SCS ENGINEERS

Remedial Action Status Report

Hansville Landfill

Kitsap County, WA

Presented to:

KITSAP COUNTY/
WASTE MANAGEMEMENT OF WASHINGTON, INC

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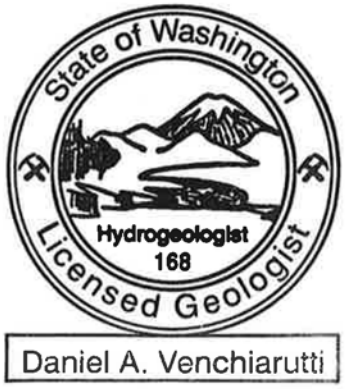

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SELECTED ACRONYMS AND DEFINITIONS

bgs	below ground surface
CAP	Cleanup Action Plan
CDL	construction, demolition, and land clearing wastes
CMP	Compliance Monitoring Plan
COCs	contaminants of concern
CPOC	Conditional Point of Compliance
County	Kitsap County
Ecology	Washington State Department of Ecology
ft	feet
GP	gas probe
HDPE	high density polyethylene
KCSL	Kitsap County Sanitary Landfill
KPHD	Kitsap Public Health District
Landfill	Hansville Landfill solid waste disposal area, the demolition waste disposal area, and the septage disposal area located on the landfill property
LFG	landfill gas
Landfill property	Total area and facilities encompassed by the Hansville Landfill property boundary
LCL	lower confidence limit
mg/L	milligrams per liter
µg/L	micrograms per liter
msl	mean sea level
MCL	maximum contaminant level
MTCA	Model Toxics Control Act
MW	groundwater monitoring well
ND	non-detect
Protection Area	The area within the Port Gamble S'Klallam Tribal Reservation that is or may be potentially impacted by contaminants from the site for which Ecology has required institutional controls to protect Tribal resources and the health and welfare of the Reservation population
QAP	Quality Assurance Plan
RASR	Remedial Action Summary Report
RCW	Revised Code of Washington
RI/FS	Remedial Investigation/Feasibility Study
SAP	Sampling and Analysis Plan
scfm	standard cubic feet per minute
SCS	SCS Engineers
SHA	Site Hazard Assessment
SIM	Selected ion monitoring

Site	Landfill property boundary plus the extent of groundwater and surface water contamination impacts from the Landfill on Port Gamble S'Klallam Tribal property
SW	surface water monitoring stations
TOC	total organic carbon
UCL	upper confidence limit
VOCs	volatile organic compounds
WAC	Washington Administrative Code
WMW	Waste Management of Washington, Inc.

1.0 INTRODUCTION

This report presents the results of evaluations performed to support the Washington Department of Ecology's (Ecology) Five Year Review of the protectiveness and effectiveness of cleanup actions taken at Kitsap County's Hansville Landfill. This report was prepared by SCS Engineers (SCS) on behalf of Kitsap County Public Works and Waste Management of Washington, Incorporated (WMW) in order to satisfy Section XXVI of the amended Consent Decree covering the remedial actions being completed at the property. This section requires that the site owner submit a Remedial Action Summary Report to Ecology at least 90 days preceding the agency's initiation of the five-year review of the site cleanup actions completed under the decree.

Regulations implementing Washington's Model Toxics Control Act (MTCA) list criteria to be evaluated during the five year review process. Specifically, Washington Administrative Code (WAC) 173-340-420 (4) identifies the following six criteria that are to be evaluated to determine whether human health and the environment are being protected:

(a) The effectiveness of ongoing or completed cleanup actions, including the effectiveness of engineered controls and institutional controls in limiting exposure to hazardous substances remaining at the site;

(b) New scientific information for individual hazardous substances or mixtures present at the site;

(c) New applicable state and federal laws for hazardous substances present at the site;

(d) Current and projected site and resource uses;

(e) The availability and practicability of more permanent remedies; and

(f) The availability of improved analytical techniques to evaluate compliance with cleanup levels.

1.1 REPORT ORGANIZATION

A summary of site conditions follows this introduction. The remainder of this report is organized around the six MTCA-specified evaluation criteria noted above. Therefore, this report includes the following sections:

- Introduction
- Site background
- Effectiveness of cleanup actions
- New scientific information
- New applicable state and federal laws
- Current and projected site and resource uses
- Availability and practicality of more permanent remedies
- Availability of improved analytical techniques
- Proposed actions for 2017 through 2021
- References.

All figures referenced in the document are included in Appendix A. Tables are contained in Appendix B.

2.0 SUMMARY OF SITE CONDITIONS

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 property is situated on an upland area approximately five miles south of the unincorporated community of Hansville on the northernmost reach of the Kitsap Peninsula. The property is bordered to the south and west by woodlands owned by the Port Gamble S'Klallam Tribe. Surrounding areas to the north and east of the facility are zoned low-density residential, rural wooded, or light industrial and are sparsely developed. Port Gamble Bay is located approximately 4,000 feet west of the facility. A site location map is provided as Figure 1.

The following subsections present a description of the Hansville Landfill facility, the landfill's regulatory history, the nature and extent of contamination and the associated risk assessments documented in the Remedial Investigation/Feasibility Study (RI/FS) completed for the site (Parametrix, 2007, 2009), a description of the site cleanup actions undertaken at the closed landfill, and a summary of the cleanup standards determined by Ecology to be applicable to the site. The summaries presented in the following sections are based on information contained in the RI/FS, the amended Consent Decree, the Cleanup Action Plan (CAP) and their referenced site documentation.

2.1 SITE DESCRIPTION

The Hansville Landfill is a former municipal landfill that stopped accepting waste and officially closed in 1989. The landfill closure met the requirements of Chapter 173-304 WAC. The closure consisted of final site grading, surface capping (including the installation of a high-density polyethylene [HDPE] liner over three distinct disposal areas), and the installation of surface water controls. Consistent with WAC 173-304 closure requirements, none of the disposal areas are provided with an engineered bottom liner. As illustrated on Figures 2 and 3, the three closed disposal areas include the following:

- 13-acre municipal solid waste (MSW) disposal cell situated within the central portion of the property.
- 4-acre demolition disposal cell situated on the northeast corner of the property, which accepted construction, demolition, and land clearing (CDL) wastes.
- 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 also located near the northeast corner of the demolition disposal area.

In addition to capping the former waste disposal cells, landfill closure included the installation and operation of a landfill gas (LFG) extraction/flaring system. The active LFG extraction system, which was installed in 1991, included interior LFG extraction wells and trenches (installed in refuse), perimeter gas extraction wells located in native soil adjacent to the solid waste disposal area, a condensate collection system, and a fenced blower/flare facility. A series of seven LFG monitoring probes (with one a triple completion) were located proximal to the

facility borders to monitor for potential offsite LFG migration. The surface water drainage control system manages stormwater flow and minimizes erosion and offsite migration of sediment-bearing water. Drainage and erosion protection improvements include hydroseeding and the construction of stormwater culverts and drainage ditches.

2.2 REGULATORY BACKGROUND

In 1991, Ecology completed an MTCA Site Hazard Assessment (SHA) which resulted in the Hansville Landfill being initially categorized with a hazard ranking of 3 (moderate risk). This ranking was subsequently changed to a 1 (the highest rank on a scale of 1 to 5) in 1992, based on changes in the state ranking model. Throughout this period, the facility owner (Kitsap County Sanitary Landfill [KCSL], which later merged into WMW) conducted additional site investigations, continued environmental monitoring, and implemented additional improvements at the property as part of a corrective action program.

In October 1995, Ecology signed a consent decree with the County and KCSL to conduct a RI/FS for the Site. The RI was completed in 2007 and the FS was completed in 2009. The RI initially identified arsenic and vinyl chloride in groundwater (and in seepage to surface water) as the primary contaminants of concern (COCs) related to the landfill. The highest concentrations of these COCs were generally observed adjacent to the waste disposal areas with decreasing concentrations at increasing distances from the landfill. 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.

A preferred remedial alternative of Natural Attenuation of Groundwater with Enhanced Monitoring and Institutional Controls was selected for implementation at the Hansville Landfill Site. The CAP was specifically developed to implement the selected remedy. Along with an environmental covenant for the landfill property, the CAP was incorporated into the Amended Consent Decree executed on August 5, 2011. A Compliance Monitoring Plan (CMP), including a MTCA-compliant Sampling and Analysis Plan (SAP) and Quality Assurance Plan (QAP), was prepared by SCS in September 2011 to document the revised monitoring program to be executed under the CAP. Compliance monitoring under the CAP was initiated during the fourth quarter of 2011 and continues through the present time.

2.3 NATURE AND EXTENT OF CONTAMINATION

Groundwater monitoring was initiated at the Landfill Hansville in 1982 with the installation of three groundwater monitoring wells (MW-1 through MW-3). Three more groundwater monitoring wells (MW-4 though MW-6) were added to the monitoring network in 1988. Beginning in 1996, additional groundwater wells were installed as part of the phased RI, including wells MW-7 through MW-12 during Phase I, and wells MW-8D, MW-12I, MW-13S, MW-13D, and MW-14 during Phase II.

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 established in 1992 and 1994, respectively. An additional seven new surface water sampling locations (SW-4 through SW-10) were subsequently created as part of the 1997 RI activities.

The RI included four comprehensive groundwater and surface water sampling events that were conducted quarterly between August 1996 and June 1997. Ecology-directed quarterly monitoring was subsequently initiated in March 1998 using a subset of the groundwater and surface water locations established during the RI. During the first quarter of 2000, Ecology approved further streamlining of the monitoring program, which remained largely unchanged through the third quarter of 2011. As part of amended Consent Decree, the water quality monitoring program was subsequently modified to comply with the final CAP developed for the site. As detailed in Section 3.1.2, the CAP-defined water quality monitoring program includes quarterly monitoring of six (6) groundwater compliance wells and four (4) surface water sampling stations.

2.3.1 Local and Regional Hydrogeology

Near-surface geology in the vicinity of the Hansville Landfill is dominated by glacio-fluvial and glacio-lacustrine sedimentary deposits associated with the Vashon glaciation. The RI (Parametrix, 2007) identified 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). The RI references the sand unit as the site's upper aquifer, and identified this unit as outwash associated with the Vashon Drift.
- Transition Zone - This zone was encountered at several boring locations and is approximately 15 feet thick. It consists of interbedded layers of sand, silty sand, and silt, and is not areally extensive.
- Silt - This unit was reported in all the borings advanced through the upper aquifer at depths ranging from approximately 66 feet to 163 feet bgs. This unit has been interpreted to be the Kitsap Formation.

Groundwater in the immediate vicinity of the landfill property has been reported to occur within the upper sand aquifer at depths ranging between 41 to 104 feet bgs. To the west (downgradient) of the property, groundwater within the upper aquifer occurs between 7 and 45 feet bgs. The water table beneath the landfill generally ranges between 250 and 265 feet above mean sea level (msl).

Groundwater flow in the upper aquifer in the vicinity of the Hansville Landfill has been consistently reported to be towards the west-southwest. The 2007 RI noted that groundwater from the upper aquifer discharges into the headwaters of several small, perennial creeks immediately west (downgradient) of the landfill. Within the deeper hydrologic unit, the dense silts reported for the Kitsap Formation have a relatively low hydraulic conductivity, restricting vertical movement of groundwater through the formation.

2.3.2 Groundwater Quality

Groundwater immediately adjacent to and downgradient of the closed landfill contains volatile organic compounds (VOCs), trace metals, and general water quality parameters at concentrations above state standards or risk-based levels. The extent of groundwater contamination is primarily

coincident with areas located immediately downgradient (west) of the landfill within the property boundary.

During the RI, arsenic, bis(2-ethylhexyl)phthalate, copper, lead, manganese, nickel, nitrate, silver, vinyl chloride, and zinc were reported in groundwater at concentrations that exceeded their initial site screening criteria. These screening level exceedances were largely restricted to the upper aquifer (i.e., the sandy horizons situated above the upper Kitsap Formation silts). Based on the risk evaluations completed as part of the subsequent FS, vinyl chloride, dissolved arsenic, and dissolved manganese were identified as the groundwater COCs for the site.

Between the 1996 RI and 2011 (the effective date of the final CAP) the observed concentrations of most of the groundwater COCs have decreased significantly. Vinyl chloride and manganese in the upper aquifer were found at their highest concentrations adjacent to the waste disposal areas at the landfill. Vinyl chloride, which was initially reported during the RI at 10 to 11 µg/L in near-landfill wells MW-6 and MW-14, and at 3.8 µg/L in downgradient well MW-12I, was reduced to less than 0.3 µg/L in all of these wells by the third quarter of 2011. The most elevated manganese levels, which have historically been observed in MW-14, decreased from 12 to 3.0 mg/L at this location. Manganese concentrations also diminished in MW-6 (from 6 to 0.51 mg/L). In addition, arsenic levels have also been observed to decrease over time, but at a slower rate. Between 2007 and 2016, arsenic concentrations in the most impacted downgradient well (MW-14) have gradually declined from approximately 0.03 mg/L to 0.015 mg/L (an approximately 50 percent decrease). Time series plots since 2007 for the groundwater COCs are provided in Appendix C.

Although the highest detected concentrations of arsenic occur immediately adjacent to the disposal areas, arsenic also occurs naturally in the upper aquifer. Concentrations of these chemicals decrease downgradient, to the west and southwest, and beyond the property boundary, where groundwater from the upper aquifer and discharges to surface water.

2.3.3 Surface Water Quality

Groundwater from the upper aquifer that is hydraulically downgradient (west) of the Hansville Landfill property contributes to seep discharges at the heads of several small creeks that originate within the Protection Area, including Middle Creek and its tributaries, Creek B, and possibly Creek A. Exceedances of initial RI screening criteria were reported in these seep discharges for arsenic, copper, vinyl chloride, and zinc. Subsequent risk evaluations identified vinyl chloride and dissolved arsenic as surface water COCs. The approximate borders of the Tribal Lands Protection Area are illustrated on Figure 2.

Vinyl chloride was initially reported during the RI at SW-1 (head of main Middle Creek tributary) and SW-4 (headwaters of Middle Creek north tributary) at 0.48 µg/L and 0.26 µg/L, respectively. Since this time however, vinyl chloride levels at the surface water monitoring stations decreased significantly through 2007, after which vinyl chloride was only detected a single time (0.032 µg/L in SW-1 during July 2013) in any of the surface water samples. Only one other significant vinyl chloride detection (0.022 µg/L at SW-04 during April 2007) has been reported in surface water since 2007. Both detections were considered anomalous and were not repeated during the next sampling event. Manganese and arsenic concentrations in surface water

have generally remained stable over this period. Time series plots for surface water COCs are provided in Appendix D.

2.3.4 Landfill Gas

As previously noted, landfill closure construction included the installation of a passive LFG collection system, which was subsequently converted to an active gas extraction and flaring system in 1991. Additional modifications to the LFG system were completed in 1994 to separate the perimeter extraction well (soil gas) flow from the in-refuse LFG extraction well and trench flow. The perimeter soil gas extraction system ceased full time operation in 1995 (Parametrix, 2011). Between 1991 and 1996, a total of seven LFG probes were installed (GP-1 through GP-7, with GP-2 a triple completion) to monitor LFG migration. The probes were placed in the native soils around the perimeter of the property to a depth approximately equal to the depth of refuse. The LFG control system layout is shown on Figure 3.

A downsized flare was installed in 2003 to handle the decreased volume of LFG generated at the landfill. In November 2006, system piping was upgraded from aboveground polyvinyl chloride (PVC) to below ground HDPE pipe within the solid waste disposal area and demolition footprint areas. During November 2013, the primary and backup blowers were replaced with a pair of new, 1.0 horsepower, high-efficiency blowers to improve the performance of the LFG system. Additional upgrades were completed during December 2014 at five LFG extraction wellheads (R-3, R-6, R11, R-12 and T-7) which included the installation of improved orifice plates and sampling ports.

At the 1991 startup of the LFG control system, methane concentrations up to 70 percent (by volume) were observed within the extraction field, and perimeter LFG probes reported methane levels approaching 20 percent (by volume). However, methane levels decreased dramatically within the first 12 months of system operation. Since this startup period, methane has generally not been detected at the perimeter LFG probes. None of the probes currently monitored have reported levels of landfill gas components in excess of regulatory standards.

2.4 REMEDIAL MEASURES

As part of the RI/FS process, risk assessments were conducted to evaluate the potential impacts to human health and the environment in the vicinity of the Hansville Landfill. The risk evaluations completed for the site identified potential source areas of hazardous substances, indicator hazardous substances, potential exposure pathways, and ecological receptors, and evaluated the potential exposures. An initial screening level risk assessment (Parametrix, 1999) identified four chemicals (arsenic, vinyl chloride, manganese and nitrate) for further evaluation in the subsequent RI/FS based on their potential risk to people who may drink the groundwater. The 1999 screening level human health and ecological risk evaluations did not identify any chemicals that required further consideration pertaining to either surface water or site sediments.

As previously noted, the 2007 RI identified vinyl chloride and dissolved arsenic as primary site COCs for both groundwater and surface water. In addition, the final environmental risk assessment, which was completed as part of the 2009 FS, also identified dissolved manganese in groundwater as a site COC. The principal exposure route of concern was determined to be

human ingestion of impacted groundwater from shallow aquifer wells or surface seeps. Groundwater associated with deeper aquifers (below the Kitsap Formation) was not associated with any human health or ecological risks. The results also indicated that the site-related chemicals in the shallow emergent groundwater pose a negligible risk of adverse effects to ecological receptors in the aquatic and terrestrial habitat downgradient of the site. No complete exposure pathways to potentially contaminated subsurface soil or sediments were identified.

