# 2019 ANNUAL ENVIRONMENTAL MONITORING REPORT

## Hansville Landfill, Kitsap County, Washington

Prepared for: Kitsap County Public Works - Solid Waste

Project No. 160423-004-2019 • February 28, 2020 Final

Aspect CONSULTING

earth + water

# 2019 ANNUAL ENVIRONMENTAL MONITORING REPORT

## Hansville Landfill, Kitsap County, Washington

Prepared for: Kitsap County Public Works - Solid Waste

Project No. 160423-004-2019 • February 28, 2020 Final

Aspect Consulting, LLC



**Peter S. Bannister, PE**
Associate Engineer
pbannister@aspectconsulting.com

**Meilani Lanier-Kamaha'o, LG**
Project Geologist
mlkamahao@aspectconsulting.com

V:\160423 Kitsap County Hansville Landfill\Deliverables\2019 Reports\2019Annual\Final\Hansville LF 2019 Annual Report_Final.docx

# Contents

## List of Tables



## List of Appendices

# Acronyms

| | |
|---|---|
| Aspect | Aspect Consulting, LLC |
| CAP | Cleanup Action Plan |
| CMP | Compliance Monitoring Plan |
| COCs | contaminants of concern |
| Ecology | Washington Department of Ecology |
| KCSL | Kitsap County Sanitary Landfill |
| mg/L | milligrams per liter |
| µg/L | micrograms per liter |
| MSW | municipal solid waste |
| MTCA | Model Toxics Control Act |
| NAVD88 | North American Vertical Datum of 1988 |
| RASR | Remedial Action Status Report |
| RI/FS | Remedial Investigation/Feasibility Study |
| scfm | standard cubic feet per minute |
| Site | Hansville Landfill Site |
| SHA | Site Hazard Assessment |
| UCL / LCL | upper confidence limit / lower confidence limit |
| VOCs | volatile organic compounds |
| WAC | Washington Administrative Code |
| WMW | Waste Management of Washington |

# 1 Introduction

This combined fourth quarter 2019 and 2019 annual monitoring report documents site activities conducted at and environmental monitoring results for the Hansville Landfill Site (Site; or the Landfill). This report was prepared by Aspect Consulting, LLC (Aspect) on behalf of Kitsap County (County) Public Works Solid Waste Division and Waste Management of Washington (WMW). Cleanup activities at the Site have been conducted under the Washington State Model Toxics Control Act (MTCA). Ongoing environmental monitoring at the Site supports the remedy of natural attenuation of groundwater with enhanced monitoring and institutional controls that was established with the final Cleanup Action Plan (CAP) provided with the Amended Consent Decree No. 95-2-03005-1 (August 5, 2011). The data sets presented in this report were collected in accordance with the Ecology-approved Compliance Monitoring Plan (CMP; SCS Engineers, 2011; SCS Engineers, 2012), except where otherwise noted.

During 2019, conditions monitored at the Site were consistent with historical trends and continued to show improvements in protection of human health and the environment. This report is organized to include topics listed in the CMP (SCS Engineers, 2011).

- Section 2 summarizes Site background, including general Site information, regulatory framework, surrounding land use, hydrogeologic conditions, the environmental monitoring network, and cleanup criteria.
- Section 3 describes Site activities during the fourth quarter 2019 and provides a summary of previous Site activities in 2019.
- Section 4 describes landfill gas collection activities and monitoring results during the fourth quarter 2019. The landfill gas collection system was safely operated to improve groundwater protection.
- Section 5 describes groundwater and surface water conditions observed during the fourth quarter 2019, including statistical analysis of trends in groundwater concentrations for 2019 and an assessment of natural attenuation processes.
- Section 6 summarizes landfill inspection reports prepared by the Kitsap Public Health District.
- Section 7 summarizes operations and maintenance updates associated with groundwater sampling and the condensate system improvements.
- Section 8 lists reference sources used in this report.

# 2 Site Background

Details on Site background were provided in the Remedial Investigation (RI) report (Parametrix, 2007), and the Feasibility Study (FS) report (Parametrix, 2009). This section summarizes Site background to provide context for ongoing Site activities and compliance monitoring.

## 2.1 Site Location and Description

The closed Hansville Landfill is located on an approximately 73-acre parcel within the northeast quarter of Section 9, Township 27 North, Range 2 East of the Willamette Meridian, in Kitsap County, Washington. The Landfill is approximately five miles south of the unincorporated community of Hansville on the northernmost reach of the Kitsap Peninsula, and is situated on the upper portions of several sloping drainages with perennial creeks that ultimately discharge into Port Gamble Bay. The topography ranges between approximately 310 and 390 feet elevation North American Vertical Datum of 1988 (NAVD88). A Site location map is provided in Figure B-1, showing property boundaries and other Site features.

The Site includes the Landfill, the Landfill property (Property), and a portion of land owned by the Port Gamble S'Klallam Tribe. The Landfill was active between 1962 and 1989, and consists of three separate disposal areas, or cells. These include the following:

1. 13-acre municipal solid waste disposal cell (main municipal solid waste (MSW) cell) situated within the central portion of the Property.
2. 4-acre demolition disposal cell situated on the northeast corner of the property, which accepted construction, demolition, and land clearing wastes.
3. 1/3-acre septage lagoon located immediately southwest of the demolition disposal area, which accepted residential septic tank waste until 1982. A second septage disposal area was reportedly located near the northeast corner of the demolition disposal area.

### *2.1.1 Engineering Controls*

The engineering controls at the Landfill include engineered cover systems and an active landfill gas collection system. The engineered cover systems incorporate a geomembrane, vegetated surface, and integrated surface water control to prevent erosion. The layout of the landfill gas collection system is shown on Figure A-1, and includes:

- 13 vertical collection wells installed within the main MSW cell.
- 10 perimeter collection wells installed outside the western edge of the main MSW cell.
- Approximately 3,200 feet of horizontal collector trench installed below the engineered cover system at the main MSW cell and the demolition disposal cell with 8 monitoring and control points.
- Laterals and a perimeter header leading to the blower and flare compound.

### 2.1.2 Current Property Uses

The County owns the Property, and has operated a transfer station east of the Landfill for solid waste transfer and/or recycling operations since 1989. The remaining portions of the Property are largely comprised of a former soil borrow area and wooded land. Prior to development of the landfill, the Property was undeveloped forested land.

## 2.2 Regulatory Framework

The Hansville Landfill is a former MSW landfill that stopped accepting waste and closed in 1989. The closure met requirements of Chapter 173-304 of the Washington Administrative Code (WAC), and included the following engineering controls (for example):

- Installation of horizontal gas collector trenches in the main MSW cells and the demolition disposal cell to prevent landfill gas migration.
- Installation of an engineered cover system over all three distinct disposal areas to reduce or eliminate precipitation infiltration through refuse.

In 1991, the Bremerton-Kitsap County Health Department required corrective actions to better control landfill gas migration and prevent groundwater impacts. Kitsap County Sanitary Landfill[1] (KCSL) converted the landfill gas collection system from passive to active. KCSL also conducted additional investigations, continued environmental monitoring, and implemented additional improvements at the Site as part of a corrective action program. The active landfill gas collection and flare system has been in operation since 1991.

Also, in 1991, the Washington Department of Ecology (Ecology) performed a Site Hazard Assessment (SHA) under MTCA, which resulted in an initial ranking of 3. In 1992, this ranking was subsequently changed to a 1 (the highest rank on a scale of 1 to 5) based on changes in the state ranking model.

In October 1995, Ecology signed a consent decree with the County and KCSL to conduct a RI/FS for the Site. The RI/FS reports (Parametrix, 2007; Parametrix, 2009) identified contaminants of concern (COCs) related to the landfill in groundwater and in seepage to surface water. Based on these findings, Site-specific cleanup levels were developed for arsenic, vinyl chloride, and manganese in groundwater, and arsenic and vinyl chloride in surface water. The highest concentrations of these COCs were observed adjacent to the waste disposal areas, with decreasing concentrations at increasing distances to the landfill.

In preparing the 2011 Amended Consent Decree and CAP, Ecology selected the remedy involving natural attenuation of groundwater with enhanced monitoring and institutional controls (including a restrictive covenant for the Landfill Property). A CMP (SCS Engineers, 2011; SCS Engineers, 2012) provides monitoring program details, including the Sampling and Analysis Plan and the Quality Assurance Plan. Ongoing compliance monitoring under the CAP has been conducted since the fourth quarter of 2011.

[1] By 1998, WMW assumed control of KCSL through a series of sales, mergers, and acquisitions.

During the summer of 2016, Ecology initiated the first five-year review of the Hansville Landfill MTCA remedy as defined under the 2011 Amended Consent Decree. Consistent with Section XXVI of the Amended Consent Decree, a Remedial Action Status Report (RASR; SCS Engineers, 2016) was prepared and submitted to Ecology. In August 2016, Ecology prepared a draft memorandum that included an evaluation of the previous five years of groundwater data and comments to the RASR. Based on Ecology's review, the current monitoring program will continue to be implemented through the next five-year MTCA review cycle.

## 2.3 Surrounding Land Use

The Property is bordered to the south and west by lands owned by the Port Gamble S'Klallam Tribe. Tribal lands in the immediate vicinity of the Landfill Property consists of woodland and recreational land. The Point Casino and Hotel is located approximately 1,000 feet from the Landfill. The nearest Tribal residential land use is approximately 2,000 feet from the Landfill.

Surrounding areas to the north and east of the Property are zoned by the County as light industrial use, low-density residential, and rural woodland. The nearest off-property structures include a shop and office approximately 200 feet from the demolition disposal cell.

## 2.4 Hydrogeology

The regional near-surface geology in the vicinity of the Landfill is dominated by glacio-fluvial and glacio-lacustrine deposits associated with the Vashon glaciation. The RI (Parametrix, 2007) identifies the following main stratigraphic units at the Site (from ground surface downward):

- **Sand –** This unit was reported in all the investigative borings from the ground surface to depths ranging from 62 to 142 feet below ground surface (bgs), and is also called the upper aquifer. All the monitoring wells are completed in the upper aquifer. The sand deposit consists primarily of poorly graded, fine- and medium-grained sand with trace amounts of silt and gravel. The material is dark yellowish brown to dark gray in color, dense to very dense, and dry to saturated. The RI references the sand unit as the upper aquifer. This unit has been interpreted as outwash associated with the Vashon Drift.
- **Transition Zone –** This zone was reported at three boring locations (MW-8, MW-9, and MW-14), occurs at the bottom of the upper aquifer, and is approximately 15 feet thick. It consists of interbedded layers of sand, silty sand, and silt, and does not appear to be extensive.
- **Silt –** This unit was reported in all borings advanced through the upper aquifer. It occurred at depths ranging from approximately 66 feet bgs (at MW-9) to 163 feet bgs (at MW-14). The silt is dark gray, silty to moderately plastic, very dense, and dry. This unit has been interpreted to be the Kitsap Formation.

Groundwater in the upper aquifer near the Landfill is approximately 50 feet below the bottom extent of refuse. Groundwater flows towards the west-southwest, and discharges into the headwaters of perennial creeks, including Creek A, Creek B, and Middle Creek

(see Figure B-1). The dense silts reported for the Kitsap Formation underlying the upper aquifer restrict downward groundwater flow.

## 2.5 Environmental Monitoring Network

This section summarizes historical development of the Site performance and compliance monitoring network. The following are the conditional points of compliance for the Hansville Site described in the CAP:

- The Upper Aquifer at the Landfill Property boundary.
- The Upper Aquifer downgradient of the Landfill Property boundary and upgradient of the creek headwaters on Tribal property.
- Groundwater discharge to surface water at the headwaters of Creek A, Creek B, and Middle Creek on Tribal property.

### *2.5.1 Subsurface Gas*

The landfill gas collection system and gas probes have been monitored since 1990 to assess potential landfill gas migration from the Landfill, and landfill gas concentrations within the waste.

All (nine) subsurface gas probes were installed outside the waste in native soils to measure for potential landfill gas migration. Six subsurface gas probes (GP-1, GP-2S, GP-2I, GP-2D, GP-3, and GP-4) were installed in 1990 at four on-Property locations, monitoring the southern portion of the Landfill. Gas probes GP-5 and GP-6 were installed in 1994 and 1996, for monitoring the northern portion of the Landfill. Gas probe GP-7 was installed in 1996, for monitoring the off-Property area west of the Landfill, adjacent to groundwater monitoring well MW-9.

Per the CAP, landfill gas performance monitoring includes quarterly field measurements at the nine subsurface gas probes at seven locations, and the landfill gas collection system (21 vertical well and horizontal trench monitoring locations, the blower inlet and outlet ports). Subsurface gas compliance monitoring locations are shown on Figures A-1 and B-1.

### *2.5.2 Groundwater*

Groundwater monitoring was initiated at the Site in 1982 with the installation of three monitoring wells (MW-1 through MW-3). Three additional monitoring wells (MW-4 through MW-6) were added to the monitoring program in 1988. Beginning in 1996, 10 monitoring wells were installed as part of a phased RI (Parametrix, 2007):

- Phase I included wells MW-7 through MW-12
- Phase II included wells MW-8D, MW-12I, MW-13S, MW-13D, and MW-14

Based on the RI groundwater monitoring results, the CAP includes the following six points of compliance: MW-5, MW-6, MW-7, MW-12I, MW-13D, and MW-14. See Figure B-1 for the groundwater compliance monitoring locations.

### 2.5.3 Surface Water

Surface water monitoring commenced in 1991 at two locations on Middle Creek (SW-1 and SW-2). Two additional locations (SW-SB and SW-3) were added in 1992 and 1994, respectively. Seven new surface water sampling locations (SW-4, SW-5, SW-6, SW-7, SW-8, SW-9, SW-10) were established in 1996 during the RI (Parametrix, 2007). Based on the RI surface water monitoring results, the CAP includes the following four points of compliance: SW-1, SW-4, SW-6, and SW-7. See Figure B-1 for the surface water compliance monitoring locations.

### 2.5.4 Cleanup Criteria

The CAP established the final Site-specific cleanup levels for groundwater and surface water, summarized in the table below.

**Table 1. Hansville Landfill Site Cleanup Levels**

| Chemical | Media | Site Cleanup Level (µg/L) | Origin of Cleanup Level |
|---|---|---|---|
| Vinyl Chloride | Groundwater | 0.025 | EPA Human Health, 2004 |
| Arsenic | | 5 | Background |
| Manganese | | 2,240 | Method B Formula Value |
| Vinyl Chloride | Surface Water | 0.025 | EPA Human Health, 2004 |
| Arsenic | | 5 | Background |

The performance standard for on-Property probes is to operate the landfill gas collection system to maintain methane concentrations below five percent by volume (see WAC 173-304-460).

# 3 Site Activities

2019 Site activities included environmental monitoring of landfill gas, groundwater, and surface water. A chronology of on-Site activities performed during the fourth quarter of 2019 is provided below.

- On October 16, 2019, Aspect conducted monthly landfill gas system tuning. Details of landfill gas monitoring are provided in Section 4.
- On October 23, 2019, Aspect completed groundwater and surface water sampling in accordance with the CMP (SCS Engineers, 2011). Details of groundwater and surface water sampling are provided in Section 5.
- On October 25, 2019, Aspect disconnected the perimeter gas wells from the landfill gas collection system. A memorandum was prepared to document the end of collection and monitoring at these wells (Aspect, 2020) and is included in Appendix F.
- On November 21, 2019, Aspect conducted monthly landfill gas system tuning. Details of landfill gas monitoring are provided in Section 4.
- On December 11, 2019, Aspect conducted compliance landfill gas monitoring in accordance with the CMP (SCS Engineers, 2011). Details of landfill gas monitoring are provided in Section 4.
- In November and December 2019, Aspect completed improvements to the condensate collection system. A minor modification in operations and maintenance of the condensate system is discussed in Section 7.

Previously during 2019, Site activities were documented in quarterly reports (Aspect 2019a; Aspect 2019b; Aspect 2019c) and included the following:

- Monthly landfill gas system tuning and maintenance
- Quarterly landfill gas compliance monitoring
- Quarterly groundwater and surface water performance and compliance monitoring

## 3.1 Deviations from the Compliance Monitoring Plan

There was one deviation from the CMP (SCS, 2011) during the fourth quarter of 2019 reporting period. On October 25, 2019, Aspect disconnected the perimeter gas wells from the landfill gas collection system. An addendum to the CMP was prepared to document the end of collection and monitoring at these wells (Aspect, 2020), and is included in Appendix F.

# 4 Landfill Gas Conditions

The following sections provide a discussion of landfill gas monitoring, landfill gas collection system performance, and explosive gas control. The layout of the landfill gas collection system is shown on Figure A-1.

Since active landfill gas collection started in 1991, the system has historically been operated to control landfill gas migration and to protect groundwater. Little to no methane has been observed at gas compliance probes since 1992. In 1995, the maximum methane concentration was 38 percent, and the balance gas concentration was 44 percent, indicating that approximately half of the gas collected was from the atmosphere. Until approximately January 2013, landfill gas collection rates decreased steadily due to low methane concentrations and difficulty in sustaining flare operation.

Since 2013, the landfill gas collection rate has been maintained at approximately 70 standard cubic feet per minute (scfm) to improve groundwater protection. Since 2013, the average methane concentration has been about 4 percent, and the average carbon dioxide concentration has been about 12 percent.

## 4.1 Landfill Gas Monitoring

During the fourth quarter of 2019, the landfill gas collection system was turned on October 16 and November 21, and compliance monitoring of the landfill gas collection system and compliance probes performed on December 11.

Measurements were made with a GEM-5000 multigas meter. Landfill gas monitoring parameters collected for the quarterly compliance monitoring events during 2019 are listed in Tables A-1 through A-4, and summarized below:

- Landfill gas composition measurements included methane (CH4), carbon dioxide (CO2), oxygen (O2), and balance gas (Balance) concentrations.
- Collection system pressure measurements included the static pressure measured before and after any valve adjustments, reported as “initial” and “adjusted,” respectively. No valve adjustments were made during the December 11 compliance monitoring round.
- Collection system flow-rate measurements were obtained at locations with orifice plates, including differential pressure and gas temperature.

### *4.1.1 Minor Changes to Landfill Gas Collection*

In January 2017, Aspect observed that the perimeter gas wells were under vacuum, and oxygen concentrations typically reflected atmospheric air. On March 31, 2017, valves at perimeter gas wells were closed to redirect vacuum to in-refuse landfill gas collection locations. Landfill gas migration control was maintained based on compliance probe monitoring. Over time, it became apparent that several of the 26-year-old valves were occasionally leaking and landfill gas was unintentionally being collected.

In October 2019, the perimeter gas wells were disconnected from the landfill gas collection system by cutting and capping the polyvinyl chloride (PVC) piping at each of

the 10 perimeter gas wells and the laterals from the landfill gas collection system. Details on these minor changes to the landfill gas system, including photos, historical, and regulatory context were documented in a memorandum dated February 21, 2020 (Aspect, 2020, Appendix F).

## 4.2 Landfill Gas System Performance

During the fourth quarter of 2019, the flow at the blower inlet was approximately 69 scfm. Methane and carbon dioxide concentrations at the blower inlet were 4.3 and 14.3 percent by volume, respectively. The oxygen concentration was 4.0 percent by volume. The explosive range for methane in air is approximately 5 to 15 percent by volume, whereas the minimum methane concentration to sustain a flame is approximately 20 percent. Landfill gas measured at the blower inlet has contained less than 20 percent methane since 2012.

During the fourth quarter of 2019, methane concentrations measured at individual collection locations ranged between 0.0 and 14.1 percent by volume, similar to methane concentrations observed during the third quarter 2019. The landfill gas concentrations across the wellfield have remained relatively stable since mid-2017. Wellfield optimization will continue to focus on maximizing methane and carbon dioxide collection rates. Therefore, valves at trench collectors TR-3 and TR-5 are kept closed except during monitoring, while other locations are operated with valves wide open.

The condensate system storage tank held 550 gallons on December 11, 2019, and was accumulating approximately 100 gallons per month during colder months of the year. The County will be notified when the volume reaches 1,500 gallons.

## 4.3 Explosive Gas Control

Methane was not detected at any of the landfill gas compliance monitoring locations during the fourth quarter of 2019. Routine compliance monitoring continues to show that the Site remains in compliance with explosive gas control per WAC 173-304-460. Carbon dioxide concentrations in the compliance monitoring probes ranged from 0.1 to 4.7 percent by volume, and oxygen concentrations ranged from 15.5 to 21.8 percent by volume.

# 5 Groundwater and Surface Water Conditions

The following sections describe groundwater and surface water monitoring, address observed groundwater elevations and flow, water quality results, and an evaluation of statistical trends to ensure progress toward Site-specific cleanup levels.

## 5.1 Groundwater and Surface Water Monitoring

During the fourth quarter of 2019, groundwater and surface water was monitored and sampled by Aspect on October 23, 2019.

Measurements of field parameters were made with a calibrated YSI multiparameter probe, and a calibrated Hach turbidimeter. Samples for laboratory analysis were collected in supplied bottles and delivered using standard chain-of-custody methods. Field parameters and laboratory results (see Appendix D for laboratory data certificates) for all sampling events in 2019 are organized in Tables B-2 and B-3 (Appendix B), and listed below:

- Field parameters included dissolved oxygen, pH, oxidation reduction potential, specific conductivity, temperature, and turbidity.
- Conventional parameters included alkalinity, ammonia (as N), bicarbonate, carbonate, chloride, nitrate (as N), nitrite (as N), orthophosphate (as P), sulfate, and total organic carbon.
- Dissolved metals included arsenic and manganese.
- Detected volatile organic compounds (VOCs) included total 1,2-dichloroethene, cis-1,2-dichloroethene, diethyl ether, and vinyl chloride.

## 5.2 Groundwater Elevations and Flow

Depth to groundwater measurements and calculated water table elevations for the fourth quarter of 2019 are presented in Table B-1, and a potentiometric surface map is provided in Figure B-1. Groundwater elevations ranged from 238.1 feet NAVD88 in MW-12I to 267.1 feet NAVD88 in MW-5. Groundwater at the Site flowed generally towards the west-southwest. Groundwater gradients ranged from 0.006 feet/feet in the upgradient areas, to 0.01 feet/feet further downgradient, with the gradient steepening and becoming more southwest oriented as it approaches the groundwater discharge area (Figure B-1). Groundwater elevation and gradient conditions were consistent with those observed during previous monitoring events.

