DEMOLITION LANDFILL REMEDIATION —ENGINEERING DUE DILIGENCE

OSU-CASCADES

Prepared for
OREGON STATE UNIVERSITY
OSU-CASCADES
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The material and data in this report were prepared under the supervision and direction of the undersigned.

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ACRONYMS AND ABBREVIATIONS

ac	acre
ACM	asbestos containing material
bgs	below ground surface
cy	cubic yard
DEQ	Department of Environmental Quality (Oregon)
ft	foot
MFA	Maul Foster & Alongi, Inc.
MRF	Material Recovery Facility
OAR	Oregon Administrative Rule
ORS	Oregon Revised Statute
RI	remedial investigation
RI/FS	remedial investigation and feasibility study
TPH	total petroleum hydrocarbons

EXECUTIVE SUMMARY

This summary is not intended as a stand-alone document
and must be evaluated in context with the entire document.

Maul Foster and Alongi, Inc. (MFA) has prepared this report detailing our engineering due diligence for the potential remediation of the Deschutes County (County) Demolition Waste Landfill (site) to assist Oregon State University (OSU) in its evaluation of future campus expansion.

BACKGROUND

The site is an inactive construction and demolition waste landfill that was previously a pumice surface mine. The site was developed in three distinct landfill areas: Area 1, Area 2, and Area 3. The limits of waste in each area are delineated into three cells: Cell 1, Cell 2, and Cell 3. The landfill operated under an Oregon Department of Environmental Quality (DEQ) Solid Waste Permit from 1972 to 1996 to dispose of construction and demolition waste, industrial waste, woodwaste, brush, and tires. Cell 2 and Cell 3 were closed in 1997. Cell 1 (the eastern 23-acre portion of the site) closure certification from DEQ has not been received because a portion of the waste is undergoing pyrolysis. The pyrolysis is preventing the site, as a whole, from receiving official permitted closure.

MFA has discussed the landfill's history, closure, and regulatory requirements in association with redevelopment with the DEQ Solid Waste engineer, Joe Gingerich, P.E. Mr. Gingerich indicated that DEQ envisions all remediation and redevelopment work would be completed under the existing Solid Waste Disposal Site Closure Permit. Mr. Gingerich also noted that DEQ would require pyrolysis in Cell 1 to be addressed through excavation or other means. This remediation and redevelopment work could be incorporated into the DEQ's Prospective Purchaser Agreement process, if desired by OSU. DEQ stated that they see removal of the waste and extinguishing of the pyrolysis in Cell 1 as an environmental benefit.

INITIAL SITE ANALYSIS

For the initial site analysis, MFA reviewed all available landfill studies and reports and identified two main data gaps: 1) landfill cap material quality and its suitability for use as clean fill, and 2) whether landfill-related compounds, including methane- and non-methane-related volatile organic compounds (VOCs), are present in soil gas at the Site. MFA performed a site investigation and found that the cover soil can be used as clean fill, and that both methane and VOCs are present in subsurface soils.

Initial Remediation Scenarios

MFA initially evaluated developing over waste in its current location in an effort to minimize disturbance to existing conditions. The existing waste in Cells 2 and 3 could be left in place, however Cell 1 will require implementation of other remediation methods due to the presence of pyrolysis in the cell and the regulatory requirement to extinguish the pyrolysis in order to attain final closure.

Development over waste would require structural ground reinforcement such as piles or rock columns to stabilize structure and utility foundations against differential settlement and seismic impacts. Development over existing waste would also require long-term monitoring and maintenance of the entire landfill. Leaving the waste in place poses some risks, such as differential settlement, methane gas exposure, and the potential of future pyrolysis. We don't see pyrolysis as an issue for Cells 2 and 3 or for Cell 1 waste that has been processed and relocated. Due to the arid climate, the absence of shallow groundwater, and the lack of contaminants in deep groundwater, leachate control does not appear warranted.

MFA also evaluated excavating and hauling all waste off-site to the local landfill. Accepting all waste from the site (over 2.4 M cubic yards (cy)) would greatly reduce the lifespan of the receiving landfill (Knott Landfill). This factor, along with hauling costs, landfill tipping fees, and the negative environment and community impacts of significant heavy truck-traffic (over **101,000 truck trips**) in local neighborhoods makes this option unacceptable.

MFA assessed the potential of screening and sorting waste at a material recovery facility (MRF), to separate the waste into recyclable materials, reusable materials, and rejected materials. However, the results of the Deschutes County pilot study indicated that the amount of recoverable material available is much less than originally estimated. Based on the results of the pilot study, this is not an effective option for site remediation.

Based on the findings listed above, our discussions with DEQ, feedback from the OSU team, review of background documents provided by OSU, and field investigations, MFA refined the following remediation options.

Waste Removal

Waste could be excavated in full from Cells 1 and 2. Excavated waste could be stockpiled for screening and reuse, or relocated to an expanded Cell 3. Prior to waste removal, the existing cover soil would be removed and stockpiled on-site for future reuse as backfill.

Cell 1 has additional considerations in the removal of waste, including pyrolysis, the near vertical face of the pumice mine on the east side of the cell, and the tires contained in the waste.

Cell 3 waste will most likely remain in place. Developing of Area 3 for passive use, such as sports fields, park, or parking lots, could occur on top of existing waste and relocated Cell 1 and Cell 2 waste without requiring major structural ground reinforcement.

Waste Screening

Excavated materials would require screening to separate fines (such as ash and gravel) from debris. Screenings could be stockpiled for use as backfill or reconsolidated in an expanded Cell 3.

MFA evaluated the potential of sorting waste into recyclable, reusable, and rejected materials. As part of this evaluation, results of a materials separation pilot study completed by Deschutes County in late August, 2016 were reviewed. The results of the pilot study indicate that the amount of waste and its suitability for recovery is low when standard screening/separation methods are employed. Specifically, the results suggest that the overwhelming majority of material in Cells 1 and 2 are high organic content fines (after separation using standard methods), making them unsuitable for structural fill without amendment.

MFA also obtained a sample of screened fines from the pilot study excavation and submitted it for agricultural testing. Results show the material contains inadequate nutrients for use as a compost feedstock. The material may be used as a soil amendment, but the low market value for this material is not expected to provide adequate net revenue.

Screened Fines Beneficial Reuse

MFA evaluated a potentially viable option of blending the screened fines with soil sourced on-site (i.e., cover soil and excavated native material) for reuse as backfill throughout the site. The small batch of screened fines obtained from the pilot study have a high organic content (22%), but could be blended with additional clean soil to produce a backfill material with an organic content suitable for development (4%). Based on this limited test, the screened material would require blending with soil at a ratio of 4.5 to 1. At this ratio, there is not enough soil on-site to be able to blend the entire volume of screened fines; however, a different screening method could be developed to reduce the breakdown of the larger wood debris and thereby reduce the screened fines organic content, resulting in a lower soil-to-fines blending requirement. This increases the amount of screened waste that can be used as blended backfill material. The excess screened fines could be used as cell cover soil and topsoil for landscape areas, or relocated to Cell 3. Large wood material separated during the screening process would be relocated to Cell 3 and consolidated into a single area. This wood material can then later be removed or repurposed as needed by OSU.

Relocation to Expanded Cell 3

Excavated waste could be consolidated on-site to Area 3. Cell 3 sits within a depression, and if the cover soil were removed, there would be roughly 450,000 cy of additional capacity to landfill waste. The proposed landfill cell could also be expanded south beyond the existing waste footprint of Cell 3, but still within the limits of Area 3. Native material could be excavated from this area to create an additional 581,410 cy of storage capacity for waste, and then be used as backfill elsewhere on-site. This would provide a total of 1,031,410 cy of capacity in Area 3, which is enough capacity to facilitate all the waste from Cell 1 and Cell 2—after repurposing a portion of the screened waste for backfill, cover soil, and top soil.

Maintaining a landfill cell on-site will require landfill gas (LFG) monitoring and long-term maintenance. Limited groundwater monitoring is also anticipated. It could also put some restrictions on future development over the waste footprint. Additional structural and ground improvements may be needed to support structures. Also, stormwater facilities should be constructed outside of the waste footprint or otherwise designed to avoid infiltration and leachate generation.

1 INTRODUCTION AND BACKGROUND

Maul Foster and Alongi, Inc. (MFA) has prepared this report to provide Oregon State University (OSU) Cascades the findings of the engineering due diligence for remediation and reuse of the former Deschutes County Demolition Waste Landfill (site). MFA has been working in collaboration with the OSU team, which includes OSU-Cascades leadership, engineering faculty, and the Long

Range Development Plan (LRDP) team, to develop recommendations for waste removal and reuse, funding strategies, and next-step recommendations to assist OSU in its evaluation of future campus expansion.

1.1 Site Location

The site is an inactive construction and demolition waste landfill that was previously a pumice surface mine. It is currently owned by Deschutes County and is located in the southwest portion of Bend, Oregon (see Figure 1). The site is bordered to the north and west by residential properties, to the east by commercial development, and to the south by a former surface pumice mine (now owned by OSU), and the current OSU-Cascades campus.

1.2 Background

As shown on Figure 2, the site is 72.4 acres in size and was developed in three distinct areas: Area 1 in the eastern portion of the site (tax parcel 1812060000110 and 181206A000719); Area 2 in the south-center portion of the site (tax parcel 1812060000111); and Area 3 in the western portion of the site (tax parcel 1812060000100). The landfill was operated under an Oregon Department of Environmental Quality (DEQ) solid waste permit (#215) from 1972 to 1996 to dispose of construction and demolition waste, industrial waste, woodwaste, brush, and tires. A previous site investigation conducted by Gershman Brickner & Bratton, Inc. (GBB, 2008) estimated the waste limits (defined herein as waste cell) and composition, in each area. Area 1 is the oldest landfill area and was filled with a large quantity of woodwaste from local saw mills. Area 1 is 23.2 acres; however, the footprint of waste, Cell 1, which extends beyond the western parcel boundary, into property owned by the Bend Park and Recreation District, is estimated to be approximately 24.7 acres. The waste composition in Area 2 is very similar to that of Area 1, except that it also contains construction and demolition debris. Area 2 is 9.8 acres and the waste footprint, Cell 2, is estimated to be 7.1 acres. Area 3 is 39.4 acres and the waste footprint, Cell 3, is estimated to be 19.5 acres. Cell 3 waste includes mill waste, construction and demolition debris, and large woody debris such as logs and stumps[1].

Cells 2 and 3 were closed in 1997. A portion of Cell 1 has been undergoing pyrolysis[2], and therefore could not receive closure certification by DEQ.

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[1] Note that the permit allowed for disposal of industrial waste, but none was specifically identified in the prior investigations (GBB, 2008, Apex 2016).

[2] Pyrolysis is thermochemical decomposition of organic material at elevated temperatures in the absence of oxygen.

2 INITIAL SITE ANALYSIS

2.1 Document Review and Data Gap Analysis

The MFA team reviewed all of the available engineering and environmental documents that have been completed for the landfill. After this review, MFA identified the following environmental data gaps and associated action items:

- Soil gas—historically, soil gas samples have been collected along the perimeter of the Site. Per OSU's site planning, future redevelopment scenarios would involve construction of buildings at the Site. Characterizing soil gas within the landfill footprint would help inform redevelopment decisions and enhance understanding of potential exposure pathways and receptors.
- Landfill cap—anecdotal evidence suggests that much of the landfill cap material was generated on-site. No sampling of the cap material had been performed to assess contaminant levels, if any. Sampling the cap material would help inform redevelopment decisions at the Site.
- Groundwater—groundwater at the Site was sampled in 2013 from three monitoring wells for parameters identified in the DEQ closure permit. Total petroleum hydrocarbons (TPH), specifically diesel-range TPH, has been detected in waste material. Groundwater samples from the Site have not been analyzed for TPH. While it is unlikely that TPH impacts have extended to groundwater, testing to verify the presence or absence of TPH in groundwater would help inform acquisition decisions.
- Asbestos containing materials (ACMs)—potential ACMs were visually observed in refuse at the Site during past investigations. Industry standard practice would be to assume that any potential ACMs encountered should be treated as such.

After the data gap analysis, MFA prepared a field investigation plan to collect and characterize subsurface soil gas and landfill cap material. The purpose of the field investigation was to obtain data of sufficient quality to understand impacts in environmental media, and to evaluate data relative to appropriate risk-based criteria in support of site redevelopment. Evaluation of the groundwater and ACMs were not included in the field investigation study. It was assumed at the time of the investigation that groundwater and ACM will be addressed during acquisition and/or redevelopment activities. A copy of the Data Gaps Summary and Focused Site Investigation Plan is included as Attachment A.

Before site investigation work began, MFA developed a Site Safety and Access Plan that described the recommended practices and procedures to protect the health and safety of MFA team members working on the site. The plan included evaluation of potential hazards at the site, including pyrolysis, safety equipment needed to perform work and air monitoring for LFG exposure.

2.2 Field Investigation

MFA collected multiple subsurface soil vapor and composite soil samples throughout the site. Subsurface soil vapor results collected in Cells 1 and 2 had methane levels at or above the DEQ guidance concentration for methane mitigation for structure and confined space entry. Subsurface soil vapor samples results from Cells 1, 2, and 3 were compared to DEQ risk-based concentrations for urban residential vapor intrusion into buildings. Of the 51 compounds tested, two samples exceeded these criteria for ethylbenzene and three exceeded these criteria for naphthalene. The remaining compounds were below these criteria.

Soil sample results from all cells showed detections of some metals, all of which were within DEQ background concentration for the Bend region, and below DEQ risk-based concentrations for residential use.

Based on these results, future development on the Site would likely involve methane mitigation and vapor intrusion measures incorporated into the redevelopment plan. Existing cap material could be reused as backfill on-site. Field investigation results are included as Attachment B.

2.3 Deschutes County Pilot Study

In the spring of 2016, Deschutes County commissioned a pilot study to assist in the evaluation of potential waste beneficial reuses and revenue. The Draft County Pilot Study Report (Apex, 2016), was prepared and made available to MFA in August 2016. The pilot test data was collected to evaluate whether landfill materials can be segregated in a cost-effective manner; if reduction of waste is possible as a result of segregation and recycling; the process and time required to segregate materials; and processes necessary to prevent nuisance conditions (e.g., dust, odors, noise) and protect public safety and health. Apex also compared its results to those of GBB (GBB, 2008).

The pilot study investigation was focused on an area limited to approximately one-third of Area 1, and equally limited portions of Area 2. This may not provide an accurate representation of the entire waste volume due to its heterogeneous nature. The investigation also excluded the pyrolysis area due to safety concerns. However, cause of combustion and other issues remain a data gap. Estimates of waste quantities in Cells 1 and 2 developed by the pilot study are included in the following tables:

Table 2-1
County Pilot Study Cell 1 Estimated and Observed Waste Distribution
Deschutes County Demolition Landfill, Bend, OR

<table>
<tr><td>Operation Period</td><td colspan="2">1972–1987</td><td colspan="2">Est. Max. Waste Depth (ft)</td><td>60–70</td></tr>
<tr><td>Size (ac)</td><td colspan="2">23.2</td><td colspan="2">Est. Waste Volume (cy)</td><td>1,133,500</td></tr>
<tr><td>Waste Footprint (ac)</td><td colspan="2">25.3</td><td colspan="2">Est. Cover Material Volume</td><td>258,000</td></tr>
<tr><td colspan="3">GBB Estimate</td><td colspan="3">Pilot Test Results</td></tr>
<tr><td>Est. Materials</td><td>% of total</td><td>Volume (cy)</td><td>Material</td><td>% of total</td><td>Volume (cy)</td></tr>
<tr><td>Ash</td><td>3.1</td><td>35,650</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td>Gravel</td><td>0.9</td><td>10,223</td><td>Concrete/Brick</td><td>0.81</td><td>916</td></tr>
<tr><td>Demolition Wastes</td><td>9.5</td><td>107,457</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td>Reclamation Fill</td><td>1.0</td><td>11,638</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td>Sawdust</td><td>7.0</td><td>78,987</td><td>Fines</td><td>98.4</td><td>1,115,918</td></tr>
<tr><td>Metal</td><td>0.6</td><td>7,119</td><td>Metal</td><td>0.003</td><td>35</td></tr>
<tr><td>Tires</td><td>0.3</td><td>3,638</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td>Unidentified</td><td>43.1</td><td>488,883</td><td>Misc.</td><td>0.1</td><td>1,268</td></tr>
<tr><td>Woodwaste</td><td>34.4</td><td>389,895</td><td>Wood</td><td>1.4</td><td>15,361</td></tr>
<tr><td>Total</td><td>100</td><td>1,133,500</td><td></td><td>100.0</td><td>1,133,500</td></tr>
</table>

Notes:
Est. = estimated
ac = acres
cy = cubic yards
Misc. = miscellaneous

Table 2-2
County Pilot Study Cell 2 Estimated and Observed Waste Distribution
Deschutes County Demolition Landfill, Bend, OR

<table>
<tr><td>Operation Period</td><td colspan="2">1988–1992</td><td colspan="2">Est. Max. Waste Depth (ft)</td><td>70–80</td></tr>
<tr><td>Size (ac)</td><td colspan="2">9.8</td><td colspan="2">Est. Waste Volume (cy)</td><td>456,000</td></tr>
<tr><td>Waste Footprint (ac)</td><td colspan="2">6.8</td><td colspan="2">Est. Cover Material Volume</td><td>24,000</td></tr>
<tr><td colspan="3">GBB Estimate</td><td colspan="3">Pilot Test Results</td></tr>
<tr><td>Est. Materials</td><td>% of total</td><td>Volume (cy)</td><td>Material</td><td>% of total</td><td>Volume (cy)</td></tr>
<tr><td>Ash</td><td>2.1</td><td>9,555</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td>Gravel</td><td>0.0</td><td>0</td><td>Concrete/Brick</td><td>9.4</td><td>42,735</td></tr>
<tr><td>Demolition Wastes</td><td>18.1</td><td>82,482</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td>Reclamation Fill</td><td>0.5</td><td>2,422</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td>Sawdust</td><td>8.1</td><td>36,877</td><td>Fines</td><td>81.4</td><td>371,365.4</td></tr>
<tr><td>Metal</td><td>0.0</td><td>0</td><td>Metal</td><td>1</td><td>4,416.8</td></tr>
<tr><td>Tires</td><td>0.0</td><td>0</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td>Unidentified</td><td>0.0</td><td>0</td><td>Misc.</td><td>5.2</td><td>23,874.4</td></tr>
<tr><td>Woodwaste</td><td>71.2</td><td>324,664</td><td>Wood</td><td>3</td><td>13,608.4</td></tr>
<tr><td>Total</td><td>100.0</td><td>456,000</td><td></td><td>100.0</td><td>456,000</td></tr>
</table>

Notes:
Est. = estimated
ac = acres
cy = cubic yards
Misc. = miscellaneous

The GBB and Apex estimates vary substantially for several materials, possibly due to differing identification methods and definitions. Regardless, the pilot study results suggest a much higher percentage of fine material than the amount of fines estimated in the GBB report. MFA noted that characteristics of the fines were not well defined in relation to the physical properties in the pilot study report. The test pit logs note sawdust as the primary component of the fines; however, there is no analysis to confirm the sawdust component of the fines compared to soil, which would provide critical data for determining beneficial reuse of fines as backfill and cover soil. Photos of the test pits and stockpiles included in the pilot study report appear to have significant amounts of larger wood debris. The calculations suggest the wood component to be only 1.4% in Cell 1 and 3% in Cell 2, is low compared to the visual evidence. After discussing with Apex staff, MFA found that large wood debris broke down into finer material during the mechanical screening process. During the pilot study, excavated material was run twice through a shaker screen before being hauled offsite to be sorted.

The results also suggest the amount of recoverable material is much less than originally anticipated. This information significantly altered MFA's development of remediation scenarios. MFA had originally evaluated the screening and sorting waste at a material recovery facility (MRF), either developed on-site or at an existing regional MRF located off-site, to separate the waste into recyclable materials, reusable materials (e.g., biomass fuel, compost), and rejected materials. However, based on the results of the pilot study, MFA determined that the recovery of reusable and recyclable material may not be feasible, due to the low percentage of recoverable material that would justify the level of effort for marketing.

Due to the variances in estimated waste quantities between the pilot study and GBB reports, MFA has utilized the average of the volumes estimated in both reports to develop remediation scenarios for each landfill area.

3 REMEDIATION SCENARIO DEVELOPMENT

3.1 Initial Remediation Scenarios

MFA initially evaluated developing over waste in its current location in an effort to minimize disturbance to existing conditions. The existing waste in Cells 2 and 3 could be left in place, however Cell 1 will require implementation of other remediation methods due to the presence of pyrolysis in the cell and the regulatory requirement to extinguish the pyrolysis in order to attain final closure. This would require structural ground improvements such as piles or rock columns to stabilize structure and utility foundations from differential settlement and seismic impacts. Developing over existing waste also poses additional risks such as methane exposure and potential for future pyrolysis. As discussed in Section 2.2, any development will need to account for methane mitigation and vapor intrusion. Given the substantial limitations and based on feedback from the OSU team, it was determined that leaving all waste in place posed too much risk and was not a preferred approach.

MFA also evaluated excavation and hauling waste off-site for disposal at the Knott Landfill in Bend, or at another appropriate disposal facility. MFA assumed an average truck capacity of 24 cy per vehicle (using truck and pup) and estimated hauling all of the waste from the demolition landfill would result in over **101,000 truck trips**. Assuming a fleet of ten trucks, making a total of 40 trips per day, 5 days per week, it would take approximately **10 years** to haul all waste from the site. The Knott landfill currently has available capacity to accommodate most of the waste from the demolition landfill; however, accepting all of the waste from the site would consume the community's existing landfill capacity. Large landfills with greater capacity are available, but the haul distance to these facilities is two to three times farther than the haul distance to the Knott Landfill, resulting in greater environmental impact and cost. Due to hauling costs, landfill tipping fees, and negative impact to Knott Landfill capacity, on top of the projected heavy truck-traffic in local neighborhoods over an extended period of time, this scenario was not considered to be a beneficial remediation alternative.

As previously noted, MFA assessed the potential of screening and sorting waste at a MRF, either developed and located on-site or at an existing regional MRF located off-site, to separate the waste into recyclable materials, reusable materials, and rejected materials. However, the results of the pilot study indicate that the amount of recoverable material available is much less than originally estimated in the GBB report. Based on the results of the pilot study, this option is not an effective option for site remediation.

Based on the findings listed above, our discussions with DEQ, feedback from the OSU team, review of background documents provided by OSU, and field investigations, MFA has refined the following remediation options.

3.2 Waste Removal

Waste could be excavated in full from Cells 1 and 2. Excavated waste would be stockpiled for screening and reuse, or relocated to an expanded Cell 3. Prior to waste removal, the cover soil would be removed and stockpiled on-site for future reuse as backfill. MFA has assumed a waste excavation production rate of 1,300 cy/day per excavator.

As previously noted, Cell 1 cannot receive permitted closure certification through DEQ or be developed until pyrolysis has been addressed. If pyrolysis could be addressed in-situ, development over existing waste would require extensive design elements to mitigate differential settlement effects, long-term monitoring, and maintenance. Therefore, it is assumed that the most favorable option would be to remove all of the waste in Cell 1. During excavation of the waste in Cell 1, the exposed east face may not have a sufficient factor of safety for support of three existing buildings to the east. Shoring, such as soil nails, would need to be installed as excavation proceeds. Reportedly, there are also approximately 3,600 cy of tires landfilled in Cell 1. Once excavated, Oregon Revised

Statute 459.247 prohibits reburying them on-site They would therefore be disposed of at an approved facility.

Cell 2 lies directly adjacent to the existing pumice mine. The most beneficial reuse for Cell 2 would be full removal of waste as it would provide a transitional grade between the pumice mine and the rest of the site.

Cell 3 waste will most likely remain in place. Development of Area 3 as passive uses, such as sports fields, park, or parking lots, could occur on top of existing waste and relocated Cell 1 and Cell 2 waste without requiring major structural ground reinforcement. Development over existing waste would require long-term maintenance and monitoring activities, as described in detail in Section 5.2.

3.2.1 Removing and Processing Pyrolysis Material

The active pyrolysis area in Cell 1 is estimated to be a 75'-wide strip along the entire pumice face, 1,390 feet, on the east side of Area 1. Based on the GBB report, average pyrolysis depth is estimated at 50 feet. Volume of active pyrolysis material is estimated to be 192,700 cy.

Prior to moving excavation equipment onto Cell 1, ground density monitoring would need to be conducted to test for and avoid sinkholes in active working zones. During excavation, temperature surveying would also be needed to identify pyrolysis areas and ensure worker safety. In addition, a fire suppression system would be needed on-site in case of any flare ups. A potential method evaluated for pyrolysis material removal is isolation of the material in smaller confinements utilizing vertical slurry walls (down to a stable former daily cover soils stratum). Slurry walls would be extended down to the bottom of the waste (or to a former cover soil level) to isolate a portion of the pyrolysis material, limiting the pyrolysis work/control area. Water or slurry could then be injected into the isolated area to stabilize and cool the material prior to excavation.

Pyrolysis material is not suitable for reuse such as backfill or compost. Excavated pyrolysis material will be processed to remove moisture and heat, and then relocated to Area 3 for re-landfilling in an expanded cell.

3.3 Waste Screening

MFA's analysis assumes screening of waste after excavation at a screening rate of 1,200 cy/hour. Material waste was screened as part of the pilot study and was twice run through a shaker screen that broke down much of the large wood material into fines. This resulted in the overwhelming majority of waste material in Cells 1 and 2 being reported as fines in the pilot study. To prevent the breakdown of large wood material, MFA proposes screening waste using a less abrasive method, such as a bar screen. Large wood material separated during the screening process would be relocated to Area 3 and consolidated into a single area. This wood material can then later be removed or repurposed as needed by OSU. Waste streams generated by the screening process and disposal methods for each waste stream are shown in Figure 3 – Cell 1 Remediation Approach and Figure 4 – Cell 2 Remediation Approach included at the end of this report.

3.4 Screened Fines Beneficial Reuse

MFA obtained a sample of screened fines from the pilot study excavation and submitted it for agricultural testing. Agricultural testing results included in Attachment C show the material does not contain enough nutrients to be used for composting. The material may be used as a soil amendment, but the low market value for this material would likely provide little to no-net revenue.

MFA has evaluated a potentially viable option of blending the screened fines with soil sourced on-site (i.e., cover soil and excavated native material) and reusing it as backfill throughout the site. The small batch of screened fines obtained from the pilot study have a high organic content (22%), but could be blended with additional soil to produce a backfill material with an organic content suitable for development (approximately 4%[3]). Based on this limited test, the screened material would require blending with soil at a ratio of 4.5 to 1. At this ratio, there is not enough soil on-site to be able to blend the entire volume of screened fines; however, a different screening method could be developed to reduce the breakdown of the larger wood debris and thereby reduce the screened fines organic content, resulting in a lower soil-to-fines blending requirement. This increases the amount of screened waste that can be used as blended backfill material. The excess screened fines could be used as cell cover soil and topsoil for landscape areas, or relocated to Cell 3. Large wood material separated during the screening process would be relocated to Cell 3 and consolidated into a single area. This wood material can then later be removed or repurposed as needed by OSU.

3.4.1 Materials Management Grant

MFA has assisted Deschutes County, in cooperation with OSU-Cascades, in applying for a materials management grant through DEQ to further explore the opportunity of beneficial re-use of waste at the site. If accepted, the grant would be used to complete a pilot study to test the viability of materials found in the landfill for use as a soil amendment or clean backfill in remediation of the landfill. The study will seek to determine if there is one or more routes to successfully extract, treat, and prepare materials for reuse. Additionally, this study would look into identifying effective methods of screening and sorting waste.

3.5 Relocation of Waste to Expanded Cell 3

Excavated waste could be consolidated on-site to Area 3. Cell 3 sits within a depression and if the cover soil were removed, there would be roughly 450,000 cy of additional airspace capacity. The proposed landfill cell could also be expanded farther beyond the existing waste footprint of Cell 3, but still within the limits of Area 3. Native material could be excavated from this area to create an additional 581,410 cy of storage capacity for waste, and then be used as backfill elsewhere on-site. This would provide a total of 1,031,410 cy of airspace capacity in Area 3, which is enough capacity to facilitate all the waste from Cell 1 and Cell 2 after repurposing a portion of the screened waste for backfill, cover soil, and top soil. Figure 5 – Cell 3 Remediation Approach depicts the options evaluated

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[3] http://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=2676&context=jtrp

Given the arid condition of the area and deep groundwater elevations, a bottom liner and leachate collection system should not be necessary as part of the expansion of the existing landfill cell. MFA discussed this approach with DEQ as the remediation alternatives were refined (see DEQ Notes included as Attachment D).

Maintaining a landfill cell on-site will require LFG monitoring, and long-term maintenance. Limited groundwater monitoring is also anticipated. It could also put some restrictions on future development over the waste footprint. Additional structural and ground improvements may be needed to support structures. Also stormwater facilities should be constructed outside of the waste footprint or otherwise designed to avoid infiltration and leachate generation. Monitoring requirements are discussed further in Section 5.2.

4 REGULATORY REQUIREMENTS

4.1 Regulatory process strategy

MFA has discussed the landfill's history, closure, and regulatory requirements in association with redevelopment with DEQ Solid Waste engineer, Joe Gingerich, P.E. Mr. Gingerich indicated that DEQ envisions all remediation and redevelopment work would be completed under the existing Solid Waste Disposal Site Closure Permit (No. 215). Mr. Gingerich also noted that DEQ would require pyrolysis in Cell 1 to be addressed through excavation or other means. This remediation and redevelopment work could be incorporated into the DEQ's Prospective Purchaser Agreement (PPA) process, if desired by OSU.

The MFA team developed a summary of the closure and post-closure regulatory requirements for the various remediation and reuse strategies. Specific tasks will include the following:

- Identify significant benefits or challenges that may exist for obtaining permits to allow certain activities, such as mining of waste, to reclaim, recycle, or dispose of materials.
- Coordinate with DEQ solid waste and environmental cleanup program staff to identify landfill monitoring, maintenance, and administration requirements that could be streamlined as allowed by the nature of the demolition landfill (primarily woodwaste and demolition/construction debris) or by specific developed features.
- Detail the PPA process, specific to site conditions and identified options. Establish risk-control mechanisms.
- Draft a report that summarizes the local, state, and federal regulations for air quality, water quality, and solid waste and stormwater management that apply to the various remediation and reuse scenarios. The report will contain permitting timelines to show how the processes overlie site-development schedule requirements.
- Deliverables:

  - Notes from meetings with DEQ
  - Regulatory process strategy technical memorandum
  - Requirements for long-term monitoring

4.2 Long-Term Monitoring Requirements

Leaving the waste in place poses some risks, such as differential settlement, methane gas exposure, and the potential of future pyrolysis (if not addressed through remediation). To address these potential risk factors, the following elements would likely be required for buildings constructed over waste:

- A LFG barrier under building slabs (geotextile or liquid membranes).
- LFG venting systems below floor slabs.
- Long-term methane monitoring for internal building and exterior spaces.
- Long-term structural monitoring for differential settlement.
- Subsurface temperature monitoring.
- Long-term groundwater monitoring.

For open spaces where waste is present, the following elements would likely be required:

- LFG extraction and venting systems.
- Long-term LFG perimeter and surface monitoring.
- Long-term site monitoring (inspections, LFG measurements).
- Long-term physical cap and surface maintenance (settlement, vegetation management, etc.).
- Long-term groundwater monitoring.
- Subsurface temperature monitoring.

LFG, pyrolysis, and differential settlement are the primary concerns for short- and long-term development scenarios. Due to the arid climate and deep groundwater, leachate control is not likely a concern for this site.

5 PHASING AND SCHEDULING

MFA has developed a remediation phasing plan to align with projected funding availability. Remediation of the site is anticipated to be complete in three phases, as described below. Each phase could be completed within two years. See Figure 6 – Remediation and Reclamation Phasing for a depiction of the phasing areas.

Phase 1 would include remediation of the southern four acres of Area 1. The remediation would include excavation of approximately 18% of the total waste in Cell 1. All of the excavated waste would be screened, processed to address pyrolysis, and stockpiled. The wood waste and processed pyrolysis material would be re-landfilled in Cell 3 within the existing waste footprint. This phase assumes that all of the documented tires (3,400 cy) would be removed and disposed of off-site. Screened waste would be blended with cover soil from Cell 3 and backfilled into Area 1 to a desired finish grade. This would create approximately four acres of developable land in Area 1. There would be a surplus of waste screenings, approximately 92,400 cy, which could be blended with loose material that exists in the pumice mine and cover soil from Cell 3 to create 508,00 cy (assuming a 4.5:1 mixing ratio as described in section 3.4 above) for placement in the reclamation of the pumice mine. The projected cost for the remediation of this phase is approximately $5.7M (see Attachment E).

Phase 2 would include the remediation of the entirety of Cell 2. Approximately 135,000 cy of waste would be screened to prepare 113,500 cy of it for blending with soil to create suitable backfill for use in the pumice mine; and the remainder would be used for cell cover soil and landscaping topsoil. The wood waste and non-screened waste would be re-landfilled in Cell 3 within the existing waste footprint. In addition to the remediation of Cell 2, this phase also involves the reclamation of the remaining pumice mine. The activities would include the excavation of an additional 370,000 cy beyond the excavation of Cell 2. The phase would also include embankment and compaction of 624,000 cy (containing 113,500 cy of screened waste) to a desired finish grade. This would create approximately 21.6 acres (9.8 in Area 2 and 11.8 in the pumice mine) of unencumbered. The projected cost for the remediation and reclamation of this phase is approximately $11.8M (see Attachment E).

Phase 3 would include remediation of the remaining 19.2 acres of Area 1. The remediation would include excavation of the remaining 82% of the total waste in Cell 1. 160,450 cy of the excavated waste would be screened and stockpiled for beneficial reuse. The wood waste, processed pyrolysis material, and un-screened waste would be placed in Cell 3. Screened waste would be blended with cover soil from Cell 1 and soil from Cell 3 and then backfilled into Area 1 to a desired finish grade. This would create an additional 19.2 acres of developable land in Area 1. The projected cost for the remediation of this phase is approximately $25.6M (see Attachment E).

6 REMEDIATION COSTS

The MFA team utilized results of the initial site analysis to develop remediation costs for the multiple redevelopment scenarios. Using the iterative design process, MFA refined the remediation alternatives in collaboration with the OSU team, incorporating feedback received at design charrettes, and prepared opinion of probable costs for each scenario.

MFA prepared budgetary-level cost estimates for remediation of each cell, which are included in Attachment E. In developing these cost estimates, MFA assumed a 15% contingency to account for design of remediation, monitoring during construction, and reflect unknown conditions (such as adverse weather conditions, material cost variances, or unfavorable market conditions). It is assumed that approximately 3% of all waste is not amenable to processing or on-site relocation and will need to be hauled off-site for disposal in an appropriate landfill. For the purposes of remediation cost estimating, we have assumed that the cost of disposal of the rejected material will be paid for by a party other that OSU.

Costs associated with recycling of metal materials are not included in the cost estimate. It is assumed that material's reuse preparation process and associated sales revenue are net zero items. Due to the low market value, no revenue was assumed for sale of the screened fines as soil amendment material.

A summary of budgetary-level remediation cost estimates is provided below:

Table 4-1
Budget-Level Remediation Cost Estimate

Phase 1	$5.7 M
Phase 2	$11.8 M
Phase 3	$25.6 M
Total	$43.1 M

7 FUNDING STRATEGIES

MFA has collaborated with OSU-Cascades to identify potential grant sources from state and federal agencies, as well as funding through direct state appropriations. Potential grant sources are summarized in the Funding Strategy memorandum included as Attachment F.

8 CONCLUSIONS

Based on the results of the engineering due diligence and remediation scenario development described in this report, MFA has demonstrated that the existing landfill can be repurposed to benefit the community and improve the environmental quality of the encumbered site. MFA evaluated the option of hauling waste off-site to the Knott Landfill, but determined that this alternative generated negative impacts to the local community by significantly increasing truck-traffic (over 101,000 truckloads) over an extended period of time and eliminating the municipal landfill capacity for local waste disposal.

MFA recommends managing waste on-site and utilizing screened material as backfill for the site or adjacent pumice mine. This approach will reduce environmental impacts and consolidate the total waste at the site to a smaller footprint, which minimizes long-term maintenance and monitoring efforts, and also provides more flexible campus development opportunities.

These options are consistent with OSU sustainability objectives and will likely provide research and educational opportunities to the University.

LIMITATIONS

The services undertaken in completing this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

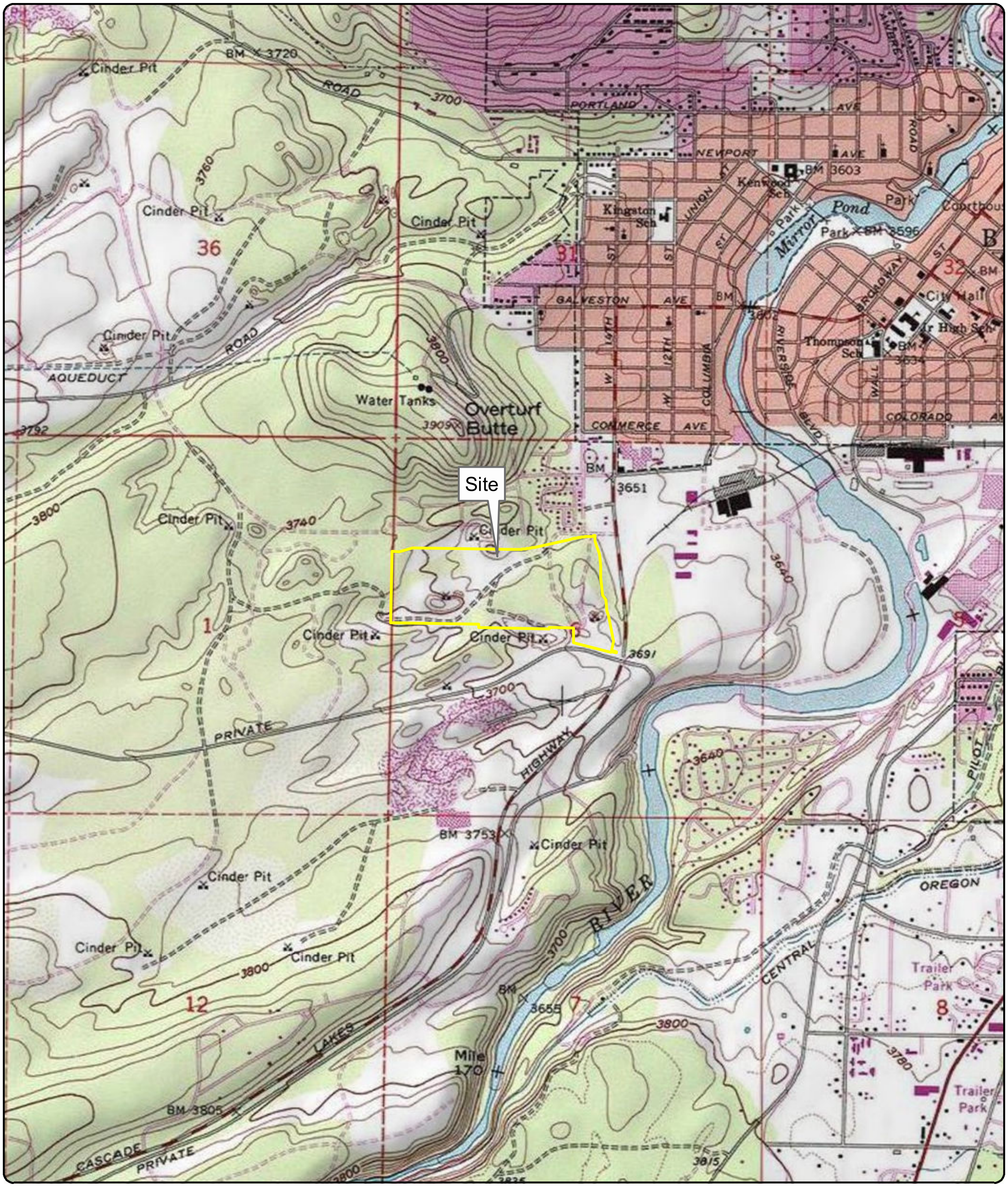
Opinions and recommendations contained in this report apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this report.

REFERENCES

GBB, 2008. Demolition Landfill Subsurface Investigations Study, prepared by Gershman, Brickner, and Bratton, Fairfax, Virginia. October 31, 2008.

Apex, 2016. Draft Pilot Study Report, Deschutes County Construction Demolition Landfill. August, 2016.

