 28, 2011 and the accompanying cover letter that responded to our August 16, 2011 comment letter. While some of our concerns were addressed, issues remain that have not been adequately addressed.

We understand that SHD plans to require a permit for the Go East Landfill closure under the authority of Chapter 3.1 of the county's Sanitary Code, Section VI. Permit Required, which states: *... a permit may be required for any activity that substantially alters an existing closed or abandoned landfill. Plans and specifications for the proposed alteration shall be submitted to and approved by the Health Officer.*

We also understand the SHD is requiring that the Go East Landfill activities comply with the applicable sections of WAC 173-350-400 Limited purpose landfill.

This letter discusses the permit application process and then lists our comments on the most recent closure plan.

Permit Application Process

The permit application process described in WAC 173-350-710 states that once the jurisdictional health department (JHD) determines an application is complete, the JHD shall refer a copy to Ecology for review and comment. Because the Go East Landfill closure is not a typical project the permit application review process has not proceeded in a typical fashion. Ecology, the SHD, and the facility owner have *been* meeting, reviewing draft documents, responding to agency comments, and reviewing revised drafts over the past two to three years.

Ecology feels it is appropriate for the SHD to make a determination about the completeness of the permit application as it now stands. If SHD does not believe it is complete, we recommend you ask the owner to provide the missing elements. When SHD has a complete application, forward it to Ecology for review. Ecology will review the application for conformity with the applicable laws and regulations and recommend for or against the issuance of a permit within forty-five days of our receipt of a complete application.

In our opinion, as indicated in the comments below on the closure plan revision, the owner has not yet provided all of the required elements of a permit application for the proposed activity at the Go East Landfill. The major elements that are missing are:

- An acceptable waste excavation, screening, and disposition plan.
  Appendix I was added.
- A current sampling and analysis plan (SAP) for groundwater and surface water monitoring that includes sampling procedures, analytical methods, data evaluation, and reporting if SHD requires sample collection prior to construction. It must be prepared by a licensed professional and stamped. The SAP must be updated when new wells are installed.
  Appendix H was added to cover this.
- A work plan for installing new wells.
  Two new wells to be constructed were shown on plans per State requirements under direction of licensed geologist.
- A post-closure cost estimate for a period of 20 years or a time frame determined by the Health District.
  Included in Appendix F.
- Evidence that the owner meets the requirements set forth in WAC 173-350-600(3)(f) for the *financial test/corporate guarantee* financial assurance instrument option.
  See page 37 of 38 of LFCP and Appendix J.
- Post-closure operation and maintenance plan that describes how to operate, maintain, inspect, and repair the facilities, including the landfill cover, pond, drainage, and gas control systems.
  See Appendix F.

It may not be possible for the owner to complete some of the required items at this time. Examples are 1) preparation of a work plan for installing the additional wells, 2) revising the SAP after the new wells are installed, and 3) preparing a detailed post-closure operations and maintenance plan. The completion of these items, and possibly others, could be made permit conditions. *No comment, Item 3 is completed.*

October 28, 2011 Closure Plan Revision

Following are our comments on the October 28, 2011 Go East Landfill closure plan revision.

General Comments

1. The closure plan does not acknowledge Ecology's comments that only inert materials can be used in structural fill and that all excavated waste that is not recycled or reused (such as for structural fill) must be disposed at a permitted facility. Ecology maintains the position that waste excavated from the perimeter cannot be disposed of onsite.

Perimeter landfill material is being used as structural fill on the landfill to provide final grades to comply with current landfill surface grade of min. 2% (recommend 5%) slopes towards the detention pond. Some sands will be screened and used for foundation for geomembrane. Some clean wood to be chipped and used for cover in landscaped areas. Any hazardous materials such as asbestos, lead paint wood, treated wood, etc. (as directed by SHD) will be screened, removed from landfill, and stored in containers onsite until it is transported offsite to an approved facility. The goal is to minimize handling of landfill material for worker safety and minimize waste being removed from the site to reduce impacts to the adjacent neighborhoods. Further discussion is included in the LFCP.

2. We recommend the facility continue groundwater sampling and analysis before site improvements to monitor any trends in the groundwater and surface water before, during construction activities, and after site closure.

   If Appendix H is considered to be the Sampling and Analysis Plan under WAC 173-350-500 for groundwater, it must be prepared by a licensed professional and stamped. We recommend the contractor that is responsible for the quarterly sampling and data evaluation prepares this document. Once the additional wells are installed this document will need to be revised to stay current. Consider making this a permit condition.

   The facility owners indicate they plan to make a case to reduce or cease monitoring after two to three years. Although the landfill closure will help decrease infiltration of precipitation into the waste, if the waste is in contact with groundwater, releases to the environment may still continue which could have long term monitoring implications. We recommend SHD make clear to the owner that it is premature to count on approval of such a request at this time.
   This is included in the LFCP.
3. As we previously commented, in accordance with WAC 173-350-600(6)(a)(i) the post-closure cost estimate must be for a period of 20 years or a time frame determined by the Health District. Ecology sees no reason to deviate from the 20 year period at this time. In the future, if the owner demonstrates to the Health District's satisfaction that the landfill is stable and protective of human health and the environment, the fund duration can be changed.
   Although this landfill has not received waste for over 30 years, the plan includes this.
   We recommend SHD consider carefully the length of the post-closure period and the corresponding amount of financial assurance needed. Post-closure activities will include operation, inspection, maintenance and repair of the cover, pond, drainage, and gas systems as well as groundwater, surface water, and landfill gas monitoring.
   Includes post closure period of 20 years unless a shorter period is proven.
   The current owner should be required to demonstrate financial assurance for the entire post-closure period that SHD determines is appropriate. If a home owners' association exists at a later time and the required post-closure funds are in place, the Health District could consider allowing the transfer, of financial responsibility.
   It is a condition of approval.

Specific Comments
<u>Cover/response letter</u>

1. Item 1, Groundwater Monitoring: The installation of the monitoring wells will need a work plan for SHD approval before implementing. Depending on the well design, a variance may be necessary from Chapter 173-160 WAC, which will require additional processing time. The SHD should tell the facility the timeframe needed for agency review. The work plan should show the proposed locations, justification for the locations, design and construction

materials, decontamination procedures, logging of geologic materials, well development, management of any residual drilling materials and well development water, record keeping, timing of the project, surveying and final report, as a minimum. The work plan should be prepared by a licensed professional who meets the requirements of Chapter 18.220 RCW, Geologist. Since these wells will not be installed until cover improvements, consider making this a permit condition. The monitoring network cannot be determined to be adequate until these wells are installed and evaluated.
Two new wells are to be installed per State requirement and under direction of a licensed geologist.

2. Item 4. Sampling: There is no response to Ecology's statements that:
   - Non-inert waste must either be disposed off-site in a permitted landfill or recycled/reused
   - Material that cannot be recycled or used as structural fill will need to be sent offsite to a permitted solid waste facility.

   The non-inert landfill material such as clean wood and tree branches, will be either chipped and reused onsite or reused in the landfill to create final grades to comply with current WAC requirements.
3. Item 7. Financial Assurance: Financial assurance for the post-closure period is not mentioned. The owner must estimate post-closure costs and provide financial assurance.
   Included in Appendix F.

Closure Plan

1. Section 3.4. Site Setbacks: Applying the requirement of WAC 173-350-400(3)(i) for a setback of 100 feet between the landfill and the property boundary at this facility means there should be 100 feet between the edge of the closed landfill and the new housing lots.
   This requirement is for "active" landfill and not a closed landfill. This landfill has not been active for over 30 years.
2. Section 3.5.1 Landfill Debris Screening Plan: Ecology's previous comment that non-inert waste cannot be used as structural fill was not addressed. Ecology's previous comment that material that cannot be recycled or used as structural fill will need to be sent offsite to a permitted solid waste facility was not addressed.
   The landfill material is being used to create final grades that comply with current WAC requirements. See further discussion in the LFCP.
3. Section 10 Post-Closure Operations and Maintenance Plan: By the time the landfill closure is completed, the owner needs to have developed a detailed post-closure plan of operations. It should specify how to operate, maintain, inspect, and repair the facilities, including the landfill cover, pond, drainage, and gas control systems. The table for pond operations and maintenance in Appendix F would be part of the plan.
   Plan is included in Appendix F.
4. Section 10.2.1. Overview: It is not appropriate that the surface water comply with WAC 173-350-500 because this section is specific to groundwater, although at this site the groundwater discharges to surface water. It may be more appropriate to acknowledge surface water monitoring as part of the environmental monitoring for the site to monitor the groundwater to surface water flow path.
   See Appendix H, page 7 of 35. WAC 173-201A is referenced.
5. Section 103.1 Schedule, last sentence: What does the term "once annually" mean? Does this mean one time, or annually?
   Revised.

6. Section 10.4 Financial Assurance Plan: Until a cost estimate for post-closure is developed, we will not know if the owner qualifies for the corporate guarantee financial assurance mechanism.
   Cost is included in plan. See section 9.5 of LFCP.

Appendix II. Monitoring Program and Procedures

1. Page 1: According to WAC 173-350-500(1) *Groundwater monitoring Professional qualifications, "All reports, plans, procedures, and design specifications required by this section shall be prepared by a licensed professional in accordance with the requirements of Chapter 18.220 RCW."* This includes the sampling and analysis plan under WAC 173-350-500(4). It is unclear if what is presented here is conceptual or if it is intended to meet this section of the regulation. As submitted, it does not meet this requirement. The groundwater sampling and analysis plan should be a stamped document. We recommend the contractor who is responsible for the quarterly sampling and data evaluation prepares this document.
   Plan has been prepared by a P.E. and has been stamped.
2. Page 1, first paragraph, last sentence: The landfill is being classified as a limited purpose landfill, not a woodwaste landfill. There is no woodwaste landfill category in chapter 173350 WAC.
   Changed.
3. Page 1, fourth paragraph, third sentence: The plan indicates the impacts to groundwater from precipitation infiltration will be reduced with this design. The design will help decrease the infiltration into the waste, but if the waste is in contact with groundwater, releases to the environmental may still continue.
   Ok.
4. Page 2, third paragraph, fifth bullet: It would be more appropriate to state that the intrawell and interwell comparison is used to determine if the landfill is impacting *groundwater* not *adjacent lands.*
   Revised.
5. Page 2, Information Included in this Monitoring Plan, Section 3: This mentions the plan for groundwater *monitoring following Phase 2.* We recommend the continuation of monitoring of the existing wells and surface water on site. The purpose of the sampling and analysis plan is to provide information on the *current* monitoring at the site. The plan would be updated when additional wells are installed but the current monitoring should be approved by the SHD. It is unclear if any sampling is being conducted now. Having information before, during and after site improvements is recommended to evaluate trends.
   Until the closure plan is approved, there is no assurance implementing a draft of the plan is meaningful. Once the plan is approved monitoring can begin.
6. Page 5, Propose Landfill Methane Gas. Control Monitoring, Overview, second paragraph: "This should ensure and prevent gas migration ..." This is probably intended to say "This should prevent gas migration ..." or "This should ensure the prevention of gas migration ..."
   Ok, done.
7. Page 5, Methane Vent Trench Design:
   - A figure or plan should be provided for better understanding of what is being proposed.
   - Information about the monitoring units should be provided.

   Provided. See D-1 for similar unit to be used.
8. Page 5, Monitoring of Gas Levels: The SIM needs to approve the *ending* of gas vent monitoring.

Yes, see Appendix H, page 4 of 35, last sentence.

9. Page 6, Home Protection: We recommend not including the drawing in Attachment E, but rather, require the homebuilder to hire a qualified professional engineer to design the gas bathers beneath the homes. The design should be approved by the SHD or other responsible county agency.
   A sample design that has been used on multiple similar applications is included and alternatives are also acceptable.
10. Page 6, Documentation, *first* paragraph, last sentence: In addition to levels at the perimeter being below the lower explosive level, there should not be an increasing trend in gas concentrations.
    See Appendix H, page 4, last paragraph.
11. Page 6, Proposed Ground Water Monitoring System, Overview
    - Third bullet: It appears a word is left out in this sentence; it should be revised.
      Fixed.
    - Fourth Bullet: The phrase "new baseline" is confusing. We recommend substituting "additional". The rest of this bullet pertains to reducing or eliminating the groundwater monitoring program. This will need *SHD's* approval when appropriate.
      Revised.
12. Page 7, Location of Existing Well Network: The listing of the well construction should indicate the screen length and the elevation of the top and bottom of the screen interval. Another column could be added that indicates the sampling device for each well.
    Added on plans.
13. Page 8, Schedule: Even though there has been some monitoring of the site over the last 30+ years, the monitoring has not met the requirements of WAC 173-350-500. This regulation was promulgated in 2003 and only recently has this site been required to meet these regulations. It may also be premature to indicate monitoring will continue two years after closure when post closure under this regulation is 20 years.
    The sentence has been reworded to require SHD approval.
14. Page 8, Documentation: Data evaluation should be more developed with a discussion of the statistical procedures. See WAC 173-350-500(5). This is to be approved by the SHD during the permitting process.
    Sentence added.
15. Page 8, Overview for Surface Water: It may be more appropriate to indicate the surface water monitoring will collect the same parameters as groundwater but surface water results will be compared to the surface water quality standards of Chapter 173-201A WAC. This section did not provide any sampling procedures for surface water. The sampling procedure needs to be compatible with standards that are to be met.
    Reference added.
16. Page 8, Locations for Surface Water: There is no figure located in Appendix C that shows the surface water monitoring locations. Appropriate revisions should be made.
    Locations have been added to the plans, sheet 1.
17. Page B-1, Attachment B, Groundwater Sampling Methodology: This section should provide more detail on the following, as a minimum:
    - Field inspection.
    - Equipment list.
    - Calibration of field equipment.
    - Examples of field logs, calibration form and chain-of-custody form.
    - General health and safety and persona] protection equipment.

- We recommend dedicated sampling devices *be* installed in the wells if possible and low flow purge and sample techniques. Bailers are not recommended.
- Purged water should be disposed away from the well head. If there is a release of a hazardous substance, the water should be containerized and disposed of off-site.
- During purging, parameters should be monitored for stabilization. The plan indicates which field parameters will be monitored but should include the range of values that will be considered stable before a sample is collected.
- Bottles and preservation should be included.
- More detail on storage and shipment.
- It is unclear if metals will be collected as total or dissolved. .Unfortunately the regulations are not specific. If total metals are collected, turbidity and total suspended solids should be collected.

References added to various sections of the LFCP. Testing supplies, bottles, etc. are set up by the testing lab.

18. Page C-1, Attachment C: Data validation should be part of the QA/QC.
QA/QC added and included in C-2.
19. Page C-4, Table 1:
    - The table is missing bicarbonate and total dissolved solids, which are included in the list of parameters to be tested according to WAC 173-350-500(4)(i).
    Added.
    - Columns titled "Groundwater Cleanup Level" and "EPA Drinking Water Standard" should be deleted. The standards that should be listed are the groundwater quality criteria of Chapter 173.200 WAC. These are the standards that are used to evaluate landfill' performance (WAC 173-350-500(4)(k)). These standards have been updated and can be found at http://www.ecy.wa.govibiblio/9602.html. See Appendix A in this publication. Table 1 should be corrected to these criteria.
    Done.
    - The analytical methods to be used are *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* US EPA Publication SW-846 or other test methods approved by the health district. See WAC 173-350-500(4)(j). We recommend using SW 846 methods or methods that can be considered equivalent.
    Table revised.

Please contact us if you have questions about these comments. You can reach Madeline at 425-649-7015 or madeline.wall@ecy.wa.gov and Sally at 425-649-7089 or sally.safioles@ecy.wa.gov.

Sincerely,

STATE OF. WASHINGTON

DEPARTMENT OF ECOLOGY

Northwest Regional Office • 3190 160th Avenue SE • Bellevue, Washington 98008-5452 • (425)649-7000

August 16, 2011

Mr. Mike Young, M.S., R.S.
Snohomish Health District
3020 Rucker Avenue, Suite 104
Everett, WA 98201-3900

Dear Mr. Young:

Subject: Revised Go East Landfill Closure Plan

As you requested in your July 13, 2011 letter to the Department of Ecology (Ecology), Ecology Waste 2 Resources staff reviewed the Go East Landfill Closure Plan, revised June 15, 2011. We addressed your questions regarding the plan's adequacy in the comments below. We also commented on additional issues we feel are important.

The Closure Plan is a conceptual document. Before any closure construction begins, detailed plans, specifications, and a Construction Quality Assurance plan must be submitted to the Snohomish Health District (SHD) for review and approval. We also recommend that SHD review any future property development plans for landfill impacts to the development and development impacts to the landfill.

Section 9 of the Closure Plan states that landfill closure is not expected to occur for 4 to 7 years. We recommend the SHD consider what concerns, if any, they have about approving a plan now that won't be implemented for several years.

