2016 ANNUAL MONITORING REPORT

OLALLA LANDFILL

KITSAP COUNTY, WASHINGTON

MARCH 2017

Prepared by

Environmental Partners, Inc., on behalf of
Kitsap County Department of Public Works
Port Orchard, Washington

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CHECKLIST FOR GROUNDWATER REPORTING
Municipal Solid Waste Landfills
WAC 173-351-415

Include a signed, completed copy of this checklist with each quarterly and annual report.

Quarterly groundwater reports shall be submitted to the jurisdictional health department and Ecology within 60 days of receipt of analytical data. Annual groundwater reports shall be submitted to the jurisdictional health department and Ecology by April 1 of each year.

1st ____ 2nd ____ 3rd ____ 4th X YEAR 2016	Reference (section, subsection)	Included in this report	Location – page # or appendix #
Quarterly Groundwater Reports: *173-351-415 (2) plus the referenced section*			
Statistical calculations and summaries			
Descriptive statistics	420, (1)	☒	Pages 12-22
Statistical tests	420, (2)	☒	Pages 12-22
Notification of statistical increase (if applicable)	420, (4)	☒	Pages 20-21
Notification of concentrations above Chapter 173-200 WAC criteria (if any)	430, (4)	☒	Pages 10-11
Static water level readings	415, (2)	☒	Appendix A
Potentiometric surface elevation maps depicting flow direction	415, (2)	☒	Appendix A
Flow rate – calculated	415, (2)	☐	
Cation-anion balances	430, (5a)	☐	
Explanation of greater than 5% (or 10%) difference if needed	430, (5a)	☐	
Trilinear diagrams	430, (5b)	☐	
Leachate analyses (if sampled and tested)	415, (2)	☐	
Data entered into EIM database (date entered: 1/30/2017)	415, (3)	☒	N/A
Complete copy of the lab report with chain of custody record.		☒	CD ROM
Annual Groundwater Reports: *173-351-415 (1)* YEAR 2016			
Summary of statistical results and trends	415, (1)	☒	Appendix C
Summary of groundwater flow rate and direction for the year	415, (1)	☒	Page 6
Copy of all potentiometric maps for the year	415, (1)	☒	Appendix A
Summary geochemical evaluation	415, (1)	☐	
For Quarterly and Annual Reports			
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Douglas Kunkel — Signature of Report Author
3/17/17 — Date
Ola 1a — Landfill

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CONTENTS

FIGURES

TABLES

APPENDICES

ATTACHMENT

INTRODUCTION

The Olalla Landfill (Landfill) is located approximately 0.75 miles east of Highway 16 on Burley-Olalla Road in Kitsap County, Washington. The Landfill was closed in 1989 in accordance with the Olalla Final Closure Plan (Parametrix, Inc., 1988). Post-closure activities have consisted primarily of quarterly monitoring and maintenance per WAC 173-304-407 (Minimum Functional Standards for Solid Waste Handling [MFS]), "General Closure and Post Closure Requirements" Kitsap County Board of Health Ordinance 2010-01 "Solid Waste Regulations" and Solid Waste Handling Permits (SWHP) issued annually by the Kitsap Public Health District (KPHD).

A Remedial Investigation/Feasibility Study (RI/FS) (Parametrix, 2014a) was performed at the Landfill starting in May 2010 and ending May 2014 when the RI/FS was submitted to the Washington State Department of Ecology (Ecology) and KPHD. Upon approval of the RI/FS the Kitsap County Solid Waste Division (SWD) prepared a Cleanup Action Plan (CAP) (Parametrix, 2014b) to summarize the RI/FS activities and present the preferred cleanup action, which was selected based on the results of the RI/FS. Ecology and KPHD approved the CAP in December 2014. The December 2016 Landfill monitoring event is the eighth event performed under the approved CAP.

The preferred cleanup action, monitored natural attenuation (MNA) and land use controls, is based on a continuation of ongoing groundwater monitoring in accordance with the SWHP. Quarterly monitoring results will be used to evaluate the effectiveness of the cleanup action and to verify that natural attenuation continues to occur at the Landfill. The overall effectiveness of the cleanup action will be evaluated at 5-year intervals as part of the periodic review process.

Specific groundwater, surface water, and landfill gas monitoring methods and procedures that are performed under the requirements of MFS, the SWHP, and the CAP are documented in a Compliance Monitoring Plan (CMP) (Environmental Partners, Inc., 2015). The CMP integrates all the previously noted monitoring program requirements into one document that contains a site-specific Sampling and Analysis Plan (SAP), Quality Assurance Plan (QAP), and Health and Safety Plan (HASP).

This Annual Report documents the results of the fourth quarter 2016 groundwater and landfill gas monitoring event and summarizes the results of the previous quarterly monitoring and reporting events completed at the Landfill in 2016, in accordance with WAC 173-304-405(4), CAP, CMP, and the 2016-2020 SWHP issued by KPHD on February 18, 2016.

Kitsap County Solid Waste Division (SWD) and Environmental Partners, Inc. (EPI) developed the current statistical evaluation process used in this report with input and direction from KPHD and the Washington State Department of Ecology (Ecology). KPHD and Ecology referenced the United States Environmental Protection Agency (USEPA) 2004 *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities* (Unified Guidance) (USEPA, 2004) as the basis for evaluating appropriate statistical methods for Landfill groundwater data. The

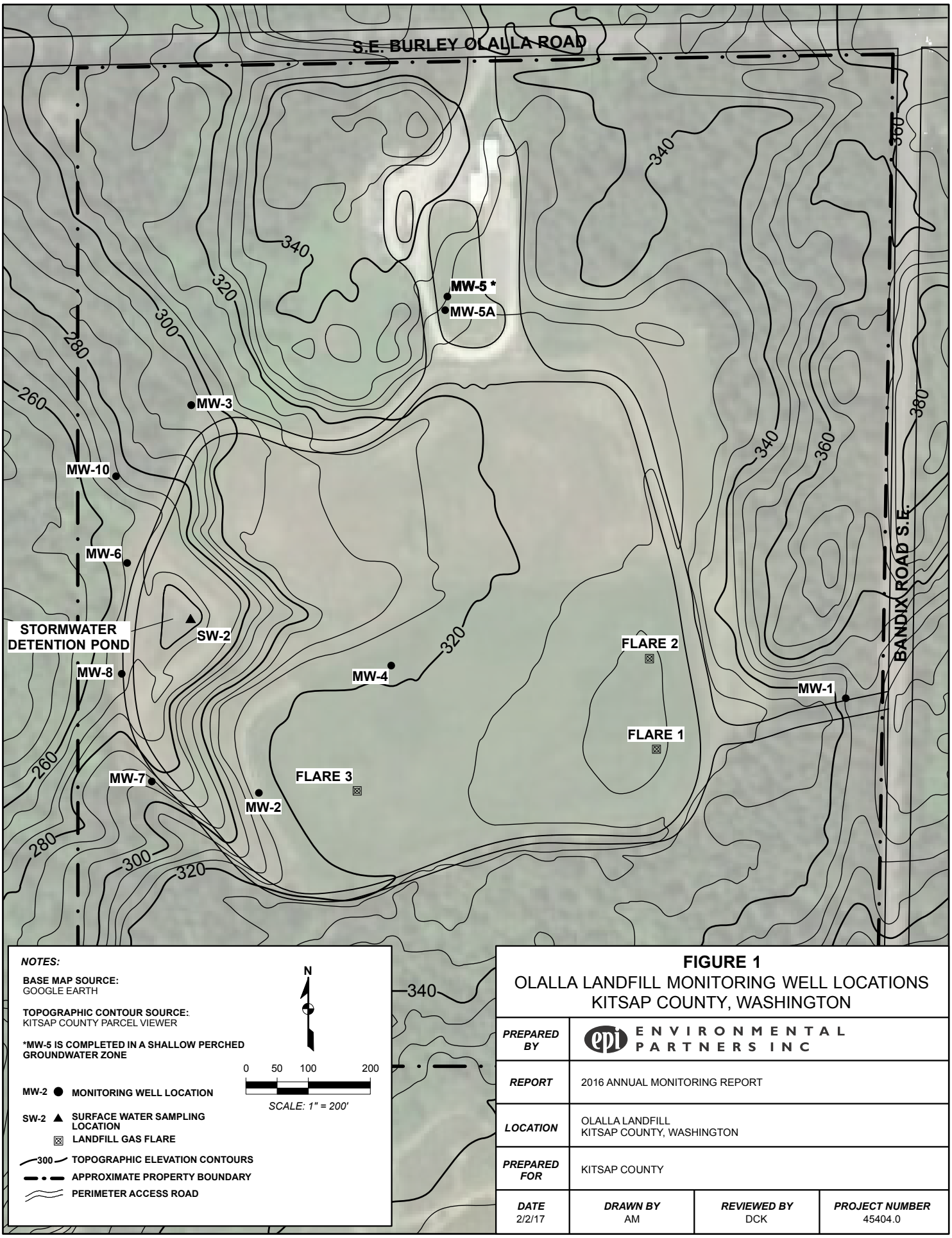
statistical methods used in this report are consistent with recommended methods found in the Unified Guidance, which was updated in 2009 (USEPA, 2009).

Including this section, the 2016 Annual Monitoring Report consists of five main sections: Introduction, Monitoring Program Description, Monitoring Results, Statistical Analysis, and Conclusions. The Monitoring Program Description summarizes the monitoring well network and laboratory analyses. Landfill gas field measurement data, groundwater elevations, and groundwater analytical results are presented in the Monitoring Results section. The statistical data evaluation methods used in this report are consistent with recommended methods found in the Unified Guidance. Results of statistical and non-statistical evaluations of the 2016 monitoring data are summarized in the Conclusions section.

MONITORING PROGRAM DESCRIPTION

The sampling locations, analytical parameters, and frequency of sample collection for quarterly monitoring at the Landfill are specified in the 2016-2020 SWHP and the 2015 CMP. Groundwater, surface water and landfill gas monitoring locations are shown in Figure 1. Specific information pertaining to the 2016 fourth quarter monitoring event is summarized as follows:

- EPI performed groundwater and surface water sampling activities and measured landfill gas parameters at each of the three on-site passive landfill gas flares on December 20-21, 2016.
- Depth to water measurements were performed at all onsite monitoring wells on December 20, 2016. Field staff also measured the depth to water in well MW-5, which is screened in a discontinuous shallow perched groundwater zone that is not hydraulically connected to the uppermost aquifer beneath the Landfill.
- EPI collected groundwater samples from upgradient monitoring well MW-1 on December 20, 2016. The generator used to power the dedicated sampling pumps failed to re-start after MW-1 sampling was completed so it was replaced. Downgradient monitoring wells MW-3, MW-6, MW-8, and MW-10, and cross-gradient monitoring wells MW-5A and MW-7 were sampled on December 21, 2016.
- EPI measured landfill gas parameters at each of the three on-site passive landfill gas flares on December 20, 2016.
- EPI staff collected a surface water sample from location SW-2 on December 20, 2016 as part of the 4th quarter monitoring event.
- One set of field duplicate samples was collected from monitoring well MW-10 and was given the identifier OL-MW-13.
- Groundwater samples were hand delivered to Analytical Resources, Inc. in Tukwila, Washington, for sample analysis on December 22, 2016.
- Samples were analyzed within their respective holding times except laboratory measured pH samples. The pH holding time is 15-minutes, which cannot be achieved at the laboratory but is achieved by the field-measured pH data, which are used for the statistical evaluations.
- Data evaluations, statistical tests, and reporting were performed by EPI in accordance with methods described in the Unified Guidance (USEPA, 2004 [draft] and 2009 [final]) and developed with input and direction from KPHD and Ecology.
- Reporting limits for ammonia, carbonate, iron, nitrite, TOC, potassium, and zinc changed slightly relative to historical data as a result of changing analytical laboratories. All reporting limits are lower than regulatory standards.



NOTES:

BASE MAP SOURCE:
GOOGLE EARTH

TOPOGRAPHIC CONTOUR SOURCE:
KITSAP COUNTY PARCEL VIEWER

***MW-5 IS COMPLETED IN A SHALLOW PERCHED GROUNDWATER ZONE**

MW-2 ● MONITORING WELL LOCATION

SW-2 ▲ SURFACE WATER SAMPLING LOCATION

⊠ LANDFILL GAS FLARE

300 TOPOGRAPHIC ELEVATION CONTOURS

APPROXIMATE PROPERTY BOUNDARY

PERIMETER ACCESS ROAD

FIGURE 1
OLALLA LANDFILL MONITORING WELL LOCATIONS
KITSAP COUNTY, WASHINGTON

PREPARED BY	epi ENVIRONMENTAL PARTNERS INC		
REPORT	2016 ANNUAL MONITORING REPORT		
LOCATION	OLALLA LANDFILL KITSAP COUNTY, WASHINGTON		
PREPARED FOR	KITSAP COUNTY		
DATE 2/2/17	***DRAWN BY*** AM	***REVIEWED BY*** DCK	***PROJECT NUMBER*** 45404.0

MONITORING RESULTS

Results for 2016 quarterly monitoring events consist of landfill gas composition, groundwater elevations, calculated groundwater gradients and velocities, and groundwater quality data. Surface water quality data were obtained during the December 2016 sampling event, which was performed following several days of heavy precipitation. These data are summarized in this section and in Appendix A. Quarterly monitoring field notes associated with the monitoring events performed in 2016 are presented in Appendix B. The laboratory analytical data reports are provided in electronic format in Attachment 1 on the CD ROM included with this report.

Landfill Gas Data

Field measurements of landfill gas were taken from the three passive flares at the Landfill on March 24, 2016, June 21, 2016, September 21, 2016, and December 20, 2016. Landfill gas field measurement data tables are included in Appendix A. Data from the quarterly landfill gas monitoring events performed in 2016 are summarized in the following sections.

March 24, 2016 – First Quarter

- Methane was not detected in any of the flares. The calculated Lower Explosive Limit (LEL) value is 0% for all three flares.
- Carbon dioxide concentration measurements were 0.3%, 0.1%, and 1.6% by volume for Flares 1, 2, and 3, respectively.
- Oxygen concentration measurements were 20.3%, 20.4%, and 19.4% by volume in Flares 1, 2, and 3, respectively.
- Gas pressure measurements were 0.1, 0.1-0.3, and 0.48 inches of water in Flares 1, 2, and 3, respectively. Variable winds at the time of flare monitoring affected the gas pressure measurements.

June 21, 2016 – Second Quarter

- Methane was not detected in any of the flares. The calculated LEL value is 0% for all three flares.
- Carbon dioxide concentration measurements were 3.2%, 1.3%, and 7.1% by volume for Flares 1, 2, and 3, respectively.
- Oxygen concentration measurements were 17.8%, 16.2%, and 12.5% by volume in Flares 1, 2, and 3, respectively.
- Gas pressure measurements were 0.01, 0.01, and 0.00 inches of water in Flares 1, 2, and 3, respectively. Variable winds at the time of flare monitoring affected the gas pressure measurements.

September 21, 2016 – Third Quarter

- Methane was detected in Flares 1, 2, and 3 at concentrations of 0.3%, 0.3%, and 0.1% by volume, respectively. Calculated LEL values for Flares 1, 2, and 3 are 6%, 6%, and 2%, respectively.

- Carbon dioxide concentration measurements were 0.8%, 6.9%, and 8.1% by volume for Flares 1, 2, and 3, respectively.

- Oxygen concentration measurements were 17.4%, 10.2%, and 6.8% by volume in Flares 1, 2, and 3, respectively.

- Gas pressure measurements were 0.00 inches of water in all three flares indicating no flow from the flares during the monitoring event.

December 20, 2016 – Fourth Quarter

- Methane was not detected in any of the flares. The calculated LEL value is 0% for all three flares.

- Oxygen concentration measurements were 23.0%, 23.1%, and 22.9% by volume in Flares 1, 2, and 3, respectively.

- Carbon dioxide concentration measurements were 0.1%, 0.1%, and 0.2% by volume in Flares 1, 2, and 3, respectively.

- Gas pressure measurements were 0.00 to 0.05, 0.00 to 0.04, and 0.02 inches of water in Flares 1, 2, and 3, respectively. Variable winds at the time of flare monitoring affected the gas pressure measurements.

Groundwater Elevation, Flow Direction, Gradient, and Velocity

All monitoring wells installed at the Landfill, except for MW-5, are screened in a laterally continuous sand and gravel unit that has been interpreted as belonging to the same aquifer unit (Parametrix, Inc., 1988). Monitoring well MW-5 is screened in a shallow perched groundwater zone. Replacement monitoring well MW-5A was drilled at a nearby location to MW-5 and is screened in the same aquifer as the other monitoring wells at the Landfill.

The Permit and CAP do not require water level or water quality data to be collected from MW-5 as part of the monitoring program for the Landfill because the shallow perched groundwater zone that MW-5 is completed in is not hydraulically connected to the uppermost continuous aquifer in which the other Landfill monitoring wells are completed. However, SWD has elected to measure the depth to water in MW-5 as additional information. Depth to water measurements for MW-5 are included in the field notes presented in Appendix B.

The Permit and CAP specify annual monitoring of cross-gradient monitoring wells MW-5A and MW-7. As requested by the SWD, quarterly groundwater level measurements are made at

MW-5A and MW-7 to provide a more comprehensive data set for the groundwater elevation contour map and the groundwater elevation hydrograph.

The groundwater flow direction beneath the Landfill during the December 2016 monitoring event was generally toward the northwest as depicted in Figure 2. Based on the groundwater elevation contours the groundwater flow direction at the Landfill is toward the northwest, with potentially a western component near MW-3 and MW-10, as demonstrated by the quarterly groundwater elevation contour maps for all four quarters of 2016, which are presented in Appendix A. Groundwater elevation contour pattern and flow directions have been consistent throughout all four seasons and over many years of water level measurements.

The four quarters of groundwater flow direction figures for the Landfill are consistent with historical groundwater flow direction maps. The groundwater flow direction maps demonstrate that well MW-1 is consistently upgradient of the Landfill, wells MW-3, MW-6, MW-8, and MW-10 are downgradient of the Landfill, and wells MW-5A and MW-7 are consistently cross-gradient to the Landfill. Historically MW-7 was classified as a downgradient monitoring well but was reclassified as a cross-gradient well in 2013 based on consistent historical groundwater flow directions.

Groundwater elevation data from 1991 through the fourth quarter of 2016 for each of the on-site MFS monitoring wells (except MW-5) are plotted and shown on the water level elevation time-series graph in Appendix A.

December 2016 groundwater elevation data were mixed relative to the December 2015 groundwater elevation data. Water level elevations were higher in 2016 in five of the nine wells ranging in magnitude from 1.42 feet higher in cross-gradient well MW-7 to 3.91 feet higher in upgradient well MW-1. Water level elevations were lower in 2016 in four of the nine wells ranging in magnitude from 0.15 feet lower in downgradient well MW-3 to 1.96 feet lower in downgradient well MW-8.

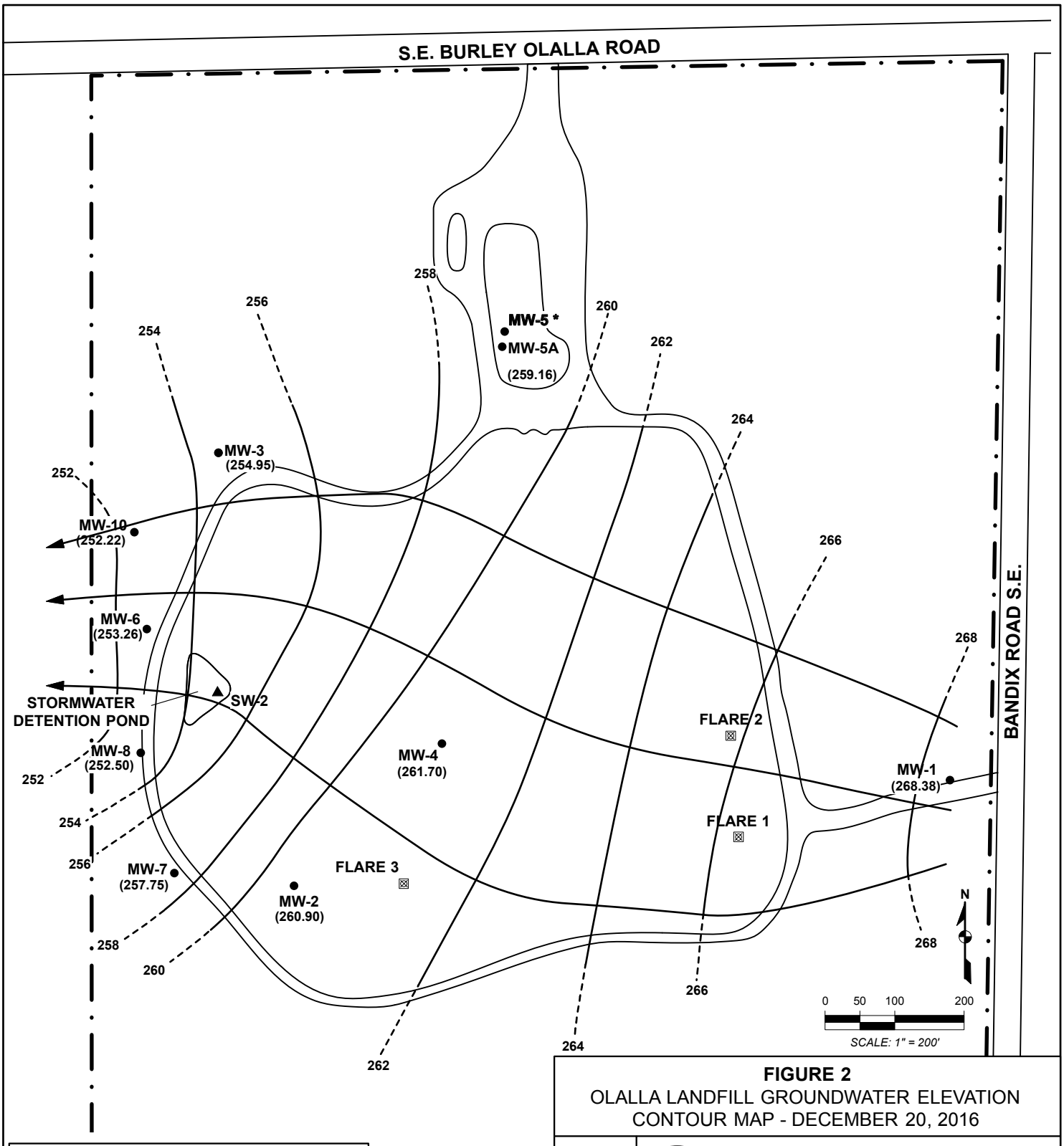
Precipitation data from the Bremerton Washington Airport Weather Station indicate that during water year 2016 (November 2015 to October 2016) the area near the Landfill received 81.54[1] inches of precipitation, which is significantly greater than the 59.83 inches of precipitation for water year 2015 (Weather Underground, 2017).

Groundwater flow rates based on the quarterly groundwater elevation contour maps have been calculated based on a modified form of Darcy's Law:

$$V = KI/n$$

Where: V = average linear velocity (L/T)
K = hydraulic conductivity (L/T)
I = hydraulic gradient (L/L [dimensionless])
n = effective porosity (percent expressed as a decimal)

[1] Likely erroneous precipitation value of 10.00 inches for March 25, 2016 was removed from data set for 2016 water year.



NOTES:

* MW-5 is completed in a shallow perched groundwater zone.

MW-2 ● MONITORING WELL LOCATION

SW-2 ▲ SURFACE WATER SAMPLING LOCATION

⊠ LANDFILL GAS FLARE

KEY:

GROUNDWATER ELEVATION CONTOUR

INFERRED GROUNDWATER FLOW PATH

APPROXIMATE PROPERTY BOUNDARY

PERIMETER ACCESS ROAD

FIGURE 2
OLALLA LANDFILL GROUNDWATER ELEVATION CONTOUR MAP - DECEMBER 20, 2016

PREPARED BY	epi ENVIRONMENTAL PARTNERS INC		
REPORT	2016 ANNUAL MONITORING REPORT		
LOCATION	OLALLA LANDFILL KITSAP COUNTY, WASHINGTON		
PREPARED FOR	KITSAP COUNTY		
DATE 2/21/17	*DRAWN BY* AM	*REVIEWED BY* DCK	*PROJECT NUMBER* 45404.0

The hydraulic conductivity "K" of the aquifer was calculated from the results of single well aquifer tests (slug tests) performed in monitoring wells MW-1, MW-2, MW-3, and MW-4. The range of values obtained from these tests indicated that the hydraulic conductivity of the uppermost aquifer at the Landfill is approximately 7×10^{-3} to 3×10^{-2} cm/sec, with an average value of 2.2×10^{-2} cm/sec (62.4 feet/day) (Parametrix, Inc., 1988). This value correlates well with the hydraulic conductivity values calculated using the Hazen equation for soil samples from MW-8 and MW-10, which were 1.2×10^{-2} cm/sec (34 feet/day) and 1.4×10^{-2} cm/sec (40 feet/day), respectively. The single well aquifer test hydraulic conductivity value of 2.2×10^{-2} cm/sec is used for groundwater velocity calculations.

The hydraulic gradient "I" of the aquifer is calculated from groundwater elevation contour maps presented in Appendix A. Average hydraulic gradients calculated for the four quarterly events at the Landfill range from 0.0130 in December 2016 to 0.0176 in September 2016.

The effective porosity "n" of the aquifer is estimated to be 0.40, which is a typical value for fine to medium-grained sand (Freeze and Cherry, 1979).

The resulting groundwater flow velocities "V" calculated from 2016 quarterly data range from 2.03 ft./day in December 2016 to 2.74 ft./day in September 2016. The calculated groundwater gradients and flow velocities are summarized in Table 1.

Table 1
2016 Olalla Landfill Calculated Groundwater Flow Velocities

Measurement Date	Calculated Hydraulic Gradient, (L/L)	Calculated Groundwater Flow Velocity (ft./day)
March 24, 2016	0.0138	2.15
June 21, 2016	0.0170	2.65
September 21, 2016	0.0176	2.74
December 20, 2016	0.0130	2.03

Surface Water Quality Data

Section IV.D.3.a of the KPHD-issued 2016-2020 SWHP for the Landfill states that surface water samples shall be collected at location SW-2 (see Figure 1) between January and March or between November and December if there is sufficient water for a sample.

Surface water station SW-2 had sufficient water flow to sample during the December 20, 2016 sampling event due to heavy rains in the days preceding the sampling event. A surface water sample was collected and analyzed from station SW-2 during the December 2016 sampling event.

A summary of surface water quality data is presented in Appendix A. Analytical results (laboratory data sheets) are presented as an electronic file (a PDF file) in Attachment 1 of the CD ROM for this report to reduce the amount of paper required to produce this report.

Groundwater Quality Data

A summary of the groundwater quality data for 2016 is presented in Appendix A. Laboratory data sheets for all field samples, duplicates, and laboratory quality control samples reported by ARI are presented as an electronic file in Attachment 1 of the CD ROM for this report.

Exceedances of Primary Regulatory Standards

Constituent concentrations in groundwater that exceeded Washington State Drinking Water Primary Standards (WAC 246-290-310) or Washington State Groundwater Primary Standards (WAC 173-300-040) are summarized in Table 2.

Table 2
2016 Water Quality Constituent Concentrations
Exceeding Washington State Primary Standards

Constituent	Drinking Water Standards[a]	Groundwater Quality Standards[b]	March	June	September	December
MW-1 (upgradient)						
Arsenic	10 µg/L	0.05 µg/L	0.09	0.09	0.10	0.10
MW-3 (downgradient)						
Arsenic	10 µg/L	0.05 µg/L	0.10	0.08	0.12	0.10
MW-5A (cross-gradient)						
Arsenic	10 µg/L	0.05 µg/L	NA	NA	NA	0.21
MW-6 (downgradient)						
Arsenic	10 µg/L	0.05 µg/L	0.90	0.81	1.21	1.20
Arsenic FD	10 µg/L	0.05 µg/L	0.80	0.78		
MW-7 (cross-gradient)						
Arsenic	10 µg/L	0.05 µg/L	NA	NA	NA	0.43
MW-8 (downgradient)						
Arsenic	10 µg/L	0.05 µg/L	2.20	1.89	1.74	2.71
Arsenic FD	10 µg/L	0.05 µg/L			1.77	
Vinyl Chloride	2 µg/L	0.02 µg/L		0.035	0.036	0.071
Vinyl Chloride FD	2 µg/L	0.02 µg/L			0.033	
MW-10 (downgradient)						
Arsenic	10 µg/L	0.05 µg/L	0.90	1.57	1.82	1.72
Arsenic FD	10 µg/L	0.05 µg/L				1.67

Notes:
Values are reported in the same units as the regulatory standards
FD = Field Duplicate
NA = Not Analyzed per the SWHP
[a] WAC 246-290-310
[b] WAC 173-200-040

Exceedances of Secondary Regulatory Standards

Constituent concentrations in groundwater that exceeded Washington State Drinking Water Secondary Standards (WAC 246-290-310) and Washington State Groundwater Secondary Standards (WAC 173-300-040) are summarized in Table 3.

Table 3
2016 Water Quality Constituent Concentrations
Exceeding Washington State Secondary Standards

Constituent	Drinking Water Standards[a]	Groundwater Quality Standards[b]	March	June	September	December
MW-1 (upgradient)						
pH (field)	--	6.5 – 8.5		5.8	6.3	
pH (lab)	--	6.5 – 8.5			6.2	6.4
MW-3 (downgradient)						
Manganese	50 µg/L	50 µg/L	2,430	2,460	6,820	6,610
pH (field)	--	6.5 – 8.5	6.4	5.7	6.1	6.3
pH (lab)	--	6.5 – 8.5		6.1	6.0	6.2
MW-5A (cross-gradient)						
MW-6 (downgradient)						
Iron	300 µg/L	300 µg/L		800	1,300	734
Iron FD	300 µg/L	300 µg/L		810		
Manganese	50 µg/L	50 µg/L	430	645	594	488
Manganese FD	50 µg/L	50 µg/L	405	634		
pH (field)	--	6.5 – 8.5		6.4		
pH (lab)	--	6.5 – 8.5			6.4	
MW-7 (cross-gradient)						
MW-8 (downgradient)						
Iron	300 µg/L	300 µg/L		320		1,080
Manganese	50 µg/L	50 µg/L	350	3,590	3,020	3,150
Manganese FD	50 µg/L	50 µg/L			2,980	
pH (field)	--	6.5 – 8.5		6.2		
MW-10 (downgradient)						
Manganese	50 µg/L	50 µg/L	5,440	6,470	4,370	4,120
Manganese FD	50 µg/L	50 µg/L				4,180
pH (field)	--	6.5 – 8.5	6.4	6.2		
pH (lab)	--	6.5 – 8.5			6.4	6.4
pH (lab) FD	--	6.5 – 8.5				6.4

Notes:
Values are reported in the same units as the regulatory standards
FD = Field Duplicate
[a] WAC 246-290-310
[b] WAC 173-200-040
[c] WAC 173-201A-200

STATISTICAL ANALYSIS

Statistical analysis of groundwater data uses four tools: Shapiro-Wilk test for normality, confidence intervals (parametric and non-parametric), time-series plots, and the Mann-Kendall test for trend. Application of these tools is based on statistical methods identified in the Unified Guidance. These four statistical tools, and non-statistical evaluation tools, are applied to the data following the process shown in Figure 3.

Statistical analyses are performed on a data set consisting of a moving window of the 20 most recent sampling events (as one new data point is added the oldest data point is dropped). For most wells, this is a five-year moving window of data. However, with MW-5A and MW-7 now on an annual sampling schedule SWD has clarified this moving window of data to be defined as 20 sampling events rather than five years of data. The moving window of 20 sampling events provides a sufficient number of data points for adequate statistical power while focusing the statistical evaluations on the most recent and most relevant data. Statistical analyses for the Landfill groundwater monitoring data are performed using the following criteria:

- Dissolved metals, VOCs, conventional water quality parameters, and field parameters required for groundwater analysis under Section IV.D.2 of the 2016-2020 SWHP for the Landfill are presented in two sets of time-series plots and tables showing summary results of Mann-Kendall, Shapiro-Wilk, and confidence interval tests.
- Statistical tests are not automatically performed for every constituent analyzed during quarterly groundwater monitoring. Some constituents have not been detected in the past 20 sampling events or have too few detected data points to support statistical analysis. Data sets that have fewer than four detected values in the past 20 events are not amenable to statistical evaluations. These data sets are temporarily dropped from the statistical evaluation process until they have the minimum number of detected values required for statistical evaluation.
- Non-detections are managed by assigning them a uniform value that is less than the reporting limit for that constituent as prescribed in Section 14.4.2.2 of the Unified Guidance. Recent guidance from the United States Geological Survey (USGS, 2008) suggests that censoring values that are less than the detection limit (non-detects) provides more accurate statistical results compared to substituting a value, commonly one half of the reporting limit. SWD assigns a value of zero to non-detected results as recommended by the USGS and KPHD. Estimated (J-qualified) results are reported as individual values as recommended by the USGS.
- VOC detections may include values at concentrations less than laboratory specified reporting limits (i.e., qualified with a J), but do not include values where the constituent was also detected in the method blank (i.e., values qualified with a B).
- Beginning in 2012, wells MW-5A and MW-7 are sampled at a reduced (annual) frequency and for a reduced list of constituents relative to the other Olalla Landfill monitoring wells. Thus, the statistical evaluations at MW-5A and MW-7 ended in 2012 for some constituents that were no longer analyzed but will continue at a reduced frequency for other constituents.

The following subsections briefly describe the tools used in the statistical evaluation and summarize analytical results for 2016.

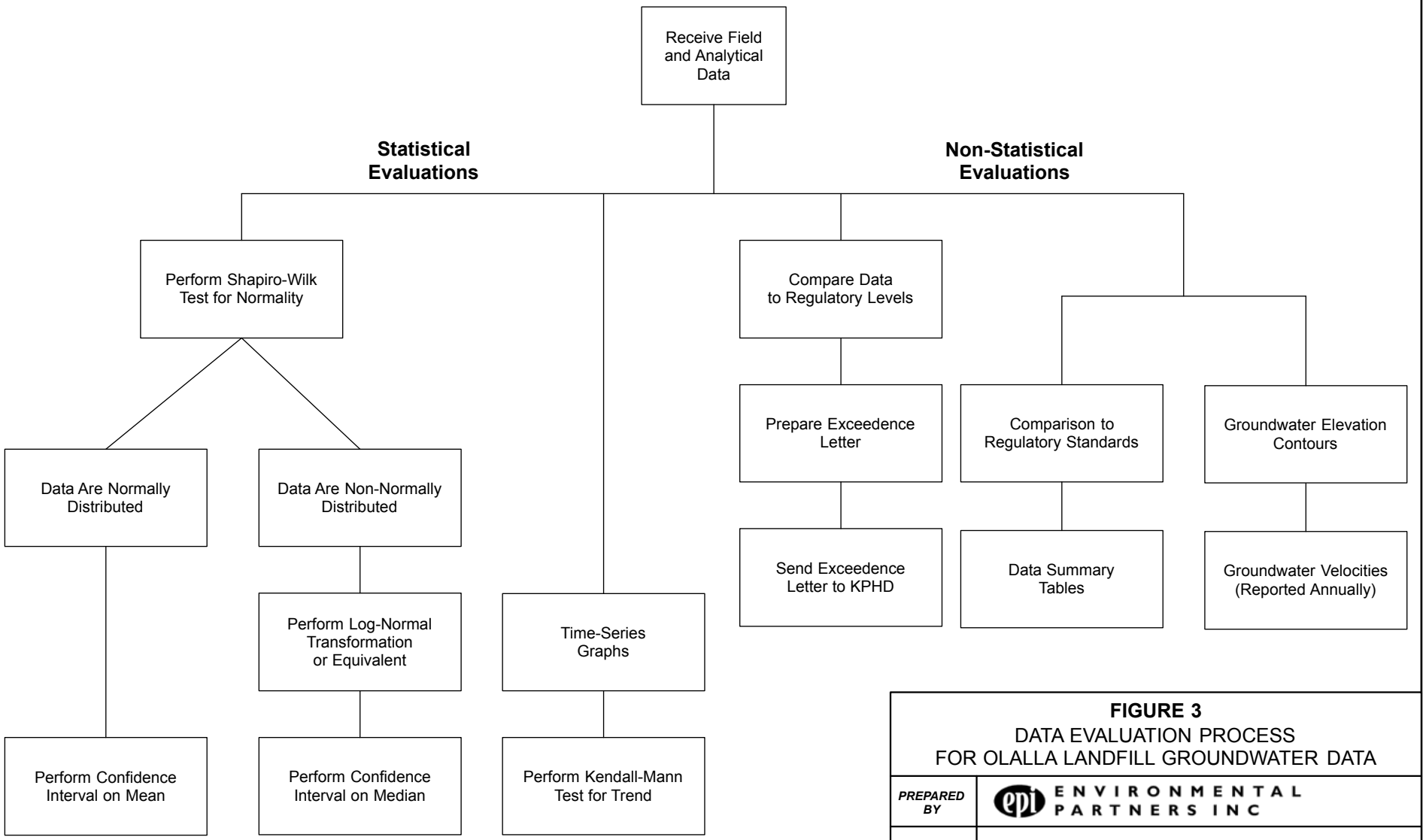


FIGURE 3
DATA EVALUATION PROCESS
FOR OLALLA LANDFILL GROUNDWATER DATA

PREPARED BY	ENVIRONMENTAL PARTNERS INC		
REPORT	2016 ANNUAL MONITORING REPORT		
LOCATION	OLALLA LANDFILL KITSAP COUNTY, WASHINGTON		
PREPARED FOR	KITSAP COUNTY		
DATE 1/11/17	***DRAWN BY*** AM	***REVIEWED BY*** DCK	***PROJECT NUMBER*** 45404.0

Time–Series Plots

Time-series plots are used to compare field measurements or analytical results from a well or a set of wells over time. The plots provide a convenient graphical means of delineating seasonal trends and large differences in concentration between upgradient and downgradient wells, and can be used to readily identify data that exceed regulatory levels. Time-series plots are presented by constituent for upgradient well MW-1, cross-gradient wells MW-5A and MW-7, and downgradient wells MW-3, MW-6, MW-8, and MW-10.

Historical data are presented as two time-series plots for each constituent. The first time-series plot for each constituent presents all quarterly data dating to 1992, when groundwater monitoring was initiated at the Landfill. This time-series plot is useful to graphically demonstrate that groundwater quality has improved over time. Because MW-8 and MW-10 are relatively new (installed in 2010) their data sets are smaller than for other wells in the full time-series plots. The second time-series plot for each constituent presents a moving five-year window of data providing a greater level of detail for more recent data that might not be readily seen at the scale required for time-series plots that graph all historical results.

The moving 20 event window of data adds new data with each successive quarter and drops data from the oldest quarter to maintain a consistent sample population of the most current 20 data points. Using the 20 most current data points corresponds to the same data set used in the other statistical analyses. Full and recent (20-event window) time-series plots are presented in Appendix C.

Applicable Washington State drinking water and groundwater regulatory levels are shown graphically on each time-series plot when possible. Some constituents have regulatory levels that are significantly greater than concentrations detected in groundwater samples from the Landfill and those regulatory levels might not be visible at the scale of the time-series plots. Increasing the Y-axis scale to accommodate the applicable regulatory level would compress the analytical data resulting in a loss of detail on the time-series plots.

Mann-Kendall Trend Test

The Mann-Kendall trend test is a non-parametric statistical method recommended in the Unified Guidance for sites in the compliance assessment and corrective action monitoring phases and is appropriately paired with time-series plots. For this report, the Mann-Kendall trend test is used to determine if upward or downward data trends graphically presented in time-series plots are statistically significant. The Mann-Kendall test is applied to the same five-year moving window of data described in the Time-Series Plots section. December 2016 Mann-Kendall Trend Test results are presented in Table 4 and are summarized in the following bullets. Tabulated Mann-Kendall trend test results for all four quarters of 2016 are presented in Appendix C.

As described in the 2016-2020 SWHP, cross-gradient wells MW-5A and MW-7 are sampled annually for a reduced list of constituents relative to the other Olalla Landfill monitoring wells. The SWHP also specifies the fourth quarter monitoring event as the annual monitoring event during which MW-5A and MW-7 are sampled for the reduced list of constituents included in Table 4.

Table 4: December 2016 Mann-Kendall Statistically Significant Trend Test Results

Constituent or Parameter	MW-1	MW-3	MW-5A	MW-6	MW-7	MW-8	MW-10
Ammonia (N)	NO TREND	NO TREND	NA	NO TREND	NA	NO TREND	NO TREND
Arsenic - Dissolved	NO TREND	NO TREND	NO TREND	**UP**	NO TREND	**UP**	**DOWN**
Barium - Dissolved	**UP**	NO TREND	NA	NO TREND	NA	NO TREND	NO TREND
Bicarbonate	NO TREND	NO TREND	NA	NO TREND	NA	NO TREND	NO TREND
Calcium	**UP**	NO TREND	NA	NO TREND	NA	NO TREND	NO TREND
Carbonate	NO TREND	NO TREND	NA	NO TREND	NA	NO TREND	NO TREND
COD	NO TREND	NO TREND	NA	NO TREND	NA	NO TREND	NO TREND
Chloride	**UP**	**UP**	NA	NO TREND	NA	NO TREND	**DOWN**
Dissolved Oxygen	NO TREND	**UP**	NO TREND	**UP**	NO TREND	**UP**	**UP**
Iron - Dissolved	NO TREND	NO TREND	NO TREND	NO TREND	NO TREND	NO TREND	NO TREND
Manganese - Dissolved	NO TREND	**UP**	NO TREND	NO TREND	NO TREND	NO TREND	NO TREND
Nitrate	NO TREND	NO TREND	NA	NO TREND	NA	NO TREND	NO TREND
Nitrite	NO TREND	NO TREND	NA	NO TREND	NA	**DOWN**	NO TREND
Oxidation Reduction Potential	NO TREND	NO TREND	NO TREND	NO TREND	NO TREND	NO TREND	NO TREND
pH - Field	NO TREND	NO TREND	NO TREND	NO TREND	NO TREND	NO TREND	NO TREND
pH - Laboratory	NO TREND	NO TREND	**DOWN**	NO TREND	**DOWN**	NO TREND	**DOWN**
Potassium	NO TREND	NO TREND	NA	NO TREND	NA	NO TREND	NO TREND
Sodium	**UP**	NO TREND	NA	NO TREND	NA	NO TREND	NO TREND
Specific Conductance	NO TREND	NO TREND	NO TREND	NO TREND	**DOWN**	NO TREND	NO TREND
Sulfate	NO TREND	NO TREND	NA	NO TREND	NA	NO TREND	NO TREND
Temperature	**DOWN**	**DOWN**	**DOWN**	**DOWN**	NO TREND	**DOWN**	**DOWN**
Total Coliform	**DOWN**	NO TREND	NA	NO TREND	NA	NO TREND	NO TREND
TOC	NO TREND	NO TREND	NA	NO TREND	NA	NO TREND	NO TREND
Vinyl Chloride	NO TREND	NO TREND	NO TREND	**DOWN**	NO TREND	NO TREND	**DOWN**
Zinc - Dissolved	NO TREND	NO TREND	NA	NO TREND	NA	NO TREND	NO TREND

NO TREND = No statistically significant trend.
UP = Statistically significant upward trend.
DOWN = Statistically significant downward trend.
NA = Not analyzed per the SWHP

- Sixteen well-constituent combinations have statistically significant downward concentration trends. The 16 downward well-constituent combination trends are:
    - Arsenic: MW-10
    - Chloride: MW-10
    - Nitrite: MW-8
    - pH (laboratory): MW-5A, MW-7, and MW-10
    - Specific Conductance: MW-7
    - Temperature: MW-1, MW-3, MW-5A, MW-6, MW-8, and MW-10
    - Total Coliform: MW-1
    - Vinyl Chloride: MW-6 and MW-10
- Two of the 16 well-constituent combinations with statistically significant downward concentration trends also have regulatory standard exceedances in December 2016 data. The two well-constituent combinations are arsenic and pH (laboratory) at MW-10.
- Twelve well-constituent combinations have statistically significant upward concentration trends. The 12 upward well-constituent combination trends are:
    - Arsenic: MW-6 and MW-8
    - Barium: MW-1
    - Calcium: MW-1
    - Chloride: MW-1 and MW-3
    - Dissolved Oxygen: MW-3, MW-6, MW-8, and MW-10
    - Manganese: MW-3
    - Sodium: MW-1
- Four of the 12 statistically significant upward concentration trends are for constituents in the data set from upgradient well MW-1. Those constituents are: barium, calcium, chloride, and sodium.
- Three of the 12 well constituent combinations with statistically significant upward concentration trends also have regulatory standard exceedances in December 2016 data. The three well-constituent combinations are arsenic at MW-6 and MW-8 and manganese at MW-3.
- There are 147 well-constituent combinations that have no statistically significant concentration trend or the constituents are no longer analyzed in wells MW-5A and MW-7 per the SWHP. Of these 147 well-constituent combinations with no statistically significant trends samples from the wells listed in the following bullets exceed regulatory levels.
    - Arsenic in samples from MW-1, MW-3, MW-5A, and MW-7 exceed the Washington State Groundwater Primary Standard of 0.05 μg/L.
    - Iron in the samples from MW-6 and MW-8 exceed the Washington State Groundwater and Drinking Water Secondary Standards of 300 μg/L.

- Manganese in samples from MW-6, MW-8, MW-10, and MW-13 (field duplicate of MW-10) respectively, exceed the Washington State Groundwater and Drinking Water Secondary Standards of 50 μg/L.

- Field-measured pH in purge water from well MW-3 is lower than the low value of the Washington State Groundwater Secondary Standard range of 6.5 to 8.5.

- Laboratory-measured pH values in the samples from MW-1 and MW-3 are lower than the low value of the Washington State Secondary Groundwater Standard range of 6.5 to 8.5.

Shapiro-Wilk Test for Normality

The Shapiro-Wilk Test for Normality is a method recommended in the Unified Guidance for evaluating if data sets are normally distributed. The Shapiro-Wilk Test for Normality is applied annually to the five-year moving window of analytical data for each well-constituent pair that has enough data points to apply this statistical method. Shapiro-Wilk results for the December 2016 monitoring event are summarized in Table 5 and in the following bullets. Shapiro-Wilk result summary tables for all four quarters of 2016 are presented in Appendix C.

As described in the Mann-Kendall Trend Test section, MW-5A and MW-7 are sampled at a reduced frequency (annually) and for a reduced list of constituents relative to the other Olalla Landfill monitoring wells and the Shapiro-Wilk statistical evaluations of the reduced list of constituents are included in Table 5.

- There are 175 well-constituent combinations presented in Table 5.

- Sixty-two well-constituent combinations had fewer than four detections and could not be tested for normality or the constituents are no longer analyzed in wells MW-5A and MW-7 per the SWHP; the remaining 113 well-constituent combinations were tested for normality.

- Normal data distributions were noted in 61 of the 113 well-constituent combinations that were tested for normality.

- Non-normal data distributions were noted in 52 of the 113 well-constituent combinations tested for normality.

Data that are normally distributed are evaluated using the 95% confidence interval around the mean (a parametric statistical test). Data that are not normally distributed are adjusted by log-normal transformation prior to being evaluated using the 95% confidence interval around the median (a non-parametric statistical test).

Table 5: December 2016 Shapiro-Wilk Test for Normality Results

Constituent or Parameter	MW-1	MW-3	MW-5A	MW-6	MW-7	MW-8	MW-10
Ammonia (N)	Non-Normal	Non-Normal	NA	Non-Normal	NA	Normal	Non-Normal
Arsenic - Dissolved	Non-Normal	Non-Normal	Non-Normal	Normal	Normal	Non-Normal	Normal
Barium - Dissolved	Non-Normal	Normal	NA	Normal	NA	Normal	Normal
Bicarbonate	Normal	Non-Normal	NA	Normal	NA	Normal	Normal
Calcium	Normal	Normal	NA	Normal	NA	Normal	Normal
Carbonate	ND	ND	NA	ND	NA	ND	ND
COD	ND	ND	NA	ND	NA	ND	Non-Normal
Chloride	Non-Normal	Non-Normal	NA	Non-Normal	NA	Non-Normal	Normal
Dissolved Oxygen	Normal	Non-Normal	Normal	Non-Normal	Normal	Non-Normal	Non-Normal
Iron - Dissolved	ND	ND	ND	Normal	ND	Non-Normal	ND
Manganese - Dissolved	ND	Normal	ND	Normal	ND	Normal	Normal
Nitrate	Normal	Non-Normal	NA	Non-Normal	NA	Non-Normal	Non-Normal
Nitrite	Non-Normal	ND	NA	Non-Normal	NA	Non-Normal	Non-Normal
Oxidation-Reduction Potential	Non-Normal	Normal	Normal	Non-Normal	Normal	Non-Normal	Non-Normal
pH - Field	Normal	Normal	Non-Normal	Normal	Normal	Non-Normal	Normal
pH - Laboratory	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Potassium	Non-Normal	Non-Normal	NA	Non-Normal	NA	Non-Normal	Non-Normal
Sodium	Normal	Normal	NA	Normal	NA	Normal	Normal
Specific Conductance	Non-Normal	Normal	Non-Normal	Normal	Non-Normal	Non-Normal	Normal
Sulfate	Normal	Normal	NA	Non-Normal	NA	Normal	Non-Normal
Temperature	Normal	Normal	Normal	Normal	Normal	Normal	Non-Normal
Total Coliform	Non-Normal	ND	NA	ND	NA	ND	ND
TOC	ND	Normal	NA	Normal	NA	Non-Normal	Non-Normal
Vinyl Chloride	ND	ND	ND	Non-Normal	ND	Non-Normal	Non-Normal
Zinc - Dissolved	ND	ND	NA	ND	NA	ND	ND

Notes:
ND = Data set has four or fewer quarters with detects and statistical tests cannot be performed.
NA = Not analyzed per the SWHP

Confidence Interval

The statistical test for confidence interval is recommended in the Unified Guidance and is appropriate for compliance assessment and corrective action monitoring phases. In addition, evaluation of the confidence interval is appropriate when analytical data are compared to a fixed limit such as a regulatory standard. Confidence intervals are a common and statistically defensible way to assess compliance with a fixed numerical limit.

A moving 20 event window of data was evaluated for the 95% confidence interval for each well-constituent pair that had enough data points to apply this statistical method. The moving 20 event window of data adds a new data point with each successive quarter and drops the data from the oldest quarter to maintain a consistent sample population of the most current 20 events of data.

Confidence interval results for December 2016 are compared to Washington State Drinking Water and Groundwater Quality Standards and are summarized in Table 6. Confidence interval summaries for all four quarters of 2016 are presented in Appendix C. Exceedance of a regulatory standard is triggered when the lower 95% confidence interval is greater than the regulatory standard. Exceedances are highlighted in red on Table 6. Successful remediation is attained if the upper 95% confidence limit does not exceed the regulatory standard, which is highlighted in green on Table 6. In some cases, the upper 95% confidence interval exceeds the regulatory standard but the lower 95% confidence interval does not. This condition is not an exceedance but should be monitored for changes and is highlighted in yellow on Table 6.

Observations regarding the 95% confidence interval results are summarized in the following bullets:

- Sixty-three of the well-constituent combinations evaluated had an insufficient number of detections in the moving five-year window of data to perform the statistical analysis or the constituents are no longer analyzed in wells MW-5A and MW-7 per the SWHP. These well-constituent combinations were not evaluated statistically and are represented as ND (not detected) or NA (not analyzed) in Table 6.

- Confidence intervals were evaluated for remaining 112 well-constituent combinations.

- Eighty-eight of the well-constituent combinations that were statistically evaluated had 95% confidence intervals that did not exceed applicable regulatory standards or have no applicable regulatory standards.