## 5.3 Water Quality Results

**Groundwater quality results** from the fourth quarter 2019 are presented in Table B-2, including field parameters, conventional parameters, dissolved metals, and VOCs. During the fourth quarter 2019 monitoring event, field parameters were within the range of observed values during previous monitoring events. Analytical results for groundwater COCs are summarized below (see Appendix B for water quality results tables and figures).

- The dissolved arsenic concentrations in monitoring wells MW-14 and MW-13D were 0.0125 mg/L and 0.00517 mg/L, respectively, and exceeded the 0.005 mg/L cleanup level. Dissolved arsenic was detected at concentrations below the cleanup level at the other groundwater points of compliance. See Section 5.5 for statistical evaluation of the arsenic concentrations.
- Dissolved manganese concentrations were less than the 2.24 mg/L cleanup level at all groundwater points of compliance. During 2019, dissolved manganese concentrations in MW-14 decreased significantly compared with previous years.
- The vinyl chloride concentrations at monitoring wells MW-6, MW-12I, and MW-14 were 0.061 ug/L, 0.170 ug/L, and 0.061 ug/L, respectively, and exceeded the 0.025 ug/L cleanup level. Vinyl chloride was not detected at a reporting limit of 0.020 ug/L at other groundwater points of compliance. See Section 5.5 for statistical evaluation of the vinyl chloride concentrations

**Surface water quality results** from the fourth quarter 2019 are presented in Table B-3, including field parameters, conventional parameters, dissolved metals, and VOCs. During the fourth quarter 2019 monitoring event, stream flows appeared seasonally low at the end of the dry season. Field parameters and analyte concentrations observed during the fourth quarter 2019 monitoring event were within the range of observed values during other monitoring events in 2019. During the fourth quarter of 2019, all analytical results for surface water COCs were either not detected at their respective reporting limits or were detected at concentrations below the site cleanup levels.

- Dissolved arsenic was detected at concentrations below the site cleanup level of 0.005 mg/L at all locations.
- Dissolved manganese was detected at concentrations below the site cleanup level of 2.24 mg/L at SW-4, SW-6, and SW-7 and was not detected at SW-1.
- Vinyl chloride has not been detected in surface water samples since the third quarter of 2013, and reporting limits have been less than the cleanup level of 0.025 µg/L.

## 5.4 Geochemical Parameters

Geochemical parameters in groundwater and surface water serve as indicators of landfill effects and can distinguish leachate impacts from gas-to-groundwater impacts. As shown in Tables B-2 and B 3, geochemical parameters collected at the Site include field parameters (dissolved oxygen, pH, Redox [reduction-oxidation potential], specific conductivity, and temperature), alkalinity/carbonate/bicarbonate, chloride, nitrate/nitrite/ammonia, sulfate, and total organic carbon.

Based on low concentrations of geochemical parameters identified as leachate indicators (such as chloride, sulfate, alkalinity, and bicarbonate) across the Site, there appears to be little if any leachate effect on groundwater and surface water quality. Historically, the downgradient monitoring wells show lower dissolved oxygen concentrations than the upgradient well (MW-5) or surface water sampling locations (SW-1, SW-4, SW-6, and SW-7). Carbon dioxide in landfill gas readily dissolves in groundwater, reducing

dissolved oxygen concentrations. Optimizing landfill gas collection will reduce the gas-to-groundwater pathway that appears to be affecting groundwater geochemistry.

## 5.5 Statistical Evaluation

The groundwater quality data were evaluated following the description provided in the CAP (Appendix D). Time-series graphs show arsenic and vinyl chloride concentrations since 2007. Trend analysis and projected average concentrations are based on data collected since 2007, following Ecology guidance from the first five-year review. See Appendix C for time-series graphs for groundwater quality.

### *5.5.1 Time-Series Graphs*

Groundwater sampling results since 2007 are shown on time-series plots for dissolved arsenic (Figure C-1) and vinyl chloride (Figure C-2) at all compliance monitoring locations. Figure C-1 shows that dissolved arsenic concentrations in groundwater have been less than the cleanup level of 0.005 mg/L at MW-5 (background well), MW-6, MW-7, and MW-12I. Dissolved arsenic concentrations at MW-14 have been decreasing over time. In contrast, a slow and steady increase in dissolved arsenic concentrations has been observed at MW-13D, and exceedances have triggered a statistical trend analysis (described in the next sub-section).

Figure C-2 shows vinyl chloride concentrations in groundwater have been less than the cleanup level of 0.025 µg/L at MW-5 (background well), MW-7, and MW-13D. Vinyl chloride concentrations at MW-6 and MW-14 continued to trend downward over the long-term. During 2019, the vinyl chloride concentration at MW-12I showed both a decreasing long-term trend and seasonality with maximum concentrations during the fourth quarter, previously observed in 2015, 2013, 2012, for example.

### *5.5.2 Statistical Trend Analysis*

Based on the results of statistical analysis, the dissolved arsenic concentrations in groundwater at MW-14, and vinyl chloride concentrations in groundwater at MW-6, MW-12I, and MW-14, have statistically significant downward trends. These results show continued progress toward achieving cleanup levels.

Statistical analysis of groundwater data was performed in accordance with the CMP (SCS Engineers, 2011). The program Sanitas WQStat (ver. 9.0.34) was used to evaluate the Mann-Kendall Test and Sen's Slope. Mann-Kendall testing was performed to assess whether there were statistically significant trends in groundwater concentrations using the two-tailed test (alpha = 0.05). Mann-Kendall results are reported as an approximated normal distribution Test Value "Z" (where the number of data points was greater than 40). Sen's slope analysis was performed to identify the trend direction for statistically significant trends, and reflects the median of the slopes of all pairs of historical data.

Table C-1 provides results of statistical trend analysis, including the Mann-Kendall Test and Sen's Slope analysis. In all cases, the trends are statistically significant because the magnitude of the Mann-Kendall Test Value (Z) was greater than the Critical Value (which is based on the number of data points and alpha). In cases where the Sen's Slope is negative, it indicates a decreasing trend, and where the Sen's Slope is positive it indicates an increasing trend.

For the first time, a statistical trend analysis was conducted for dissolved arsenic concentrations in MW-13D due to concentrations that exceeded the cleanup limit in 2018 (once) and 2019 (three times). The results in Table C-1 confirm the statistically significant increasing trend since 2007. However, the arsenic results from MW-13D have shown a history of long-term oscillating concentrations dating back to the beginning of the remedial investigation in 1996 (see Figure 9-13b from the *Remedial Investigation Report* (Parametrix, 2006)). Based on the data available, it is likely that arsenic concentrations since 2007 reflect natural variations or off-Site influences, as opposed to effects from the Hansville Landfill Site. Dissolved arsenic concentrations in MW-13D and other locations will continue to be closely monitored and evaluated.

### 5.5.3 Trend Projections

To qualitatively evaluate the convergence of downward trending groundwater exceedances with cleanup levels, exponential attenuation curves are shown on Figure C-3. These curves are projected 10 years, through the end of 2028. Based on these long-term projections, the findings include the following:

- Within 10 years, the average vinyl chloride concentrations will meet the cleanup levels in MW-6, MW-12I and MW-14.
- In more than 10 years, the average dissolved arsenic in MW-14 will meet the cleanup levels.

Optimizing the landfill gas collection system may reduce the time to meet cleanup levels. This is consistent with elements of the contaminant fate and transport model presented in the RI/FS (Parametrix, 2007; Parametrix, 2009). Increasing landfill gas collection reduces the potential for landfill gas (containing carbon dioxide, methane, and VOCs) to come in contact with groundwater, which results in low dissolved oxygen.

- For vinyl chloride, this means reducing the mass transfer from vapor-phase to groundwater, and increasing the natural attenuation rates.
- For dissolved metals, this means maintaining a higher pH in groundwater, and preventing mobilization of naturally occurring arsenic and manganese.

A linear trend was calculated for increasing dissolved arsenic concentrations at MW-13D, as shown on Figure C-3. This projected trend biases future concentrations high because it does not account for the historical oscillation in concentrations. For reference, the graph for MW-13D on Figure C-3 shows the average natural background concentration for the Puget Sound basin, based on Ecology's 2016 publication: *Natural Background Groundwater Arsenic Concentrations in Washington State*. Based on the statistical trendline, the mean dissolved arsenic concentration at MW-13D is projected to exceed the cleanup level by the end of 2020, but is not expected to exceed the natural background concentration in the next 10 years.

### 5.5.4 Calculation of Statistical Limits

Where historical concentrations have consistently exceeded groundwater cleanup levels, statistical limit concentrations were evaluated to assess the approach toward cleanup levels (CAP, Appendix D). Table C-2 shows the calculated annual statistics—including

the mean[2], 95 percent upper confidence limit (UCL), and 95 percent lower confidence limit (LCL)—for sampling results from 2011 through 2019.

The statistical limits for vinyl chloride concentrations at MW-6, MW-12I, and MW-14 are all approaching the cleanup level. At MW-14, the statistical mean and UCL arsenic concentrations were decreasing at less than 0.001 ug/L per year in 2019, as shown in Figure C-3.

Statistical limits were not determined for the dissolved arsenic concentrations at MW-13D due to the history of oscillating concentrations. This approach will be reconsidered during the next annual report.

[2] The mean statistic was based on the least-squares regression method for log-transformed data, as shown by the curved trend lines in Figure C-3.

# 6 Annual Inspections

During 2019, the Kitsap Public Health District inspected the Landfill once each quarter. Appendix E provides the inspection letters and forms. The inspection dates and comments included the following:

- March 9, 2019: Compliant; condensate system to be inspected; no items noted during inspection.
- June 4, 2019: Compliant; condensate system to be inspected; mowing required.
- September 18, 2019: Compliant; new condensate system to be installed; landfill survey to be completed in next year; no issues during site visit.
- December 17, 2019: Compliant; slight pooling in the northwest corner of the cap, monitor over time.

# 7 Operations and Maintenance Updates

Minor updates in operations and maintenance are summarized below for landfill gas and condensate system improvements.

## 7.1 Landfill Gas Monitoring

With the perimeter gas collection wells disconnected from the landfill gas collection system, these wells do not require future monitoring.

## 7.2 Condensate System Improvements

Operations and maintenance updates for condensate system improvements include the following activities:

- Monitor the new aboveground storage tank for condensate volume. Increases in volume confirm proper operation of the condensate system. If no increase was observed, confirm water level in condensate riser is below actuation level for the sump pump.
- Notify the County for bulk condensate disposal when the tank is approximately ¾ full.

# 8 References

Aspect Consulting, LLC (Aspect), 2019a, First Quarter 2019 Environmental Monitoring Report, Hansville Landfill, Kitsap County, WA, May 28, 2019.

Aspect Consulting, LLC (Aspect), 2019b, Second Quarter 2019 Environmental Monitoring Report, Hansville Landfill, Kitsap County, WA, August 29, 2019.

Aspect Consulting, LLC (Aspect), 2019c, Third Quarter 2019 Environmental Monitoring Report, Hansville Landfill, Kitsap County, WA, November 29, 2019.

Aspect Consulting, LLC (Aspect), 2020, Final memorandum re: Hansville Landfill – Minor Changes to Landfill Gas Collection, February 21, 2020.

Parametrix, 2007, Hansville Landfill Remedial Investigation/Feasibility Study, Remedial Investigation Report, July 2007.

Parametrix, 2009, Hansville Landfill Remedial Investigation/Feasibility Study, Final Feasibility Study Report, June 2009.

SCS Engineers (SCS), 2011, Compliance Monitoring Plan with Sampling & Analysis Plan and Quality Assurance Plan – Remedial Action at the Hansville Landfill, September 15, 2011.

SCS Engineers (SCS), 2012, Addendum to the Hansville Landfill Compliance Monitoring Plan, January 27, 2012.

SCS Engineers (SCS), 2016, Remedial Action Status Report (RASR), May 2016

Washington State Department of Ecology (Ecology), 2016, Natural Background Groundwater Arsenic Concentrations in Washington State, Ecology Publication No. 14-09-044, March, 2016.

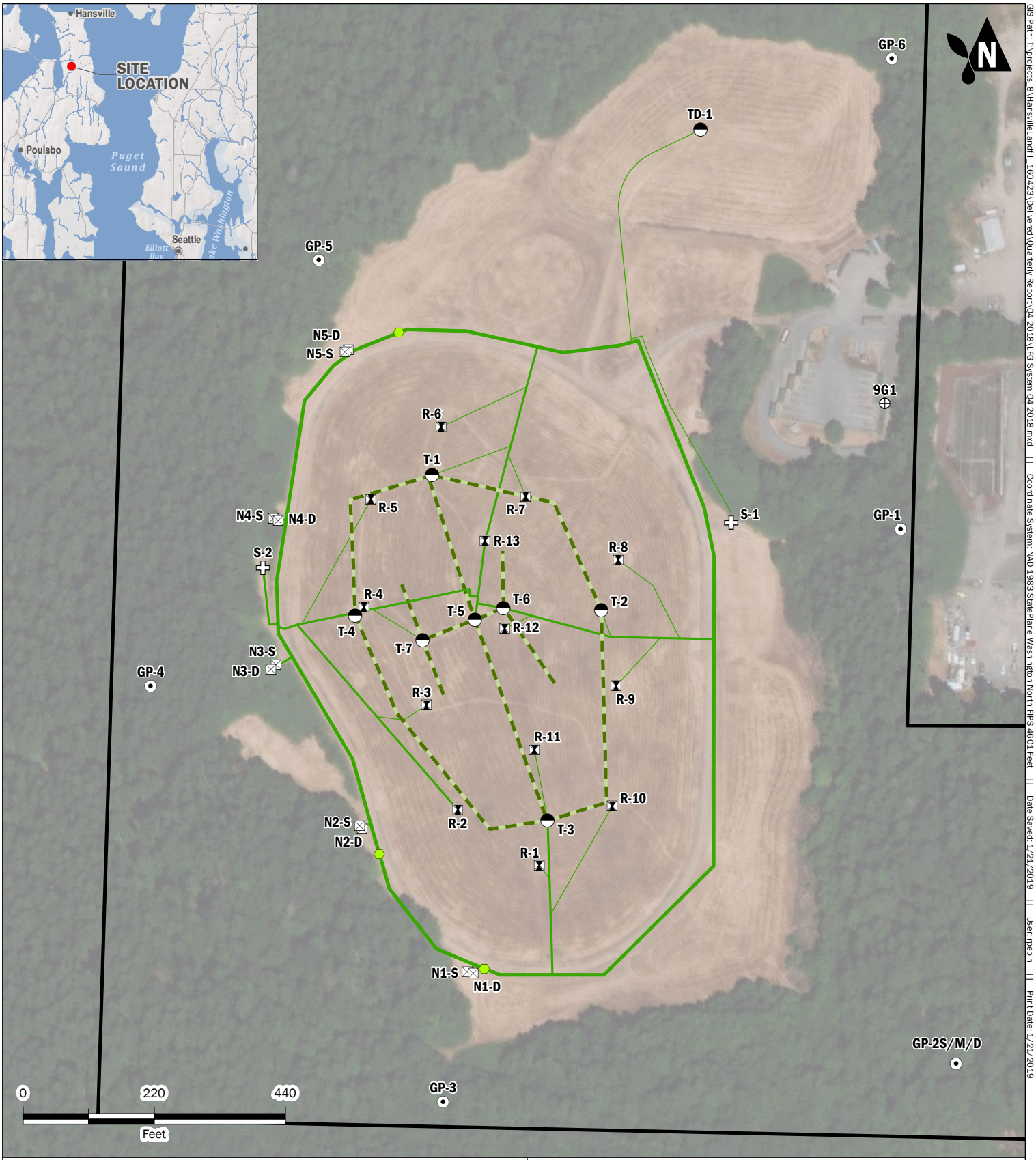
# 9 Limitations

Work for this project was performed for the Kitsap County Public Works Division (Client), and this report was prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. This report does not represent a legal opinion. No other warranty, expressed or implied, is made.

All reports prepared by Aspect Consulting for the Client apply only to the services described in the Agreement(s) with the Client. Any use or reuse by any party other than the Client is at the sole risk of that party, and without liability to Aspect Consulting. Aspect Consulting's original files/reports shall govern in the event of any dispute regarding the content of electronic documents furnished to others.

# APPENDIX A

# Landfill Gas Data




**Exploration**

- Condensate Sump
- Gas Detection Probe
- Gas Extraction Well (Native Soil Completion)
- Gas Extraction Well (in Refuse Completion)
- Trench Completion
- Well Geologic Control

**Landfill Gas System**

- LFG Pipe - 2"
- LFG Pipe - 4"
- LFG Pipe - 6"
- Trench
- LFG Valve
- Landfill Boundary

# Landfill Gas System

Fourth Quarter 2019 Environmental Monitoring Report
Hansville Landfill
Kitsap County, Washington

| Aspect Consulting | JAN-2019 | BY: MLK / RAP | FIGURE NO. A-1 |
|---|---|---|---|
| | PROJECT NO. 160423 | REVISED BY: --- | |



GIS Path: T:\projects_8\Hansville\Landfill_160423\Delivered\Quarterly Report\Q4 2018\LFG System Q4 2018.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 1/21/2019 || User: rpepin || Print Date: 1/21/2019

## Table A-4. Landfill Gas Data, Fourth Quarter, 2019

Project No. 160423, Hansville Landfill, Hansville, WA

| Location | Device ID | Date | Methane CH4 (% by vol) | Carbon Dioxide CO2 (% by vol) | Oxygen O2 (% by vol) | Balance Bal (% by vol) | Static Pressure (inches H2O) | | Gas Temperature (degrees F) | | Flow Rate (SCFM) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Initial | Adjusted | Initial | Adjusted[2] | Initial | Adjusted |
| **Blower Inlet** | HANSBLIN | 12/11/2019 | 4.30 | 14.30 | 4.00 | 77.40 | -4.55 | -4.57 | 46.90 | 46.90 | 68.60 | 68.60 |
| **Blower Outlet** | HANSBLOT | 12/11/2019 | 4.40 | 14.20 | 4.10 | 77.30 | N/A | N/A | N/A | N/A | N/A | N/A |
| **Extraction Well 001** | HANSR001 | 12/11/2019 | 7.10 | 15.30 | 0.00 | 77.60 | -0.12 | -0.16 | 54.90 | 54.90 | 1.10 | 1.00 |
| **Extraction Well 002** | HANSR002 | 12/11/2019 | 2.20 | 15.20 | 4.40 | 78.20 | N/A | N/A | N/A | N/A | N/A | N/A |
| **Extraction Well 003** | HANSR003 | 12/11/2019 | 8.50 | 15.00 | 0.00 | 76.50 | -0.53 | -0.37 | 57.30 | 57.40 | 3.00 | 3.70 |
| **Extraction Well 004** | HANSR004 | 12/11/2019 | 3.60 | 18.40 | 0.10 | 77.90 | -1.09 | -1.09 | 61.20 | 61.30 | 2.40 | 2.10 |
| **Extraction Well 005** | HANSR005 | 12/11/2019 | 4.70 | 19.40 | 0.00 | 75.90 | -0.59 | -0.59 | 67.80 | 67.80 | 2.90 | 2.70 |
| **Extraction Well 006** | HANSR006 | 12/11/2019 | 3.60 | 17.90 | 2.40 | 76.10 | -0.74 | -0.77 | 79.10 | 79.10 | 3.50 | 3.50 |
| **Extraction Well 007** | HANSR007 | 12/11/2019 | 0.60 | 16.70 | 0.30 | 82.40 | -0.01 | -0.01 | 64.40 | 64.40 | 2.90 | 2.70 |
| **Extraction Well 008** | HANSR008 | 12/11/2019 | 5.80 | 19.00 | 0.00 | 75.20 | -0.12 | -0.13 | 54.00 | 54.10 | 1.60 | 1.80 |
| **Extraction Well 009** | HANSR009 | 12/11/2019 | 2.10 | 16.20 | 1.60 | 80.10 | N/A | N/A | N/A | N/A | N/A | N/A |
| **Extraction Well 010** | HANSR010 | 12/11/2019 | 5.70 | 11.00 | 4.40 | 78.90 | -0.15 | -0.15 | 55.40 | 55.60 | 0.50 | 0.70 |
| **Extraction Well 011** | HANSR011 | 12/11/2019 | 3.60 | 9.30 | 0.00 | 87.10 | -0.21 | -0.21 | 53.60 | 53.60 | 1.50 | 1.40 |
| **Extraction Well 012** | HANSR012 | 12/11/2019 | 9.40 | 4.70 | 0.00 | 85.90 | -0.33 | -0.35 | 51.30 | 51.50 | 1.10 | 1.80 |
| **Extraction Well 013** | HANSR013 | 12/11/2019 | 3.80 | 14.70 | 1.40 | 80.10 | N/A | N/A | N/A | N/A | N/A | N/A |
| **Trench Collector TD-1** | HANSTD01 | 12/11/2019 | 2.10 | 21.30 | 0.00 | 76.60 | -0.06 | -0.06 | 50.80 | 50.80 | 12.80 | 12.80 |
| **Trench Collector TR-1** | HANSTR01 | 12/11/2019 | 0.70 | 16.50 | 2.00 | 80.80 | -0.27 | -0.25 | 56.90 | 57.00 | 2.90 | 2.40 |
| **Trench Collector TR-2** | HANSTR02 | 12/11/2019 | 10.90 | 17.90 | 0.00 | 71.20 | N/A | N/A | N/A | N/A | N/A | N/A |
| **Trench Collector TR-3** | HANSTR03 | 12/11/2019 | 0.00 | 0.20 | 21.50 | 78.30 | N/A | N/A | N/A | N/A | N/A | N/A |
| **Trench Collector TR-4** | HANSTR04 | 12/11/2019 | 2.10 | 18.30 | 0.00 | 79.60 | -0.20 | -0.21 | 52.30 | 52.40 | 3.10 | 2.90 |
| **Trench Collector TR-5** | HANSTR05 | 12/11/2019 | 0.00 | 0.10 | 21.80 | 78.10 | N/A | N/A | N/A | N/A | N/A | N/A |
| **Trench Collector TR-6** | HANSTR06 | 12/11/2019 | 14.10 | 14.50 | 0.10 | 71.30 | N/A | N/A | N/A | N/A | N/A | N/A |
| **Trench Collector TR-7** | HANSTR07 | 12/11/2019 | 11.70 | 15.40 | 1.10 | 71.80 | -0.23 | -0.23 | 53.60 | 53.60 | 3.60 | 3.90 |
| **Native Soil Extraction Well 1 Shallow** | HANSN01S | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **Native Soil Extraction Well 1 Deep** | HANSN01D | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **Native Soil Extraction Well 2 Shallow** | HANSN02S | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **Native Soil Extraction Well 2 Deep** | HANSN02D | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **Native Soil Extraction Well 3 Shallow** | HANSN03S | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **Native Soil Extraction Well 3 Deep** | HANSN03D | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **Native Soil Extraction Well 4 Shallow** | HANSN04S | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **Native Soil Extraction Well 4 Deep** | HANSN04D | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **Native Soil Extraction Well 5 Shallow** | HANSN05S | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **Native Soil Extraction Well 5 Deep** | HANSN05D | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **Gas Probe 1** | HANSGP01 | 12/11/2019 | 0.00 | 1.90 | 19.10 | 79.00 | N/A | N/A | N/A | N/A | N/A | N/A |
| **Gas Probe 2 Shallow** | HANSGP2S | 12/11/2019 | 0.00 | 1.30 | 20.30 | 78.40 | N/A | N/A | N/A | N/A | N/A | N/A |
| **Gas Probe 2 Middle** | HANSGP2M | 12/11/2019 | 0.00 | 1.20 | 20.30 | 78.50 | N/A | N/A | N/A | N/A | N/A | N/A |
| **Gas Probe 2 Deep** | HANSGP2D | 12/11/2019 | 0.00 | 0.20 | 21.80 | 78.00 | N/A | N/A | N/A | N/A | N/A | N/A |
| **Gas Probe 3** | HANSGP03 | 12/11/2019 | 0.00 | 1.30 | 20.80 | 77.90 | N/A | N/A | N/A | N/A | N/A | N/A |
| **Gas Probe 4** | HANSGP04 | 12/11/2019 | 0.00 | 1.90 | 20.40 | 77.70 | N/A | N/A | N/A | N/A | N/A | N/A |
| **Gas Probe 5** | HANSGP05 | 12/11/2019 | 0.00 | 1.40 | 20.70 | 77.90 | N/A | N/A | N/A | N/A | N/A | N/A |
| **Gas Probe 6** | HANSGP06 | 12/11/2019 | 0.00 | 4.70 | 15.50 | 79.80 | N/A | N/A | N/A | N/A | N/A | N/A |
| **Gas Probe 7** | HANSGP07 | 12/11/2019 | 0.00 | 2.60 | 19.40 | 78.00 | N/A | N/A | N/A | N/A | N/A | N/A |