Snohomish Health District Questions

1. *Is the ground water monitoring system adequate to meet the requirements of WAC 173-350-500? Are there sufficient numbers of monitoring wells at appropriate locations, given that monitoring well number 4 was reported dry? The sample plan also included sampling of a spring to represent ground water, is this allowed under WAC 173-350?*

a) Is the ground water monitoring system adequate to meet the requirements of WAC 173-350-500? Are there sufficient numbers of monitoring wells at appropriate locations, give that monitoring well number 4 is dry?

The two sections that pertain to these questions are WAC 173-350-500(2)-site characterization and (3)-system design. To clearly show that a plan meets the regulations, the facility should include the regulation by subsection and the elements within the subsection and how they meet that requirement or provide a checklist of the location in the document where the subsections are addressed. In the case of this landfill, where a regulation is retroactively being applied, some elements such as subsurface investigation under the proposed landfill footprint would be difficult and therefore would not be applicable. The site characterization is limited due to this. The site characterization provided is an adequate overview of the geology and hydrogeology given the retroactive application of the regulation. However, the monitoring plan does not appear adequate and needs more explanation and more monitoring points. Looking at Figure 2 in Appendix B, monitoring well MW-4 and spring SP-1 appear to be located downgradient but MW-4 is dry and SP-1 as a viable monitoring point for early detection is questionable. See the following comment. A cross-section that includes MW-4 should be included.

Other Observations:

- From the cross-sections it appears the base of the refuse is in ground water. Closure may help infiltration and direct exposure of waste but the potential for releases to the environment will exist.
- Appendix B, page 6: calculation of the ground water flow rate is not correct, it should be 0.4 feet per day. Using the numbers they provided the formula should be velocity=hydraulic conductivity x gradient/porosity:
    - 3 feet/day x 0.02/0.15 = 0.4 feet per day. *Revision made*

b) The sample plan also included sampling of a spring to represent ground water, is this allowed under WAC 173-350?

The regulation requires ground water monitoring wells. Any deviations from the regulation will require a variance (WAC 173-350-700(7).

Looking at the cross sections provided in Appendix B, Figure 5, SP-1 appears to be seeping out of the glacial lacustrine unit down slope from the contact area of the advance outwash and glacial lacustrine where the ground water monitoring wells are installed. SP-1 water quality could have very different geochemistry and could also incorporate overland flow of surface water that could introduce other contaminants. The regulation requires monitoring wells. Using a spring would require a variance from the regulation. If access is an issue, drive points should be installed at the base of the landfill area that would intercept ground water at the contact with the advance outwash and the lacustrine units. The advance outwash aquifer appears to be the aquifer that would provide the earliest detection of a release.

Other subsections that have not been addressed adequately for ground water are: WAC 173-351-500(4)-sampling and analysis plan, WAC 173-351-500(5)-ground water monitoring-data analysis, notification and reporting; this includes the statistical analysis. Comments are:

- The proposed monitoring includes gas, ground water and surface water. An environmental monitoring plan needs to be submitted. What is provided only mentions proposed locations and parameters but does not provide information on sample collection, quality assurance quality control etc. *A sampling, analysis and monitoring plan has been added, Appendix H.*
- Section 10.2.4 discusses the documentation of the results of the monitoring but does

not indicate the frequency of submittals to the health district. *Included in Appendix H*

– We recommend EPA's Unified Guidance for the statistics. *Ok*

2. *Is the storm water detention pond and water quality treatment pond proposed on the landfill allowed under WAC 173-350, or would this require a variance?*

The regulation does not prohibit a storm water detention or water quality treatment pond on the landfill. The pond, however, must be designed and constructed in a manner that does not compromise the integrity of the cover system. The main concern for the Go East landfill is the integrity of the geomembrane beneath the pond. The closure plan describes excavating the pond into the existing waste, rather than placing it on top of added fill. This will help minimize settlement in the pond area. The pond design includes a double geomembrane liner. Ecology has significant concerns about the design of the cover system including the area beneath the ponds, as discussed below under "Additional Comments". If the cover system concerns are addressed, adequate inspection and maintenance are conducted, and financial assurance to cover inspection, maintenance, and repairs is in place, the presence of the storm water pond would be allowed under chapter 173-356 WAC. *Ok*

Another issue pertaining to the ponds is the prevention of storm water run-on. In accordance with WAC 173-350-400(3)(d)[11], the cover design must not allow storm water run-on from areas outside of the cover footprint. The closure plan is not clear as to whether or not run-on is prevented from flowing across the landfill cover to the storm water ponds. *Grading plan precludes run-on from areas outside the cover footprint.*

3. *Will the plan to excavate waste from the landfill, screen and dispose of unusable waste, reuse the wood waste fraction, test and reused soil as structural fill comply with the requirements of WAC 173-350, or other laws such as MTCA?*

The only materials that can be re-used as structural fill are inert materials as described in WAC 173-350-990 — either listed materials or materials that have been demonstrated to meet the criteria for inert waste.

Section 3.5.1 of the closure plan states, "Material that can be re-used as structural fill includes, but is not limited to: concrete, unburned wood, metals, plastics, bricks, gravel, glass, rubber and soil". Of this list, unburned wood, plastics, and rubber are not listed inert wastes, nor are they likely to meet the criteria for inert Waste. If they are not inert wastes, they must either be disposed off-site in a permitted landfill or recycled/reused.
All permitted landfill materials are planned to be reused on the landfill unless they are required by SHD to be removed from site.

On page 14, the frequency of collecting soil samples is discussed. The rate of testing is described as, "one sample for every 500 cubic yards for the first 2,500 cubic yards of soils and then one sample approximately every 2,500 cubic yards thereafter." We recommend the frequency also be based on observed characteristics of the soil. For example, if changes in color, texture, or other characteristics are observed that indicate a possible different source of the soil, a sample should be taken even if it results in a frequency greater than one per 2,500 cubic yards.
A sentence has been added to this effect. Also, the plan requires a professional to be on-site and oversee the relocation work.

Table GA — Recommended Parameters and Suggested Values for Determining Reuse and

Disposal Options — aligns well with MTCA Method A Soil Cleanup Levels for Unrestricted Land Uses. There are, however, some differences:

- Chromium, total. Table GA value is 42 mg/kg. Method A has two values. Chromium VI is 19 mg/kg and chromium III is 2,000 mg/kg.
- PAHs (carcinogenic). Table G.4 gives a range of 0.1 to 2.0 mg/kg. Method A has one value of 0.1 mg/kg.
- Method A includes several additional organic compounds.

We recommend SHD review the MTCA Method A table and decide if the landfill materials are likely to contain the compounds that are not included in Table G.4.

We understand that the facility owners want to minimize off-site hauling of materials. Any material that cannot be recycled or used as structural fill, however, will need to be sent off-site to a permitted solid waste facility.
To maximum extent possible the plan is to reuse all landfill material by just relocating it within the landfill as required to meet the grading requirements for the closure. This also minimizes worker exposure to landfill waste and minimizes impact to the adjacent communities (dust, noise, traffic through community, etc.).

4. *The landfill closure proposal includes maintaining a 2:1 slope on the PIE side. The applicant made a design change that includes terracing the waste and applying a soil cap, this changes the values of the slope stability model, which now shows it meets their factor of safety, is this adequate to meet WAC 173-350?*

Although we reviewed the revised (May 26, 2011) *Subsurface Exploration, Geologic Hazards, and Geotechnical Engineering Report* prepared by Associated Earth Sciences, Inc. (AESI), we do not have the geotechnical engineering expertise to fully evaluate the report. If you feel the need for a full evaluation of the geotechnical report, we recommend SHD contract with an engineering firm that has geotechnical engineering expertise.
A third party review was accomplished by Snohomish County PDS.

WAC 173-350-400 does not specify an acceptable Factor of Safety (FS). The FS values calculated by AESI for this project, 1.8 for static conditions and 1.1 for seismic conditions, are consistent with those recommended by Koerner and Daniel in *Final Covers for Solid Waste Landfills and Abandoned Dumps"2.*

Additional comments

***5.* Cover Design**
As stated in Section 4.3 of the Closure Plan, the presumptive design for the final cover of a limited purpose landfill is:

- **Cover System**

The proposed Cover System 1, from the top down, consists of

- 6 inches minimum of vegetative soil cover
- 2 feet of compacted soil (permeability less than $lx10^{-6}$ cm/sec)
- 30 mil geomembrane liner

- 6 - 12 inches foundation layer
- 2 10 feet soil fill, as required to achieve proposed grades

Ecology's primary concern with the proposed design is the compacted soil layer on top of the geomembrane. Compacting soil on top of a geomembrane will likely damage the geomembrane. The presumptive remedy requires a minimum of two feet of earthen material (not compacted) with at least the top 12 inches capable of sustaining native vegetation.
Compaction is not planned over the geomembrane.

- **Cover System 2**

This is the cover system proposed for the area of the storm water pond. The proposed Cover System 2, from the top down, consists of

- 6 inches minimum of vegetative soil cover
- 2 feet of compacted soil (permeability less than $1x10^{-6}$ cm/see)
- 30 mil upper geomembrane
- 6 inches of foundation material (upper foundation layer) with a monitoring pipe
- 30 mil lower geomembrane
- 6 - 12 inches of foundation material (lower sub-grade layer)

As with Cover System 1, a compacted soil layer should not be placed on top of the geomembrane. For the pond, the cover material and thickness should be chosen based on protecting the geomembrane and supporting the desired plant growth. Also consider the possibility that repairs to the liner may be necessary at some time in the future.

The upper foundation layer (between the geomembranes) is shown as "low permeable material" on Detail 2 of the cross sections (Sheet 2 of 2), Because this layer is used for monitoring for leakage from the pond above, the material should be permeable to allow liquid to flow to the monitoring point where it can be detected.
Sand is to be used as layer between the geomembranes.

- **Cover System 3**

For this cover system, the compacted soil layer is appropriate. The vegetative soil layer is proposed to be a minimum of 6 inches deep. We recommend a depth of 12 inches so that plant roots have more room and may be less likely to = tur e ow permeable soil layer. Establishing plant growth on the slope is critical for erosion control.
Agreed, also an alternative cover 3 system using a product called “Closure Turf” may be considered on the slope.

The 4-inch horizontal pipe in the bench drains should be perforated. We assume this is the intent, but it isn't stated. *Yes*

6. Landfill Gas

- Our previous comments on landfill gas at the Go East Landfill still apply. The proposed landfill gas collection trench is described as extending vertically to the depth of existing landfill debris at the perimeter of the reduced landfill area, or about 15 feet. Figures in the submitted reports show the depth of the waste as significantly greater than 15 feet throughout much of the landfill, Landfill gas could migrate from the landfill into surrounding native soil at greater depths, bypassing the collection trench. Although it appears from monitoring results that methane concentrations are not high, methane may be present at greater concentrations at locations not tested, and unknown subsurface pathways may exist.

- The placement of an impermeable cover will change the gas migration pathways. How will this be monitored for? *Four 24/7 monitors will be placed in vaults around the landfill for monitoring for gas.*

- Ecology does not expect the proposed vent pipe in the middle of the landfill to effectively influence gas control. *This will be eliminated.*

- Monitoring for four months in manholes is not long enough to make a determination about gas safety. *Monitoring is to continue quarterly until it is shown gas levels are less than 5% and declining.*

- If housing units are constructed near the landfill, greater precautions will be required than if no nearby structures were planned. Such precautions could include monitoring permanent gas probes between the edge of waste and proposed structures, installing methane monitoring devices in new structures, and installing gas migration barriers beneath structures. *Gas mitigating design is required for all homes within 100 feet of the landfill parcel.*

7. Financial Assurance

- The post-closure cost estimate must be for a period of 20 years or a time frame determined by the Health District [WAC 173-350-600(6)(a)(i)] Ecology sees no reason to deviate from the 20 year period at this time. In the future, if the owner demonstrates to the Health District's satisfaction that the landfill is stable and protective of human health and the environment, the fund duration can be changed.

  - A detailed cost estimate for closure and post-closure is required. *And provided*
  - The current owner's assumption that another party will carry on the post-closure care (that is a future home owners' association) is not appropriate. The current owner should be required to demonstrate financial assurance for the entire post-closure period, that is, for 20 years. If a home owners' association exists at a later time and the required post-closure funds are in place, the Health District could consider allowing the transfer of financial responsibility. *With an estimated 5-year build out post closure activities will not be turned over to the HOA for at least 5 years. It is expected within this period most of the monitoring requirements will be concluded. Continuing activities will include surface and pond maintenance.*
  - The Closure Plan proposes to use the financial test/corporate guarantee as the financial assurance instrument for closure and post-closure. Ecology recommends the Health District require proof that the company qualifies for this option before approving the closure plan. The detailed estimate of the costs of closure and post-closure are necessary to determine whether or not the company qualifies. *Estimates are provided in the LFCP. A surety bond is the most likely instrument*

used for the quarantee.

8. Construction Quality Assurance

We recommend the owner be required to hire a construction quality assurance (CQA) manager experienced with landfill construction, including the installation of geomembranes. *This is included in the plan.*

9. Deed Notifications and Covenants

WAC 173-350-400(6)(g) requires the owner or operator to record the landfill location as part of the deed after closure. There may also be applicable local requirements pertaining to deed notifications. *A covenant is being recorded on the plat.*

Please contact us if you have questions about these comments. You can reach Madeline at 425 649-7015 or madeline.wall®ecy.wa.gov and Sally at 425-649-7089 or sally.safioles®ecy.wa. gov.

Sincerely,

Madeline Wall, P.E.
Waste 2 Resources Program

Sally Safioles, LHG
Waste 2 Resource Program

cc: Peter Christiansen, Ecology Waste 2 Resources Program

1[1] Limited purpose landfills shall be constructed in accordance with a design that: (i) will prevent flow onto the active portion of the landfill during the peak discharge from a twenty-five-year storm, as defined in WAC 173-350100 [WAC 173-350-400(3)(d)1

The "active portion" does not only refer to when the landfill was actively receiving waste. It also refers to closed areas: *"Active area" means that portion of a facility where solid waste recycling, reuse, treatment, storage, or disposal operations are being, are proposed to be, or have been conducted* WAC 173350-100. (emphasis added.)

[2] Robert M. Koerner and David E. Daniel, *Final Covers for Solid Waste Landfills and Abandoned Dumps,* ASCE Press, 1997.'

(A) An antierosion layer consisting of a minimum of two feet (60 cm) of earthen material of which at least twelve *inches* (30 cm) of the uppermost layer is capable of sustaining native vegetation, seeded with grass or other shallow rooted vegetation; and

(B) A geomembrane with a minimum of 30-mil (.76 mm) thickness, or a greater thickness that Is commensurate with the ability to join the geomembrane material and site characteristics such as slope, overlaying a competent foundation.

January 14, 2014

Marty Panhallegon, President
PACE Engineers, Inc.
11255 Kirkland Way, Ste 300
Kirkland, WA 98033-6715

Subject: Conditionally Approved Revised Plans for Go East Landfill Closure

Dear Mr. Panhallegon:

Snohomish Health District (SHD) conditionally approves the revised Go East Landfill Closure Plan, which includes a new Grading and Drainage Plan for the landfill on three sheets dated 12/20/2013, a response letter from Steve Calhoon of the same date, and information received from Gary East regarding Financial Assurance dated 12/23/2013. These most recent plans include revisions to the Go East Landfill Closure Plan that was originally conditionally approved in our letter of 2/17/2012. The revisions in the current Grading and Drainage plans dated 12/20/2013, include the delineation of where "Dynamic Compaction" will occur, which is now proposed under the water quality pond and under the related drainage structures. The new plans also include *a* simplification of type 3 landfill cover, which eliminates bench construction and returns to a uniform 2: 1 slope. Based on the new information provided, the amended plan is approved at this time with the following conditions:
All conditions of this "Conditional Approval " are addressed in Section 2. 1.2 Closure Requirements of the LFCP.

- Provide evidence of SEPA compliance as required by WAC 173-350-715(1)(e). Snohomish County Planning and Development Services will be the lead agency for this project. Snohomish Health District may provide additional comments after they have made the SEPA threshold determination.
  SEPA review in process.
- Prior to construction permit issuance for landfill closure and/or Bakerview plat construction activities, SHD must approve the Financial Assurance (FA) documentation as described in your plan and WAC 173-350-400(8). *A condition of LFCP see Secti9n 9.5 Financial Assurance Plan.* The cost estimate for post closure must include monitoring and maintenance associated with the landfill for 20 years after the date when SHD verifies that closure maps and a statement of fact were recorded with the county auditor as per WAC 173350-400(6)(h). A new post closure monitoring cost estimate may be considered when substantial evidence is provided that the landfill is stable and monitoring can be reduced.
  Included in LFCP. See Appendix F, page 7 of 10.
- Provide a copy of any plat covenants that will address the requirement to provide gas safety construction mitigation measures for homes surrounding the landfill, as shown in the closure plan. The covenant must also include any future obligations of landfill maintenance and financial assurance responsibilities.