Table 6: December 2016 Results of 95% Confidence Interval Evaluations

Constituent or Parameter	MW-1	MW-3	MW-5A	MW-6	MW-7	MW-8	MW-10	Regulatory Level	Basis for Comparison
Ammonia (N)	ND to 40	ND to 40	NA	ND to 40	NA	36 to 88	22 to 83	None	
Arsenic - Dissolved	**0.085 to 0.103**	**0.089 to 0.122**	**0.124 to 0.189**	**0.789 to 0.992**	**0.334 to 0.436**	**0.749 to 1.74**	**2.10 to 2.60**	0.05 µg/L	Primary GW Standard
Barium - Dissolved	**ND**	**12.5 to 15.3**	NA	**9.11 to 12.5**	NA	**6.82 to 8.54**	**11.6 to 14.5**	1000 µg/L	Primary GW Standard
Bicarbonate (mg of $CaCO_3$/L)	36.6 to 44.4	96.2 to 133	NA	101 to 139	NA	84.9 to 108	142 to 165	None	
Calcium	10,512 to 11, 407	38,618 to 47,056	NA	25,452 to 33,729	NA	18,746 to 23,542	35,174 to 40,003	None	
Carbonate (mg of $CaCO_3$/L)	ND	ND	NA	ND	NA	ND	ND	None	
COD	ND	ND	NA	ND	NA	ND	ND to 11.4	None	
Chloride	**2,910 to 4,620**	**2,840 to 3,380**	NA	**1,800 to 2,300**	NA	**2,050 to 2,350**	**5,199 to 8,504**	250,000 µg/L	Secondary GW and DW Standard
Dissolved Oxygen (mg/L)	9.6 to 10.3	0.0 to 11.6	8.93 to 10.7	0.00 to 0.43	6.45 to 9.68	0.0 to 17.3	0.0 to .47	None	
Iron - Dissolved	**ND**	**ND**	**ND**	**771 to 1,264**	**ND**	**ND to 471**	**ND**	300 µg/L	Secondary GW and DW Standard
Manganese - Dissolved	**ND**	**2,679 to 4,004**	**ND**	**547 to 663**	**ND**	**2,147 to 3,330**	**4,175 to 4,901**	50 µg/L	Secondary GW and DW Standard
Nitrate	**346 to 598**	**ND to 28**	NA	**ND to 13**	NA	**ND to 84**	**ND to 20**	10,000 µg/L	Primary GW and DW Standard
Nitrite	**ND to 4**	**ND**	NA	**ND to 5**	NA	**ND to 4**	**ND to 3**	1,000 µg/L	Primary DW Standard
Oxidation-Reduction Potential	116 to 186	127 to 211	101 to 155	11 to 38	82 to 133	32.8 to 54	73 to 134.9	None	
pH - Field	**6.1 to 6.3**	**6.1 to 6.2**	**6.4 to 6.6**	**6.5 to 6.7**	**6.4 to 6.7**	**6.5 to 6.7**	**6.4 to 6.6**	6.5 - 8.5	Secondary GW Standard
pH - Laboratory	**6.5 to 6.7**	**6.3 to 6.4**	**6.7 to 6.9**	**6.7 to 6.8**	**6.7 to 7.0**	**6.7 to 6.9**	**6.6 to 6.8**	6.5 - 8.5	Secondary GW Standard

Table 6: December 2016 Results of 95% Confidence Interval Evaluations

Constituent or Parameter	MW-1	MW-3	MW-5A	MW-6	MW-7	MW-8	MW-10	Regulatory Level	Basis for Comparison
Potassium	ND to 710	ND to 1030	NA	1220 to 1540	NA	900 to 1080	984 to 1210	None	
Sodium	**4,304 to 4,647**	**8,305 to 9,381**	NA	**6,759 to 7,974**	NA	**6,992 to 8,008**	**9,286 to 10, 857**	20,000 µg/L	Secondary DW Standard
Specific Conductance (µmhos/cm)	**124 to 131.1**	**338 to 425**	**128 to 157**	**246 to 334**	**110 to 155**	**187 to 226**	**357 to 407**	700 µmhos/cm	Secondary DW Standard
Sulfate	**3,964 to 4,504**	**13,630 to 18,291**	NA	**7,250 to 10,600**	NA	**4.099 to 5,070**	**7,190 to 9,760**	250,000 µg/L	Secondary GW and DW Standard
Temperature (°C)	11.3 to 12.6	12.0 to 12.8	12.5 to 13.5	11.8 to 12.7	10.9 to 12.0	11.2 to 12.1	11.6 to 12.3	None	
Total Coliform (count)	**ND to 1**	**ND**	NA	**ND**	NA	**ND**	**ND**	1/100mL	Primary GW and DW Standard
TOC	ND	2,254 to 2,905	NA	1,659 to 2,042	NA	ND to 1,000	2,830 to 3,260	None	
Vinyl Chloride	**ND**	**ND**	**ND**	**ND to 0.02**	**ND**	**ND to 0.04**	**ND to 0.03**	0.02 µg/L	Primary GW Standard
Zinc - Dissolved	**ND**	**ND**	NA	**ND**	NA	**ND**	**ND**	5,000 µg/L	Secondary GW and DW Standard

Notes:

All concentrations reported as µg/L unless otherwise noted.

NA = Not analyzed per the SWHP

ND = Data all non-detects or 4 or fewer detections

= 95% Lower CI Exceeds Regulatory Level (Exceedence)

= 95% Upper CI Exceeds Regulatory Level but Lower CI Does Not (No Exceedence, No Compliance)

= 95% Upper CI Does not Exceed Regulatory Level (No Exceedence)

= No Regulatory Level

Normally Distributed Data - Parametric Confidence Interval - Data not Transformed

Non-Normally Distributed Data - Non-Parametric Confidence Interval - Log Base-10 Transformed Data

Non-Detects treated as 0

- Fifteen of the well-constituent combinations that were statistically evaluated had lower 95% confidence intervals that were greater than applicable regulatory levels (are exceedances). The exceedances are highlighted red in Table 6 and are summarized in the following bullets:

    - Arsenic: MW-1, MW-3, MW-5A, MW-6, MW-7, MW-8, and MW-10
    - Iron: MW-6
    - Manganese: MW-3, MW-6, MW-8, and MW-10
    - pH (field): MW-1 and MW-3
    - pH (laboratory): MW-3

- Eight well-constituent combinations have upper 95% confidence intervals that were greater than (less than in the case of pH) applicable regulatory levels but have lower 95% confidence intervals that are less than applicable regulatory levels. These are not statistical exceedances but they should be monitored for changes. The well-constituent combinations are highlighted yellow in Table 6 and are summarized in the following bullets:

    - Iron: MW-8
    - pH (field): MW-5A, MW-6, and MW-10
    - Total Coliform: MW-1
    - Vinyl Chloride: MW-6, MW-8, and MW-10

CONCLUSIONS

Quarterly monitoring data collected during 2016 at the Olalla Landfill are summarized in the following sections.

Landfill Gas Data

Landfill gas field measurements were performed at the three onsite passive flares during the four quarterly monitoring events in 2016. Landfill gas data for all four quarterly monitoring events are included in Appendix A and are summarized in the following sections.

March 24, 2016 - First Quarter

None of the three flares had measurable concentrations of methane; however, Flare 1 and Flare 2 had trace concentrations of carbon dioxide and Flare 3 had a carbon dioxide concentration of 1.6 % by volume. In addition, Flare 3 had a slightly depleted oxygen concentration, indicating an influence of the biodegradation of organics.

Gas pressure measurements ranged from 0.1 to 0.48 inches of water, which was likely affected by windy conditions at the time of measurement. These low-pressure readings indicate a low potential for landfill gas flow from the flares.

Weather station data from the Bremerton Airport (Station KPWT) indicate that mean barometric pressure decreased slightly from a high of 30.3 inches of mercury on March 23, 2016 to 30.14 inches of mercury on March 24, 2016, the day that the flares were measured (source Weather Underground, 2016). The decreasing barometric pressure just prior to and during the March 24, 2016 measurement event likely caused subsurface landfill gas, which was in equilibrium with previous higher barometric pressure, to flow from the subsurface into the flares resulting in the measured presence of landfill gas indicators.

June 21, 2016 - Second Quarter

None of the three flares had measurable concentrations of methane; however, all three flares had depressed oxygen concentrations and measurable concentrations of carbon dioxide indicating an influence of the biodegradation of organics.

Gas pressure measurements ranged from 0.0 to 0.01 inches of water. These zero to low pressure readings indicate a low potential for landfill gas flow from the flares.

Weather station data from the Bremerton Airport (Station KPWT) indicate that barometric pressure increased slightly from of 30.19 inches of mercury on June 20, 2016 to 30.26 inches of mercury on June 21, 2016, the day that the flares were measured (source Weather Underground, 2016). This increase in barometric pressure likely contributed to the zero to very low pressure measurements noted in all three flares.

September 21, 2016 - Third Quarter

Methane was detected in all three flares at concentrations ranging from 1.7% to 8.9% by volume. The presence of methane in combination with depressed oxygen concentrations, ranging from 0.0% to 10.5%, and elevated carbon dioxide concentrations, ranging from 3.6% to 14.3%, indicate the presence of landfill gas in all three flares.

Gas pressure measurements ranged from 0.0 to 0.03 inches of water. The low gas pressure readings indicate a low potential for landfill gas flow from the flares.

Weather station data from the Bremerton Airport (Station KPWT) indicate that barometric pressure decreased from of 30.16 inches of mercury on September 20, 2016 to 30.07 inches of mercury on September 21, 2016, the day that the flares were measured (source Weather Underground, 2016). This decrease in barometric pressure likely contributed to the presence of landfill gas indicators that were noted in all three flares.

December 20, 2016 - Fourth Quarter

None of the three flares had measurable concentrations of methane or depleted oxygen concentrations. However, all three flares had trace concentrations of carbon dioxide. which could indicate a minor influence of the biodegradation of organics.

Gas pressure measurements ranged from 0.00 to 0.05 inches of water. Variable winds at the time of flare monitoring affected the gas pressure measurements. The low gas pressure readings indicate a low potential for landfill gas flow from the flares.

Weather station data from Bremerton Airport (Station KPWT) indicate that barometric pressure rose from a low of 29.88 inches of mercury on December 19, 2016 to 30.52 inches of mercury on December 20, 2016, the day that flare measurements were made (Weather Underground, 2017). The increasing barometric pressure the day of the measurement event likely contributed to gas being retained in the subsurface at the time of the monitoring event.

Groundwater Elevation and Flow Direction Data

The groundwater flow direction beneath the Landfill is generally toward the northwest, with groundwater from beneath the Landfill flowing toward downgradient wells MW-3, MW-6, MW-8, and MW-10 as depicted in the quarterly groundwater elevation contour and flow direction figures presented in Attachment A. The groundwater flow directions and elevation contour patterns are consistent with historical groundwater elevation data from the Landfill.

The lowest calculated groundwater gradient among the four quarters of 2016 occurred in December 20, 2016 with a horizontal gradient of 0.0130. The resulting calculated groundwater flow velocity is 2.03 ft./day. Groundwater gradients and calculated groundwater velocities were greatest during September 21, 2016, which had a horizontal gradient of 0.0176 and a calculated flow velocity of 2.74 ft./day.

Exceedances of Primary Regulatory Standards

Upgradient Well (MW-1)

Arsenic

- Groundwater samples collected from MW-1 during the four quarterly monitoring events of 2016 had arsenic concentrations ranging from 0.09 μg/L in March and June to 0.10 μg/L in September and December. Arsenic concentrations exceed the Washington State Groundwater Primary Standard of 0.05 μg/L in samples from MW-1 during all four quarters. Arsenic concentrations in the samples from MW-1 were significantly less than both the Washington State Drinking Water Primary Standard of 10 μg/L and the site-specific Cleanup Level of 1.29 μg/L.
- The presence of arsenic at concentrations greater than the Washington State Groundwater Primary Standard in samples from upgradient well MW-1 is an indication that dissolution of naturally-occurring arsenic in soil contributes to the arsenic concentrations noted in groundwater data from other wells at the Landfill.

Cross-Gradient Wells (MW-5A and MW-7)

Arsenic
MW-5A, MW-7

- Per the SWHP and CMP, cross-gradient wells MW-5A and MW-7 were not sampled during the first three quarterly monitoring events. Groundwater samples collected from MW-5A and MW-7 during the December monitoring event had arsenic concentrations of 0.21 μg/L and 0.43 μg/L, respectively. These concentrations exceed the Washington State Groundwater Primary Standard of 0.05 μg/L but are less than both the Washington State Drinking Water Primary Standard of 10 μg/L and the site-specific Cleanup Level of 1.29 μg/L.
- The presence of arsenic at concentrations greater than the Washington State Groundwater Primary Standard in samples from cross-gradient wells MW-5A and MW-7 is an indication that dissolution of naturally occurring arsenic in soil contributes to the arsenic concentrations noted in groundwater data from other wells at the Landfill.

Downgradient Wells (MW-3, MW-6, MW-8, and MW-10)

Arsenic
MW-3, MW-6, MW-8, and MW-10

- Groundwater samples from downgradient monitoring wells had arsenic concentrations exceeding the Washington State Groundwater Primary Standard of 0.05 μg/L during the four quarterly events in 2016. None of the arsenic concentrations detected during 2016 exceed the Washington State Drinking Water Primary Standard of 10 μg/L. Arsenic concentrations for specific wells are summarized in the following bullets:
    - MW-3 had arsenic concentrations ranging from 0.08 μg/L in June to 0.12 μg/L in September.
    - MW-6 had arsenic concentrations ranging from 0.81 μg/L in June to 1.21 μg/L in September. Arsenic concentrations in samples from MW-6 exhibit an increasing trend as noted in Table 4.

- MW-8 had arsenic concentrations ranging from 1.74 μg/L in September to 2.71 μg/L in December. Arsenic concentrations in samples from MW-8 exhibit an increasing trend as noted in Table 4.
- MW-10 had arsenic concentrations ranging from 0.90 μg/L in March to 1.82 μg/L in September. Arsenic concentrations in samples from MW-10 exhibit a decreasing trend as noted in Table 4.

Vinyl Chloride
MW-8

- Vinyl chloride was detected in the June, September, and December samples from MW-8 at concentrations of 0.035 μg/L, 0.036 μg/L, and 0.071 μg/L, respectively. These concentrations exceed the Washington State Groundwater Primary Standard of 0.02 μg/L but do not exceed the Washington State Drinking Water Primary Standard of 2.0 μg/L or the site-specific Cleanup Level of 0.29 μg/L.
- Vinyl chloride concentrations have generally declined in downgradient wells, most notably in samples from MW-6 and MW-10 as demonstrated by the statistically significant downward trends noted in Table 4.
- Vinyl chloride was not detected in samples from downgradient wells MW-3, MW-6, and MW-10 during any of the four quarterly monitoring events of 2016.

Exceedances of Secondary Regulatory Standards

Upgradient Well (MW-1)

pH (field-measured)

- Groundwater purged from well MW-1 had field-measured pH values of 5.8 and 6.3 during the June and September monitoring events, respectively. These values are lower than the lower limit of the 6.5 to 8.5 range for the Washington State Groundwater Secondary Standard.

pH (laboratory-measured)

- Groundwater samples from well MW-1 had laboratory-measured pH values of 6.2 and 6.4 during the September and December monitoring events, respectively. These values are lower than the lower limit of 6.5 for the Washington State Groundwater Secondary Standard.

Cross-gradient Wells (MW-5A and MW-7)

There were no exceedances of the Washington State Groundwater Secondary Standards for samples from cross-gradient wells MW-5A and MW-7.

Downgradient Wells (MW-3, MW-6, MW-8, and MW-10)

Iron
MW-6 and MW-8

- Iron is a common constituent in landfill leachate and iron concentrations in groundwater samples from downgradient wells MW-6 and MW-8 exceeded the Washington State

Drinking Water Secondary Standard and Groundwater Secondary Standard of 300 μg/L during some of the quarterly monitoring events in 2016 as summarized below

- MW-6 had iron concentrations of 800 μg/L, 1,300 μg/L, and 734 μg/L for the June, September, and December sampling events, respectively. Iron concentrations in samples from MW-6 have generally decreased since approximately 2000 but exhibit no statistical trend in the more recent data.
- MW-8 had iron concentrations of 320 μg/L and 1,080 μg/L during the June and December sampling events, respectively.

Manganese

MW-3, MW-6, MW-8, and MW-10

- Manganese is a common constituent of landfill leachate and manganese concentrations in groundwater samples from downgradient wells MW-3 MW-6, MW-8, and MW-10 exceeded the Washington State Drinking Water Secondary Standard and Groundwater Secondary Standard of 50 μg/L during all four quarterly monitoring events in 2016 as summarized below.
  - MW-3 had manganese concentrations ranging from 2,430 μg/L in March to 6,820 μg/L in September. Manganese concentrations in samples from MW-3 exhibit an increasing trend as noted in Table 4.
  - MW-6 had manganese concentrations ranging from 430 μg/L in March to 645 μg/L in June. Manganese concentrations have generally decreased in samples from well MW-6 since peaking in 1997 but exhibit no statistical trend in the more recent data
  - MW-8 had manganese concentrations ranging from 350 μg/L in March to 3,590 μg/L in June.
  - MW-10 had manganese concentrations ranging from 4,120 μg/L in December to 6,470 μg/L in June.

pH (field-measured)

MW-3, MW-6, MW-8, and MW-10

- Purge water from downgradient monitoring wells MW-3, MW-6, MW-8, and MW-10 had field-measured pH values of less than the lower limit of the 6.5 to 8.5 range of the Washington State Groundwater Secondary Standard during at least one quarterly event in 2016 as summarized below.
  - MW-3 had field-measured pH values ranging from 5.7 in June to 6.4 in March.
  - MW-6 had a field-measured pH of 6.4 in June.
  - MW-8 had a field-measured pH of 6.2 in June.
  - MW-10 had field-measured pH values of 6.4 and 6.2 in March and June, respectively.

pH (laboratory-measured)

MW-3, MW-6, and MW-10

- Purge water from downgradient monitoring wells MW-3, MW-6, and MW-10 had laboratory-measured pH values of less than the lower limit of the 6.5 to 8.5 range of the Washington State Groundwater Secondary Standard during at least one quarterly event in 2016 as summarized below.
    - MW-3 had laboratory-measured pH values of 6.1, 6.0, and 6.2 in June, September, and December, respectively.
    - MW-6 had a laboratory-measured pH value of 6.4 in September.
    - MW-10 had laboratory-measured pH values of 6.4 in September and December. There is a statistically significant downward trend in laboratory pH values for samples from MW-10 as noted in Table 4.

Analytical Tests for Volatile Organic Compounds

This section lists and describes detections of additional VOC constituents in groundwater samples from the Landfill monitoring well network. The VOC detections listed in this section are at concentrations less than applicable Washington State Drinking Water Standards or Washington State Groundwater Quality Standards or are for VOCs that do not have applicable groundwater standards.

- Chlorobenzene was detected in samples from MW-6 at concentrations of 1.30 μg/L, 1.60 μg/L, 1.83 μg/L, and 2.14 μg/L in March, June, September, and December, respectively. These concentrations are significantly less than the Washington State Drinking Water Standard of 100 μg/L. There is no Washington State Groundwater Standard for chlorobenzene.

- cis-1,2-Dichloroethene was detected in the following samples:
    - MW-3 at a concentration of 0.20 μg/L in September.
    - MW-8 at concentrations of 2.5 μg/L, 0.30 μg/L, 0.33 μg/L, and 0.40 μg/L in March, June, September, and December, respectively.
    - MW-10 at a concentration of 0.25 μg/L in June.

These cis-1,2-dichloroethene concentrations are significantly less than the Washington State Drinking Water Standard of 70 μg/L. There is no Washington State Groundwater Standard for cis-1,2-dichloroethene.

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Appendix A:
2016 Quarterly Monitoring Data

Landfill Gas Data
Groundwater Elevations and Contour Maps
Groundwater Quality Data

Olalla Landfill
2016 Landfill Gas Data

March 24, 2016	Flare #1	Flare #2	Flare #3
METHANE, (% LEL)	0.0	0.0	0.0
METHANE, (% Volume)	0.0	0.0	0.0
OXYGEN, (% Volume)	20.3	20.4	19.4
CARBON DIOXIDE, (% Volume)	0.3	0.1	1.6
PRESSURE (inches of water column)	0.1	0.1-0.3	0.48
AMBIENT TEMPERATURE, (^{O}F)	50		

June 21, 2016	Flare #1	Flare #2	Flare #3
METHANE, (% LEL)	0.0	0.0	0.0
METHANE, (% Volume)	0.0	0.0	0.0
OXYGEN, (% Volume)	17.8	16.2	12.5
CARBON DIOXIDE, (% Volume)	3.2	1.3	7.1
PRESSURE (inches of water column)	0.01	0.01	0.00
AMBIENT TEMPERATURE, (^{O}F)	70		

September 21, 2016	Flare #1	Flare #2	Flare #3
METHANE, (% LEL)	34	44	178
METHANE, (% Volume)	1.7	2.2	8.9
OXYGEN, (% Volume)	10.5	9.1	0.0
CARBON DIOXIDE, (% Volume)	3.6	7.2	14.3
PRESSURE (inches of water column)	0.01	0.03	0.00
AMBIENT TEMPERATURE, (^{O}F)	58		

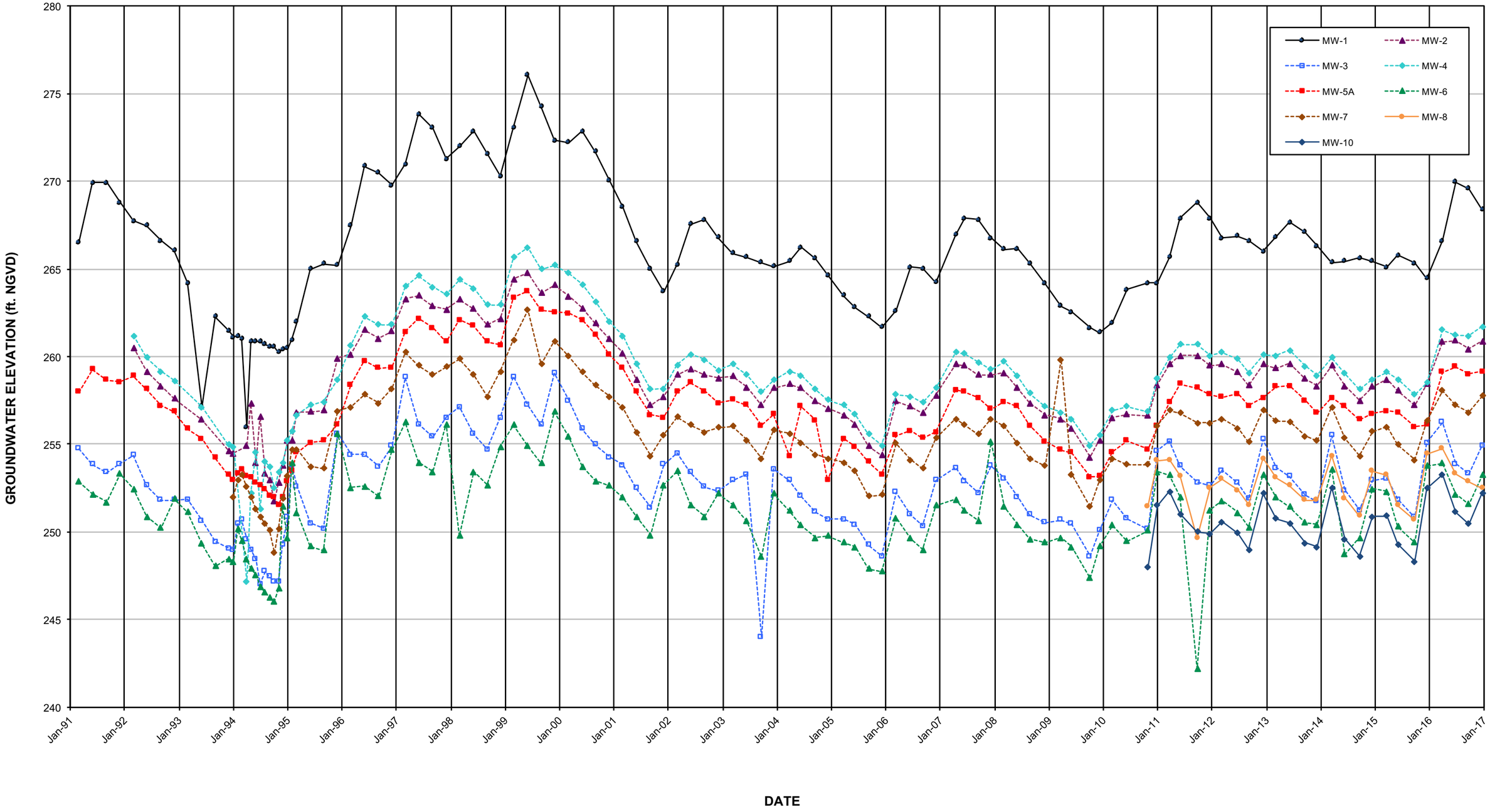
December 20, 2016	Flare #1	Flare #2	Flare #3
METHANE, (% LEL)	0	0	0
METHANE, (% Volume)	0.0	0.0	0.0
OXYGEN, (% Volume)	23.0	23.1	22.9
CARBON DIOXIDE, (% Volume)	0.1	0.1	0.2
PRESSURE (inches of water column)	0.05	0.04	0.02
AMBIENT TEMPERATURE, (^{O}F)	47		

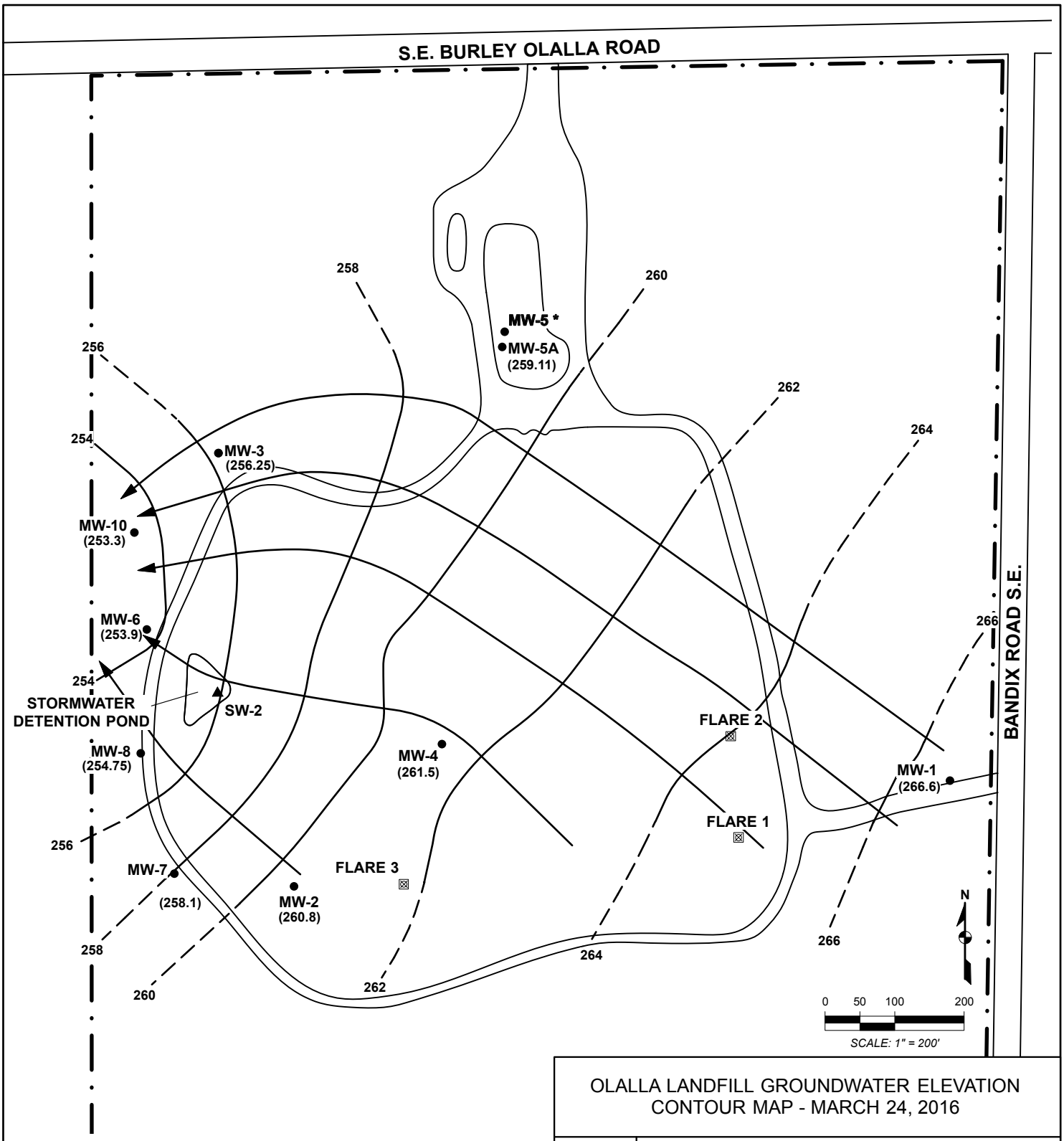
Olalla Landfill
2016 Groundwater Elevations

Station	Reference Elevation*	Depth to Water (feet)	Groundwater Elevation*
March 24, 2016			
MW-1	343.79	77.18	266.61
MW-2	323.25	62.42	260.83
MW-3	296.95	40.70	256.25
MW-4	320.93	59.41	261.52
MW-5A	332.53	73.43	259.10
MW-6	271.17	17.26	253.91
MW-7	280.43	22.35	258.08
MW-8	272.85	18.10	254.75
MW-10	279.21	25.94	253.27
June 21, 2016			
MW-1	343.79	73.82	269.97
MW-2	323.25	62.34	260.91
MW-3	296.95	43.08	253.87
MW-4	320.93	59.70	261.23
MW-5A	332.53	73.13	259.40
MW-6	271.17	19.01	252.16
MW-7	280.43	23.18	257.25
MW-8	272.85	19.52	253.33
MW-10	279.21	28.07	251.14
September 21, 2016			
MW-1	343.79	74.23	269.56
MW-2	323.25	62.81	260.44
MW-3	296.95	43.64	253.31
MW-4	320.93	59.75	261.18
MW-5A	332.53	73.52	259.01
MW-6	271.17	19.57	251.60
MW-7	280.43	23.60	256.83
MW-8	272.85	19.98	252.87
MW-10	279.21	28.73	250.48
December 20, 2016			
MW-1	343.79	75.41	268.38
MW-2	323.25	62.35	260.90
MW-3	296.95	42.00	254.95
MW-4	320.93	59.23	261.70
MW-5A	332.53	73.37	259.16
MW-6	271.17	17.91	253.26
MW-7	280.43	22.68	257.75
MW-8	272.85	20.35	252.50
MW-10	279.21	26.99	252.22

*Elevations in Feet NGVD, 29

OLALLA LANDFILL
Groundwater Elevations





NOTES:

* MW-5 is completed in a shallow perched groundwater zone.

MW-2 ● MONITORING WELL LOCATION

SW-2 ▲ SURFACE WATER SAMPLING LOCATION

⊠ LANDFILL GAS FLARE

KEY:

GROUNDWATER ELEVATION CONTOUR

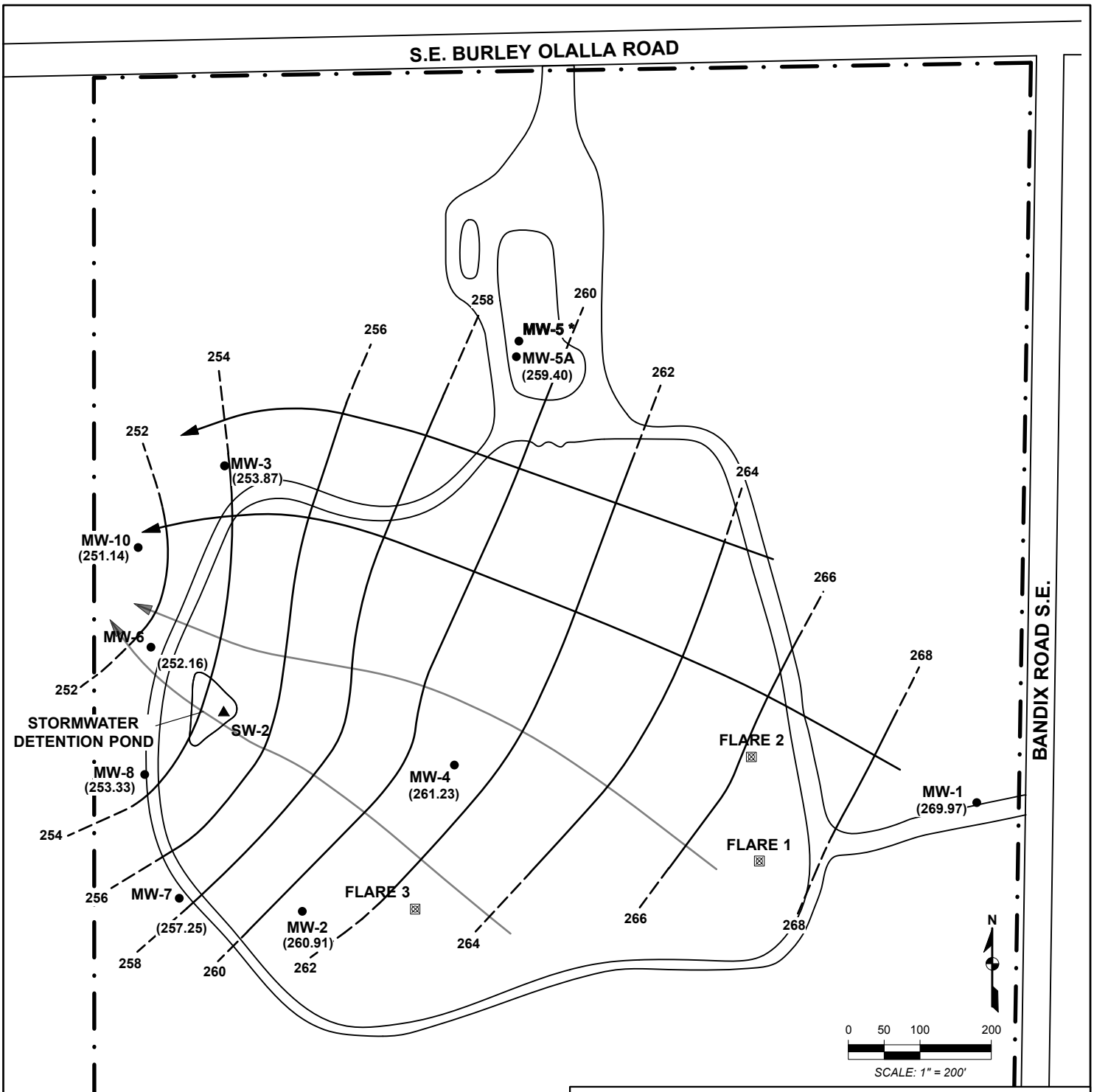
INFERRED GROUNDWATER FLOW PATH

APPROXIMATE PROPERTY BOUNDARY

PERIMETER ACCESS ROAD

OLALLA LANDFILL GROUNDWATER ELEVATION CONTOUR MAP - MARCH 24, 2016

PREPARED BY	epi ENVIRONMENTAL PARTNERS INC		
REPORT	2016 ANNUAL MONITORING REPORT		
LOCATION	OLALLA LANDFILL KITSAP COUNTY, WASHINGTON		
PREPARED FOR	KITSAP COUNTY		
DATE 2/2/17	*DRAWN BY* AM	*REVIEWED BY* DCK	*PROJECT NUMBER* 45404.0



NOTES:

* MW-5 is completed in a shallow perched groundwater zone.

MW-2 ● MONITORING WELL LOCATION

SW-2 ▲ SURFACE WATER SAMPLING LOCATION

⊠ LANDFILL GAS FLARE

KEY:

GROUNDWATER ELEVATION CONTOUR

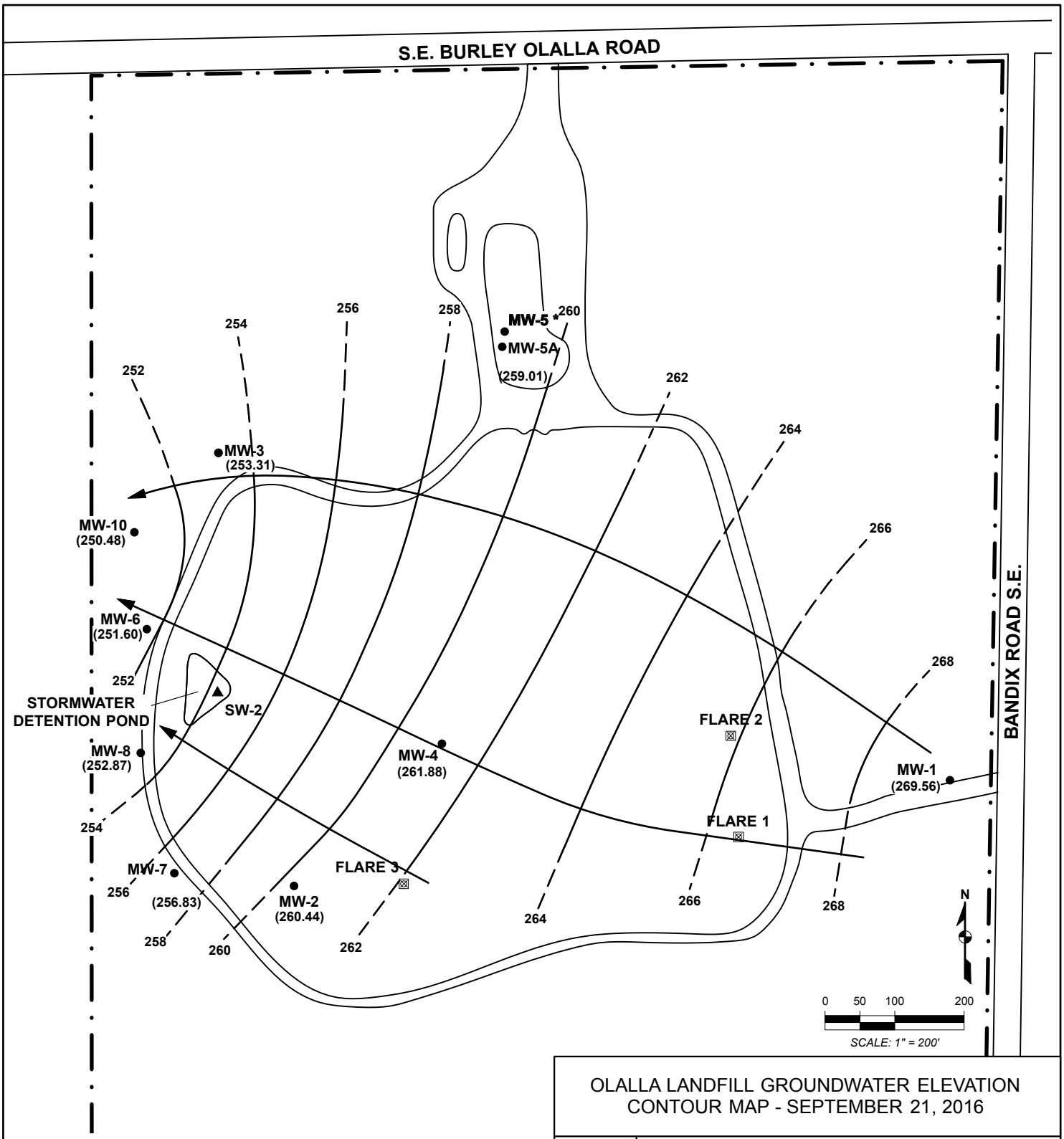
INFERRED GROUNDWATER FLOW PATH

APPROXIMATE PROPERTY BOUNDARY

PERIMETER ACCESS ROAD

OLALLA LANDFILL GROUNDWATER ELEVATION CONTOUR MAP - JUNE 21, 2016

PREPARED BY	epi ENVIRONMENTAL PARTNERS INC		
REPORT	2016 ANNUAL MONITORING REPORT		
LOCATION	OLALLA LANDFILL KITSAP COUNTY, WASHINGTON		
PREPARED FOR	KITSAP COUNTY		
DATE 2/2/17	*DRAWN BY* AM	*REVIEWED BY* DCK	*PROJECT NUMBER* 45404.0



NOTES:

* MW-5 is completed in a shallow perched groundwater zone.

MW-2 ● MONITORING WELL LOCATION

SW-2 ▲ SURFACE WATER SAMPLING LOCATION

⊠ LANDFILL GAS FLARE

KEY:

GROUNDWATER ELEVATION CONTOUR

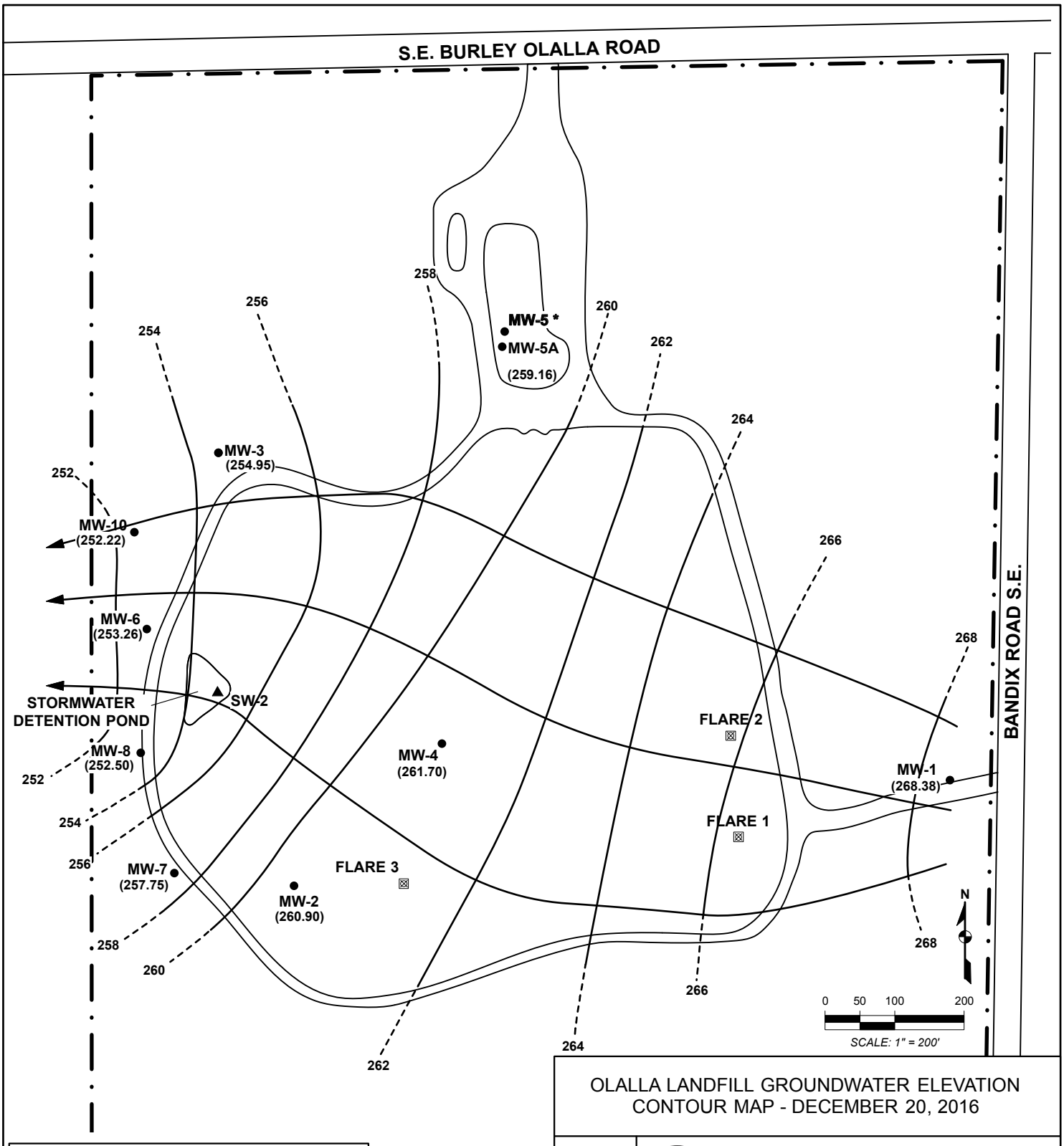
INFERRED GROUNDWATER FLOW PATH

APPROXIMATE PROPERTY BOUNDARY

PERIMETER ACCESS ROAD

OLALLA LANDFILL GROUNDWATER ELEVATION CONTOUR MAP - SEPTEMBER 21, 2016

PREPARED BY	epi ENVIRONMENTAL PARTNERS INC		
REPORT	2016 ANNUAL MONITORING REPORT		
LOCATION	OLALLA LANDFILL KITSAP COUNTY, WASHINGTON		
PREPARED FOR	KITSAP COUNTY		
DATE 2/2/17	*DRAWN BY* AM	*REVIEWED BY* DCK	*PROJECT NUMBER* 45404.0



NOTES:

* MW-5 is completed in a shallow perched groundwater zone.

MW-2 ● MONITORING WELL LOCATION

SW-2 ▲ SURFACE WATER SAMPLING LOCATION

⊠ LANDFILL GAS FLARE

KEY:

GROUNDWATER ELEVATION CONTOUR

INFERRED GROUNDWATER FLOW PATH

APPROXIMATE PROPERTY BOUNDARY

PERIMETER ACCESS ROAD

OLALLA LANDFILL GROUNDWATER ELEVATION CONTOUR MAP - DECEMBER 20, 2016

PREPARED BY	epi ENVIRONMENTAL PARTNERS INC		
REPORT	2016 ANNUAL MONITORING REPORT		
LOCATION	OLALLA LANDFILL KITSAP COUNTY, WASHINGTON		
PREPARED FOR	KITSAP COUNTY		
DATE 2/21/17	DRAWN BY AM	REVIEWED BY DCK	PROJECT NUMBER 45404.0

Groundwater Quality Data
March 2016 Quarterly Monitoring Event
Page 1 of 3

	State Drinking Water Standards (a)	State Ground-water Standards (b)	Units	MW-1	MW-3	MW-6	MW-8	MW-10	MW-13 (FD)
CONVENTIONALS									
ALKALINITY	-----	-----	mg/L	50.3	70.4	51.2	55.3	233	50.2
AMMONIA NITROGEN	-----	-----	mg/L	0.011	0.024	0.018	0.018	0.097	0.044
BICARBONATE	-----	-----	mg/L	50	70	51	55	233	50
CARBONATE	-----	-----	mg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
CHEMICAL OXYGEN DEMAND	-----	-----	mg/L	10.0 U	10.0 U	10.0 U	10.0 U	13.7	10.0 U
CHLORIDE	250**	250**	mg/L	4.2	3.1	1.8	1.4	3.9	1.6
DISSOLVED OXYGEN	-----	-----	mg/L	9.78	1.34	0.95	4.08	0.95	NA
NITRATE NITROGEN	10*	10*	mg/L	0.703	0.649	0.028	0.074	0.606	0.010 U
NITRITE NITROGEN	1*	-----	mg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
ORP	-----	-----	mV	69.9	15.5	8.0	40.6	19.9	NA
pH (field)	-----	6.5-8.5**	-log H+	6.5	**6.4**	6.8	6.7	**6.4**	NA
pH (laboratory)	-----	6.5-8.5**	-log H+	6.7	6.5	6.9	6.8	6.6	6.8
SPECIFIC CONDUCTANCE	700**	-----	umhos/cm	130	219	113	114	422	NA
SULFATE	250**	250**	mg/L	4.2	29.8	6.6	2.8	22.5	7.1
TEMPERATURE	-----	-----	°C	10.0	11.3	10.2	9.4	10.3	NA
TOTAL COLIFORM	1/100 mL*	1/100 mL*	cfu/100 mL	1 U	1 U	1 U	1 U	1 U	1 U
TOTAL ORGANIC CARBON	-----	-----	mg/L	0.5 U	1.74	2.1	0.8	3.4	2.1
TURBIDITY	-----	-----	NTU	0.00	0.20	3.30	6.60	0.21	NA
DISSOLVED METALS									
ARSENIC	10*	0.05*	µg/L	**0.09**	**0.10**	**0.90**	**2.2**	**0.90**	**0.80**
BARIUM	2,000*	1,000*	µg/L	4	9	4	4	18	3
CALCIUM	-----	-----	mg/L	12	23	53	12	54	11
IRON	300**	300**	µg/L	20 U	20 U	290	30	20 U	290
MANGANESE	50**	50**	µg/L	1 U	**2,430**	**430**	**350**	**5,440**	**405**
POTASSIUM	-----	-----	mg/L	0.7	0.6	1.4	0.6	1.4	0.8
SODIUM	20,000***	-----	mg/L	4.6	5.5	9.2	5.1	9.3	4.8
ZINC	5,000**	5,000**	µg/L	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U
VOLATILE ORGANIC COMPOUNDS									
VINYL CHLORIDE	2*	0.02*	µg/L	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U

Notes:

Concentration exceeds Washington State Drinking Water or Groundwater Standards

FD = Field Duplicate of MW-6 was labeled MW-13.

NA = Not Analyzed

Regulatory Standards:

(a) WAC 246-290-310

(b) WAC 173-200-040

(c) WAC 173-201A-200 - Nitrate and Nitrite Standards noted are for Class AA water. Fecal coliform standard is 100/100mL for Primary The appropriate class of water for the detention pond has not been established.

* Primary Standard

** Secondary Standard

*** Recommended level of concern for consumers with restricted daily sodium intake.

Data Qualifiers:

U = Indicates compound was analyzed for, but not detected at the specified detection limit.

J = Estimated value - Compound positively identified, but below specified detection limit.

Groundwater Quality Data
March 2016 Quarterly Monitoring Event

VOLATILE ORGANIC COMPOUNDS	State Drinking Water Standards (a)	State Groundwater Standards (b)	Units	MW-1	MW-3	MW-6	MW-8	MW-10	MW-13 (FD)
1,1,1,2-TETRACHLOROETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1,1-TRICHLOROETHANE	200	200	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1,2,2-TETRACHLOROETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1,2-TRICHLOROETHANE	5	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1-DICHLOROETHANE	-----	1	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1-DICHLOROETHENE	7	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1-DICHLOROPROPENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2,3-TRICHLOROBENZENE	-----	-----	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,3-TRICHLOROPROPANE	-----	-----	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,4-TRICHLOROBENZENE	70	-----	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,4-TRIMETHYLBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2-DIBROMO-3-CHLOROPROPANE	-----	-----	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROBENZENE	600	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2-DICHLOROETHANE	5	0.5	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2-DICHLOROPROPANE	5	0.6	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,3,5-TRIMETHYLBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,3-DICHLOROBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,3-DICHLOROPROPANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,4-DICHLOROBENZENE	75	4	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2,2-DICHLOROPROPANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2-BUTANONE	-----	-----	µg/L	5 U	5 U	5 U	5 U	5 U	5 U
2-CHLOROETHYLVINYLETHER	-----	-----	µg/L	1 U	1 U	1 U	1 U	1 U	1 U
2-CHLOROTOLUENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2-HEXANONE	-----	-----	µg/L	5 U	5 U	5 U	5 U	5 U	5 U
4-CHLOROTOLUENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
4-ISOPROPYLTOLUENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
4-METHYL-2-PANTANONE	-----	-----	µg/L	5 U	5 U	5 U	5 U	5 U	5 U
ACETONE	-----	-----	µg/L	5 U	5 U	5 U	5 U	5 U	5 U
ACROLEIN	-----	-----	µg/L	5 U	5 U	5 U	5 U	5 U	5 U
ACRYLONITRILE	-----	-----	µg/L	1 U	1 U	1 U	1 U	1 U	1 U
BENZENE	5	1	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
BROMOBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
BROMOCHLOROMETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
BROMOETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
BROMOFORM	-----	5	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
BROMOMETHANE	-----	-----	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
CARBON DISULFIDE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CARBON TETRACHLORIDE	5	0.3	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CFC-113	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CHLOROBENZENE	100	-----	µg/L	0.2 U	0.2 U	**1.3**	0.2 U	0.2 U	**1.3**
CHLOROBROMOMETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CHLORODIBROMOMETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CHLOROETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CHLOROFORM	-----	7	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CHLOROMETHANE	-----	-----	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CIS-1,2-DICHLOROETHENE	70	-----	µg/L	0.2 U	0.2 U	0.2 U	**2.5**	0.2 U	0.2 U

Groundwater Quality Data
March 2016 Quarterly Monitoring Event

VOLATILE ORGANIC COMPOUNDS	State Drinking Water Standards (a)	State Groundwater Standards (b)	Units	MW-1	MW-3	MW-6	MW-8	MW-10	MW-13 (FD)
CIS-1,3-DICHLOROPROPENE	-----	0.2	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
DIBROMOETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
DICHLOROBROMOMETHANE	-----	0.5	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
ETHYLBENZENE	700	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
ETHYLENE DIBROMIDE	-----	0.001	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
HEXACHLOROBUTADIENE	-----	-----	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
IODOMETHANE	-----	-----	µg/L	1 U	1 U	1 U	1 U	1 U	1 U
ISOPROPYLBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
METHYLENE CHLORIDE	5	5	µg/L	1 U	1 U	1 U	1 U	1 U	1 U
M & P-XYLENE	10	-----	µg/L	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
NAPHTHALENE	-----	-----	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
N-BUTYLBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
N-PROPYLBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
O-XYLENE	10	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
SEC-BUTYLBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
STYRENE	100	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TERT-BUTLYBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TETRACHLOROETHENE	5	0.8	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TOLUENE	1000	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TRANS-1,2-DICHLOROETHENE	100	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TRANS-1,3-DICHLOROPROPENE	-----	0.2	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TRANS-1,4-DICHLORO-2-BUTENE			µg/L	1 U	1 U	1 U	1 U	1 U	1 U
TRICHLOROETHENE	5	3	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TRICHLOROFLUOROMETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
VINYL ACETATE			µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
VINYL CHLORIDE	2	0.02	µg/L	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U

Notes: **Concentration exceeds State Drinking Water Standards or Groundwater Standards**

FD = Field Duplicate of MW-6 was labeled MW-13.