**Notes**

Flow rates measured using orifice plates

N/A = indicates parameter not measured

inches H2O = inches water column

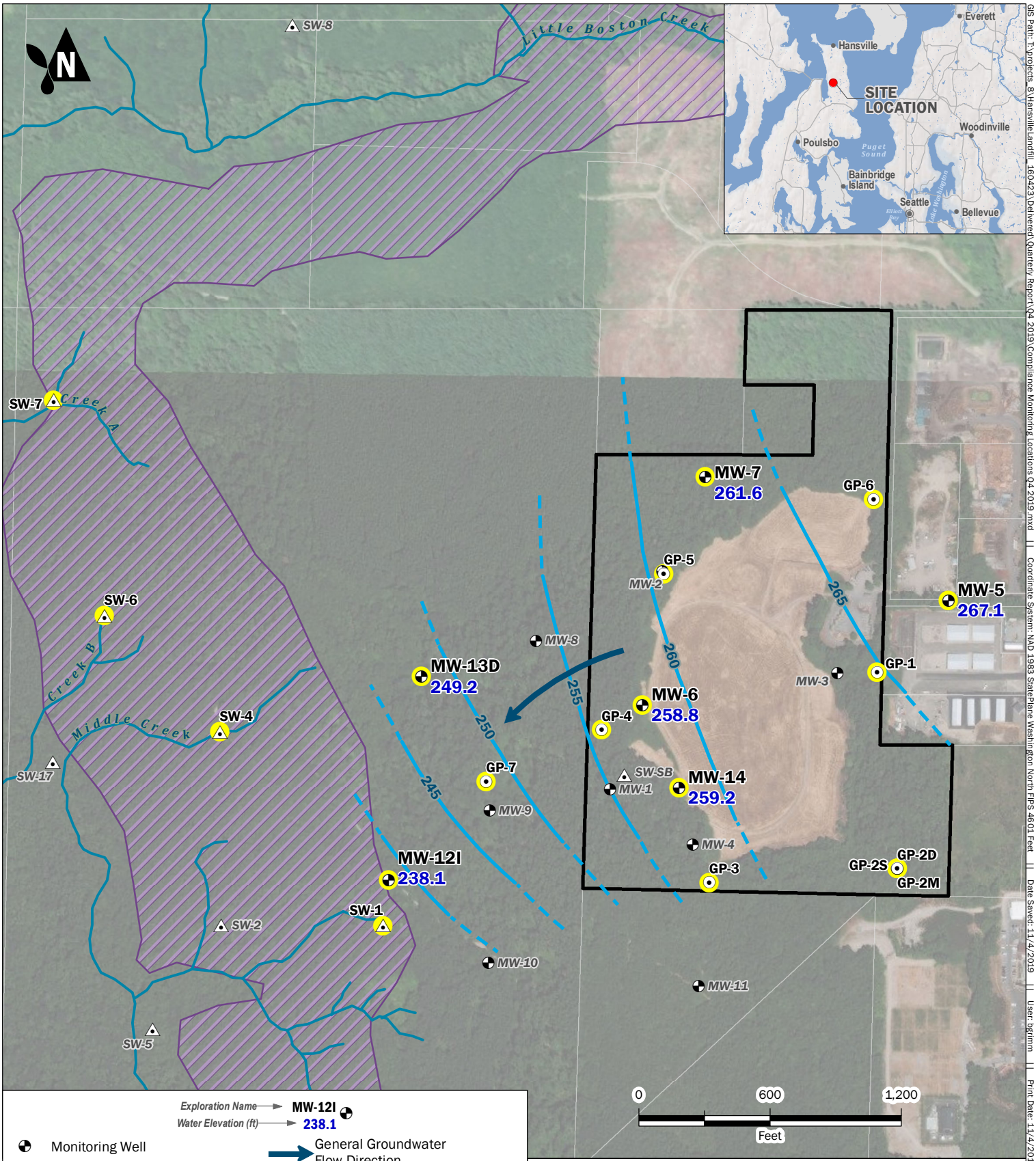
degrees F = degrees Fahrenheit

SCFM = standard cubic feet per minute

(--) = indicates location was not monitored and is to be decommissioned due to little to no landfill gas collection

# APPENDIX B

# Water Quality Results




Exploration Name → MW-12I
Water Elevation (ft) → 238.1

- Monitoring Well
- Gas Detection Probe
- Surface Water Station
- Compliance Monitoring Location
- Inferred Water Elevation Contour (ft, dashed where inferred) *Measured October 23rd, 2019*
- General Groundwater Flow Direction
- Approximate Area of Groundwater Discharge from Upper Aquifer
- Stream
- Landfill Boundary
- Tax Parcel

*Note: Vertical datum is NAVD88. Approximate area of groundwater discharge from upper aquifer delineation from Remedial Investigation Report (Parametrix, 2006).*

# Compliance Monitoring Locations

Fourth Quarter 2019 Environmental Monitoring Report
Hansville Landfill
Kitsap County, Washington

| Aspect Consulting | NOV-2019 | BY: MLK / RAP | FIGURE NO. B-1 |
|---|---|---|---|
| | PROJECT NO. 160423 | REVISED BY: WEG | |



GIS Path: T:\projects_8\HansvilleLandfill_160423\Delivered\Quarterly Report\Q4 2019\Compliance Monitoring Locations Q4 2019.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 11/4/2019 || User: bgrimm || Print Date: 11/4/2019

# Table B-1. Water Level Elevations

Project No. 160423, Hansville Landfill, Hansville, WA

| Well | Ground Elevation (ft NAVD88) | Top of Casing Elevation (ft NAVD88) | Screen Elevation (ft NAVD88) | | First Quarter 2019 | | Second Quarter 2019 | |
|---|---|---|---|---|---|---|---|---|
| | | | Top | Bottom | Depth to Water (ft) | Water Level Elevation (ft NAVD88) | Depth to Water (ft) | Water Level Elevation (ft NAVD88) |
| **MW-5** | 363.7 | 366.9 | 244 | 234 | 98.10 | 268.8 | 98.82 | 268.1 |
| **MW-6** | 332.0 | 332.7 | 260 | 245 | 72.58 | 260.1 | 73.12 | 259.6 |
| **MW-7** | 344.3 | 346.0 | 259 | 244 | 83.55 | 262.5 | 83.68 | 262.3 |
| **MW-12I** | 245.6 | 248.1 | 217 | 207 | 9.39 | 238.7 | 9.58 | 238.5 |
| **MW-13D** | 258.1 | 260.4 | 205 | 195 | 10.38 | 250.0 | 10.59 | 249.8 |
| **MW-14** | 338.6 | 341.1 | 262 | 247 | 79.50 | 261.6 | 81.76 | 259.3 |

| Well | Ground Elevation (ft NAVD88) | Top of Casing Elevation (ft NAVD88) | Screen Elevation (ft NAVD88) | | Third Quarter 2019 | | Fourth Quarter 2019 | |
|---|---|---|---|---|---|---|---|---|
| | | | Top | Bottom | Depth to Water (ft) | Water Level Elevation (ft NAVD88) | Depth to Water (ft) | Water Level Elevation (ft NAVD88) |
| **MW-5** | 363.7 | 366.9 | 244 | 234 | 99.06 | 267.8 | 99.76 | 134.2 |
| **MW-6** | 332.0 | 332.7 | 260 | 245 | 73.40 | 259.3 | 75.87 | 169.1 |
| **MW-7** | 344.3 | 346.0 | 259 | 244 | 83.87 | 262.1 | 94.44 | 149.6 |
| **MW-12I** | 245.6 | 248.1 | 217 | 207 | 9.42 | 238.7 | 10.05 | 197.0 |
| **MW-13D** | 258.1 | 260.4 | 205 | 195 | 11.00 | 249.4 | 11.25 | 183.8 |
| **MW-14** | 338.6 | 341.1 | 262 | 247 | 83.87 | 257.2 | 94.44 | 152.6 |

**Notes**

Depths to water collected January 16 (Q1), April 17 (Q2), July 17 (Q3), and October 23 (Q4) of 2019.

Elevations relative to North American Vertical Datum of 1988 (NAVD88).

ft - feet

# Table B-2. Groundwater Quality Results

Project No. 160423, Hansville Landfill, Hansville, WA

| | | Date | MW-5 01/16/2019 | MW-5 04/17/2019 | MW-5 07/17/2019 | MW-5 10/23/2019 | MW-6 01/16/2019 | MW-6 04/17/2019 | MW-6 07/17/2019 | MW-6 10/23/2019 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter** | **Units** | **Site Cleanup Level** | | | | | | | | |
| Field Parameters | | | | | | | | | | |
| Dissolved Oxygen | mg/L | | **8.82** | **9.08** | **8.93** | **9.95** | **0.32** | **0.16** | **0.47** | **0.22** |
| pH | pH units | | **7.36** | **7.23** | **7.35** | **7.21** | **7.14** | **7.05** | **7** | **7.05** |
| Oxidation Reduction Potential | mV | | **100.9** | **22.0** | **105.1** | **110.2** | **144.4** | **115.7** | **154.5** | **74.2** |
| Specific Conductivity | uS/cm | | **146.8** | **152.3** | **162.2** | **159** | **332.7** | **332.9** | **375.8** | **377.2** |
| Temperature | deg C | | **10.2** | **10.1** | **11** | **10.4** | **12.3** | **12.8** | **13.5** | **12.8** |
| Turbidity | NTU | | **1.88** | **0.56** | **0.31** | **8** | **0.87** | **3.89** | **0.74** | **0.32** |
| Conventional Parameters | | | | | | | | | | |
| Alkalinity | mg/L | | **61** | **64** | **67** | **69** | **140** | **150** | **170** | **180** |
| Ammonia (as N) | mg/L | | 0.030 U | 0.030 U | 0.030 U | **0.031** | **0.88** | 0.030 U | 0.030 U | **1.0** |
| Bicarbonate | mg/L | | **61** | **64** | **67** | **69** | **140** | **150** | **170** | **180** |
| Carbonate | mg/L | | 5.0 U | 10 U | 10 U | 10 U | 5.0 U | 10 U | 10 U | 10 U |
| Chloride | mg/L | | **1.6** | **1.7** | **1.8** | 3.0 U | **7.0** | **5.0** | **5.7** | **4.4** |
| Nitrate (as N) | mg/L | | **4.01** | **2.03** | **2.00** | **3.93 J** | **0.753** | **0.696** | **0.676** | **0.764 J** |
| Nitrite (as N) | mg/L | | 0.100 U | 0.1 U | 0.100 U | 0.100 R | **0.246** | **0.176** | **0.194** | 0.100 R |
| Orthophosphate (as P) | mg/L | | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| Sulfate | mg/L | | **8.3** | **7.9** | **8.4** | **6.9** | **25** | **24** | **27** | **23** |
| Total Organic Carbon | mg/L | | 1.0 U | 1.0 U | 1.0 U | 1.0 U | **1.6** | **1.4** | **1.6** | **1.9** |
| Dissolved Metals | | | | | | | | | | |
| Arsenic | mg/L | 0.005 | **0.00207** | **0.00203** | **0.00186** | **0.00192** | **0.00171** | **0.00176** | **0.00155** | **0.00153** |
| Manganese | mg/L | 2.24 | **0.0010** | 0.0010 U | 0.0010 U | 0.0010 U | **0.4** | **0.41** | **0.4** | **0.43** |
| Volatile Organic Compounds (detected only) | | | | | | | | | | |
| 1,2-Dichloroethene (total) | ug/L | | 2.0 U | -- | -- | -- | 2.0 U | -- | -- | -- |
| cis-1,2-Dichloroethene | ug/L | | 1.0 U | -- | -- | -- | 1.0 U | -- | -- | -- |
| Vinyl Chloride | ug/L | 0.025 | 0.020 U | 0.020 U | 0.02 U | 0.02 U | **0.088** | **0.096** | **0.061** | **0.061** |

**Notes**

Bold - detected
Shaded - Exceeded Site Cleanup Level
U - Not detected at or above reporting limit
J or UJ - Estimated "usable"
NA - parameter not measured

mg/L - milligrams per liter
mV - millivolts
uS - microSiemens
degrees C - degrees Celcius
NTU - Nephthalometric Turbidity Units

ug/L - micrograms per liter

# Table B-2. Groundwater Quality Results

Project No. 160423, Hansville Landfill, Hansville, WA

| | | Date | MW-7 01/16/2019 | MW-7 04/17/2019 | MW-7 07/17/2019 | MW-7 10/23/2019 | MW-12I 01/16/2019 | MW-12I 04/17/2019 | MW-12I 07/17/2019 | MW-12I 10/23/2019 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter** | **Units** | **Site Cleanup Level** | | | | | | | | |
| Field Parameters | | | | | | | | | | |
| Dissolved Oxygen | mg/L | | **1.36** | **1.09** | **1.2** | **1.31** | **0.47** | **0.73** | **0.55** | **0.7** |
| pH | pH units | | **6.59** | **6.34** | **6.52** | **6.43** | **7.33** | **7.14** | **7.2** | **7.16** |
| Oxidation Reduction Potential | mV | | **79.9** | **14.2** | **77.5** | **887** | **96.4** | **6.8** | **120** | **102.3** |
| Specific Conductivity | uS/cm | | **228** | **236.3** | **242.5** | **229.5** | **147.7** | **158.4** | **190.2** | **184.6** |
| Temperature | deg C | | **9.4** | **9.5** | **10.2** | **9.7** | **9.5** | **9.8** | **10.6** | **10.1** |
| Turbidity | NTU | | **4.46** | **0.67** | **0.62** | **8** | **0.94** | **0.44** | **0.28** | **8** |
| Conventional Parameters | | | | | | | | | | |
| Alkalinity | mg/L | | **120** | **130** | **140** | **130** | **72** | **84** | **93** | **92** |
| Ammonia (as N) | mg/L | | 0.030 U | 0.030 U | 0.030 U | 0.030 UJ | **0.063** | 0.030 U | 0.030 U | **0.033** |
| Bicarbonate | mg/L | | **120** | **130** | **140** | **130** | **72** | **84** | **93** | **92** |
| Carbonate | mg/L | | 5.0 U | 10 U | 10 U | 10 U | 5.0 U | 10 U | 10 U | 10 U |
| Chloride | mg/L | | 1.0 U | 1.0 U | 1.0 UJ | 3.0 U | **1.9** | **2.3** | **3.4** | **3.3** |
| Nitrate (as N) | mg/L | | **0.331** | **0.324** | **0.284** | **0.239 J** | 0.100 U | 0.1 U | 0.100 U | 0.100 UJ |
| Nitrite (as N) | mg/L | | 0.100 U | 0.1 U | 0.100 U | 0.100 R | 0.100 U | 0.1 U | 0.100 U | 0.100 UJ |
| Orthophosphate (as P) | mg/L | | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| Sulfate | mg/L | | **2.4** | **2.8** | **5.9 J** | 5.0 U | **4.0** | **4.5** | **6.8** | **5.9** |
| Total Organic Carbon | mg/L | | **1.9** | **2.0** | **1.8** | **2.0** | **3.0** | **2.8** | **2.3** | **2.3** |
| Dissolved Metals | | | | | | | | | | |
| Arsenic | mg/L | 0.005 | **0.00127** | **0.00118** | **0.00117** | **0.00118** | **0.00230** | **0.00215** | **0.00207** | **0.00224** |
| Manganese | mg/L | 2.24 | 0.0010 U | 0.0010 UJ | 0.0010 U | 0.0010 U | **0.031** | **0.027** | **0.035** | **0.04** |
| Volatile Organic Compounds (detected only) | | | | | | | | | | |
| 1,2-Dichloroethene (total) | ug/L | | 2.0 U | -- | -- | -- | 2.0 U | -- | -- | -- |
| cis-1,2-Dichloroethene | ug/L | | 1.0 U | -- | -- | -- | 1.0 U | -- | -- | -- |
| Vinyl Chloride | ug/L | 0.025 | 0.020 U | 0.020 U | 0.02 U | 0.02 U | **0.039** | **0.054** | **0.082** | **0.17** |

**Notes**

Bold - detected
Shaded - Exceeded Site Cleanup Level
U - Not detected at or above reporting limit
J or UJ - Estimated "usable"
NA - parameter not measured

mg/L - milligrams per liter
mV - millivolts
uS - microSiemens
degrees C - degrees Celcius
NTU - Nephthalometric Turbidity Units

ug/L - micrograms per liter

# Table B-2. Groundwater Quality Results

Project No. 160423, Hansville Landfill, Hansville, WA

| | | Date | MW-13D 01/16/2019 | MW-13D 04/17/2019 | MW-13D 07/17/2019 | MW-13D 10/23/2019 | MW-14 01/16/2019 | MW-14 04/17/2019 | MW-14 07/17/2019 | MW-14 10/23/2019 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter** | **Units** | **Site Cleanup Level** | | | | | | | | |
| Field Parameters | | | | | | | | | | |
| Dissolved Oxygen | mg/L | | **0.17** | **0.73** | **0.39** | **1.16** | **0.51** | **1.46** | **0.97** | **0.52** |
| pH | pH units | | **7.65** | **7.51** | **7.66** | **7.59** | **7.13** | **7.05** | **7** | **7.13** |
| Oxidation Reduction Potential | mV | | **100.1** | **6.5** | **126.4** | **59.8** | **95.1** | **35.4** | **172.6** | **72.6** |
| Specific Conductivity | uS/cm | | **184.1** | **182.9** | **191.2** | **185.1** | **205.8** | **330.5** | **340.7** | **282.7** |
| Temperature | deg C | | **10.2** | **10.4** | **11.3** | **10.7** | **10.9** | **11.4** | **12.3** | **11.1** |
| Turbidity | NTU | | **0.82** | **0.68** | **0.59** | **8** | **7.73** | **0.86** | **0.82** | **8** |
| Conventional Parameters | | | | | | | | | | |
| Alkalinity | mg/L | | **71** | **74** | **77** | **77** | **94** | **120** | **120** | **110** |
| Ammonia (as N) | mg/L | | 0.030 U | 0.030 U | 0.030 U | **0.030** | 0.030 U | 0.030 U | 0.030 U | 0.030 UJ |
| Bicarbonate | mg/L | | **71** | **74** | **77** | **77** | **94** | **120** | **120** | **110** |
| Carbonate | mg/L | | 5.0 U | 10 U | 10 U | 10 U | 5.0 U | 10 U | 10 U | 10 U |
| Chloride | mg/L | | **5.1** | **5.4** | **5.4** | **4.3** | **3.8** | **21** | **19** | **13** |
| Nitrate (as N) | mg/L | | 0.100 U | 0.1 U | 0.100 U | 0.100 UJ | **0.124** | **0.548** | **1.53** | 0.100 UJ |
| Nitrite (as N) | mg/L | | 0.100 U | 0.1 U | 0.100 U | 0.100 UJ | 0.100 U | 0.1 U | 0.100 U | 0.100 UJ |
| Orthophosphate (as P) | mg/L | | **0.14** | 0.10 U | 0.10 U | 0.10 U | **0.14** | 0.10 U | 0.10 U | 0.10 U |
| Sulfate | mg/L | | **17** | **16** | **17** | **14** | **11** | **14** | **14** | **10** |
| Total Organic Carbon | mg/L | | 1.0 U | 1.0 U | 1.0 U | 1.0 U | **1.9** | **2.4** | **2.3** | **2.4** |
| Dissolved Metals | | | | | | | | | | |
| Arsenic | mg/L | 0.005 | **0.00473** | **0.00513** | **0.00512** | **0.00517** | **0.0146** | **0.0121** | **0.0115** | **0.0125** |
| Manganese | mg/L | 2.24 | **0.0065** | **0.0056** | **0.0053** | **0.0065** | **1.6** | **0.12** | **0.16** | **1.5** |
| Volatile Organic Compounds (detected only) | | | | | | | | | | |
| 1,2-Dichloroethene (total) | ug/L | | 2.0 U | -- | -- | -- | **2.5** | -- | -- | -- |
| cis-1,2-Dichloroethene | ug/L | | 1.0 U | -- | -- | -- | **2.5** | -- | -- | -- |
| Vinyl Chloride | ug/L | 0.025 | 0.020 U | 0.020 U | 0.02 U | 0.02 U | **0.033** | 0.020 U | 0.020 U | **0.061** |