The feasibility of seven cleanup alternatives was evaluated during the RI/FS process. The remedial alternative selected for implementation at the Hansville Landfill was Natural Attenuation of Groundwater with Enhanced Monitoring and Institutional Controls. The cleanup actions associated with the selected site remedy are summarized in the following sections.

2.4.1 Cleanup Actions

The cleanup actions selected for the Hansville Landfill are defined in the 2011 CAP and specified the following components:

- Continued performance of landfill post-closure care activities, including maintenance of the existing landfill cap, operation of the LFG collection and flaring system and upkeep of the stormwater management infrastructure.
- Monitored natural attenuation.
- Implementation of the Compliance Monitoring Plan (SCS, 2011).
- Institutional controls.

2.4.2 Existing Control Systems and Post Closure Care Activities

The existing source control and containment systems that continue to be operated and maintained as part of the post-closure care activities for the site include:

- An impermeable cap, including a 50-mil HDPE liner, over the municipal solid waste, CDL and septage lagoon disposal cells to reduce precipitation infiltration and any associated leachate generation.
- Stormwater runoff diversion and control structures to reduce precipitation infiltration and leachate generation.
- A landfill gas extraction and flaring system (Figure 3).

2.4.3 Monitored Natural Attenuation

The selected cleanup alternative relies upon source control and natural attenuation processes to achieve site cleanup levels. Source control measures include containment resulting from installation, operation and maintenance of the impermeable landfill cover, landfill gas extraction and maintenance of stormwater controls. Implementation of these source control measures has reduced impacts to groundwater beneath the site. With these reductions, it is expected that natural attenuation by physical, biological and chemical processes will reduce the concentration of chemicals downgradient of the landfill over time.

Natural attenuation has been shown to effectively reduce the concentrations of inorganic and organic contaminants in groundwater at landfills and other contaminated sites.

2.4.4 Compliance Monitoring Plan

A critical element of the remedial action is an environmental monitoring program designed to assess the progress toward achievement of cleanup standards. The compliance monitoring being conducted under the Hansville Landfill CAP is defined in the 2011 CMP. Key components of the CMP include groundwater monitoring locations, water quality parameters to be tested, and monitoring frequency. The Hansville Landfill CMP includes a Sampling and Analysis Plan and Quality Assurance Plan as appendices (SCS, 2011) that meet the requirements specified under WAC 173-340-820 and -830.

Environmental monitoring at the Hansville Landfill is currently being conducted in accordance with the CMP.

2.4.5 Institutional Controls

Institutional controls currently in place due to the site's status as a closed municipal solid waste landfill include:

- Signage to identify the presence of the landfill.
- Access restrictions – localized fencing, locked gates on roadways, and perimeter berms to restrict vehicles and trespassers.
- Restrictions on the use of the landfill surface.
- Restrictions on the extraction and use of groundwater from the landfill property and Tribal Lands within the downgradient Protection Area.
- Deed notification regarding the presence of the landfill.
- Financial assurance for post-closure operation and maintenance costs.
- Existing regulatory prohibitions on installing water supply wells within 1,000 feet of the waste management unit boundaries of a solid waste landfill.

2.4.6 Cleanup Standards

As previously noted, the Hansville Landfill CAP identifies arsenic and vinyl chloride in groundwater and surface water as the primary site COCs. Manganese was also identified as an additional groundwater COC. The table below summarizes the final site-specific cleanup levels that have been approved by Ecology for the site.

FINAL SITE CLEANUP LEVELS – HANSVILLE LANDFILL REMEDY [1]			
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

[1] As referenced in Section 5.3 in the June 2011 Cleanup Action Plan.

The point of compliance for groundwater is the point or points where the established groundwater cleanup levels must be attained for a site to be in compliance with the cleanup standards. Ecology established the following conditional points of compliance (CPOC) for the Hansville Landfill site:

1. The Upper Aquifer at the landfill property boundary.
2. The Upper Aquifer downgradient of the landfill property boundary and upgradient of the creek headwaters on Tribal property.
3. Groundwater discharge to surface water at the headwaters of Creek A, Creek B, and Middle Creek on Tribal Lands (i.e., the Protection Area).

CPOC #1 was established in accordance with WAC 173-340-720(8)(c). Points of Compliance #2 and #3 are off property conditional CPOCs, per WAC 173-340-720(8)(d)(ii). The Port Gamble S'Klallam Tribe has accepted the CPOCs. As illustrated on Figure 2, these conditional points of compliance are monitored by groundwater monitoring wells (MW-5, MW-6, MW-7, MW-12I, MW-13D and MW-14) and surface water monitoring stations (SW-1, SW-4, SW-6 and SW-7).

3.0 EFFECTIVENESS OF CLEANUP ACTIONS

This section discusses the effectiveness of the engineering and institutional controls that have been implemented at Hansville Landfill.

3.1 EFFECTIVENESS OF ENGINEERING CONTROLS

This section presents an evaluation of effectiveness of the engineering controls in-place at Hansville Landfill towards achievement of the site specific cleanup standards and in limiting exposures to hazardous substances.

3.1.1 Existing Engineering Controls

As discussion in Section 2.4.2 the following engineering controls have been implemented at OVSL:

- Impermeable cap over the three waste disposal cells to reduce precipitation infiltration and any associated leachate generation;
- Stormwater runoff diversion and control structures to reduce precipitation infiltration and leachate generation;
- Landfill gas extraction and treatment system.

3.1.2 Effectiveness of Existing Engineering Controls

The effectiveness of the existing engineering controls was evaluated based on the results of ongoing inspection, maintenance and monitoring of the condition and performance of the various engineering controls at Hansville Landfill. Inspection and maintenance data considered the results of inspection and maintenance of the landfill cover and stormwater collection and conveyance systems. Immediately after the issuance of the amended Consent Decree, SCS conducted an engineering inspection of the landfill site closure and remediation systems (SCS, August 2011). The inspection included the landfill cover and cap vegetation, the stormwater drainage channels and pond, the LFG control system (including extraction wells, surface piping, perimeter probes and blower/flare station) and the groundwater monitoring network. Other than a few minor depressions noted on the edges of the landfill cap, several short sections of LFG piping that were worn (and recommended for repair/replacement), and minor clearing of vegetation in the stormwater pond, the existing engineering controls were observed to be functional and in reasonable condition.

The review of monitoring data included an evaluation of LFG system operations and gas quality monitoring data, as well as groundwater quality monitoring results obtained from the site. LFG monitoring includes operational monitoring of the LFG collection system metrics (flow, blower/well vacuums, methane production, and balance gas levels) and compliance monitoring of LFG probes (for methane, carbon dioxide and depressed oxygen) situated immediately outside the landfill mass to detect potential LFG migration.

Water quality monitoring at the site is conducted quarterly at six groundwater monitoring wells situated along the landfill perimeter and on downgradient locations in the Protection Area. In addition, surface water monitoring is performed quarterly at four surface water sampling stations located in the drainage headwaters within the Protection Area. Groundwater monitoring data are compared to the cleanup standards established in the CAP for arsenic, manganese and vinyl chloride. Surface water data are compared to CAP-defined cleanup standards for arsenic and vinyl chloride. Temporal trends for arsenic and vinyl chloride in groundwater are reviewed on both a quarterly and annual basis. Results of the LFG and water quality monitoring are presented in quarterly monitoring reports and evaluated in detail in annual monitoring reports that are provided to Ecology (SCS, 2011, 2012, 2013, 2014 and 2015).

Landfill Cover and Stormwater Collection and Conveyance System

Maintenance of the landfill cover includes implementation of weed control measures in the spring and twice yearly mowing, typically early to mid-summer and late summer. The County conducts monthly inspections of the landfill cap and surrounding area; the Kitsap Public Health District (KPHD) conducts a routine inspection of the landfill cap and associated site controls on a quarterly basis with the County representative. Additional inspections are usually performed within one week following a major storm (generally defined to be greater than 2-inches of rain in 24 hours). Any minor issues identified during such inspections are repaired immediately. More significant repairs, if needed, are performed by the County or a contractor retained by the County and the results of such activities are reported to Ecology and KPHD.

Quarterly inspection reports issued by KPHD between 2011 through 2015 indicated that the landfill cover and stormwater system engineering controls were functional over this period, and that the facility was in compliance with WAC 173-304 closure requirements. The landfill cover system remains in good condition, with no significant recent settlement or surface erosion being reported. Stormwater drainage ditches and the facility's stormwater pond were also reported to be properly maintained and in good condition. Overall, the landfill cover and stormwater collection and conveyance structures, in conjunction with ongoing maintenance, evaluation and repair being performed by the County, are effective at limiting the amount of infiltration that could otherwise contribute to leachate generation within the landfill. Copies of the KPHD inspection forms are typically included in the final appendix of the facility's annual compliance monitoring reports.

Landfill Gas Extraction System

Over the past five years, adjustments have been made to the LFG extraction system on a routine basis to help optimize gas collection. This work was primality performed by SCS and included:

- Installation of a pair of new, 1.0 horsepower, high-efficiency LFG blowers (primary and secondary units).
- Replacement of five LFG extraction wellheads (R-3, R-6, R11, R-12 and T-7) with new QED Precision Quick-Change™ wellheads, with the addition of changeable orifice plates and sample ports to improve localized monitoring of the system.
- Enlargement of the condensate drain pipe/sump below the blower units.

- Installation of a beacon light on the LFG flare tower to signal the operation status of the blower system.
- Incremental adjustment of system vacuum level on at least a quarterly basis, but monthly when needed.

Consistent with the size, age and waste types present in the disposal cells, current LFG production has declined significantly since the LFG system became operational in 1991. As previously noted, methane levels in excess of 70 percent by volume were initially reported, with flow rates of over 300 standard cubic feet per minute (scfm). As summarized on Table 1, the most recent LFG monitoring results (February 2016) for the Hansville Landfill reported methane measured concentrations between 0 and 19.4 percent by volume with significantly lower average flow (69 scfm). Current static pressure, gas balance and LFG temperature results for the landfill are consistent with those expected at the asymptotic "tail end" of a LFG generation curve. LFG generation rates at the site are expected to continue to decline.

Overall, LFG collection at the site continues to result in positive effects observed in both the perimeter gas monitoring probes and in the groundwater monitoring wells. Historically, methane has only been rarely measured in the perimeter LFG probes, and over the past five years there have been no exceedances for methane in any gas probes on site. Continued operation and enhancement of the landfill gas collection system has also contributed to improvements in the underlying and downgradient groundwater quality specifically with regard to VOC occurrences and concentrations. These improvements are discussed further in the next section.

Water Quality Monitoring Network

Overview of the Groundwater and Surface Water Monitoring

Water quality monitoring at the closed Hansville Landfill is performed in accordance with the final CAP and is reported on a quarterly basis with a comprehensive evaluation presented in annual reports prepared in conjunction with the fourth quarter monitoring results. The groundwater and surface water monitoring networks present at the property are as follows:

- Groundwater: One (1) upgradient monitoring well (MW-5) and five (5) downgradient monitoring wells (MW-6, MW-7, MW-12I, MW-13D and MW-14).
- Surface Water: Four (4) monitoring stations (SW-1, SW-4, SW-6 and SW-7).

The following water quality parameters are included in the quarterly analysis for both groundwater and surface water: field parameters (pH, conductivity, dissolved oxygen, redox and temperature), arsenic, manganese, chloride, ammonia, nitrate, nitrite, bicarbonate, carbonate, alkalinity, sulfate, total organic carbon (TOC), orthophosphate, and vinyl chloride (by SIM). A full EPA method 8260 scan for VOCs is also conducted annually. Depth to water measurements are also recorded for the monitoring wells on a quarterly basis for the calculation of groundwater flow and direction.

Current and 5-Year Compliance Summary

The 2015 statistical evaluation (Table 2), using the most recent data set reporting COC means, upper confidence limits (UCL) and lower confidence limits (LCL) for arsenic and vinyl chloride, indicates that three groundwater monitoring wells continue to exceed the CAP-established cleanup standards for these analytes. Wells MW-6, MW-12I and MW-14 all continue to exceed the 0.025 µg/L vinyl chloride standard. Well MW-14 also continues to exceed the 0.005 mg/L arsenic standard. Although manganese is not statistically evaluated under the CAP, over the past five years this parameter has routinely been reported in MW-14 at concentrations ranging between 2.2 and 2.8 mg/L, often in excess of the of the 2.24 mg/L site specific cleanup standard.

Comparison of the 2015 groundwater monitoring results to the cleanup levels shown on Table 2 have been performed for each of the prior four years. Results of these evaluations are presented in the prior annual monitoring reports (SCS, 2011, 2012, 2013, and 2014). Tables 3 through 5 present a summary of the most recent groundwater and surface water monitoring results (February 2016). As shown by these tables, MW-5, MW-7, and MW-13, as well as all of the surface water sampling locations (SW-1, SW-4, SW-6 and SW-7), meet the CAP-defined site cleanup levels.

VOC concentrations in groundwater continue to diminish at the site with only vinyl chloride persisting above its cleanup level (in MW-6, MW-12I and MW-14). However, vinyl chloride concentrations in these wells are decreasing, and the trend of improving water quality specific to this parameter is anticipated to continue. Some uncertainty with regard to achieving the water quality criteria for arsenic and manganese remains given the natural geochemical environment present at the facility. This concern is discussed in greater detail at the conclusion of this section.

Trend Analysis

In addition to evaluation of the concentrations of the COCs for which cleanup standards were established in the CAP, temporal trends for arsenic and vinyl chloride are also routinely evaluated to assess the effectiveness of the site engineering controls. Over the past nine years (2007 through 2015, the period for which analytically comparable parameter test results are available), decreasing or stable parameter trends have consistently been observed for the site COCs.

As illustrated by the time series plots included in Appendix C, vinyl chloride levels in the three wells that continue to exceed the 0.025 µg/L vinyl chloride cleanup standard all show a declining attenuation curve. In addition, statistically significant, decreasing, Mann-Kendall and Sens Slope trends are reported for vinyl chloride in MW-14. A less pronounced decreasing trend can also be discerned for arsenic in MW-14. However, a statistically significant, decreasing Mann-Kendall or Sens Slope arsenic trend has not been reported at this location. Overall, these results are consistent with the ongoing, gradual improvement in groundwater quality at the site.

As previously noted, manganese concentrations in excess of the 2.24 mg/L cleanup standard have been consistently reported at the downgradient edge of the landfall in MW-14 over that past five years. These results have generally ranged between 2.2 and 2.8 mg/L, with no discernable temporal trend. It is suspected that the manganese levels observed in this well may be

attributable to the reducing geochemical environment that immediately surrounds the closed waste disposal cell.

Summary of CAP Effectiveness

The past five years of groundwater monitoring data indicates that impacts to groundwater continue to decline across the site. For the three groundwater monitoring wells that continue to report arsenic and/or vinyl chloride exceedances, all show downward trends for these parameters going back to 2007. In addition, substantially higher contaminant concentrations were initially reported in both groundwater and surface water immediately following the 1991 landfill closure. Combined with the observation that since August 2011 (the date of the Amended Consent Decree) no exceedances of the CAP-defined cleanup standards have been reported at any of the Protection Area surface water monitoring stations, these results support the conclusion that the remedial remedy being implemented at the Hansville Landfill is effectively mitigating the environmental impacts of the landfill.

Similarly, the occurrence of only a single VOC (i.e., vinyl chloride) above a site cleanup standard in site groundwater, as well as the decreasing concentrations of this parameter indicates that: (1) mitigation controls at the site (landfill capping, leachate minimization, LFG extraction, etc.) have been effective; and (2) reductive dechlorination is an active natural attenuation process in the groundwater system beneath the site. The nature and extent of vinyl chloride in groundwater should continue to diminish as a result of mitigation measures in place, as well as the continued natural attenuation processes in the groundwater system.

Redox Sensitive Inorganic Parameters

The presence of arsenic and manganese at concentrations greater than the CAP-defined cleanup standards may in large part be a reflection of the actual background levels of these constituents in the site groundwater. It is apparent that groundwater conditions change naturally across the landfill site from upgradient to downgradient locations. Although the concentrations of redox sensitive inorganic parameters have generally deceased since landfill closure it is possible that they may never reach background or ambient levels.

The groundwater geochemistry, and distribution and mobility of certain redox sensitive inorganic constituents, are influenced by the exposure to naturally occurring or anthropogenic organic material (i.e., wetland sediments or unlined solid waste cells, respectively). Shallow groundwater immediately east (upgradient) of the Hansville Landfill site is subject to a geochemically oxidizing (i.e., aerobic) environment due to the percolation of recharge water with high dissolved oxygen. As the groundwater flows westward, the amount of recharge decreases (due to the presence of the landfill cap) and oxygen is consumed by aerobic microbial conditions. At the downgradient margins of the site, reduced (i.e., anaerobic) geochemical conditions prevail. Under reducing conditions observed downgradient of the site, and in the presence of anaerobic microbial consortiums (including iron reducing bacteria), the concentrations of soil-bound metals, such as arsenic, manganese and iron may be naturally elevated. These reducing conditions persist as groundwater moves through the discharge zone within the downgradient Protection Area. Natural recharge within this wooded area contributes to restoring the background groundwater geochemical environment.

As a result, it may eventually become necessary to reconsider the use of background parameter concentrations for these redox sensitive parameters for wells situated immediately adjacent to WAC 173-304 closed waste disposal cells that lack an impermeable bottom liner. The elevated arsenic and manganese levels observed in monitoring well MW-14 may be attributable to this precise circumstance.

