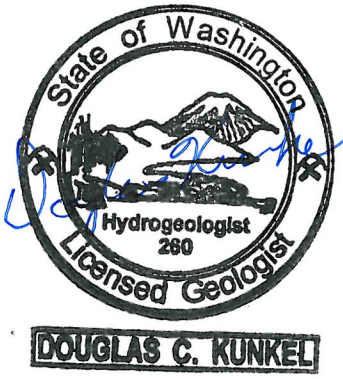
2018 ANNUAL MONITORING REPORT

OLALLA LANDFILL

KITSAP COUNTY, WASHINGTON

MARCH 2019



Prepared by

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

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Principal Hydrogeologist

WASHINGTON STATE DEPARTMENT OF ECOLOGY

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__2018_____	**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 12-20
Statistical tests	420, (2)	☒	pages 12-20
Notification of statistical increase (if applicable)	420, (4)	☒	page 20
Notification of concentrations above Chapter 173-200 WAC criteria (if any)	430, (4)	☒	page 10
Static water level readings	415, (2)	☒	Appendix A
Potentiometric surface elevation maps depicting flow direction	415, (2)	☒	Appendix A
Flow rate – calculated	415, (2)	☒	page 9
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: 2/7/19)	415, (3)	☒	N A
Complete copy of the lab report with chain of custody record.		☒	Attachment 1
***Annual Groundwater Reports**: 173-351-415 (1)* **YEAR** 2018			
Summary of statistical results and trends	415, (1)	☒	pages 12-20
Summary of groundwater flow rate and direction for the year	415, (1)	☒	page 9
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

3/11/19 — Date

Olalla — 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 preferred cleanup action, monitored natural attenuation (MNA) and land use controls, is based on a continuation of ongoing groundwater, surface water, and landfill gas 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 2018 groundwater, surface water, and landfill gas monitoring event and summarizes the results of the previous quarterly monitoring and reporting events completed at the Landfill in 2018, 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).

In addition to this Introduction, the 2018 Annual Monitoring Report consists of four main sections: 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 2018 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 2018 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 18, 2018.
- Depth-to-water measurements were performed at all on-site monitoring wells on December 18, 2018. EPI 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.
- One set of field duplicate samples was collected from monitoring well MW-10 and was given the sample identifier OL-MW-13.
- Groundwater samples were hand-delivered to Analytical Resources, Inc. in Tukwila, Washington, for sample analysis on December 19, 2018.
- 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 data 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 and in accordance with procedures documented in the CAP and CMP.

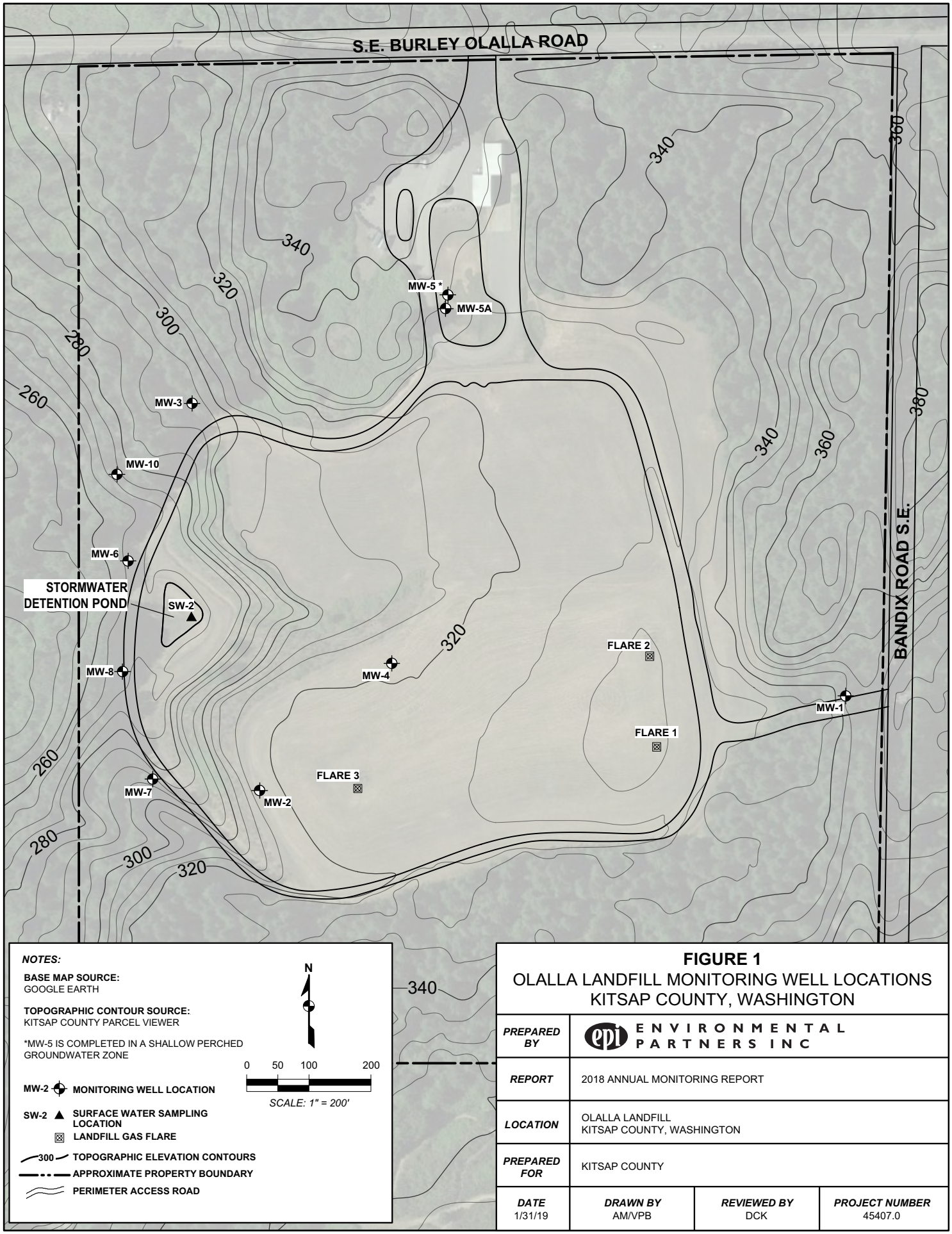


FIGURE 1
OLALLA LANDFILL MONITORING WELL LOCATIONS
KITSAP COUNTY, WASHINGTON

PREPARED BY	ENVIRONMENTAL PARTNERS INC		
REPORT	2018 ANNUAL MONITORING REPORT		
LOCATION	OLALLA LANDFILL KITSAP COUNTY, WASHINGTON		
PREPARED FOR	KITSAP COUNTY		
DATE 1/31/19	*DRAWN BY* AM/VPB	*REVIEWED BY* DCK	*PROJECT NUMBER* 45407.0

MONITORING RESULTS

Results for 2018 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 2018 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 2018 are presented in Appendix B. The laboratory analytical data reports for 2018 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 21, June 21, October 4, and December 18, 2018. Landfill gas field measurement data summary tables are included in Appendix A. Data from the four quarterly landfill gas monitoring events performed in 2018 are summarized in the following sections.

March 21, 2018 – First Quarter

- Methane was detected at concentrations of 5.5%, 7.6%, and 11.9 % by volume in Flares 1, 2, and 3, respectively. As a result, the Lower Explosive Limit (LEL) was greater than 100% for all three flares.

- Oxygen concentration measurements were 2.3%, 0.7%, and 1.6% by volume in Flares 1, 2, and 3, respectively.

- Carbon dioxide concentration measurements were 12.7%, 13.6%, and 14.2% by volume in Flares 1, 2, and 3, respectively.

- Gas pressure measurements were 0.03, 0.01, and 0.01 inches of water in Flares 1, 2, and 3, respectively.

June 21, 2018 – Second Quarter

- Methane was not detected in any of the flares. As a result, the LEL values were 0% for all three flares.

- Oxygen concentration measurements were 20.2%, 19.2%, and 19.3% by volume in Flares 1, 2, and 3, respectively.

- Carbon dioxide concentration measurements were 2.2%, 1.2%, and 1.1% by volume in Flares 1, 2, and 3, respectively.

- Gas pressure measurements were 0.01 inches of water in all three flares.

October 4, 2018 – Third Quarter

- Methane was not detected in Flares 2 and 3 but was detected at a concentration of 0.2% by volume in Flare 1. Measured LEL values were 3% for Flare 1 and 0% for Flares 2 and 3.

- Oxygen concentration measurements were 20.1%, 19.9%, and 20.2% by volume in Flares 1, 2, and 3, respectively.

- Carbon dioxide concentration measurements were 0.8%, 1.3%, and 0.0% by volume in Flares 1, 2, and 3, respectively.

- Gas pressure measurements were 0.02, 0.01, and 0.02 inches of water in Flares 1, 2, and 3, respectively.

December 18, 2018 – Fourth Quarter

- Methane was not detected in Flares 1 and 3 but was detected at a concentration of 0.1% by volume in Flare 2. Measured LEL values were 0%, 0.1%, and 0% in Flares 1, 2, and 3, respectively.

- Oxygen concentration measurements were 20.8% by volume in all three flares.

- Carbon dioxide concentration measurements were 0% by volume in all three flares.

- Pressure measurements were 0.03, 0.03, and 0.01 inches of water in Flares 1, 2, and 3, respectively.

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 2018 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 2018, 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 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.

Groundwater elevation data from 1991 through the fourth quarter of 2018 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 2018 groundwater elevation data were consistently lower than the December 2017 groundwater elevation data for all nine wells. The lower 2018 water level elevations range in magnitude from 0.94 feet lower in downgradient well MW-6 to 2.64 feet lower in upgradient well MW-1.

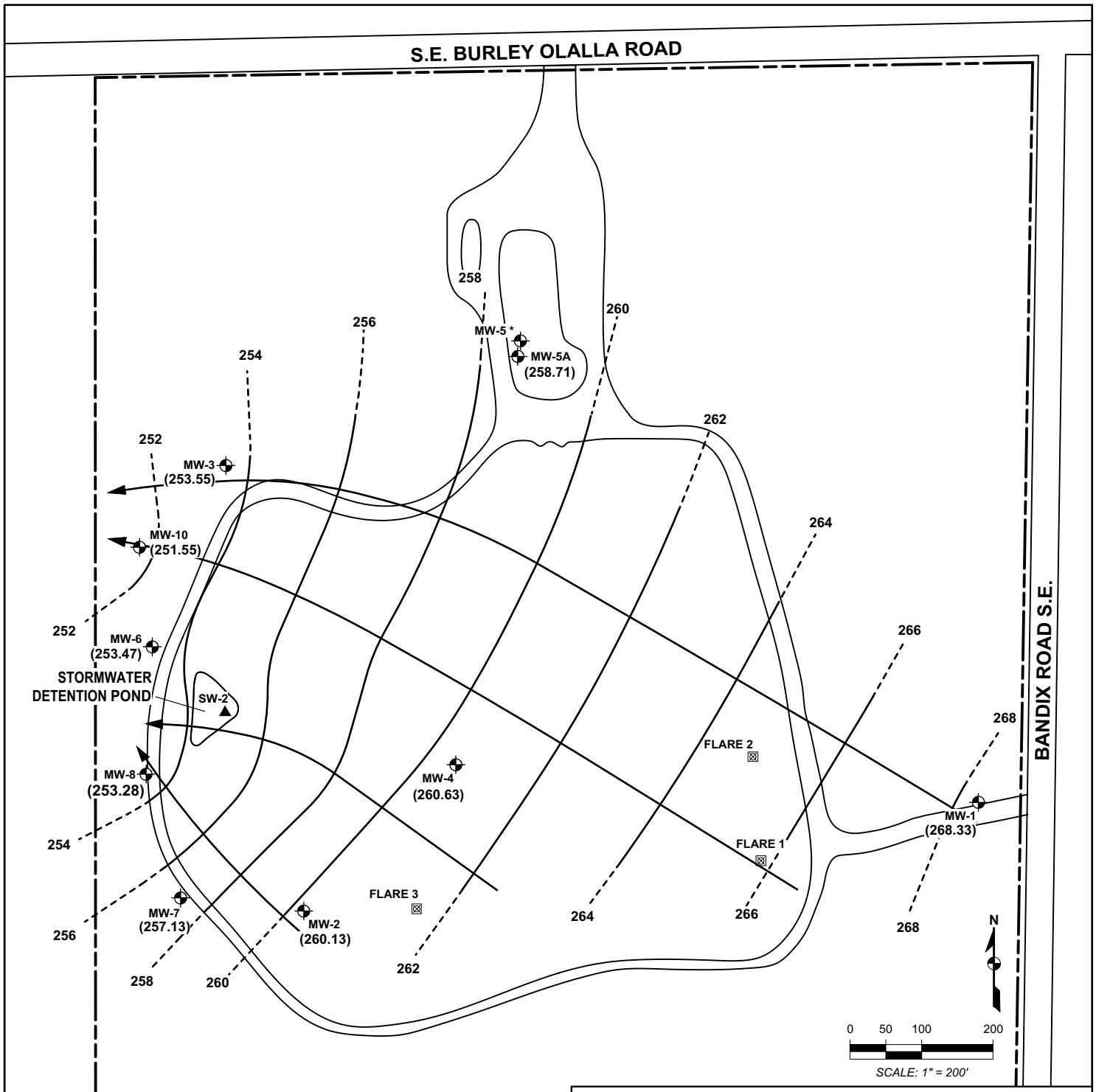
Precipitation data from the Bremerton Washington Airport Weather Station (KPWT) indicate that during the 2018 water year (November 2017 to October 2018) the area near the Landfill received 39.77 inches of precipitation, which is less than the 66.85 inches of precipitation for the 2017 water year (Weather Underground, 2019).

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)

The hydraulic conductivity "K" of the aquifer was calculated from the results of single well aquifer 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} centimeters per second (cm/sec), with a mean value of 2.2×10^{-2} cm/sec (62.4 feet/day) (Parametrix, Inc., 1988). This mean value correlates with the hydraulic conductivity values calculated using the Hazen equation for soil samples collected from the screened intervals from the boreholes for MW-8 and MW-10. Hazen equation calculated hydraulic conductivity values for soil at MW-8 and MW-10 are 1.2×10^{-2} cm/sec (34 feet/day) and 1.4×10^{-2} cm/sec (40 feet/day), respectively. The mean hydraulic conductivity value from the single well aquifer tests of 2.2×10^{-2} cm/sec is used for groundwater velocity calculations presented below.



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

GROUNDWATER ELEVATION CONTOUR

INFERRED GROUNDWATER FLOW PATH

APPROXIMATE PROPERTY BOUNDARY

PERIMETER ACCESS ROAD

FIGURE 2
OLALLA LANDFILL GROUNDWATER ELEVATION CONTOUR MAP - DECEMBER 18, 2018

PREPARED BY	ENVIRONMENTAL PARTNERS INC		
REPORT	2018 ANNUAL MONITORING REPORT		
LOCATION	OLALLA LANDFILL KITSAP COUNTY, WASHINGTON		
PREPARED FOR	KITSAP COUNTY		
DATE 1/31/19	***DRAWN BY*** VPB	***REVIEWED BY*** DCK	***PROJECT NUMBER*** 45407.0

The hydraulic gradients "I" of the aquifer for each monitoring event are calculated from quarterly groundwater elevation contour maps presented in Appendix A. Average hydraulic gradients calculated for the four 2018 quarterly events at the Landfill range from 0.0154 in March to 0.0165 in October and December. 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 2018 quarterly data range from 2.40 ft./day in March to 2.57 ft./day in October and December. The calculated groundwater gradients and flow velocities are summarized in Table 1.

Table 1
2018 Olalla Landfill Calculated Groundwater Flow Velocities

Measurement Date	Calculated Hydraulic Gradient, (L/L)	Calculated Groundwater Flow Velocity (feet/day)
March 21, 2018	0.0154	2.40
June 21, 2018	0.0159	2.48
October 4, 2018	0.0165	2.57
December 18, 2018	0.0165	2.57

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 enough water for a sample. Surface water station SW-2 had enough water flow to sample during the December 18, 2018 sampling event due to rain in the days preceding the sampling event and a surface water sample was collected and analyzed from station SW-2. 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 on 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 the four quarterly events of 2018 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
2018 Water Quality Constituent Concentrations
Exceeding Washington State Primary Standards

Constituent	Drinking Water Standards[a]	Groundwater Quality Standards[b]	Site-Specific CUL[c]	March	June	October	December
MW-1 (upgradient)							
Arsenic	10 µg/L	0.05 µg/L	1.29 µg/L	0.10	0.12	0.11	0.11
MW-3 (downgradient)							
Arsenic	10 µg/L	0.05 µg/L	1.29 µg/L	0.11	0.14	0.11	0.13
Arsenic FD	10 µg/L	0.05 µg/L	1.29 µg/L	0.12	NA	NA	NA
MW-5A (cross-gradient)							
Arsenic	10 µg/L	0.05 µg/L	1.29 µg/L	NA	NA	NA	0.20
MW-6 (downgradient)							
Arsenic	10 µg/L	0.05 µg/L	1.29 µg/L	1.08	1.33	1.57	1.14
Arsenic FD	10 µg/L	0.05 µg/L	1.29 µg/L	NA	1.29	NA	NA
Vinyl Chloride	2 µg/L	0.02 µg/L	0.29 µg/L	--	0.03	0.03	0.03
Vinyl Chloride FD	2 µg/L	0.02 µg/L	0.29 µg/L	NA	0.03	NA	NA
MW-7 (cross-gradient)							
Arsenic	10 µg/L	0.05 µg/L	1.29 µg/L	NA	NA	NA	0.31
MW-8 (downgradient)							
Arsenic	10 µg/L	0.05 µg/L	1.29 µg/L	1.78	2.14	1.06	1.99
Arsenic FD	10 µg/L	0.05 µg/L	1.29 µg/L	NA	NA	1.02	NA
Vinyl Chloride	2 µg/L	0.02 µg/L	0.29 µg/L	0.10	0.04	--	0.06
Vinyl Chloride FD	2 µg/L	0.02 µg/L	0.29 µg/L	NA	NA	--	NA
MW-10 (downgradient)							
Arsenic	10 µg/L	0.05 µg/L	1.29 µg/L	1.73	1.68	1.67	1.98
Arsenic FD	10 µg/L	0.05 µg/L	1.29 µg/L	NA	NA	NA	2.02
Vinyl Chloride	2 µg/L	0.02 µg/L	0.29 µg/L	--	--	--	0.03
Vinyl Chloride FD	2 µg/L	0.02 µg/L	0.29 µg/L	NA	NA	NA	0.03

Notes:
Values are reported in the same units as the regulatory standards.
µg/L = Micrograms per liter.
FD = Field Duplicate
NA = Not Applicable or Not Analyzed per the SWHP
-- = Analyzed with no regulatory exceedance
[a] WAC 246-290-310
[b] WAC 173-200-040
[c] Site-Specific Cleanup Level

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
2018 Water Quality Constituent Concentrations
Exceeding Washington State Secondary Standards

Constituent	Drinking Water Standards[a]	Groundwater Quality Standards[b]	March	June	October	December
MW-1 (upgradient)						
pH (field)	NA	6.5 – 8.5	--	5.8	--	--
pH (lab)	NA	6.5 – 8.5	6.2	6.3	6.0	6.3
MW-3 (downgradient)						
Manganese	50 µg/L	50 µg/L	8,840	8,090	6,240	7,120
Manganese FD	50 µg/L	50 µg/L	8,850	NA	NA	NA
pH (field)	NA	6.5 – 8.5	6.1	6.1	6.3	6.3
pH (lab)	NA	6.5 – 8.5	6.1	6.4	6.1	6.3
pH (lab) FD	NA	6.5 – 8.5	6.1	NA	NA	NA
MW-5A (cross-gradient)						
NA	NA	NA	NA	NA	NA	--
MW-6 (downgradient)						
Iron	300 µg/L	300 µg/L	865	1,010	1,440	848
Iron FD	300 µg/L	300 µg/L	NA	1,040	NA	NA
Manganese	50 µg/L	50 µg/L	914	978	1,110	809
Manganese FD	50 µg/L	50 µg/L	NA	853	NA	NA
pH (field)	NA	6.5 – 8.5	--	6.4	--	--
pH (lab)	NA	6.5 – 8.5	--	--	6.4	--
MW-7 (cross-gradient)						
			NA	NA	NA	--
MW-8 (downgradient)						
Iron	300 µg/L	300 µg/L	1,340	799	--	727
Iron FD	300 µg/L	300 µg/L	NA	NA	--	NA
Manganese	50 µg/L	50 µg/L	3,700	2,350	2,680	2,870
Manganese FD	50 µg/L	50 µg/L	NA	NA	2,630	NA
pH (field)	NA	6.5 – 8.5	--	6.2	--	6.4
pH (lab)	NA	6.5 – 8.5	--	--	6.3	--
pH (lab) FD	NA	6.5 – 8.5	--	--	6.3	--
MW-10 (downgradient)						
Manganese	50 µg/L	50 µg/L	4,730	3,730	4,870	5,300
Manganese FD	50 µg/L	50 µg/L	NA	NA	NA	5,360
pH (field)	NA	6.5 – 8.5	--	6.4	--	--

Notes:
Values are reported in the same units as the regulatory standards
FD = Field Duplicate
NA = Not Applicable or Not Analyzed per the SWHP
-- = Analyzed with no regulatory exceedance
[a] WAC 246-290-310 and Site-Specific Cleanup Level
[b] WAC 173-200-040

STATISTICAL ANALYSIS

SWD and 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).

Statistical analysis of groundwater data for the Landfill uses four tools: time-series plots, Mann-Kendall test for trend, Shapiro-Wilk test for normality, and confidence intervals (parametric and non-parametric). Application of these tools is based on statistical methods identified in the Unified Guidance and is documented in the CAP. These four statistical tools, along with non-statistical data 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. Wells MW-5A and MW-7 are on an annual sampling schedule and SWD has defined the window of data used for the Mann-Kendall, Shapiro-Wilk and 95% Confidence Interval statistical analyses as 20 sampling events rather than five years of data. The moving window of 20 sampling events provides enough 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, volatile organic compounds (VOCs), conventional water quality parameters, and field parameters required for groundwater analysis under the current Section IV.D.2 Solid Waste Handling Permit for Olalla Landfill are presented in time-series plots (Appendix C), and tables showing summary results of the Mann-Kendall trend test, Shapiro-Wilk test for normality, and 95% confidence intervals.

- Statistical tests are not automatically performed for every constituent or parameter measured. Some constituents have not been detected in samples collected during the past five years (20 events) or do not have enough detections to support one or more of the statistical analysis. Data sets that are all non-detects, or do not have enough detections, are temporarily dropped from the specific statistical evaluations that are not amenable to those data sets.

- VOC and metals detections include values at concentrations less than laboratory specified reporting limits (i.e., J-qualified), 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 that are analyzed annual in samples from these two wells.

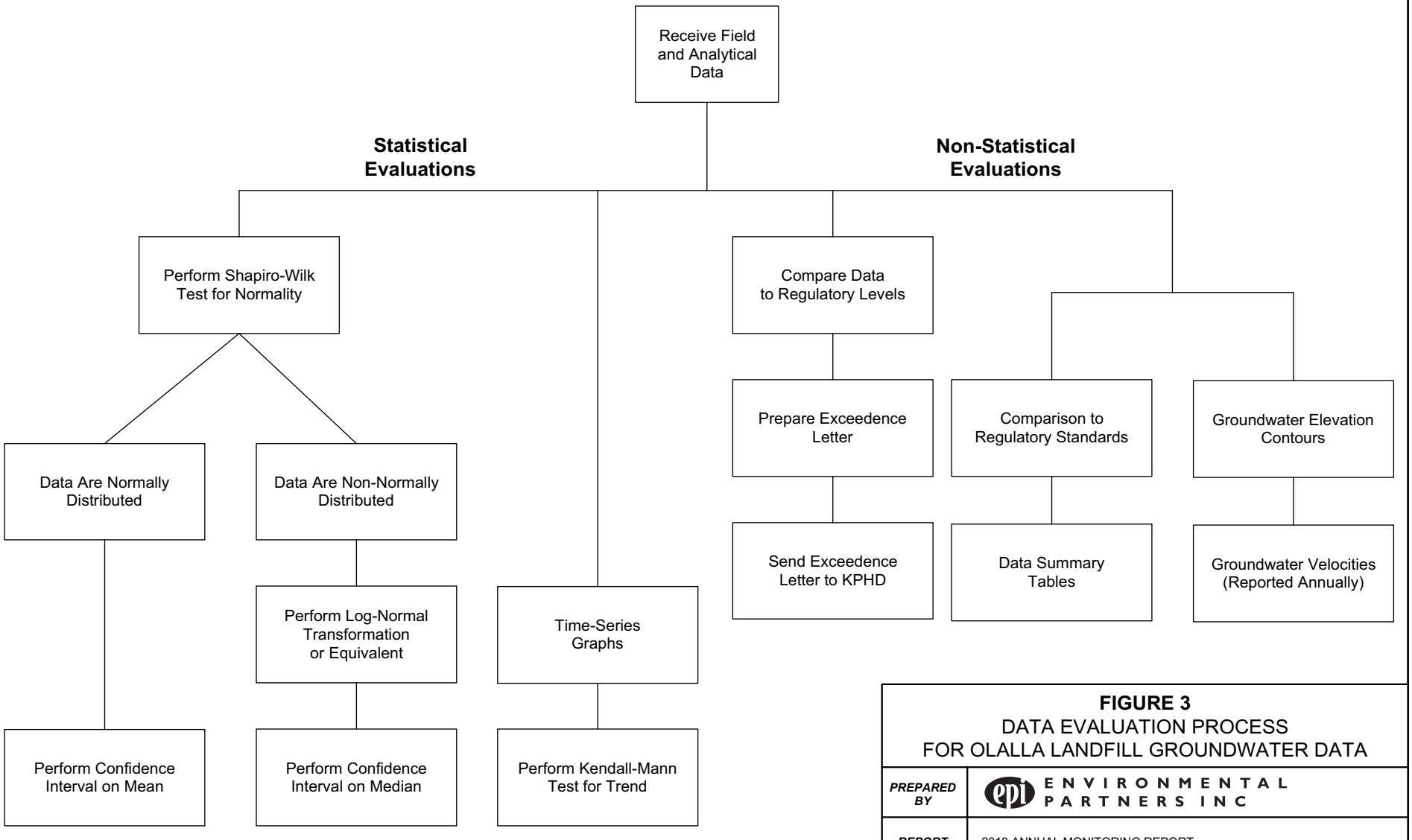


FIGURE 3
DATA EVALUATION PROCESS
FOR OLALLA LANDFILL GROUNDWATER DATA

PREPARED BY	epi ENVIRONMENTAL PARTNERS INC		
REPORT	2018 ANNUAL MONITORING REPORT		
LOCATION	OLALLA LANDFILL KITSAP COUNTY, WASHINGTON		
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DATE 1/31/19	***DRAWN BY*** VPB	***REVIEWED BY*** DCK	***PROJECT NUMBER*** 45407.0

- 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. 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. The SWD assigns a value of zero to non-detected results as recommended by the USGS and KPHD. J-qualified analytical results are reported as individual detected values as recommended by the USGS guidance.

The following subsections briefly describe the tools used in the statistical evaluation and summarize analytical results for 2018.

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 were installed in 2010, their data sets are smaller than 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 2018 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 2018 are presented in Appendix C.

As described in the 2016-2020 SWHP, cross-gradient wells MW-5A and MW-7 are sampled annually, during the fourth quarter, for a reduced list of constituents relative to the other Olalla Landfill monitoring wells.

- Fourteen (14) well-constituent combinations have statistically significant downward concentration trends. The 14 downward well-constituent combination trends are:
    - Arsenic: MW-10
    - Calcium: MW-1
    - Chloride: MW1 and MW-3
    - Dissolved Oxygen: MW-3 and MW-8
    - Nitrite: MW-1 and MW-8
    - pH (laboratory): MW-1, MW-6, and MW-8
    - Sodium: MW-1
    - Specific Conductance: MW-1
    - Temperature: MW-6
- Two (2) of the 14 well-constituent combinations with statistically significant downward concentration trends also have regulatory standard exceedances in December 2018 data. The two well-constituent combinations are arsenic at MW-10 and pH (laboratory) at MW-1.
- Thirty-one (31) well-constituent combinations have statistically significant upward concentration trends. The 31 upward well-constituent combination trends are:
    - Ammonia: MW-10
    - Arsenic: MW-1, MW-6, and MW-8
    - Bicarbonate: MW-3, MW-8, and MW-10
    - Calcium: MW-8
    - Chloride: MW-6 and MW-8
    - Dissolved Oxygen: MW-1
    - Iron: MW-8 and MW-10
    - Manganese: MW-3 and MW-6
    - Nitrate: MW-1
    - Oxidation Reduction Potential: MW-1, MW-3, and MW-7
    - pH (field): MW-5A
    - Potassium: MW-3, MW-8, and MW-10
    - Sodium: MW-3 and MW-8
    - Specific Conductance: MW-6 and MW-8
    - Sulfate: MW-8
    - Vinyl Chloride: MW-6, MW-8, and MW-10

Table 4
December 2018 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	**UP**
Arsenic - Dissolved	**UP**	NO TREND	NO TREND	**UP**	NO TREND	**UP**	**DOWN**
Barium - Dissolved	NO TREND	NO TREND	NA	NO TREND	NA	NO TREND	NO TREND
Bicarbonate	NO TREND	**UP**	NA	NO TREND	NA	**UP**	**UP**
Calcium	**DOWN**	NO TREND	NA	NO TREND	NA	**UP**	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	**DOWN**	**DOWN**	NA	**UP**	NA	**UP**	NO TREND
Dissolved Oxygen	**UP**	**DOWN**	NO TREND	NO TREND	NA	**DOWN**	NO TREND
Iron - Dissolved	NO TREND	NO TREND	NO TREND	NO TREND	NO TREND	**UP**	**UP**
Manganese - Dissolved	NO TREND	**UP**	NO TREND	**UP**	NO TREND	NO TREND	NO TREND
Nitrate	**UP**	NO TREND	NA	NO TREND	NA	NO TREND	NO TREND
Nitrite	**DOWN**	NO TREND	NA	NO TREND	NA	**DOWN**	NO TREND
Oxidation Reduction Potential	**UP**	**UP**	NO TREND	NO TREND	**UP**	NO TREND	NO TREND
pH - Field	NO TREND	NO TREND	**UP**	NO TREND	NO TREND	NO TREND	NO TREND
pH - Laboratory	**DOWN**	NO TREND	NO TREND	**DOWN**	NO TREND	**DOWN**	NO TREND
Potassium	NO TREND	**UP**	NA	NO TREND	NA	**UP**	**UP**
Sodium	**DOWN**	**UP**	NA	NO TREND	NA	**UP**	NO TREND
Specific Conductance	**DOWN**	NO TREND	NO TREND	**UP**	NO TREND	**UP**	NO TREND
Sulfate	NO TREND	NO TREND	NA	NO TREND	NA	**UP**	NO TREND
Temperature	NO TREND	NO TREND	NO TREND	**DOWN**	NO TREND	NO TREND	NO TREND
Total Coliform	NO TREND	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	**UP**	NO TREND	**UP**	**UP**
Zinc - Dissolved	NO TREND	NO TREND	NA	NO TREND	NA	NO TREND	NO TREND

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

- Nine (9) of the 31 well-constituent combinations with statistically significant upward concentration trends also have regulatory standard exceedances in December 2018 data. The nine well-constituent combinations with currently regulatory exceedances are:
    - Arsenic: MW-1, MW-6, and MW-8
    - Iron: MW-8
    - Manganese: MW-3 and MW-6
    - Vinyl Chloride: MW-6, MW-8, and MW-10

- There are 130 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 130 well-constituent combinations with no statistically significant trends samples from the wells listed in the following nine (9) well-constituent combinations exceed regulatory levels.
    - Arsenic: MW-3, MW-5A, and MW-7
    - Iron: MW-6
    - Manganese: MW-8 and MW-10
    - pH (field): MW-3 and MW-8
    - pH (laboratory): MW-3

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 2018 monitoring event are summarized in Table 5 and in the following bullets. Shapiro-Wilk result summary tables for all four quarters of 2018 are presented in Appendix C.

As described in the Mann-Kendall Trend Test section, MW-5A and MW-7 are sampled 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 and 62 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 67 of the 113 well-constituent combinations that were tested for normality.

- Non-normal data distributions were noted in 46 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 2018 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	ND	NA	Non-normal	NA	Non-normal	Non-normal
Arsenic - Dissolved	Non-normal	Non-normal	Non-normal	Normal	Normal	Normal	Normal
Barium - Dissolved	Non-normal	Normal	NA	Normal	NA	Normal	Normal
Bicarbonate	Normal	Normal	NA	Normal	NA	Normal	Normal
Calcium	Normal	Non-normal	NA	Normal	NA	Normal	Normal
Carbonate	ND	ND	NA	ND	NA	ND	ND
COD	ND	Non-normal	NA	ND	NA	ND	Non-Normal
Chloride	Normal	Non-normal	NA	Non-normal	NA	Normal	Normal
Dissolved Oxygen	Normal	Non-normal	Normal	Non-normal	Normal	Normal	Non-normal
Iron - Dissolved	ND	ND	ND	Normal	ND	Non-normal	Non-normal
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	Normal	Non-normal	Normal	Non-normal	Non-normal	Non-normal	Non-normal
pH - Field	Non-normal	Normal	Normal	Non-normal	Normal	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	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Sulfate	Normal	Normal	NA	Non-normal	NA	Normal	Non-normal
Temperature	Non-normal	Normal	Normal	Normal	Normal	Normal	Non-normal
Total Coliform	ND	ND	NA	ND	NA	ND	ND
TOC	ND	Normal	NA	Normal	NA	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.

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

Confidence intervals for December 2018 are compared to Washington State Drinking Water and Groundwater Quality Standards and also to site-specific cleanup levels for arsenic and vinyl chloride only. The results of these comparisons are summarized in Table 6. Confidence interval summaries for all four quarters of 2018 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:

- Seventy-three (73) 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 were not analyzed in samples from 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 109 well-constituent combinations.

- Ninety-six (96) 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.

- Thirteen (13) 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-6, MW-7, MW-8, and MW-10
    - Iron: MW-6
    - Manganese: MW-3, MW-6, MW-8, and MW-10
    - pH (field): MW-3
    - pH (laboratory): MW-3

Table 6
December 2018 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)	40 to 40	40 to 40	NA	40 to 42	NA	40 to 45	77 to 98	None	
Arsenic - Dissolved	**0.09 to 0.11**	**0.099 to 0.122**	NA	**0.0.931 to 1.166**	**0.249 to 0.535**	**1.41 to 1.978**	**1.684 to 2.108**	0.05 µg/L	Primary GW Standard
Arsenic - Dissolved	**0.09 to 0.11**	**0.099 to 0.122**	NA	**0.0.931 to 1.166**	**0.249 to 0.535**	**1.41 to 1.978**	**1.684 to 2.108**	1.29 µg/L	Site-Specific Cleanup Level
Barium - Dissolved	**3.1 to 5.0**	**12.91 to 15.86**	NA	**9.35 to 12.89**	NA	**5.84 to 8.09**	**12.8 to 15.7**	1000 µg/L	Primary GW Standard
Bicarbonate (mg of $CaCO_3$/L)	37.40 to 47.19	143 to 207	NA	112 to 159	NA	98.7 to 140	156 to 190	None	
Calcium	10,343 to 11,327	34,000 to 54,000	NA	27,272 to 34,858	NA	20,986 to 27,014	37,636 to 42,075	None	
Carbonate (mg of $CaCO_3$/L)	ND	ND	NA	ND	NA	ND	ND	None	
COD	ND	ND to 10.2	NA	ND	NA	ND	ND to 13.0	None	
Chloride	**3,630 to 4,419**	**2,450 to 3,420**	NA	**1,800 to 2,610**	NA	**2,154 to 2,637**	**4,267 to 7741**	250,000 µg/L	Secondary GW and DW Standard
Dissolved Oxygen (mg/L)	9.83 to 10.42	0.27 to 0.94	8.13 to 11.29	0.20 to 0.43	6.63 to 8.96	1.03 to 2.24	0.15 to 0.31	None	
Iron - Dissolved	**ND**	**ND**	**ND**	**687 to 1,074**	**ND**	**290 to 799**	**20 to 25.2**	300 µg/L	Secondary GW and DW Standard
Manganese - Dissolved	**ND**	**4,635 to 6,162**	**ND**	**616 to 785**	**ND**	**2,169 to 2,999**	**4,366 to 6,163**	50 µg/L	Secondary GW and DW Standard
Nitrate	**505 to 975**	**19 to 30**	NA	**ND to 32.1**	NA	**53.1 to 156**	**ND to 82**	10,000 µg/L	Primary GW and DW Standard
Nitrite	**4 to 10**	**ND**	NA	**3 to 10**	NA	**4 to 10**	**ND**	1,000 µg/L	Primary DW Standard
Oxidation-Reduction Potential	156 to 226	165 to 239	106 to 208	10.8 to 36.8	NA	42.2 to 67.1	94.6 to 139.5	None	
pH - Field	**6.1 to 6.5**	**6.1 to 6.2**	**6.4 to 6.8**	**6.4 to 6.7**	**6.6 to 6.7**	**6.5 to 6.7**	**6.4 to 6.6**	6.5 - 8.5	Secondary GW Standard
pH - Laboratory	**6.3 to 6.5**	**6.2 to 6.3**	**6.5 to 6.9**	**6.6 to 6.7**	**6.5 to 6.9**	**6.6 to 6.7**	**6.5 to 6.7**	6.5 - 8.5	Secondary GW Standard
Potassium	520 to 710	747 to 979	NA	1,100 to 1,490	NA	891 to 1,120	1,040 to 1,310	None	
Sodium	**4,271 to 4,609**	**8,447 to 9,781**	NA	**6,855 to 7,873**	NA	**7,372 to 8,520**	**9,159 to 10,579**	20,000 µg/L	Secondary DW Standard
Specific Conductance (µmhos/cm)	**115 to 122**	**295 to 400**	**99 to 144**	**246 to 310**	**90 to 108**	**202 to 261**	**364 to 418**	700 µmhos/cm	Secondary DW Standard
Sulfate	**3,689 to 4,153**	**13,506 to 18,256**	NA	**6,100 to 9,200**	NA	**4,081 to 4,830**	**7,630 to 9,370**	250,000 µg/L	Secondary GW and DW Standard
Temperature (^oC)	10.8 to 11.0	11.6 to 12.2	10.5 to 12.5	11.1 to 11.7	9.4 to 11.9	10.4 to 11.1	11.2 to 11.7	None	
Total Coliform (count)	**ND**	**ND**	NA	**ND**	NA	**ND**	**ND**	1/100 mL	Primary GW and DW Standard
TOC	ND	2,448 to 3,104	NA	1,530 to 2,102	NA	745 to 1,182	2,870 to 3,580	None	
Vinyl Chloride	**ND**	**ND**	**ND**	**ND**	**ND**	**ND to 0.06**	**ND**	0.02 µg/L	Primary GW Standard
Vinyl Chloride	**ND**	**ND**	**ND**	**ND**	**ND**	**ND to 0.06**	**ND**	0.29 µg/L	Site-Specific Cleanup Level
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

- Seven (7) 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-1, MW-5A, MW-6, and MW-10
    - pH (laboratory): MW-1
    - Vinyl Chloride: MW-8

CONCLUSIONS

Quarterly monitoring data collected during 2018 at the Olalla Landfill are summarized in the following sections.

Landfill Gas Data

Landfill gas field measurements were performed at the three on-site passive flares during the four quarterly monitoring events in 2018. Landfill gas data for all four quarterly monitoring events are included in Appendix A and are summarized in the following sections.

March 21, 2018 – First Quarter

Landfill gas indicator parameters, specifically measurable concentrations of carbon dioxide and methane, combined with lower than ambient oxygen concentrations suggest that landfill gas was present in all three flares at the time of measurement.

Gas pressure measurements ranged from 0.01 to 0.03 inches of water. The low gas pressure readings indicate limited potential for landfill gas flow from the flares.

Weather station data from the Bremerton Airport indicate that barometric pressure decreased from 30.10 inches of mercury on March 20, 2018, the day before the monitoring event, to 29.74 inches of mercury on March 21, 2018, the day the flares were measured (source Weather Underground, Station KPWT, 2018). This significant decrease in barometric pressure likely contributed to the measurable concentrations of landfill gas indicators in all three flares.

June 21, 2018 – Second Quarter

Methane was not detected in any of the three flares. In addition, all flares had oxygen concentrations that were at or near ambient conditions. These measurements indicate that landfill gas, as indicated by the detection of methane, was not present at measurable concentrations in the flares at the time of monitoring.

Low but measurable concentrations of carbon dioxide were noted in all three flares. The detected carbon dioxide concentrations in combination with near ambient oxygen concentrations and no detections of methane likely indicate aerobic decomposition of organic materials in the landfill.

Gas pressure measurements were 0.01 inches of water at all three flare locations. The low gas pressure readings indicate limited potential for landfill gas flow from the flares.

Weather station data from the Bremerton Airport indicate that barometric pressure increased from 29.99 inches of mercury on June 20, 2018, the day before the monitoring event, to 30.15 inches of mercury on June 21, 2018, the day the flares were measured (source Weather Underground, Station KPWT, 2018). This increasing trend in barometric pressure likely contributed to the lack of measurable concentrations of landfill gas indicators and low pressure (indicating low flow) in all three flares.

October 4, 2018 – Third Quarter

Methane was detected in Flare 1 at a low concentration of 0.2% by volume, which is 3% of the LEL. In addition, all flares had oxygen concentrations that were at or near ambient conditions. These measurements indicate that landfill gas, as indicated by the detection of methane, was only present at measurable concentrations in Flare 1 at the time of monitoring.

Low but measurable concentrations of carbon dioxide were noted in Flares 1 and 2. The detected carbon dioxide concentrations in combination with near ambient oxygen concentrations and a single low detection of methane likely indicate a low decomposition rate of organic materials in the landfill.

Gas pressure measurements were 0.02, 0.01, and 0.02 inches of water in Flares 1, 2, and 3, respectively. The low gas pressure readings indicate a low potential for landfill gas flow from the flares.

Weather station data from the Bremerton Airport indicate that barometric pressure increased from 30.11 inches of mercury on October 3, 2018, the day before the monitoring event, to 30.16 inches of mercury on October 4, 2018, the day the flares were measured (source Weather Underground, Station KPWT, 2018). This increasing barometric pressure likely contributed to the low gas pressure in the flares lack of measurable concentrations of landfill gas indicators at Flares 2 and 3 and a low methane concentration at Flare 1.

December 18, 2018 – Fourth Quarter

Only Flare 2 had a measurable concentration of methane at 0.1% by volume. All three flares were non-detect for carbon dioxide and had oxygen concentrations of 20.8% by volume, which are considered ambient conditions. These landfill gas measurements indicate little to no influence from landfill gas in any of the wells.

Gas pressure measurements ranged from 0.01 to 0.03 inches of water. The low gas pressure readings from all three flares indicate a very limited potential for landfill gas flow from the flares.

Weather station data from Bremerton Airport (Station KPWT) indicate that barometric pressure increased from 30.01 inches of mercury on December 17, 2018, the day before the monitoring event, to 30.15 inches of mercury on December 18, 2018, the day that flare measurements were made (Weather Underground, 2019). This increasing barometric pressure likely contributed to the low gas pressure in the flares lack of measurable concentrations of landfill gas indicators at Flares 1 and 3 and a low methane concentration at Flare 2.

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 Appendix 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 2018 occurred in March with a mean horizontal gradient of 0.0154. The resulting calculated groundwater flow velocity is 2.40 feet/day. Groundwater gradients and calculated groundwater velocities were greatest during October and December, both of which had mean horizontal gradients of 0.0165 and calculated flow velocities of 2.57 feet/day.

Exceedances of Primary Regulatory Standards

Upgradient Well (MW-1)

Arsenic

- Groundwater samples collected from MW-1 during the four quarterly monitoring events of 2018 had arsenic concentrations of 0.10 µg/L, 0.12 µg/L, 0.11 µg/L, and 0.11 µg/L in March, June, October, and December, respectively. 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 CUL of 1.29 µg/L.
- The upper and lower 95% confidence intervals for arsenic in samples from MW-1 exceed the Washington State Primary Groundwater Standard of 0.05 µg/L. This represents a statistically significant exceedance for arsenic in samples from the upgradient well.
- 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 are sampled only during the fourth quarter monitoring event. Groundwater samples collected from MW-5A and MW-7 had arsenic concentrations of 0.20 µg/L and 0.31 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 CUL of 1.29 µg/L.
- The upper and lower 95% confidence intervals for arsenic in samples from MW-7 exceed the Washington State Primary Groundwater Standard of 0.05 µg/L. This represents a statistically significant exceedance for arsenic in samples from a cross-gradient well. There were an insufficient number of arsenic detections in the data from MW-5A for a confidence interval evaluation.
- 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 2018. None of the arsenic concentrations detected during 2018 exceed the Washington State Drinking Water Primary Standard of 10 µg/L. Some samples from MW-6, MW-8, and MW-10 exceeded the site-specific CUL of 1.29 µg/L. Arsenic concentrations for specific wells are summarized in the following bullets:
    - MW-3 had arsenic concentrations of 0.11 µg/L, 0.14 µg/L, 0.11 µg/L, and 0.13 µg/L in March, June, October, and December, respectively.
    - MW-6 had arsenic concentrations of 1.08 µg/L, 1.33 µg/L, 1.57 µg/L, and 1.14 µg/L in March, June, October, and December, respectively.
    - MW-8 had arsenic concentrations of 1.78 µg/L, 2.14 µg/L, 1.06 µg/L, and 1.99 µg/L in March, June, October, and December, respectively.
    - MW-10 had arsenic concentrations of 1.73 µg/L, 1.68 µg/L, 1.67 µg/L, and 1.98 µg/L in March, June, October, and December, respectively.
- Upper and lower 95% confidence intervals for arsenic in samples from the four downgradient wells exceed the Washington State Primary Groundwater Standard of 0.05 µg/L. This represents statistically significant exceedances for arsenic in samples from the downgradient wells.