**Notes**

Bold - detected
Shaded - Exceeded Site Cleanup Level
U - Not detected at or above reporting limit
J or UJ - Estimated "usable"
NA - parameter not measured

mg/L - milligrams per liter
mV - millivolts
uS - microSiemens
degrees C - degrees Celcius
NTU - Nephthalometric Turbidity Units

ug/L - micrograms per liter

## Table B-3. Surface Water Quality Results

Project No. 160423, Hansville Landfill, Hansville, WA

| Parameter | Units | Site Cleanup Level | Date | SW-1 01/16/2019 | SW-1 04/17/2019 | SW-1 07/17/2019 | SW-1 10/23/2019 | SW-4 01/16/2019 | SW-4 04/17/2019 | SW-4 07/17/2019 | SW-4 10/23/2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Field Parameters | | | | | | | | | | | |
| Dissolved Oxygen | mg/L | | | **11.19** | **9.80** | **18.93** | **10.46** | **10.39** | **8.89** | **16.6** | **9.21** |
| pH | pH units | | | **7.3** | **6.95** | **7.63** | **7.2** | **7.76** | **7.2** | **7.97** | **7.73** |
| Oxidation Reduction Potential | mV | | | **108.8** | **117.8** | **34.1** | **76** | **102.7** | **87.6** | **112.9** | **79** |
| Specific Conductivity | uS/cm | | | **167.3** | **170.6** | **167** | **184.4** | **307.7** | **113.1** | **354.2** | **347** |
| Temperature | deg C | | | **8.6** | **9.7** | **11.5** | **10.2** | **6.6** | **10.1** | **12.8** | **10.3** |
| Turbidity | NTU | | | **1.73** | **25.9** | **6.96** | **8.2** | **2.62** | **9.71** | **7.55** | **4.03** |
| Conventional Parameters | | | | | | | | | | | |
| Alkalinity | mg/L | | | **66** | **72** | **76** | **75** | **140** | **140** | **180** | **150** |
| Ammonia (as N) | mg/L | | | 0.030 U | 0.030 U | 0.030 U | **0.074** | 0.030 U | 0.030 U | 0.030 U | 0.030 U |
| Bicarbonate | mg/L | | | **66** | **72** | **76** | **75** | **140** | **140** | **180** | **150** |
| Carbonate | mg/L | | | 5.0 U | 10 U | 10 U | 10 U | 5.0 U | 10 U | 10 U | 10 U |
| Chloride | mg/L | | | **4.0** | **4.5** | **4.8** | **3.9** | **12** | **12** | **15** | **10** |
| Nitrate (as N) | mg/L | | | **1.79** | **1.71** | **1.66** | **1.84 J** | **0.877** | **0.804** | **0.876** | **0.773 J** |
| Nitrite (as N) | mg/L | | | 0.100 U | 0.1 U | 0.100 U | 0.100 R | 0.100 U | 0.1 U | 0.100 U | 0.100 R |
| Orthophosphate (as P) | mg/L | | | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| Sulfate | mg/L | | | **10** | **9.4** | **10** | **8.5** | **17** | **17** | **22** | **15** |
| Total Organic Carbon | mg/L | | | **2.8** | **2.0** | **1.4** | **2.6** | **10** | **9.0** | **3.8** | **12** |
| Dissolved Metals | | | | | | | | | | | |
| Arsenic | mg/L | 0.005 | | **0.00160** | **0.00164** | **0.00170** | **0.00163** | **0.00200** | **0.00215** | **0.00190** | **0.00240** |
| Manganese | mg/L | 2.24 | | **0.0020** | 0.0010 U | 0.0010 U | 0.0010 U | **0.051** | **0.031** | **0.055** | **0.04** |
| Volatile Organic Compounds | | | | | | | | | | | |
| 1,2-Dichloroethene (total) | ug/L | | | 2.0 U | -- | -- | -- | 2.0 U | -- | -- | -- |
| cis-1,2-Dichloroethene | ug/L | | | 1.0 U | -- | -- | -- | 1.0 U | -- | -- | -- |
| Vinyl Chloride | ug/L | 0.025 | | 0.020 U | 0.020 U | 0.020 U | 0.020 U | 0.020 U | 0.020 U | 0.020 U | 0.020 U |

**Notes**

Bold - detected
Shaded - Exceeded Site Cleanup Level
U - Not detected at or above reporting limit
J or UJ - Estimated "usable"
NA - parameter not measured

mg/L - milligrams per liter
mV - millivolts
uS - microSiemens
degrees C - degrees Celcius
NTU - Nephthalometric Turbidity Units

ug/L - micrograms per liter

## Table B-3. Surface Water Quality Results

Project No. 160423, Hansville Landfill, Hansville, WA

| Parameter | Units | Site Cleanup Level | SW-6 01/16/2019 | SW-6 04/17/2019 | SW-6 07/17/2019 (dry) | SW-6 10/23/2019 | SW-7 01/16/2019 | SW-7 04/17/2019 | SW-7 07/17/2019 | SW-7 10/23/2019 |
|---|---|---|---|---|---|---|---|---|---|---|
| Field Parameters | | | | | | | | | | |
| Dissolved Oxygen | mg/L | | **10.34** | **8.89** | -- | **9.01** | **11.81** | **10.37** | **7.37** | **10.59** |
| pH | pH units | | **7.36** | **7.25** | -- | **7.02** | **7.54** | **7.65** | **7.14** | **7.56** |
| Oxidation Reduction Potential | mV | | **85** | **87.6** | -- | **64.4** | **94.3** | **101.5** | **171.3** | **67.4** |
| Specific Conductivity | uS/cm | | **105.8** | **113.1** | -- | **143.8** | **124.9** | **130.1** | **197.2** | **150.8** |
| Temperature | deg C | | **4.9** | **10.1** | -- | **10.4** | **6.2** | **9.6** | **14.2** | **10.4** |
| Turbidity | NTU | | **6.19** | **24.5** | -- | **8.67** | **4.63** | **3.24** | **8.46** | **4.32** |
| Conventional Parameters | | | | | | | | | | |
| Alkalinity | mg/L | | **42** | **50** | -- | **62** | **43** | **52** | **68** | **61** |
| Ammonia (as N) | mg/L | | **0.039** | **0.031** | -- | **0.030** | 0.030 U | 0.030 U | 0.030 U | **1.0** |
| Bicarbonate | mg/L | | **42** | **50** | -- | **62** | **43** | **52** | **68** | **61** |
| Carbonate | mg/L | | 5.0 U | 10 U | -- | 10 U | 5.0 U | 10 U | 10 U | 10 U |
| Chloride | mg/L | | **3.7** | **3.6** | -- | **3.6** | **3.7** | **3.9** | **3.7** | **3.5** |
| Nitrate (as N) | mg/L | | **0.194** | **0.135** | -- | **0.421 J** | **1.47** | **0.973** | **0.706** | **0.996 J** |
| Nitrite (as N) | mg/L | | 0.100 U | 0.1 U | -- | 0.100 R | 0.100 U | 0.1 U | 0.100 U | 0.100 R |
| Orthophosphate (as P) | mg/L | | 0.10 U | 0.10 U | -- | 0.10 U | 0.10 U | 0.10 U | 0.10 U | 0.10 U |
| Sulfate | mg/L | | **3.8** | **4.6** | -- | **6.8** | **7.8** | **10** | **7.5** | **7.3** |
| Total Organic Carbon | mg/L | | **23** | **19** | -- | **21** | **9.8** | **11** | **5.8** | **12** |
| Dissolved Metals | | | | | | | | | | |
| Arsenic | mg/L | 0.005 | **0.00259** | **0.00348** | -- | **0.00348** | **0.00111** | **0.00126** | **0.00160** | **0.00138** |
| Manganese | mg/L | 2.24 | **0.051** | **0.057** | -- | **0.086** | **0.0023** | **0.0025** | **0.0055** | **0.0042** |
| Volatile Organic Compounds | | | | | | | | | | |
| 1,2-Dichloroethene (total) | ug/L | | 2.0 U | -- | -- | -- | 2.0 U | -- | -- | -- |
| cis-1,2-Dichloroethene | ug/L | | 1.0 U | -- | -- | -- | 1.0 U | -- | -- | -- |
| Vinyl Chloride | ug/L | 0.025 | 0.020 U | 0.020 U | -- | 0.020 U | 0.020 U | 0.020 U | 0.020 U | 0.020 U |

**Notes**

Bold - detected
Shaded - Exceeded Site Cleanup Level
U - Not detected at or above reporting limit
J or UJ - Estimated "usable"
NA - parameter not measured

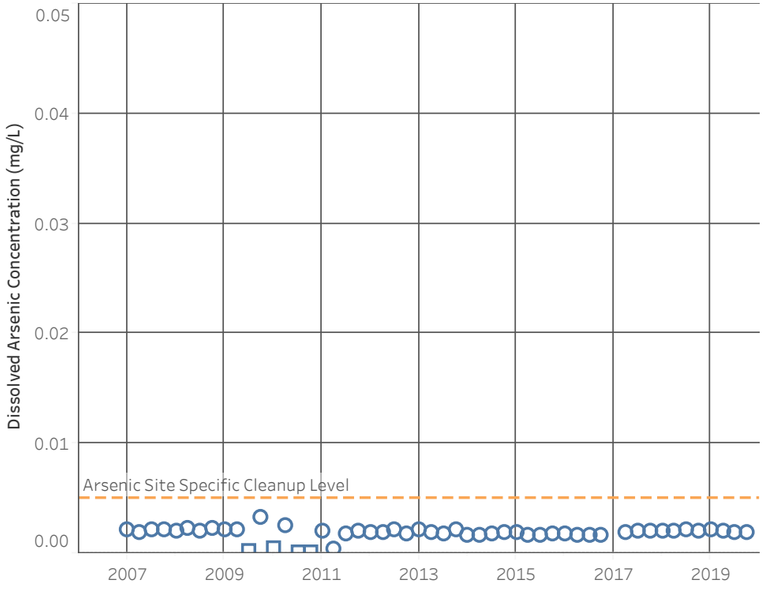
mg/L - milligrams per liter
mV - millivolts
uS - microSiemens
degrees C - degrees Celcius
NTU - Nephthalometric Turbidity Units

ug/L - micrograms per liter

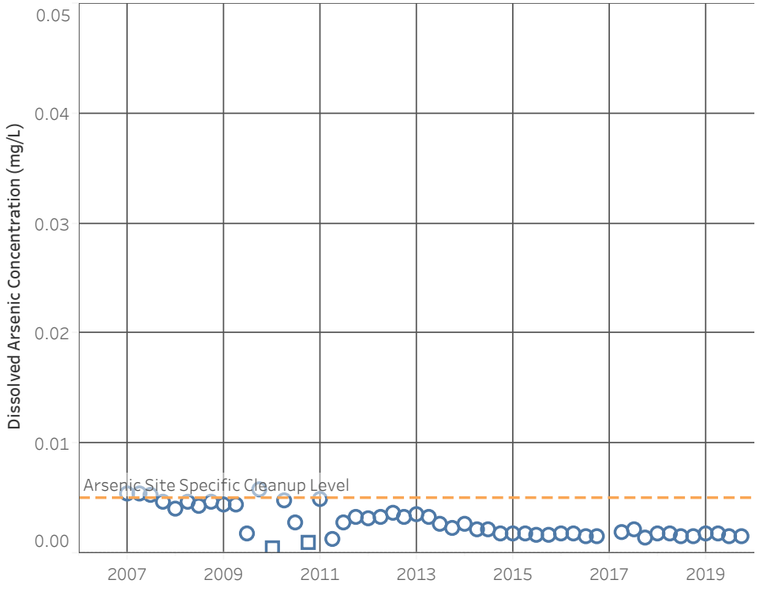
# APPENDIX C

# Groundwater Statistics and Time-Series Plots

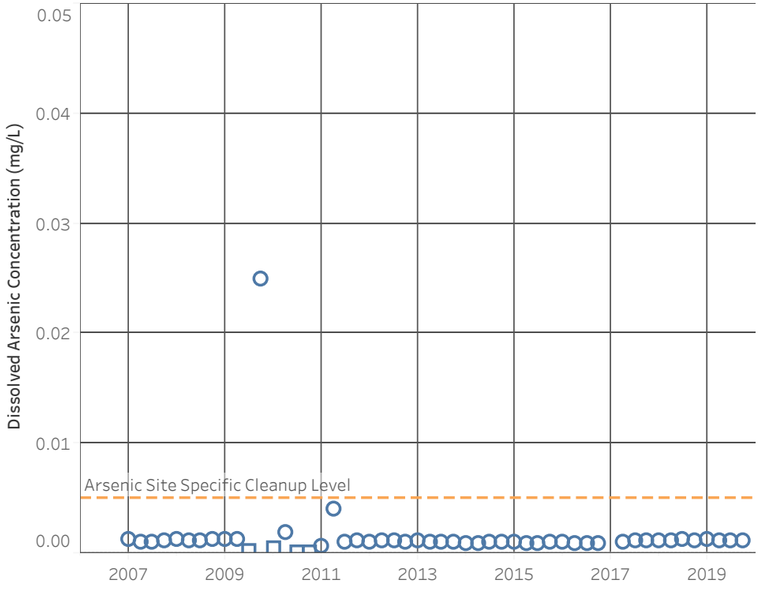
MW-5 (Background Well)



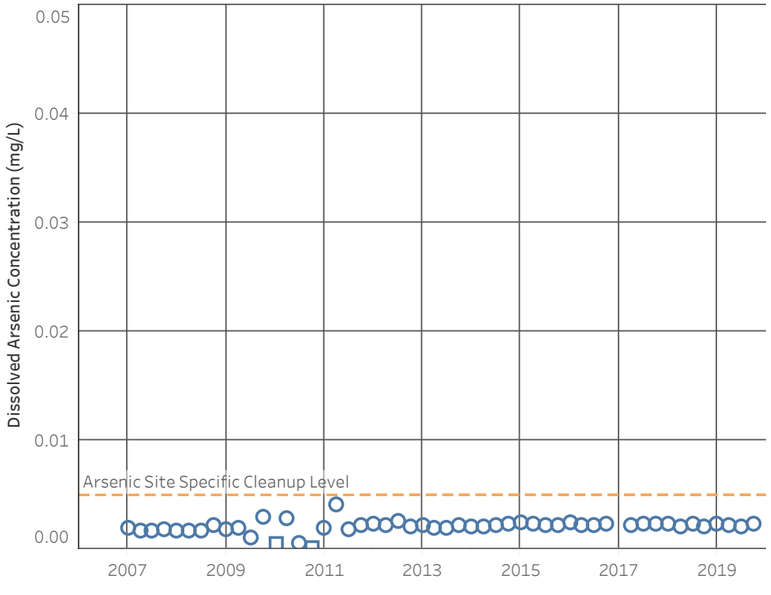

MW-6



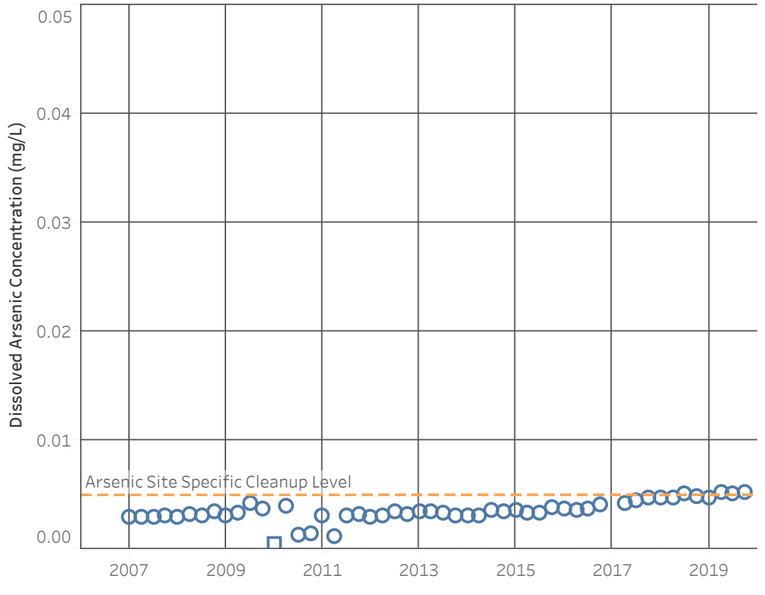

MW-7



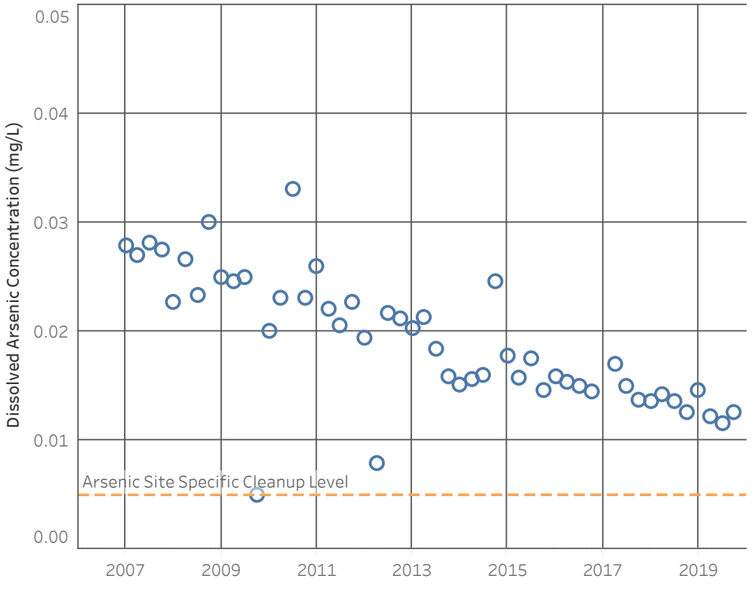

MW-12I




MW-13D




MW-14




**Note:** Non-detected values are shown at 1/2 the reporting limit.
Results from First Quarter 2017 were rejected. See text.

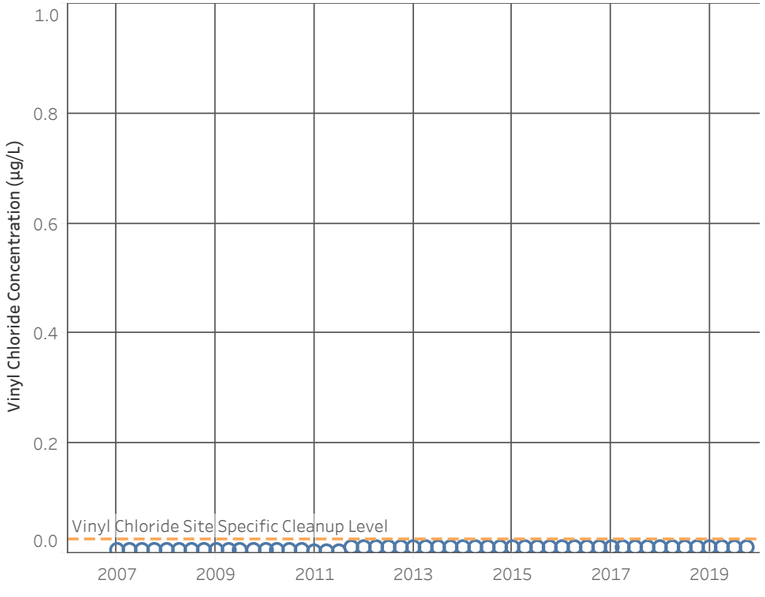
Result Flags
○ Detected □ U - Non-Detect

Aspect CONSULTING

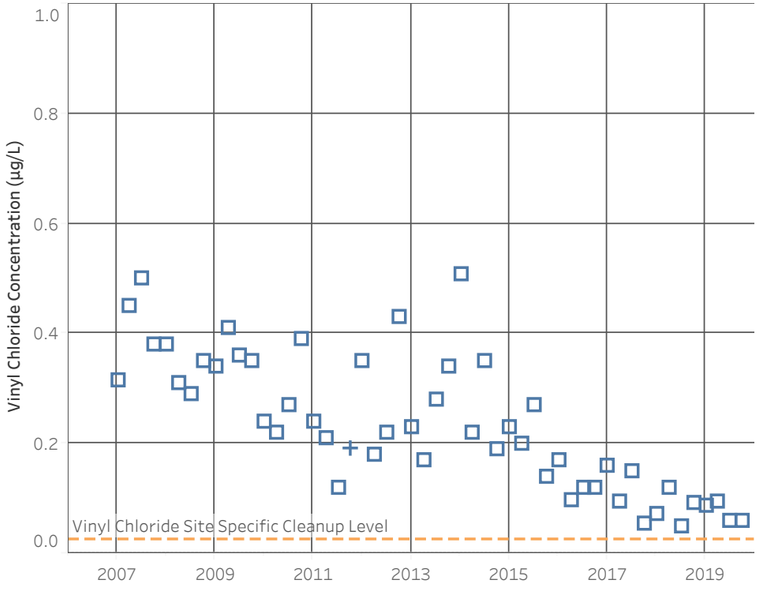
1/10/2020
Trend Plots (As)

**Figure C-1 - Dissolved Arsenic Sampling Results**
2019 Annual Environmental Monitoring Report
Hansville Landfill
Kitsap County, WA