Natural Attenuation

Natural attenuation has been demonstrated to be effective at sites with the following characteristics:

- Source control is concurrently and effectively applied.
- Human health and the environment are protected.
- Site-specific remediation objectives can be achieved in a reasonable timeframe.
- Migration of contaminants in groundwater is limited.
- Transformation of contaminants into more mobile or more toxic substances is unlikely.
- Transformation processes are irreversible.
- Appropriate monitoring is conducted and data are evaluated to ensure the natural attenuation process is taking place.
- Backup or contingency plans are available.

Source control is concurrently being effectively applied through implementation of the various engineering controls described above including the presence and maintenance of the landfill cover, the stormwater collection and conveyance system, and the landfill gas collection system. Ecology previously determined that humans and the environment are not currently being exposed to site chemicals and therefore human health and the environment are protected.

The declines in the extent and concentrations of vinyl chloride in groundwater discussed above support the conclusion that remediation objectives are expected to be achieved in a reasonable time frame. Migration of chemicals in groundwater is limited and the extent of organic chemical occurrences in groundwater has declined. The more gradual declines in the extent and concentrations of arsenic and manganese suggest that the mobilization of these trace metals may be more directly attributable to the reducing groundwater conditions present in the immediate vicinity of the landfill. As a result, attenuation processes for these naturally occurring metals can be expected to remain slow in and around the waste cells, with natural attenuation becoming more pronounced once the shallow groundwater moves beyond the landfill's reductive zone into a more aerobic and/or oxidized hydrological environment. Under these conditions, trace metals previously mobilized from the native soils surrounding the landfill can then naturally transform to less soluble species.

Vinyl chloride has been identified in groundwater at many of the MSW facilities historically closed in the United States. Most of these occurrences are attributed to the formation of vinyl chloride through the reductive dechlorination of chemical precursors such as perchloroethene (PCE) or trichloroethene (TCE), which in turn can be leached from certain types of refuse (such

as old plastic scrap or spent paint/chemical containers). This process requires anaerobic and/or reducing environmental conditions, both which are commonly present in and immediately around MSW landfills. Once formed, vinyl chloride is generally stable under anaerobic conditions. However, when exposed to aerobic conditions, vinyl chloride is actively consumed by native soil microorganisms, resulting in non-toxic constituents such as acetate, ethane, and carbon dioxide. This natural attenuation process is irreversible. (ITRC, 1999). As a result, vinyl chloride concentrations often decline significantly once the affected groundwater migrates beyond the reductive (or anaerobic) zone associated with the landfill.

An appropriate groundwater monitoring program has been developed and implemented for the site. Implementation of this monitoring network has provided data necessary to evaluate declines in organic chemical occurrence and concentrations and the progress towards achievement of the cleanup standards.

3.2 EXISTING INSTITUTIONAL CONTROLS

This section presents an evaluation of the effectiveness of the existing institutional controls in-place at Hansville Landfill in limiting exposures to hazardous substances. Under MTCA, institutional controls can include physical barriers (such as fences or gated roadways), the posting of warning signs or notices, prohibitions on site disturbances, land use restrictions on property or resource use; and/or maintenance requirements for site engineering controls or monitoring systems.

Existing institutional controls for the Hansville Landfill site are defined in the Restrictive (Environmental) Covenant that was granted by Kitsap County to Ecology and is attached as Appendix D to the site's 2011 Consent Decree. Additional institutional controls are also defined in the Settlement Agreement (April 2007) between the Port Gamble S'Klallam Tribe and Kitsap County/WMW pertaining to the Protection Area situated on Tribal Lands that lie immediately to the west of the Hansville Landfill (Figure 2).

3.2.1 Land Use Restrictions

Controls on land use at the Hansville Landfill consist of physical barriers (site access restrictions to isolate site hazards from potential receptors and to protect the integrity of the landfill cap, stormwater drainage and LFG control systems) and legal restrictions.

Physical barriers include signage to identify the presence of the closed landfill and fencing, gates, berms and other barricades on the surrounding portions of the property. Although the entire perimeter of the property has not been fenced, the entrance road to the landfill is secured by a fenced gate, and both the LFG blower/flare station and the stormwater pond are fully surrounded by steel fencing. The landfill engineering controls, stormwater conveyances and LFG management systems are regularly inspected and maintained to ensure their continued integrity and effectiveness.

Historically, physical controls on site access have only been partially effective as sporadic trespassing and minor vandalism has occurred at the property. Trespassing primarily consisted of off-road vehicle use on non-landfill related portions of the property. Occurrences of

trespassing were identified by ruts and tracks from off-road vehicles, and the presence of bottles, cans and trash. Kitsap County is currently evaluating additional site controls (trail blockage, signage, improved Tribal enforcement, etc.) that can be implemented to further restrict access to the site by the general public. However, none of the trespassing identified to date has been reported to have materially impacted any of the engineering controls being implemented at the property.

The environmental covenant states that the property contains three former landfill units with engineered caps. The covenant restricts the use of groundwater from the property and prohibits any activities on the property that may result in a release or exposure to the environment of the waste contained in the closed landfill, may interfere with the integrity of the Remedial Action and continued protection of human health and the environment, or that may result in the release or exposure to the environment of a hazardous substance that remains on the property or create a new exposure pathway. Legal restrictions specified by the covenant include:

- Any activity on the property that may interfere with the integrity of the remedial action and continued protection of human health and the environment is prohibited.
- Any activity on the property that may result in the release or exposure to the environment of a hazardous substance that remains on the Property as part of the remedial action, or create a new exposure pathway, is prohibited without prior written approval from Ecology.
- The owner of the property must give thirty (30) days advance written notice to Ecology of the owner's intent to convey any interest in the property.
- The owner must restrict leases to uses and activities consistent with the covenant and notify all lessees of the restrictions on the use of the property.
- The Owner must notify and obtain approval from Ecology prior to any use of the property that is inconsistent with the terms of the covenant.

The Settlement Agreement with the Port Gamble S'Klallam Tribe also defines a specific series of land use restrictions covering the Tribal Lands located within the defined Protection Area. In addition to prohibitions on surface and groundwater use, the agreement prohibits any surface disturbances in the Protection Area that would disturb any of the water quality sampling locations and/or change the local hydrology of the area. However, this document also states that Tribal members may continue to access the Protection Area for recreational and other activities (such as the gathering of plants for traditional and medicinal uses) provided that such activities do not include any of the restricted uses identified in the agreement, or that may be imposed by Ecology.

No changes in land use have occurred during the five-year period from 2011 through 2015. The existing covenants and restrictions on land use all remain in-place.

3.2.2 Groundwater Use Restrictions

The environmental covenant granted by Kitsap County to Ecology contains restrictions on the use of groundwater from the site. Per Section 1 of this document "No groundwater may be taken from the property for domestic, agricultural or industrial use except for collection of

samples from monitoring wells or maintenance activities or as otherwise provided for in the Consent Decree and Cleanup Action Plan". A prohibition on the use of surface waters and shallow aquifer groundwater (down to the depth of the Kitsap Formation) from within the Protection Area for drinking water or agricultural purposes is also formalized in the Tribal Settlement Agreement. In addition, existing solid waste regulations prohibit the installation of water supply wells within 1,000 feet of the waste management unit boundaries of a solid waste landfill.

No beneficial groundwater use from these restricted sources has occurred at the Hansville Landfill site or the adjacent Protection Area during the five-year period from 2011 through 2015.

4.0 NEW SCIENTIFIC INFORMATION ON HAZARDOUS SUBSTANCES

The regulations, standards and criteria considered by Ecology for the development of the site-specific groundwater cleanup levels established for the Hansville Landfill were reviewed to identify any changes in standards or criteria that may have occurred during the past five years. Specifically, the Federal and State drinking water standards maximum contaminant levels (MCLs) (40 CFR 141 and WAC 246-290-310), MTCA Method B CLARC Database Levels, Washington Surface Water Quality Standards (WAC 173-201A-240), the National Toxics Rule (40 CFR Part 131) and the National Recommended Water Quality Criteria (Section 304 of the Clean Water Act) were reviewed for possible changes to the numerical standards or criteria since 2011 when the cleanup levels for the site were developed by Ecology.

Based on our review, no revisions were identified for the Federal or State MCLs, the Washington State Surface Water Quality Standards, or the National Toxics Rule criteria for protection of surface water. However, the MTCA Method B CLARC Database now contains values for the carcinogenic risk of 1,1-dichloroethane 1,1-dichlorobenzene and trichloroethene; and for the non-carcinogenic risks associated with 1,4-dichlorobenzene, cis-1,2-dichloroethene and trichloroethene, which had not been established at the time the CAP was prepared in 2011. In addition, the National Recommended Water Quality Criteria values for human health relative to consumption of water plus organisms and consumption of organisms were also revised downward for trichloroethene and vinyl chloride.

However, none of the aforementioned revisions are expected to materially impact the remedial actions being implemented at the Hansville Landfill.

5.0 NEW APPLICABLE STATE AND FEDERAL LAWS

The Hansville Landfill Remedy is being conducted pursuant to Amended Consent Decree No. 95-2-03005-1 issued by the Kitsap County Superior Court and filed on August 5th, 2011, consistent with provisions of the MTCA RCW 70.105D.050(1). In addition, the Hansville Landfill is subject to a current Solid Waste Landfill Post Closure Permit (covering the 2015 to 2020 permit period) issued by the KPHD. Therefore, MTCA and Solid Waste Regulations were reviewed to determine if any changes had been made to these regulations during the last five years that could affect the cleanup actions at Hansville Landfill site.

Significant changes were made to MTCA in 2013 primarily in order to speed up cleanup work and reduce impacts caused by stormwater (Ecology, 2013). Specifically, changes were made to introduce the concept of "brownfields" into MTCA and facilitate the cleanup and redevelopment of brownfields sites, to authorize Ecology to establish model remedies (standardized cleanup methods) for lower risk sites, to create a more stable and effective funding program for stormwater management by local governments and changes to Ecology's reporting and accountability requirements, and to establish changes related to the distribution, use and management of MTCA funding (Ecology 2013a, Pendowski, 2013). These changes did not change the process or standards for cleaning up contaminated sites (Pendowski, 2013). Therefore, these 2013 changes to MTCA do not affect the cleanup actions or cleanup standards being applied to Hansville Landfill.

KPHD issued a new Solid Waste Landfill Post Closure Permit to the Hansville Landfill on February 5th, 2015, pursuant to the provisions of WAC 173-304 and the Kitsap County Board of Health Ordinance 2010-1 "Solid Waste Regulations". The specific conditions noted in this permit indicate that post-closure activities to be conducted at the closed landfill shall be consistent with all requirements under MTCA and the Consent Decree, and shall be implemented, conducted, and required only after consultation with Ecology, as long as the Consent Decree is in effect. Consistent with the recent issuance of the current solid waste permit, no changes in permit conditions or KPHD specified requirements were noted during our review.

6.0 CURRENT AND PROJECTED SITE AND RESOURCE USE

This section describes the current and projected future use of the site and its attendant resources.

6.1 SITE USE

The Hansville Landfill site consists of three closed waste cells (a 13-acre MSW landfill, a four-acre CDL landfill, and a one-third acre septage lagoon fill) that are situated on a 73-acre parcel of County-owned land. These waste disposal areas are all continuing to be managed under WAC 173-304 post-closure care. Tribal Lands immediately to the west of the landfill are currently managed as a Protection Area, with certain restrictions on site resource (primarily groundwater) use.

The site is expected to remain a closed sanitary landfill that is subject to post-closure care for the foreseeable future, that is until the site-specific MTCA groundwater cleanup goals and the post-closure termination criteria for functional stability have been achieved. The County has recorded a restriction on the property deed for the County property containing the closed landfill and has also recorded an environmental covenant in favor of Ecology on the property that restricts the activities that can be conducted on the property and requires notification be submitted to Ecology prior to conveyance of any interest in the property. The County has indicated that the site use will continue to remain that of a closed municipal solid waste landfill undergoing post-closure care.

In April 2007, the Port Gamble S'Klallam Tribe entered into a Settlement Agreement with Kitsap County and WMW that places certain restrictions on land and resource use within the Protection Area situated on Tribal Lands that border the Hansville Landfill site. This agreement commits the Tribe to enforce the land use restrictions consistent with the final Consent Decree, including limiting access within the Protection Area, maintaining no trespassing signs posted by the County, and restricting groundwater use.

Surrounding properties, including Tribal Lands, situated outside of the Hansville Landfill site and adjacent Protection Area are not subject to any of the land use restrictions associated with the Consent Decree, deed restriction or environmental covenant.

6.1.1 Permit Requirements

The only permit containing conditions affecting use of the property or site resources is the solid waste post-closure permit issued by KPHD. Relative to site use, this permit specifies that the permittee (Kitsap County Public Works) shall maintain the facility structures and systems (including stormwater controls, landfill cover, LFG control and water quality monitoring infrastructure). In addition, the permit indicates that the permittee will control unauthorized access to the facility through the means of a lockable gate, barrier or fence, etc., at the property boundary (Section 1V [B.6]).

6.1.2 Land Use Restrictions

As previously noted, the use of the land on the Hansville Landfill site is restricted in accordance with the environmental covenant previously recorded against the property and by the Settlement Agreement covering the Tribal Lands Protection Area. The environmental covenant states that the remedial actions being conducted at the property, as described in the Hansville Landfill CAP (Exhibit B of the Consent Decree) are the primary subject of the covenant. The covenant restricts use of groundwater from the property and prohibits any activities on the property that may result in a release or exposure to the environment of the waste contained in the landfill cells, may interfere with the integrity of the remedial action and continued protection of human health and the environment, or that may result in the release or exposure to the environment of a hazardous substance that remains on the property or create a new exposure pathway to sensitive receptors.

The Settlement Agreement, which restricts site uses within the Protection Area that may interfere with the implementation of the CAP, provides for enforcing access limitations, the maintenance of no trespassing signs, and restrictions on groundwater use (as drinking or agricultural water). In addition, no surface disturbances shall occur within the Protection Area that would impact any of the CAP-established sampling locations, would encounter groundwater, and/or change the hydrology of the area. However, Tribal members may continue to access the Protection Area for recreational and other activities, such as the gathering of plants for traditional and medicinal uses, provided that such activities do not include the previously noted restricted site uses.

6.2 RESOURCE USE

Other than the gathering of plants by Tribal members within portions of the Tribal Lands included in the Protection Area adjacent to the Hansville Landfill property, no use of any resources have occurred at the site in the past or are anticipated to occur in the future.

6.2.1 Groundwater Use Restrictions

The environmental covenant prohibits taking of groundwater from the Hansville Landfill property for any domestic, agricultural or industrial use other than the collection of water quality samples from monitoring wells or surface water/seep monitoring stations. Relatedly, per the April 2007 Settlement Agreement, the Port Gamble S'Klallam Tribe shall enforce the restrictions on groundwater use (i.e., no drinking water or agricultural water use) within the Protection Area from the shallow aquifer system (i.e., down to the depth of the Kitsap Formation). Deeper groundwater occurring below the upper boundary of the Kitsap Formation may be still be used for any purpose; however, such groundwater may not be accessed through a production well situated within the Protection Area.

6.2.2 Other Resources

As previously indicated, the only resource located at the site that may be subject to use are plants which may be gathering by Tribal members from portions of the property outside of the area containing the landfill and associated facilities such as the stormwater pond.

7.0 AVAILIBILITY AND PRACTICALITY OF MORE PERMANENT REMEDIES

Containment is considered to be the appropriate response action for the source area of MSW landfills (EPA, 1993a and 1993b). The active treatment of solid wastes in MSW landfills is considered to be impracticable due to the size, volume and the heterogeneity of the contents of MSW landfills (EPA, 1993a and 1993b). Therefore more permanent remedies, such as treatment, are not considered to be practical for MSW landfills, such as the Hansville Landfill.

8.0 AVAILIBILITY OF IMPROVED ANALYTICAL TECHNIQUES

The analytical methods used at the time of the Hansville Landfill remedial action were capable of detection below selected Site cleanup levels. The presence of improved analytical techniques is not anticipated to affect future decisions or recommendations made for the Site.

9.0 PROPOSED ACTIONS FOR 2017 - 2021

The following section provides discussion regarding how to improve the efficiency and effectiveness of the remedial action (Natural Attenuation of Groundwater with Enhanced Monitoring and Institutional Controls) being implemented at the Hansville Landfill. As previously detailed in this report, the selected remedial action, which includes the presumptive remedy for closure of old municipal landfills (surface capping, LFG controls and stormwater management), has been demonstrated to have significantly improved groundwater and surface water quality. In addition, LFG generation rates, especially with respect to methane, have been substantially reduced since landfill closure. As a result, the continued implementation of the existing site engineering controls is recommended.

However, given the notable improvements in water quality observed at the site, optimization of the CAP-defined monitoring program should be considered. The current water quality monitoring network includes 10 locations that are sampled quarterly (6 groundwater wells and 4 surface water stations), including 6 locations situated on Tribal Lands. Quarterly sampling results between 2007 and 2015 (a total of 36 events) strongly indicate that site COCs are no longer present at a number of these locations.

As illustrated on the time series graphs attached as Appendixes C and D, site COCs are rarely (or never) reported in groundwater wells MW-5, MW-7 and MW-13D. Since 2007, vinyl chloride has not been detected in these three groundwater monitoring wells. In addition, with the exception of a single, anomalous, arsenic detection (0.025 mg/L in MW-7 during October 2010), neither arsenic nor manganese have exceeded their site specific cleanup levels in these three wells over this same period. Similarly, barring two exceptions (in SW-6 in April 2007 and SW-1 in July 2013) vinyl chloride was not detected in any of the surface water monitoring stations since 2007. These detections were considered anomalous (possibly due to low-level, field cross contamination or laboratory artifacts), as they were not repeated in subsequent sampling events. Over this same period a single arsenic exceedance (0.00556 mg/L in SW-6 during July 2011) was reported at these stations. Manganese was not reported above its site specific cleanup standard in any of the surface water stations over this same period.