Included in LFCP. See Appendix H, Attachment E-1 and F-1. Post Closure requirements are included in Appendix F.

- Provide a gas mitigation plan to be used in the event methane gas discharge exceeds 5% by volume, after the closure activity is complete at one or more of the vents. The plan must include what additional measures could be taken, such as installing an active gas collection system in order to maintain gas discharge levels below the LEL at the property line (or proposed property line) and include what additional monitoring would be done at off-site structures.
  Piping is being constructed as part of the LFCP that would be converted to an active system as discussed in Section 7.4.. The piping is stubbed into four monitoring structures sized and designed to accept blowers for a forced air system should it become necessary.
- Provide a final work plan for installing the additional ground water monitoring wells as recommended by Washington State Department of Ecology.
  See LFCP Section 8.3, two (2) new wells will be installed where shown on the site drawing under the supervision of a licensed geologist and in accordance with State requirements.
- Obtain other permits and approvals to meet all local, state or federal requirements in effect at the site, including but not limited to, Snohomish County grading permit, Storm water discharge permits.
  This is a requirement of the LFCP. See Section 2. 1. 2 Closure Requirements, "Special Closure Requirements "(b).
- Provide a specific storm water pond operation plan and design drawings. This plan would include how leaks will be found using the proposed monitoring system and how to repair the liner, along with the estimated cost. The operation plan should include the inspection checklist in Appendix F arid any other information that may be helpful to future owners.
  Included in Appendix F.
- Additional construction details are needed in the Waste Excavation , Screening and Disposal Plan, Appendix I when the contractor has been selected. This plan needs to include the following specifics for waste handling: *See Appendix I*
  - Provide a construction layout map for location of waste piles, screens , product piles, and over piles. Include maximum size of piles, footprint and height. Include access road construction and surface water control.
    Location on site plan just uphill from the detention pond. Also, see Section 3.6.7 for preliminary project construction sequence.
  - Describe how waste will be stored until test results are reviewed and approved.
  - Although all waste excavated will be kept inside the landfill area, provide any change in plans where waste could be taken off-site for disposal or recycling.
    Yes.
  - Describe how large the active area (uncovered debris) of the landfill will be at any one time. We want to minimize the amount of waste exposed to reduce chimney effect for fire potential and water infiltration from precipitation.
    See proposed preliminary construction schedule sequence Section 3.6. 7.
  - Provide the job site contacts and location where documentation will be kept for review.
    See Section 2. 1.2 for job trailer and document requirements .
  - Include a notification requirement that SHD inspects the excavation prior to clean fill placement, in order to verify all excavated waste has been removed to natural soil.
    See Section 2. 1. 2 Closure Requirements, page 7, Requirements for job trailer and schedule.

SHD cannot support the construction, or any development , of the current property the landfill occupies until evidence is proved that the landfill has been closed according to state and local solid waste regulations. Fulfillment of said conditions above would allow SHD to issue a permit for the substantial alteration of the Go East landfill, as described in Snohomish Health District Sanitary Code *Solid Waste Handling Regulations,* Chapter 3.1 (VI). *PDS recommendations cover this concern.*

Please note that this letter of conditional approval will become invalid if the closure plans are changed, or if a permit for landfill alteration is not applied for within 1 year from the date of this letter. In the event that a plan re-submittal is required a copy of the complete plans, new permit application and payment of the required plan review fees would be needed.

If you have any questions about these comments, please contact me at 425.339.8765.

Sincerely,

Mike Young, MS, RS Senior Sanitarian
Solid Waste and Toxics Program

c: Steve Calhoon, Senior Principal Planner, PACE Engineers, Inc.
Tom Rowe, Snohomish County Planning & Development Services
Madeline Wall, WA State Dept of Ecology, 3190 - 160th Ave SE, Bellevue, WA 98008-5452

Engineers | Planners | Surveyors

PACE
An Engineering Services Company

October 28, 2015

Mr. Gary G. Hanada, RS Manager
Environmental Health Division
Snohomish Health District
3020 Rucker Avenue, Suite 104
Everett, WA 98201-3900

Subject: ***Go East Landfill Closure, Your letter dated October 19, 2015***
PACE Project No. 09382

Dear Mr. Hanada,

As requested in your subject letter please find attached an updated and revised Landfill Closure Plan dated October 28, 2015, incorporating the technical review comments included in the October 8, 2015, letter from Department of Ecology and your five (5) narrative details requested in your subject letter. The following documents are included with this submittal:

- Redlined response to your October 19, 2015, letter and the five (5) narrative detail items with the follow attached items:
  - Attachment including "Remediation Plan Where Methane Gas is Measured Above Safe Limit"
  - Documentation of what was allowed to be placed in the landfill as shown in Snohomish County Zoning Adjustor Written Order No. 76 which issues a permit for 7 years and includes those items shown on page 8 listing # 14.
- Revised and updated redline response to Department of Ecology's technical letter dated October 8, 2015 with attachment.
- Two copies of the updated and revised Landfill Closure Plan for the Go East landfill incorporating the revision to both of the prior two bulleted items as you requested.

If you have any questions or additional items you would like changed, please let us know.

Sincerely,

PACE Engineers, Inc.

Martin Penhallegon, PE
Principal Engineer

PACE Engineers, Inc.
11255 Kirkland Way | Suite 300
Kirkland, Washington 98033-6715
p 425.827.2014 | f 425.827.5043

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SNOHOMISH
HEALTH DISTRICT
WWW.SNOHD.ORG

Environmental Health Division

October 28, 2015

Marty Penhallegon, PE
PACE Engineers, Inc.
11255 Kirkland Way, Suite 300
Kirkland, WA 98033-6715

Subject: Go East Landfill Closure

Dear Mr. Penhallegon:

As you know, Snohomish Health District is in the process of completing its review of the revised Go East Landfill Closure Plan dated July 31, 2015, for compliance with the *Minimum Functional Standards for Solid Waste Handling,* WAC 173-350. Additionally, the Health District received the Department of Ecology's technical review of the plan dated October 8, 2015, forwarded a copy of Ecology's review to you and recently received your preliminary response comments to the same. Please incorporate your revisions into a revised closure plan and submit one copy to the Health District. Once the revised copy is approved, two additional copies should be submitted to this agency.

For sake of completing our review, please incorporate your preliminary responses in narrative detail into a final revised closure plan upon which we will make our determination. In addition to the revisions covering Ecology's comments, please address in narrative detail the following in that revised closure plan:

1. When the solid waste is removed from the wedge areas, how will it be determined when native soils are reached, before placement of engineered fill? Please specify the methods, tests and personnel.

   "The full time geotechnical engineer onsite will monitor the landfill closure activity and wedge removal. The type of material, density and color all will be apparent when the native material is encountered. The landfill waste is dark brown to gray in color with no bedding features and contains abundant debris. The native soils consist of tan to gray sand and gray silt with bedding features indicative of the native soils. Visual distinction between the landfill waste and the native soils will be obvious." (Note: this language has been added to section 3.4.4 of the LFCP.)

2. Provide detailed contract specifications for the contractor relative to the level of screening and what will be allowed regarding the disposition of excavated waste. Include a list of allowed wastes. If there are solid wastes other than wood waste and inert wastes, please provide documentation to support that the waste was allowed as a part of the operating permit.

   Section 3.6.1 of the LFCP has been modified as follows: Only material excavated from the "Wedge" such as a tire, carpeting, and organics that are not wood waste

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3020 Rucker Avenue, Suite 104 ■ Everett, WA 98201-3900 ■ tel: 425.339.5250 s fax: 425.339.5254

(material not readily compactable) would be removed during excavation. This would be accomplished by the excavator setting aside any such items encountered and the material being manually separated and piled on site until a full load is obtained. At that time a dump truck shall be loaded and covered to transport the material offsite to an approved landfill site accepting the material. Any hazardous material if encountered would be placed into a container on site and stored until it is hauled and disposed of offsite at an appropriated landfill site. Of the materials encountered in past exploration including gravel, concrete, wire, woody debris, tire, brick asphalt, plastic pipe, dimensional lumber, burned wood, metal, glass shards and carpet, only the tire and carpet would not be proposed to be put back into the landfill. Unless directed by the project geotechnical engineer monitoring the landfill excavation activities, all material will be relocated directly and compacted on the portion of the landfill to remain.

Some additional materials that may be encountered in the landfill are those allowed under the "Written Order No. 76" dated September 18, 1975 by the Snohomish County Zoning Adjustor. They include "Wood, including tree stumps, logs, and demolished buildings: mineral, concrete, asphaltic products: any type of waste soils; bulk packaging materials, pallets, warehousing waste material of wood or metal components; and tires." In addition to these items Go-East was allowed to dispose of broken glass which was used to stabilize the haul roads. Any non-inert materials not listed above would not be allowed to be relocated unless approved by SHD.

3. Provide supported and documented evidence that you meet the Financial Assurance requirements. The evidence will be forwarded to Ecology to determine if it complies with requirements. The permit will not be issued until compliance is met.

Section 10.5 of the Landfill Closure Plan ("LFCP") has been revised to address the Financial Assurance question posed by DOE and requested here. In reviewing this revision it is helpful to place the regulation requiring Financial Assurance in its historical context and current incentive assurance built into the current project permit approval process. In August 1983 SHD detailed the closure requirements for the Go East Landfill under its "Regulations Governing Solid Waste Handling." Notably absent therefrom was any requirement for "Financial Assurance." In October 1986 SHD invoked WAC 173-304 ("Minimum Functional Standards for Solid Waste Handling") and again did not identify nor mention "Financial Assurance" as a requirement for closure of the Go East Landfill. WAC 173-304 was promulgated in October, 1985, two (2) years after the Go East Landfill had ceased operations and the prior owner had attempted to close the landfill in accordance with the then requirements. It wasn't until October 1988 (five years after the Go East Landfill had ceased operating) WAC 173-304-468 ("Financial Assurance for Private Landfill Disposal Facilities") was promulgated. Following adoption of this rule by Ecology, SHD then began insisting for the first time there had to be "Financial Assurance" to permit official closure/post closure of the Go East Landfill. It is in the context of this *ex post facto* application of the Financial Assurance requirement, that Section 10.5 of the Landfill Closure Plan has now been revised. The other key element in the revision made to Section 10.5 of the Closure Plan is that Ecology in its October 8, 2015 letter states that it "sees no need for Financial Assurance for the closure because (it) understand(s) the landfill closure is planned to occur soon after the owner obtains the required permits...the owner should be required to demonstrate Financial Assurance for the entire post-closure that SHD determines is appropriate". Furthermore, because the "Closure" is being funded by the associated subdivision which by County permit process can only be accomplished after the closure of the landfill, there is great incentive to complete the landfill closure as quickly as possible. Therefore, the revision to Section 10.5 of the LFCP addresses only the post-closure Financial Assurance provided for by WAC 173-350-600 as Ecology suggests.

4. The gas monitoring probes should be spaced a 100 feet apart.

   We have added the requirement of 12 gas probes around the closed landfill, just outside the gas trench and inside the landfill property line to provide the ability to monitor for gas. These are shown on sheet 1 of 3 in Appendix D. A detail of a typical probe has been added to sheet 3 of 3 in Appendix D.

5. Provide a remediation plan to address events where methane gas is measured above the levels stated in WAC 173-350-400 (4)(b)(v).

   Appendix H of the LFCP contains a detailed "Landfill Gas Monitoring" Plan. This section has been expanded to further address a plan in the event high levels of methane has are discovered by monitoring the edge of the landfill boundary after it has been closed. The proposed revision is attached.

The Health District plans to render its decision on November 19, 2015. In order to meet this goal, your final revised proposed closure plan addressing all of the above must be submitted (original and at least one copy) to the Health District by November 1, 2015.

Please let me know if you have any questions regarding this letter.

Sincerely,

Gary G Hanada, RS, Manager
Environmental Health Division

GGH:jg

To be added to Appendix H of the LFCP at the end of 2. Monitoring Methodology, Landfill Gas Monitoring, (at the top of page 5 of 39).

Remediation Plan Where Methane Gas is Measured Above Safe Limit

If detection of explosive gases exceed the following limits a remediation plan will be implemented:

- Twenty-five percent of the lower explosive limit for the gases in facility structures (excluding the gas control or recover system components);
- The lower explosive limit in soil gases or in ambient air for the gases at the property boundary or beyond; and
- One hundred parts per million by volume of hydrocarbons (expressed as methane) in offsite structures;

Typically for methane this is 5% by volume which is the limit for this project. Any amount beyond this level is referred to hereafter as "High Levels."

The remediation plan for this landfill closure is as follows:

- The gas mitigation plan for the closure has be discussed earlier. Gas generated within the closed landfill is being directed to and collected in the gravel gas trench surrounding the upper portions of the landfill and directed by piping to 100 feet away from the landfill boundary to the interior of the landfill in a common, uninhabited space where it is released via several vents. This will allow for an easy way to monitor methane discharge levels.
- Methane is being monitored 24/7 for a 6-month period or longer as determined appropriate by SHD. Methane recorders will be located inside four manhole structures installed along the gravel trench at locations of maximum concentrations prior to being released directly to the atmosphere thru piping directing it at least 100 feet from inhabited structures.
- Should levels increase above 5% by volume ("High Levels") a forced air ventilation system can be sized and installed to help dissipate the High Levels.
- SHD will be promptly notified of events of High Levels. Within 7 calendar days of High Level detection a written report will be provided to SHD to include remediation steps to be employed to protect human health.
- Any homes constructed within 100 feet of the landfill will be monitored as set forth in this plan.
- Any homes found with High Levels will be immediately notified and evacuated until levels drop to safe levels.
- Within 60 calendar days of detection the remediation plan describing nature and extent of High Level problem and its remediation will be undertaken.
- Monitoring of the probes will be increased to weekly from quarterly, until level are confirmed to drop below 5%.
- Monitoring of the home installed gas monitoring systems will be checked to see they are in working order and in place.
- Results of all testing including the 24/7, results of the probes, and any issues with the home monitoring systems will be recorded and reported quarterly to SHD. After the limits have been confirmed to be below 5% and declining, the reporting period will be reduced to yearly.

- After it has been determined that methane gas levels are not a concern, the probes will be decommissioned per state requirements.

SNOHOMISH COUNTY ZONING ADJUSTOR

WRITTEN ORDER NO. 76

SUBJECT:	File No.	CU-3-75
	Applicant:	REKOWAY, INC.
	Location:	Generally located at 108th Street S.E. and 39th E., approximately 1-1/2 miles east of Silver Lake.
	Request:	Modification and expansion of the existing solid waste landfill permit to include tire carcasses and bulk packaging materials such as cardboard cartons, pallets, large paper wrappings, shredded paper, and warehousing waste material
	Date Filed:	December 2, 1974
	Hearing Date:	September 4, 1975
	Legal Description:	NW 1/4, SE 1/4, Sec 21, Twp 28 N, Rge 5 E, W.M. Situate in County of Snohomish, State of Washington.

Notice in the form prescribed by law in Section 18.88.050 of the Snohomish County Code was mailed to all property owners of record within three-hundred feet of said property

I. PUBLIC HEARING

Public hearing was held by the Snohomish County Zoning Adjustor on September 4, 1975, 1975, in the Snohomish County Hearing Room, County Administration Building, Everett, Washington.

1. Exhibits entered:

   (1) Picture

   (2) Picture

   (3) Affidavit from Mrs. Theresa L. Hoder

   (4) 6 pictures

   (5) Petition (7 pages)

   (6) Petition

   (7) Letter from Mr. Richard Brunner, Health District, Environmental Health Div.

2. Speakers for the application:

   (A) Mr. Leroy Linson

   (B) Mr. Max Meyring

3. Speakers against the application

   (A) Mr. Thomas R. Collins, representing Stuart, Duryee, et al

   (B) Mr. Robert J. Varro

   (C) Mr. Michael W. Hoder

   (D) Mr. Dean A. Hannig

   (E) Mr. Frank Forrest

   (F) Mr. Gordon Garnhart

   (G) Mrs. Barbara Gold

   (H) Mr. Morris Gold

   (I) Mr. Earl Rook

   (J) Mr. Mike L. Hammond

   (K) Mr. Fred L. Kaufman

   (L) Mrs. L. Hoder

4. Agencies representatives testifying:

   (A) Mr. Rich Brunner, Snohomish Health District

II. FINDINGS

All matters in the file having been considered, together with the testimony and exhibits presented in open hearing held on September 4, 1975, and made a part of the record of this matter, as well as visual inspection of the subject property by the Zoning Adjustor, the Zoning Adjustor hereby enters the following:

1. CU-7-72, Written Order No. 14, of the Board of Adjustment now exists and is a valid conditional use permit for excavation and limited fill on the subject property.