Vinyl Chloride

MW-6, MW-8 and MW-10

- Vinyl chloride was detected at concentrations greater than the Washington State Groundwater Primary Standard of 0.02 µg/L in samples from MW-6, MW-8, and MW-10 in at least one quarter of 2018. However, none of the detected concentrations of vinyl chloride exceeded the Washington State Drinking Water Primary Standard of 2.0 µg/L or the site-specific CUL of 0.29 µg/L. Vinyl chloride concentrations for specific wells are summarized in the following bullets:
    - MW-6 had vinyl chloride concentrations of 0.03 µg/L in June October, and December.
    - Vinyl chloride was detected in samples from MW-8 at concentrations of 0.10 µg/L, 0.04 µg/L, and 0.06 µg/L in March, June, and December, respectively.
    - MW-10 had a vinyl chloride concentration of 0.03 µg/L in December.
- Upper and lower 95% confidence intervals for vinyl chloride in samples from MW-6 and MW-10 are both lower than the Washington State Primary Groundwater Standard of 0.02 µg/L (presented as “ND” on Table 5 based on too few detections for a statistically valid result). This represents statistically significant compliance with the standard in samples from those wells.
- The lower 95% confidence limit for vinyl chloride in samples from MW-8 is less than and the upper 95% confidence is greater than the Washington State Primary Groundwater Standard of 0.02 µg/L. This is not a statistical exceedance or compliance but indicates that continued monitoring and evaluation is warranted.

Exceedances of Secondary Regulatory Standards

Upgradient Well (MW-1)

pH (field-measured)

- Groundwater purged from well MW-1 had a field-measured pH value of 5.8 during the June monitoring event. This value is lower than the lower limit of the 6.5 to 8.5 range for the Washington State Groundwater Secondary Standard.
- The lower 95% confidence limit for field-measured pH in purge water from MW-1 is less than but the upper 95% confidence is greater than the Washington State Secondary Groundwater Standard range of 6.5 to 8.5. This is not a statistical exceedance or compliance but indicates that continued monitoring and evaluation is warranted.

pH (laboratory-measured)

- Groundwater samples from well MW-1 had laboratory-measured pH values of 6.2, 6.3, 6.0, and 6.3 during the March, June, October, and December monitoring events, respectively. These values are less than the lower limit of 6.5 for the Washington State Groundwater Secondary Standard.
- The lower 95% confidence limit for laboratory-measured pH in samples from MW-1 is less than but the upper 95% confidence is greater than the Washington State Secondary Groundwater Standard range of 6.5 to 8.5. This is not a statistical exceedance or compliance but indicates that continued monitoring and evaluation is warranted.

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 the quarterly monitoring events in 2018 as summarized below.
    - MW-6 had iron concentrations of 865 µg/L, 1,010 µg/L, 1,440 µg/L, and 848 µg/L for the March, June, October, and December sampling events, respectively.
    - MW-8 had iron concentrations of 1,340 µg/L, 799 µg/L, and 727 µg/L for the March, June, and December sampling events, respectively.
- Upper and lower 95% confidence intervals for iron in samples from MW-6 exceed the Washington State Secondary Groundwater Standard of 300 µg/L. This represents a statistically significant exceedance for iron.
- The upper 95% confidence interval for iron in samples from MW-8 exceeds the Washington State Secondary Groundwater Standard of 300 µg/L but the lower 95% confidence limit does not. This is not a statistical exceedance or compliance but indicates that continued monitoring and evaluation is warranted.

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 2018 as summarized below.
    - MW-3 had manganese concentrations of 8,840 µg/L, 8,090 µg/L, 6,240 µg/L, and 7,120 µg/L for the March, June, October, and December sampling events, respectively.
    - MW-6 had manganese concentrations of 914 µg/L, 978 µg/L, 1,110 µg/L, and 809 µg/L for the March, June, October, and December sampling events, respectively.
    - MW-8 had manganese concentrations of 3,700 µg/L, 2,350 µg/L, 2,680 µg/L, and 2,870 µg/L for the March, June, October, and December sampling events, respectively.
    - MW-10 had manganese concentrations of 4,730 µg/L, 3,730 µg/L, 4,870 µg/L, and 5,300 µg/L for the March, June, October, and December sampling events, respectively.
- Upper and lower 95% confidence limits for manganese in samples from all four downgradient wells exceed the Washington State Secondary Groundwater Standard of 50 µg/L indicating statistically significant exceedances for manganese in downgradient wells.

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 each 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 2018 as summarized below.
    - MW-3 had field-measured pH values of 6,1, 6.1, 6.3, and 6.3 in March, June, October, and December, respectively.
    - MW-6 had field-measured pH values of 6.4 in June.
    - MW-8 had field-measured pH values of 6.2 and 6.4 in June and December, respectively.
    - MW-10 had a field-measured pH of 6.4 in June.
- Both the upper and lower 95% confidence limits for field-measured pH in purge water from MW-3 are outside of (less than) the Washington State Secondary Groundwater Standard range of 6.5 to 8.5, indicating a statistically significant exceedance.
- The lower 95% confidence limits for field-measured pH in purge water from MW-6 and MW-10 are lower but the upper 95% confidence limits are greater than the Washington State Secondary Groundwater Standard range of 6.5 to 8.5. These are not statistical exceedances or compliance but indicate that continued monitoring and evaluation is warranted.
- Both the upper and lower 95% confidence limits for field-measured pH in purge water from MW-8 are within the Washington State Secondary Groundwater Standard range of 6.5 to 8.5, indicating statistically significant compliance.

pH (laboratory-measured)

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

- Purge water from downgradient monitoring wells MW-3, MW-6, and MW-8 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 2018 as summarized below.
    - MW-3 had a laboratory-measured pH value of 6.1 in March.
    - MW-6 had a laboratory-measured pH value of 6.4 in October.
    - MW-8 had a laboratory-measured pH value of 6.3 in October.
- Both the upper and lower 95% confidence limits for laboratory-measured pH in samples from MW-3 are outside of (less than) the Washington State Secondary Groundwater Standard range of 6.5 to 8.5, indicating a statistically significant exceedance.
- Both the upper and lower 95% confidence limits for laboratory-measured pH in samples from MW-6 and MW-8 are within the Washington State Secondary Groundwater Standard range of 6.5 to 8.5, indicating statistically significant compliance.

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.

- Benzene was detected in the sample from MW-6 at a concentration of 0.23 µg/L in October. This concentration is less than the Washington State Primary Groundwater Standard of 1.0 µg/L and the Washington State Drinking Water Standard of 5.0 µg/L.

- Chlorobenzene was detected in samples from MW-6 at concentrations of 2.20 µg/L, 2.45 µg/L, 2.89 µg/L, and 3.16 µg/L in March, June, October, and December, respectively. These concentrations are significantly less than the Washington State Primary Drinking Water Standard of 100 µg/L. There is no Washington State Groundwater Standard for chlorobenzene.

- cis-1,2-Dichlororethene was detected in samples from MW-8 at concentrations of 0.69 µg/L, 0.46 µg/L, 0.26 µg/L, and 0.46 µg/L in March, June, October, and December, respectively. These concentrations are significantly less than the Washington State Primary Drinking Water Standard of 70 µg/L. There is no Washington State Groundwater Standard for cis-1,2-dichloroethene.

Inspection and Maintenance Summary for 2018 and Activities Planned for 2019

A summary of the inspection, maintenance, and engineering work peformed at the Olalla Landifll in 2018 is presented in Appendix D. Activities planned for 2019 are summarized in Appexdix E.

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Appendix A:
2018 Quarterly Monitoring Data

Landfill Gas Data
Groundwater Elevations and Contour Maps
Groundwater Quality Data

Olalla Landfill
2018 Landfill Gas Data

March 21, 2018	Flare #1	Flare #2	Flare #3
METHANE, (% LEL)[a]	>100	>100	>100
METHANE, (% Volume)	5.5	7.6	11.9
OXYGEN, (% Volume)	2.3	0.7	1.6
CARBON DIOXIDE, (% Volume)	12.7	13.6	14.2
PRESSURE (inches of water column)	0.03	0.01	0.01
AMBIENT TEMPERATURE, (^{o}F)	55		

June 21, 2018	Flare #1	Flare #2	Flare #3
METHANE, (% LEL)[a]	0	0	0
METHANE, (% Volume)	0.0	0.0	0.0
OXYGEN, (% Volume)	20.2	19.2	19.3
CARBON DIOXIDE, (% Volume)	2.2	1.2	1.1
PRESSURE (inches of water column)	0.01	0.01	0.01
AMBIENT TEMPERATURE, (^{o}F)	65		

October 4, 2018	Flare #1	Flare #2	Flare #3
METHANE, (% LEL)[a]	3	0	0
METHANE, (% Volume)	0.2	0.0	0.0
OXYGEN, (% Volume)	20.1	19.9	20.2
CARBON DIOXIDE, (% Volume)	0.8	1.3	0.0
PRESSURE (inches of water column)	0.02	0.01	0.02
AMBIENT TEMPERATURE, (^{o}F)	57		

December 18, 2018	Flare #1	Flare #2	Flare #3
METHANE, (% LEL)[a]	0	1	0
METHANE, (% Volume)	0.0	0.1	0.0
OXYGEN, (% Volume)	20.8	20.8	20.8
CARBON DIOXIDE, (% Volume)	0.0	0.0	0.0
PRESSURE (inches of water column)	0.03	0.03	0.01
AMBIENT TEMPERATURE, (^{o}F)	48		

Notes:

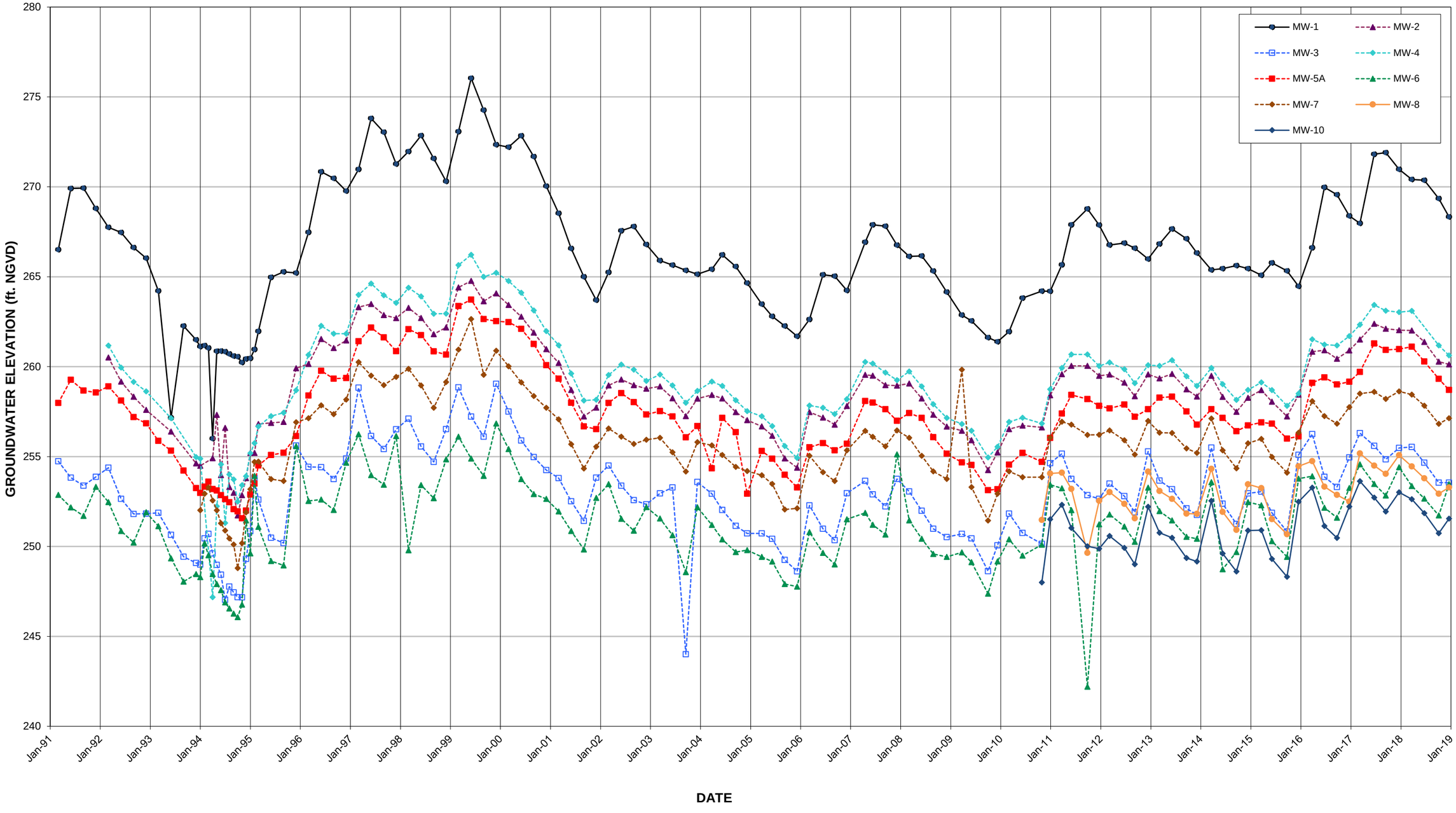
[a] LEL is the GEM 2000 instrument reading, not a calculated value from the methane % volume measuremen

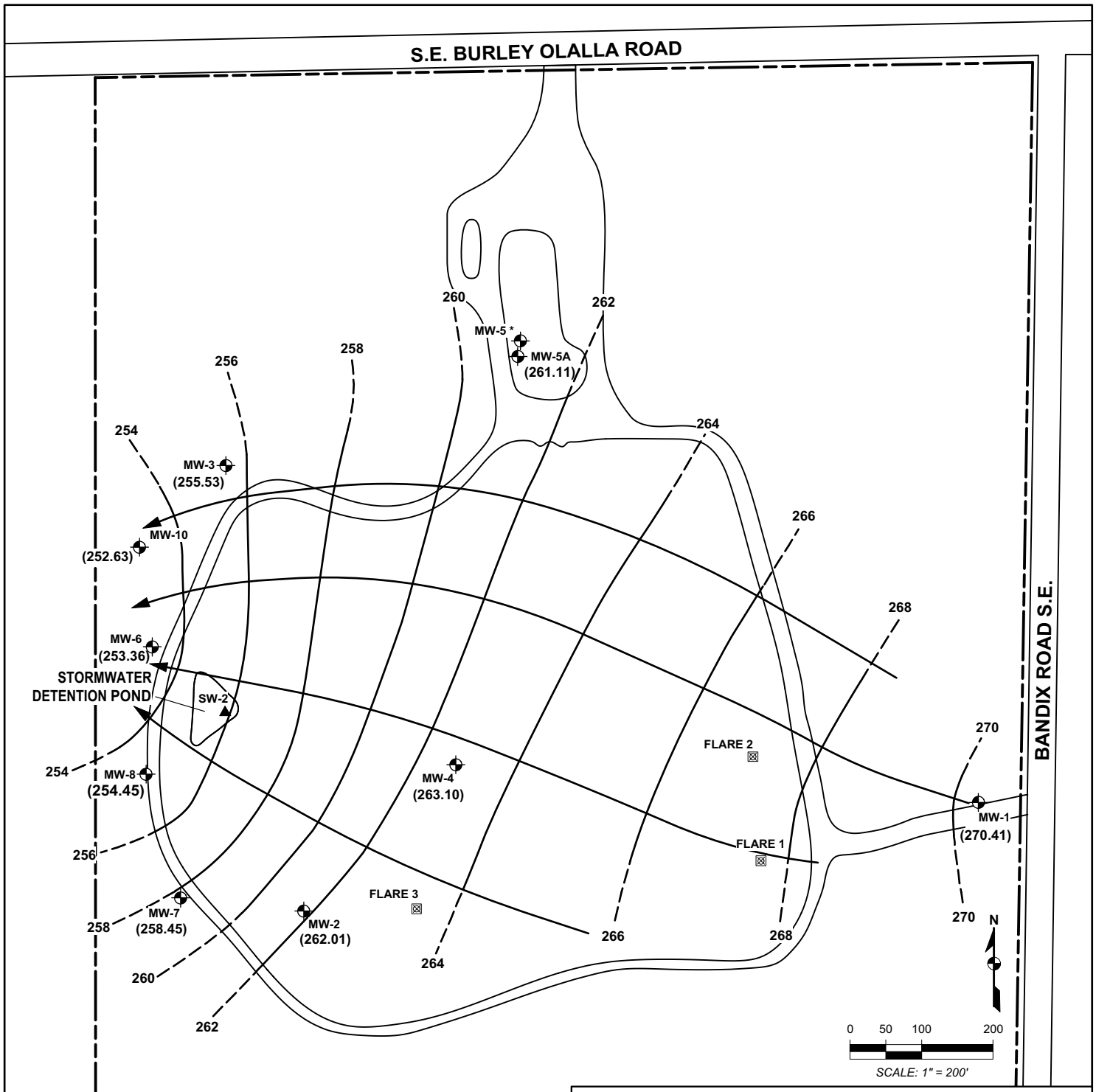
Olalla Landfill
2018 Groundwater Elevations

Station	Reference Elevation[1]	Depth to Water (feet)	Groundwater Elevation[1]
March 21, 2018			
MW-1	343.79	73.38	270.41
MW-2	323.25	61.24	262.01
MW-3	296.95	41.42	255.53
MW-4	320.93	57.83	263.10
MW-5A	332.53	71.42	261.11
MW-6	271.17	17.81	253.36
MW-7	280.43	21.98	258.45
MW-8	272.85	18.40	254.45
MW-10	279.21	26.58	252.63
June 21, 2018			
MW-1	343.79	73.42	270.37
MW-2	323.25	61.87	261.38
MW-3	296.95	42.29	254.66
MW-4	320.93	NM[2]	NM[2]
MW-5A	332.53	72.24	260.29
MW-6	271.17	18.50	252.67
MW-7	280.43	22.60	257.83
MW-8	272.85	19.06	253.79
MW-10	279.21	27.36	251.85
October 4, 2018			
MW-1	343.79	74.44	269.35
MW-2	323.25	62.97	260.28
MW-3	296.95	43.40	253.55
MW-4	320.93	59.75	261.18
MW-5A	332.53	73.21	259.32
MW-6	271.17	19.44	251.73
MW-7	280.43	23.61	256.82
MW-8	272.85	19.92	252.93
MW-10	279.21	28.47	250.74
December 18, 2018			
MW-1	343.79	75.46	268.33
MW-2	323.25	63.12	260.13
MW-3	296.95	43.40	253.55
MW-4	320.93	60.30	260.63
MW-5A	332.53	73.82	258.71
MW-6	271.17	17.70	253.47
MW-7	280.43	23.30	257.13
MW-8	272.85	19.57	253.28
MW-10	279.21	27.66	251.55

[1]Elevations in Feet NGVD, 29

OLALLA LANDFILL
Groundwater Elevations





NOTES:

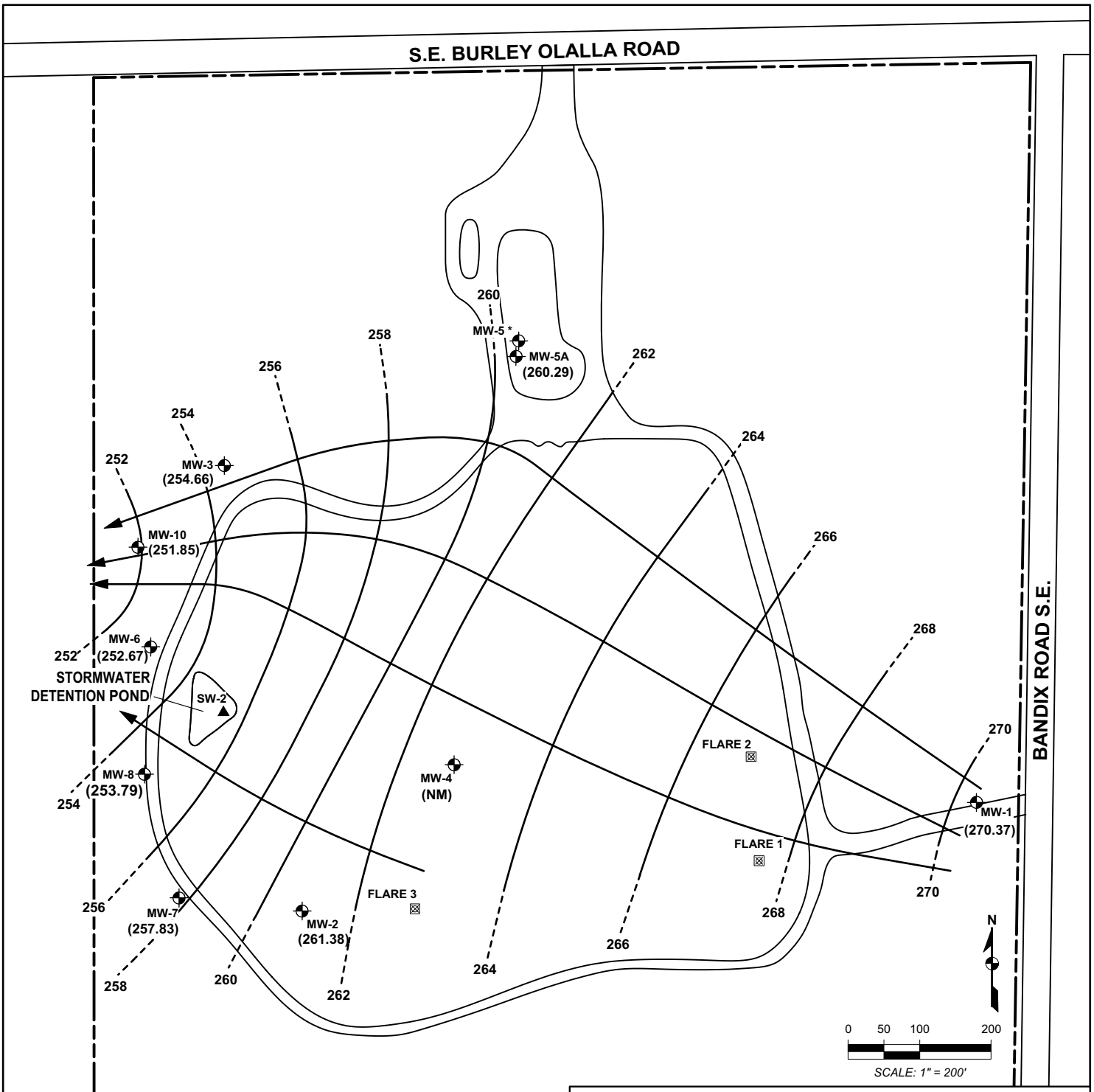
* *MW-5 IS COMPLETED IN A SHALLOW PERCHED GROUNDWATER ZONE.*

- MW-2 — MONITORING WELL LOCATION
- SW-2 — SURFACE WATER SAMPLING LOCATION
- LANDFILL GAS FLARE
- GROUNDWATER ELEVATION CONTOUR
- INFERRED GROUNDWATER FLOW PATH
- APPROXIMATE PROPERTY BOUNDARY
- PERIMETER ACCESS ROAD

OLALLA LANDFILL GROUNDWATER ELEVATION CONTOUR MAP - MARCH 21, 2018

PREPARED BY	ENVIRONMENTAL PARTNERS INC
REPORT	2018 ANNUAL MONITORING REPORT
LOCATION	OLALLA LANDFILL KITSAP COUNTY, WASHINGTON
PREPARED FOR	KITSAP COUNTY

DATE	*DRAWN BY*	*REVIEWED BY*	*PROJECT NUMBER*
1/31/19	VPB	DCK	45406.0



NOTES:

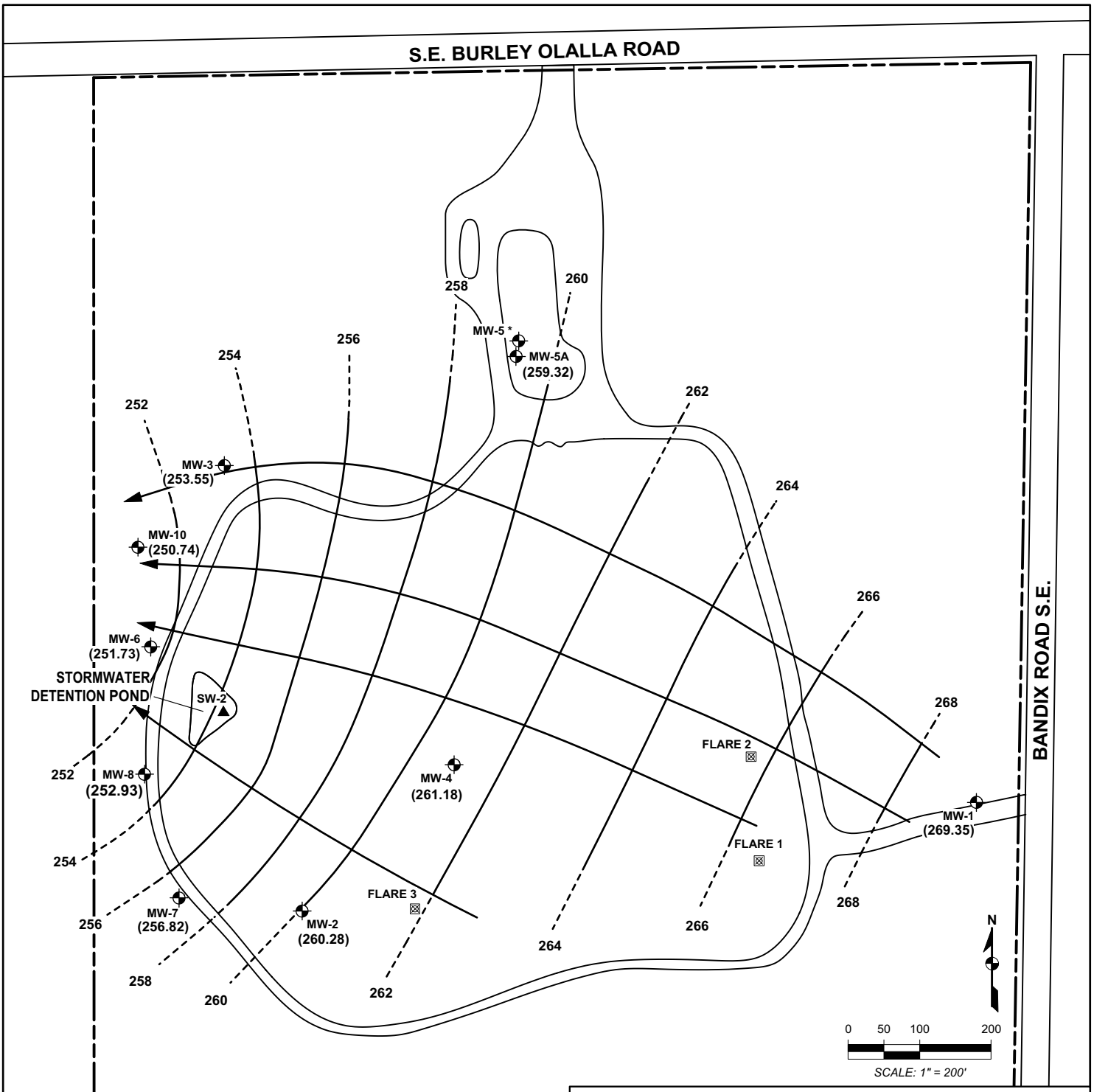
* *MW-5 IS COMPLETED IN A SHALLOW PERCHED GROUNDWATER ZONE.*

- MW-2 — MONITORING WELL LOCATION
- SW-2 — SURFACE WATER SAMPLING LOCATION
- LANDFILL GAS FLARE
- (NM) — NOT MEASURED
- GROUNDWATER ELEVATION CONTOUR
- INFERRED GROUNDWATER FLOW PATH
- APPROXIMATE PROPERTY BOUNDARY
- PERIMETER ACCESS ROAD

OLALLA LANDFILL GROUNDWATER ELEVATION CONTOUR MAP - JUNE 21, 2018

PREPARED BY	epi ENVIRONMENTAL PARTNERS INC
REPORT	2018 ANNUAL MONITORING REPORT
LOCATION	OLALLA LANDFILL KITSAP COUNTY, WASHINGTON
PREPARED FOR	KITSAP COUNTY

DATE	*DRAWN BY*	*REVIEWED BY*	*PROJECT NUMBER*
1/31/19	VPB	DCK	45407.0



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

GROUNDWATER ELEVATION CONTOUR

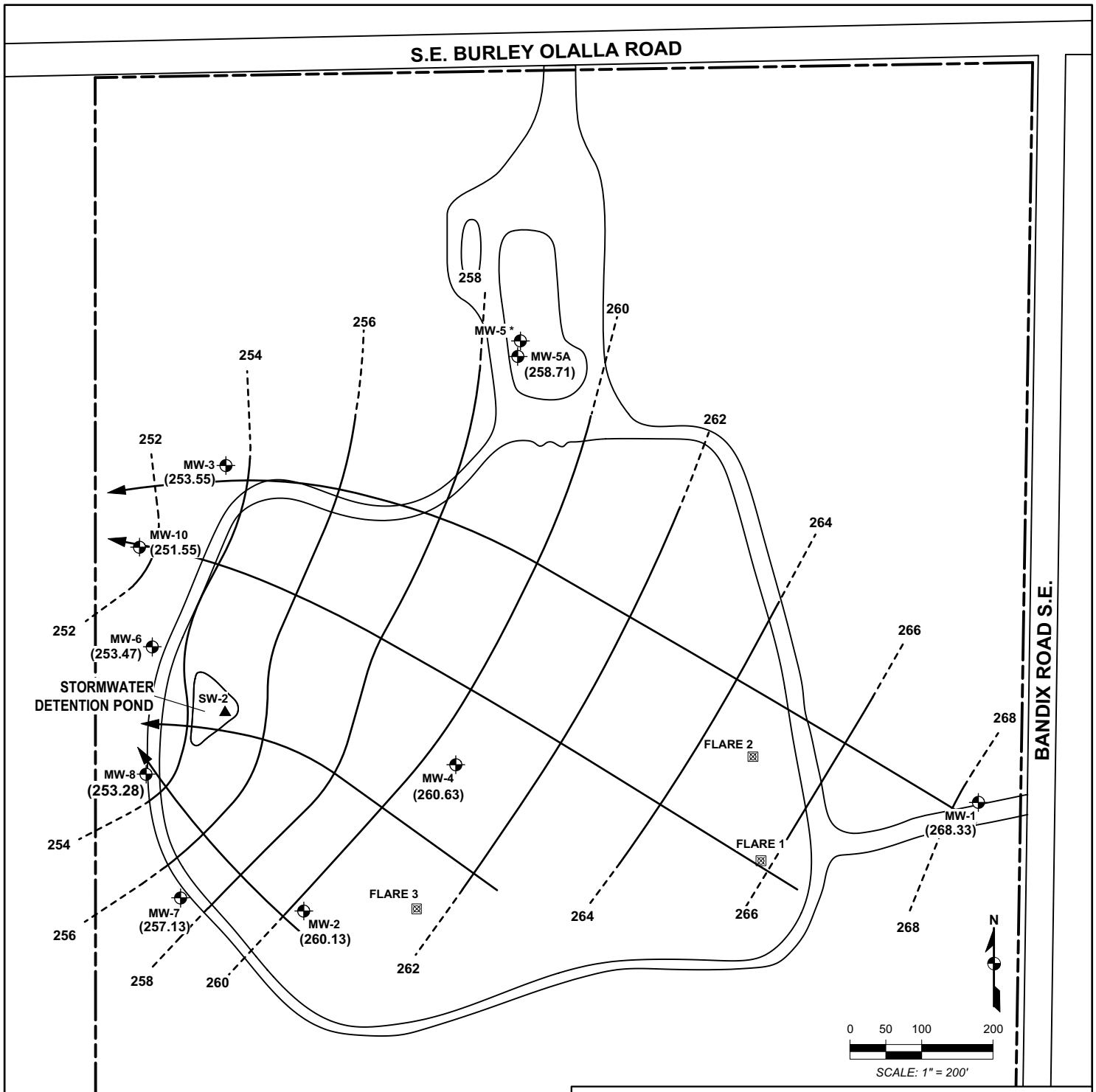
INFERRED GROUNDWATER FLOW PATH

APPROXIMATE PROPERTY BOUNDARY

PERIMETER ACCESS ROAD

OLALLA LANDFILL GROUNDWATER ELEVATION CONTOUR MAP - OCTOBER 4, 2018

PREPARED BY	ENVIRONMENTAL PARTNERS INC		
REPORT	2018 ANNUAL MONITORING REPORT		
LOCATION	OLALLA LANDFILL KITSAP COUNTY, WASHINGTON		
PREPARED FOR	KITSAP COUNTY		
DATE 11/31/19	***DRAWN BY*** VPB	***REVIEWED BY*** DCK	***PROJECT NUMBER*** 45406.0



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
- GROUNDWATER ELEVATION CONTOUR
- INFERRED GROUNDWATER FLOW PATH
- APPROXIMATE PROPERTY BOUNDARY
- PERIMETER ACCESS ROAD

OLALLA LANDFILL GROUNDWATER ELEVATION CONTOUR MAP - DECEMBER 18, 2018

PREPARED BY	ENVIRONMENTAL PARTNERS INC
REPORT	2018 ANNUAL MONITORING REPORT
LOCATION	OLALLA LANDFILL KITSAP COUNTY, WASHINGTON
PREPARED FOR	KITSAP COUNTY

DATE	*DRAWN BY*	*REVIEWED BY*	*PROJECT NUMBER*
1/31/19	VPB	DCK	45407.0

Groundwater Quality Data
March 2018 Quarterly Monitoring Event
Page 1 of 3

	State Drinking Water Standards (a)	State Ground-water Standards (b)	Site-Specific Cleanup Level (c)	Units	MW-1	MW-3	MW-6	MW-8	MW-10	MW-9 (FD)
CONVENTIONALS										
ALKALINITY	-----	-----	-----	mg/L	38.5	253	162	173	197	255
AMMONIA NITROGEN	-----	-----	-----	mg/L	0.040 U	0.040 U	0.040 U	0.040 U	0.079	0.040 U
BICARBONATE	-----	-----	-----	mg/L	38.5	253	162	173	197	255
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	10.7	10.0 U
CHLORIDE	250**	250**	-----	mg/L	2.70	1.94	4.11	3.28	13.5	1.93
DISSOLVED OXYGEN	-----	-----	-----	mg/L	10.54	0.14	0.11	1.20	0.10	NA
NITRATE NITROGEN	10*	10*	-----	mg/L	2.21	0.030 U	0.059	0.085	0.020 U	0.030 U
NITRITE NITROGEN	1*	-----	-----	mg/L	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.01 U
ORP	-----	-----	-----	mV	224.1	255.7	36.8	57.7	143.2	NA
pH (field)	-----	6.5-8.5**	-----	-log H+	6.5	**6.1**	6.6	6.6	6.6	NA
pH (laboratory)	-----	6.5-8.5**	-----	-log H+	**6.2**	**6.1**	6.5	6.6	6.6	**6.1**
SPECIFIC CONDUCTANCE	700**	-----	-----	umhos/cm	108	491	322	328	424	NA
SULFATE	250**	250**	-----	mg/L	3.24	12.9	6.14	4.78	7.30	12.7
TEMPERATURE	-----	-----	-----	°C	10.8	11.8	11.2	10.4	11.5	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	3.58	2.19	1.63	3.79	3.63
TURBIDITY	-----	-----	-----	NTU	0.2	1.1	1.5	6.3	NR	NA
DISSOLVED METALS										
ARSENIC	10*	0.05*	1.29	µg/L	**0.10**	**0.11**	**1.08**	**1.78**	**1.73**	**0.12**
BARIUM	2,000*	1,000*	-----	µg/L	3.0 U	18.0	11.9	9.9	15.6	18.6
CALCIUM	-----	-----	-----	mg/L	9.4	55.4	32.2	33.4	41.2	54.1
IRON	300**	300**	300	µg/L	20 U	20 U	**865**	**1,340**	27	26
MANGANESE	50**	50**	50	µg/L	1.0 U	**8,840**	**914**	**3,700**	**4,730**	**8,850**
POTASSIUM	-----	-----	-----	mg/L	0.50 U	0.77	0.95	0.94	0.98	0.77
SODIUM	20***	-----	-----	mg/L	3.93	10.1	6.25	8.92	9.44	9.98
ZINC	5,000**	5,000**	-----	µg/L	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.37 U
VOLATILE ORGANIC COMPOUNDS										
VINYL CHLORIDE	2*	0.02*	0.29	µg/L	0.02 U	0.02 U	0.02	**0.096**	0.02	0.02 U

Notes:

Concentration exceeds Washington State Drinking Water or Groundwater Standards

FD = Field Duplicate of MW-3 was labeled MW-9.

NA = Not Analyzed

NR = Not Recorded: turbidity meter provided eratic readings at MW-10.

Regulatory Standards:

(a) WAC 246-290-310

(b) WAC 173-200-040

* 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.

Groundwater Quality Data
March 2018 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-9 (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	**2.20**	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	**0.69**	0.2 U	0.2 U

Groundwater Quality Data
March 2018 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-9 (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	**0.10**	0.02 U	0.02 U

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

FD = Field Duplicate of MW-3 was labeled MW-9.

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 2018 Quarterly Monitoring Event
Page 1 of 3

	State Drinking Water Standards (a)	State Ground-water Standards (b)	Site-Specific Cleanup Level (c)	Units	MW-1	MW-3	MW-6	MW-8	MW-10	MW-17 (FD)
CONVENTIONALS										
ALKALINITY	-----	-----	-----	mg/L	42.6	238	154	134	158	151
AMMONIA NITROGEN	-----	-----	-----	mg/L	0.040 U	0.040 U	0.040 U	0.043	0.073	0.040 U
BICARBONATE	-----	-----	-----	mg/L	42.6	238	154	134	158	151
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	10.2	10.0 U	10.0 U	10.0 U	10.0 U
CHLORIDE	250**	250**	-----	mg/L	3.30	1.77	1.77	3.06	11.1	1.88
DISSOLVED OXYGEN	-----	-----	-----	mg/L	10.53	0.27	0.25	0.35	0.23	NA
NITRATE NITROGEN	10*	10*	-----	mg/L	0.964	0.020 U	0.060 U	0.040	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
ORP	-----	-----	-----	mV	283.4	263.7	33.1	59.4	137	NA
pH (field)	-----	6.5-8.5**	-----	-log H+	**5.8**	**6.1**	**6.4**	**6.2**	**6.4**	NA
pH (laboratory)	-----	6.5-8.5**	-----	-log H+	**6.3**	**6.4**	6.6	6.7	6.7	6.6
SPECIFIC CONDUCTANCE	700**	-----	-----	umhos/cm	109	500	306	272	349	NA
SULFATE	250**	250**	-----	mg/L	3.73	30.5	7.76	5.11	8.39	7.25
TEMPERATURE	-----	-----	-----	°C	10.7	11.8	10.8	10.0	11.2	NA
TOTAL COLIFORM	1/100 mL*	1/100 mL*	-----	cfu/100 mL	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ
TOTAL ORGANIC CARBON	-----	-----	-----	mg/L	0.5 U	3.22	1.86	1.02	2.81	1.87
TURBIDITY	-----	-----	-----	NTU	0.50	1.3	4.3	21.0	0.44	NA
DISSOLVED METALS										
ARSENIC	10*	0.05*	1.29	µg/L	**0.12**	**0.14**	**1.33**	**2.14**	**1.68**	**1.29**
BARIUM	2,000*	1,000*	-----	µg/L	3.0 U	15.3	9.8	5.4	7.7	10.1
CALCIUM	-----	-----	-----	mg/L	9.9	59.0	32.3	28.6	32.4	32.3
IRON	300**	300**	300	µg/L	20 U	20 U	**1,010**	**799**	23	**1,040**
MANGANESE	50**	50**	50	µg/L	1.0 U	**8,090**	**978**	**2,350**	**3,730**	**853**
POTASSIUM	-----	-----	-----	mg/L	0.63	0.95	1.10	1.00	1.05	1.10
SODIUM	20***	-----	-----	mg/L	4.29	10.6	7.61	9.09	8.32	7.52
ZINC	5,000**	5,000**	-----	µg/L	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	12.2
VOLATILE ORGANIC COMPOUNDS										
VINYL CHLORIDE	2*	0.02*	0.29	µg/L	0.02 U	0.02 U	**0.03**	**0.04**	0.02	**0.03**

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

* 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.

Groundwater Quality Data
June 2018 Quarterly Monitoring Event

VOLATILE ORGANIC COMPOUNI	State Drinking Water Standards (a)	State Ground-water 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-CHLOROPROPAI	-----	-----	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	**2.45**	0.2 U	0.2 U	**2.43**
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	**0.46**	0.2 U	0.2 U

Groundwater Quality Data
June 2018 Quarterly Monitoring Event
Page 3 of 3

VOLATILE ORGANIC COMPOUNI	State Drinking Water Standards (a)	State Ground-water 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	**0.03**	**0.04**	**0.02**	**0.03**

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
October 2018 Quarterly Monitoring Event
Page 1 of 3

	State Drinking Water Standards (a)	State Ground-water Standards (b)	Site-Specific Cleanup Level (c)	Units	MW-1	MW-3	MW-6	MW-8	MW-10	MW-12 (FD)
CONVENTIONALS										
ALKALINITY	-----	-----	-----	mg/L	41.4	201	183	92	209	92
AMMONIA NITROGEN	-----	-----	-----	mg/L	0.040 U	0.040 U	0.040 U	0.046	0.073	0.040 U
BICARBONATE	-----	-----	-----	mg/L	41.4	201	183	92	209	92
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	10.0 U	10.0 U
CHLORIDE	250**	250**	-----	mg/L	2.94	1.81	4.06	2.47	11.3	2.46
DISSOLVED OXYGEN	-----	-----	-----	mg/L	10.54	0.22	0.20	0.23	0.18	NA
NITRATE NITROGEN	10*	10*	-----	mg/L	1.080	0.020 U	0.020 U	0.053	0.020 U	0.051
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	304.6	239.2	35.8	79.8	107	NA
pH (field)	-----	6.5-8.5**	-----	-log H+	6.6	**6.3**	6.5	6.7	6.7	NA
pH (laboratory)	-----	6.5-8.5**	-----	-log H+	**6.0**	**6.1**	**6.4**	**6.3**	6.5	**6.3**
SPECIFIC CONDUCTANCE	700**	-----	-----	umhos/cm	110	396	364	188	430	NA
SULFATE	250**	250**	-----	mg/L	3.62	11.0	6.10	3.88	8.06	3.76
TEMPERATURE	-----	-----	-----	°C	10.8	11.9	10.9	10.8	11.4	NA
TOTAL COLIFORM	1/100 mL*	1/100 mL*	-----	cfu/100 mL	1 UH	1 UH	1 UH	1 UH	1 UH	1 UH
TOTAL ORGANIC CARBON	-----	-----	-----	mg/L	0.5 U	2.52	2.26	0.70	3.85	0.69
TURBIDITY	-----	-----	-----	NTU	0.54	0.17	1.8	3.6	0.49	NA
DISSOLVED METALS										
ARSENIC	10*	0.05*	1.29	µg/L	**0.106**	**0.105**	**1.57**	**1.06**	**1.67**	**1.02**
BARIUM	2,000*	1,000*	-----	µg/L	3.9	15.4	16.4	5.8	15.5	5.9
CALCIUM	-----	-----	-----	mg/L	9.7	46.6	37.0	17.1	43.3	17.2
IRON	300**	300**	300	µg/L	20 U	20 U	**1,440**	280	27.3	257
MANGANESE	50**	50**	50	µg/L	1.0 U	**6,240**	**1,110**	**2,680**	**4,870**	**2,630**
POTASSIUM	-----	-----	-----	mg/L	0.58	0.84	1.26	0.89	1.16	0.92
SODIUM	20***	-----	-----	mg/L	3.89	10.0	8.14	7.43	9.06	7.44
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*	0.29	µg/L	0.02 U	0.02 U	**0.03**	0.02 U	**0.02**	0.02 U

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

* 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.

H = Hold time was exceeded.