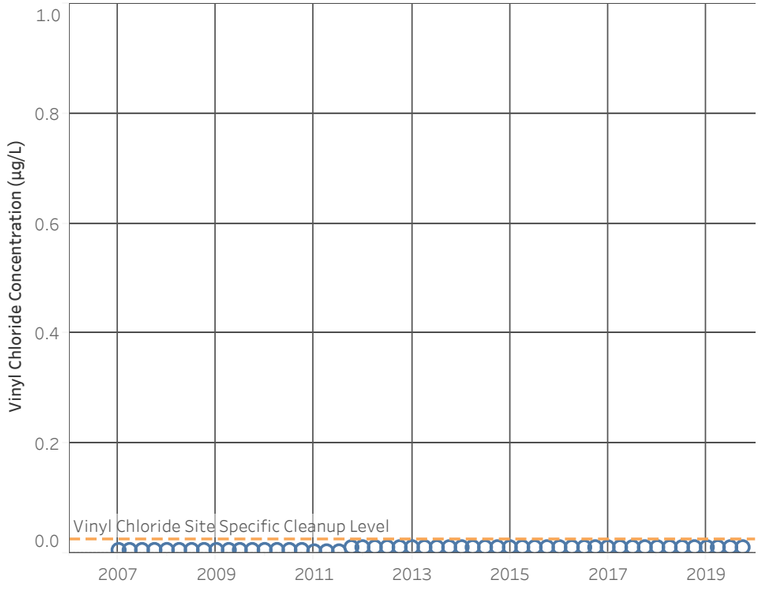
MW-5 (Background Well)



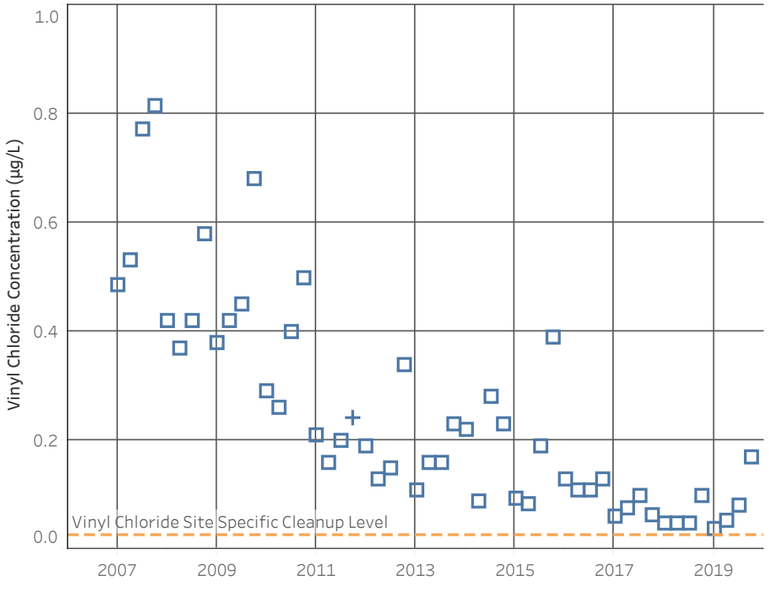

MW-6



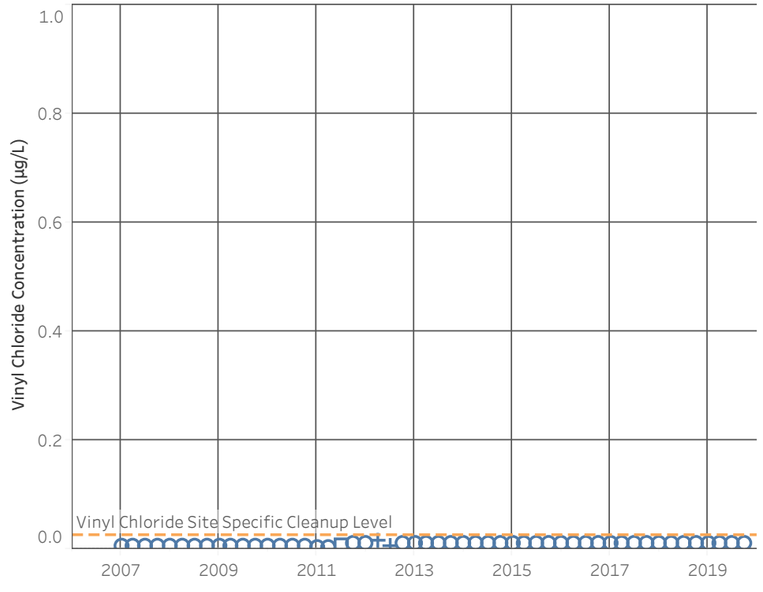

MW-7



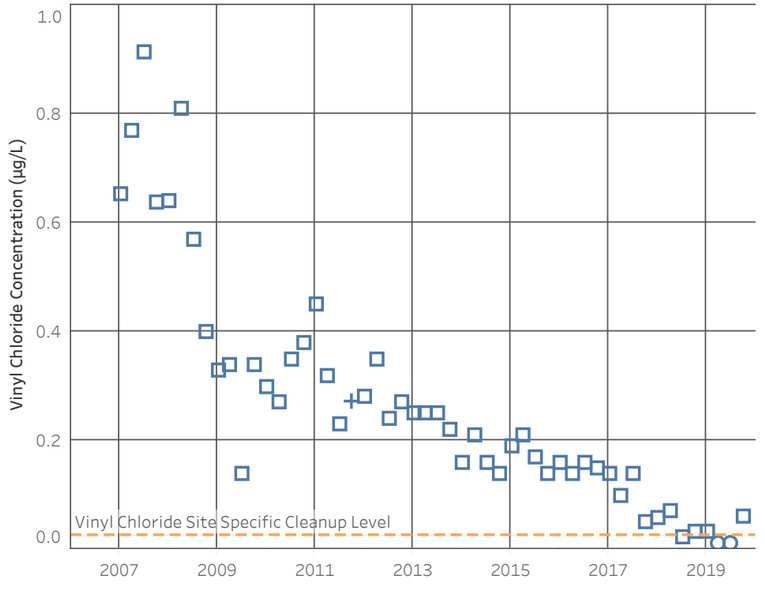

MW-12I




MW-13D




MW-14




Result Flags
□ Detected + J - Estimate ○ U - Non-Detect

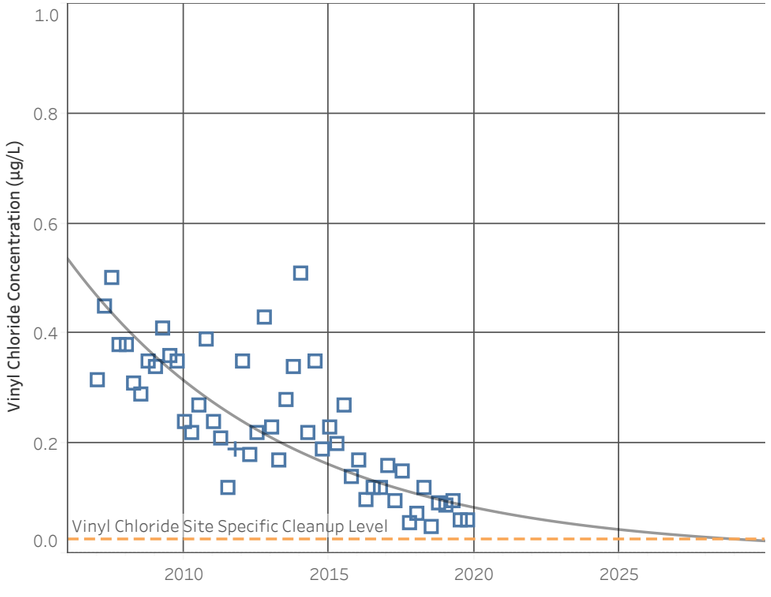
**Note:** Non-detected values are shown at 1/2 the reporting limit.

Aspect CONSULTING

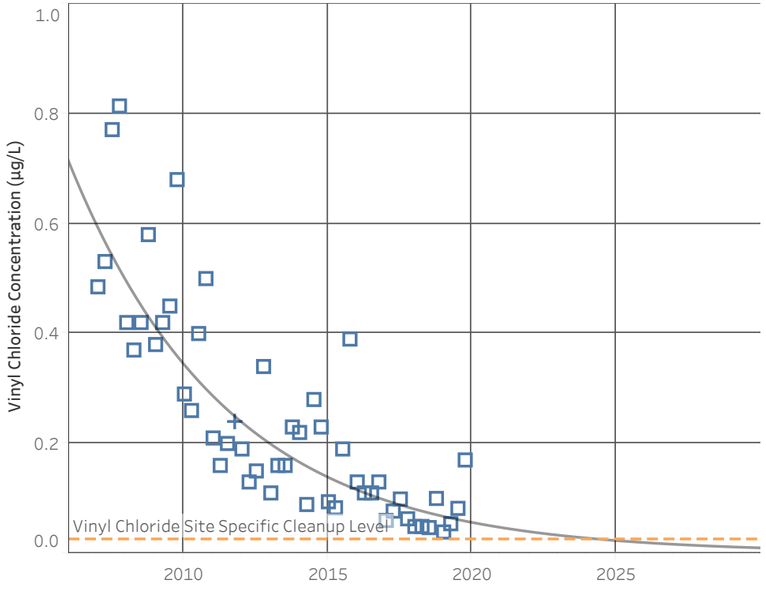
1/10/2020
Trend Plots (VC)

**Figure C-2 - Vinyl Chloride Sampling Results**
2019 Annual Environmental Monitoring Report
Hansville Landfill
Kitsap County, WA

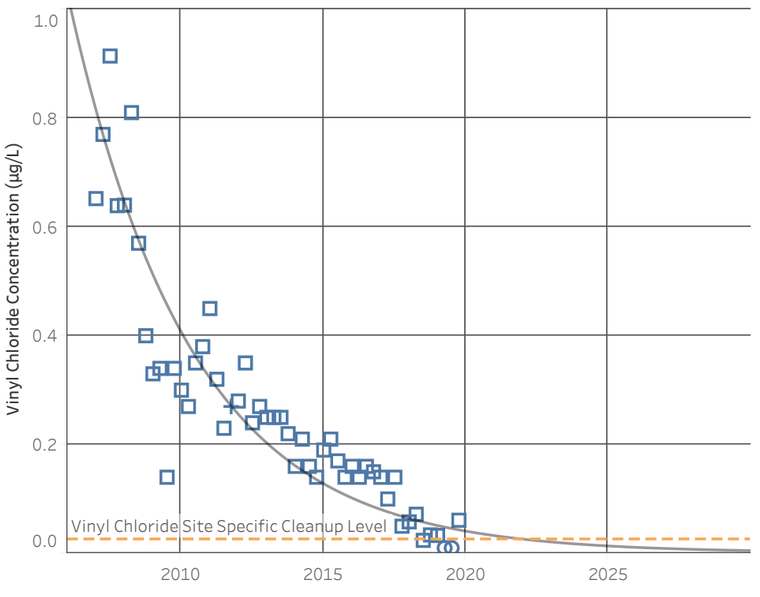
MW-6 Vinyl Chloride Trend



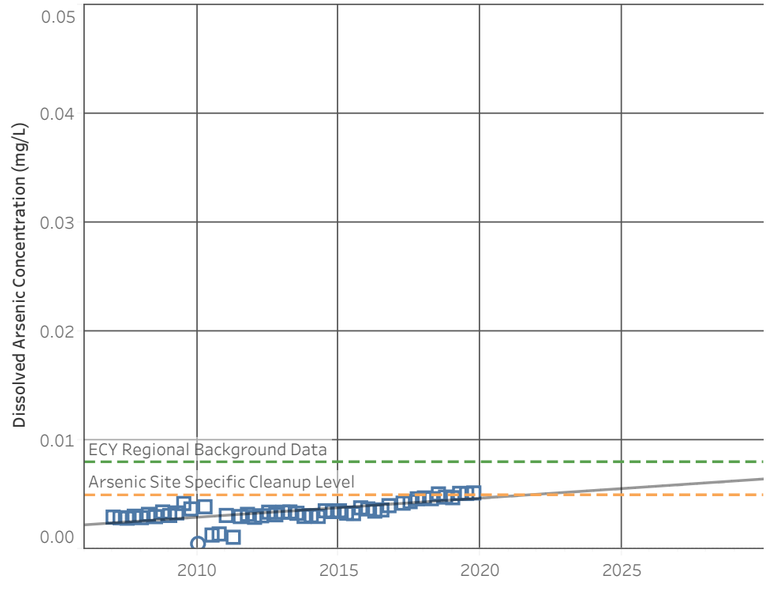

MW-12I Vinyl Chloride Trend



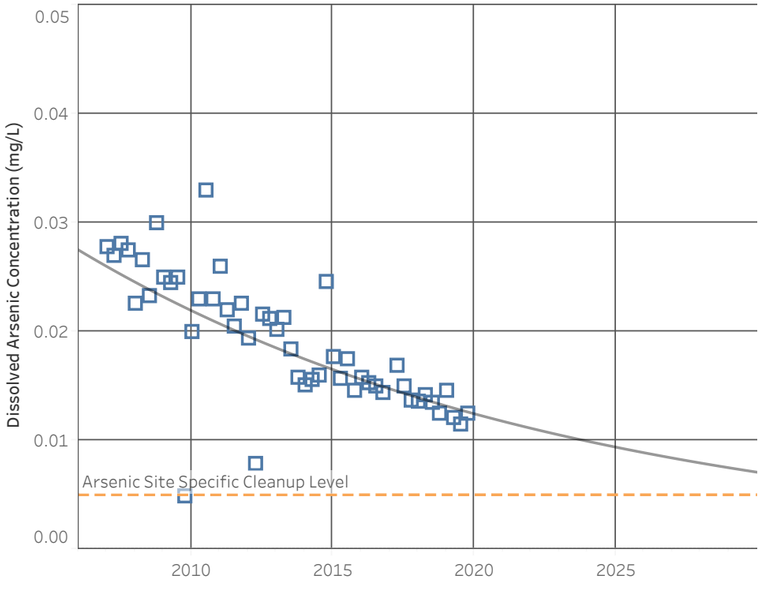

MW-14 Vinyl Chloride Trend




MW-13D Dissolved Arsenic Trend




MW-14 Dissolved Arsenic Trend




**Note:** Non-detected values are shown at 1/2 the reporting limit.
Attentuation curves based on exponential least squares fit to the data.

Result Flags
□ Detected + J - Estimate ○ U - Non-Detect

Aspect CONSULTING

1/10/2020
Trend Plots (VC)

**Figure C-3 - 10 Year Attenuation Curves**
2019 Annual Environmental Monitoring Report
Hansville Landfill
Kitsap County, WA

# Table C-1. Statistical Analysis

Project 160423, Hansville Landfill, Hansville, WA

**Dissolved Arsenic Statistical Results**

| Well | Statistical Trend[1] | Mann-Kendall Test[2] | | | | Sen's Slope | |
|---|---|---|---|---|---|---|---|
| | | Test Value, Z | Critical Value | Number of data points, n | Statistical Significance | (ug/L per day) | (ug/L per year) |
| MW-5 | --[3] | -- | -- | -- | -- | -- | -- |
| MW-6 | -- | -- | -- | -- | -- | -- | -- |
| MW-7 | -- | -- | -- | -- | -- | | -- |
| MW-12I | -- | -- | -- | -- | -- | -- | -- |
| MW-13D | Increasing | 6.4 | 1.960 | 51 | Yes | 4.6E-07 | 0.00017 |
| MW-14 | Decreasing | -7.2 | -1.96 | 51 | Yes | -3.4E-06 | -0.0012 |

**Vinyl Chloride Statistical Results**

| Well | Statistical Trend[1] | Mann-Kendall Test[2] | | | | Sen's Slope | |
|---|---|---|---|---|---|---|---|
| | | Test Value, Z | Critical Value | Number of data points, n | Statistical Significance | (ug/L per day) | (ug/L per year) |
| MW-5 | --[3] | -- | -- | -- | -- | | -- |
| MW-6 | Decreasing | -6.6 | -1.96 | 52 | Yes | -7.0E-05 | -0.025 |
| MW-7 | -- | -- | -- | -- | -- | | -- |
| MW-12I | Decreasing | -7.0 | -1.96 | 52 | Yes | -9.9E-05 | -0.036 |
| MW-13D | -- | -- | -- | -- | -- | | -- |
| MW-14 | Decreasing | -8.5 | -1.96 | 52 | Yes | -1.1E-04 | -0.038 |

**Notes**

1 - The Statistical Trend indicates:

"Non-significant" if the magnitude of the Test Value is less than the Critical Value,

"Increasing" if the magnitude of the Test Value is greater than the Critical Value and the Sen's Slope is positive, or

"Decreasing" if the magnitude of the Test Value is greater than the Critical Value and the Sen's Slope is negative.

2 - Mann-Kendall tests were performed with alpha = 0.05 (95% confidence level).

For N>40, Mann-Kendall uses an approximation of a normal distribution, represented by Test Value Z.

3 - "--" Indicates statistical analysis not conducted.

ug/L - micrograms per liter

# Table C-2. Statistical Limit Analysis

Project 160423, Hansville Landfill, Hansville, WA

**Dissolved Arsenic Statistical Concentrations (mg/L) since 2011**

| Well | Statistic | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | Site-specific Cleanup Level |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-14 | LCL | 0.018 | 0.017 | 0.016 | 0.015 | 0.014 | 0.013 | 0.012 | 0.011 | 0.010 | 0.005 |
| | Trend | 0.020 | 0.019 | 0.018 | 0.017 | 0.016 | 0.015 | 0.015 | 0.014 | 0.013 | |
| | UCL | 0.023 | 0.021 | 0.020 | 0.019 | 0.019 | 0.018 | 0.018 | 0.017 | 0.017 | |

**Vinyl Chloride Statistical Concentrations (ug/L) since 2011**

| Well | Statistic | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | Site-specific Cleanup Level |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MW-6 | LCL | 0.231 | 0.204 | 0.180 | 0.156 | 0.135 | 0.117 | 0.100 | 0.085 | 0.073 | 0.025 |
| | Trend | 0.261 | 0.228 | 0.200 | 0.175 | 0.153 | 0.134 | 0.117 | 0.102 | 0.090 | |
| | UCL | 0.295 | 0.255 | 0.223 | 0.195 | 0.173 | 0.154 | 0.137 | 0.122 | 0.110 | |
| MW-12I | LCL | 0.232 | 0.196 | 0.164 | 0.136 | 0.112 | 0.092 | 0.074 | 0.060 | 0.049 | |
| | Trend | 0.268 | 0.223 | 0.186 | 0.154 | 0.129 | 0.108 | 0.089 | 0.074 | 0.062 | |
| | UCL | 0.308 | 0.254 | 0.211 | 0.176 | 0.148 | 0.126 | 0.107 | 0.092 | 0.078 | |
| MW-14 | LCL | 0.259 | 0.210 | 0.170 | 0.135 | 0.107 | 0.084 | 0.066 | 0.051 | 0.040 | |
| | Trend | 0.298 | 0.238 | 0.192 | 0.153 | 0.123 | 0.099 | 0.079 | 0.063 | 0.050 | |
| | UCL | 0.342 | 0.271 | 0.217 | 0.174 | 0.141 | 0.115 | 0.094 | 0.077 | 0.063 | |

**Notes**

LCL is the 95% Lower Confidence Limit calculated using log-normal transformed concentrations.

Trend is the average concentration calculated using least-squares fit a line for log-normal transformed concentrations.

UCL is the 95% Upper Confidence Limit calculated using log-normal transformed concentrations.

UCL, LCL calculated based on method described in CMP (SCS Engineers, 2011), except using data collected since January 2007.