FIGURES



Site Address: 1675 Southwest Simpson Ave, Bend Oregon
Source: US Geological Survey (1990) 7.5-minute
topographic quadrangle: Bend
Section 6, Township 18 South, Range 6 East

Figure 1
Site Location

Oregon State University
Cascades Campus
Bend, Oregon

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Project: 0041.18 Produced By: jschane Approved By: cbryan Print Date: 10/31/2016 Path: X:\1290.01 Oregon State University Cascades Campus\Projects\Fig1_Site Location.mxd

FIGURE 2: ESTIMATED WASTE VOLUME AND EXTENT

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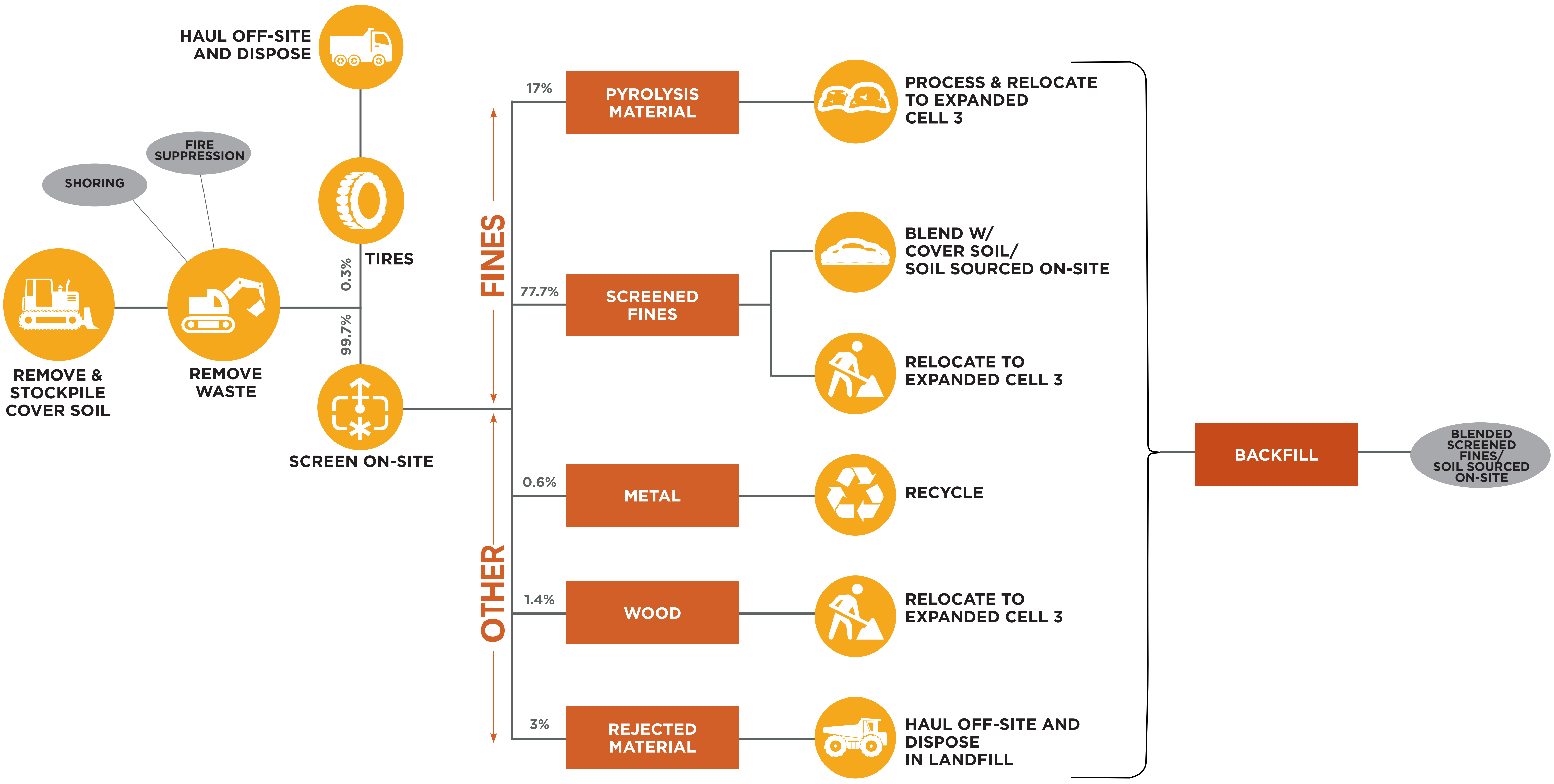

FIGURE 3: CELL 1 - REMEDIATION APPROACH

OREGON STATE UNIVERSITY - CASCADES, BEND, OREGON

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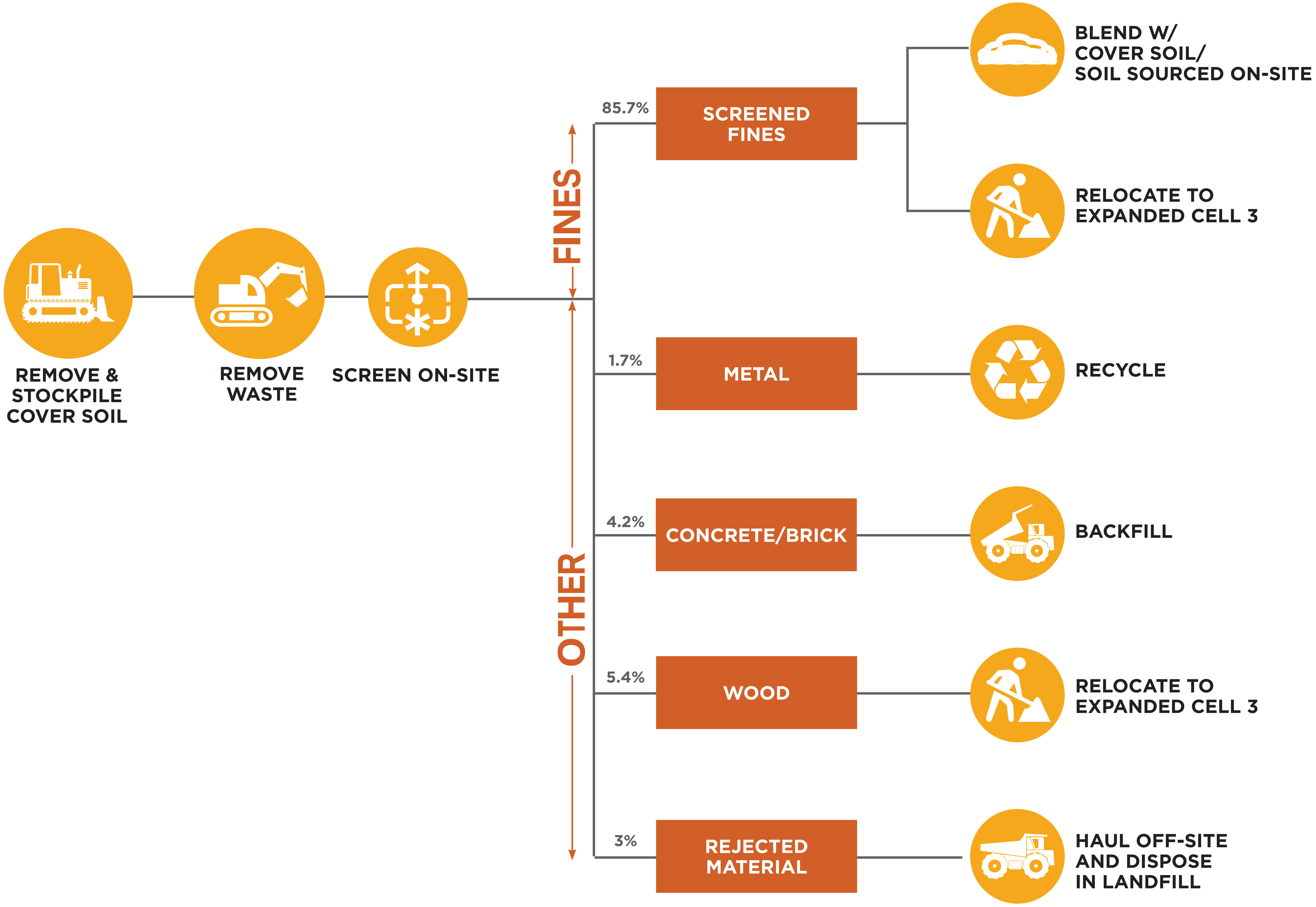

FIGURE 4: CELL 2 - REMEDIATION APPROACH

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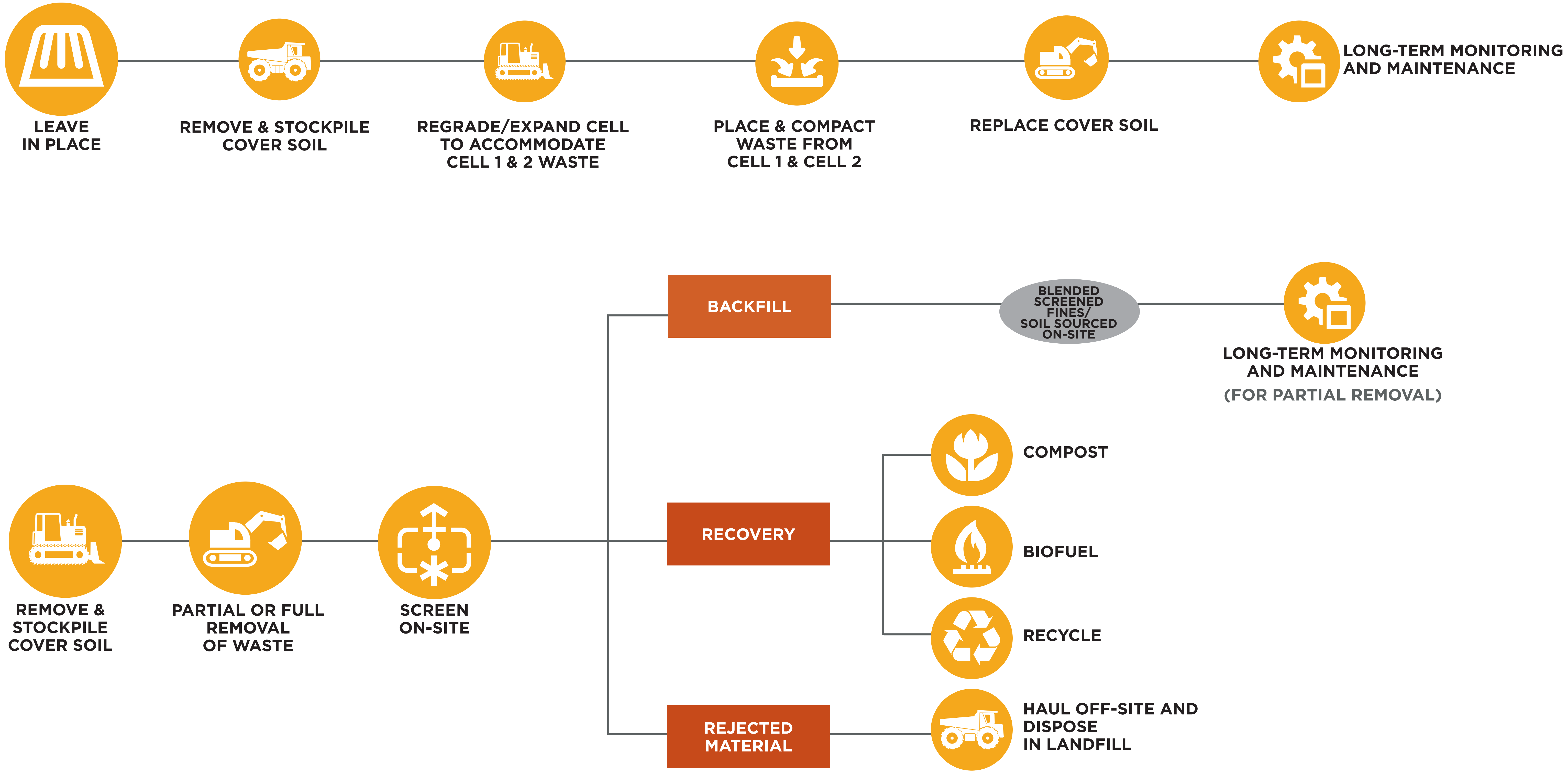

LEAVE IN PLACE

REMOVE & STOCKPILE COVER SOIL

REGRADE/EXPAND CELL TO ACCOMMODATE CELL 1 & 2 WASTE

PLACE & COMPACT WASTE FROM CELL 1 & CELL 2

REPLACE COVER SOIL

LONG-TERM MONITORING AND MAINTENANCE

REMOVE & STOCKPILE COVER SOIL

PARTIAL OR FULL REMOVAL OF WASTE

SCREEN ON-SITE

BACKFILL

BLENDED SCREENED FINES/ SOIL SOURCED ON-SITE

LONG-TERM MONITORING AND MAINTENANCE

(FOR PARTIAL REMOVAL)

RECOVERY

COMPOST

BIOFUEL

RECYCLE

REJECTED MATERIAL

HAUL OFF-SITE AND DISPOSE IN LANDFILL

FIGURE 5: CELL 3 - REMEDIATION APPROACH

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SEE UPDATED PHASING PLAN ON NEXT PAGE

FIGURE 6: REMEDIATION & RECLAMATION PHASING

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REMEDIATION & RECLAMATION PHASING

OREGON STATE UNIVERSITY - CASCADES, BEND, OREGON

DRAFT

FIGURE 7: CONCEPTUAL GRADING SCHEME

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ATTACHMENT A

DATA GAPS SUMMARY AND FOCUSED SITE INVESTIGATION PLAN

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CELEBRATING 20 YEARS 1996-2016

July 20, 2016
Project No. 1290.01.01

Kelly Sparks
Associate VP Finance and Strategic Planning
Oregon State University - Cascades
497 SW Century Drive, Suite 105
Bend, Oregon 97702

Re: Demolition Landfill Reclamation—Data Gaps Summary and Focused Site Investigation Plan

Dear Ms. Sparks:

Oregon State University - Cascades (OSU-C) is conducting due diligence efforts in anticipation of the acquisition of the former Demolition Landfill properties located in Bend, Oregon (the Site) (see Figure 1). The Site is comprised of four tax lots and includes approximately 76 acres of land in Deschutes County (the County). The landfill comprises three cells (Areas 1 through 3) (see Figure 2); various historical environmental investigations have been conducted in all three areas, with the primary focus being Area 1. The framework for characterizing environmental data gaps at the former Demolition Landfill is presented below.

BACKGROUND

The Site is currently an inactive construction- and demolition-waste landfill that was developed at a former pumice surface mine. Area 1, the easternmost landfill cell, was the oldest area where landfilling took place and was filled with a large quantity of woodwaste from local saw mills. Most of the landfill was closed in 1997; however, Area 1 has not been closed because it is undergoing pyrolysis. Subsurface temperature changes, landfill-gas production, and groundwater monitoring are ongoing at the Site. Various environmental investigations have been conducted at the Site and are summarized below.

In 2002, URS Corporation (URS) provided the County with a redevelopment study for the Site. The purpose of the report was to convey site conditions to the County and to identify possible reuse. The report reviewed then-current vegetation, zoning, available utilities in the area, transportation considerations, and nearby water rights, as well as a groundwater beneficial use survey. The report included a property evaluation and identified potential reuse scenarios, such as a golf course (URS, 2002).

In 2008, because there was considerable interest in redeveloping the Site, Gershman, Brickner & Bratton, Inc. (GBB) provided the County a summary of completed site investigations as well as performed additional site assessment activities. The County's goal was to provide as much information as possible about the Site to prospective developers (GBB, 2008). The report also provided a summary of the 1997 David Evans & Associates, Inc. (DEA) subsurface assessment performed for the County.

According to GBB, the primary focus of the 1997 investigation was the assessment of Area 1. Test pits TP1 through TP9, ranging from 3 feet to 21 feet below ground surface (bgs), were advanced. Twenty-eight borings (B1 through B28), ranging from 5.5 feet to 34.5 feet bgs, were advanced, meeting with refusal in some instances. Eight deeper borings were also advanced (B29 through B36). According to GBB, this assessment provided information on waste thickness; however, the exploration pattern was spotty and included only minor analysis of soil and gas (and those data were not available for Maul Foster & Alongi, Inc.'s [MFA's] review). This assessment also identified the issue of pyrolysis associated with the anaerobic decomposition of woodwaste in the landfill.

It appears that subsurface temperature and landfill-gas monitoring locations were established in 1997; however, data from those also were unavailable for review, and it is unknown if those locations still exist.

In 2008, GBB conducted additional subsurface investigation activities to supplement the 1997 investigation and provide more information on the composition of the waste and the potential for impacts to the native material below the landfill. GBB completed full-depth drilling into waste and underlying soils; this included 13 exploratory borings (B37 through B49) and 14 shallow test pits (TP10 through TP23; up to 20 feet bgs), as well as replacement of three landfill-gas wells and three temperature probes originally installed by DEA in 1997.

Test pits were advanced primarily to identify waste composition and materials. Waste consisted primarily of ash, sawdust, metal, tires, woodwaste, roofing materials, and fill/fines. In addition, potential asbestos-containing materials (ACMs) were observed in a few test pits. GBB also performed a subsurface magnetic and electrical resistivity survey to understand waste thicknesses.

Waste and underlying soils from borings were sampled and analyzed for metals, total petroleum hydrocarbons (TPH), volatile organic compounds (VOCs), semivolatile organic compounds, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls, and pesticides/herbicides, in addition to moisture and organic content. The analytical results were screened against Oregon Department of Environmental Quality (DEQ) risk-based criteria (RBCs) established at the time (July 2007); results are as follows:

- Area 1
  - Generally, waste from borings B38 through B41 and MW2 contained TPH, VOCs (specifically benzene and tetrachloroethylene), the PAH benzo(a)pyrene, and metals arsenic and lead above residential RBCs. Benzene concentrations observed in B38 (condensate) were above the residential vapor intrusion RBC.
  - Two native soil samples (B40 and B42) had arsenic above residential RBCs.
- Area 2
  - Waste from B37 had diesel-range TPH above residential RBCs (22,400 parts per million). The report indicated that this result could be due to matrix interference. Soils exhibited elevated PAHs, arsenic, and lead above residential RBCs.
- Area 3
  - Waste from B48 had the VOC trichloroethylene at ten times the residential leaching-to-groundwater RBC. Samples from B45 and B48 had arsenic above residential RBCs.

Some chemicals were identified in some of the waste materials; however, it does not appear that waste constituents have impacted the underlying soils. In addition, the waste material does not appear to be hazardous (GBB, 2008). GBB concluded that the deepest point of waste in the landfill is more than 200 feet above the static groundwater level, and infiltration to the soil below the landfill was not indicated. General flow of groundwater was assumed to be northeast; however, this interpretation was not based on data collected from monitoring wells.

In 2013, completing work for the County (the current site owner), PBS Engineering + Environmental (PBS) advanced three deep borings (ranging from 265 feet to 315 feet bgs), which were completed as monitoring wells (MW-1 through MW-3) in March and April 2013. Groundwater was encountered between 242 and 293 feet bgs at the Site and, based on depth-to-water measurements taken at the time, groundwater flow is interpreted to be east-northeast. Groundwater is located approximately 150 feet below fill waste and is not in contact with landfill materials. Groundwater monitoring was completed in accordance with the DEQ solid waste closure permit number 251. Analytical results show a closure permit exceedance for pH in groundwater from two of the three monitoring wells (MW-2 and MW-3). Arsenic, barium, chromium, vanadium, and zinc were detected in one or more monitoring wells but at concentrations below U.S. Environmental Protection Agency (USEPA) maximum contaminant levels and DEQ guidance levels. Additionally, PBS visually assessed the active pumice mine south adjacent to the Site to interpret the subsurface geology within the uppermost 100 feet. Rock coring was completed (BH-1) at the Site to 260 feet bgs and a site geologic interpretation of the volcanoclastic material was provided (PBS, 2013a).

In October 2013, PBS completed a Phase I environmental site assessment (ESA) for two properties owned by OSU-C that are adjacent south and west of the Site. At the time, these properties were referred to as the Chandler and Robinson properties. The ESA identified no recognized environmental conditions pertaining to the properties but indicated that the adjacent landfill cap extended onto the properties and recommended an investigation to understand if landfill material was present (PBS, 2013c). Based on the recommendation, PBS completed a focused subsurface investigation of two properties located south adjacent to the Site. Test pits advanced along the property boundary to delineate the waste material/native soil boundary confirmed that solid waste material extends approximately 20 feet south from the northern edge of the Chandler property and approximately 340 feet laterally along the boundary. Solid waste was not observed to extend onto the Robinson property (PBS, 2013b).

In 2014, Apex Companies, LLC (Apex) completed a geoenvironmental conditions summary for development of mitigation alternatives for future redevelopment at the Site. Apex identified four primary site redevelopment constraints: areas that contain significant landfill material; areas where low temperature subsurface combustion may occur; requirements of the DEQ solid waste permit pertaining to the Site; and migration/impacts to the surrounding community, including fugitive odors and trucking impacts. Many alternatives and approaches were identified, including avoidance of landfilled areas during redevelopment, and excavation and reconsolidation of landfill materials in other cells at the Site (Apex, 2014).

Refer to Figure 2 for historical sampling locations and features of interest.

DATA GAPS

Based on the above summary of data and review of historical sampling and analysis completed at the Site, MFA has identified the following data gaps:

- Soil gas—historically, soil gas samples have been collected along the perimeter of the Site. Future redevelopment scenarios may involve construction of buildings on top of the Site. Characterizing soil gas from the footprint of the landfill may help inform redevelopment decisions and enhance understanding of exposure pathways and receptor potential.
- Landfill cap—anecdotal evidence suggests that much of the landfill cap material was generated from the Site. The cap material has not been sampled to understand if it has been impacted by metals or other activities at the Site. Sampling the cap material may help inform redevelopment decisions at the Site. Cap thickness is variable at the Site.

- Groundwater—groundwater at the Site was sampled in 2013 from three monitoring wells for parameters identified in the DEQ closure permit. TPH, specifically diesel-range TPH, has been detected in waste material. Groundwater samples from the Site have not been analyzed for TPH. While it is unlikely that TPH impacts have extended to groundwater, no testing to verify the presence or absence of TPH in groundwater has been completed.
- ACMs—potential ACMs were visually observed in refuse at the Site during past investigations. The presence of ACMs in refuse at the Site is likely, and industry standard practice would be to assume that any potential ACMs encountered should be treated as ACMs.

PURPOSE AND OBJECTIVES

The purpose of this focused site characterization is to generate data of sufficient quality to understand impacts in environmental media, to evaluate data relative to appropriate RBCs, and to support site redevelopment. The approach and methods are intended to support the following project objectives:

- Evaluation of potential risk to current and likely future receptors on the Site
- Evaluation of potential cleanup options/engineering controls for impacted media at the Site

The activities outlined in this plan are designed consistent with DEQ guidance concerning Risk-Based Decision Making for the Remediation of Petroleum-Contaminated Sites (DEQ, 2003).

SCOPE OF WORK

MFA proposes sampling of subsurface soil gas and landfill cap material for chemicals of interest. Note that not all data gaps identified are being addressed in this assessment (i.e. groundwater and ACM). In the event that OSU-C moves forward with acquisition, groundwater would likely be addressed as part of a Prospective Purchaser Agreement, and ACM would be addressed during acquisition and/or redevelopment activities.

Proposed sampling locations are shown on Figure 3. Soil-gas sampling locations were chosen based on elevated analytical results for chemicals of interest from previous investigations. Additionally, one boring will be advanced in Area 3 to confirm cap thickness in this area (see Figure 3)[1].

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[1] Historical investigations have logged cap thickness up to 45 feet in this vicinity.

Soil-Gas Sampling

Public and private utility-locating services and other information sources will be used to check for underground utilities before work begins. MFA will coordinate fieldwork to locate possible on-site utilities and piping or other subsurface obstructions.

Soil-gas samples will be collected from temporary boreholes in up to six locations, as shown on the attached Figure 3. The borings will be advanced by Pacific Soil and Water of Tigard, Oregon, with oversight provided by an MFA geologist registered in Oregon or a geologist or engineer working under the supervision of a geologist registered in Oregon.

The soil borings will be advanced using a Geoprobe™ direct-push drilling unit. A "Post Run Tubing" (PRT) system will be used to eliminate problems that may occur with sampling directly through the steel rods. See Figure 4 for sample system configuration. The PRT system uses an adapter and tubing to isolate the landfill-gas sample from the drill rods, thereby eliminating possible leaks of ambient air from the rod joints into the sample. A PRT point holder and expendable point are attached to the leading end of a sampling screen, and the drill rods will be advanced to the desired depth. Sample depths are anticipated to be between 5 and 15 feet, making sure to target material below the existing cap, when possible. The PRT adapter attached to the sample tubing is threaded into the reverse thread fitting in the top of the point holder. The rods will be retracted to release the expendable point, exposing the screen, and creating an opening where landfill gas can enter the PRT. The upper end of the tubing will be connected to the purging/sampling system. A flow controller will be attached to the sample setup to regulate the flow of landfill gas into the sample container. The line will be purged for at least one minute or a period of time sufficient to achieve a purge volume that equals at least three pore volumes, and then the sample will be collected. Helium will be contained in a small tent-like structure that is set up around the sampling apparatus and sampling location, and will serve as a leak-check compound. A helium test will be conducted, using a hand held helium meter, to verify the integrity of the sampling system before the landfill-gas sample is collected for laboratory analysis.

Soil gas samples will be analyzed for the following landfill-gas constituents:

- VOCs by USEPA Method TO-15
- Helium by American Society for Testing and Materials D1946
- Field screening for methane, hydrogen sulfide, helium, and VOCs, using portable meters

Pace Analytical Services, Inc., of Minneapolis, Minnesota, will provide a 6-liter, stainless steel canister (Summa© canister) for each sample. MFA will coordinate with the laboratory to obtain the lowest possible method reporting limits and to screen concentrations against appropriate DEQ RBCs.

Landfill Cap Material Sampling

Cap-material sampling will consist of 30-point composite samples from each landfill area (see Figure 3). The sampling will incorporate the more statistically sound Interstate Technology & Regulatory Council's (ITRC) incremental sampling methodology (ISM) guidance (ITRC, 2012), to obtain consistent and reproducible analytical results. ISM is a structured composite sampling and processing procedure that provides a reasonable, unbiased estimate of mean contaminant concentrations in a targeted area, i.e., decision unit (DU). Within a DU, increments of soil are collected and composited into one sample container. The laboratory then processes the samples according to methods described in the ITRC guidance (ITRC, 2012).

For ISM, DUs are typically determined based on current and previous site uses. The Site historically was used for mining and landfilling; however, because of the site size as well as the use of these data to inform the need for a contaminated-media management plan, the Site was divided into three DUs, one corresponding to each landfill area identified at the Site (see Figure 3). Consistent with ISM methodology, 30 randomly selected soil increments will be collected from the surface to 6 inches bgs in each DU and then composited into one sample, providing one soil sample from each DU (see Figure 3 for approximate ISM soil sample locations[2]). The sample from DU 1 will be collected in triplicate and tested to determine variability in results. Soil will be collected directly from a stainless-steel spoon or trowel and placed in laboratory-provided containers. A minimum of 1 kilogram and no more than 2 kilograms of sample will be collected for each composite sample (approximately 34 to 68 grams per increment). Samples will be located, prepared, handled, and documented as follows:

- Soil-sampling equipment will be decontaminated before it is used for each sample.
- The increments to be sampled, identified in Figure 3, will be programmed into a global positioning system (GPS) device with submeter accuracy.
- Each increment in the DU will be sampled using a stainless steel sampling device. Once the increment location is identified using GPS, the sample will be obtained. New, disposable gloves will be used for the collection of each sample.
- Approximately 34 to 68 grams of soil will be collected per increment. If coarse-grained particles are encountered, an adjacent location may be sampled.

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[2] In the event that a chosen sample location is not accessible (i.e. surface is covered in asphalt), the location will be field-adjusted and surveyed with a handheld GPS device.

- Soil from each DU will be placed in a laboratory-provided, 1-gallon glass jar, using a gloved hand or a decontaminated stainless steel spoon or trowel.
- Coarse-grained particles (larger than 0.25 inch) may be removed before the sample is placed in a laboratory-supplied container.
- Filled containers will be labeled, packed in iced shipping containers with chain-of-custody (COC) documentation, and delivered to the contract laboratory.
- Sampling information will be recorded in a field notebook or on a field sampling data sheet, as well as on the COC form.

Analytical quality control requires collection of one triplicate ISM sample per sampling event. The triplicate ISM sample will be collected from the DU in landfill Area 1.

Apex Laboratories, LLC, of Portland, Oregon, will complete the ISM sample processing and analysis for Resource Conservation and Recovery Act 8 metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver) by USEPA Method 200.7/6010.

MFA will receive the data electronically from the laboratory and the data will be transferred to an EQuIS™ database. The data will be validated consistent with DEQ and USEPA protocols. To document data reliability, a memorandum will be prepared summarizing evaluation procedures, the usability of the data, and deviations from specific field and/or laboratory methods.

REPORTING

A brief letter report, presenting analytical results of the soil gas and soil sampling with a comparison to DEQ RBCs, will be developed to inform redevelopment approaches.

Sincerely,

Maul Foster & Alongi, Inc.

Stacy J Frost

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Attachments: Limitations
References
Figures

cc: John Condon, Tammy Wisco

LIMITATIONS

The services undertaken in completing this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

Opinions and recommendations contained in this report apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this report.

REFERENCES

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FIGURES

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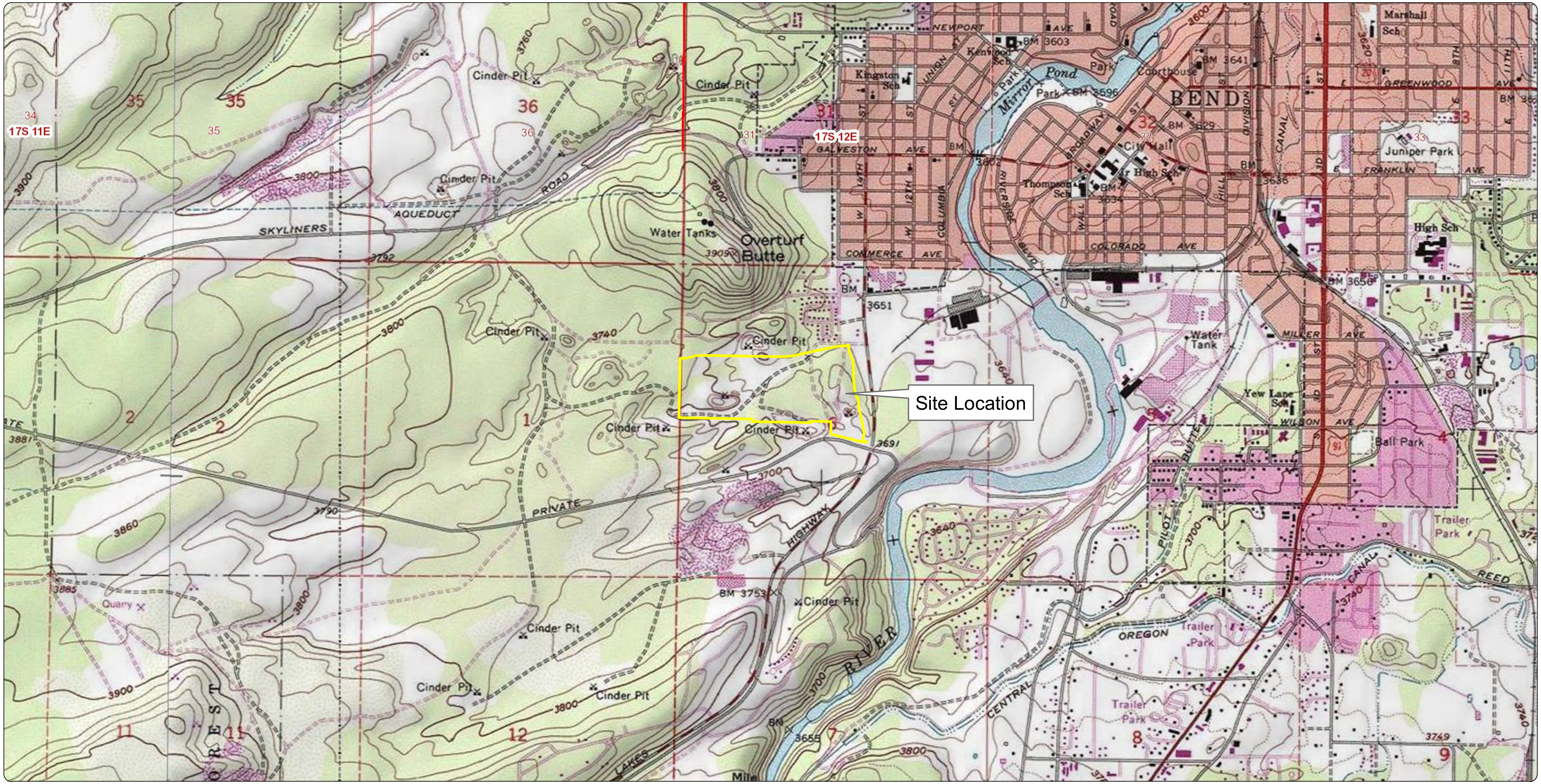
Produced By: estrandhagen Approved By:
Project:



Oregon State University Cascades Campus Bend Oregon
Source: US Geological Survey (1986) 7.5-minute topographic quadrangle: Bend Section 6, Township 18 South, Range 12 East

Legend

🟨 Project Site

Figure 1
Site Overview

Oregon State University Cascades Campus
Bend, Oregon

0 810 1,620
Feet

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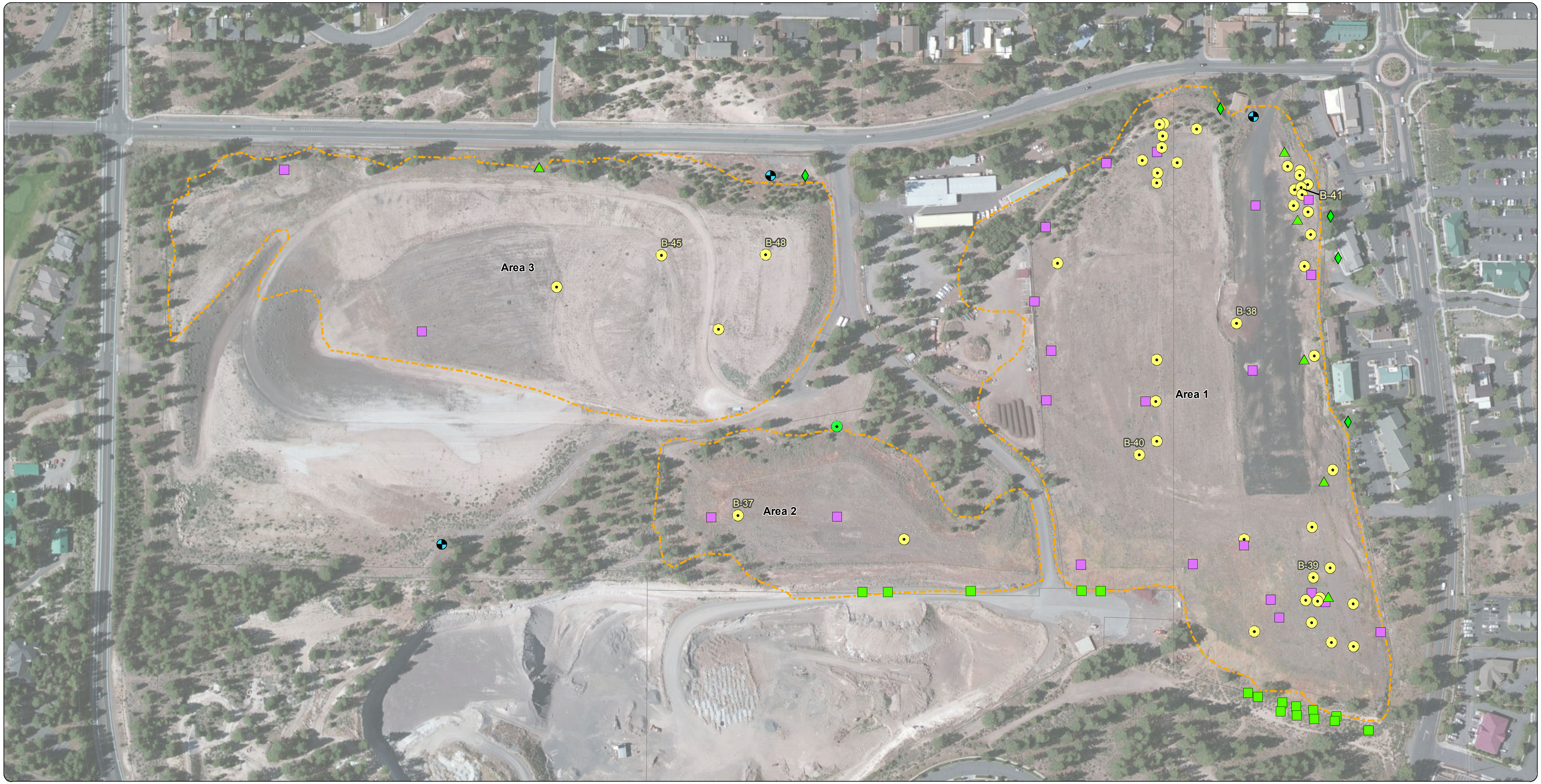

Source: Aerial photograph obtained from Esri ArcGIS Online

Notes:
1. Location labels indicate borings with historical exceedances from 1997/2008 investigations.

Legend

2013 Study
- ● Borehole
- ◆ Gas Probe
- ▲ Temperature Probe
- 🟩 Test Pit

1997/2008 Subsurface Investigation
- ● DEA Boring
- ■ DEA Test Pit

- ● Monitoring Well
- ☐ Landfill Areas
- ☐ Taxlots

Figure 2
Historical Sample Locations

Oregon State University Cascades Campus
Bend, Oregon

0 125 250
Feet

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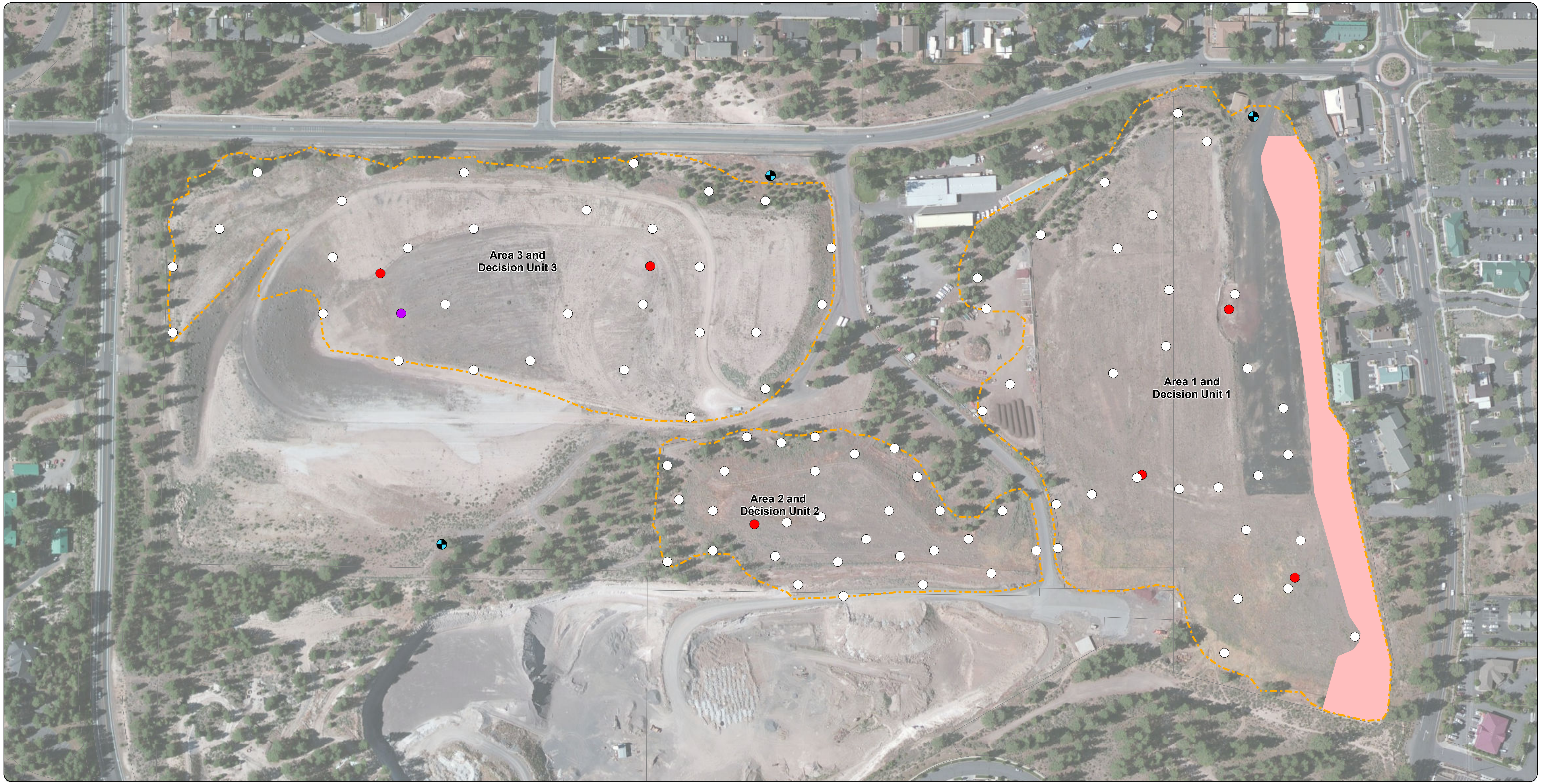

Source: Aerial photograph obtained from Esri ArcGIS Online

Legend

- ○ Proposed ISM Sample Location
- 🔴 Proposed Soil Vapor Sample
- 🟣 Proposed Soil Boring to confirm Cover Thickness
- ⊕ Monitoring Well
- ▭ Landfill Areas
- 🟥 High Hazard Area
- ☐ Taxlots

Figure 3
Proposed Sample Locations
Oregon State University Cascades Campus
Bend, Oregon

0 125 250
Feet

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Produced By: estrandhagen Approved By:
Project:

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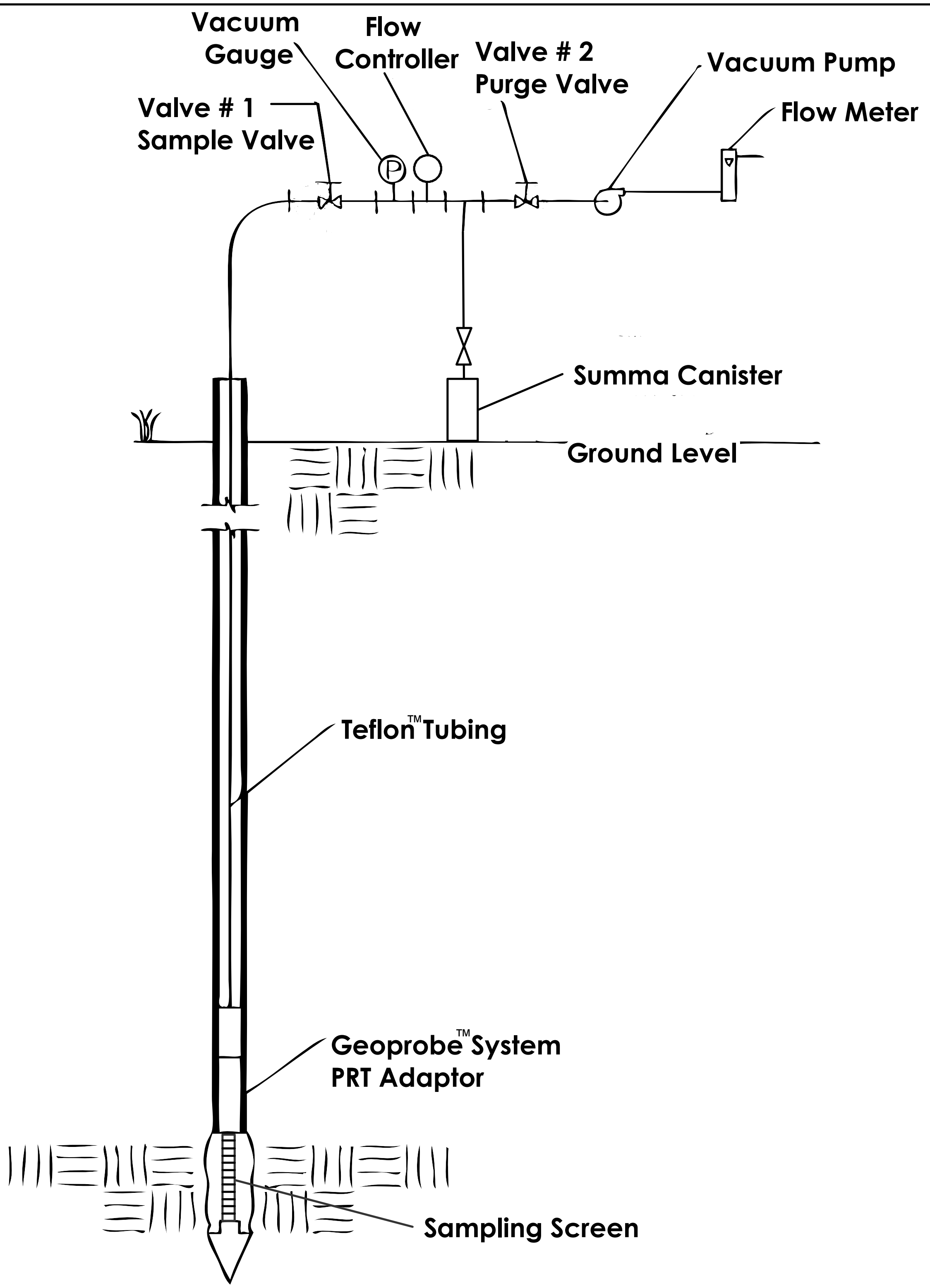
Print Date: 02-17-2010

Approved By: M. Gibson

Produced By: Hines

Project: 8006.31.01/02



Source: CH2MHill, Corvallis Applied Sciences Laboratory

Figure 4
Soil Gas/ Evacuated Sampler System

Oregon State University Cascades Campus
Bend, Oregon

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ATTACHMENT B

FIELD INVESTIGATION SAMPLING RESULTS

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20 CELEBRATING YEARS 1996-2016

November 9, 2016
Project No. 1290.01.01

Kelly Sparks
Associate VP Finance and Strategic Planning
Oregon State University—Cascades
497 SW Century Drive, Suite 105
Bend, Oregon 97702

Re: Demolition Landfill Reclamation—Focused Site Investigation Results

Dear Ms. Sparks:

Oregon State University–Cascades (OSU-C) is conducting due diligence efforts in anticipation of the acquisition of the former Demolition Landfill properties located in Bend, Oregon (the Site) (see Figure 1). The Site is comprised of four tax lots and includes approximately 72.4 acres of land in Deschutes County (the County). The landfill comprises three cells (Areas 1 through 3) (see Figure 2); various historical environmental investigations have been conducted in all three areas, with the primary focus being Area 1. Maul Foster & Alongi, Inc. (MFA) has prepared this letter on behalf of OSU-C describing the results of an investigation which included evaluation of the existing landfill cap material as well as potential landfill gas in soil at the Site. The work has been completed in support of landfill closure and redevelopment activities.