2. A conditional use permit for the excavation was initially granted in 1969 for a period of 2 years.

3. In 1970, a conditional use permit to establish a sanitary landfill on the site was denied to Mr. Vern Holt who was then the owner. Said sanitary landfill pertained to putrescible garbage.

4. In 1972, subsequent to the existing conditional use permit mentioned in Finding No. 1, application was again filed for a limited number of special wastes, specifically putrescible and industrial type wastes.

5. Now comes the request for the expansion of CU-7-72 by application of CU-3-75 to expand filling operations to include tire carcasses and bulk packaging materials such as cardboard cartons, pallets, large paper wrappings, shredded paper, and warehousing waste materials, etc., including car parts such as seats and upholstery materials.

6. Disposing of tires in fills, with their apparent ability to work their way to the surface, will encounter future problems unless filling and compaction are conducted properly.

7. Bulk packaging materials, pallets, and warehousing waste material may properly be classified as wood wastes, therefore compatible with the present waste landfill.

8. Cardboard cartons, paper wrappings, shredded paper, and combustible car parts are classified as special wastes and would need special handling, filling, and compacting processes.

9. This proposal also includes tires to be stored on the subject property, possibly ground with a grinding machine and then removed from the subject property at a later date.

10. Present topsoil mixing operations are allowed under conditional use permit as per Mineral Conservation zone, which states under Section 18.70.040 (2): "Primary reduction, treatment and processing of minerals or materials together with the necessary buildings, but only when at least one of the major mineral or material constituents being exploited is from said property, ..."

11. Subject property is zoned Rural Use and under Section 18.64, no provision is made for the processing of imported materials on a subject property when such operation is normally carried on within a more intense zoning classification.

12. Testimony indicated that within the last 3 year period there has been an average of 19 truck trips per day.

13. Applicant states this will not increase by more than 10 percent average truck trips per day.

14. Application states that 4 to 6 trucks per week would bring in bulk packaging material and 5 to 7 trucks would bring in tires.

15. Original estimates indicated an increase of 4 trucks per day for wastes, plus additional trucks for tires.

16. Because these discrepancies existed upon the application being filed and the Zoning Adjustor called for a full Environmental Impact Statement on January 22, 1975, a final Environmental Impact Statement was issued and dated August 27, 1975.

17. Said Environmental Impact Statement again refers to a 10 percent increase in truck traffic on the access roads to the subject site.

18. Testimony at public hearing indicated substantial discrepancies in the average numbers of trucks per day ranging from 3 trucks per day to 10 percent increase to 1 truck per day from 10 companies as possibilities.

19. Environmental Impact Statement, Section 7 (A), Page 7, shows combination possibilities of portions of the above request and their purported increase effect on the now adverse impacts.

20. Requested hours of operation would be from 8:00 a.m. to 7:30 p.m.

21. All trucking would be by private carriers and applicant would have no direct responsibility for conduct of said trucks off the subject property.

22. Testimony indicated that traffic control virtually did not exist in the immediate area.

23. Requests were made for the existing permit, CU-7-72, to be revoked; however, this was not scheduled as an enforcement or review hearing of that said permit.

24. There are substantial findings of fact of CU-7-72, however, that do apply to this requested extension of said permit.

25. Applicant is presently excavating sand and gravel as well as bringing in peat and topsoil to mix with sandy aggregates on subject property to produce a suitable mix for landscaping purposes.

26. The present operation includes the filling of the ravine by dumping of wood, mineral and concrete wastes, including logs, stumps and brush.

27. The Department of Natural Resources Surface Mining Permit still exists on the subject property.

28. The original proposal showed a ridge comprising of approximately 15 acres in the approximate center of the subject property to be excavated in order to create a residential development site as per the plans that were submitted and approved.

29. The landscaping mix is being sold both wholesale and retail from the subject property and not at any other location.

30. Location of the mixing plant and stored mix is out of sight from adjoining properties in an existing low area on the northwest corner of the subject property.

31. Finding No. 14 of the Board of Adjustment Written Order No. 14, CU-7-72, found by testimony presented that the traffic to and from the site would not be unduly heavy, although it will be greater on Saturdays than on other workdays.

32. Detailed drainage and grading plans were prepared by Ruskin Fisher and Assoc., and presented to the Board of Adjustment, which were included in the Written Order and were to be complied with.

33. The proper execution of said filling and excavation would eliminate water problems which had existed in the past.

34. Those particular plans as to the drainage were not properly followed and construction of drainage ditches were not accomplished.

35. Snohomish Health District is now recommending a bypass of all drainage on the west side of the subject property from the north to the south.

36. The access road from 35th North, known as 108th Street, to the subject property is now surfaced.

37. Finding No. 22, CU-7-72, of the Board of Adjustment found that property values in the area would be lowered due to the truck operations to and from the site.

38. Any expediting of this present permit regarding the excavation and fill would substantially reduce the timeperiod for which above condition would apply.

39. Equipment on the site would be limited to loaders and trucks for hauling material aggregates and screening and mixing equipment for the preparation of soil materials for landscaping purposes.

40. There will be no equipment located on this site for the manufacturing of concrete products, washing of gravel aggregates, or manufacturing of asphaltic products.

41. The applicant is now asking for the addition of a tire grinding machine.

42. Reclamation of the slopes would be ratio of 2-1, and upon completion, will be sown with grass mulch mix in order to stabilize the slopes, with the excavation proceeding from the upper slopes in order to create suitable building sites as the excavation proceeds.

43. The interim report from: Solid Waste Management Planning substantiated a need for sanitary landfills in the Snohomish County area.

44. There are two major accesses from major arterials to the corner of 108th S.E. and 35th S.E.; and from that point approximately 1/2 mile east to the site, 108th S.E. is the only access.

45. The improvement of 108th Street S.E. has been complied with.

46. The life expectency of said fill is approximately 7 years if nonindustrial wastes only are to be used in this fill site.

47. CU-56-72, Written Order No. 30, of the Zoning Adjustor was denied primarily because of inadequate evidence regarding the traffic, noise, and dust control, etc.

48. Substantial opposition to this application was due to the proposed increased traffic along the major arterials through residential areas.

49. Alternatives to this total proposal which would allow portions of the proposal would not greatly affect the traffic by substantial increase.

50. Applicant does carry a liability insurance for negligent damage caused by activity on his property or by his operation.

51. There was testimony expressing concern that the present operation was not in compliance with the areas to be filled and the drainage system that was supposed to have been installed.

52. Substantial concern was expressed as to the fire danger on the subject property, particularly in view of the request of the combustible materials within this application; one such incident occurred when industrial wastes were brought onto the subject property.

53. The requirement of the present conditional use permit as to cover and compacting is not adequate for the requested materials which applicant now desires to include within the fill.

54. With additional fill materials permitted and additional cover required for compacting, a depletion of the existing site would be expedited.

55. Whether or not this expansion proposal is approved for the addition to the existing permit, the Snohomish Health District is and will be requiring compliance with the Snohomish Health District specifications for landfills.

56. Reserved within the public hearing of September 4, 1975, to be submitted as evidence in testimony, now comes on September 9, 1975, a letter from the Snohomish Health District to be considered as a finding of fact in its entirety(Exhibit 7 - attached).

57. By mutual agreement, the Snohomish Health District is to be the policing agency in landfills approved by the Zoning Adjustor and subsequently the Snohomish County Commissioners will hold for the Snohomish Health District any bond required by the Zoning Adjustor.

III. CONCLUSIONS

1. The Zoning Adjustor has the jurisdiction to hear applications for a conditional use permit as provided in Chapter 18.88 of Title 18 and Chapter 2.03 of Title 2, Snohomish County Code.

2. This application request is authorized pursuant to Section 18.64.020 (A) and Chapter 18.88 of Title 18, Snohomish County Code.

3. CU-7-72, Finding of Fact No. 27, of the Board of Adjustment finds by testimony presented that this type of operation will not be unduly detrimental to the surrounding properties at this time.

CU-3-75
Written Order No. 76

4. CU-7-72, Conclusion No. 2, of the Board of Adjustment states: "The granting of this permit will not be detrimental to the public health, safety and welfare of the surrounding area.

5. Modification of previous Written Order No. 14, CU-7-72, together with the limited expansion, will not be materially detrimental to the public health, safety, and welfare in the area and zone in which the subject property is located.

IV. ACTION

BE IT ORDERED BY THE SNOHOMISH COUNTY ZONING ADJUSTOR that this application be GRANTED.

BE IT FURTHER ORDERED that if applicant desires to validate this permit, Written Order No. 14, CU-7-72 shall be voided and the following Conditions shall apply to the subject property hereinafter:

1. This permit shall be granted for a period of 7 years from the date of this Written Order subject to a thorough review within 18 months of the date of this Written Order to determine compliance, imposition of additional conditions, or revocation of any portion of this Written Order.

TO BE COMPLIED WITH PRIOR TO COMMENCING OPERATIONS

2. Up-to-date present topography maps physically surveyed showing the present progress of the excavation fill, including greenbelts and locations from periphery of the property lines together with any contemplated changes within the final topography and plot plan, shall be submitted to the Zoning Adjustor within 90 days of the date of this Written Order and prior to exercising the dumping of materials not permitted in CU-7-72.

3. Drawings and specifications for surface water diversion and groundwater intercepter facilities shall be submitted to the Zoning Adjustor and the Snohomish Health District prior to accepting any wastes not previously allowed, and shall be submitted within 90 days of the date of this Written Order. Said specifications shall state timeperiod of complaince for proposals as submitted and approved.

4. Rekoway, Inc., Leroy Linson, Manager, shall obtain a valid Snohomish Health District operating permit for this landfill.

5. Rekoway shall provide the Zoning Adjustor with assurances that adequate fire protection as approved by the Fire Marshal's Office and District #11 shall be complied with.

6. Applicant shall provide a copy of the bond in favor of the Department of Natural Resources for reclamation to the Zoning Adjustor for inclusion in the file. If said bond is not now in effect, presentation shall be required prior to any additional operations on the subject site.

7. A performance surety bond in the amount of $5,000 shall be maintained in the name of the Snohomish County Board of County Commissioners through the Zoning Adjustor for inclusion in the file.

CU-3-75
Written Order No. 76

TO BE CONTINUALLY COMPLIED WITH

8. Snohomish Health District shall have the prerogative of restricting any material allowed by this permit as not acceptable for this disposal site.

9. Compaction and placement of the fill material shall be performed in accordance with the Snohomish Health District specifications.

10. All excavation, filling, mixing operation, drainage, and reclamation shall be carried out according to the plans (above) as submitted and approved and on file with the Zoning Adjustor.

11. All mixing and storage of materials shall be located in an existing area in the northeast corner of the property.

12. Hours of excavation, filling and hauling shall be limited from 7:00 a.m. to 5:30 p.m., according to locally applied time, 6 days per week, excluding Sundays and legal federal holidays.

13. This permit shall limit the equipment that is to be used on the property to trucks for hauling, loading and compacting equipment, and equipment for mixing topsoil.

14. Items to be included within fill shall be limited to: Wood, including tree stumps, logs, and demolished buildings; mineral, concrete, asphaltic products; any type of waste soils; bulk packaging materials, pallets, warehousing waste material of wood or metal components; and tires.

15. None of the following shall be included within this filling operation: Hog fuel or sawdust, cardboard cartons, paper wrappings, shredded paper, car bodies, seats and upholstery material, putrescible garbage, and any other material that in the opinion of the Snohomish Health District will produce a fire or leachate hazard.

16. There shall be no prolonged storage of automobile tires on the site without being incorporated within the fill itself.

17. Applicant shall maintain liability insurance for the operations conducted on and in connection with the subject property.

18. Snohomish Health District shall make periodic inspections of the site with a report at least annually submitted to the Zoning Adjustor for inclusion in the file. Said report shall be available for public inspection in the Snohomish County Planning Department.

19. Applicant shall notify in writing any company and/or driver of any truck entering or exiting the subject property in connection with this permit: The jeopardy that is placed on this permit by said trucks when not exercising the utmost concern for the health, safety, and welfare of the populous and properties, specifically noise and dust pollution and speed while using the general access routes to the site.

CU-3-75
Written Order No. 76

TO BE COMPLETED PRIOR TO RELEASE OF ANY BONDS

20. Final cover and reforestation shall be in accordance with Snohomish Health District and Department of Natural Resources requirements.

DATE OF ACTION: September 18, 1975

D. L. Thomson

D. L. THOMSON
SNOHOMISH COUNTY ZONING ADJUSTOR

Revised 10/23/2015

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
Northwest Regional Office • 3190 160th Ave SE • Bellevue, WA 98008-5452 • 425-649-7000
711 for Washington Relay Service • Persons with a speech disability can call 877-833-6341

October 8, 2015

Mr. Kevin E. Plemel
Environmental Health Division
Snohomish Health District
3020 Rucker Avenue, Suite 104
Everett, WA 98201-3900

Dear Mr. Plemel:

Subject: Go East Landfill Closure Plan

As you requested, the Department of Ecology (Ecology) reviewed the Go East Landfill Closure Plan, revised July 31, 2015 and prepared for P&GE, LLC by PACE Engineers, Inc. We have significant concerns with four aspects of the proposed landfill closure. These are discussed in the following paragraphs. Additional comments on the Closure Plan are provided in an attachment to this letter.

Ecology's primary concerns with the proposed closure are in the areas of:

1. Waste excavation, screening, and disposition
2. Landfill gas monitoring
3. Setback
4. Financial assurance

1. Waste excavation, screening, and disposition

Ecology understands the following materials will be generated during the construction activities:

- Trees, stumps, and other vegetation from clearing and grubbing the site
- Waste and soil excavated from the perimeter "wedge" area
- Waste excavated from the pond area
- Waste excavated from the NE slope during re-grading

Trees, stumps, and other vegetation from clearing and grubbing activities should not be buried in the landfill because degradation of the organic material could result in additional landfill gas production and differential settlement. — Clearing and grubbing debris that cannot be used for topsoil and cover material will be disposed of offsite and not in the landfill.

The closure plan indicates the owner will employ a professional who is qualified to identify hazardous materials, including asbestos and lead-based paint, to be present during excavation of the wedge area. Materials suspected to be hazardous will be separated for evaluation. If determined to be hazardous, the materials will be removed to an appropriately permitted offsite facility. The owner proposes all other materials excavated from the wedge area be moved to the landfill area to be incorporated into the landfill during grading activities.

While Ecology's position is that waste materials should not be deposited into a landfill that does not meet current regulations, the excavation proposed for the Go East Landfill closure involves regrading waste to reduce the NE slope, adjust elevations for drainage, and reduce the landfill footprint, and is not introducing additional waste into the landfill.

We note, however, that some of the materials in the landfill were not allowed by the permits in place when the landfill was operating. The historic background section of the Closure Plan states that operating under the initial conditional use permit, the landfill was permitted to accept wood, mineral, and concrete. Later, the health district issued a woodwaste permit for the landfill. Based on test pit and boring logs, other materials present include wire, tires, brick, asphalt, plastic pipe, metal, glass shards, and carpet. Ecology recommends these and other non-permitted materials be screened out of waste excavated from the wedge area and disposed at a permitted offsite facility. — The prior owner was permitted to dispose of certain materials such as glass, brick, etc., that was inert. In fact Written Order No. 76 dated September 18, 1975 by the Snohomish County Zoning Adjustor approved "Wood, including tree stumps logs, and demolished buildings: mineral, concrete, asphaltic products: any type of waste soils; bulk packaging materials, pallets, warehousing waste material of wood or metal components; and tires.". However, it is agreed some of these materials are not desirable to be placed back into the landfill if they cannot be easily compacted, such as tires, carpet, etc. We will work with the Snohomish Health District in defining materials not allowed back into the landfill and to be disposed of offsite.

All waste excavated during the closure construction project, including waste from the NE slope and pond area, should be observed by a qualified professional for suspected hazardous materials. Any suspected hazardous materials should be removed for further evaluation and appropriate disposition. — Agreed!

The closure plan indicates that other than monitoring for hazardous materials, no waste screening or offsite removal is planned during waste excavation unless SHD requires it. Ecology recommends SHD communicate to the project owner what level of screening will be required and what will be allowed regarding disposition of excavated waste. Then the owner should prepare a detailed plan for SHD approval. — Agreed! A detailed specification has been prepared to provide direction for the contractor doing the work and is included in the updated LFCP for SHD approval.

2. Landfill Gas

The Closure Plan proposes to control landfill gas migration after the cap is constructed by installing a gravel-filled trench around most of the perimeter of the Cover System 1 area.