Regulatory Standards:

All regulatory standards listed for VOCs are Primary Regulatory Standards

(a) WAC 246-290-310

(b) WAC 173-200-040

Data Qualifiers:

U = Indicates compound was analyzed for but was not detected at the specified detection limit.

Groundwater Quality Data
June 2016 Quarterly Monitoring Event
Page 1 of 3

	State Drinking Water Standards (a)	State Ground-water Standards (b)	Units	MW-1	MW-3	MW-6	MW-8	MW-10	MW-17 (FD)
CONVENTIONALS									
ALKALINITY	-----	-----	mg/L	58.9	76.4	177.0	109	264	177
AMMONIA NITROGEN	-----	-----	mg/L	0.047	0.040 U	0.040 U	0.040 U	0.083	0.040 U
BICARBONATE	-----	-----	mg/L	59	76	177	109	264	177
CARBONATE	-----	-----	mg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
CHEMICAL OXYGEN DEMAND	-----	-----	mg/L	10.0 U	26.0	26.0	11.0	21.6	25.4
CHLORIDE	250**	250**	mg/L	5.5	3.8	1.5	2.2	4.3	1.7
DISSOLVED OXYGEN	-----	-----	mg/L	9.28	1.16	1.30	1.39	1.21	NA
NITRATE NITROGEN	10*	10*	mg/L	0.141	0.109	0.024	0.054	0.114	0.027
NITRITE NITROGEN	1*	-----	mg/L	0.010 U	0.010 U	0.018	0.010 U	0.010 U	0.018
ORP	-----	-----	mV	108.8	88	-11.0	42.2	52.8	NA
pH (field)	-----	6.5-8.5**	-log H+	**5.8**	**5.7**	**6.4**	**6.2**	**6.2**	NA
pH (laboratory)	-----	6.5-8.5**	-log H+	6.5	**6.1**	6.7	6.6	6.5	6.7
SPECIFIC CONDUCTANCE	700**	-----	umhos/cm	130	157	343	202	540	NA
SULFATE	250**	250**	mg/L	4.8	10.8	20.2	4.6	47.3	20.1
TEMPERATURE	-----	-----	°C	11.0	12.0	11.1	10.4	11.2	NA
TOTAL COLIFORM	1/100 mL*	1/100 mL*	cfu/100 mL	1 U	1 U	1 U	1 U	1 U	1 U
TOTAL ORGANIC CARBON	-----	-----	mg/L	0.5 U	1.23	1.6	0.8	3.1	1.7
TURBIDITY	-----	-----	NTU	0.25	3.50	3.22	8.95	1.26	NA
DISSOLVED METALS									
ARSENIC	10*	0.05*	µg/L	**0.09**	**0.08**	**0.81**	**1.89**	**1.57**	**0.78**
BARIUM	2,000*	1,000*	µg/L	6	7	14	7	22	14
CALCIUM	-----	-----	mg/L	13	17	36	19	51	37
IRON	300**	300**	µg/L	20 U	20 U	**800**	**320**	20 U	**810**
MANGANESE	50**	50**	µg/L	2	**2,460**	**645**	**3,590**	**6,470**	**634**
POTASSIUM	-----	-----	mg/L	0.7	0.5 U	1.3	0.9	1.2	1.3
SODIUM	20,000***	-----	mg/L	4.9	5.7	8.3	7.0	13.9	8.5
ZINC	5,000**	5,000**	µg/L	4.0 U	6.0	4.0 U	4.0 U	4.0 U	4.0 U
VOLATILE ORGANIC COMPOUNDS									
VINYL CHLORIDE	2*	0.02*	µg/L	0.02 U	0.02 U	0.02 U	**0.035**	0.02 U	0.02 U

Notes:

Concentration exceeds Washington State Drinking Water or Groundwater Standards

FD = Field Duplicate of MW-6 was labeled MW-17.

NA = Not Analyzed

Regulatory Standards:

(a) WAC 246-290-310

(b) WAC 173-200-040

(c) WAC 173-201A-200 - Nitrate and Nitrite Standards noted are for Class AA water. Fecal coliform standard is 100/100mL for Primary The appropriate class of water for the detention pond has not been established.

* Primary Standard

** Secondary Standard

*** Recommended level of concern for consumers with restricted daily sodium intake.

Data Qualifiers:

U = Indicates compound was analyzed for, but not detected at the specified detection limit.

J = Estimated value - Compound positively identified, but below specified detection limit.

Groundwater Quality Data
June 2016 Quarterly Monitoring Event

VOLATILE ORGANIC COMPOUNDS	State Drinking Water Standards (a)	State Groundwater Standards (b)	Units	MW-1	MW-3	MW-6	MW-8	MW-10	MW-17 (FD)
1,1,1,2-TETRACHLOROETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1,1-TRICHLOROETHANE	200	200	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1,2,2-TETRACHLOROETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1,2-TRICHLOROETHANE	5	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1-DICHLOROETHANE	-----	1	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1-DICHLOROETHENE	7	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1-DICHLOROPROPENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2,3-TRICHLOROBENZENE	-----	-----	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,3-TRICHLOROPROPANE	-----	-----	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,4-TRICHLOROBENZENE	70	-----	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,4-TRIMETHYLBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2-DIBROMO-3-CHLOROPROPANE	-----	-----	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROBENZENE	600	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2-DICHLOROETHANE	5	0.5	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2-DICHLOROPROPANE	5	0.6	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,3,5-TRIMETHYLBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,3-DICHLOROBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,3-DICHLOROPROPANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,4-DICHLOROBENZENE	75	4	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2,2-DICHLOROPROPANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2-BUTANONE	-----	-----	µg/L	5 U	5 U	5 U	5 U	5 U	5 U
2-CHLOROETHYLVINYLETHER	-----	-----	µg/L	1 U	1 U	1 U	1 U	1 U	1 U
2-CHLOROTOLUENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2-HEXANONE	-----	-----	µg/L	5 U	5 U	5 U	5 U	5 U	5 U
4-CHLOROTOLUENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
4-ISOPROPYLTOLUENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
4-METHYL-2-PANTANONE	-----	-----	µg/L	5 U	5 U	5 U	5 U	5 U	5 U
ACETONE	-----	-----	µg/L	5 U	5 U	5 U	5 U	5 U	5 U
ACROLEIN	-----	-----	µg/L	5 U	5 U	5 U	5 U	5 U	5 U
ACRYLONITRILE	-----	-----	µg/L	1 U	1 U	1 U	1 U	1 U	1 U
BENZENE	5	1	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
BROMOBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
BROMOCHLOROMETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
BROMOETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
BROMOFORM	-----	5	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
BROMOMETHANE	-----	-----	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
CARBON DISULFIDE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CARBON TETRACHLORIDE	5	0.3	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CFC-113	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CHLOROBENZENE	100	-----	µg/L	0.2 U	0.2 U	**1.6**	0.2 U	0.2 U	**1.5**
CHLOROBROMOMETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CHLORODIBROMOMETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CHLOROETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CHLOROFORM	-----	7	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CHLOROMETHANE	-----	-----	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CIS-1,2-DICHLOROETHENE	70	-----	µg/L	0.2 U	0.2 U	0.2 U	**0.3**	**0.25**	0.2 U

Groundwater Quality Data
June 2016 Quarterly Monitoring Event

VOLATILE ORGANIC COMPOUNDS	State Drinking Water Standards (a)	State Groundwater Standards (b)	Units	MW-1	MW-3	MW-6	MW-8	MW-10	MW-17 (FD)
CIS-1,3-DICHLOROPROPENE	-----	0.2	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
DIBROMOETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
DICHLOROBROMOMETHANE	-----	0.5	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
ETHYLBENZENE	700	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
ETHYLENE DIBROMIDE	-----	0.001	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
HEXACHLOROBUTADIENE	-----	-----	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
IODOMETHANE	-----	-----	µg/L	1 U	1 U	1 U	1 U	1 U	1 U
ISOPROPYLBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
METHYLENE CHLORIDE	5	5	µg/L	1 U	1 U	1 U	1 U	1 U	1 U
M & P-XYLENE	10	-----	µg/L	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
NAPHTHALENE	-----	-----	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
N-BUTYLBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
N-PROPYLBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
O-XYLENE	10	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
SEC-BUTYLBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
STYRENE	100	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TERT-BUTLYBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TETRACHLOROETHENE	5	0.8	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TOLUENE	1000	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TRANS-1,2-DICHLOROETHENE	100	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TRANS-1,3-DICHLOROPROPENE	-----	0.2	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TRANS-1,4-DICHLORO-2-BUTENE			µg/L	1 U	1 U	1 U	1 U	1 U	1 U
TRICHLOROETHENE	5	3	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TRICHLOROFLUOROMETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
VINYL ACETATE			µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
VINYL CHLORIDE	2	0.02	µg/L	0.02 U	0.02 U	0.02 U	**0.035**	0.02 U	0.02 U

Notes: **Concentration exceeds State Drinking Water Standards or Groundwater Standards**

FD = Field Duplicate of MW-6 was labeled MW-17.

Regulatory Standards:

All regulatory standards listed for VOCs are Primary Regulatory Standards

(a) WAC 246-290-310

(b) WAC 173-200-040

Data Qualifiers:

U = Indicates compound was analyzed for but was not detected at the specified detection limit.

Groundwater Quality Data
September 2016 Quarterly Monitoring Event
Page 1 of 3

	State Drinking Water Standards (a)	State Ground-water Standards (b)	Units	MW-1	MW-3	MW-6	MW-8	MW-10	MW-12 (FD)
CONVENTIONALS									
ALKALINITY	-----	-----	mg/L	56	220	197	103	212	96
AMMONIA NITROGEN	-----	-----	mg/L	0.040 U	0.040 U	0.042	0.044	0.077	0.048
BICARBONATE	-----	-----	mg/L	56	220	197	103	212	96
CARBONATE	-----	-----	mg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
CHEMICAL OXYGEN DEMAND	-----	-----	mg/L	10.0 U	10.0 U	11.2	10.0 U	10.2	10.0 U
CHLORIDE	250**	250**	mg/L	3.6	3.4	2.3	2.2	2.4	2.2
DISSOLVED OXYGEN	-----	-----	mg/L	10.68	0.10	0.02	0.01	0.01	NA
NITRATE NITROGEN	10*	10*	mg/L	0.643	0.010 U	0.010 U	0.020	0.010 U	0.016
NITRITE NITROGEN	1*	-----	mg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
ORP	-----	-----	mV	175	203.3	-1.9	42.2	93.9	NA
pH (field)	-----	6.5-8.5**	-log H+	**6.3**	**6.1**	6.5	6.6	6.5	NA
pH (laboratory)	-----	6.5-8.5**	-log H+	**6.2**	**6.0**	**6.4**	6.7	**6.4**	6.6
SPECIFIC CONDUCTANCE	700**	-----	umhos/cm	131	455	384	197	411	NA
SULFATE	250**	250**	mg/L	3.8	20.7	10.2	4.1	16.1	3.9
TEMPERATURE	-----	-----	°C	11.0	12.0	11.4	11.0	11.6	NA
TOTAL COLIFORM	1/100 mL*	1/100 mL*	cfu/100 mL	1 U	1 U	1 U	1 U	1 U	1 U
TOTAL ORGANIC CARBON	-----	-----	mg/L	0.5 U	2.9	2.0	0.7	2.6	0.7
TURBIDITY	-----	-----	NTU	0.8	0.9	8.9	4.3	1.1	NA
DISSOLVED METALS									
ARSENIC	10*	0.05*	µg/L	**0.10**	**0.12**	**1.21**	**1.74**	**1.82**	**1.77**
BARIUM	2,000*	1,000*	µg/L	5	19	17	8	16	7
CALCIUM	-----	-----	mg/L	12	50	42	18	40	18
IRON	300**	300**	µg/L	20 U	20 U	**1,300**	202	20.5	181
MANGANESE	50**	50**	µg/L	1	**6,820**	**594**	**3,020**	**4,370**	**2,980**
POTASSIUM	-----	-----	mg/L	0.7	0.9	1.5	1.0	1.2	1.0
SODIUM	20,000***	-----	mg/L	4.8	10.1	7.8	6.9	13.2	7.1
ZINC	5,000**	5,000**	µg/L	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U
VOLATILE ORGANIC COMPOUNDS									
VINYL CHLORIDE	2*	0.02*	µg/L	0.02 U	0.02 U	0.02 U	**0.036**	0.02 U	**0.033**

Notes:

Concentration exceeds Washington State Drinking Water or Groundwater Standards

FD = Field Duplicate of MW-8 was labeled MW-12.

NA = Not Analyzed

Regulatory Standards:

(a) WAC 246-290-310

(b) WAC 173-200-040

(c) WAC 173-201A-200 - Nitrate and Nitrite Standards noted are for Class AA water. Fecal coliform standard is 100/100mL for Primary The appropriate class of water for the detention pond has not been established.

* Primary Standard

** Secondary Standard

*** Recommended level of concern for consumers with restricted daily sodium intake.

Data Qualifiers:

U = Indicates compound was analyzed for, but not detected at the specified detection limit.

J = Estimated value - Compound positively identified, but below specified detection limit.

Groundwater Quality Data
September 2016 Quarterly Monitoring Event

VOLATILE ORGANIC COMPOUNDS	State Drinking Water Standards (a)	State Groundwater Standards (b)	Units	MW-1	MW-3	MW-6	MW-8	MW-10	MW-12 (FD)
1,1,1,2-TETRACHLOROETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1,1-TRICHLOROETHANE	200	200	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1,2,2-TETRACHLOROETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1,2-TRICHLOROETHANE	5	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1-DICHLOROETHANE	-----	1	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1-DICHLOROETHENE	7	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1-DICHLOROPROPENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2,3-TRICHLOROBENZENE	-----	-----	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,3-TRICHLOROPROPANE	-----	-----	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,4-TRICHLOROBENZENE	70	-----	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,4-TRIMETHYLBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2-DIBROMO-3-CHLOROPROPANE	-----	-----	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROBENZENE	600	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2-DICHLOROETHANE	5	0.5	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2-DICHLOROPROPANE	5	0.6	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,3,5-TRIMETHYLBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,3-DICHLOROBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,3-DICHLOROPROPANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,4-DICHLOROBENZENE	75	4	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2,2-DICHLOROPROPANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2-BUTANONE	-----	-----	µg/L	5 U	5 U	5 U	5 U	5 U	5 U
2-CHLOROETHYLVINYLETHER	-----	-----	µg/L	1 U	1 U	1 U	1 U	1 U	1 U
2-CHLOROTOLUENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2-HEXANONE	-----	-----	µg/L	5 U	5 U	5 U	5 U	5 U	5 U
4-CHLOROTOLUENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
4-ISOPROPYLTOLUENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
4-METHYL-2-PANTANONE	-----	-----	µg/L	5 U	5 U	5 U	5 U	5 U	5 U
ACETONE	-----	-----	µg/L	5 U	5 U	5 U	5 U	5 U	5 U
ACROLEIN	-----	-----	µg/L	5 U	5 U	5 U	5 U	5 U	5 U
ACRYLONITRILE	-----	-----	µg/L	1 U	1 U	1 U	1 U	1 U	1 U
BENZENE	5	1	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
BROMOBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
BROMOCHLOROMETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
BROMOETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
BROMOFORM	-----	5	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
BROMOMETHANE	-----	-----	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
CARBON DISULFIDE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CARBON TETRACHLORIDE	5	0.3	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CFC-113	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CHLOROBENZENE	100	-----	µg/L	0.2 U	0.2 U	**1.83**	0.2 U	0.2 U	**1.5**
CHLOROBROMOMETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CHLORODIBROMOMETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CHLOROETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CHLOROFORM	-----	7	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CHLOROMETHANE	-----	-----	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CIS-1,2-DICHLOROETHENE	70	-----	µg/L	0.2 U	**0.20**	0.2 U	**0.33**	0.2 U	**0.32**

Groundwater Quality Data
September 2016 Quarterly Monitoring Event

VOLATILE ORGANIC COMPOUNDS	State Drinking Water Standards (a)	State Groundwater Standards (b)	Units	MW-1	MW-3	MW-6	MW-8	MW-10	MW-12 (FD)
CIS-1,3-DICHLOROPROPENE	-----	0.2	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
DIBROMOETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
DICHLOROBROMOMETHANE	-----	0.5	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
ETHYLBENZENE	700	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
ETHYLENE DIBROMIDE	-----	0.001	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
HEXACHLOROBUTADIENE	-----	-----	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
IODOMETHANE	-----	-----	µg/L	1 U	1 U	1 U	1 U	1 U	1 U
ISOPROPYLBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
METHYLENE CHLORIDE	5	5	µg/L	1 U	1 U	1 U	1 U	1 U	1 U
M & P-XYLENE	10	-----	µg/L	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
NAPHTHALENE	-----	-----	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
N-BUTYLBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
N-PROPYLBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
O-XYLENE	10	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
SEC-BUTYLBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
STYRENE	100	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TERT-BUTLYBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TETRACHLOROETHENE	5	0.8	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TOLUENE	1000	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TRANS-1,2-DICHLOROETHENE	100	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TRANS-1,3-DICHLOROPROPENE	-----	0.2	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TRANS-1,4-DICHLORO-2-BUTENE			µg/L	1 U	1 U	1 U	1 U	1 U	1 U
TRICHLOROETHENE	5	3	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TRICHLOROFLUOROMETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
VINYL ACETATE			µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
VINYL CHLORIDE	2	0.02	µg/L	0.02 U	0.02 U	0.02 U	**0.036**	0.02 U	**0.033**

Notes: **Concentration exceeds State Drinking Water Standards or Groundwater Standards**

FD = Field Duplicate of MW-8 was labeled MW-12.

Regulatory Standards:

All regulatory standards listed for VOCs are Primary Regulatory Standards

(a) WAC 246-290-310

(b) WAC 173-200-040

Data Qualifiers:

U = Indicates compound was analyzed for but was not detected at the specified detection limit.

Groundwater Quality Data
December 2016 Quarterly Monitoring Event

	State Drinking Water Standards (a)	State Ground-water Standards (b)	Units	MW-1	MW-3	MW-5A	MW-6	MW-7	MW-8	MW-10	SW-2	MW-13 (FD)
CONVENTIONALS												
ALKALINITY	-----	-----	mg/L	48.1	223		102		101	180		182
AMMONIA NITROGEN	-----	-----	mg/L	0.040 U	0.040 U		0.040 U		0.040 U	0.103		0.091
BICARBONATE	-----	-----	mg/L	48.1	223		102		101	180		181
CARBONATE	-----	-----	mg/L	1.0 U	1.0 U		1.0 U		1.0 U	1.0 U		1.0 U
CHEMICAL OXYGEN DEMAND	-----	-----	mg/L	10.0 U	10.0 U		10.0 U		10.0 U	14		10.0 U
CHLORIDE	250**	250**	mg/L	2.91	6.15		2.57		2.62	10.7		10.8
DISSOLVED OXYGEN	-----	-----	mg/L	10.51	0.25	8.84	0.18	4.48	2.16	0.20		NA
NITRATE NITROGEN	10*	10*	mg/L	1.41	0.020 U		0.020		0.163	0.020 U	0.020 U	0.020 U
NITRITE NITROGEN	1*	-----	mg/L	0.010 U	0.010 U		0.010 U		0.010 U	0.010 U	0.010 U	0.010 U
ORP	-----	-----	mV	171.2	165.1	157.3	-4.7	115.5	32.8	113.6		NA
pH (field)	-----	6.5-8.5**	-log H+	6.5	**6.3**	6.7	6.7	6.8	6.7	6.5	8.1	NA
pH (laboratory)	-----	6.5-8.5**	-log H+	**6.4**	**6.2**	6.7	6.6	6.7	6.6	**6.4**	7.2	**6.4**
SPECIFIC CONDUCTANCE	700**	-----	umhos/cm	115.4	417.2	145.6	199.4	98.9	301.4	357.7	43.4	NA
SULFATE	250**	250**	mg/L	4.04	13.2		7.25		5.06	7.19		7.18
TEMPERATURE	-----	-----	°C	10.8	11.7	11.6	11.9	11.0	11.4	11.7	3.8	NA
FECAL COLIFORM	-----	-----	cfu/100 mL								3	
TOTAL COLIFORM	1/100 mL*	1/100 mL*	cfu/100 mL	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
TOTAL ORGANIC CARBON	-----	-----	mg/L	0.5 U	2.51		2.77		1.36	2.87		3.00
TURBIDITY	-----	-----	NTU	1.9	0.6	0.6	3.5	0.6	4.4	1.5		NA
DISSOLVED METALS												
ARSENIC	10*	0.05*	µg/L	**0.10**	**0.10**	**0.21**	**1.20**	**0.43**	**2.71**	**1.72**		**1.67**
BARIUM	2,000*	1,000*	µg/L	3.0 U	14.5	4.3	8.2	3.0 U	7.5	10.2		11.1
CALCIUM	-----	-----	mg/L	10.8	47.3		19.9		32.4	35.5		35.9
IRON	300**	300**	µg/L	20 U	20 U	20 U	**734**	20 U	**1,080**	20 U		20 U
MANGANESE	50**	50**	µg/L	1.0 U	**6,610**	1.0 U	**488**	1.0 U	**3,150**	**4,120**		**4,180**
POTASSIUM	-----	-----	mg/L	0.64	0.86		1.1		1.1	1.2		1.2
SODIUM	20***	-----	mg/L	4.62	9.44		5.66		8.80	10.9		10.8
ZINC	5,000**	5,000**	µg/L	4.0 U	4.0 U		4.0 U		4.0 U	4.0 U		4.0 U
VOLATILE ORGANIC COMPOUNDS												
VINYL CHLORIDE	2*	0.02*	µg/L	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	**0.071**	0.02 U	0.02 U	0.02 U

Notes:

Concentration exceeds Washington State Drinking Water or Groundwater Standards

FD = Field Duplicate of MW-10 was labeled MW-13.

NA = Not Analyzed

Regulatory Standards:

(a) WAC 246-290-310

(b) WAC 173-200-040

(c) WAC 173-201A-200 - Nitrate and Nitrite Standards noted are for Class AA water. Fecal coliform standard is 100/100mL for Primary Contact Recreation. The appropriate class of water for the detention pond has not been established.

* Primary Standard

** Secondary Standard

*** Recommended level of concern for consumers with restricted daily sodium intake.

Data Qualifiers:

U = Indicates compound was analyzed for, but not detected at the specified detection limit.

J = Estimated value - Compound positively identified, but below specified detection limit.

Groundwater Quality Data
December 2016 Quarterly Monitoring Event

VOLATILE ORGANIC COMPOUNDS	State Drinking Water Standards (a)	State Groundwater Standards (b)	Units	MW-1	MW-3	MW-6	MW-8	MW-10	MW-13 (FD)
1,1,1,2-TETRACHLOROETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1,1-TRICHLOROETHANE	200	200	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1,2,2-TETRACHLOROETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1,2-TRICHLOROETHANE	5	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1-DICHLOROETHANE	-----	1	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1-DICHLOROETHENE	7	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,1-DICHLOROPROPENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2,3-TRICHLOROBENZENE	-----	-----	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,3-TRICHLOROPROPANE	-----	-----	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,4-TRICHLOROBENZENE	70	-----	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,4-TRIMETHYLBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2-DIBROMO-3-CHLOROPROPANE	-----	-----	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROBENZENE	600	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2-DICHLOROETHANE	5	0.5	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,2-DICHLOROPROPANE	5	0.6	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,3,5-TRIMETHYLBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,3-DICHLOROBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,3-DICHLOROPROPANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
1,4-DICHLOROBENZENE	75	4	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2,2-DICHLOROPROPANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2-BUTANONE	-----	-----	µg/L	5 U	5 U	5 U	5 U	5 U	5 U
2-CHLOROETHYLVINYLETHER	-----	-----	µg/L	1 U	1 U	1 U	1 U	1 U	1 U
2-CHLOROTOLUENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
2-HEXANONE	-----	-----	µg/L	5 U	5 U	5 U	5 U	5 U	5 U
4-CHLOROTOLUENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
4-ISOPROPYLTOLUENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
4-METHYL-2-PANTANONE	-----	-----	µg/L	5 U	5 U	5 U	5 U	5 U	5 U
ACETONE	-----	-----	µg/L	5 U	5 U	5 U	5 U	5 U	5 U
ACROLEIN	-----	-----	µg/L	5 U	5 U	5 U	5 U	5 U	5 U
ACRYLONITRILE	-----	-----	µg/L	1 U	1 U	1 U	1 U	1 U	1 U
BENZENE	5	1	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
BROMOBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
BROMOCHLOROMETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
BROMOETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
BROMOFORM	-----	5	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
BROMOMETHANE	-----	-----	µg/L	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
CARBON DISULFIDE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CARBON TETRACHLORIDE	5	0.3	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CFC-113	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CHLOROBENZENE	100	-----	µg/L	0.2 U	0.2 U	2.14	0.2 U	0.2 U	0.2 U
CHLOROBROMOMETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CHLORODIBROMOMETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CHLOROETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CHLOROFORM	-----	7	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CHLOROMETHANE	-----	-----	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CIS-1,2-DICHLOROETHENE	70	-----	µg/L	0.2 U	0.2 U	0.2 U	0.40	0.2 U	0.2 U

Groundwater Quality Data
December 2016 Quarterly Monitoring Event

VOLATILE ORGANIC COMPOUNDS	State Drinking Water Standards (a)	State Groundwater Standards (b)	Units	MW-1	MW-3	MW-6	MW-8	MW-10	MW-13 (FD)
CIS-1,3-DICHLOROPROPENE	-----	0.2	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
DIBROMOETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
DICHLOROBROMOMETHANE	-----	0.5	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
ETHYLBENZENE	700	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
ETHYLENE DIBROMIDE	-----	0.001	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
HEXACHLOROBUTADIENE	-----	-----	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
IODOMETHANE	-----	-----	µg/L	1 U	1 U	1 U	1 U	1 U	1 U
ISOPROPYLBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
METHYLENE CHLORIDE	5	5	µg/L	1 U	1 U	1 U	1 U	1 U	1 U
M & P-XYLENE	10	-----	µg/L	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
NAPHTHALENE	-----	-----	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
N-BUTYLBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
N-PROPYLBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
O-XYLENE	10	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
SEC-BUTYLBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
STYRENE	100	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TERT-BUTLYBENZENE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TETRACHLOROETHENE	5	0.8	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TOLUENE	1000	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TRANS-1,2-DICHLOROETHENE	100	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TRANS-1,3-DICHLOROPROPENE	-----	0.2	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TRANS-1,4-DICHLORO-2-BUTENE			µg/L	1 U	1 U	1 U	1 U	1 U	1 U
TRICHLOROETHENE	5	3	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
TRICHLOROFLUOROMETHANE	-----	-----	µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
VINYL ACETATE			µg/L	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
VINYL CHLORIDE	2	0.02	µg/L	0.02 U	0.02 U	0.02 U	**0.071**	0.02 U	0.02 U

Notes: **Concentration exceeds State Drinking Water Standards or Groundwater Standards**

FD = Field Duplicate of MW-10 was labeled MW-13.

Regulatory Standards:

All regulatory standards listed for VOCs are Primary Regulatory Standards

(a) WAC 246-290-310

(b) WAC 173-200-040

Data Qualifiers:

U = Indicates compound was analyzed for but was not detected at the specified detection limit.

Appendix B:
2016 Monitoring Field Notes

ENVIRONMENTAL PARTNERS INC

1180 NW Maple Street, Suite 310 Issaquah, Washington 98027 ph 425.395.0010

Olalla Landfill Quarterly Monitoring Field Book March 2016

Olalla Landfill
Kitsap County, Washington
Project Number: 45403.04

Environmental Partners, Inc.
1180 NW Maple Street, Suite 310
Issaquah, Washington 98027
(425) 395-0010

Attachment B: Olalla Landfill MFS Monitoring Recommended Equipment List

Field Instruments Provided by Consultant:	Example
Multi-parameter meter or individual meters as noted:	YSI 556 or Horiba U-22
pH meter	Orion 250A
Specific conductance meter	YSI Pro 30
Dissolved oxygen meter	YSI Model 50B
ORP meter	YSI ORP15
Turbidity meter	LaMott 2020
Flow-through cell for field parameter instruments	
Landfill gas meter (rented)	Landtech GEM 5000, or equivalent
Water Level Indicator	Solinst, Heron, Slope Indicator

Equipment to Obtain from the County:
Keys to Bandix Road Gate, wells, and gates to flares
Grundfos Rediflow II pump controller and electrical cables

Equipment Provided by Consultant:
Appropriate gas powered generator (Honda eu2000i or equvalent)
Power cord for generator
Extra fuel for generator in DOT-approved container(s)
Field logbook with appropriate field data forms
Pens
Sample bottles and coolers
Spray bottles
Appropriate PPE (see HASP)
5-gallon purge water buckets
Watch or phone for sample times
Utility knife or equivalent
Cell Phone

Expendible Supplies:
0.45 micron in-line filters for dissolved metals samples
Nitrile gloves
Garbage bags
Ziploc-type bags
Paper towels
Ice
Distilled or deionized water
Liquinox™ or equivalent non-phosphate detergent
Chain of custody forms
Strapping tape (if shipping sample coolers)
Clear packing tape (if shipping sample coolers)
Calibration fluids for pH, specific conductance, DO, and ORP
Calibration gases (methane, oxygen, CO_2) and appropriate regulators and hoses
Extra batteries or charging cords for meters and water level indicator

Notes:
DOT = Department of Transportation
CO_2 = Carbon dioxide
HASP = Health and safety plan
ORP = Oxidation reduction potential
PPE = Personal protective equipment
YSI = Yellow Springs Instruments

- grey Tub

Table 2-1: CAP and SWHP Monitoring Schedule
Olalla Landfill, Kitsap County, WA

Sample Location	First Quarter									Second and Third Quarters								Fourth Quarter											
	Water Level	Field Parameters	VOCs	T & D Metals	Total Coliform	Fecal Coliform	Geochemical	TOC / COD	Landfill Gas Parameters	Water Level	Field Parameters	VOCs	T & D Metals	Total Coliform	Geochemical	TOC / COD	Landfill Gas Parameters	Water Level	Field Parameters	VOCs	T & D Metals	Total Coliform	Fecal Coliform	Geochemical	TOC / COD	D. Metals - COC list	pH (field and lab)	Vinyl Chloride	Landfill Gas Parameters
MW-1	■	■	■	■	■		■	■		■	■	■	■	■	■	■		■	■	■	■	■		■	■				
MW-2	■									■								■											
MW-3	■	■	■	■	■		■	■		■	■	■	■	■	■	■		■	■	■	■	■		■	■				
MW-4	■									■								■											
MW-5	■									■								■											
MW-5A	■									■								■	■							■	■	■	
MW-6	■	■	■	■	■		■	■		■	■	■	■	■	■	■		■	■	■	■	■		■	■				
MW-7	■									■								■	■							■	■	■	
MW-8	■	■	■	■	■		■	■		■	■	■	■	■	■	■		■	■	■	■	■		■	■				
MW-10	■	■	■	■	■		■	■		■	■	■	■	■	■	■		■	■	■	■	■		■	■				
SW-2[1]		■				■	■												■				■	■					
Flares 1, 2, 3									■								■												■

Notes:

[1] Surface water sample from SW-2 collected during first quarter or fourth quarter, not both quarters.

Field Parameters = pH, specific conductance, temperature, ORP, and DO

VOCs = Volatile organic compounds by EPA Method 8260C standard list, vinyl chloride by selective ion monitoring (SIM)

T (total) Metals = calcium, potassium, sodium

D (dissolved) Metals = arsenic, barium, iron, manganese, zinc

Geochemical = alkalinity, ammonia, bicarbonate, carbonate, chloride, sulfate, nitrate, nitrite, pH

TOC / COD = total organic carbon / chemical oxygen demand

Dissolved Metals - COC list = arsenic, iron, manganese

Landfill gas parameters = methane (%LEL), oxygen(% vol), carbon dioxide (% vol), and gas pressure

Instrument Calibration Log - Olalla Landfill Monitoring

Calibrated By: Equipco - see certification of calibration **Date:** _____

Meter Type	Manufacturer	Model Number	Manufacturer Serial #	Rental Co. Serial #	Time
pH					
pH Electrode					

Calibrated: _____ to 4.00 buffer _____ to 7.00 buffer _____ to 10.00 buffer at _____ °C

Slope = _____ Comments:

Meter Type	Manufacturer	Model Number	Manufacturer Serial #	Rental Co. Serial #	Time
Specific Cond.					

Specific Conductance: Calibrated _____ µS/cm to _____ µS/cm calibration standard

Electrical Conductivity: Calibrated _____ µS/cm to _____ µS/cm calibration standard at _____ °C

Comments:

Meter Type	Manufacturer	Model Number	Manufacturer Serial #	Rental Co. Serial #	Time
ORP Meter					
ORP Electrode					

Electrode measured _____ millivolts at _____ °C using Zobell prepared on / /

Table value for Zobell solution at this temperature is _____ mV.

Meter Type	Manufacturer	Model Number	Manufacturer Serial #	Rental Co. Serial #	Time
Turbidity					

Meter reads _____ NTUs using _____ NTUs standard | Comments:

Meter reads _____ NTUs using _____ NTUs standard

Meter Type	Manufacturer	Model Number	Manufacturer Serial #	Rental Co. Serial #	Time
DO Meter					

Air-Calibration: Measured temperature _____ °C corresponds to _____ mg/L DO (from Table I)

Atmospheric pressure / elevation correction factor _____ (from Table II)

Corrected calibration value _____ mg/L DO (Table I value multiplied by Table II value)

Comments:

Multiparameter Probe Calibration Log - Olalla Landfill Groundwater Monitoring

Meter Type	Manufacturer	Model Number	Mfg. Serial#	Rental Co. Serial #	Date	Time

Calibrated to Autocal Solution

Calibration Solution Manufacturer _____ Lot Number _____ Exp. Date _____

pH = _____ Turbidity = _____ Temperature = _____

Conductivity = _____ Dissolved Oxygen = _____ ORP = _____

Comments:

Meter Type	Manufacturer	Model Number	Mfg. Serial#	Rental Co. Serial #	Date	Time

Calibrated to Autocal Solution

Calibration Solution Manufacturer _____ Lot Number _____ Exp. Date _____

pH = _____ Turbidity = _____ Temperature = _____

Conductivity = _____ Dissolved Oxygen = _____ ORP = _____

Comments:

Table 3-1: Monitoring Well Construction Data Summary

Olalla Landfill, Kitsap County, WA

Well	Total Well Depth (ft bgs)	Measuring Point Elevation (ft NGVD 29)	Surface Elevation (ft NGVD 29)	Screened Interval (ft bgs)	Northing	Easting	Measuring Point Description
MW-1	87	343.79	342.53	82-87	161858.133	560525.840	Pump wellhead
MW-2	73	323.25	318.95	68-73	161704.534	559572.839	Top of PVC casing
MW-3	55.5	296.95	294.95	50.5-55.5	162333.903	559463.060	Pump wellhead
MW-4	68	320.93	317.35	63-68	161911.192	559787.735	Top of PVC casing
MW-5	35.5	334.17	332.78	25-35	162510.115	559878.901	Top of PVC casing
MW-5A	98	332.53	331.43	86-96	162487.878	559875.742	Pump wellhead
MW-6	35	271.17	269.14	28-33	162077.699	559358.970	Pump wellhead
MW-7	33	280.43	278.21	21-31	161723.016	559398.979	Pump wellhead
MW-8	38	272.85	270.73	25-35	161897.813	559350.147	Pump wellhead
MW-10	47	279.21	276.84	37-47	162218.490	559340.899	Pump wellhead

Notes:

NGVD 29 = National Geodetic Vertical Datum (1929)

bgs = below ground surface

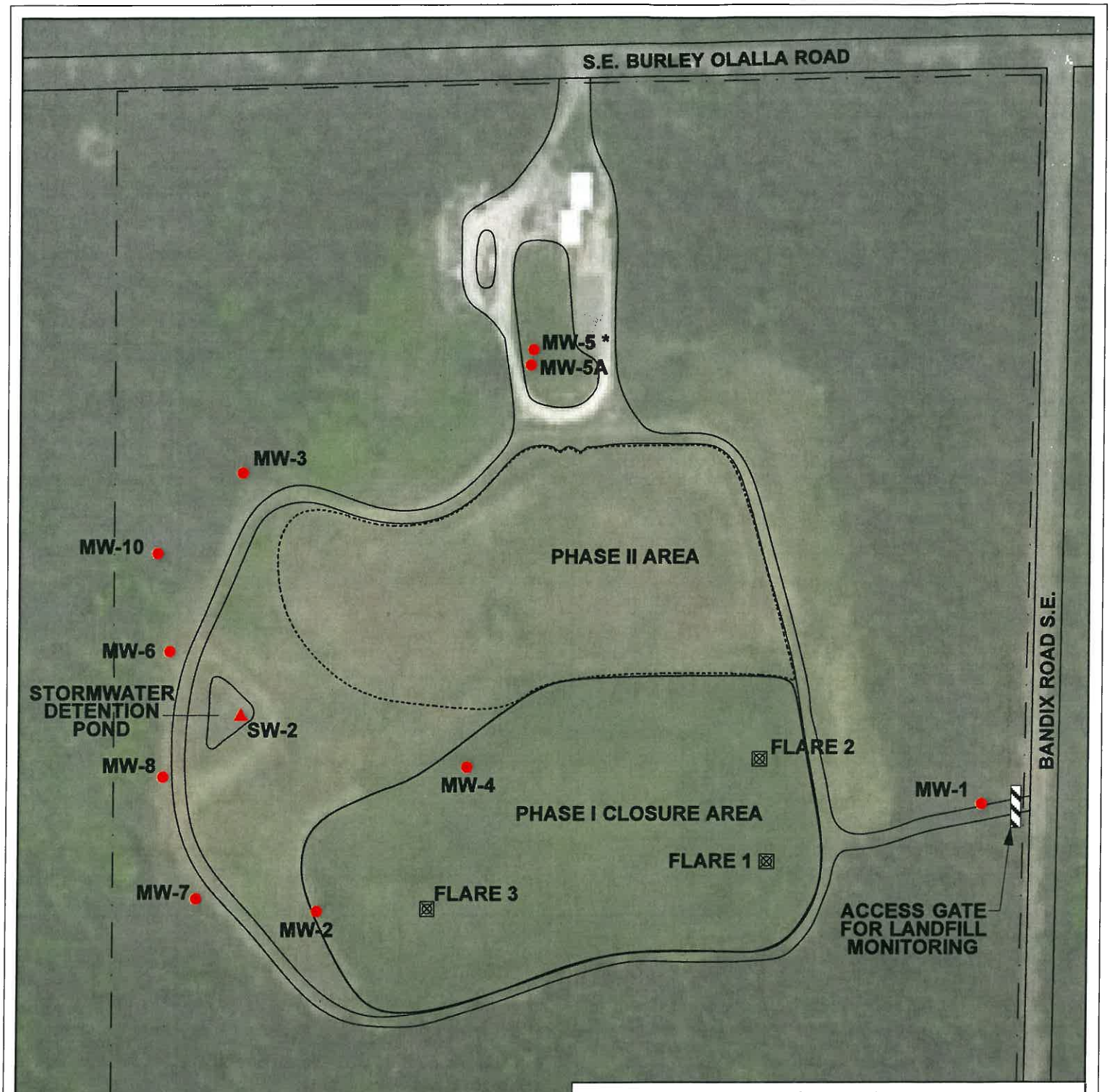


FIGURE 1-2

OLALLA LANDFILL
MONITORING WELL, FLARE, AND SURFACE WATER SAMPLING LOCATIONS
KITSAP COUNTY, WASHINGTON

PREPARED BY	epi ENVIRONMENTAL PARTNERS INC		
PROJECT	OLALLA LANDFILL QAPP/45403.0		
LOCATION	2850 SE BURLEY-OLALLA ROAD OLALLA, WASHINGTON		
PREPARED FOR	KITSAP COUNTY		
DATE 2/25/15	DRAWN BY ALW/CLM	REVIEWED BY ALW/CLM	PROJECT NUMBER 45403.0

Depth to Water Measurement Field Data - Olalla Landfill Monitoring

Well	Time	Measuring Point Elevation (ft. NGVD[1])	Depth to Water (ft.)	Comments and Well Inspection[2] Notes
MW-1	08:36	343.79	77.18	
MW-2	14:55	323.25	62.42	
MW-3	10:15	296.95	40.70	
MW-4	15:00	320.93	59.41	
MW-5	09:58	334.17	8.35	
MW-5A	0955	332.53	73.43	
MW-6	12:44	271.17	17.26	
MW-7	14:41	280.43	22.35	
MW-8	13:48	272.85	18.10	
MW-10	11:20	279.21	25.94	

Notes:

[1]NGVD = National Geodetic Vertical Datum (1929)

[2]Observations regarding the condition of the well and surrounding area (e.g., protective casing, surface seal, cap, lock, bollards, soil conditions near the well such as depressions, ponded surface water, or other subsidence features, and any installed sampling equipment).

Groundwater Sampling Field Data

EPI Project No./Site: 45403.0/Kitsap County - Olalla Landfill

Station	MW-1	Date	3/24/16
Sample ID	Olalla-MW1-3/16	Field Team: (Initials)	ELC
Field Conditions	clear & cool		

Purge Information

Well Diameter (in.)	4"
Well Depth (ft.)	87
Initial Depth to Water (ft.)	77.18
Depth of Water Column	9.82
1 Casing Volume	1.57
3 Casing Volumes	4.7

Cont

Purge Method : (Submersible pump) / Peristaltic Pump / Bladder Pump / Other: :

Start Time	09:00
End Time	09:19
Total Gallons Purged	15

Time	Gallons	pH	Conductivity	NTU	DO mg/L	Temp.	ORP	Appearance
09:03	3.5	6.83	0.131		9.92	9.93	65.9	clear
09:06	5.5	6.70	0.131		9.82	10.01	66.3	"
09:09	7.5	6.60	0.131		9.79	10.03	67.4	"
09:12	10	6.56	0.131		9.79	10.06	68.6	"
09:15	12.5	6.53	0.130		9.78	10.02	69.9	"
09:16 - Sample				4.1				

Sample Information

Sample Method(s) (Submersible pump) / Peristaltic pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	09:16	~~(2)~~ 40-ml VOA	HCL, ice	
Total Coliform		~~300-ml sterile AG or poly~~	Ice	
Geochemical Parameters		500-ml HDPE	ice	
Nitrate/Nitrite		500-ml HDPE	ice	
TOC		250-ml AG	H_2SO_4 to ph<2, ice	
COD		250-ml HDPE	H_2SO_4 to ph<2, ice	
Total Metals		250-ml HDPE	HNO_3 to ph<2, ice	
Dissolved Metals		250-ml HDPE	HNO3 to ph<2, ice. Field filter	

End Time 09:19

Comments / Exceptions:

Controller setting 210.7

Groundwater Sampling Field Data

EPI Project No./Site: 45403.0/Kitsap County - Olalla Landfill

Station	MW-3	Date	3/24/16
Sample ID	Olalla-MW3-3/16	Field Team: (Initials)	ELC
Field Conditions	Cool & Clear		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	55.5
Initial Depth to Water (ft.)	40.70
Depth of Water Column	14.8
1 Casing Volume	2.37
3 Casing Volumes	7.1

Purge Method : (Submersible pump) / Peristaltic Pump / Bladder Pump / Other: :

Start Time	10:27
End Time	10:48
Total Gallons Purged	Y

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
10:28	.5	6.75	0.271		3.89	10.18	20.1	Cloudy
10:31	2	6.51	0.219		1.75	11.06	20.3	"
10:34	3.2	6.45	0.219		1.51	11.20	19.1	"
10:37	4.8	6.42	0.219		1.42	11.26	18.2	"
10:40	5.6	6.41	0.219		1.32	11.36	17.1	"
10:43	7.2	6.40	0.219	.20	1.34	11.29	15.5	"
10:45	Sample							

Sample Information

Sample Method(s) : (Submersible pump) / Peristaltic pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	10:45	5~~2~~ 40-ml VOA	HCL, ice	
Total Coliform		300-ml sterile AG or poly	ice	
Geochemical Parameters		500-ml HDPE	ice	
Nitrate/Nitrite		500-ml HDPE	ice	
TOC		250-ml AG	H_2SO_4 to ph<2, ice	
COD		250-ml HDPE	H_2SO_4 to ph<2, ice	
Total Metals		250-ml HDPE	HNO_3 to ph<2, ice	
Dissolved Metals		250-ml HDPE	HNO3 to ph<2, ice. Field filter	

End Time 10:48

Comments / Exceptions:

Conductivity 1.78 1 29.5

Groundwater Sampling Field Data

EPI Project No./Site: 45403.0/Kitsap County - Olalla Landfill

Station	MW-10	Date	3/24/16
Sample ID	Olalla - MW10 - 3/16	Field Team: (Initials)	ELC
Field Conditions	Cool & clear		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	47
Initial Depth to Water (ft.)	25.94
Depth of Water Column	21.06
1 Casing Volume	3.37
3 Casing Volumes	10.1

Purge Method: (Submersible pump) / Peristaltic Pump / Bladder Pump / Other: :

Start Time	12:00
End Time	12:23
Total Gallons Purged	~~7~~ 7

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
12:07	4	6.42	0.499		1.47	10.17	25.2	Clear
12:10	5	6.41	0.493		1.12	10.25	25.0	"
12:13	6.8	6.41	0.490		1.04	10.24	24.9	"
12:16	9	6.41	0.492		0.97	10.25	22.1	"
12:19	10.2	6.41	0.422	0.21	0.95	10.26	19.9	"
12:21 -	caught							

Sample Information

Sample Method(s): (Submersible pump) / Peristaltic pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	12:21	5 ~~(8)~~ 40-ml VOA	HCL, ice	
Total Coliform		300-ml sterile AG or poly	ice	
Geochemical Parameters		500-ml HDPE	ice	
Nitrate/Nitrite		500-ml HDPE	ice	
TOC		250-ml AG	H_2SO_4 to ph<2, ice	
COD		250-ml HDPE	H_2SO_4 to ph<2, ice	
Total Metals		250-ml HDPE	HNO_3 to ph<2, ice	
Dissolved Metals		250-ml HDPE	HNO3 to ph<2, ice. Field filter	

End Time: 12:23

Comments / Exceptions:

Jetting - 12.7.8

Groundwater Sampling Field Data

EPI Project No./Site: 45403.0/Kitsap County - Olalla Landfill

Station	MW-6	Date	3/24/16
Sample ID	Olalla-MW6-3/16 and Duplicate	Field Team: (Initials)	ELC
Field Conditions	Clear & cool		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	35
Initial Depth to Water (ft.)	17.23
Depth of Water Column	17.77
1 Casing Volume	2.5
3 Casing Volumes	8.5

Purge Method : (Submersible pump) / Peristaltic Pump / Bladder Pump / Other: :

Start Time	12:56
End Time	13:21
Total Gallons Purged	13

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
12:59	2.1	7.27	0.095		1.87	10.14	36.0	cloudy
13:02	4.5	7.02	0.098		1.70	10.18	34.8	clearing up
13:05	6.3	6.97	0.103		1.10	10.17	21.2	clear
13:08	9	6.88	0.107		1.02	10.18	14.6	"
13:11	10.2	6.84	0.108		0.98	10.18	8.2	"
13:14	12.1	6.82	0.113	3.3	0.95	10.19	8.0	"

Sample Information

Sample Method(s) : Submersible pump / Peristaltic pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	12:16	40-ml VOA	HCL, ice	
Total Coliform		300-ml sterile AG or poly	ice	
Geochemical Parameters		500-ml HDPE	ice	
Nitrate/Nitrite		500-ml HDPE	ice	
TOC		250-ml AG	H_2SO_4 to ph<2, ice	
COD		250-ml HDPE	H_2SO_4 to ph<2, ice	
Total Metals		250-ml HDPE	HNO_3 to ph<2, ice	
Dissolved Metals		250-ml HDPE	HNO3 to ph<2, ice. Field filter	

End Time 13:21

Comments / Exceptions: Duplicate - Olalla-MW6-3/16

Container ID

Groundwater Sampling Field Data

EPI Project No./Site: 45403.0/Kitsap County - Olalla Landfill

Station	MW-8	Date	3/24/16
Sample ID	Olalla - MW8-3/16	Field Team: (Initials)	ELC
Field Conditions	Cloudy, Cool		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	35
Initial Depth to Water (ft.)	15.10
Depth of Water Column	19.4
1 Casing Volume	3.18
3 Casing Volumes	9.55

Purge Method : Submersible pump / Peristaltic Pump / Bladder Pump / Other: :

Start Time	13:58
End Time	14:18
Total Gallons Purged	~~10~~ 8

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
13:59	.5	7.43	0.064		8.60	8.93	55.1	clear
14:02	3.8	6.96	0.093		5.33	9.26	50.2	"
14:05	4.8	6.87	0.101		4.51	9.33	46.1	"
14:08	7.1	6.81	0.107		4.24	9.35	42.7	"
14:11	9	6.79	0.110		4.12	9.36	41.2	"
14:14	11.8	6.74	0.114	6.6	4.08	9.35	40.6	"

Sample Information

Sample Method(s) : Submersible pump / Peristaltic pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	14:16	5 ~~or~~ 40-ml VOA	HCL, ice	
Total Coliform		300-ml sterile AG or poly	ice	
Geochemical Parameters		500-ml HDPE	ice	
Nitrate/Nitrite		500-ml HDPE	ice	
TOC		250-ml AG	H_2SO_4 to ph<2, ice	
COD		250-ml HDPE	H_2SO_4 to ph<2, ice	
Total Metals		250-ml HDPE	HNO_3 to ph<2, ice	
Dissolved Metals		250-ml HDPE	HNO3 to ph<2, ice. Field filter	

End Time 14:18

Comments / Exceptions:

Controller - 110

Groundwater Sampling Field Data

EPI Project No./Site: 45403.0/Kitsap County - Olalla Landfill

Station		Date	
Sample ID		Field Team: (Initials)	ELC
Field Conditions			

Purge Information

Well Diameter (in.)	
Well Depth (ft.)	
Initial Depth to Water (ft.)	
Depth of Water Column	
1 Casing Volume	
3 Casing Volumes	

Purge Method : Submersible pump
Peristaltic Pump
Bladder Pump
Other: : _____

Start Time	
End Time	
Total Gallons Purged	

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance

Sample Information

Sample Method(s) : Submersible pump / Peristaltic pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC		(3) 40-ml VOA	HCL, ice	
Total Coliform		300-ml sterile AG or poly	ice	
Geochemical Parameters		500-ml HDPE	ice	
Nitrate/Nitrite		500-ml HDPE	ice	
TOC		250-ml AG	H_2SO_4 to ph<2, ice	
COD		250-ml HDPE	H_2SO_4 to ph<2, ice	
Total Metals		250-ml HDPE	HNO_3 to ph<2, ice	
Dissolved Metals		250-ml HDPE	HNO3 to ph<2, ice. Field filter	

End Time

Comments / Exceptions:

Landfill Gas Monitoring Field Data - Olalla Landfill Monitoring

Instrument Used:	GEM 2000	Date and Time:	3/24/16 15:10
Ambient Temperature:	50° F	Field Team:	EL C
Field Conditions:	Cloudy & cool, moderate breeze		

Landfill Gas Data

Flare #	Time	Methane (% vol.)	% LEL	Oxygen (% vol.)	Carbon Dioxide (% vol.)	Temperature (°C)	Gas Pressure ("H_2O)
#3	15:12	00.0	0.0	19.4	1.6	—	0.48
#1	15:32	0	0	20.3	0.3	—	0.10
#2	15:41	0	0	20.4	0.1	—	0.1 - 0.3

Comments / Inspection Results[1]

- valve on #3 very loose

[1]Inspect the following: lock and gate operation, tightness of bolts and clamps, differential settlement, valve operation, debris or breaks in hose barb.