The purpose of the investigation was to assess landfill cap material and whether landfill-related compounds, including methane- and non-methane-related volatile organic compounds (VOCs) are present in soil gas at the Site. The scope of work is described in the investigation work plan (MFA, 2016).

BACKGROUND

The Site is currently an inactive construction- and demolition-waste landfill that was developed at a former pumice surface mine. Area 1, the easternmost landfill cell, was the oldest area where landfilling took place and was filled with a large quantity of wood waste from local saw mills. Most of the landfill was closed in 1997; however, Area 1 has not been closed because it is undergoing pyrolysis (see high hazard area in Figure 2). Subsurface temperature monitoring and groundwater monitoring are ongoing at the Site. Various environmental investigations have been conducted at the Site and a full summary is provided in the work plan (MFA, 2016).

SAMPLING AND ANALYSES

Consistent with the work plan, six borings were advanced to evaluate soil gas and composite surface samples were collected to assess landfill cap material at the Site. In addition, one boring was advanced to assess the thickness of the cap material in an area where historical investigations had shown the greatest thickness. Soil-gas boring locations were chosen based on historical sample locations and lateral distribution across the three identified areas at the Site. Sample locations are presented on Figure 2.

Landfill Cap Evaluation

Surface cap material on the Site was sampled using incremental sampling methodology (ISM). ISM is a structured composite-sampling protocol that reduces data variability and provides a reasonable, unbiased estimate of mean contaminant concentrations in a targeted area (i.e., a decision unit [DU]). Within each DU, increments of soil are collected and composited into one sample for laboratory analysis. Each DU sample was comprised of 30 approximately equal increments collected from sample locations placed randomly over a grid. DU1's composite sample was collected in triplicate to comply with the quality assurance protocol of the sampling method. Incremental soil samples were prepared by collecting multiple increments of soil, typically weighing approximately 20 grams, from a specified sample point within the DU and physically combining these increments into a single composite sample. Soil samples were collected within the top six inches of the soil with a stainless-steel hand trowel, which was decontaminated between DUs.

Figure 2 depicts the Site's three DUs as well as individual ISM sample points. The DUs were selected (in general) based on each DU corresponding with a separate landfilled area. Composite soil samples from each DU were analyzed by Apex Laboratories, LLC of Portland, Oregon for the following constituents:

- Resource Recovery and Conservation Act priority pollutant metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver) by U.S. Environmental Protection Agency (USEPA) Method 6020.

Soil Gas Evaluation

Landfill soil gas samples were collected from six temporary boreholes (soil gas monitoring wells B1 through B6) screened from approximately 5.0 feet to 10.0 feet below ground surface (bgs) (see Figure 2). Boring logs for the soil gas sample points are included as Attachment A. Soils observed in boring B1 through B6 indicate cap-thickness ranges from 0.5 feet to 5.0 feet. Additionally, boring B7 was advanced to confirm cap thickness in Area 3, where past investigations had observed a thicker presence of cap material. Soil observations at boring B7 show a cap thickness of approximately 40 feet in the vicinity of that boring (see Figure 2 and Attachment A).

The borings were advanced by Pacific Soil & Water of Tigard, Oregon with oversight provided by MFA. The soil borings were advanced using a truck-mounted Geoprobe™ 6600 direct-push drilling unit. A "Post Run Tubing" (PRT) system was used to eliminate problems related to sampling directly through the steel rods. The PRT system uses an adapter and tubing to isolate the landfill gas sample from the drill rods, thereby eliminating possible leaks of ambient air from the rod joints into the sample. Boring logs are included as Attachment A. Helium served as a leak-check compound and a helium test was conducted using a hand-held helium meter to verify the integrity of the sampling system before the landfill gas sample was collected. The samples were collected under a helium shroud to detect leaks in the collection system.

Samples were analyzed for the following landfill gas constituents:

- Fixed gases including methane, carbon dioxide, carbon monoxide, nitrogen, and oxygen by USEPA Method 3C, and
- VOCs by USEPA Method TO-15.

Pace Analytical of Minneapolis, Minnesota supplied a 1.5-liter, stainless-steel canister (Summa© canister) for each sample. Samples were also field-screened to evaluate soil gas concentrations during fieldwork. Soil gas was field-screened using a four gas meter (QRAE II), a hydrogen sulfide meter (Jerome 631X), and a photoionization detector (Mini RAE).

MFA received the data electronically from the laboratory and the data was validated consistent with Oregon Department of Environmental Quality (DEQ) and USEPA protocols. The analytical data and laboratory reports are included as Attachment B. A data validation memorandum is included as Attachment C. The data are considered acceptable for their intended use, with the appropriate data qualifiers assigned.

RESULTS

Surface soil composite samples were collected from the three DUs at the Site. Soil analytical data is presented in Table 1. The results show detections of arsenic, barium, cadmium, chromium, lead, and silver in some samples, however at concentrations that are below DEQ risk-based concentrations (RBCs) for residential use as well as within DEQ background concentrations for the Bend region.(see Table 1). Soil cap thickness ranged from approximately 0.5 feet to 5.0 feet thick in borings B1 through B6. Cap thickness in the vicinity of B7 is approximately 40 feet (see Attachment A).

Soil gas was field screened for the presence of landfill gases and VOCs. Table 2 presents field-screening results. Soil gas samples were collected from six locations (B1 through B6) at depths ranging from 5.0 feet bgs and 10.0 feet bgs. Soil gas analytical results are shown in Table 3.

Methane was not detected in soil gas collected from borings B3 and B6. Methane concentrations in the remaining four borings ranged from 1.2 percent (B2) to 10.8 percent (B5) (see Table 3). DEQ guidance requires concentrations above 1.25 percent methane in confined spaces or structures to be remediated and methane mitigation will be needed during redevelopment at the Site. VOCs were detected in all samples; however only two VOCs, ethylbenzene and naphthalene, were detected at concentrations exceeding their respective DEQ RBCs for urban residential vapor intrusion into buildings (in borings B1, B2, B4, and B5; see Table 3). VOC concentrations in B3 and B6 were below DEQ RBCs.

Based on this evaluation, in the event the Site is redeveloped, the potential for vapor intrusion and methane migration will have to be considered and mitigation potentially incorporated into the redevelopment plan.

Sincerely,

Maul Foster & Alongi, Inc.

Stacy J Frost

Kyle K. Roslund, RG
Project Geologist

Stacy Frost, PE
Senior Engineer

Attachments: Limitations
References
Tables
Figures
Attachment A—Boring Logs
Attachment B—Laboratory Analytical Results
Attachment C—Data Validation Memorandum

LIMITATIONS

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REFERENCES

MFA, 2016. Demolition landfill reclamation—data gaps summary and focused site investigation plan. Letter to K. Sparks, OSU from MFA. July 20.

TABLES

Table 1
Soil Analytical Results
OSU Cascades Campus
Demolition Landfill Site
Bend, Oregon

Location					DU1	DU2	DU3	DU3	DU3	DU1	DU2	DU3	DU3	DU3
Sample Date					07/29/2016	07/29/2016	07/29/2016	07/29/2016	07/29/2016	07/29/2016	07/29/2016	07/29/2016	07/29/2016	07/29/2016
Sample Name					DU1-SO-ISM AFTER PROCESSING	DU2-SO-ISM AFTER PROCESSING	DU3A-SO-ISM AFTER PROCESSING	DU3B-SO-ISM AFTER PROCESSING	DU3C-SO-ISM AFTER PROCESSING	DU1-SO-ISM AS RECEIVED	DU2-SO-ISM AS RECEIVED	DU3A-SO-ISM AS RECEIVED	DU3B-SO-ISM AS RECEIVED	DU3C-SO-ISM AS RECEIVED
	DEQ Oregon Background Metals, High Lava Plains	DEQ RBC, Soil Direct Contact Urban Residential	DEQ RBC, Soil Direct Contact Construction Worker	DEQ RBC, Soil Direct Contact Occupational										
Total Metals (mg/kg)														
Arsenic	7.2	1	15	1.9	**0.759**	0.953 U	0.825 U	0.842 U	0.899 U	--	--	--	--	--
Barium	790	31000	69000	220000	**89.9**	**61.1**	**30.4**	**32.3**	**29.9**	--	--	--	--	--
Cadmium	0.78	160	350	1100	**0.186**	0.191 U	0.165 U	0.168 U	0.18 U	--	--	--	--	--
Chromium	140	NV	NV	NV	**5.91**	**4.46**	**1.44**	**1.41**	**1.27**	--	--	--	--	--
Lead	21	400	800	800	**6.39**	**2.88**	**1.54**	**1.74**	**1.51**	--	--	--	--	--
Mercury	0.060	47	110	350	0.119 U	0.0762 U	0.066 U	0.0674 U	0.0719 U	0.0617 U	0.0702 U	0.0748 U	0.074 U	0.0727 U
Selenium	0.54	NV	NV	NV	0.744 U	1.91 U	1.65 U	1.68 U	1.8 U	--	--	--	--	--
Silver	0.68	780	1800	5800	**0.484**	0.191 U	0.165 U	0.168 U	0.18 U	--	--	--	--	--

NOTES:

Result values in **bold** font indicate a detection. Results not evaluated against background concentrations.

Shaded results indicate DEQ RBC exceedance.

-- = not analyzed

DEQ = Oregon Department of Environmental Quality.

J = Result is an estimated value.

mg/kg = milligrams per kilogram.

NV = no value.

RBC = Risk-Based Concentration for Individual Chemicals (DEQ November 1, 2015).

U = Result not detected at or above method reporting limit.

Table 2
Soil Vapor Field Screening Results
Demolition Landfill
Bend, Oregon

Analyte	Field Screening Results											
Sample Location:	B1	B1-SV-5.0	B2	B2-SV-10.0	B3	B3-SV-5.0	B4	B4-SV-10.0	B5	B5-SV-10.0	B6	B6-SV-10.0
Sample Date:	07/28/2016	07/28/2016	07/28/2016	07/28/2016	07/28/2016	07/28/2016	07/28/2016	07/28/2016	07/28/2016	07/28/2016	07/29/2016	07/29/2016
Collection Method:	Boring Downhole	Tedlar Bag Purge	Boring Downhole	Tedlar Bag Purge	Boring Downhole	Tedlar Bag Purge	Boring Downhole	Tedlar Bag Purge	Boring Downhole	Tedlar Bag Purge	Boring Downhole	Tedlar Bag Purge
Collection Depth (ft bgs):	15	5	10	10	6	5	10	10	15	10	46	10
CO (ppm)	23	0	22	0	0	5	5	10	0	0	11	8
H_2S (ppm)	0	0	0	20.1	0	0	3.6	41.1	73	22.2	0	0
LEL (%)	44	54	0	20	0	0	107	97	115	106	42	0
Oxygen (O_2 % by volume)	12.1	7.4	17.7	4.1	14	9.7	9.2	5.4	0	1.1	1.7	13.8
PID (volumetric ppm)	0	4.2	0	3	11.5	5	31.5	9.7	5.8	1.7	6.9	1.9

NOTES:

CO = carbon monoxide.

ft bgs = feet below ground surface.

H2S = hydrogen sulfide.

LEL = lower explosive limit.

PID = photoionization detector.

ppm = parts per million.

Table 3
Soil Gas Analytical Results
OSU Cascades Campus
Demolition Landfill Site
Bend, Oregon

		Location Sample Date Sample Name	B1 07/28/2016 B1-SV-5.0	B2 07/28/2016 B2-SV-10.0	B3 07/28/2016 B3-SV-5.0	B4 07/28/2016 B4-SV-10.0	B5 07/28/2016 B5-SV-10.0	B6 07/29/2016 B6-SV-10.0
	DEQ RBC, Soil Gas Vapor Intrusion into Buildings Occupational	DEQ RBC, Soil Gas Vapor Intrusion into Buildings, Urban Residential						
Fixed Gases (%)								
Carbon Dioxide	NV	NV	**29.9**	**27.2**	**25.7**	**27.6**	**31.5**	**9.3**
Carbon Monoxide	NV	NV	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
Methane	NV	NV	**5.3**	**1.2 J**	0.73 U	**7.9**	**10.8**	0.73 U
Nitrogen	NV	NV	**64.9**	**71.2**	**73.9**	**64.5**	**57.7**	**76.9**
Oxygen	NV	NV	0.29 U	**0.42 J**	0.29 U	0.29 U	0.29 U	**13.8**
Volatile Organic Compounds (ug/m^3)								
1,1,1-Trichloroethane	21900000	1000000	0.47 U	0.45 U	**3.4**	0.52 U	0.47 U	0.45 U
1,1,2,2-Tetrachloroethane	NV	NV	0.63 U	0.6 U	0.63 U	**151**	0.63 U	0.6 U
1,1,2-Trichloroethane	770	42	0.47 U	0.45 U	0.47 U	0.52 U	0.47 U	0.45 U
1,1-Dichloroethane	7700	830	0.3 U	**8.5**	**27.4**	**24.6**	**2.6**	0.29 U
1,1-Dichloroethene	880000	42000	0.46 U	**3.7**	0.46 U	**12.3**	0.46 U	0.44 U
1,2,4-Trichlorobenzene	NV	NV	1.7 U	1.7 U	1.7 U	1.9 U	1.7 U	1.7 U
1,2,4-Trimethylbenzene	31000	1500	**165**	**67.2**	0.24 U	**831**	**0.24 U**	**6.8**
1,2-Dibromoethane	20	2.2	1.5 U	1.4 U	1.5 U	1.6 U	1.5 U	1.4 U
1,2-Dichlorobenzene	880000	42000	0.98 U	0.94 U	0.98 U	1.1 U	**323**	0.94 U
1,2-Dichloroethane	470	51	0.39 U	0.38 U	0.39 U	**2.9**	0.39 U	0.38 U
1,2-Dichloropropane	NV	NV	0.52 U	0.49 U	0.52 U	0.57 U	0.52 U	0.49 U

Table 3
Soil Gas Analytical Results
OSU Cascades Campus
Demolition Landfill Site
Bend, Oregon

		Location	B1	B2	B3	B4	B5	B6
		Sample Date	07/28/2016	07/28/2016	07/28/2016	07/28/2016	07/28/2016	07/29/2016
		Sample Name	B1-SV-5.0	B2-SV-10.0	B3-SV-5.0	B4-SV-10.0	B5-SV-10.0	B6-SV-10.0
	DEQ RBC, Soil Gas Vapor Intrusion into Buildings Occupational	DEQ RBC, Soil Gas Vapor Intrusion into Buildings, Urban Residential						
1,3,5-Trimethylbenzene	NV	NV	**151**	**63.2**	**21.2**	**276**	**14.4**	**1.9**
1,3-Butadiene	NV	NV	0.34 U	0.32 U	0.34 U	0.37 U	0.34 U	0.32 U
1,3-Dichlorobenzene	NV	NV	**16.1**	**13.1**	**60.6**	**25.8**	**47.7**	**4.3**
1,4-Dichlorobenzene	1100	120	**45.7**	0.91 U	0.96 U	1.1 U	**27.3**	0.91 U
2-Butanone	NV	NV	**80**	**7**	**20.9**	**188**	0.44 U	**7.1**
2-Hexanone	NV	NV	0.79 U	0.75 U	0.79 U	**31.4**	0.79 U	**1.2 J**
2-Propanol	NV	NV	0.46 U	0.44 U	**30.4**	**427**	**20.8**	**2.1 J**
4-Ethyltoluene	NV	NV	7.2 U	**57.3**	0.36 U	**164**	**20.8**	**1.7 J**
4-Methyl-2-pentanone	NV	NV	0.42 U	**3.3 J**	0.42 U	**370**	0.42 U	**1.3 J**
Acetone	NV	NV	**342**	**22.2**	**111**	**1220**	**32.2**	**49.3**
Benzene	1600	170	**35.7**	**27.4**	**43.1**	**34.8**	**31**	**2.1**
Benzyl Chloride	NV	NV	0.32 U	0.3 U	0.32 U	0.35 U	0.32 U	0.3 U
Bromodichloromethane	330	36	0.37 U	0.36 U	0.37 U	0.41 U	0.37 U	0.36 U
Bromoform	11000	1200	1.7 U	1.6 U	1.7 U	1.9 U	1.7 U	1.6 U
Bromomethane	22000	1000	0.6 U	0.57 U	0.6 U	0.66 U	0.6 U	0.57 U
Carbon disulfide	NV	NV	**8.1**	**44.8**	**0.19 U**	**49.3**	**19.1**	**11**
Carbon tetrachloride	2000	220	0.37 U	0.35 U	0.37 U	0.41 U	0.37 U	0.35 U
Chlorobenzene	220000	10000	0.26 U	0.25 U	0.26 U	**15.6**	**9.6**	0.25 U

Table 3
Soil Gas Analytical Results
OSU Cascades Campus
Demolition Landfill Site
Bend, Oregon

		Location	B1	B2	B3	B4	B5	B6
		Sample Date	07/28/2016	07/28/2016	07/28/2016	07/28/2016	07/28/2016	07/29/2016
		Sample Name	B1-SV-5.0	B2-SV-10.0	B3-SV-5.0	B4-SV-10.0	B5-SV-10.0	B6-SV-10.0
	DEQ RBC, Soil Gas Vapor Intrusion into Buildings Occupational	DEQ RBC, Soil Gas Vapor Intrusion into Buildings, Urban Residential						
Chloroethane	43800000	2100000	0.37 U	**35.2**	**17.3**	**31.5**	0.37 U	0.36 U
Chloroform	530	58	0.36 U	0.35 U	0.36 U	0.4 U	0.36 U	0.35 U
Chloromethane	390000	19000	0.21 U	0.2 U	0.21 U	0.23 U	0.21 U	0.2 U
cis-1,2-Dichloroethene	NV	NV	**17.4**	**4.4**	0.47 U	**121**	**24.8**	0.45 U
cis-1,3-Dichloropropene	NV	NV	0.71 U	0.68 U	0.71 U	0.78 U	0.71 U	0.68 U
Cyclohexane	NV	NV	**21**	**14.5**	**111**	**87.1**	**511**	**3.5**
Dibromochloromethane	450	49	1.6 U	1.6 U	1.6 U	1.8 U	1.6 U	1.6 U
Dichlorodifluoromethane	NV	NV	0.92 U	**31.3**	**10**	**831**	0.92 U	**3.3**
Ethyl Acetate	NV	NV	**3**	0.64 U	0.67 U	**4.8**	0.67 U	**1.4**
Ethanol	NV	NV	0.51 U	0.48 U	0.51 U	0.56 U	0.51 U	0.48 U
Ethylbenzene	4900	530	**1050**	**566**	**21.6**	**518**	**109**	**3.5**
Freon 113	131400000	6300000	0.58 U	0.55 U	**5.2**	0.64 U	0.58 U	0.55 U
Freon 114	NV	NV	0.6 U	0.57 U	0.6 U	0.66 U	0.6 U	0.57 U
Tetrahydrofuran	NV	NV	0.23 U	0.22 U	0.23 U	0.25 U	0.23 U	0.22 U
Heptane	NV	NV	**306**	**268**	**37.3**	**729**	**490**	**1.6**
Hexachlorobutadiene	NV	NV	1.2 U	1.2 U	1.2 U	1.4 U	1.2 U	1.2 U
Methyl tert-butyl ether	47000	5100	0.58 U	0.55 U	0.58 U	**1.6 J**	0.58 U	0.55 U
Methylene chloride	1200000	37000	**9**	**10**	**8.7**	**67.4**	1 U	**232**

Table 3
Soil Gas Analytical Results
OSU Cascades Campus
Demolition Landfill Site
Bend, Oregon

		Location	B1	B2	B3	B4	B5	B6
		Sample Date	07/28/2016	07/28/2016	07/28/2016	07/28/2016	07/28/2016	07/29/2016
		Sample Name	B1-SV-5.0	B2-SV-10.0	B3-SV-5.0	B4-SV-10.0	B5-SV-10.0	B6-SV-10.0
	DEQ RBC, Soil Gas Vapor Intrusion into Buildings Occupational	DEQ RBC, Soil Gas Vapor Intrusion into Buildings, Urban Residential						
Naphthalene	360	39	**22**	**43.8**	**30.4**	**42.5**	**63.8**	**11**
n-Hexane	NV	NV	**67.7**	**33.9**	**87**	**88.3**	**413**	**21.5**
o-Xylene	NV	NV	**417**	**55.6**	**5.5**	**424**	**31.2**	**4.2**
Propylene	NV	NV	0.26 U	**88.7**	0.26 U	**747**	0.26 U	**55**
Styrene	4400000	210000	0.37 U	**2.1**	**3**	0.41 U	0.37 U	**1.4 J**
Tetrachloroethene	47000	5100	**10.1**	**12.1**	0.53 U	**264**	**3.9**	0.51 U
Toluene	21900000	1000000	**416**	**64**	**57.5**	**815**	**63.8**	**14.2**
trans-1,2-Dichloroethene	NV	NV	0.74 U	0.7 U	0.74 U	0.81 U	0.74 U	0.7 U
trans-1,3-Dichloropropene	NV	NV	0.5 U	0.48 U	0.5 U	0.55 U	0.5 U	0.48 U
Trichloroethene	2900	200	**7.1**	**6.6**	0.53 U	**141**	**1.8**	0.51 U
Trichlorofluoromethane	3100000	150000	0.25 U	**277**	0.25 U	0.28 U	**8.4**	**9**
Vinyl Acetate	NV	NV	0.63 U	**5.5**	0.63 U	0.7 U	0.63 U	0.6 U
Vinyl Chloride	2800	41	0.37 U	0.36 U	0.37 U	0.41 U	0.37 U	0.36 U
Xylene, m-,p-	NV	NV	**1250**	**121**	**9.6**	**1170**	**35.8**	**10.4**
Xylenes, total[a]	440000	21000	**1667**	**176.6**	**15.1**	**1594**	**67**	**14.6**

Table 3
Soil Gas Analytical Results
OSU Cascades Campus
Demolition Landfill Site
Bend, Oregon

NOTES:

Result values in **bold** font indicate a detection.

Shaded results indicate DEQ RBC exceedance.

DEQ = Oregon Department of Environmental Quality.

J = Result is an estimated value.

ug/m^3 = micrograms per cubic meter.

NV = no value.

RBC = Risk-Based Concentration for Individual Chemicals (DEQ, November 1, 2015).

U = Result not detected at or above method detection limit.

[a] Sum of m,p- and o-xylenes.

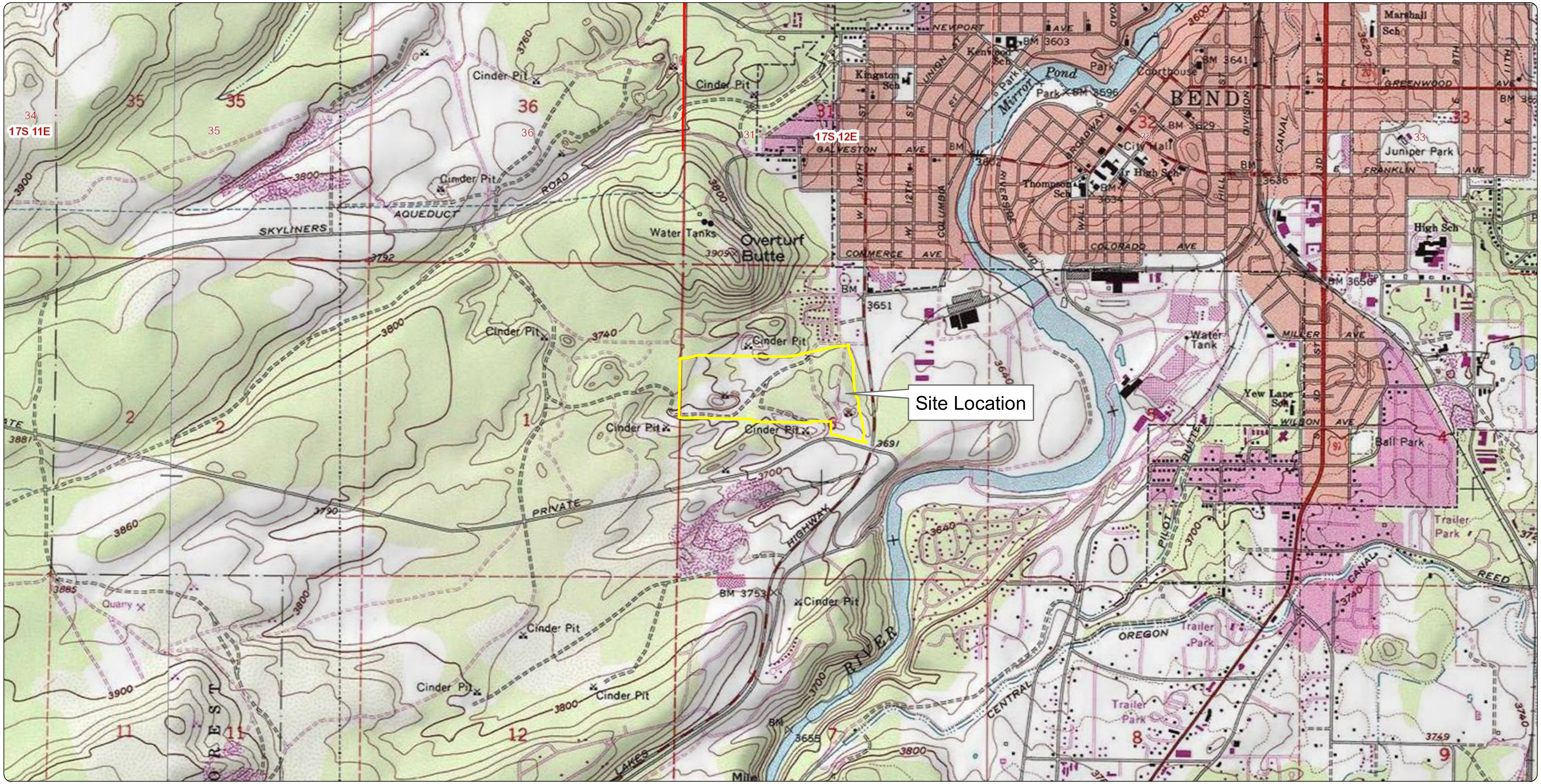
FIGURES

Path: X:\1290.01 Oregon State University Cascades Campus\Projects\OSU_Cascade_site_overview.mxd

Print Date: 7/15/2016

Produced By: estrandhagen Approved By:

Project:



Oregon State University Cascades Campus Bend Oregon
Source: US Geological Survey (1986) 7.5-minute topographic
quadrangle: Bend Section 6, Township 18 South, Range 12 East

Legend

🟨 Project Site

Figure 1
Site Overview

Oregon State University Cascades Campus
Bend, Oregon

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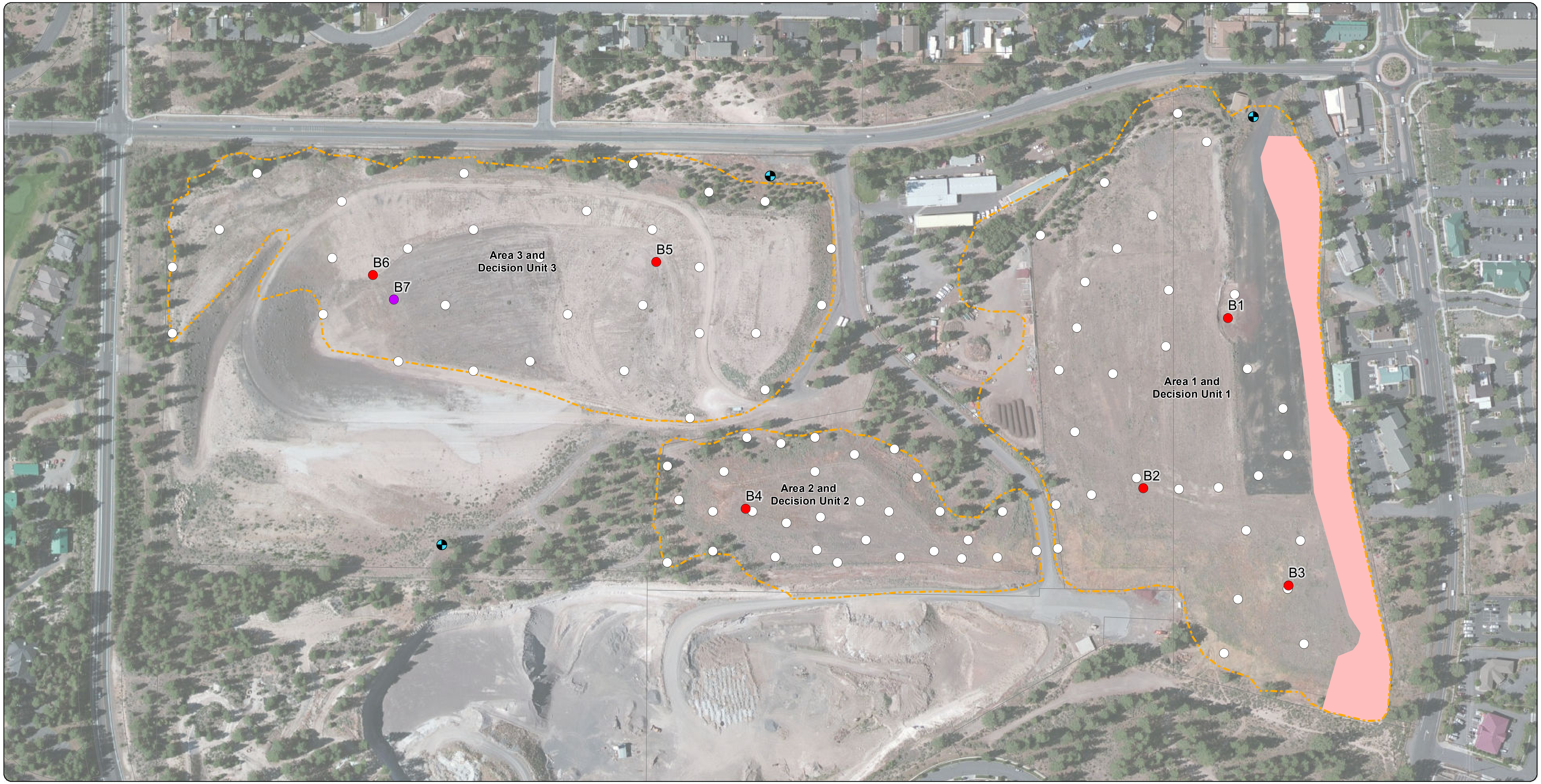
0 810 1,620
Feet



Source: Aerial photograph obtained from Esri ArcGIS Online

Legend

○ ISM Sample Location	⊕ Monitoring Well
● Soil Vapor Sample	▭ Landfill Areas
● Soil Boring to Confirm Cover Thickness	🟥 High Hazard Area
	▭ Tax Lot

0 125 250
Feet

Figure 2
Investigation Locations

Oregon State University Cascades Campus
Bend, Oregon

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Path: X:\1290.01 Oregon State University Cascades Campus\Projects\Fig3_Sample Locations.mxd
Print Date: 8/3/2016
Approved By: E. Hess
Produced By: apadilla
Project: 1290.01.01-02

ATTACHMENT A

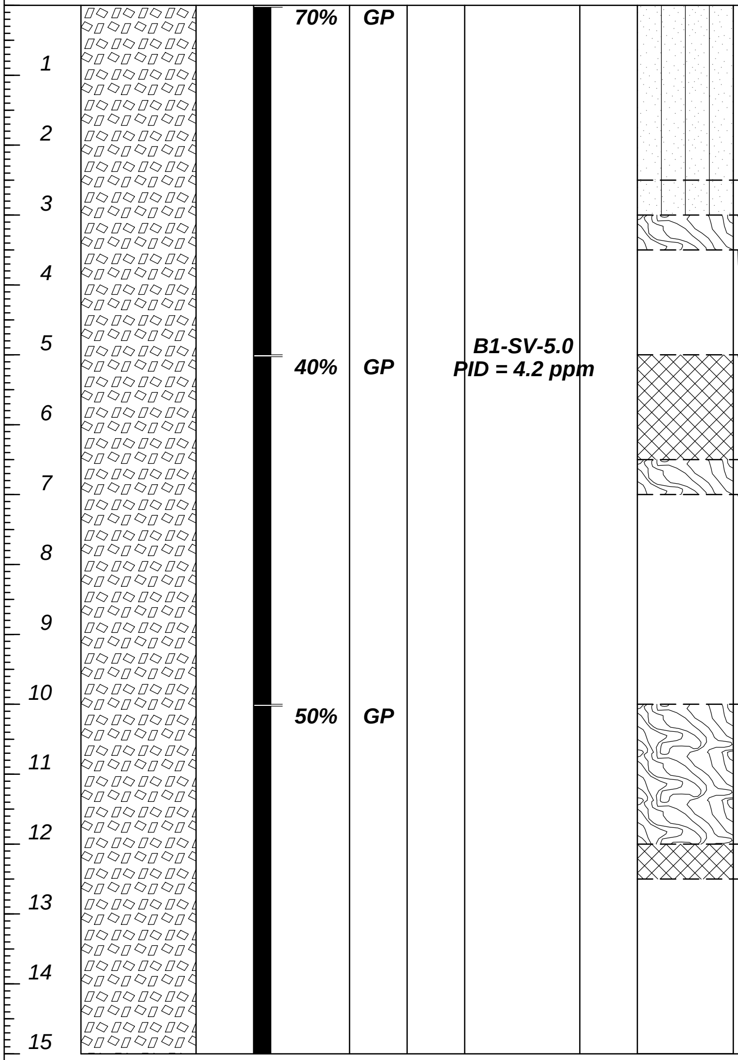
BORING LOGS

Maul Foster & Alongi, Inc.

Geologic Borehole Log/Well Construction

Project Number	Well Number	Sheet
1290.01.01	**B1**	**1 of 1**

Project Name	**Demolition Landfill**	TOC Elevation (feet)	
Project Location	**Bend, Oregon**	Surface Elevation (feet)	
Start/End Date	**7/28/16 to 7/28/16**	Northing	
Driller/Equipment	**Pacific Soil and Water - Marcus Johnson, James Melton/GP 6600**	Easting	
Geologist/Engineer	**Emily Hess**	Hole Depth	**15.0-feet**
Sample Method	**Direct Push**	Outer Hole Diam	**2.25-inch**



Depth (feet, BGS)	Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"
0		**70%**	**GP**			
5		**40%**	**GP**		**B1-SV-5.0 PID = 4.2 ppm**	
10		**50%**	**GP**			

Soil Description

0.0 to 2.5 feet: SILTY SAND (SM); grayish brown; 20% fines; 70% sand, fine to coarse; 10% gravel, up to 3 centimeters in diameter; friable; loose; moist.

@ 0.5 to 2.5 feet: Dense.
@ 1.8 feet: Rootlet.

2.5 to 3.0 feet: SILTY SAND (SM); black; 20% fines; 70% sand; 10% gravel; abundant organics; moist.

3.0 to 3.5 feet: WOODY DEBRIS; light brown; 100% organics; moist.
@ 3.5 feet: 0.1-foot-thick piece of concrete. Material in shoe was dark brown silt with sand with wood; petroleum hydrocarbon-like odor.

3.5 to 5.0 feet: No recovery.

5.0 to 6.5 feet: SAWDUST; light yellow; moist.

6.5 to 7.0 feet: WOODY DEBRIS; dark brown; 10% fines; 10% gravel; 80% organics; moist.

7.0 to 10.0 feet: No recovery.

10.0 to 12.0 feet: WOODY DEBRIS; dark brown and gray to black; 20% fines; 10% sand; 10% gravel; 60% organics; chemcial-like odor; moist.

12.0 to 12.5 feet: SAWDUST; moist.

12.5 to 15.0 feet: No recovery.

Total Depth = 15.0 feet below ground surface.

<u>Borehole Completion Details:</u>
0.0 to 15.0 feet bgs: 2.25-inch borehole.
0.0 to 15.0 feet bgs: Bentonite chips hydrated with potable water.

NOTES: 1. bgs = below ground surface. 2. GP = Geoprobe macro-core sampler. 3. Depths are relative to feet bgs. 4. ppm = parts per million. 5. PID = photoionization detector, soil head space reading in ppm. 6. SV = soil vapor sample collected using post run tubing.

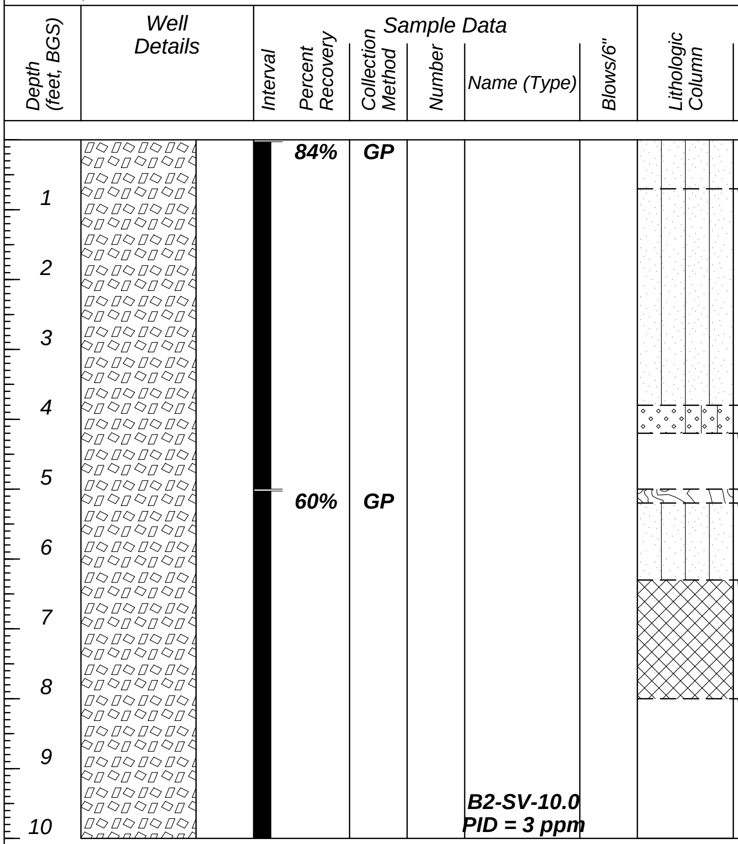
Maul Foster & Alongi, Inc.