The Closure Plan describes the proposed landfill gas control trench as "... a deepened gravel trench that extends down vertically to the contact point with the glacial till and landfill area ..." (Section 7.4, top of page 44.) Cross-sections in Appendix B, however, show advance outwash beneath the landfill. It appears the proposed methane trench does not key into the glacial till.

The plan assumes that all landfill gas will rise and then travel laterally beneath the cover to the proposed perimeter trench. Landfill gas is a mixture of methane, carbon dioxide, oxygen, nitrogen, and other gases in trace amounts. It does not necessarily rise, but travels the path of least resistance. Landfill gas can travel great distances from the source. It could travel beneath the gravel trench and into surrounding areas. The statement, "This system will ensure and prevent any possible gas horizontal migration beyond the capped landfill area" (page 44) is not supportable. With residential units proposed to be constructed adjacent to the landfill, every precaution should be taken to prevent methane-containing gas from migrating away from the landfill and accumulating in enclosed areas where it could pose a risk to human health, including the risk of explosion. Agreed, thus the gravel gas trench, 24/7 monitoring, house methane protection, etc.

Ecology recommends:

- Permanent gas monitoring probes between the gravel trench and the residential lots. — So noted and they will be added.
- For gas monitoring probes located less than 200 feet from the refuse boundary, the depth of the probe should equal the greatest depth of refuse measured within a 500-foot radius of the probe location. However, a probe does not need to be any deeper than the historical minimum ground water level. — Okay.
- If development is less than 200 feet from the landfill, probes should be spaced 100 feet apart. — At 100 feet apart, this would result in about 12 probes. These have been added to Sheet 1of 3 in Appendix D of the LFCP. A detail showing a typical probe has been added to Sheet 3 of 3 of Appendix D.
- Vapor barriers and methane detectors should be installed in crawl spaces of structures near the landfill. — Included. See Appendix H Attachment E for details of vapor barrier requirements. The requirement for a methane detector can be added.
- For cost estimating purposes, monitoring of the proposed gravel trench and monitoring probes should be assumed for at least five years from when the closure is complete. It may not be necessary to monitor for that long, but you want to make sure there are funds available if needed. — Okay.

3. Setback

WAC 173-350-400(i) states, "Limited purpose landfills "**shall be designed"** (these are the operative words of the WAC section, distinguishing our closed, inert and inactive 32-year old landfill from a landfill that is about to undergo a design. Because of this distinction it is inappropriate to apply this WAC regulation to the former landfill that as designed and completed under an entirely different set of regulations.) to provide a setback of at least one hundred feet between the active area and the property boundary. The setback shall be increased if necessary ..."

The definition of "active area" is, "that portion of a facility where solid waste recycling, reuse, treatment, storage, or disposal operations are being, are proposed to be, or have been conducted" (WAC 173-350-100, emphasis added). By this definition, the Go East Landfill is an active area. Recall that the entire legislative foundation for WAC 173-350 is to deal with "existing" facilities and to govern solid waste handling. This definition quoted by DOE must be understood to be a part of the entire regulatory scheme set forth in WAC 173-350: and not a stand-alone regulation. This definition begins with these words, "When used in the chapter… "Unless the entirety of WAC 173-350 applies to the Go East site, its definitions, including the "active areas" definition have no application whatsoever.) — However, there will be no home within 100 feet of the landfill while it is being officially closed.

For the Go East Landfill, the minimum distance between the boundary of the active area (new edge of landfill after closure) and the property boundary of the new residential lots should be 100 feet. — This item is fully addressed in the LFCP Section 3.5 "Site Setbacks". This Code relates to the design of new landfills (not one designed over 30 year ago) and does not consider the added mitigation for the Bakerview project and history of very low levels of methane related to this 30+ year old landfill. The landfill has not accepted waste in over 30 years. Furthermore, a trail is planned around the perimeter of the landfill that provides access to the gas trench and methane detection system which is designed to discharge any methane collected at least 100 feet from the landfill boundary, therefore added distance is not needed to provide a safe living environment. Please refer to Section 3.5.

4. Financial assurance

As we previously commented, in accordance with WAC 173-350-600(6)(a)(i), the post-closure cost estimate must be for a period of 20 years or a time frame determined by the Health District. Ecology sees no reason to deviate from the 20 year period at this time. In the future, if the owner demonstrates to the Health District's satisfaction that the landfill is stable and protective of human health and the environment, the fund duration can be changed. — We understand the 20-year requirement, however, the landfill has been inactive for over 30 years. Therefore, it is anticipated the time for continuing to monitor the landfill will be reduced as a result of the length of time since the landfill accepted any new material.

Section 10.5 of the closure plan (second paragraph, page 57) indicates the owner may not understand the financial assurance requirements. In the case of this landfill, financial assurance is required for post-closure care. (Ecology sees no need for financial assurance for closure because we understand the landfill closure is planned to occur soon after the owner obtains the required permits. — That is correct!) A corporate guarantee and a surety bond are both mentioned in this paragraph. These are separate financial assurance mechanisms. The corporate guarantee is part of the financial test option. A company must pass the financial test to use this option. The requirements are found in WAC 173-350-600(3)(f). The surety bond option is described in WAC 173-350-600(3)(c). A surety bond will be used for any required financial assurance. It will be issued after all permits allowing for the "Post Closure" activity.

Options for financial assurance mechanisms are listed in WAC 173-350-600(4)(c) and include:

- Trust account
- Surety bond
- Letter of credit
- Insurance
- Financial test/corporate guarantee

The owner should be required to demonstrate financial assurance for the entire post-closure period that SHD determines is appropriate. If a homeowners association exists at a later time and the required post-closure funds are in place, the Health District could consider allowing the transfer of financial responsibility. — So noted.

If you would like to discuss our review comments, please contact Madeline Wall at madw461@ecy.wa.gov or at 425-649-7015.

Sincerely,

Pete Christiansen

Enclosure

cc: Mike Young, Snohomish Health District

Specific Comments on: **Go East Landfill Closure Plan**
Prepared for: P&GE, LLC
By: PACE Engineers, Inc.
Revision: July 13, 2015

Comments prepared for: Snohomish Health District
By: Department of Ecology, Waste 2 Resources Division
Date: October 8, 2015

Waste testing

Page 27. Addresses testing materials before relocating them to the landfill. It's not clear what materials are proposed to be tested. — This reference relates to materials being relocated from the wedge area.

Page 28. States that the contractor will compare results of waste testing to MTCA values to determine the level of worker protection required. MTCA values are not intended to be used for this purpose. The contractor should be looking at Labor and Industry and worker health and safety regulatory requirements. — Statement added on page 28.

Cover design

Page 22, section 3.4.2

- The statement, "The current code requires the landfill be covered with an impermeable cover meeting certain permeability requirements" is not correct.
- As previously communicated by SHD and Ecology, the closure system design must meet the performance standards listed in WAC 173-350-400(3)(e)(i). The Closure Plan lists them on page 29. The facility owner must show that the proposed design meets the performance standards. These performance standards do not require "an impermeable cover meeting certain permeability requirements."
- A facility owner may choose to use the presumptive design, which does include a geomembrane. If the presumptive design is used, a demonstration that the design meets the performance standards is not needed. — Section 3.4.2 has been reworded.

Page 22, section 3.4.2. The statement "The pond has to be constructed at the proper grades to collect the runoff from the majority of the landfill and be oversized to compensate for any runoff area that is not possible to drain to the pond (the northeast landfill slope area) and other requirements" needs clarification. Why does the pond need to be oversized? — The slope area runs off uncontrolled, as there is no place to construct a detention pond downstream of it. As the peak flow discharge from the site cannot exceed a predeveloped 100-year flow requirement, the pond has to be oversized to reduce the discharge from the portion of the site that drains to the detention so that the combined flow meets the allowable discharge requirements.

Page 30, section 4.3.

- The design described is the presumptive final closure cover, not "prescriptive". It means if the presumptive design is used, the performance standards are presumed to be met and the facility owner does not need to demonstrate that the design meets the performance standards. — Word changed to "presumptive."

- The first paragraph in section 4.3 refers to Table 4-1, but the table is not provided. — Wording revised to eliminate this reference.

Page 30, section 4.4. This states, "The minimum requirements for the final landfill cover system for proper closure are stated in WAC 173-350-400(e)(ii)A&B." Again, this is referring to the presumptive final closure cover, not to "minimum requirements." If the presumptive design is not used, the owner needs to demonstrate that the proposed design meets the performance standards listed in WAC 173-350-400(3)(e)(i). For the Go East Landfill final cover design, this demonstration is needed for the NE slope area. — So noted.

Page 31, section 4.4.1.1. After compacting the final lift of this layer, it should be carefully inspected for protruding objects, and they should be removed before laying down the sub-grade. — Sentence added to Section 4.4.1.1.

Page 31, section 4.4.1.2. Careful inspection is required of the sub-grade layer before placement of the geomembrane. The 6 inches of foundation material must be a measured 6 inches above the soil fill material layer, in other words, foundation material that fills voids in the fill material layer is not part of the 6 inch sub-grade layer. — Sentence added to Section 4.4.1.2.

Page 32, section 4.4.1.5. If anything other than grass will be planted, landscape specialists should be consulted about required soil depth needed and soil depth should be increased as appropriate. — So noted.

Page 33, section 4.4.3.1

- How do ecology blocks and a silt fence at the toe of the slope minimize slope erosion? Perhaps what is meant is these features are intended to minimize sediment (from slope erosion) leaving the property. — So revised.
- It is unclear how ecology blocks and a silt fence could stabilize the slope. Was this recommended by the geotechnical engineer? — It provides a barrier (short wall) that is keyed into the ground as a starting point for covering the slope. If it is determined to be unecessary during final design it can be eliminated.

Stormwater management

Page 36, section 5.1

- We recommend SHD confirm with Snohomish County that the project is vested in the 1992 manual. — It is vested.
- Were calculations for sizing the stormwater pond and conveyance system submitted to the County for review? If so have they been approved? — Yes and yes, as part of the preliminary plat process.

Groundwater and surface water monitoring

Page 46, section 8.4. WAC 173-304-400(5) should be changed to WAC 173-350-500. — Changed.

Construction

Page 48, section 9. Detailed project plans, specifications, and an updated CQA Plan must be submitted to SHD before construction activities begin. Adequate time should be allowed for SHD to review and approve the documents. SHD should specify the amount of review time needed. — So noted.

Post-closure plan

Page 55, section 10. The post-closure plan and the financial assurance are for post-closure care of the landfill. Section 10, Post-Closure Operations and Maintenance Plan includes information related to closure activities that is not relevant to post-closure care, such as section 10.4.5 and parts of other sections. — Section 10.4.5 has been moved to Section 3.6.3. Other minor wording changes have been made as requested.

Appendix A

The figures, Tables 3 — 6, and Appendix A to the Geotechnical Report are not in the copy provided. These items should be provided. — to be added.

Appendix D, Engineering Plans

Sheet 1

- The drawing is challenging to understand because of the amount of information on it. It would be helpful to break it up into more than one drawing, perhaps one that shows the excavation (waste relocation) areas, one that shows the cover areas, elevations, and roads, and one that shows the drainage system, including the pond and elevations throughout the drainage system. — So noted. Final design drawings will provided details.
- Show a detail of how the cover on the NE slope ties in with the land on the north and east edges. Cross-sections through those edges are needed. — Details will be added for final design.
- The drawing seems to show the pond overflow piped across the landfill to the rock-lined channel on the north and another pipe (the normal outlet?) leading southeast, then turning and sweeping westward following the road and ultimately ending up in the re-aligned stream on the west side. The text describes this differently. This needs to be clarified. — So noted.
- It's not clear how stormwater gets from the future developed area into the pond. — It is shown on preliminary plat drawings submitted for Snohomish County approval. These will be revised to incorporate comments received throughout the review process.

Sheet 2

- Cross-sections should show run-on prevention features. — So noted.

- A cross-section of the stormwater conveyance across the landfill to the HDPE SD Outfall would be helpful in understanding the intended design. — So noted.
- A larger detail of the stormwater interception trenches on the NE slope would be helpful to show the intended design. — So noted.

Appendix F: Post-Closure Operation Plan

Page 1, first paragraph, second sentence: "The Go East Landfill has been closed since 1983." Ecology's understanding is the landfill stopped accepting waste in 1983, but its closure was not approved by the Health District, which is why closure is required now. — Sentence modified.

Page 1, last paragraph: The title of this paragraph is "Purpose of the Post-Closure Operation Plan", but it addresses closure, not post-closure. This should be revised to state the purpose of the post-closure plan. — So noted. This paragraph has been revised.

Page 5, second paragraph, second sentence: "The owners recommend mowing the landfill cap once per month during the growing season." The post-closure plan should state what will be done, not what is recommended to be done. — Wording revised.

Page 5, item 2, third sentence, beginning "The owners will maintain ..." The word "required" should be inserted at the end of the sentence. — Sentence revised.

Page 5, item 2, last sentence: "Sampling and analysis of all wells will continue at the required frequency and all results submitted to SHD as described in more detail in the following sections." As no details on sampling and analysis, including frequency, are provided in the "following sections", a reference should be made to the sampling and analysis plan if that is where the details are provided. — Note added.

Page 6, Repair Plan — "Damage and associated repairs will be reported to SHD in an annual report for up to ten years." It is not appropriate to limit the number of years. Suggest instead: "... in an annual report during the post-closure care period." — Sentence revised.

Page 7, Operational Cost/Financial underwriting:

- The post-closure funds must be placed in an approved financial assurance instrument as described in chapter 173-350 WAC. An escrow account is not an approved instrument. SHD was requiring a separate fund to be immediately available to repair a leak in the pond liner should it be needed. It was anticipated a separate account would be set up for this purpose and designated for this purpose to address SHD's past requirement. If this is no longer required as the post closure surety bond covers this concern, then no problem it will be deleted.
- A detailed cost estimate is required to support the proposed annual monitoring and repair fund amounts. —This Section has been rewritten to address these concerns.

Pages 8 and 9, Inspection Checklist:

- Cap maintenance should include observing if unwanted vegetation is present that could compromise the integrity of the liner system. — Sentence added.

- Detention pond maintenance — what is the basis of 1 gpm as the indicator of a possible leak? That is the equivalent of 1,440 gallons per day or 2,057 gallons/acre/day. These are large amounts and would indicate leakage is occurring. It is also possible leakage could be even greater than that measured at the leak detection outfall if the secondary liner is also leaking. Ecology suggests a lower trigger, perhaps 0.5 gpm. — Change made.
- Methane gas venting system: "If yes, how many?" does not make sense by itself. This section should be revised. — This has been revised to show number and results of the 12 proposed probes to be added around the landfill edge.

Appendix G, HELP Model:
The document is missing the even-numbered pages. The complete document should be provided. — So noted, to be included in revised Landfill Closure Plan.

Appendix H, Sampling/Analysis and Monitoring Plan:
Ecology provided detailed comments to SHD on the groundwater monitoring portion of Appendix H in our November 23, 2011 letter. We no longer have a hydrogeologist assigned to this plan review and request SHD's staff with hydrogeologic expertise review the revised Appendix H for appropriate changes made to address previous comments. — Prior comments incorporated.

Page 4, Home Protection: We recommend SHD require the home building to include vapor barriers beneath the homes. — Gas mitigation barriers are required! See detail included in Appendix H, Exhibit E.

Page 4 last paragraph: The statement is made that gas monitoring reports and field testing results will be kept on file for two years following the construction finish date. What is the basis of two years? SHD should determine how long they will be kept. — These will be furnished to SHD to be kept as long as they wish.

Attachment F (of Appendix H), Proposed Plat Covenant:
- "All homes constructed within 100 feet from tract 999 shall include "Residential Methane Mitigation ..." Ecology recommends no homes be constructed within 100 feet of the boundary of the landfill. In accordance with WAC 173-350-400(3)(i) there should be at least 100 feet between the edge of the waste area and the landfill property boundary. For the Go East Landfill, this would mean a buffer of 100 feet between the edge of the new landfill cap and the closest residential lot line. — Comment noted.
- For mitigation, Ecology recommends at a minimum, homes adjacent to the landfill should include a vapor barrier and methane detectors. SHD should determine if additional homes in the development should include landfill gas mitigation features. — Vapor barrier is required per Appendix H, Exhibit E. Methane detection can be required as SHD directs.

Appendix I, Waste Excavation, Screening, and Disposal

Page 3, Structural Fill Placement, last sentence: "In lieu of compaction, the area to receive fill should be blanketed with gravel or quarry spalls to act as a capillary break between the new fill and the existing subgrade." This statement should be prefaced by, "If the subgrade contains too

much moisture to adequate re-compact ..." as stated on page 19 of the Geotechnical Report.
— Sentence revised.