Groundwater Quality Data
October 2018 Quarterly Monitoring Event

VOLATILE ORGANIC COMPOUNDS	State Drinking Water Standards (a)	State Ground-water 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	**0.23**	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	**2.89**	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	**0.26**	0.2 U	**0.21**

Groundwater Quality Data
October 2018 Quarterly Monitoring Event
Page 3 of 3

VOLATILE ORGANIC COMPOUNDS	State Drinking Water Standards (a)	State Ground-water 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	**0.03**	0.02 U	**0.02**	0.02 U

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 2018 Quarterly Monitoring Event
Page 1 of 3

	State Drinking Water Standards (a)	State Ground-water Standards (b)	Site-Specific Cleanup Level (c)	Units	MW-1	MW-3	MW-5A	MW-6	MW-7	MW-8	MW-10	SW-2	MW-13 (FD)
CONVENTIONALS													
ALKALINITY	-----	-----	-----	mg/L	41.3	223	NA	138	NA	173	227	NA	225
AMMONIA NITROGEN	-----	-----	-----	mg/L	0.040 U	0.040 U	NA	0.040 U	NA	0.040 U	0.081	NA	0.045
BICARBONATE	-----	-----	-----	mg/L	41.3	223	NA	138	NA	173	227	NA	225
CARBONATE	-----	-----	-----	mg/L	1.0 U	1.0 U	NA	1.0 U	NA	1.0 U	1.0 U	NA	1.0 U
CHEMICAL OXYGEN DEMAND	-----	-----	-----	mg/L	10.0 U	12.2	NA	10.0 U	NA	10.0 U	12.8	NA	14.4
CHLORIDE	250**	250**	-----	mg/L	3.07	2.59	NA	5.77	NA	3.54	14.9	NA	14.4
DISSOLVED OXYGEN	-----	-----	-----	mg/L	10.28	0.44	9.88	0.32	10.90	0.31	0.31	NA	NA
NITRATE NITROGEN	10*	10*	-----	mg/L	1.11	0.02 U	NA	0.11 U	NA	0.20 U	0.02 U	0.02 U	0.02 U
NITRITE NITROGEN	1*	-----	-----	mg/L	0.01 U	0.01 U	NA	0.01 U	NA	0.10 U	0.01 U	0.01 U	0.01 U
ORP	-----	-----	-----	mV	247.8	220.8	200.6	20.8	200.2	52.2	97.1	NA	NA
pH (field)	-----	6.5-8.5**	-----	-log H+	6.5	**6.3**	6.8	6.6	6.6	**6.4**	6.6	7.5	NA
pH (laboratory)	-----	6.5-8.5**	-----	-log H+	**6.3** H	**6.3** H	6.9 H	6.7 H	6.7 H	6.5 H	6.6 H	6.5 H	6.7 H
SPECIFIC CONDUCTANCE	700**	-----	-----	umhos/cm	105	400	102	278	89	343	464	41	NA
SULFATE	250**	250**	-----	mg/L	3.73	21.3	NA	4.89	NA	5.67	7.65	NA	2.68
TEMPERATURE	-----	-----	-----	°C	10.8	12.0	11.5	11.2	10.9	11.1	11.2	8.2	NA
FECAL COLIFORM	-----	-----	-----	cfu/100 mL	NA	NA	NA	NA	NA	NA	NA	12 H	NA
TOTAL COLIFORM	1/100 mL*	1/100 mL*	-----	cfu/100 mL	1 UH	1 UH	NA	1 UH	NA	1 UH	1 UH	NA	1 UH
TOTAL ORGANIC CARBON	-----	-----	-----	mg/L	0.5 U	2.98	NA	1.66	NA	1.37	3.58	NA	3.56
TURBIDITY	-----	-----	-----	NTU	0.80	0.23	7.80	2.20	1.32	1.62	0.98	NA	NA
DISSOLVED METALS													
ARSENIC	10*	0.05*	1.29	µg/L	**0.11**	**0.13**	**0.20**	**1.14**	**0.31**	**1.99**	**1.98**	NA	**2.02**
BARIUM	2,000*	1,000*	-----	µg/L	3.0 U	16.4	3.1	11.7	3.0	11.6	15.7	NA	17.0
CALCIUM	-----	-----	-----	mg/L	9.16	51.2	NA	26.7	NA	35.2	46.1	NA	45.5
IRON	300**	300**	300	µg/L	20 U	20 U	20 U	**848**	20 U	**727**	25.2	NA	28
MANGANESE	50**	50**	50	µg/L	1.0 U	**7,120**	1.0 U	**809**	1.0 U	**2,870**	**5,300**	NA	**5,360**
POTASSIUM	-----	-----	-----	mg/L	0.62	0.98	NA	1.17	NA	1.24	1.28	NA	1.26
SODIUM	20***	-----	-----	mg/L	3.97	10.6	NA	7.38	NA	11.2	9.79	NA	9.84
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	4.0 U	NA	4.0 U
VOLATILE ORGANIC COMPOUNDS													
VINYL CHLORIDE	2*	0.02*	0.29	µg/L	0.02 U	0.02 U	0.02 U	**0.03**	0.02 U	**0.06**	**0.03**	NA	**0.03**

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

* Primary Standard

** Secondary Standard

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

Data Qualifiers:

H = Hold time was exceeded.

NA = Not Analyzed

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

Groundwater Quality Data
December 2018 Quarterly Monitoring Event

VOLATILE ORGANIC COMPOUNDS	State Drinking Water Standards (a)	State Ground-water 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	**3.16**	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	**0.46**	0.2 U	0.2 U

Groundwater Quality Data
December 2018 Quarterly Monitoring Event
Page 3 of 3

VOLATILE ORGANIC COMPOUNDS	State Drinking Water Standards (a)	State Ground-water 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	**0.03**	**0.06**	**0.03**	**0.03**

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:
2018 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 2018

Olalla Landfill
Kitsap County, Washington
Project Number: 45406.0

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

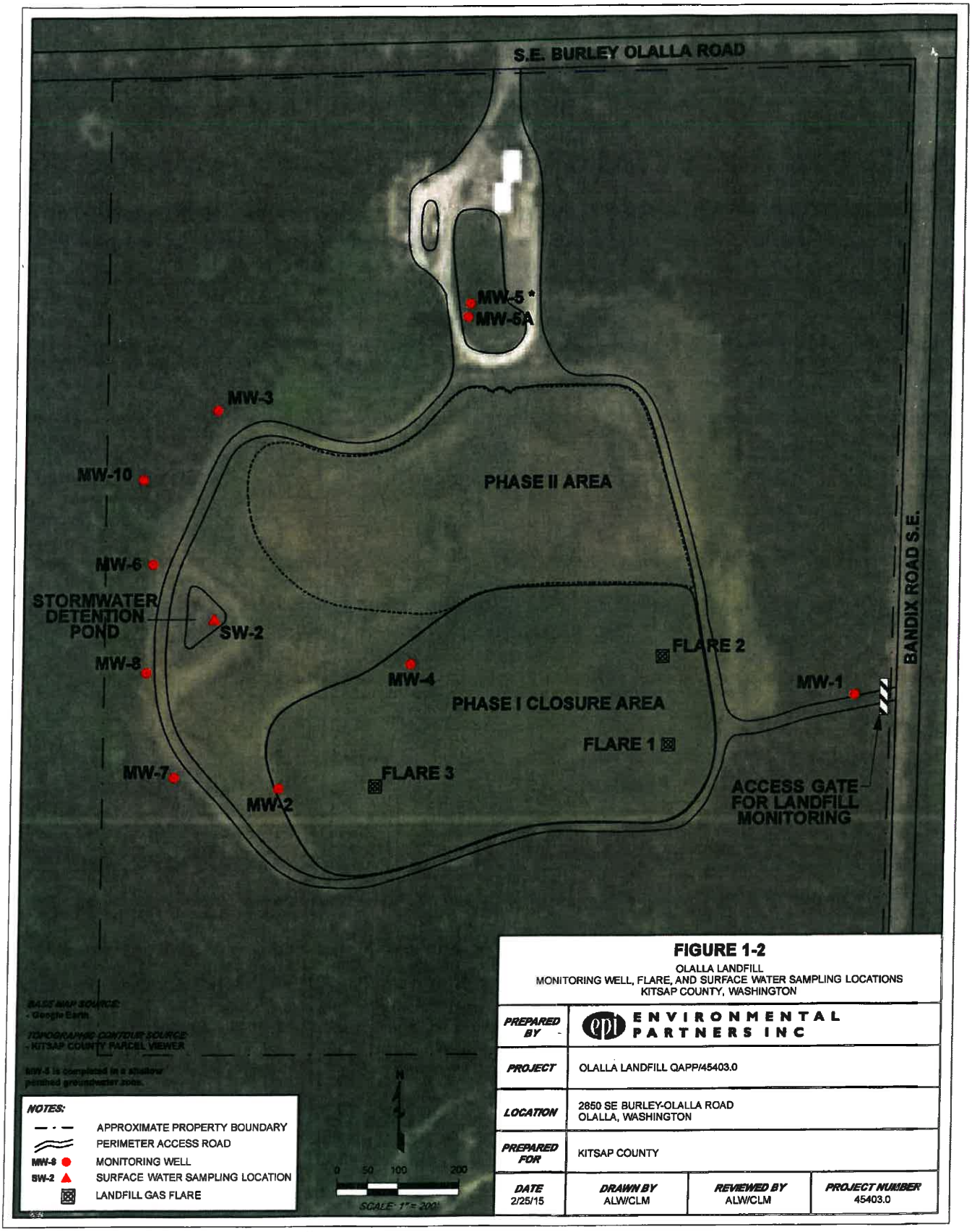


FIGURE 1-2

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

Instrument Calibration Log - Olalla Landfill Monitoring

Calibrated By: Jaica Miller-Equico - See YSI Calibration Log. **Date:** 7/24/18

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 standa

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	Hanna	HI 98703	SN G0046927	———	0800

Meter reads 14.5 NTUs using 15.0 NTUs standa Comments:

Meter reads 1.2 NTUs using 2.0 NTUs standa

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)

Multiparameter Probe Calibration Log - Olalla Landfill Groundwater Monitoring

Meter Type	Manufacturer	Model Number	Mfg. Serial#	Rental Co. Serial #	Date	Time
multiparameter	YSI	Pro DSS	16F104585	ProDSS.07	3/20/18	

Calibrated to Autocal Solution

Calibration Solution Manufacturer _____ Lot Number _____ Exp. Date _____

pH = _____ Turbidity = _____ Temperature = _____

Conductivity = _____ Dissolved Oxygen = _____ ORP = _____

Comments:

See attached certificate of calibration by Equipco - Jason Miller

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

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

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	08:26	343.79	75.38	No changes since last qtr.
MW-2	1530 casing	323.25	61.24 water	
MW-3	10:10	296.95	41.42	
MW-4	1557	320.93	57.83	
MW-5	0943	334.17	9.40	
MW-5A	0946	332.53	71.42	
MW-6	1313	271.17	17.81	
MW-7	15:23	280.43	21.98	
MW-8	14:15	272.85	18.40	
MW-10	11:40	279.21	26.58	✓

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: 45406.0/Kitsap County - Olalla Landfill

Station	MW-1	Date	21 20-Mar-18
Sample ID	MW-1-318	Field Team: (Initials)	ELC
Field Conditions	Cool, partly Cloudy, 50°F		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	87
Initial Depth to Water (ft.)	73.38
Depth of Water Column	17.62
1 Casing Volume	2.8
Controller Setting (Hz)	20

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

Start Time	0558
End Time	0921
Total Gallons Purged	20

Time	Gallons	pH	Conductivity (mS/cm)	NTU	DO (mg/L)	Temp. (°C)	ORP (mV)	Appearance
0900	2.5	6.62	0.109	—	10.54	10.6	200.8	clear
0903	5	6.55	0.109	—	10.52	10.7	208.7	"
0906	7.5	6.54	0.109	—	10.52	10.7	212.2	"
0909	11	6.53	0.109	—	10.54	10.8	217.0	"
0912	13.5	6.52	0.108	—	10.54	10.8	220.1	"
0915	16	6.53	0.108	—	10.55	10.8	222.2	"
0918	18.5	6.52	0.108	0.2	10.54	10.8	224.1	"

Sample Information

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

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	0918	(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**	

End Time: 0921

Comments / Exceptions:

Groundwater Sampling Field Data

EPI Project No./Site: 45406.0/Kitsap County - Olalla Landfill

Station	MW-3 Duplicate	Date	21-Mar-18
Sample ID	MW-3-3/18 & MW-9-3/18	Field Team: (Initials)	ELC
Field Conditions	Cool, partly cloudy, 50°F		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	55.5
Initial Depth to Water (ft.)	41.42
Depth of Water Column	14.08
1 Casing Volume	2.25
Controller Setting (Hz)	143

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

Start Time	10:30
End Time	10:55
Total Gallons Purged	14

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
10:33	2	6.11	0.499	—	0.45	11.5	254.0	clear
10:36	4.2	6.10	0.494	—	0.30	11.7	254.5	"
10:39	5.1	6.11	0.493	—	0.24	11.7	255.0	"
10:42	7.1	6.10	0.490	—	0.20	11.7	255.3	"
10:45	8.2	6.10	0.490	—	0.18	11.7	255.5	"
10:48	10	6.10	0.492	—	0.16	11.8	255.7	"
10:51	12.2	6.09	0.491	1.1	0.14	11.8	255.7	"

Sample Information

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

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	10:52	(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 1055

Comments / Exceptions:

Duplicate MW-9-3/18

Groundwater Sampling Field Data

EPI Project No./Site: 45406.0/Kitsap County - Olalla Landfill

Station	MW-10	Date	21 ~~20~~-Mar-18
Sample ID	MW-10-3/18	Field Team: (Initials)	ELC
Field Conditions	~~Cloudy~~ Clear, 55°F		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	47
Initial Depth to Water (ft.)	26.58
Depth of Water Column	20.42
1 Casing Volume	3.27
Controller Setting (Hz)	123

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

Start Time	1223
End Time	1243
Total Gallons Purged	~~12~~ 12

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1225	1.2	6.58	0.431	–	0.41	11.2	152.2	Cloudy
1230	2.5	6.56	0.425	–	0.23	11.4	149.9	"
1231	5	6.56	0.425		0.14	11.5	147.1	"
1234	7	6.55	0.423		0.13	11.4	146.5	"
1235	9	6.56	0.425		0.11	11.5	146.5	"
1240	10.5	6.56	0.424		0.10	11.5	143.2	"

Sample Information

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

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	(1241)	(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**	

End Time: 1243

Comments / Exceptions:

Groundwater Sampling Field Data

EPI Project No./Site: 45406.0/Kitsap County - Olalla Landfill

Station	MW-6	Date	~~20~~ 21-Mar-18
Sample ID	MW-6-3/18	Field Team: (Initials)	ELC
Field Conditions	Clear Sunny 55°F		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	35
Initial Depth to Water (ft.)	17.81
Depth of Water Column	17.19
1 Casing Volume	2.75
Controller Setting (Hz)	107

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

Start Time	1325
End Time	1347
Total Gallons Purged	17

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1328	2.8	6.56	0.329	—	0.33	11.2	57.5	Slightly cloudy
1331	5.1	6.56	0.321	-	0.23	11.2	49.0	"
1334	8.2	6.55	0.320	—	0.18	11.2	43.2	clearing up
1337	11.5	6.55	0.322		0.13	11.2	39.5	"
1341	13.3	6.55	0.322	-	0.12	11.2	38.0	"
1344	15.2	6.55	0.722	105	0.11	11.2	36.8	clear

Sample Information

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

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	1345	(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: 1347

Comments / Exceptions:

Groundwater Sampling Field Data

EPI Project No./Site: 45406.0/Kitsap County - Olalla Landfill

Station	MW-8	Date	21 ~~20~~ Mar-18
Sample ID	MW-8-3/21	Field Team: (Initials)	ELC
Field Conditions	Sunny, 55°F		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	38
Initial Depth to Water (ft.)	18.40
Depth of Water Column	14.60
1 Casing Volume	3.63
Controller Setting (Hz)	102

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

Start Time	14:30
End Time	1456
Total Gallons Purged	14

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
14:32	1.2	6.65	0.300	—	1.14	10.2	89.4	cloudy
14:36	3	6.61	0.314	-	1.02	10.3	68.9	"
14:39	5	6.60	0.322		1.08	10.4	62.2	"
14:43	7	6.59	0.326		1.18	10.4	59.8	clearing
14:46	8.7	6.58	0.327		1.14	10.4	58.4	"
14:49	10.2	6.58	0.325		1.14	10.4	57.4	clear
14:52	12	6.58	0.328	6.33	1.20	10.4	57.7	"
~~1455~~								

Sample Information

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

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	14:54	(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	1456			

Comments / Exceptions:

Landfill Gas Monitoring Field Data - Olalla Landfill Monitoring

Instrument Used:	LandTech GEM 2000	Date and Time:	3/21/18 1546
Ambient Temperature:	55° F	Field Team:	E. Caddy
Field Conditions:	Partly cloudy, still		

Landfill Gas Data

Flare #	Time	Methane (% vol.)	% LEL	Oxygen (% vol.)	Carbon Dioxide (% vol.)	Temperature (°C)	Gas Pressure ("H_2O)
3	15:49	11.9	>100	1.6	14.2		0.01
1	16:00	5.5	>100	2.3	12.7		0.03
2	16:06	7.6	>100	0.7	13.6		0.01

Comments / Inspection Results[1]

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

EQUIPCO

CES LANDTECH MODEL: GEM 2000
CALIBRATION CERTIFICATE

SERVICE TECHNICIAN: JM DATE: 3/20/18

INSTRUMENT INFORMATION

RENTAL ID: GEM2000.11

SERIAL NUMBER: 6M0763/04

CALIBRATION INFORMATION

1..CALIBRATION GAS: 35 % CO_2 LOT #: S73162

GAS RESPONSE: 35 % CO_2 ±2%

2. CALIBRATION GAS: 50 % Vol. Methane LOT #: S73162

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

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

EQUIPCO RENTALS

YSI ProDSS RENTAL
CALIBRATION CERTIFICATE

SERVICE TECHNICIAN: SM DATE: 3/20/18

RENTAL CUSTOMER: EPI

INSTRUMENT INFORMATION

RENTAL I.D. NUMBER: YSIPRODSS.07

SERIAL NUMBER: 16F104825

CALIBRATION INFORMATION

PARAMETER:	STANDARD:	PASS ( )	LOT #
1. CONDUCTIVITY	1,000 µMhos	X	50227
2. pH ZERO	pH 7	X	51187
pH SLOPE	pH 4	X	51238
pH SLOPE	pH 10	X	50268
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	061317

2686 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 2018

Olalla Landfill
Kitsap County, Washington
Project Number: 45406.0

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

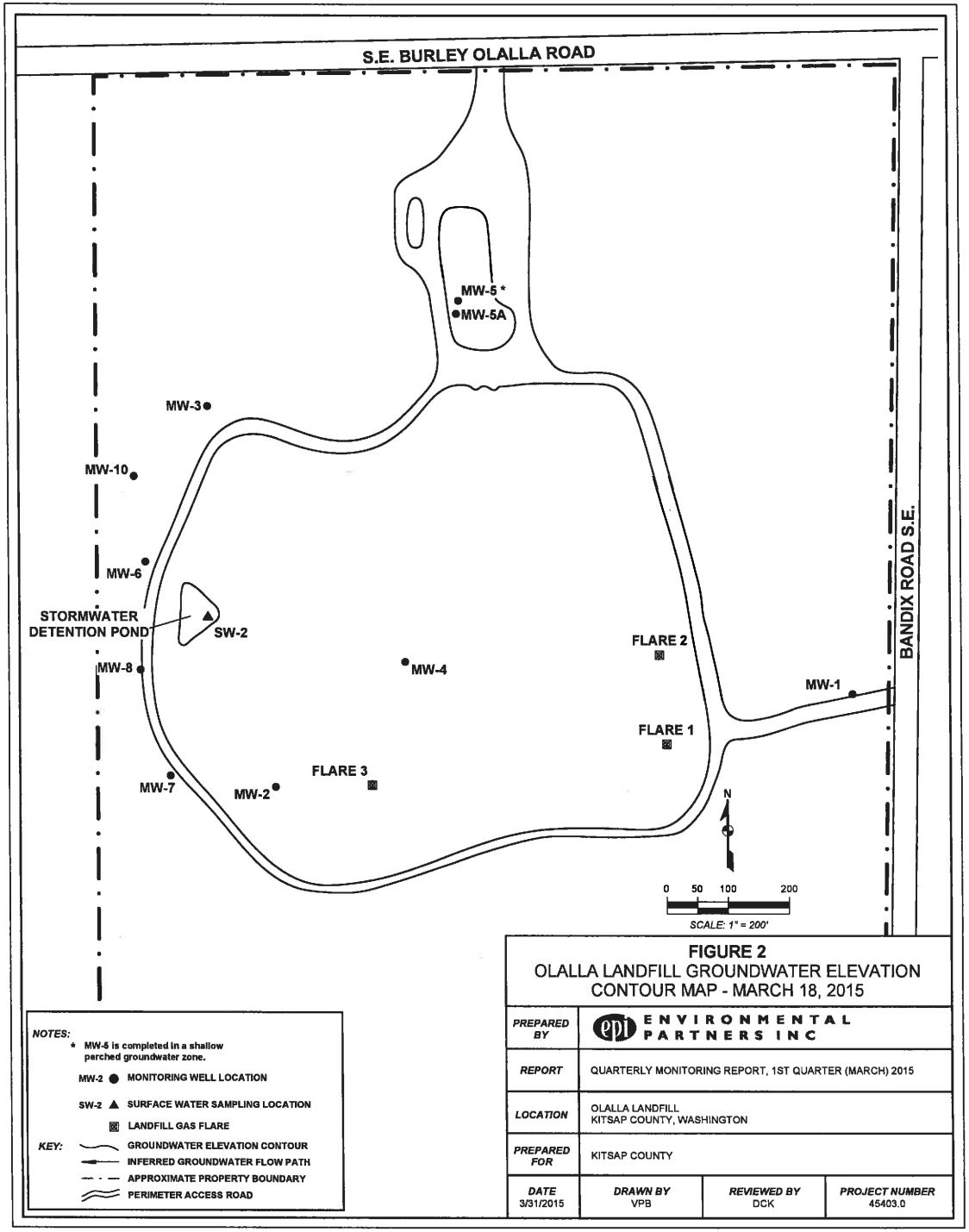


FIGURE 2
OLALLA LANDFILL GROUNDWATER ELEVATION CONTOUR MAP - MARCH 18, 2015

PREPARED BY	epi ENVIRONMENTAL PARTNERS INC		
REPORT	QUARTERLY MONITORING REPORT, 1ST QUARTER (MARCH) 2015		
LOCATION	OLALLA LANDFILL KITSAP COUNTY, WASHINGTON		
PREPARED FOR	KITSAP COUNTY		
DATE 3/31/2015	DRAWN BY VPB	REVIEWED BY DCK	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

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

Multiparameter Probe Calibration Log - Olalla Landfill Groundwater Monitoring

Rental Meter Type	Manufacturer	Model Number	Mfg. Serial#	Rental Co. Serial #	Date	Time
YSI multi-meter	YSI	Pro DSS	16F102612	YSI Pro DSS 01	6/20/18	

Calibrated to Autocal Solution

Calibration Solution Manufacturer _____ Lot Number _____ Exp. Date _____

pH = _____ Turbidity = _____ Temperature = _____

Conductivity = _____ Dissolved Oxygen = _____ ORP = _____

Comments:

See Equipment Calibration Certificate

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:

Instrument Calibration Log - Olalla Landfill Monitoring

Calibrated By: EC **Date:** 6/21/18

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 standa

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	Hanna	HI 98703	SN F0055292		08:25

Meter reads 14.8 NTUs using 15 NTUs standa Comments:

Meter reads 96.2 NTUs using 100 NTUs standa

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:

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	08:54	343.79	73.42	Good
MW-2	15:17	323.25	61.87	-same as before
MW-3	10:25	296.95	42.29	Good
MW-4	15:20	320.93		no access - bee hive in stick-up monument.
MW-5	10:04	334.17	10.70	Good
MW-5A	10:08	332.53	72.24	Good
MW-6	12:48	271.17	18.50	Good
MW-7	15:00	280.43	22.60	Good
MW-8	14:00	272.85	19.06	Good
MW-10	11:29	279.21	27.36	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: 45406.0/Kitsap County - Olalla Landfill

Station	MW-1	Date	21-Jun-18
Sample ID	~~MW-1-6/18~~ MW1-6/18	Field Team: (Initials)	ELC
Field Conditions	Overcast, 59°F		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	87
Initial Depth to Water (ft.)	73.42
Depth of Water Column	13.58
1 Casing Volume	2.07
Controller Setting (Hz)	~~40~~

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

Start Time	0915
End Time	0939
Total Gallons Purged	22

Time	Gallons	pH	2.07 Conductivity (mS/cm)	NTU	DO (mg/L)	Temp. °C	ORP (mV)	Appearance
0918	2.5	6.13	~~0.106~~ OK	—	~~44.5~~	10.6	259.2	cloudy
0921	5	5.87	0.109	—	10.51	10.7	255.8	"
0924	8	5.80	0.109	—	10.51	10.7	264.2	"
0927	11	5.76	0.109	—	10.52	10.8	272.5	"
0930	14	5.75	0.109	—	10.52	10.7	278.7	"
0933	16.5	5.75	0.109	—	10.53	10.7	281.1	"
0936	19.5	5.75	0.109	0.50	10.52	10.7	283.4	"

Sample Information

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

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	0936	~~3~~ 6 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		~~Sm~~ Lg OJ	ice	
TOC/COD/NH3		500-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**	
	D			

End Time: 0939

Comments / Exceptions:

Groundwater Sampling Field Data

EPI Project No./Site: 45406.0/Kitsap County - Olalla Landfill

Station	MW-3	Date	21-Jun-18
Sample ID	MW3-6/18	Field Team: (Initials)	ELC
Field Conditions	Overcast, 55°F		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	55.5
Initial Depth to Water (ft.)	42.29
Depth of Water Column	13
1 Casing Volume	1.45
Controller Setting (Hz)	145

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

Start Time	1034
End Time	1458
Total Gallons Purged	14

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1037	2	6.14	0.510	—	0.58	11.7	256.4	clear
1040	3.5	6.12	0.507	—	0.45	11.8	279.5	"
1043	5.5	6.11	0.506	—	0.36	11.8	273.6	"
1046	7.5	6.09	0.503	—	0.32	11.8	270.0	"
1049	9.5	6.09	0.504	—	0.30	11.8	268.5	"
10:52	11	6.09	0.501	—	0.28	11.8	265.6	"
1055	12.5	6.09	0.500	1.26	0.27	11.8	263.7	"

Sample Information

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

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	10:55	(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		500-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: 10:58

Comments / Exceptions:

Groundwater Sampling Field Data

EPI Project No./Site: 45406.0/Kitsap County - Olalla Landfill

Station	PW-10	Date	21-Jun-18
Sample ID	PW10-6/18	Field Team: (Initials)	ELC
Field Conditions	Overcast 60°F		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	47
Initial Depth to Water (ft.)	27.36
Depth of Water Column	19.64
1 Casing Volume	3.14
Controller Setting (Hz)	22

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

Start Time	11:37
End Time	12:03
Total Gallons Purged	13

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
11:40	2	6.59	0.348	—	0.44	11.0	157.7	clear
11:43	3.8	6.50	0.348	—	0.34	11.1	152.1	"
11:46	5	6.45	0.349	—	0.30	11.2	148.9	"
11:49	6.5	6.38	0.345	—	0.27	11.1	146.6	"
11:52	8	6.34	0.347	—	0.25	11.1	145.5	"
11:55	9.8	6.34	0.350	—	0.24	11.2	138.5	"
11:58	11	6.35	0.349	0.44	0.23	11.2	137.3	"

Sample Information

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

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	12:00	(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		500-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: 1207

Comments / Exceptions:

Groundwater Sampling Field Data

EPI Project No./Site: 45406.0/Kitsap County - Olalla Landfill

Station	MW-6	Date	21-Jun-18
Sample ID	MW6-6/18 and MW17-6/18	Field Team: (Initials)	ELC
Field Conditions	overcast 65°F		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	35
Initial Depth to Water (ft.)	18.50
Depth of Water Column	16.50
1 Casing Volume	2.64
Controller Setting (Hz)	105

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

Start Time	1300
End Time	1326
Total Gallons Purged	15

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1303	1	6.64	0.305	—	0.55	10.7	66.6	cloudy
1306	3	6.52	0.305	—	0.45	10.5	51.4	"
1309	5	6.49	0.305	—	0.36	10.5	42.1	cloudy, up
1312	7	6.45	0.305	—	0.29	10.8	36.5	" "
1315	8.25	6.43	0.305	—	0.28	10.8	34.5	" "
1318	10	6.40	0.306	—	0.26	10.8	33.2	"
1321	12	6.40	0.306	4.33	0.25	10.8	33.1	slight cloudy

Sample Information

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

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	1321	(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		500-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: 1326

Comments / Exceptions:

Collect Duplicate MW-17

Groundwater Sampling Field Data

EPI Project No./Site: 45406.0/Kitsap County - Olalla Landfill

Station	MW-8	Date	21-Jun-18
Sample ID	MW8-6/18	Field Team: (Initials)	ELC
Field Conditions	Overcast 65°F		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	38
Initial Depth to Water (ft.)	14.06
Depth of Water Column	18.94
1 Casing Volume	3.03
Controller Setting (Hz)	107

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

Start Time	1405
End Time	1432
Total Gallons Purged	18

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1408	2	6.85	0.193	—	0.44	9.9	58.6	cloudy
1411	4	6.56	0.240	—	0.35	10.0	57.4	"
1414	6	6.46	0.258	—	0.30	10.0	56.1	"
1417	7.8	6.39	0.260	—	0.29	10.0	57.0	"
1420	9.8	6.35	0.265	—	0.30	10.1	57.6	slightly cloudy
1423	11.5	6.26	0.267	—	0.35	10.0	59.2	"
1426	13.25	6.25	0.270	—	0.34	10.0	59.7	"
1429	15	6.21	0.272	21.0	0.35	10.0	59.4	"

Sample Information

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

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	1430	(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		500-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: 1432

Comments / Exceptions:

Landfill Gas Monitoring Field Data - Olalla Landfill Monitoring

Instrument Used:	GEM 2000	Date and Time:	6/21/18
Ambient Temperature:	65°F	Field Team:	E. Caddy
Field Conditions:	Cloudy, 65°F		

Landfill Gas Data

Flare #	Time	Methane (% vol.)	% LEL	Oxygen (% vol.)	Carbon Dioxide (% vol.)	Temperature (°C)	Gas Pressure ("H_2O)
#3	15:40	0.0	0%	19.3	1.1		0.01
#2	15:55	0.0	0%	19.2	1.2		0.01
#1	16:10	0.0	0	20.2	2.2		0.01

Comments / Inspection Results[1]

[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: JM

DATE: 6/20/18

RENTAL CUSTOMER: EPI

INSTRUMENT INFORMATION

RENTAL I.D. NUMBER: YSIPRODSS.01

SERIAL NUMBER: 16F102612

CALIBRATION INFORMATION

PARAMETER:	STANDARD:	PASS ( )	LOT #
1. CONDUCTIVITY	1,000 µMhos	X	S0227
2. pH ZERO	pH 7	X	51187
pH SLOPE	pH 4	X	51238
pH SLOPE	pH 10	X	S0268
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	06137

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: [signature] DATE: 6/20/18

INSTRUMENT INFORMATION

RENTAL ID: GEM2000. 08

SERIAL NUMBER: GM07210103

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 October 2018

Olalla Landfill
Kitsap County, Washington
Project Number: 45406.0

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

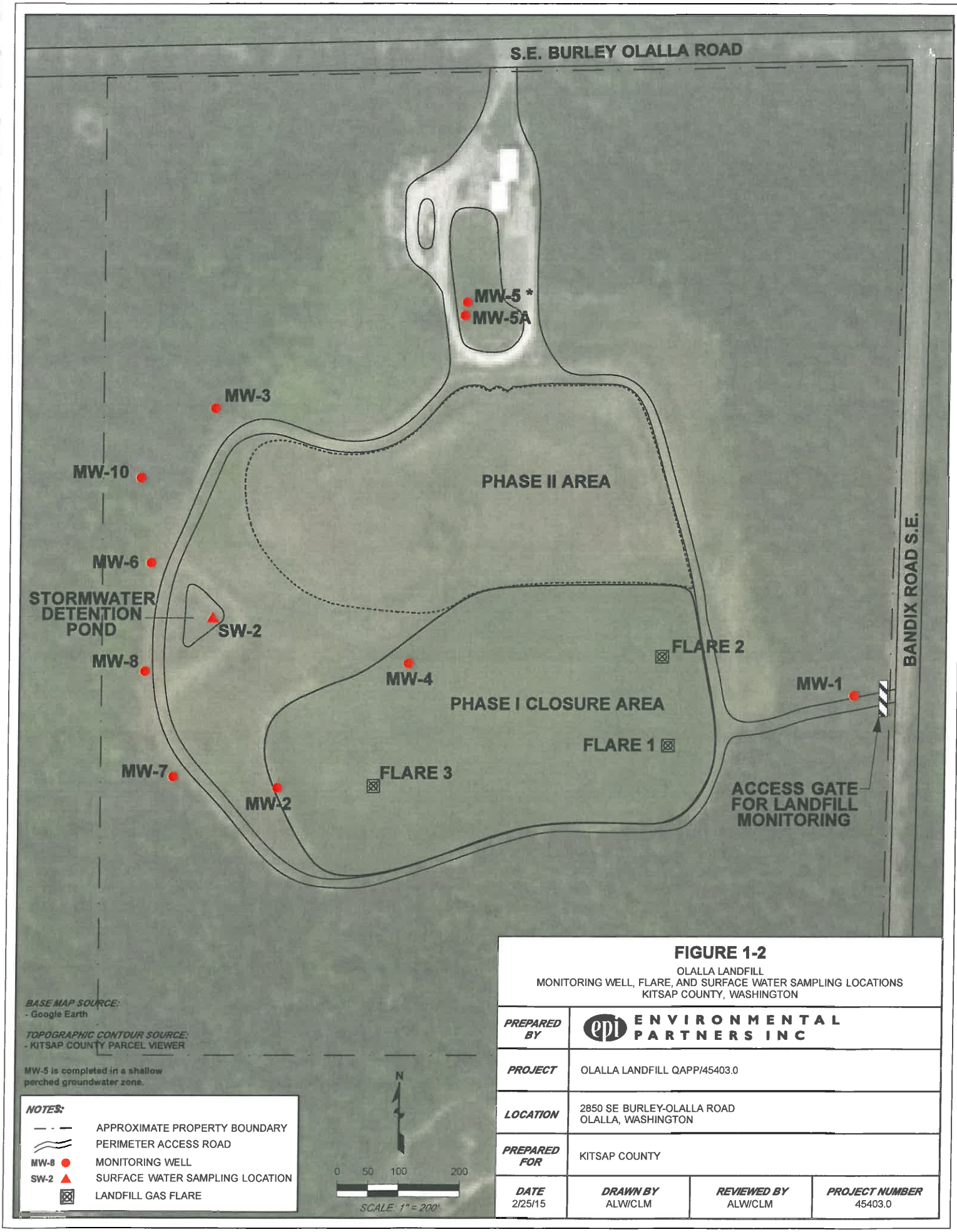


FIGURE 1-2

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
YSI multi. Pro DSS Meter	YSI	Pro DSS	16F102614	05	10/3/18	

Calibrated to Autocal Solution

Calibration Solution Manufacturer _____ Lot Number _____ Exp. Date _____

pH = _____ Turbidity = _____ Temperature = _____

Conductivity = _____ Dissolved Oxygen = _____ ORP = _____

Comments: See certificate of calibration (attached) by EquipCo Rentals

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:

Instrument Calibration Log - Olalla Landfill Monitoring

Calibrated By: _____ **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	Hanna	HI 98703	03080058901		0800

Meter reads 14.6 NTUs using 15 NTUs standard | Comments:

Meter reads 101.1 NTUs using 100 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

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

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	0826	343.79	74.44	No changes since last quarter
MW-2	1424	323.25	62.97	" no bees
MW-3	0947	296.95	43.40	"
MW-4	1434	320.93	59.75	"
MW-5	0922	334.17	12.28	"
MW-5A	0924	332.53	73.21	"
MW-6	1230	271.17	19.44	"
MW-7	1410	280.43	23.61	"
MW-8	1315	272.85	19.92	"
MW-10	1055	279.21	28.47	"

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: 45406.0/Kitsap County - Olalla Landfill

Station	MW-1	Date	4-Oct-18
Sample ID	Olalla - MW1 - 10/18	Field Team: (Initials)	ELC
Field Conditions	Sunny, high 60's Today		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	87
Initial Depth to Water (ft.)	74.44
Depth of Water Column	12.56
1 Casing Volume	1.88
Controller Setting (Hz)	30

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

Start Time	0839
End Time	0857
Total Gallons Purged	16

Time	Gallons	pH	Conductivity (mS/cm)	NTU	DO (mg/L)	Temp. (°C)	ORP (mV)	Appearance
0842	3	6.62	0.110	—	10.54	10.7	271.7	cloudy
0845	5.5	6.61	0.110	—	10.54	10.8	254.0	"
0848	9	6.60	0.110	—	10.54	10.8	244.6	"
0851	11.5	6.60	0.110	—	10.54	10.8	305.5	"
0854	14	6.60	0.110	0.54	10.54	10.8	304.6	"

Sample Information

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

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	0855	~~3~~ 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		~~Sm~~ Lg OJ	ice	
TOC/COD/NH3		250 ~~500~~-ml AG	H_2SO_4	
Total Metals		250 ~~500~~-ml HDPE	HNO_3 to ph<2, ice	
Dissolved Metals		~~500~~ 250-ml HDPE	HNO3 to ph<2, ice. **Field filter**	

End Time: 0857

Comments / Exceptions:

Groundwater Sampling Field Data

EPI Project No./Site: 45406.0/Kitsap County - Olalla Landfill

Station	MW-3	Date	4-Oct-18
Sample ID	Olalla - MW3 - 10/18	Field Team: (Initials)	ELC
Field Conditions	Sunny, high 60° Today		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	55.5
Initial Depth to Water (ft.)	43.46
Depth of Water Column	12.04
1 Casing Volume	1.81
Controller Setting (Hz)	~~143~~ 145

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

Start Time	10:04
End Time	10:34
Total Gallons Purged	15

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
10:07	1.5	6.28	0.404	—	0.74	11.6	302.0	clear
10:10	3	6.28	0.399	—	0.48	11.8	287.9	"
10:13	~~4.5~~	6.28	0.395	—	0.38	11.9	274.0	"
10:16	6	6.28	0.391	—	0.32	11.9	265.7	"
10:19	7.5	6.28	0.390	—	0.29	11.9	258.4	"
10:22	9	6.28	0.400	—	0.27	11.9	251.8	"
10:25	10.5	6.28	0.398	—	0.25	11.9	247.2	"
10:28	12	6.28	0.401	—	0.25	11.9	242.1	"
10:31	13.5	6.28	0.396	0.17	0.22	11.9	239.2	"

Sample Information

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

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	10:32	(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		500-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 10:34

Comments / Exceptions:

Groundwater Sampling Field Data

EPI Project No./Site: 45406.0/Kitsap County - Olalla Landfill

Station	MW-10	Date	4-Oct-18
Sample ID	Olalla-MW10-10/18	Field Team: (Initials)	ELC
Field Conditions	Sunny, 60°F Today		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	47
Initial Depth to Water (ft.)	28.47
Depth of Water Column	18.53
1 Casing Volume	2.78
Controller Setting (Hz)	124

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

Start Time	11:00
End Time	1127
Total Gallons Purged	Approx. 12.5

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
11:03	1	6.66	0.438	–	0.60	11.0	163.7	Cloudy
11:06	2.5	6.67	0.436	–	0.38	11.2	146.5	"
1109	4	6.67	0.437	–	0.29	11.3	135.2	"
1112	5.5	6.67	0.436	–	0.24	11.3	124.4	"
1115	7	6.67	0.437	–	0.22	11.3	120.2	"
1118	8.5	6.67	0.438	–	0.20	11.3	113.1	"
1121	10	6.67	0.439	–	0.19	11.4	109.5	"
1124	11.5	6.67	0.436	0.49	0.18	11.4	106.9	

Sample Information

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

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	11:25	(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		500-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: 1127

Comments / Exceptions:

Groundwater Sampling Field Data

EPI Project No./Site: 45406.0/Kitsap County - Olalla Landfill

Station	MW-6	Date	4-Oct-18
Sample ID	Olalla - MW6 - 10/18	Field Team: (Initials)	ELC
Field Conditions	Partly cloudy 55°F		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	35
Initial Depth to Water (ft.)	19.44
Depth of Water Column	15.56
1 Casing Volume	2.53
Controller Setting (Hz)	107

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

Start Time	12:30
End Time	1256
Total Gallons Purged	15

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1233	1	6.55	0.361	—	0.57	10.8	75.1	Slightly cloudy
1236	3	6.53	0.361	—	0.43	10.9	58.1	"
1239	5	6.53	0.361	—	0.34	10.9	51.8	"
1242	7	6.53	0.362	—	0.27	10.9	44.3	"
1245	9	6.53	0.362	—	0.25	10.9	41.6	clear
1248	11	6.53	0.363	—	0.22	10.9	37.8	"
1251	13	6.53	0.364	1.81	0.20	10.9	35.8	"

Sample Information

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

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	1252	(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		500-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 1256

Comments / Exceptions:

Groundwater Sampling Field Data

EPI Project No./Site: 45406.0/Kitsap County - Olalla Landfill

Station	MW-8	Date	4-Oct-18
Sample ID	Olalla-MW8-10/18	Field Team: (Initials)	ELC
Field Conditions	Partly cloudy 60°F and Duplicate Olalla-MW10-10/18		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	38
Initial Depth to Water (ft.)	19.92
Depth of Water Column	18.08
1 Casing Volume	2.71
Controller Setting (Hz)	102

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

Start Time	1321
End Time	1345
Total Gallons Purged	9

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1324	1	6.86	0.119	–	0.60	10.6	93.0	clear
1327	2.5	6.75	0.157		0.36	10.7	82.9	"
1330	4	6.70	0.175		0.28	10.8	79.7	"
1333	5	6.69	0.177		0.25	10.8	79.5	"
1336	6.5	6.67	0.181		0.23	10.8	79.1	"
1339	7.5	6.67	0.188	3.58	0.23	10.8	79.8	"

Sample Information

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

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	1340	(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		500-ml AG	H_2SO_4	
Total Metals		500-ml HDPE	HNO_3 to ph<2, ice	
Dissolved Metals		500-ml HDPE	HNO_3 to ph<2, ice. **Field filter**	

End Time: 1345

Comments / Exceptions:

Groundwater Sampling Field Data

EPI Project No./Site: 45406.0/Kitsap County - Olalla Landfill

Station		Date	4-Oct-18
Sample ID		Field Team: (Initials)	ELC
Field Conditions			

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	
Initial Depth to Water (ft.)	
Depth of Water Column	
1 Casing Volume	
Controller Setting (Hz)	

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		(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		500-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

Comments / Exceptions:

Groundwater Sampling Field Data

EPI Project No./Site: 45406.0/Kitsap County - Olalla Landfill

Station		Date	4-Oct-18
Sample ID		Field Team: (Initials)	ELC
Field Conditions			

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	
Initial Depth to Water (ft.)	
Depth of Water Column	
1 Casing Volume	
Controller Setting (Hz)	

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		(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		500-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

Comments / Exceptions:

Landfill Gas Monitoring Field Data - Olalla Landfill Monitoring

Instrument Used:	LandTec GEM 2000	Date and Time:	10/4/18
Ambient Temperature:	57° F	Field Team:	E, Caddy
Field Conditions:	Partly cloudy		

Landfill Gas Data

Flare #	Time	Methane (% vol.)	% LEL	Oxygen (% vol.)	Carbon Dioxide (% vol.)	Temperature (°C)	Gas Pressure ("H_2O)
3	1445	0.0	0.0	20.2	0.0		0.02
1	1453	0.2	3 ~~0~~	20.1	0.8		0.02
2	1500	0	0	19.9	1.3		0.01

Comments / Inspection Results[1]

LandTech GEM 2000 calibrated by Equipco Rental, see attached Calibration Certificate.