Water Quality Monitoring Frequency:

Given the volume of the historical quarterly data, the documented historical decline of COC levels and the stable site geochemistry, a strong argument can be made for reducing the water quality monitoring frequency to a semi-annual basis. This is particularly applicable for monitoring wells MW-5, MW-7 and MW-13D, and for all the surface water sampling stations (SW-1, SW-4, SW-6 and SW-7). It is recommended that these locations be gradually reduced to a semi-annual monitoring schedule over the next five year (2017 to 2021) period.

The gradual reduction of site wide quarterly monitoring is envisioned to be implemented as follows:

- Continuation of the current quarterly monitoring program at six groundwater wells and four surface monitoring stations for two additional years (through 2018).

- Assuming the trends in site COC concentrations continue during the initial two year period, selected monitoring locations (including MW-5, MW-7, MW-13D and all four surface sampling stations) will be monitored on a semiannual basis (i.e., the wet and dry seasons) beginning in 2019. Given the vegetative obstructions and unstable terrain that surround the surface water monitoring stations, it will remain important to regularly maintain safe access to these locations.

- The remaining monitoring locations (MW-6, MW-12I and MW-14) will continue to be sampled on a quarterly basis.

- Should an exceedance of a site COC be reported at one of the semi-annual sampling locations, that well/station will be resampled as part of the following scheduled monitoring quarter. If the result is confirmed, this well/station can be returned to the quarterly monitoring schedule.

The existing site data and the demonstrated COC trends support optimizing the monitoring program. The optimized program can be readily implemented without compromising the selected remedial action for the site. In addition to regular data review during the monitoring program, the reduced sampling frequency will be specifically re-evaluated at the conclusion of the second five year MTCA review cycle (2021).

10.0 REFERENCES

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Appendix A

Site Figures

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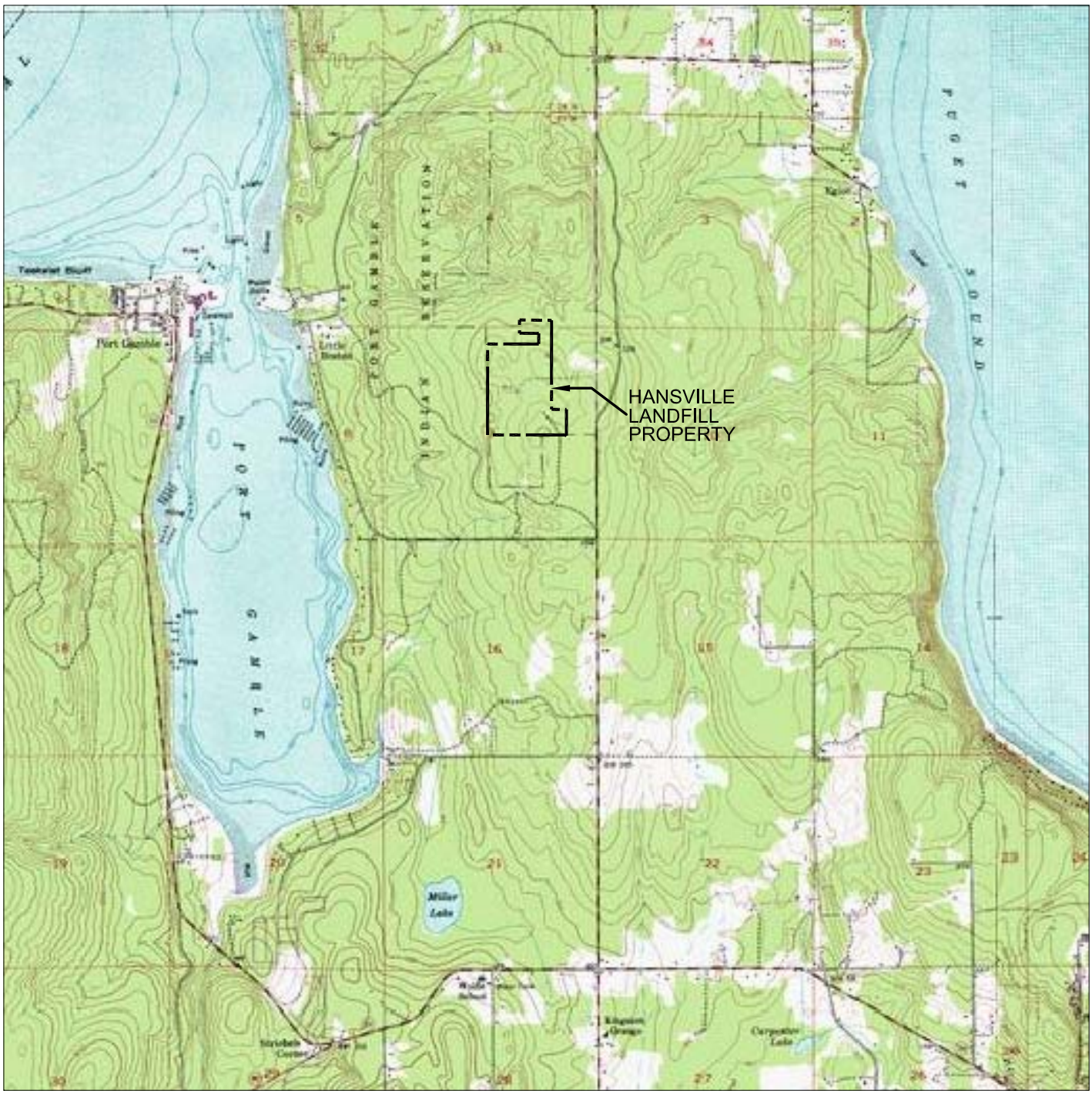

SOURCE: USGS

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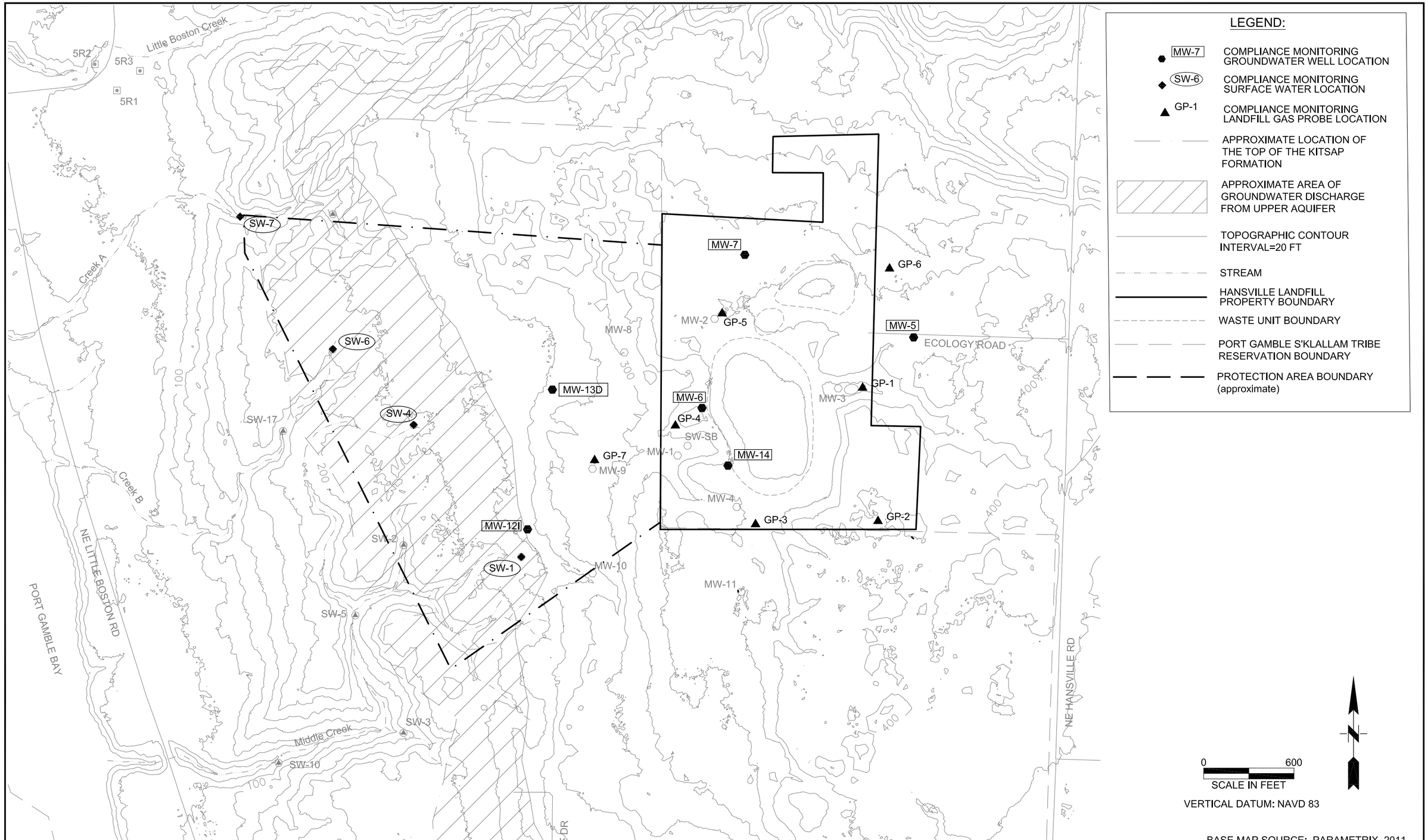
PROJECT NO. 04211017.05	DES BY L.L.
SCALE NA	CHK BY D.V.
CAD FILE FIGURE 1	APP BY G.H.

LANDFILL PROPERTY LOCATION MAP

HANSVILLE LANDFILL SITE
KITSAP COUNTY, WASHINGTON

DATE APRIL 2016

FIGURE 1



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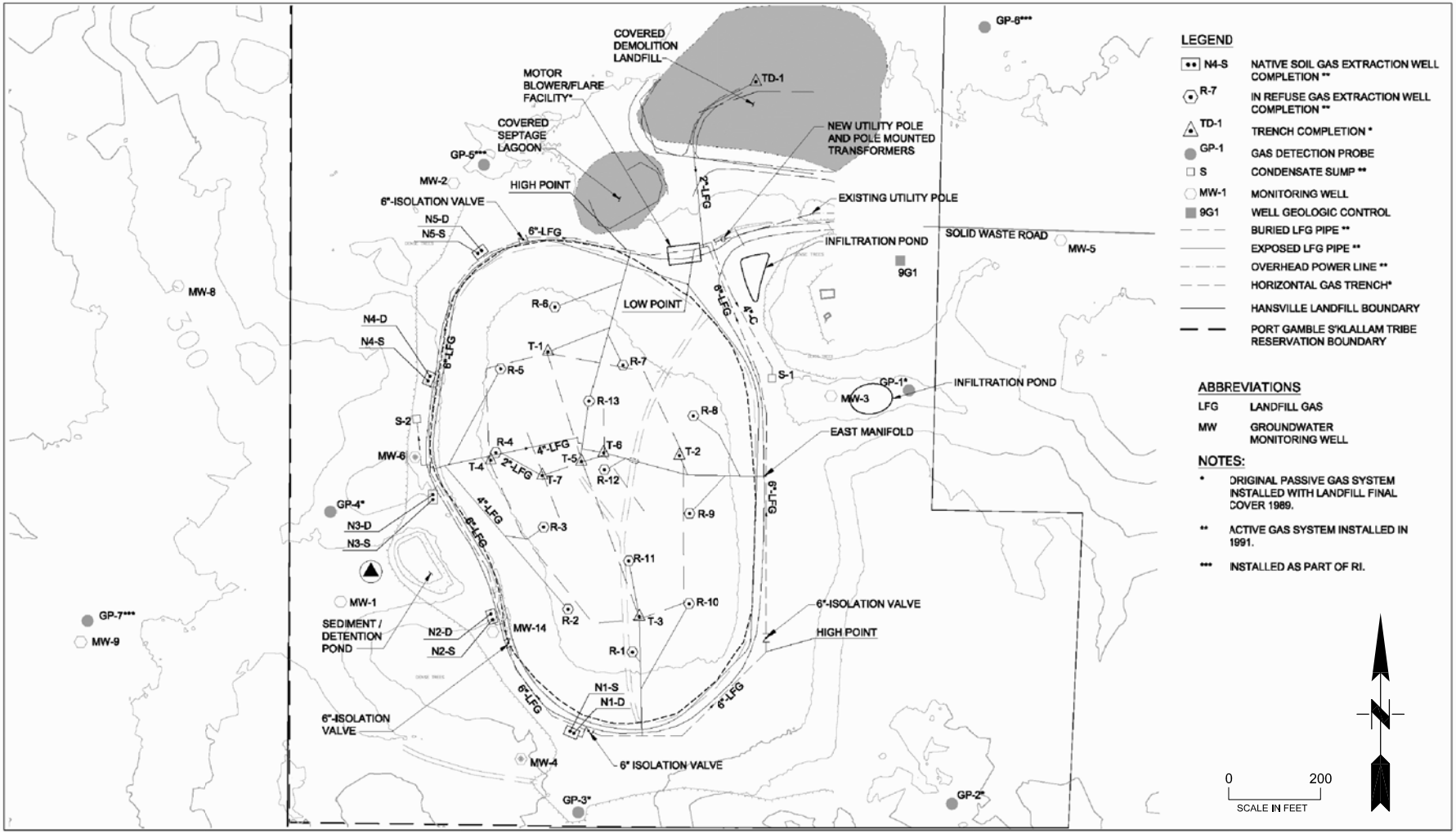
PROJECT NO. 042110017.05	DES BY L.L.	COMPLIANCE MONITORING LOCATIONS HANSVILLE LANDFILL KITSAP COUNTY, WASHINGTON	DATE APRIL 2016
SCALE AS SHOWN	CHK BY D.V.		FIGURE 2
CAD FILE FIGURE 2	APP BY G.H.		



BASE MAP SOURCE: PARAMETRIX, 2004

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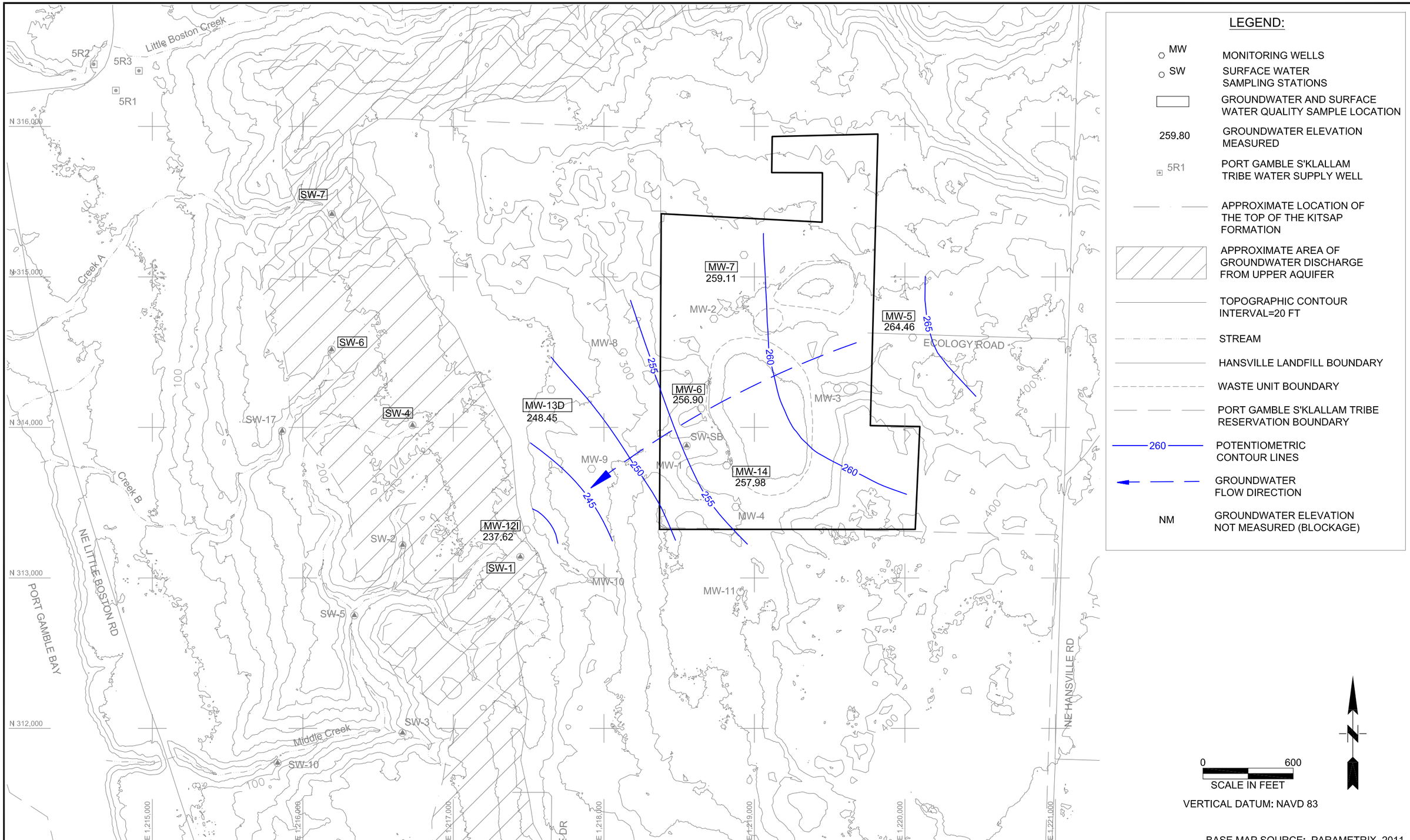
PROJECT NO.	DES BY
04211017.05	L.L
SCALE	CHK BY
AS SHOWN	D.V.
CAD FILE	APP BY
FIGURE 3	G.H.