Appendix K, CQA Plan

Page 1, 1.3: note, the soil is not "impermeable", but rather of low permeability. — Revised.

Page 23, Geomembranes: The geomembrane liner installer's Construction Quality Control (CQC) program does not take the place of the owner's Construction Quality Assurance (CQA) program. The geomembrane installer is a subcontractor and will perform CQC activities related to geomembrane installation in the same way the general contractor will perform CQC activities for other aspects of the construction. The owner's CQA engineer and CQA staff must perform CQA activities related to geomembrane installation. Ecology can provide an example CQA plan from a landfill cover installation project, if that would be helpful. — Section revised.

GO EAST
LANDFILL CLOSURE PLAN
Snohomish County, Washington

Appendix M
Third Party Peer Review

TECHNICAL MEMORANDUM

Date: August 5, 2016
To: Mr. Kevin Plemel MPA, RS
From: Chad Darby, Frank Shuri, PE
cc:
Project No.: 1661103
Company: Snohomish County Health District
Email:

RE: GO EAST LANDFILL CLOSURE PLAN TECHNICAL REVIEW AIR QUALITY FUGUITIVE DUST IMPACT ANALYSIS

1.0 INTRODUCTION

Golder has conducted an evaluation of air quality impacts for the Go East Landfill closure in Snohomish County, Washington (Project) as part of a 3rd party review of the Landfill Closure Plan dated October 28, 2015 (the LFCP). Based on the Snohomish County Planning and Development Services letter dated June 14, 2016, fugitive dust and particulate matter generated from construction activities associated with landfill closure was identified as one of the areas in need of additional environmental review. The assessment presented in this memorandum will include a discussion of sources of fugitive dust and proposed mitigation measures.

2.0 BASIC FUGITIVE DUST AND PARTICULATE INFORMATION

Particulate emissions from landfill closure activities generally result from vehicle exhaust, vehicle generated road dust, wind erosion, and soil disturbance in combination with wind movement. Vehicle exhaust is mitigated by the standards that vehicle manufacturers must meet for engine design. No additional mitigation is expected to be necessary for vehicle exhaust. Vehicles also create dust by tracking dirt in or out of the site as well as re-suspending any dust already on the roads. Fugitive dust is generated when wind velocities reach a critical level at which surface materials are stripped and become airborne. This can occur on uncovered storage piles or ground that has been freshly disturbed.

3.0 MITIGATION OF FUGITIVE DUST EMISSIONS

The following discusses mitigation measures that are appropriate for this project. Many of these are already included in the Landfill Closure Plan.

3.1 Road Dust

Road dust can be generated from tires that are tracking material as well as dust on the road that becomes resuspended when disturbed by tires. To minimize dust from these sources, the Closure Plan has proposed a number of mitigation measures that meet best management practices. These include:

Golder Associates Inc.
18300 NE Union Hill Road, Suite 200
Redmond, WA 98052 USA

Tel: (425) 883-0777 Fax: (425) 882-5498 www.golder.com

- **Watering:** Water trucks will be used to ensure that surfaces are not dusty. This is a standard industry practice to minimize dust from roadways and disturbed surfaces. (Closure Plan p. 4)
- **Vegetative buffer:** Only 10 acres of the 40 acre property will be devegetated for the landfill closure. Fugitive dust is typically heavy and settles relatively nearby. The dense tree canopy and vegetation remaining around the perimeter of the site will provide a screen around the closure activities to help mitigate the drift of fugitive dust from the property. (Closure Plan p. 21)
- **Earthen materials will be obtained on-site:** To minimize off-site vehicle travel, the project is proposing to use on-site earthen materials for backfill and grading. This will reduce track-in/track-out of material and off-site road dust generation. (Closure Plan p. 5)
- **Track-out control:** The facility will have a stabilized construction entrance consisting of coarse rock that cannot be tracked off the property and will also help remove soil from tires. The Closure Plan also indicates that there will be a wheel wash station. (Closure Plan p. 9)
- **Hours of Operation:** Hours of activity will be limited to 8 a.m. to 5 p.m. which reduces the number of hours of dust generation and therefore the overall amount of generation. (Closure Plan p. 5)

Several additional measures are also recommended. These represent the best practices of the industry and include the following: These additional measures have been added to Section 3.6.3. Air and Odor Control Activities in the LFCP.

- **Speed limits on-site:** Vehicle speed affects the disturbance of dusty road surfaces. For both safety and dust control, vehicles should limit on-site speeds to 15 mph.
- **High Wind Closures:** Earthwork operations should be curtailed during dry, windy conditions when mitigation measures (such as watering) cannot be effectively implemented. Road dust is easily generated during dry conditions and can remain airborne for a long distance during high winds. Curtailment of dust-generating activities is a standard surface disturbance best practice when other mitigation measures are no longer effective.
- **Training:** The construction manager should provide training and regular debriefings of crews on the importance of implementing and maintaining fugitive dust control measures. This includes the importance of ongoing observations to determine if conditions have deteriorated or a mitigation measure is ineffective or not being used properly.
- **Inspections:** On-site workers should conduct a daily inspection to ensure that mitigation measures are remaining effective and that there are no areas of inadequate dust control.

These mitigation measures represent the best practices of the industry for reducing road dust impacts from closure construction, and fugitive dust from road travel should be minimized to the extent practicable.

3.2 Fugitive Dust Emissions from Wind Erosion

Fugitive dust from wind erosion results when wind exceeds a threshold friction velocity that will suspend erodible material from a surface. Wind erosion is most severe on storage piles of fine material due to the pile profile and the availability of erodible material. The Closure Plan includes several best management practices that should minimize wind erosion to the extent practicable. These include:

- **Storage Pile Covering:** Any exposed piles of soil or landfill material will be covered when not being worked with visqueen and sandbags. (Visqueen is a thin plastic sheet). (Closure Plan p. 4)

- **Limiting Disturbed Areas:** The area of the landfill being worked on will be limited to one acre at a given time. (Closure Plan p. 5) This will significantly reduce the amount of surface area that can produce dust. The site consists of 40 acres, so this limited disturbance area will represent only a small portion of the site.
- **Covering Disturbed Areas:** Exposed landfill areas will be covered at the end of each working day with visqueen and anchored with sandbags. (Closure Plan p. 5) This will prevent wind erosion when the site is not actively being worked.
- **Vegetative cover:** Once final grading is concluded, the site will be revegetated as soon as possible to secure soils from wind and water erosion. (Closure Plan p. 24)
- **Other best management practices:** Several of the practices discussed previously for dust control from roads will also reduce dust from disturbed areas. These include watering, maintaining a vegetative buffer, limiting hours of operation, implementing high-wind closures, training, and inspections.

The limitation to one acre of disturbance and the effort to cover storage piles and landfill areas when not in use exceed standard practices on many projects. These relatively restrictive efforts represent best dust management practices and will have a significant impact on reducing emissions from the site.

4.0 CONCLUSIONS

The Go East Landfill Closure plan includes a number of actions that will be taken to mitigate fugitive dust. These represent best management practices for dust control. We recommend adding best management practices of establishing on-site vehicle speed limits, curtailing operations in high winds during dry conditions, conducting training on minimizing fugitive dust, and ensuring that there are daily inspections of mitigation measures. In aggregate, these actions will reduce fugitive dust emissions to minimal levels. With the proposed additions, the Closure Plan represents best management practices that are consistent with other sites where fugitive dust is mitigated in a well-controlled manner. Golder's opinion is that the proposed mitigation measures, when implemented properly, will result in insignificant off-site impacts from fugitive dust. All additional recommended mitigation measures have been added to requirements in the LFCP.

GOLDER ASSOCIATES INC.

Chad Darby
Senior Consultant

Frank S. Shuri, LG, LEG, PE
Principal and Practice Leader

August 5, 2016 Project No. 1661103

Mr. Kevin Plemel MPA, RS
Snohomish County Health District, Environmental Health Division
3020 Rucker Avenue, Ste 104
Everett, WA 98201

RE: GO EAST LANDFILL CLOSURE PLAN ENVIRONMENTAL ASPECTS REVIEW

Dear Mr. Plemel:

Golder Associates Inc. has conducted an evaluation of the environmental aspects of the Go East Landfill closure in Snohomish County, Washington (Project) as part of a 3rd party review of the Landfill Closure Plan dated October 28, 2015 (the LFCP). Based on the Snohomish County Planning and Development Services letter dated June 14, 2016, potential environmental impacts associated with landfill closure were identified as an area requiring additional environmental review. The assessment presented in the following sections of this letter will discuss potential environmental impacts, mitigation measures proposed in the LFCP, and deficiencies (if any) in the proposed plans together with additional or alternative approaches to adequately mitigate potential risks.

1.0 INTRODUCTION

Adverse environmental impacts from closed landfills can be grouped into several broad categories:

- Direct exposure of the waste to the environment
- Contamination of groundwater
- Contamination of surface water
- Release of landfill gases

Specific regulatory requirements and design standards, in this case WAC 173-350-400 Solid Waste Standards for Limited Purpose Landfills, fall into one of these categories.

Each of these categories will be discussed in more detail in the following sections of this document, together with the ways in which the Landfill Closure Plan addresses the associated risks. Where potential deficiencies have been identified, these will be described, together with supplemental or alternative approaches to address the deficiency.

In general, although most of the materials disposed of in the Go East Landfill appear to consist of inert construction debris, the regulatory agencies have determined that this facility should be closed under the requirements of WAC 173-350-400 (Limited Purpose Landfills)[1] rather than the less stringent

[1] Washington Administrative Code 173-350-400. Solid Waste Standards for Limited Purpose Landfills. Statutory Authority: Chapter 70.95 RCW. WSR 03-03-043 (Order 99-24), § 173-350-400, filed 1/10/03, effective 2/10/03.]

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WAC 173-350-410 (Inert Waste Landfills)[2]. This is appropriate given the limited record keeping typical of landfill operations during the time that the Go East Landfill was operational. However, based on the absence of any observed release of contaminants via the pathways listed above during the time period since operations, it is likely that the LFCP includes an implicit degree of conservatism that applies to each of the following discussions.

2.0 DIRECT EXPOSURE OF WASTE TO THE ENVIRONMENT

2.1 Exposure Mechanisms

Direct exposure of waste presents risks associated with contact by humans or biota, dispersion by wind or surface water, and physical hazards (e.g., for construction debris). Assuming that the waste is covered, direct exposure typically results from one of the following mechanisms:

- Erosion
- Slope failure
- Excessive subsidence

2.2 Erosion

Erosion results from excessive surface water flows physically removing the landfill cover. The LFCP minimizes the potential for erosion in the following ways:

1. The surface slopes over approximately 2/3 of the post-closure landfill area will range from 2% to 5%. These low slopes will limit the velocity surface water flow in these areas to low levels which will not significant ability to erode the cover soils.
2. The waste in this relatively flat area will also be covered by a geomembrane, which would provide an effective erosion barrier. Even if the overlying 2-foot thickness of cover soil were to be entirely removed by erosion, the geomembrane would prevent waste from being exposed.
3. The 2H:1V slope at the northeast corner of the landfill area will be covered with 2 feet of low-permeability soil and 1 foot of vegetative soil, for a total thickness of 3 feet. This provides a large physical thickness of soil that would need to be penetrated to expose waste.
4. The permeability requirement of the 2-foot-thick soil layer on the 2H:1V slope is 1×10^{-7} centimeters per second (cm/sec) or less. With natural soils, as proposed in the LFCP, this value is difficult to achieve unless the soil contains a significant fraction of clay, which in turn imparts cohesion to the soil mass and thereby increases its resistance to erosion.
5. The 2H:1V slope includes horizontal benches at 50-foot horizontal intervals. Water flowing down the slopes will be intercepted by these benches and drained laterally to the north edge of the cover. This will limit the downslope velocity, hence erosion potential, that the runoff can obtain.
6. All areas of the landfill cover will be revegetated. Although the type of vegetation has not been specified at this stage of the design, it is assumed to comply with the WAC 173-350-400 requirement for "grass or other shallow rooted vegetation" (LFCP Section 4.3). This type of vegetation will reduce the potential for erosion by reducing flow velocities across the cover surface and binding the surficial soil layer into a more erosion-resistant mass.
7. Runoff on the cover surface will be controlled with the water quality and sediment ponds and buried discharge pipe. On the 2H:1V slope, specific flow channels will be established

[2] Washington Administrative Code 173-350-410. Inert Waste Landfills. Statutory Authority: Chapter 70.95 RCW. WSR 03-03-043 (Order 99-24), § 173-350-400, filed 1/10/03, effective 2/10/03.]

and will be lined with rock to prevent erosion. Examples include the 50-foot benches and the downslope drainage channel at the north edge of the landfill cover.

8. The volume of water that could potential cause erosion will be limited to that which falls directly on the cover. The surface water design for the surrounding area (2% slopes away from the landfill) will divert surface water away from the cover area so that there is no run-on.

9. The cover areas will be clearly visible by the local residents so that any incipient erosion can be identified early and repairs made before a significant problem develops.

2.3 Slope Failure

Most of the landfill area is relatively flat, and therefore slope failure risks are associated only with the 2H:1V northeast facing slope. A slope stability analysis was performed for the LFCP (Appendix A), which concluded that factors of safety for this slope were above acceptable values for both static and seismic loading conditions. The strength and unit weight parameters used in the analysis appear to be reasonable and the required factors of safety are consistent with industry standard of practice. The peak ground acceleration used as the basis for seismic loading has a probability of exceedance of less than 10% in 50 years, based on the 2014 USGS hazard map of the U.S. (http://pubs.usgs.gov/sim/3325/), which is considered reasonable for this type of landfill.

2.4 Excessive Subsidence

The proposed geomembrane and soil cover systems are capable of accommodating settlement and subsidence that normally occurs over broad areas of closed landfills. Several feet of subsidence over a very short horizontal distance would be required to rupture and offset the cover layers sufficiently to expose the underlying waste. This type of excessive subsidence would result from the presence of a large (several feet in dimension), undetected void closure to the surface. The presence of such a void is unlikely because of the nature of the debris placed in the landfill and the methods of placement and covering with soil. There has been no evidence of this type of subsidence on the landfill surface over the approximately 30 years since closure.

2.5 Evaluation of Approach to Prevent Direct Exposure of Waste

The measures described above represent the standard of practice for landfill closure covers and address the pertinent regulatory requirements. No deficiencies were identified with respect to waste exposure risks.

3.0 CONTAMINATION OF GROUNDWATER

3.1 Site Groundwater Conditions and Mitigating Measures

Groundwater below or adjacent to a closed landfill becomes contaminated if the following conditions and processes are present:

1. There are contaminants in the waste material.
2. Water enters the landfill, either from upgradient groundwater or from infiltration of surface precipitation.
3. The water comes in contact with the waste and leaches the contaminants.
4. The groundwater flows out of the landfill and into the surrounding geohydrologic system.

In practice, preventing groundwater contamination at a closed landfill generally consists of methods to address process 2 above, namely preventing inflow of water to the waste.

Based on field investigations presented in Appendices A and B of the LFCP, the waste sits on a layer of sandy advance outwash deposits that in turn sit above a thick, low-permeability glacial lacustrine deposit. Geologic cross sections presented in Appendix B indicate that the groundwater in the outwash deposits is generally below the elevation of the waste, except possibly in the northeastern corner of the landfill. The waste materials were disposed of within a pre-existing ravine that drained to the northeast. As a result, spring SP-1 appears to represent not only groundwater discharge in the northeastern portion of the landfill, but probably most of the landfill area. This water is considered a perched layer on top of the lacustrine deposit (Appendix A) and therefore by implication not connected to the deeper regional groundwater system. The hydrogeologic studies (Appendix B) conclude that "recharge of the ground water system in advance outwash deposits is likely from infiltration of precipitation". Water quality measurements from Spring SP-1 at the toe of the steep slope at the northeast corner of the landfill indicate only very slight impacts from waste materials.

Infiltration will be controlled by constructing low-permeability covers over the waste. On the flat portion of the landfill, a geomembrane cover will be installed as an infiltration barrier. Geomembranes when properly installed are essentially impermeable and have been successfully used as moisture barriers since the 1980s. The geomembrane system proposed in the LFCP meets the minimum technical requirements of WAC 173-350-400; however, we believe that the proposed material is not the most suitable choice to provide longevity, and the design and construction methods introduce a significant risk of damaging the geomembrane and significantly degrading its ability to prevent infiltration. These deficiencies and proposed alternatives will be discussed at the end of this section.

The other aspect of preventing groundwater contamination is monitoring to detect any contamination at an early time so that appropriate remedial measures can be implemented. The existing groundwater monitoring system (Section 8.3) includes two upgradient and two downgradient monitoring wells. An additional two downgradient wells will be installed as part of landfill closure. Since groundwater chemistry in seeps can change rapidly due to exposure to the atmosphere, the new monitoring wells MW-5 and MW-6 will provide more direct groundwater quality results immediately upgradient of the discharge point at SP-1. This system is considered appropriate for monitoring groundwater at this facility.