Rental ID - GEM200.11

Serial No GM07638104

[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: SM DATE: 10/3/18

RENTAL CUSTOMER: EPI

INSTRUMENT INFORMATION

RENTAL I.D. NUMBER: YSIPRODSS.05

SERIAL NUMBER: 16F10266

CALIBRATION INFORMATION

PARAMETER:	STANDARD:	PASS ( )	LOT #
1. CONDUCTIVITY	1,000 µMhos	X	50227
2. pH ZERO	pH 7	X	51187
pH SLOPE	pH 4	X	51238
pH SLOPE	pH 10	X	50268
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~~	~~__~~	~~N/A~~
5. REDOX (ORP)	231mV (YSI Zobell solution)	X	06137

2386 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: 10/3/18

INSTRUMENT INFORMATION

RENTAL ID: GEM2000.1

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

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested: Standard
ARI Client Company: Environmental Partners, Inc	Phone: 425-395-0010
Client Contact: Doug Kunkel	
Client Project Name: Olalla Landfill	
Client Project #: 45406.0	Samplers: E. Caddey

Page: 1	of 1
Date: 10/5/18	Ice Present?
No. of Coolers: 1	Cooler Temps: 2.4

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Analytical Chemists and Consultants
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206-695-6200 206-695-6201 (fax)
www.arilabs.com

Sample ID	Date	Time	Matrix	No. Containers	Analysis Requested: VOCs (8260C)	Dissolved Metals	Total Metals	Conventional	TOC/DOC	Total Coliforms			Notes/Comments
Olalla-MW1-10/18	10/4/18	0855	water	9	X	X	X	X	X	X			-See email for complete list
Olalla-MW3-10/18	10/4/18	1032			X	X	X	X	X	X			
Olalla-MW10-10/18	10/4/18	1125			X	X	X	X	X	X			
Olalla-MW6-10/18	10/4/18	1252			X	X	X	X	X	X			
Olalla-MW8-10/18	10/4/18	1340			X	X	X	X	X	X			
Olalla-MW12-10/18	10/4/18	—	↓	↓	X	X	X	X	X	X			
Trip Blank	—	—	water	2	X								

Comments/Special Instructions	Relinquished by: (Signature)	Received by: (Signature)	Relinquished by: (Signature)	Received by: (Signature)
	Printed Name: E.W. Caddey	Printed Name: Stephanie Fishel	Printed Name:	Printed Name:
	Company: EPI	Company: ARI	Company:	Company:
	Date & Time: 10/5/18 0815	Date & Time: 10-5-18 0815	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

ENVIRONMENTAL PARTNERS INC

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

Olalla Landfill Quarterly Monitoring Field Book December 2018

Olalla Landfill
Kitsap County, Washington
Project Number: 45406.0

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

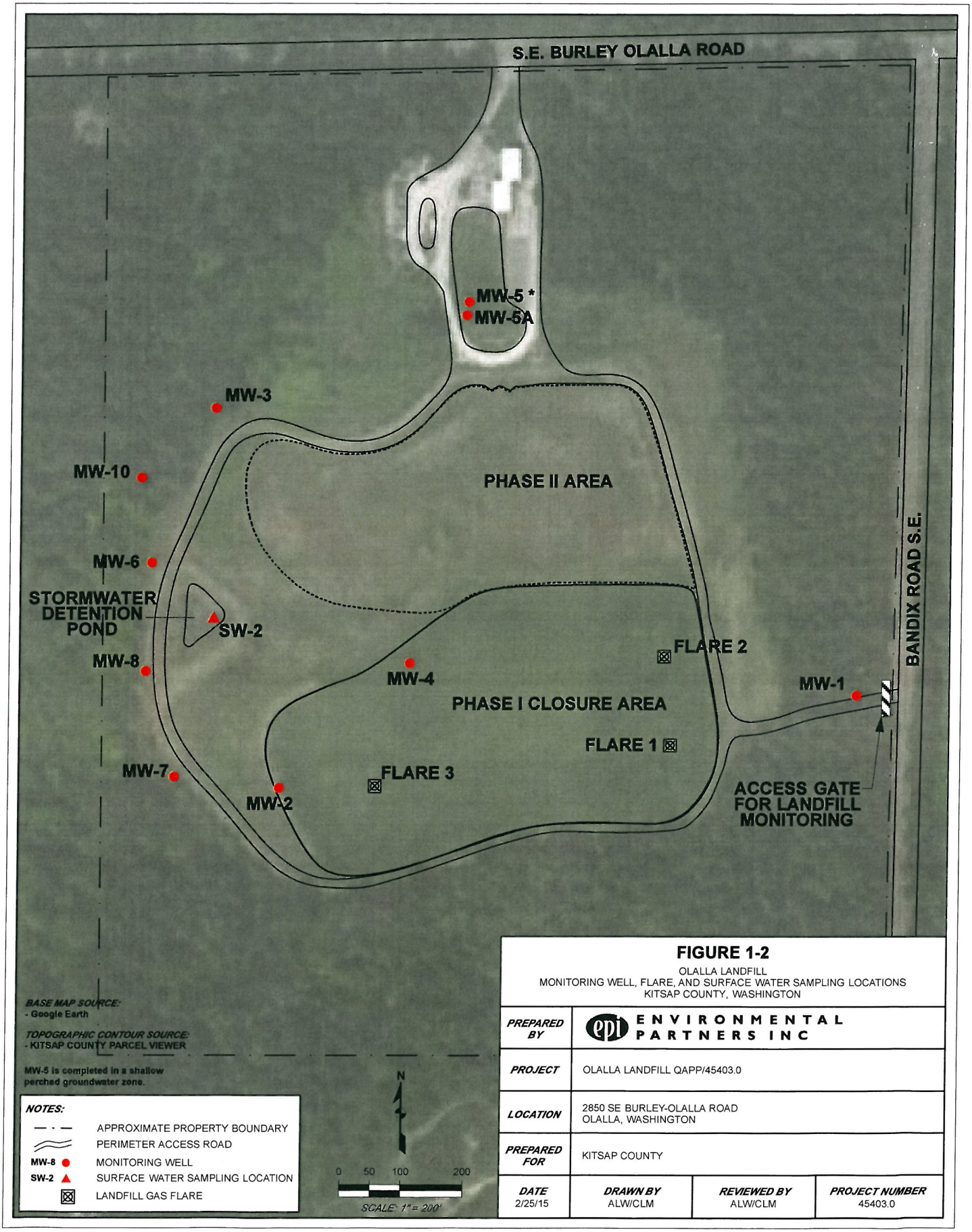


FIGURE 1-2

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

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

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

For YSI multimeter - 566 calibration cert from Equipco
For GEM 2000 Landfill gas meter - 566 calibration cert from Equipco } attached

Instrument Calibration Log - Olalla Landfill Monitoring

Calibrated By: E. Cadd V **Date:** 12/18/18

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.	LaMotte	2020we	3566	—	08:20

Specific Conductance: Calibrated 9.5 µS/cm to 10 µS/cm calibration standa

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 standa Comments:

Meter reads _____ NTUs using _____ NTUs standa

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:

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	0838	343.79	75.46	
MW-2	15:34	323.25	63.12	
MW-3	10:40	296.95	43.40	
MW-4	15:39	320.93	60.30	
MW-5	0941	334.17	9.28	
MW-5A	0943	332.53	73.82	
MW-6	1245	271.17	17.70	
MW-7	1435	280.43	23.30	
MW-8	13:46	272.85	29.57	
MW-10	1138	279.21	27.66	

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: 45406.0/Kitsap County - Olalla Landfill

Station	MW-1	Date	18-Dec-18
Sample ID	MW1-[illegible]GW-121818	Field Team: (Initials)	ELC
Field Conditions	light rain 50°F		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	87
Initial Depth to Water (ft.)	75.46
Depth of Water Column	11.54
1 Casing Volume	1.8
Controller Setting (Hz)	209

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

Start Time	0858
End Time	0918
Total Gallons Purged	9

Time	Gallons	pH	Conductivity (mS/cm)	NTU	DO (mg/L)	Temp. (°C)	ORP (mV)	Appearance
0900	2.5	6.46	0.105		10.33	10.7	233.8	clear
0903	5	6.44	0.105		10.29	10.8	237.7	"
0906	7	6.44	0.105		10.24	10.8	242.2	"
0909	10	6.45	0.105		10.24	10.8	245.1	"
0912	12.5	6.45	0.105		10.29	10.8	246.2	"
0915	15	6.45	0.105	0.8	10.28	10.8	247.8	"

Sample Information

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

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	0915	(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**	

End Time: 0915 0918

Comments / Exceptions:

Groundwater Sampling Field Data

EPI Project No./Site: 45406.0/Kitsap County - Olalla Landfill

Station	MW-5A	Date	18-Dec-18
Sample ID	MW5A-Grw-121818	Field Team: (Initials)	ELC
Field Conditions	light rain, 50°F		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	98
Initial Depth to Water (ft.)	73.82
Depth of Water Column	24.18
1 Casing Volume	3.86
Controller Setting (Hz)	20.3

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

Start Time	0955
End Time	1015
Total Gallons Purged	13.5

Time	Gallons	pH 6.78	Conductivity	NTU	DO	Temp.	ORP	Appearance
0958	1.5	[illegible]	0.100		9.78	11.2	190.3	slightly cloudy
1001	4.5	6.74	0.101		9.81	11.5	190.8	"
1004	6	6.73	0.101		9.85	11.5	195.3	cloudy
1007	8	6.74	0.102		9.87	11.5	197.9	"
1010	10	6.73	0.102		9.85	11.5	199.2	"
1012	12.5	6.75	0.102	7.8	9.85	11.5	200.6	clear

Sample Information

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

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	1013	~~(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**	

End Time 1015

Comments / Exceptions:

Groundwater Sampling Field Data

EPI Project No./Site: 45406.0/Kitsap County - Olalla Landfill

Station	MW-3	Date	18-Dec-18
Sample ID	MW3-GW-12/18	Field Team: (Initials)	ELC
Field Conditions	Rain, 50°F		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	55.5
Initial Depth to Water (ft.)	43.40
Depth of Water Column	12.10
1 Casing Volume	1.93
Controller Setting (Hz)	143

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

Start Time	1055
End Time	1124
Total Gallons Purged	13

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1058	.5	6.19	0.468		2.42	11.2	258.2	Slight/ cloudy
1101	2	6.27	0.461		1.00	11.7	249.1	Clear
1104	3.5	6.25	0.462		0.78	11.9	241.9	"
1107	5	6.29	0.462		0.80	12.0	234.1	"
1110	6	6.30	0.459		0.51	11.9	225.9	"
1113	7.5	6.31	0.457		0.46	11.9	221.2	"
1116	8.5	6.32	0.457		0.45	12.0	220.0	"
1119	10	6.32	0.460	0.23	0.44	12.0	220.8	

Sample Information

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

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	1120	(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**	

End Time 1124

Comments / Exceptions:

Groundwater Sampling Field Data

EPI Project No./Site: 45406.0/Kitsap County - Olalla Landfill

Station	MW-10	Date	18-Dec-18
Sample ID	MW10-GW-121/18 and Duplicate as MW13-GW-121/18	Field Team: (Initials)	ELC
Field Conditions			

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	47
Initial Depth to Water (ft.)	27.66
Depth of Water Column	19.34
1 Casing Volume	3.09
Controller Setting (Hz)	125

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

Start Time	1150
End Time	1225
Total Gallons Purged	18.5

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1154	2	6.63	0.465		0.92	11.1	125.7	slight HC cloudy
1156	4.5	6.62	0.467		0.59	11.2	117.0	cloudy
1202	7	6.62	0.464		0.45	11.2	110.7	"
1205	9	6.62	0.464		0.40	11.3	106.1	"
1208	11	6.62	0.463		0.37	11.2	103.2	"
1211	12.5	6.62	0.467		0.33	11.2	99.9	"
1214	14.5	6.62	0.465		0.32	11.2	98.0	"
1217	16.5	6.62	0.467	.98	0.31	11.2	97.1	"

Sample Information

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

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	12.18	(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 1225

Comments / Exceptions:

Duplicate MW13-GW-121/18

Groundwater Sampling Field Data

EPI Project No./Site: 45406.0/Kitsap County - Olalla Landfill

Station	MW-6	Date	18-Dec-18
Sample ID	MW6-GW-12/18	Field Team: (Initials)	ELC
Field Conditions	Showers, 50°F		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	35
Initial Depth to Water (ft.)	17.70
Depth of Water Column	17.30
1 Casing Volume	2.77
Controller Setting (Hz)	10.7

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

Start Time	1254
End Time	1325
Total Gallons Purged	19

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1857	2	6.58	0.269		1.21	11.1	48.4	Clear
1300	5	6.56	0.273		0.69	11.2	35.7	"
1303	6.5	6.55	0.275		0.52	11.2	30.5	"
1306	9	6.55	0.276		0.45	11.2	27.5	"
1309	11	6.55	0.276		0.35	11.2	24.5	"
1313	13.5	6.55	0.277		0.35	11.2	22.9	"
1316	15	6.55	0.277		0.33	11.2	21.6	"
1319	17.5	6.55	0.278	2.20	0.32	11.2	20.5	"

Sample Information

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

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	13:20	(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 1325

Comments / Exceptions:

Groundwater Sampling Field Data

EPI Project No./Site: 45406.0/Kitsap County - Olalla Landfill

Station	MW-8	Date	18-Dec-18
Sample ID	MW8-GW-12/18	Field Team: (Initials)	ELC
Field Conditions	Windy, 50°F		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	38
Initial Depth to Water (ft.)	29.57
Depth of Water Column	8.43
1 Casing Volume	1.34
Controller Setting (Hz)	102

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

Start Time	1354
End Time	14:24
Total Gallons Purged	17

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1357	1.5	6.42	0.386		1.10	11.0	67.2	slightly cloudy
1400	3.5	6.42	0.377		0.66	11.1	60.4	cloudy
1403	5.5	6.41	0.363		0.47	11.1	57.5	"
1406	7.5	6.42	0.359		0.41	11.1	56.1	"
1409	9.5	6.42	0.354		0.37	11.1	54.2	"
1413	11	6.42	0.345		0.33	11.1	52.8	clear
1416	13	6.42	0.344		0.31	11.1	52.5	"
1419	15	6.43	0.343	1.62	0.31	11.1	52.2	"

Sample Information

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

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	1420	(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 1424

Comments / Exceptions:

Groundwater Sampling Field Data

EPI Project No./Site: 45406.0/Kitsap County - Olalla Landfill

Station	MW-7	Date	18-Dec-18
Sample ID	MW7-GW-121818	Field Team: (Initials)	ELC
Field Conditions	Showers, 45°F		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	33
Initial Depth to Water (ft.)	23.30
Depth of Water Column	9.70
1 Casing Volume	1.55
Controller Setting (Hz)	114

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

Start Time	1438
End Time	1506
Total Gallons Purged	8

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1441	1	6.64	0.059		7.54	10.6	170.6	Clear
1444	2	6.60	0.059		7.39	10.8	177.9	"
1448	2.75	6.58	0.059		7.33	10.9	185.8	"
1451	4	6.56	0.059		7.29	11.0	192.7	"
1454	5	6.57	0.059		7.28	11.0	196.5	"
1457	6	6.56	0.059		7.26	10.9	199.9	"
1500	7	6.57	0.059	1.32	7.25	10.9	200.2	"

Sample Information

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

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles and VC	1502	(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 1506

Comments / Exceptions:

Surface Water Sampling Field Data - Olalla Landfill Monitoring

Station	SW-2	Date	12/18/18
Sample: ID	SW2-12/18	Field Team: (Initials)	EC
Field Conditions	Rain, heavy at times. Temp 50°F		

Field Parameter Data

Time	pH	Specific Conductance	Temperature (°C)	Appearance and Flow Rate
0817	7.52	0.041 mS/cm	8.2	≈60 gpm, slight amber color

Sample Information

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Fecal Coliform	0815	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: 0815

Comments / Exceptions:

- Pond is full up to the out flow, water flowing out of out flow pipe. Heavy rain all night.

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:	GEM 2000	Date and Time:	12/18/18 15:48
Ambient Temperature:	48°F	Field Team:	E. Caddy
Field Conditions:	windy w/showers		

Landfill Gas Data

Flare #	Time	Methane (% vol.)	% LEL	Oxygen (% vol.)	Carbon Dioxide (% vol.)	Temperature (°C)	Gas Pressure ("H_2O)
3	15:50	0	0	20.8	0	—	0.01
1	1600	0	0	20.8	0	—	0.03
2	"	0.1	1	20.8	0	—	0.03

Comments / Inspection Results[1]

[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: [illegible] DATE: 12/17/18

RENTAL CUSTOMER: EPJ

INSTRUMENT INFORMATION

RENTAL I.D. NUMBER: YSIPRODSS. 05

SERIAL NUMBER: 16F102616

CALIBRATION INFORMATION

PARAMETER:	STANDARD:	PASS ( )	LOT #
1. CONDUCTIVITY	1,000 µMhos	X	S0227
2. pH ZERO	pH 7	X	S1187
pH SLOPE	pH 4	X	S3605
pH SLOPE	pH 10	X	S4049
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	12616

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: DM DATE: 12/17/18

INSTRUMENT INFORMATION

RENTAL ID: GEM2000. 11

SERIAL NUMBER: GM07638/041

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

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested: Standard
ARI Client Company: Environmental Partners, Inc.	Phone: 425-395-0010
Client Contact: Doug Kunkel	
Client Project Name: Olalla Landfill	
Client Project #: 45406.0	Samplers: E. Caddey

Page: 1	of 2
Date: 12/19/18	Ice Present?
No. of Coolers:	Cooler Temps: 2.1

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)
www.arilabs.com

Sample ID	Date	Time	Matrix	No. Containers	Analysis Requested: VOCs + VC	Dissolved Metals	Total Metals	Geochem	TOC/COD	Total Coliforms			Notes/Comments
MW1-GW-12/18	12/18/18	0915	water	9	X	X	X	X	X	X			SOG email for
MW3-GW-12/18		1120			X	X	X	X	X	X			complete analyte
MW10-GW-12/18		1218			X	X	X	X	X	X			list.
MW6-GW-12/18		1321			X	X	X	X	X	X			
MW8-GW-12/18		1420			X	X	X	X	X	X			
MW13-GW-12/18		—		↓	X	X	X	X	X	X			
Trip Blank	↓	—	↓	2	X								

Comments/Special Instructions	Relinquished by: (Signature)	Received by: (Signature)	Relinquished by: (Signature)	Received by: (Signature)
	Printed Name: Eric Caddey	Printed Name: Jasmine Bauman	Printed Name:	Printed Name:
	Company: EPI	Company: ARI	Company:	Company:
	Date & Time: 12/19/18 0825	Date & Time: 12/19/18 825	Date & Time: 825	Date & Time:

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:	Turn-around Requested: Standard
ARI Client Company: Environmental Partners, Inc.	Phone: 425-395-0010
Client Contact: Doug Kunkel	
Client Project Name: Olalla Olalla Landfill	
Client Project #: 45406.0	Samplers: E. Caddey

Page: 2	of 2		
Date: 12/19/18	Ice Present?		
No. of Coolers:	Cooler Temps:		

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)
www.arilabs.com

Sample ID	Date	Time	Matrix	No. Containers	Fecal coliform	Nitrate-Nitrogen	pH	Vinyl Chloride by SIM	Dissolved metals				Notes/Comments
SW2-12/18	12/18/18	0815	water	3	X	X	X						
MW5A-GW-12/18	12/18/18	1013	"	3			X	X	X				
MW7-GW-12/18	12/18/18	1502	"	3			X	X	X				

Comments/Special Instructions	Relinquished by:	Received by:	Relinquished by:	Received by:
	(Signature) [signature]	(Signature) [signature]	(Signature)	(Signature)
	Printed Name: Eric Caddey	Printed Name: Jasmine Bauman	Printed Name:	Printed Name:
	Company: EPI	Company: ARI	Company:	Company:
	Date & Time: 12/19/18 0825	Date & Time: 12/19/18 825	Date & Time:	Date & Time:

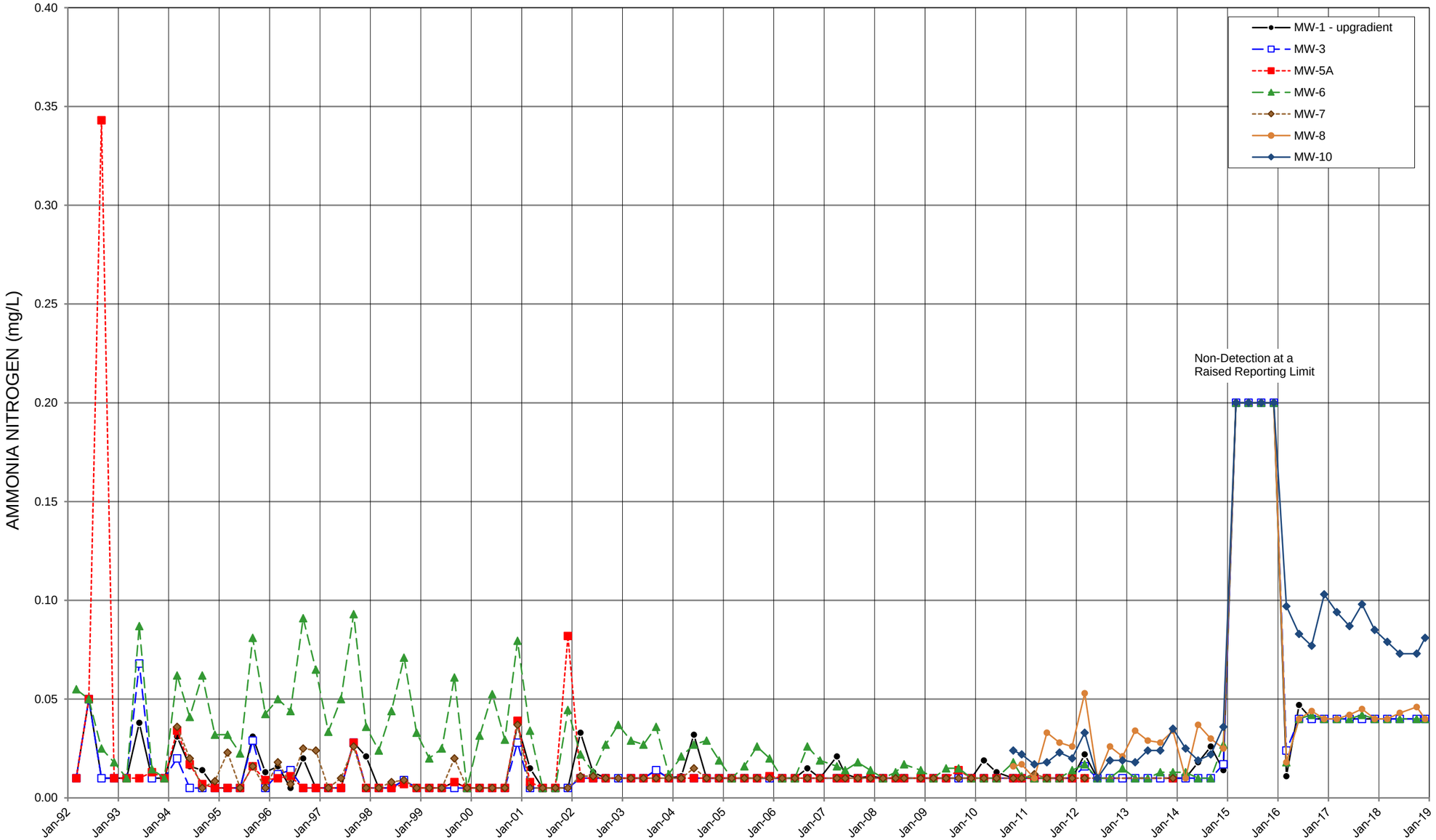
Limits of Liability: ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the Invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

Appendix C:
2018 Statistical Summaries

Time-Series Plots through December 2018
Mann-Kendall Statistically Significant Trend Test Summary Tables
Shapiro-Wilk Test for Normality Summary Tables
Confidence Interval Summary Tables

OLALLA LANDFILL
Quarterly Monitoring Data

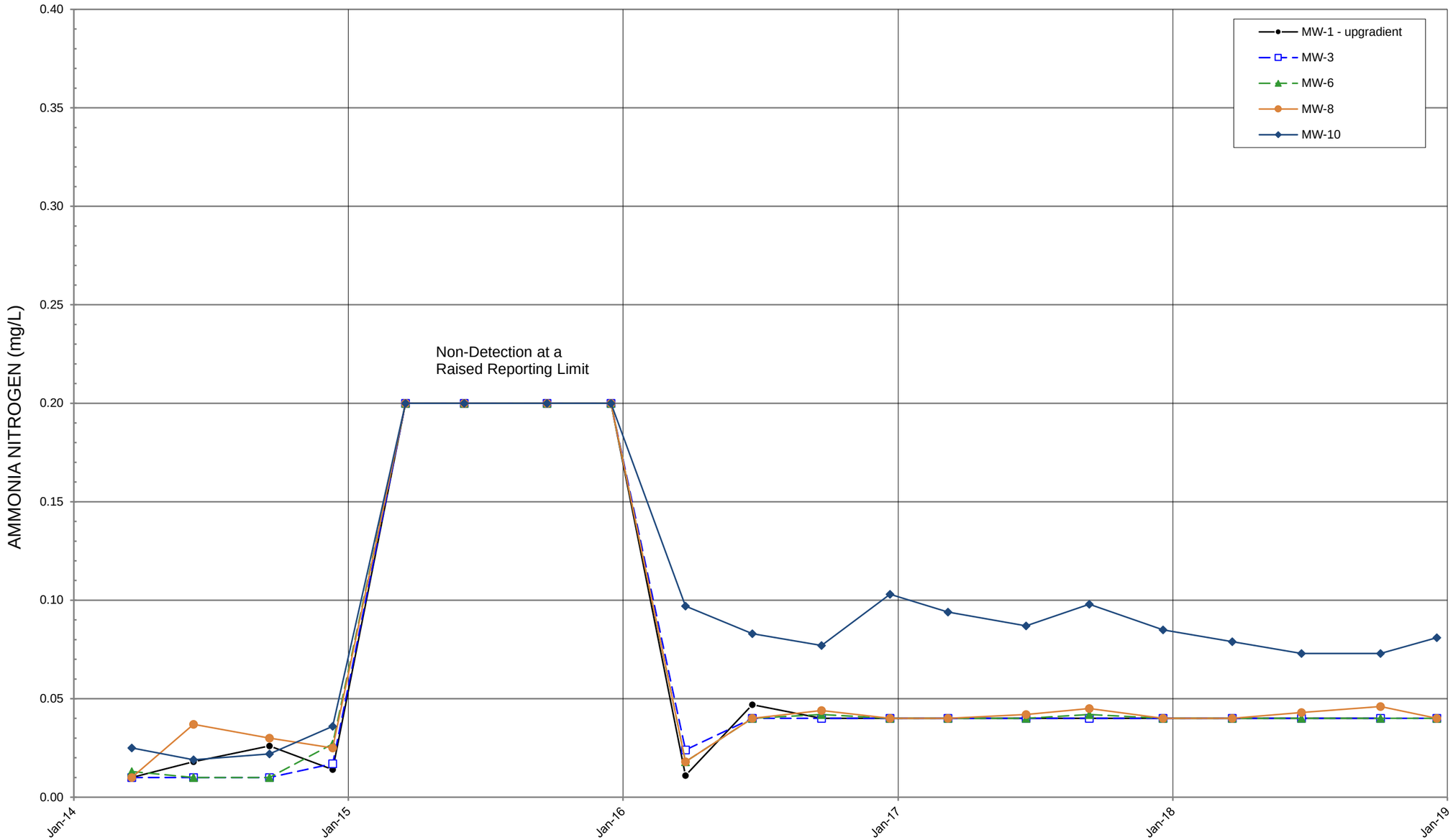


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

AMMONIA
NITROGEN

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

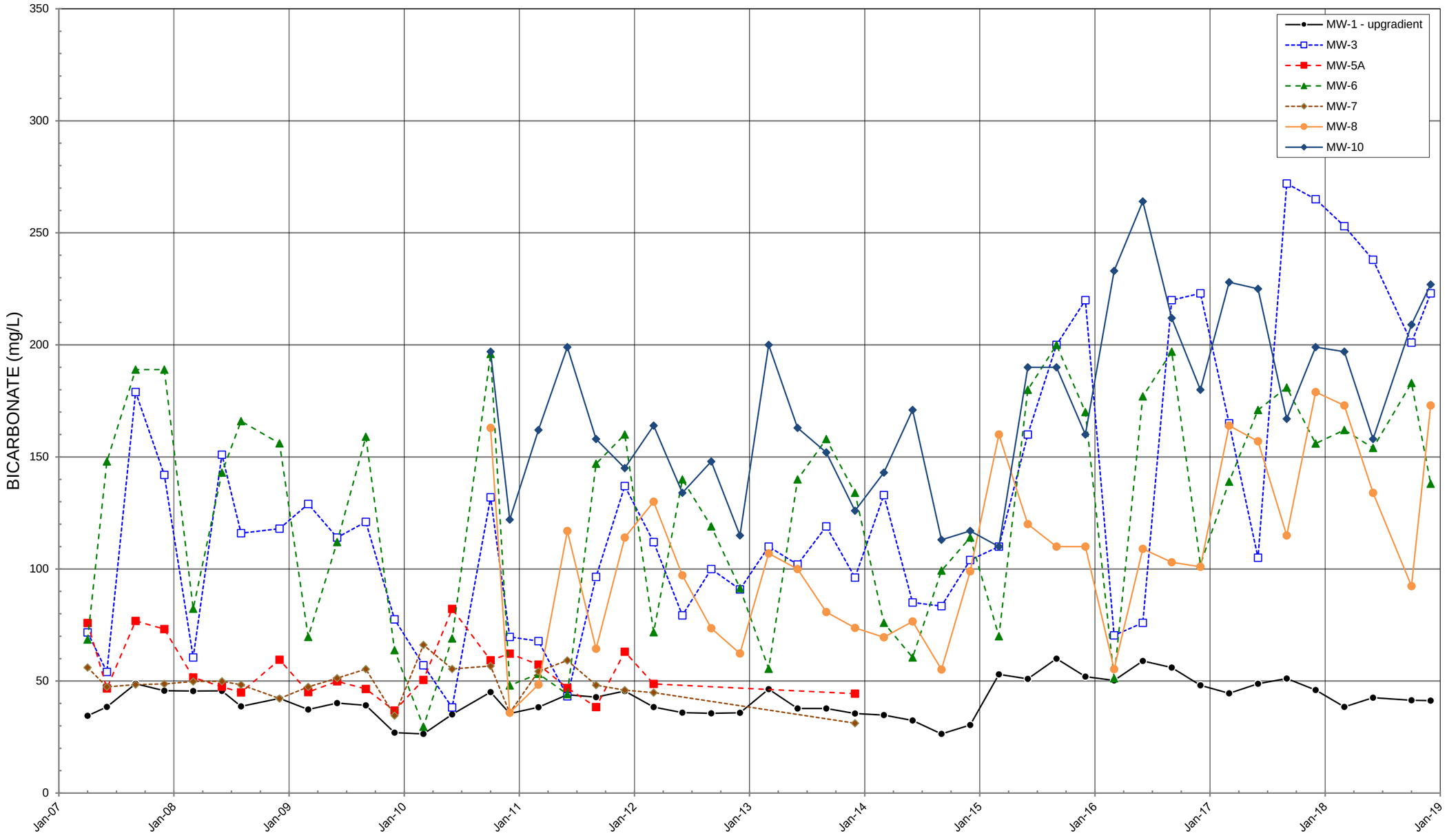


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

AMMONIA NITROGEN
(RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

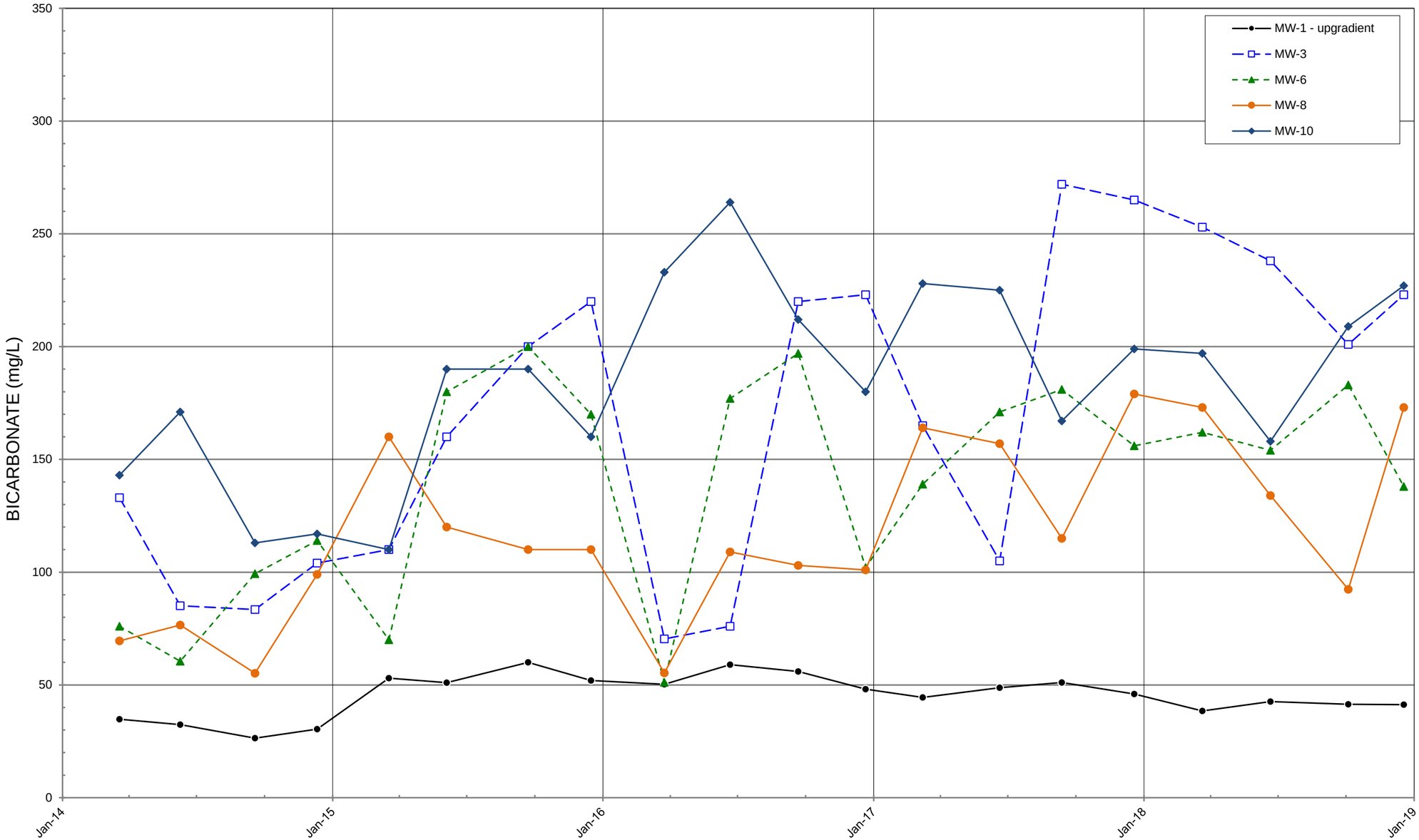


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

BICARBONATE
(Analysis started in 2007)

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

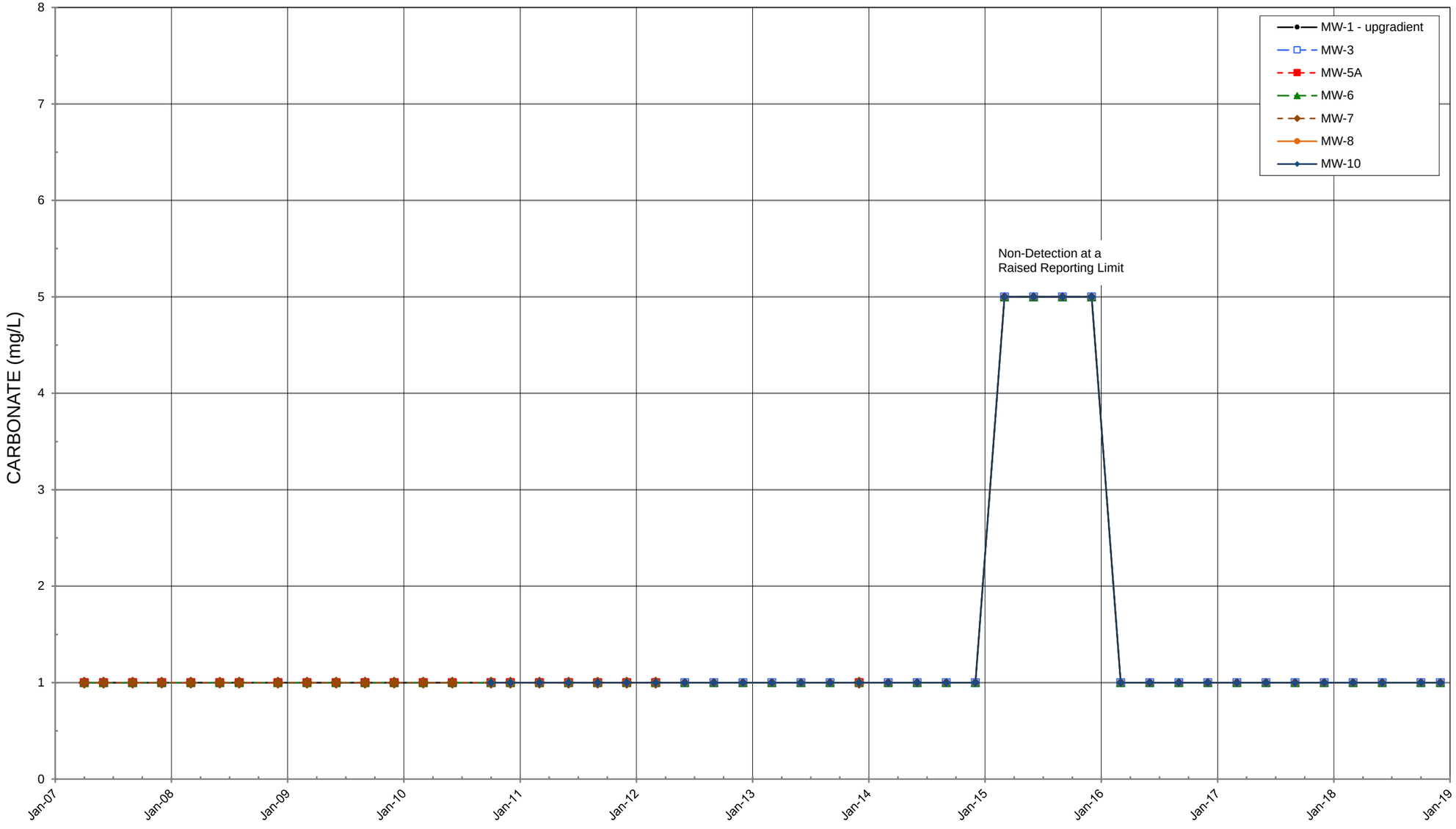


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

BICARBONATE
(RECENT)

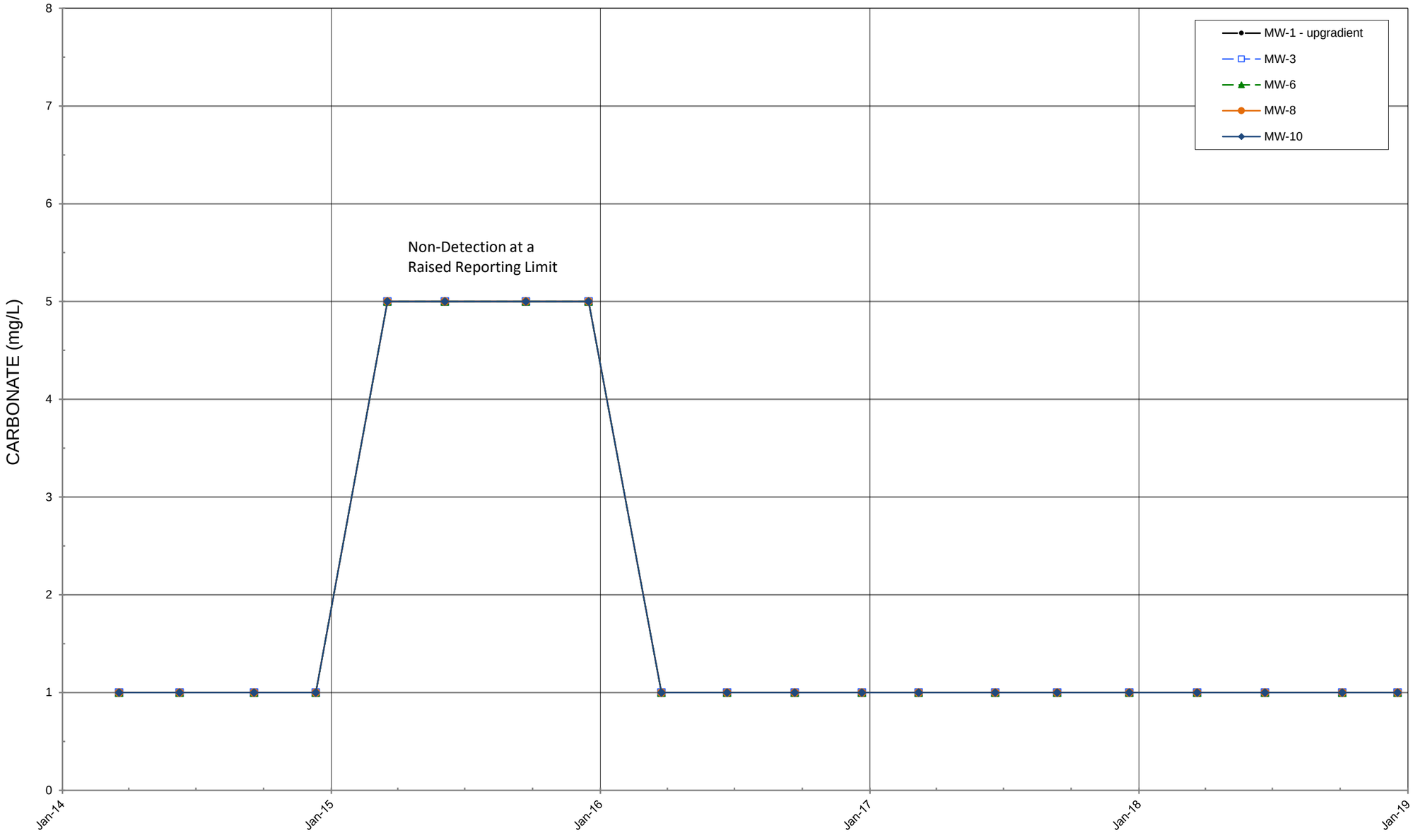
OLALLA LANDFILL
Quarterly Monitoring Data



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

CARBONATE
(Analysis started in 2007)