Geologic Borehole Log/Well Construction

Project Number	Well Number	Sheet
1290.01.01	**B2**	**1 of 1**

Project Name **Demolition Landfill**
Project Location **Bend, Oregon**
Start/End Date **7/28/16 to 7/28/16**
Driller/Equipment **Pacific Soil and Water - Marcus Johnson, James Melton/GP 6600**
Geologist/Engineer **Emily Hess**
Sample Method **Direct Push**

TOC Elevation (feet)
Surface Elevation (feet)
Northing
Easting
Hole Depth **10.0-feet**
Outer Hole Diam **2.25-inch**



Soil Description

0.0 to 0.7 feet: SILTY SAND (SM); light grayish brown; 30% fines; 60% sand, fine to coarse; 10% gravel; friable; loose; trace rootlets; dry.

0.7 to 3.8 feet: SILTY SAND (SM); reddish brown; 30% fines; 60% sand, fine to coarse; 10% gravel; friable; dense; moist.

3.8 to 4.2 feet: SAND WITH SILT AND GRAVEL (SW-SM); dark brown; 10% fines; 70% sand, fine to coarse; 10% gravel; 10% organics; moist.

4.2 to 5.0 feet: No recovery.

5.0 to 5.2 feet: WOODY DEBRIS; dark brown; moist.

5.2 to 6.3 feet: SILTY SAND (SM); light brown; 40% fines; 50% sand; 10% gravel; trace woody debris; moist.

@ 5.9 to 6.1 feet: Brick.

@ 6.0 feet: Color change to dark brown.

6.3 to 8.0 feet: ORGANICS WITH SAND; dark brown to black; 10% fines; 20% sand; 10% gravel; 60% organics; petroleum hydrocarbon-like odor; moist.

@ 7.4 to 8.0 feet: Blue carpet with sewage-like odor.

8.0 to 10.0 feet: No recovery.

Total Depth = 10.0 feet below ground surface.

Borehole Completion Details:
0.0 to 10.0 feet bgs: 2.25-inch borehole.
0.0 to 10.0 feet bgs: Bentonite chips hydrated with potable water.

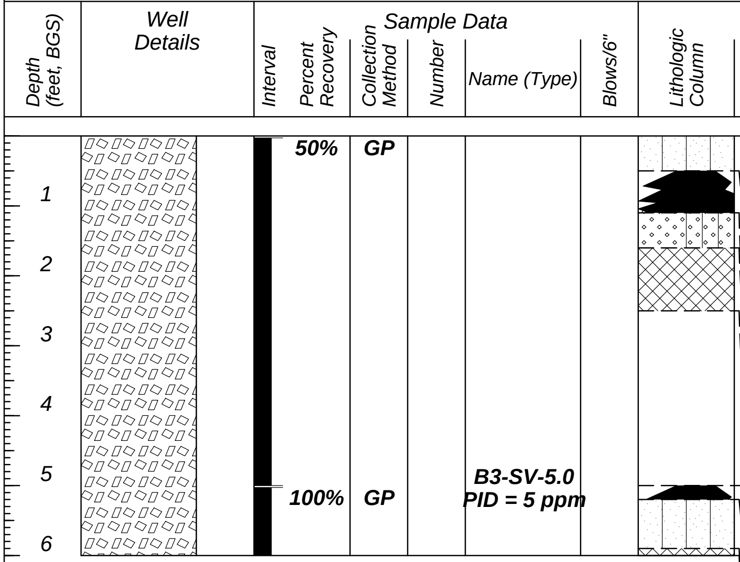
NOTES: 1. bgs = below ground surface. 2. GP = Geoprobe macro-core sampler. 3. Depths are relative to feet bgs. 4. ppm = parts per million. 5. PID = photoionization detector, soil head space reading in ppm. 6. SV = soil vapor sample collected using post run tubing.

Maul Foster & Alongi, Inc.

Geologic Borehole Log/Well Construction

Project Number	Well Number	Sheet
1290.01.01	**B3**	**1 of 1**

Project Name	**Demolition Landfill**	TOC Elevation (feet)	
Project Location	**Bend, Oregon**	Surface Elevation (feet)	
Start/End Date	**7/28/16 to 7/28/16**	Northing	
Driller/Equipment	**Pacific Soil and Water - Marcus Johnson, James Melton/GP 6600**	Easting	
Geologist/Engineer	**Emily Hess**	Hole Depth	**6.0-feet**
Sample Method	**Direct Push**	Outer Hole Diam	**2.25-inch**



Sample Data

Depth (feet, BGS)	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"
0.0	**50%**	**GP**			
5.0	**100%**	**GP**		**B3-SV-5.0** **PID = 5 ppm**	

Soil Description

0.0 to 0.5 feet: SILTY SAND (SM); light brown; 30% fines; 60% sand, fine to coarse; 10% gravel; friable; loose; trace rootlets; dry.

0.5 to 1.1 feet: CHARCOAL; black; 5% fines; 5% sand; 5% gravel; 85% organics; trace rootlets; decayed burnt charcoal-like odor; dry.

1.1 to 1.6 feet: SAND WITH SILT AND GRAVEL (SW-SM); light grayish brown; 10% fines; 80% sand, fine to coarse; 10% gravel; medium density; burnt rubber-like odor; dry.

1.6 to 2.5 feet: WOODY DEBRIS; dark brown; 5% fines; 5% sand; 90% woody debris; trace glass fragments; petroleum hydrocarbon-like odor; moist.

2.5 to 5.0 feet: No recovery.

5.0 to 5.2 feet: CHARCOAL; black; 5% fines; 5% sand; 5% gravel; 85% charcoal; trace woody debris; dry.

5.2 to 5.9 feet: SILTY SAND (SM); light grayish brown; 25% fines; 60% sand, fine to coarse; 15% gravel; medium density; trace woody debris; organic-like odor; dry.

5.9 to 6.0 feet: WOODY DEBRIS; dark brown; 5% fines; 5% sand; 5% gravel; 85% organics; trace metal, rubber, and glass; moist.

Refusal, metal in drilling shoe.
Total Depth = 6.0 feet below ground surface.

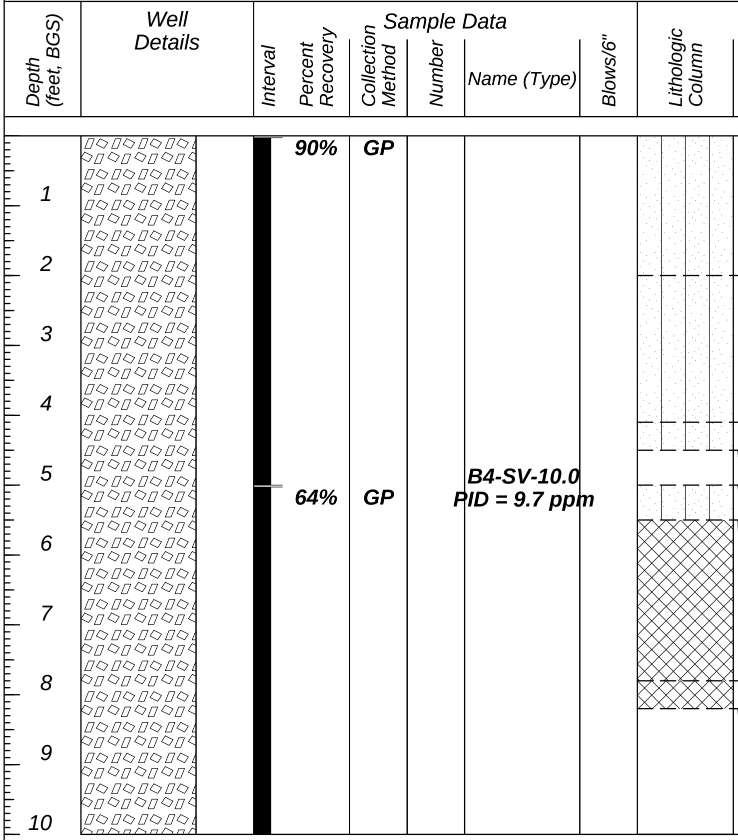
Borehole Completion Details:
0.0 to 6.0 feet bgs: 2.25-inch borehole.
0.0 to 6.0 feet bgs: Bentonite chips hydrated with potable water.

NOTES: 1. bgs = below ground surface. 2. GP = Geoprobe macro-core sampler. 3. Depths are relative to feet bgs. 4. ppm = parts per million. 5. PID = photoionization detector, soil head space reading in ppm. 6. SV = soil vapor sample collected using post run tubing.

Maul Foster & Alongi, Inc.	Geologic Borehole Log/Well Construction		
	Project Number **1290.01.01**	Well Number **B4**	Sheet **1 of 1**

Project Name **Demolition Landfill**
Project Location **Bend, Oregon**
Start/End Date **7/28/16 to 7/28/16**
Driller/Equipment **Pacific Soil and Water - Marcus Johnson, James Melton/GP 6600**
Geologist/Engineer **Emily Hess**
Sample Method **Direct Push**

TOC Elevation (feet)
Surface Elevation (feet)
Northing
Easting
Hole Depth **10.0-feet**
Outer Hole Diam **2.25-inch**



Soil Description

0.0 to 2.0 feet: SILTY SAND (SM); grayish brown; 20% fines; 70% sand, fine to coarse; 10% gravel; friable; trace rootlets from 0.0 to 0.3 feet; loose grading to dense; dry.

2.0 to 4.1 feet: SILTY SAND (SM); dark brown to black; 30% fines; 60% sand; 10% gravel; trace organics and charcoal; interbedded with 1- to 3-inch-thick layers of decomposed wood; dense; moist.

4.1 to 4.5 feet: SILTY SAND (SM); grayish brown; 20% fines; 70% sand, fine to coarse; 10% gravel; friable; trace organics; dense; dry.

4.5 to 5.0 feet: No recovery.

5.0 to 5.5 feet: SILTY SAND (SM); light grayish brown; 20% fines; 70% sand, fine to coarse; 10% gravel; friable; trace organics; dense; dry to moist.

5.5 to 7.8 feet: SAWDUST; light yellow; trace fines, sand, gravel, and large woody debris; urea-like odor; moist.

7.8 to 8.2 feet: DEBRIS; brown to black with pink insulation material; 10% fines; 10% sand; 20% gravel; moist; 60% debris. Insulation material is pink and appears to be fiberglass.

8.2 to 10.0 feet: No recovery.

Total Depth = 10.0 feet below ground surface.

Borehole Completion Details:
0.0 to 10.0 feet bgs: 2.25-inch borehole.
0.0 to 10.0 feet bgs: Bentonite chips hydrated with potable water.

NOTES: 1. bgs = below ground surface. 2. GP = Geoprobe macro-core sampler. 3. Depths are relative to feet bgs. 4. ppm = parts per million. 5. PID = photoionization detector, soil head space reading in ppm. 6. SV = soil vapor sample collected using post run tubing.

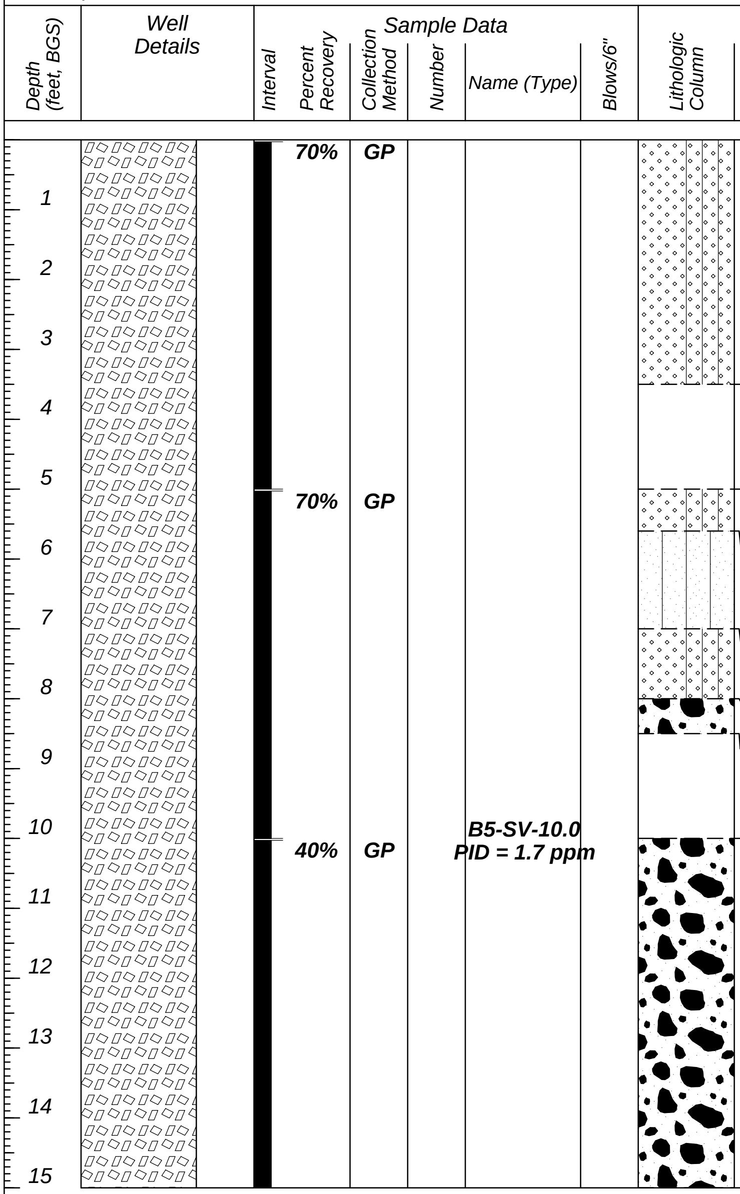
Maul Foster & Alongi, Inc.

Geologic Borehole Log/Well Construction

Project Number	Well Number	Sheet
1290.01.01	**B5**	**1 of 1**

Project Name **Demolition Landfill**
Project Location **Bend, Oregon**
Start/End Date **7/28/16 to 7/28/16**
Driller/Equipment **Pacific Soil and Water - Marcus Johnson, James Melton/GP 6600**
Geologist/Engineer **Emily Hess**
Sample Method **Direct Push**

TOC Elevation (feet)
Surface Elevation (feet)
Northing
Easting
Hole Depth **15.0-feet**
Outer Hole Diam **2.25-inch**



Sample Data

Depth (feet, BGS)	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"
0	**70%**	**GP**			
5	**70%**	**GP**			
10	**40%**	**GP**		**B5-SV-10.0** **PID = 1.7 ppm**	

Soil Description

0.0 to 3.5 feet: SAND WITH SILT AND GRAVEL (SW-SM); light grayish brown; 15% fines; 75% sand, fine to coarse; 10% gravel; friable; pumice; trace rootlets from 0.0 to 0.5 feet; dry.

@ 1.5 feet: Moist.

3.5 to 5.0 feet: No recovery.

5.0 to 5.6 feet: SAND WITH SILT AND GRAVEL (SW-SM); light grayish brown; 15% fines; 75% sand, fine to coarse; 10% gravel; friable; pumice; moist.

5.6 to 7.0 feet: SILTY SAND (SM); dark brown to black; 25% fines; 70% sand, fine to coarse; 5% gravel; burnt rubber-like odor; moist.

@ 7.0 feet: 0.1-foot-thick rock fragment.

7.0 to 8.0 feet: SAND WITH SILT (SW-SM); dark red; 10% fines; 90% sand; petroleum hydrocarbon-like odor; moist.

8.0 to 8.5 feet: SANDY GRAVEL (GW); dark gray to black; 15% fines; 25% sand; 60% gravel; creosote-like odor; moist.

@ 8.5 feet: Wood.

8.5 to 10.0 feet: No recovery.

10.0 to 15.0 feet: SANDY GRAVEL (GW); dark gray to black; 10% fines; 20% sand; 60% gravel; 10% woody debris; creosote-like odor; moist.

@ 10.5 feet: Light gray lens of 0.1-foot thick SAND WITH SILT AND GRAVEL (SW-SM); 15% fines; 75% sand; 10% gravel.

Total Depth = 15.0 feet below ground surface.

Borehole Completion Details:
0.0 to 15.0 feet bgs: 2.25-inch borehole.
0.0 to 15.0 feet bgs: Bentonite chips hydrated with potable water.

NOTES: 1. bgs = below ground surface. 2. GP = Geoprobe macro-core sampler. 3. Depths are relative to feet bgs. 4. ppm = parts per million. 5. PID = photoionization detector, soil head space reading in ppm. 6. SV = soil vapor sample collected using post run tubing.

Maul Foster & Alongi, Inc.

Geologic Borehole Log/Well Construction

Project Number	Well Number	Sheet
1290.01.01	**B6**	**1 of 3**

Project Name	**Demolition Landfill**	TOC Elevation (feet)	
Project Location	**Bend, Oregon**	Surface Elevation (feet)	
Start/End Date	**7/29/16 to 7/29/16**	Northing	
Driller/Equipment	**Pacific Soil and Water - Marcus Johnson, James Melton/GP 6600**	Easting	
Geologist/Engineer	**Emily Hess**	Hole Depth	**46.0-feet**
Sample Method	**Direct Push**	Outer Hole Diam	**2.25-inch**

Depth (feet, BGS)	Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Soil Description
0.0		80%	GP				0.0 to 0.4 feet: SILTY SAND (SM); grayish brown; 30% fines; 60% sand, fine to coarse; 10% gravel; friable; loose; trace rootlets; dry.
							0.4 to 3.6 feet: SILTY SAND (SM); dark brown; 20% fines; 70% sand, fine to coarse; 10% gravel; friable; medium dense; slight non-organic-like odor; moist.
							3.6 to 4.0 feet: GRAVELLY SAND WITH SILT (SW-SM); light grayish brown; 15% fines; 65% sand, fine to coarse; 20% gravel; friable; pumice gravel up to 3 centimeters in diameter; medium density; moist.
							4.0 to 5.0 feet: No recovery.
5.0		80%	GP				5.0 to 9.0 feet: SILTY SAND and GRAVELLY SAND WITH SILT in alternating layers; medium density; moist.
							9.0 to 10.0 feet: No recovery.
10.0		88%	GP		B6-SV-10.0 PID = 1.9 ppm		10.0 to 32.0 feet: SILTY SAND (SM); dark brown to black; 20% fines; 70% sand, fine to coarse; 10% gravel; friable; dense; moderate odor; moist.
							@ 14.0 feet; Gray pumice lens 0.5-inches thick.
15.0		80%	GP				
							@ 15.5 to 16.0 feet: Wet.
							@ 17.0 feet; Gray pumice lens 0.5-inches thick.
							@ 17.5 feet; Gray pumice lens 0.5-inches thick.

NOTES: 1. bgs = below ground surface. 2. GP = Geoprobe macro-core sampler. 3. Depths are relative to feet bgs. 4. ppm = parts per million. 5. PID = photoionization detector, soil head space reading in ppm. 6. SV = soil vapor sample collected using post run tubing.

Depth (feet, BGS)	Well Details	Sample Data: Interval	Sample Data: Percent Recovery	Sample Data: Collection Method	Sample Data: Number	Sample Data: Name (Type)	Sample Data: Blows/6"	Lithologic Column	Soil Description
			60%	**GP**					
21									@ 20.5 to 21.0 feet: Orange; less dense.
22									
23									
24									
25			**80%**	**GP**					
26									
27									
28									
29									
30			**60%**	**GP**					
31									@ 32.0 feet: 0.1-foot-thick piece of concrete, plastic, and organics.
32									32.0 to 36.0 feet: SILTY SAND (SM); dark brown to black; 30% fines; 60% sand, fine to coarse; 10% gravel; medium dense; resin-like odor; moist.
33									
34									
35			**100%**	**GP**					@ 35.5 feet: Wood.
36									36.0 to 44.5 feet: SAND WITH SILT AND GRAVEL (SW-SM); dark brown; 10% fines; 80% sand, fine to coarse; 10% gravel; medium dense to dense; shiny mineral grains; slight odor; moist.
37									
38									
39									
40			**100%**	**GP**					
41									@ 40.5 feet: Wood and concrete.
42									@ 42.0 to 44.5 feet: Wet.

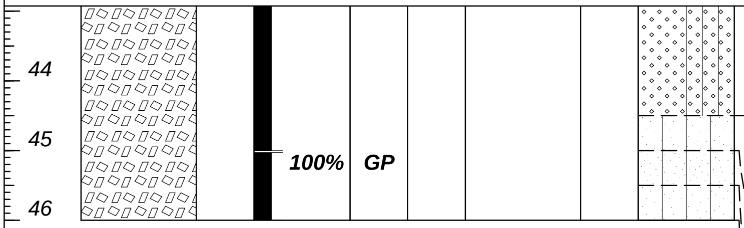
NOTES: 1. bgs = below ground surface. 2. GP = Geoprobe macro-core sampler. 3. Depths are relative to feet bgs. 4. ppm = parts per million. 5. PID = photoionization detector, soil head space reading in ppm. 6. SV = soil vapor sample collected using post run tubing.

Maul Foster & Alongi, Inc.

Geologic Borehole Log/Well Construction

Project Number	Well Number	Sheet
1290.01.01	**B6**	**3 of 3**

Depth (feet, BGS)	Well Details	Sample Data: Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description



44.5 to 45.0 feet: SILT WITH SAND (ML); orangish red; 75% fines; 20% sand, fine; 5% gravel, medium to coarse; soft to firm; moist.

45.0 to 45.5 feet: SILTY SAND (SM); dark brown to black; 40% fines; 60% sand, fine to coarse; 10% gravel; pumice fragments 2 millimeters to 10 millimeters in diameter; moist.

45.5 to 46.0 feet: SILT WITH SAND (ML); orangish red; 75% fines; 20% sand, fine; 5% gravel, medium to coarse; soft to firm; moist.

@ 46.0 feet: Refusal with a piece of basalt in core.

Total Depth = 46.0 feet below ground surface.

Borehole Completion Details:
0.0 to 46.0 feet bgs: 2.25-inch borehole.
0.0 to 46.0 feet bgs: Bentonite chips hydrated with potable water.

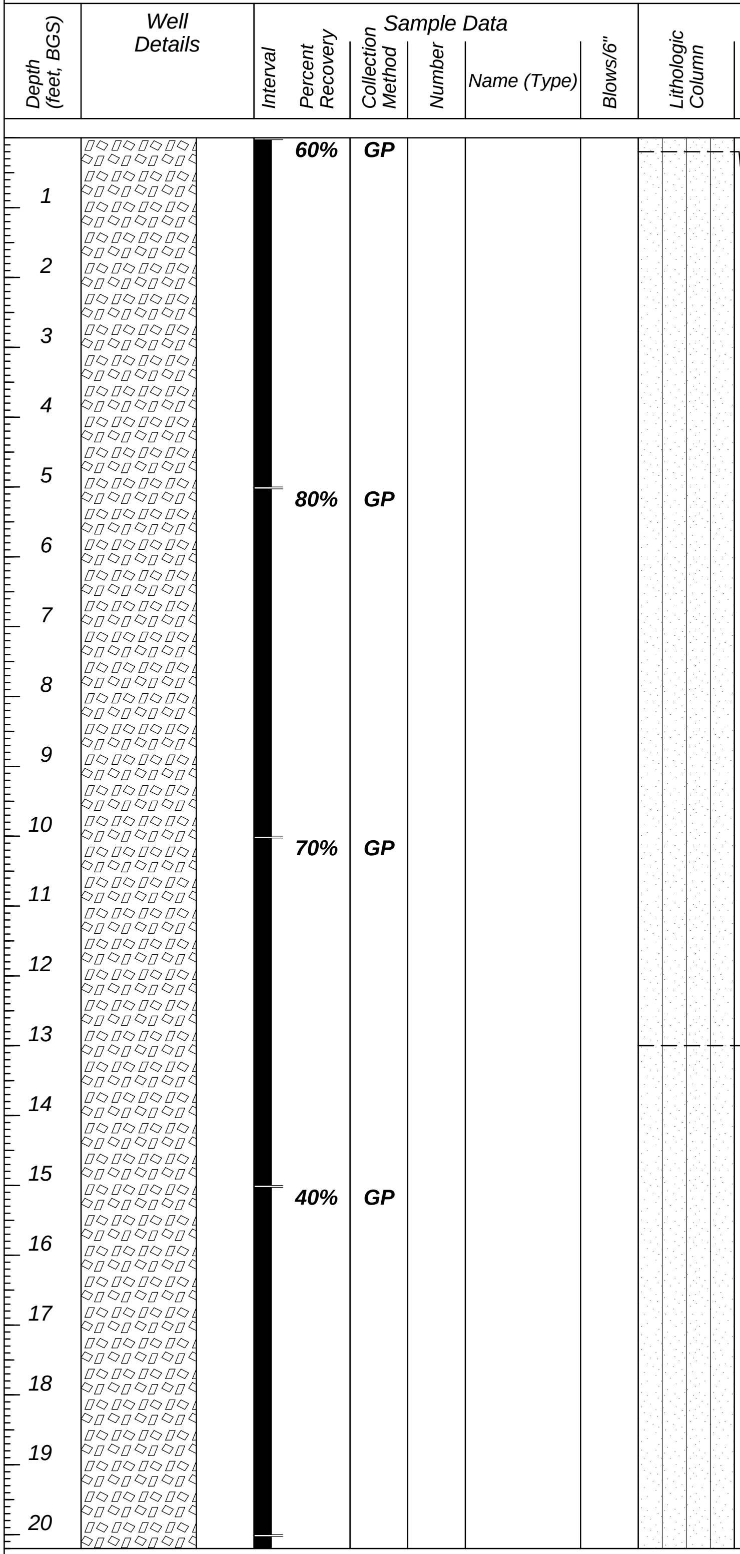
NOTES: 1. bgs = below ground surface. 2. GP = Geoprobe macro-core sampler. 3. Depths are relative to feet bgs. 4. ppm = parts per million. 5. PID = photoionization detector, soil head space reading in ppm. 6. SV = soil vapor sample collected using post run tubing.

Geologic Borehole Log/Well Construction

Maul Foster & Alongi, Inc.

Project Number	Well Number	Sheet
1290.01.01	**B7**	**1 of 3**

Project Name	**Demolition Landfill**	TOC Elevation (feet)	
Project Location	**Bend, Oregon**	Surface Elevation (feet)	
Start/End Date	**7/29/16 to 7/29/16**	Northing	
Driller/Equipment	**Pacific Soil and Water - Marcus Johnson, James Melton/GP 6600**	Easting	
Geologist/Engineer	**Emily Hess**	Hole Depth	**43.0-feet**
Sample Method	**Dual tube with 1.5 inch casing**	Outer Hole Diam	**2.25-inch**



Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"
60%	**GP**			
80%	**GP**			
70%	**GP**			
40%	**GP**			

Soil Description

0.0 to 0.2 feet: SILTY SAND (SM); gray; 30% fines; 60% sand, fine to coarse; 10% gravel; friable; loose; dry.

0.2 to 13.0 feet: SILTY SAND (SM); dark brown to grayish black; 20% fines; 70% sand, fine to coarse; 10% gravel, up to 2 centimeters in diameter; dense; rubber/charcoal-like odor; moist.

@ 1.4 to 1.7 feet: Light gray.

@ 5.3 to 5.5 feet: Light brown.

13.0 to 40.0 feet: SILTY SAND (SM); orangish brown; 30% fines; 60% sand, fine to coarse; 10% gravel; dense; moist.

@ 15.3 to 15.8 feet: Unit is wet.

NOTES: 1. bgs = below ground surface. 2. GP = Geoprobe macro-core sampler. 3. Depths are relative to feet bgs.

Maul Foster & Alongi, Inc.

Geologic Borehole Log/Well Construction

Project Number	Well Number	Sheet
1290.01.01	**B7**	**2 of 3**

Depth (feet, BGS)	Well Details	Sample Data: Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
			80%	**GP**					
21									
22									
23									
24									
25			**60%**	**GP**					
26									
27									
28									
29									
30			**80%**	**GP**					@ 30.0 feet: Very dense.
31									
32									
33									
34									
35			**80%**	**GP**					
36									
37									
38									
39									
40			**100%**	**GP**					40.0 to 41.0 feet: SILTY SAND (SM); dark grayish brown; 30% fines; 60% sand, fine to coarse; 10% gravel; very dense; moist to wet.
41									41.0 to 43.0 feet: SILTY SAND WITH GRAVEL (SM); dark gray; 20% fines; 40% sand; 20% gravel; 20% woody organics; very dense; moist.
42									

NOTES: 1. bgs = below ground surface. 2. GP = Geoprobe macro-core sampler. 3. Depths are relative to feet bgs.

Maul Foster & Alongi, Inc.	**Geologic Borehole Log/Well Construction**		
	Project Number ***1290.01.01***	*Well Number* ***B7***	*Sheet* ***3 of 3***

Depth (feet, BGS)	Well Details	Sample Data: Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
									@ 43.0 feet: Refusal, wood with tar in shoe.

Total Depth = 43.0 feet below ground surface.

Borehole Completion Details:
0.0 to 43.0 feet bgs: 2.25-inch borehole.
0.0 to 43.0 feet bgs: Bentonite chips hydrated with potable water.

NOTES: *1. bgs = below ground surface. 2. GP = Geoprobe macro-core sampler. 3. Depths are relative to feet bgs.*

ATTACHMENT B

LABORATORY ANALYTICAL RESULTS

Pace Analytical Services, Inc.
1700 Elm Street - Suite 200
Minneapolis, MN 55414
(612)607-1700

August 29, 2016

Stacy Frost
Maul Foster & Alongi, Inc
400 East Mill Plain Boulevard
Vancouver, WA 98660

RE: Project: 1290.01.01 OSU Cascades- Rev.
Pace Project No.: 10357548

Dear Stacy Frost:

Enclosed are the analytical results for sample(s) received by the laboratory on August 02, 2016. The results relate only to the samples included in this report. Results reported herein conform to the most current TNI standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

This report was revised to revise the sample qulifier for 10357548006

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Carolynne Trout

Carolynne Trout for
Joanne M Richardson
joanne.richardson@pacelabs.com
Project Manager

Enclosures

CERTIFICATIONS

Project: 1290.01.01 OSU Cascades- Rev.
Pace Project No.: 10357548

Minnesota Certification IDs

1700 Elm Street SE Suite 200, Minneapolis, MN 55414
525 N 8th Street, Salina, KS 67401
A2LA Certification #: 2926.01
Alaska Certification #: UST-078
Alaska Certification #MN00064
Alabama Certification #40770
Arizona Certification #: AZ-0014
Arkansas Certification #: 88-0680
California Certification #: 01155CA
Colorado Certification #Pace
Connecticut Certification #: PH-0256
EPA Region 8 Certification #: 8TMS-L
Florida/NELAP Certification #: E87605
Guam Certification #:14-008r
Georgia Certification #: 959
Georgia EPD #: Pace
Idaho Certification #: MN00064
Hawaii Certification #MN00064
Illinois Certification #: 200011
Indiana Certification#C-MN-01
Iowa Certification #: 368
Kansas Certification #: E-10167
Kentucky Dept of Envi. Protection - DW #90062
Kentucky Dept of Envi. Protection - WW #:90062
Louisiana DEQ Certification #: 3086
Louisiana DHH #: LA140001
Maine Certification #: 2013011
Maryland Certification #: 322
Michigan DEPH Certification #: 9909
Minnesota Certification #: 027-053-137
Mississippi Certification #: Pace
Montana Certification #: MT0092
Nevada Certification #: MN_00064
Nebraska Certification #: Pace
New Jersey Certification #: MN-002
New York Certification #: 11647
North Carolina Certification #: 530
North Carolina State Public Health #: 27700
North Dakota Certification #: R-036
Ohio EPA #: 4150
Ohio VAP Certification #: CL101
Oklahoma Certification #: 9507
Oregon Certification #: MN200001
Oregon Certification #: MN300001
Pennsylvania Certification #: 68-00563
Puerto Rico Certification
Saipan (CNMI) #:MP0003
South Carolina #:74003001
Texas Certification #: T104704192
Tennessee Certification #: 02818
Utah Certification #: MN000642013-4
Virginia DGS Certification #: 251
Virginia/VELAP Certification #: Pace
Washington Certification #: C486
West Virginia Certification #: 382
West Virginia DHHR #:9952C
Wisconsin Certification #: 999407970

SAMPLE SUMMARY

Project: 1290.01.01 OSU Cascades- Rev.
Pace Project No.: 10357548

Lab ID	Sample ID	Matrix	Date Collected	Date Received
10357548001	**B1-SV-5.0**	Air	07/28/16 10:22	08/02/16 09:15
10357548002	**B2-SV-10.0**	Air	07/28/16 12:00	08/02/16 09:15
10357548003	**B3-SV-5.0**	Air	07/28/16 13:36	08/02/16 09:15
10357548004	**B4-SV-10.0**	Air	07/28/16 15:15	08/02/16 09:15
10357548005	**B5-SV-10.0**	Air	07/28/16 17:20	08/02/16 09:15
10357548006	**B6-SV-10.0**	Air	07/29/16 09:44	08/02/16 09:15
10357548007	**Unused Can#1504**	Air		08/02/16 09:15
10357548008	**Unused Can#0164**	Air		08/02/16 09:15

SAMPLE ANALYTE COUNT

Project: 1290.01.01 OSU Cascades- Rev.
Pace Project No.: 10357548

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
10357548001	**B1-SV-5.0**	Method 3C Gases	RTP	6	PASI-M
		TO-15	DR1, RTP	61	PASI-M
10357548002	**B2-SV-10.0**	Method 3C Gases	RTP	6	PASI-M
		TO-15	DR1, RTP	61	PASI-M
10357548003	**B3-SV-5.0**	Method 3C Gases	RTP	6	PASI-M
		TO-15	DR1	61	PASI-M
10357548004	**B4-SV-10.0**	Method 3C Gases	RTP	6	PASI-M
		TO-15	DR1, RTP	61	PASI-M
10357548005	**B5-SV-10.0**	Method 3C Gases	RTP	6	PASI-M
		TO-15	DR1, RTP	61	PASI-M
10357548006	**B6-SV-10.0**	Method 3C Gases	RTP	6	PASI-M
		TO-15	DR1	61	PASI-M

ANALYTICAL RESULTS

Project: 1290.01.01 OSU Cascades- Rev.
Pace Project No.: 10357548

Sample: B1-SV-5.0 **Lab ID: 10357548001** Collected: 07/28/16 10:22 Received: 08/02/16 09:15 Matrix: Air

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
Method 3C AIR - Fixed Gases	Analytical Method: Method 3C Gases								
Carbon dioxide	**29.9**	%	2.0	0.99	1		08/15/16 10:19	124-38-9	
Carbon monoxide	**<0.16**	%	0.40	0.16	1		08/15/16 10:19	630-08-0	
Helium	**<0.98**	%	3.6	0.98	1		08/15/16 10:19	7440-59-7	
Methane	**5.3**	%	4.0	0.73	1		08/15/16 10:19	74-82-8	
Nitrogen	**64.9**	%	8.0	4.0	1		08/15/16 10:19	7727-37-9	
Oxygen	**<0.29**	%	2.0	0.29	1		08/15/16 10:19	7782-44-7	
TO15 MSV AIR	Analytical Method: TO-15								
Acetone	**342**	ug/m3	4.6	1.6	1.92		08/15/16 19:42	67-64-1	
Benzene	**35.7**	ug/m3	0.62	0.23	1.92		08/15/16 19:42	71-43-2	
Benzyl chloride	**<0.32**	ug/m3	2.0	0.32	1.92		08/15/16 19:42	100-44-7	
Bromodichloromethane	**<0.37**	ug/m3	2.6	0.37	1.92		08/15/16 19:42	75-27-4	
Bromoform	**<1.7**	ug/m3	10.1	1.7	1.92		08/15/16 19:42	75-25-2	
Bromomethane	**<0.60**	ug/m3	1.5	0.60	1.92		08/15/16 19:42	74-83-9	
1,3-Butadiene	**<0.34**	ug/m3	0.86	0.34	1.92		08/15/16 19:42	106-99-0	
2-Butanone (MEK)	**80.0**	ug/m3	5.8	0.44	1.92		08/15/16 19:42	78-93-3	
Carbon disulfide	**8.1**	ug/m3	1.2	0.19	1.92		08/15/16 19:42	75-15-0	
Carbon tetrachloride	**<0.37**	ug/m3	1.2	0.37	1.92		08/15/16 19:42	56-23-5	
Chlorobenzene	**<0.26**	ug/m3	1.8	0.26	1.92		08/15/16 19:42	108-90-7	
Chloroethane	**<0.37**	ug/m3	1.0	0.37	1.92		08/15/16 19:42	75-00-3	
Chloroform	**<0.36**	ug/m3	0.95	0.36	1.92		08/15/16 19:42	67-66-3	
Chloromethane	**<0.21**	ug/m3	0.81	0.21	1.92		08/15/16 19:42	74-87-3	
Cyclohexane	**21.0**	ug/m3	1.3	0.61	1.92		08/15/16 19:42	110-82-7	
Dibromochloromethane	**<1.6**	ug/m3	3.3	1.6	1.92		08/15/16 19:42	124-48-1	
1,2-Dibromoethane (EDB)	**<1.5**	ug/m3	3.0	1.5	1.92		08/15/16 19:42	106-93-4	
1,2-Dichlorobenzene	**<0.98**	ug/m3	2.3	0.98	1.92		08/15/16 19:42	95-50-1	
1,3-Dichlorobenzene	**16.1**	ug/m3	2.3	1.0	1.92		08/15/16 19:42	541-73-1	
1,4-Dichlorobenzene	**45.7**	ug/m3	2.3	0.96	1.92		08/15/16 19:42	106-46-7	
Dichlorodifluoromethane	**<0.92**	ug/m3	1.9	0.92	1.92		08/15/16 19:42	75-71-8	
1,1-Dichloroethane	**<0.30**	ug/m3	1.6	0.30	1.92		08/15/16 19:42	75-34-3	
1,2-Dichloroethane	**<0.39**	ug/m3	0.79	0.39	1.92		08/15/16 19:42	107-06-2	
1,1-Dichloroethene	**<0.46**	ug/m3	1.6	0.46	1.92		08/15/16 19:42	75-35-4	
cis-1,2-Dichloroethene	**17.4**	ug/m3	1.6	0.47	1.92		08/15/16 19:42	156-59-2	
trans-1,2-Dichloroethene	**<0.74**	ug/m3	1.6	0.74	1.92		08/15/16 19:42	156-60-5	
1,2-Dichloropropane	**<0.52**	ug/m3	1.8	0.52	1.92		08/15/16 19:42	78-87-5	
cis-1,3-Dichloropropene	**<0.71**	ug/m3	1.8	0.71	1.92		08/15/16 19:42	10061-01-5	
trans-1,3-Dichloropropene	**<0.50**	ug/m3	1.8	0.50	1.92		08/15/16 19:42	10061-02-6	
Dichlorotetrafluoroethane	**<0.60**	ug/m3	2.7	0.60	1.92		08/15/16 19:42	76-14-2	
Ethanol	**<0.51**	ug/m3	1.8	0.51	1.92		08/15/16 19:42	64-17-5	
Ethyl acetate	**3.0**	ug/m3	1.4	0.67	1.92		08/15/16 19:42	141-78-6	
Ethylbenzene	**1050**	ug/m3	33.8	16.3	38.4		08/17/16 01:08	100-41-4	
4-Ethyltoluene	**<7.2**	ug/m3	38.4	7.2	38.4		08/17/16 01:08	622-96-8	
n-Heptane	**306**	ug/m3	31.9	10.7	38.4		08/17/16 01:08	142-82-5	
Hexachloro-1,3-butadiene	**<1.2**	ug/m3	4.2	1.2	1.92		08/15/16 19:42	87-68-3	
n-Hexane	**67.7**	ug/m3	1.4	0.69	1.92		08/15/16 19:42	110-54-3	
2-Hexanone	**<0.79**	ug/m3	8.0	0.79	1.92		08/15/16 19:42	591-78-6	

ANALYTICAL RESULTS

Project: 1290.01.01 OSU Cascades- Rev.
Pace Project No.: 10357548

Sample: B1-SV-5.0 **Lab ID: 10357548001** Collected: 07/28/16 10:22 Received: 08/02/16 09:15 Matrix: Air