# APPENDIX D

# Fourth Quarter Field Forms and Laboratory Reports

Aspect CONSULTING

Sample number: MW-7-102319

## GROUNDWATER SAMPLING RECORD

WELL NUMBER: MW-7 Page: 1 of 1

Project Name: Hansville Landfill
Project Number: 160423
Date: 10/23/19
Starting Water Level (ft TOC): 84.44'
Sampled by: IVT
Casing Stickup (ft):
Measuring Point of Well: TOC
Total Depth (ft TOC):
Screened Interval (ft. TOC)
Casing Diameter (inches): 2"
Filter Pack Interval (ft. TOC)

Casing Volume _____ (ft Water) x _____ (Lpfv)(gpf) = _____ (L)(gal)
Casing volumes: 3/4"= 0.02 gpf 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
3/4"= 0.09 Lpf 2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf
Sample Intake Depth (ft TOC): Mid-screen

### PURGING MEASUREMENTS

| Criteria: | | Typical 0.1-0.5 Lpm | Stable | na | ± 3% | ± 10% | ± 0.1 | ± 10 mV | ± 10% | |
|---|---|---|---|---|---|---|---|---|---|---|
| Time | Cumul. Volume (gal or L) | Purge Rate (gpm or Lpm) | Water Level (ft) | Temp. (°C) | Specific Conductance (µS/cm) | Dissolved Oxygen (mg/L) | pH | ORP (mv) | Turbidity (NTU) | Comments |
| 0814 | 0 | — | 84.44 | — | | | | | | Start purge |
| 0819 | 0.375 | 0.25 | 84.44 | 9.8 | 230.6 | 6.15 | 6.43 | 103.6 | 8 | No odor / odor |
| 0824 | 0.65 | 0.25 | 84.44 | 9.7 | 219.4 | ~~6.33~~ 1.51 | 6.33 | 96.4 | 7 | " |
| 0829 | 1.0 | 0.25 | 84.45 | 9.6 | 222.5 | 1.35 | 6.37 | 92.3 | 9 | " |
| 0834 | 1.375 | 0.25 | 84.45 | 9.7 | 226.4 | 1.33 | 6.42 | 89.6 | 8 | " |
| 0839 | 1.5 | 0.25 | 84.45 | 9.7 | 227.2 | 1.31 | 6.43 | 88.9 | 8 | " |
| 0844 | 1.675 | 0.25 | 84.45 | 9.7 | 229.5 | 1.31 | 6.43 | 88.7 | 8 | |
| 0845 | | | | | | | | | | Stop purge, collect sample |

Total Gallons Purged: 2
Total Casing Volumes Removed:
Ending Water Level (ft TOC): 84.42
Ending Total Depth (ft TOC):

### SAMPLE INVENTORY

| Time | Volume | Bottle Type | Quantity | Filtration | Preservation | Appearance: Color | Appearance: Turbidity & Sediment | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0850 | 40 | VOA | 3 | — | HCl | clear | 9 | No odor |
| ↓ | 250 | Poly | 1 | Y | — | ↓ | ↓ | ↓ |
| | 500 | Poly | 2 | Y | $HNO_3$ | | | |
| | 500 | Poly | 2 | N | — | | | |
| ↓ | 500 | Amber | 1 | N | $H_2SO_4$ | ↓ | ↓ | ↓ |

### METHODS

Parameters measured with (instrument model & serial number): orange YSI, blue turbidimeter, orange/white WTW
Purging Equipment: Dedicated bladder pump
Decon Equipment: Alconox + Water
Disposal of Discharged Water: Discharged to ground
Observations/Comments: PSI ≈ 50 cycles = 6 s refill, 9 s discharge

Aspect CONSULTING

Sample number MW-5-102319

## GROUNDWATER SAMPLING RECORD

WELL NUMBER: MW-5 Page: 1 of 1

Project Name: Hansville Landfill
Date: 10/23/19
Sampled by: DWN + JW
Measuring Point of Well: NTOC
Screened Interval (ft. TOC)
Filter Pack Interval (ft. TOC)

Project Number: 160423
Starting Water Level (ft TOC): 99.76
Casing Stickup (ft):
Total Depth (ft TOC):
Casing Diameter (inches): 2"

Casing Volume _____ (ft Water) x _____ (Lpfv)(gpf) = _____ (L)(gal)
Casing volumes: 3/4"= 0.02 gpf 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
3/4"= 0.09 Lpf 2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): mid screen

## PURGING MEASUREMENTS

| Criteria: | | Typical 0.1-0.5 Lpm | Stable | na | ± 3% | ± 10% | ± 0.1 | ± 10 mV | ± 10% | |
|---|---|---|---|---|---|---|---|---|---|---|
| Time | Cumul. Volume (gal or L) | Purge Rate (gpm or Lpm) | Water Level (ft) | Temp. (°C) | Specific Conductance (µS/cm) | Dissolved Oxygen (mg/L) | pH | ORP (mv) | Turbidity (NTU) | Comments |
| ~~0928~~ 0936 | 0 | — | 99.76 | — | — | — | — | — | — | Start purge |
| ~~0933~~ 0941 | 0.67 | 0.2 | 99.77 | 10.4 | 159.4 | 9.71 | 7.04 | 108.0 | 9 | No color/odor |
| ~~0938~~ 0946 | 1.0 | 0.2 | 99.78 | 10.4 | 160.3 | 9.91 | 7.18 | 109.0 | 8 | " |
| ~~0943~~ 0951 | 1.75 | 0.2 | 99.78 | 10.3 | 159.3 | 10.06 | 7.20 | 109.4 | 8 | " |
| 0956 | 2.25 | 0.2 | 99.78 | 10.4 | 159.0 | 9.95 | 7.21 | 110.2 | 8 | " |
| 0957 | | | | | | | | | | Stop purge, collect sample |

Total Gallons Purged: 2.5
Total Casing Volumes Removed: _____
Ending Water Level (ft TOC): 99.18
Ending Total Depth (ft TOC): _____

## SAMPLE INVENTORY

| Time | Volume | Bottle Type | Quantity | Filtration | Preservation | Appearance | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Color | Turbidity & Sediment | |
| 1000 | 40 | VOA | 3 | N | HCl | clear | 9 | |
| ↓ | 500 | Amber | 1 | ↓ | $H_2SO_4$ | ↓ | ↓ | |
| | 500 | poly | 2 | ↓ | N | | | |
| | 250 | poly | 1 | Y | ↓ | | | |
| ↓ | 500 | poly | 2 | ↓ | $HNO_3$ | ↓ | ↓ | |
| | | | | | | | | |

## METHODS

Parameters measured with (instrument model & serial number): YSI - orange; Turbidimeter - blue; WLI - org/white
Purging Equipment: dedicated bladder pump Decon Equipment: Alconox + water
Disposal of Discharged Water: on site

Observations/Comments: _____

Aspect CONSULTING

Sample number SW-1 - 102314

## GROUNDWATER SAMPLING RECORD

WELL NUMBER: SW-1 Page: 1 of 1

Project Name: Hansville Landfill
Date: 10/23/14
Sampled by: SWD
Measuring Point of Well: /
Screened Interval (ft. TOC)
Filter Pack Interval (ft. TOC)

Project Number: 160423
Starting Water Level (ft TOC): /
Casing Stickup (ft): /
Total Depth (ft TOC): /
Casing Diameter (inches): /

Casing Volume _____ (ft Water) x _____ (Lpfv)(gpf) = _____ (L)(gal)
Casing volumes: 3/4"= 0.02 gpf 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
3/4"= 0.09 Lpf 2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): /

## PURGING MEASUREMENTS

| Criteria: | | Typical 0.1-0.5 Lpm | Stable | na | ± 3% | ± 10% | ± 0.1 | ± 10 mV | ± 10% | |
|---|---|---|---|---|---|---|---|---|---|---|
| Time | Cumul. Volume (gal or L) | Purge Rate (gpm or Lpm) | Water Level (ft) | Temp. (°C) | Specific Conductance (µS/cm) | Dissolved Oxygen (mg/L) | pH | ORP (mv) | Turbidity (NTU) | Comments |
| | | | | 10.2 | 194.4 | 10.46 | 7.20 | 76.0 | 8.20 | |

Total Gallons Purged: _____ Total Casing Volumes Removed: _____

Ending Water Level (ft TOC): _____ Ending Total Depth (ft TOC): _____

## SAMPLE INVENTORY

| Time | Volume | Bottle Type | Quantity | Filtration | Preservation | Appearance | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Color | Turbidity & Sediment | |
| 1200 | 40 | VOA | 3 | N | HCl | Clear | 8.20 | |
| ↓ | 500 | Amber | 1 | ↓ | $H_2SO_4$ | | | |
| | 500 | Poly | 2 | ↓ | N | | | |
| | 250 | ↓ | 1 | Y | N | | | |
| ↓ | 500 | | 2 | ↓ | | | | |
| | | | | | | | | |

## METHODS

Parameters measured with (instrument model & serial number): YSI-red; Peristaltic pump - Blue; Turb-white
Purging Equipment: Peri Pump Decon Equipment: /
Disposal of Discharged Water: /
Observations/Comments: _____

Aspect CONSULTING

Sample number MW-12I-02319

## GROUNDWATER SAMPLING RECORD

WELL NUMBER: MW-12I Page: 1 of 1

Project Name: Hansville Landfill
Date: 10/23/19
Sampled by: IVT
Measuring Point of Well: TOC
Screened Interval (ft. TOC)
Filter Pack Interval (ft. TOC)

Project Number: 160423
Starting Water Level (ft TOC): 10.05
Casing Stickup (ft):
Total Depth (ft TOC):
Casing Diameter (inches): Mid-Screen 2"

Casing Volume _____ (ft Water) x _____ (Lpfv)(gpf) = _____ (L)(gal)
Casing volumes: 3/4"= 0.02 gpf 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
3/4"= 0.09 Lpf 2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC):

### PURGING MEASUREMENTS

| Criteria: | | Typical 0.1-0.5 Lpm | Stable | na | ± 3% | ± 10% | ± 0.1 | ± 10 mV | ± 10% | |
|---|---|---|---|---|---|---|---|---|---|---|
| Time | Cumul. Volume (gal or L) | Purge Rate (gpm or Lpm) | Water Level (ft) | Temp. (°C) | Specific Conductance (µS/cm) | Dissolved Oxygen (mg/L) | pH | ORP (mv) | Turbidity (NTU) | Comments |
| 1052 | 0 | | 10.05 | | | | | | | Start purge |
| 1057 | 0.125 | 0.25 | 10.06 | 10.1 | 182.2 | 4.21 | 7.18 | 97.8 | 8 | No color / odor |
| 1102 | 0.5 | 0.25 | 10.08 | 9.9 | 186.0 | 1.47 | 7.14 | 104.3 | 8 | " |
| 1107 | 1.0 | 0.25 | 10.10 | 9.9 | 186.0 | 0.93 | 7.15 | 104.3 | 8 | " |
| 1112 | 1.5 | 0.25 | 10.11 | 9.8 | 185.2 | 0.85 | 7.16 | 104.0 | 7 | " |
| 1117 | 1.75 | 0.2 | 10.10 | 10.1 | 185.3 | 0.71 | 7.17 | 103.1 | 8 | " |
| 1122 | 2.0 | 0.2 | 10.10 | 10.3 | 186.9 | 0.72 | 7.17 | 102.4 | 7 | |
| 1127 | 2.125 | 0.2 | 10.10 | 10.1 | 184.6 | 0.70 | 7.16 | 102.3 | 8 | |
| 1128 | | | | | | | | | | Stop purge, collect |

Total Gallons Purged: 3
Total Casing Volumes Removed: _____
Ending Water Level (ft TOC): 10.05
Ending Total Depth (ft TOC): _____

### SAMPLE INVENTORY

| Time | Volume | Bottle Type | Quantity | Filtration | Preservation | Appearance | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Color | Turbidity & Sediment | |
| 1135 | 40 | VOA | 3 | — | HCl | Clear | N | |
| ↓ | 250 | Poly | 1 | Y | — | ↓ | ↓ | |
| | 500 | Poly | 2 | Y | $HNO_3$ | | | |
| | 500 | Poly | 2 | Y | — | | | |
| | 500 | Amber | 1 | — | $H_2SO_4$ | | | |

### METHODS

Parameters measured with (instrument model & serial number): orange YSI, orange/white WLI, blue turbidimeter
Purging Equipment: Dedicated bladder pump
Decon Equipment: Alconox + water
Disposal of Discharged Water: Discharged to ground
Observations/Comments:

Aspect CONSULTING

Sample number SW-4 - 102314

## GROUNDWATER SAMPLING RECORD

WELL NUMBER: SW-4 Page: 1 of 1

Project Name: Hansville Landfill
Project Number: 160423
Date: 10/23/14
Sampled by: DWO
Measuring Point of Well: /
Screened Interval (ft. TOC): /
Filter Pack Interval (ft. TOC): /

Starting Water Level (ft TOC): /
Casing Stickup (ft): /
Total Depth (ft TOC): /
Casing Diameter (inches): /

Casing Volume _____ (ft Water) x _____ (Lpfv)(gpf) = _____ (L)(gal)
Casing volumes: 3/4"= 0.02 gpf 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
3/4"= 0.09 Lpf 2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): /

### PURGING MEASUREMENTS

| Criteria: | | Typical 0.1-0.5 Lpm | Stable | na | ± 3% | ± 10% | ± 0.1 | ± 10 mV | ± 10% | |
|---|---|---|---|---|---|---|---|---|---|---|
| Time | Cumul. Volume (gal or L) | Purge Rate (gpm or Lpm) | Water Level (ft) | Temp. (°C) | Specific Conductance (µS/cm) | Dissolved Oxygen (mg/L) | pH | ORP (mv) | Turbidity (NTU) | Comments |
| 1 | | | | 10.3 | 347.0 | 9.21 | 7.73 | 79.0 | 4.03 | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

Total Gallons Purged: _____ Total Casing Volumes Removed: _____

Ending Water Level (ft TOC): _____ Ending Total Depth (ft TOC): _____

### SAMPLE INVENTORY

| Time | Volume | Bottle Type | Quantity | Filtration | Preservation | Appearance | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Color | Turbidity & Sediment | |
| 1210 | 40 | VOA | 3 | N | HCl | Pale yellow | | |
| | 500 | Amber | 1 | ↓ | $H_2SO_4$ | ↓ | | |
| | 500 | Poly | 2 | ↓ | N | | | |
| | 250 | ↓ | 1 | Y | N | | | |
| | 500 | ↓ | 2 | ↓ | $HNO_3$ | ↓ | | |
| | | | | | | | | |

### METHODS

Parameters measured with (instrument model & serial number): YSI - red; Turb - white; Pro pump blue
Purging Equipment: peristaltic pump Decon Equipment: Alconox + water
Disposal of Discharged Water: onsite

Observations/Comments: _____

Aspect CONSULTING

Sample number SW-6-102314

## GROUNDWATER SAMPLING RECORD

WELL NUMBER: SW-6 Page: 1 of 1

Project Name: Hansville Landfill
Date: 10/23/14
Sampled by: DWD
Measuring Point of Well: /
Screened Interval (ft. TOC) /
Filter Pack Interval (ft. TOC)

Project Number: 160423
Starting Water Level (ft TOC): /
Casing Stickup (ft): /
Total Depth (ft TOC): /
Casing Diameter (inches): /

Casing Volume _____ (ft Water) x _____ (Lpfv)(gpf) = _____ (L)(gal)
Casing volumes: 3/4"= 0.02 gpf 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
3/4"= 0.09 Lpf 2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): /

## PURGING MEASUREMENTS

| Criteria: | | Typical 0.1-0.5 Lpm | Stable | na | ± 3% | ± 10% | ± 0.1 | ± 10 mV | ± 10% | |
|---|---|---|---|---|---|---|---|---|---|---|
| Time | Cumul. Volume (gal or L) | Purge Rate (gpm or Lpm) | Water Level (ft) | Temp. (°C) | Specific Conductance (µS/cm) | Dissolved Oxygen (mg/L) | pH | ORP (mv) | Turbidity (NTU) | Comments |
| | | | | 10.4 | 143.8 | 9.01 | 7.02 | 64.4 | 8.67 | |

Total Gallons Purged: _____ Total Casing Volumes Removed: _____

Ending Water Level (ft TOC): _____ Ending Total Depth (ft TOC): _____

## SAMPLE INVENTORY

| Time | Volume | Bottle Type | Quantity | Filtration | Preservation | Appearance | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Color | Turbidity & Sediment | |
| 1230 | 40 | VOA | 3 | N | HCl | Lt Yellow | 8.67 | |
| | 500 | Amber | 1 | ↓ | $H_2SO_4$ | ↓ | ↓ | |
| | 500 | Poly | 2 | ↓ | N | | | |
| | 250 | ↓ | 1 | ↓ | ↓ | | | |
| | 500 | ↓ | 2 | ↓ | $HNO_3$ | ↓ | ↓ | |

## METHODS

Parameters measured with (instrument model & serial number): YSI-red; Turb-white; ORP-blue
Purging Equipment: Peristaltic Pump Decon Equipment: Alconox + water
Disposal of Discharged Water: Onsite

Observations/Comments: _____

Aspect CONSULTING

Sample number MW-13D-102319

## GROUNDWATER SAMPLING RECORD

WELL NUMBER: MW-23 Page: 1 of 1

Project Name: Hansville Landfill
Date: 10/23/19
Sampled by: IVT
Measuring Point of Well: NTOC
Screened Interval (ft. TOC)
Filter Pack Interval (ft. TOC)

Project Number: 160423
Starting Water Level (ft TOC): 11.25
Casing Stickup (ft):
Total Depth (ft TOC):
Casing Diameter (inches): 2"

Casing Volume _____ (ft Water) x _____ (Lpfv)(gpf) = _____ (L)(gal)
Casing volumes: 3/4"= 0.02 gpf 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
3/4"= 0.09 Lpf 2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): Mid-screen

## PURGING MEASUREMENTS

| Criteria: | | Typical 0.1-0.5 Lpm | Stable | na | ± 3% | ± 10% | ± 0.1 | ± 10 mV | ± 10% | |
|---|---|---|---|---|---|---|---|---|---|---|
| Time | Cumul. Volume (gal or L) | Purge Rate (gpm or Lpm) | Water Level (ft) | Temp. (°C) | Specific Conductance (µS/cm) | Dissolved Oxygen (mg/L) | pH | ORP (mv) | Turbidity (NTU) | Comments |
| 1215 | 0 | — | 11.25 | | | | | | | Start purge |
| 1220 | 0.25 | 0.25 | 11.45 | 10.7 | 185.1 | 5.36 | 7.36 | 41.5 | 8 | No color/odor |
| 1225 | 0.75 | 0.2 | 11.64 | 10.6 | 184.5 | 2.09 | 7.56 | 66.3 | 8 | " |
| 1230 | 1.25 | 0.2 | 11.69 | 10.6 | 184.6 | 1.38 | 7.59 | 66.0 | 8 | " |
| 1235 | 1.75 | 0.2 | 11.70 | 10.6 | 184.8 | 1.18 | 7.59 | 62.7 | 8 | " |
| 1240 | 2.25 | 0.2 | 11.45 | 10.7 | 184.8 | 1.15 | 7.60 | 60.8 | 8 | " |
| 1245 | 2.5 | 0.2 | 11.45 | 10.7 | 185.1 | 1.16 | 7.59 | 59.8 | 8 | " |
| | | | | | | | | | | Stop purge, collect |

Total Gallons Purged: 3
Total Casing Volumes Removed: _____
Ending Water Level (ft TOC): 11.30
Ending Total Depth (ft TOC): _____

## SAMPLE INVENTORY

| Time | Volume | Bottle Type | Quantity | Filtration | Preservation | Appearance | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Color | Turbidity & Sediment | |
| 1230 | 40 | VOA | 3 | — | HCl | ~~tan~~ | 8 | |
| ↓ | 250 | Poly | 1 | y | — | clear | ↓ | |
| ↓ | 500 | Poly | 2 | y | $HNO_3$ | ↓ | ↓ | |
| ↓ | 500 | Poly | 2 | — | — | ↓ | ↓ | |
| ↓ | 500 | Amber | 1 | — | $H_2SO_4$ | ↓ | ↓ | |
| | | | | | | | | |

## METHODS

Parameters measured with (instrument model & serial number): Orange YSI, orange/white ~~YSI~~ WLI, blue turbidimeter
Purging Equipment: Dedicated bladder pump
Decon Equipment: Alconox + water
Disposal of Discharged Water: Discharged to ground
Observations/Comments:

Aspect CONSULTING

Sample number SW-7-102314

## GROUNDWATER SAMPLING RECORD

WELL NUMBER: SW-7 Page: 1 of 1

Project Name: Hansville Landfill
Project Number: 160423
Date: 10/23/14
Sampled by: DWW/EJT
Measuring Point of Well: /
Screened Interval (ft. TOC) /
Filter Pack Interval (ft. TOC) /

Starting Water Level (ft TOC): /
Casing Stickup (ft): /
Total Depth (ft TOC): /
Casing Diameter (inches): /

Casing Volume _____ (ft Water) x _____ (Lpfv)(gpf) = _____ (L)(gal)
Casing volumes: 3/4"= 0.02 gpf 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
3/4"= 0.09 Lpf 2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): /

## PURGING MEASUREMENTS

| Criteria: | | Typical 0.1-0.5 Lpm | Stable | na | ± 3% | ± 10% | ± 0.1 | ± 10 mV | ± 10% | |
|---|---|---|---|---|---|---|---|---|---|---|
| Time | Cumul. Volume (gal or L) | Purge Rate (gpm or Lpm) | Water Level (ft) | Temp. (°C) | Specific Conductance (µS/cm) | Dissolved Oxygen (mg/L) | pH | ORP (mv) | Turbidity (NTU) | Comments |
| | | | | 10.4 | 150.8 | 10.54 | 7.56 | 62.4 | 4.32 | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

Total Gallons Purged: _____ Total Casing Volumes Removed: _____

Ending Water Level (ft TOC): _____ Ending Total Depth (ft TOC): _____

## SAMPLE INVENTORY

| Time | Volume | Bottle Type | Quantity | Filtration | Preservation | Appearance | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Color | Turbidity & Sediment | |
| 1415 | 40 | VOA | 3 | N | HCl | lt-yllw | 4.32 | |
| | 500 | Amber | 1 | ↓ | $H_2SO_4$ | ↓ | ↓ | |
| | 500 | Poly | 2 | ↓ | N | | | |
| | 250 | ↓ | 1 | Y | ↓ | | | |
| | 500 | ↓ | 2 | ↓ | $HNO_3$ | ↓ | ↓ | |
| | | | | | | | | |

## METHODS

Parameters measured with (instrument model & serial number): YSI-red; Turb-white peri pump-blue
Purging Equipment: peri pump Decon Equipment: Alconox + water
Disposal of Discharged Water: onsite

Observations/Comments: _____

Aspect CONSULTING

Sample number: MW-6 - 102314

## GROUNDWATER SAMPLING RECORD

WELL NUMBER: MW-6 Page: 1 of 1

Project Name: Hansville Landfill
Date: 10/23/14
Sampled by: DWO
Measuring Point of Well: N TOC
Screened Interval (ft. TOC)
Filter Pack Interval (ft. TOC)

Project Number: 160423
Starting Water Level (ft TOC): 73.87
Casing Stickup (ft): /
Total Depth (ft TOC): /
Casing Diameter (inches): 2"

Casing Volume _____ (ft Water) x _____ (Lpfv)(gpf) = _____ (L)(gal)
Casing volumes: 3/4"= 0.02 gpf 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
3/4"= 0.09 Lpf 2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): midscreen

## PURGING MEASUREMENTS

| Criteria: | | Typical 0.1-0.5 Lpm | Stable | na | ± 3% | ± 10% | ± 0.1 | ± 10 mV | ± 10% | |
|---|---|---|---|---|---|---|---|---|---|---|
| Time | Cumul. Volume (gal or L) | Purge Rate (gpm or Lpm) | Water Level (ft) | Temp. (°C) | Specific Conductance (µS/cm) | Dissolved Oxygen (mg/L) | pH | ORP (mv) | Turbidity (NTU) | Comments |
| 1524 1529 | 0 | 0.2 | 73.84 | | | | | | | clear |
| 1534 | | | 73.89 | 12.8 | 370.1 | 1.02 | 7.09 | 75.6 | 1.77 | |
| 1539 | | | 73.84 | 12.8 | 374.7 | 0.30 | 7.06 | 75.5 | 1.76 | |
| 1544 | | | 73.84 | 12.8 | 378.2 | 0.26 | 7.06 | 74.9 | 0.48 | |
| 1549 | | | 73.89 | 12.8 | 376.6 | 0.25 | 7.05 | 74.6 | 0.56 | |
| 1554 | | | 73.84 | 12.8 | 377.2 | 0.22 | 7.05 | 74.2 | 0.32 | sample |

Total Gallons Purged: 1.5
Total Casing Volumes Removed: _____
Ending Water Level (ft TOC): 73.89
Ending Total Depth (ft TOC): _____