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

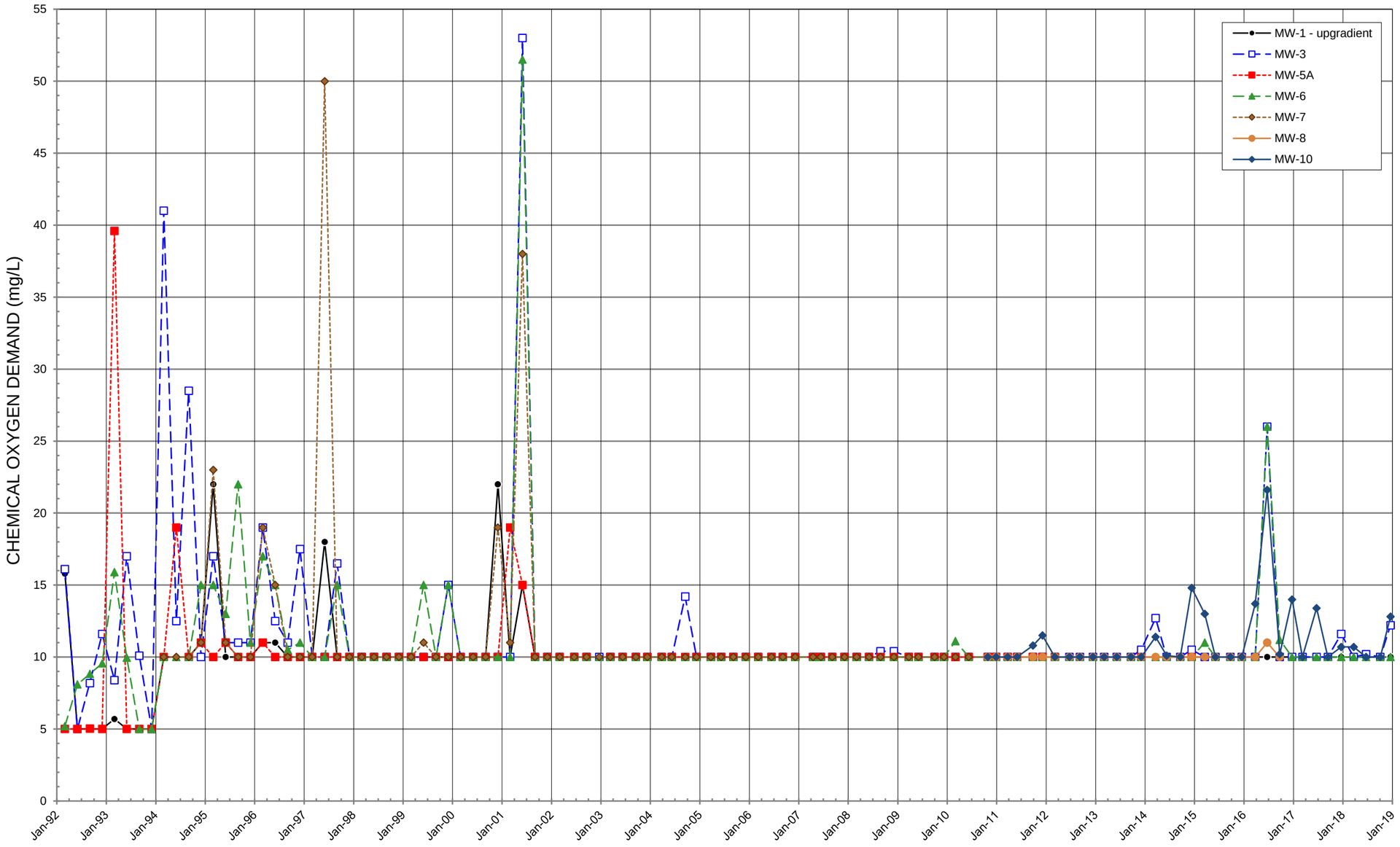


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

CARBONATE
(RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

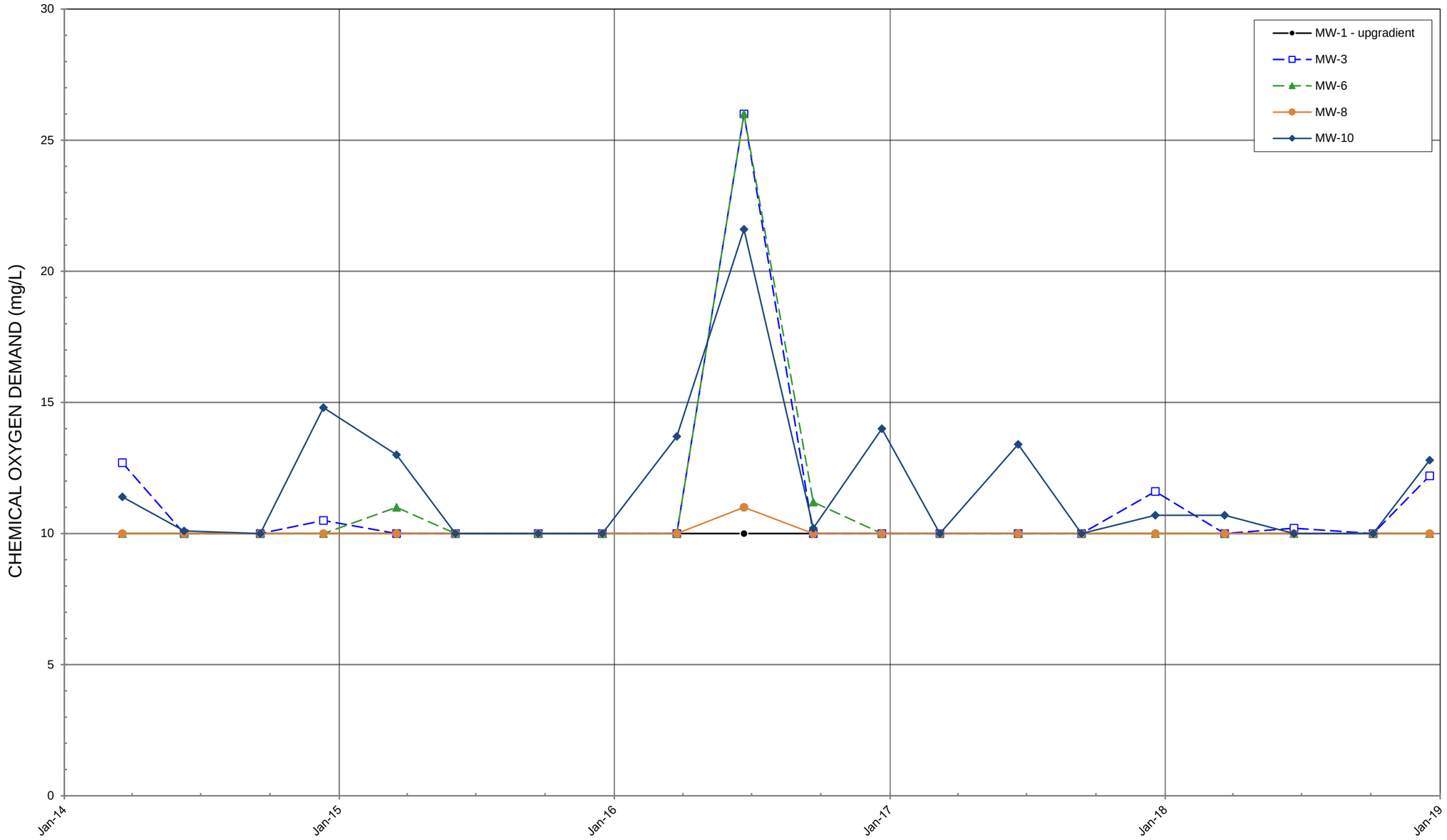


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

CHEMICAL OXYGEN DEMAND

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

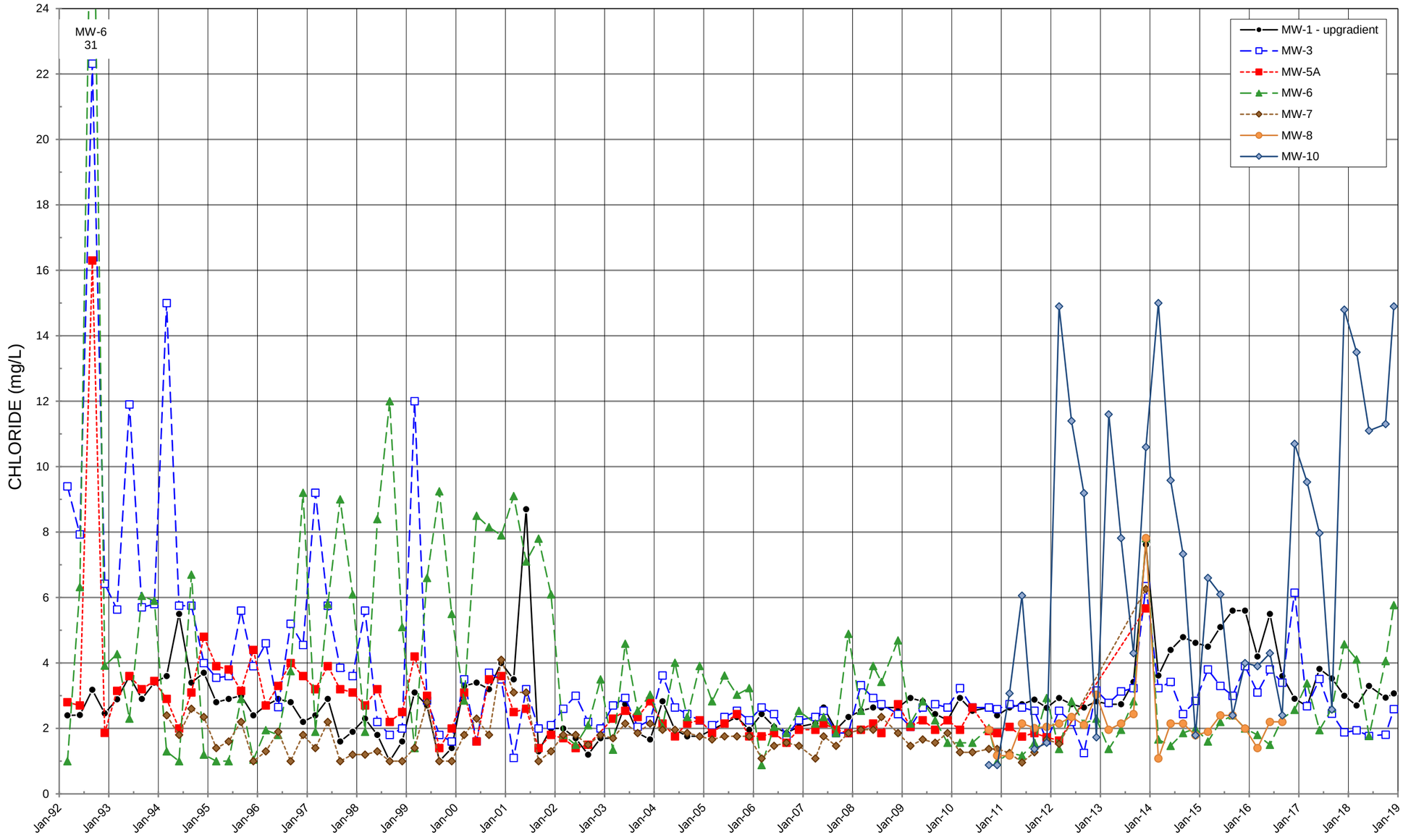


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

CHEMICAL OXYGEN DEMAND (RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

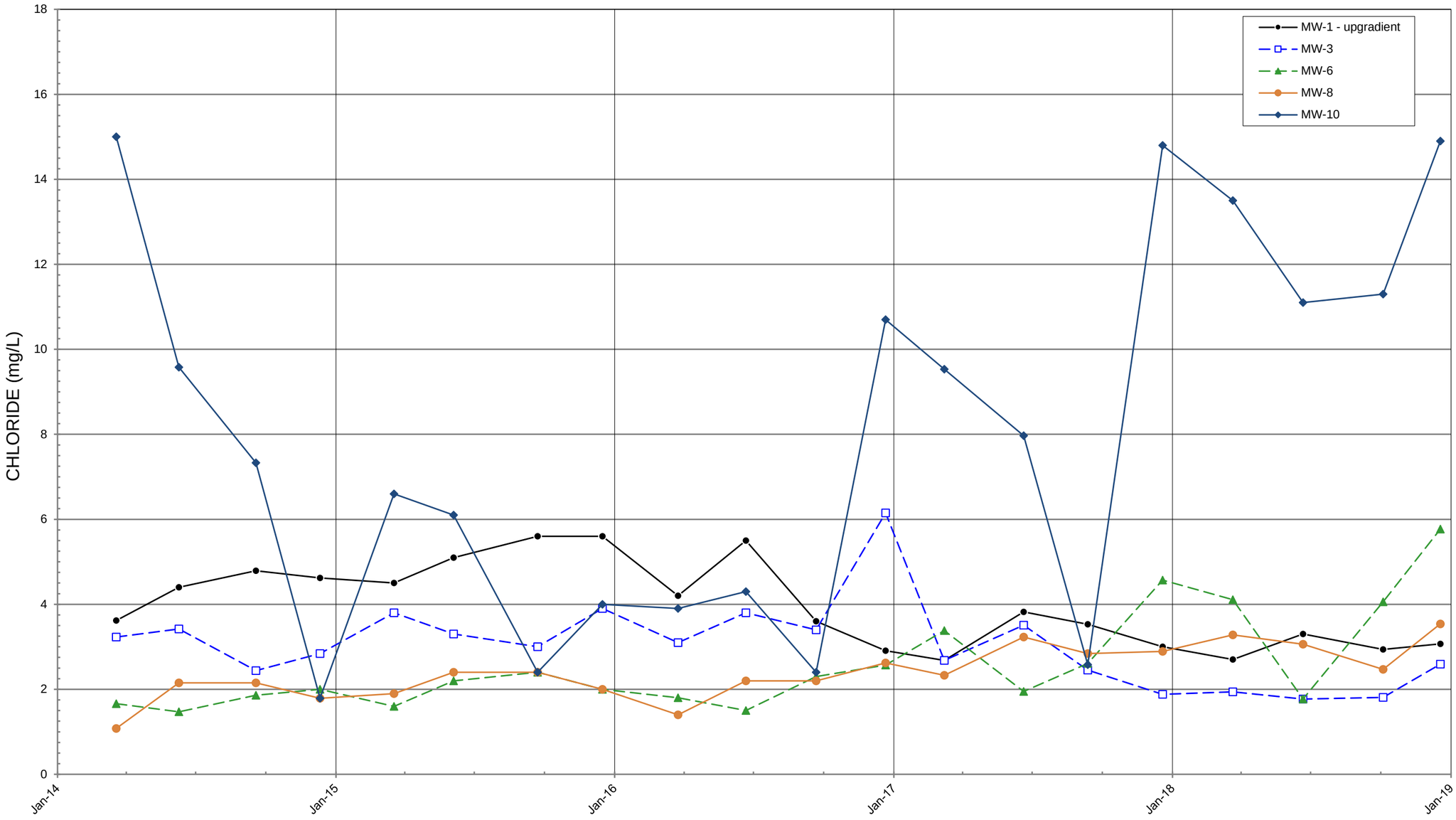


Secondary Drinking Water Standard (DWS) = 250 mg/L (off scale)
Secondary Groundwater Standard (GWS) = 250 mg/L (off scale)

DATE

CHLORIDE

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

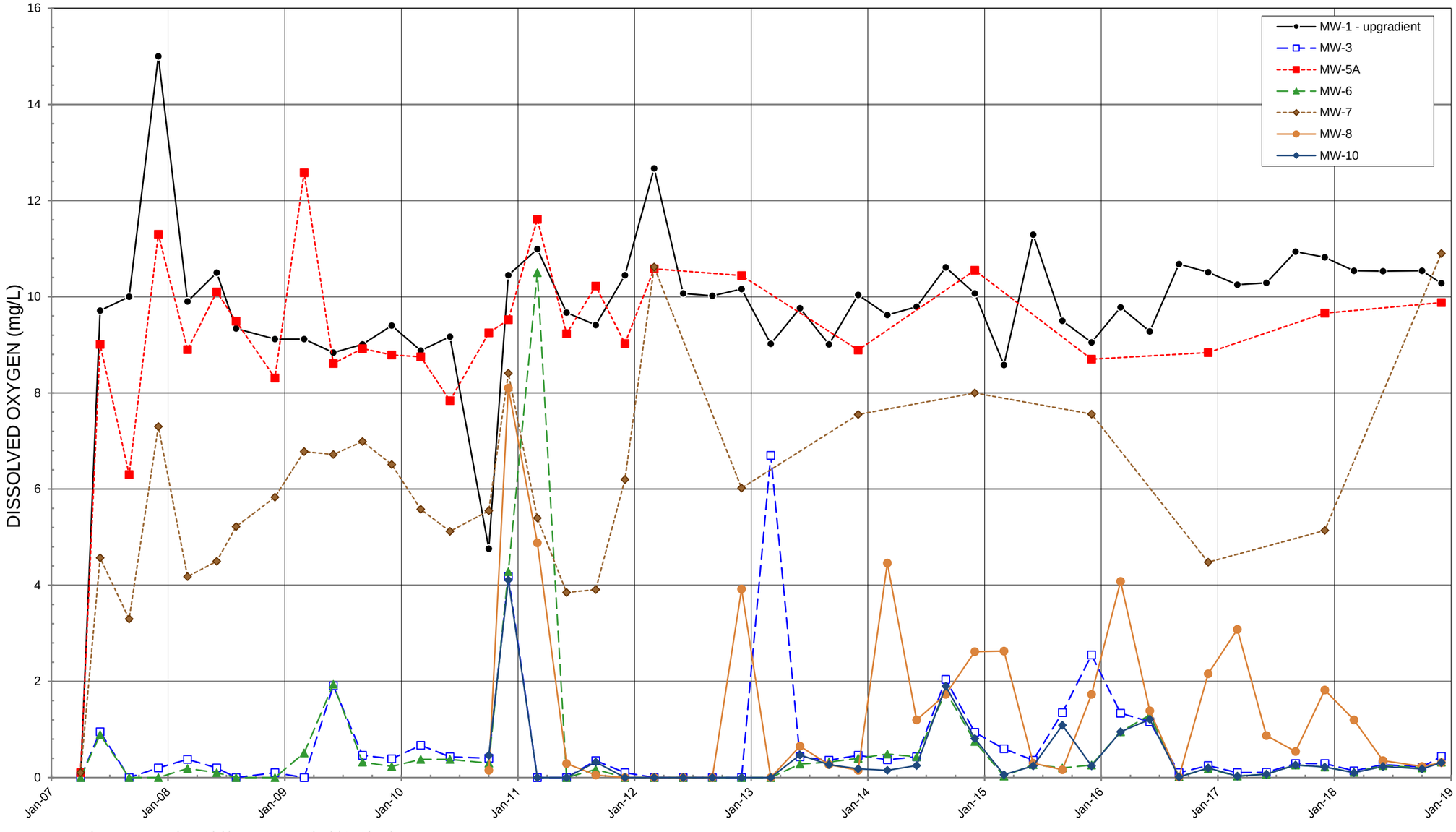


Secondary Drinking Water Standard (DWS) = 250 mg/L (off scale)
Secondary Groundwater Standard (GWS) = 250 mg/L (off scale)

DATE

CHLORIDE (RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

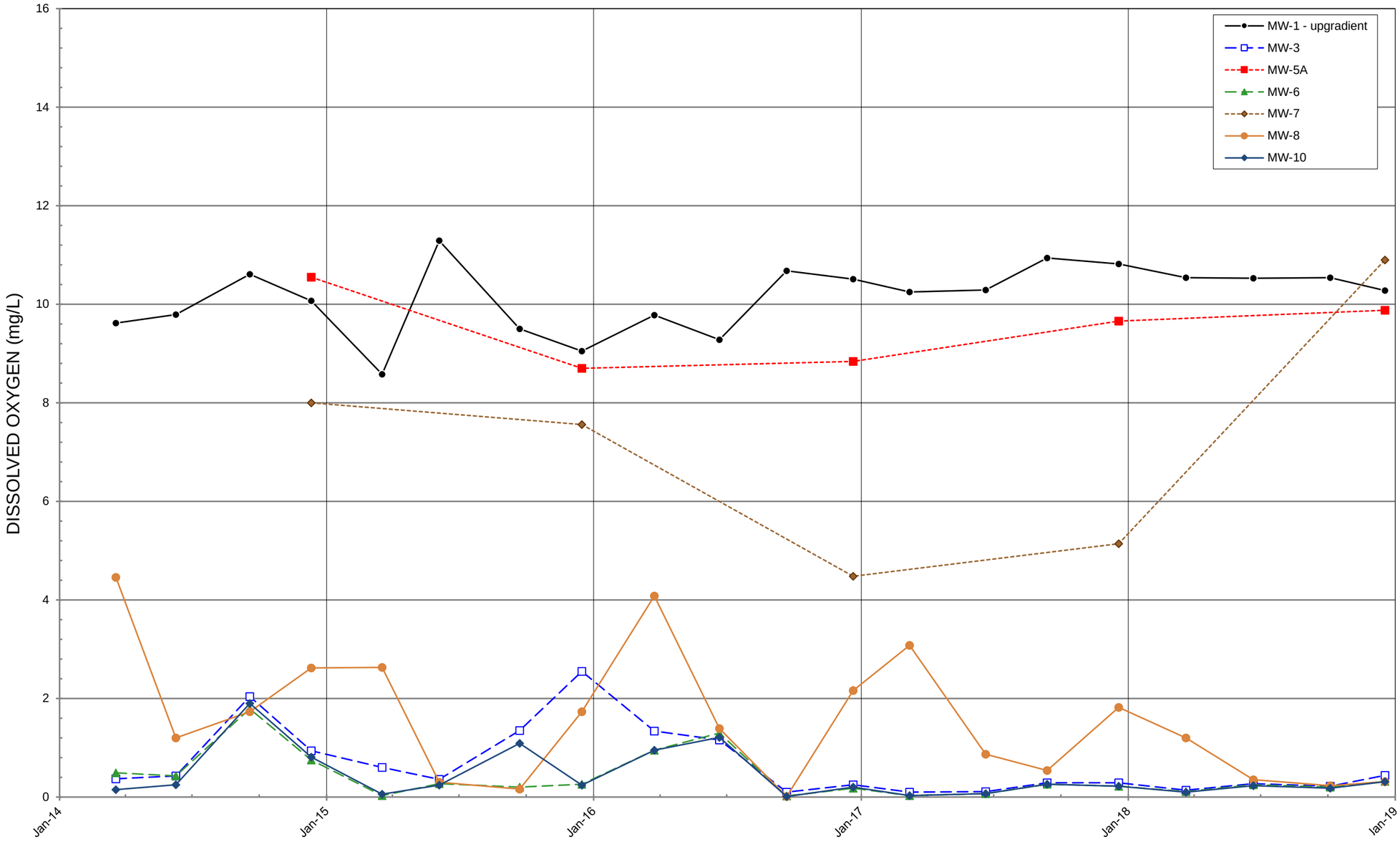


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

DISSOLVED OXYGEN
(Analysis started in 2007)

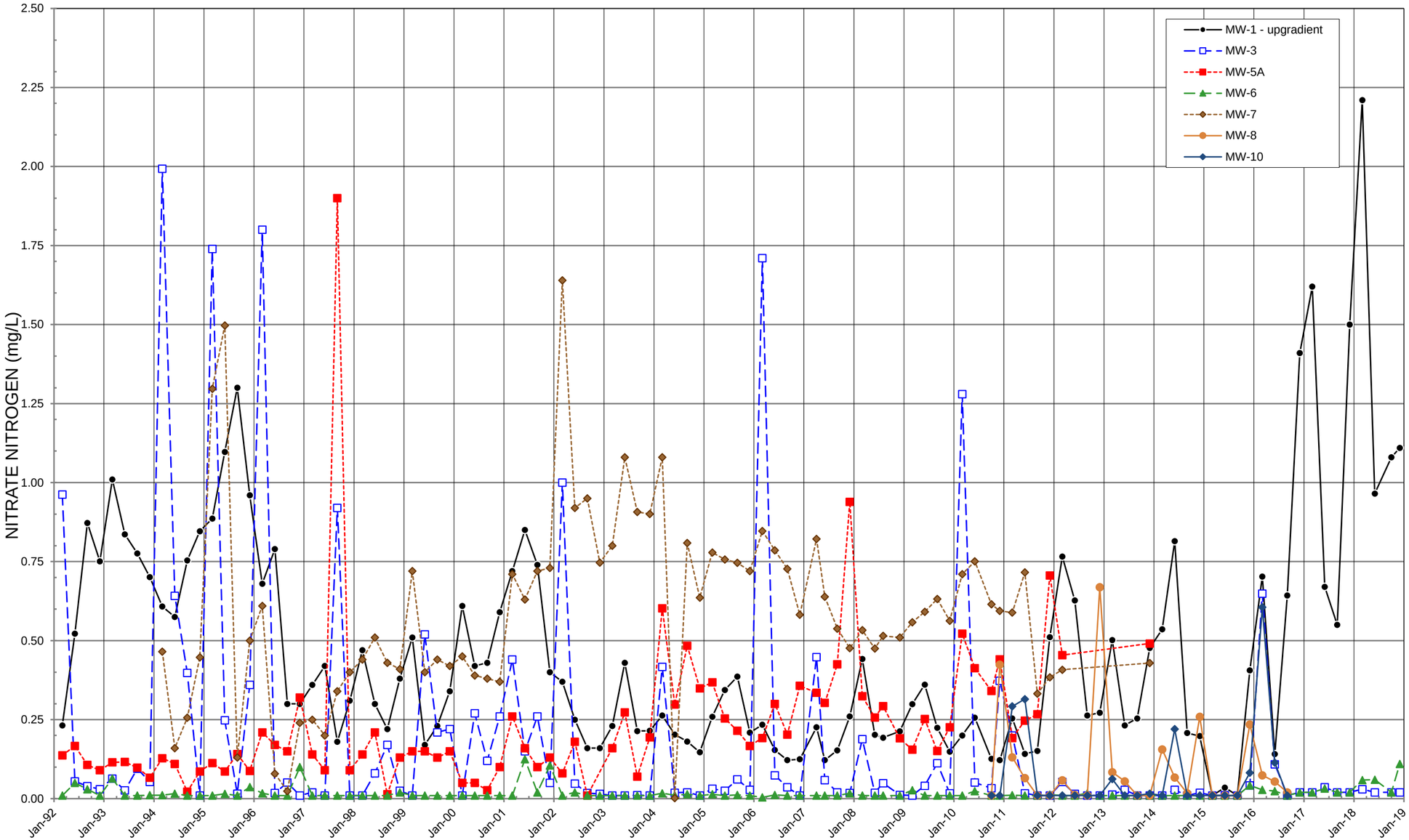
OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)



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

DISSOLVED OXYGEN
(RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

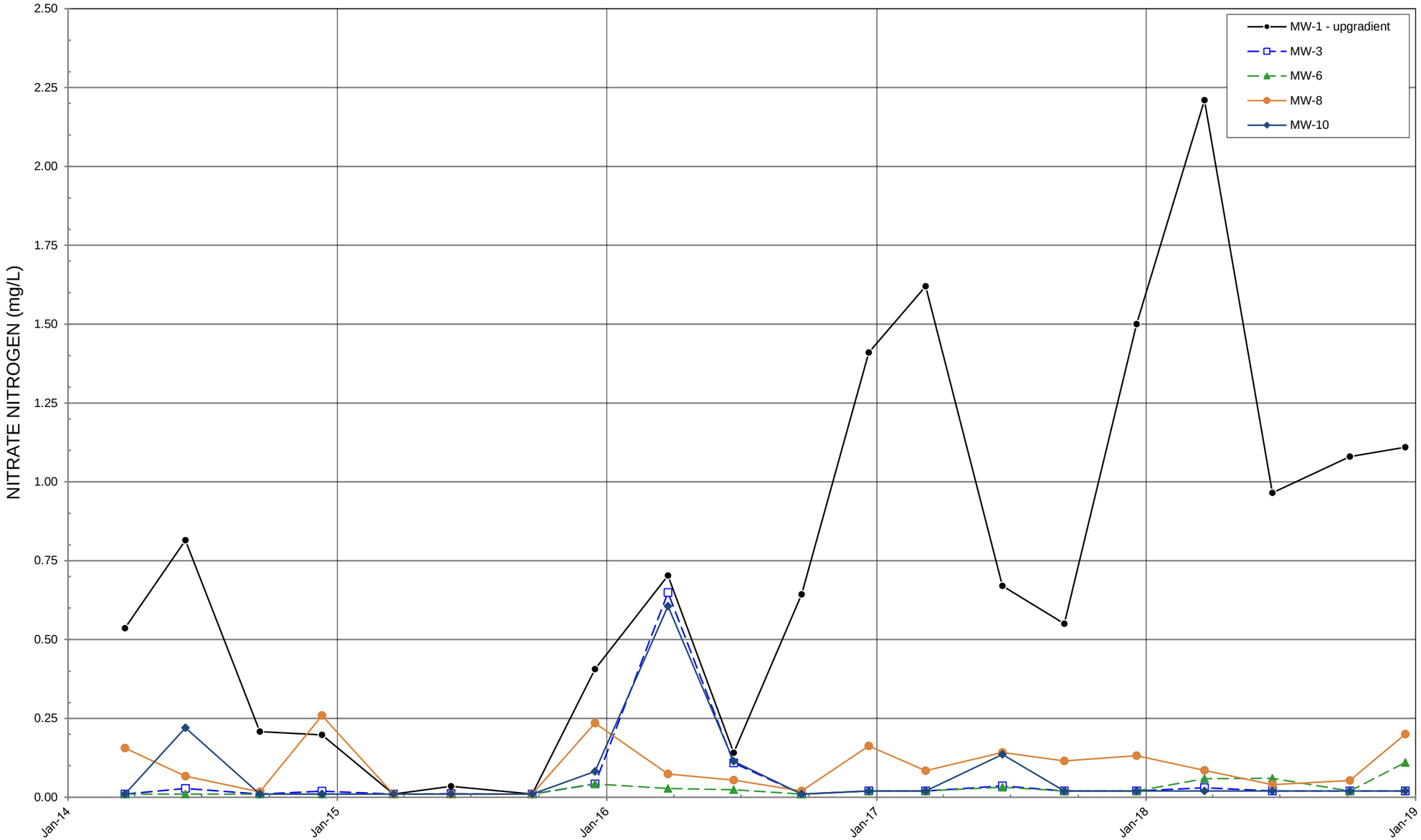


Primary Drinking Water Standard (DWS) = 10 mg/L (off scale)
Primary Groundwater Standard (GWS) = 10 mg/L (off scale)

DATE

NITRATE
NITROGEN

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

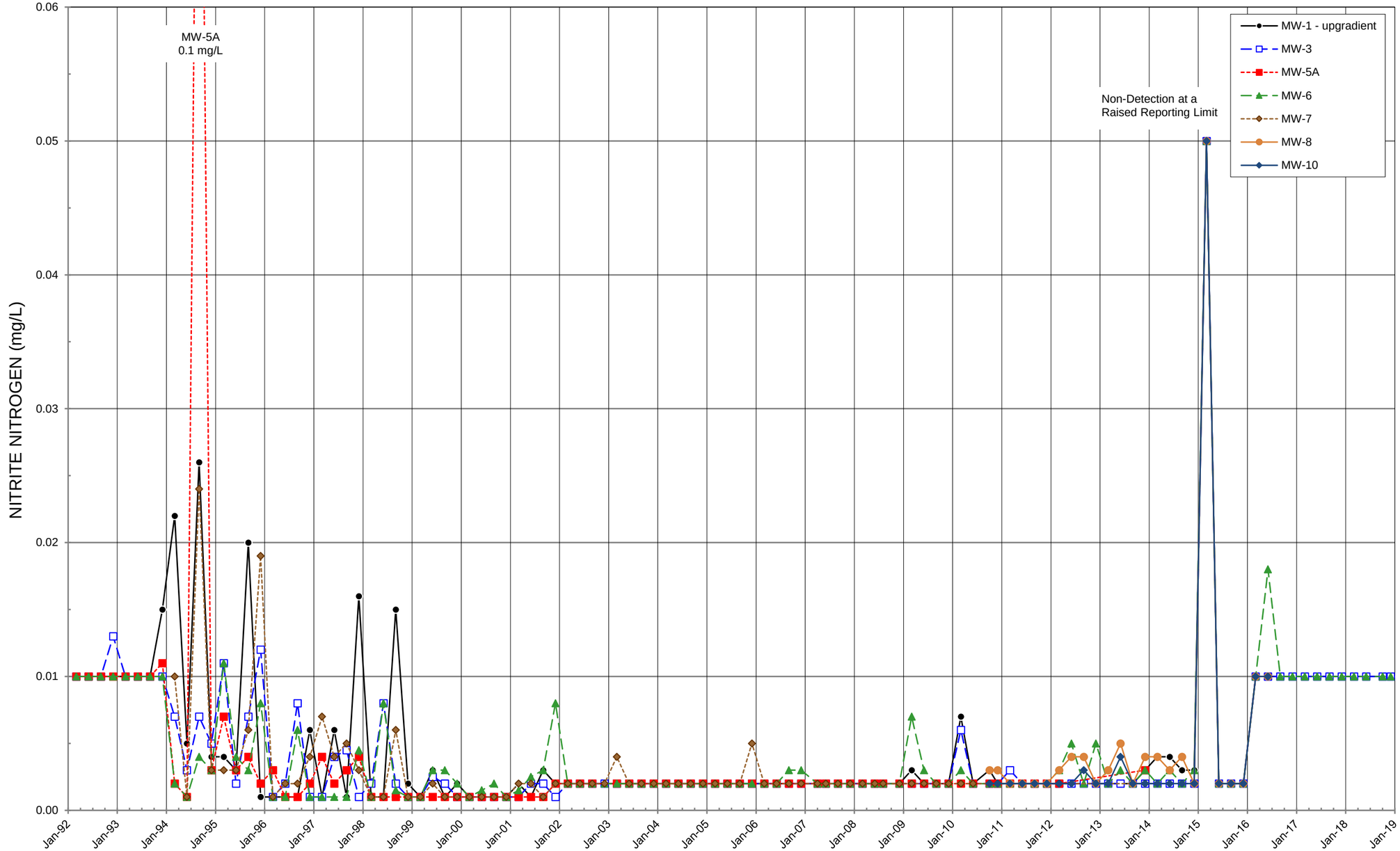


Primary Drinking Water Standard (DWS) = 10 mg/L (off scale)
Primary Groundwater Standard (GWS) = 10 mg/L (off scale)

DATE

NITRATE NITROGEN
(RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

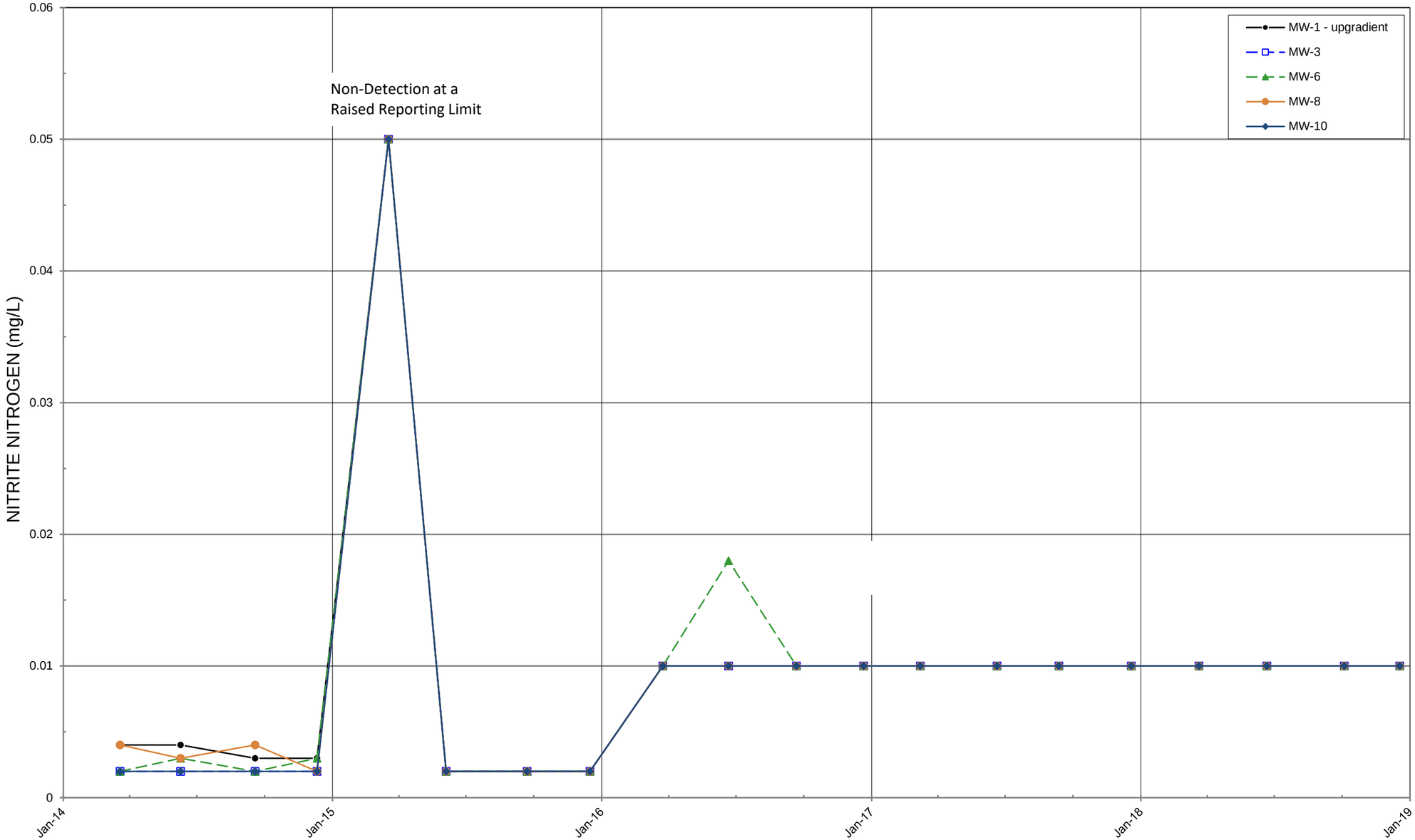


Primary Drinking Water Standard (DWS) =1 mg/L (off scale)
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

NITRITE
NITROGEN

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

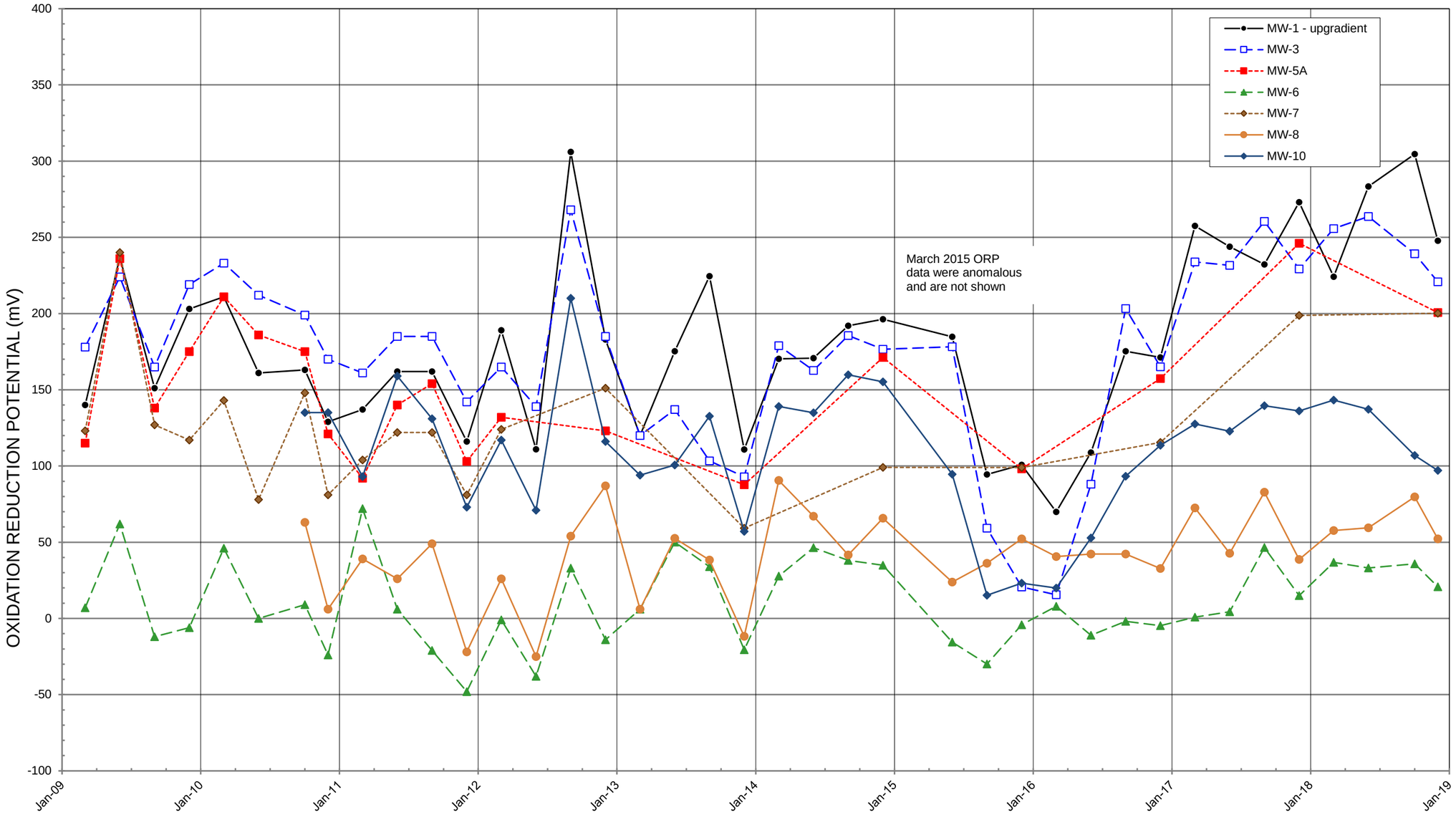


Primary Drinking Water Standard (DWS) =1 mg/L (off scale)
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

NITRITE NITROGEN
(RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

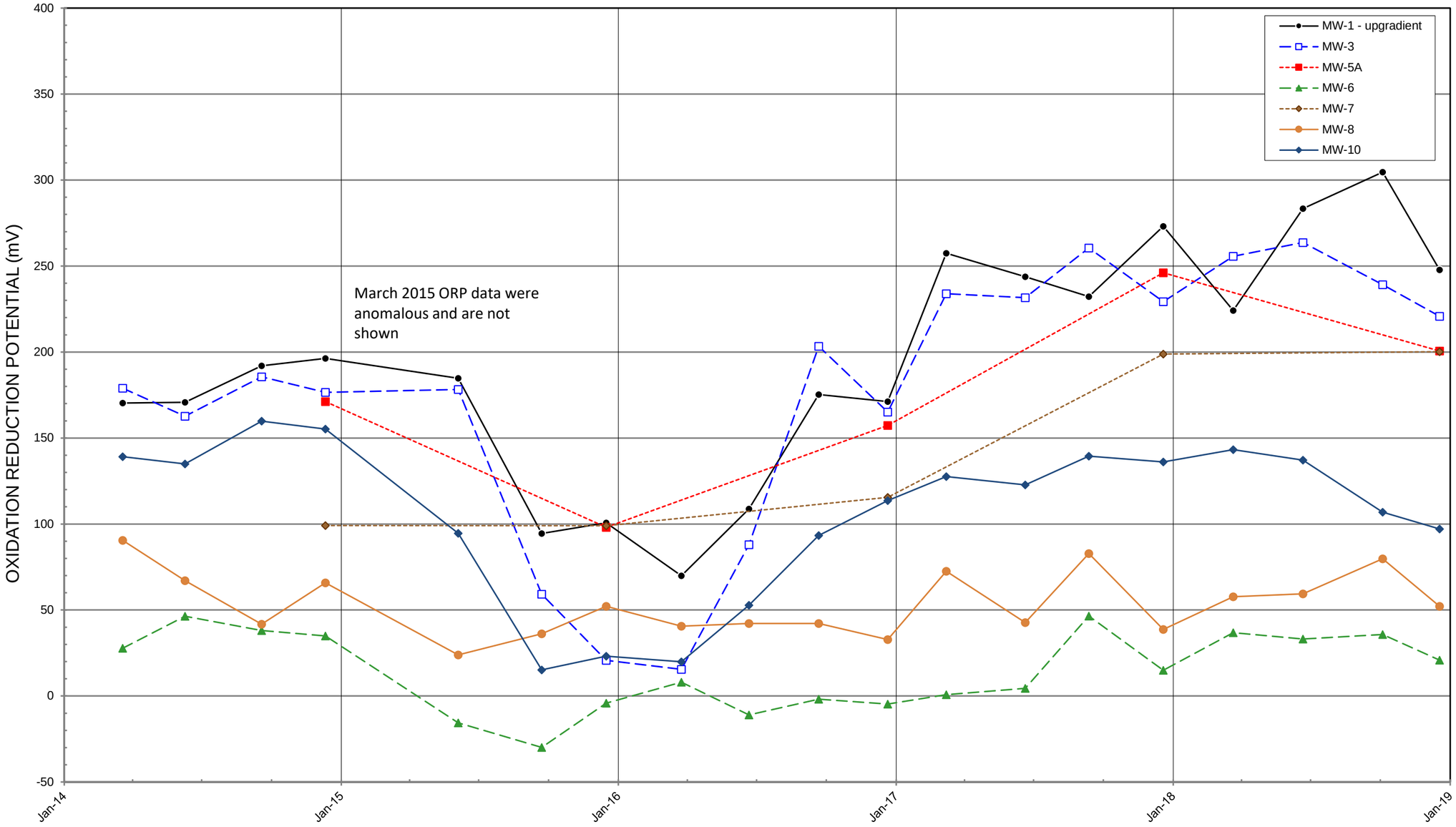


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

OXIDATION REDUCTION POTENTIAL
(Analysis started in 2009)

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

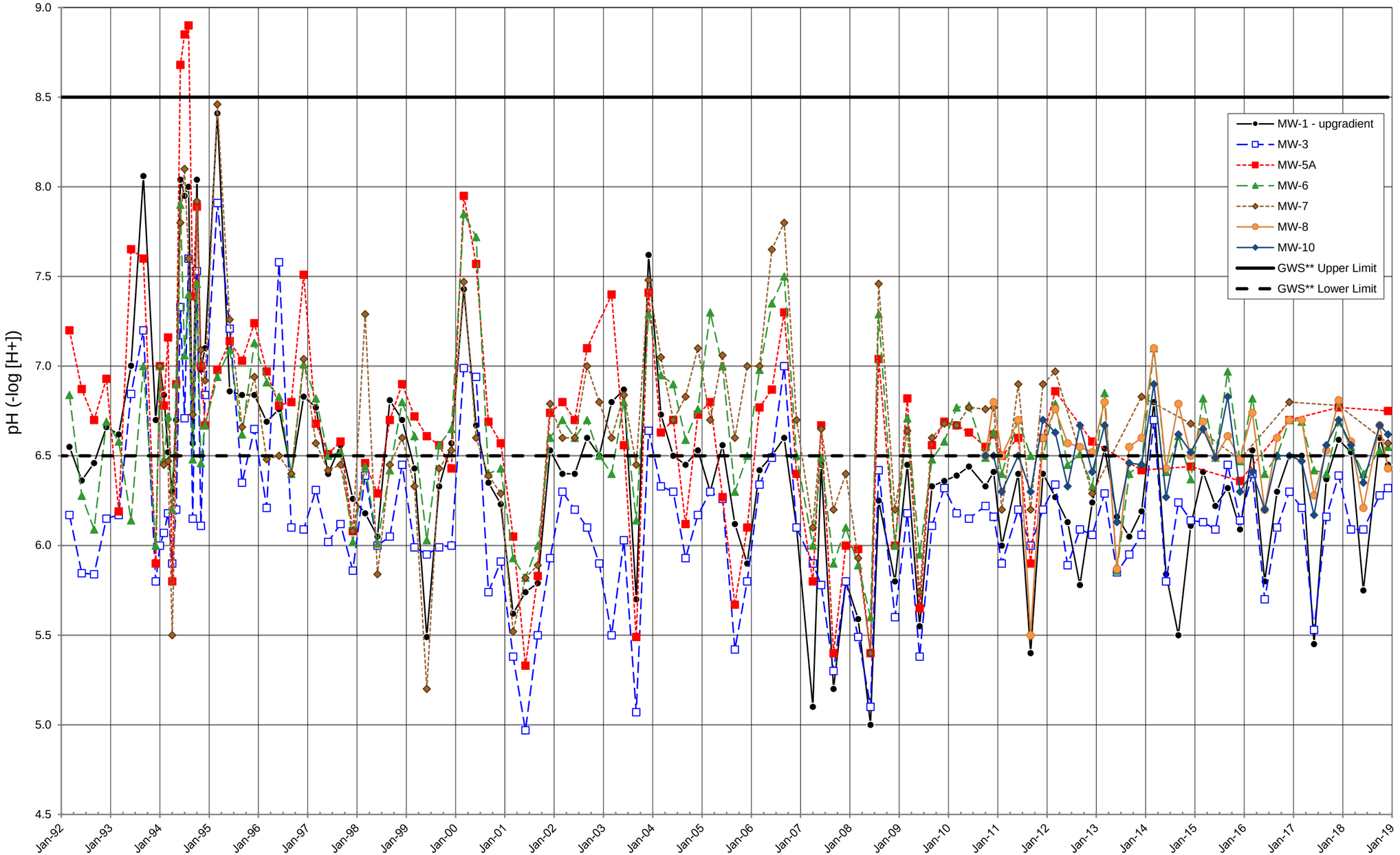


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

OXIDATION REDUCTION POTENTIAL (RECENT)