LANDFILL GAS SYSTEM & PROBE LOCATIONS

HANSVILLE LANDFILL
KITSAP COUNTY, WASHINGTON

DATE APRIL 2016

FIGURE 3



LEGEND:

- MW — MONITORING WELLS
- SW — SURFACE WATER SAMPLING STATIONS
- GROUNDWATER AND SURFACE WATER QUALITY SAMPLE LOCATION
- 259.80 — GROUNDWATER ELEVATION MEASURED
- 5R1 — PORT GAMBLE S'KLALLAM TRIBE WATER SUPPLY WELL
- APPROXIMATE LOCATION OF THE TOP OF THE KITSAP FORMATION
- APPROXIMATE AREA OF GROUNDWATER DISCHARGE FROM UPPER AQUIFER
- TOPOGRAPHIC CONTOUR INTERVAL=20 FT
- STREAM
- HANSVILLE LANDFILL BOUNDARY
- WASTE UNIT BOUNDARY
- PORT GAMBLE S'KLALLAM TRIBE RESERVATION BOUNDARY
- 260 — POTENTIOMETRIC CONTOUR LINES
- GROUNDWATER FLOW DIRECTION
- NM — GROUNDWATER ELEVATION NOT MEASURED (BLOCKAGE)

0 600
SCALE IN FEET

VERTICAL DATUM: NAVD 83

BASE MAP SOURCE: PARAMETRIX, 2011

SCS ENGINEERS
Environmental Consultants and Contractors
2405 140th Avenue NE, Suite 107
Bellevue, Washington 98005
(425) 746-4600 FAX: (425) 746-6747

PROJECT NO. 042110017.05	DES BY L.L.	UPPER AQUIFER GROUNDWATER CONTOURS JANUARY 6, 2016	DATE FEB 2016
SCALE AS SHOWN	CHK BY D.V.	HANSVILLE LANDFILL KITSAP COUNTY, WASHINGTON	FIGURE 4
CAD FILE FIGURE 4	APP BY G.H.		

Appendix B

Summary Tables

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Table 1. Landfill Gas, First Quarter 2016 Monitoring Results
Hansville Landfill, Kitsap County, Washington

Point Name	Record Date	CH4%	CO2%	O2%	Bal Gas%	Init Temp (F)	Adj Temp (F)	MaxInitAdj Temp	Init Static Pressure ("H2O)	Adj Static Pressure ("H20)	MaxStatic Pressure	Init Flow (scfm)	Comments
Blower Inlet	2/18/2016 8:52	5.6	8.6	8.5	77.3	44	44	44	-1.2	-1.2	-1.2	67	No Change
Blower Outlet	2/18/2016 8:55	7.1	10.5	5.9	76.5	68	72	72	0.1	-0.1	0.1	71	No Change
Extraction Well 001	2/18/2016 8:18	6	8.8	4.9	80.3	44	44	44	-0.5	-0.5	-0.5	2	No Change
Extraction Well 002	2/18/2016 8:15	2.3	6.6	12.8	78.3	44	44	44	-1.2	-1.2	-1.2	3	No Change
Extraction Well 003	2/18/2016 8:13	16.1	10.4	0	73.5	48	49	49	-0.6	-0.7	-0.6	1	No Change
Extraction Well 004	2/18/2016 8:07	2.4	4.4	15.1	78.1	42	42	42	-1.1	-1.2	-1.1	3	No Change
Extraction Well 005	2/18/2016 7:45	4.5	9.4	8.4	77.7	44	44	44	-1.2	-1.1	-1.1	3	No Change
Extraction Well 006	2/18/2016 7:42	1.4	2	18.2	78.4	43	43	43	-0.4	-0.4	-0.4		No Change
Extraction Well 007	2/18/2016 7:38	0	0.2	20.9	78.9	44	44	44	-0.3	-0.3	-0.3	2	No Change
Extraction Well 008	2/18/2016 7:30	0.2	0.7	20.3	78.8	46	46	46	-0.2	-0.2	-0.2	1	No Change
Extraction Well 009	2/18/2016 7:52	4.8	12	5	78.2	46	46	46	-0.4	-0.4	-0.4	3	No Change
Extraction Well 010	2/18/2016 8:23	6.1	8.8	4.9	80.2	44	44	44	-0.6	-0.6	-0.6	2	No Change
Extraction Well 011	2/18/2016 8:26	0.8	2	17.5	79.7	43	43	43	-0.5	-0.5	-0.5		No Change
Extraction Well 012	2/18/2016 8:00	11.2	3.8	2	83	44	43	44	-0.4	-0.4	-0.4		No Change
Extraction Well 013	2/18/2016 7:50	4.2	9.2	5.4	81.2	47	47	47	-0.5	-0.6	-0.5	2	No Change
Native Soil Extraction Well 1 Deep	2/18/2016 8:34	1.7	6	11	81.3	45	45	45	-0.4	-0.4	-0.4	1	No Change
Native Soil Extraction Well 1 Shallow	2/18/2016 8:32	0.4	2.2	17.4	80	44	44	44	-0.5	-0.5	-0.5	2	No Change
Native Soil Extraction Well 2 Deep	2/18/2016 8:38	6.7	10.6	2.2	80.5	48	48	48	-0.6	-0.6	-0.6	2	No Change
Native Soil Extraction Well 2 Shallow	2/18/2016 8:36	6.7	11.5	0.8	81	46	46	46	-0.6	-0.5	-0.5	3	No Change
Native Soil Extraction Well 3 Deep	2/18/2016 8:42	0.2	2.8	17.6	79.4	44	44	44	-0.6	-0.6	-0.6	3	No Change
Native Soil Extraction Well 3 Shallow	2/18/2016 8:40	0	3.1	17.6	79.3	45	45	45	-0.6	-0.6	-0.6	2	No Change
Native Soil Extraction Well 4 Deep	2/18/2016 8:45	1.5	3.4	16.1	79	44	44	44	-0.6	-0.6	-0.6	2	No Change
Native Soil Extraction Well 4 Shallow	2/18/2016 8:44	0.3	2.3	17.9	79.5	44	44	44	-1.3	-1.4	-1.3	4	No Change
Native Soil Extraction Well 5 Deep	2/18/2016 8:49	0	1.6	18.9	79.5	44	44	44	-0.9	-0.9	-0.9	3	No Change
Native Soil Extraction Well 5 Shallow	2/18/2016 8:47	0	2.3	18.2	79.5	44	44	44	-1.3	-1.3	-1.3	4	No Change
Probe 1	2/18/2016 9:05	0	2.2	17.2	80.6								
Probe 2 Deep	2/18/2016 9:17	0	1.3	17	81.7								
Probe 2 Middle	2/18/2016 9:14	0	1.2	17.5	81.3								
Probe 2 Shallow	2/18/2016 9:11	0	0.2	20.5	79.3								
Probe 3	2/18/2016 9:22	0	1.1	19.6	79.3								
Probe 4	2/18/2016 9:28	0	1.6	19.1	79.3								
Probe 5	2/18/2016 9:40	0	0.2	20.5	79.3								
Probe 6	2/18/2016 7:24	0	4.6	14.1	81.3								
Probe 7	2/18/2016 9:32	0	1	19.6	79.4								
Trench Well TD-1	2/18/2016 7:20	7.3	15.8	0	76.9	45	44	45	-0.1	-0.1	-0.1	5	No Change
Trench Well TR-1	2/18/2016 7:47	9.7	10.9	4.1	75.3	44	44	44	-0.4	-0.4	-0.4	2	No Change
Trench Well TR-2	2/18/2016 7:32	4.8	10.4	5.7	79.1	44	44	44	-0.3	-0.3	-0.3	2	No Change
Trench Well TR-3	2/18/2016 8:20	6	9.5	3.7	80.8	44	44	44	-0.6	-0.6	-0.6	2	No Change
Trench Well TR-4	2/18/2016 8:08	8.8	7.8	7.9	75.5	42	42	42	-0.7	-0.7	-0.7	2	No Change
Trench Well TR-5	2/18/2016 7:56	0.1	0.8	20.5	78.6	44	45	45	-0.5	-0.5	-0.5	2	No Change
Trench Well TR-6	2/18/2016 7:55	6.3	12.8	1.9	79	45	45	45	-0.5	-0.4	-0.4	2	No Change
Trench Well TR-7	2/18/2016 8:04	19.4	8.9	0	71.7	44	45	45	-0.5	-0.4	-0.4	1	No Change

Table 2. 2015 Groundwater Statistical Evaluation, Hansville Landfill

Arsenic (mg/L)

Monitoring Location	Mean	LCL	UCL	Site Cleanup Level	Mann-Kendall Test				Sen's Test	
					Mann-Kendall (S)	Z	Probability %	Trend	Sen's Slope	Trend
MW-05	0.00129	0.00026	0.00231	0.005	—		—	—	—	—
MW-06	0.00128	0.00027	0.00230	0.005	—		—	—	—	—
MW-07	0.00068	0.00014	0.00120	0.005	—		—	—	—	—
MW-12I	0.00170	0.00036	0.00303	0.005	—		—	—	—	—
MW-13D	0.00253	0.00054	0.00451	0.005	—		—	—	—	—
MW-14	0.01273	0.00270	0.02276	0.005	-50	-1.59	5.6	N	0.00000241	N

Vinyl Chloride (µg/L)

Monitoring Location	Mean	LCL	UCL	Site Cleanup Level	Mann-Kendall Test				Sen's Test	
					Mann-Kendall (S)	Z	Probability %	Trend	Sen's Slope	Trend
MW-05	—	—	—	0.025	—			—	—	—
MW-06	0.210	0.146	0.274	0.025	8	0.227	41.02	N	0.0001031	N
MW-07	—	—	—	0.025	—			—	—	—
MW-12I	0.189	0.022	0.356	0.025	-5	-0.13	44.84	N	-0.0000010	N
MW-13D	—	—	—	0.025	—			—	—	—
MW-14	0.178	0.142	0.213	0.025	-129	-4.155	0.001	↓	-0.0001275	↓

Footnotes:

N = 4 (Mean, LCL, UCL); 20 (Mann-Kendall/Sen's Test)

Mean, LCL and UCL at 95%

N/A = Not applicable, data are all non-detect.

NDs set at 1/2 the MDL

Probability % is the Mann-Kendall p-value shown in a percentage format (i.e, raw p-value mutipiled by factor of 100).

(—) not applicable

95% confidence level

(↑) *Test identifies a significant increasing trend*

(↓) *Test identifies a significant decreasing trend*

(N) *Test identifies no significant trend*

Table 3. Groundwater Elevations, First Quarter 2016 Monitoring Event

Hansville Landfill, Kitsap County, Washington, Janaury 6, 2016

Location ID	Elevations (ft-msl)		Screen Elevation (ft-msl)		Depth to Water (feet)	Water Level Elevation (ft-msl)
	Ground	PVC	Top	Bottom		
MW-5	363.7	366.9	244	234	102.44	264.46
MW-6	332.0	332.7	260	245	75.80	256.90
MW-7	344.3	346.0	259	244	86.89	259.11
MW-12I	245.6	248.1	217	207	10.48	237.62
MW-13D	258.1	260.4	205	195	11.95	248.45
MW-14	338.6	341.1	262	247	83.12	257.98

PVC: PVC wellhead casing measuring point elevation.

ft-msl: Elevation in feet above mean sea level.

Table 4. Groundwater Chemisrty, First Quarter 2016 Monitoring Results

Hansville Landfill, Kitsap County, Washington, January 6, 2016

Parameter	Site Cleanup Level (SCL) [1]	MW-05	MW-06	MW-07	MW-12I	MW-13D	MW-14	MW-14 DUP	Trip Blank
Field Parameters									
Dissolved Oxygen (mg/L)		5.34	0.22	1.37	1.9	2.00	0.13	--	--
pH (units)		7.25	7.00	6.64	7.24	7.55	6.84	--	--
Specific Conductivity (uS)		144	345	278	145	203	265	--	--
Temperature (degrees C)		11.9	14.4	11.0	10.0	10.4	12.7	--	--
Redox (Mv)		219.7	65	125	94.1	37.7	-73	--	--
Conventional Parameters (mg/L, unless otherwise shown)									
Alkalinity		62	140	160	74	81	120	120	--
Ammonia (As N)		0.030 U	0.030 U	0.030 U	0.030 U	0.030 U	0.030 U	0.030 U	--
Bicarbonate		62	140	160	74	81	120	120	--
Carbonate		5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	--
Chloride		2.9	15	1.5	2.2	6.2	6.7	6.7	--
Nitrate (As N)		0.86	0.78	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	--
Nitrite (As N)		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	--
Sulfate		8.9	24	3.6	4.9	18	17	17	--
Total Organic Carbon (TOC)		1.0 U	1.0 U	1.5	2.4	1.0 U	1.0 U	1.0 U	--
Orthophosphate (As P)		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	--
Dissolved Metals (mg/L)									
Arsenic	0.005	0.0018	0.0018	0.0010	0.0024	0.0037	0.0158	0.0152	--
Manganese	2.24	0.001 U	0.390	0.001 U	0.057	0.028	2.4	2.5	--
Volatile Organics Compounds (ug/L) - only detected EPA method 8260 compounds as shown.									
1,2-dichloroethene - total		2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	3.5	3.3	2.0 U
cis-1,2-dichloroethene		1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	3.5	3.3	1.0 U
Ethyl ether		1.0 U	1.8	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Vinyl chloride	0.025	0.020 U	0.17	0.020 U	0.13	0.020 U	0.16	0.16	0.020 U

1 SCLs defined in August 2011 consent decree/cleanup action plan.

U Compound not detected at reporting limit.

-- Not Tested.

Shaded results exceed site cleanup levels.

DUP The MW-14 DUP identifier is blind duplicate MW-20DD.

Table 5. Surface Water Chemistry, First Quarter 2016 Monitoring Results

Hansville Landfill, Kitsap County, Washington, January 6, 2016

Parameter	Site Cleanup Level (SCL) [1]	SW-1	SW-4	SW-6	SW-7	Trip Blank
Field Parameters						
Dissolved Oxygen (mg/L)		6.07	6.13	6.62	7.67	--
pH (units)		7.42	7.06	7.28	6.73	--
Specific Conductivity (uS)		205	298	93	217	--
Temperature (degrees C)		7.8	6.3	4.7	5.6	--
Redox (Mv)		290.4	288.9	289.3	299.6	--
Conventional Parameters (mg/L, unless otherwise shown)						
Alkalinity		83	130	28	51	--
Ammonia (As N)		0.030 U	0.030 U	0.030 U	0.030 U	--
Bicarbonate		83	130	28	51	--
Carbonate		5.0 U	5.0 U	5.0 U	5.0 U	--
Chloride		4.5	13	4.3	4.2	--
Nitrate (As N)		1.7	1.1	0.72	0.5 U	--
Nitrite (As N)		0.5 U	0.5 U	0.5 U	0.5 U	--
Sulfate		11	18	7.8	10	--
Total Organic Carbon (TOC)		2.8	13	21	8.5	--
Orthophosphate (As P)		0.5 U	0.5 U	0.5 U	0.5 U	--
Dissolved Metals (mg/L)						
Arsenic	0.005	0.0014	0.0015	0.0018	0.0011	--
Manganese	2.24	0.001 U	0.035	0.0089	0.0035	--
Volatile Organics Compounds (ug/L) - only detected EPA method 8260 compounds as shown.						
Vinyl chloride	0.025	0.020 U	0.020 U	0.020 U	0.020 U	0.020 U

1 SCLs defined in August 2011 consent decree/cleanup action plan.

Shaded results exceed site cleanup levels.

U Compound not detected at reporting limit.

-- Not Tested.