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
TO15 MSV AIR	Analytical Method: TO-15								
Methylene Chloride	**9.0**	ug/m3	6.8	1.0	1.92		08/15/16 19:42	75-09-2	
4-Methyl-2-pentanone (MIBK)	**<0.42**	ug/m3	8.0	0.42	1.92		08/15/16 19:42	108-10-1	
Methyl-tert-butyl ether	**<0.58**	ug/m3	7.0	0.58	1.92		08/15/16 19:42	1634-04-4	
Naphthalene	**22.0**	ug/m3	5.1	0.59	1.92		08/15/16 19:42	91-20-3	
2-Propanol	**<0.46**	ug/m3	4.8	0.46	1.92		08/15/16 19:42	67-63-0	
Propylene	**<0.26**	ug/m3	0.67	0.26	1.92		08/15/16 19:42	115-07-1	
Styrene	**<0.37**	ug/m3	1.7	0.37	1.92		08/15/16 19:42	100-42-5	
1,1,2,2-Tetrachloroethane	**<0.63**	ug/m3	1.3	0.63	1.92		08/15/16 19:42	79-34-5	
Tetrachloroethene	**10.1**	ug/m3	1.3	0.53	1.92		08/15/16 19:42	127-18-4	
Tetrahydrofuran	**<0.23**	ug/m3	1.2	0.23	1.92		08/15/16 19:42	109-99-9	
Toluene	**416**	ug/m3	29.6	5.9	38.4		08/17/16 01:08	108-88-3	
1,2,4-Trichlorobenzene	**<1.7**	ug/m3	7.2	1.7	1.92		08/15/16 19:42	120-82-1	
1,1,1-Trichloroethane	**<0.47**	ug/m3	2.1	0.47	1.92		08/15/16 19:42	71-55-6	
1,1,2-Trichloroethane	**<0.47**	ug/m3	1.1	0.47	1.92		08/15/16 19:42	79-00-5	
Trichloroethene	**7.1**	ug/m3	1.1	0.53	1.92		08/15/16 19:42	79-01-6	
Trichlorofluoromethane	**<0.25**	ug/m3	2.2	0.25	1.92		08/15/16 19:42	75-69-4	
1,1,2-Trichlorotrifluoroethane	**<0.58**	ug/m3	3.1	0.58	1.92		08/15/16 19:42	76-13-1	
1,2,4-Trimethylbenzene	**165**	ug/m3	1.9	0.24	1.92		08/15/16 19:42	95-63-6	
1,3,5-Trimethylbenzene	**151**	ug/m3	1.9	0.35	1.92		08/15/16 19:42	108-67-8	
Vinyl acetate	**<0.63**	ug/m3	1.4	0.63	1.92		08/15/16 19:42	108-05-4	
Vinyl chloride	**<0.37**	ug/m3	0.50	0.37	1.92		08/15/16 19:42	75-01-4	
m&p-Xylene	**1250**	ug/m3	68.0	30.2	38.4		08/17/16 01:08	179601-23-1	
o-Xylene	**417**	ug/m3	33.8	13.5	38.4		08/17/16 01:08	95-47-6	

Sample: B2-SV-10.0 **Lab ID: 10357548002** Collected: 07/28/16 12:00 Received: 08/02/16 09:15 Matrix: Air

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
Method 3C AIR - Fixed Gases	Analytical Method: Method 3C Gases								
Carbon dioxide	**27.2**	%	2.0	0.99	1		08/15/16 10:39	124-38-9	
Carbon monoxide	**<0.16**	%	0.40	0.16	1		08/15/16 10:39	630-08-0	
Helium	**<0.98**	%	3.6	0.98	1		08/15/16 10:39	7440-59-7	
Methane	**1.2J**	%	4.0	0.73	1		08/15/16 10:39	74-82-8	
Nitrogen	**71.2**	%	8.0	4.0	1		08/15/16 10:39	7727-37-9	
Oxygen	**0.42J**	%	2.0	0.29	1		08/15/16 10:39	7782-44-7	
TO15 MSV AIR	Analytical Method: TO-15								
Acetone	**22.2**	ug/m3	4.4	1.5	1.83		08/15/16 20:13	67-64-1	
Benzene	**27.4**	ug/m3	0.59	0.22	1.83		08/15/16 20:13	71-43-2	
Benzyl chloride	**<0.30**	ug/m3	1.9	0.30	1.83		08/15/16 20:13	100-44-7	
Bromodichloromethane	**<0.36**	ug/m3	2.5	0.36	1.83		08/15/16 20:13	75-27-4	
Bromoform	**<1.6**	ug/m3	9.6	1.6	1.83		08/15/16 20:13	75-25-2	
Bromomethane	**<0.57**	ug/m3	1.4	0.57	1.83		08/15/16 20:13	74-83-9	
1,3-Butadiene	**<0.32**	ug/m3	0.82	0.32	1.83		08/15/16 20:13	106-99-0	

ANALYTICAL RESULTS

Project: 1290.01.01 OSU Cascades- Rev.
Pace Project No.: 10357548

Sample: B2-SV-10.0 **Lab ID: 10357548002** Collected: 07/28/16 12:00 Received: 08/02/16 09:15 Matrix: Air

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
TO15 MSV AIR	Analytical Method: TO-15								
2-Butanone (MEK)	**7.0**	ug/m3	5.5	0.42	1.83		08/15/16 20:13	78-93-3	
Carbon disulfide	**44.8**	ug/m3	1.2	0.18	1.83		08/15/16 20:13	75-15-0	
Carbon tetrachloride	**<0.35**	ug/m3	1.2	0.35	1.83		08/15/16 20:13	56-23-5	
Chlorobenzene	**<0.25**	ug/m3	1.7	0.25	1.83		08/15/16 20:13	108-90-7	
Chloroethane	**35.2**	ug/m3	0.99	0.36	1.83		08/15/16 20:13	75-00-3	
Chloroform	**<0.35**	ug/m3	0.91	0.35	1.83		08/15/16 20:13	67-66-3	
Chloromethane	**<0.20**	ug/m3	0.77	0.20	1.83		08/15/16 20:13	74-87-3	
Cyclohexane	**14.5**	ug/m3	1.3	0.58	1.83		08/15/16 20:13	110-82-7	
Dibromochloromethane	**<1.6**	ug/m3	3.2	1.6	1.83		08/15/16 20:13	124-48-1	
1,2-Dibromoethane (EDB)	**<1.4**	ug/m3	2.9	1.4	1.83		08/15/16 20:13	106-93-4	
1,2-Dichlorobenzene	**<0.94**	ug/m3	2.2	0.94	1.83		08/15/16 20:13	95-50-1	
1,3-Dichlorobenzene	**13.1**	ug/m3	2.2	0.97	1.83		08/15/16 20:13	541-73-1	
1,4-Dichlorobenzene	**<0.91**	ug/m3	2.2	0.91	1.83		08/15/16 20:13	106-46-7	
Dichlorodifluoromethane	**31.3**	ug/m3	1.8	0.88	1.83		08/15/16 20:13	75-71-8	
1,1-Dichloroethane	**8.5**	ug/m3	1.5	0.29	1.83		08/15/16 20:13	75-34-3	
1,2-Dichloroethane	**<0.38**	ug/m3	0.75	0.38	1.83		08/15/16 20:13	107-06-2	
1,1-Dichloroethene	**3.7**	ug/m3	1.5	0.44	1.83		08/15/16 20:13	75-35-4	
cis-1,2-Dichloroethene	**4.4**	ug/m3	1.5	0.45	1.83		08/15/16 20:13	156-59-2	
trans-1,2-Dichloroethene	**<0.70**	ug/m3	1.5	0.70	1.83		08/15/16 20:13	156-60-5	
1,2-Dichloropropane	**<0.49**	ug/m3	1.7	0.49	1.83		08/15/16 20:13	78-87-5	
cis-1,3-Dichloropropene	**<0.68**	ug/m3	1.7	0.68	1.83		08/15/16 20:13	10061-01-5	
trans-1,3-Dichloropropene	**<0.48**	ug/m3	1.7	0.48	1.83		08/15/16 20:13	10061-02-6	
Dichlorotetrafluoroethane	**<0.57**	ug/m3	2.6	0.57	1.83		08/15/16 20:13	76-14-2	
Ethanol	**<0.48**	ug/m3	1.8	0.48	1.83		08/15/16 20:13	64-17-5	
Ethyl acetate	**<0.64**	ug/m3	1.3	0.64	1.83		08/15/16 20:13	141-78-6	
Ethylbenzene	**566**	ug/m3	32.2	15.6	36.6		08/17/16 01:36	100-41-4	
4-Ethyltoluene	**57.3**	ug/m3	1.8	0.34	1.83		08/15/16 20:13	622-96-8	
n-Heptane	**268**	ug/m3	30.4	10.2	36.6		08/17/16 01:36	142-82-5	
Hexachloro-1,3-butadiene	**<1.2**	ug/m3	4.0	1.2	1.83		08/15/16 20:13	87-68-3	
n-Hexane	**33.9**	ug/m3	1.3	0.65	1.83		08/15/16 20:13	110-54-3	
2-Hexanone	**<0.75**	ug/m3	7.6	0.75	1.83		08/15/16 20:13	591-78-6	
Methylene Chloride	**10.0**	ug/m3	6.5	0.99	1.83		08/15/16 20:13	75-09-2	
4-Methyl-2-pentanone (MIBK)	**3.3J**	ug/m3	7.6	0.40	1.83		08/15/16 20:13	108-10-1	
Methyl-tert-butyl ether	**<0.55**	ug/m3	6.7	0.55	1.83		08/15/16 20:13	1634-04-4	
Naphthalene	**43.8**	ug/m3	4.9	0.56	1.83		08/15/16 20:13	91-20-3	
2-Propanol	**<0.44**	ug/m3	4.6	0.44	1.83		08/15/16 20:13	67-63-0	
Propylene	**88.7**	ug/m3	0.64	0.25	1.83		08/15/16 20:13	115-07-1	
Styrene	**2.1**	ug/m3	1.6	0.35	1.83		08/15/16 20:13	100-42-5	
1,1,2,2-Tetrachloroethane	**<0.60**	ug/m3	1.3	0.60	1.83		08/15/16 20:13	79-34-5	
Tetrachloroethene	**12.1**	ug/m3	1.3	0.51	1.83		08/15/16 20:13	127-18-4	
Tetrahydrofuran	**<0.22**	ug/m3	1.1	0.22	1.83		08/15/16 20:13	109-99-9	
Toluene	**64.0**	ug/m3	1.4	0.28	1.83		08/15/16 20:13	108-88-3	
1,2,4-Trichlorobenzene	**<1.7**	ug/m3	6.9	1.7	1.83		08/15/16 20:13	120-82-1	
1,1,1-Trichloroethane	**<0.45**	ug/m3	2.0	0.45	1.83		08/15/16 20:13	71-55-6	
1,1,2-Trichloroethane	**<0.45**	ug/m3	1.0	0.45	1.83		08/15/16 20:13	79-00-5	
Trichloroethene	**6.6**	ug/m3	1.0	0.51	1.83		08/15/16 20:13	79-01-6	

ANALYTICAL RESULTS

Project: 1290.01.01 OSU Cascades- Rev.
Pace Project No.: 10357548

Sample: B2-SV-10.0 **Lab ID: 10357548002** Collected: 07/28/16 12:00 Received: 08/02/16 09:15 Matrix: Air

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
TO15 MSV AIR	Analytical Method: TO-15								
Trichlorofluoromethane	**277**	ug/m3	2.1	0.24	1.83		08/15/16 20:13	75-69-4	
1,1,2-Trichlorotrifluoroethane	**<0.55**	ug/m3	2.9	0.55	1.83		08/15/16 20:13	76-13-1	
1,2,4-Trimethylbenzene	**67.2**	ug/m3	1.8	0.23	1.83		08/15/16 20:13	95-63-6	
1,3,5-Trimethylbenzene	**63.2**	ug/m3	1.8	0.33	1.83		08/15/16 20:13	108-67-8	
Vinyl acetate	**5.5**	ug/m3	1.3	0.60	1.83		08/15/16 20:13	108-05-4	
Vinyl chloride	**<0.36**	ug/m3	0.48	0.36	1.83		08/15/16 20:13	75-01-4	
m&p-Xylene	**121**	ug/m3	3.2	1.4	1.83		08/15/16 20:13	179601-23-1	
o-Xylene	**55.6**	ug/m3	1.6	0.64	1.83		08/15/16 20:13	95-47-6	

Sample: B3-SV-5.0 **Lab ID: 10357548003** Collected: 07/28/16 13:36 Received: 08/02/16 09:15 Matrix: Air

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
Method 3C AIR - Fixed Gases	Analytical Method: Method 3C Gases								
Carbon dioxide	**25.7**	%	2.0	0.99	1		08/15/16 10:49	124-38-9	
Carbon monoxide	**<0.16**	%	0.40	0.16	1		08/15/16 10:49	630-08-0	
Helium	**<0.98**	%	3.6	0.98	1		08/15/16 10:49	7440-59-7	
Methane	**<0.73**	%	4.0	0.73	1		08/15/16 10:49	74-82-8	
Nitrogen	**73.9**	%	8.0	4.0	1		08/15/16 10:49	7727-37-9	
Oxygen	**<0.29**	%	2.0	0.29	1		08/15/16 10:49	7782-44-7	
TO15 MSV AIR	Analytical Method: TO-15								
Acetone	**111**	ug/m3	4.6	1.6	1.92		08/15/16 20:45	67-64-1	
Benzene	**43.1**	ug/m3	0.62	0.23	1.92		08/15/16 20:45	71-43-2	
Benzyl chloride	**<0.32**	ug/m3	2.0	0.32	1.92		08/15/16 20:45	100-44-7	
Bromodichloromethane	**<0.37**	ug/m3	2.6	0.37	1.92		08/15/16 20:45	75-27-4	
Bromoform	**<1.7**	ug/m3	10.1	1.7	1.92		08/15/16 20:45	75-25-2	
Bromomethane	**<0.60**	ug/m3	1.5	0.60	1.92		08/15/16 20:45	74-83-9	
1,3-Butadiene	**<0.34**	ug/m3	0.86	0.34	1.92		08/15/16 20:45	106-99-0	
2-Butanone (MEK)	**20.9**	ug/m3	5.8	0.44	1.92		08/15/16 20:45	78-93-3	
Carbon disulfide	**<0.19**	ug/m3	1.2	0.19	1.92		08/15/16 20:45	75-15-0	
Carbon tetrachloride	**<0.37**	ug/m3	1.2	0.37	1.92		08/15/16 20:45	56-23-5	
Chlorobenzene	**<0.26**	ug/m3	1.8	0.26	1.92		08/15/16 20:45	108-90-7	
Chloroethane	**17.3**	ug/m3	1.0	0.37	1.92		08/15/16 20:45	75-00-3	
Chloroform	**<0.36**	ug/m3	0.95	0.36	1.92		08/15/16 20:45	67-66-3	
Chloromethane	**<0.21**	ug/m3	0.81	0.21	1.92		08/15/16 20:45	74-87-3	
Cyclohexane	**111**	ug/m3	1.3	0.61	1.92		08/15/16 20:45	110-82-7	
Dibromochloromethane	**<1.6**	ug/m3	3.3	1.6	1.92		08/15/16 20:45	124-48-1	
1,2-Dibromoethane (EDB)	**<1.5**	ug/m3	3.0	1.5	1.92		08/15/16 20:45	106-93-4	
1,2-Dichlorobenzene	**<0.98**	ug/m3	2.3	0.98	1.92		08/15/16 20:45	95-50-1	
1,3-Dichlorobenzene	**60.6**	ug/m3	2.3	1.0	1.92		08/15/16 20:45	541-73-1	
1,4-Dichlorobenzene	**<0.96**	ug/m3	2.3	0.96	1.92		08/15/16 20:45	106-46-7	
Dichlorodifluoromethane	**10**	ug/m3	1.9	0.92	1.92		08/15/16 20:45	75-71-8	
1,1-Dichloroethane	**27.4**	ug/m3	1.6	0.30	1.92		08/15/16 20:45	75-34-3	

ANALYTICAL RESULTS

Project: 1290.01.01 OSU Cascades- Rev.
Pace Project No.: 10357548

Sample: B3-SV-5.0 **Lab ID: 10357548003** Collected: 07/28/16 13:36 Received: 08/02/16 09:15 Matrix: Air

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
TO15 MSV AIR	Analytical Method: TO-15								
1,2-Dichloroethane	**<0.39**	ug/m3	0.79	0.39	1.92		08/15/16 20:45	107-06-2	
1,1-Dichloroethene	**<0.46**	ug/m3	1.6	0.46	1.92		08/15/16 20:45	75-35-4	
cis-1,2-Dichloroethene	**<0.47**	ug/m3	1.6	0.47	1.92		08/15/16 20:45	156-59-2	
trans-1,2-Dichloroethene	**<0.74**	ug/m3	1.6	0.74	1.92		08/15/16 20:45	156-60-5	
1,2-Dichloropropane	**<0.52**	ug/m3	1.8	0.52	1.92		08/15/16 20:45	78-87-5	
cis-1,3-Dichloropropene	**<0.71**	ug/m3	1.8	0.71	1.92		08/15/16 20:45	10061-01-5	
trans-1,3-Dichloropropene	**<0.50**	ug/m3	1.8	0.50	1.92		08/15/16 20:45	10061-02-6	
Dichlorotetrafluoroethane	**<0.60**	ug/m3	2.7	0.60	1.92		08/15/16 20:45	76-14-2	
Ethanol	**<0.51**	ug/m3	1.8	0.51	1.92		08/15/16 20:45	64-17-5	
Ethyl acetate	**<0.67**	ug/m3	1.4	0.67	1.92		08/15/16 20:45	141-78-6	
Ethylbenzene	**21.6**	ug/m3	1.7	0.82	1.92		08/15/16 20:45	100-41-4	
4-Ethyltoluene	**<0.36**	ug/m3	1.9	0.36	1.92		08/15/16 20:45	622-96-8	
n-Heptane	**37.3**	ug/m3	1.6	0.54	1.92		08/15/16 20:45	142-82-5	
Hexachloro-1,3-butadiene	**<1.2**	ug/m3	4.2	1.2	1.92		08/15/16 20:45	87-68-3	
n-Hexane	**87.0**	ug/m3	1.4	0.69	1.92		08/15/16 20:45	110-54-3	
2-Hexanone	**<0.79**	ug/m3	8.0	0.79	1.92		08/15/16 20:45	591-78-6	
Methylene Chloride	**8.7**	ug/m3	6.8	1.0	1.92		08/15/16 20:45	75-09-2	
4-Methyl-2-pentanone (MIBK)	**<0.42**	ug/m3	8.0	0.42	1.92		08/15/16 20:45	108-10-1	
Methyl-tert-butyl ether	**<0.58**	ug/m3	7.0	0.58	1.92		08/15/16 20:45	1634-04-4	
Naphthalene	**30.4**	ug/m3	5.1	0.59	1.92		08/15/16 20:45	91-20-3	
2-Propanol	**30.4**	ug/m3	4.8	0.46	1.92		08/15/16 20:45	67-63-0	
Propylene	**<0.26**	ug/m3	0.67	0.26	1.92		08/15/16 20:45	115-07-1	
Styrene	**3.0**	ug/m3	1.7	0.37	1.92		08/15/16 20:45	100-42-5	
1,1,2,2-Tetrachloroethane	**<0.63**	ug/m3	1.3	0.63	1.92		08/15/16 20:45	79-34-5	
Tetrachloroethene	**<0.53**	ug/m3	1.3	0.53	1.92		08/15/16 20:45	127-18-4	
Tetrahydrofuran	**<0.23**	ug/m3	1.2	0.23	1.92		08/15/16 20:45	109-99-9	
Toluene	**57.5**	ug/m3	1.5	0.30	1.92		08/15/16 20:45	108-88-3	
1,2,4-Trichlorobenzene	**<1.7**	ug/m3	7.2	1.7	1.92		08/15/16 20:45	120-82-1	
1,1,1-Trichloroethane	**3.4**	ug/m3	2.1	0.47	1.92		08/15/16 20:45	71-55-6	
1,1,2-Trichloroethane	**<0.47**	ug/m3	1.1	0.47	1.92		08/15/16 20:45	79-00-5	
Trichloroethene	**<0.53**	ug/m3	1.1	0.53	1.92		08/15/16 20:45	79-01-6	
Trichlorofluoromethane	**<0.25**	ug/m3	2.2	0.25	1.92		08/15/16 20:45	75-69-4	
1,1,2-Trichlorotrifluoroethane	**5.2**	ug/m3	3.1	0.58	1.92		08/15/16 20:45	76-13-1	
1,2,4-Trimethylbenzene	**<0.24**	ug/m3	1.9	0.24	1.92		08/15/16 20:45	95-63-6	
1,3,5-Trimethylbenzene	**21.2**	ug/m3	1.9	0.35	1.92		08/15/16 20:45	108-67-8	
Vinyl acetate	**<0.63**	ug/m3	1.4	0.63	1.92		08/15/16 20:45	108-05-4	
Vinyl chloride	**<0.37**	ug/m3	0.50	0.37	1.92		08/15/16 20:45	75-01-4	
m&p-Xylene	**9.6**	ug/m3	3.4	1.5	1.92		08/15/16 20:45	179601-23-1	
o-Xylene	**5.5**	ug/m3	1.7	0.67	1.92		08/15/16 20:45	95-47-6	

ANALYTICAL RESULTS

Project: 1290.01.01 OSU Cascades- Rev.
Pace Project No.: 10357548

Sample: B4-SV-10.0 **Lab ID: 10357548004** Collected: 07/28/16 15:15 Received: 08/02/16 09:15 Matrix: Air

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
Method 3C AIR - Fixed Gases	Analytical Method: Method 3C Gases								
Carbon dioxide	**27.6**	%	2.0	0.99	1		08/15/16 11:00	124-38-9	
Carbon monoxide	**<0.16**	%	0.40	0.16	1		08/15/16 11:00	630-08-0	
Helium	**<0.98**	%	3.6	0.98	1		08/15/16 11:00	7440-59-7	
Methane	**7.9**	%	4.0	0.73	1		08/15/16 11:00	74-82-8	
Nitrogen	**64.5**	%	8.0	4.0	1		08/15/16 11:00	7727-37-9	
Oxygen	**<0.29**	%	2.0	0.29	1		08/15/16 11:00	7782-44-7	
TO15 MSV AIR	Analytical Method: TO-15								
Acetone	**1220**	ug/m3	102	35.3	42.4		08/17/16 02:04	67-64-1	
Benzene	**34.8**	ug/m3	0.69	0.26	2.12		08/15/16 21:16	71-43-2	
Benzyl chloride	**<0.35**	ug/m3	2.2	0.35	2.12		08/15/16 21:16	100-44-7	
Bromodichloromethane	**<0.41**	ug/m3	2.9	0.41	2.12		08/15/16 21:16	75-27-4	
Bromoform	**<1.9**	ug/m3	11.1	1.9	2.12		08/15/16 21:16	75-25-2	
Bromomethane	**<0.66**	ug/m3	1.7	0.66	2.12		08/15/16 21:16	74-83-9	
1,3-Butadiene	**<0.37**	ug/m3	0.95	0.37	2.12		08/15/16 21:16	106-99-0	
2-Butanone (MEK)	**188**	ug/m3	6.4	0.48	2.12		08/15/16 21:16	78-93-3	
Carbon disulfide	**49.3**	ug/m3	1.3	0.21	2.12		08/15/16 21:16	75-15-0	
Carbon tetrachloride	**<0.41**	ug/m3	1.4	0.41	2.12		08/15/16 21:16	56-23-5	
Chlorobenzene	**15.6**	ug/m3	2.0	0.28	2.12		08/15/16 21:16	108-90-7	
Chloroethane	**31.5**	ug/m3	1.1	0.41	2.12		08/15/16 21:16	75-00-3	
Chloroform	**<0.40**	ug/m3	1.1	0.40	2.12		08/15/16 21:16	67-66-3	
Chloromethane	**<0.23**	ug/m3	0.89	0.23	2.12		08/15/16 21:16	74-87-3	
Cyclohexane	**87.1**	ug/m3	1.5	0.67	2.12		08/15/16 21:16	110-82-7	
Dibromochloromethane	**<1.8**	ug/m3	3.7	1.8	2.12		08/15/16 21:16	124-48-1	
1,2-Dibromoethane (EDB)	**<1.6**	ug/m3	3.3	1.6	2.12		08/15/16 21:16	106-93-4	
1,2-Dichlorobenzene	**<1.1**	ug/m3	2.6	1.1	2.12		08/15/16 21:16	95-50-1	
1,3-Dichlorobenzene	**25.8**	ug/m3	2.6	1.1	2.12		08/15/16 21:16	541-73-1	
1,4-Dichlorobenzene	**<1.1**	ug/m3	2.6	1.1	2.12		08/15/16 21:16	106-46-7	
Dichlorodifluoromethane	**831**	ug/m3	42.8	20.4	42.4		08/17/16 02:04	75-71-8	
1,1-Dichloroethane	**24.6**	ug/m3	1.7	0.33	2.12		08/15/16 21:16	75-34-3	
1,2-Dichloroethane	**2.9**	ug/m3	0.87	0.43	2.12		08/15/16 21:16	107-06-2	
1,1-Dichloroethene	**12.3**	ug/m3	1.7	0.50	2.12		08/15/16 21:16	75-35-4	
cis-1,2-Dichloroethene	**121**	ug/m3	1.7	0.52	2.12		08/15/16 21:16	156-59-2	
trans-1,2-Dichloroethene	**<0.81**	ug/m3	1.7	0.81	2.12		08/15/16 21:16	156-60-5	
1,2-Dichloropropane	**<0.57**	ug/m3	2.0	0.57	2.12		08/15/16 21:16	78-87-5	
cis-1,3-Dichloropropene	**<0.78**	ug/m3	2.0	0.78	2.12		08/15/16 21:16	10061-01-5	
trans-1,3-Dichloropropene	**<0.55**	ug/m3	2.0	0.55	2.12		08/15/16 21:16	10061-02-6	
Dichlorotetrafluoroethane	**<0.66**	ug/m3	3.0	0.66	2.12		08/15/16 21:16	76-14-2	
Ethanol	**<0.56**	ug/m3	2.0	0.56	2.12		08/15/16 21:16	64-17-5	
Ethyl acetate	**4.8**	ug/m3	1.5	0.74	2.12		08/15/16 21:16	141-78-6	
Ethylbenzene	**518**	ug/m3	37.3	18.0	42.4		08/17/16 02:04	100-41-4	
4-Ethyltoluene	**164**	ug/m3	42.4	8.0	42.4		08/17/16 02:04	622-96-8	
n-Heptane	**729**	ug/m3	35.2	11.8	42.4		08/17/16 02:04	142-82-5	
Hexachloro-1,3-butadiene	**<1.4**	ug/m3	4.6	1.4	2.12		08/15/16 21:16	87-68-3	
n-Hexane	**88.3**	ug/m3	1.5	0.76	2.12		08/15/16 21:16	110-54-3	
2-Hexanone	**31.4**	ug/m3	8.8	0.87	2.12		08/15/16 21:16	591-78-6	

ANALYTICAL RESULTS

Project: 1290.01.01 OSU Cascades- Rev.
Pace Project No.: 10357548

Sample: B4-SV-10.0 **Lab ID: 10357548004** Collected: 07/28/16 15:15 Received: 08/02/16 09:15 Matrix: Air

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
TO15 MSV AIR	Analytical Method: TO-15								
Methylene Chloride	**67.4**	ug/m3	7.5	1.1	2.12		08/15/16 21:16	75-09-2	
4-Methyl-2-pentanone (MIBK)	**370**	ug/m3	8.8	0.46	2.12		08/15/16 21:16	108-10-1	
Methyl-tert-butyl ether	**1.6J**	ug/m3	7.8	0.64	2.12		08/15/16 21:16	1634-04-4	
Naphthalene	**42.5**	ug/m3	5.6	0.65	2.12		08/15/16 21:16	91-20-3	
2-Propanol	**427**	ug/m3	5.3	0.51	2.12		08/15/16 21:16	67-63-0	
Propylene	**747**	ug/m3	14.8	5.7	42.4		08/17/16 02:04	115-07-1	
Styrene	**<0.41**	ug/m3	1.8	0.41	2.12		08/15/16 21:16	100-42-5	
1,1,2,2-Tetrachloroethane	**151**	ug/m3	1.5	0.70	2.12		08/15/16 21:16	79-34-5	
Tetrachloroethene	**264**	ug/m3	1.5	0.59	2.12		08/15/16 21:16	127-18-4	
Tetrahydrofuran	**<0.25**	ug/m3	1.3	0.25	2.12		08/15/16 21:16	109-99-9	
Toluene	**815**	ug/m3	32.6	6.5	42.4		08/17/16 02:04	108-88-3	
1,2,4-Trichlorobenzene	**<1.9**	ug/m3	8.0	1.9	2.12		08/15/16 21:16	120-82-1	
1,1,1-Trichloroethane	**<0.52**	ug/m3	2.4	0.52	2.12		08/15/16 21:16	71-55-6	
1,1,2-Trichloroethane	**<0.52**	ug/m3	1.2	0.52	2.12		08/15/16 21:16	79-00-5	
Trichloroethene	**141**	ug/m3	1.2	0.59	2.12		08/15/16 21:16	79-01-6	
Trichlorofluoromethane	**<0.28**	ug/m3	2.4	0.28	2.12		08/15/16 21:16	75-69-4	
1,1,2-Trichlorotrifluoroethane	**<0.64**	ug/m3	3.4	0.64	2.12		08/15/16 21:16	76-13-1	
1,2,4-Trimethylbenzene	**831**	ug/m3	42.4	5.3	42.4		08/17/16 02:04	95-63-6	
1,3,5-Trimethylbenzene	**276**	ug/m3	2.1	0.39	2.12		08/15/16 21:16	108-67-8	
Vinyl acetate	**<0.70**	ug/m3	1.5	0.70	2.12		08/15/16 21:16	108-05-4	
Vinyl chloride	**<0.41**	ug/m3	0.55	0.41	2.12		08/15/16 21:16	75-01-4	
m&p-Xylene	**1170**	ug/m3	75.0	33.3	42.4		08/17/16 02:04	179601-23-1	
o-Xylene	**424**	ug/m3	37.3	14.9	42.4		08/17/16 02:04	95-47-6	

Sample: B5-SV-10.0 **Lab ID: 10357548005** Collected: 07/28/16 17:20 Received: 08/02/16 09:15 Matrix: Air

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
Method 3C AIR - Fixed Gases	Analytical Method: Method 3C Gases								
Carbon dioxide	**31.5**	%	2.0	0.99	1		08/15/16 11:10	124-38-9	
Carbon monoxide	**<0.16**	%	0.40	0.16	1		08/15/16 11:10	630-08-0	
Helium	**<0.98**	%	3.6	0.98	1		08/15/16 11:10	7440-59-7	
Methane	**10.8**	%	4.0	0.73	1		08/15/16 11:10	74-82-8	
Nitrogen	**57.7**	%	8.0	4.0	1		08/15/16 11:10	7727-37-9	
Oxygen	**<0.29**	%	2.0	0.29	1		08/15/16 11:10	7782-44-7	
TO15 MSV AIR	Analytical Method: TO-15								
Acetone	**32.2**	ug/m3	4.6	1.6	1.92		08/15/16 21:48	67-64-1	
Benzene	**31.0**	ug/m3	0.62	0.23	1.92		08/15/16 21:48	71-43-2	
Benzyl chloride	**<0.32**	ug/m3	2.0	0.32	1.92		08/15/16 21:48	100-44-7	
Bromodichloromethane	**<0.37**	ug/m3	2.6	0.37	1.92		08/15/16 21:48	75-27-4	
Bromoform	**<1.7**	ug/m3	10.1	1.7	1.92		08/15/16 21:48	75-25-2	
Bromomethane	**<0.60**	ug/m3	1.5	0.60	1.92		08/15/16 21:48	74-83-9	
1,3-Butadiene	**<0.34**	ug/m3	0.86	0.34	1.92		08/15/16 21:48	106-99-0	

ANALYTICAL RESULTS

Project: 1290.01.01 OSU Cascades- Rev.
Pace Project No.: 10357548

Sample: B5-SV-10.0 **Lab ID: 10357548005** Collected: 07/28/16 17:20 Received: 08/02/16 09:15 Matrix: Air

TO15 MSV AIR Analytical Method: TO-15

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
2-Butanone (MEK)	**<0.44**	ug/m3	5.8	0.44	1.92		08/15/16 21:48	78-93-3	
Carbon disulfide	**19.1**	ug/m3	1.2	0.19	1.92		08/15/16 21:48	75-15-0	
Carbon tetrachloride	**<0.37**	ug/m3	1.2	0.37	1.92		08/15/16 21:48	56-23-5	
Chlorobenzene	**9.6**	ug/m3	1.8	0.26	1.92		08/15/16 21:48	108-90-7	
Chloroethane	**<0.37**	ug/m3	1.0	0.37	1.92		08/15/16 21:48	75-00-3	
Chloroform	**<0.36**	ug/m3	0.95	0.36	1.92		08/15/16 21:48	67-66-3	
Chloromethane	**<0.21**	ug/m3	0.81	0.21	1.92		08/15/16 21:48	74-87-3	
Cyclohexane	**511**	ug/m3	26.9	12.1	38.4		08/17/16 02:32	110-82-7	
Dibromochloromethane	**<1.6**	ug/m3	3.3	1.6	1.92		08/15/16 21:48	124-48-1	
1,2-Dibromoethane (EDB)	**<1.5**	ug/m3	3.0	1.5	1.92		08/15/16 21:48	106-93-4	
1,2-Dichlorobenzene	**323**	ug/m3	46.8	19.7	38.4		08/17/16 02:32	95-50-1	
1,3-Dichlorobenzene	**47.7**	ug/m3	2.3	1.0	1.92		08/15/16 21:48	541-73-1	
1,4-Dichlorobenzene	**27.3**	ug/m3	2.3	0.96	1.92		08/15/16 21:48	106-46-7	
Dichlorodifluoromethane	**<0.92**	ug/m3	1.9	0.92	1.92		08/15/16 21:48	75-71-8	
1,1-Dichloroethane	**2.6**	ug/m3	1.6	0.30	1.92		08/15/16 21:48	75-34-3	
1,2-Dichloroethane	**<0.39**	ug/m3	0.79	0.39	1.92		08/15/16 21:48	107-06-2	
1,1-Dichloroethene	**<0.46**	ug/m3	1.6	0.46	1.92		08/15/16 21:48	75-35-4	
cis-1,2-Dichloroethene	**24.8**	ug/m3	1.6	0.47	1.92		08/15/16 21:48	156-59-2	
trans-1,2-Dichloroethene	**<0.74**	ug/m3	1.6	0.74	1.92		08/15/16 21:48	156-60-5	
1,2-Dichloropropane	**<0.52**	ug/m3	1.8	0.52	1.92		08/15/16 21:48	78-87-5	
cis-1,3-Dichloropropene	**<0.71**	ug/m3	1.8	0.71	1.92		08/15/16 21:48	10061-01-5	
trans-1,3-Dichloropropene	**<0.50**	ug/m3	1.8	0.50	1.92		08/15/16 21:48	10061-02-6	
Dichlorotetrafluoroethane	**<0.60**	ug/m3	2.7	0.60	1.92		08/15/16 21:48	76-14-2	
Ethanol	**<0.51**	ug/m3	1.8	0.51	1.92		08/15/16 21:48	64-17-5	
Ethyl acetate	**<0.67**	ug/m3	1.4	0.67	1.92		08/15/16 21:48	141-78-6	
Ethylbenzene	**109**	ug/m3	1.7	0.82	1.92		08/15/16 21:48	100-41-4	
4-Ethyltoluene	**20.8**	ug/m3	1.9	0.36	1.92		08/15/16 21:48	622-96-8	
n-Heptane	**490**	ug/m3	31.9	10.7	38.4		08/17/16 02:32	142-82-5	
Hexachloro-1,3-butadiene	**<1.2**	ug/m3	4.2	1.2	1.92		08/15/16 21:48	87-68-3	
n-Hexane	**413**	ug/m3	27.6	13.7	38.4		08/17/16 02:32	110-54-3	
2-Hexanone	**<0.79**	ug/m3	8.0	0.79	1.92		08/15/16 21:48	591-78-6	
Methylene Chloride	**<1.0**	ug/m3	6.8	1.0	1.92		08/15/16 21:48	75-09-2	
4-Methyl-2-pentanone (MIBK)	**<0.42**	ug/m3	8.0	0.42	1.92		08/15/16 21:48	108-10-1	
Methyl-tert-butyl ether	**<0.58**	ug/m3	7.0	0.58	1.92		08/15/16 21:48	1634-04-4	
Naphthalene	**63.8**	ug/m3	5.1	0.59	1.92		08/15/16 21:48	91-20-3	
2-Propanol	**20.8**	ug/m3	4.8	0.46	1.92		08/15/16 21:48	67-63-0	
Propylene	**<0.26**	ug/m3	0.67	0.26	1.92		08/15/16 21:48	115-07-1	
Styrene	**<0.37**	ug/m3	1.7	0.37	1.92		08/15/16 21:48	100-42-5	
1,1,2,2-Tetrachloroethane	**<0.63**	ug/m3	1.3	0.63	1.92		08/15/16 21:48	79-34-5	
Tetrachloroethene	**3.9**	ug/m3	1.3	0.53	1.92		08/15/16 21:48	127-18-4	
Tetrahydrofuran	**<0.23**	ug/m3	1.2	0.23	1.92		08/15/16 21:48	109-99-9	
Toluene	**63.8**	ug/m3	1.5	0.30	1.92		08/15/16 21:48	108-88-3	
1,2,4-Trichlorobenzene	**<1.7**	ug/m3	7.2	1.7	1.92		08/15/16 21:48	120-82-1	
1,1,1-Trichloroethane	**<0.47**	ug/m3	2.1	0.47	1.92		08/15/16 21:48	71-55-6	
1,1,2-Trichloroethane	**<0.47**	ug/m3	1.1	0.47	1.92		08/15/16 21:48	79-00-5	
Trichloroethene	**1.8**	ug/m3	1.1	0.53	1.92		08/15/16 21:48	79-01-6	

ANALYTICAL RESULTS

Project: 1290.01.01 OSU Cascades- Rev.
Pace Project No.: 10357548

Sample: B5-SV-10.0 **Lab ID: 10357548005** Collected: 07/28/16 17:20 Received: 08/02/16 09:15 Matrix: Air

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
TO15 MSV AIR	Analytical Method: TO-15								
Trichlorofluoromethane	**8.4**	ug/m3	2.2	0.25	1.92		08/15/16 21:48	75-69-4	
1,1,2-Trichlorotrifluoroethane	**<0.58**	ug/m3	3.1	0.58	1.92		08/15/16 21:48	76-13-1	
1,2,4-Trimethylbenzene	**<0.24**	ug/m3	1.9	0.24	1.92		08/15/16 21:48	95-63-6	
1,3,5-Trimethylbenzene	**14.4**	ug/m3	1.9	0.35	1.92		08/15/16 21:48	108-67-8	
Vinyl acetate	**<0.63**	ug/m3	1.4	0.63	1.92		08/15/16 21:48	108-05-4	
Vinyl chloride	**<0.37**	ug/m3	0.50	0.37	1.92		08/15/16 21:48	75-01-4	
m&p-Xylene	**35.8**	ug/m3	3.4	1.5	1.92		08/15/16 21:48	179601-23-1	
o-Xylene	**31.2**	ug/m3	1.7	0.67	1.92		08/15/16 21:48	95-47-6	

Sample: B6-SV-10.0 **Lab ID: 10357548006** Collected: 07/29/16 09:44 Received: 08/02/16 09:15 Matrix: Air

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
Method 3C AIR - Fixed Gases	Analytical Method: Method 3C Gases								
Carbon dioxide	**9.3**	%	2.0	0.99	1		08/15/16 11:20	124-38-9	
Carbon monoxide	**<0.16**	%	0.40	0.16	1		08/15/16 11:20	630-08-0	
Helium	**<0.98**	%	3.6	0.98	1		08/15/16 11:20	7440-59-7	
Methane	**<0.73**	%	4.0	0.73	1		08/15/16 11:20	74-82-8	
Nitrogen	**76.9**	%	8.0	4.0	1		08/15/16 11:20	7727-37-9	
Oxygen	**13.8**	%	2.0	0.29	1		08/15/16 11:20	7782-44-7	
TO15 MSV AIR	Analytical Method: TO-15								
Acetone	**49.3**	ug/m3	4.4	1.5	1.83		08/16/16 17:41	67-64-1	
Benzene	**2.1**	ug/m3	0.59	0.22	1.83		08/16/16 17:41	71-43-2	
Benzyl chloride	**<0.30**	ug/m3	1.9	0.30	1.83		08/16/16 17:41	100-44-7	
Bromodichloromethane	**<0.36**	ug/m3	2.5	0.36	1.83		08/16/16 17:41	75-27-4	
Bromoform	**<1.6**	ug/m3	9.6	1.6	1.83		08/16/16 17:41	75-25-2	
Bromomethane	**<0.57**	ug/m3	1.4	0.57	1.83		08/16/16 17:41	74-83-9	
1,3-Butadiene	**<0.32**	ug/m3	0.82	0.32	1.83		08/16/16 17:41	106-99-0	
2-Butanone (MEK)	**7.1**	ug/m3	5.5	0.42	1.83		08/16/16 17:41	78-93-3	
Carbon disulfide	**11.0**	ug/m3	1.2	0.18	1.83		08/16/16 17:41	75-15-0	
Carbon tetrachloride	**<0.35**	ug/m3	1.2	0.35	1.83		08/16/16 17:41	56-23-5	
Chlorobenzene	**<0.25**	ug/m3	1.7	0.25	1.83		08/16/16 17:41	108-90-7	
Chloroethane	**<0.36**	ug/m3	0.99	0.36	1.83		08/16/16 17:41	75-00-3	
Chloroform	**<0.35**	ug/m3	0.91	0.35	1.83		08/16/16 17:41	67-66-3	
Chloromethane	**<0.20**	ug/m3	0.77	0.20	1.83		08/16/16 17:41	74-87-3	
Cyclohexane	**3.5**	ug/m3	1.3	0.58	1.83		08/16/16 17:41	110-82-7	
Dibromochloromethane	**<1.6**	ug/m3	3.2	1.6	1.83		08/16/16 17:41	124-48-1	
1,2-Dibromoethane (EDB)	**<1.4**	ug/m3	2.9	1.4	1.83		08/16/16 17:41	106-93-4	
1,2-Dichlorobenzene	**<0.94**	ug/m3	2.2	0.94	1.83		08/16/16 17:41	95-50-1	
1,3-Dichlorobenzene	**4.3**	ug/m3	2.2	0.97	1.83		08/16/16 17:41	541-73-1	
1,4-Dichlorobenzene	**<0.91**	ug/m3	2.2	0.91	1.83		08/16/16 17:41	106-46-7	
Dichlorodifluoromethane	**3.3**	ug/m3	1.8	0.88	1.83		08/16/16 17:41	75-71-8	
1,1-Dichloroethane	**<0.29**	ug/m3	1.5	0.29	1.83		08/16/16 17:41	75-34-3	

ANALYTICAL RESULTS

Project: 1290.01.01 OSU Cascades- Rev.
Pace Project No.: 10357548

Sample: B6-SV-10.0 **Lab ID: 10357548006** Collected: 07/29/16 09:44 Received: 08/02/16 09:15 Matrix: Air