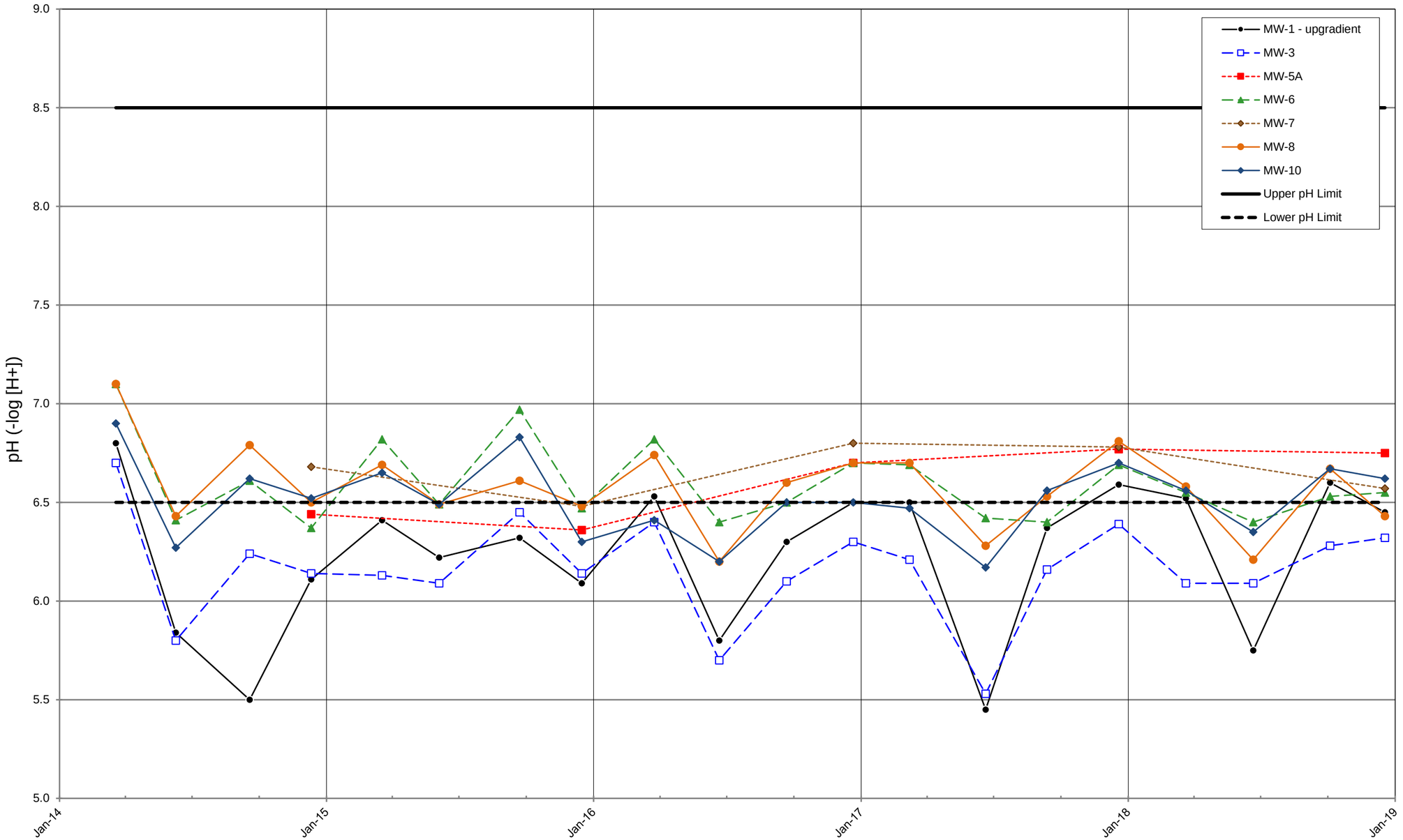
OLALLA LANDFILL
Quarterly Monitoring Data



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

pH - Field Measured

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

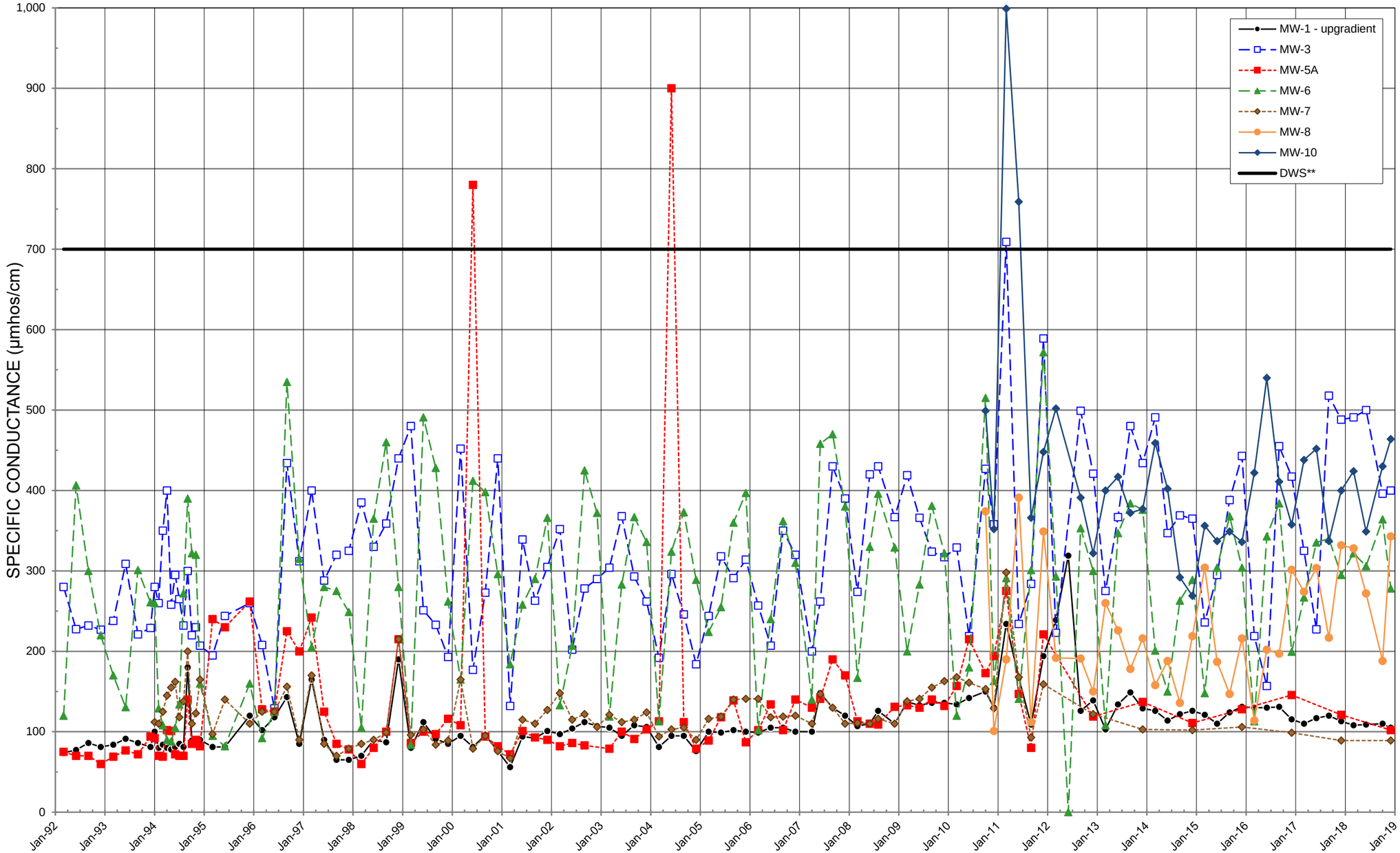


No Primary or Secondary Drinking Water Standard (DWS) Exists
Secondary Groundwater Standard (GWS) = 6.5 - 8.5 -log H+
Field measured pH is shown.

DATE

pH - Field Measured
(RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

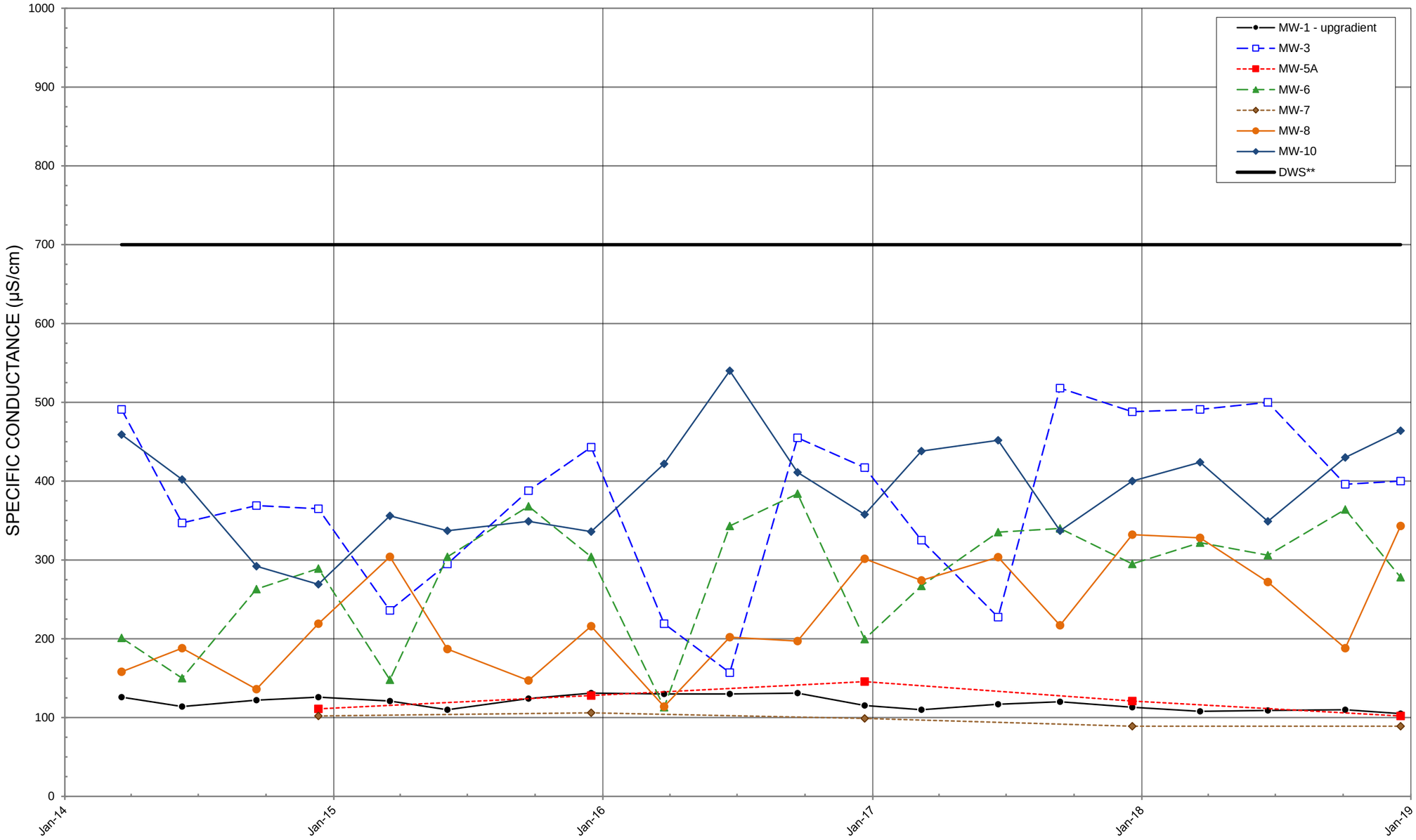


Secondary Drinking Water Standard (DWS) = 700 µmhos/cm
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

SPECIFIC CONDUCTANCE

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

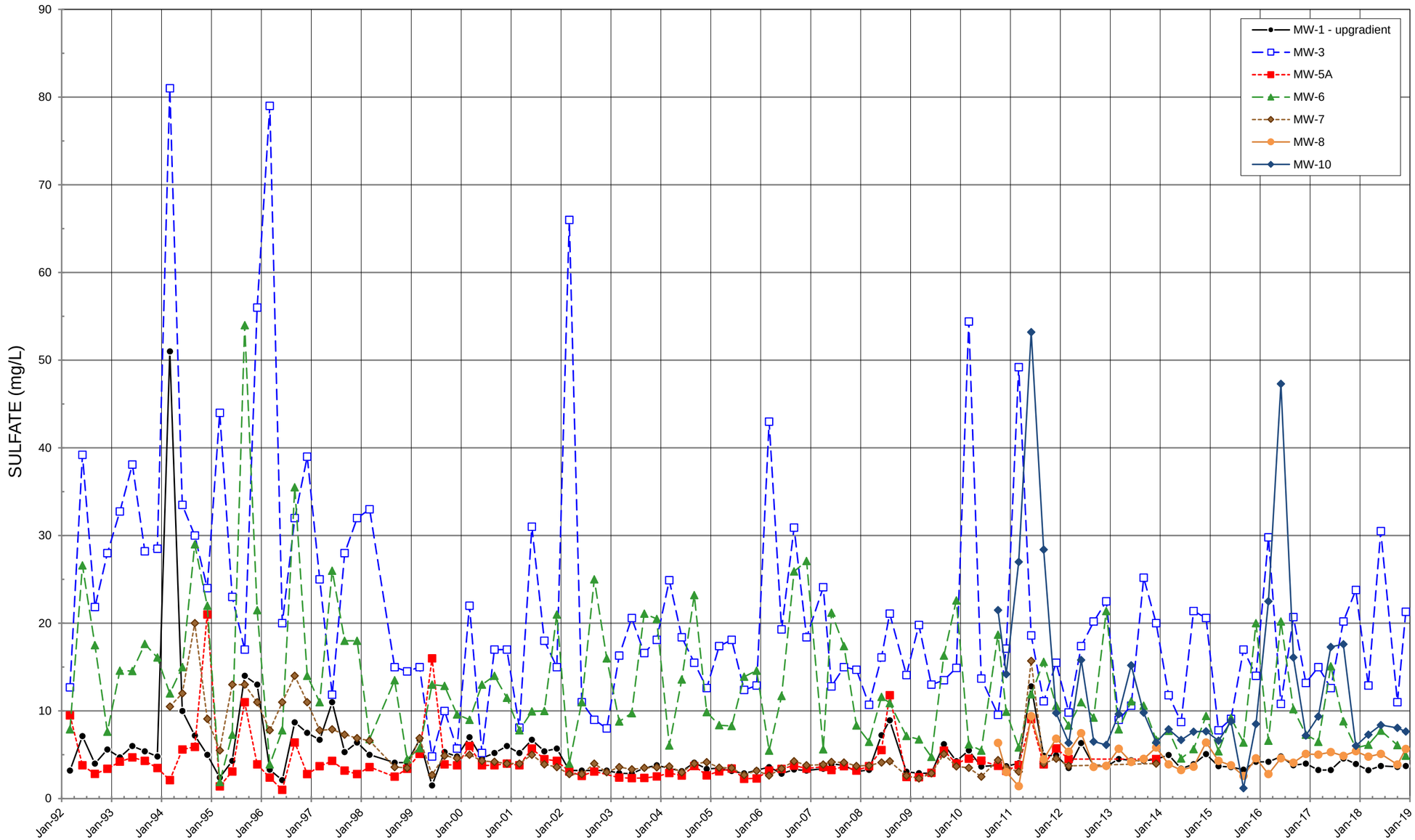


Secondary Drinking Water Standard (DWS) = 700 µS/cm
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

SPECIFIC CONDUCTANCE (RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

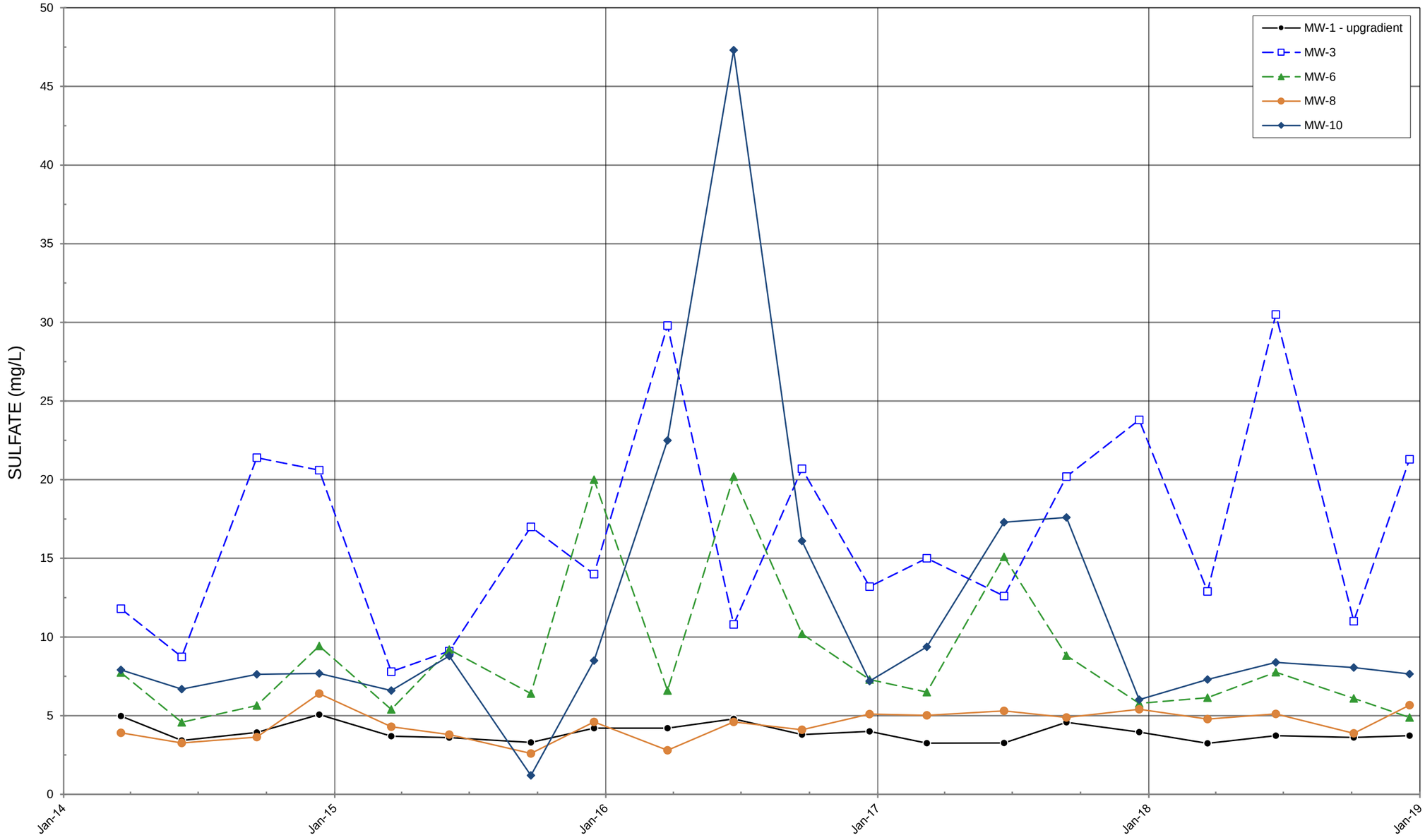


Secondary Drinking Water Standard (DWS) = 250 mg/L (off scale)
Secondary Groundwater Standard (GWS) = 250 mg/L (off scale)

DATE

SULFATE

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

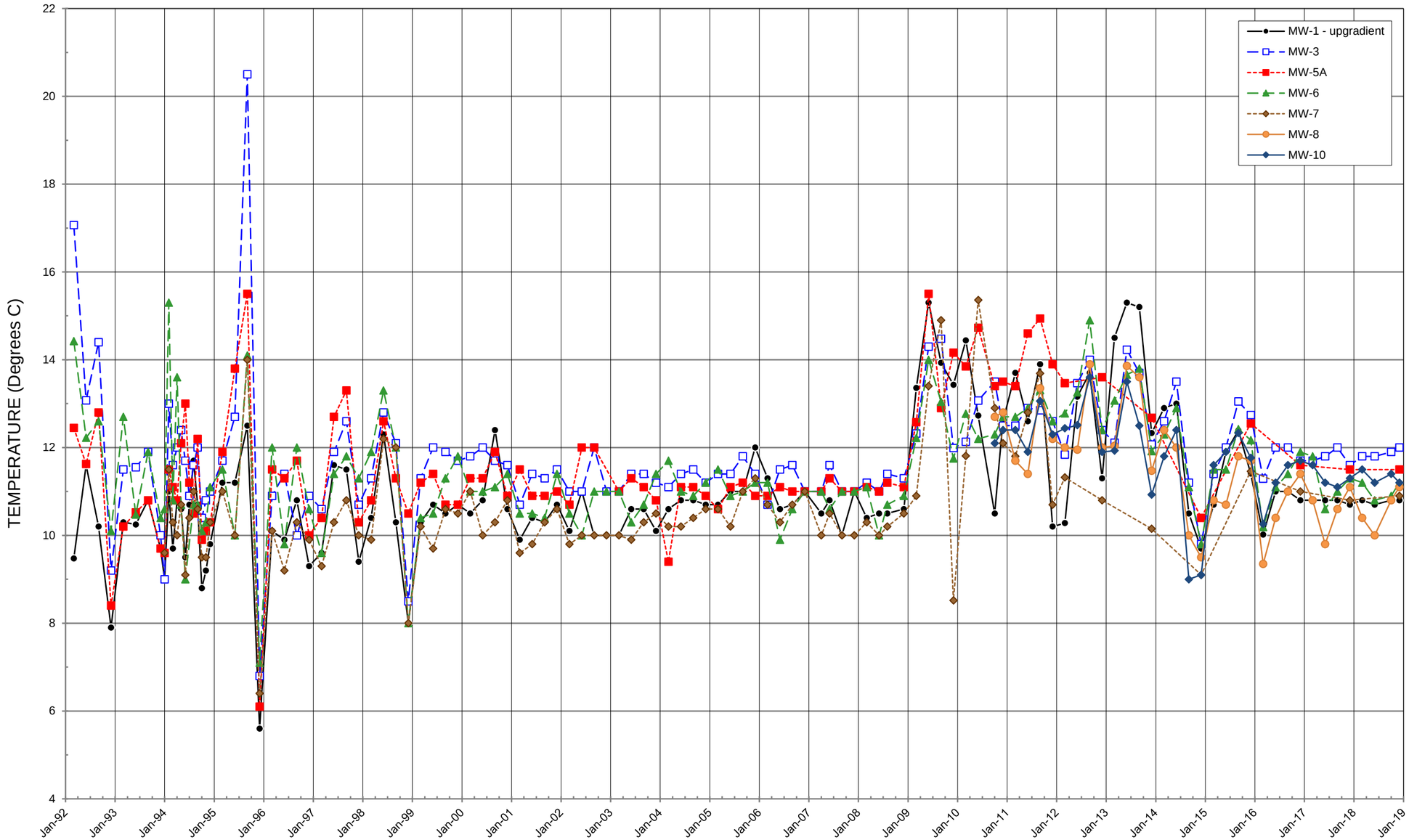


Secondary Drinking Water Standard (DWS) = 250 mg/L (off scale)
Secondary Groundwater Standard (GWS) = 250 mg/L (off scale)

DATE

SULFATE
(RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

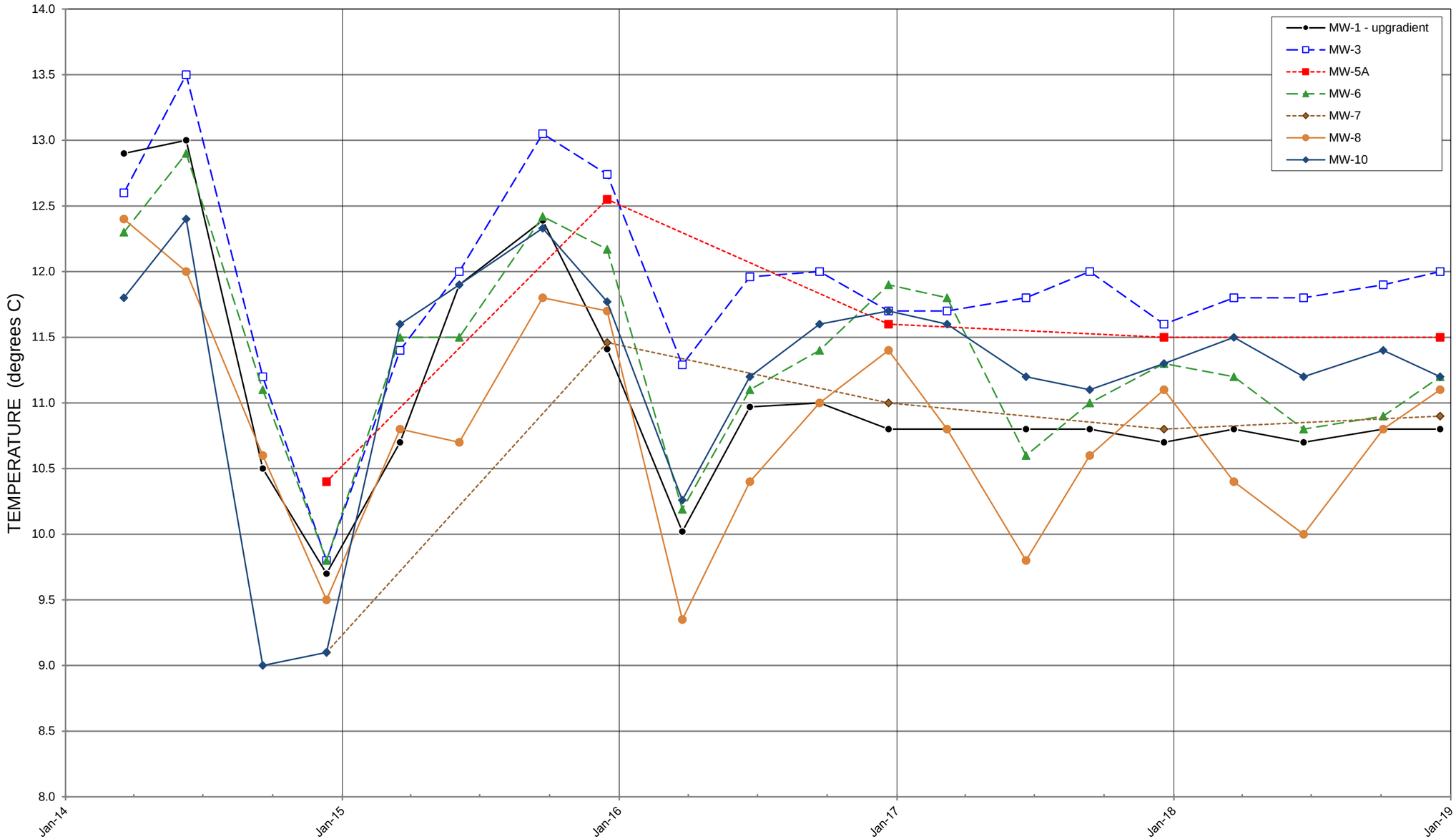


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

TEMPERATURE

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

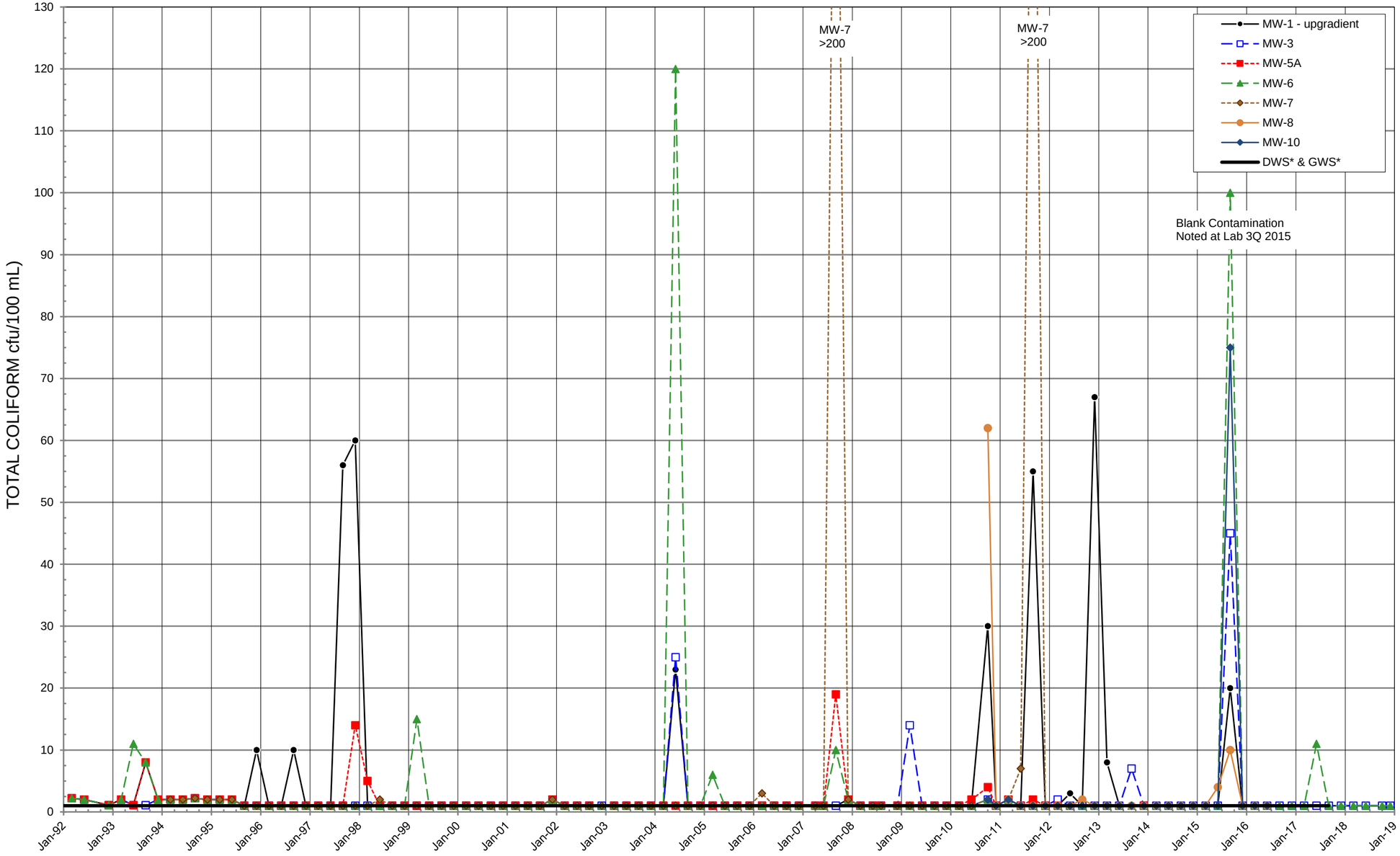


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

TEMPERATURE (RECENT)

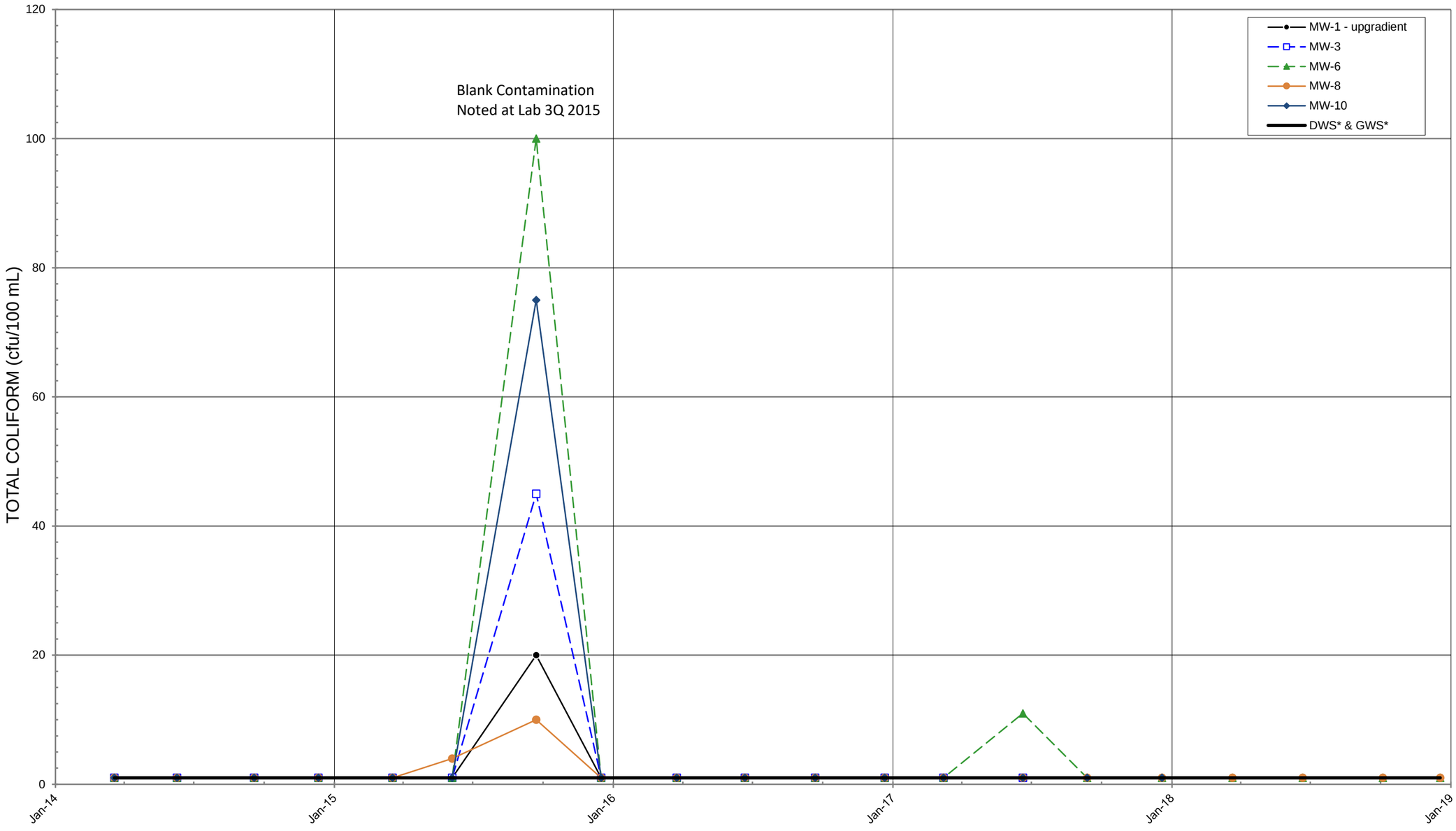
OLALLA LANDFILL
Quarterly Monitoring Data



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

TOTAL COLIFORM

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

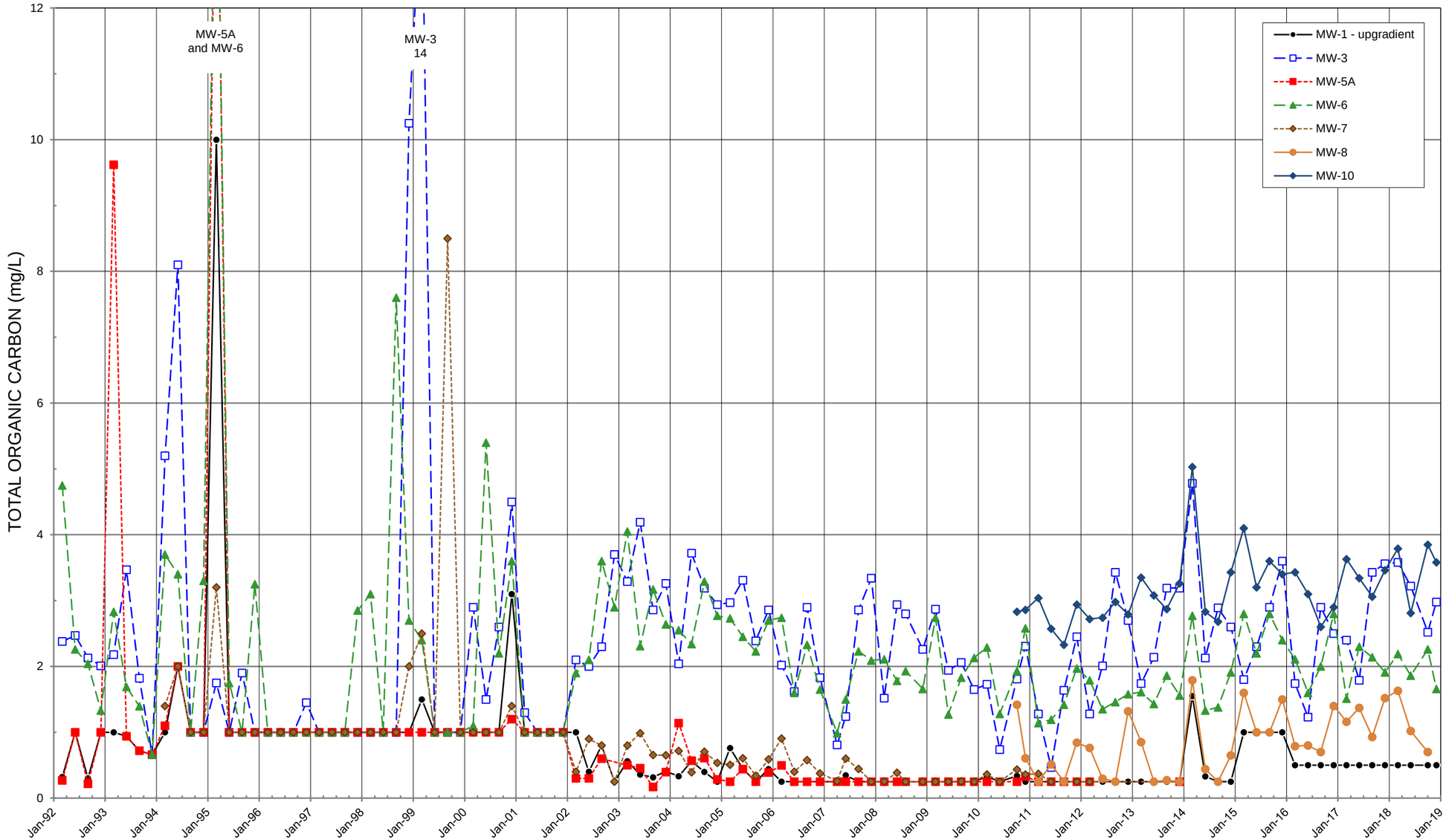


Primary Drinking Water Standard (DWS) = 1 cfu/100 mL
Primary Groundwater Standard (GWS) = 1 cfu/100 mL

DATE

TOTAL COLIFORM
(RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

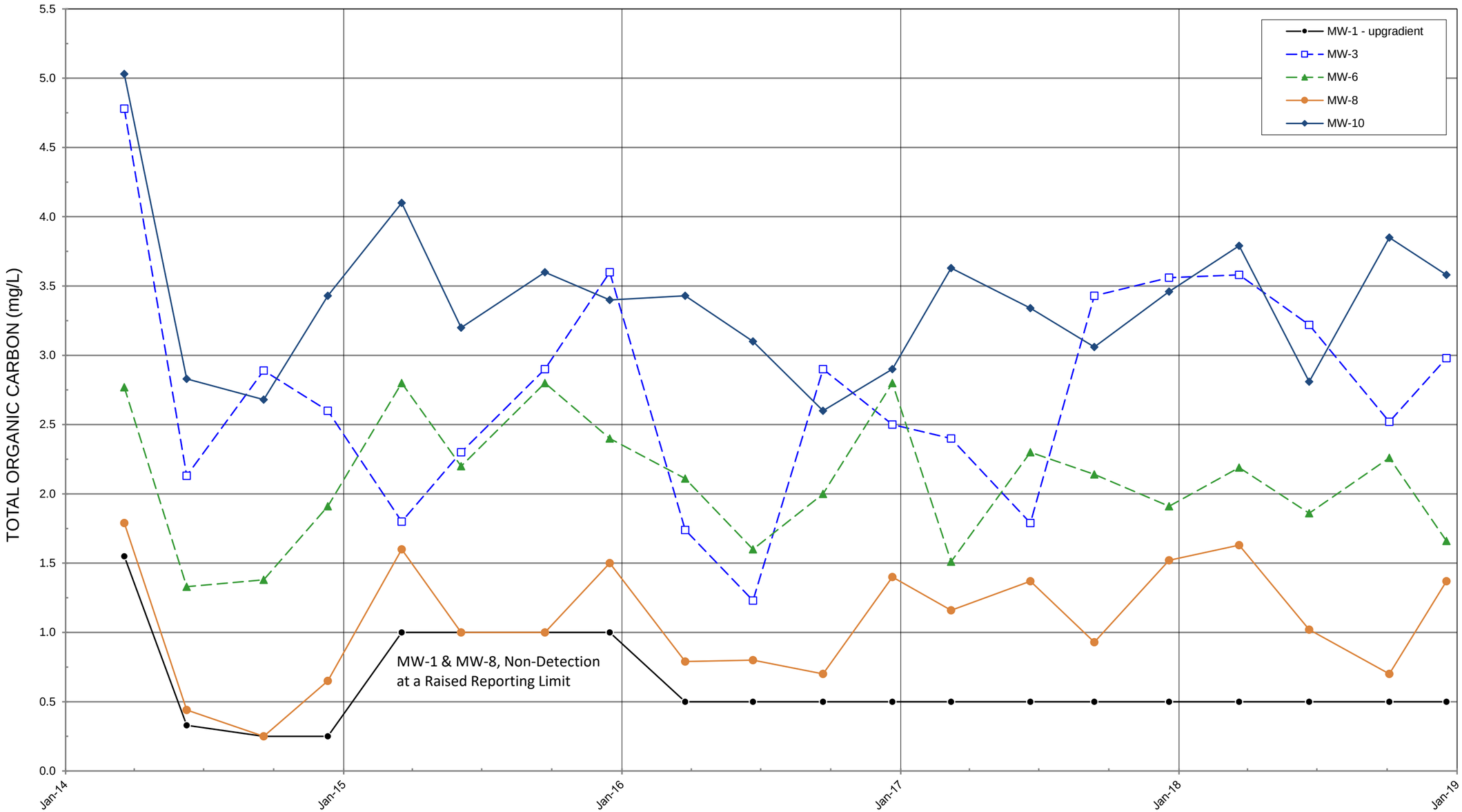


Data split (beginning 12/01) is due to a change in the Method Detection Limit
No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