Surface Water Sampling Field Data - Olalla Landfill Monitoring

Station	SW-2	Date	3/24/16
Sample: ID	—	Field Team: (Initials)	EAC
Field Conditions	Cool, clear		

Field Parameter Data

Time	pH	Specific Conductance	Temperature (°C)	Appearance and Flow Rate

Sample Information

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Fecal Coliform		300-mL sterile AG or poly	Cool to <4°C	
Nitrate-Nitrogen		500-mL HDPE	Cool to <4°C	
pH		125-mL AG	Cool to <4°C	

Sample End Time

Comments / Exceptions:

Dry - no water coming out of discharge pipe. Retention pond is muddy ~~but~~ w/ no standing water

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

EQUIPCO

CES LANDTECH MODEL: GEM 2000
CALIBRATION CERTIFICATE

SERVICE TECHNICIAN: JM DATE: 3/23/16

INSTRUMENT INFORMATION

RENTAL ID: GEM2000.03

SERIAL NUMBER: GM07210/03

CALIBRATION INFORMATION

1..CALIBRATION GAS: 35 % CO_2 LOT #: 573162

GAS RESPONSE: 35 % CO_2 ±2%

2. CALIBRATION GAS: 50 % Vol. Methane LOT #: 573162

GAS RESPONSE: 50 % Vol. Methane ±2%

OXYGEN RESPONSE IN FRESH AIR ENVIRONMENT: 20.9% ✓

OXYGEN DOWNSCALE RESPONSE CHECKED: 0% WITH 99.9% Nitrogen ✓

THIS INSTRUMENT HAS BEEN CALIBRATED TO STANDARDS SET FORTH BY THE MANUFACTURER

2389 151st Pl NE, Redmond, WA 98052 Phone (888)234-5678 Fax (925)305-1303

EQUIPCO

YSI 6920 RENTAL
CALIBRATION CERTIFICATE

SERVICE TECHNICIAN: JM DATE: 3/23/16

RENTAL CUSTOMER:

INSTRUMENT INFORMATION

RENTAL I.D. NUMBER: YSI-6920. 09
SERIALNUMBER: 97B0591AF

CALIBRATION INFORMATION

PARAMETERS:	STANDARDS:	PASS ( )	LOT#
CONDUCTIVITY	1000 µMhos	X	10932
pH ZERO	pH 7	X	10518
pH SLOPE	pH 4	X	10521
pH SLOPE 2	pH 10	X	10503
DISSOLVED OXYGEN	Air Calibration Barometric pressure = 766 mmHg	X	N/A
TURBIDITY ZERO	0.5 NTU	N/A	100A
TURBIDITY SPAN	X NTU	N/A	N/A
TURBIDITY SPAN 2	X NTU	N/A	N/A
REDOX (ORP)	242.7 mV (YSI Zobell solution)	X	111413

2689 151st Pl NE, Redmond, WA 98052 Phone (888)234-5678 Fax (925)305-1303

ENVIRONMENTAL PARTNERS INC

1180 NW Maple Street, Suite 310 Issaquah, Washington 98027 ph 425.395.0010

Olalla Landfill Quarterly Monitoring Field Book June 2016

Olalla Landfill
Kitsap County, Washington
Project Number: 45404.0

Environmental Partners, Inc.
1180 NW Maple Street, Suite 310
Issaquah, Washington 98027
(425) 395-0010

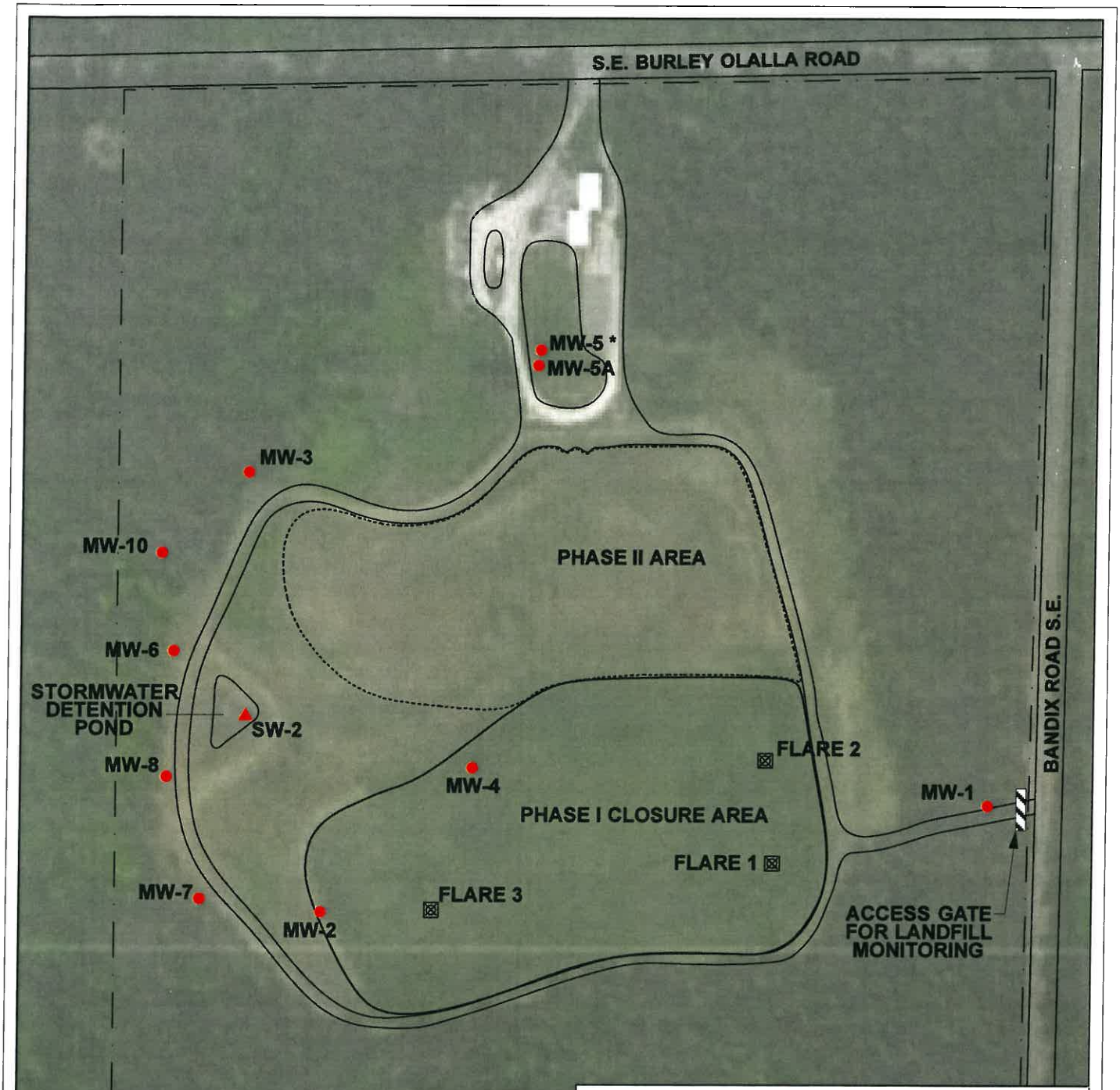


FIGURE 1-2

OLALLA LANDFILL
MONITORING WELL, FLARE, AND SURFACE WATER SAMPLING LOCATIONS
KITSAP COUNTY, WASHINGTON

PREPARED BY	epi ENVIRONMENTAL PARTNERS INC		
PROJECT	OLALLA LANDFILL QAPP/45403.0		
LOCATION	2850 SE BURLEY-OLALLA ROAD OLALLA, WASHINGTON		
PREPARED FOR	KITSAP COUNTY		
DATE 2/25/15	*DRAWN BY* ALW/CLM	*REVIEWED BY* ALW/CLM	*PROJECT NUMBER* 45403.0

Multiparameter Probe Calibration Log - Olalla Landfill Groundwater Monitoring

Meter Type	Manufacturer	Model Number	Mfg. Serial#	Rental Co. Serial #	Date	Time

Calibrated to Autocal Solution

Calibration Solution Manufacturer _____ Lot Number _____ Exp. Date _____

pH = _____ Turbidity = _____ Temperature = _____

Conductivity = _____ Dissolved Oxygen = _____ ORP = _____

Comments: YSI and CEM landfill gas meter calibrated by rental company - Equipco. Calibration certs provided.

Meter Type	Manufacturer	Model Number	Mfg. Serial#	Rental Co. Serial #	Date	Time

Calibrated to Autocal Solution

Calibration Solution Manufacturer _____ Lot Number _____ Exp. Date _____

pH = _____ Turbidity = _____ Temperature = _____

Conductivity = _____ Dissolved Oxygen = _____ ORP = _____

Comments:

Table 2-1: CAP and SWHP Monitoring Schedule

Olalla Landfill, Kitsap County, WA

Sample Location	First Quarter									Second and Third Quarters								Fourth Quarter												
	Water Level	Field Parameters	VOCs	T & D Metals	Total Coliform	Fecal Coliform	Geochemical	TOC / COD	Landfill Gas Parameters	Water Level	Field Parameters	VOCs	T & D Metals	Total Coliform	Geochemical	TOC / COD	Landfill Gas Parameters	Water Level	Field Parameters	VOCs	T & D Metals	Total Coliform	Fecal Coliform	Geochemical	TOC / COD	D. Metals - COC list	pH (field and lab)	Vinyl Chloride	Landfill Gas Parameters
MW-1	■	■	■	■	■		■	■		■	■	■	■	■	■	■		■	■	■	■	■		■	■				
MW-2	■									■								■											
MW-3	■	■	■	■	■		■	■		■	■	■	■	■	■	■		■	■	■	■	■		■	■				
MW-4	■									■								■											
MW-5	■									■								■											
MW-5A	■									■								■	■							■	■	■	
MW-6	■	■	■	■	■		■	■		■	■	■	■	■	■	■		■	■	■	■	■		■	■				
MW-7	■									■								■	■							■	■	■	
MW-8	■	■	■	■	■		■	■		■	■	■	■	■	■	■		■	■	■	■	■		■	■				
MW-10	■	■	■	■	■		■	■		■	■	■	■	■	■	■		■	■	■	■	■		■	■				
SW-2[1]		■				■	■												■				■	■					
Flares 1, 2, 3									■								■												■

Notes:

[1] Surface water sample from SW-2 collected during first quarter or fourth quarter, not both quarters.

Field Parameters = pH, specific conductance, temperature, ORP, and DO

VOCs = Volatile organic compounds by EPA Method 8260C standard list, vinyl chloride by selective ion monitoring (SIM)

T (total) Metals = calcium, potassium, sodium

D (dissolved) Metals = arsenic, barium, iron, manganese, zinc

Geochemical = alkalinity, ammonia, bicarbonate, carbonate, chloride, sulfate, nitrate, nitrite, pH

TOC / COD = total organic carbon / chemical oxygen demand

Dissolved Metals - COC list = arsenic, iron, manganese

Landfill gas parameters = methane (%LEL), oxygen(% vol), carbon dioxide (% vol), and gas pressure

3rd Qtr
Dup - MW-17 from MW-6

Table 3-1: Monitoring Well Construction Data Summary

Olalla Landfill, Kitsap County, WA

Well	Total Well Depth (ft bgs)	Measuring Point Elevation (ft NGVD 29)	Surface Elevation (ft NGVD 29)	Screened Interval (ft bgs)	Northing	Easting	Measuring Point Description
MW-1	87	343.79	342.53	82-87	161858.133	560525.840	Pump wellhead
MW-2	73	323.25	318.95	68-73	161704.534	559572.839	Top of PVC casing
MW-3	55.5	296.95	294.95	50.5-55.5	162333.903	559463.060	Pump wellhead
MW-4	68	320.93	317.35	63-68	161911.192	559787.735	Top of PVC casing
MW-5	35.5	334.17	332.78	25-35	162510.115	559878.901	Top of PVC casing
MW-5A	98	332.53	331.43	86-96	162487.878	559875.742	Pump wellhead
MW-6	35	271.17	269.14	28-33	162077.699	559358.970	Pump wellhead
MW-7	33	280.43	278.21	21-31	161723.016	559398.979	Pump wellhead
MW-8	38	272.85	270.73	25-35	161897.813	559350.147	Pump wellhead
MW-10	47	279.21	276.84	37-47	162218.490	559340.899	Pump wellhead

Notes:

NGVD 29 = National Geodetic Vertical Datum (1929)

bgs = below ground surface

Depth to Water Measurement Field Data - Olalla Landfill Monitoring

Well	Time	Measuring Point Elevation (ft. NGVD[1])	Depth to Water (ft.)	Comments and Well Inspection[2] Notes
MW-1	08:15	343.79	73.82	Good
MW-2	15:38	323.25	62.34	" ok
MW-3	09:55	296.95	43.08	Good
MW-4	15:45	320.93	54.70	* - needs new J-plug * usual issue - casing sticks above monument
MW-5	09:25	334.17	10.80	Good
MW-5A	09:30	332.53	73.13	"
MW-6	12:50	271.17	19.01	"
MW-7	15:15	280.43	23.18	"
MW-8	14:24	272.85	19.52	Good
MW-10	11:00	279.21	28.07	Good

Notes:

[1]NGVD = National Geodetic Vertical Datum (1929)

[2]Observations regarding the condition of the well and surrounding area (e.g., protective casing, surface seal, cap, lock, bollards, soil conditions near the well such as depressions, ponded surface water, or other subsidence features, and any installed sampling equipment).

Groundwater Sampling Field Data

EPI Project No./Site: 45404.0/Kitsap County - Olalla Landfill

Station	MW-1	Date	21-Jun-16
Sample ID	OL-MW-1-6/16	Field Team: (Initials)	ELC
Field Conditions	Cloudy (cool)		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	89
Initial Depth to Water (ft.)	73.52
Depth of Water Column	15.48
1 Casing Volume	2.11
3 Casing Volumes	6.32

Purge Method: (Submersible pump) / Peristaltic Pump / Bladder Pump / Other: :

Start Time	08:34
End Time	08:51
Total Gallons Purged	15.5

Time	Gallons	pH	Conductivity	NTU	DO mg/L	Temp.	ORP	Appearance
08:37	1.8	6.02	0.131		12.68	10.45	108.5	slightly cloudy
08:40	4	5.45	0.131		10.04	10.85	130.1	clear
08:43	6.5	5.48	0.131		9.56	10.91	114.2	"
08:46	9	5.62	0.131	0.26	9.46	10.91	109.3	"
08:49	11.8	5.72	0.131		9.38	10.92	105.8	"
08:52	15	5.80	0.130	0.25	9.28	10.97	105.8	"

Sample Information

Sample Method(s): (Submersible pump) / Peristaltic pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	08:54	(5) 40-ml VOA	HCL, ice	
Total Coliform		300-ml sterile AG or poly	Na2S2O3	
Geochemical Parameters		Sm OJ	ice	
Nitrate/Cl/Nitrite/SO4/pH		Lg OJ	ice	
TOC/COD/NH3		250-ml AG	H_2SO_4	
Total Metals		500-ml HDPE	HNO_3 to ph<2, ice	
Dissolved Metals		500-ml HDPE	HNO3 to ph<2, ice. **Field filter**	

End Time: 08:56

Comments / Exceptions:

Regulator set @ 210

6

Groundwater Sampling Field Data

EPI Project No./Site: 45404.0/Kitsap County - Olalla Landfill

Station	MW-3	Date	21-Jun-16
Sample ID	OL-MW-3-6/16	Field Team: (Initials)	ELC
Field Conditions	Cloudy, cool		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	55.5
Initial Depth to Water (ft.)	43.0
Depth of Water Column	12.5
1 Casing Volume	2.0
3 Casing Volumes	6.0

Purge Method: ~~Submersible pump~~ / Peristaltic Pump / Bladder Pump / Other:

Start Time	10:10
End Time	10:32
Total Gallons Purged	10

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
10:13	1.5	5.67	0.161		2.23	11.63	89.1	clear
10:16	3	5.51	0.157		1.64	11.86	95.5	"
10:19	4.5	5.58	0.157		1.38	11.92	90.4	"
10:22	6	5.66	0.160	2.60	1.25	11.92	85.4	"
10:25	7.5	5.68	0.159		1.20	11.96	85.2	"
10:28	9	5.69	0.157	7.50	1.16	11.96	88.0	"

Sample Information

Sample Method(s): ~~Submersible pump~~ / Peristaltic pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	10:30	(5) 40-ml VOA	HCL, ice	
Total Coliform		300-ml sterile AG or poly	Na2S2O3	
Geochemical Parameters		Sm OJ	ice	
Nitrate/Cl/Nitrite/SO4/pH		Lg OJ	ice	
TOC/COD/NH3		250-ml AG	H_2SO_4	
Total Metals		500-ml HDPE	HNO_3 to ph<2, ice	
Dissolved Metals		500-ml HDPE	HNO3 to ph<2, ice. **Field filter**	

End Time: 10:32

Comments / Exceptions:

Controller - 147.3

Groundwater Sampling Field Data

EPI Project No./Site: 45404.0/Kitsap County - Olalla Landfill

Station	MW-10	Date	21-Jun-16
Sample ID	OL-MW-10-6/16	Field Team: (Initials)	ELC
Field Conditions	Clear & Cool		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	47
Initial Depth to Water (ft.)	28.07
Depth of Water Column	18.93
1 Casing Volume	3.02
3 Casing Volumes	9.06

Purge Method: (Submersible pump) / Peristaltic Pump / Bladder Pump / Other: :

Start Time	11:13
End Time	11:38
Total Gallons Purged	9

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
11:16	1.2	6.05	0.540		1.77	11.03	92.2	clear
11:19	2.4	5.81	0.540		1.59	11.22	98.7	"
11:22	3.8	5.80	0.540		1.30	11.28	88.4	"
11:25	5	5.94	0.542	1.26	1.27	11.26	75.6	"
11:28	6.2	6.08	0.539		1.25	11.27	60.5	"
11:31	7	6.12	0.536		1.24	11.26	56.8	"
11:34	8.1	6.15	0.540		1.21	11.24	52.8	"

Sample Information

Sample Method(s): (Submersible pump) / Peristaltic pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	11:36	(5) 40-ml VOA	HCL, ice	
Total Coliform		300-ml sterile AG or poly	Na2S2O3	
Geochemical Parameters		Sm OJ	ice	
Nitrate/Cl/Nitrite/SO4/pH		Lg OJ	ice	
TOC/COD/NH3		250-ml AG	H_2SO_4	
Total Metals		500-ml HDPE	HNO_3 to ph<2, ice	
Dissolved Metals		500-ml HDPE	HNO3 to ph<2, ice. **Field filter**	

End Time: 11:38

Comments / Exceptions:

Conductivity 122.6

Groundwater Sampling Field Data

EPI Project No./Site: 45404.0/Kitsap County - Olalla Landfill

Station	MW-6	Date	21-Jun-16
Sample ID	OL-MW-6-6/16	Field Team: (Initials)	ELC
Field Conditions	partly cloudy, cool	and Duplicate Sample OL-MW-17-6/16	

Purge Information

Well Diameter (in.)	2
Well Depth (ft.)	35.
Initial Depth to Water (ft.)	19.04
Depth of Water Column	15.96
1 Casing Volume	2.55
3 Casing Volumes	7.66

Purge Method: (Submersible pump) ~~Peristaltic Pump~~ Bladder Pump

Other: :

Start Time	13:13
End Time	13:41
Total Gallons Purged	10.5

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
13:17	2	6.09	0.342		~~0.24~~	10.96	29.5	~~clear~~ slightly cloudy
13:20	4	5.95	0.343		2.06	10.98	28.7	cloudy
13:23	5.2	6.02	0.343		1.65	11.03	7.6	cloudy
13:26	6	6.32	0.342	3.22	1.51	11.03	-1.6	"
13:29	7	6.36	0.343		1.39	11.04	-6.8	"
13:32	8	6.38	0.343		1.31	11.06	-10.1	"
13:35	9.2	6.39	0.343		1.30	11.06	-11.0	"

Sample Information

Sample Method(s): (Submersible pump) / Peristaltic pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	13:37	(5) 40-ml VOA	HCL, ice	
Total Coliform		300-ml sterile AG or poly	Na2S2O3	
Geochemical Parameters		Sm OJ	ice	
Nitrate/Cl/Nitrite/SO4/pH		Lg OJ	ice	
TOC/COD/NH3		250-ml AG	H_2SO_4	
Total Metals		500-ml HDPE	HNO_3 to ph<2, ice	
Dissolved Metals		500-ml HDPE	HNO3 to ph<2, ice. **Field filter**	

End Time: 13:41

Comments / Exceptions:

Duplicate Sample OL-MW-17-6/16 collected at 16:00

Controller 104.7 Hz

Groundwater Sampling Field Data

EPI Project No./Site: 45404.0/Kitsap County - Olalla Landfill

Station	MW-8	Date	21-Jun-16
Sample ID	OL-MW-8-6/16	Field Team: (Initials)	ELC
Field Conditions	Partly cloudy, cool		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	38
Initial Depth to Water (ft.)	19.52
Depth of Water Column	18.48
1 Casing Volume	2.9
3 Casing Volumes	8.87

Purge Method: (Submersible pump) / Peristaltic Pump / Bladder Pump / Other: :

Start Time	14:25
End Time	14:55
Total Gallons Purged	11.5

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
14:36	1.8	6.42	0.151		3.11	10.21	88.9	Slightly cloudy
14:39	3.2	5.70	0.171		2.01	10.29	101.2	"
14:42	5	5.88	0.185		1.62	10.38	74.8	clear, Tr. Sand & sediment
14:46	6.8	6.17	0.190	9.22	1.53	10.54	55.2	"
14:49	8	6.22	0.198		1.48	10.31	46.2	"
14:52	9.6	6.25	0.201	9.00	1.42	10.35	44.1	"
14:55	10.9	6.26	0.202	8.95	1.39	10.36	42.2	"

Sample Information

Sample Method(s): (Submersible pump) / Peristaltic pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	14:56	(5) 40-ml VOA	HCL, ice	
Total Coliform		300-ml sterile AG or poly	Na2S2O3	
Geochemical Parameters		Sm OJ	ice	
Nitrate/Cl/Nitrite/SO4/pH		Lg OJ	ice	
TOC/COD/NH3		250-ml AG	H_2SO_4	
Total Metals		500-ml HDPE	HNO_3 to ph<2, ice	
Dissolved Metals		500-ml HDPE	HNO3 to ph<2, ice. **Field filter**	

End Time: 14:58

Comments / Exceptions:

Controller - 107.5 Hz

Landfill Gas Monitoring Field Data - Olalla Landfill Monitoring

Instrument Used:	GEM 2000	Date and Time:	6/24/16
Ambient Temperature:	~~25°C~~ 70°F	Field Team:	ELC
Field Conditions:	Partly cloudy, ~~25°C~~ light breeze		

Landfill Gas Data

Flare #	Time	Methane (% vol.)	% LEL	Oxygen (% vol.)	Carbon Dioxide (% vol.)	Temperature (°C)	Gas Pressure ("H_2O)
3	16:00	0.0	0.0	~~0.0~~ 12.5	7.1		0.00
2	16:08	~~0.0~~ 0.0	0.0	16.2	1.3		0.01
1	16:15	0.0	0.0	17.8	3.2		0.01

Comments / Inspection Results[1]

~~3~~ hose barbs are loose on 3 & 2

[1]Inspect the following: lock and gate operation, tightness of bolts and clamps, differential settlement, valve operation, debris or breaks in hose barb.

EQUIPCO

YSI 556MPS RENTAL
CALIBRATION CERTIFICATE

SERVICE TECHNICIAN: JM

DATE: 6/20/16

INSTRUMENT INFORMATION

RENTAL I.D. NUMBER: YSI-556. 02
SERIAL#: 01F0498B
CUSTOMER.

CALIBRATION INFORMATION

PARAMETERS:	STANDARDS:	PASS ( )	LOT#
1. CONDUCTIVITY	1000 µMhos	X	____
2. pH ZERO	pH 7	X	____
3. pH SLOPE	pH 4	X	____
pH SLOPE	pH 10	X	____
4. DISSOLVED OXYGEN	Air Calibration Barometric pressure = 758 mmHg	X	N/A
5. REDOX (ORP)	262 mV (YSI Zobell solution)	X	_____

2889 151st Pl NE, Redmond, WA 98052 Phone (888)234-5678 Fax (925)305-1303

EQUIPCO

CES LANDTECH MODEL: GEM 2000
CALIBRATION CERTIFICATE

SERVICE TECHNICIAN: [signature] DATE: 6/20/16

INSTRUMENT INFORMATION

RENTAL ID: GEM2000#01

SERIAL NUMBER: G1008904/06

CALIBRATION INFORMATION

1..CALIBRATION GAS: 35 % CO_2 LOT #: 573162

GAS RESPONSE: 35 % CO_2 ±2%

2. CALIBRATION GAS: 50 % Vol. Methane LOT #: 573162

GAS RESPONSE: 50 % Vol. Methane ±2%

OXYGEN RESPONSE IN FRESH AIR ENVIRONMENT: 20.9% ✓

OXYGEN DOWNSCALE RESPONSE CHECKED: 0% WITH 99.9% Nitrogen ✓

THIS INSTRUMENT HAS BEEN CALIBRATED TO STANDARDS SET FORTH BY THE MANUFACTURER

2[illegible]151st PLACE, Redmond, WA 98052 Phone (888)234-5678 Fax (925)305-1303

ENVIRONMENTAL PARTNERS INC

1180 NW Maple Street, Suite 310 Issaquah, Washington 98027 ph 425.395.0010

Olalla Landfill Quarterly Monitoring Field Book September 2016

Olalla Landfill
Kitsap County, Washington
Project Number: 45404.0

Environmental Partners, Inc.
1180 NW Maple Street, Suite 310
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(425) 395-0010

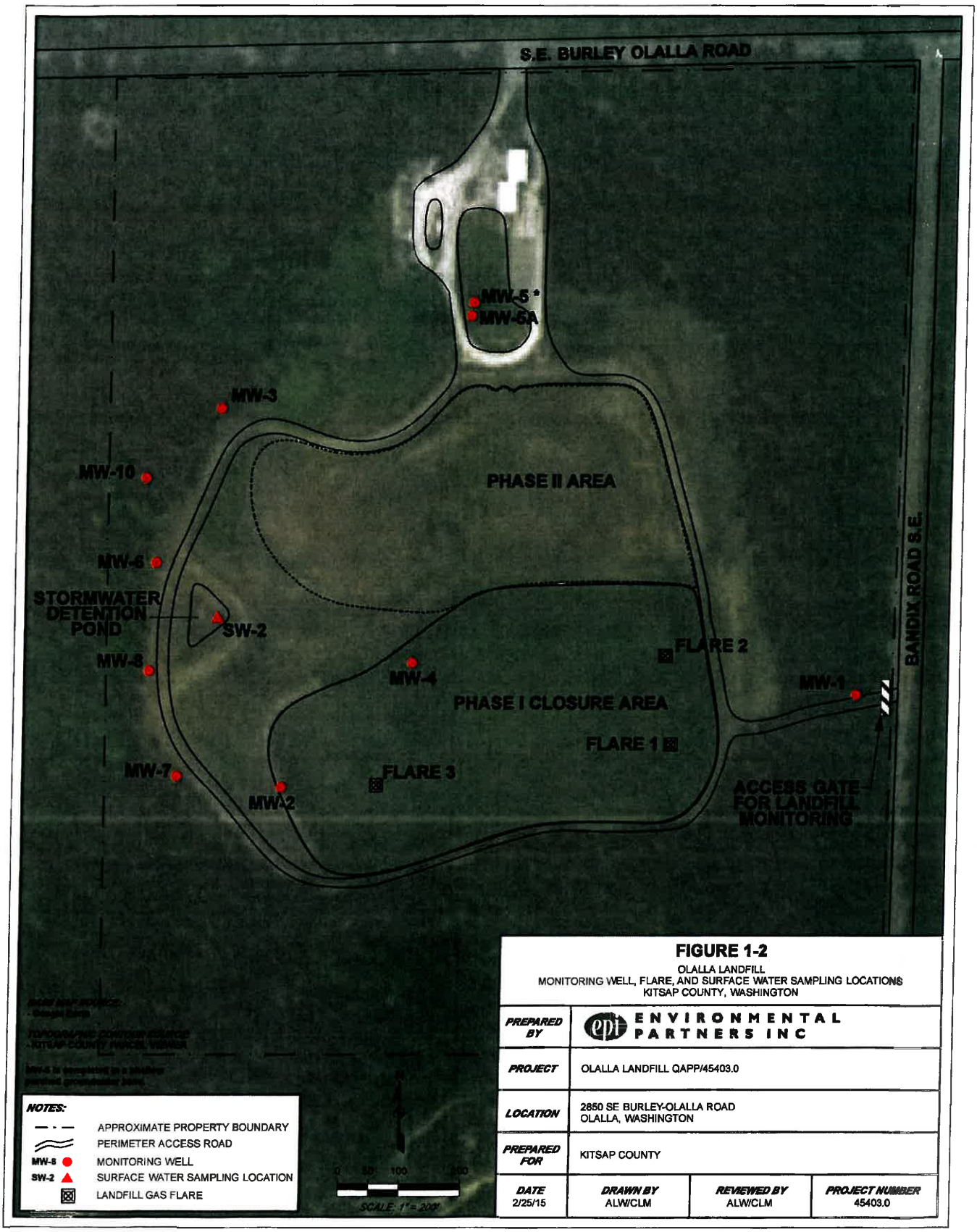

FIGURE 1-2

OLALLA LANDFILL
MONITORING WELL, FLARE, AND SURFACE WATER SAMPLING LOCATIONS
KITSAP COUNTY, WASHINGTON

PREPARED BY	ENVIRONMENTAL PARTNERS INC		
PROJECT	OLALLA LANDFILL QAPP/45403.0		
LOCATION	2850 SE BURLEY-OLALLA ROAD OLALLA, WASHINGTON		
PREPARED FOR	KITSAP COUNTY		
DATE 2/25/15	DRAWN BY ALW/CLM	REVIEWED BY ALW/CLM	PROJECT NUMBER 45403.0

Instrument Calibration Log - Olalla Landfill Monitoring

Calibrated By: Equipco - See attached Cert. Folder from Equipco **Date:** 9/19/16

Meter Type	Manufacturer	Model Number	Manufacturer Serial #	Rental Co. Serial #	Time
pH					
pH Electrode					

Calibrated: _____ to 4.00 buffer _____ to 7.00 buffer _____ to 10.00 buffer at _____ °C

Slope = _____ Comments:

Meter Type	Manufacturer	Model Number	Manufacturer Serial #	Rental Co. Serial #	Time
Specific Cond.					

Specific Conductance: Calibrated _____ µS/cm to _____ µS/cm calibration standard

Electrical Conductivity: Calibrated _____ µS/cm to _____ µS/cm calibration standard at _____ °C

Comments:

Meter Type	Manufacturer	Model Number	Manufacturer Serial #	Rental Co. Serial #	Time
ORP Meter					
ORP Electrode					

Electrode measured _____ millivolts at _____ °C using Zobell prepared on / /

Table value for Zobell solution at this temperature is _____ mV.

Meter Type	Manufacturer	Model Number	Manufacturer Serial #	Rental Co. Serial #	Time
Turbidity					

Meter reads _____ NTUs using _____ NTUs standard | Comments:

Meter reads _____ NTUs using _____ NTUs standard

Meter Type	Manufacturer	Model Number	Manufacturer Serial #	Rental Co. Serial #	Time
DO Meter					

Air-Calibration: Measured temperature _____ °C corresponds to _____ mg/L DO (from Table I)

Atmospheric pressure / elevation correction factor _____ (from Table II)

Corrected calibration value _____ mg/L DO (Table I value multiplied by Table II value)

Comments:

Table 3-1: Monitoring Well Construction Data Summary
Olalla Landfill, Kitsap County, WA

Well	Total Well Depth (ft bgs)	Measuring Point Elevation (ft NGVD 29)	Surface Elevation (ft NGVD 29)	Screened Interval (ft bgs)	Northing	Easting	Measuring Point Description
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MW-2	73	323.25	318.95	68-73	161704.534	559572.839	Top of PVC casing
MW-3	55.5	296.95	294.95	50.5-55.5	162333.903	559463.060	Pump wellhead
MW-4	68	320.93	317.35	63-68	161911.192	559787.735	Top of PVC casing
MW-5	35.5	334.17	332.78	25-35	162510.115	559878.901	Top of PVC casing
MW-5A	98	332.53	331.43	86-96	162487.878	559875.742	Pump wellhead
MW-6	35	271.17	269.14	28-33	162077.699	559358.970	Pump wellhead
MW-7	33	280.43	278.21	21-31	161723.016	559398.979	Pump wellhead
MW-8	38	272.85	270.73	25-35	161897.813	559350.147	Pump wellhead
MW-10	47	279.21	276.84	37-47	162218.490	559340.899	Pump wellhead

Notes:
NGVD 29 = National Geodetic Vertical Datum (1929)
bgs = below ground surface

Table 2-1: CAP and SWHP Monitoring Schedule
Olalla Landfill, Kitsap County, WA

Sample Location	First Quarter									Second and Third Quarters								Fourth Quarter											
	Water Level	Field Parameters	VOCs	T & D Metals	Total Coliform	Fecal Coliform	Geochemical	TOC / COD	Landfill Gas Parameters	Water Level	Field Parameters	VOCs	T & D Metals	Total Coliform	Geochemical	TOC / COD	Landfill Gas Parameters	Water Level	Field Parameters	VOCs	T & D Metals	Total Coliform	Fecal Coliform	Geochemical	TOC / COD	D. Metals - COC list	pH (field and lab)	Vinyl Chloride	Landfill Gas Parameters
MW-1	■	■	■	■	■		■	■		■	■	■	■	■	■	■		■	■	■	■	■		■	■				
MW-2	■									■								■											
MW-3	■	■	■	■	■		■	■		■	■	■	■	■	■	■		■	■	■	■	■		■	■				
MW-4	■									■								■											
MW-5	■									■								■											
MW-5A	■									■								■	■							■	■	■	
MW-6	■	■	■	■	■		■	■		■	■	■	■	■	■	■		■	■	■	■	■		■	■				
MW-7	■									■								■	■							■	■	■	
MW-8	■	■	■	■	■		■	■		■	■	■	■	■	■	■		■	■	■	■	■		■	■				
MW-10	■	■	■	■	■		■	■		■	■	■	■	■	■	■		■	■	■	■	■		■	■				
SW-2[1]		■				■	■												■				■	■					
Flares 1, 2, 3									■								■												■

Notes:

[1] Surface water sample from SW-2 collected during first quarter or fourth quarter, not both quarters.

Field Parameters = pH, specific conductance, temperature, ORP, and DO

VOCs = Volatile organic compounds by EPA Method 8260C standard list, vinyl chloride by selective ion monitoring (SIM)

T (total) Metals = calcium, potassium, sodium

D (dissolved) Metals = arsenic, barium, iron, manganese, zinc

Geochemical = alkalinity, ammonia, bicarbonate, carbonate, chloride, sulfate, nitrate, nitrite, pH

TOC / COD = total organic carbon / chemical oxygen demand

Dissolved Metals - COC list = arsenic, iron, manganese

Landfill gas parameters = methane (%LEL), oxygen(% vol), carbon dioxide (% vol), and gas pressure

~~MW-6~~
~~Dup - MW-7 from MW-6~~
3rd Qtr.
MW-8 from MW-8

Depth to Water Measurement Field Data - Olalla Landfill Monitoring 8/21/16

Well	Time	Measuring Point Elevation (ft. NGVD[1])	Depth to Water (ft.)	Comments and Well Inspection[2] Notes
MW-1	08:00 ~~08:15~~	343.79	74.23	Good condition
MW-2	15:52	323.25	62.81	ok
MW-3	09:45	296.95	43.64	Good condition
MW-4	15:57	320.93	59.75	-Casing stick up above metal monument -can't lock
MW-5	09:23	334.17	12.24	Good condition
MW-5A	09:26	332.53	73.52	" "
MW-6	13:00	271.17	19.57	top of converter socket has to be removed for monument cover to fit.
MW-7	15:30	280.43	25.60	Good condition
MW-8	14:20	272.85	19.98	Good condition
MW-10	11:10	279.21	28.73	Good condition

Notes:

[1]NGVD = National Geodetic Vertical Datum (1929)

[2]Observations regarding the condition of the well and surrounding area (e.g., protective casing, surface seal, cap, lock, bollards, soil conditions near the well such as depressions, ponded surface water, or other subsidence features, and any installed sampling equipment).

Groundwater Sampling Field Data

EPI Project No./Site: 45404.0/Kitsap County - Olalla Landfill

Station	MW-1	Date	21 ~~20~~-Sep-16
Sample ID	OL-MW-1-9/16	Field Team: (Initials)	ELC
Field Conditions	Sunny cool		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	87.00
Initial Depth to Water (ft.)	74.23
Depth of Water Column	12.77
1 Casing Volume	2.06
3 Casing Volumes	

Purge Method: (Submersible pump) / Peristaltic Pump / Bladder Pump / Other: :

Start Time	0825
End Time	0850
Total Gallons Purged	20

Time	Gallons	pH	Conductivity mS/cm	NTU	DO mg/L	Temp. °C	ORP mV	Appearance
08:25	2	7.13	4.5	—	11.95	10.4	131.1	clear
08:28	2.2	6.84	4.5	—	11.92	10.5	154.4	"
08:31	5	6.72	4.4	—	11.85	10.6	162.0	"
08:34	7.1	6.45	4.2	—	11.67	10.7	168.5	"
08:37	9	6.51	131.2	—	10.71	10.9	148.1	"
08:40	12	6.34	131.2	—	10.68	10.9	163.4	"
08:43	14.5	6.31	131.1	—	10.68	11.0	174.1	"
08:46	17.2	6.30	131.1	0.8	10.68	11.0	175.3	"

YSI Time out turned off the pump

Sample Information

Sample Method(s): (Submersible pump) / Peristaltic pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	0847	(5) 40-ml VOA	HCL, ice	5
Total Coliform		300-ml sterile AG or poly	$Na_2S_2O_3$	1
Geochemical Parameters		Sm OJ	ice	1
Nitrate/Cl/Nitrite/SO4/pH		Lg OJ	ice	1
TOC/COD/NH3		250-ml AG	H_2SO_4	1
Total Metals		500-ml HDPE	HNO_3 to ph<2, ice	1
Dissolved Metals		500-ml HDPE	HNO3 to ph<2, ice. **Field filter**	1
				11 bottles

End Time: 0850

Comments / Exceptions:

Regulator set @ 20

Groundwater Sampling Field Data

EPI Project No./Site: 45404.0/Kitsap County - Olalla Landfill

Station	PW-3	Date	21 ~~20~~ Sep-16
Sample ID	OL-PW-3-9/16	Field Team: (Initials)	ELC
Field Conditions	Sunny, 65°F, Friday		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	55.5
Initial Depth to Water (ft.)	43.64
Depth of Water Column	11.86
1 Casing Volume	1.92
3 Casing Volumes	

Purge Method: (Submersible pump) / Peristaltic Pump / Bladder Pump / Other: :

Start Time	10:07
End Time	10:29
Total Gallons Purged	7.5

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
10:10	.8	6.07	473.2	—	0.58	11.4	214.4	Clear
10:13	2	6.05	462.2	—	0.25	11.9	211.9	"
10:16	3.2	6.05	464/456	8 —	0.18	12.0	209.4	"
10:19	4.5	6.05	454.0	—	0.14	12.0	207.3	"
10:22	5.6	6.05	454.5	—	0.11	12.0	204.7	"
10:25	6.8	6.05	455.0	0.9	0.10	12.0	203.3	"

Sample Information

Sample Method(s): (Submersible pump) / Peristaltic pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	10:26	(5) 40-ml VOA	HCL, ice	
Total Coliform		300-ml sterile AG or poly	$Na_2S_2O_3$	
Geochemical Parameters		Sm OJ	ice	
Nitrate/Cl/Nitrite/SO4/pH		Lg OJ	ice	
TOC/COD/NH3		250-ml AG	H_2SO_4	
Total Metals		500-ml HDPE	HNO_3 to ph<2, ice	
Dissolved Metals		500-ml HDPE	HNO3 to ph<2, ice. **Field filter**	
		11 Total		

End Time: 10:29

Comments / Exceptions:

146 Hz

Groundwater Sampling Field Data

EPI Project No./Site: 45404.0/Kitsap County - Olalla Landfill

Station	MW-10	Date	21 ~~20~~-Sep-16
Sample ID	OL-MW-10-9/16	Field Team: (Initials)	ELC
Field Conditions	Partly cloudy 60°F		

Purge Information

Well Diameter (in.)	2
Well Depth (ft.)	47.00
Initial Depth to Water (ft.)	28.73
Depth of Water Column	18.27
1 Casing Volume	2.95
3 Casing Volumes	

Purge Method: (Submersible pump) / Peristaltic Pump / Bladder Pump / Other: :

Start Time	1127
End Time	1154
Total Gallons Purged	9

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
11:30	1.8	6.53	404.4	—	0.39	11.0	141.8	clear
11:33	2	6.51	410.1	—	0.15	11.4	121.7	"
11:36	3.4	6.50	411.2	—	0.09	11.6	110.5	"
11:39	4.8	6.49	411.2	—	0.06	11.5	105.0	"
11:42	5.7	6.48	410.5	—	0.04	11.5	100.0	"
11:45	6.6	6.47	411.1	—	0.02	11.5	96.7	"
11:48	8.1	6.47	411.4	1.1	0.01	11.6	93.9	"

Sample Information

Sample Method(s): (Submersible pump) / Peristaltic pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	11:50	(5) 40-ml VOA	HCL, ice	
Total Coliform		300-ml sterile AG or poly	$Na_2S_2O_3$	
Geochemical Parameters		Sm OJ	ice	
Nitrate/Cl/Nitrite/SO4/pH		Lg OJ	ice	
TOC/COD/NH3		250-ml AG	H_2SO_4	
Total Metals		500-ml HDPE	HNO_3 to ph<2, ice	
Dissolved Metals		500-ml HDPE	HNO3 to ph<2, ice. **Field filter**	
		11 Total		

End Time: 1154

Comments / Exceptions:

123 Hz

Groundwater Sampling Field Data

EPI Project No./Site: 45404.0/Kitsap County - Olalla Landfill

Station	MW-6	Date	~~20~~ 21-Sep-16
Sample ID	OL-MW-6-4116	Field Team: (Initials)	ELC
Field Conditions	Sunny, 65°F		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	35.00
Initial Depth to Water (ft.)	19.57
Depth of Water Column	15.43
1 Casing Volume	2.5
3 Casing Volumes	

Purge Method : (Submersible pump) / Peristaltic Pump / Bladder Pump / Other: :

Start Time	13:21
End Time	1350
Total Gallons Purged	12

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
13:24	1.1	6.49	375.5	—	0.33	11.4	18.0	Slightly cloudy
13:27	2.5	6.48	381.1	—	0.16	11.4	8.7	" "
13:30	4.8	6.47	381.9	—	0.10	11.4	4.6	" "
13:33	6	6.47	382.5	—	0.07	11.4	1.8	" "
13:36	8.8	6.44	383.3	—	0.04	11.4	-0.5	" "
13:39	9.8	6.46	387.8	—	0.03	11.41	-1.7	" "
13:42	10.8	6.45	387.8	8.9	0.02	11.4	-1.9	" "

Sample Information

Sample Method(s): (Submersible pump) / Peristaltic pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	13:44	~~40~~ 40-ml VOA	HCL, ice	15
Total Coliform		300-ml sterile AG or poly 2	Na2S2O3	2
Geochemical Parameters		Sm OJ	ice	1
Nitrate/Cl/Nitrite/SO4/pH		Lg OJ	ice	1
TOC/COD/NH3		250-ml AG	H_2SO_4	1
Total Metals		500-ml HDPE	HNO_3 to ph<2, ice	1
Dissolved Metals		500-ml HDPE	HNO3 to ph<2, ice. **Field filter**	2
End Time	1351			23

Comments / Exceptions:

Conductivity 109.5 Hz

Groundwater Sampling Field Data

EPI Project No./Site: 45404.0/Kitsap County - Olalla Landfill

Station	MW-8	Date	21 ~~20~~-Sep-16
Sample ID	~~DE~~-OL-MW-8-9/16	Field Team: (Initials)	ELC
Field Conditions	9/2 duplicate of OL-MW-12-9/16		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	38.00
Initial Depth to Water (ft.)	19.98
Depth of Water Column	18.02
1 Casing Volume	2.91
3 Casing Volumes	

Purge Method: (Submersible pump) / Peristaltic Pump / Bladder Pump / Other: :

Start Time	14:37
End Time	16:00
Total Gallons Purged	9.5

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
14:40	1.2	6.82	130.8	—	0.23	10.7	30.1	clear
14:43	2.8	6.66	171.8	—	0.11	10.9	43.1	"
14:46	4.2	6.64	183.2	—	0.07	10.9	45.4	"
14:49	5.5	6.62	193.4	—	0.04	10.9	44.5	"
15:52	6.8	6.62	194.8	—	0.02	10.9	44.0	"
15:55	8.3	6.63	196.5	43	0.01	11.0	42.2	"

Sample Information

Sample Method(s): (Submersible pump) / Peristaltic pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	15:56	(5) 40-ml VOA	HCL, ice	MW-8 MW-12
Total Coliform		300-ml sterile AG or poly	$Na_2S_2O_3$	
Geochemical Parameters		Sm OJ	ice	
Nitrate/Cl/Nitrite/SO4/pH		Lg OJ	ice	
TOC/COD/NH3		250-ml AG	H_2SO_4	
Total Metals		500-ml HDPE	HNO_3 to ph<2, ice	
Dissolved Metals		500-ml HDPE	HNO3 to ph<2, ice. **Field filter**	
End Time	16:00			" "

Comments / Exceptions:

Conductivity H2
108

Landfill Gas Monitoring Field Data - Olalla Landfill Monitoring

Instrument Used:	GEM 2000	Date and Time:	9/21/16 16:10
Ambient Temperature:	58°F	Field Team:	EL C
Field Conditions:	Clear, ~~88°F~~ slight breeze		

Landfill Gas Data

Flare #	Time	Methane (% vol.)	% LEL	Oxygen (% vol.)	Carbon Dioxide (% vol.)	Temperature (°C)	Gas Pressure ("H_2O)
#3	16:14	8.9	0	0.0	14.3		0.0
#1	16:26	1.7	47%	10.5	3.6		0.01
#2	16:37	8.2	55%	9.1	7.2		0.03

Comments / Inspection Results[1]

#1 - Jumped to 49% LEL, then reduced to 22%, then 0%, went back up to 22% when no source

#2 - at 4500, jumped to 55 LEL, then reduced to 32, 0, and up again.

[1]Inspect the following: lock and gate operation, tightness of bolts and clamps, differential settlement, valve operation, debris or breaks in hose barb.

EQUIPCO RENTALS

YSI ProDSS RENTAL
CALIBRATION CERTIFICATE

SERVICE TECHNICIAN: GM DATE: 9/19/16

RENTAL CUSTOMER: EPI

INSTRUMENT INFORMATION

RENTAL I.D. NUMBER: YSIPRODSS.02

SERIAL NUMBER: 16F102613

CALIBRATION INFORMATION

PARAMETER:	STANDARD:	PASS ( )	LOT #
1. CONDUCTIVITY	1,000 µMhos	X	46387
2. pH ZERO	pH 7	X	10518
pH SLOPE	pH 4	X	10521
pH SLOPE	pH 10	X	10503
3. DISSOLVED OXYGEN	Air Calibration Barometric pressure = 760mmHg	X	N/A
~~4. TURBIDITY ZERO~~	~~0.0 NTU's~~		~~N/A~~
~~TURBIDITY SPAN~~	~~20 NTU's~~		
5. REDOX (ORP)	231mV (YSI Zobell solution)	X	110113

2686 151st PL NE, Redmond WA, 98052 Phone (888) 234-5678 Fax (925) 305-1303

EQUIPCO

CES LANDTECH MODEL: GEM 2000
CALIBRATION CERTIFICATE

SERVICE TECHNICIAN: JM DATE: 9/19/16

INSTRUMENT INFORMATION

RENTAL ID: GEM2000. 11

SERIAL NUMBER: GM07638/04

CALIBRATION INFORMATION

1..CALIBRATION GAS: 35 % CO_2 LOT #: 573162

GAS RESPONSE: 35 % CO_2 ±2%

2. CALIBRATION GAS: 50 % Vol. Methane LOT #: 573162

GAS RESPONSE: 50 % Vol. Methane ±2%

OXYGEN RESPONSE IN FRESH AIR ENVIRONMENT: 20.9% ✓

OXYGEN DOWNSCALE RESPONSE CHECKED: 0% WITH 99.9% Nitrogen ✓

THIS INSTRUMENT HAS BEEN CALIBRATED TO STANDARDS SET FORTH BY THE MANUFACTURER

2689 151st Pl NE, Redmond, WA 98052 Phone (888)234-5678 Fax (925)305-1303

ENVIRONMENTAL PARTNERS INC

1180 NW Maple Street, Suite 310 Issaquah, Washington 98027 ph 425.395.0010

Olalla Landfill Quarterly Monitoring Field Book December 2016

Olalla Landfill
Kitsap County, Washington
Project Number: 45404.0

Environmental Partners, Inc.
1180 NW Maple Street, Suite 310
Issaquah, Washington 98027
(425) 395-0010

FIGURE 1-2

OLALLA LANDFILL
MONITORING WELL, FLARE, AND SURFACE WATER SAMPLING LOCATIONS
KITSAP COUNTY, WASHINGTON

PREPARED BY	ENVIRONMENTAL PARTNERS INC		
PROJECT	OLALLA LANDFILL QAPP/45403.0		
LOCATION	2850 SE BURLEY-OLALLA ROAD OLALLA, WASHINGTON		
PREPARED FOR	KITSAP COUNTY		
DATE 2/25/15	DRAWN BY ALW/CLM	REVIEWED BY ALW/CLM	PROJECT NUMBER 45403.0

Table 2-1: CAP and SWHP Monitoring Schedule
Olalla Landfill, Kitsap County, WA

Sample Location	First Quarter									Second and Third Quarters								Fourth Quarter											
	Water Level	Field Parameters	VOCs	T & D Metals	Total Coliform	Fecal Coliform	Geochemical	TOC / COD	Landfill Gas Parameters	Water Level	Field Parameters	VOCs	T & D Metals	Total Coliform	Geochemical	TOC / COD	Landfill Gas Parameters	Water Level	Field Parameters	VOCs	T & D Metals	Total Coliform	Fecal Coliform	Geochemical	TOC / COD	D. Metals - COC list	pH (field and lab)	Vinyl Chloride	Landfill Gas Parameters
MW-1	■	■	■	■	■		■	■		■	■	■	■	■	■	■		■	■	■	■	■		■	■				
MW-2	■									■								■											
MW-3	■	■	■	■	■		■	■		■	■	■	■	■	■	■		■	■	■	■	■		■	■				
MW-4	■									■								■											
MW-5	■									■								■											
MW-5A	■									■								■	■							■	■	■	
MW-6	■	■	■	■	■		■	■		■	■	■	■	■	■	■		■	■	■	■	■		■	■				
MW-7	■									■								■	■							■	■	■	
MW-8	■	■	■	■	■		■	■		■	■	■	■	■	■	■		■	■	■	■	■		■	■				
MW-10	■	■	■	■	■		■	■		■	■	■	■	■	■	■		■	■	■	■	■		■	■				
SW-2[1]		■				■	■												■				■	■					
Flares 1, 2, 3									■								■												■

Notes:

[1] Surface water sample from SW-2 collected during first quarter or fourth quarter, not both quarters.