Parameters	Results	Units	PQL	MDL	DF	Prepared	Analyzed	CAS No.	Qual
TO15 MSV AIR	Analytical Method: TO-15								
1,2-Dichloroethane	**<0.38**	ug/m3	0.75	0.38	1.83		08/16/16 17:41	107-06-2	
1,1-Dichloroethene	**<0.44**	ug/m3	1.5	0.44	1.83		08/16/16 17:41	75-35-4	
cis-1,2-Dichloroethene	**<0.45**	ug/m3	1.5	0.45	1.83		08/16/16 17:41	156-59-2	
trans-1,2-Dichloroethene	**<0.70**	ug/m3	1.5	0.70	1.83		08/16/16 17:41	156-60-5	
1,2-Dichloropropane	**<0.49**	ug/m3	1.7	0.49	1.83		08/16/16 17:41	78-87-5	
cis-1,3-Dichloropropene	**<0.68**	ug/m3	1.7	0.68	1.83		08/16/16 17:41	10061-01-5	
trans-1,3-Dichloropropene	**<0.48**	ug/m3	1.7	0.48	1.83		08/16/16 17:41	10061-02-6	
Dichlorotetrafluoroethane	**<0.57**	ug/m3	2.6	0.57	1.83		08/16/16 17:41	76-14-2	
Ethanol	**<0.48**	ug/m3	1.8	0.48	1.83		08/16/16 17:41	64-17-5	
Ethyl acetate	**1.4**	ug/m3	1.3	0.64	1.83		08/16/16 17:41	141-78-6	
Ethylbenzene	**3.5**	ug/m3	1.6	0.78	1.83		08/16/16 17:41	100-41-4	
4-Ethyltoluene	**1.7J**	ug/m3	1.8	0.34	1.83		08/16/16 17:41	622-96-8	
n-Heptane	**1.6**	ug/m3	1.5	0.51	1.83		08/16/16 17:41	142-82-5	
Hexachloro-1,3-butadiene	**<1.2**	ug/m3	4.0	1.2	1.83		08/16/16 17:41	87-68-3	
n-Hexane	**21.5**	ug/m3	1.3	0.65	1.83		08/16/16 17:41	110-54-3	
2-Hexanone	**1.2J**	ug/m3	7.6	0.75	1.83		08/16/16 17:41	591-78-6	
Methylene Chloride	**232**	ug/m3	6.5	0.99	1.83		08/16/16 17:41	75-09-2	
4-Methyl-2-pentanone (MIBK)	**1.3J**	ug/m3	7.6	0.40	1.83		08/16/16 17:41	108-10-1	
Methyl-tert-butyl ether	**<0.55**	ug/m3	6.7	0.55	1.83		08/16/16 17:41	1634-04-4	
Naphthalene	**11.0**	ug/m3	4.9	0.56	1.83		08/16/16 17:41	91-20-3	
2-Propanol	**2.1J**	ug/m3	4.6	0.44	1.83		08/16/16 17:41	67-63-0	
Propylene	**55.0**	ug/m3	0.64	0.25	1.83		08/16/16 17:41	115-07-1	
Styrene	**1.4J**	ug/m3	1.6	0.35	1.83		08/16/16 17:41	100-42-5	
1,1,2,2-Tetrachloroethane	**<0.60**	ug/m3	1.3	0.60	1.83		08/16/16 17:41	79-34-5	
Tetrachloroethene	**<0.51**	ug/m3	1.3	0.51	1.83		08/16/16 17:41	127-18-4	
Tetrahydrofuran	**<0.22**	ug/m3	1.1	0.22	1.83		08/16/16 17:41	109-99-9	
Toluene	**14.2**	ug/m3	1.4	0.28	1.83		08/16/16 17:41	108-88-3	
1,2,4-Trichlorobenzene	**<1.7**	ug/m3	6.9	1.7	1.83		08/16/16 17:41	120-82-1	
1,1,1-Trichloroethane	**<0.45**	ug/m3	2.0	0.45	1.83		08/16/16 17:41	71-55-6	
1,1,2-Trichloroethane	**<0.45**	ug/m3	1.0	0.45	1.83		08/16/16 17:41	79-00-5	
Trichloroethene	**<0.51**	ug/m3	1.0	0.51	1.83		08/16/16 17:41	79-01-6	
Trichlorofluoromethane	**9.0**	ug/m3	2.1	0.24	1.83		08/16/16 17:41	75-69-4	
1,1,2-Trichlorotrifluoroethane	**<0.55**	ug/m3	2.9	0.55	1.83		08/16/16 17:41	76-13-1	
1,2,4-Trimethylbenzene	**6.8**	ug/m3	1.8	0.23	1.83		08/16/16 17:41	95-63-6	
1,3,5-Trimethylbenzene	**1.9**	ug/m3	1.8	0.33	1.83		08/16/16 17:41	108-67-8	
Vinyl acetate	**<0.60**	ug/m3	1.3	0.60	1.83		08/16/16 17:41	108-05-4	
Vinyl chloride	**<0.36**	ug/m3	0.48	0.36	1.83		08/16/16 17:41	75-01-4	
m&p-Xylene	**10.4**	ug/m3	3.2	1.4	1.83		08/16/16 17:41	179601-23-1	
o-Xylene	**4.2**	ug/m3	1.6	0.64	1.83		08/16/16 17:41	95-47-6	

QUALITY CONTROL DATA

Project: 1290.01.01 OSU Cascades- Rev.
Pace Project No.: 10357548

QC Batch: 430558
Analysis Method: Method 3C Gases
QC Batch Method: Method 3C Gases
Analysis Description: METHOD 3C AIR - FIXED GASES
Associated Lab Samples: 10357548001, 10357548002, 10357548003, 10357548004, 10357548005, 10357548006

METHOD BLANK: 2342358
Matrix: Air
Associated Lab Samples: 10357548001, 10357548002, 10357548003, 10357548004, 10357548005, 10357548006

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Carbon dioxide	%	<0.99	2.0	0.99	08/15/16 10:09	
Carbon monoxide	%	<0.16	0.40	0.16	08/15/16 10:09	
Helium	%	<0.98	3.6	0.98	08/15/16 10:09	
Methane	%	<0.73	4.0	0.73	08/15/16 10:09	
Nitrogen	%	<4.0	8.0	4.0	08/15/16 10:09	
Oxygen	%	<0.29	2.0	0.29	08/15/16 10:09	

LABORATORY CONTROL SAMPLE & LCSD: 2342359 2342360

Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% Rec Limits	RPD	Max RPD	Qualifiers
Carbon dioxide	%	10	9.1	9.0	91	90	70-130	0	30	
Carbon monoxide	%	2	1.7	1.7	87	86	70-130	2	30	
Helium	%	18	21.9	22.2	121	123	70-130	2	30	
Methane	%	20	17.3	17.0	87	85	70-130	2	30	
Nitrogen	%	40	39.8	39.5	100	99	70-130	1	30	
Oxygen	%	10	10.2	10.5	102	105	70-130	4	30	

SAMPLE DUPLICATE: 2342361

Parameter	Units	10357548001 Result	Dup Result	RPD	Max RPD	Qualifiers
Carbon dioxide	%	29.9	29.8	0	30	
Carbon monoxide	%	<0.16	<0.16		30	
Helium	%	<0.98	<0.98		30	
Methane	%	5.3	5.2	1	30	
Nitrogen	%	64.9	64.6	0	30	
Oxygen	%	<0.29	0.40J		30	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: 1290.01.01 OSU Cascades- Rev.
Pace Project No.: 10357548

QC Batch: 430662
Analysis Method: TO-15
QC Batch Method: TO-15
Analysis Description: TO15 MSV AIR Low Level
Associated Lab Samples: 10357548001, 10357548002, 10357548003, 10357548004, 10357548005

METHOD BLANK: 2342998
Matrix: Air
Associated Lab Samples: 10357548001, 10357548002, 10357548003, 10357548004, 10357548005

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
1,1,1-Trichloroethane	ug/m3	<0.25	1.1	0.25	08/15/16 10:22	
1,1,2,2-Tetrachloroethane	ug/m3	<0.33	0.70	0.33	08/15/16 10:22	
1,1,2-Trichloroethane	ug/m3	<0.25	0.55	0.25	08/15/16 10:22	
1,1,2-Trichlorotrifluoroethane	ug/m3	<0.30	1.6	0.30	08/15/16 10:22	
1,1-Dichloroethane	ug/m3	<0.16	0.82	0.16	08/15/16 10:22	
1,1-Dichloroethene	ug/m3	<0.24	0.81	0.24	08/15/16 10:22	
1,2,4-Trichlorobenzene	ug/m3	<0.91	3.8	0.91	08/15/16 10:22	
1,2,4-Trimethylbenzene	ug/m3	<0.12	1.0	0.12	08/15/16 10:22	
1,2-Dibromoethane (EDB)	ug/m3	<0.77	1.6	0.77	08/15/16 10:22	
1,2-Dichlorobenzene	ug/m3	<0.51	1.2	0.51	08/15/16 10:22	
1,2-Dichloroethane	ug/m3	<0.20	0.41	0.20	08/15/16 10:22	
1,2-Dichloropropane	ug/m3	<0.27	0.94	0.27	08/15/16 10:22	
1,3,5-Trimethylbenzene	ug/m3	<0.18	1.0	0.18	08/15/16 10:22	
1,3-Butadiene	ug/m3	<0.18	0.45	0.18	08/15/16 10:22	
1,3-Dichlorobenzene	ug/m3	<0.53	1.2	0.53	08/15/16 10:22	
1,4-Dichlorobenzene	ug/m3	<0.50	1.2	0.50	08/15/16 10:22	
2-Butanone (MEK)	ug/m3	<0.23	3.0	0.23	08/15/16 10:22	
2-Hexanone	ug/m3	<0.41	4.2	0.41	08/15/16 10:22	
2-Propanol	ug/m3	<0.24	2.5	0.24	08/15/16 10:22	
4-Ethyltoluene	ug/m3	<0.19	1.0	0.19	08/15/16 10:22	
4-Methyl-2-pentanone (MIBK)	ug/m3	<0.22	4.2	0.22	08/15/16 10:22	
Acetone	ug/m3	<0.83	2.4	0.83	08/15/16 10:22	
Benzene	ug/m3	<0.12	0.32	0.12	08/15/16 10:22	
Benzyl chloride	ug/m3	<0.17	1.0	0.17	08/15/16 10:22	
Bromodichloromethane	ug/m3	<0.19	1.4	0.19	08/15/16 10:22	
Bromoform	ug/m3	<0.90	5.3	0.90	08/15/16 10:22	
Bromomethane	ug/m3	<0.31	0.79	0.31	08/15/16 10:22	
Carbon disulfide	ug/m3	<0.10	0.63	0.10	08/15/16 10:22	
Carbon tetrachloride	ug/m3	<0.19	0.64	0.19	08/15/16 10:22	
Chlorobenzene	ug/m3	<0.13	0.94	0.13	08/15/16 10:22	
Chloroethane	ug/m3	<0.19	0.54	0.19	08/15/16 10:22	
Chloroform	ug/m3	<0.19	0.50	0.19	08/15/16 10:22	
Chloromethane	ug/m3	<0.11	0.42	0.11	08/15/16 10:22	
cis-1,2-Dichloroethene	ug/m3	<0.25	0.81	0.25	08/15/16 10:22	
cis-1,3-Dichloropropene	ug/m3	<0.37	0.92	0.37	08/15/16 10:22	
Cyclohexane	ug/m3	<0.32	0.70	0.32	08/15/16 10:22	
Dibromochloromethane	ug/m3	<0.86	1.7	0.86	08/15/16 10:22	
Dichlorodifluoromethane	ug/m3	<0.48	1.0	0.48	08/15/16 10:22	
Dichlorotetrafluoroethane	ug/m3	<0.31	1.4	0.31	08/15/16 10:22	
Ethanol	ug/m3	<0.26	0.96	0.26	08/15/16 10:22	
Ethyl acetate	ug/m3	<0.35	0.73	0.35	08/15/16 10:22	

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QUALITY CONTROL DATA

Project: 1290.01.01 OSU Cascades- Rev.
Pace Project No.: 10357548

METHOD BLANK: 2342998 Matrix: Air
Associated Lab Samples: 10357548001, 10357548002, 10357548003, 10357548004, 10357548005

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Ethylbenzene	ug/m3	<0.42	0.88	0.42	08/15/16 10:22	
Hexachloro-1,3-butadiene	ug/m3	<0.65	2.2	0.65	08/15/16 10:22	
m&p-Xylene	ug/m3	<0.79	1.8	0.79	08/15/16 10:22	
Methyl-tert-butyl ether	ug/m3	<0.30	3.7	0.30	08/15/16 10:22	
Methylene Chloride	ug/m3	<0.54	3.5	0.54	08/15/16 10:22	
n-Heptane	ug/m3	<0.28	0.83	0.28	08/15/16 10:22	
n-Hexane	ug/m3	<0.36	0.72	0.36	08/15/16 10:22	
Naphthalene	ug/m3	<0.30	2.7	0.30	08/15/16 10:22	
o-Xylene	ug/m3	<0.35	0.88	0.35	08/15/16 10:22	
Propylene	ug/m3	<0.14	0.35	0.14	08/15/16 10:22	
Styrene	ug/m3	<0.19	0.87	0.19	08/15/16 10:22	
Tetrachloroethene	ug/m3	<0.28	0.69	0.28	08/15/16 10:22	
Tetrahydrofuran	ug/m3	<0.12	0.60	0.12	08/15/16 10:22	
Toluene	ug/m3	<0.15	0.77	0.15	08/15/16 10:22	
trans-1,2-Dichloroethene	ug/m3	<0.38	0.81	0.38	08/15/16 10:22	
trans-1,3-Dichloropropene	ug/m3	<0.26	0.92	0.26	08/15/16 10:22	
Trichloroethene	ug/m3	<0.28	0.55	0.28	08/15/16 10:22	
Trichlorofluoromethane	ug/m3	<0.13	1.1	0.13	08/15/16 10:22	
Vinyl acetate	ug/m3	<0.33	0.72	0.33	08/15/16 10:22	
Vinyl chloride	ug/m3	<0.20	0.26	0.20	08/15/16 10:22	

LABORATORY CONTROL SAMPLE: 2342999

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
1,1,1-Trichloroethane	ug/m3	55.5	62.2	112	60-143	
1,1,2,2-Tetrachloroethane	ug/m3	69.8	83.5	120	49-150	
1,1,2-Trichloroethane	ug/m3	55.5	62.7	113	57-149	
1,1,2-Trichlorotrifluoroethane	ug/m3	77.9	88.6	114	66-131	
1,1-Dichloroethane	ug/m3	41.2	45.6	111	62-139	
1,1-Dichloroethene	ug/m3	40.3	43.7	108	62-135	
1,2,4-Trichlorobenzene	ug/m3	75.5	74.9	99	55-146	
1,2,4-Trimethylbenzene	ug/m3	50	59.5	119	57-143	
1,2-Dibromoethane (EDB)	ug/m3	78.1	92.6	118	63-150	
1,2-Dichlorobenzene	ug/m3	61.2	74.4	122	57-141	
1,2-Dichloroethane	ug/m3	41.2	46.0	112	61-144	
1,2-Dichloropropane	ug/m3	47	51.6	110	63-144	
1,3,5-Trimethylbenzene	ug/m3	50	58.7	117	54-147	
1,3-Butadiene	ug/m3	22.5	24.1	107	61-140	
1,3-Dichlorobenzene	ug/m3	61.2	71.3	117	51-150	
1,4-Dichlorobenzene	ug/m3	61.2	67.6	111	57-143	
2-Butanone (MEK)	ug/m3	30	31.9	106	66-144	
2-Hexanone	ug/m3	104	124	119	63-147	
2-Propanol	ug/m3	125	139	111	54-146	
4-Ethyltoluene	ug/m3	50	58.8	118	56-150	

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QUALITY CONTROL DATA

Project: 1290.01.01 OSU Cascades- Rev.
Pace Project No.: 10357548

LABORATORY CONTROL SAMPLE: 2342999

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
4-Methyl-2-pentanone (MIBK)	ug/m3	104	120	116	58-150	
Acetone	ug/m3	121	132	110	46-140	
Benzene	ug/m3	32.5	35.4	109	62-141	
Benzyl chloride	ug/m3	52.5	67.9	129	66-138	
Bromodichloromethane	ug/m3	68.2	78.6	115	58-149	
Bromoform	ug/m3	105	105	100	61-150	
Bromomethane	ug/m3	39.5	43.1	109	58-136	
Carbon disulfide	ug/m3	31.7	34.3	108	59-135	
Carbon tetrachloride	ug/m3	64	77.0	120	60-149	
Chlorobenzene	ug/m3	46.8	52.7	113	60-150	
Chloroethane	ug/m3	26.8	28.4	106	61-136	
Chloroform	ug/m3	49.7	55.7	112	65-138	
Chloromethane	ug/m3	21	23.3	111	62-133	
cis-1,2-Dichloroethene	ug/m3	40.3	45.6	113	65-139	
cis-1,3-Dichloropropene	ug/m3	46.2	53.7	116	61-149	
Cyclohexane	ug/m3	35	37.2	106	64-134	
Dibromochloromethane	ug/m3	86.6	110	127	59-150	
Dichlorodifluoromethane	ug/m3	50.3	55.3	110	63-134	
Dichlorotetrafluoroethane	ug/m3	71.1	78.3	110	62-134	
Ethanol	ug/m3	95.8	93.1	97	50-144	
Ethyl acetate	ug/m3	36.6	42.2	115	55-146	
Ethylbenzene	ug/m3	44.2	50.1	114	59-149	
Hexachloro-1,3-butadiene	ug/m3	108	110	101	42-150	
m&p-Xylene	ug/m3	88.3	103	117	59-146	
Methyl-tert-butyl ether	ug/m3	91.6	102	111	64-135	
Methylene Chloride	ug/m3	177	192	109	64-128	
n-Heptane	ug/m3	41.7	43.1	103	64-140	
n-Hexane	ug/m3	35.8	39.7	111	50-138	
Naphthalene	ug/m3	53.3	57.3	107	46-146	
o-Xylene	ug/m3	44.2	51.3	116	54-149	
Propylene	ug/m3	17.5	18.9	108	58-135	
Styrene	ug/m3	43.3	51.4	119	54-150	
Tetrachloroethene	ug/m3	69	75.5	109	60-142	
Tetrahydrofuran	ug/m3	30	31.5	105	56-143	
Toluene	ug/m3	38.3	42.0	109	61-138	
trans-1,2-Dichloroethene	ug/m3	40.3	45.1	112	67-137	
trans-1,3-Dichloropropene	ug/m3	46.2	55.0	119	59-145	
Trichloroethene	ug/m3	54.6	59.7	109	60-144	
Trichlorofluoromethane	ug/m3	57.1	65.0	114	59-134	
Vinyl acetate	ug/m3	35.8	42.4	118	55-143	
Vinyl chloride	ug/m3	26	28.2	108	63-135	

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QUALITY CONTROL DATA

Project: 1290.01.01 OSU Cascades- Rev.
Pace Project No.: 10357548

SAMPLE DUPLICATE: 2343553

Parameter	Units	10357826002 Result	Dup Result	RPD	Max RPD	Qualifiers
1,1,1-Trichloroethane	ug/m3	<1.9	<0.43		25	
1,1,2,2-Tetrachloroethane	ug/m3	<1.2	<0.58		25	
1,1,2-Trichloroethane	ug/m3	<0.96	<0.43		25	
1,1,2-Trichlorotrifluoroethane	ug/m3	<2.8	<0.53		25	
1,1-Dichloroethane	ug/m3	<1.4	<0.27		25	
1,1-Dichloroethene	ug/m3	<1.4	<0.42		25	
1,2,4-Trichlorobenzene	ug/m3	<6.6	<1.6		25	
1,2,4-Trimethylbenzene	ug/m3	<1.7	1.7J		25	
1,2-Dibromoethane (EDB)	ug/m3	<2.7	<1.4		25	
1,2-Dichlorobenzene	ug/m3	<2.1	<0.90		25	
1,2-Dichloroethane	ug/m3	<0.72	<0.36		25	
1,2-Dichloropropane	ug/m3	<1.6	<0.47		25	
1,3,5-Trimethylbenzene	ug/m3	<1.7	<0.32		25	
1,3-Butadiene	ug/m3	<0.79	<0.31		25	
1,3-Dichlorobenzene	ug/m3	<2.1	<0.93		25	
1,4-Dichlorobenzene	ug/m3	<2.1	<0.87		25	
2-Butanone (MEK)	ug/m3	7.1	8.0	12	25	
2-Hexanone	ug/m3	<7.3	1.9J		25	
2-Propanol	ug/m3	<4.4	<0.42		25	
4-Ethyltoluene	ug/m3	<1.8	<0.33		25	
4-Methyl-2-pentanone (MIBK)	ug/m3	<7.3	0.82J		25	
Acetone	ug/m3	27.1	29.3	8	25	
Benzene	ug/m3	0.76	0.76	0	25	
Benzyl chloride	ug/m3	<1.8	<0.29		25	
Bromodichloromethane	ug/m3	<2.4	<0.34		25	
Bromoform	ug/m3	<9.2	<1.6		25	
Bromomethane	ug/m3	<1.4	<0.54		25	
Carbon disulfide	ug/m3	<1.1	<0.18		25	
Carbon tetrachloride	ug/m3	<1.1	<0.34		25	
Chlorobenzene	ug/m3	<1.6	<0.23		25	
Chloroethane	ug/m3	<0.94	<0.34		25	
Chloroform	ug/m3	<0.87	<0.33		25	
Chloromethane	ug/m3	1.1	1.1	0	25	
cis-1,2-Dichloroethene	ug/m3	<1.4	<0.43		25	
cis-1,3-Dichloropropene	ug/m3	<1.6	<0.65		25	
Cyclohexane	ug/m3	<1.2	0.90J		25	
Dibromochloromethane	ug/m3	<3.0	<1.5		25	
Dichlorodifluoromethane	ug/m3	2.5	2.5	0	25	
Dichlorotetrafluoroethane	ug/m3	<2.5	<0.54		25	
Ethanol	ug/m3	5.4	5.9	10	25	
Ethyl acetate	ug/m3	<1.3	<0.61		25	
Ethylbenzene	ug/m3	<1.5	<0.74		25	
Hexachloro-1,3-butadiene	ug/m3	<3.8	<1.1		25	
m&p-Xylene	ug/m3	<3.1	2.8J		25	
Methyl-tert-butyl ether	ug/m3	<6.4	<0.53		25	
Methylene Chloride	ug/m3	<6.2	4.6J		25	
n-Heptane	ug/m3	2.0	2.3	13	25	

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QUALITY CONTROL DATA

Project: 1290.01.01 OSU Cascades- Rev.
Pace Project No.: 10357548

SAMPLE DUPLICATE: 2343553

Parameter	Units	10357826002 Result	Dup Result	RPD	Max RPD	Qualifiers
n-Hexane	ug/m3	2.7	3.0	12	25	
Naphthalene	ug/m3	<4.7	2.6J		25	
o-Xylene	ug/m3	<1.5	1.0J		25	
Propylene	ug/m3	<0.61	<0.24		25	
Styrene	ug/m3	<1.5	<0.34		25	
Tetrachloroethene	ug/m3	<1.2	<0.49		25	
Tetrahydrofuran	ug/m3	<1.0	<0.21		25	
Toluene	ug/m3	5.3	5.4	1	25	
trans-1,2-Dichloroethene	ug/m3	<1.4	<0.67		25	
trans-1,3-Dichloropropene	ug/m3	<1.6	<0.46		25	
Trichloroethene	ug/m3	8.1	8.4	4	25	
Trichlorofluoromethane	ug/m3	<2.0	1.4J		25	
Vinyl acetate	ug/m3	<1.3	<0.58		25	
Vinyl chloride	ug/m3	<0.46	<0.34		25	

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QUALITY CONTROL DATA

Project: 1290.01.01 OSU Cascades- Rev.
Pace Project No.: 10357548

QC Batch: 430887
Analysis Method: TO-15
QC Batch Method: TO-15
Analysis Description: TO15 MSV AIR Low Level
Associated Lab Samples: 10357548006

METHOD BLANK: 2343897
Matrix: Air
Associated Lab Samples: 10357548006

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
1,1,1-Trichloroethane	ug/m3	<0.25	1.1	0.25	08/16/16 11:03	
1,1,2,2-Tetrachloroethane	ug/m3	<0.33	0.70	0.33	08/16/16 11:03	
1,1,2-Trichloroethane	ug/m3	<0.25	0.55	0.25	08/16/16 11:03	
1,1,2-Trichlorotrifluoroethane	ug/m3	<0.30	1.6	0.30	08/16/16 11:03	
1,1-Dichloroethane	ug/m3	<0.16	0.82	0.16	08/16/16 11:03	
1,1-Dichloroethene	ug/m3	<0.24	0.81	0.24	08/16/16 11:03	
1,2,4-Trichlorobenzene	ug/m3	<0.91	3.8	0.91	08/16/16 11:03	
1,2,4-Trimethylbenzene	ug/m3	<0.12	1.0	0.12	08/16/16 11:03	
1,2-Dibromoethane (EDB)	ug/m3	<0.77	1.6	0.77	08/16/16 11:03	
1,2-Dichlorobenzene	ug/m3	<0.51	1.2	0.51	08/16/16 11:03	
1,2-Dichloroethane	ug/m3	<0.20	0.41	0.20	08/16/16 11:03	
1,2-Dichloropropane	ug/m3	<0.27	0.94	0.27	08/16/16 11:03	
1,3,5-Trimethylbenzene	ug/m3	<0.18	1.0	0.18	08/16/16 11:03	
1,3-Butadiene	ug/m3	<0.18	0.45	0.18	08/16/16 11:03	
1,3-Dichlorobenzene	ug/m3	<0.53	1.2	0.53	08/16/16 11:03	
1,4-Dichlorobenzene	ug/m3	<0.50	1.2	0.50	08/16/16 11:03	
2-Butanone (MEK)	ug/m3	<0.23	3.0	0.23	08/16/16 11:03	
2-Hexanone	ug/m3	<0.41	4.2	0.41	08/16/16 11:03	
2-Propanol	ug/m3	<0.24	2.5	0.24	08/16/16 11:03	
4-Ethyltoluene	ug/m3	<0.19	1.0	0.19	08/16/16 11:03	
4-Methyl-2-pentanone (MIBK)	ug/m3	<0.22	4.2	0.22	08/16/16 11:03	
Acetone	ug/m3	<0.83	2.4	0.83	08/16/16 11:03	
Benzene	ug/m3	<0.12	0.32	0.12	08/16/16 11:03	
Benzyl chloride	ug/m3	<0.17	1.0	0.17	08/16/16 11:03	
Bromodichloromethane	ug/m3	<0.19	1.4	0.19	08/16/16 11:03	
Bromoform	ug/m3	<0.90	5.3	0.90	08/16/16 11:03	
Bromomethane	ug/m3	<0.31	0.79	0.31	08/16/16 11:03	
Carbon disulfide	ug/m3	<0.10	0.63	0.10	08/16/16 11:03	
Carbon tetrachloride	ug/m3	<0.19	0.64	0.19	08/16/16 11:03	
Chlorobenzene	ug/m3	<0.13	0.94	0.13	08/16/16 11:03	
Chloroethane	ug/m3	<0.19	0.54	0.19	08/16/16 11:03	
Chloroform	ug/m3	<0.19	0.50	0.19	08/16/16 11:03	
Chloromethane	ug/m3	<0.11	0.42	0.11	08/16/16 11:03	
cis-1,2-Dichloroethene	ug/m3	<0.25	0.81	0.25	08/16/16 11:03	
cis-1,3-Dichloropropene	ug/m3	<0.37	0.92	0.37	08/16/16 11:03	
Cyclohexane	ug/m3	<0.32	0.70	0.32	08/16/16 11:03	
Dibromochloromethane	ug/m3	<0.86	1.7	0.86	08/16/16 11:03	
Dichlorodifluoromethane	ug/m3	<0.48	1.0	0.48	08/16/16 11:03	
Dichlorotetrafluoroethane	ug/m3	<0.31	1.4	0.31	08/16/16 11:03	
Ethanol	ug/m3	<0.26	0.96	0.26	08/16/16 11:03	
Ethyl acetate	ug/m3	<0.35	0.73	0.35	08/16/16 11:03	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: 1290.01.01 OSU Cascades- Rev.
Pace Project No.: 10357548

METHOD BLANK: 2343897 Matrix: Air
Associated Lab Samples: 10357548006

Parameter	Units	Blank Result	Reporting Limit	MDL	Analyzed	Qualifiers
Ethylbenzene	ug/m3	<0.42	0.88	0.42	08/16/16 11:03	
Hexachloro-1,3-butadiene	ug/m3	<0.65	2.2	0.65	08/16/16 11:03	
m&p-Xylene	ug/m3	<0.79	1.8	0.79	08/16/16 11:03	
Methyl-tert-butyl ether	ug/m3	<0.30	3.7	0.30	08/16/16 11:03	
Methylene Chloride	ug/m3	<0.54	3.5	0.54	08/16/16 11:03	
n-Heptane	ug/m3	<0.28	0.83	0.28	08/16/16 11:03	
n-Hexane	ug/m3	<0.36	0.72	0.36	08/16/16 11:03	
Naphthalene	ug/m3	<0.30	2.7	0.30	08/16/16 11:03	
o-Xylene	ug/m3	<0.35	0.88	0.35	08/16/16 11:03	
Propylene	ug/m3	<0.14	0.35	0.14	08/16/16 11:03	
Styrene	ug/m3	<0.19	0.87	0.19	08/16/16 11:03	
Tetrachloroethene	ug/m3	<0.28	0.69	0.28	08/16/16 11:03	
Tetrahydrofuran	ug/m3	<0.12	0.60	0.12	08/16/16 11:03	
Toluene	ug/m3	<0.15	0.77	0.15	08/16/16 11:03	
trans-1,2-Dichloroethene	ug/m3	<0.38	0.81	0.38	08/16/16 11:03	
trans-1,3-Dichloropropene	ug/m3	<0.26	0.92	0.26	08/16/16 11:03	
Trichloroethene	ug/m3	<0.28	0.55	0.28	08/16/16 11:03	
Trichlorofluoromethane	ug/m3	<0.13	1.1	0.13	08/16/16 11:03	
Vinyl acetate	ug/m3	<0.33	0.72	0.33	08/16/16 11:03	
Vinyl chloride	ug/m3	<0.20	0.26	0.20	08/16/16 11:03	

LABORATORY CONTROL SAMPLE: 2343898

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
1,1,1-Trichloroethane	ug/m3	55.5	65.4	118	60-143	
1,1,2,2-Tetrachloroethane	ug/m3	69.8	87.3	125	49-150	
1,1,2-Trichloroethane	ug/m3	55.5	63.9	115	57-149	
1,1,2-Trichlorotrifluoroethane	ug/m3	77.9	94.0	121	66-131	
1,1-Dichloroethane	ug/m3	41.2	48.2	117	62-139	
1,1-Dichloroethene	ug/m3	40.3	46.4	115	62-135	
1,2,4-Trichlorobenzene	ug/m3	75.5	78.5	104	55-146	
1,2,4-Trimethylbenzene	ug/m3	50	62.6	125	57-143	
1,2-Dibromoethane (EDB)	ug/m3	78.1	91.5	117	63-150	
1,2-Dichlorobenzene	ug/m3	61.2	69.6	114	57-141	
1,2-Dichloroethane	ug/m3	41.2	49.3	120	61-144	
1,2-Dichloropropane	ug/m3	47	53.2	113	63-144	
1,3,5-Trimethylbenzene	ug/m3	50	59.2	118	54-147	
1,3-Butadiene	ug/m3	22.5	24.7	110	61-140	
1,3-Dichlorobenzene	ug/m3	61.2	74.4	122	51-150	
1,4-Dichlorobenzene	ug/m3	61.2	70.3	115	57-143	
2-Butanone (MEK)	ug/m3	30	33.1	110	66-144	
2-Hexanone	ug/m3	104	133	128	63-147	
2-Propanol	ug/m3	125	127	102	54-146	
4-Ethyltoluene	ug/m3	50	58.5	117	56-150	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALITY CONTROL DATA

Project: 1290.01.01 OSU Cascades- Rev.
Pace Project No.: 10357548

LABORATORY CONTROL SAMPLE: 2343898

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
4-Methyl-2-pentanone (MIBK)	ug/m3	104	126	121	58-150	
Acetone	ug/m3	121	139	115	46-140	
Benzene	ug/m3	32.5	37.3	115	62-141	
Benzyl chloride	ug/m3	52.5	70.5	134	66-138	CH
Bromodichloromethane	ug/m3	68.2	80.9	119	58-149	
Bromoform	ug/m3	105	103	98	61-150	
Bromomethane	ug/m3	39.5	44.7	113	58-136	
Carbon disulfide	ug/m3	31.7	36.1	114	59-135	
Carbon tetrachloride	ug/m3	64	81.5	127	60-149	
Chlorobenzene	ug/m3	46.8	53.6	115	60-150	
Chloroethane	ug/m3	26.8	29.9	111	61-136	
Chloroform	ug/m3	49.7	59.5	120	65-138	
Chloromethane	ug/m3	21	23.8	113	62-133	
cis-1,2-Dichloroethene	ug/m3	40.3	47.1	117	65-139	
cis-1,3-Dichloropropene	ug/m3	46.2	55.4	120	61-149	
Cyclohexane	ug/m3	35	39.2	112	64-134	
Dibromochloromethane	ug/m3	86.6	104	120	59-150	
Dichlorodifluoromethane	ug/m3	50.3	56.4	112	63-134	
Dichlorotetrafluoroethane	ug/m3	71.1	80.7	113	62-134	
Ethanol	ug/m3	95.8	81.4	85	50-144	
Ethyl acetate	ug/m3	36.6	44.1	120	55-146	
Ethylbenzene	ug/m3	44.2	51.3	116	59-149	
Hexachloro-1,3-butadiene	ug/m3	108	115	106	42-150	
m&p-Xylene	ug/m3	88.3	105	119	59-146	
Methyl-tert-butyl ether	ug/m3	91.6	107	116	64-135	
Methylene Chloride	ug/m3	177	205	116	64-128	
n-Heptane	ug/m3	41.7	44.9	108	64-140	
n-Hexane	ug/m3	35.8	41.5	116	50-138	
Naphthalene	ug/m3	53.3	59.6	112	46-146	
o-Xylene	ug/m3	44.2	51.9	118	54-149	
Propylene	ug/m3	17.5	19.2	110	58-135	
Styrene	ug/m3	43.3	51.5	119	54-150	
Tetrachloroethene	ug/m3	69	75.4	109	60-142	
Tetrahydrofuran	ug/m3	30	34.3	114	56-143	
Toluene	ug/m3	38.3	43.0	112	61-138	
trans-1,2-Dichloroethene	ug/m3	40.3	47.7	118	67-137	
trans-1,3-Dichloropropene	ug/m3	46.2	56.5	122	59-145	
Trichloroethene	ug/m3	54.6	61.0	112	60-144	
Trichlorofluoromethane	ug/m3	57.1	66.5	116	59-134	
Vinyl acetate	ug/m3	35.8	45.6	128	55-143	
Vinyl chloride	ug/m3	26	28.6	110	63-135	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

QUALIFIERS

Project: 1290.01.01 OSU Cascades- Rev.
Pace Project No.: 10357548

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to dilution of the sample aliquot.

ND - Not Detected at or above adjusted reporting limit.

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PQL - Practical Quantitation Limit.

RL - Reporting Limit.

S - Surrogate

1,2-Diphenylhydrazine decomposes to and cannot be separated from Azobenzene using Method 8270. The result for each analyte is a combined concentration.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

LABORATORIES

PASI-M	Pace Analytical Services - Minneapolis

SAMPLE QUALIFIERS

Sample: 10357548006

[1]	The internal standard recoveries associated with this sample exceed the lower control limit for EPA Method TO-15. Results confirmed by second analysis.

ANALYTE QUALIFIERS

CH	The continuing calibration for this compound is outside of Pace Analytical acceptance limits. The results may be biased high.

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: 1290.01.01 OSU Cascades- Rev.
Pace Project No.: 10357548

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
10357548001	**B1-SV-5.0**	Method 3C Gases	430558		
10357548002	**B2-SV-10.0**	Method 3C Gases	430558		
10357548003	**B3-SV-5.0**	Method 3C Gases	430558		
10357548004	**B4-SV-10.0**	Method 3C Gases	430558		
10357548005	**B5-SV-10.0**	Method 3C Gases	430558		
10357548006	**B6-SV-10.0**	Method 3C Gases	430558		
10357548001	**B1-SV-5.0**	TO-15	430662		
10357548002	**B2-SV-10.0**	TO-15	430662		
10357548003	**B3-SV-5.0**	TO-15	430662		
10357548004	**B4-SV-10.0**	TO-15	430662		
10357548005	**B5-SV-10.0**	TO-15	430662		
10357548006	**B6-SV-10.0**	TO-15	430887		

10357548

Pace Analytical®
www.pacelabs.com

AIR: CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

19987

Page: 1 of 1

Section A
Required Client Information:

Company: Mavi Foster & Alongi
Address: 400 E Mill Plain Blvd #400
Vancouver, WA 98660
Email To: sfrost@maulfoster.com
Phone:
Fax:
Requested Due Date/TAT: standard

Section B
Required Project Information:

Report To: Stacy Frost
Copy To: Meredith D'Andrea
Kyle Roslund
Purchase Order No.: 1290.01.01
Project Name: OSU Cascades
Project Number: 1290.01.01

Section C
Invoice Information:

Attention: Stephanie Ashmore
Company Name: Maul Foster & Alongi
Address: 400 E Mill Plain Blvd #400/Vancouver WA
Pace Quote Reference:
Pace Project Manager/Sales Rep. James Forrest, John Richardson
Pace Profile #: (inches Hg)

Program
☐ UST ☐ Superfund ☐ Emissions ☐ Clean Air Act
☐ Voluntary Clean Up ☐ Dry Clean ☐ RCRA ☐ Other___

Location of Sampling by State: OR Oregon

Reporting Units
ug/m³ X mg/m³ ___
PPBV ___ PPMV ___
Other ___

Report Level II.___ III.___ IV.___ Other___

Section D Required Client Information
AIR SAMPLE ID
Sample IDs MUST BE UNIQUE

Valid Media Codes

MEDIA	CODE
Tedlar Bag	TB
1 Liter Summa Can	1LC
6 Liter Summa Can	6LC
Low Volume Puff	LVP
High Volume Puff	HVP
Other	PM10

ITEM #	AIR SAMPLE ID	MEDIA CODE	PID Reading (Client only)	COLLECTED COMPOSITE START DATE	COMPOSITE START TIME	COMPOSITE - END/GRAB DATE	COMPOSITE - END/GRAB TIME	Canister Pressure (Initial Field - psig)	Canister Pressure (Final Field - psig)	Summa Can Number	Flow Control Number	PM10	3C- Fixed Gas (%)	TO-3	TO-3M (Methane)	TO-4 (PCBs)	TO-13 (PAH)	TO-14	TO-15	TO15 Short List*	Helium method 3C	Pace Lab ID
1	B1-SV-5.0	6LC	4.2	7/28/16	0947	7/28/16	1022	-27	-5.5	0152	FC0938								X		X	001
2	B2-SV-10.0	6LC	3.0		1125		1200	-29	-6.5	0628	FC1223								X		X	002
3	B3-SV-5.0	6LC	5.0		1301		1336	-30	-10	0177	FC0961								X		X	003
4	B4-SV-10.0	6LC	9.7		1442		1515	-26.5	-6	0783	FC0686								X		X	004
5	B5-SV-10.0	6LC	1.7		1641		1720	-30	-9.5	2341	FC0997								X		X	005
6	B6-SV-10.0	6LC		7/29/16	910	7/29/16	944	-25	-5	0556	FC0834								X		X	006
7																						007,008
8																						
9																						
10																						
11																						
12																						

Comments :
- Report should have MDLs and PQLs.
- For B3-SV-5.0, can # says both PACE 0177 and #639.
- Summa can 1504/FC0626 initial vacuum = -16" Hg. Not used.
- Summa can 164 initial vacuum = -29" Hg. Not used.

ORIGINAL

RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME
Emily Hess / MFA	7/29/16	15:00	Pace	8/2/16	0915

SAMPLE CONDITIONS

Temp in °C	Received on Ice	Custody Sealed Cooler	Samples Intact
AMB	Y [✓ N]	Y [✓ N]	[✓ Y] N
	Y/N	Y/N	Y/N
	Y/N	Y/N	Y/N
	Y/N	Y/N	Y/N

SAMPLER NAME AND SIGNATURE
PRINT Name of SAMPLER: EMILY HESS
SIGNATURE of SAMPLER: Emily Hess
DATE Signed (MM / DD / YY): 07/29/16

Pace Analytical	Document Name: Air Sample Condition Upon Receipt	Document Revised: 26APR2016 Page 1 of 1
	Document No.: F-MN-A-106-rev.11	Issuing Authority: Pace Minnesota Quality Office

Air Sample Condition Upon Receipt

Client Name: Maul Foster + Alongi

Project #: WO#:10357548

10357548

Courier: ☑ Fed Ex ☐ UPS ☐ Speedee ☐ Client ☐ Commercial ☐ Pace ☐ Other:

Tracking Number: 663750378880, 663750378879

Optional: Proj. Due Date: Proj. Name:

Custody Seal on Cooler/Box Present? ☐ Yes ☒ No **Seals Intact?** ☐ Yes ☒ No

Packing Material: ☐ Bubble Wrap ☐ Bubble Bags ☒ Foam ☐ None ☐ Tin Can ☐ Other: **Temp Blank rec:** ☐ Yes ☒ No

Temp. (TO17 and TO13 samples only) (°C): X **Corrected Temp (°C):** X **Thermom. Used:** ☐ B88A912167504 ☐ B88A0143310098 ☐ 151401163 ☐ 151401164

Temp should be above freezing to 6°C **Correction Factor:** X **Date & Initials of Person Examining Contents:** 8216

Type of ice Received ☐ Blue ☐ Wet ☒ None

				Comments:
Chain of Custody Present?	☑ Yes	☐ No	☐ N/A	1.
Chain of Custody Filled Out?	☑ Yes	☐ No	☐ N/A	2.
Chain of Custody Relinquished?	☑ Yes	☐ No	☐ N/A	3.
Sampler Name and/or Signature on COC?	☑ Yes	☐ No	☐ N/A	4.
Samples Arrived within Hold Time?	☑ Yes	☐ No	☐ N/A	5.
Short Hold Time Analysis (<72 hr)?	☐ Yes	☑ No	☐ N/A	6.
Rush Turn Around Time Requested?	☐ Yes	☑ No	☐ N/A	7.
Sufficient Volume?	☑ Yes	☐ No	☐ N/A	8.
Correct Containers Used?	☑ Yes	☐ No	☐ N/A	9.
-Pace Containers Used?	☑ Yes	☐ No	☐ N/A	
Containers Intact?	☑ Yes	☐ No	☐ N/A	10.
Media: [✓ Air Can] Airbag Filter TDT Passive				11.
Sample Labels Match COC?	☑ Yes	☐ No	☐ N/A	12.