TOTAL ORGANIC CARBON

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

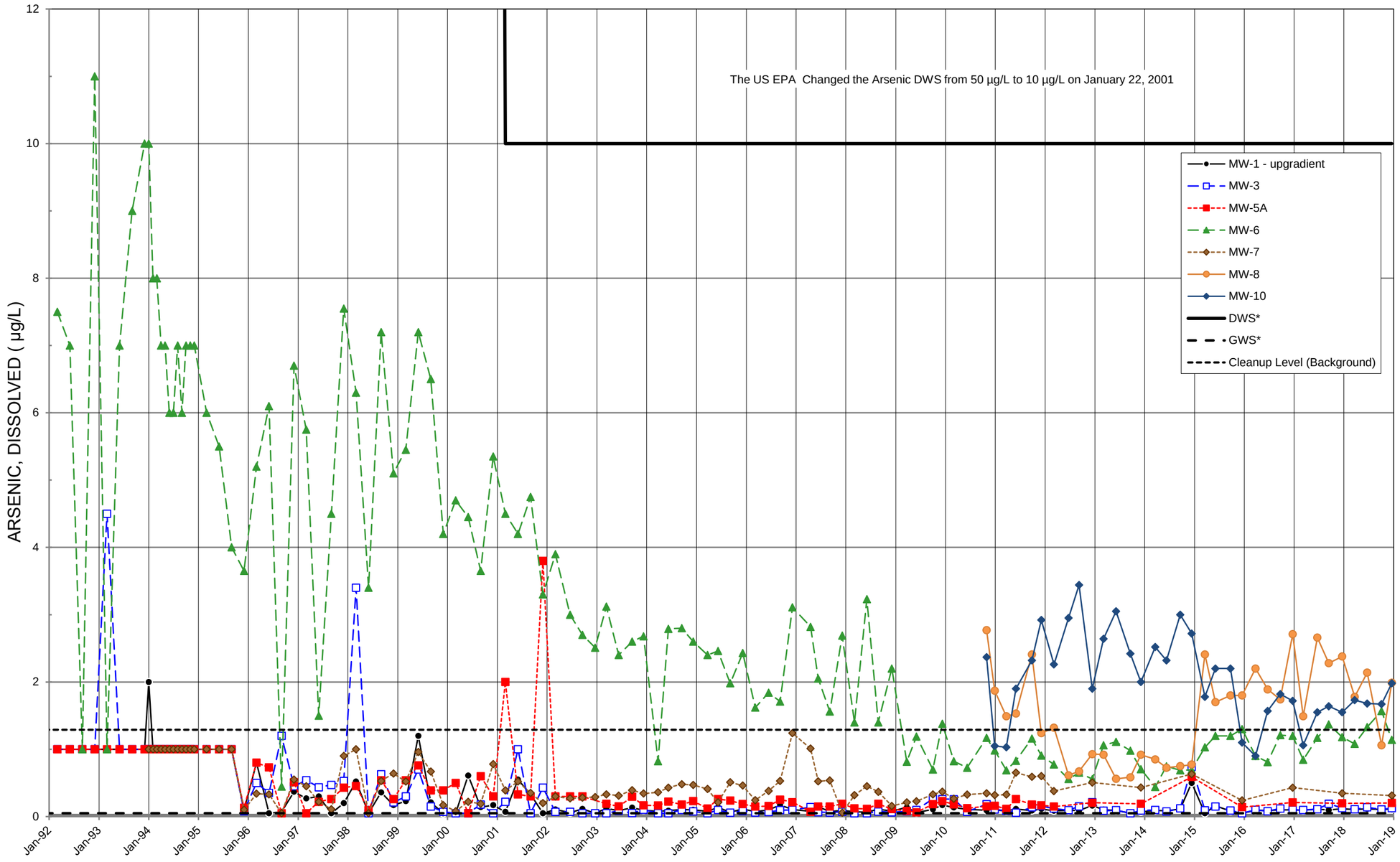


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

TOTAL ORGANIC CARBON (RECENT)

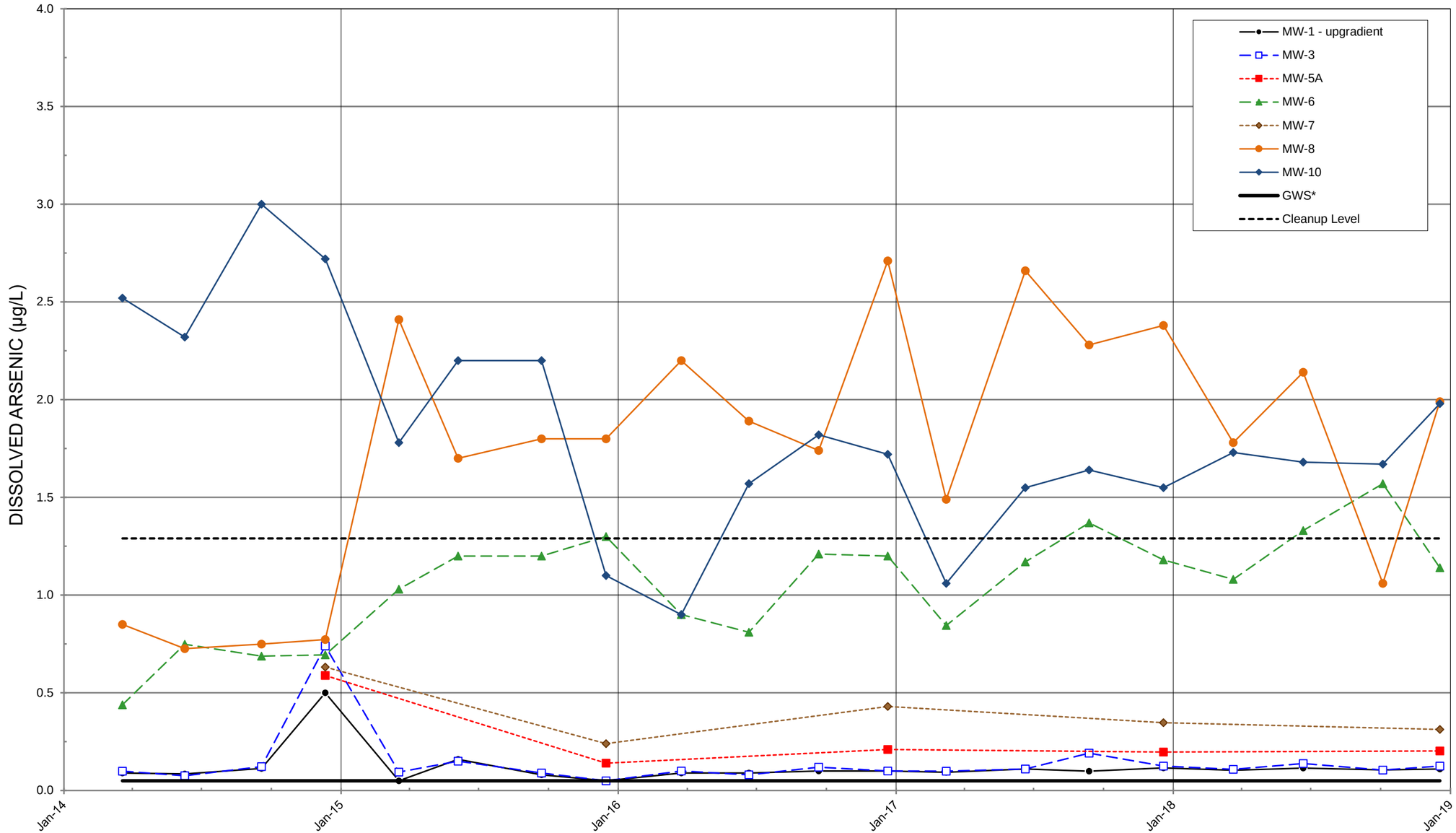
OLALLA LANDFILL
Quarterly Monitoring Data



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)

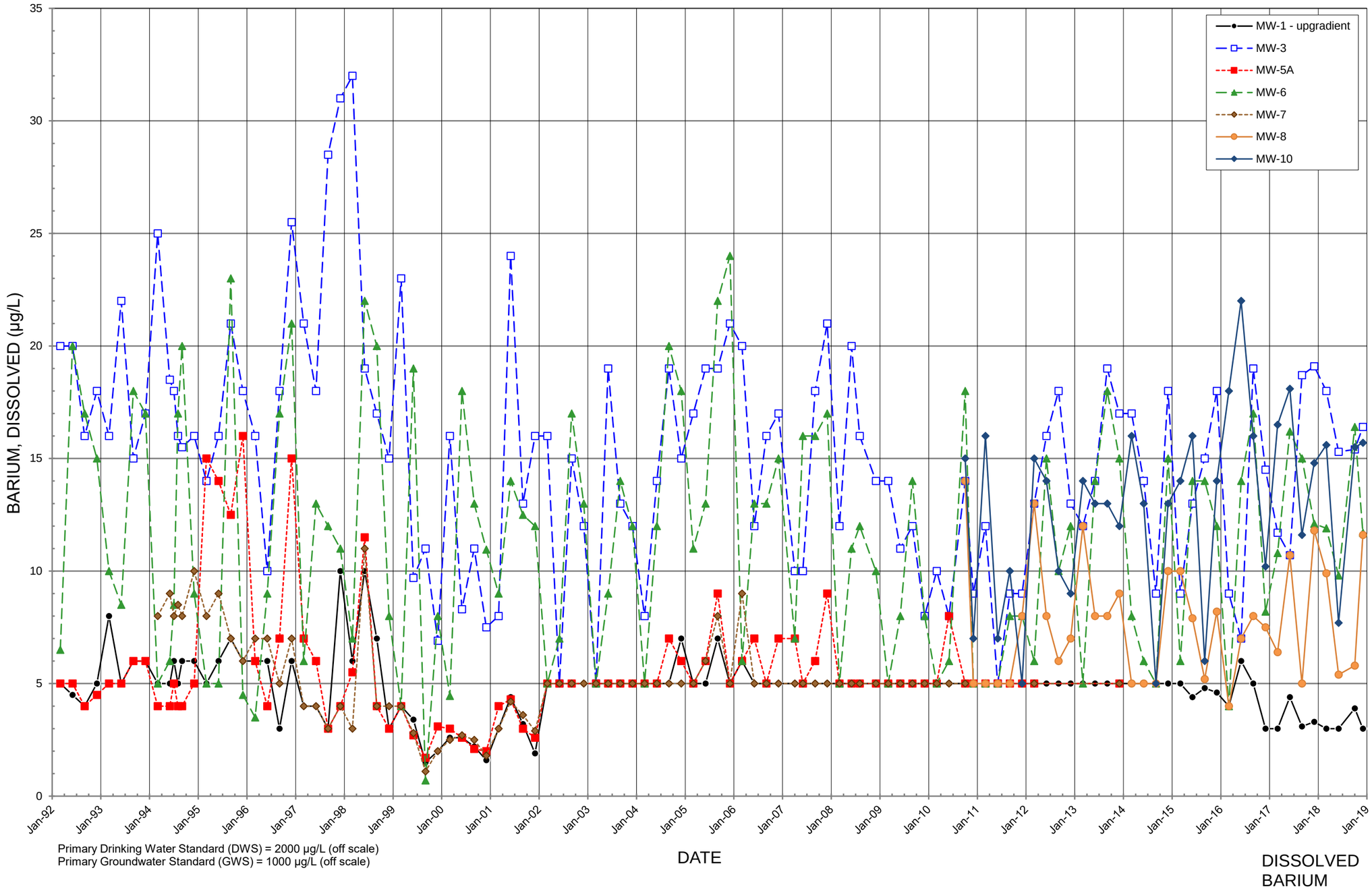


Site Specific Cleanup Level (background) = 1.29 µg/L
Primary Drinking Water Standard (DWS) = 10 µg/L (off scale)
Primary Groundwater Standard (GWS) = 0.05 µg/L

DATE

DISSOLVED ARSENIC
(RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

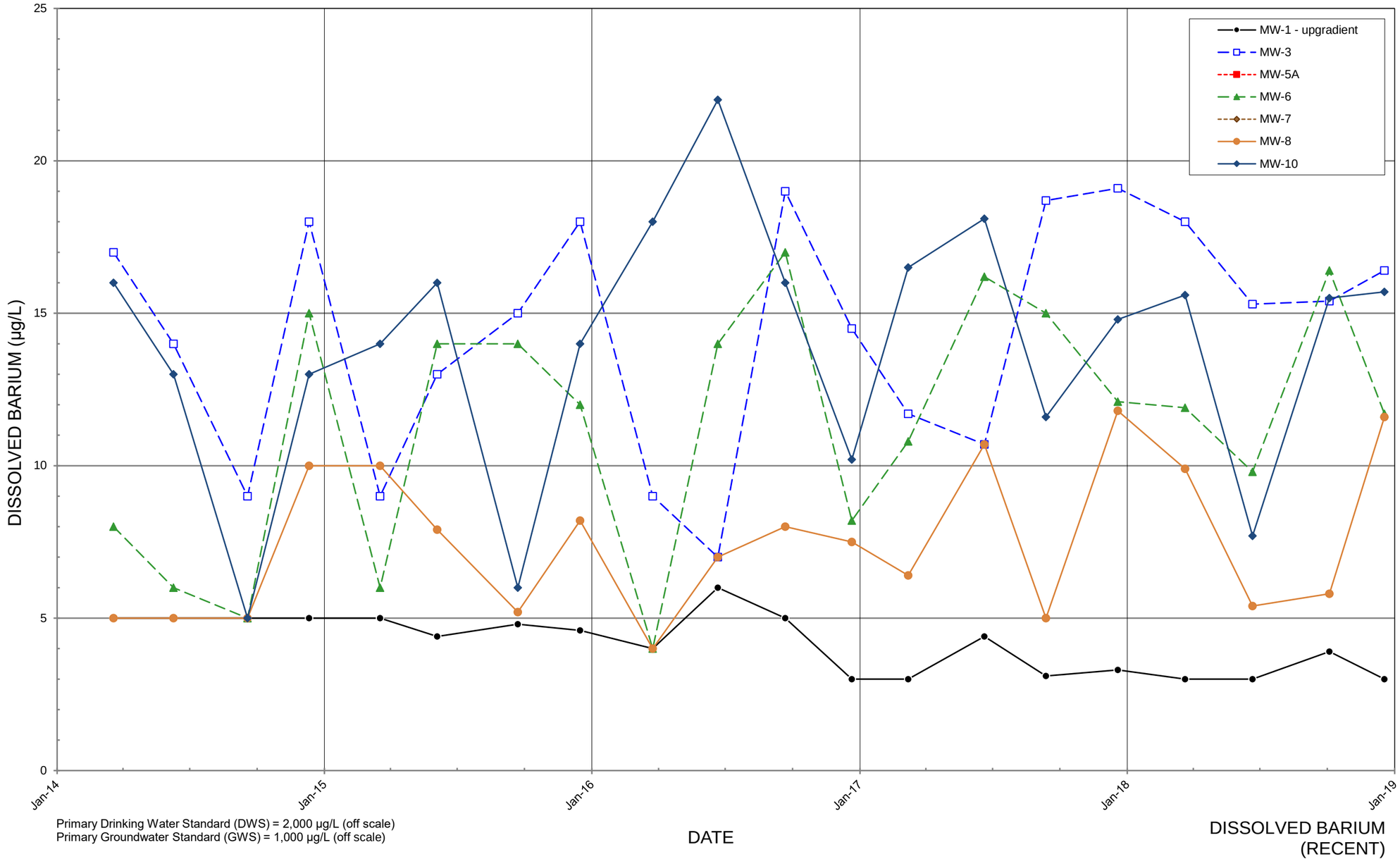


Primary Drinking Water Standard (DWS) = 2000 µg/L (off scale)
Primary Groundwater Standard (GWS) = 1000 µg/L (off scale)

DATE

DISSOLVED BARIUM

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

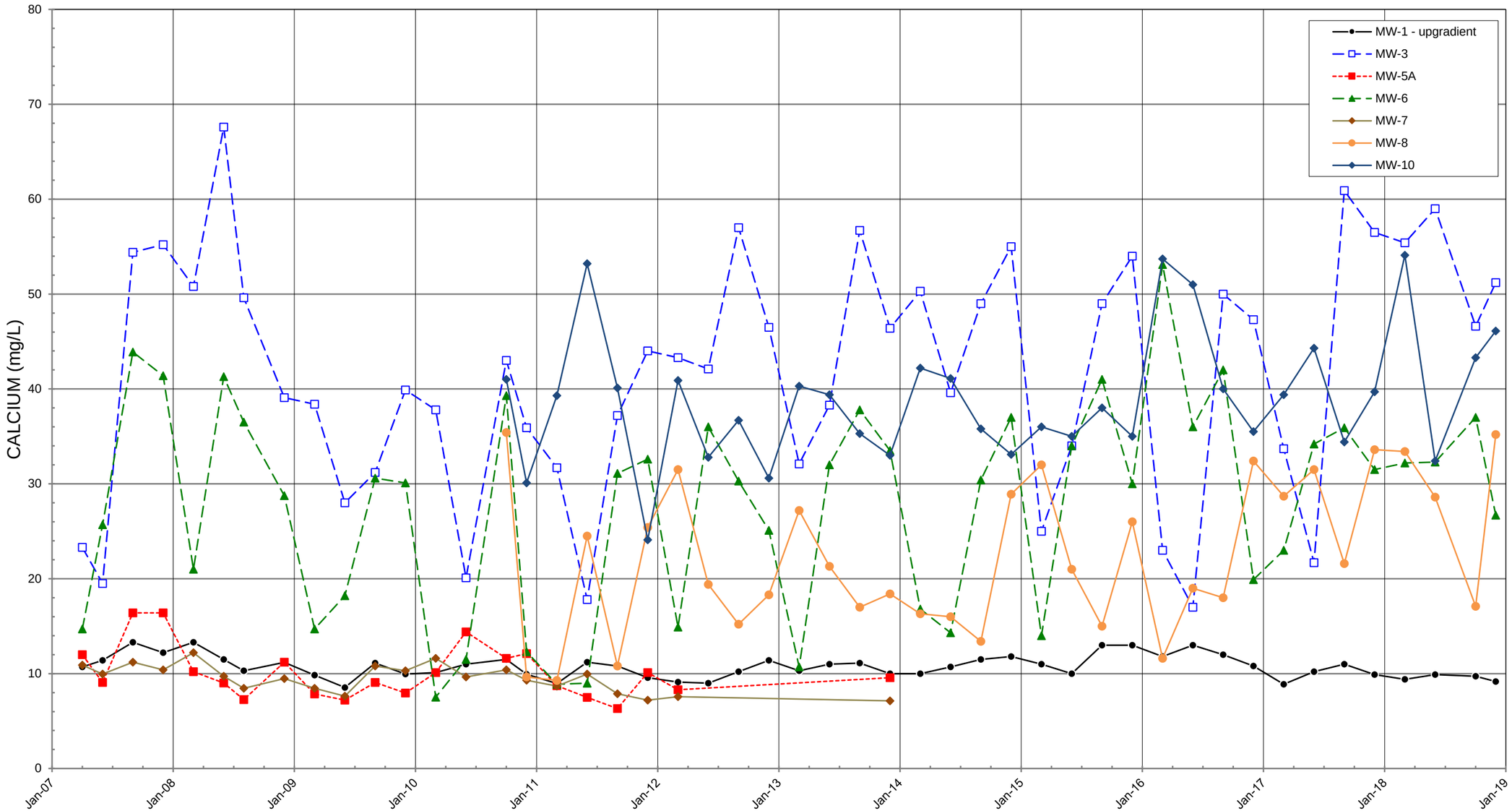


Primary Drinking Water Standard (DWS) = 2,000 µg/L (off scale)
Primary Groundwater Standard (GWS) = 1,000 µg/L (off scale)

DATE

DISSOLVED BARIUM
(RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

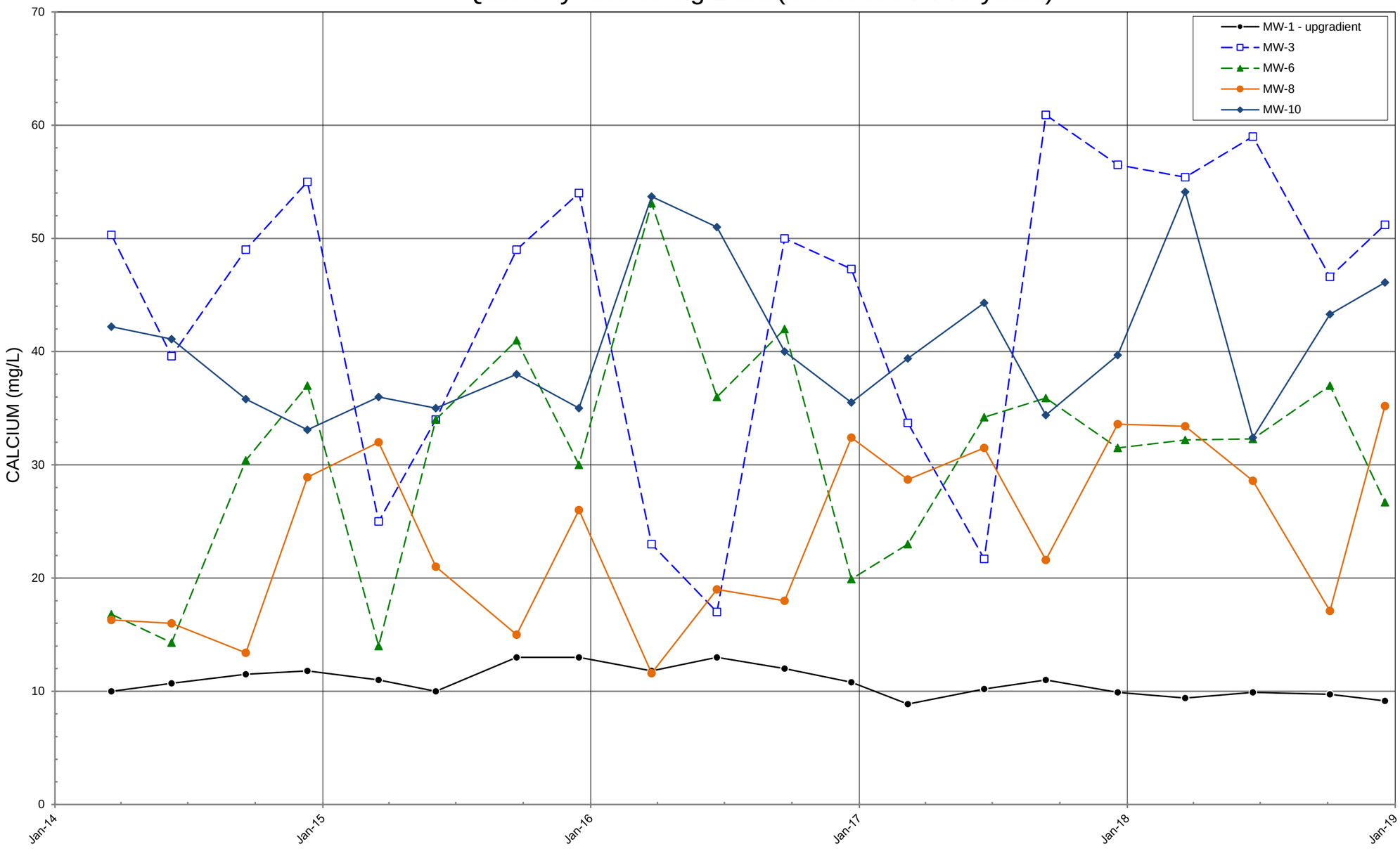


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

CALCIUM
(Analysis started in 2007)

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

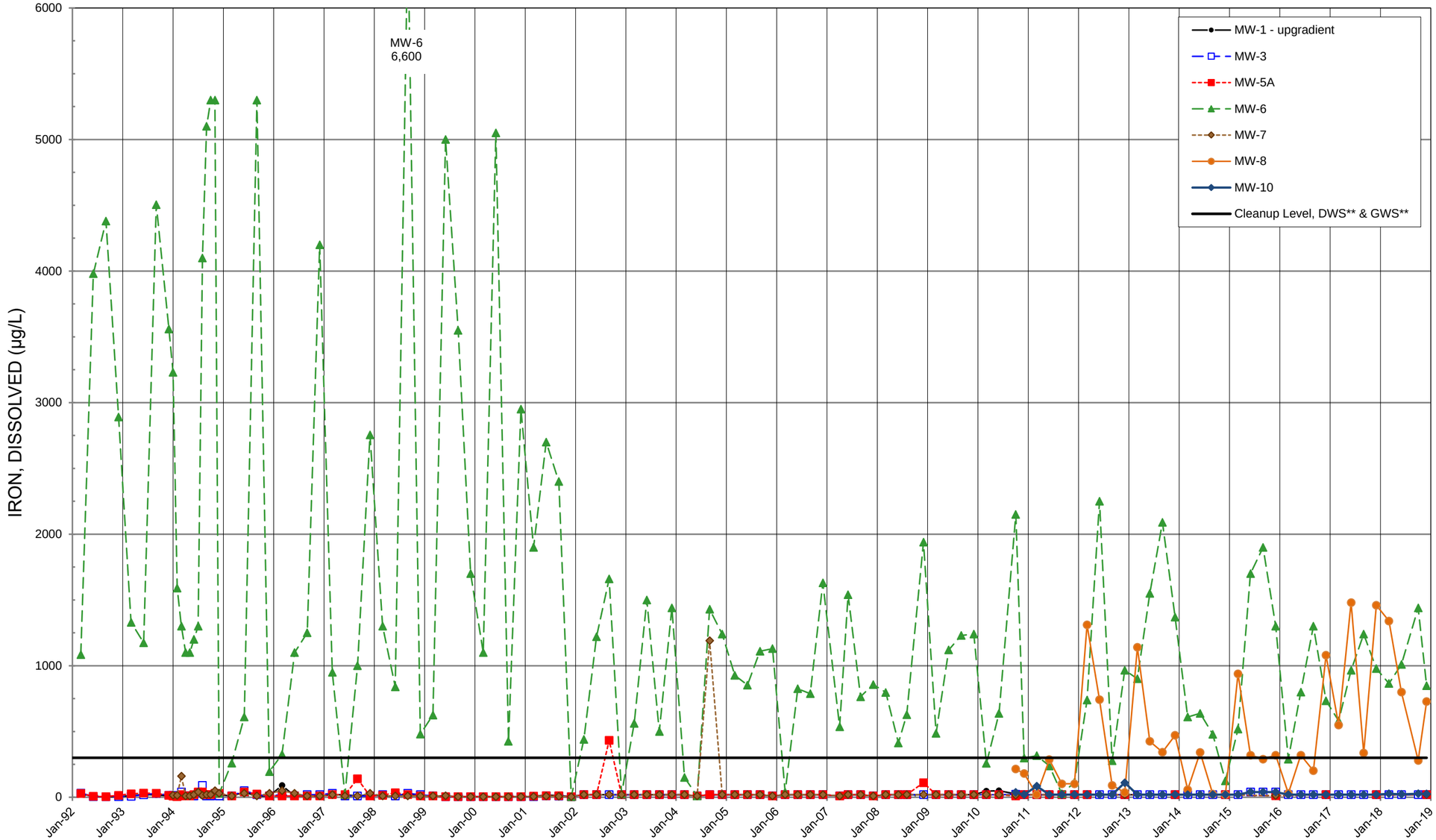


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

CALCIUM
(RECENT)

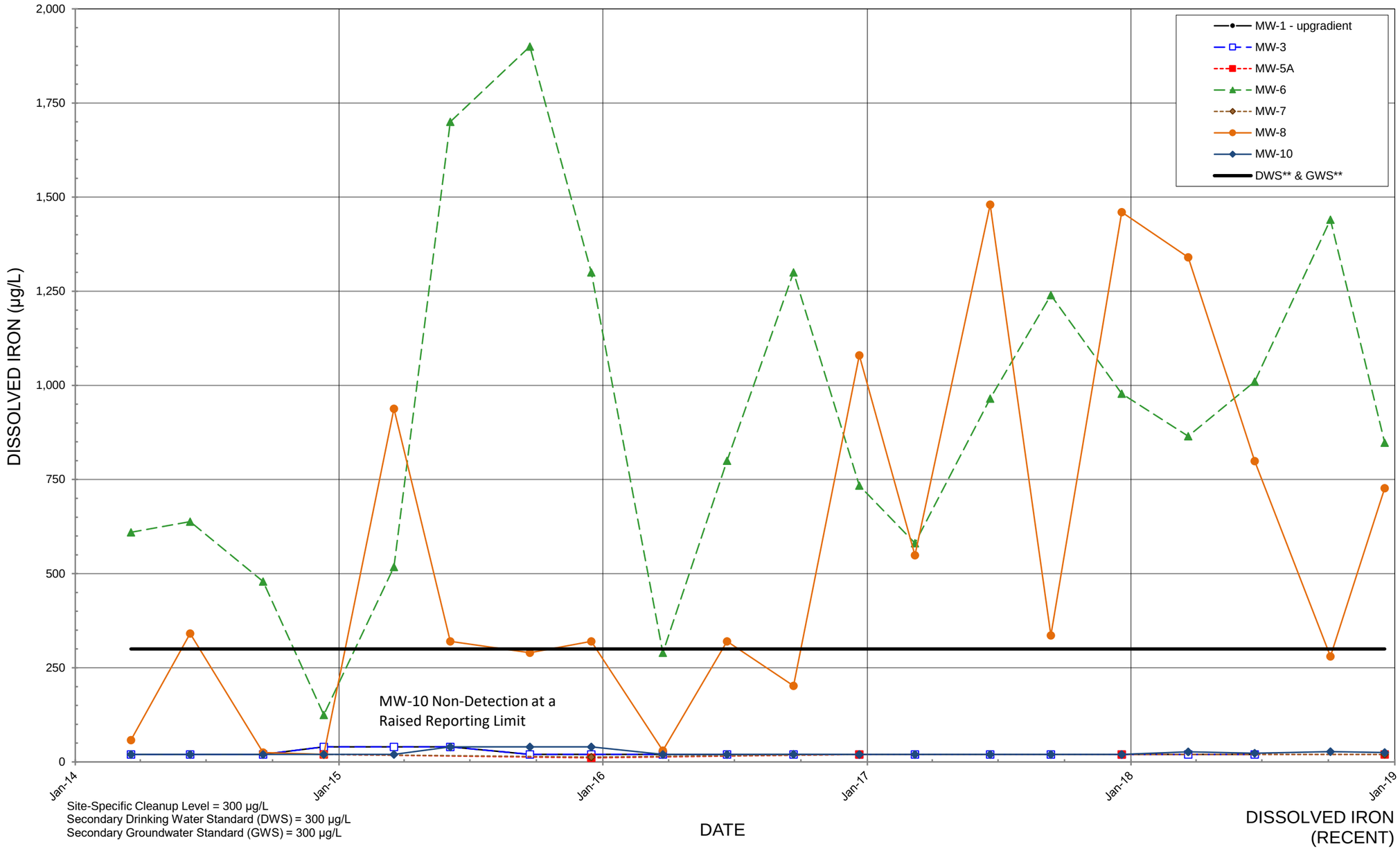
OLALLA LANDFILL
Quarterly Monitoring Data



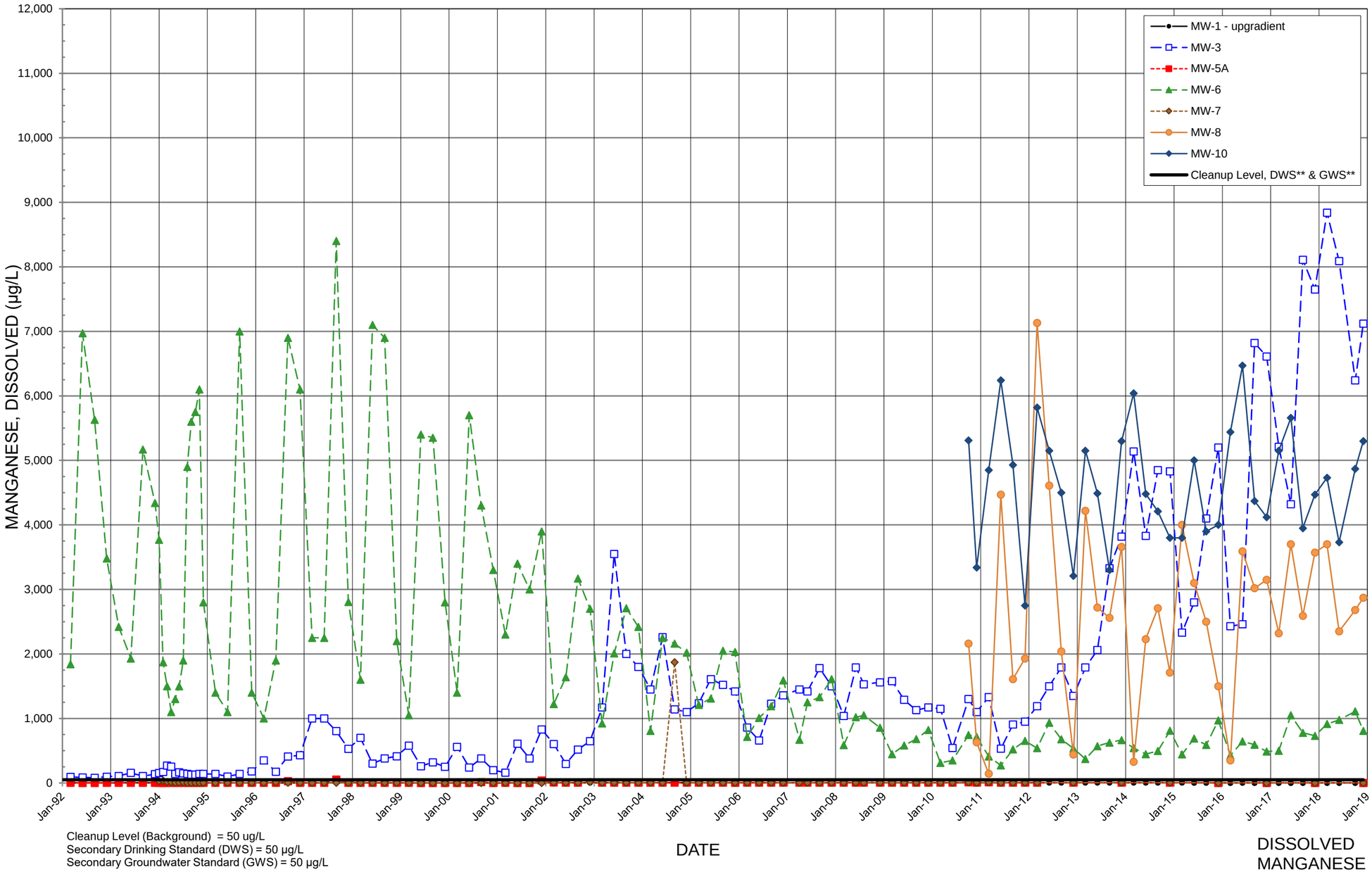
Cleanup Level = 300 µg/L
Secondary Drinking Water Standard (DWS) = 300 µg/L
Secondary Groundwater Standard (GWS) = 300 µg/L

DISSOLVED IRON

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)



OLALLA LANDFILL
Quarterly Monitoring Data

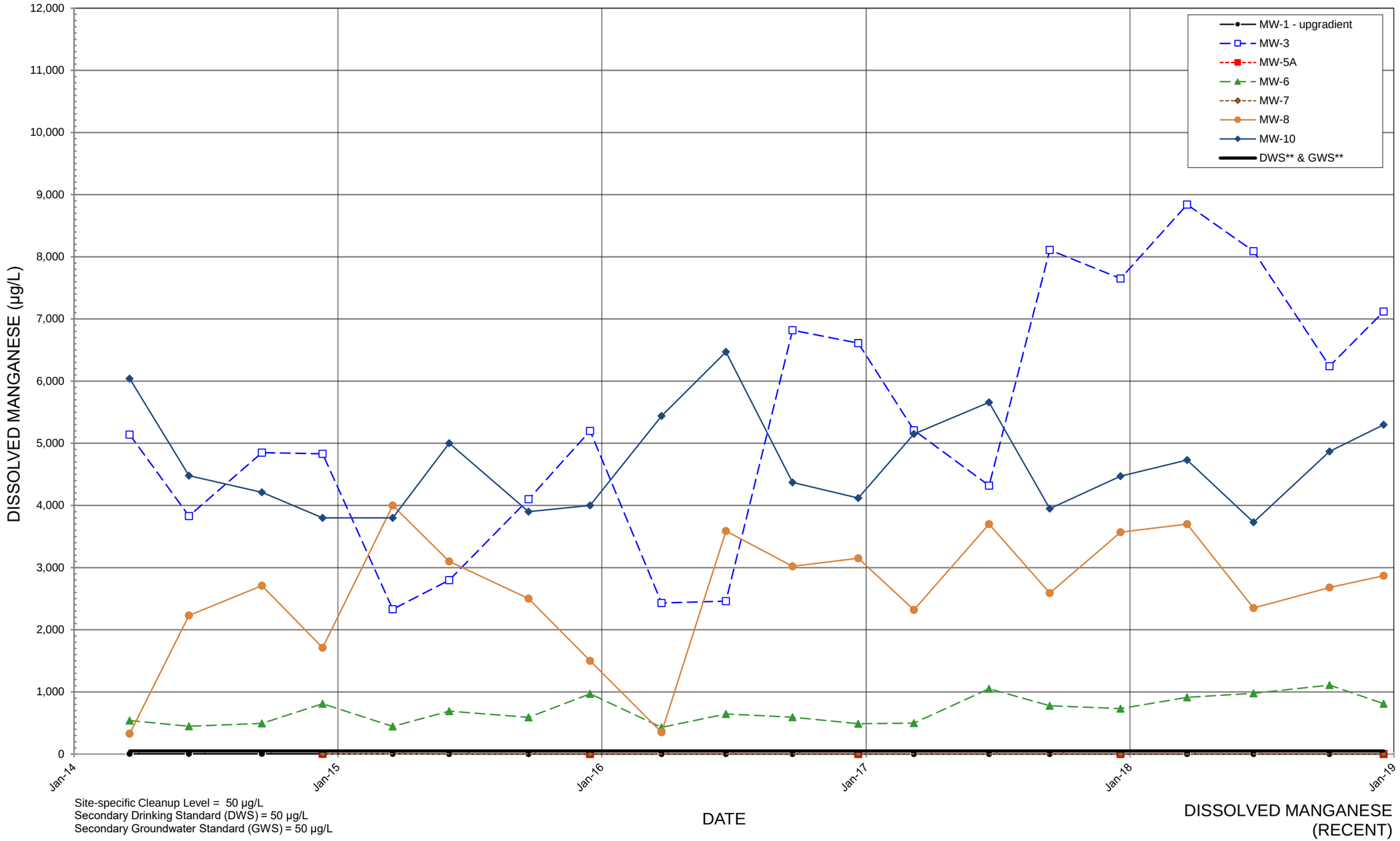


Cleanup Level (Background) = 50 ug/L
Secondary Drinking Standard (DWS) = 50 µg/L
Secondary Groundwater Standard (GWS) = 50 µg/L

DATE

DISSOLVED MANGANESE

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

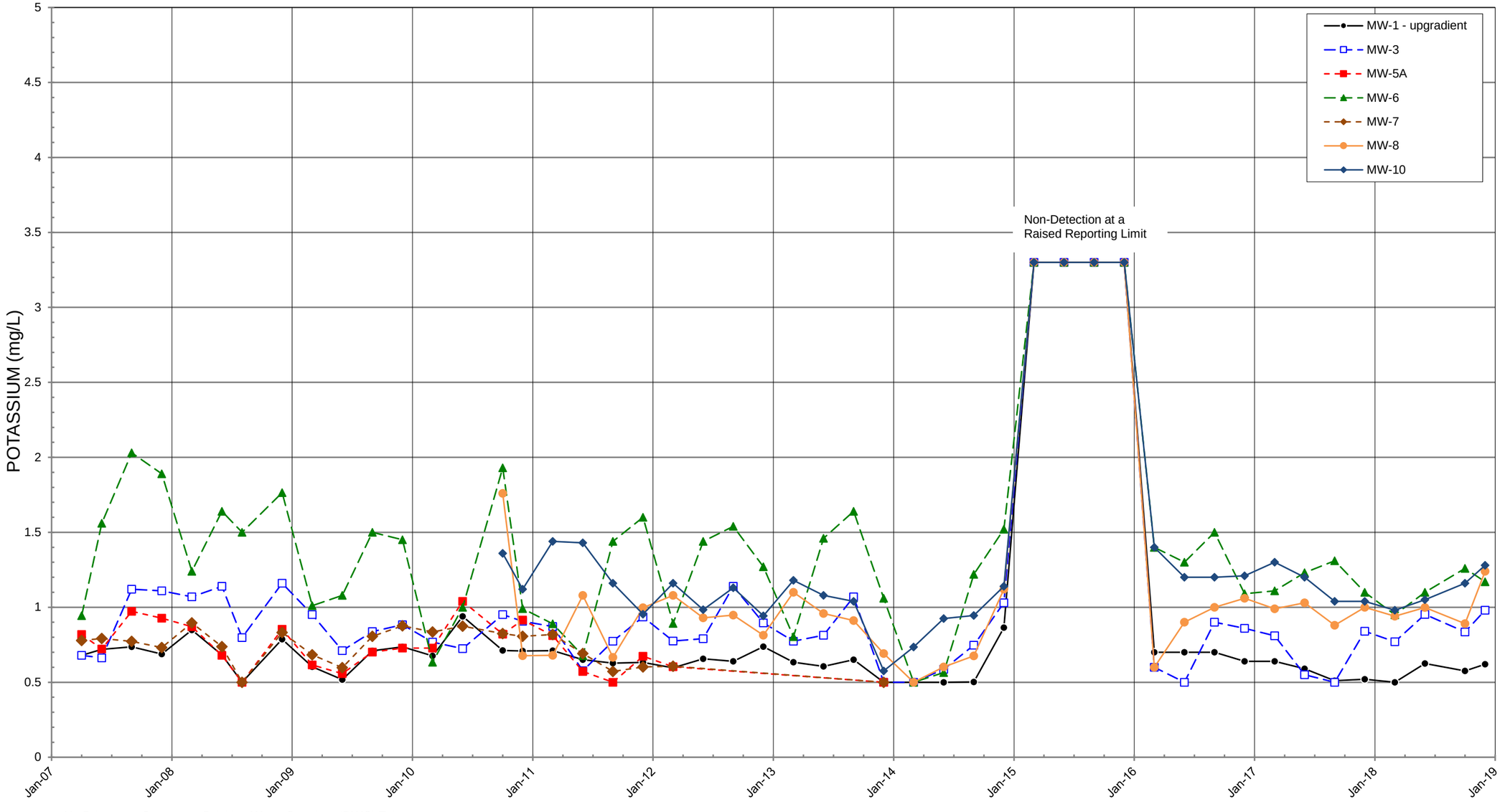


Site-specific Cleanup Level = 50 µg/L
Secondary Drinking Standard (DWS) = 50 µg/L
Secondary Groundwater Standard (GWS) = 50 µg/L

DATE

DISSOLVED MANGANESE (RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

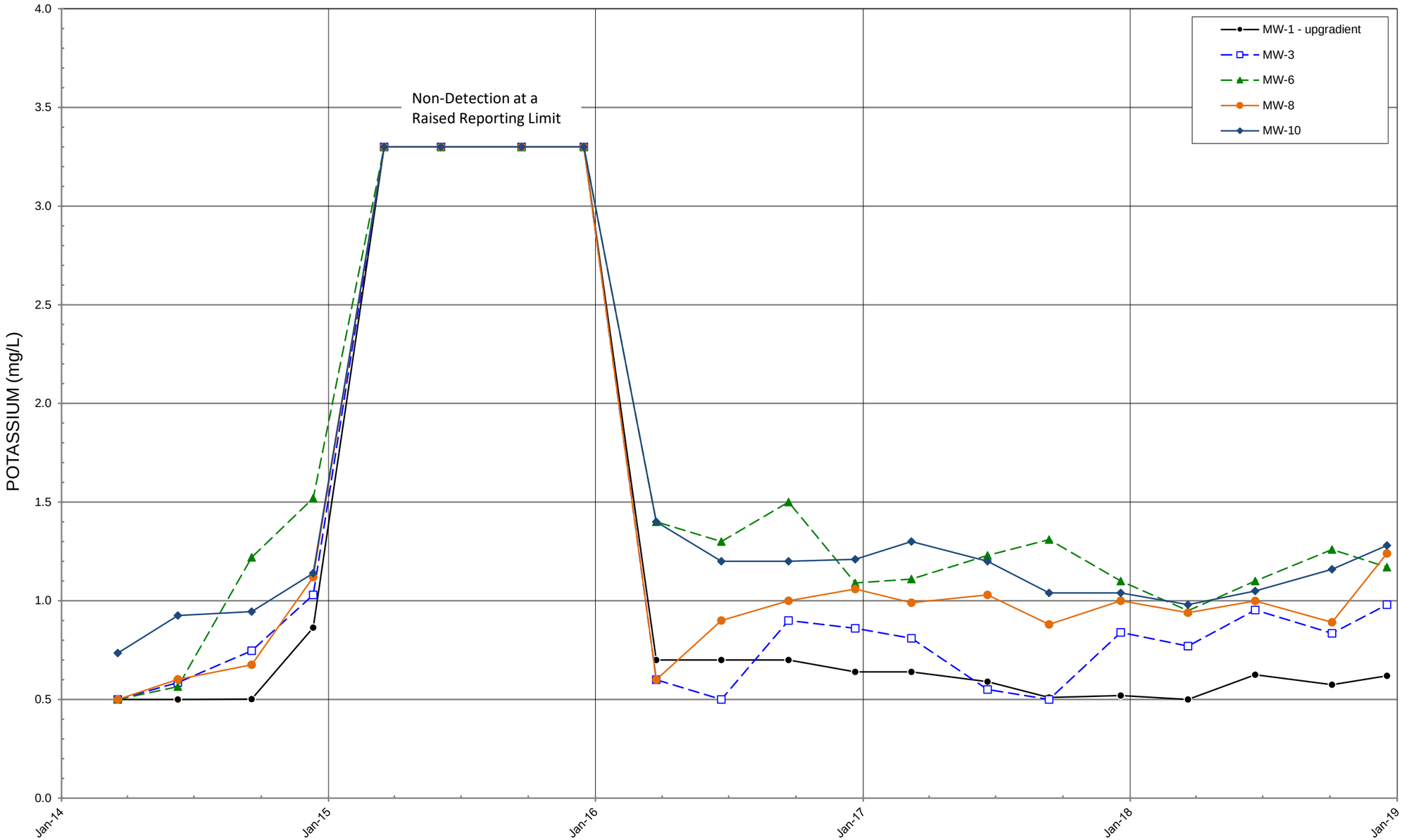


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

POTASSIUM
(Analysis started in 2007)