## SAMPLE INVENTORY

| Time | Volume | Bottle Type | Quantity | Filtration | Preservation | Appearance: Color | Appearance: Turbidity & Sediment | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1555 | 40 | VOA | 3 | N | HCl | clear | 0.36 | |
| | 500 | Amber | 1 | | $H_2SO_4$ | | | |
| | 500 | Poly | 2 | | N | | | |
| | 250 | | 1 | Y | | | | |
| | 500 | | 2 | | $HNO_3$ | | | |

## METHODS

Parameters measured with (instrument model & serial number): YSE-red; Turbidimeter-white; WLI-red/yel
Purging Equipment: Dedicated bladder pump Decon Equipment: Alconox + water
Disposal of Discharged Water: onsite
Observations/Comments: _____

Aspect CONSULTING

Sample number MW-14-102319 / MW-20DD-102319

## GROUNDWATER SAMPLING RECORD

WELL NUMBER: MW-14 Page: 1 of 1

Project Name: Hansville Landfill
Date: 10/23/19
Sampled by: IVT
Measuring Point of Well: NTOC
Screened Interval (ft. TOC)
Filter Pack Interval (ft. TOC)

Project Number: 160423
Starting Water Level (ft TOC): 81.95
Casing Stickup (ft):
Total Depth (ft TOC):
Casing Diameter (inches): 2"

Casing Volume _____ (ft Water) x _____ (Lpfv)(gpf) = _____ (L)(gal)
Casing volumes: 3/4"= 0.02 gpf 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf
3/4"= 0.09 Lpf 2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): Mid-Screen

### PURGING MEASUREMENTS

| Criteria: | | Typical 0.1-0.5 Lpm | Stable | na | ± 3% | ± 10% | ± 0.1 | ± 10 mV | ± 10% | |
|---|---|---|---|---|---|---|---|---|---|---|
| Time | Cumul. Volume (gal or L) | Purge Rate (gpm or Lpm) | Water Level (ft) | Temp. (°C) | Specific Conductance (µS/cm) | Dissolved Oxygen (mg/L) | pH | ORP (mv) | Turbidity (NTU) | Comments |
| 1530 | 0 | 0.2 | 81.95 | | | | | | | Start purge |
| 1535 | 0.25 | 0.2 | 81.97 | 11.5 | 297.2 | 3.36 | 7.10 | 84.4 | 16 | No color/odor |
| 1540 | 0.5 | 0.2 | 81.97 | 11.4 | 311.0 | 0.97 | 7.09 | 85.2 | 10 | " |
| 1545 | 0.675 | 0.2 | 81.97 | 11.4 | 305.1 | 0.58 | 7.12 | 80.9 | 8 | " |
| 1550 | 1.0 | 0.2 | 82.02 | 11.4 | 299.2 | 0.53 | 7.13 | 77.4 | 8 | " |
| 1555 | 1.25 | 0.2 | 82.02 | 11.4 | 289.8 | 0.52 | 7.13 | 75.0 | 8 | " |
| 1600 | 1.50 | 0.2 | 82.02 | 11.4 | 284.4 | 0.51 | 7.13 | 73.5 | 8 | " |
| 1605 | 1.75 | 0.2 | | 11.1 | 282.7 | 0.52 | 7.13 | 72.6 | 8 | " |
| 1607 | | | | | | | | | | Stop purge - collect |

Total Gallons Purged: 2.5
Total Casing Volumes Removed:
Ending Water Level (ft TOC): 81.96
Ending Total Depth (ft TOC):

### SAMPLE INVENTORY

| Time | Volume | Bottle Type | Quantity | Filtration | Preservation | Appearance | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Color | Turbidity & Sediment | |
| IVT 1610 | 40 | VOA | 6 | — | HCl | Clear | 8 | Duplicated |
| 1610 | 250 | Poly | 2 | Y | — | ↓ | ↓ | ↓ |
| ↓ | 500 | Poly | 4 | Y | $HNO_3$ | | | |
| | 500 | Poly | 4 | — | — | | | |
| ↓ | 500 | amber | 2 | — | $H_2SO_4$ | ↓ | ↓ | |

### METHODS

Parameters measured with (instrument model & serial number): orange YSI, orange/white WTW, blue turbidimeter
Purging Equipment: dedicated bladder pump
Decon Equipment: alconox + water
Disposal of Discharged Water: discharged to ground
Observations/Comments:

# APPENDIX E

# Annual Inspection Forms – Kitsap Public Health District

KITSAP PUBLIC
HEALTH DISTRICT

345 6th Street, Suite 300
Bremerton, WA 98337
360-728-2235

March 27, 2019

Alexis McKinnon
Kitsap County Public Works
614 Division Street, MS-27
Port Orchard, WA 98366

RE: HANSVILLE LANDFILL INSPECTION, 2019 1st QUARTER

Dear Ms. McKinnon:

The Kitsap Public Health District (Health District) is writing to relay the results of the 1st quarter inspection of 2019 at the Hansville Landfill. Enclosed please find a copy of the inspection checklist/report for the quarterly inspection conducted on March 26, 2019, at 12:15pm.

The following items were noted or discussed:

- A drone survey of the landfill is planned for this year to determine the number of survey points that will be needed for monitoring the landfill and evaluating any future subsidence.
- The landfill cover was wet due to the rain, but no pooling of water anywhere during the inspection.
- The next inspection is scheduled for June 2019.
- A copy of the inspection form is attached.

If you have any questions or comments, please feel free to contact me at (360) 728-2274.

Sincerely,

Patrick Hamel
Environmental Health Specialist
Solid and Hazardous Waste Program
360-728-2274 phone
patrick.hamel@kitsappublichealth.org

enc: Inspection Checklist

KITSAP PUBLIC
HEALTH DISTRICT

345 6th Street, Suite 300
Bremerton, WA 98337
360-337-5235

# SOLID WASTE FACILITY INSPECTION FORM

**Facility Name:** Hansville Landfill **Operator:** Kitsap County Public Works **Phone #:** (360) 337-5665

**Location of Facility:** 7791 NE Ecology Rd Poulsbo

**Inspector:** Patrick Hamel **Date:** 3-26-19 **Time:** 12:00 pm

**Type of Inspection Checklist Used:** **Facility Representative Present:**

| Reason for Inspection | Type of Inspection | Results | Sample Taken? |
|---|---|---|---|
| ✓ Scheduled | ✓ Full Quarterly | ✓ Compliant | ___ Yes ✓ No |
| ___ Return | ___ Brief | ___ Non-Compliant | |
| ___ Complaint | ___ No Entry | ___ Approved | |
| ___ Permit Investigation | ___ Consultation | ___ Disapproved | **Attachments? (photos, etc.)** |
| ___ Sample | ___ Plan Review | ___ Other | ___ Yes ✓ No |
| ___ By Request | ___ Site Review | | Type? |
| ___ Other | ___ Other | | |

| Item # | Description (see attached checklist for complete list of items) | Correction Date |
|---|---|---|
| | • Ponding in places in surrounding drainage ditch. Plan to have the ditches cleaned this spring. | |
| | • Drone survey to determine survey points will be conducted this year. | |
| | • NO issues. | |
| | | |

**Comments:**

**Signatures:** X _____ Facility Representative _____ KPHD Inspector

**File Name:** _____

KITSAP PUBLIC
HEALTH DISTRICT

345 6th Street, Suite 300
Bremerton, WA 98337
360-728-2235

June 19, 2019

Alexis McKinnon
Kitsap County Public Works
614 Division Street, MS-27
Port Orchard, WA 98366

RE: HANSVILLE LANDFILL INSPECTION, 2019 2nd QUARTER

Dear Ms. McKinnon:

The Kitsap Public Health District (Health District) is writing to relay the results of the 2nd quarter inspection of 2019 at the Hansville Landfill. Enclosed please find a copy of the inspection checklist/report for the quarterly inspection conducted on June 17, 2019, at 1:00pm.

The following items were noted or discussed:

- The landfill cover was dry and covered with tall grass and several blackberry bushes. The cap and access roads need mowing. As discussed, it is scheduled for mid-July after drone survey work completed.
- Manual survey will be conducted after the drone survey is complete.
- The next inspection is scheduled for September 2019.
- A copy of the inspection form is attached.

If you have any questions or comments, please feel free to contact me at (360) 728-2274.

Sincerely,

Patrick Hamel
Environmental Health Specialist
Solid and Hazardous Waste Program
360-728-2274 phone
patrick.hamel@kitsappublichealth.org

enc: Inspection Checklist

KITSAP PUBLIC HEALTH DISTRICT

345 6th Street, Suite 300
Bremerton, WA 98337
360-337-5235

# SOLID WASTE FACILITY INSPECTION FORM

**Facility Name:** HANSVILLE LANDFILL **Operator:** KITSAP COUNTY PUBLIC WORKS **Phone #:** 360-337-5665

**Location of Facility:** 7791 NE ECOLOGY RD. POULSBO

**Inspector:** PATRICK HAMEL **Date:** 6-17-19 **Time:** 1:00pm

**Type of Inspection Checklist Used:** **Facility Representative Present:**

| Reason for Inspection | Type of Inspection | Results | Sample Taken? |
|---|---|---|---|
| ✓ Scheduled | ✓ Full Quarterly | ✓ Compliant | ___ Yes ✓ No |
| ___ Return | ___ Brief | ___ Non-Compliant | |
| ___ Complaint | ___ No Entry | ___ Approved | |
| ___ Permit Investigation | ___ Consultation | ___ Disapproved | **Attachments?** (photos, etc.) |
| ___ Sample | ___ Plan Review | ___ Other | ___ Yes ✓ No |
| ___ By Request | ___ Site Review | | Type? |
| ___ Other | ___ Other | | |

| Item # | Description (see attached checklist for complete list of items) | Correction Date |
|---|---|---|
| | - Landfill cap & access roads had tall grass & some blackberry bush growth. Scheduled for cutting in mid-July. Current survey crew activity work being done. | July 21st ↓ |
| | - Initial survey will be done, secondary survey will be done manually | |

**Comments:** - NO other issues.

**Signatures:** X _____ Facility Representative _____ 6-17-19 KPHD Inspector

**File Name:** _____

KITSAP PUBLIC
HEALTH DISTRICT

345 6th Street, Suite 300
Bremerton, WA 98337
360-728-2235

October 2, 2019

Alexis McKinnon
Kitsap County Public Works
614 Division Street, MS-27
Port Orchard, WA 98366

RE: HANSVILLE LANDFILL INSPECTION, 2019 3rd QUARTER

Dear Ms. McKinnon:

The Kitsap Public Health District (Health District) is writing to relay the results of the 2nd quarter inspection of 2019 at the Hansville Landfill. Enclosed please find a copy of the inspection checklist/report for the quarterly inspection conducted on October 1, 2019, at 12:00pm.

The following items were noted or discussed:

- The landfill cover was in good condition but in need of mowing. The ditch surrounding the landfill had considerable amounts of vegetative growth and needs to be cleaned out.
- The survey monuments have been installed and another survey will be conducted in approximately two years to measure any potential subsidence.
- The next inspection is scheduled for December 2019.
- A copy of the inspection form is attached.

If you have any questions or comments, please feel free to contact me at (360) 728-2274.

Sincerely,

Patrick Hamel
Environmental Health Specialist
Solid and Hazardous Waste Program
360-728-2274 phone
patrick.hamel@kitsappublichealth.org

enc: Inspection Checklist

KITSAP PUBLIC
HEALTH DISTRICT

345 6th Street, Suite 300
Bremerton, WA 98337
360-337-5235

# SOLID WASTE FACILITY INSPECTION FORM

**Facility Name:** HANSVILLE LANDFILL **Operator:** Kitsap County Public Works **Phone #:** (360) 337-5665

**Location of Facility:** 7791 NE Eccles Rd. Poulsbo

**Inspector:** Patrick Hamel **Date:** 10/1/19 **Time:** 12:09pm

**Type of Inspection Checklist Used:** **Facility Representative Present:**

| Reason for Inspection | Type of Inspection | Results | Sample Taken? |
|---|---|---|---|
| ✓ Scheduled | ✓ Full Quarterly | ✓ Compliant | ___ Yes ✓ No |
| ___ Return | ___ Brief | ___ Non-Compliant | |
| ___ Complaint | ___ No Entry | ___ Approved | |
| ___ Permit Investigation | ___ Consultation | ___ Disapproved | **Attachments?** (photos, etc.) |
| ___ Sample | ___ Plan Review | ___ Other | ___ Yes ✓ No |
| ___ By Request | ___ Site Review | | Type? |
| ___ Other | ___ Other | | |

| Item # | Description (see attached checklist for complete list of items) | Correction Date |
|---|---|---|
| | Ditch in need of cleaning out of old brush growth. | 11/30/19 |
| | | |
| | | |
| | | |
| | | |
| | | |

**Comments:**
- Survey monuments complete.
- Ditches starting to fill in. Clean out when possible.

**Signatures:** AMcKinnon — Facility Representative; 10-1-19 — KPHD Inspector

**File Name:** _____

KITSAP PUBLIC
HEALTH DISTRICT

345 6th Street, Suite 300
Bremerton, WA 98337
360-728-2235

December 11, 2019

Alexis McKinnon
Kitsap County Public Works
614 Division Street, MS-27
Port Orchard, WA 98366

RE: HANSVILLE LANDFILL INSPECTION, 2019 4th QUARTER

Dear Ms. McKinnon:

The Kitsap Public Health District (Health District) is writing to relay the results of the 4th quarter inspection of 2019 at the Hansville Landfill. Enclosed please find a copy of the inspection checklist/report for the quarterly inspection conducted on December 11, 2019, at 12:30pm.

The following items were noted or discussed:

- The landfill cover was in good condition and the surrounding ditch did have some water in it but seemed to be draining as intended.
- The native soil wells have been disconnected and capped.
- The next inspection is scheduled for March 2020.
- A copy of the inspection form is attached.

If you have any questions or comments, please feel free to contact me at (360) 728-2274.

Sincerely,

Patrick Hamel
Environmental Health Specialist
Solid and Hazardous Waste Program
360-728-2274 phone
patrick.hamel@kitsappublichealth.org

enc: Inspection Checklist

KITSAP PUBLIC
HEALTH DISTRICT

345 6th Street, Suite 300
Bremerton, WA 98337
360-728-2235

# SOLID WASTE FACILITY INSPECTION FORM

**Facility Name:** HANSVILLE LANDFILL **Operator:** KITSAP COUNTY PUBLIC WORKS **Phone #:** 360-337-5665

**Location of Facility:** 7791 NE ECOLOGY RD. POULSBO

**Inspector:** PATRICK HAMEL **Date:** 12/10/19 **Time:** 12:30

**Type of Inspection Checklist Used:** **Facility Representative Present:**

| Reason for Inspection | Type of Inspection | Results | Sample Taken? |
|---|---|---|---|
| ✓ Scheduled | ✓ Full Quarterly | ✓ Compliant | ___ Yes ✓ No |
| ___ Return | ___ Brief | ___ Non-Compliant | |
| ___ Complaint | ___ No Entry | ___ Approved | |
| ___ Permit Investigation | ___ Consultation | ___ Disapproved | **Attachments?** (photos, etc.) |
| ___ Sample | ___ Plan Review | ___ Other | ___ Yes ✓ No |
| ___ By Request | ___ Site Review | | Type? |
| ___ Other | ___ Other | | |

| Item # | Description (see attached checklist for complete list of items) | Correction Date |
|---|---|---|
| | | |
| | NO ISSUES. | |
| | | |
| | | |
| | | |
| | | |

**Comments:** Native Soil wells have been decommissioned. disconnected + capped. (PH)

**Signatures:** _____ Facility Representative _____ KPHD Inspector

**File Name:** _____

# APPENDIX F

# Memorandum: Hansville Landfill – Minor Changes to Landfill Gas Collection

# MEMORANDUM

Project No. 160423

February 21, 2020

**To:** Ronald Timm, Washington Department of Ecology
Patrick Hamel, Kitsap Public Health District

**cc:** Alexis McKinnon, Kitsap County Solid Waste
Pat Campbell, Kitsap County Solid Waste
Phillip Perley, Waste Management of Washington, Inc.

**From:**

**Peter Bannister, PE**
Associate Engineer
pbannister@aspectconsulting.com

**Re:** **Hansville Landfill – Minor Changes to Landfill Gas Collection**

---

Aspect Consulting, LLC (Aspect) has prepared this memorandum to describe minor changes in landfill gas collection at the Hansville Landfill on behalf of Kitsap County Solid Waste and Waste Management of Washington, Inc. (Clients). An active landfill gas collection system operates at the Hansville Landfill as part of the ongoing cleanup actions under an amended consent decree (No. 95-2-03005) with the Washington State Department of Ecology. A map of the landfill gas collection system layout is provided on Figure 1. The minor changes involved temporarily decommissioning perimeter gas collection wells. These changes are aimed at optimizing landfill gas collection in alignment with the Hansville Landfill Post Closure Permit for 2015 to 2020 (Kitsap Public Health District, 2015) and the Hansville Landfill Compliance Monitoring Plan (SCS Engineers, 2011).

## Background

During landfill closure, the landfill gas collection system was installed in three distinct locations (see Figure 1):

1. The Solid Waste Disposal Area included 13 vertical wells (R-1 through R-13) and a network of horizontal trench collectors (T-1 through T-7).

2. The Demolition Waste Disposal Area included one horizontal trench collector (TD-1).

3. The western perimeter of the Solid Waste Disposal Area included shallow and deep vertical wells at five locations, for a total of 10 wells (NS-1S, NS-1D, NS-2S, NS-2D, NS-3S, NS-3D, NS-4S, NS-4D, NS-5S, and NS-5D).

A description of perimeter landfill gas collection was provided in Section 2.2.2 of the Remedial Investigation Report (Parametrix, 2006):

> The perimeter gas wells, installed in the native soils, were designed to remove the gas that had previously migrated from the solid waste disposal area, provide a second line of defense should future gas escape from the Landfill, and to serve as vapor extraction wells to remove VOCs from the surrounding soils and groundwater. The in-refuse wells were installed to a depth of approximately 80% to 90% of the projected refuse depth. The native soil wells extended to depths of approximately 40 to 45 ft below the projected refuse depth…
>
> Within the first 6 months of operation of the gas system, it became necessary to reduce the vacuum in most of the extraction wells on the Property (including the perimeter gas wells) as a result of the reduced gas flow. By June 1993, it became necessary to close the perimeter wells to ensure that the flare had enough high quality gas to burn continuously and efficiently.
>
> Additional modifications to the gas system were completed June 8, 1994. These modifications separated the perimeter gas extraction well flow from the in-refuse gas extraction and trench flow. The perimeter wells were intended to be operated at a stronger vacuum to improve cleanup of the groundwater. The flow from the perimeter wells was almost entirely air. The flow from the perimeter wells was piped into the flare above the landfill gas ignition point to ensure that any VOCs in the perimeter well flow were also combusted.
>
> The perimeter gas extraction system was turned off in 1995 when it was determined that the zone of influence of the in-refuse well was extending to the perimeter wells, as indicated by recorded vacuum, level in the perimeter wells.

## Recent Observations

In January 2017, Aspect observed that the perimeter gas wells were under vacuum, and oxygen concentrations typically reflected atmospheric air. On March 31, 2017, valves at perimeter gas wells were closed to redirect vacuum to in-refuse landfill gas collection locations (Aspect, 2017). Landfill gas migration control was maintained based on compliance probe monitoring. Over time, it became apparent that several of the 26-year-old valves were occasionally leaking and landfill gas was unintentionally being collected.

## Decommissioning Perimeter Gas Wells

After discussing the benefits and costs of repairing or replacing valves, the Clients decided to temporarily decommission the perimeter gas wells. This work was completed in October 2019 by cutting and capping the polyvinyl chloride (PVC) piping at each of the 10 perimeter gas wells and the laterals from the landfill gas collection system. Photographs of decommissioned perimeter locations are provided in Appendix A; several locations were photographed before and after decommissioning. The perimeter wells will be fully decommissioned in accordance with Chapter 173-160 Washington Administrative Code (WAC): *Minimum Standards for Construction and Maintenance of Wells.*

## References

Aspect Consulting, LLC (Aspect), 2017, Letter Re: First Quarter 2017 Environmental Monitoring Report, Hansville Landfill, Kitsap County, WA, May 30, 2017.

Kitsap County Public Health, 2015, Letter Re: Hansville Landfill Port Closure Permit 2015 to 2020, February 5, 2015.

Parametrix, 2006, Hansville Landfill Remedial Investigation/Feasibility Study Remedial Investigation Report, Public Review Draft, September 22, 2006.

SCS Engineers, 2011, Hansville Landfill Compliance Monitoring Program, September 2011.