3.2 Evaluation of Approach to Prevent Groundwater Contamination

The measures described above represent the standard of practice for landfill closure covers and address the pertinent regulatory requirements. This review, however, has identified several deficiencies in the proposed approach:

3.2.1 Geomembrane Material

Deficiency 1: The current design utilizes a polyvinyl chloride (PVC) geomembrane. PVC obtains its flexibility through the incorporation of plasticizing agents. Over time, exposure to weather, oxidizing conditions, and other adverse factors, the geomembrane may lose these oxidizers, causing it to deteriorate. Burial under a soil cover will extend the life of a PVC geomembrane, but it is still considered to be in the range of 10s of years; one manufacturer states on their website that "In buried applications, PVC can provide a service life of over 20 years" http://www.coloradolining.com/products/pvc.htm . Because of the difficulty and disruption replacing a liner system in a residential setting like the proposed project, an alternative type of geomembrane material should be used.

Alternative Approach 1: Several geomembrane materials which have much longer service lives than PVC are commercially available. These include high density polyethylene (HDPE), linear low density poly ethylene (LLDPE), XR-5 (a proprietary polymer manufactured by Seaman Corporation), and polypropylene (PP). Of these materials, we recommend LLDPE for this project. This material has very high resistance to chemicals and weathering. It also has very favorable mechanical properties, particularly high elongation prior to failure, which means that it can accommodate settlement, irregular surface geometries, and other mechanical strains without rupturing. HDPE should not be used, as it can cold flow and develop holes around areas of higher loading. XR-5 is a high-performance liner material that would perform well, although it may not be as cost-effective as LLDPE. PP has not been widely used and therefore does not have the performance record of the other materials. The minimum available thickness of LLDPE is typically 40 mils; sometimes a 60-mil sheet is used to facilitate the thermal welding that is necessary to join the panels of this material. The installer should be consulted to determine the most cost-effective approach. Because of relatively flat slopes of the landfill surface, smooth sheet can be used, although textured sheet may be required on the sideslopes of the pond to provide the necessary friction to support the soil layer; these details should be evaluated as part of the final design process. Although the PVC liner system meets the current WAC requirements, with this recommendation for change from a PVC linier to LLDPE liner, the LFCP has been updated and now includes the use of LLDPE for the linier on this project. References to PVC have been replaced with LLDPE material and the contents of Appendix E have been replace with the specifications of LLDPE material. (See Section 4.4 of the LFCP and Appendix E)

3.2.2 Geomembrane Seam Testing

Deficiency 2: Destructive tests of liner seams are included in the Construction Quality Assurance (CQA) Plan. These tests involve cutting out a section of seam and patching the resulting hole with a piece of the same type of geomembrane. These patches can be a source of weakness and future leakage in the geomembrane. Destructive tests were used for extensively in the early days of geomembrane construction, when only smooth, low friction liner sheet was available and minimum seam strengths needed to be verified so that the liner did not pull apart on slopes due to tensile loading. With the advent of high-friction textured geomembrane, or on flat slopes such as those at the Go East Landfill, high seam strengths are not necessary, and destructive testing can adversely affect the performance of the geomembrane as a moisture barrier.

Alternative Approach 2: Most LLDPE geomembrane seams will be produced using an apparatus which produces two welded tracks about an inch apart, leaving an open channel that can be pressurized with air to verify that the seam is continuous and adequately strong. All such seams should be tested in accordance with ASTM method D5820-95(2011) "Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes". In geometries where the track welding equipment cannot be used, the extrusion welding process is used to join adjacent geomembrane panels. All extrusion welded seams should be tested in accordance with ASTM method D5641-94(2011) "Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber". Specifications for the use and testing of LLDPE has been included in Appendix E of the LFCP.

3.2.3 Geomembrane Cushion Layer

Deficiency 3: The design does not include a geotextile cushion layer above the geomembrane to minimize the risk of puncture when the overlying soil is placed. Unless this soil is very fine with no large or angular particles, there is a risk of puncturing the geomembrane as the soil is placed and spread.

Alternative Approach 3: A geotextile layer should be placed directly above the geomembrane to reduce the risk of puncture. A 12 oz/sy or heavier non-woven needle punched polypropylene geotextile is recommended. The use of a geomembrane cushion has been added in the LFCP as suggested or the use of site sands could also provide the suggested cushion. (See Section 4.4.1.3 of the LFCP)

3.2.4 Soil Placement Methods

Deficiency 4: The LFCP proposed to place soil above the geomembrane in a maximum loose lift thickness of 12 inches (e.g., section 4.4.1.4). Spreading cover soil in such thin lifts does not provide a sufficient thickness of soil between the dozer track or truck wheel and the geomembrane. Starts, stops, turns, etc. can transmit significant shear forces down to the geomembrane, causing it to tear and lose its function as a moisture barrier. Because the soil covers the geomembrane, such damage cannot be detected.

Alternative Approach 4: The two-foot-thick soil layer above the geomembrane should be placed as a single layer, with soil pushed carefully over the existing face as the layer is advanced. Only low ground pressure (LGP) dozers should be allowed to work on the two-foot lift; trucks should operate on travel ways that are a minimum of three feet thick, which are cut to grade by the dozer as the final step in the grading process. Note that the geotextile cushion recommended in alternative approach 3 will also help lower the risk of this type of damage. The recommended method of placing material over the geomembrane has been included in the LFCP. (See Section 4.4.1.4 of the LFCP)

3.2.5 Hydraulic Head on Geomembrane

Deficiency 5: Detail 2 on sheet 3 of the design drawings in Appendix D of the LFCP shows the water level in the detention pond at the same elevation as the top of the two-foot soil layer above the geomembrane. Water at this elevation could seep into the soil layer and apply a hydraulic head on the single geomembrane layer, which would result in leakage through any holes or damaged areas. Such flaws in the geomembrane often occur as a result of material defects and construction damage, regardless of the care taken at all stages of the process.

Alternative Approach 5: To the extent practical, the pond should be lowered to prevent seepage back into the soil layer. Alternatively, a zone of the low-permeability soil using for the cover on the 2H:1V slope could be placed around the perimeter of the pond to limit flow into the soil layer during detention events. The detail on Sheet 3 of 3 of Appendix D has been corrected to reflect this concern. The pond overflow elevation is one foot below the pond liners.

4.0 CONTAMINATION OF SURFACE WATER

4.1 Site Groundwater Conditions and Mitigating Measures

Surface water at a landfill can become contaminated if it comes into direct contact with the waste or if contaminated groundwater emerges at the ground surface. The mechanisms and mitigation measures related to direct exposure at the Go East Landfill have been discussed above and will not be repeated here. No surface water contamination has been observed at the site except for extremely low levels of two semi-volatile organic compounds detected at seep location SP-1 at the toe of the northeast slope. These detections are attributed to groundwater that has been in contact with the waste discharging at this location, as described above.

Two existing streams at the site, Streams 1 and 2, drain the western and southern portions of the site, respectively. As part of site development, Stream 1 will be diverted further to the west, increasing the distance to the landfill relative to its current location, and will discharge into Stream 2 in the southwest corner of the site. This activity, together with grading around the perimeter of the closed landfill, will direct all surface flow away from the landfill area. Stream 1 will be at an elevation over most of its length that is similar to that of the landfill cover, and therefore will not be susceptible to groundwater seepage from the landfill. Stream 2 is deeply incised to the south of the landfill, but surface water sampling at point SP-2 did not indicate any impacts that could be attributed to waste material (Appendix B). Based on the pre-existing topography of the landfill area, it is reasonable to assume that the groundwater gradient is generally to the northeast, away from Stream 2, which would reduce the potential for seep discharge and resulting surface water contamination; this is not inconsistent with water elevation measurements in the monitoring wells and is supported by the SP-2 monitoring results.

4.2 Evaluation of Approach to Prevent Surface Water Contamination

The measures described in previous sections to prevent direct exposure of the waste and to minimize the potential for groundwater contamination will, to the extent that they are effective, also prevent surface water contamination. The existing surface water monitoring program will serve to identify impacted seepage that would adversely affect surface water quality at an early time so that appropriate remedial measures can be implemented.

5.0 RELEASE OF LANDFILL GASES

5.1 Gas Migration and Mitigating Measures

Waste decomposition produces gases, typically methane and carbon dioxide, often including minor amounts of more complex organic volatile compounds, hydrogen sulfide, ammonia, elemental hydrogen, carbon monoxide, or other gases. Release of these gases into the atmosphere can produce nuisance odors, while accumulation of gas in confined spaces, such as below-grade structures, can increase the risk of explosion (if sufficient methane is present) or create a toxic or low-oxygen atmosphere that would be dangerous to persons entering the structure.

Landfill gas measurements in gas probes at the Go East Landfill indicated the following percentages of the gases that were measured (Appendix A, Table 1):

Methane	0% to 8%
Carbon Dioxide	0.1% to 23%
Oxygen	0% to 22%

Methane was present at 24% of the 34 sampling points, while elevated carbon dioxide was measured at 91% of the sampling points. Methane is a product of anaerobic decomposition, and carbon dioxide is produced by aerobic decomposition. The sampling results indicate that both processes are occurring in the Go East Landfill.

To prevent these gases from migrating into the basements of houses built near the landfill, a gravel-filled trench will be constructed around the perimeter of the consolidated waste area. This trench will extend from about two feet below the ground surface down to undisturbed native soils, which correspond to the base of the adjacent waste, and will intercept gas flowing laterally from the landfill. At intervals along the trench, horizontal pipes will be installed that lead into the landfill area and connect to at-grade boxes which will house methane measuring instruments and provide an exit point for gases from the trench to discharge into the atmosphere. If elevated methane levels are detected, an active removal system can be installed to lower the pressure in the perimeter trench, thereby preventing any migration away from the landfill.

At some closed landfills where gas generation rates are high, more elaborate extraction systems consisting of wells and \ or horizontal gravel-filled trenches are necessary to prevent gas pressure from building up under the geomembrane and damaging the cover system. However, these measures are not considered necessary at the Go East Landfill for the following reasons:

- The gas generation rate for construction debris, primarily wood waste, is much lower than for general municipal solid waste, which was not disposed of at the Go East facility.
- The LFCP does not indicate that any complaints of odor or other gas-related problems have been received from housing developments on either side of the property, indicating low gas generation rates.
- The geomembrane cover will reduce infiltration into the landfill, which will decrease the rate of waste decomposition.
- The sandy soil used for cover over the waste layers likely provides an adequately transmissive pathway for lateral flow to the interceptor trench.

5.2 Evaluation of Approach to Control Landfill Gas Migration

The perimeter gas interceptor trench proposed for the Go East Landfill is often used along the boundary of landfill areas and is considered appropriate for controlling the lateral migration of landfill gas. Monitoring will ensure that changes in gas generation rates are identified, and the system has the capability of adding active extraction equipment if required.

Our review identified one aspect of the design that could be improved:

Deficiency 6: Gases in the measurement boxes will vent into the atmosphere through holes in the lids of the boxes. These discharge points will be at grade. The boxes are located in publically-accessible areas (e.g., labeled "potential play area" on sheet 1 of the design drawings). If toxic gases are generated at some point in the future, humans or animals could be exposed under the current approach.

Alternative Approach 6: Gases in the measurement box should be vented through a pipe extending to about 10 feet above ground level. For example, this could be done using a concrete below-grade vault to provide an adequate mass for mechanical stability, vented through a 4-inch galvanized pipe with a "gooseneck" at the top to exclude precipitation. This type of system would also allow the future installation of wind turbines, which would passively increase the extraction of gas from the trench without the need for installing more complicated mechanical systems, electrical service, etc. The detail and note on sheet 3 of 3 in Appendix D has been modified to include this recommendation.

6.0 CLOSING

We appreciate the opportunity to review this Closure Plan. If you have any questions, please feel free to contact us.

GOLDER ASSOCIATES INC.

Frank S. Shuri, LG, LEG, PE
Principal and Practice Leader

FSS/kkm

TECHNICAL MEMEORANDUM

Date:	August 5, 2016	**Project No:**	1661103
To:	Mr. Kevin Plemel MPA, RS	**Company:**	Snohomish County Health District
From:	Gage Miller, Frank Shuri, PE		
Cc:		**Email:**	

RE: GO EAST LANDFILL CLOSURE PLAN TECHNICAL REVIEW NOISE IMPACT ANALYSIS

1.0 INTRODUCTION

Golder Associates Inc. (Golder) has performed this noise study for the Go East Landfill property in Snohomish County, Washington (Project) as part of a 3' party review of the Landfill Closure Plan dated October 28, 2015 (the LFCP). Based on the Snohomish County Planning and Development Services letter dated June 14, 2016, noise generated from construction activities associated with landfill closure was identified as one of the areas in need of additional environmental review. The assessment presented in this memorandum will include noise impact calculations based on expected noise sources associated with landfill closure that are based on the LFCP.

2.0 BASIC NOISE INFORMATION

For the purposes of this technical memo, pertinent noise information used in the noise impact assessment has been presented below.

2.1 Noise Fundamentals

Acoustic values can be described in terms of noise or sound. Sound is generated by pressure fluctuations in air. Noise is genially defined as any "unwanted" sound, and is therefore based on human perception, but the terms noise and sound are often used interchangeably. Sound propagation involves three principal components: a noise source, a person or a group of people, and the transmission path. While two of these components, the noise source and the transmission path, are easily quantified (i.e., by direct measurements or through predictive calculations), the effect of noise on humans is the most difficult to determine due to the varying responses to the same or similar noise patterns, and therefore it is difficult to predict a response from one particular individual to another.

Noise and noise levels are used to describe ambient levels perceived by off-site receptors, while sound sources and sound emissions describe acoustic energy emitted by activities/equipment associated with the project.

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2.1.1 Atmospheric Attenuation of Sound

In general sound levels decrease with distance as the sound propagates away from a noise source. This is known as atmospheric attenuation of sound. From singular sources (point sources), such as construction equipment, the rate of reduction is generally 6 dBA (A-weighted decibels; see definitions below) per doubling of distance.

Atmospheric Attenuation of Sound

Distance, meters (m)	Noise Level (dBA)
50	86
100	80
200	74

2.1.2 Addition of Noise Sources

Sound pressure level is expressed on a logarithmic scale in units of decibels (dB). Since the scale is logarithmic, a sound that is ten times the sound energy as another sound will be 10 dB higher, and a sound that is two times the sound energy as another sound will be 3 dB higher

Addition of Sound:

- A doubling of energy, or doubling of identical sources, yields and increase of three decibels.
  - Example: 50 dBA + 50 dBA = 53 dBA
- Addition of a 3rd equal source (tripling of energy) does not yield an increase of another 3 decibels.
  - Example: 50 dBA + 50 dBA = 53
  - dBA 53 dBA + 50 dBA = 54.8 dBA

2.1.3 Human Perception of Sound

A change of 3 dB is generally barely perceptible by humans, while a 5 dB change is clearly perceptible and a 10 dB increase is perceived as a doubling of the sound pressure level (Cowan 1994)

Change in decibel level and perceived change in loudness to humans:

- +/- 1 dBA = Not noticeable
- +/- 3 dBA = Threshold of perception
- +/- 5 dBA = Noticeable change
- +/-10 dBA = Twice / half as loud
- +/- 20 dBA = Four times / one quarter as loud

2.1.4 Typical Noise Levels and Environments

Environmental noise levels vary over time, and are described using an overall sound level known as the Leq, or equivalent sound pressure level. The Leq is the energy-averaged continuous sound pressure level which has the same total energy as the time varying noise level over a stated time period. Typical sound pressure levels are listed in the following tables.

Table 1: Sound Pressure Levels of Typical Sound Sources (Harris 1991)

Activity / Sound Source	Sound Pressure Level (dBA)
Air Raid Siren at 15 m	120
Jackhammer at 15 m	95
Loud Shout	90
Heavy Truck at 15 m	85
Vacuum Cleaner at 3 m	70
Automobile (100 km/hr) at 30 m	65
Normal Conversation at 1 m	60
Quiet Living Room	40
Soft Whisper at 2 m	35
Unoccupied Broadcast Studio	28
Threshold of Hearing	0

Table 2: Sound Pressure Levels of Typical Environments (Harris 1991)

Activity / Sound Source	Sound Pressure Level (dBA)
Rock Concert	
Subway Platform with Passing Train	
Sidewalk with Passing Heavy Truck or Bus	
Sidewalk by Typical Highway	
Sidewalk of Typical Road with Passing Traffic	
Typical Urban Area	60—70
Typical Suburban Area	50—60
Quiet Suburban Area at Night	40—50
Typical Rural Area at Night	30—40
Quiet Living Room	40
Isolated Broadcast Studio	20 - 30

2.2 TECHNICAL TERMS

A-weighted decibel (dBA): To account for the effect of how the human ear perceives sound pressure, the sound pressure level is adjusted for frequency to approximate response of the human ear to low-frequency levels [i.e., below 1,000 hertz (Hz)] and high-frequency levels (i.e., above 10,000 Hz).