Appendix C

Groundwater Trend Plots

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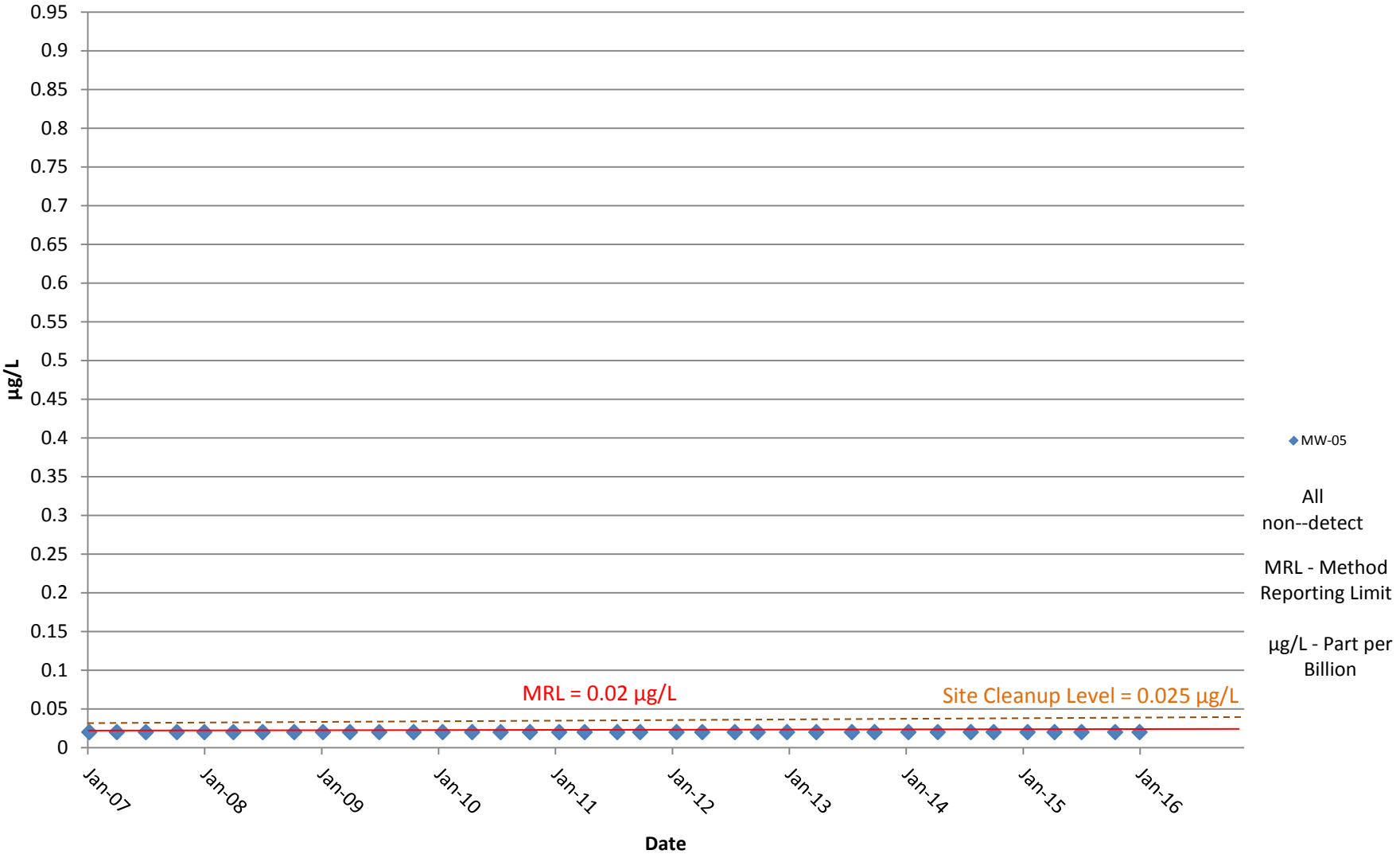
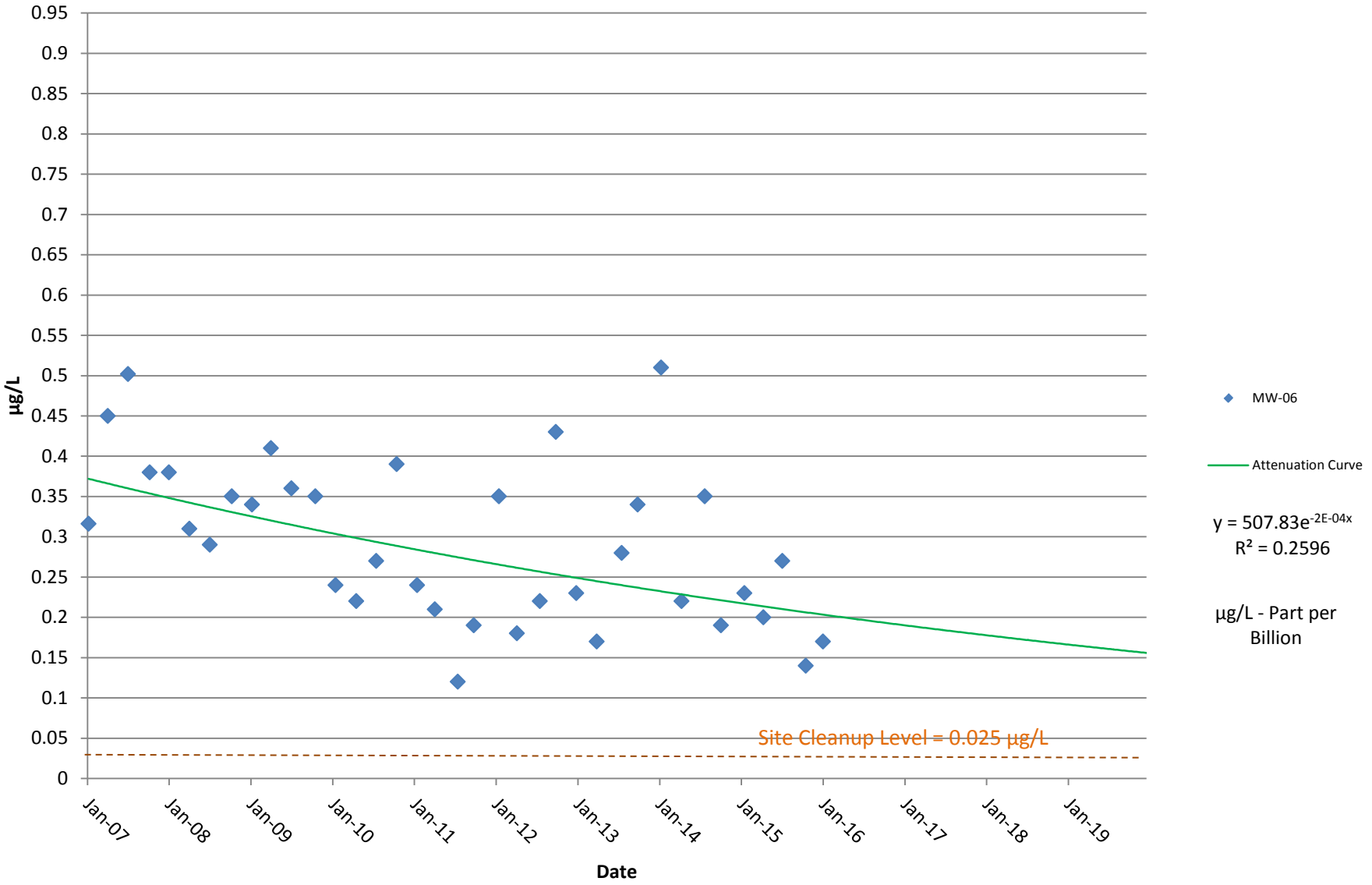
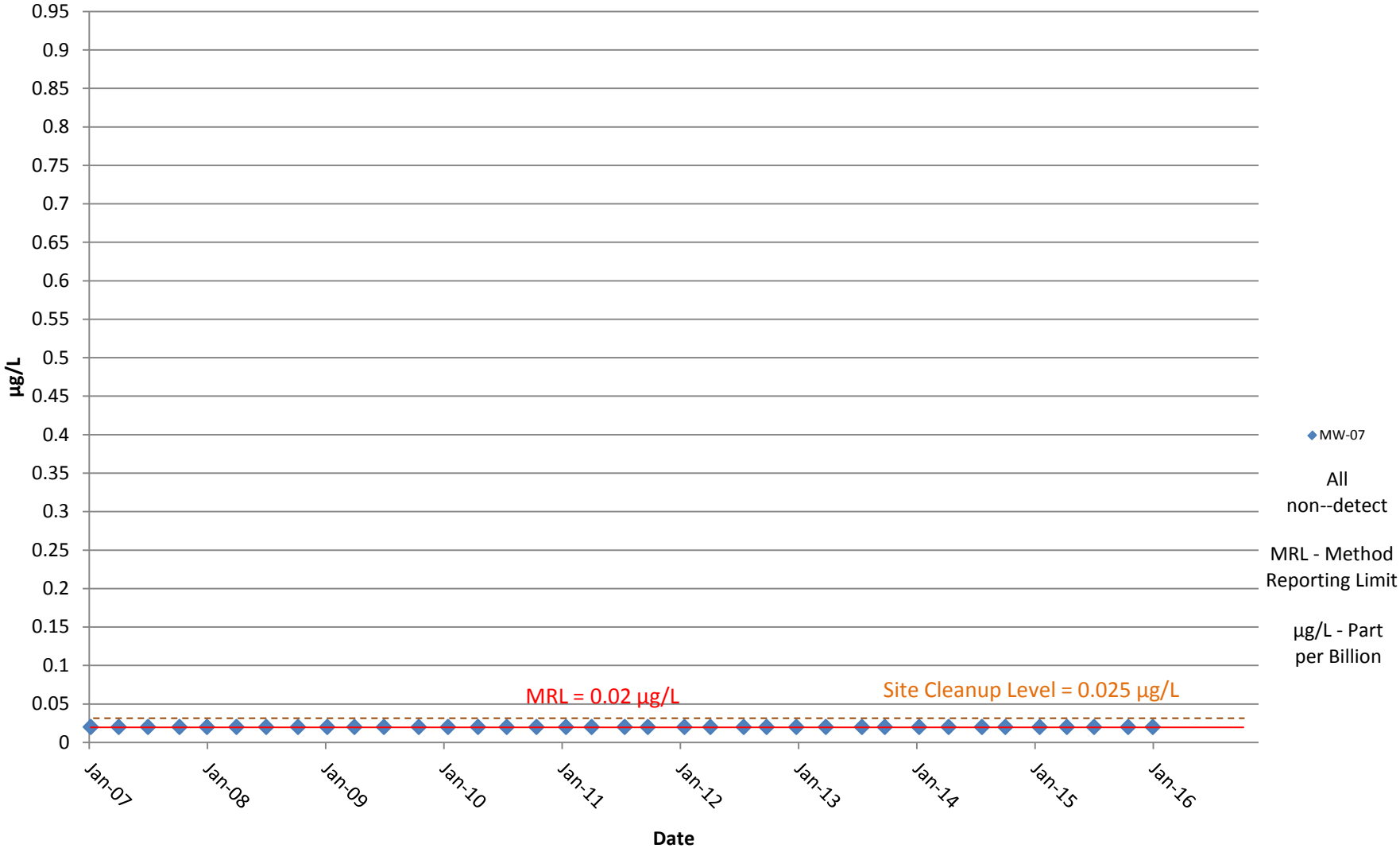
Vinyl Chloride , MW-05
Hansville Landfill



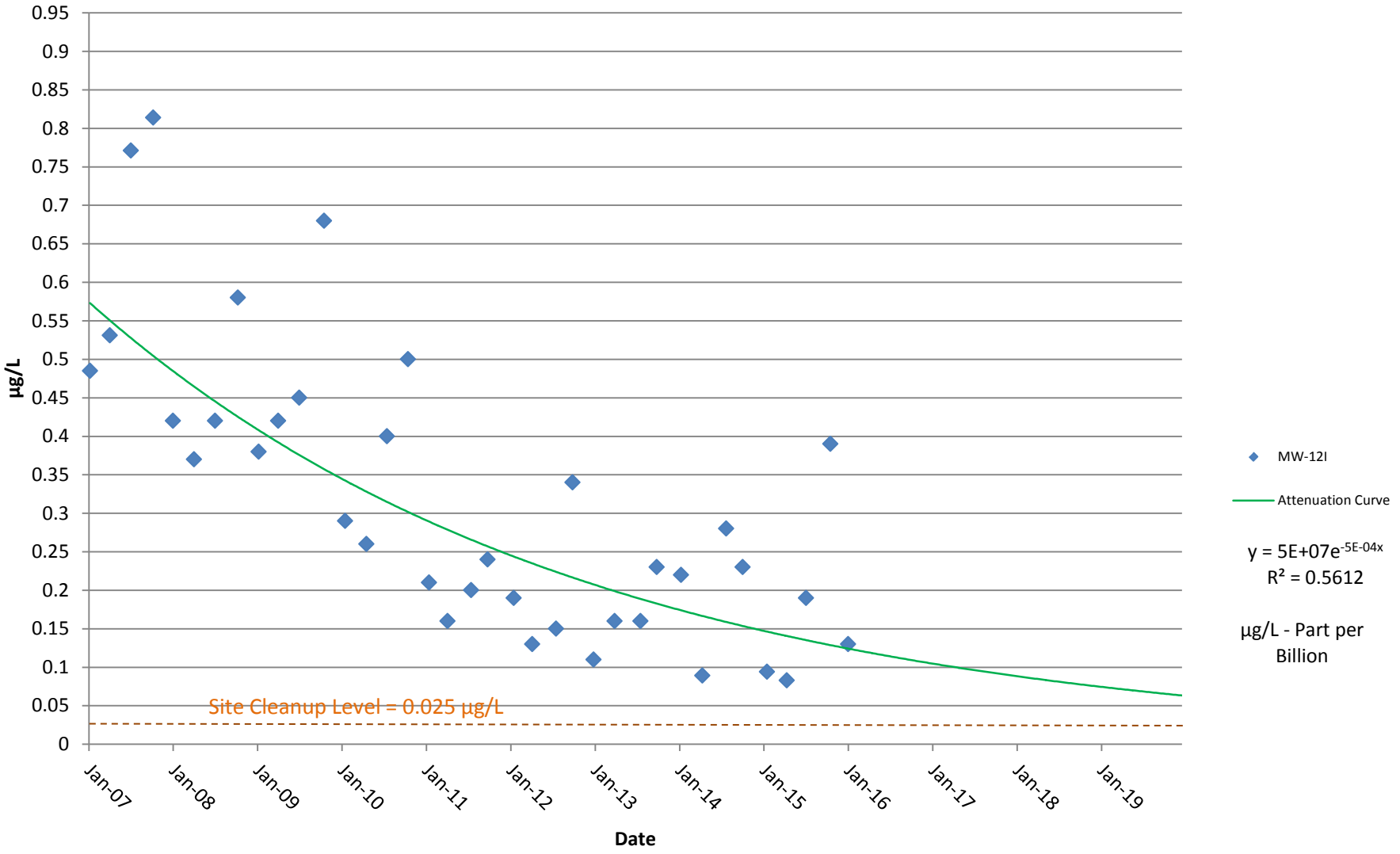
Vinyl Chloride, MW-06
Hansville Landfill



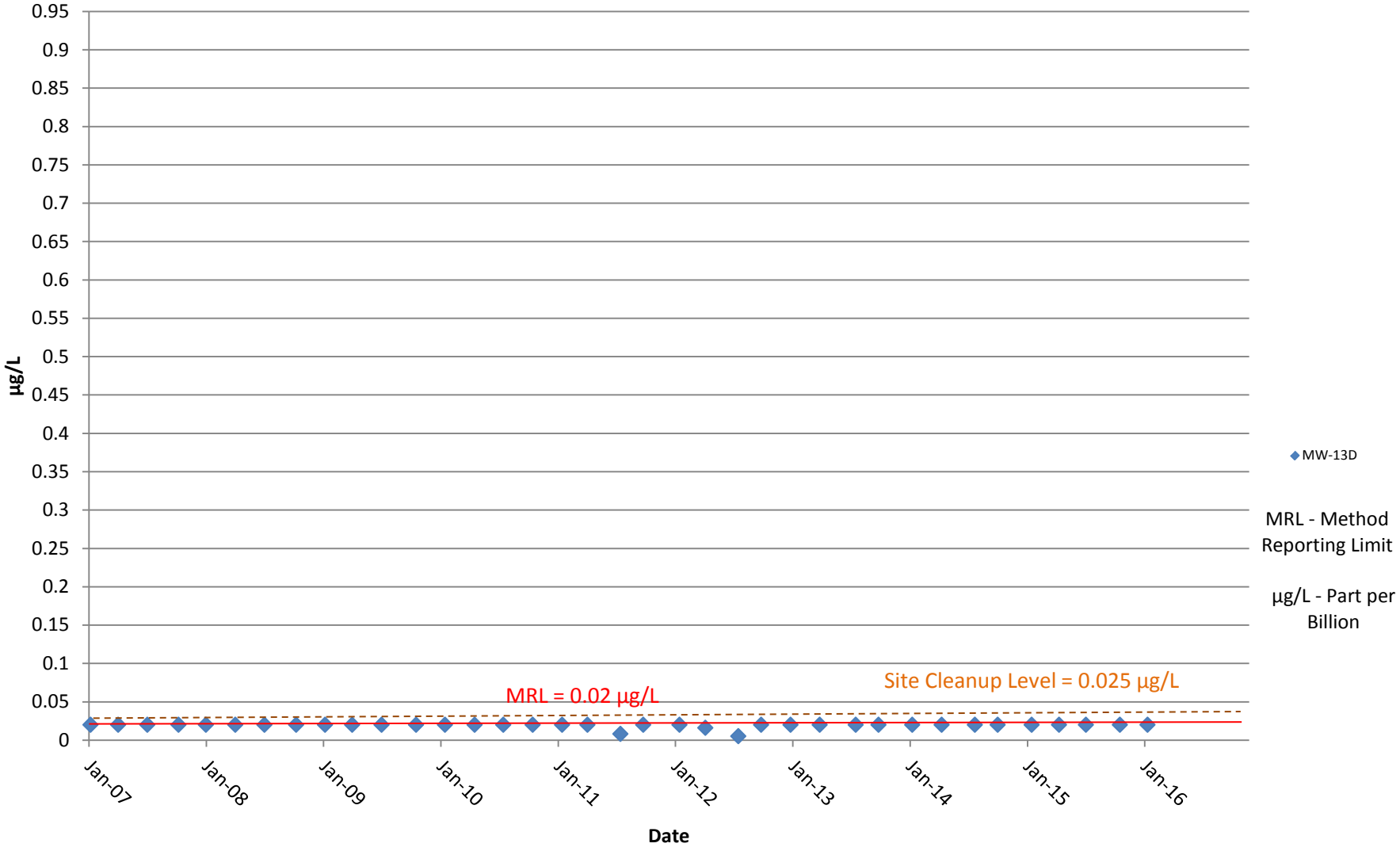
Vinyl Chloride , MW-07
Hansville Landfill