## Limitations

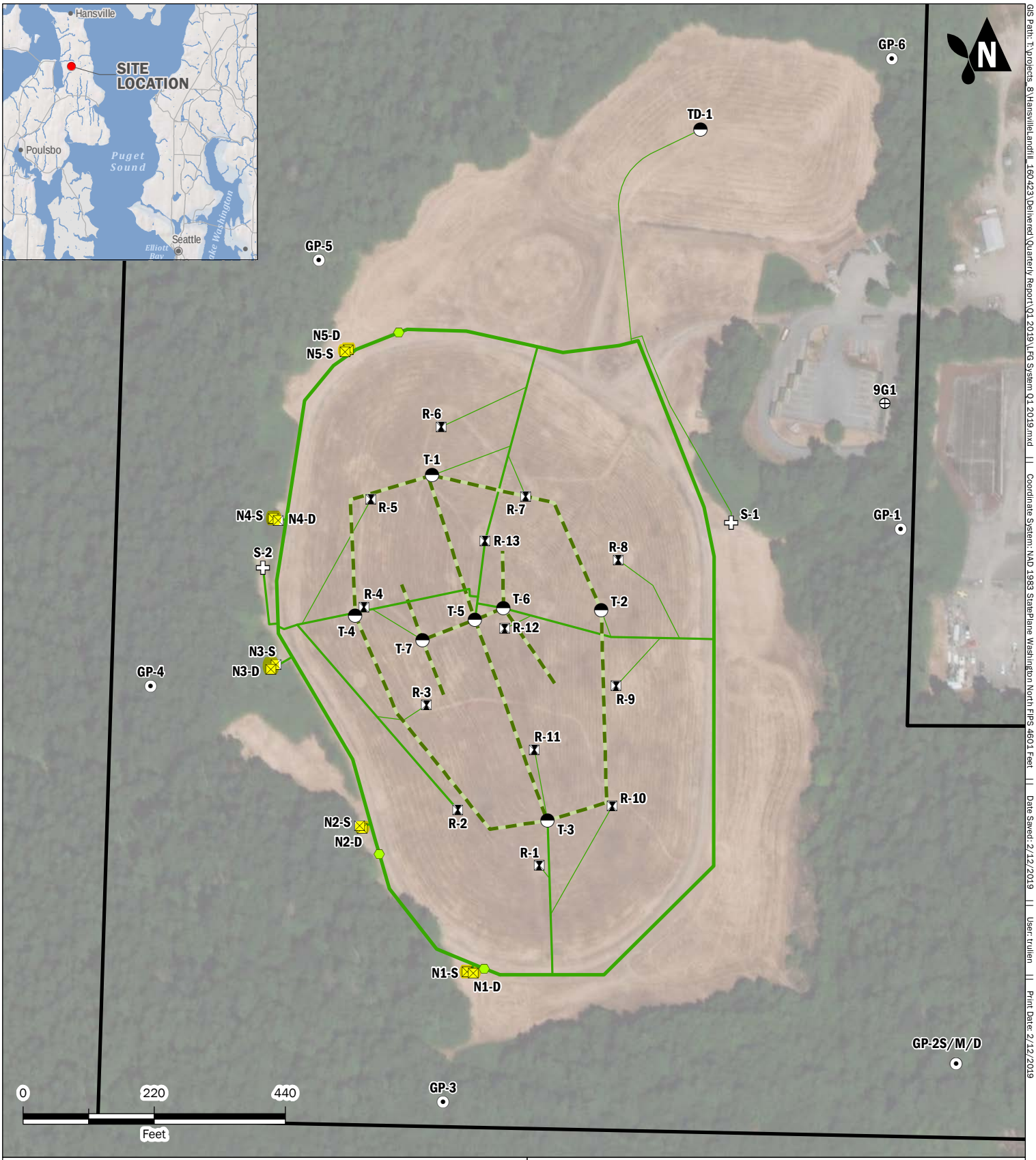
Work for this project was performed for the Kitsap County Solid Waste and Waste Management of Washington, Inc. (Clients), and this memorandum was prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. This memorandum does not represent a legal opinion. No other warranty, expressed or implied, is made.

All reports prepared by Aspect Consulting for the Clients apply only to the services described in the Agreement(s) with the Clients. Any use or reuse by any party other than the Clients is at the sole risk of that party, and without liability to Aspect Consulting. Aspect Consulting's original files/reports shall govern in the event of any dispute regarding the content of electronic documents furnished to others.

Attachments: Figure 1 – Landfill Gas System
Appendix A – Photographs of Decommissioned Perimeter Locations

V:\160423 Kitsap County Hansville Landfill\Deliverables\2019 Reports\Perimeter Well Update\Hansville_MinorChangesLFGCollection_FINAL_20200221.docx

# FIGURES




**Exploration**

- Condensate Sump
- Gas Detection Probe
- Gas Extraction Well (Native Soil Completion)
- Gas Extraction Well (in Refuse Completion)
- Trench Completion
- Well Geologic Control

**Landfill Gas System**

- LFG Pipe - 2"
- LFG Pipe - 4"
- LFG Pipe - 6"
- Trench
- LFG Valve
- Landfill Boundary

# Landfill Gas System

Hansville Landfill
Kitsap County, Washington

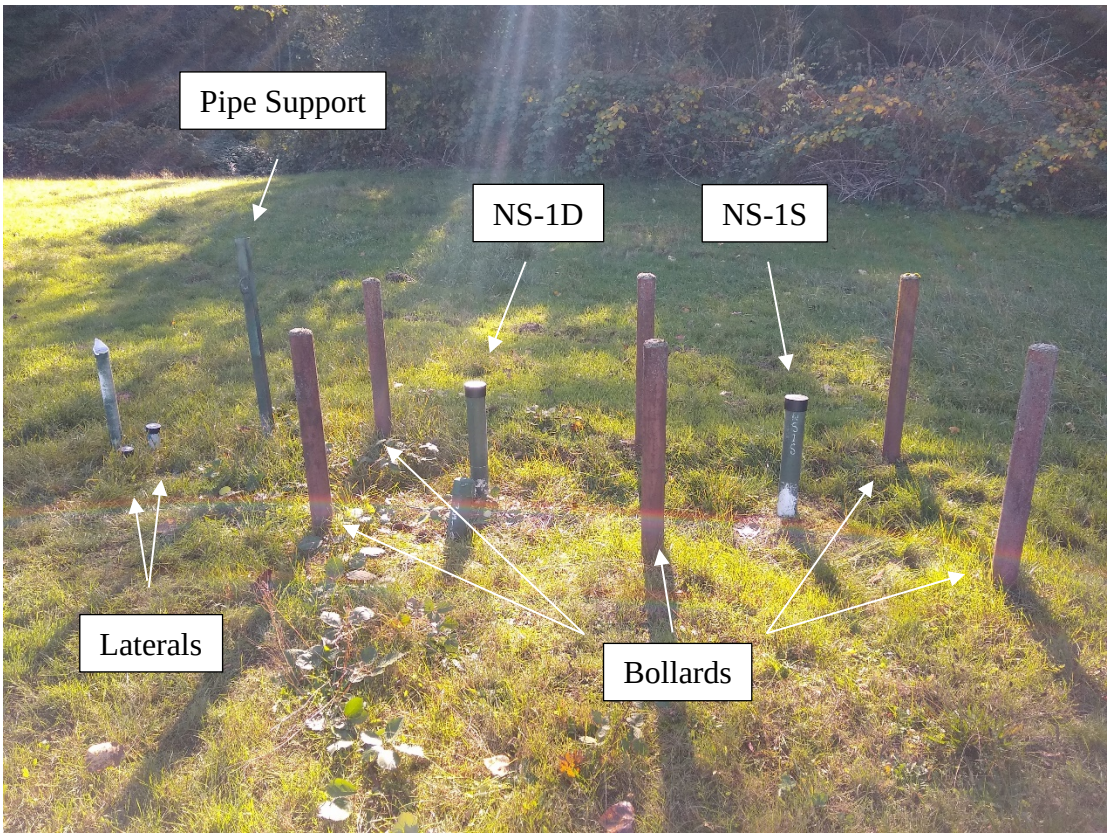
| Aspect Consulting | JUL-2019 | BY: MLK / RAP | FIGURE NO. 1 |
|---|---|---|---|
| | PROJECT NO. 160423 | REVISED BY: --- | |



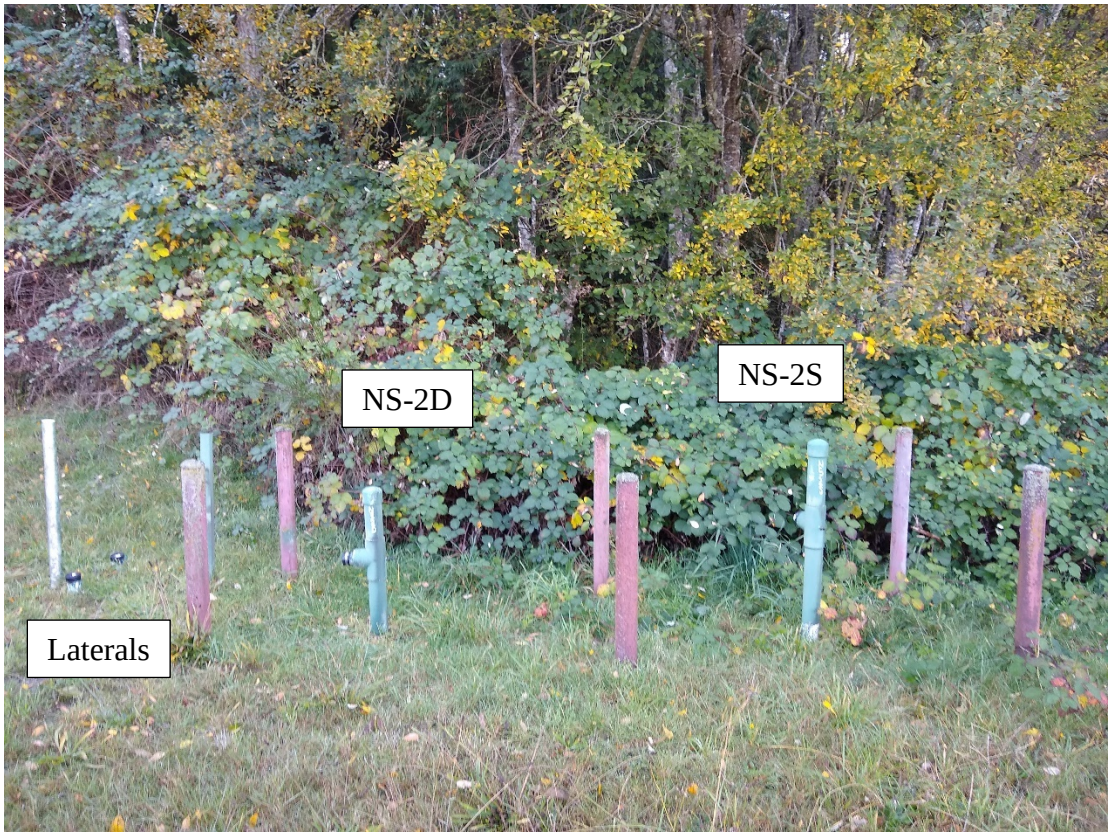
GIS Path: T:\projects_8\Hansville\Landfill_160423\Delivered\Quarterly Report\Q1 2019\LFG System Q1 2019.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 2/12/2019 || User: trulien || Print Date: 2/12/2019

# APPENDIX A

# Photographs of Decommissioned Perimeter Locations

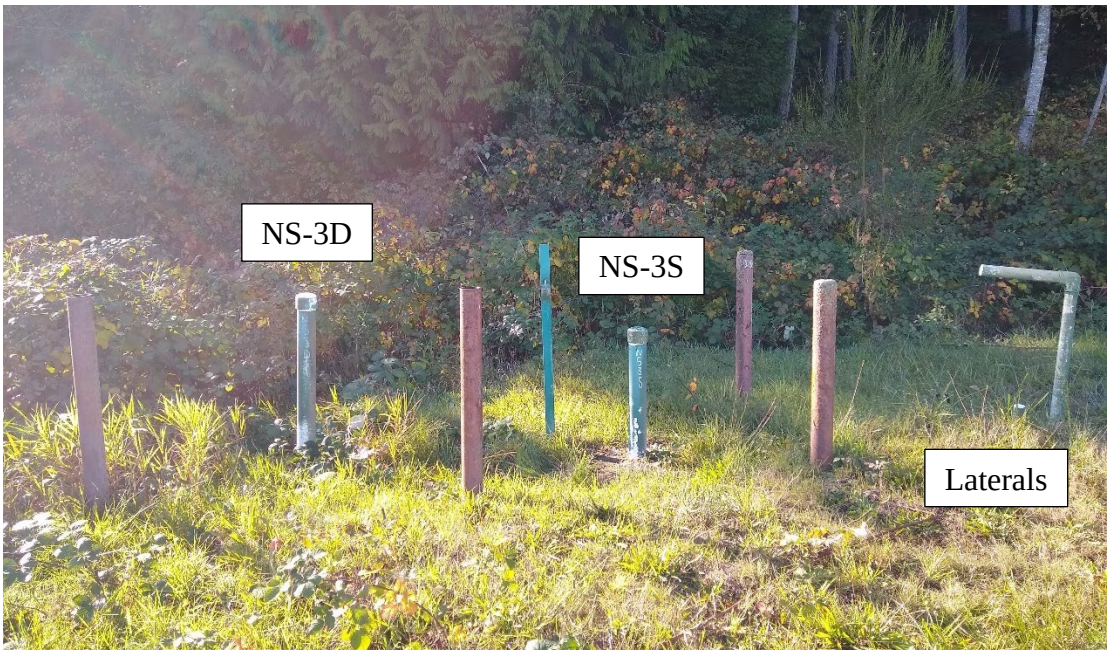



Photograph 1. Decommissioned NS-1 Location

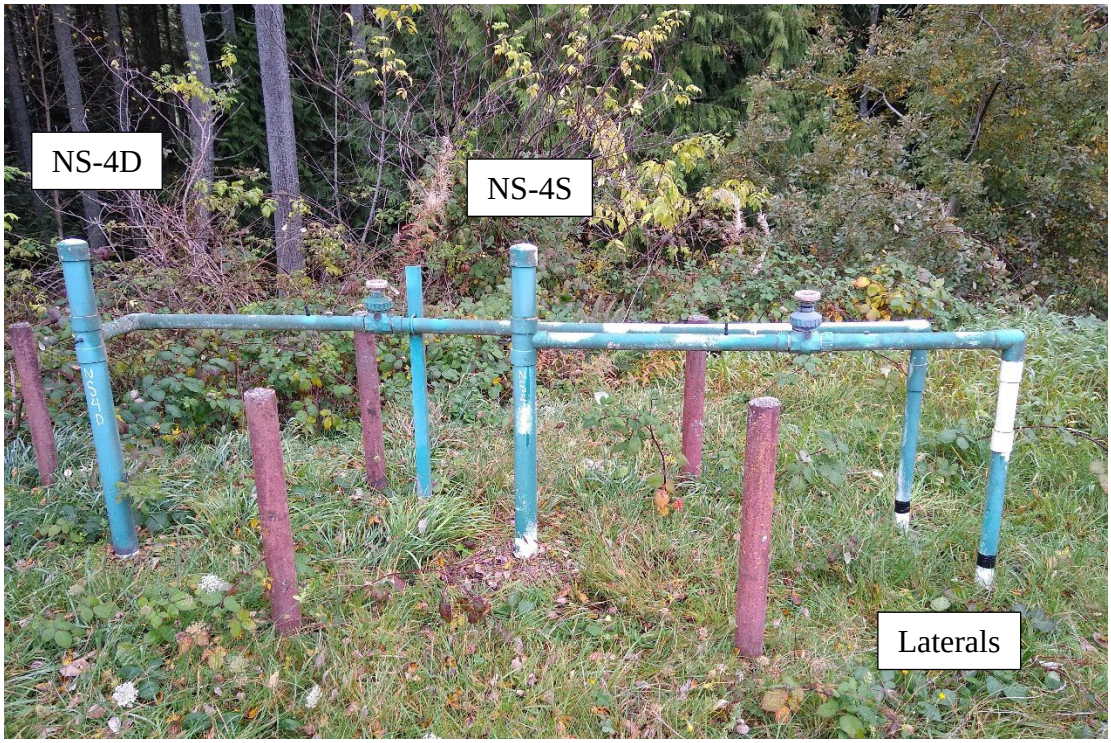



Photograph 2. Decommissioned NS-2 Location

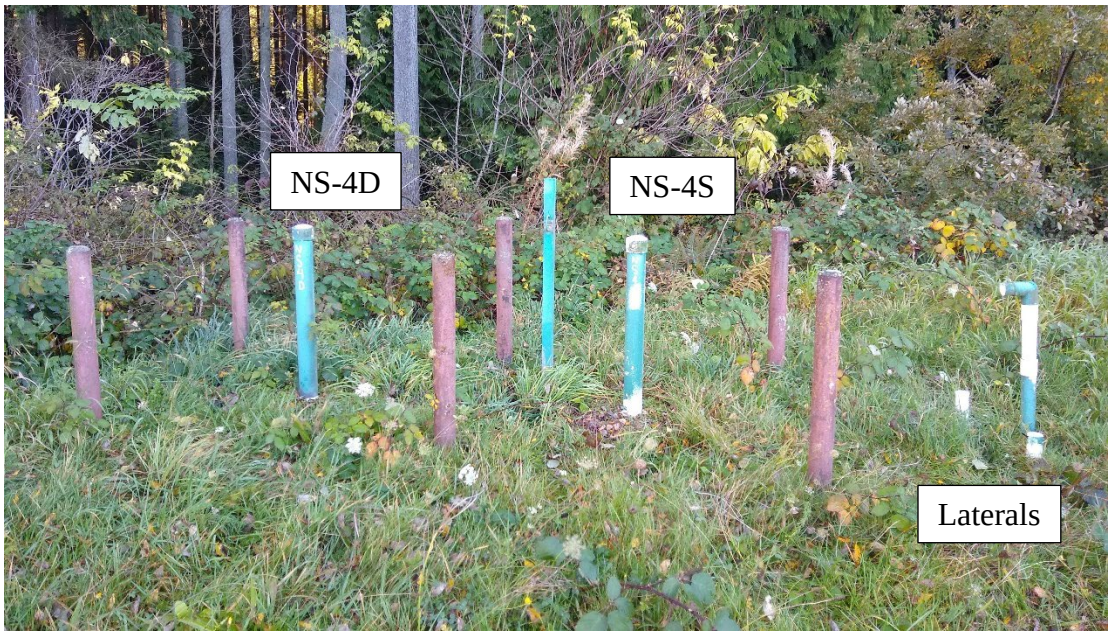

Photograph 3. NS-3 Location before decommissioning



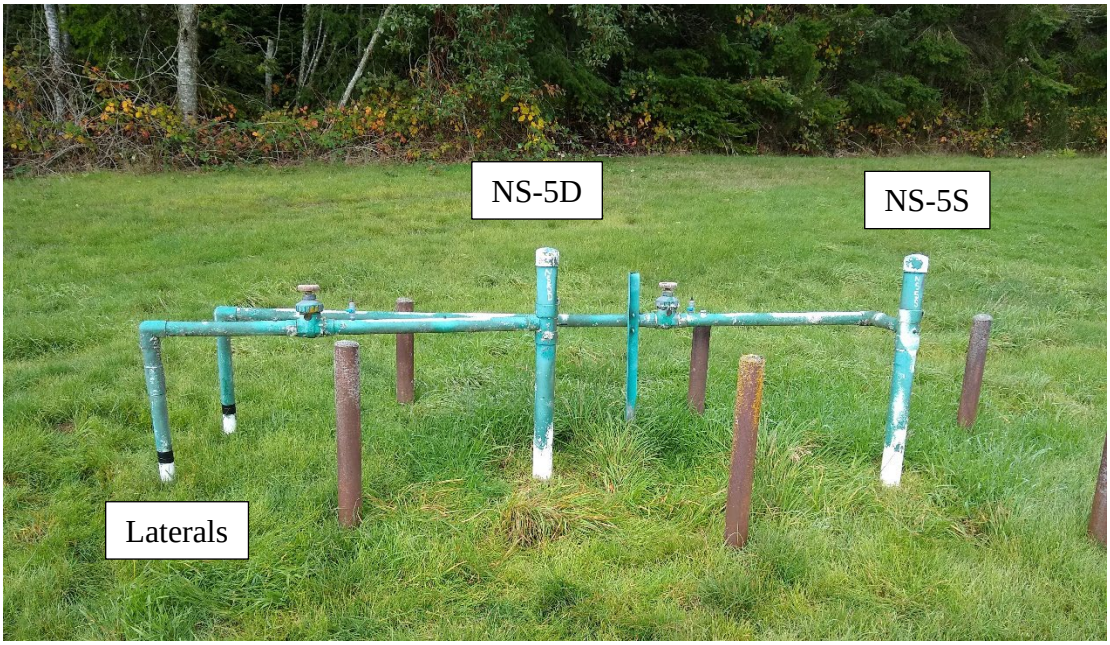

Photograph 4. Decommissioned NS-3 Location



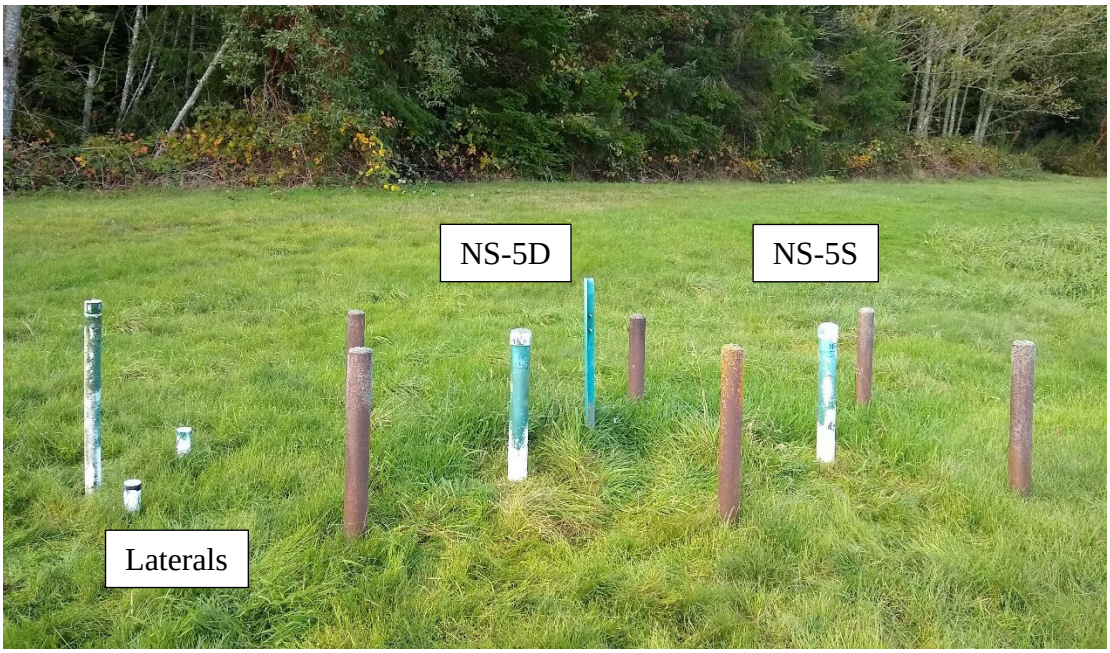

Photograph 5. NS-4 Location before decommissioning




Photograph 6. Decommissioned NS-4 Location




Photograph 7. NS-5 Location before decommissioning




Photograph 8. Decommissioned NS-5 Location