Background (Baseline) Noise: The environmental noise sources other than the noise source of concern. For the purposes of this memo, the background and baseline noise are the same.

Decibel (dB): A unit for describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure, which is 20 micronewtons per square meter.

LAeq: The A weighted sound pressure level averaged over the measurement period; this parameter is the continuous steady sound pressure level that would have the same total acoustic energy as the real fluctuating noise over the same time period.

Lmax: The highest instantaneous (1 second interval or less) sound pressure value generated by a source. Typically A weighted.

Noise: Any sound which annoys or disturbs humans or causes any adverse effects.

Sound Pressure Level: 20 times the logarithm to the base 10 at the ratio of the root mean square sound pressure to the reference pressure of 20 micropascals and is expressed in decibels.

3.0 NOISE GUIDELINES AND LOCAL NOISE STANDARDS

Noise resulting from construction activities can impact the health and welfare of both workers and the general public. As a result national guidelines and state and local noise standards have been created in order to limit this impact to workers and the general public.

3.1 NOISE GUIDELINES

Under the Clean Air Act, the U.S. Environmental Protection Agency (EPA) administrator established the Office of Noise Abatement and Control (ONAC) to carry out investigations and studies on noise and its effect on the public health and welfare. Through ONAC, the EPA coordinated all Federal noise control activities; but in 1981 the federal government concluded that noise issues were best regulated at the state and local level. While there are no federal standards that are applicable to the Project, EPA has developed noise level guidelines requisite to protect public health and welfare against hearing loss, annoyance, and activity interference. These noise levels are contained in the EPA document "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety." One of the purposes of this document was to provide a basis for state and local governments' judgments in setting standards. The document identifies a 24-hour exposure level of 70 dB as the level of environmental noise that will prevent any measurable hearing loss over a lifetime. Likewise, levels of 55 dB outdoors and 45 dB indoors are identified as preventing activity interference and annoyance. These levels of noise are considered those that will permit spoken conversation and other activities such as sleeping, working, and recreation, which are part of the daily human condition (EPA 1974).

3.2 LOCAL NOISE ORDINANCES

Snohomish County establishes its noise control policy in Chapter 10.01 of the Snohomish County Code. Quantitative standards for sound are outlined in the table below as "maximum permissible sound levels" from all sources measured at receiving land uses property boundary except motor vehicles on public roads.

Table 3: Snohomish County Noise Standards (dBA)

District of Receiving Property	District of Noise Source			
	Rural	**Residential**	**Commercial**	**Industrial**
Rural	**49**	**52**	**55**	**57**
Residential	**52**	**55**	**57**	**60**
Commercial	**55**	**57**	**60**	**65**
Industrial	**57**	**60**	**65**	**70**

Modifications to the above maximum permissible sound levels are altered by the sum of the increases and reductions in (a), (b), and (c) below:

a) Sounds of short duration may exceed the maximum permissible sound levels by a total of not more than fifteen minutes in any one-hour period, when comprised of one or any combination of the following:
   1. 5 dB(A) for a total of fifteen minutes.
   2. 10 dB(A) for a total of five minutes.
   3. 15 dB(A) for a total of one-and-one-half minutes.

b) At night (10:00 p.m. and 7:00 a.m.), the maximum permissible sound levels are reduced by ten dB(A) where the receiving property lies within a rural or residential district of Snohomish county.

c) For any source of sound which is periodic, has a pure tone component, or is impulsive, the maximum permissible sound levels are reduced by 5 dB(A) at night where the receiving property lies within a rural or residential district of Snohomish County."

The ordinance also designates activities and circumstances that are exempt from the above standards. The following exemption applies to this Project:

County Ordinance Chapter 10.01 Noise Control 10.01.050(2) Sounds Exempt during Daytime Hours subsection (a): Sounds created by construction equipment, including special construction vehicles, at temporary construction sites.

4.0 EXISTING NOISE ENVIRONMENT

The Project is located in a suburban residential area with some agricultural land uses to the northeast of the site. No baseline noise measurements were collected for this study. Based on the sound pressure levels of typical environments listed in Table 2 above, the existing noise levels in the Project area most likely range from 40 dBA to 50 dBA during the nighttime hours (10 p.m. to 7 a.m.) to 50 dBA to 60 dBA during the daytime hours (7 a.m. to 10 p.m.). These noise levels would exclude local traffic, airplane noise, or localized farming activities.

5.0 NOISE ASSESSMENT

Predictive noise calculations are based on expected construction phases and construction equipment that is considered likely to be used during implementation of the Go East Landfill Closure Plan. Multiple resources were reviewed to identify appropriate noise source parameters to use when calculating construction noise impacts. For common construction equipment, reference source noise levels as well as default acoustic usage factors listed in the Federal Highway Administration's (FHWA) Roadway Construction Noise Model (RCNM) database where utilized as the source data. This data can be found in Table 4 below. If the equipment was not found in this database, the referenced source is noted in a footnote to the table.

Table 4: Construction Noise Source Data

Equipment Descri . tion	Usage Factor % 5	Measured Lmax . 15 m dBA	Total Pieces of E. ui . ment	Total Noise @ 15m (dBA)6
Land Clearing Phase				
Chain Saw	20	84	3	82
Logging Truck[2]	40	74	2	73
Wood Chipper[3]	40	81	1	77
			Phase Noise Level	83.5
Earthworks Phase				
Excavator	40	81	2	80
Dump Truck	40	76	4	78
Dozer[3]	40	78	1	74
Compactor	20	83	1	76
Water Truck[2]	40	74	1	70
			Phase Noise Level	83.8
Dynamic Compaction Phase				
Crane	20	81	1	74
Com paction[4]	10	82	1	72
			Phase Noise Level	76.1

Notes
1 Source data from RCNM database unless otherwise noted
2 Used Flat Bed Truck from RCNM database
3 200-hp Caterpillar D7 Dozer, 1972 mod
4 Rapid Impact Compactor — An Innovative Dynamic Compaction Device for Soil Improvement (Adam and Paulmichl, 2007)
6 Accounts for a fraction of time an equipment unit is in use, 10 log (U.F./10)
6 Total of equipment noise level for all equipment added up, with Usage Factor subtracted from total.

Based on the maximum expected total noise level of 83.8 dBA at 15 m during earthworks construction phase, distance calculations (described in Section 1.1) were performed to conservatively estimate noise levels at various distances from the center of the Project site (Table 5). Table 5 also includes the estimated number of residences within the radius of each of these distances. These are conservative estimates due to the fact that it is very unlikely that all equipment will be operating at the same time and the same distance from an off-site receptor. Additionally neither ground attenuation, nor the effects of topographical features, foliage, or the residential structures themselves were included in the calculations. In practice, it is likely that equipment will be spread out over much more significant distances across the project site and the attenuation features not included in the calculations will result in even lower than calculated noise levels.

Table 5: Predicted Maximum Noise Level at Increasing Distances and Number of Residences

Distance from Construction Equipment (m)	Predicted Cumulative Leq Noise Level (dBA)	Approximate Number of Residences @ Reference Distance'
15	83.8	0
30	77.8	0
60	71.8	0
120	65.8	<10
240	59.8	45

Notes:
Individual residences estimated from Google Earth, does not include residences in the closer distance category

6.0 RESULTS AND CONCLUSIONS

6.1 Residential Noise Levels

Less than 10 residences will exposed to noise levels around 65 dBA. This is approximately the noise level of an urban daytime environment and can interfere with outside activities. Approximately 45 additional residence will be exposed to noise levels between 59 dBA and 65 dBA. Again this can interfere with outside activities.

Approximately 171 residences will be exposed to noise levels above 54 dBA and below 59 dBA. According to Table 2, this is a typical daytime suburban environment, and there may be some interference with outdoor activities according to EPA guidelines.

When compared to Snohomish County maximum permissible limits, the Project impact calculations exceed the daytime limit of 60 dBA for industrial noise source and residential receiving land use at approximately 50 receptors. However, the construction activities do fall under the daytime exemption for noise generated by temporary construction sites and are not subject to these limits.

6.2 Health Effects

Based on the conservative estimated noise levels, no residence will be subject to average noise levels above 70 dBA during any construction phase, which is the EPA guideline for 24 hour exposure level that causes hearing damage over a lifetime if exceeded. Based on these results, there is no human health related issue with the Project causing hearing loss at residential receptors.

Since the Project is temporary in duration, scheduled to only occur during daytime hours (8 a.m. to 5 p.m.), and only on weekdays, the health effects on humans is expected to be low. There will be no operations during nighttime hours when sleep disturbance could be an issue. The weekday schedule will limit the amount of outdoor interference to which some residences could be exposed.

7.0 RECOMMENDATIONS

For a Project such as this, Golder suggests that a Noise Control Plan (NCP) be developed and implemented to limit potential noise impacts to the local residential community and to minimize noise complaints which cost time and effort not only for the contractor, but also for local officials.

The goal of the NCP is to reduce the potential for noise impacts from the Project. The activities described in the NCP should be implemented for the duration of the Project along the entire Project footprint. If additional mitigation is needed at specific locations, supplementary measures can be implemented for that location.

Typical noise control guidelines include: Note: these supplementary measures have been added to Section 1.1.2.4 Landfill Surface Impacts, Mitigation requirements in the LFCP.

- Measuring noise levels at the property boundary to determine the actual effects of the construction equipment and operating schedule
- Using newer and/or well-maintained quieter equipment that is inspected regularly
- Using equipment suitable for the job that isn't over or under powered
- Whenever possible using the quietest equipment alternative
- Scheduling louder or impulsive noise sources during mid-day hours only
- Locating equipment to position prominent noise sources away from the property boundary to the extent practical
- Limiting the use of back up beepers through truck / equipment routing or the use of flagmen
- Using a sound level meter to determine if the Project noise levels are approaching limits, if construction activities need to be performed in close proximity to residences
- Using best management practices such as enhanced muffler systems and barriers to prevent exceedances if construction noise is approaching unacceptable levels

GOLDER ASSOCIATES INC.

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Principal and Practice Leader

List of Tables (in text)

8.0 REFERENCES

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Gibson Traffic Consultants, Inc.

Transportation Planners and Traffic Engineers

MEMORANDUM

To: Marty Penhallegon, P&G East, LLC
From: Brad Lincoln BJL
Project: Bakerview Property/Go-East Landfill Closure
Subject: Construction Traffic Analysis
Date: August 3, 2016

This memorandum summarizes the anticipated construction traffic from the Go-East Landfill Closure as part of the Bakerview Property development to address comments from Snohomish County Planning and Development Services, dated June 14, 2016. The proposed development was granted concurrency for 106 units, which would generate approximately 1,014 average daily trips with approximately 107 PM peak-hour trips. The development is currently proposed to have only 97 units and will generate fewer trips than what concurrency was granted for.

The Go-East Landfill Closure Plan identifies that the construction traffic for the landfill closure could generate up to 160 daily truck trips (an average of 10 trucks an hour for an eight-hour day and each truck generating an inbound and outbound trip) and 10 PM peak-hour truck trips, all of which are assumed to be outbound trips. Although the plan does not specifically identify the number of workers on the site, there would need to be 97 workers on-site to reach the number of trips that are anticipated to be generated by the completed development. The actual number of workers on the site is anticipated to be much lower than 97 and therefore the construction traffic for the closure of the landfill is anticipated to be much less than the trip generation of the development.

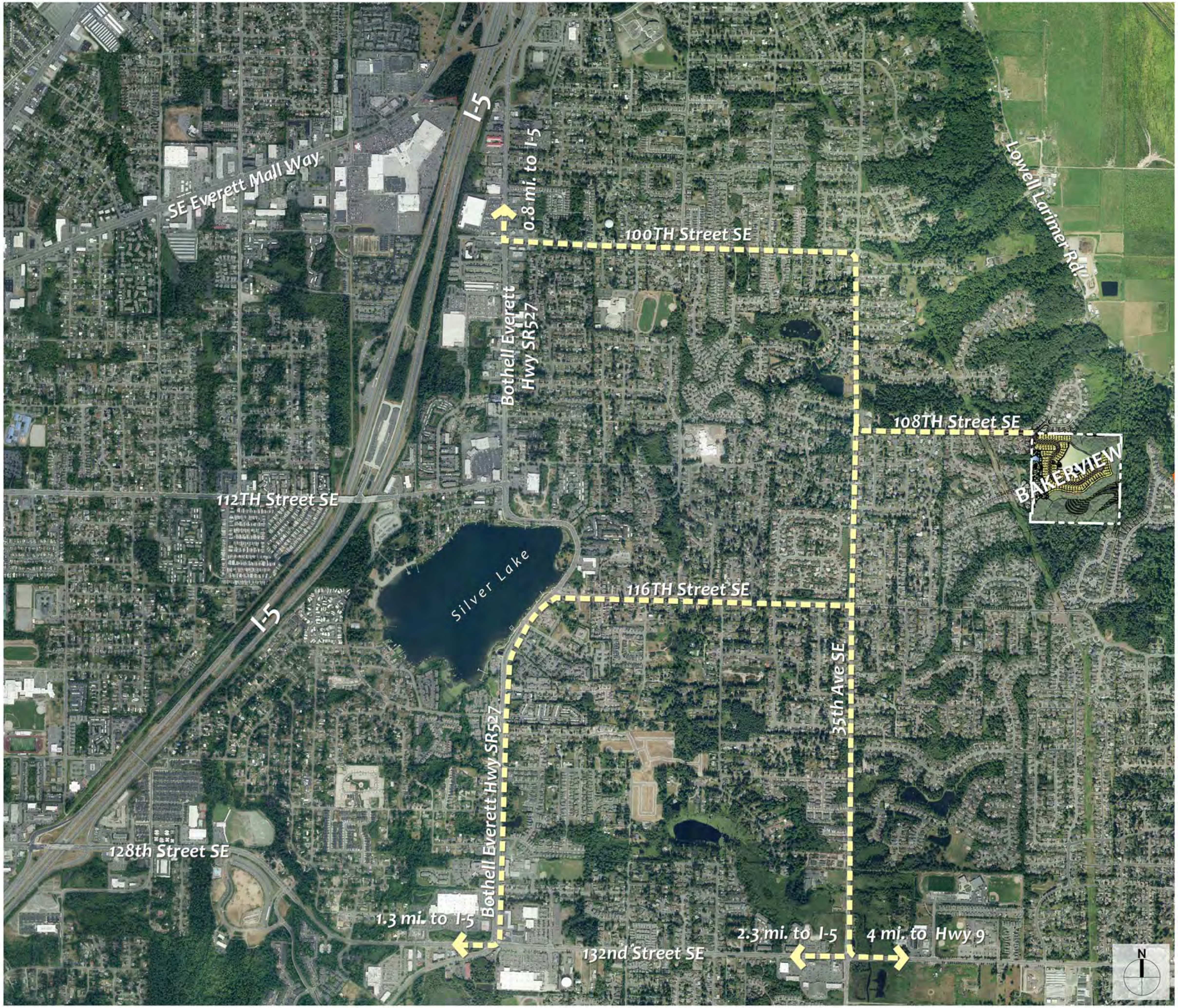
Additionally, construction related traffic, including 'Haul Routes,' will be required to use major arterials in the vicinity, including:

- 35th Avenue SE – north-south between SR-96/132nd Street SE and 100th Street SE
- 100th Street SE – east-west between SR-527 and 35th Avenue SE
- 116th Street SE – east-west/north-south between SR-96/132nd Street SE and 35th Avenue SE
- SR-96/132nd Street SE – east-west between Interstate-5 and SR-9

The 'Haul Routes' are also identified in the attached map.

The construction traffic generated by the Go-East Landfill Closure is not anticipated to generate more trips than the proposed Bakerview residential development and any trips will be routes along major arterials in the vicinity. The Go-East Landfill Closure is therefore not anticipated to create a more significant impact than the proposed Bakerview residential development.

Haul Route Map



Potential Haul Routes

Final Route will be determined based on source of imported material and destination for exported material.

- I-5 via 35th, 100th ,SR527 Heading North approx. 2.7 mi
- I-5 via 35th, 116th, SR527, 132nd, 128th Heading South approx. 4.3 mi
- Hwy 9 via 35th, 132nd, Cathcart Way/ Heading East approx. 6.0 mi

July 28, 2016

BAKERVIEW

Proposed Plat

10-101204-SD

Applicant: P & GE LLC

PACE

An Engineering Services Company

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