Field Parameters = pH, specific conductance, temperature, ORP, and DO

VOCs = Volatile organic compounds by EPA Method 8260C standard list, vinyl chloride by selective ion monitoring (SIM)

T (total) Metals = calcium, potassium, sodium

D (dissolved) Metals = arsenic, barium, iron, manganese, zinc

Geochemical = alkalinity, ammonia, bicarbonate, carbonate, chloride, sulfate, nitrate, nitrite, pH

TOC / COD = total organic carbon / chemical oxygen demand

Dissolved Metals - COC list = arsenic, iron, manganese

Landfill gas parameters = methane (%LEL), oxygen(% vol), carbon dioxide (% vol), and gas pressure

4th QTr, Dup is MW-10, call it MW-15

Sept 216 settings:

MW-1 210 Hz
MW-3 146
MW-10 123
MW-6 109
MW-8 108
MW-5A 199
MW-7 118.2

Instrument Calibration Log - Olalla Landfill Monitoring

Calibrated By: See Certification of calibration from Equipco **Date:**

Meter Type	Manufacturer	Model Number	Manufacturer Serial #	Rental Co. Serial #	Time
pH					
pH Electrode					

Calibrated: _____ to 4.00 buffer _____ to 7.00 buffer _____ to 10.00 buffer at _____ °C

Slope = _____ Comments:

Meter Type	Manufacturer	Model Number	Manufacturer Serial #	Rental Co. Serial #	Time
Specific Cond.					

Specific Conductance: Calibrated _____ µS/cm to _____ µS/cm calibration standard

Electrical Conductivity: Calibrated _____ µS/cm to _____ µS/cm calibration standard at _____ °C

Comments:

Meter Type	Manufacturer	Model Number	Manufacturer Serial #	Rental Co. Serial #	Time
ORP Meter					
ORP Electrode					

Electrode measured _____ millivolts at _____ °C using Zobell prepared on / /

Table value for Zobell solution at this temperature is _____ mV.

Meter Type	Manufacturer	Model Number	Manufacturer Serial #	Rental Co. Serial #	Time
Turbidity					

Meter reads _____ NTUs using _____ NTUs standard | Comments:

Meter reads _____ NTUs using _____ NTUs standard

Meter Type	Manufacturer	Model Number	Manufacturer Serial #	Rental Co. Serial #	Time
DO Meter					

Air-Calibration: Measured temperature _____ °C corresponds to _____ mg/L DO (from Table I)

Atmospheric pressure / elevation correction factor _____ (from Table II)

Corrected calibration value _____ mg/L DO (Table I value multiplied by Table II value)

Comments:

Table 3-1: Monitoring Well Construction Data Summary

Olalla Landfill, Kitsap County, WA

Well	Total Well Depth (ft bgs)	Measuring Point Elevation (ft NGVD 29)	Surface Elevation (ft NGVD 29)	Screened Interval (ft bgs)	Northing	Easting	Measuring Point Description
MW-1	87	343.79	342.53	82-87	161858.133	560525.840	Pump wellhead
MW-2	73	323.25	318.95	68-73	161704.534	559572.839	Top of PVC casing
MW-3	55.5	296.95	294.95	50.5-55.5	162333.903	559463.060	Pump wellhead
MW-4	68	320.93	317.35	63-68	161911.192	559787.735	Top of PVC casing
MW-5	35.5	334.17	332.78	25-35	162510.115	559878.901	Top of PVC casing
MW-5A	98	332.53	331.43	86-96	162487.878	559875.742	Pump wellhead
MW-6	35	271.17	269.14	28-33	162077.699	559358.970	Pump wellhead
MW-7	33	280.43	278.21	21-31	161723.016	559398.979	Pump wellhead
MW-8	38	272.85	270.73	25-35	161897.813	559350.147	Pump wellhead
MW-10	47	279.21	276.84	37-47	162218.490	559340.899	Pump wellhead

Notes:
NGVD 29 = National Geodetic Vertical Datum (1929)
bgs = below ground surface

Depth to Water Measurement Field Data - Olalla Landfill Monitoring

Well	Time	Measuring Point Elevation (ft. NGVD[1])	Depth to Water (ft.)	Comments and Well Inspection[2] Notes
MW-1	08:45	343.79	75.41	12/20/16
MW-2	11:49	323.25	62.35	
MW-3	11:03	296.95	42.00	
MW-4	11:55	320.93	59.23	
MW-5	10:55	334.17	8.80	
MW-5A	10:51	332.53	73.37	
MW-6	11:21	271.17	17.91	
MW-7	11:35	280.43	22.68	
MW-8	11:29	272.85	30.35	
MW-10	11:09	279.21	26.99	

Notes:

[1]NGVD = National Geodetic Vertical Datum (1929)

[2]Observations regarding the condition of the well and surrounding area (e.g., protective casing, surface seal, cap, lock, bollards, soil conditions near the well such as depressions, ponded surface water, or other subsidence features, and any installed sampling equipment).

Groundwater Sampling Field Data - Olalla Landfill Monitoring

Station	MW-1	Date	12/20/16 and 12/21/16
Sample: ID	Olalla-MW1-12/16	Field Team: (Initials)	ELC
Field Conditions	Clear, cool ~38°F		

Low-Flow Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	87
Initial Depth to Water (ft.)	75.41
Depth of Water Column	11.59
1 Casing Volume (gal.)	1.85
Controller setting (Hz)	~~210~~ 207

Purge Method : Submersible pump

Other: : /

Start Time	0911 / 0833
End Time	0850
Total Gallons Purged	12

Time	Gallons	pH	Conductivity (mS/cm)	NTU	DO (mg/L)	Temp.	ORP (mV)	Appearance
0913	1	6.79	~~[illegible]~~ 115		10.52	10.4	160.5	Clear
0916	4.5	6.85	~~[illegible]~~ 113.1		10.56	10.7	167.7	
generator stopped								
0921	5	6.65	114.5		92.7	11.0	163.9	
0924 generator quit again, cont. got started, disc. Took back to unit Rental								
0833	1.5	7.26	112.2		10.87	9.9	142.2	Clear
0836	2.8	6.66	115.4		10.55	10.6	157.5	"
0839	5	6.61	115.4		10.53	10.7	162.2	"
0842	7.8	6.55	115.4		10.51	10.8	168.6	"
0845	10	6.54	115.4	1.94	10.51	10.8	171.2	"

(Margin notes: 12/20 beside first rows; 12/21/16 beside rows from 0833.)

Sample Information

Sample Method(s) (Submersible pump) / Peristaltic pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	0848	5 ~~(3)~~ 40-mL VOA	HCl, cool to <4°C	
Total Coliform		300-mL sterile AG or poly	Cool to <4°C	
Geochemical Parameters		500-mL HDPE	Cool to <4°C	
Nitrate/Nitrite		500-mL HDPE	Cool to <4°C	
TOC		250-mL AG	H_2SO_4 to pH <2, cool to <4°C	
COD		250-mL HDPE	H_2SO_4 to pH <2, cool to <4°C	
Total Metals		250-mL HDPE	HNO_3 to pH <2, cool to <4°C	
Dissolved Metals		250-mL HDPE	Field filter, HNO_3 to pH <2, cool to <4°C	

Sample End Time: 0850

Comments / Exceptions:

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

Groundwater Sampling Field Data - Olalla Landfill Monitoring

Station	MW-5A	Date	12/21/16
Sample: ID	Olalla-MW5A-12/16	Field Team: (Initials)	EL
Field Conditions	Sunny, Cool, high 45°F Today		

Low-Flow Purge Information

Well Diameter (in.)	2
Well Depth (ft.)	98
Initial Depth to Water (ft.)	77.37
Depth of Water Column	24.63
1 Casing Volume (gal.)	3.94
Controller setting (Hz)	49

Purge Method : Submersible pump
Other: :

Start Time	0949
End Time	1008
Total Gallons Purged	9

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
0952	1.5	6.84	146.5		8.64	11.4	146.8	clear
0955	4	6.73	147.7		8.77	11.6	150.1	"
0958	5.5	6.69	145.4		8.85	11.6	153.7	"
10:01	7.2	6.69	145.5		8.85	11.6	155.8	"
10:04	8.8	6.68	145.6	0.63	8.84	11.6	157.3	"

Sample Information

Sample Method(s) : Submersible pump / Peristaltic pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
~~Volatiles and~~ VC	10:06	~~2 (3)~~ 40-mL VOA	HCl, cool to <4°C	
Total Coliform	NA	300-mL sterile AG or poly	Cool to <4°C	
Geochemical Parameters	pH	500-mL HDPE	Cool to <4°C	
Nitrate/Nitrite	NA	500-mL HDPE	Cool to <4°C	
TOC	NA	250-mL AG	H_2SO_4 to pH <2, cool to <4°C	
COD	NA	250-mL HDPE	H_2SO_4 to pH <2, cool to <4°C	
Total Metals	NA	250-mL HDPE	HNO_3 to pH <2, cool to <4°C	
Dissolved Metals		250-mL HDPE	Field filter, HNO_3 to pH <2, cool to <4°C	

Sample End Time: 1008

Comments / Exceptions:

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

Groundwater Sampling Field Data - Olalla Landfill Monitoring

Station	MW-3	Date	12/21/16
Sample: ID	Olalla-MW3-12/16	Field Team: (Initials)	EC
Field Conditions	Cool, Sunny		

Low-Flow Purge Information

Well Diameter (in.)	2
Well Depth (ft.)	55.5
Initial Depth to Water (ft.)	42.00
Depth of Water Column	13.5
1 Casing Volume (gal.)	2.16
Controller setting (Hz)	46

Purge Method : Submersible pump

Other: :

Start Time	10:50
End Time	11:10
Total Gallons Purged	12

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
10:53	1.5	6.43	448.5		1.45	11.0	186.9	clear
10:56	3.7	6.27	418.4		0.40	11.6	172.3	"
10:59	6.25	6.26	415.8		0.31	11.7	168.2	"
11:02	8.5	6.26	415.7		0.28	11.7	166.4	"
11:05	10	6.26	417.2	0.61	0.25	11.7	165.1	"

Sample Information

Sample Method(s) : (Submersible pump) / Peristaltic pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	11:07	5~~(3)~~ 40-mL VOA	HCl, cool to <4°C	
Total Coliform		300-mL sterile AG or poly	Cool to <4°C	
Geochemical Parameters		500-mL HDPE	Cool to <4°C	
Nitrate/Nitrite		500-mL HDPE	Cool to <4°C	
TOC		250-mL AG	H_2SO_4 to pH <2, cool to <4°C	
COD		250-mL HDPE	H_2SO_4 to pH <2, cool to <4°C	
Total Metals		250-mL HDPE	HNO_3 to pH <2, cool to <4°C	
Dissolved Metals		250-mL HDPE	Field filter, HNO_3 to pH <2, cool to <4°C	

Sample End Time: 11:10

Comments / Exceptions:

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

Groundwater Sampling Field Data - Olalla Landfill Monitoring

Station	MW-10	Date	12/21/16
Sample: ID	Olalla-MW10-12/17	Field Team: (Initials)	EC
Field Conditions	Cool, sunny	Duplicate MW-13	

Low-Flow Purge Information

Well Diameter (in.)	2
Well Depth (ft.)	47
Initial Depth to Water (ft.)	27
Depth of Water Column	20
1 Casing Volume (gal.)	3.20
Controller setting (Hz)	25

Purge Method : Submersible pump

Other: :

Start Time	1201
End Time	1271
Total Gallons Purged	13

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1204	1.8	6.57	357.5		0.44	11.4	137.7	clear
1207	3.5	6.55	357.2		0.30	11.6	129.1	"
1210	5	6.54	357.1		0.28	11.6	121.8	"
1213	6.5	6.53	356.9		0.23	11.6	119.1	"
1216	8.5	6.53	357.3		0.20	11.6	116.6	"
1219	10.2	6.53	357.5	1.5	0.20	11.7	113.6	"

Sample Information

Sample Method(s) : Submersible pump / Peristaltic pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	1221	~~5~~ 6 40-mL VOA	HCl, cool to <4°C	
Total Coliform		300-mL sterile AG or poly	Cool to <4°C	
Geochemical Parameters		500-mL HDPE	Cool to <4°C	
Nitrate/Nitrite		500-mL HDPE	Cool to <4°C	
TOC		250-mL AG	H_2SO_4 to pH <2, cool to <4°C	
COD		250-mL HDPE	H_2SO_4 to pH <2, cool to <4°C	
Total Metals		250-mL HDPE	HNO_3 to pH <2, cool to <4°C	
Dissolved Metals		250-mL HDPE	Field filter, HNO_3 to pH <2, cool to <4°C	

Sample End Time 1231

Comments / Exceptions:

Duplicate MW-13

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

Groundwater Sampling Field Data - Olalla Landfill Monitoring

Station	MW-6	Date	12/21/16
Sample: ID	Olalla-MW6-12/16	Field Team: (Initials)	E C
Field Conditions	Sunny, clear, cool		

Low-Flow Purge Information

Well Diameter (in.)	2
Well Depth (ft.)	35
Initial Depth to Water (ft.)	17.91
Depth of Water Column	17.09
1 Casing Volume (gal.)	2.73
Controller setting (Hz)	10

Purge Method : Submersible pump

Other: :

Start Time	1302
End Time	1325
Total Gallons Purged	16

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1305	2	6.80	186.2		0.48	11.9	14.3	Slightly cloudy
1308	4.8	6.76	191.0		0.29	11.9	5.0	cloudy
1311	6.5	6.76	193.5		0.24	11.9	1.9	clear
1314	9	6.75	195.5		0.21	11.9	-0.7	"
1317	11	6.74	197.3		0.19	11.9	-2.9	"
1320	13.2	6.74	199.4	3.53	0.18	11.9	-4.7	"

Sample Information

Sample Method(s) : Submersible pump / Peristaltic pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	1322	~~5~~ (3) 40-mL VOA	HCl, cool to <4°C	
Total Coliform		300-mL sterile AG or poly	Cool to <4°C	
Geochemical Parameters		500-mL HDPE	Cool to <4°C	
Nitrate/Nitrite		500-mL HDPE	Cool to <4°C	
TOC		250-mL AG	H_2SO_4 to pH <2, cool to <4°C	
COD		250-mL HDPE	H_2SO_4 to pH <2, cool to <4°C	
Total Metals		250-mL HDPE	HNO_3 to pH <2, cool to <4°C	
Dissolved Metals		250-mL HDPE	Field filter, HNO_3 to pH <2, cool to <4°C	

Sample End Time 1325

Comments / Exceptions:

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

Groundwater Sampling Field Data - Olalla Landfill Monitoring

Station	MW-8	Date	12/21/16
Sample: ID	Olalla-MW8-12/16	Field Team: (Initials)	EC
Field Conditions	Clear & Cool		

Low-Flow Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	38
Initial Depth to Water (ft.)	30.35
Depth of Water Column	7.65
1 Casing Volume (gal.)	1.22
Controller setting (Hz)	10

Purge Method : Submersible pump

Other: :

Start Time	13:56
End Time	14:14
Total Gallons Purged	12

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
13:59	2.5	6.76	242.1	—	2.18	11.4	58.0	Slightly cloudy
14:02	5	6.70	248.1		2.15	11.4	56.1	"
1405	7	6.70	301.1		2.12	11.4	33.9	clear/slight
1408	9	6.70	302.9		2.08	11.4	33.2	Clear
1411	10.5	6.70	301.4	4.36	2.16	11.4	32.8	

Sample Information

Sample Method(s) : Submersible pump / Peristaltic pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	14:12	5 ~~(3)~~ 40-mL VOA	HCl, cool to <4°C	
Total Coliform		300-mL sterile AG or poly	Cool to <4°C	
Geochemical Parameters		500-mL HDPE	Cool to <4°C	
Nitrate/Nitrite		500-mL HDPE	Cool to <4°C	
TOC		250-mL AG	H_2SO_4 to pH <2, cool to <4°C	
COD		250-mL HDPE	H_2SO_4 to pH <2, cool to <4°C	
Total Metals		250-mL HDPE	HNO_3 to pH <2, cool to <4°C	
Dissolved Metals		250-mL HDPE	Field filter, HNO_3 to pH <2, cool to <4°C	

Sample End Time 1414

Comments / Exceptions:

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

Groundwater Sampling Field Data - Olalla Landfill Monitoring

Station	MW-7	Date	12/21/16
Sample: ID	Ola4a-MW7-12/16	Field Team: (Initials)	E C
Field Conditions	Cool, Clear, 38°F		

Low-Flow Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	33
Initial Depth to Water (ft.)	22.68
Depth of Water Column	10.32
1 Casing Volume (gal.)	1.65
Controller setting (Hz)	~~18~~ 17

Purge Method : Submersible pump

Other: :

Start Time	1451
End Time	1512
Total Gallons Purged	7.5

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
14:54	1	6.87	98.8		4.74	10.6	91.2	Clear
14:57	2	6.79	98.7		4.60	10.9	101.2	"
15:00	3.5	6.78	98.9		4.54	10.9	106.0	"
15:03	4.5	6.75	98.9		4.52	10.9	109.5	"
15:06	5.5	6.77	98.9		4.50	11.0	114.1	"
15:09	6.5	6.76	98.9	0.56	4.48	11.0	115.5	"

Sample Information

Sample Method(s) : Submersible pump / Peristaltic pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
~~Volatiles and~~ VC	1510	2 ~~(3)~~ 40-mL VOA	HCl, cool to <4°C	
Total Coliform	NA	300-mL sterile AG or poly	Cool to <4°C	
Geochemical Parameters	8 yes	500-mL HDPE	Cool to <4°C	
Nitrate/Nitrite	No	500-mL HDPE	Cool to <4°C	
TOC		250-mL AG	H_2SO_4 to pH <2, cool to <4°C	
COD		250-mL HDPE	H_2SO_4 to pH <2, cool to <4°C	
Total Metals		250-mL HDPE	HNO_3 to pH <2, cool to <4°C	
Dissolved Metals		250-mL HDPE	Field filter, HNO_3 to pH <2, cool to <4°C	

Sample End Time 1512

Comments / Exceptions:

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

Surface Water Sampling Field Data - Olalla Landfill Monitoring

Station	SW-2	Date	12/20/16
Sample: ID	Olalla-SW2-12/16	Field Team: (Initials)	ELC
Field Conditions	Clear, cool, windy, heavy rain last night		

Field Parameter Data

Time	pH	Specific Conductance	Temperature (°C)	Appearance and Flow Rate
0820	8.09	43.4 ~~mS~~ µS/cm	3.8°	~5 gallons/min, light brown color, no odors,

DO - 13.10 mg/L ORP - 125.7

Sample Information

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Fecal Coliform	0820	300-mL sterile AG or poly	Cool to <4°C	
Nitrate-Nitrogen	"	500-mL HDPE	Cool to <4°C	
pH	"	125-mL AG	Cool to <4°C	

Sample End Time: 1.

Comments / Exceptions:

- grab from water discharge from pipe

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

Landfill Gas Monitoring Field Data - Olalla Landfill Monitoring

Instrument Used: Landtec GEM 2000 Landfill Gas meter		Date and Time:	12/20/16 12:05
Ambient Temperature:	47° F	Field Team:	E C
Field Conditions:	clear, very windy		

Landfill Gas Data

Flare #	Time	Methane (% vol.)	% LEL	Oxygen (% vol.)	Carbon Dioxide (% vol.)	Temperature (°C)	Gas Pressure ("H_2O)
#3	12:05	0.0	0	22.9	0.2		0.02
#1	12:19	0.0	0	23.0	0.1		0.00-0.05
#2	12:25	0.0	0	23.1	0.1		0.00 0.04

Comments / Inspection Results[1]

Dwyer magnehelic for Gas pressure

[1]Inspect the following: lock and gate operation, tightness of bolts and clamps, differential settlement, valve operation, debris or breaks in hose barb.

EQUIPCO RENTALS

YSI ProDSS RENTAL
CALIBRATION CERTIFICATE

SERVICE TECHNICIAN: [signature]

DATE: 12/19/16

RENTAL CUSTOMER: EPS

INSTRUMENT INFORMATION

RENTAL I.D. NUMBER: YSIPRODSS 05

SERIAL NUMBER: 16F10216

CALIBRATION INFORMATION

PARAMETER:	STANDARD:	PASS ( )	LOT #
1. CONDUCTIVITY	1,000 µMhos	X	46387
2. pH ZERO	pH 7	X	44912
pH SLOPE	pH 4	X	44935
pH SLOPE	pH 10	X	10503
3. DISSOLVED OXYGEN	Air Calibration Barometric pressure = 760mmHg	X	N/A
~~4. TURBIDITY ZERO~~	~~0.0 NTU's~~		~~N/A~~
~~TURBIDITY SPAN~~	~~20 NTU's~~	~~X~~	
5. REDOX (ORP)	231mV (YSI Zobell solution)	X	10113

2[illegible] 151st Pl. NE, Redmond WA, 98052 Phone (888) 234-5678 Fax (925) 305-1303

EQUIPCO

CES LANDTECH MODEL: GEM 2000
CALIBRATION CERTIFICATE

SERVICE TECHNICIAN: GM DATE: 12/19/6

INSTRUMENT INFORMATION

RENTAL ID: GEM2000.68

SERIAL NUMBER: GM07210/3

CALIBRATION INFORMATION

1..CALIBRATION GAS: 35 % CO_2 LOT #: 57162

GAS RESPONSE: 35 % CO_2 ±2%

2. CALIBRATION GAS: 60 % Vol. Methane LOT #: 57162

GAS RESPONSE: 60 % Vol. Methane ±2%

OXYGEN RESPONSE IN FRESH AIR ENVIRONMENT: 20.9% ✓

OXYGEN DOWNSCALE RESPONSE CHECKED: 0% WITH 99.9% Nitrogen ✓

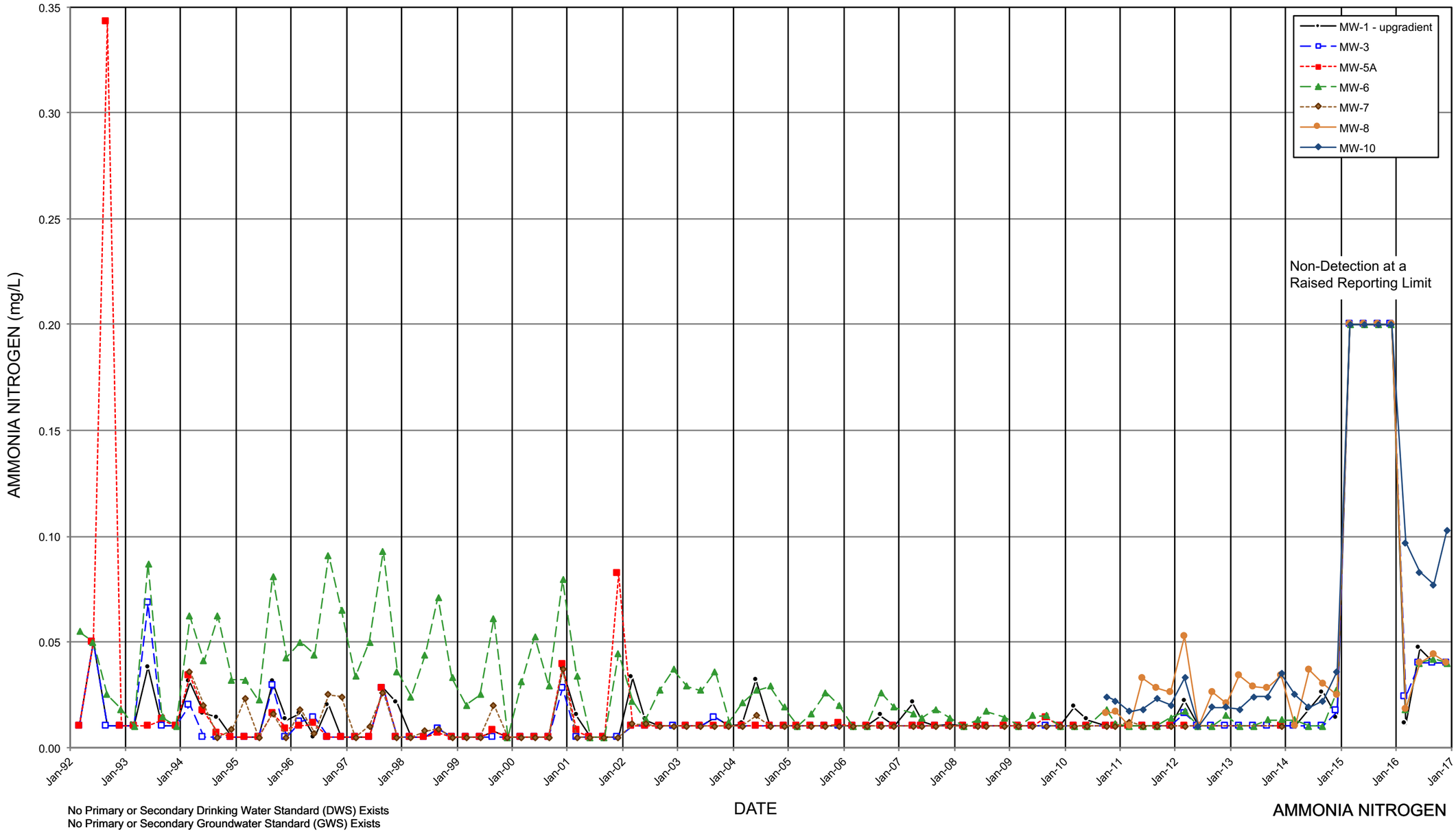
THIS INSTRUMENT HAS BEEN CALIBRATED TO STANDARDS SET FORTH BY THE MANUFACTURER

2689 151st PLNE, Redmond, WA 98052 Phone (888)234-5678 Fax (925)305-1303

Appendix C:
2016 Statistical Summaries

Time-Series Plots through December 2016
Mann-Kendall Statistically Significant Trend Test Summary Tables
Shapiro-Wilk Test for Normality Summary Tables
Confidence Interval Summary Tables

OLALLA LANDFILL
Quarterly Monitoring Data

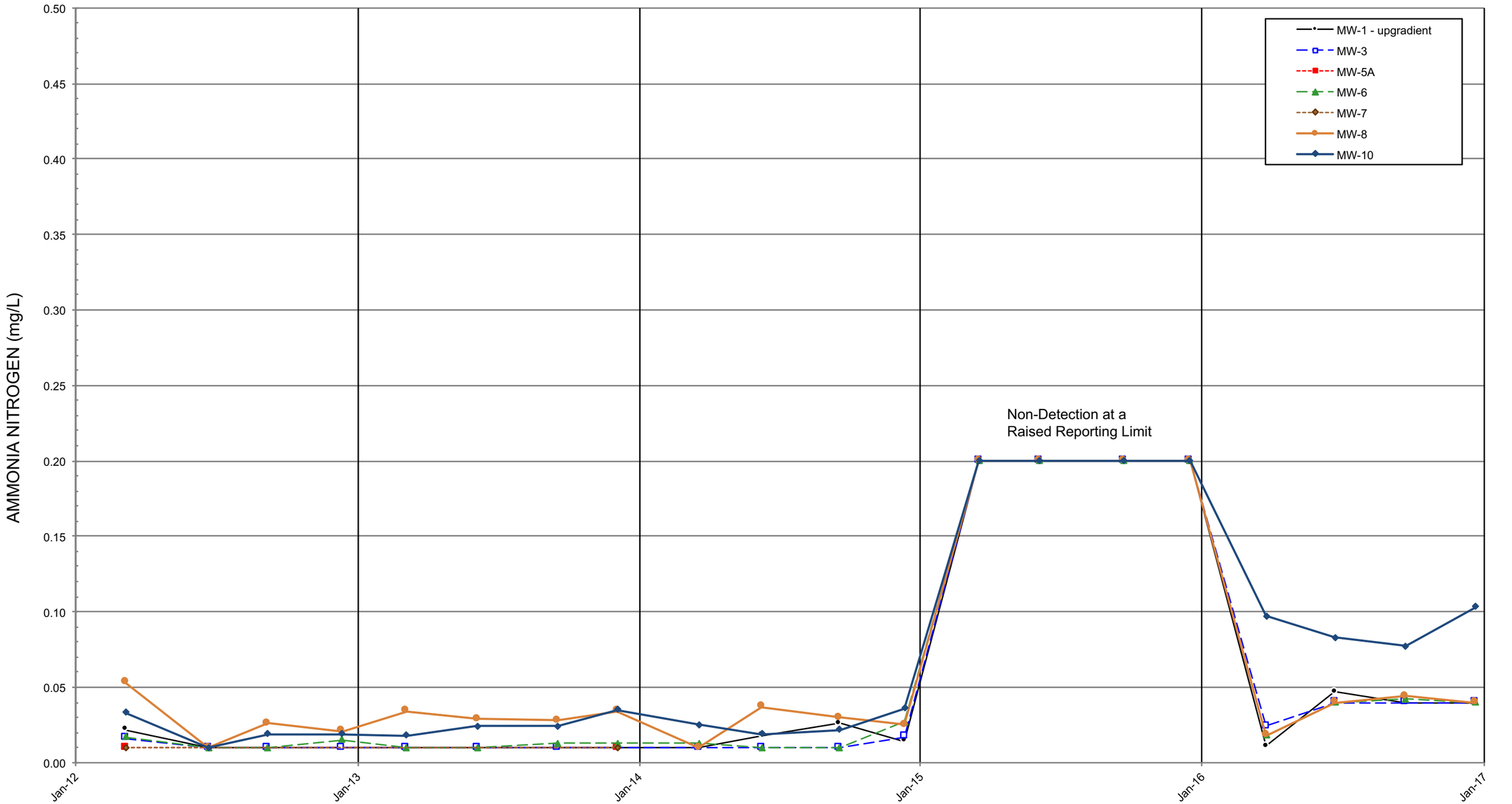


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

AMMONIA NITROGEN

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

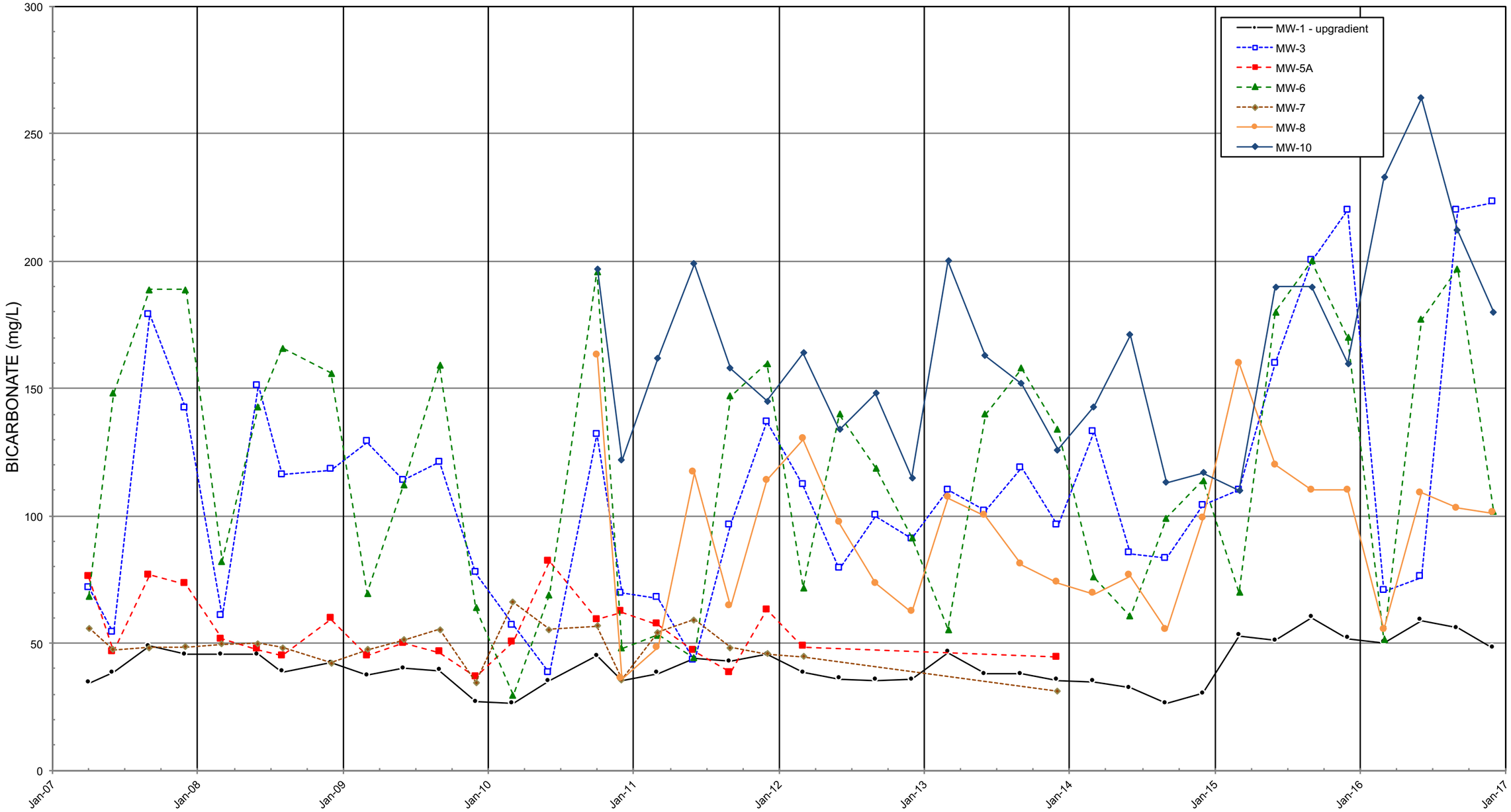


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

AMMONIA NITROGEN
(RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

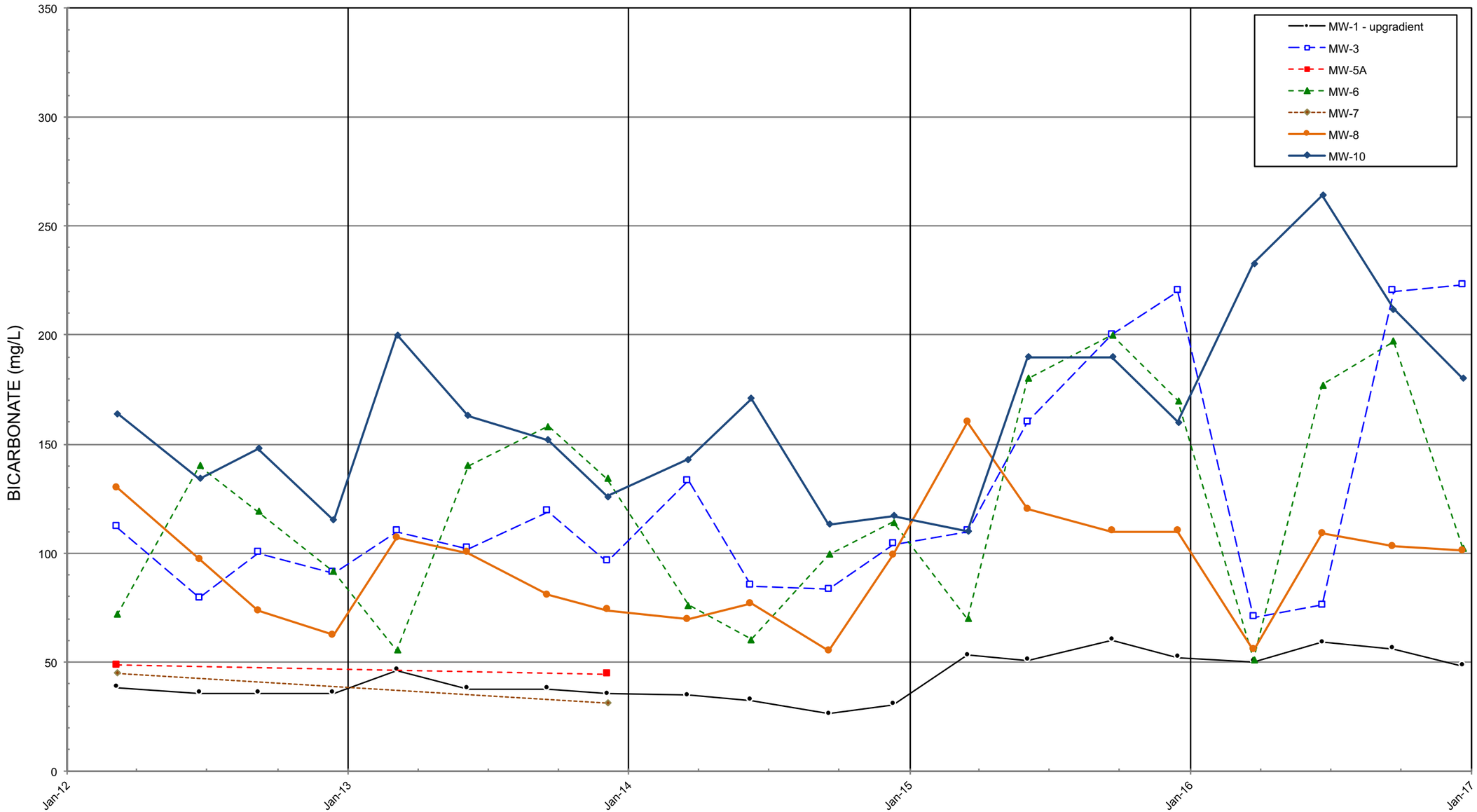


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

BICARBONATE
(Analysis started in 2007)

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

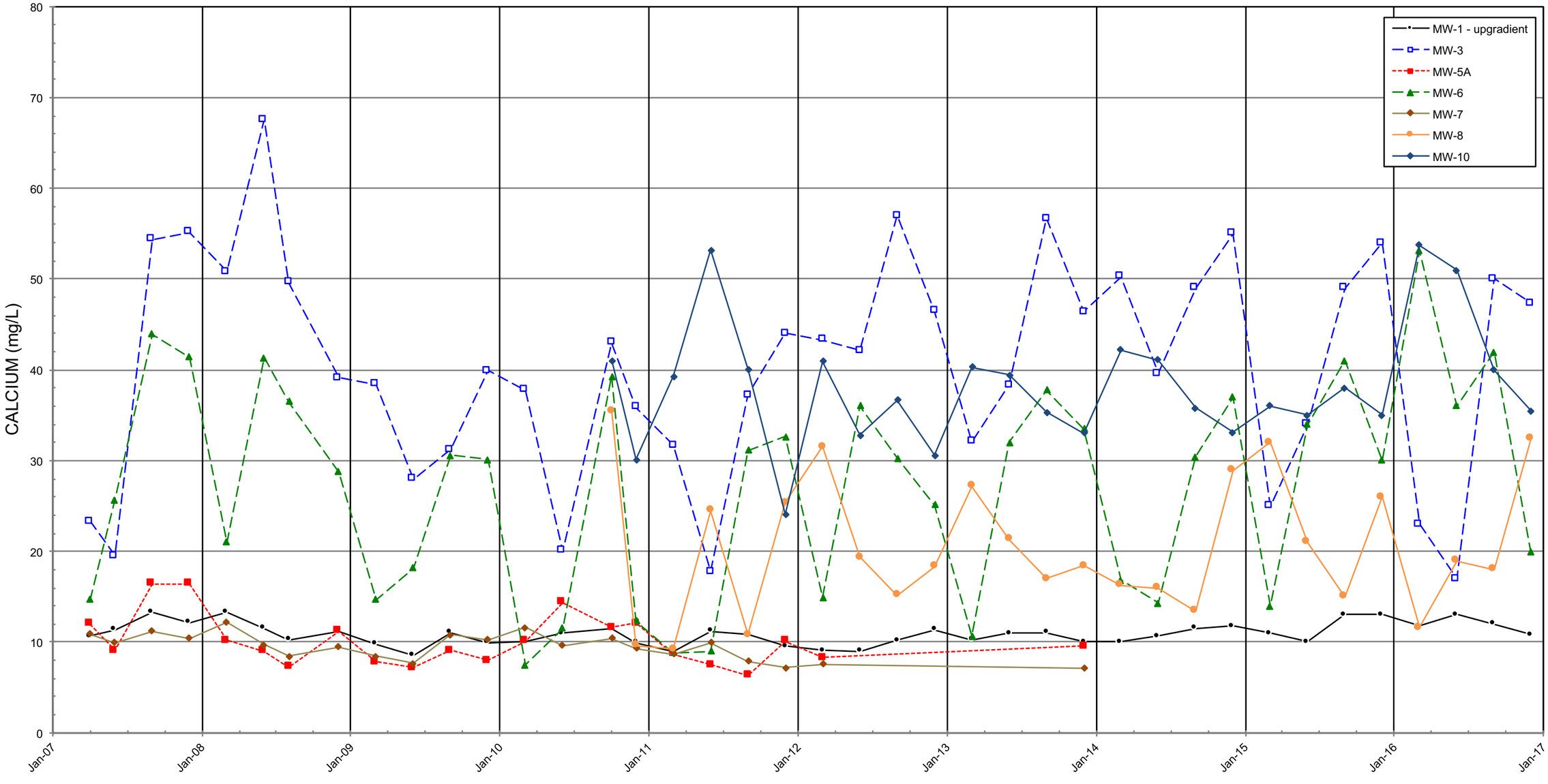


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

BICARBONATE
(RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

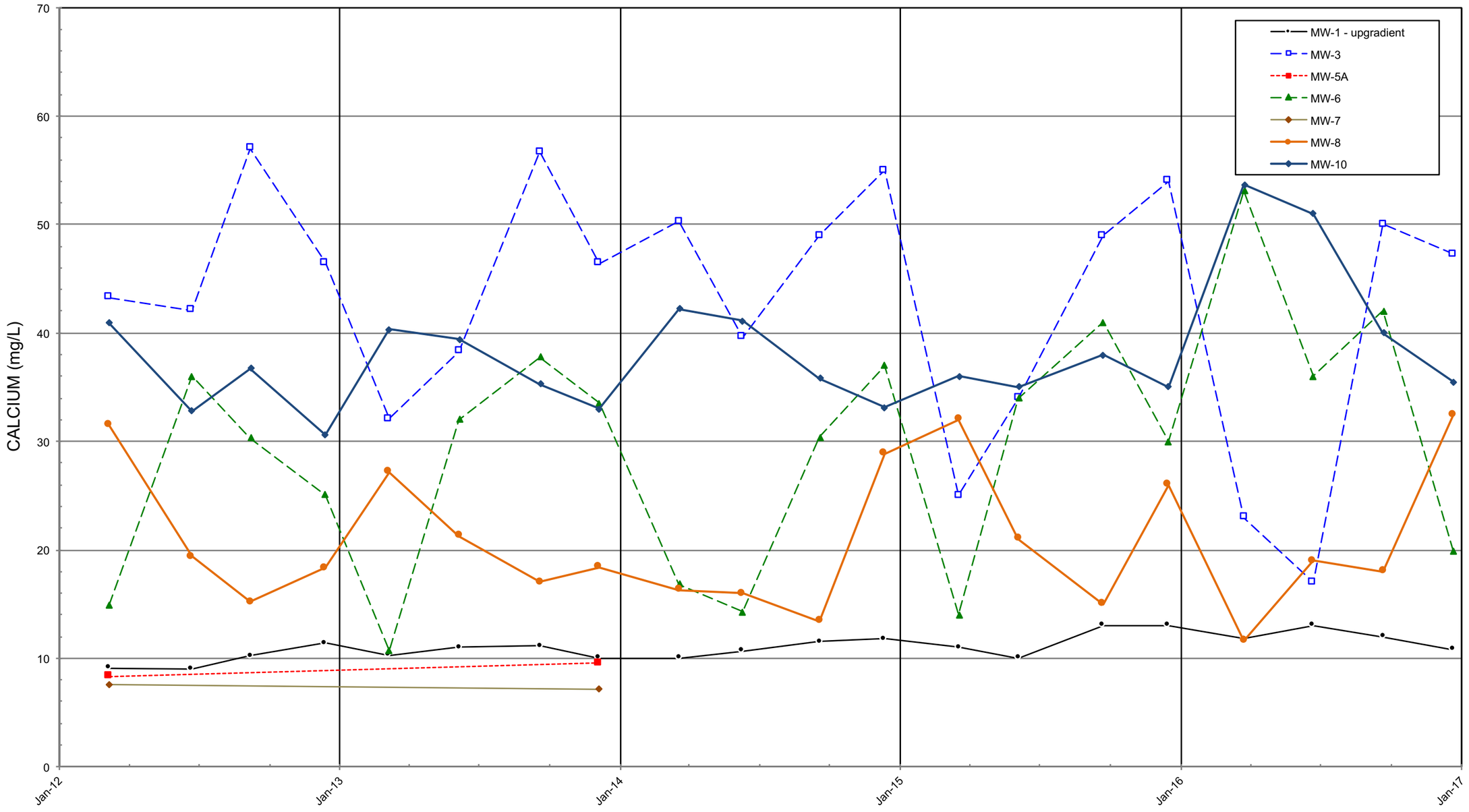


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

CALCIUM
(Analysis started in 2007)

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

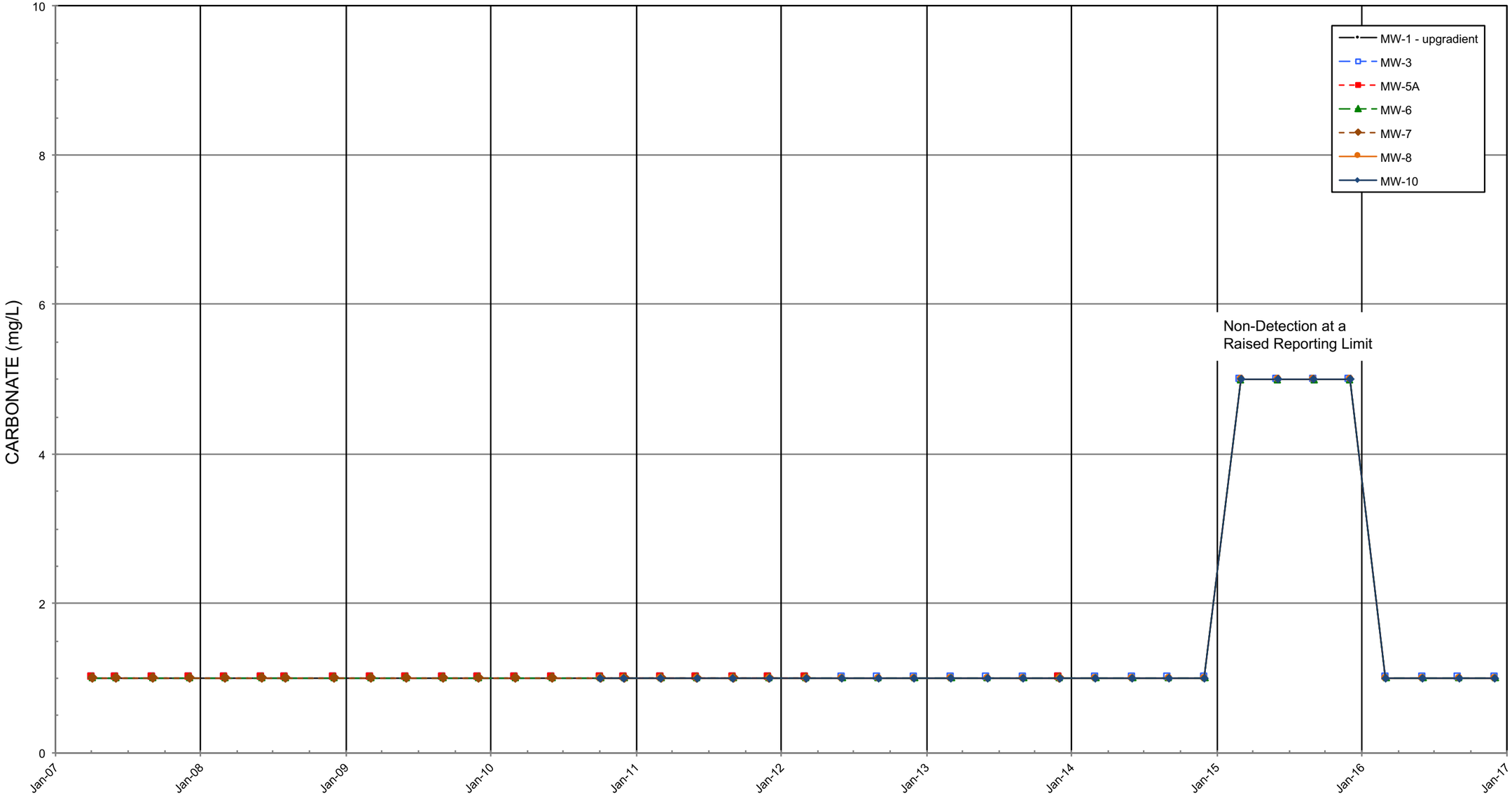


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

CALCIUM
(RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

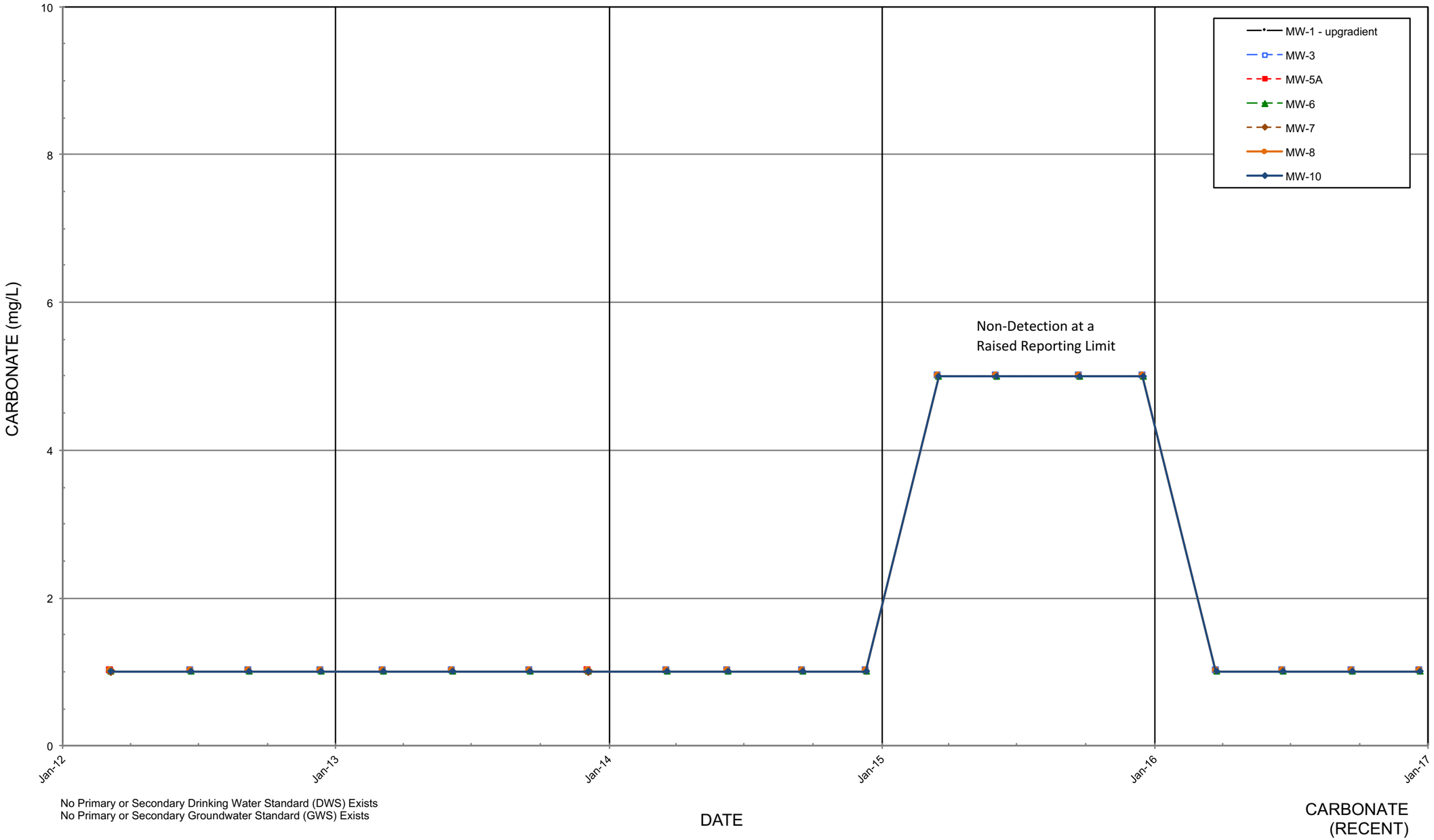


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

CARBONATE
(Analysis started in 2007)