Samples Received:

Canisters			Canisters		
Sample Number	Can ID	Flow Controller ID	Sample Number	Can ID	Flow Controller ID
unused	1504	0626	inital vac	-16 per client	
unused	0164	0629	initail pressure	per client	-24
			(actual	pressure -28)	~~[illegible]~~

CLIENT NOTIFICATION/RESOLUTION **Field Data Required?** ☐ Yes ☐ No

Person Contacted: Date/Time:

Comments/Resolution:

Project Manager Review: Joanne Richardson **Date:** 8-17-16

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office (i.e out of hold, incorrect preservative, out of temp, incorrect containers)

Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

Friday, August 19, 2016

Stacy Frost
Maul Foster & Alongi, INC.
2001 NW 19th Ave, STE 200
Portland, OR 97209

RE: OSU Cascades / 1290.01.01

Enclosed are the results of analyses for work order A6H0076, which was received by the laboratory on 8/1/2016 at 11:00:00AM.

Thank you for using Apex Labs. We appreciate your business and strive to provide the highest quality services to the environmental industry.

If you have any questions concerning this report or the services we offer, please feel free to contact me by email at: pnerenberg@apex-labs.com, or by phone at 503-718-2323.

Apex Laboratories

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.

Philip Nerenberg

Philip Nerenberg, Lab Director

ANALYTICAL REPORT FOR SAMPLES

SAMPLE INFORMATION

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
DU3A-SO-ISM As Received	A6H0076-01	Soil	07/29/16 10:45	08/01/16 11:00
DU3A-SO-ISM After Processing	A6H0076-02	Soil	07/29/16 10:45	08/01/16 11:00
DU3B-SO-ISM As Received	A6H0076-03	Soil	07/29/16 10:45	08/01/16 11:00
DU3B-SO-ISM After Processing	A6H0076-04	Soil	07/29/16 10:45	08/01/16 11:00
DU3C-SO-ISM As Received	A6H0076-05	Soil	07/29/16 10:45	08/01/16 11:00
DU3C-SO-ISM After Processing	A6H0076-06	Soil	07/29/16 10:45	08/01/16 11:00
DU2-SO-ISM As Received	A6H0076-07	Soil	07/29/16 11:45	08/01/16 11:00
DU2-SO-ISM After Processing	A6H0076-08	Soil	07/29/16 11:45	08/01/16 11:00
DU1-SO-ISM As Received	A6H0076-09	Soil	07/29/16 12:55	08/01/16 11:00
DU1-SO-ISM After Processing	A6H0076-10	Soil	07/29/16 12:55	08/01/16 11:00
Bead Blank	A6H0076-11	Solid	07/29/16 10:45	08/01/16 11:00

Maul Foster & Alongi, INC.	Project: **OSU Cascades**	
2001 NW 19th Ave, STE 200	Project Number: 1290.01.01	**Reported:**
Portland, OR 97209	Project Manager: Stacy Frost	08/19/16 16:13

ANALYTICAL SAMPLE RESULTS

Total Metals by EPA 6020 (ICPMS)

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
DU3A-SO-ISM As Received (A6H0076-01)			**Matrix: Soil**					
Batch: 6080452								
Mercury	ND	---	0.0748	mg/kg dry	10	08/15/16 22:15	EPA 6020A	
DU3A-SO-ISM After Processing (A6H0076-02)			**Matrix: Soil**					
Batch: 6080452								
Arsenic	ND	---	0.825	mg/kg dry	10	08/15/16 22:27	EPA 6020A	
Barium	**30.4**	---	0.825	"	"	"	"	
Cadmium	ND	---	0.165	"	"	"	"	
Chromium	**1.44**	---	0.825	"	"	"	"	
Lead	**1.54**	---	0.165	"	"	"	"	
Mercury	ND	---	0.0660	"	"	"	"	R-01
Selenium	ND	---	1.65	"	"	"	"	
Silver	ND	---	0.165	"	"	"	"	
DU3B-SO-ISM As Received (A6H0076-03)			**Matrix: Soil**					
Batch: 6080452								
Mercury	ND	---	0.0740	mg/kg dry	10	08/15/16 22:39	EPA 6020A	
DU3B-SO-ISM After Processing (A6H0076-04)			**Matrix: Soil**					
Batch: 6080452								
Arsenic	ND	---	0.842	mg/kg dry	10	08/15/16 22:42	EPA 6020A	
Barium	**32.3**	---	0.842	"	"	"	"	
Cadmium	ND	---	0.168	"	"	"	"	
Chromium	**1.41**	---	0.842	"	"	"	"	
Lead	**1.74**	---	0.168	"	"	"	"	
Mercury	ND	---	0.0674	"	"	"	"	R-01
Selenium	ND	---	1.68	"	"	"	"	
Silver	ND	---	0.168	"	"	"	"	
DU3C-SO-ISM As Received (A6H0076-05)			**Matrix: Soil**					
Batch: 6080452								
Mercury	ND	---	0.0727	mg/kg dry	10	08/15/16 22:45	EPA 6020A	
DU3C-SO-ISM After Processing (A6H0076-06)			**Matrix: Soil**					
Batch: 6080452								
Arsenic	ND	---	0.899	mg/kg dry	10	08/15/16 22:48	EPA 6020A	
Barium	**29.9**	---	0.899	"	"	"	"	
Cadmium	ND	---	0.180	"	"	"	"	
Chromium	**1.27**	---	0.899	"	"	"	"	
Lead	**1.51**	---	0.180	"	"	"	"	

ANALYTICAL SAMPLE RESULTS

Total Metals by EPA 6020 (ICPMS)

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
DU3C-SO-ISM After Processing (A6H0076-06)			**Matrix: Soil**					
Mercury	ND	---	0.0719	mg/kg dry	10	"	EPA 6020A	R-01
Selenium	ND	---	1.80	"	"	"	"	
Silver	ND	---	0.180	"	"	"	"	
DU2-SO-ISM As Received (A6H0076-07)			**Matrix: Soil**					
Batch: 6080452								
Mercury	ND	---	0.0702	mg/kg dry	10	08/15/16 22:51	EPA 6020A	
DU2-SO-ISM After Processing (A6H0076-08)			**Matrix: Soil**					
Batch: 6080452								
Arsenic	ND	---	0.953	mg/kg dry	10	08/15/16 22:54	EPA 6020A	
Barium	**61.1**	---	0.953	"	"	"	"	
Cadmium	ND	---	0.191	"	"	"	"	
Chromium	**4.46**	---	0.953	"	"	"	"	
Lead	**2.88**	---	0.191	"	"	"	"	
Mercury	ND	---	0.0762	"	"	"	"	R-01
Selenium	ND	---	1.91	"	"	"	"	
Silver	ND	---	0.191	"	"	"	"	
DU1-SO-ISM As Received (A6H0076-09)			**Matrix: Soil**					
Batch: 6080452								
Mercury	ND	---	0.0617	mg/kg dry	10	08/15/16 22:57	EPA 6020A	
DU1-SO-ISM After Processing (A6H0076-10)			**Matrix: Soil**					
Batch: 6080348								
Arsenic	**0.759**	---	0.744	mg/kg dry	10	08/11/16 18:25	EPA 6020A	
Barium	**89.9**	---	0.744	"	"	"	"	
Cadmium	**0.186**	---	0.149	"	"	"	"	
Chromium	**5.91**	---	0.744	"	"	"	"	
Lead	**6.39**	---	0.149	"	"	"	"	
Mercury	ND	---	0.119	"	"	"	"	R-01
Selenium	ND	---	0.744	"	"	"	"	
Silver	**0.484**	---	0.149	"	"	"	"	
Bead Blank (A6H0076-11)			**Matrix: Solid**					
Batch: 6080431								
Arsenic	ND	---	0.962	mg/kg	10	08/12/16 18:14	EPA 6020A	
Barium	ND	---	0.962	"	"	"	"	
Cadmium	ND	---	0.192	"	"	"	"	
Chromium	ND	---	0.962	"	"	"	"	

ANALYTICAL SAMPLE RESULTS

Total Metals by EPA 6020 (ICPMS)

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
Bead Blank (A6H0076-11)			**Matrix: Solid**					
Lead	ND	---	0.192	mg/kg	10	"	EPA 6020A	
Mercury	ND	---	0.192	"	"	"	"	R-01
Selenium	ND	---	0.962	"	"	"	"	
Silver	ND	---	0.192	"	"	"	"	

ANALYTICAL SAMPLE RESULTS

Percent Dry Weight

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
DU3A-SO-ISM As Received (A6H0076-01)			**Matrix: Soil**		**Batch: 6080155**			
% Solids	**98.6**	---	1.00	% by Weight	1	08/05/16 09:03	EPA 8000C	
DU3A-SO-ISM After Processing (A6H0076-02)			**Matrix: Soil**		**Batch: 6080321**			
% Solids	**99.5**	---	1.00	% by Weight	1	08/11/16 09:07	EPA 8000C	
DU3B-SO-ISM As Received (A6H0076-03)			**Matrix: Soil**		**Batch: 6080155**			
% Solids	**99.0**	---	1.00	% by Weight	1	08/05/16 09:03	EPA 8000C	
DU3B-SO-ISM After Processing (A6H0076-04)			**Matrix: Soil**		**Batch: 6080321**			
% Solids	**99.5**	---	1.00	% by Weight	1	08/11/16 09:07	EPA 8000C	
DU3C-SO-ISM As Received (A6H0076-05)			**Matrix: Soil**		**Batch: 6080155**			
% Solids	**99.1**	---	1.00	% by Weight	1	08/05/16 09:03	EPA 8000C	
DU3C-SO-ISM After Processing (A6H0076-06)			**Matrix: Soil**		**Batch: 6080321**			
% Solids	**99.5**	---	1.00	% by Weight	1	08/11/16 09:07	EPA 8000C	
DU2-SO-ISM As Received (A6H0076-07)			**Matrix: Soil**		**Batch: 6080155**			
% Solids	**99.1**	---	1.00	% by Weight	1	08/05/16 09:03	EPA 8000C	
DU2-SO-ISM After Processing (A6H0076-08)			**Matrix: Soil**		**Batch: 6080321**			
% Solids	**99.1**	---	1.00	% by Weight	1	08/11/16 09:07	EPA 8000C	
DU1-SO-ISM As Received (A6H0076-09)			**Matrix: Soil**		**Batch: 6080155**			
% Solids	**98.4**	---	1.00	% by Weight	1	08/05/16 09:03	EPA 8000C	
DU1-SO-ISM After Processing (A6H0076-10)			**Matrix: Soil**		**Batch: 6080321**			
% Solids	**98.9**	---	1.00	% by Weight	1	08/11/16 09:07	EPA 8000C	

QUALITY CONTROL (QC) SAMPLE RESULTS

Total Metals by EPA 6020 (ICPMS)

Batch 6080348 - EPA 3051A **Soil**

Blank (6080348-BLK1) Prepared: 08/10/16 15:34 Analyzed: 08/11/16 18:15

EPA 6020A

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Arsenic	ND	---	1.00	mg/kg wet	10	---	---	---	---	---	---	
Barium	ND	---	1.00	"	"	---	---	---	---	---	---	
Cadmium	ND	---	0.200	"	"	---	---	---	---	---	---	
Chromium	ND	---	1.00	"	"	---	---	---	---	---	---	
Lead	ND	---	0.200	"	"	---	---	---	---	---	---	
Mercury	ND	---	0.0800	"	"	---	---	---	---	---	---	
Selenium	ND	---	1.00	"	"	---	---	---	---	---	---	
Silver	ND	---	0.200	"	"	---	---	---	---	---	---	

LCS (6080348-BS1) Prepared: 08/10/16 15:34 Analyzed: 08/11/16 18:22

EPA 6020A

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Arsenic	51.5	---	1.00	mg/kg wet	10	50.0	---	103	80-120%	---	---	
Barium	51.8	---	1.00	"	"	"	---	103	"	---	---	
Cadmium	52.9	---	0.200	"	"	"	---	106	"	---	---	
Chromium	51.4	---	1.00	"	"	"	---	103	"	---	---	
Lead	54.2	---	0.200	"	"	"	---	108	"	---	---	
Mercury	1.03	---	0.0800	"	"	1.00	---	103	"	---	---	
Selenium	29.0	---	1.00	"	"	25.0	---	116	"	---	---	
Silver	25.7	---	0.200	"	"	"	---	103	"	---	---	

Duplicate (6080348-DUP1) Prepared: 08/10/16 15:34 Analyzed: 08/11/16 18:28

QC Source Sample: DU1-SO-ISM After Processing (A6H0076-10)

EPA 6020A

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Arsenic	ND	---	0.748	mg/kg dry	10	---	0.759	---	---	***	40%	
Barium	**90.3**	---	0.748	"	"	---	89.9	---	---	0.5	40%	
Cadmium	**0.209**	---	0.150	"	"	---	0.186	---	---	12	40%	
Chromium	**6.04**	---	0.748	"	"	---	5.91	---	---	2	40%	
Lead	**6.39**	---	0.150	"	"	---	6.39	---	---	0.05	40%	
Mercury	ND	---	0.120	"	"	---	ND	---	---	---	40%	
Selenium	ND	---	0.748	"	"	---	0.394	---	---	***	40%	
Silver	**0.464**	---	0.150	"	"	---	0.484	---	---	4	40%	

Matrix Spike (6080348-MS1) Prepared: 08/10/16 15:34 Analyzed: 08/11/16 18:31

QC Source Sample: DU1-SO-ISM After Processing (A6H0076-10)

EPA 6020A

QUALITY CONTROL (QC) SAMPLE RESULTS

Total Metals by EPA 6020 (ICPMS)

Batch 6080348 - EPA 3051A **Soil**

Matrix Spike (6080348-MS1) Prepared: 08/10/16 15:34 Analyzed: 08/11/16 18:31

QC Source Sample: DU1-SO-ISM After Processing (A6H0076-10)

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Arsenic	46.5	---	0.912	mg/kg dry	10	45.6	0.759	100	75-125%	---	---	
Barium	139	---	0.912	"	"	"	89.9	108	"	---	---	
Cadmium	48.7	---	0.182	"	"	"	0.186	106	"	---	---	
Chromium	52.4	---	0.912	"	"	"	5.91	102	"	---	---	
Lead	54.7	---	0.182	"	"	"	6.39	106	"	---	---	
Mercury	0.988	---	0.146	"	"	0.912	ND	108	"	---	---	
Selenium	24.3	---	0.912	"	"	22.8	ND	107	"	---	---	
Silver	24.5	---	0.182	"	"	"	0.484	105	"	---	---	

Maul Foster & Alongi, INC.	Project: **OSU Cascades**	
2001 NW 19th Ave, STE 200	Project Number: 1290.01.01	**Reported:**
Portland, OR 97209	Project Manager: Stacy Frost	08/19/16 16:13

QUALITY CONTROL (QC) SAMPLE RESULTS

Total Metals by EPA 6020 (ICPMS)

Batch 6080431 - EPA 3051A **Solid**

Blank (6080431-BLK1) Prepared: 08/12/16 09:50 Analyzed: 08/12/16 18:11

EPA 6020A

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Arsenic	ND	---	1.00	mg/kg	10	---	---	---	---	---	---	
Barium	ND	---	1.00	"	"	---	---	---	---	---	---	
Cadmium	ND	---	0.200	"	"	---	---	---	---	---	---	
Chromium	ND	---	1.00	"	"	---	---	---	---	---	---	
Lead	ND	---	0.200	"	"	---	---	---	---	---	---	
Mercury	ND	---	0.0800	"	"	---	---	---	---	---	---	
Selenium	ND	---	1.00	"	"	---	---	---	---	---	---	
Silver	ND	---	0.200	"	"	---	---	---	---	---	---	

LCS (6080431-BS1) Prepared: 08/12/16 09:50 Analyzed: 08/12/16 18:05

EPA 6020A

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Arsenic	48.9	---	1.00	mg/kg	10	50.0	---	98	80-120%	---	---	
Barium	48.8	---	1.00	"	"	"	---	98	"	---	---	
Cadmium	49.1	---	0.200	"	"	"	---	98	"	---	---	
Chromium	49.4	---	1.00	"	"	"	---	99	"	---	---	
Lead	50.0	---	0.200	"	"	"	---	100	"	---	---	
Mercury	1.01	---	0.0800	"	"	1.00	---	101	"	---	---	
Selenium	26.8	---	1.00	"	"	25.0	---	107	"	---	---	
Silver	24.8	---	0.200	"	"	"	---	99	"	---	---	

Duplicate (6080431-DUP1) Prepared: 08/12/16 09:50 Analyzed: 08/12/16 20:38

QC Source Sample: Other (A6H0304-02)

EPA 6020A

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Arsenic	**318**	---	50.1	mg/kg	500	---	415	---	---	27	40%	
Barium	**385**	---	50.1	"	"	---	411	---	---	6	40%	
Cadmium	**72.6**	---	10.0	"	"	---	79.5	---	---	9	40%	
Chromium	ND	---	50.1	"	"	---	29.6	---	---	***	40%	
Lead	**239**	---	10.0	"	"	---	317	---	---	28	40%	
Mercury	ND	---	4.01	"	"	---	ND	---	---	---	40%	
Silver	ND	---	10.0	"	"	---	ND	---	---	---	40%	

Duplicate (6080431-DUP2) Prepared: 08/12/16 09:50 Analyzed: 08/15/16 21:54

QC Source Sample: Other (A6H0304-02RE1)

EPA 6020A

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Selenium	**23600**	---	1000	mg/kg	5000	---	22700	---	---	4	40%	Q-16

Apex Laboratories

Philip Nerenberg

Philip Nerenberg, Lab Director

QUALITY CONTROL (QC) SAMPLE RESULTS

Total Metals by EPA 6020 (ICPMS)

Batch 6080431 - EPA 3051A **Solid**

Matrix Spike (6080431-MS1) Prepared: 08/12/16 09:50 Analyzed: 08/12/16 20:41

QC Source Sample: Other (A6H0304-02)

EPA 6020A

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Arsenic	609	---	50.7	mg/kg	500	50.7	415	383	75-125%	---	---	Q-11
Barium	369	---	50.7	"	"	"	411	-82	"	---	---	Q-11
Cadmium	199	---	10.1	"	"	"	79.5	236	"	---	---	Q-11
Chromium	76.6	---	50.7	"	"	"	29.6	93	"	---	---	
Lead	354	---	10.1	"	"	"	317	73	"	---	---	Q-11
Mercury	ND	---	4.06	"	"	1.01	ND		"	---	---	Q-11
Silver	24.8	---	10.1	"	"	25.3	ND	98	"	---	---	

Matrix Spike (6080431-MS2) Prepared: 08/12/16 09:50 Analyzed: 08/15/16 21:57

QC Source Sample: Other (A6H0304-02RE1)

EPA 6020A

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Selenium	26400	---	1010	mg/kg	5000	25.3	22700	14800	75-125%	---	---	Q-03, Q-16

QUALITY CONTROL (QC) SAMPLE RESULTS

Total Metals by EPA 6020 (ICPMS)

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 6080452 - EPA 3051A							**Soil**					
Blank (6080452-BLK1)					Prepared: 08/12/16 14:33		Analyzed: 08/15/16 22:06					
EPA 6020A												
Arsenic	ND	---	1.00	mg/kg wet	10	---	---	---	---	---	---	
Barium	ND	---	1.00	"	"	---	---	---	---	---	---	
Cadmium	ND	---	0.200	"	"	---	---	---	---	---	---	
Chromium	ND	---	1.00	"	"	---	---	---	---	---	---	
Lead	ND	---	0.200	"	"	---	---	---	---	---	---	
Mercury	ND	---	0.0800	"	"	---	---	---	---	---	---	
Selenium	ND	---	2.00	"	"	---	---	---	---	---	---	
Silver	ND	---	0.200	"	"	---	---	---	---	---	---	
LCS (6080452-BS1)					Prepared: 08/12/16 14:33		Analyzed: 08/15/16 22:09					
EPA 6020A												
Arsenic	51.1	---	1.00	mg/kg wet	10	50.0	---	102	80-120%	---	---	
Barium	51.1	---	1.00	"	"	"	---	102	"	---	---	
Cadmium	51.0	---	0.200	"	"	"	---	102	"	---	---	
Chromium	50.0	---	1.00	"	"	"	---	100	"	---	---	
Lead	53.2	---	0.200	"	"	"	---	106	"	---	---	
Mercury	1.08	---	0.0800	"	"	1.00	---	108	"	---	---	
Selenium	28.4	---	2.00	"	"	25.0	---	114	"	---	---	
Silver	26.0	---	0.200	"	"	"	---	104	"	---	---	
Duplicate (6080452-DUP1)					Prepared: 08/12/16 14:33		Analyzed: 08/15/16 22:30					
QC Source Sample: DU3A-SO-ISM After Processing (A6H0076-02)												
EPA 6020A												
Arsenic	ND	---	0.826	mg/kg dry	10	---	ND	---	---	---	40%	
Barium	**28.6**	---	0.826	"	"	---	30.4	---	---	6	40%	
Cadmium	ND	---	0.165	"	"	---	ND	---	---	---	40%	
Chromium	**1.20**	---	0.826	"	"	---	1.44	---	---	18	40%	
Lead	**1.44**	---	0.165	"	"	---	1.54	---	---	7	40%	
Mercury	ND	---	0.0661	"	"	---	ND	---	---	---	40%	R-01
Selenium	ND	---	1.65	"	"	---	ND	---	---	---	40%	
Silver	ND	---	0.165	"	"	---	ND	---	---	---	40%	
Matrix Spike (6080452-MS1)					Prepared: 08/12/16 14:33		Analyzed: 08/15/16 22:33					
QC Source Sample: DU3A-SO-ISM After Processing (A6H0076-02)												
EPA 6020A												

QUALITY CONTROL (QC) SAMPLE RESULTS

Total Metals by EPA 6020 (ICPMS)

Batch 6080452 - EPA 3051A **Soil**

Matrix Spike (6080452-MS1) Prepared: 08/12/16 14:33 Analyzed: 08/15/16 22:33

QC Source Sample: DU3A-SO-ISM After Processing (A6H0076-02)

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Arsenic	46.0	---	0.918	mg/kg dry	10	45.9	ND	100	75-125%	---	---	
Barium	74.3	---	0.918	"	"	"	30.4	96	"	---	---	
Cadmium	46.4	---	0.184	"	"	"	ND	101	"	---	---	
Chromium	45.8	---	0.918	"	"	"	1.44	97	"	---	---	
Lead	48.2	---	0.184	"	"	"	1.54	102	"	---	---	
Mercury	1.02	---	0.0735	"	"	0.918	ND	111	"	---	---	R-01
Selenium	25.8	---	1.84	"	"	22.9	ND	113	"	---	---	
Silver	23.4	---	0.184	"	"	"	ND	102	"	---	---	

QUALITY CONTROL (QC) SAMPLE RESULTS

Percent Dry Weight

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 6080155 - Total Solids (Dry Weight)							**Soil**					
Duplicate (6080155-DUP1)						Prepared: 08/04/16 12:07	Analyzed: 08/05/16 09:03					
QC Source Sample: Other (A6H0125-03)												
EPA 8000C												
% Solids	**90.6**	---	1.00	% by Weight	1	---	89.7	---	---	1	10%	
Duplicate (6080155-DUP2)						Prepared: 08/04/16 12:07	Analyzed: 08/05/16 09:03					
QC Source Sample: Other (A6H0125-13)												
EPA 8000C												
% Solids	**86.5**	---	1.00	% by Weight	1	---	86.2	---	---	0.4	10%	
Duplicate (6080155-DUP3)						Prepared: 08/04/16 12:07	Analyzed: 08/05/16 09:03					
QC Source Sample: Other (A6H0132-04)												
EPA 8000C												
% Solids	**85.6**	---	1.00	% by Weight	1	---	85.5	---	---	0.1	10%	
Duplicate (6080155-DUP4)						Prepared: 08/04/16 13:10	Analyzed: 08/05/16 09:03					
QC Source Sample: Other (A6H0115-09)												
EPA 8000C												
% Solids	**77.4**	---	1.00	% by Weight	1	---	76.3	---	---	1	10%	
Duplicate (6080155-DUP5)						Prepared: 08/04/16 15:06	Analyzed: 08/05/16 09:03					
QC Source Sample: Other (A6H0155-02)												
EPA 8000C												
% Solids	**78.6**	---	1.00	% by Weight	1	---	79.8	---	---	2	10%	
Duplicate (6080155-DUP6)						Prepared: 08/04/16 18:13	Analyzed: 08/05/16 09:03					
QC Source Sample: Other (A6H0171-02)												
EPA 8000C												
% Solids	**91.1**	---	1.00	% by Weight	1	---	90.0	---	---	1	10%	
Duplicate (6080155-DUP7)						Prepared: 08/04/16 19:53	Analyzed: 08/05/16 09:03					
QC Source Sample: Other (A6H0179-02)												
EPA 8000C												
% Solids	**80.3**	---	1.00	% by Weight	1	---	80.5	---	---	0.2	10%	

QUALITY CONTROL (QC) SAMPLE RESULTS

Percent Dry Weight

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 6080321 - Total Solids (Dry Weight)							**Soil**					
Duplicate (6080321-DUP1)					Prepared: 08/10/16 10:51		Analyzed: 08/11/16 09:07					
QC Source Sample: Other (A6H0292-01)												
EPA 8000C												
% Solids	**75.7**	---	1.00	% by Weight	1	---	75.4	---	---	0.3	10%	
Duplicate (6080321-DUP2)					Prepared: 08/10/16 10:51		Analyzed: 08/11/16 09:07					
QC Source Sample: Other (A6H0297-05)												
EPA 8000C												
% Solids	**76.2**	---	1.00	% by Weight	1	---	76.6	---	---	0.5	10%	
Duplicate (6080321-DUP3)					Prepared: 08/10/16 15:15		Analyzed: 08/11/16 09:07					
QC Source Sample: Other (A6H0309-03)												
EPA 8000C												
% Solids	**76.1**	---	1.00	% by Weight	1	---	75.9	---	---	0.3	10%	
Duplicate (6080321-DUP5)					Prepared: 08/10/16 19:21		Analyzed: 08/11/16 09:07					
QC Source Sample: Other (A6H0332-01)												
EPA 8000C												
% Solids	**91.4**	---	1.00	% by Weight	1	---	91.1	---	---	0.3	10%	

SAMPLE PREPARATION INFORMATION

Total Metals by EPA 6020 (ICPMS)

Prep: EPA 3051A

Lab Number	Matrix	Method	Sampled	Prepared	Sample Initial/Final	Default Initial/Final	RL Prep Factor
Batch: 6080348							
A6H0076-10	Soil	EPA 6020A	07/29/16 12:55	08/10/16 15:34	1.359g/100mL	0.5g/50mL	0.74
Batch: 6080431							
A6H0076-11	Solid	EPA 6020A	07/29/16 10:45	08/12/16 15:26	0.52g/50mL	0.5g/50mL	0.96
Batch: 6080452							
A6H0076-01	Soil	EPA 6020A	07/29/16 10:45	08/12/16 14:33	1.084g/100mL	0.5g/50mL	0.92
A6H0076-02	Soil	EPA 6020A	07/29/16 10:45	08/12/16 14:33	1.218g/100mL	0.5g/50mL	0.82
A6H0076-03	Soil	EPA 6020A	07/29/16 10:45	08/12/16 14:33	1.092g/100mL	0.5g/50mL	0.92
A6H0076-04	Soil	EPA 6020A	07/29/16 10:45	08/12/16 14:33	1.194g/100mL	0.5g/50mL	0.84
A6H0076-05	Soil	EPA 6020A	07/29/16 10:45	08/12/16 14:33	1.111g/100mL	0.5g/50mL	0.90
A6H0076-06	Soil	EPA 6020A	07/29/16 10:45	08/12/16 14:33	1.118g/100mL	0.5g/50mL	0.89
A6H0076-07	Soil	EPA 6020A	07/29/16 11:45	08/12/16 14:33	1.151g/100mL	0.5g/50mL	0.87
A6H0076-08	Soil	EPA 6020A	07/29/16 11:45	08/12/16 14:33	1.059g/100mL	0.5g/50mL	0.94
A6H0076-09	Soil	EPA 6020A	07/29/16 12:55	08/12/16 14:33	1.317g/100mL	0.5g/50mL	0.76

Percent Dry Weight

Prep: Total Solids (Dry Weight)

Lab Number	Matrix	Method	Sampled	Prepared	Sample Initial/Final	Default Initial/Final	RL Prep Factor
Batch: 6080155							
A6H0076-01	Soil	EPA 8000C	07/29/16 10:45	08/04/16 15:06	1N/A/1N/A	1N/A/1N/A	NA
A6H0076-03	Soil	EPA 8000C	07/29/16 10:45	08/04/16 15:06	1N/A/1N/A	1N/A/1N/A	NA
A6H0076-05	Soil	EPA 8000C	07/29/16 10:45	08/04/16 15:06	1N/A/1N/A	1N/A/1N/A	NA
A6H0076-07	Soil	EPA 8000C	07/29/16 11:45	08/04/16 15:06	1N/A/1N/A	1N/A/1N/A	NA
A6H0076-09	Soil	EPA 8000C	07/29/16 12:55	08/04/16 15:06	1N/A/1N/A	1N/A/1N/A	NA
Batch: 6080321							
A6H0076-02	Soil	EPA 8000C	07/29/16 10:45	08/10/16 15:15	1N/A/1N/A	1N/A/1N/A	NA
A6H0076-04	Soil	EPA 8000C	07/29/16 10:45	08/10/16 10:51	1N/A/1N/A	1N/A/1N/A	NA
A6H0076-06	Soil	EPA 8000C	07/29/16 10:45	08/10/16 10:51	1N/A/1N/A	1N/A/1N/A	NA
A6H0076-08	Soil	EPA 8000C	07/29/16 11:45	08/10/16 10:51	1N/A/1N/A	1N/A/1N/A	NA
A6H0076-10	Soil	EPA 8000C	07/29/16 12:55	08/10/16 10:51	1N/A/1N/A	1N/A/1N/A	NA

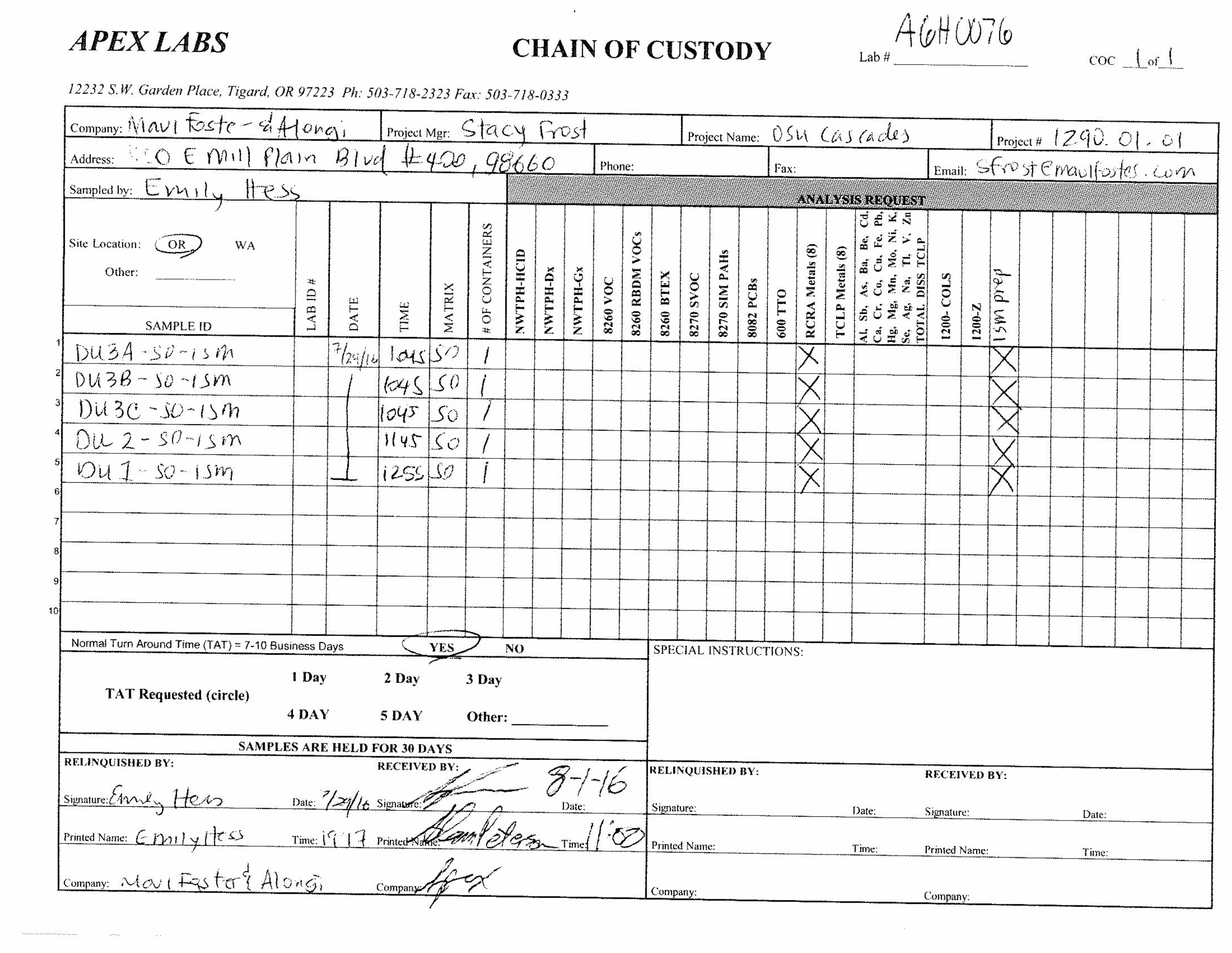
Notes and Definitions

Qualifiers:

Q-03	Spike recovery and/or RPD is outside control limits due to the high concentration of analyte present in the sample.
Q-11	Spike recovery cannot be accurately quantified due to sample dilution required for high analyte concentration and/or matrix interference.
Q-16	Reanalysis of an original Batch QC sample.
R-01	The Reporting Limit for this analyte has been raised to account for matrix interference.

Notes and Conventions:

DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis. Results listed as 'wet' or without 'dry'designation are not dry weight corrected.
RPD	Relative Percent Difference
MDL	If MDL is not listed, data has been evaluated to the Method Reporting Limit only.
WMSC	Water Miscible Solvent Correction has been applied to Results and MRLs for volatiles soil samples per EPA 8000C.
Batch QC	In cases where there is insufficient sample provided for Sample Duplicates and/or Matrix Spikes, a Lab Control Sample Duplicate (LCS Dup) is analyzed to demonstrate accuracy and precision of the extraction and analysis.
Blank Policy	Apex assesses blank data for potential high bias down to a level equal to ½ the method reporting limit (MRL), except for conventional chemistry and HCID analyses which are assessed only to the MRL. Sample results flagged with a B or B-02 qualifier are potentially biased high if they are less than ten times the level found in the blank for inorganic analyses or less than five times the level found in the blank for organic analyses. For accurate comparison of volatile results to the level found in the blank; water sample results should be divided by the dilution factor, and soil sample results should be divided by 1/50 of the sample dilution to account for the sample prep factor. Results qualified as reported below the MRL may include a potential high bias if associated with a B or B-02 qualified blank. B and B-02 qualifications are not applied to J qualified results reported below the MRL.
---	QC results are not applicable. For example, % Recoveries for Blanks and Duplicates, % RPD for Blanks, Blank Spikes and Matrix Spikes, etc.
***	Used to indicate a possible discrepancy with the Sample and Sample Duplicate results when the %RPD is not available. In this case, either the Sample or the Sample Duplicate has a reportable result for this analyte, while the other is Non Detect (ND).



APEX LABS

CHAIN OF CUSTODY

Lab # A6H0076

COC 1 of 1

12232 S.W. Garden Place, Tigard, OR 97223 Ph: 503-718-2323 Fax: 503-718-0333

Company: Maul Foste-&Alongi
Project Mgr: Stacy Frost
Project Name: OSU Cascades
Project # 1290.01.01
Address: 0 E Mill Plain Blvd #400, 98660
Phone:
Fax:
Email: sfrost@maulfoster.com
Sampled by: Emily Hess

Site Location: [✓ OR] WA
Other:

	SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	NWTPH-HCID	NWTPH-Dx	NWTPH-Gx	8260 VOC	8260 RBDM VOCs	8260 BTEX	8270 SVOC	8270 SIM PAHs	8082 PCBs	600 TTO	RCRA Metals (8)	TCLP Metals (8)	Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Hg, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Tl, V, Zn TOTAL DISS TCLP	1200- COLS	1200-Z	15m prep						
1	DU3A-SO-15m		7/29/16	1045	SO	1											X					X						
2	DU3B-SO-15m			1045	SO	1											X					X						
3	DU3C-SO-15m			1045	SO	1											X					X						
4	DU2-SO-15m			1145	SO	1											X					X						
5	DU1-SO-15m			1255	SO	1											X					X						
6																												
7																												
8																												
9																												
10																												

Normal Turn Around Time (TAT) = 7-10 Business Days [✓ YES] NO

TAT Requested (circle) **1 Day** **2 Day** **3 Day** **4 DAY** **5 DAY** **Other:** ____________

SPECIAL INSTRUCTIONS:

SAMPLES ARE HELD FOR 30 DAYS

RELINQUISHED BY:
Signature: Emily Hess Date: 7/29/16
Printed Name: Emily Hess Time: 1917
Company: Maul Foster & Alongi

RECEIVED BY:
Signature: Date: 8-1-16
Printed Name: Sam Peterson Time: 11:00
Company: Apex

RELINQUISHED BY:
Signature: Date:
Printed Name: Time:
Company:

RECEIVED BY:
Signature: Date:
Printed Name: Time:
Company:

ATTACHMENT C

DATA VALIDATION MEMORANDUM

DATA QUALITY ASSURANCE/QUALITY CONTROL REVIEW

PROJECT NO. 1290.01.01 | NOVEMBER 9, 2016 | OREGON STATE UNIVERSITY, CASCADES CAMPUS

Maul Foster & Alongi, Inc. (MFA) conducted an independent review of the quality of analytical results for the demolition landfill, and potential Oregon State University Cascades Campus site in Bend, Oregon. Six soil gas samples and eleven soil samples were collected. Ten of the soil samples were comprised of soil increments composited using incremental sampling methodology (ISM) procedures by the laboratory, as described in the Oregon Department of Environmental Quality-approved (DEQ) incremental sampling plan (DEQ, 2012). The samples were collected on July 29, 2016.

Apex Laboratories, LLC (Apex) and Pace Analytical (Pace) performed the analyses. Report numbers A6H0076 and 10357548 were reviewed. ISM samples were processed by Apex. The analyses performed and samples analyzed are listed below.

Analysis	Reference
Fixed Gases	USEPA 3C Gases
Total Metals	USEPA 6020A
Volatile Organic Compounds (VOCs)	USEPA TO-15

USEPA = U.S. Environmental Protection Agency.

Samples Analyzed		
Report A6H0076		
DU3A-SO-ISM As Received	DU3C-SO-ISM As Received	DU1-SO-ISM As Received
DU3A-SO-ISM After Processing	DU3C-SO-ISM After Processing	DU1-SO-ISM After Processing
DU3B-SO-ISM As Received	DU2-SO-ISM As Received	--
DU-3B-ISM After Processing	DU2-SO-ISM After Processing	--
Report 10357548		
B1-SV-5.0	B3-SV-5.0	B5-SV-10.0
B2-SV-10.0	B4-SV-10.0	B6-SV-10.0

DATA QUALIFICATIONS

Analytical results were evaluated according to applicable sections of USEPA procedures (USEPA, 2014) and appropriate laboratory and method-specific guidelines (Apex 2016; USEPA, 1986).

Soil gas samples submitted for report 10357548 were collected under a helium shroud to detect leaks in the collection system. The samples were non-detect for helium.

The data are considered acceptable for their intended use, with the appropriate data qualifiers assigned.

HOLDING TIMES, PRESERVATION, AND SAMPLE STORAGE

Holding Times

Extractions and analyses were performed within the recommended holding-time criteria.

Preservation and Sample Storage

The samples were preserved and stored appropriately.

BLANKS

Method Blanks

Laboratory method blank analyses were performed at the required frequencies. For purposes of data qualification, the method blanks were associated with all samples prepared in the analytical batch. All method blank results were below reporting limits.

Trip Blanks

Trip blanks were not required for this sampling event.

MATRIX SPIKE/MATRIX SPIKE DUPLICATE RESULTS

Matrix spike/matrix spike duplicate (MS/MSD) results are used to evaluate laboratory precision and accuracy. MS samples were extracted and analyzed at the required frequency.

In report A6H0076, several USEPA Method 6020A (batch 6080431) MS metals results were outside of acceptance criteria. The sample used to prepare the MS was from an unrelated project; thus, no results were qualified.