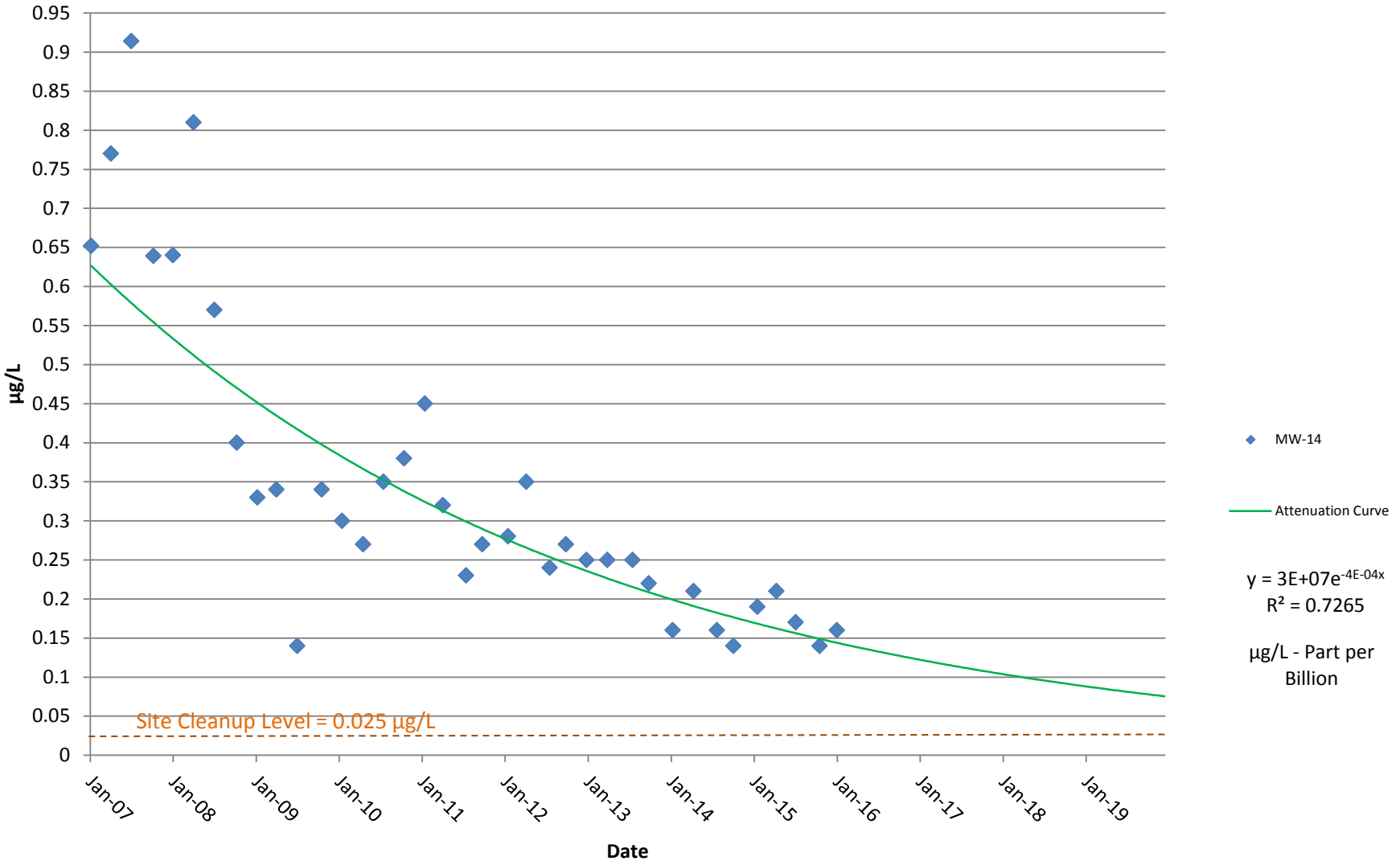
Vinyl Chloride, MW-12I
Hansville Landfill

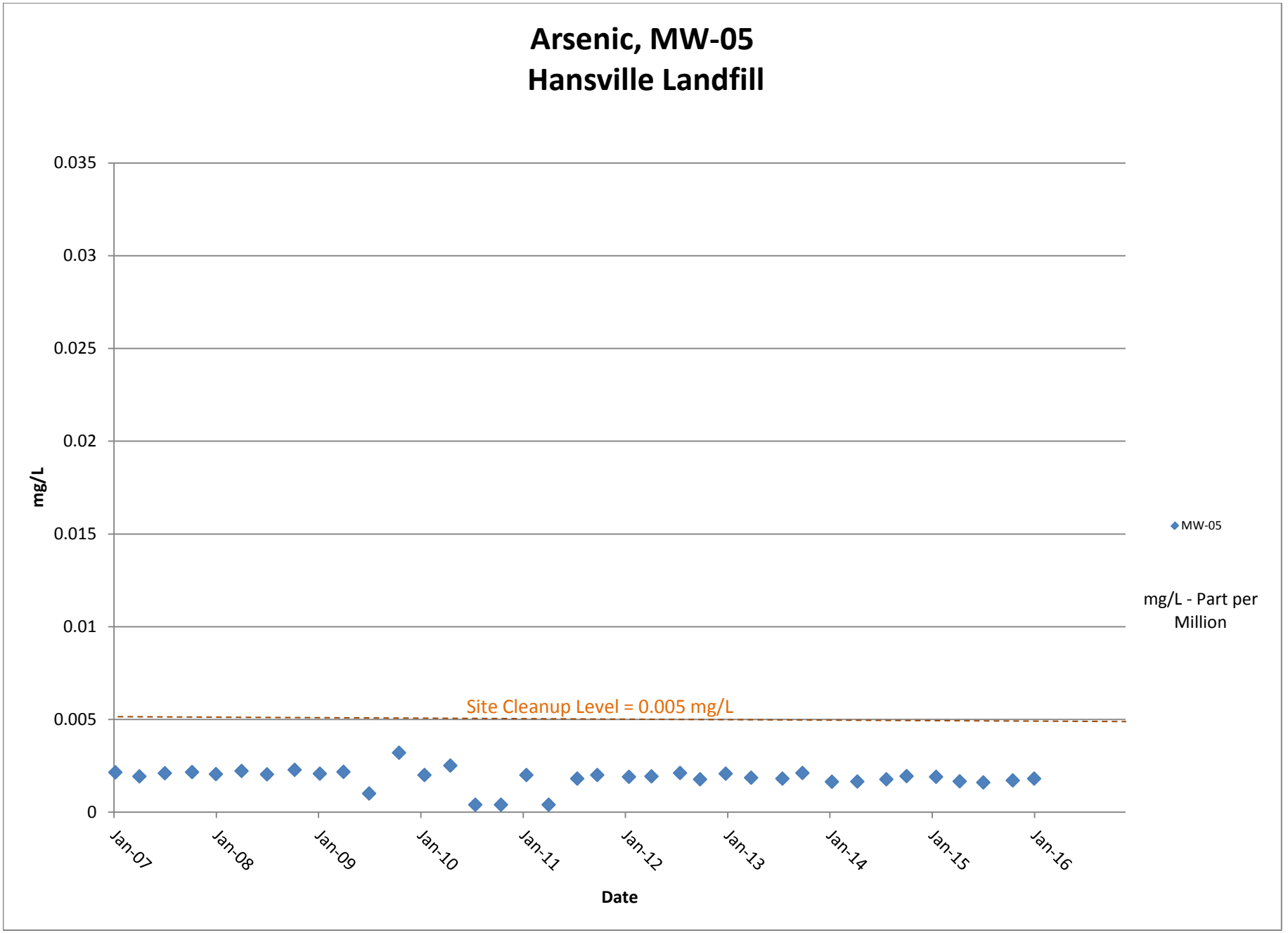


Vinyl Chloride, MW-13D
Hansville Landfill

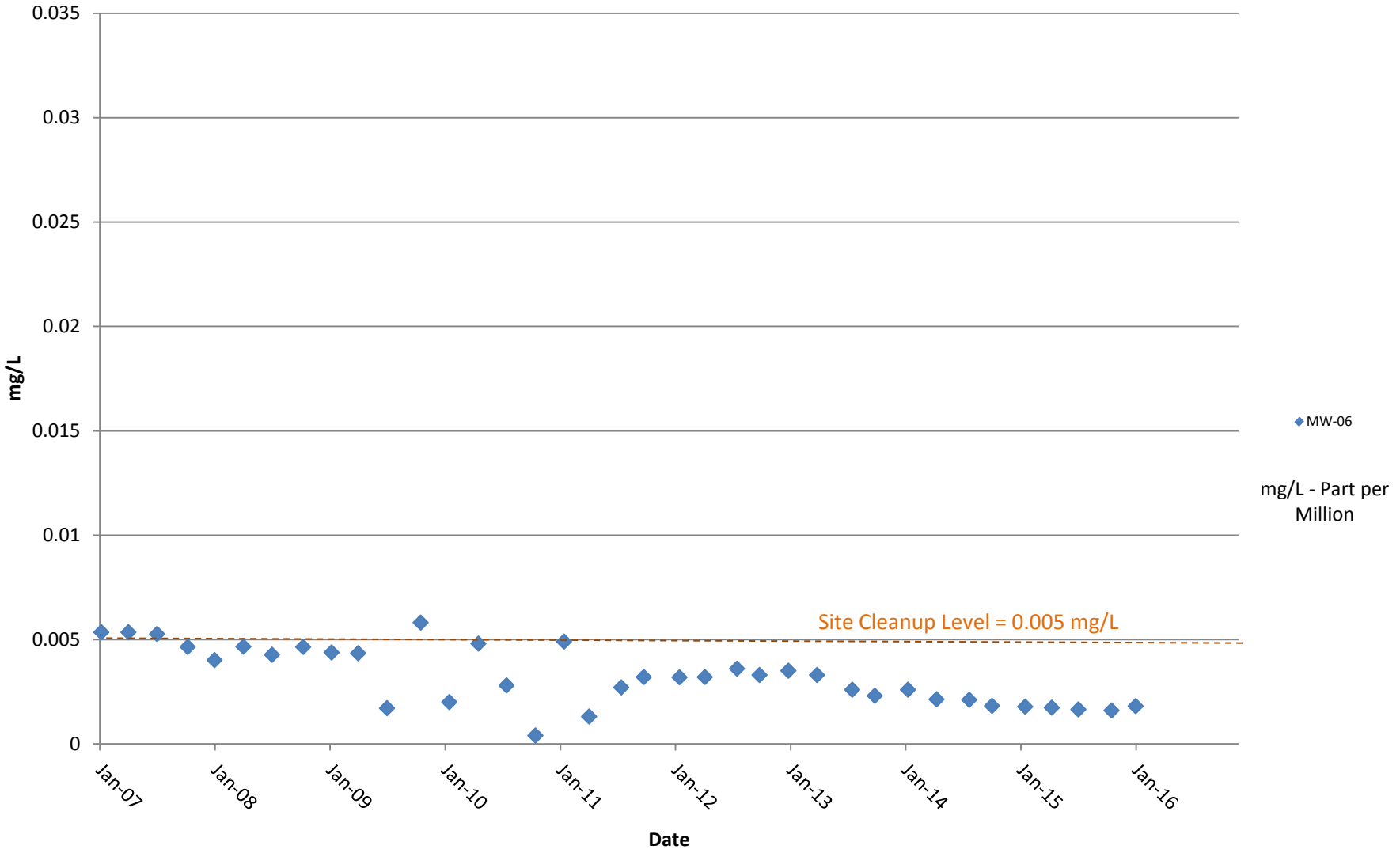


Vinyl Chloride, MW-14
Hansville Landfill

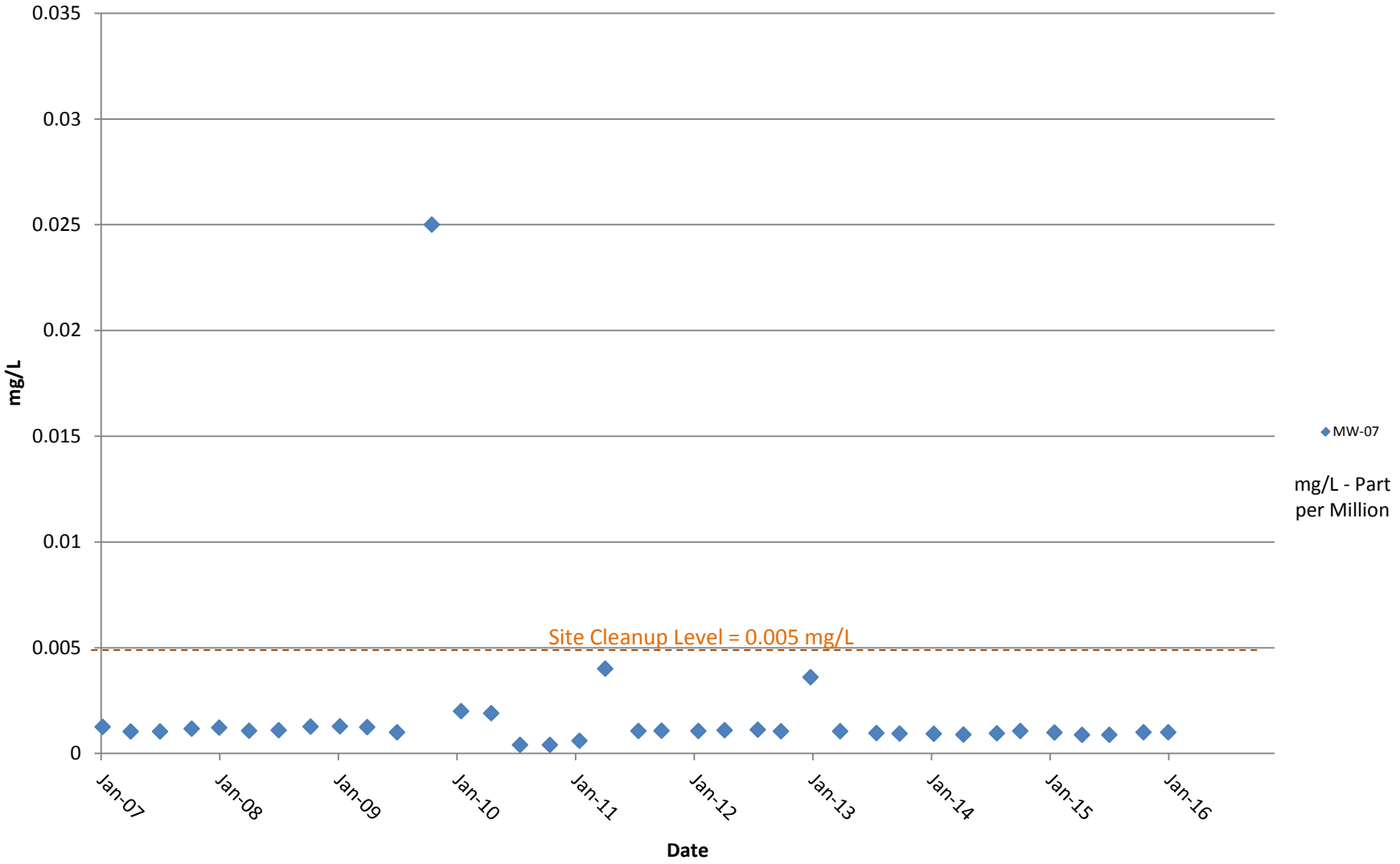



Arsenic, MW-05
Hansville Landfill
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
mg/L
Site Cleanup Level = 0.005 mg/L
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Date
MW-05
mg/L - Part per Million