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

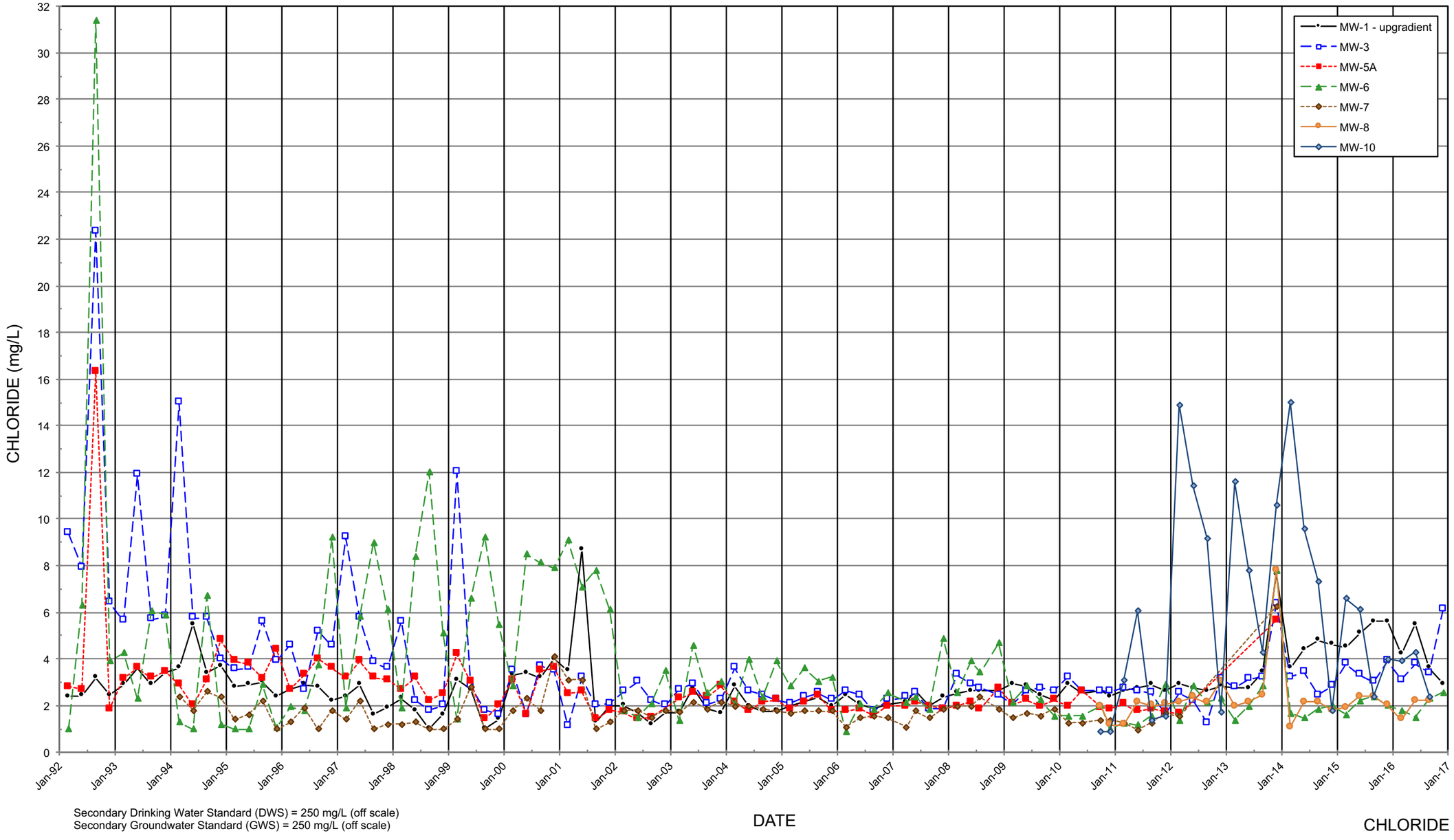


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

CARBONATE
(RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

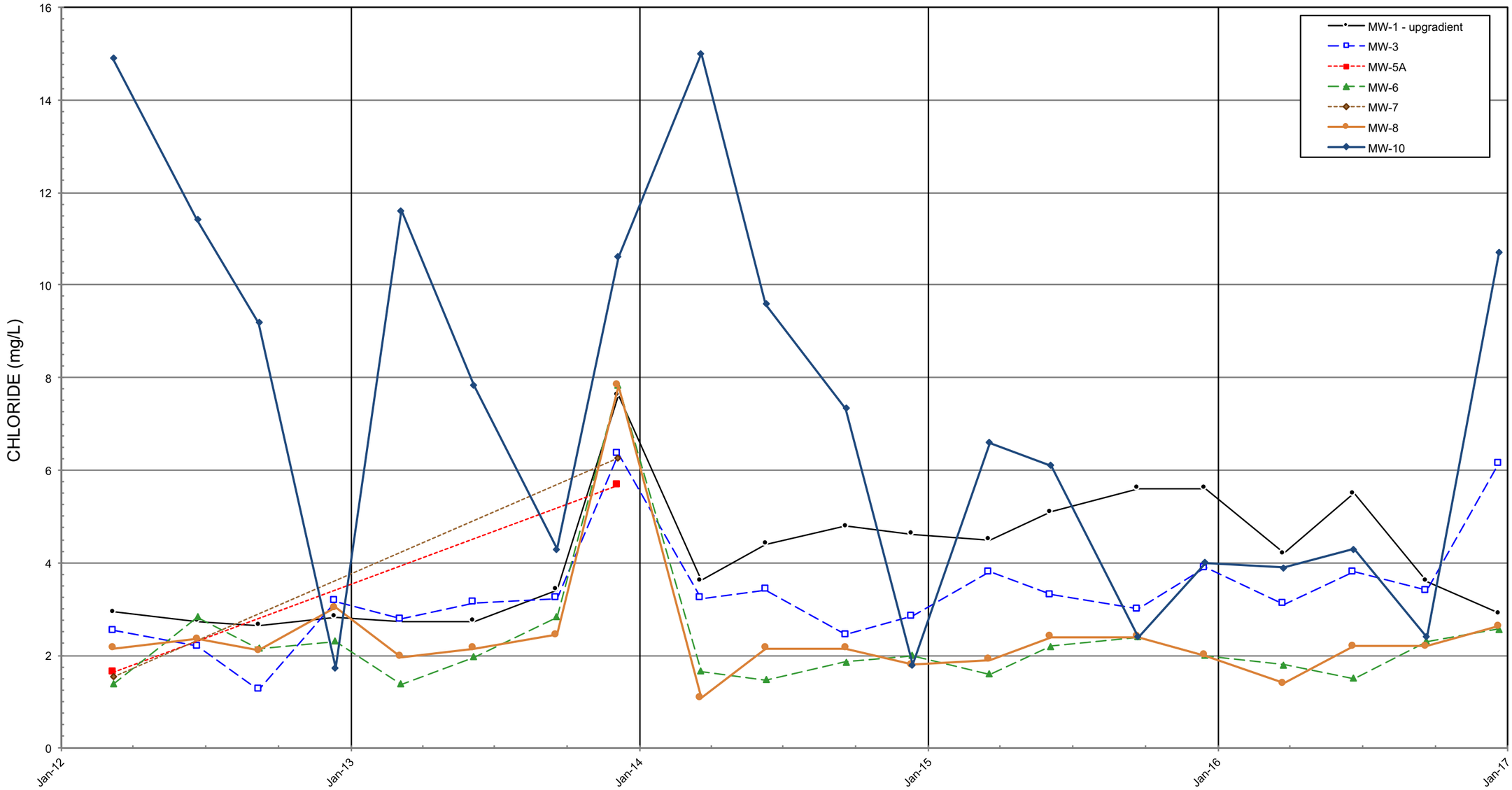


Secondary Drinking Water Standard (DWS) = 250 mg/L (off scale)
Secondary Groundwater Standard (GWS) = 250 mg/L (off scale)

DATE

CHLORIDE

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

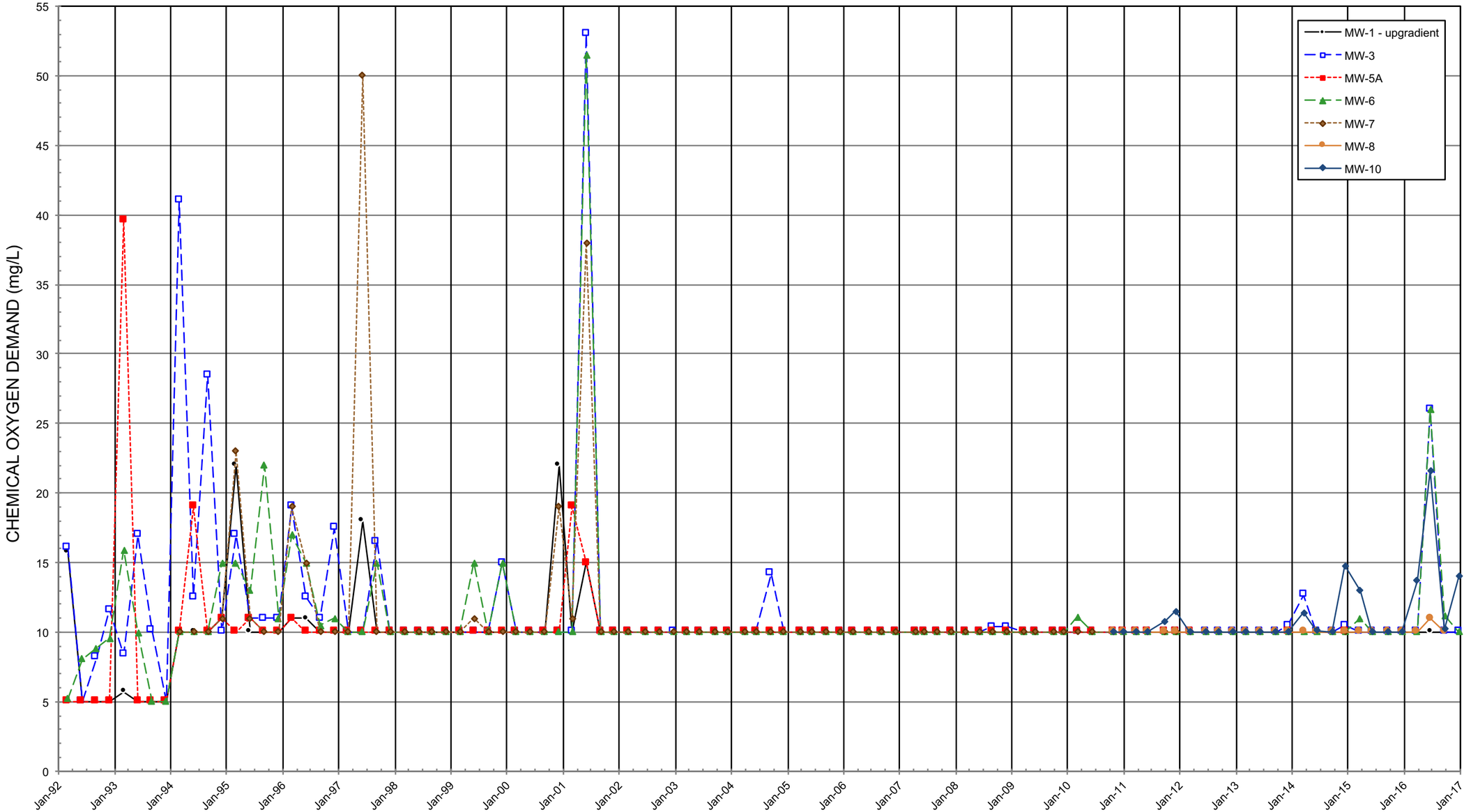


Secondary Drinking Water Standard (DWS) = 250 mg/L (off scale)
Secondary Groundwater Standard (GWS) = 250 mg/L (off scale)

DATE

CHLORIDE (RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

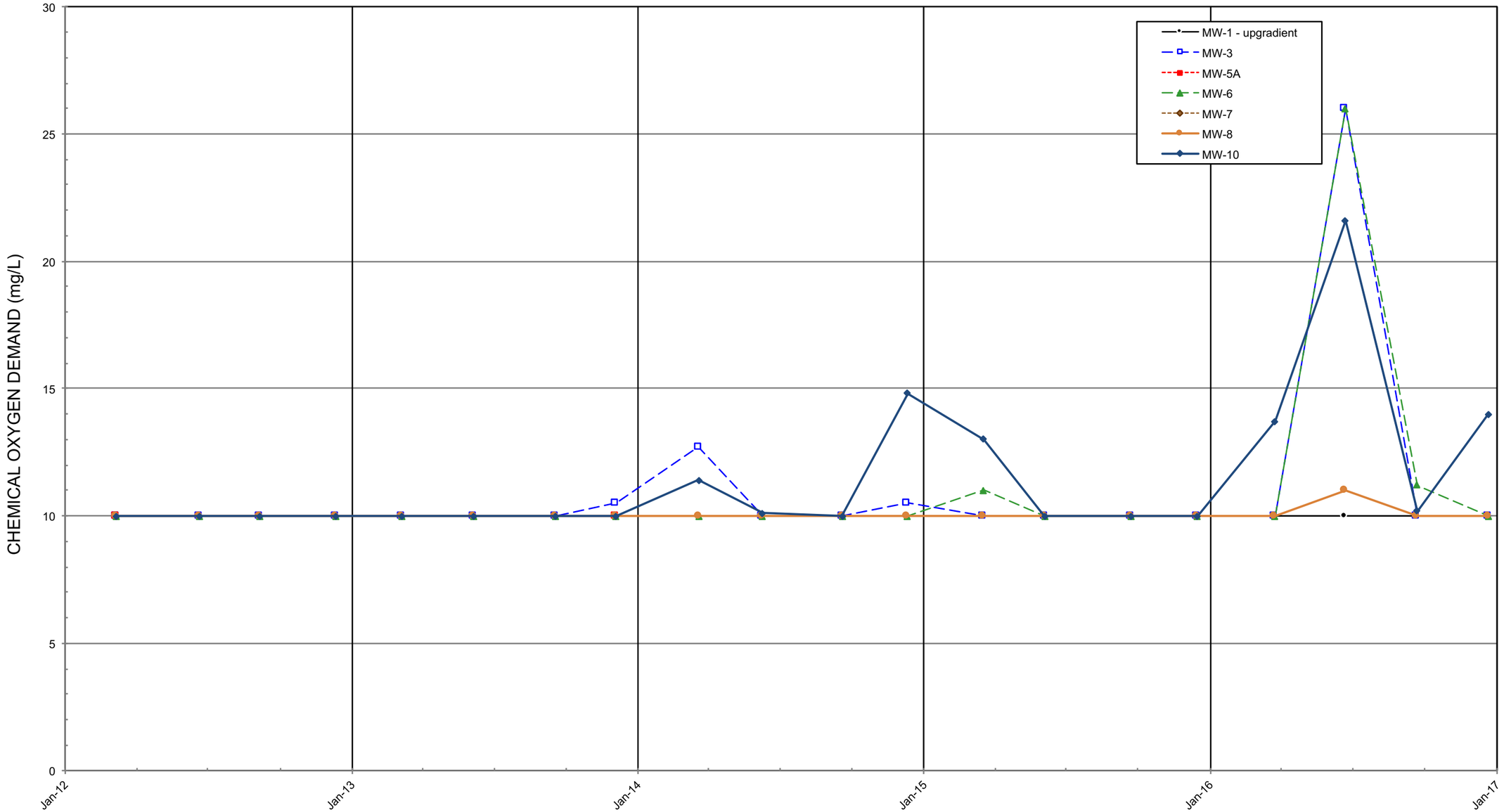


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

CHEMICAL OXYGEN DEMAND

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

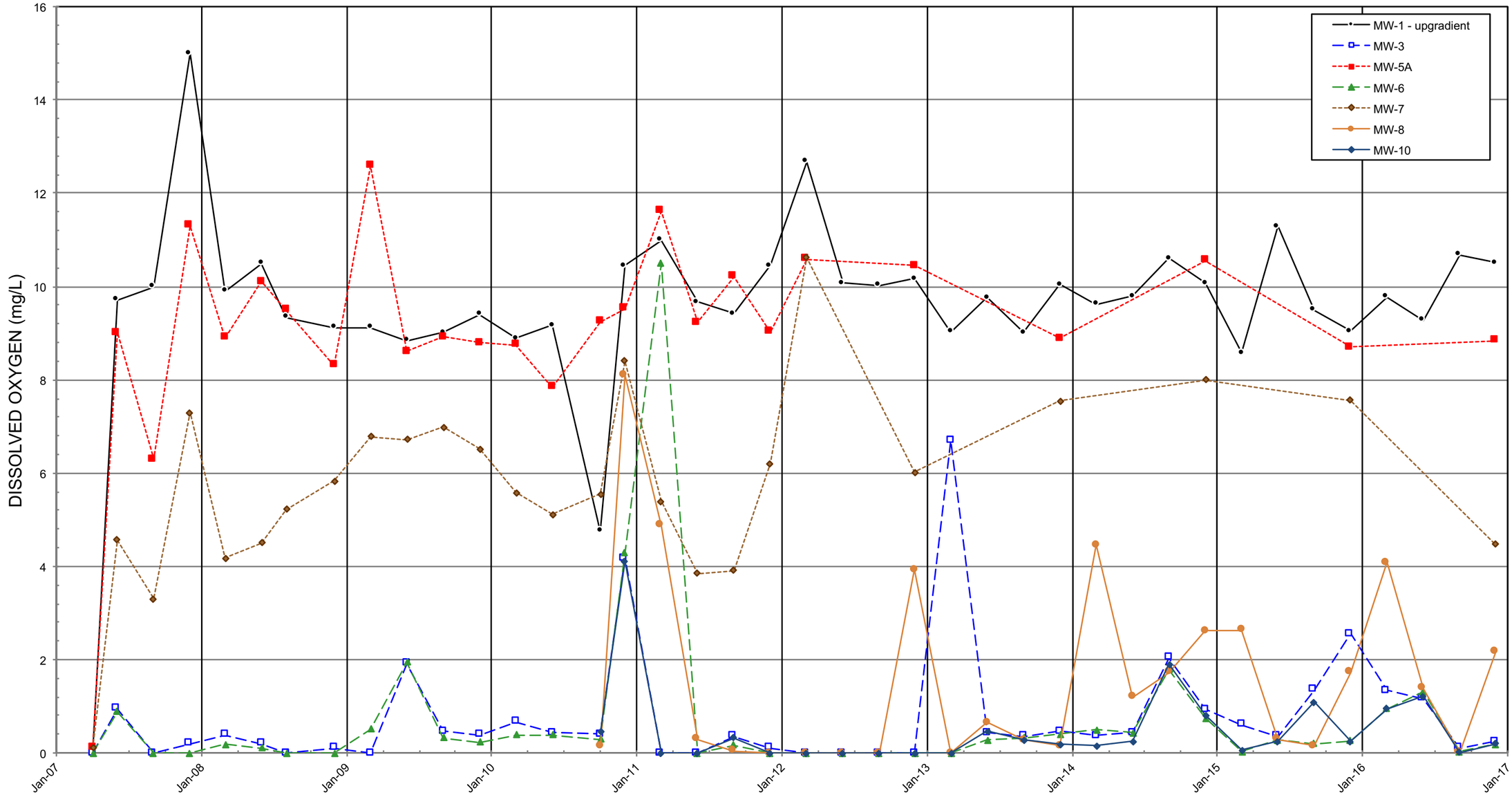


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

CHEMICAL OXYGEN DEMAND (RECENT)

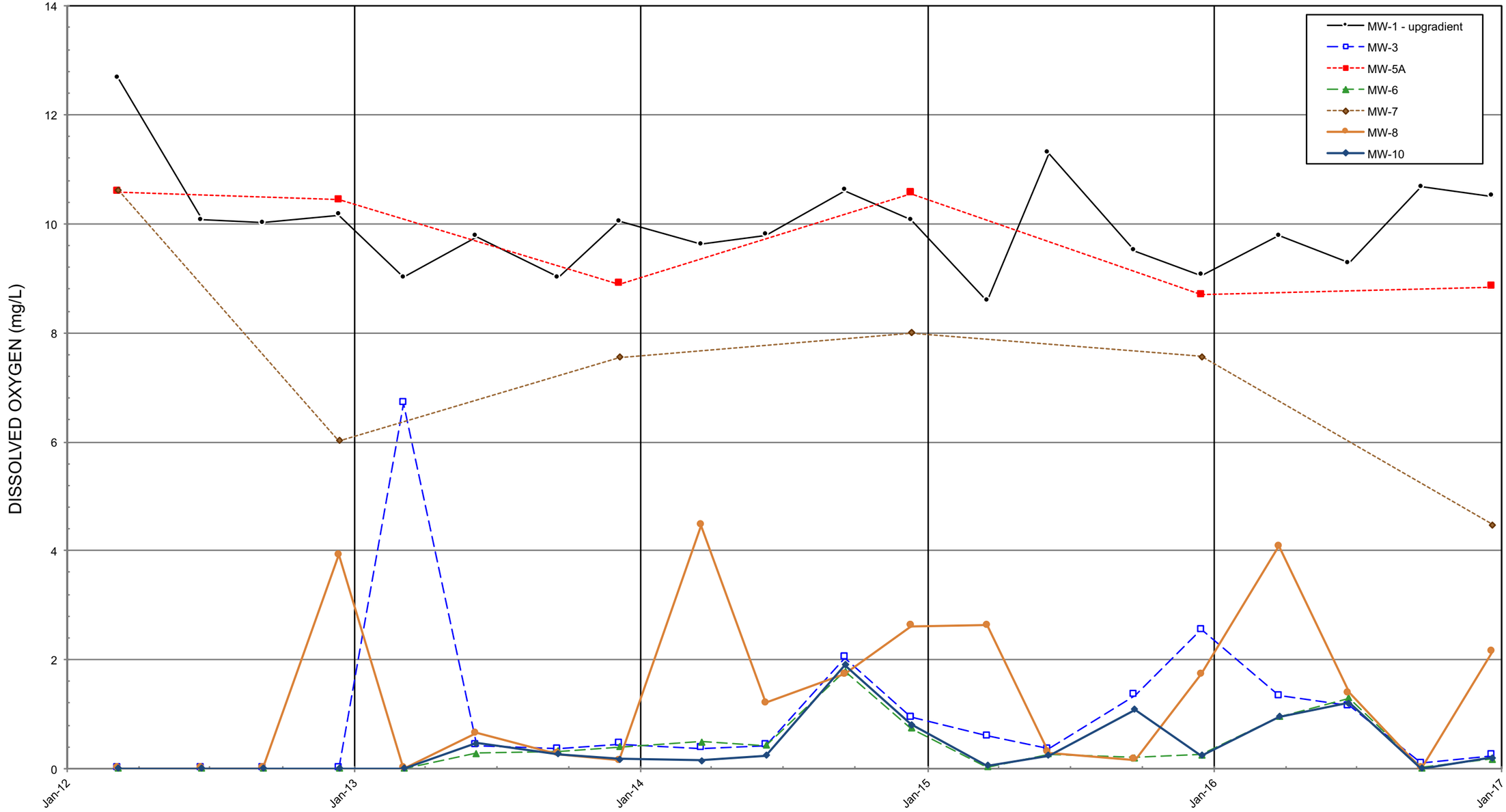
OLALLA LANDFILL
Quarterly Monitoring Data



No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DISSOLVED OXYGEN

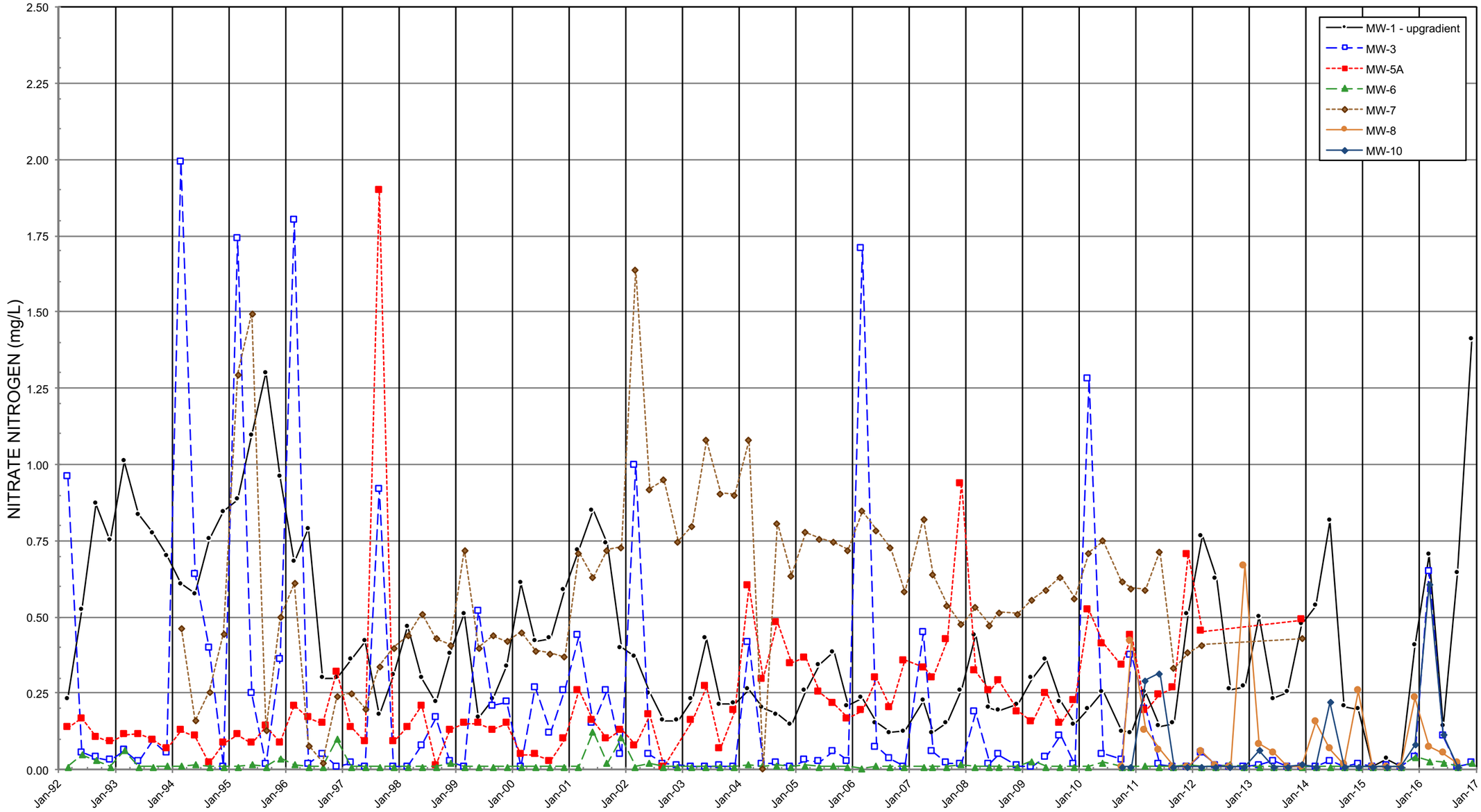
OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)



No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DISSOLVED OXYGEN
(RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

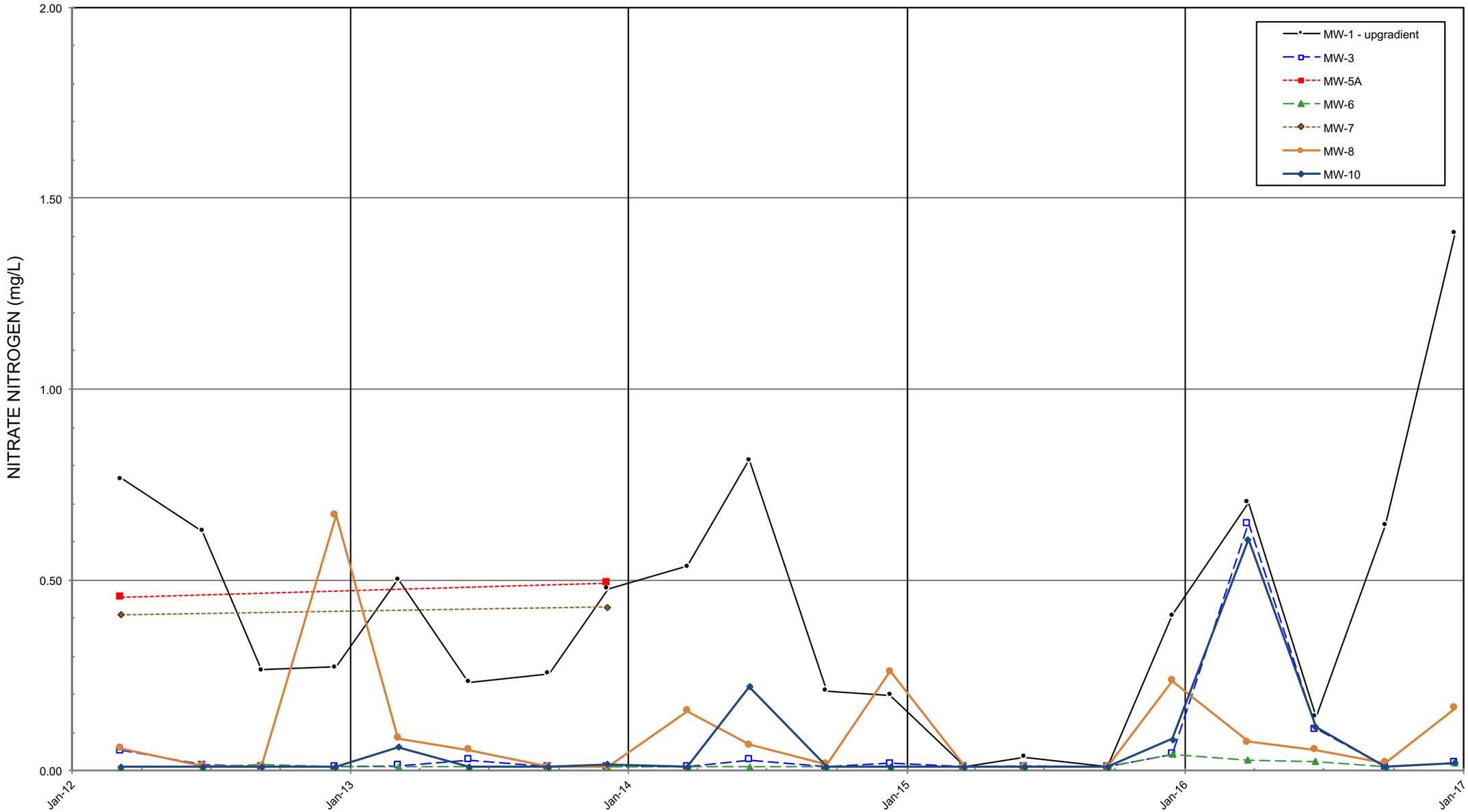


Primary Drinking Water Standard (DWS) = 10 mg/L (off scale)
Primary Groundwater Standard (GWS) = 10 mg/L (off scale)

DATE

NITRATE NITROGEN

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

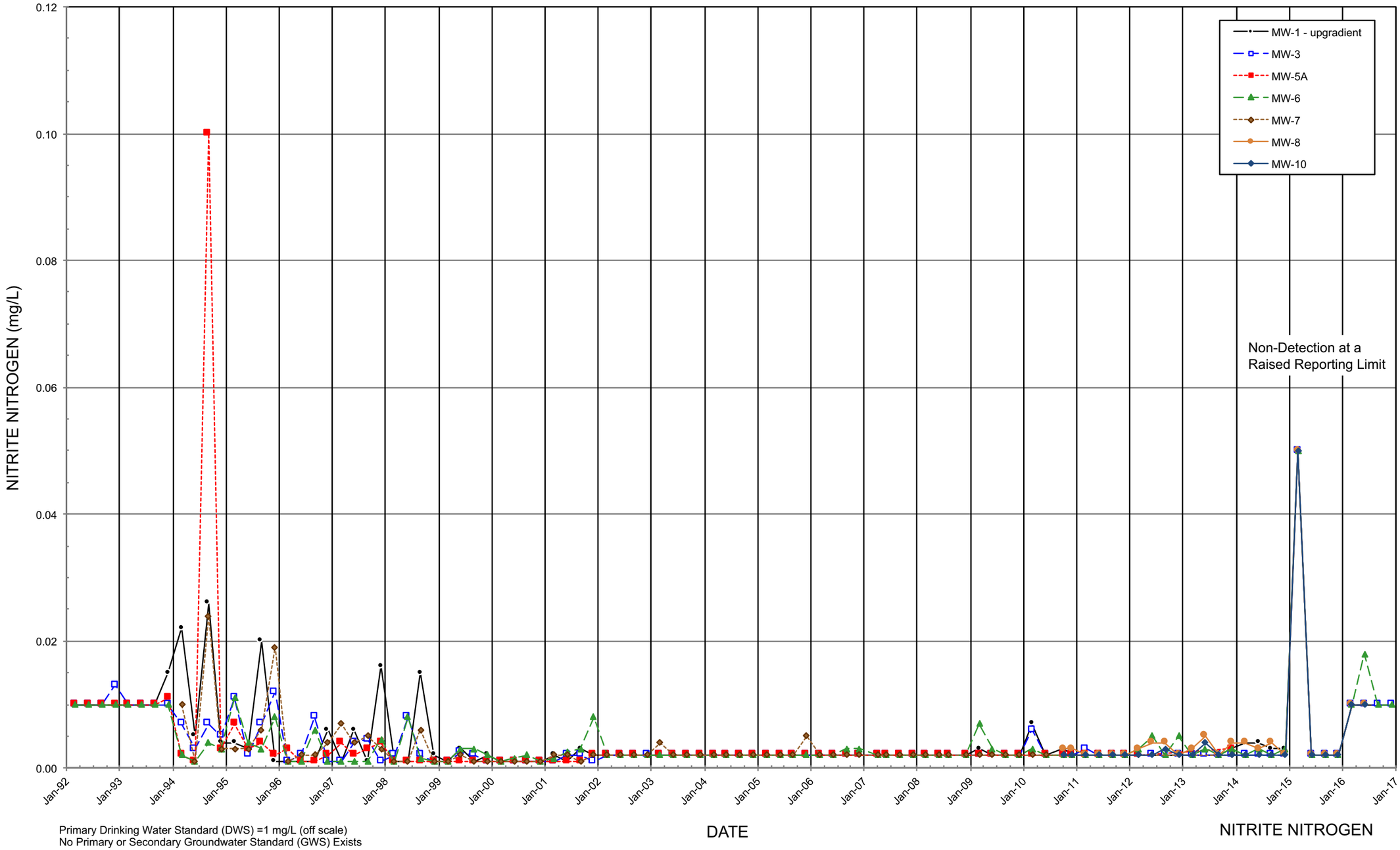


Primary Drinking Water Standard (DWS) = 10 mg/L (off scale)
Primary Groundwater Standard (GWS) = 10 mg/L (off scale)

DATE

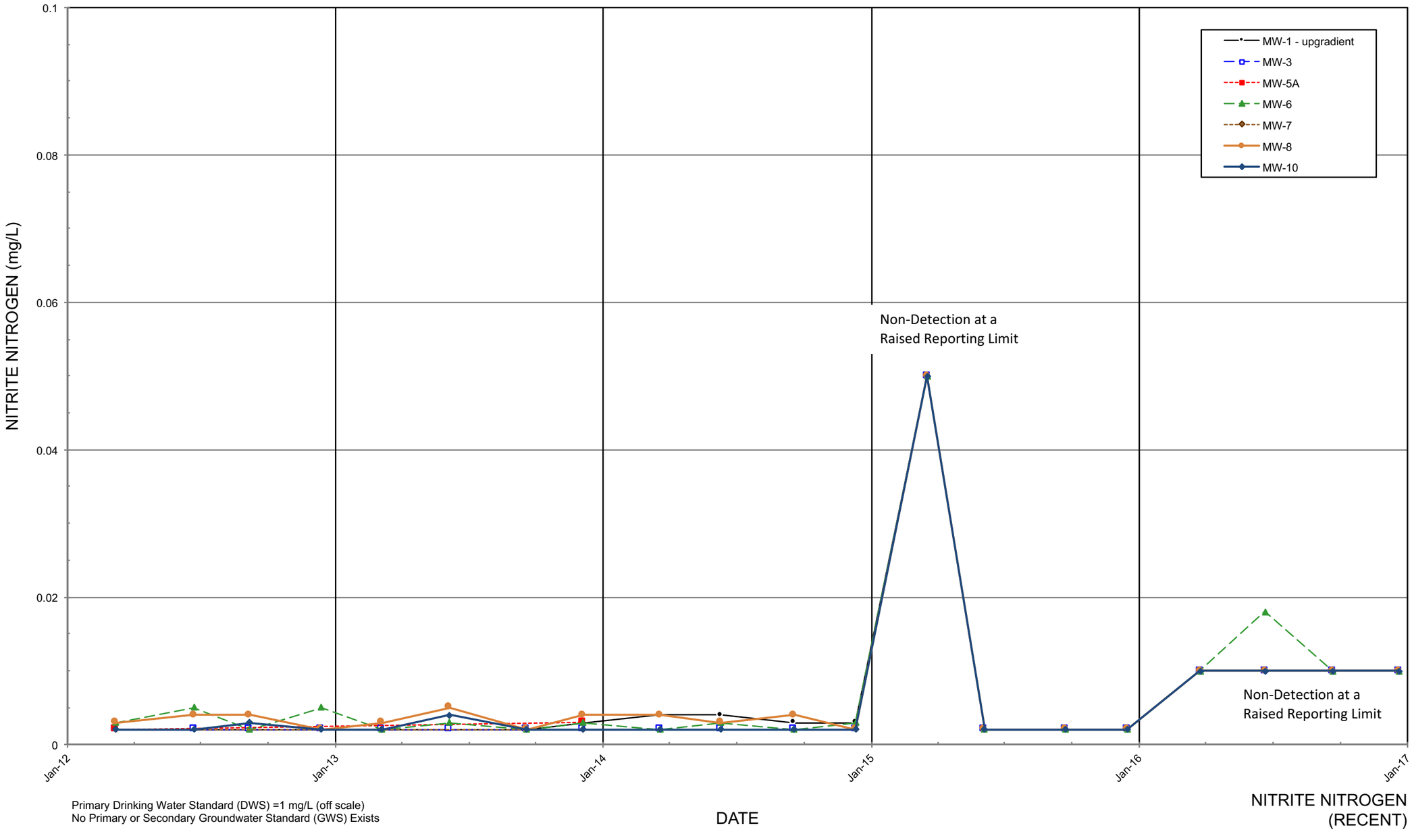
NITRATE NITROGEN
(RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data



Primary Drinking Water Standard (DWS) =1 mg/L (off scale)
No Primary or Secondary Groundwater Standard (GWS) Exists

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

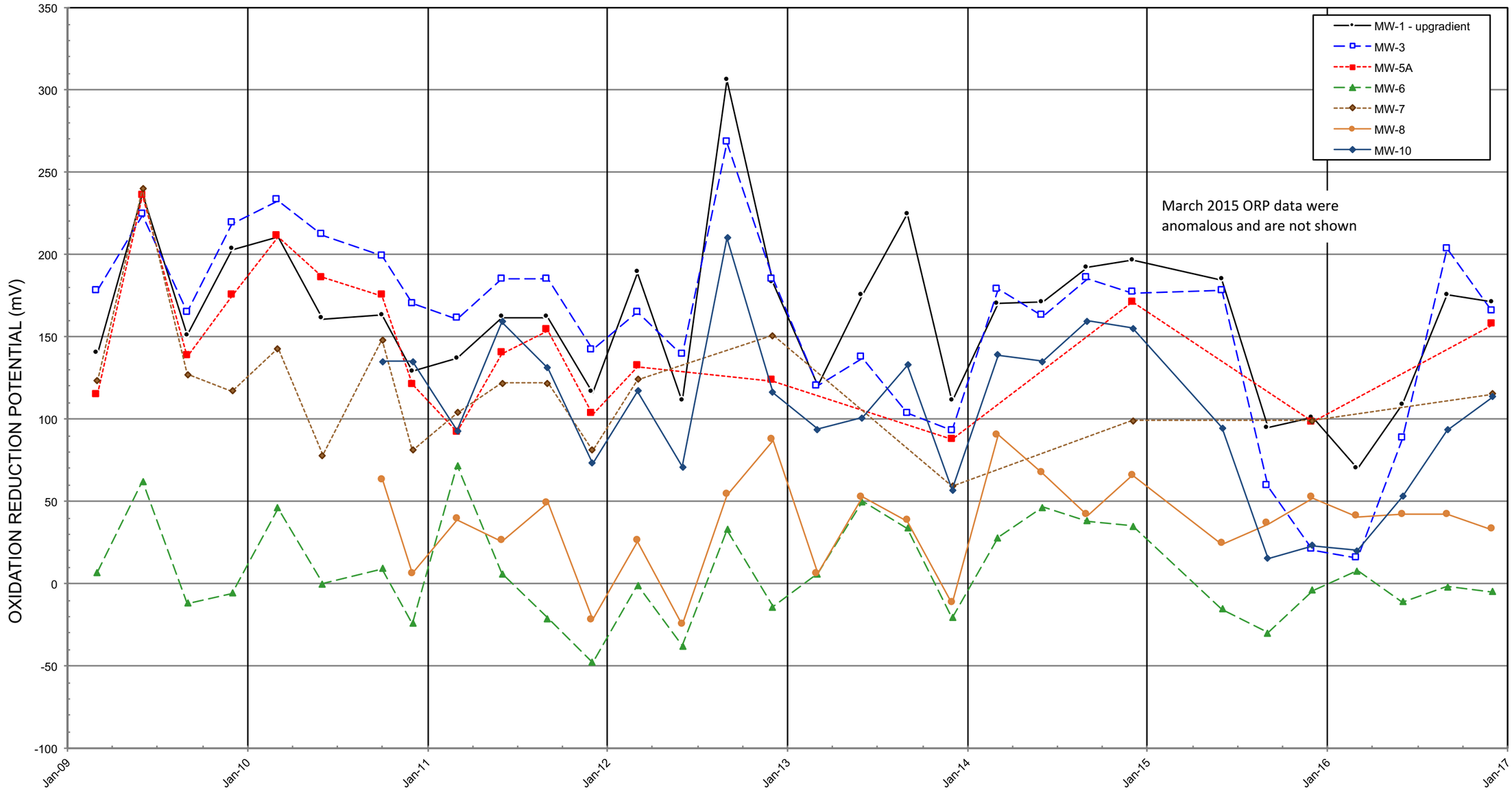


Primary Drinking Water Standard (DWS) =1 mg/L (off scale)
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

NITRITE NITROGEN
(RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

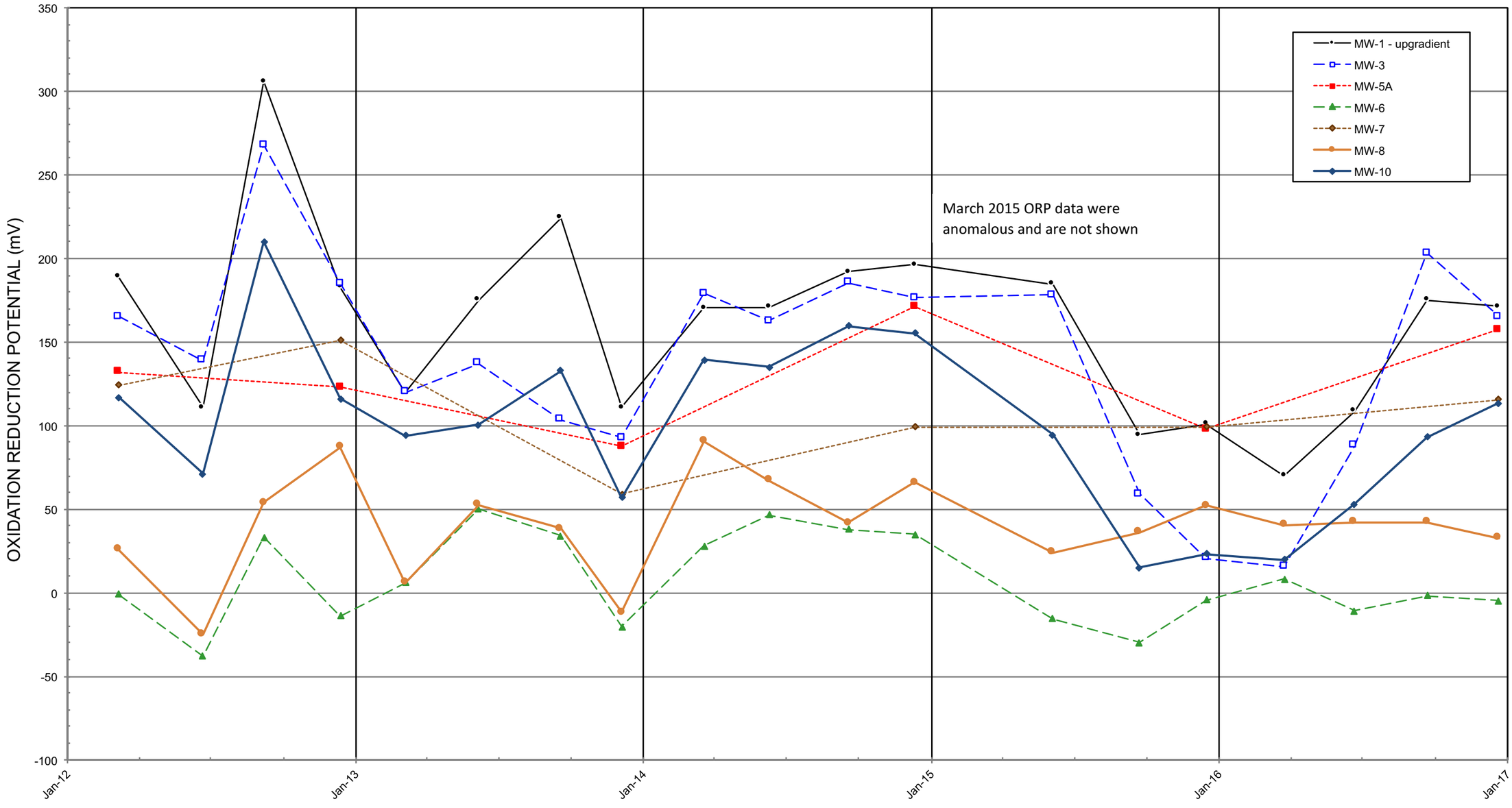


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

OXIDATION REDUCTION POTENTIAL
(Analysis started in 2009)

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

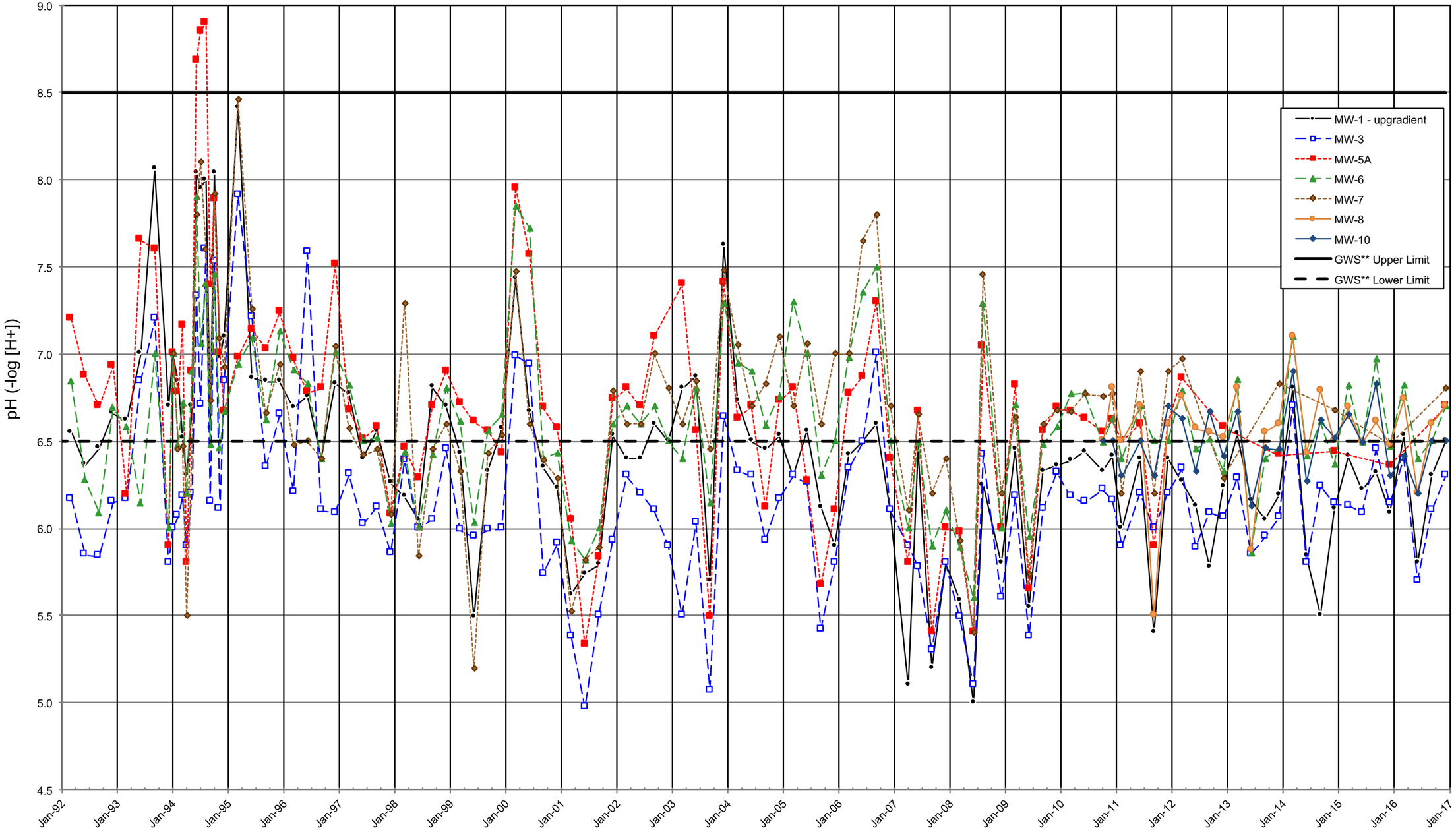


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

OXIDATION REDUCTION POTENTIAL (RECENT)

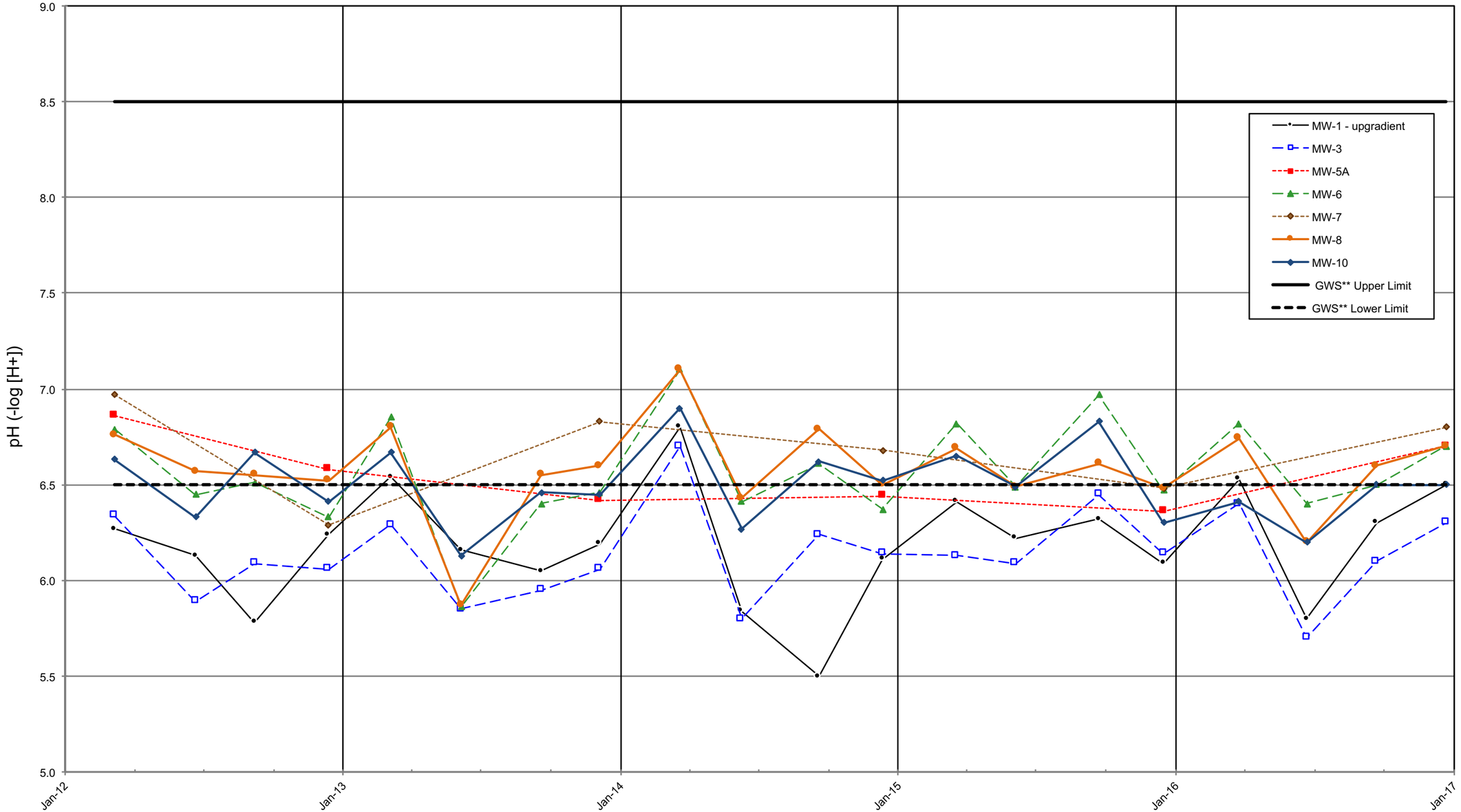
OLALLA LANDFILL
Quarterly Monitoring Data



No Primary or Secondary Drinking Water Standard (DWS) Exists
Secondary Groundwater Standard (GWS) = 6.5 - 8.5 -log H+

pH - Field Measured

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

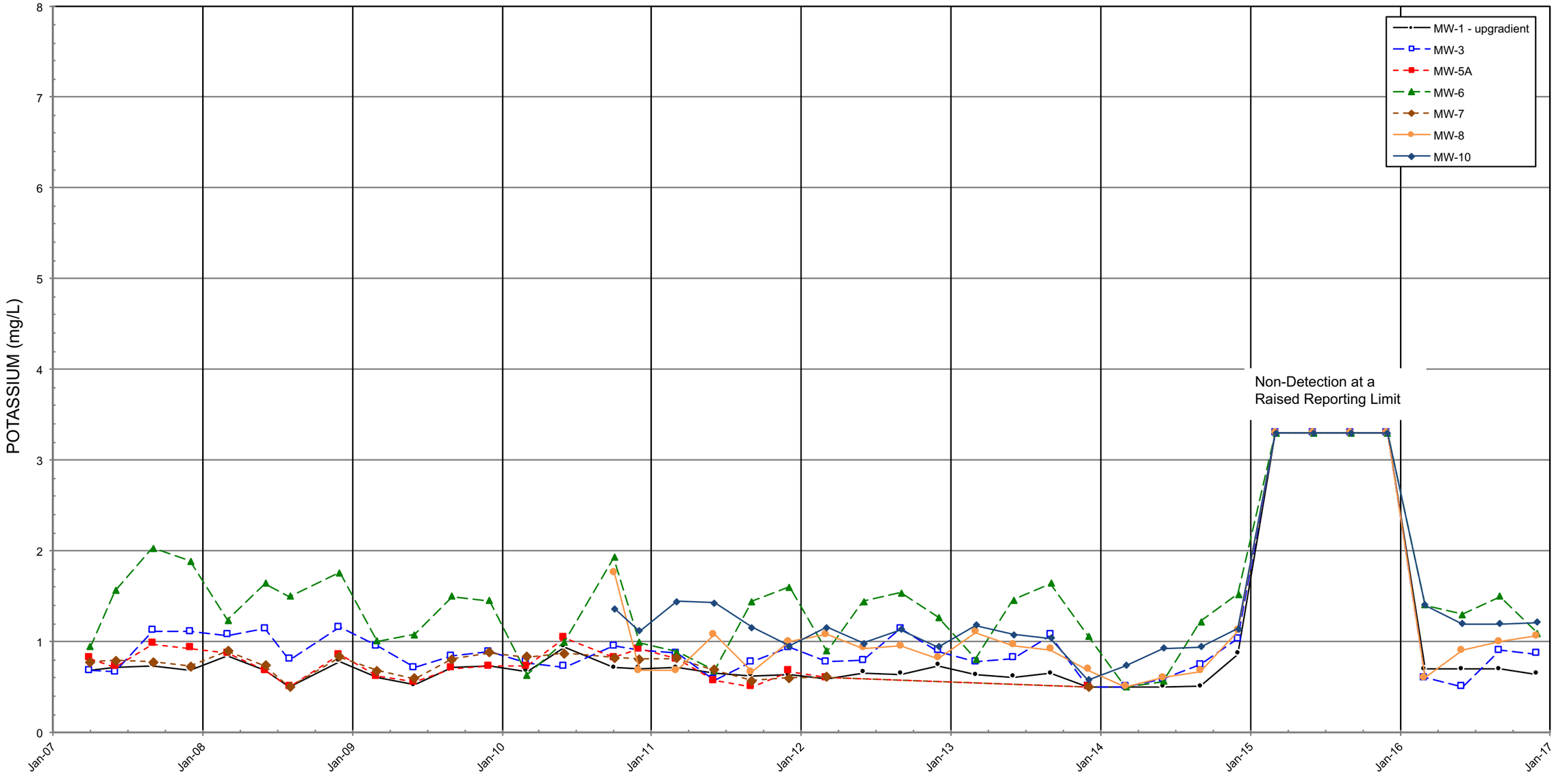


No Primary or Secondary Drinking Water Standard (DWS) Exists
Secondary Groundwater Standard (GWS) = 6.5 - 8.5 -log H+
Field measured pH is shown.