All remaining recoveries were within acceptance limits.

LABORATORY DUPLICATE RESULTS

Duplicate results are used to evaluate laboratory precision. Results less than five times the reporting limit were not evaluated for RPD exceedances. All duplicate samples were extracted and analyzed at the required frequency.

All RPDs were within acceptance limits.

LABORATORY CONTROL SAMPLE/LABORATORY CONTROL SAMPLE DUPLICATE RESULTS

A laboratory control sample/laboratory control sample duplicate (LCS/LCSD) is spiked with target analytes to provide information on laboratory precision and accuracy. The LCS sample was analyzed at the required frequency.

All LCS analytes were within acceptance limits for percent recovery.

REPORTING LIMITS

Apex used routine MRLs for non-detect results except for samples requiring dilutions due to matrix interference. Some total-mercury reporting limits were additionally raised due to matrix interference. Pace Analytical used MDLs for non-detect results. Soil gas results between the MDL and MRL were qualified "J" as estimated by the laboratory.

DATA PACKAGE

The data packages were reviewed for transcription errors, omissions, and anomalies.

In report A6H0076, a sample named "Bead Blank" was included in the sample list of the report. The reviewer confirmed with the laboratory that this was not a project sample. The laboratory indicated that the "bead blank" is part of the laboratory ISM quality-control process.

In report 10357548, the laboratory indicated that the USEPA Method TO-15 internal standard results for sample B6-SV-10.0 were below acceptance criteria. The results were confirmed by reanalysis; thus, no results were qualified.

No other issues were found.

REFERENCES

Apex. 2016. Quality systems manual. Apex Laboratories, LLC, Tigard, Oregon. April 1.

DEQ, 2012. Quality assurance project plan. Oregon department of environmental quality EPA PA/SI investigations. Oregon Department of Environmental Quality. August 14.

USEPA. 1986. Test methods for evaluating solid waste: physical/chemical methods. EPA-530/SW-846 Update V. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. September (revision 1, July 2014).

USEPA. 2014. USEPA contract laboratory program, national functional guidelines for inorganic Superfund data review. EPA 540/R-013/001. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation. August.

ATTACHMENT C

AGRICULTURAL TESTING RESULTS

US Composting Council
STA Certified Lab

soiltest
farm consultants, inc.
2925 Driggs Dr., Moses Lake, Wa 98837 - www.soiltestlab.com
Office: (509)765-1622 - Fax:(509)765-0314 - (800)764-1622

Client: **Maul Foster Alongi**
Attn: Kyle Rosland
400 E. Mil C Plain
Van, WA 98660

Product: **Sawdust**
Date Sampled: 09/15/16
Date Received: 09/16/16

Date Reported: 9/21/2016
Laboratory # C16-576
Reveiwed by Brent Thyssen, CPSSc

Invoice # C16-576

Project#: 1290.01.01
Amount: $128.00

Nutrients

	Method	As Rcvd.	Dry Wt.	Units	Low	Normal	High	Typical Compost Range
Moisture	70 C	25.8		%	****************			15 to 40
Solids	70 C	74.2		%	*****************			60 to 85
pH	1:5	7.4	NA	SU	*****************			5.5 to 8.5
Organic Matter	TMECC 05.07A	22.1	29.8	%	*******			40 to 60
Ash	550 C	52.1	70.2	%	********************************			40 to 60
Total N	TMECC 04.02D	0.16	0.22	%	**			1 to 5
Organic C	TMECC 04.01A	3.2	4.3	%	****			18 to 45
Ammonium -N	TMECC 04.03 B	8.0	10.8	mg/kg	***			90 to 450
Nitrate-N	TMECC 04.03 B	215	290	mg/kg	*************************			50 to 250
Chloride	TMECC 04.03 B	200	269	mg/kg	************			500 to 5000
Sulfate-S	TMECC 04.03 B	1300	1751	mg/kg				
Phosphorous	TMECC 04.03 B	0.20	0.27	mg/kg				
Potassium	TMECC 04.03 B	68.5	92.3	mg/kg				
C/N Ratio			20	ratio	*************			18 to 24

Sample was received, handled and tested in accordance with TMECC procedures

US Composting Council
STA Certified Lab

soiltest
farm consultants, inc.
2925 Driggs Dr., Moses Lake, Wa 98837 - www.soiltestlab.com
Office: (509)765-1622 · Fax:(509)765-0314 · (800)764-1622

Client: **Maul Foster Alongi**
Attn: Kyle Rosland
400 E. Mil C Plain
Van, WA 98660

Product: **Wood Chips**
Date Sampled: 09/15/16
Date Received: 09/16/16
Project#: 1290.01.01

Date Reported: 9/21/2016
Laboratory # C16-577
Reveiwed by Brent Thyssen, CPSSc
Invoice # C16-577
Amount: $128.00

Nutrients

	Method	As Rcvd.	Dry Wt.	Units	Low	Normal	High	Typical Compost Range
Moisture	70 C	**36.8**		%	****************			15 to 40
Solids	70 C	**63.2**		%	*****************			60 to 85
pH	1:5	**5.3**	**NA**	SU	*****			5.5 to 8.5
Organic Matter	TMECC 05.07A	**21.8**	**34.5**	%	*******			40 to 60
Ash	550 C	**41.4**	**65.5**	%	********************************			40 to 60
Total N	TMECC 04.02D	**1.51**	**2.39**	%	*************			1 to 5
Organic C	TMECC 04.01A	**17.3**	**27.3**	%	*****************			18 to 45
Ammonium -N	TMECC 04.03 B	**9.0**	**14.2**	mg/kg	***			90 to 450
Nitrate-N	TMECC 04.03 B	**1.0**	**1.6**	mg/kg	***			50 to 250
Chloride	TMECC 04.03 B	**450**	**712**	mg/kg	************			500 to 5000
Sulfate-S	TMECC 04.03 B	**611**	**967**	mg/kg				
Phosphorous	TMECC 04.03 B	**0.30**	**0.47**	mg/kg				
Potassium	TMECC 04.03 B	**68.3**	**108**	mg/kg				
C/N Ratio			**11**	ratio	********			18 to 24

Sample was received, handled and tested in accordance with TMECC procedures

ATTACHMENT D

DEQ MEETING MINUTES

MAUL FOSTER ALONGI

MEETING NOTES

Meeting Topic and Number:	OSU Cascades Demolition Landfill Engineering Due Diligence Status
Meeting Date & Time:	September 7, 2016, 10:00 – 11:30 a.m.
Project Number:	1290.01.01
Project Name:	Oregon State University – Cascades Campus Demolition Landfill Engineering Due Diligence
Meeting Location:	DEQ Eastern Region Office, 400 E Scenic Drive, Building 2, The Dalles, OR
Recorded By:	Ted Wall, Stacy Frost
Attendees:	Tammy Wisco, Retia Consult (via telephone) Joe Gingerich, DEQ Bob Schwarz, DEQ Stacy Frost, MFA Ted Wall, MFA
Distribution:	All attendees, file

Meeting Agenda:

1. Background and primary issues per DEQ – J. Gingerich
2. OSU planning process, status – T. Wisco
3. Engineering due diligence status – S. Frost
4. Prospective Purchaser Agreement and solid waste regulatory framework – T. Wall
5. Next Steps/Action Items – All

Background and Primary Issues per DEQ:

This was the first meeting on this subject and MFA asked to begin with an overview of J. Gingerich's observation and thoughts on primary issues associated with the landfill. Issues covered include:

1. Possible landfill gas (LFG) migration from Area 1 to adjacent commercial businesses to the east of the landfill warranted installation of a grid of LFG monitoring wells on the eastern property line, providing full-time coverage. No excess levels have been detected, but this condition warrants continued monitoring to ensure safety. LFG in Area 1 is a primary factor; safety at the landfill boundary is paramount.

2. Pyrolysis in Area 1 is also a primary factor, potentially impacting available options, material handling, final closure, etc. For example, excavation and material handling may change conditions, which will need to be controlled, e.g. cooling and replacement may alter LFG production rates.

3. Areas 2 and 3 are more "traditional" construction debris landfill cells, likely requiring routine material handling processes only.

4. Hoped to see excavation within the pyrolysis area as part of the pilot study that may have provided insight about working with the waste, e.g. will exposure to air cause a flare or cool down the material?

OSU Planning Process:

T. Wisco described her role as OSU's Project Manager (on contract) for the landfill due diligence, as well as land use approval processes for the future campus expansion.

The 10-acre parcel has been developed with students arriving now. The university purchased the adjacent 46-acre pumice mine last year, with long-range planning under development now. A primary question through this process is whether the university and community needs can be met by the currently owned parcels (56 acres) or whether the 70+ acres represented by the landfill are needed. This in turn leads to questions about the viability, cost, and risk associated with the landfill property.

The ongoing long-term planning process involves Page and SERA architects. They are supporting the understanding and development of programming needs, space planning, lay-out, etc. Understanding the potential options and limitations associated with development within the landfill footprint is informing the long-term planning, which is an iterative process.

Engineering Due Diligence

S. Frost summarized the findings to date and how they may impact decision-making and landfill closure.

1. As previously discussed, Area 1 is the most challenging due to volume and depth of waste, waste type, etc. The waste has a large fraction of sawdust, which is less attractive for alternate uses (e.g. as a hog fuel substitute, mulch, high-grade compost). The group discussed 1) materials handling, phasing (generally), grade constraints, possible use at Knott Landfill as a daily and final cover material (approximately 200,000 - 300,000 cubic yards are needed at Knott Landfill), etc.

2. Removal and off-site disposal of all waste was assessed and rejected due to multiple factors including cost, consumption of Knott Landfill air space, damage to roads, high traffic, etc.

3. Possible options include material handling elsewhere on-site, composting on- or off-site, placement elsewhere on-site, etc.

4. Cover soil in Area 1 would be removed and used as backfill. Soil from other areas on-site could be mined for use as backfill material. Backfill volume needs could be reduced by deliberate planning and facility layout, e.g. build underground parking structures in Area 1.

5. Areas 2 and 3 are less problematic, but still require materials handling, phasing/timing, etc. Looking at these areas in conjunction with Area 1, on-site soil sources, backfill opportunities, and specific land uses (e.g. open space in areas where waste is placed) are all factors in play.

Prospective Purchaser Agreement, Solid Waste Regulatory Framework

T. Wall discussed the possible pursuit of a Prospective Purchaser Agreement (PPA) and how the landfill closure/post-closure requirements may be addressed:

1. The four criteria for PPA eligibility are: 1) the Buyer is not a liable party, 2) an environmental impairment exists, 3) the Buyer will perform actions that will enhance environmental conditions, and 4) there will be a public benefit. All four criteria are met.

2. Standard closure and post-closure requirements as stipulated in statute and regulation will be addressed, with an understanding that unique conditions exist and can be accommodated (e.g. landfill cap via parking lot).

3. Clear definition of obligations and obligation limits is necessary for the University to quantify (monetize) costs and minimize uncertainty/risk. The PPA is the only avenue that can provide this definition and certainty.

General Discussion

The items below were discussed throughout the course of the conversations summarized above. Where attributable, the specific attendees' comments are noted. The statements below represent general DEQ engagement in the discussion and are not formal determinations by the agency.

1. Timeframe, phasing:
    a. The University will expand the facility in phases, and landfill redevelopment will necessarily also occur in phases.
    b. The DEQ expects flexibility in implementation schedule can be accommodated, with interim milestones a necessary element of the PPA.
2. Materials handling and all aspects of redevelopment will involve multiple factors (e.g. dust control, noise control, and periods of operation). These will be spelled out in the PPA and subsequent planning documents, and thus will require DEQ approval.
3. Public education and ultimately acceptance will be an important factor in the success of this redevelopment, should the University proceed.
4. The DEQ will need to ensure compatibility with local and state land use requirements. (Note: conformance is a standard PPA obligation.)
5. T. Wisco summarized the current land use process:
    a. The City's current UGB package includes code language for new mixed use zones, as well as changes to the City's Comprehensive Plan for several areas within the UGB. Once adopted by the City and acknowledged by DLCD, the OSU-C area will be re-designated on the Comprehensive Plan as Mixed Use Urban (MU) and is identified as an "Opportunity Area". It is anticipated that this package will be approved by the City in late September, for submittal to DLCD by October. Timeline is uncertain for the acknowledgement by DLCD.
    b. The University will need to submit a zone change and master plan application for the expanded campus. This will likely occur after the DLCD acknowledgement of the UGB package.
6. T. Wisco reported that, based on County input, the University is working under the premise that purchasing only portions of the demo landfill site is not an option.
7. T. Wisco reported that the Letter of Intent between the University and Deschutes County sets the purchase price as the fair market value minus the cost of remediation. If the cost of remediation is greater than the fair market value, the purchase price will be $1.

8. T. Wisco reported that the University plans to make its go/no-go decision on the landfill in November 2016.

9. Moving waste within a permitted landfill site boundary is a normal process in landfill closure. The removal of waste from Area 1 and 2 and relocation to Area 3 is comparable.

10. DEQ confirmed that waste from Cell 1 would need to be farmed before reconsolidation in Area 3 first to protect against future pyrolysis creation.

11. DEQ indicated that considering the depth to ground water and climate, an argument could be made to exclude groundwater monitoring in the reconsolidated waste area.

12. With removal of all of the waste from Area 1 and 2, the permitted landfill boundary could be reduced to just Area 3, i.e. the PPA/permit boundaries will not include Areas 1 and 2 after this occurs.

13. Reuse of various portions of the waste (e.g. daily cover for Knott landfill, final cover for Knott landfill, compost, and soil amendment) could possibly meet DEQ's Beneficial Use Determination criteria.

14. The ultimate use of recycled materials will dictate the processes needed to ensure protection of human health and the environment:

    a. Testing will differ if the material is used in ways that confine potential exposure (e.g. Knott Landfill cover soil) versus those that do not (e.g. compost production for wholesale/retail use).

    b. Materials management on-site versus off-site.

15. There is an estimated 50,000 cubic yards of waste on adjacent Parks and Recreation land. This waste is outside of the permitted landfill, with the County and Parks and Recreation being the two responsible parties for proper management of this material. This waste is not currently within the property boundary that the University and Deschutes County are addressing, and would not be managed by the University if the landfill is purchased (unless done so through other negotiations/procedures).

16. The DEQ sees benefits to redevelopment in ways the University may pursue, and will work with and support the University, as needed. The DEQ sees this as a viable PPA candidate. Specifically, they see removal of the waste and extinguishing of the pyrolysis in Cell 1 as an environmental benefit.

Next Steps/Action Items:

Item Number	Description	Person Responsible	Date Due
1	Continue due diligence, progress report (telephone call)	T. Wisco, S. Frost, T. Wall	Approximately 9/21/16
2	Internal DEQ assessment, progress report (telephone call)	J. Gingerich, B. Schwarz	Approximately 9/21/16

ATTACHMENT E

COST ESTIMATES

Title:	**Opinion of Probable Remediation Costs - Phase 1**
Project:	Demolition Landfill Engineering Due Diligence
Client:	Oregon State University - Cascades
Project #/Task:	1290.01.01/03
Prepared By:	Cem Gokcora/Lindsey Crosby
Checked By:	Stacy Frost
Date:	11/11/2016
Revision #.:	3

MAUL FOSTER ALONGI
400 East Mill Plain Blvd, Suite 400
Vancouver, WA
360.694.2691 (p)
360.906.1958 (f)
www.maulfoster.com

Cost Estimate Summary - Feasibility Level

Phase 1 Remediation Cost	**$ 5,699,671**
Total Waste Excavated	*202,637 cy*
Excess Screenings Available for Blending	*92,400 cy*
Potential Pumice Mine Backfill - After Blending of Screenings with Site Soil	***508,200 cy***

Assumptions:

1. Assumed 18% of Cell 1 will be remediated for Phase 1.
2. This phased excavation of Area 1 assumes a similar constituent make up as identified in the original estimate, with the exclusion of tires.
3. Based on previous reports, this estimate assumes that all tires within Area 1 will be encountered in the first phase of remediation.
4. All waste in Cell 3 to remain in place.
5. Pyrolysis material is not suitable for reuse and will be processed and relocated to Cell 3.
6. The active pyrolysis area is estimated to be approximately 75' wide, 250' long (along the entire pumice wall face on the east side of Area 1), 50' in depth based on the GBB report. Volume of active pyrolysis material is estimated to be 192,700 CY. This cost estimate assumes that 18% of this material will be encountered in the first phase of remediation.
7. Approximately 3% of all waste is not suitable for recycle or reuse and will be hauled off-site for disposal. Disposal cost by others.
8. Based on the results of the County's pilot study, the screened fines have an organic content up to 22%. Screened fines will be blended with soil sourced on-site at a ratio of 4.5:1 to produce a suitable backfill with an organic content not exceeding 4%.
9. This estimate is based on an averaged estimated quantities from the GBB report, and the County pilot study.
10. Assume the 15% contingency accounts for design of remediation, monitoring during construction, and reflect unknown conditions (such as adverse weather conditions, material costs, or unfavorable market conditions).
11. The maintenance and monitoring cost associated with landfill Cell 3 is estimated to be approximately $20,000 per year. This has not been included in this estimate.
12. Metals are not accounted for within the cost estimate, assuming that material reuse preparation and associated sales revenue are net-zero items.

OPINION OF PROBABLE REMEDIATION AND RECLAMATION COSTS - PHASE 1

Maul Foster & Alongi, Inc.

Cell 1 Waste Removal					
Item #	*Description*	*MFA Quantity*	*Unit*	*Unit Cost*	*Total Cost*
1	Mobilization	1	LS	$ 144,356	$ 144,356
2	Remove and Stockpile Cover Soil - Including Haul	45,485	CY	$ 4.00	$ 181,942
3	Excavation of Waste - Including Haul	165,264	CY	$ 8.00	$ 1,322,109
4	Excavation of Pyrolysis Waste - Including Haul	33,973	CY	$ 12.00	$ 407,676
5	Tire Collection and Disposal	1,275	Ton	$ 177.00	$ 225,675
6	Temperature Monitoring/Fire Suppression	1.0	LS	$ 17,630.00	$ 17,630
				Cell 1 Waste Removal	**$ 2,299,388**

Cell 1 Waste Screening					
Item #	*Description*	*Quantity*	*Unit*	*Unit Cost*	
7	Screen Waste	169,734	CY	$ 5.00	$ 848,672
8	Water Application (Dust Control)	1	LS	$ 50,000.00	$ 50,000
9	Process Pyrolysis Waste	33,973	CY	$ 3.00	$ 101,919
				Cell 1 Waste Screening	**$ 1,000,591**

Cell 1 Backfill - Reuse Waste Screenings					
Item #	*Description*	*Quantity*	*Unit*	*Unit Cost*	
10	Excavation and Haul of Cell 3 Cover Soil	95,067	CY	$ 4.00	$ 380,269
11	Blend Screenings/Cover Soil	171,787	CY	$ 2.00	$ 343,573
12	Embankment & Compaction	171,787	CY	$ 3.50	$ 601,254
				Cell 1 Backfill - Reuse Waste Screenings	**$ 1,325,096**

Cell 1 Waste - Relocate to Cell 3					
Item #	*Description*	*Quantity*	*Unit*	*Unit Cost*	
13	Wood Waste - Haul to Cell 3	29,976	CY	$ 3.00	$ 89,929
14	Wood Waste - Place and Compact in Cell 3	29,976	CY	$ 2.50	$ 74,941
15	Pyrolysis Waste - Haul to Cell 3	33,973	CY	$ 2.00	$ 67,946
16	Pyrolysis Waste - Place and Compact in Cell 3	33,973	CY	$ 2.50	$ 84,933
17	Cover Soil - Placement on Cell 3	4,471	CY	$ 3.00	$ 13,412
				Cell 1 Waste - Relocate to Cell 3	**$ 331,160**

Subtotal		**$ 4,956,236**
Contingency	15 %	$ 743,435.39
Phase 1* Total Cost		**$ 5,699,671**

* Phase 1 = 18% of Cell 1, see page 1

Title:	**Opinion of Probable Remediation & Reclamation Costs - Phase 2**	
Project:	Demolition Landfill Engineering Due Diligence	
Client:	Oregon State University - Cascades	
Project #/Task:	1290.01.01/03	
Prepared By:	Cem Gokcora/Lindsey Crosby	
Checked By:	Stacy Frost	
Date:	11/10/2016	
Revision #.:	2	

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Cost Estimate Summary - Feasibility Level

Phase 2 Remediation & Reclamation Cost	**$ 11,830,925**
Total Waste Excavated	*456,000 cy*
Excess Screenings Available for Blending	*113,455 cy*
Potential Pumice Mine Backfill - After Blending of Screenings with Site Soil	***624,000 cy***

Assumptions:

1. Assumed all Cell 2 will be remediated for Phase 2.
2. All waste in Cell 3 to remain in place.
3. Approximately 3% of all waste is not suitable for recycle or reuse and will be hauled off-site for disposal. Disposal cost by others.
4. Based on the results of the County's pilot study, the screened fines have an organic content up to 22%. Screened fines will be blended with soil sourced on-site at a ratio of 4.5:1 to produce a suitable backfill with an organic content not exceeding 4%.
5. This estimate is based on an averaged estimated quantities from the GBB report, and the County pilot study.
6. Assumes 15% contingency accounts for design of reclamation, monitoring during construction, and reflect unknown conditions (such as adverse weather conditions, material costs, or unfavorable market conditions).
7. The maintenance and monitoring cost associated with landfill Cell 3 is estimated to be approximately $20,000 per year. This has not been included in this estimate.
8. Metals are not accounted for within the cost estimate, assuming that material reuse preparation and associated sales revenue are net-zero items.

OPINION OF PROBABLE REMEDIATION AND RECLAMATION COSTS - PHASE 2

Maul Foster & Alongi, Inc.

Cell 2 Waste Removal

Item #	*Description*	*Quantity*	*Unit*	*Unit Cost*	*Total Cost*
1	Mobilization	1	LS	$ 358,915	$ 358,915
2	Remove and Stockpile Cover Soil - Including Haul	24,000		$ 4.00	$ 96,000
3	Excavation of Waste - Including Haul	456,000	CY	$ 8.00	$ 3,648,000
				Cell 2 Waste Removal	**$ 4,102,915**

Phase 2 Excavation

Item #	*Description*	*Quantity*	*Unit*	*Unit Cost*	*Total Cost*
4	Excavation Adjacent to Cell 2	370,000	CY	$ 5.50	$ 2,035,000
	Phase 2 Remediation & Reclamation Cost			**Phase 2 Excavation**	**$ 2,035,000**

Cell 2 Waste Screening

Item #	*Description*	*Quantity*	*Unit*	*Unit Cost*	*Total Cost*
5	Screen Waste	134,751	CY	$ 5.00	$ 673,753
6	Water Application (Dust Control)	1	LS	$ 125,000.00	$ 125,000
7	Crush Concrete/Brick	19,160	CY	$ 4.00	$ 76,640
				Cell 2 Waste Screening	**$ 875,393**

Cell 2 Reuse Waste Screenings

Item #	*Description*	*Quantity*	*Unit*	*Unit Cost*	*Total Cost*
8	Excavation and Haul of Cell 3 Cover Soil	97,385	CY	$ 4.00	$ 389,542
9	Blend Screenings/Cover Soil/Clean Fill	624,000	CY	$ 2.00	$ 1,248,000
10	Embankment & Compaction	624,000	CY	$ 3.50	$ 2,184,000
				Cell 2 Reuse Waste Screenings	**$ 3,821,542**

Cell 2 Waste - Relocate to Cell 3

Item #	*Description*	*Quantity*	*Unit*	*Unit Cost*	*Total Cost*
11	Wood Waste - Haul to Cell 3	24,600	CY	$ 3.00	$ 73,800
12	Wood Waste - Place and Compact in Cell 3	24,600	CY	$ 2.50	$ 61,500
13	Non-Blended Fines - Haul to Cell 3	256,049	CY	$ 2.00	$ 512,099
14	Non-Blended Fines - Place and Compact in Cell 3	256,049	CY	$ 2.50	$ 640,124
15	Remove and Stockpile Cell 3 Cover Soil - for Phase 3	29,855	CY	$ 4.00	$ 119,421
16	Cover Soil	26,989	CY	$ 3.00	$ 80,968
				Cell 2 Waste - Relocate to Cell 3	**$ 1,487,911**

Subtotal		**$ 10,287,761**
Contingency	15 %	$ 1,543,164
Phase 2 Total Cost		**$ 11,830,925**

Title:	**Opinion of Probable Remediation Costs - Phase 3**
Project:	Demolition Landfill Engineering Due Diligence
Client:	Oregon State University - Cascades
Project #/Task:	1290.01.01/03
Prepared By:	Cem Gokcora/Lindsey Crosby
Checked By:	Stacy Frost
Date:	11/11/2016
Revision #.:	1

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Cost Estimate Summary - Feasibility Level

Phase 3 Remediation Cost	**$ 25,604,923**
Total Waste Excavated	*880,863 cy*

Assumptions:

1. Assumes remaining 82% of Cell 1 will be remediated for Phase 3. This estimate excludes the estimated 50,000 cy of waste located within the Bend Park and Recreation property.
2. This phased excavation of Area 1 assumes a similar constituent make up as identified in the original estimate, with the exclusion of tires.
3. Based on previous reports, this estimate assumes that all tires within Area 1 would have been encountered in the first phase of remediation.
4. All waste in Cell 3 to remain in place.
5. Pyrolysis material is not suitable for reuse and will be processed and relocated to Cell 3.
6. The active pyrolysis area is estimated to be approximately 75' wide, 1,390' long (along the entire pumice wall face on the east side of Area 1), 50' in depth based on the GBB report. Volume of active pyrolysis material is estimated to be 192,700 CY. This cost estimate assumes that 82% of this material will be encountered in the last phase of remediation.
7. Approximately 3% of all waste is not suitable for recycle or reuse (i.e. drums)and will be hauled off-site for disposal. Disposal cost by others.
8. Based on the results of the County's pilot study, the screened fines have an organic content up to 22%. Screened fines will be blended with soil sourced on-site at a ratio of 4.5:1 to produce a suitable backfill with an organic content not exceeding 4%.
9. This estimate is based on an averaged estimated quantities from the GBB report, and the County pilot study.
10. Assumes 15% contingency accounts for design of reclamation, monitoring during construction, and reflect unknown conditions (such as adverse weather conditions, material costs, or unfavorable market conditions).
11. The maintenance and monitoring cost associated with landfill Cell 3 is estimated to be approximately $20,000 per year. This has not been included in this estimate.
12. Metals are not accounted for within the cost estimate, assuming that material reuse preparation and associated sales revenue are net-zero items.

OPINION OF PROBABLE REMEDIATION COSTS - PHASE 3

Maul Foster & Alongi, Inc.

Cell 1 Waste Removal					
Item #	*Description*	*MFA Quantity*	*Unit*	*Unit Cost*	*Total Cost*
1	Mobilization	1	LS	$ 648,500	$ 648,500
2	Remove and Stockpile Cover Soil - Including Haul	212,515	CY	$ 4.00	$ 850,058
3	Excavation of Waste - Including Haul	722,136	CY	$ 8.00	$ 5,777,090
4	Excavation of Pyrolysis Waste - Including Haul	158,727	CY	$ 12.00	$ 1,904,725
5	Temperature Monitoring/Fire Suppression	1.0	LS	$85,000.00	$ 85,000
6	Shoring	12,500	SF	$ 50.00	$ 625,000
				Cell 1 Waste Removal	**$ 9,890,373**

Cell 1 Waste Screening					
Item #	*Description*	*Quantity*	*Unit*	*Unit Cost*	
7	Screen Waste	160,450	CY	$ 5.00	$ 802,248
8	Water Application (Dust Control)	1	LS	#########	$ 210,000
9	Process Pyrolysis Material	158,727	CY	$ 3.00	$ 476,181
				Cell 1 Waste Screening	**$ 1,488,430**

Cell 1 Backfill - Reuse Waste Screenings					
Item #	*Description*	*Quantity*	*Unit*	*Unit Cost*	
10	Excavation and Haul of Cell 3 Expansion material	581,405	CY	$ 5.50	$ 3,197,730
11	Blend Screenings/Cover Soil	802,613	CY	$ 2.00	$ 1,605,227
12	Embankment & Compaction	802,613	CY	$ 3.50	$ 2,809,146
				Cell 1 Backfill - Reuse Waste Screenings	**$ 7,612,103**

Cell 1 Waste - Relocate to Cell 3					
Item #	*Description*	*Quantity*	*Unit*	*Unit Cost*	
13	Wood Waste - Haul to Cell 3	140,054	CY	$ 3.00	$ 420,161
14	Place and compact wood waste at Cell 3	140,054	CY	$ 2.50	$ 350,134
15	Non-Blended Fines-Stockpile for Cell 3 Cover Soil	14,520	CY	$ 3.00	$ 43,560
16	Pyrolysis Material - Haul to Cell 3	158,727	CY	$ 2.00	$ 317,454
17	Place and compact pyro material at Cell 3	158,727	CY	$ 2.50	$ 396,818
18	Non-Blended Fines to be re-landfilled	388,026	CY	$ 2.00	$ 776,052
19	Place and compact non-blended fines at Cell 3	388,026	CY	$ 2.50	$ 970,065
				Cell 1 Waste - Relocate to Cell 3	**$ 3,274,244**

Subtotal		**$ 22,265,150**
Contingency	15 %	$ 3,339,772.53
Phase 3* Total Cost		**$ 25,604,923**

* Phase 3 = 82% of Cell 1, see page 1

ATTACHMENT G

GEOTECHNICAL FIELD INVESTIGATION REPORT

GEODESIGN INC

Memorandum

To:	Stacy Frost	From:	John C Hook, G.I.T. and Shawn M. Dimke, P.E., G.E.
Company:	Maul Foster Alongi, Inc.	Date:	November 11, 2016
Address:	2001 NW 19th Avenue, Suite 200 Portland, OR 97209		
cc:	n/a		
GDI Project:	OSU-1-01		
RE:	Field Observations Oregon State University-Cascades Demolition Landfill Reclamation		

INTRODUCTION

GeoDesign, Inc. is pleased to submit this memorandum that presents our characterization of the demolition landfill. This memorandum briefly summarizes the background geologic information and current subsurface conditions within the landfill. We also identify geotechnical considerations for the potential redevelopment plan for the site.

Our findings are based on our review of existing information collected by others and our recent site reconnaissance for the approximately 75-acre Deschutes County demolition landfill site for the proposed extension to the Oregon State University Cascades Campus. Multiple previous subsurface and surface explorations have been completed on or adjacent to the Deschutes County demolition landfill site. Specifically we reviewed the following documents in preparing this memorandum:

- Gershaman, Brickner & Bratton, Inc. (GBB), *Demolition Landfill Subsurface Investigations Study, prepared for Deschutes County Department of Solid Waste, Bend Oregon*, dated October 31 2008. GBB Project Number C08016 (GBB, 2008)
- PBS Engineering + Environmental (PBS), *Phase II Characterization Report – Groundwater Assessment Monitoring; Demolition Landfill; 19755 Simpson Avenue; Bend, Oregon*, dated June 2013. PBS Project No: 80570.000 (PBS, 2013)
- Carlson, *Report of Supplemental Geologic Reconnaissance & Preliminary Slope Stability Analysis for Eastern Portion of OSU Cascades 46-Acre Site, 1707 & 1757 SW Simpson Avenue; Bend Oregon*, dated May 21 2014. CGT Project Number G1303959.B (Carlson, 2014a)
- APEX, DRAFT *Former Demolition Landfill Mitigation Evaluation; Deschutes County; Bend, Oregon*, dated June 4 2014. Apex Project No. 1348-20 (APEX, 2014)
- Carslon Geotechnical (Carlson), *Report of Preliminary Geotechnical Investigation; OSU Cascades 46-Acre Site; 1707 & 1757 SW Simpson Avenue; Bend Oregon,* dated July 25 2014. CGT Project Number G1303959.A (Carlson, 2014b)

We conducted a site reconnaissance and observed seven supplemental boring explorations completed by Maul Foster Alongi's subcontractor, Pacific Soil & Water, on July 28 and 29, 2016. The direct-push borings were advanced to depths ranging from 6.0 to 46.0 feet below ground surface (BGS). One of the borings (B7) was advanced to 46.0 feet BGS in landfill Area 3 to provide further geotechnical information on the depth and composition of cover materials for potential re-use as structural fill for the project. The additional subsurface information will be presented by Maul Foster Alongi in a separate document.

GEOLOGIC SETTING

Subsurface geology in the area is dominated by recent unconformable air-fall and pyroclastic units with locally variable degrees of consolidation and welding underlain by basaltic cinder and lava flows of the adjacent Overturf Butte Complex (Carlson, 2014b). In sequence, the following units are likely to be exposed in the relict quarry sidewalls and beneath landfill areas:

- *Shelvin Park Tuff* - Dark gray andesitic to dacitic tuff with various volcanic lithic fragments, densely welded, and of generally blocky/columnar nature within the lower portion of the unit (Carlson, 2014a).
- *Tumalo Tuff* - Light gray ryolitic air-fall tephra deposits (locally referred to as the Bend Pumice) overlain by a pyroclastic flow deposit of similar composition. Where exposed in outcrop, these units show varying degrees of consolidation and welding and generally exhibit moderate to poor consolidation (Carlson, 2014a).
- *Desert Spring Tuff* - Dark gray to brownish orange ryodacitic ash flow tuff, moderate to well consolidated, with evidence of partial welding in the lower portion of the unit (Carlson, 2014a).
- *Overturf Butte Complex* - Reddish brown to dark gray and black basaltic cinder, spatter, and flow deposits associated with the adjacent Overturf Butte Vent complex. Previous explorations have identified potential paleosols and weathering between flow and deposit margins within this unit (APEX, 2014).

Slope stability analyses were previously completed in order to provide slope gradient recommendations for the quarry site to the south (Carlson, 2014a). During our brief field reconnaissance we did not observe slope conditions in the south quarry different than identified by the prior report or any signs of inherent instability or slope failure under current conditions.

AREA 1

Access to Area 1 consists of a single road that is wide, well graded, and of gentle slope running from the north entrance to the center of the site, with a smaller track running east-west to a gate on the west side. The Area 1 fill has generally been built level to roughly 15 feet above the adjacent surrounding grades. While loose, the cap material provides a competent subgrade that can support light vehicular traffic. At the time of our reconnaissance surface vegetation in Area 1 consisted of light grass and sagebrush in immature soils (cap material), with the cap material sourced primarily from the Desert Springs and Tumalo Tuff units. The cap material can be generally classified as silty sand (SM) with gravel. Surface subsidence was observed in the majority of Area 1, with the exception of the roadways running through its central portion. Cracking, slumping, and some dark gray to black-stained, non-organic precipitation at fissures and cracks (within the zone undergoing pyrolysis) are generally present in subsiding areas. Areas undergoing pyrolysis were observed to have a distinct and acute non-organic odor at the surface. Deschutes County employees informed us that subsiding areas were periodically filled in with a stockpile of cap material located in the central area of the site, per their standard procedure for the surface of areas undergoing pyrolysis.

Previous explorations, and those observed by us, show cap thicknesses vary between approximately 0.5 foot and 10 feet, with thickness highly dependent on location (GBB, 2008). Portions of the cap material also appear intermingled with landfill material 0.5 foot to 10 feet below the base of the cap. Landfill material in Area 1 is likely more diverse than that found in Areas 2 and 3, and previous reports indicate approximately 43 percent of the landfill listed as uncharacterized, in addition to significant concentrations of tires and metal (APEX, 2014).

AREA 2

Surface vegetation and cap composition in Area 2 is very similar to Area 1, with some sagebrush significant enough to prevent passage of conventional vehicles. Two very steep access roads provide access to Area 2 on the north and west sides, with a small track blocked by boulders at the southwest boundary of the area. Area 2 fill has generally been built above the surrounding grades with the greatest slope heights up to approximately 45 feet and slope gradients up to approximately 1.5H:1V on the south edge of the area adjacent to the quarry to the south of the site. Subsidence, while not as severe as that observed in Area 1, is present in multiple locations in the center of Area 2, as well as evidence of some previously filled areas of subsidence.

Cap material observed in Area 2 is also very similar to that observed in Area 1. Cap thickness within Area 2 was generally observed by us and others to range between 0.5 foot and 5 feet with an average thickness of 2 to 3 feet (Carlson, 2014b; GBB, 2008). Landfill debris was observed in the sidewall of the landfill portion above original subgrade elevation. Stacked tires are present along the north side of Area 2, likely placed to stabilize the slope at the boundary of the landfill material. In the single boring exploration conducted in Area 2 while we were on site, landfill material was observed to consist primarily of sawdust, with minor amounts of construction debris (wood and fiberglass) observed in the 5 feet immediately below the base of the cap. Previous explorations of the landfill material in Area 2 generally show a mixture of wood waste, demolition waste, sawdust, and ash (GBB, 2008).

AREA 3

Surface vegetation in the landfill portion of Area 3 is very similar to Areas 1 and 2, with sparse grass, sagebrush, and a few small trees on the adjacent slopes. A main access road in fair condition rings the large depression in the middle of the quarry area and connects to the entrance off of SW Simpson Road in the north-central portion of the site. With the exception of the lowest area on the west side of the depression and above the access road at the northwest corner, the majority of the landfill area is accessible by conventional highway vehicles. A slope with gradients of roughly 3.5H:1V is present below the access road down to the gently sloping bottom in the middle of the Area 3 depression. The slope height increases up to approximately 40 feet at the west end of the depression. Slopes with variable gradients of up to approximately 1.5H:1V and slope heights up to approximately 40 feet are present immediately above the west end of the circular access road. Slopes with gradients up to approximately 2H:1V and slope heights of 15 feet are present immediately above the south side of the circular access road. We did not observe any signs of instability or failures of the existing slopes. Subsidence and some associated surface cracking were observed at the north side of the bottom of the depression during our reconnaissance.

Cap material in this area is extremely similar to Area 1. But it appears to be very loose at the surface and contains a higher proportion of pumice, likely due to a higher percentage of Tumalo Tuff used as cap material. Cap thickness in this area ranged from 3 to 40 feet (Carlson, 2014b; GBB, 2008); these thicknesses were generally confirmed with subsurface explorations conducted while we were on site. Several intervals of perched water were observed in the fill material at depth during the course of explorations. Significant portions of the tuffaceous fill observed are dark in color and odiferous and may have been moved from an original location in another area with close proximity to landfill material. Minor subsidence along the north side of the landfill area was observed, as well as concurrent cracking and void spaces in the adjacent subgrade. Outcrop of the Desert Springs tuff was sporadically encountered in the south slope of Area 3 up to 40 feet above the base of the slope. According to the previous studies, the majority of the waste material found in Area 3 consists of mixed demolition waste, wood waste, ash, and other unidentified materials (GBB, 2008).

DISCUSSION AND GEOTECHNICAL CONSIDERATIONS

We understand current development plans are to remove and process the landfill material from Areas 1 and 2 to reduce the amount of landfill material to the extent feasible. Beneficial uses will be sought for materials, including generation of material that can be used as structural fill to re-grade the excavations and other areas of the OSU Cascades Campus development. Removal of the landfill materials and replacement with structural fill will allow structures in Areas 1 and 2 to be supported on conventional shallow foundations. The cap material for Area 3 may also be removed and re-used for structural fill. Unusable landfill material from Areas 1 and 2 may be placed to fill in the depression of Area 3.

Past pumice mining within Area 1 created a near-vertical slope up to roughly 60 feet high at the eastern boundary of the excavation prior to being filled with landfill material. The steep cut stood for some time and would likely stand at the same configuration if exposed again from the removal of landfill materials. However, the exposed slope will likely have an unacceptable factor of safety since the three buildings are now located adjacent to the property boundary. We believe that the most cost-effective way to stabilize the slope will be to shore the slope using a soil nail wall as the waste is excavated. We recommend conducting explorations adjacent to the landfill in the native predominantly tuff and pumice to evaluate and design the actual required slope reinforcement prior to exposing the near-vertical slope in proximity to the existing developments near the eastern property boundary.

While significant amounts of cap material exist on site, especially in Area 3, we observed significant transition zones in the recent explorations where cap material is mixed with landfill waste prior to the transition into landfill material. The majority of the cap material appears geotechnically suitable for placement and compaction as structural fill; however, due to the mixing with waste in the transition zones, we expect some material will have to be selectively excavated and processed to remove deleterious materials prior to placement and compaction as structural fill.

We understand the landfill materials may be processed to separate the soil from other landfill debris for re-use as structural fill. The processing may not remove enough organics from a geotechnical perspective for immediate re-use as structural fill. The decrease in geotechnical engineering properties of fill material is more significant with organic content exceeding approximately 4 percent. Therefore, we recommend a target maximum organic content of 4 percent for fill to be re-used as structural fill for the development. The fill can be mixed with clean material to decrease the organic content as necessary. Any organic material present in structural fill material should be uniformly mixed with the fill and less than ¼ inch in diameter. If trace organics are present in the fill, suitable construction observation and laboratory testing should be conducted to evaluate if organics in the fill are being limited to acceptable amounts. We further recommend structural fill be relatively free of organic material for the top 1 foot of fill below slabs and pavements and the top 2 feet below foundations.

We understand waste material will remain in Area 3; additional landfill waste may be placed in the area prior to the planned non-settlement-sensitive developments over the capped landfill area. New landfill materials for the area should be compacted to the extent feasible. The thickness of the cap fill over the area should be based on the planned overlying developments; however, a preliminary cap thickness of 5 to 10 feet could be assumed for planning purposes. The cap may also incorporate geosynthetic reinforcement to limit differential settlement. Depending on the final depth, configuration, observed settlement rates, and planned non-settlement-sensitive developments, an extended surcharge on the order of 10 feet above the cap may also be required over the landfill area.

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One copy submitted (via email only)
Document ID: OSU-1-01-111116-geom.docx

REGISTERED PROFESSIONAL ENGINEER
63114PE
OREGON
March 14, 2006
SHAWN DIMKE
EXPIRES: 12/31/17