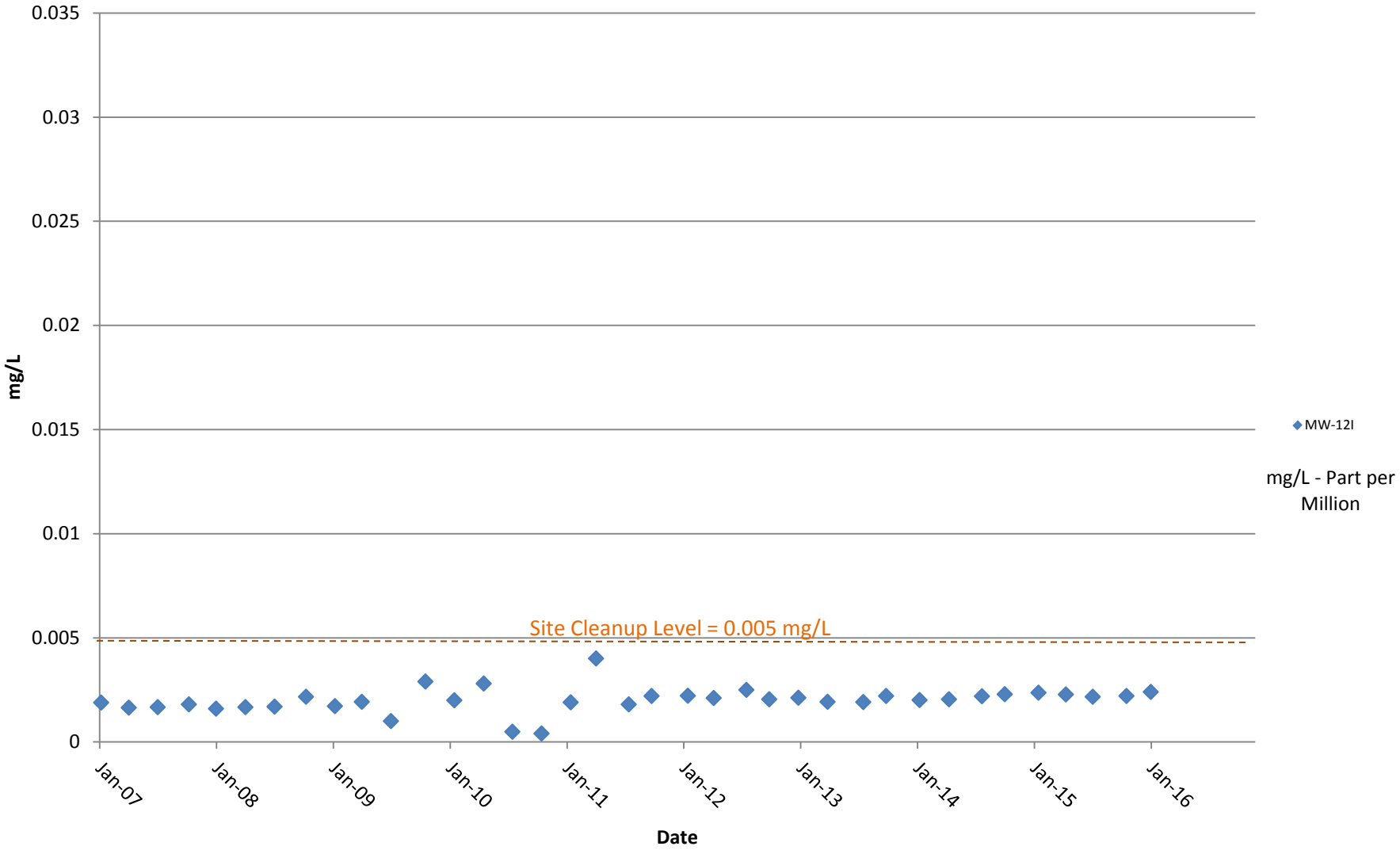
Arsenic, MW-06
Hansville Landfill



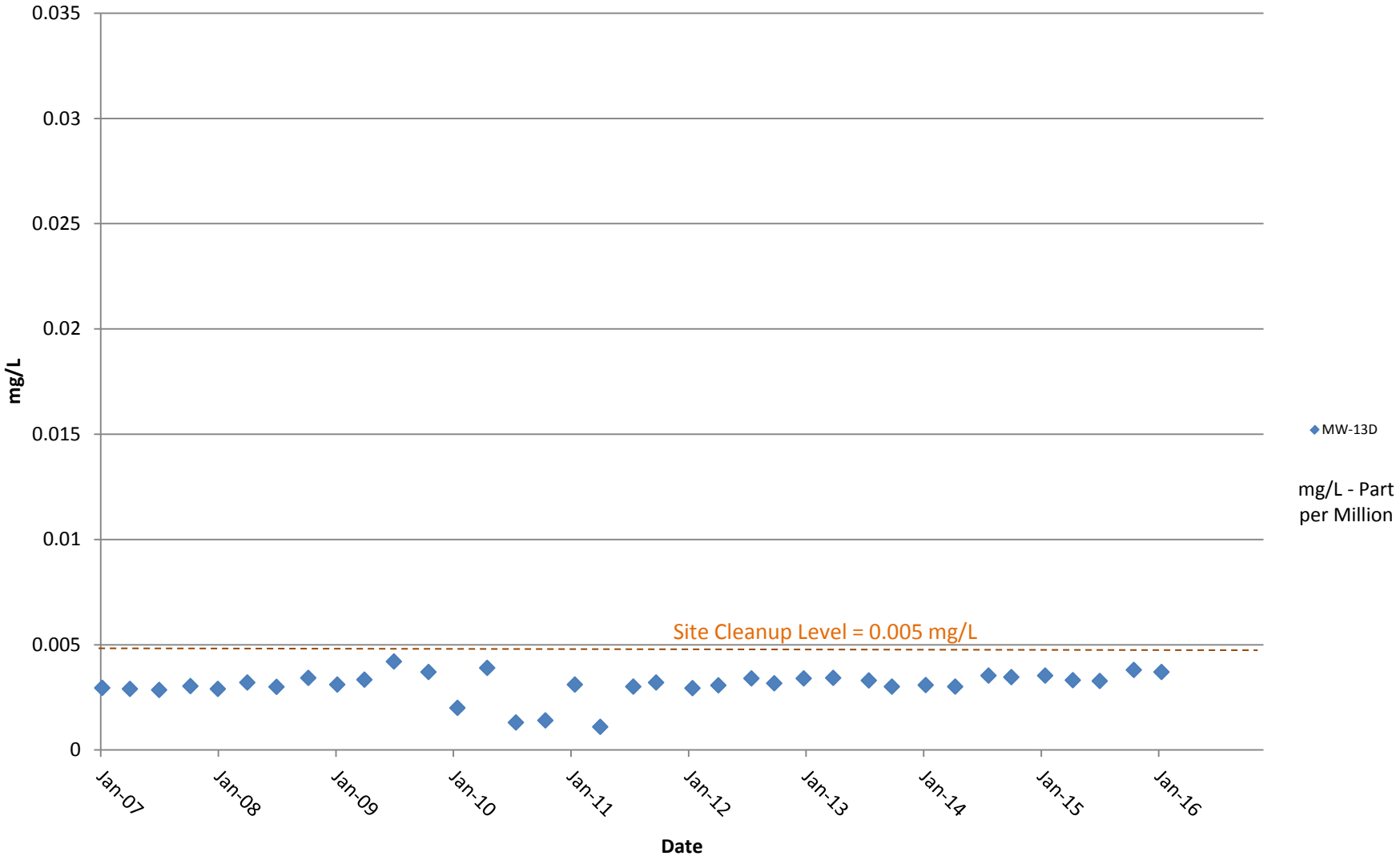
Arsenic, MW-07
Hansville Landfill



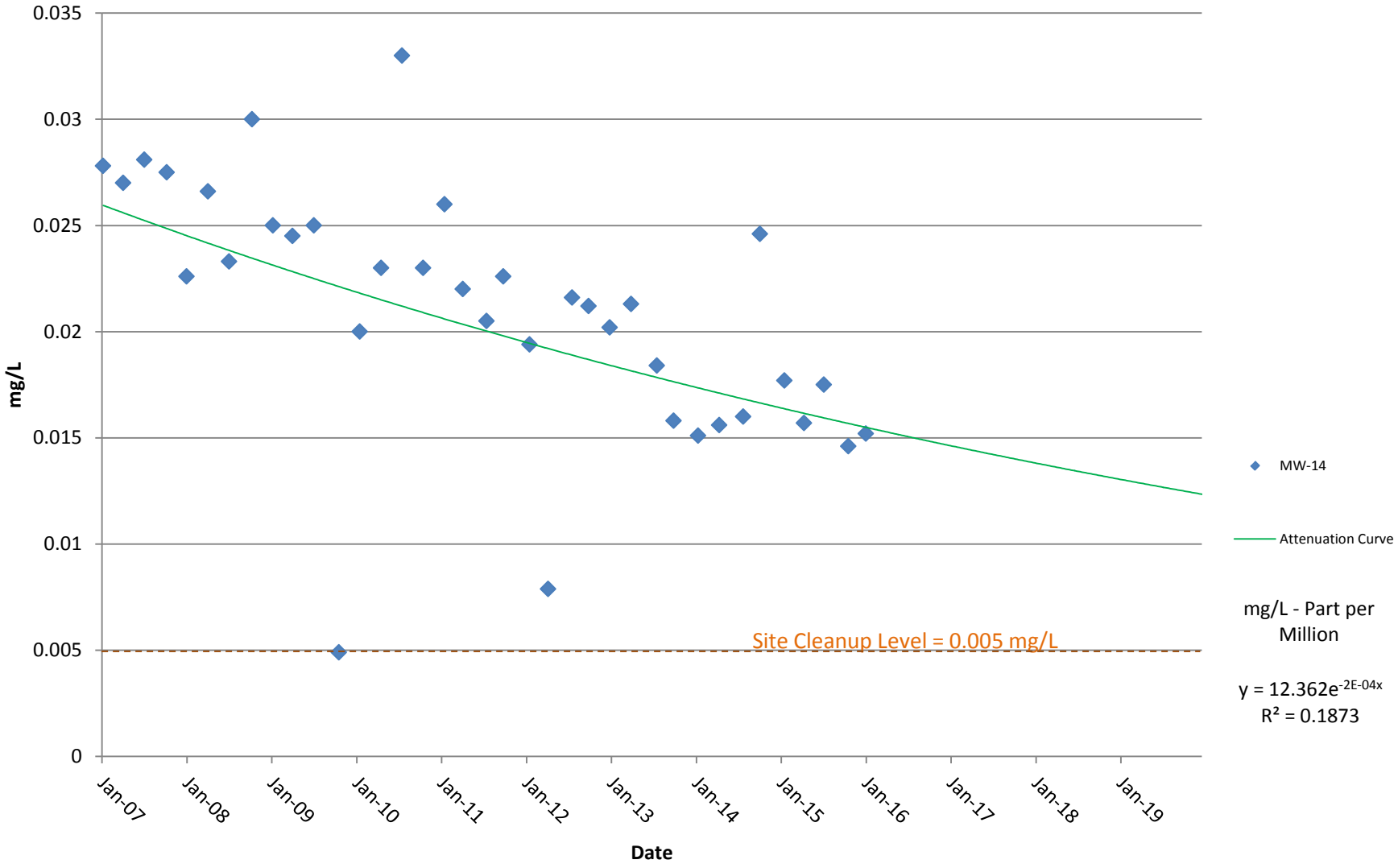
Arsenic, MW-12I
Hansville Landfill



Arsenic, MW-13D
Hansville Landfill



Arsenic, MW-14
Hansville Landfill



Appendix D

Surface Water Trend Plots

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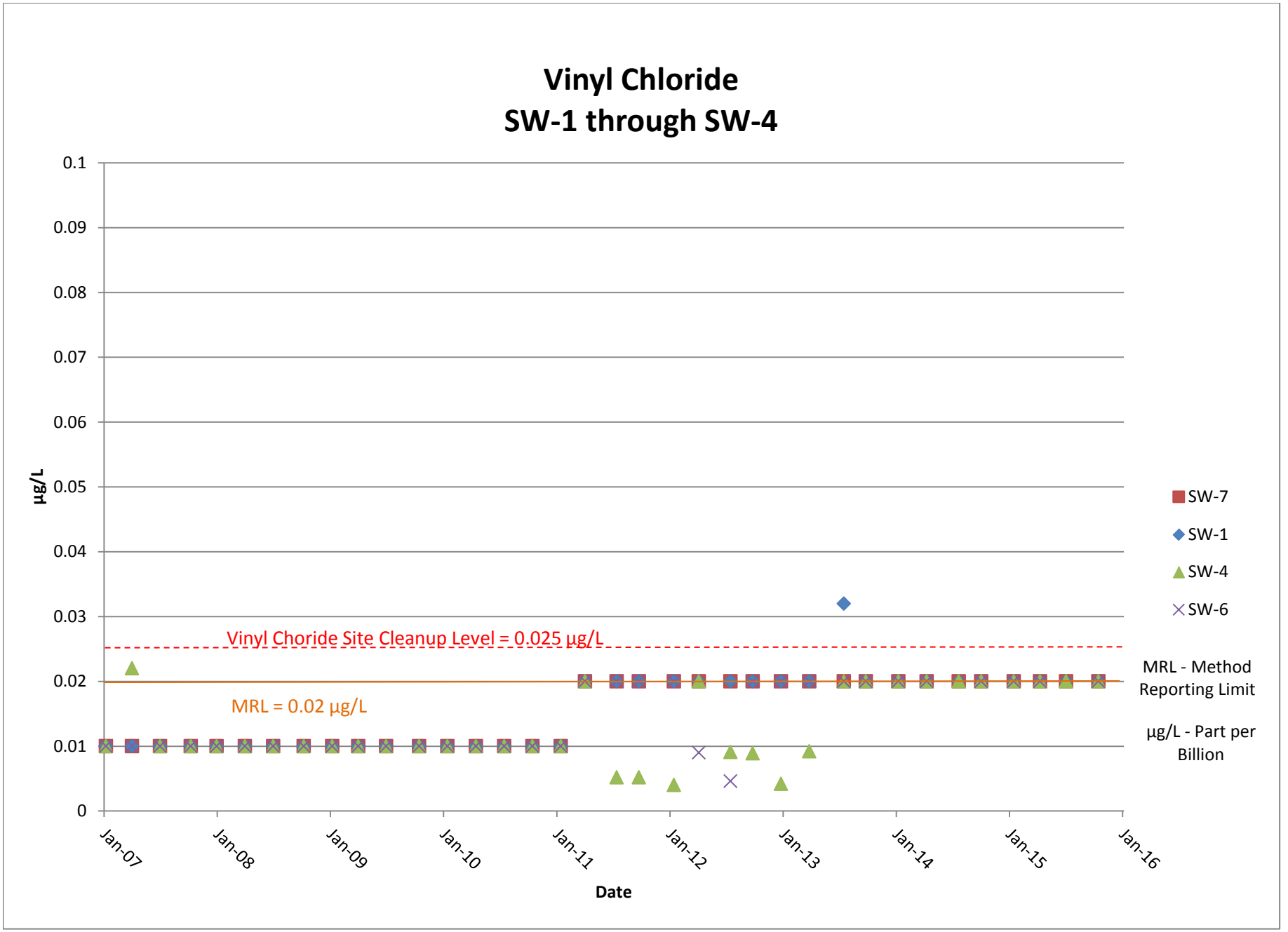
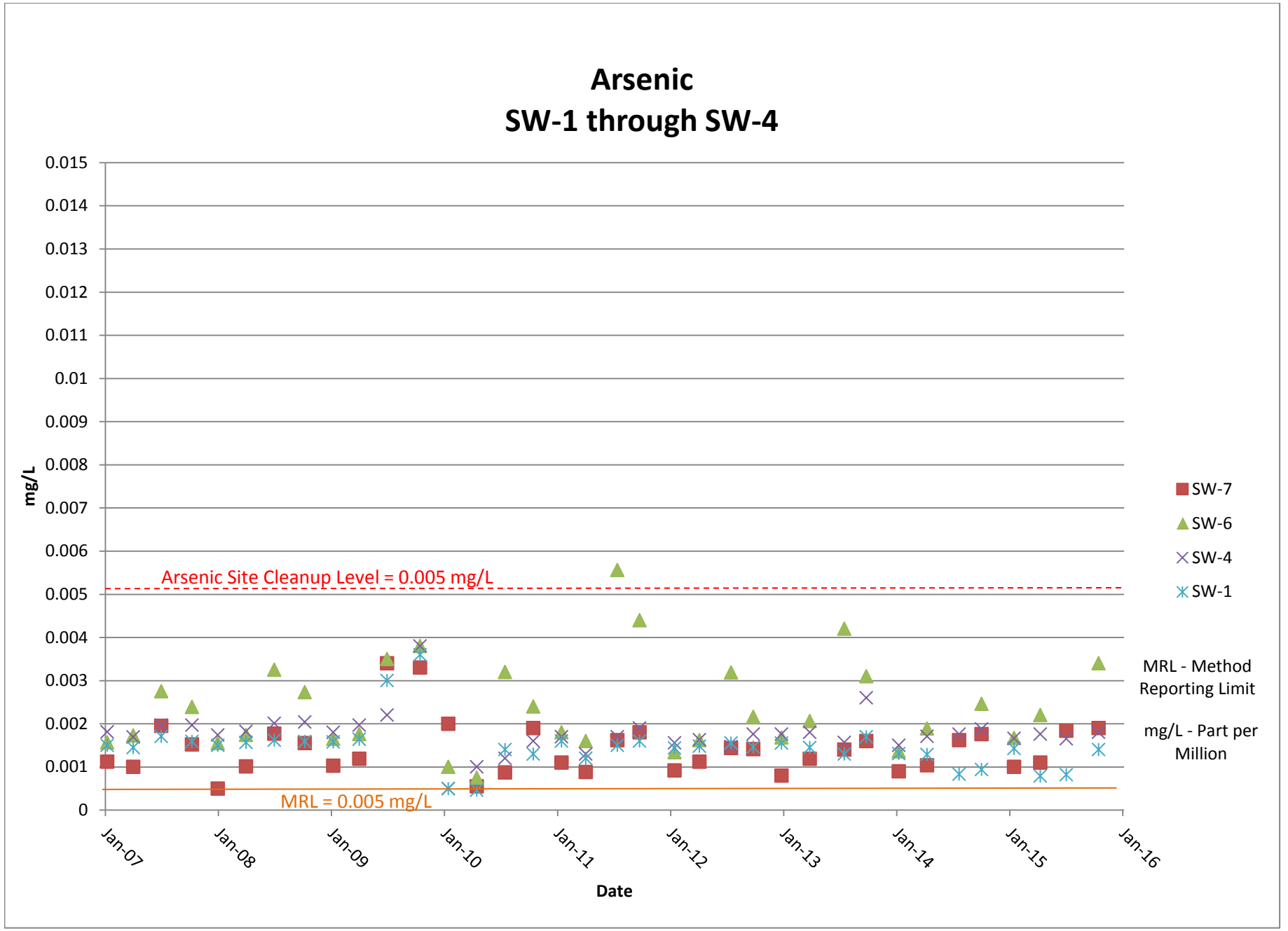

Vinyl Chloride
SW-1 through SW-4
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
µg/L
Vinyl Choride Site Cleanup Level = 0.025 µg/L
MRL = 0.02 µg/L
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Date
SW-7
SW-1
SW-4
SW-6
MRL - Method Reporting Limit
µg/L - Part per Billion


Arsenic
SW-1 through SW-4
0.015
0.014
0.013
0.012
0.011
0.01
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
mg/L
Arsenic Site Cleanup Level = 0.005 mg/L
MRL = 0.005 mg/L
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Date
SW-7
SW-6
SW-4
SW-1
MRL - Method Reporting Limit
mg/L - Part per Million

Manganese
SW-1 though SW-4