DATE

pH - Field Measured
(RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

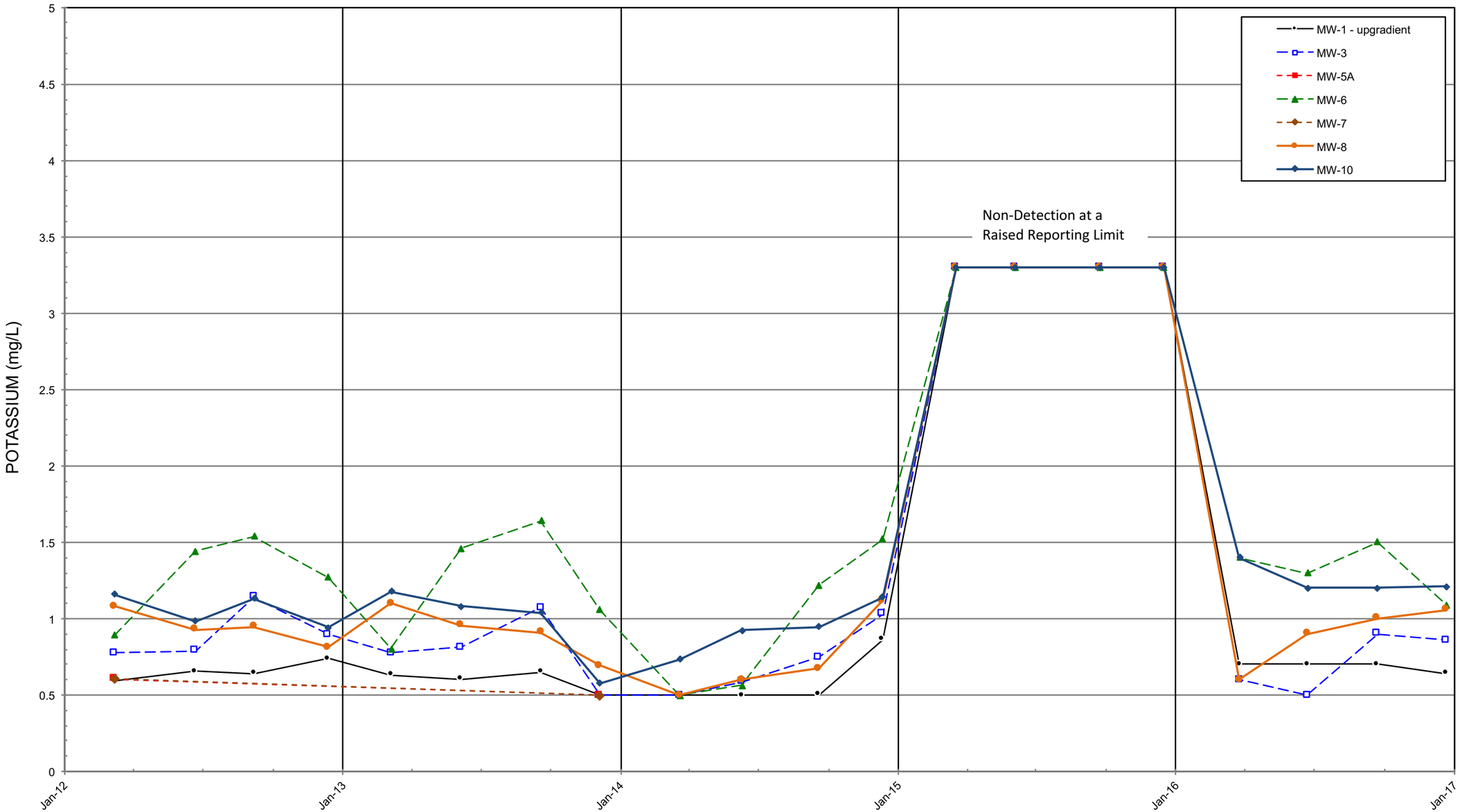


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

POTASSIUM
(Analysis started in 2007)

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

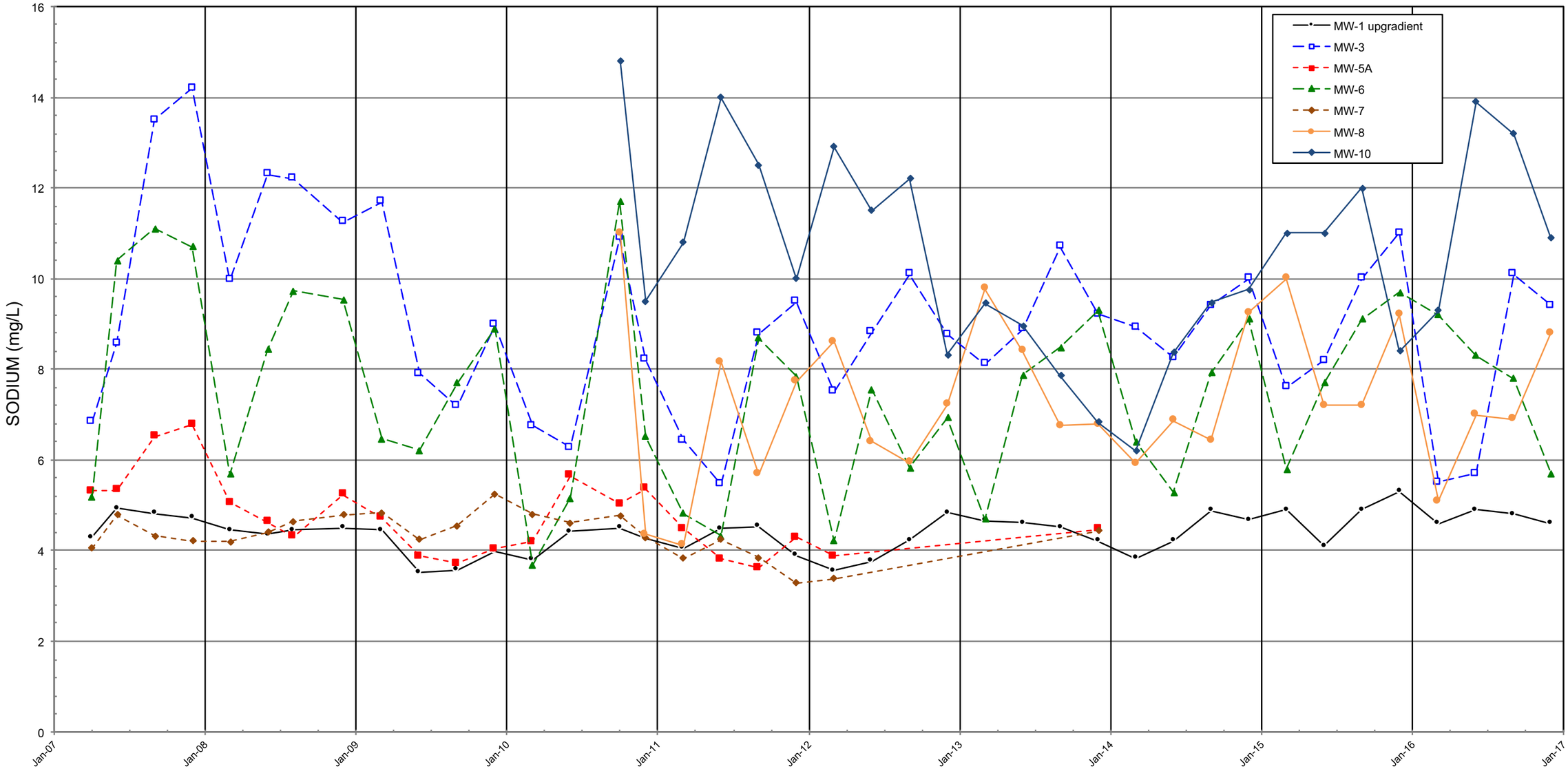


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

POTASSIUM
(RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

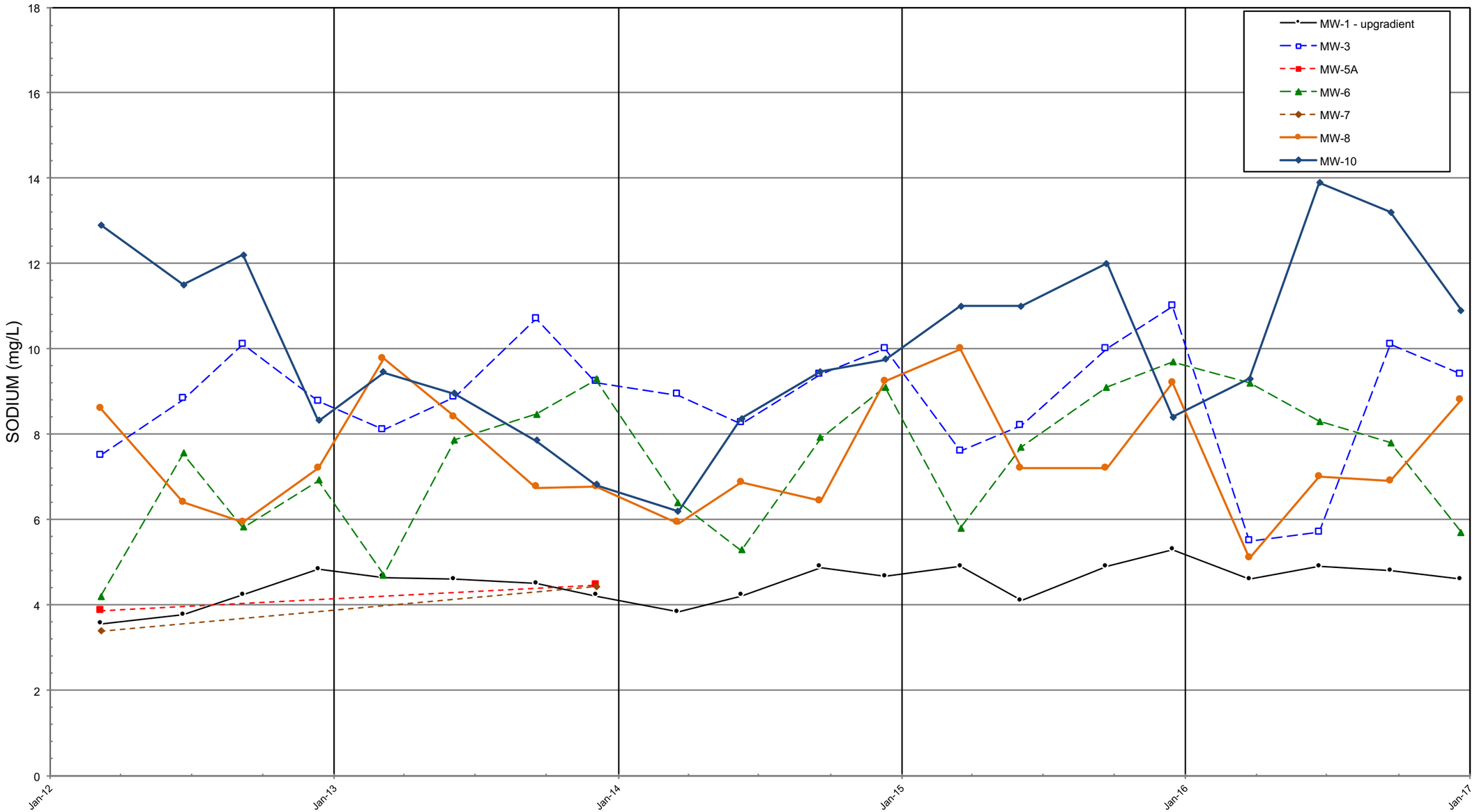


No Primary or Secondary Drinking Water Standard (DWS) Exists. Recommended level of concern for consumers with restricted daily sodium intake is 20 mg/L (off scale)
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

SODIUM
(Analysis started in 2007)

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

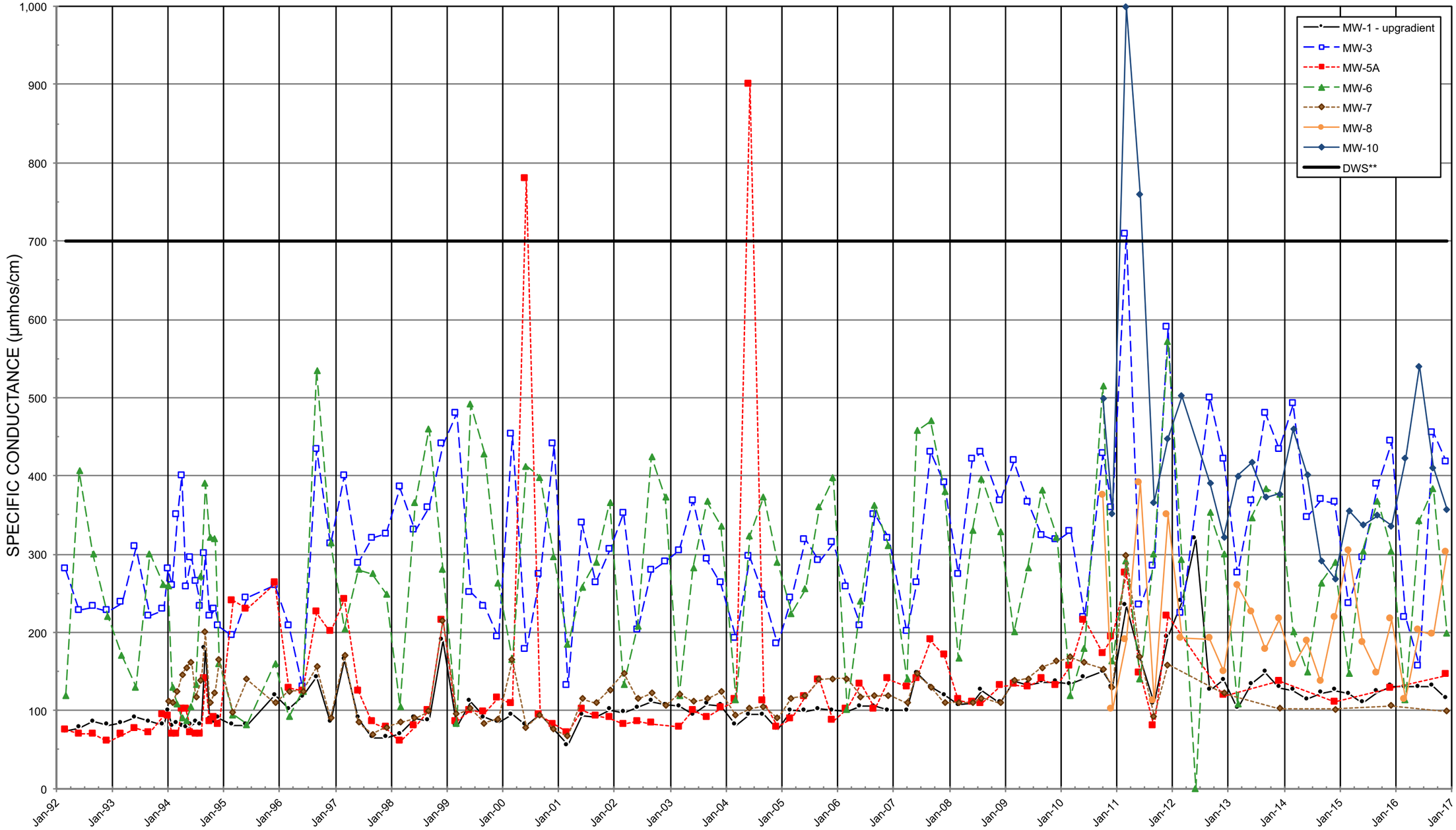


No Primary or Secondary Drinking Water Standard (DWS) Exists. Recommended level of concern for consumers with restricted daily sodium intake is 20 mg/L (off scale)
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

SODIUM (RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

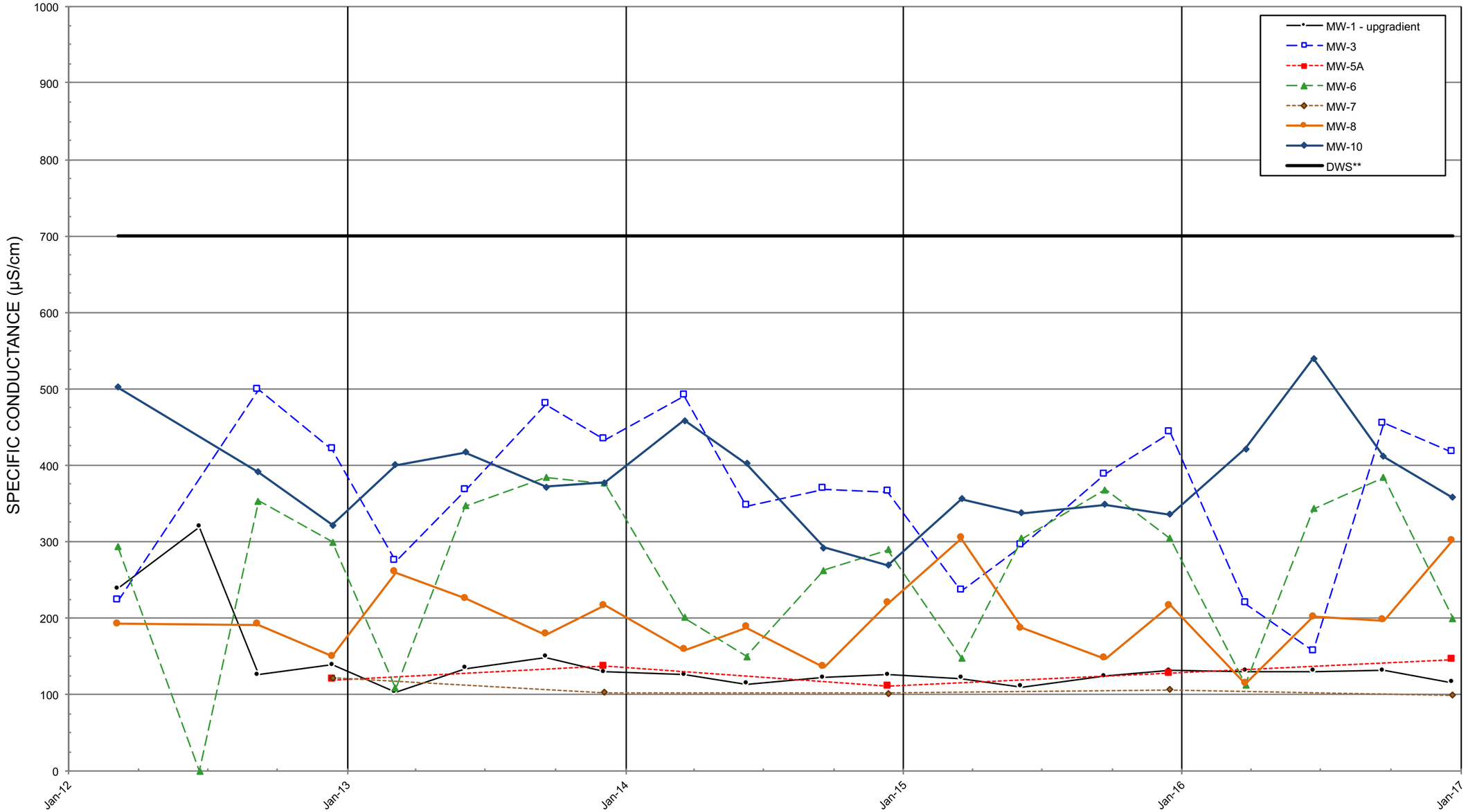


Secondary Drinking Water Standard (DWS) = 700 µmhos/cm
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

SPECIFIC CONDUCTANCE

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

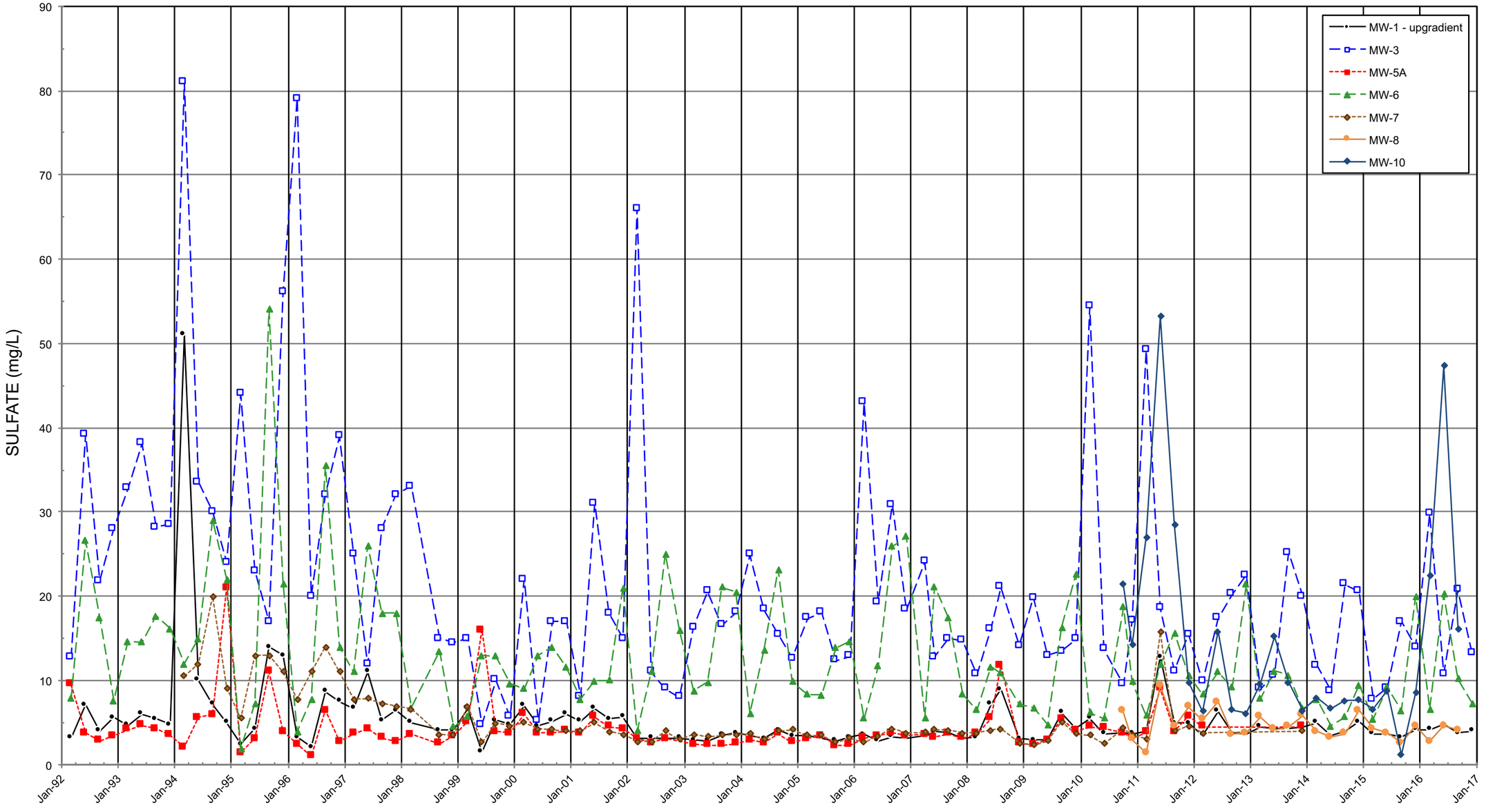


Secondary Drinking Water Standard (DWS) = 700 µS/cm
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

SPECIFIC CONDUCTANCE (RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

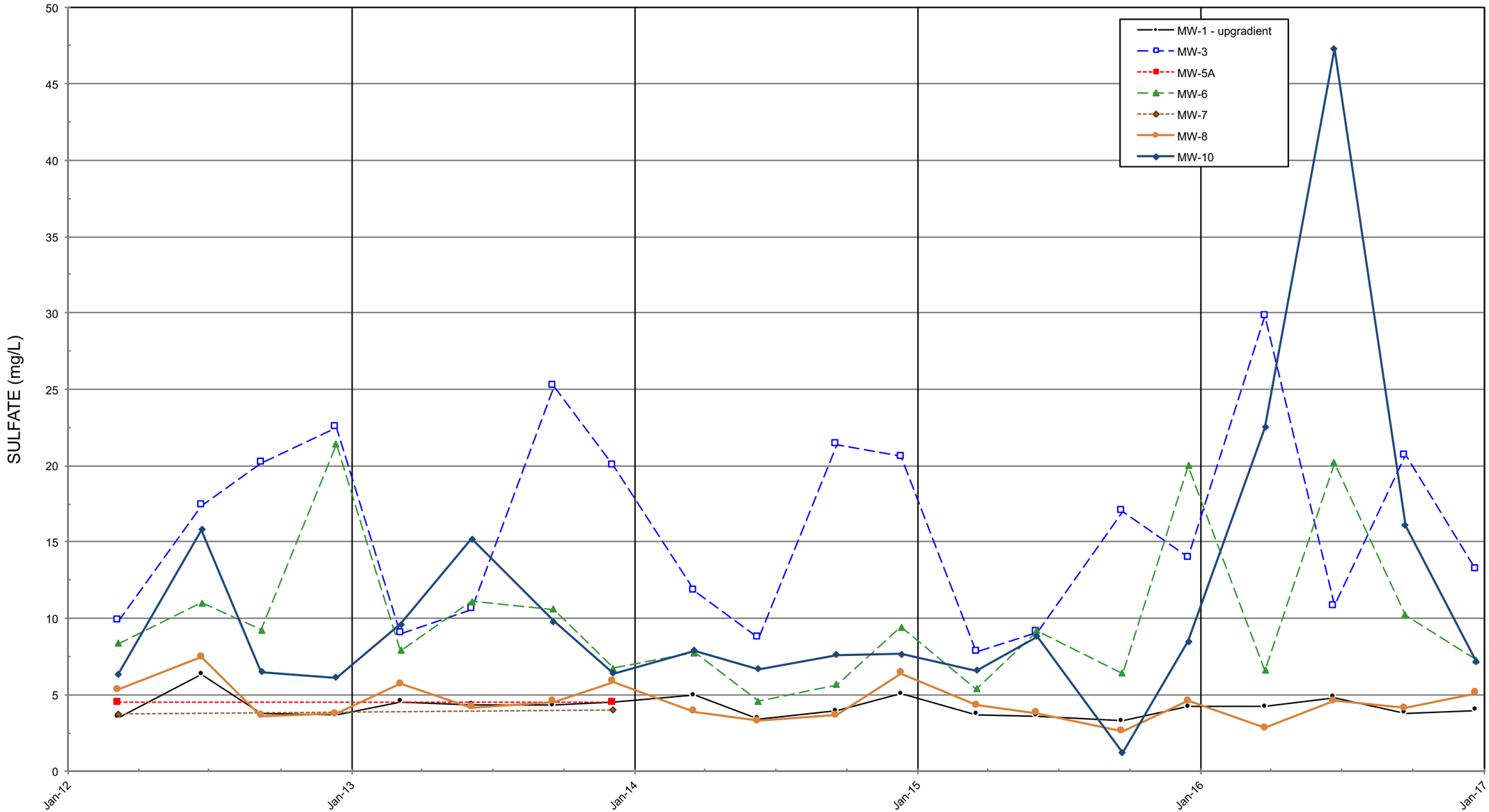


Secondary Drinking Water Standard (DWS) = 250 mg/L (off scale)
Secondary Groundwater Standard (GWS) = 250 mg/L (off scale)

DATE

SULFATE

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

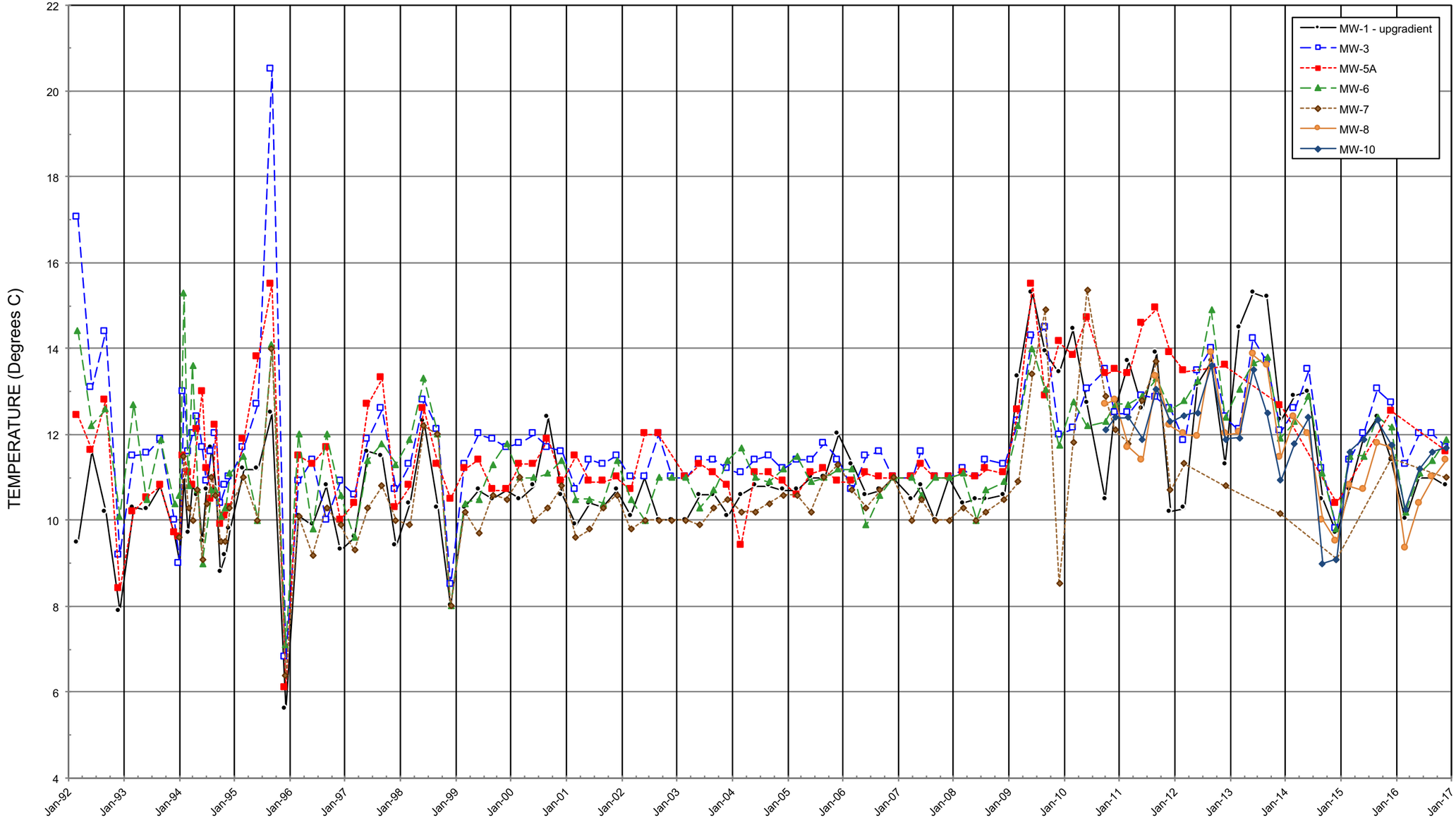


Secondary Drinking Water Standard (DWS) = 250 mg/L (off scale)
Secondary Groundwater Standard (GWS) = 250 mg/L (off scale)

DATE

SULFATE
(RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

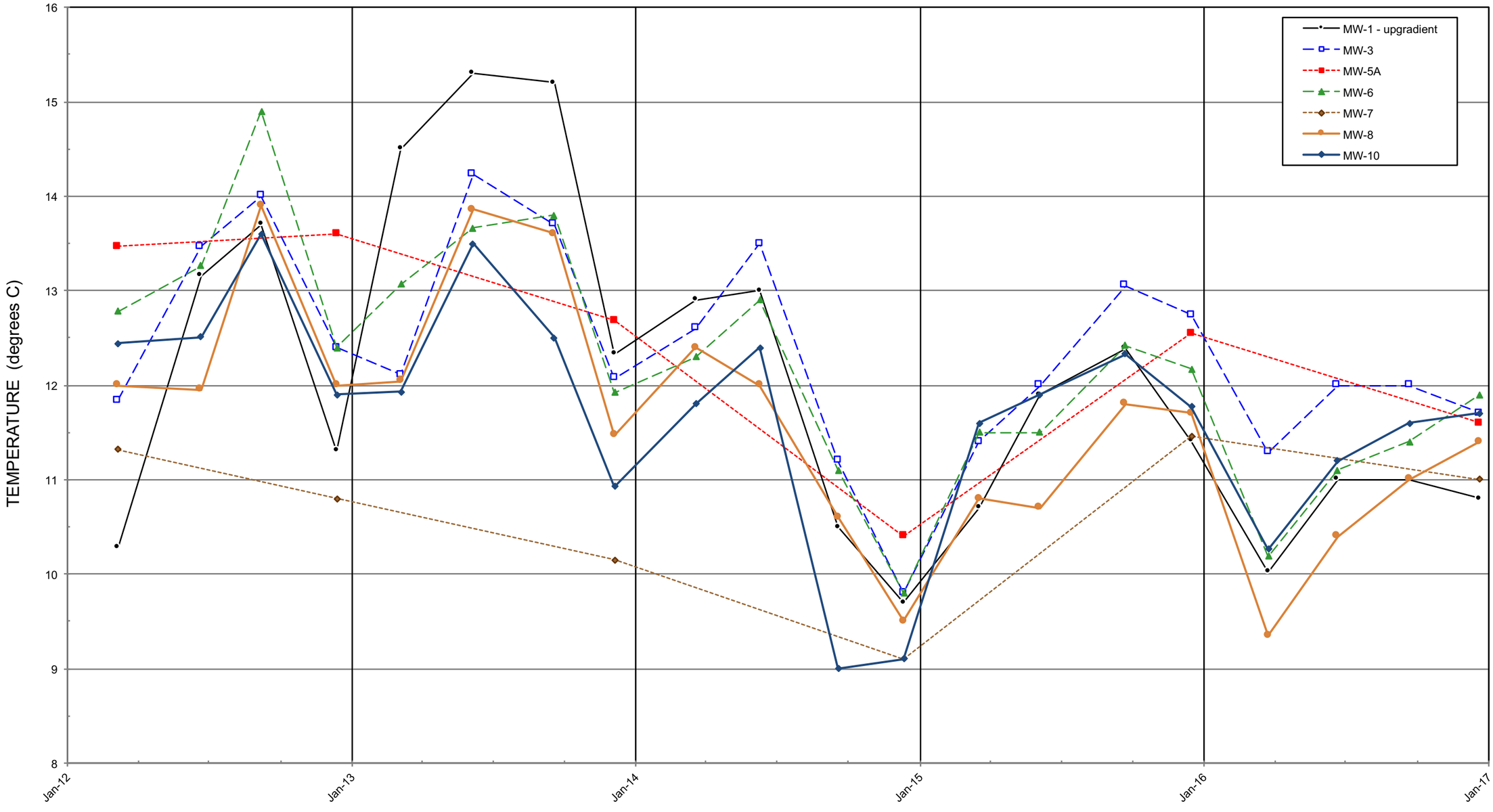


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

TEMPERATURE

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

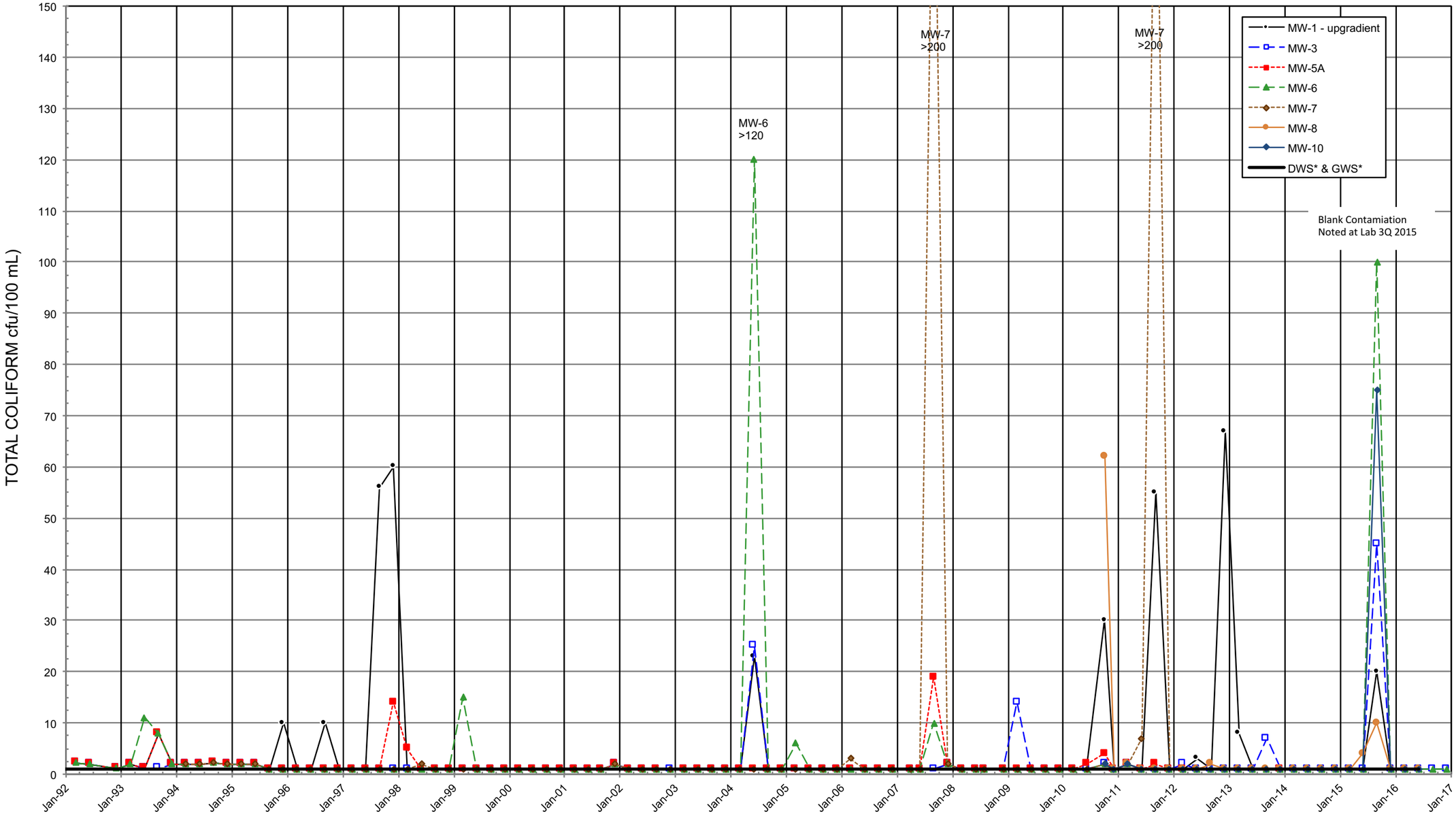


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

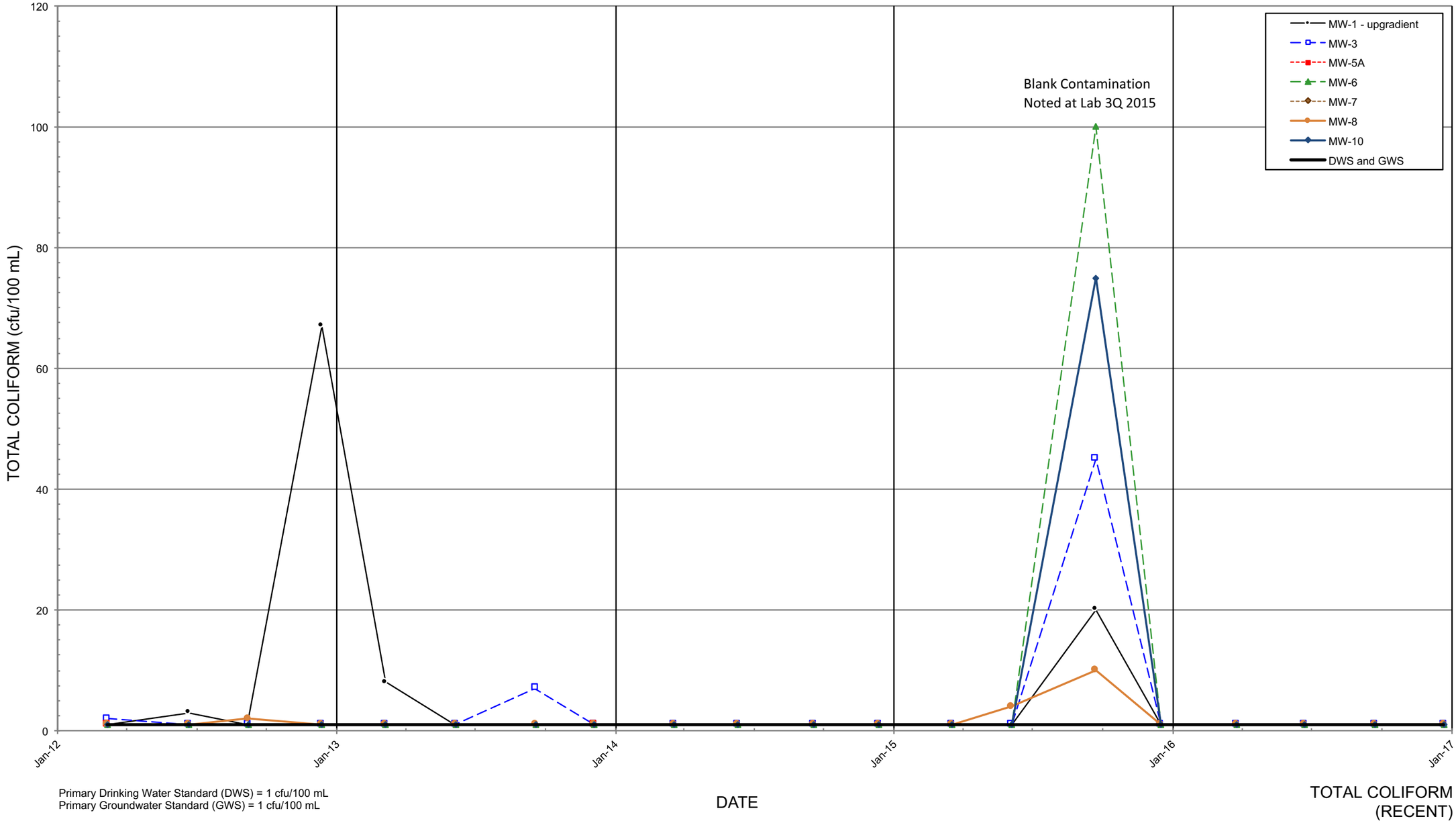
TEMPERATURE
(RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data



Primary Drinking Water Standard (DWS) = 1 cfu/100 mL
Primary Groundwater Standard (GWS) = 1 cfu/100 mL

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

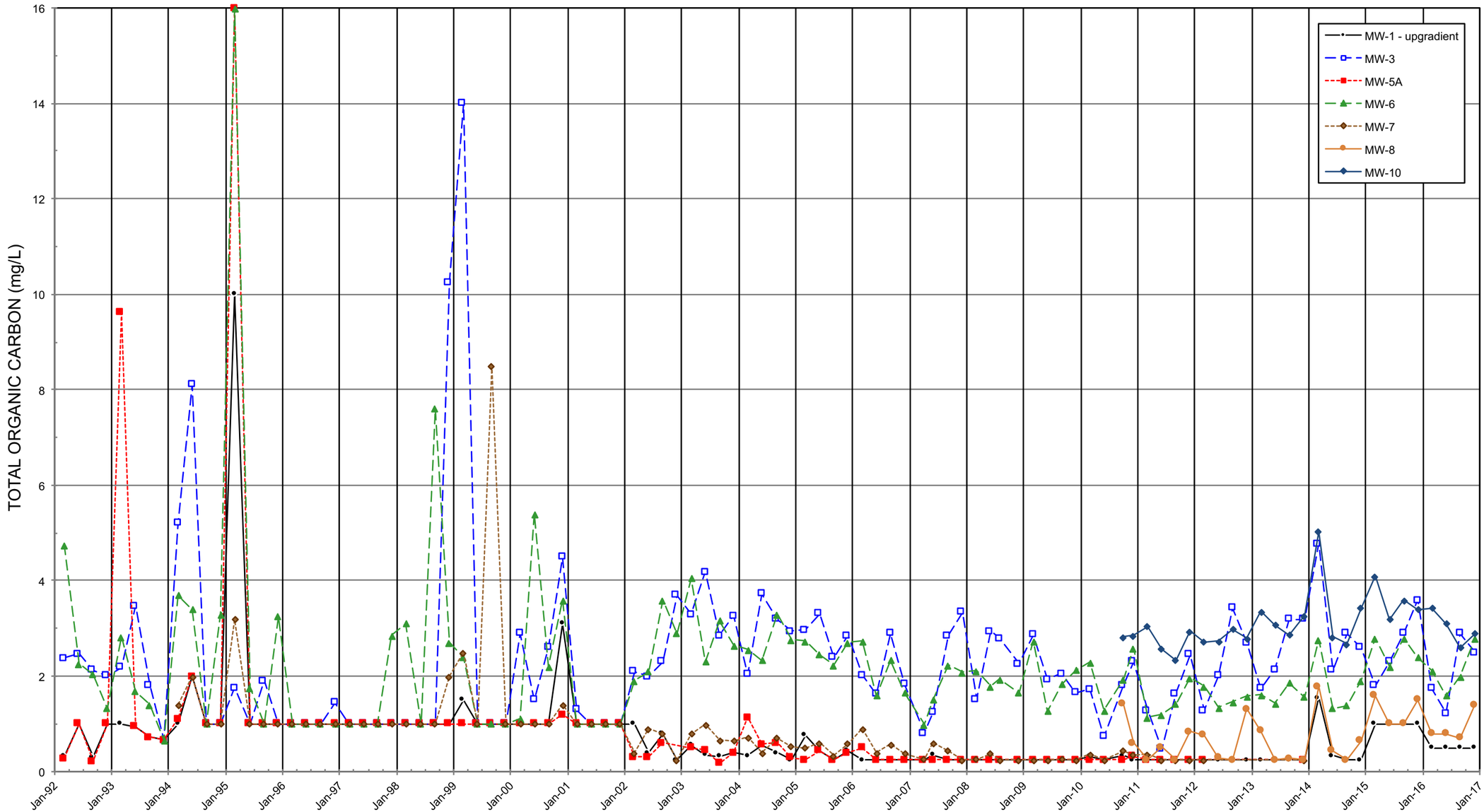


Primary Drinking Water Standard (DWS) = 1 cfu/100 mL
Primary Groundwater Standard (GWS) = 1 cfu/100 mL

DATE

TOTAL COLIFORM
(RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

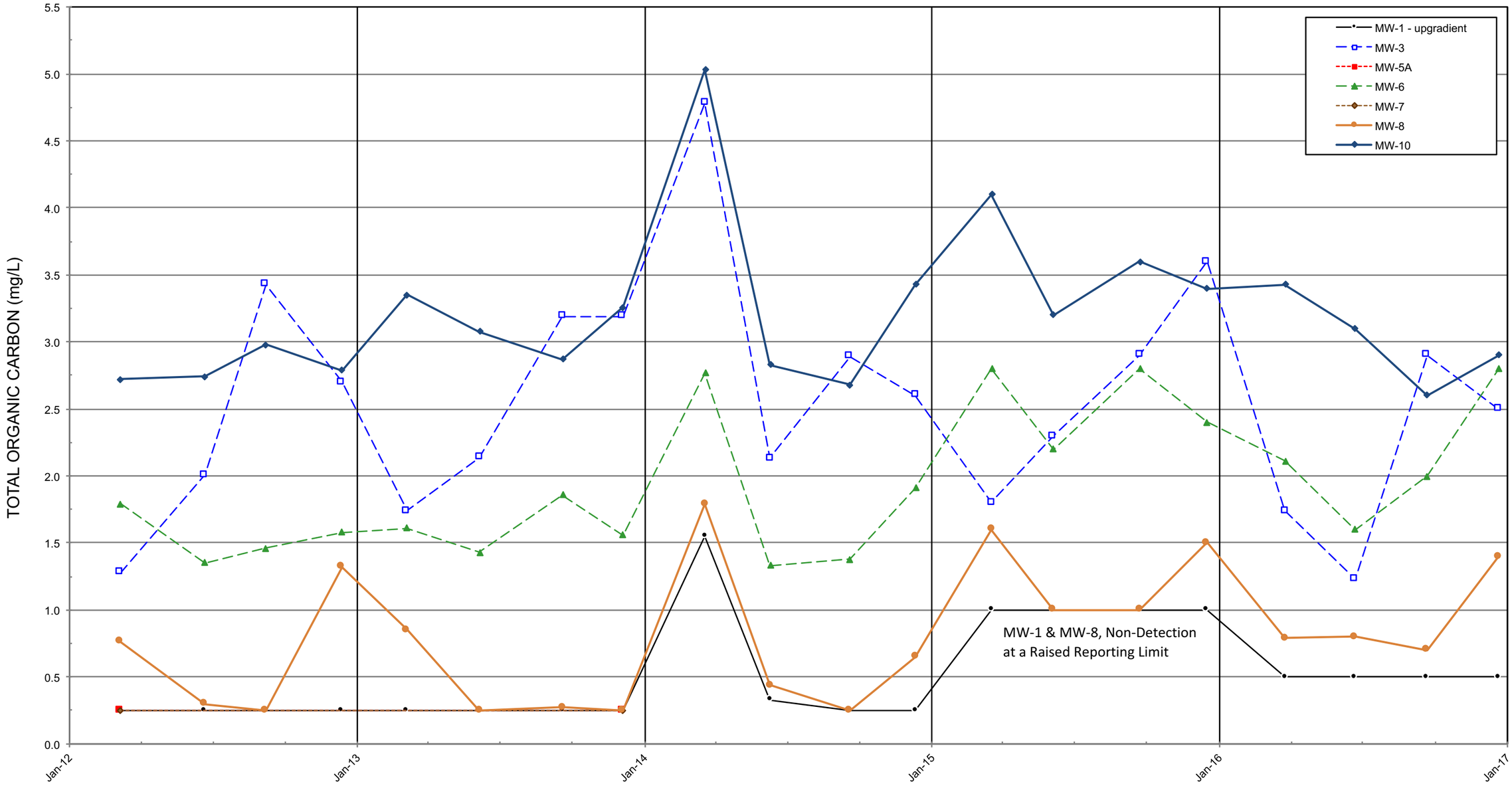


Data split (beginning 12/01) is due to a change in the Method Detection Limit
No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

TOTAL ORGANIC CARBON

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

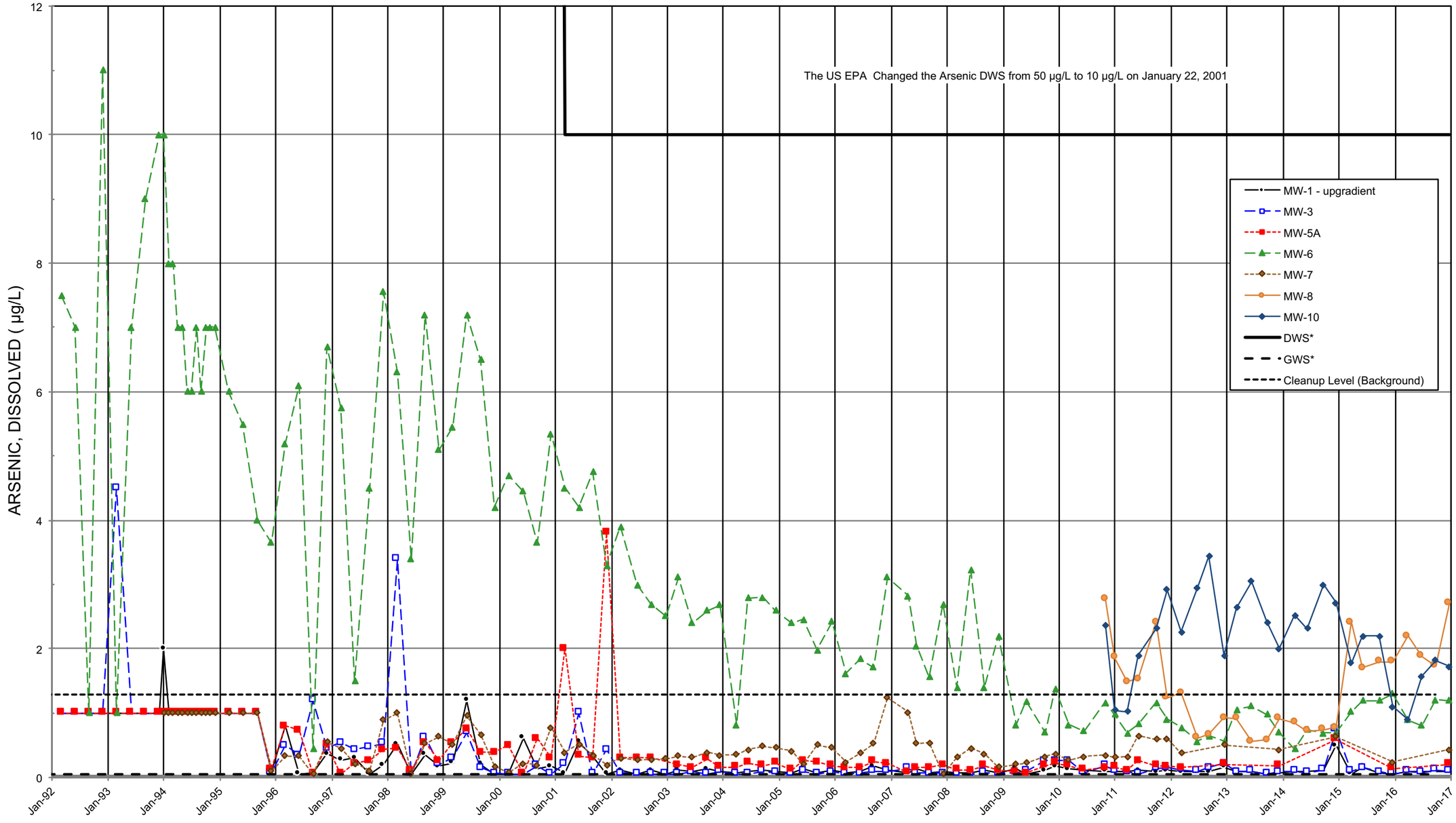


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

TOTAL ORGANIC CARBON (RECENT)

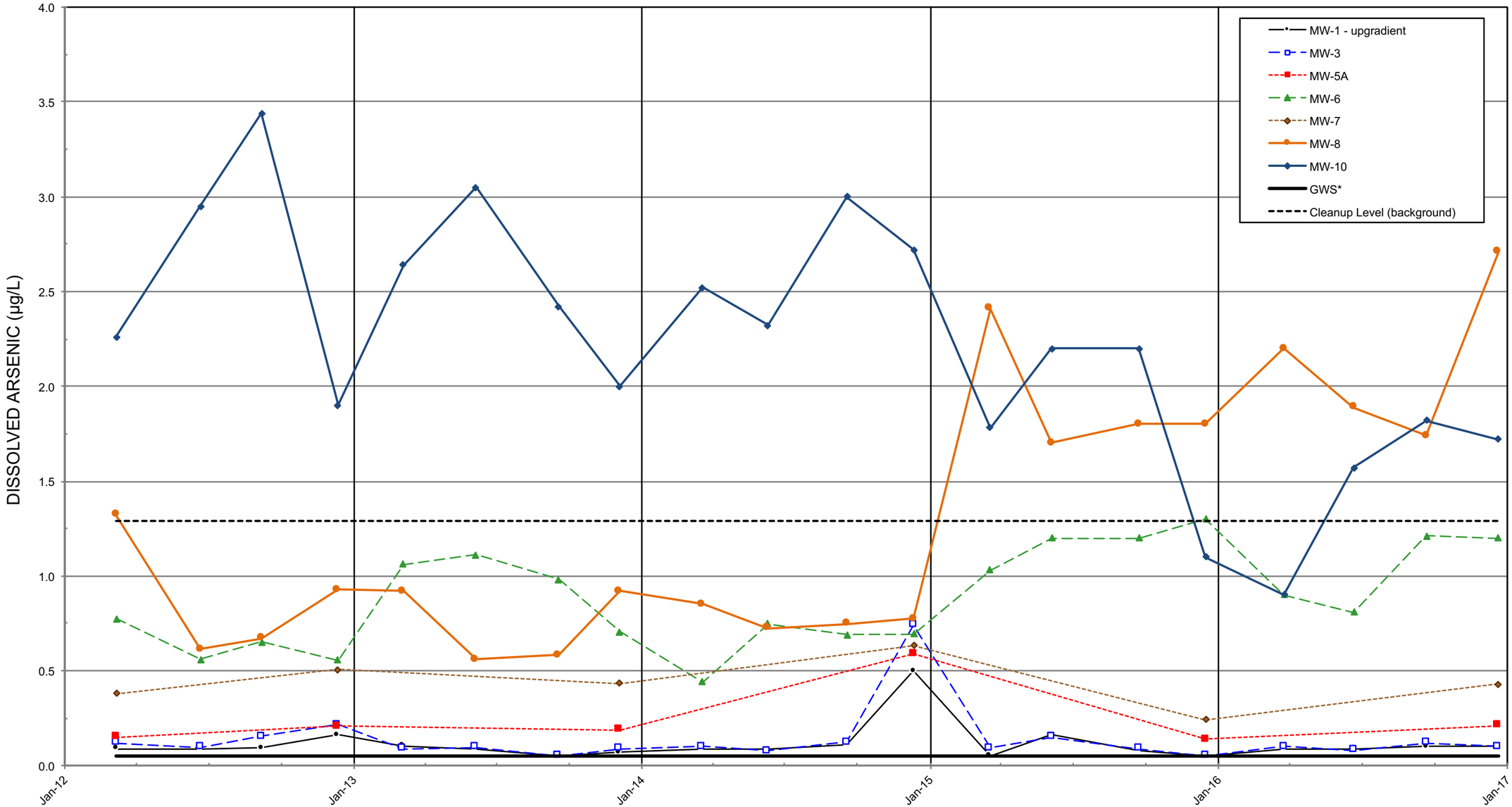
OLALLA LANDFILL
Quarterly Monitoring Data



Cleanup Level (Background) = 1.29 ug/L
Primary Drinking Water Standard (DWS) = 10 µg/L
Primary Groundwater Standard (GWS) = 0.05 µg/L

DISSOLVED ARSENIC

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

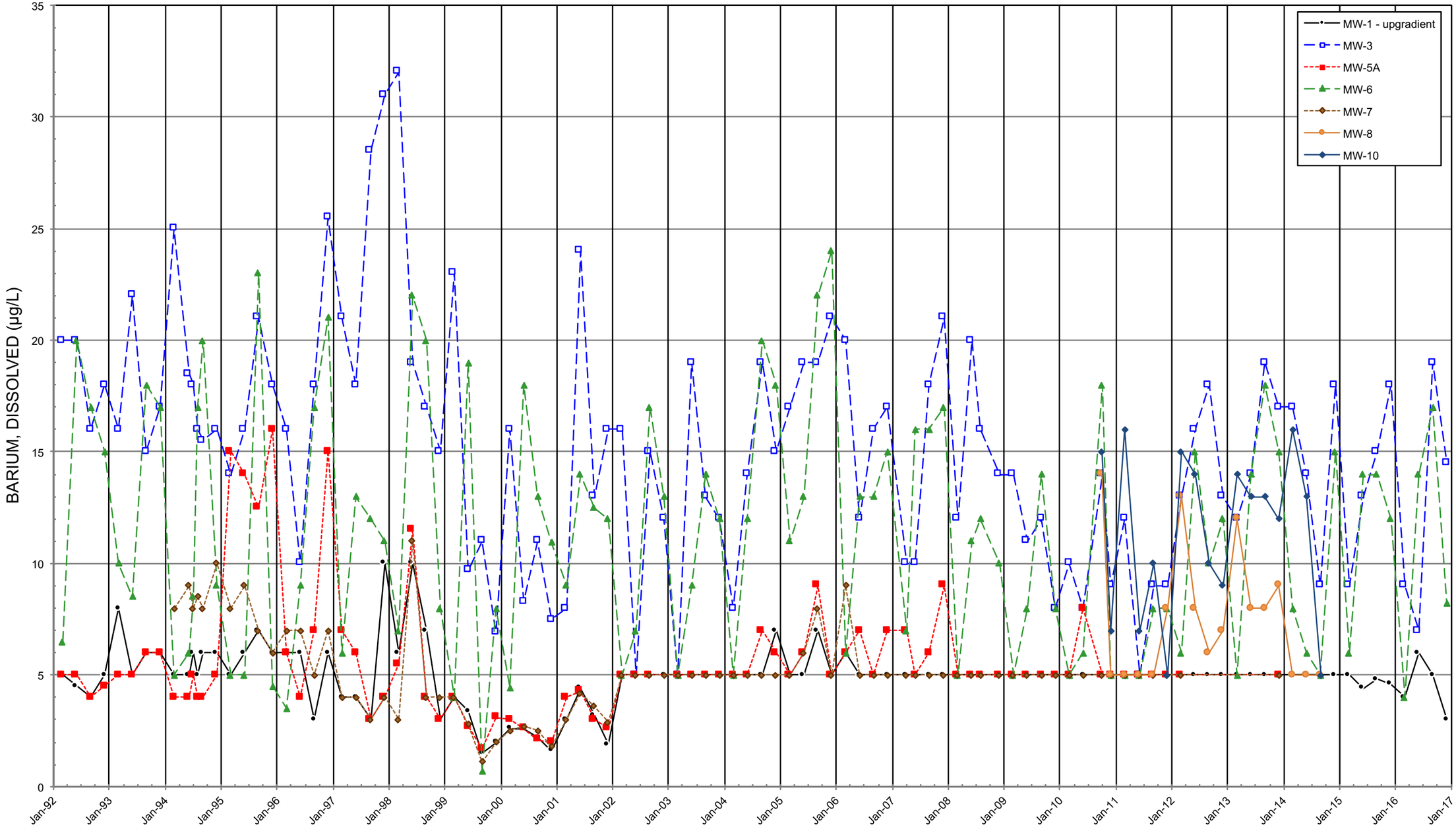


Site Specific Cleanup Level (background) = 1.29 µg/L
Primary Drinking Water Standard (DWS) = 10 µg/L (off scale)
Primary Groundwater Standard (GWS) = 0.05 µg/L

DATE

DISSOLVED ARSENIC
(RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

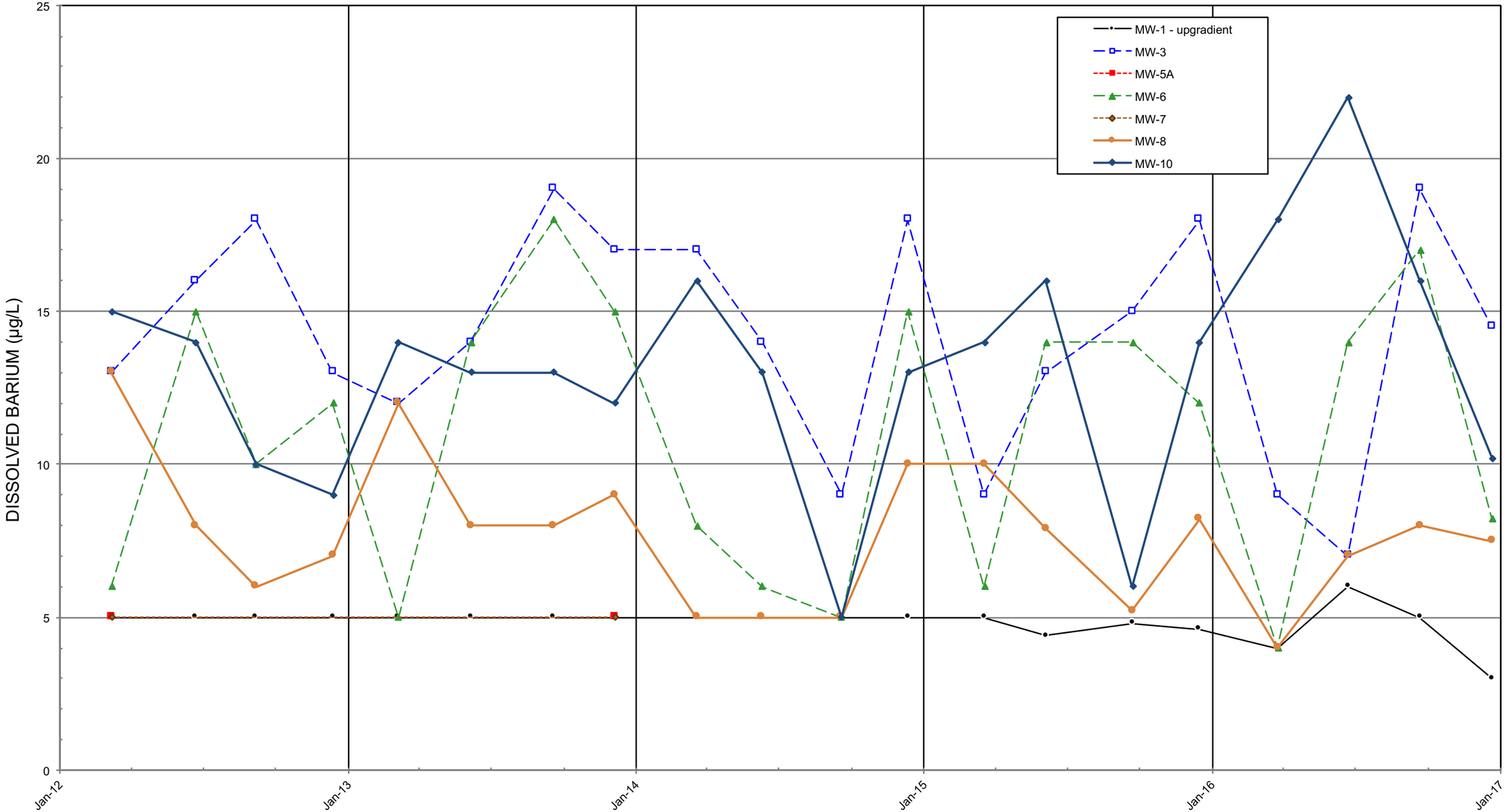


Primary Drinking Water Standard (DWS) = 2000 µg/L (off scale)
Primary Groundwater Standard (GWS) = 1000 µg/L (off scale)

DATE

DISSOLVED BARIUM

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

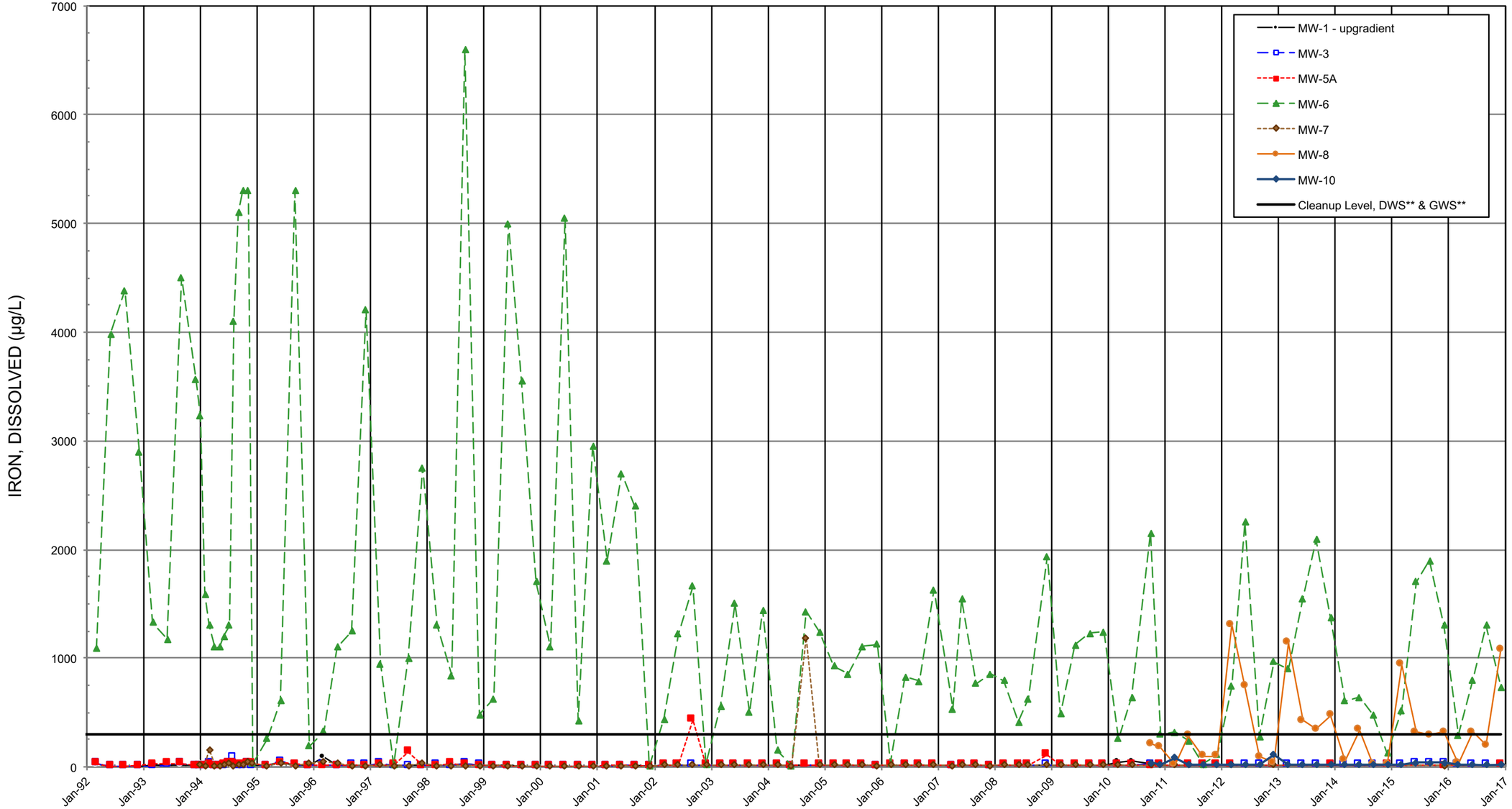


Primary Drinking Water Standard (DWS) = 2,000 µg/L (off scale)
Primary Groundwater Standard (GWS) = 1,000 µg/L (off scale)

DATE

DISSOLVED BARIUM
(RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

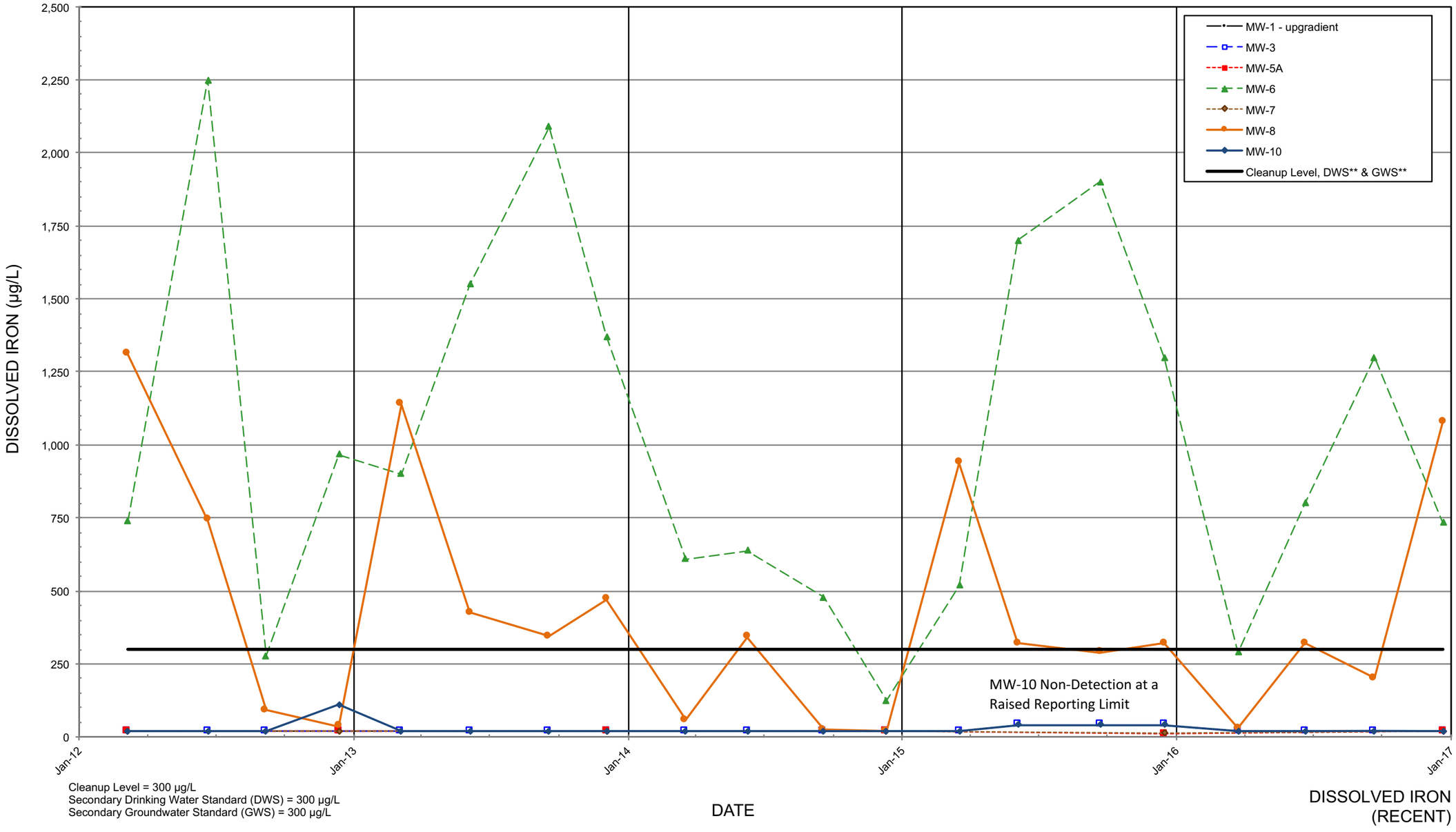


Cleanup Level = 300 µg/L
Secondary Drinking Water Standard (DWS) = 300 µg/L
Secondary Groundwater Standard (GWS) = 300 µg/L

DATE

DISSOLVED IRON

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

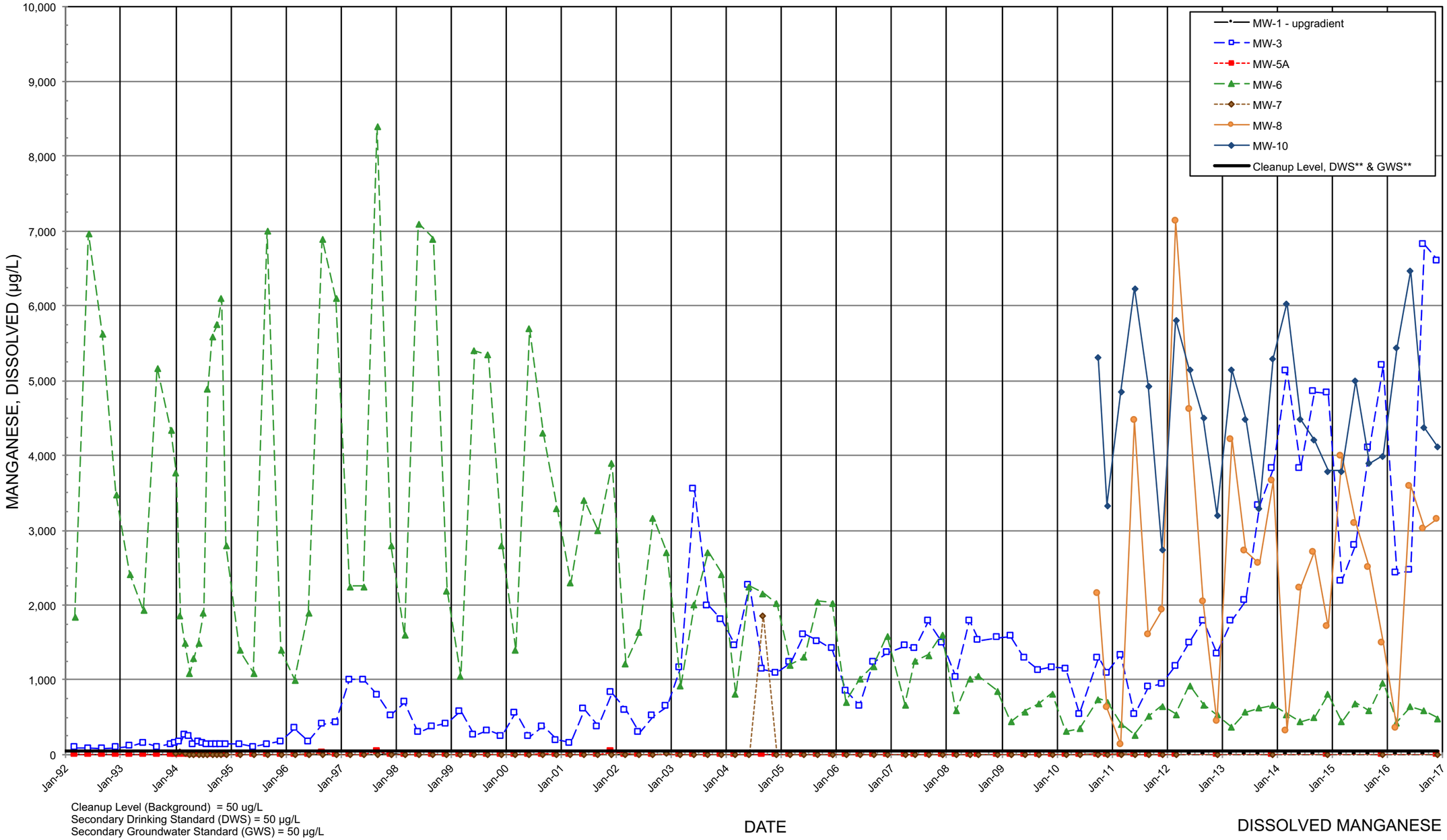


Cleanup Level = 300 µg/L
Secondary Drinking Water Standard (DWS) = 300 µg/L
Secondary Groundwater Standard (GWS) = 300 µg/L

DATE

DISSOLVED IRON (RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

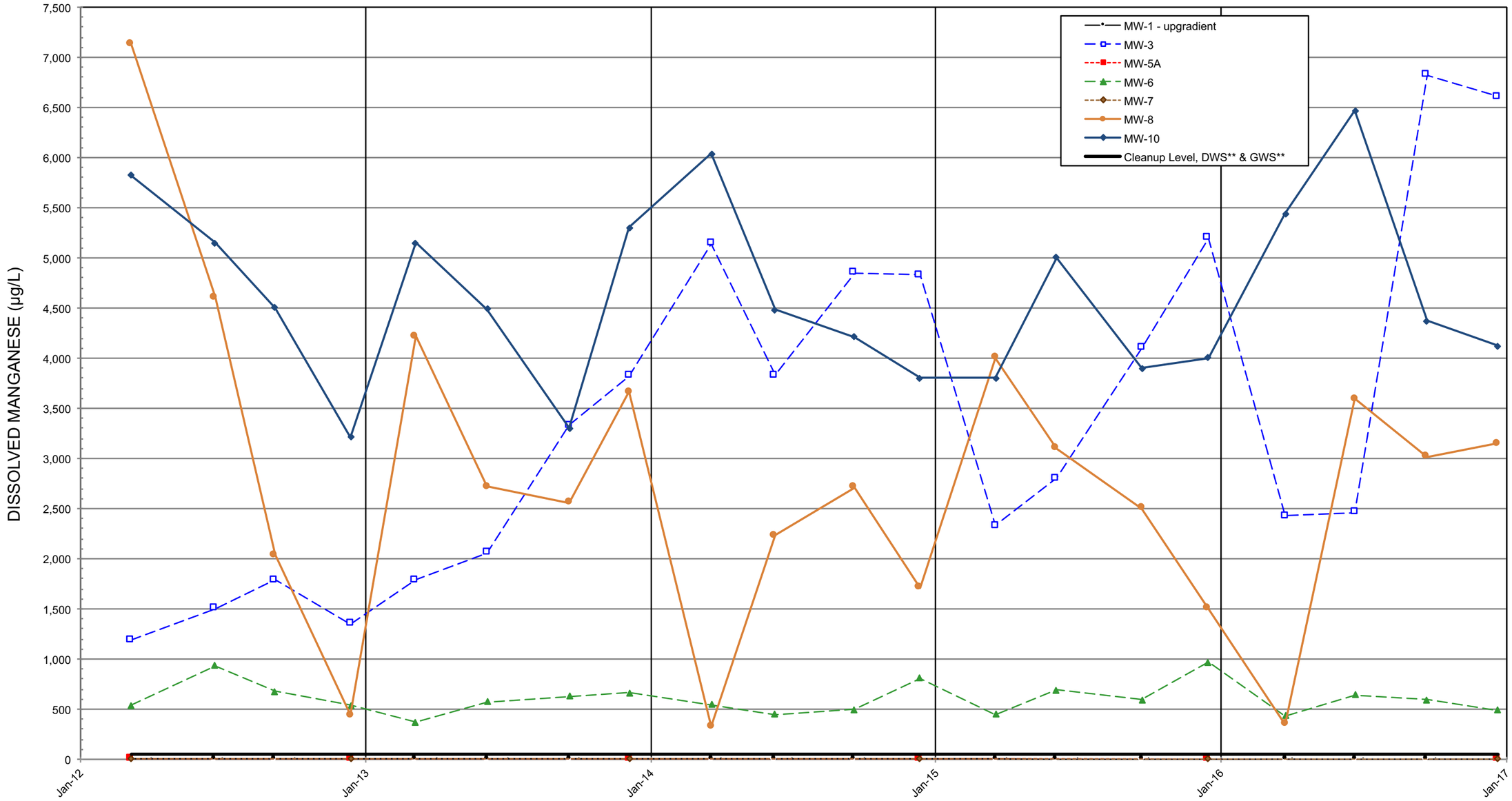


Cleanup Level (Background) = 50 ug/L
Secondary Drinking Standard (DWS) = 50 µg/L
Secondary Groundwater Standard (GWS) = 50 µg/L

DATE

DISSOLVED MANGANESE

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

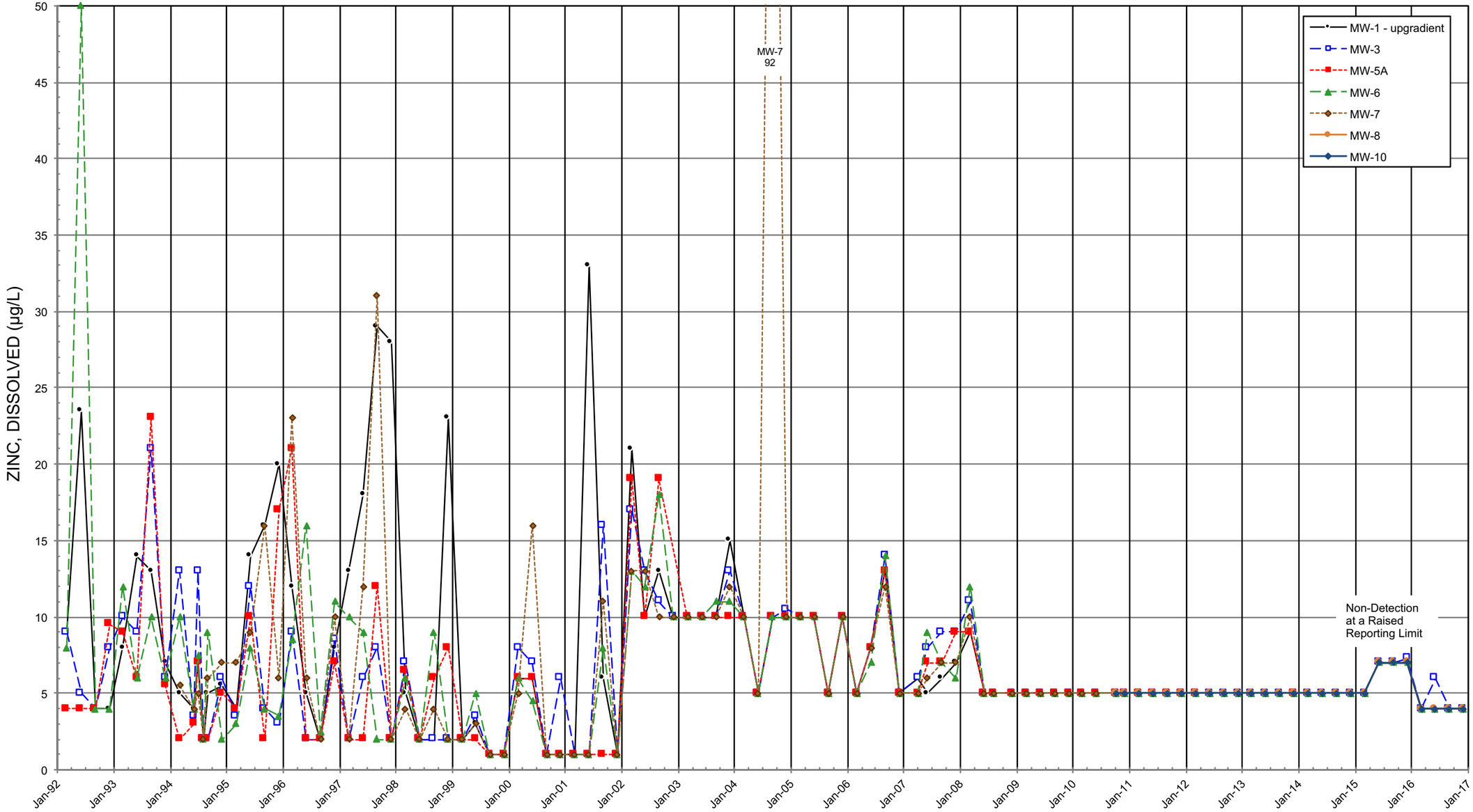


Site-specific Cleanup Level = 50 µg/L
Secondary Drinking Standard (DWS) = 50 µg/L
Secondary Groundwater Standard (GWS) = 50 µg/L

DATE

DISSOLVED MANGANESE (RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

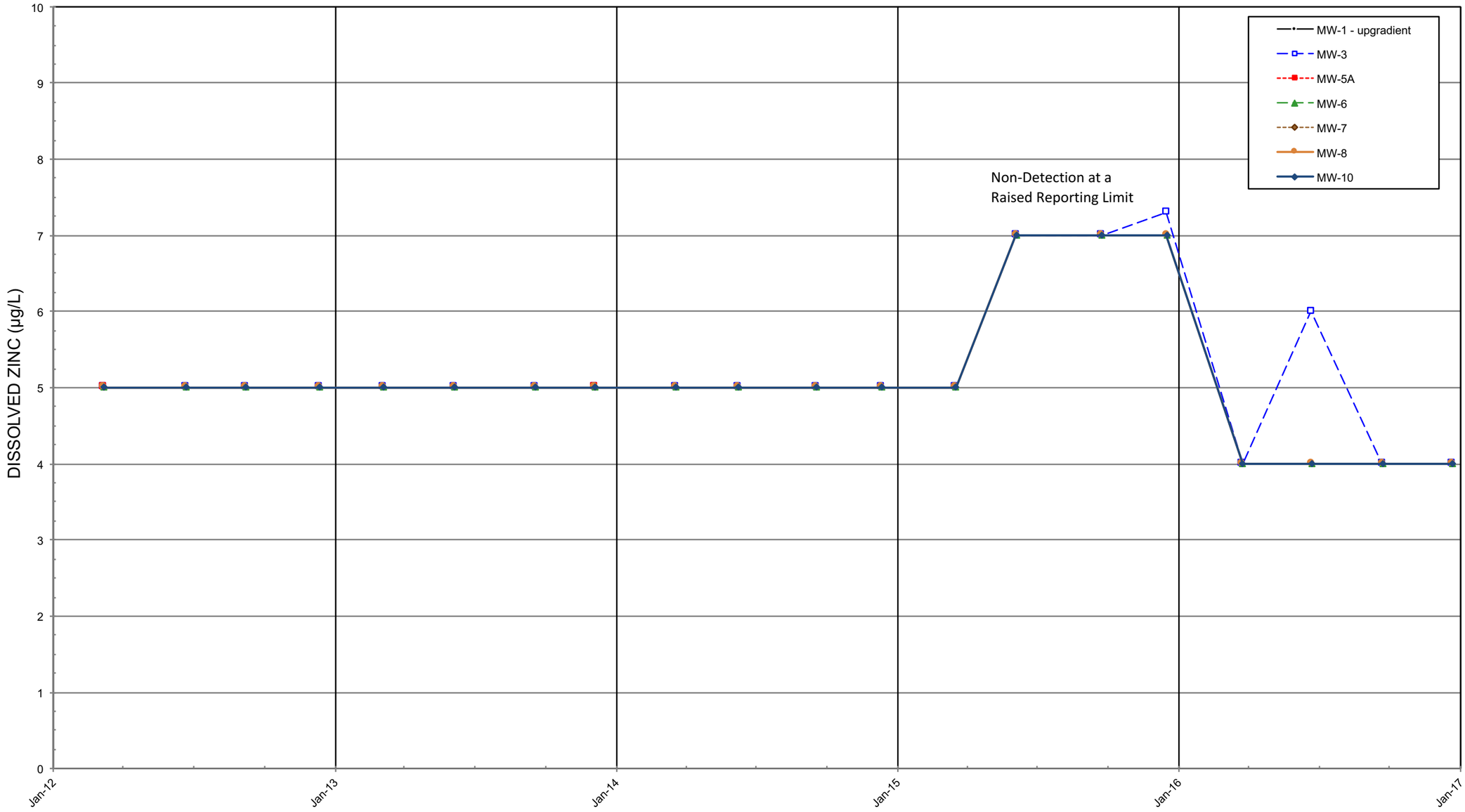


Secondary Drinking Water Standard (DWS) = 5000 µg/L (off scale)
Secondary Groundwater Standard (GWS) = 5000 µg/L (off scale)

DATE

DISSOLVED ZINC

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

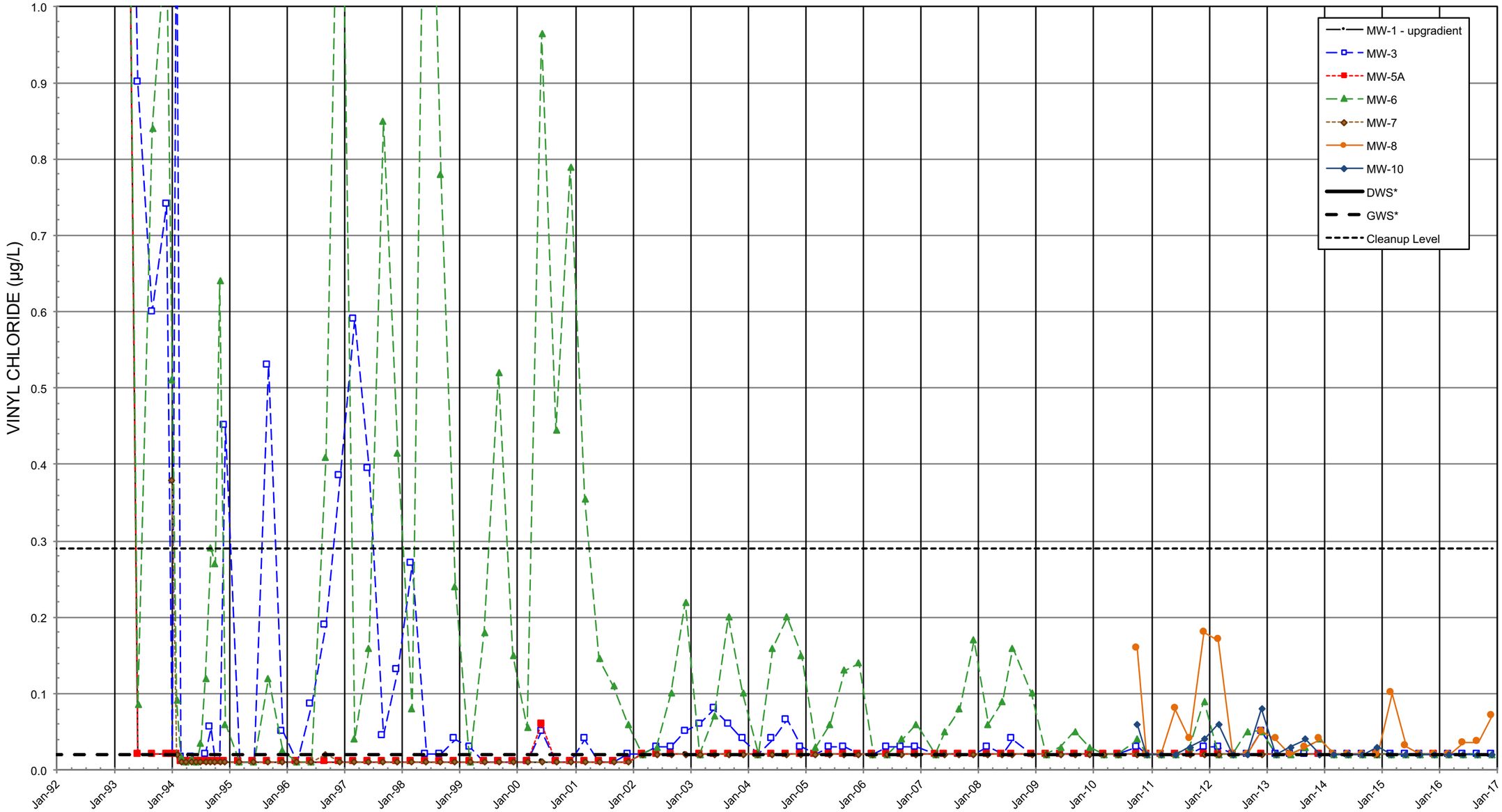


Secondary Drinking Water Standard (DWS) = 5000 µg/L (off scale)
Secondary Groundwater Standard (GWS) = 5000 µg/L (off scale)

DATE

DISSOLVED ZINC
(RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

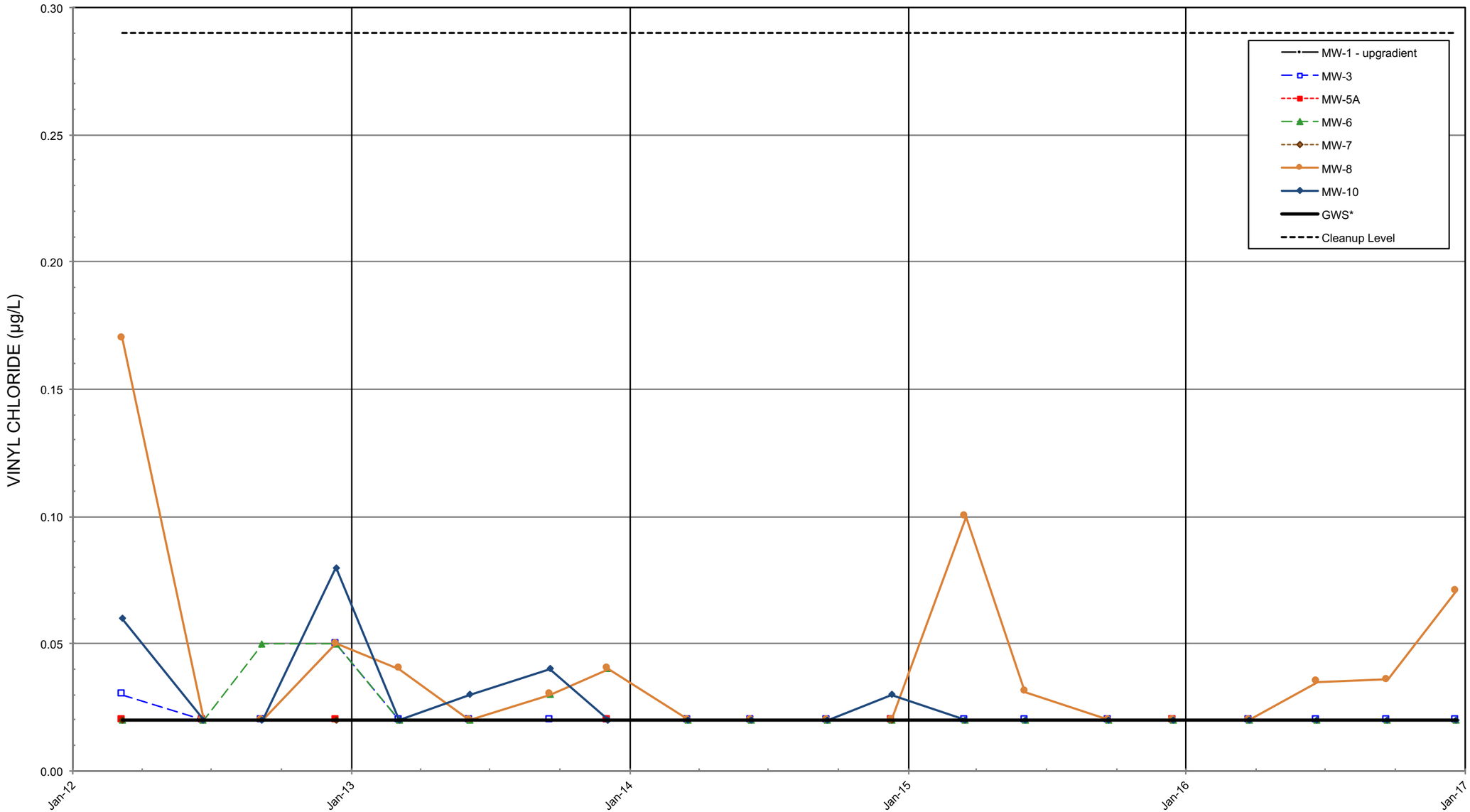


Site-Specific Cleanup Level = 0.29 ug/L
Primary Drinking Water Standard (DWS) = 2 µg/L (off scale)
Primary Groundwater Standard (GWS) = 0.02 µg/L

DATE

VINYL CHLORIDE

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)



Site-Specific Cleanup Level = 0.29 µg/L
Primary Drinking Water Standard (DWS) = 2 µg/L (off scale)
Primary Groundwater Standard (GWS) = 0.02 µg/L

DATE

VINYL CHLORIDE
(RECENT)

Appendix D:
Inspection, Maintenance, and Engineering Summary for 2016

Inspection, Maintenance, and Engineering Summary for 2016

The bulleted items below present a summary of the inspection, maintenance, and engineering tasks that were performed by SWD during 2016 at the Olalla Landfill.

- EPI conducted groundwater and landfill gas monitoring activities in all four quarters of 2016. The results are discussed in this report.

- EPI continued reporting and data analysis in accordance with Section IV of the SWHP and the CAP. The results are discussed in this report.

- SWD supported KPHD in quarterly inspections conducted at the Landfill. After the inspections, KPHD stated that no problems were noted during the inspections.

- SWD conducted regular inspections of the Landfill and its engineered systems including evaluation of the drainage systems and potential erosion areas. During 2016, all systems were operating as designed.

- SWD worked with other divisions in KCPW to maintain the systems at the Landfill including maintenance of the cap, stormwater drainage systems, and the stormwater detention pond. During 2016, routine maintenance was required including mowing of the cap and removal of vegetation.

Appendix E:
Activities Planned for 2017

Activities Planned for 2017

The bulleted items below present a summary of the planned inspections, maintenance and engineering activities planned for 2017 by SWD at the Olalla Landfill.

- Quarterly monitoring, sampling, and reporting will continue in accordance with Section IV of the SWHP and the CAP. SWD will continue to contract with EPI for monitoring and sampling activities for 2017.

- EPI will continue to conduct the reporting and data analysis in accordance with Section IV of the SWHP and the CAP.

- Regular inspections of the Landfill and its engineered systems will be conducted.

- SWD will continue to support KPHD in their quarterly inspections of the Landfill.

- SWD will continue to work with other divisions in the KCPW to maintain the systems at the Landfill including maintenance of the cap, stormwater drainage systems and the stormwater detention pond.

Attachment 1:
2016 Quarterly Monitoring Analytical Data Sheets
(Provided on attached CD ROM)