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

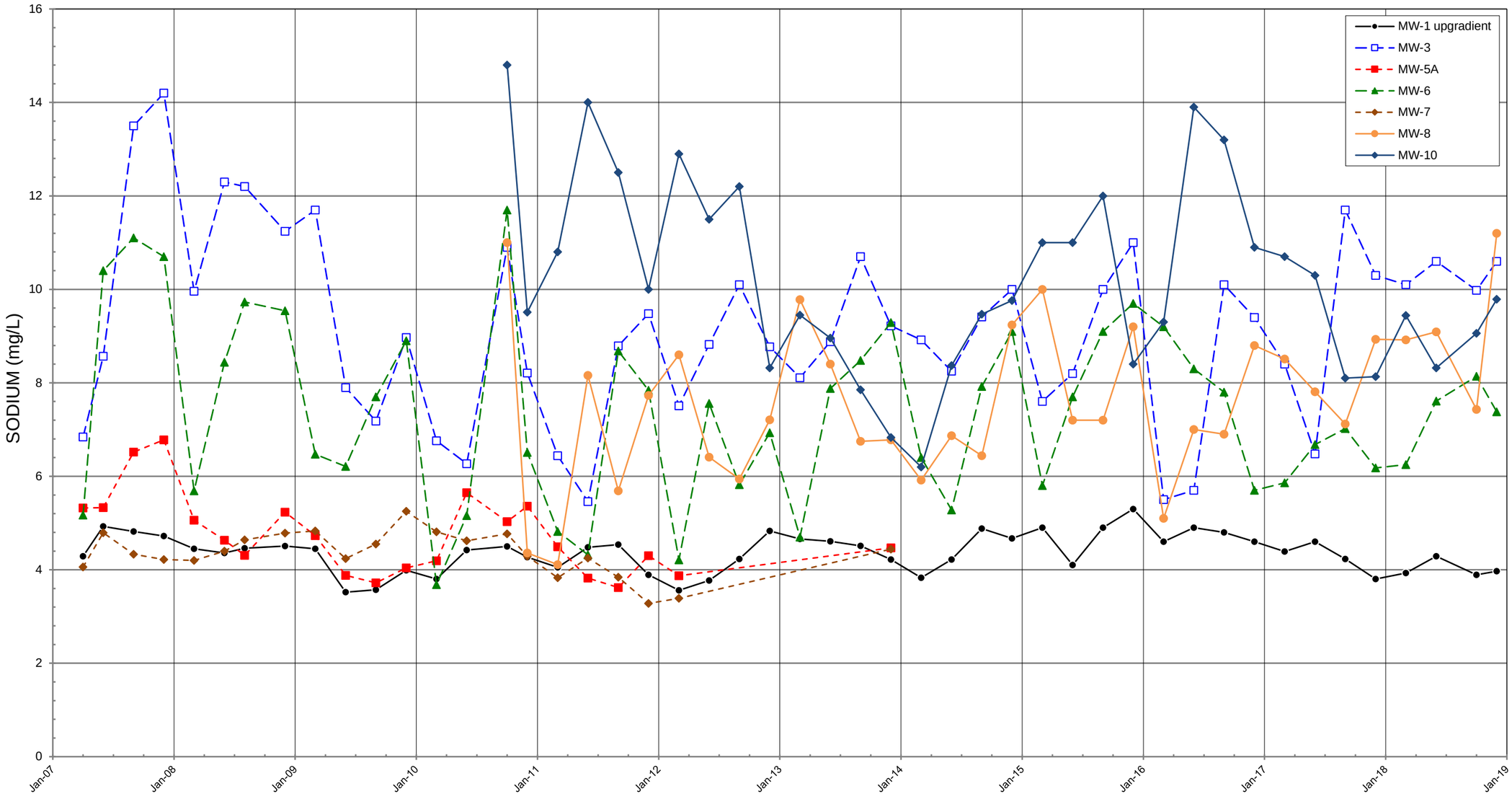


No Primary or Secondary Drinking Water Standard (DWS) Exists
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

POTASSIUM
(RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

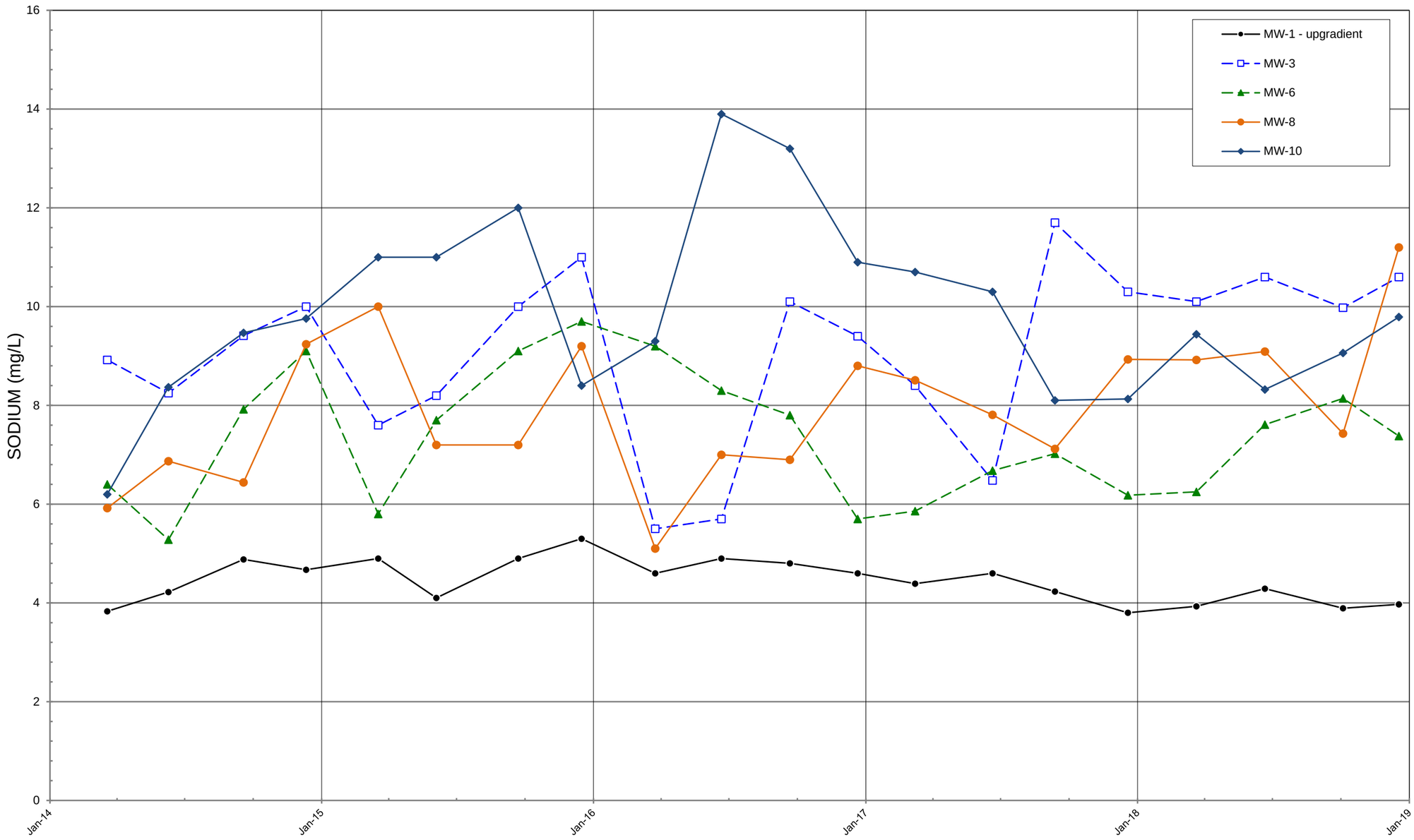


No Primary or Secondary Drinking Water Standard (DWS) Exists. Recommended level of concern for consumers with restricted daily sodium intake is 20 mg/L (off scale)
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

SODIUM
(Analysis started in 2007)

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

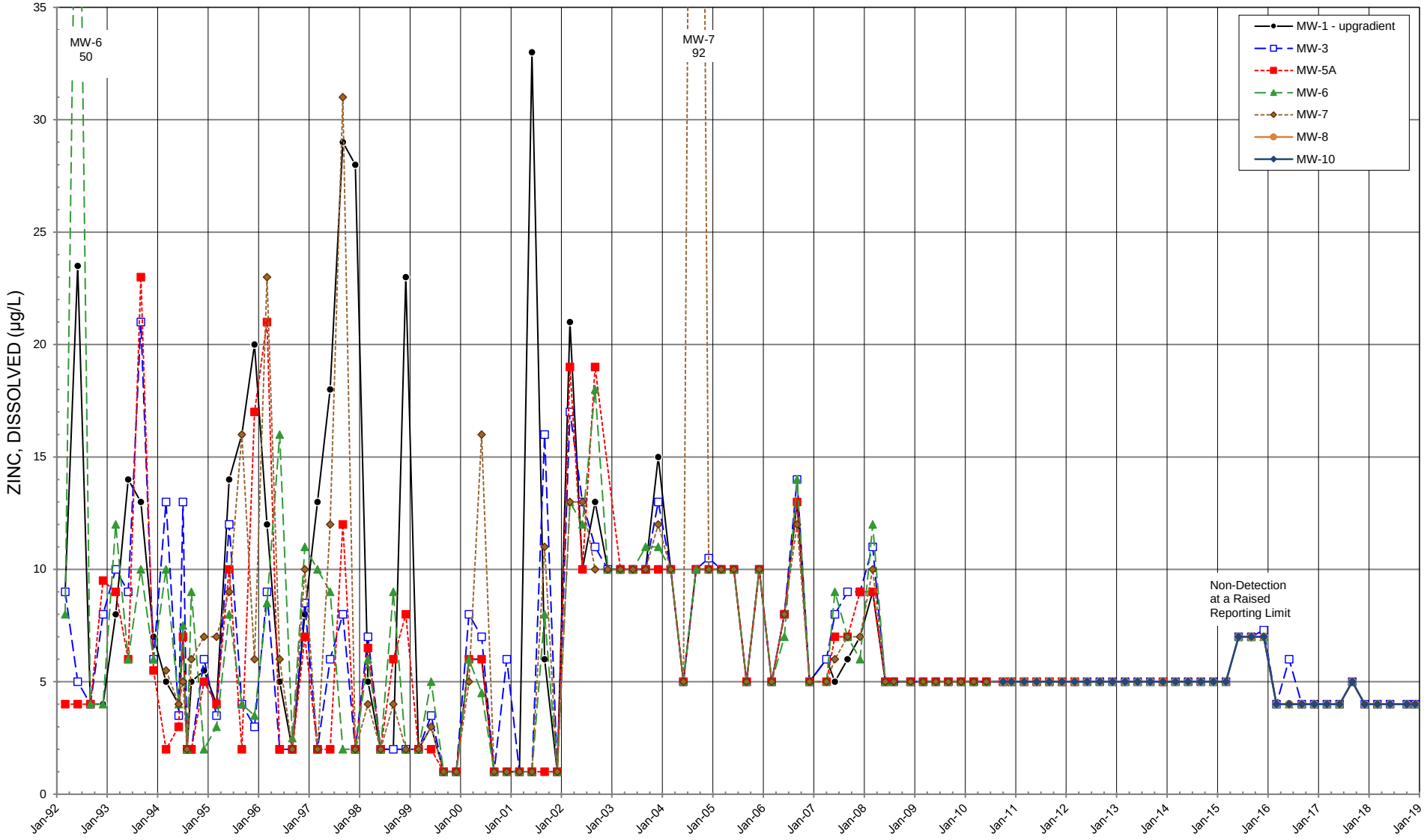


No Primary or Secondary Drinking Water Standard (DWS) Exists. Recommended level of concern for consumers with restricted daily sodium intake is 20 mg/L (off scale)
No Primary or Secondary Groundwater Standard (GWS) Exists

DATE

SODIUM (RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

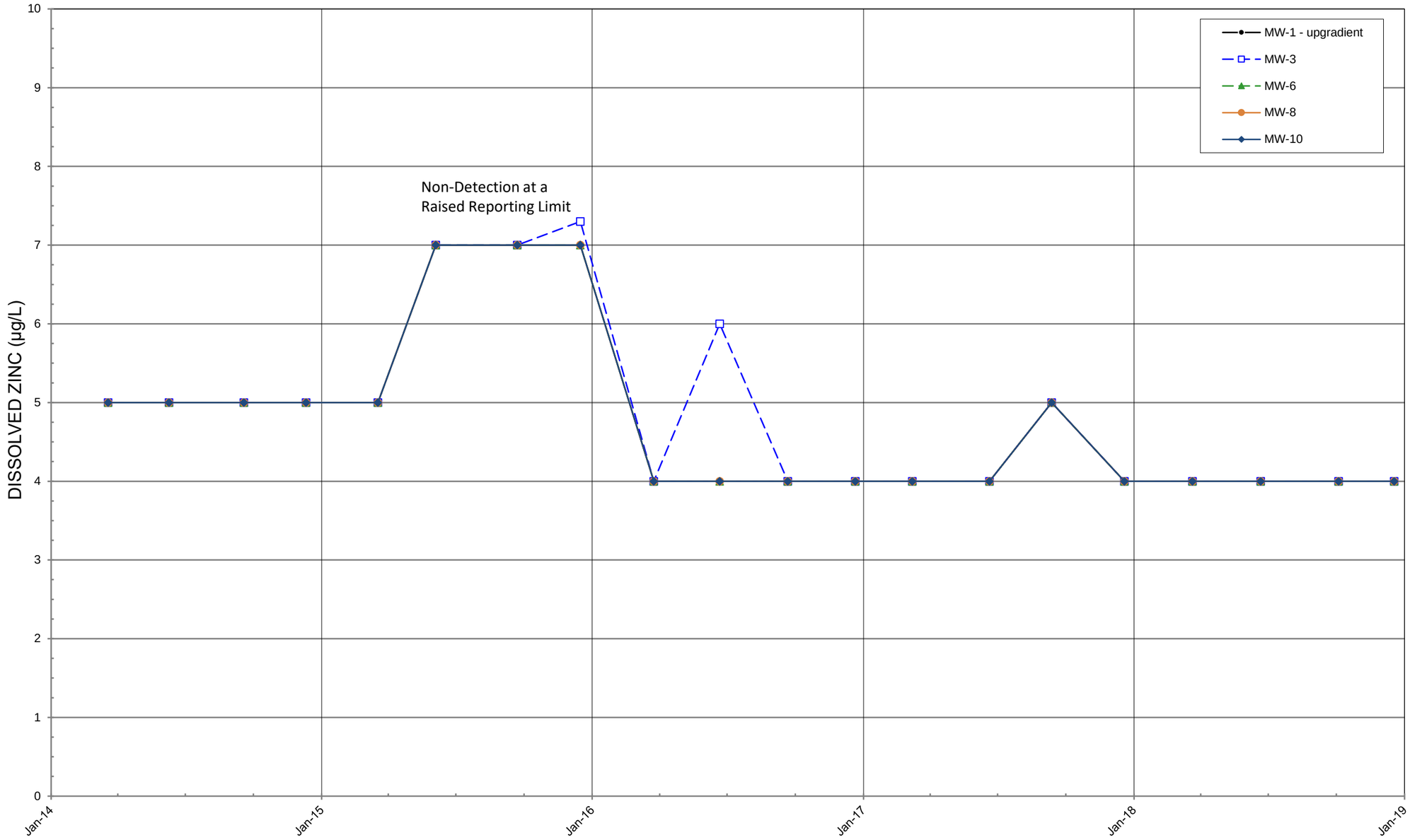


Secondary Drinking Water Standard (DWS) = 5000 µg/L (off scale)
Secondary Groundwater Standard (GWS) = 5000 µg/L (off scale)

DATE

DISSOLVED
ZINC

OLALLA LANDFILL
Quarterly Monitoring Data (most recent five years)

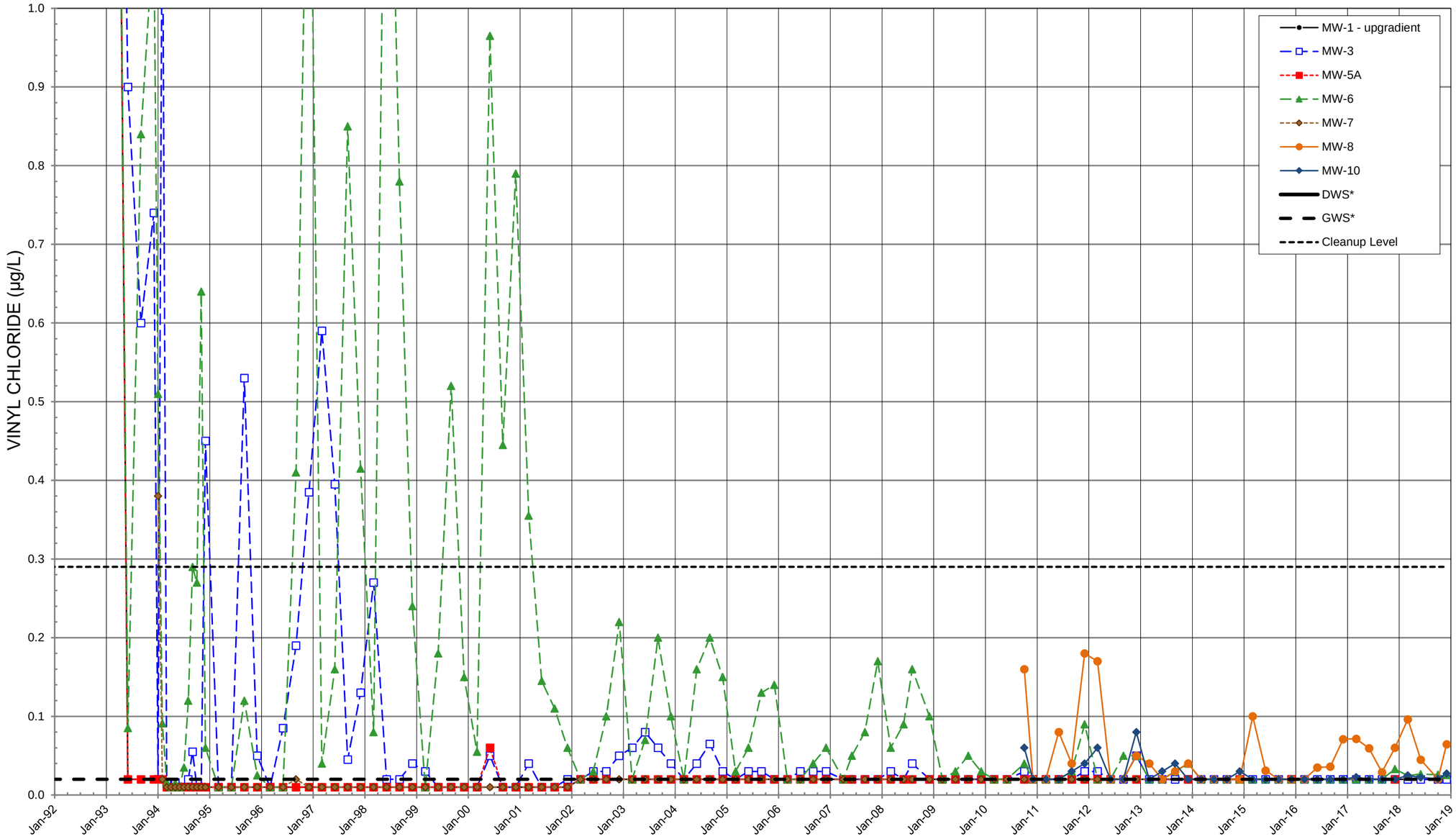


Secondary Drinking Water Standard (DWS) = 5000 µg/L (off scale)
Secondary Groundwater Standard (GWS) = 5000 µg/L (off scale)

DATE

DISSOLVED ZINC
(RECENT)

OLALLA LANDFILL
Quarterly Monitoring Data

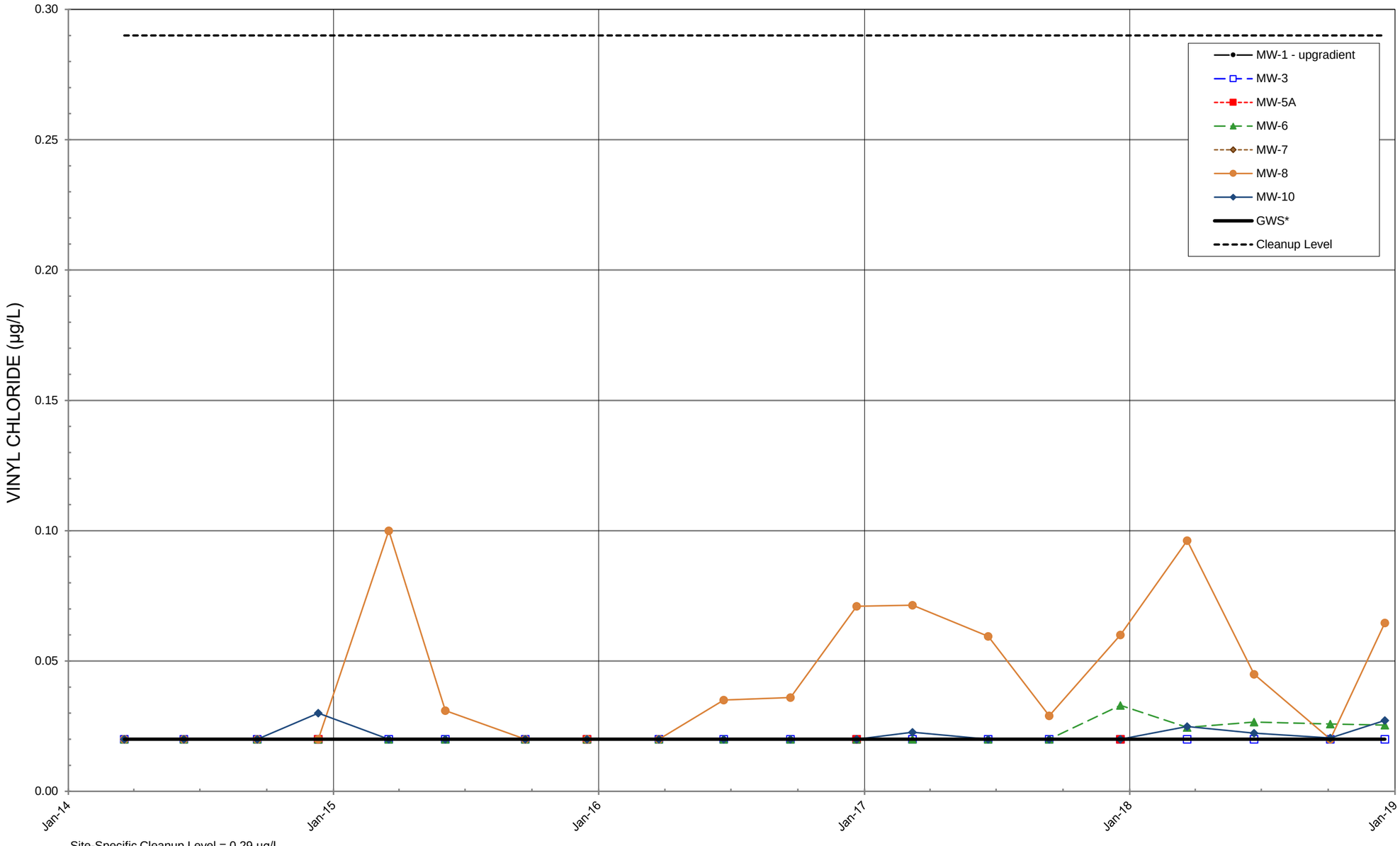


Site-Specific Cleanup Level = 0.29 ug/L
Primary Drinking Water Standard (DWS) = 2 µg/L (off scale)
Primary Groundwater Standard (GWS) = 0.02 µg/L

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)

March 2018 Mann-Kendall Statistically Significant Trend Test Results

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

NO TREND = No statistically significant trend.
UP = Statistically significant upward trend.
DOWN = Statistically significant downward trend.

June 2018 Mann-Kendall Statistically Significant Trend Test Results

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

NO TREND = No statistically significant trend.
UP = Statistically significant upward trend.
DOWN = Statistically significant downward trend.

October 2018 Mann-Kendall Statistically Significant Trend Test Results

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

NO TREND = No statistically significant trend.
UP = Statistically significant upward trend.
DOWN = Statistically significant downward trend.

December 2018 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	**UP**
Arsenic - Dissolved	**UP**	NO TREND	NO TREND	**UP**	NO TREND	**UP**	**DOWN**
Barium - Dissolved	NO TREND	NO TREND	NA	NO TREND	NA	NO TREND	NO TREND
Bicarbonate	NO TREND	**UP**	NA	NO TREND	NA	**UP**	**UP**
Calcium	**DOWN**	NO TREND	NA	NO TREND	NA	**UP**	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	**DOWN**	**DOWN**	NA	**UP**	NA	**UP**	NO TREND
Dissolved Oxygen	**UP**	**DOWN**	NO TREND	NO TREND	NA	**DOWN**	NO TREND
Iron - Dissolved	NO TREND	NO TREND	NO TREND	NO TREND	NO TREND	**UP**	**UP**
Manganese - Dissolved	NO TREND	**UP**	NO TREND	**UP**	NO TREND	NO TREND	NO TREND
Nitrate	**UP**	NO TREND	NA	NO TREND	NA	NO TREND	NO TREND
Nitrite	**DOWN**	NO TREND	NA	NO TREND	NA	**DOWN**	NO TREND
Oxidation Reduction Potential	**UP**	**UP**	NO TREND	NO TREND	**UP**	NO TREND	NO TREND
pH - Field	NO TREND	NO TREND	**UP**	NO TREND	NO TREND	NO TREND	NO TREND
pH - Laboratory	**DOWN**	NO TREND	NO TREND	**DOWN**	NO TREND	**DOWN**	NO TREND
Potassium	NO TREND	**UP**	NA	NO TREND	NA	**UP**	**UP**
Sodium	**DOWN**	**UP**	NA	NO TREND	NA	**UP**	NO TREND
Specific Conductance	**DOWN**	NO TREND	NO TREND	**UP**	NO TREND	**UP**	NO TREND
Sulfate	NO TREND	NO TREND	NA	NO TREND	NA	**UP**	NO TREND
Temperature	NO TREND	NO TREND	NO TREND	**DOWN**	NO TREND	NO TREND	NO TREND
Total Coliform	NO TREND	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	**UP**	NO TREND	**UP**	**UP**
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

March 2018 Shapiro-Wilk Test for Normality Results

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

June 2018 Shapiro-Wilk Test for Normality Results

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

October 2018 Shapiro-Wilk Test for Normality Results

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

December 2018 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	ND	NA	Non-normal	NA	Non-normal	Non-normal
Arsenic - Dissolved	Non-normal	Non-normal	Non-normal	Normal	Normal	Normal	Normal
Barium - Dissolved	Non-normal	Normal	NA	Normal	NA	Normal	Normal
Bicarbonate	Normal	Normal	NA	Normal	NA	Normal	Normal
Calcium	Normal	Non-normal	NA	Normal	NA	Normal	Normal
Carbonate	ND	ND	NA	ND	NA	ND	ND
COD	ND	Non-normal	NA	ND	NA	ND	Non-Normal
Chloride	Normal	Non-normal	NA	Non-normal	NA	Normal	Normal
Dissolved Oxygen	Normal	Non-normal	Normal	Non-normal	Normal	Normal	Non-normal
Iron - Dissolved	ND	ND	ND	Normal	ND	Non-normal	Non-normal
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	Normal	Non-normal	Normal	Non-normal	Non-normal	Non-normal	Non-normal
pH - Field	Non-normal	Normal	Normal	Non-normal	Normal	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	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Sulfate	Normal	Normal	NA	Non-normal	NA	Normal	Non-normal
Temperature	Non-normal	Normal	Normal	Normal	Normal	Normal	Non-normal
Total Coliform	ND	ND	NA	ND	NA	ND	ND
TOC	ND	Normal	NA	Normal	NA	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

March 2018 Results of 95% Confidence Interval Evaluations

Constituent or Parameter	MW-1	MW-3	MW-6	MW-8	MW-10	Regulatory Level	Basis for Comparison
Ammonia (N)	11 to 40	11 to 40	13 to 40	34 to 42	35 to 97	None	
Arsenic - Dissolved	**0.085 to 0.104**	**0.089 to 0.118**	**0.858 to 1.14**	**1.26 to 1.82**	**1.81 to 2.25**	0.05 µg/L	Primary GW Standard
Barium - Dissolved	**4.4 to 5**	**12.9 to 15.9**	**9.85 to 13.2**	**6.87 to 8.66**	**12.9 to 15.5**	1000 µg/L	Primary GW Standard
Bicarbonate	36.9 to 46.3	102 to 200	104 to 149	90.0 to 126	150 to 179	None	
Calcium	10,532 to 11,400	37,637 to 47,591	26,467 to 34,418	20,290 to 25,710	35,500 to 40,300	None	
Carbonate	ND	ND	ND	ND	ND	None	
COD	ND	ND	ND	ND	11.4	None	
Chloride	**3,689 to 4,679**	**2,840 to 3,420**	**1,860 to 2,570**	**2,150 to 2,440**	**5,075 to 8,077**	250,000 µg/L	Secondary GW and DW Standard
Dissolved Oxygen	9.62 to 10.2	0.360 to 1.16	0.11 to 0.43	0.96 to 2.14	0.10 to 0.47	None	
Iron - Dissolved	**ND**	**ND**	**834 to 1,231**	**320 to 938**	**ND**	300 µg/L	Secondary GW and DW Standard
Manganese - Dissolved	**ND**	**3,881 to 5,407**	**566 to 705**	**2.322 to 3,128**	**4,351 to 4,965**	50 µg/L	Secondary GW and DW Standard
Nitrate	**254 to 703**	**11 to 28**	**ND to 20**	**54 to 132**	**ND to 62**	10,000 µg/L	Primary GW and DW Standard
Nitrite	**3 to 10**	**ND**	**2 to 10**	**3 to 10**	**2 to 10**	1,000 µg/L	Primary DW Standard
Oxidation-Reduction Potential	170 to 196	120 to 203	10.8 to 36.8	40.6 to 65.8	94 to 139.1	None	
pH - Field	**6.1 to 6.4**	**6.0 to 6.2**	**6.5 to 6.7**	**6.5 to 6.7**	**6.4 to 6.6**	6.5 - 8.5	Secondary GW Standard
pH - Laboratory	**6.4 to 6.6**	**6.2 to 6.4**	**6.6 to 6.8**	**6.6 to 6.8**	**6.6 to 6.7**	6.5 - 8.5	Secondary GW Standard
Potassium	705 to 1,525	849 to 1,630	1,227 to 1,910	968 to 1,712	1,151 to 1,834	None	

March 2018 Results of 95% Confidence Interval Evaluations

Constituent or Parameter	MW-1	MW-3	MW-6	MW-8	MW-10	Regulatory Level	Basis for Comparison
Sodium	**4,358 to 4,655**	**8.332 to 9,574**	**6,795 to 7,919**	**7,257 to 8,258**	**9,267 to 10,595**	20,000 µg/L	Secondary DW Standard
Specific Conductance	**118 to 126**	**324 to 405**	**201 to 343**	**198 to 248**	**363 to 412**	700 µmhos/cm	Secondary DW Standard
Sulfate	**3,827 to 4,284**	**13,585 to 18,247**	**6,490 to 9,430**	**4,140 to 4,874**	**7,630 to 9,800**	250,000 µg/L	Secondary GW and DW Standard
Temperature	10.8 to 12.39	11.9 to 12.6	11.4 to 12.2	10.7 to 11.7	11.2 to 11.9	None	
Total Coliform	**ND**	**ND**	**ND**	**ND**	**ND**	1cfu/100mL	Primary GW and DW Standard
TOC	334 to 500	2,390 to 3,044	1,751 to 2,130	766 to 1,144	3,060 to 3,430	None	
Vinyl Chloride	**ND**	**ND**	**ND to 0.02**	**ND to 0.06**	**ND to 0.02**	0.02 µg/L	Primary GW Standard
Zinc - Dissolved	**ND**	**ND**	**ND**	**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 fewer than 5 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 (Compliance)

= 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

June 2018 Results of 95% Confidence Interval Evaluations

Constituent or Parameter	MW-1	MW-3	MW-6	MW-8	MW-10	Regulatory Level	Basis for Comparison
Ammonia (N)	14 to 40	ND	18 to 40	33 to 42	36 to 98	None	
Arsenic - Dissolved	**0.085 to 0.104**	**0.089 to 0.118**	**0.90 to 1.10**	**1.28 to 1.86**	**1.77 to 2.23**	0.05 µg/L	Primary GW Standard
Barium - Dissolved	**4.0 to 5.0**	**13.12 to 16.03**	**9.73 to 13.2**	**6.19 to 8.23**	**12.5 to 15.3**	1000 µg/L	Primary GW Standard
Bicarbonate	36.7 to 45.9	102 to 219	113 to 154	91.5 to 129	148 to 186	None	
Calcium	10,509 to 11,388	38,019 to 53,703	27,878 to 35,065	20,339 to 25,794	35,481 to 39,811	None	
Carbonate	ND	ND	ND	ND	ND	None	
COD	ND	10,000	ND	ND	10,000 to 11,482	None	
Chloride	**3,727 to 4,696**	**2,818 to 3,388**	**1,862 to 2,512**	**2,137 to 2,570**	**4,780 to 7,783**	250,000 µg/L	Secondary GW and DW Standard
Dissolved Oxygen	9.71 to 10.3	0.288 to 0.933	0.200 to 0.426	0.991 to 2.15	0.148 to 0.467	None	
Iron - Dissolved	**ND**	**ND**	**757 to 1,188**	**324 to 794**	**ND**	300 µg/L	Secondary GW and DW Standard
Manganese - Dissolved	**ND**	**4,173 to 5,716**	**593 to 736**	**2,344 to 3,090**	**4,278 to 4,904**	50 µg/L	Secondary GW and DW Standard
Nitrate	**251 to 813**	**11 to 28**	**10 to 24**	**40 to 132**	**10 to 20**	10,000 µg/L	Primary GW and DW Standard
Nitrite	**3 to 10**	**ND**	**3 to 10**	**ND**	**2 to 10**	1,000 µg/L	Primary DW Standard
Oxidation-Reduction Potential	148 to 212	126 to 199	11.0 to 37.2	41.7 to 66.1	95.5 to 138	None	
pH - Field	**6.1 to 6.3**	**6.0 to 6.2**	**6.4 to 6.7**	**6.5 to 6.6**	**6.4 to 6.5**	6.5 - 8.5	Secondary GW Standard
pH - Laboratory	**6.4 to 6.6**	**6.2 to 6.4**	**6.6 to 6.7**	**6.6 to 6.8**	**6.6 to 6.7**	6.5 - 8.5	Secondary GW Standard
Potassium	520 to 708	741 to 955	1,096 to 1,479	891 to 1,023	1,047 to 1,202	None	

June 2018 Results of 95% Confidence Interval Evaluations

Constituent or Parameter	MW-1	MW-3	MW-6	MW-8	MW-10	Regulatory Level	Basis for Comparison
Sodium	**4,341 to 4,638**	**8,441 to 9,702**	**6,983 to 8,009**	**7,241 to 8,209**	**8,892 to 10,362**	20,000 µg/L	Secondary DW Standard
Specific Conductance	**119 to 127**	**301 to 402**	**257 to 348**	**198 to 249**	**361 to 409**	700 µmhos/cm	Secondary DW Standard
Sulfate	**3,790 to 4,242**	**13,887 to 18,637**	**6,457 to 9,333**	**4,124 to 4,837**	**7,762 to 9,772**	250,000 µg/L	Secondary GW and DW Standard
Temperature	10.7 to 12.3	11.7 to 12.5	11.3 to 12.1	10.6 to 11.6	11.0 to 11.8	None	
Total Coliform	**ND**	**ND**	**ND**	**ND**	**ND**	1cfu/100mL	Primary GW and DW Standard
TOC	**ND**	2,469 to 3,106	1,549 to 2,188	597 to 1,067	3,020 to 3,467	None	
Vinyl Chloride	**ND**	**ND**	**ND to 0.02**	**ND to 0.06**	**ND to 0.02**	0.02 µg/L	Primary GW Standard
Vinyl Chloride	**ND**	**ND**	**ND to 0.02**	**ND to 0.06**	**ND to 0.02**	0.29 µg/L	Site-Specific Cleanup Level
Zinc - Dissolved	**ND**	**ND**	**ND**	**ND**	**ND**	5,000 µg/L	Secondary GW and DW Standard

Notes:

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= 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

October 2018 Results of 95% Confidence Interval Evaluations

Constituent or Parameter	MW-1	MW-3	MW-6	MW-8	MW-10	Regulatory Level	Basis for Comparison
Ammonia (N)	ND to 40	ND	ND to 13	ND to 40	25 to 85	None	
Arsenic - Dissolved	**0.085 to 0.106**	**0.09 to 0.118**	**0.90 to 1.14**	**1.32 to 1.87**	**1.72 to 2.13**	0.05 µg/L	Primary GW Standard
Barium - Dissolved	**ND to 4.0**	**13 to 18**	**9.81 to 13.4**	**6.08 to 8.13**	**13.2 to 16.1**	1000 µg/L	Primary GW Standard
Bicarbonate	36.95 to 46.2	130.9 to 193.1	115.4 to 158.4	90.8 to 128.2	149.7 to 179.5	None	
Calcium	10,437 to 11,338	39,600 to 54,000	28,088 to 35,331	17,100 to 28,700	35,300 to 41,200	None	
Carbonate	ND	ND	ND	ND	ND	None	
COD	ND	ND	ND	ND	ND to 11,400	None	
Chloride	**3,742 to 4,702**	**2,680 to 3,420**	**1,860 to 2,610**	**2,150 to 2,620**	**4,590 to 7,779**	250,000 µg/L	Secondary GW and DW Standard
Dissolved Oxygen	9.75 to 10.35	0.27 to 0.94	0.20 to 0.43	0.957 to 2.14	0.15 to 0.27	None	
Iron - Dissolved	**ND**	**ND**	**753 to 1,181**	**290 to 799**	**ND**	300 µg/L	Secondary GW and DW Standard
Manganese - Dissolved	**ND**	**4,407 to 5,880**	**611 to 770**	**2,350 to 3,150**	**4,295 to 4,923**	50 µg/L	Secondary GW and DW Standard
Nitrate	**462 to 911**	**ND to 11**	**ND to 10**	**52 to 110**	**ND to 10**	10,000 µg/L	Primary GW and DW Standard
Nitrite	**ND to 3**	**ND**	**ND**	**ND to 2**	**ND**	1,000 µg/L	Primary DW Standard
Oxidation-Reduction Potential	152.5 to 219.5	130.1 to 204.6	ND to 34.9	40.6 to 65.8	93.9 to 137.2	None	
pH - Field	**6.1 to 6.4**	**6.1 to 6.2**	**6.4 to 6.7**	**6.5 to 6.7**	**6.4 to 6.6**	6.5 - 8.5	Secondary GW Standard
pH - Laboratory	**6.4 to 6.6**	**6.2 to 6.3**	**6.6 to 6.7**	**6.6 to 6.8**	**6.6 to 6.7**	6.5 - 8.5	Secondary GW Standard
Potassium	ND to 640	500 to 835	952 to 1,260	602 to 980	925 to 1,160	None	

October 2018 Results of 95% Confidence Interval Evaluations

Constituent or Parameter	MW-1	MW-3	MW-6	MW-8	MW-10	Regulatory Level	Basis for Comparison
Sodium	**4,299 to 4,611**	**8,489 to 9,759**	**6,9934 to 8,023**	**7,197 to 8,159**	**8,898 to 10,366**	20,000 µg/L	Secondary DW Standard
Specific Conductance	**118 to 126**	**302 to 404**	**263 to 343**	**196 to 247**	**361 to 410**	700 µmhos/cm	Secondary DW Standard
Sulfate	**3,753 to 4,205**	**13,914 to 18,650**	**6,400 to 9,200**	**4,107 to 4,826**	**7,630 to 9,370**	250,000 µg/L	Secondary GW and DW Standard
Temperature	10.8 to 11.9	11.7 to 12.3	11.2 to 11.9	10.5 to 11.4	11.0 to 11.8	None	
Total Coliform	**ND**	**ND**	**ND**	**ND**	**ND**	1cfu/100mL	Primary GW and DW Standard
TOC	ND	2,491 to 3,120	1,580 to 2,190	641 to 1,089	2,870 to 3,430	None	
Vinyl Chloride	**ND**	**ND**	**ND**	**ND to 0.04**	**ND**	0.02 µg/L	Primary GW Standard
Vinyl Chloride	**ND**	**ND**	**ND**	**ND to 0.04**	**ND**	0.29 µg/L	Site-Specific Cleanup Level
Zinc - Dissolved	**ND**	**ND**	**ND**	**ND**	**ND**	5,000 µg/L	Secondary GW and DW Standard

Notes:

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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

December 2018 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)	40 to 40	40 to 40	NA	40 to 42	NA	40 to 45	77 to 98	None	
Arsenic - Dissolved	**0.09 to 0.11**	**0.099 to 0.122**	NA	**0.0.931 to 1.166**	**0.249 to 0.535**	**1.41 to 1.978**	**1.684 to 2.108**	0.05 µg/L	Primary GW Standard
Arsenic - Dissolved	**0.09 to 0.11**	**0.099 to 0.122**	NA	**0.0.931 to 1.166**	**0.249 to 0.535**	**1.41 to 1.978**	**1.684 to 2.108**	1.29 µg/L	Site-Specific Cleanup Level
Barium - Dissolved	**3.1 to 5.0**	**12.91 to 15.86**	NA	**9.35 to 12.89**	NA	**5.84 to 8.09**	**12.8 to 15.7**	1000 µg/L	Primary GW Standard
Bicarbonate (mg of $CaCO_3$/L)	37.40 to 47.19	143 to 207	NA	112 to 159	NA	98.7 to 140	156 to 190	None	
Calcium	10,343 to 11,327	34,000 to 54,000	NA	27,272 to 34,858	NA	20,986 to 27,014	37,636 to 42,075	None	
Carbonate (mg of $CaCO_3$/L)	ND	ND	NA	ND	NA	ND	ND	None	
COD	ND	ND to 10.2	NA	ND	NA	ND	ND to 13.0	None	
Chloride	**3,630 to 4,419**	**2,450 to 3,420**	NA	**1,800 to 2,610**	NA	**2,154 to 2,637**	**4,267 to 7741**	250,000 µg/L	Secondary GW and DW Standard
Dissolved Oxygen (mg/L)	9.83 to 10.42	0.27 to 0.94	8.13 to 11.29	0.20 to 0.43	6.63 to 8.96	1.03 to 2.24	0.15 to 0.31	None	
Iron - Dissolved	**ND**	**ND**	**ND**	**687 to 1,074**	**ND**	**290 to 799**	**20 to 25.2**	300 µg/L	Secondary GW and DW Standard
Manganese - Dissolved	**ND**	**4,635 to 6,162**	**ND**	**616 to 785**	**ND**	**2,169 to 2,999**	**4,366 to 6,163**	50 µg/L	Secondary GW and DW Standard
Nitrate	**505 to 975**	**19 to 30**	NA	**ND to 32.1**	NA	**53.1 to 156**	**ND to 82**	10,000 µg/L	Primary GW and DW Standard
Nitrite	**4 to 10**	**ND**	NA	**3 to 10**	NA	**4 to 10**	**ND**	1,000 µg/L	Primary DW Standard
Oxidation-Reduction Potential	156 to 226	165 to 239	106 to 208	10.8 to 36.8	NA	42.2 to 67.1	94.6 to 139.5	None	
pH - Field	**6.1 to 6.5**	**6.1 to 6.2**	**6.4 to 6.8**	**6.4 to 6.7**	**6.6 to 6.7**	**6.5 to 6.7**	**6.4 to 6.6**	6.5 - 8.5	Secondary GW Standard

December 2018 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
pH - Laboratory	**6.3 to 6.5**	**6.2 to 6.3**	**6.5 to 6.9**	**6.6 to 6.7**	**6.5 to 6.9**	**6.6 to 6.7**	**6.5 to 6.7**	6.5 - 8.5	Secondary GW Standard
Potassium	520 to 710	747 to 979	NA	1,100 to 1,490	NA	891 to 1,120	1,040 to 1,310	None	
Sodium	**4,271 to 4,609**	**8,447 to 9,781**	NA	**6,855 to 7,873**	NA	**7,372 to 8,520**	**9,159 to 10,579**	20,000 µg/L	Secondary DW Standard
Specific Conductance (µmhos/cm)	**115 to 122**	**295 to 400**	**99 to 144**	**246 to 310**	**90 to 108**	**202 to 261**	**364 to 418**	700 µmhos/cm	Secondary DW Standard
Sulfate	**3,689 to 4,153**	**13,506 to 18,256**	NA	**6,100 to 9,200**	NA	**4,081 to 4,830**	**7,630 to 9,370**	250,000 µg/L	Secondary GW and DW Standard
Temperature (^{o}C)	10.8 to 11.0	11.6 to 12.2	10.5 to 12.5	11.1 to 11.7	9.4 to 11.9	10.4 to 11.1	11.2 to 11.7	None	
Total Coliform (count)	**ND**	**ND**	NA	**ND**	NA	**ND**	**ND**	1/100 mL	Primary GW and DW Standard
TOC	ND	2,448 to 3,104	NA	1,530 to 2,102	NA	745 to 1,182	2,870 to 3,580	None	
Vinyl Chloride	**ND**	**ND**	**ND**	**ND**	**ND**	**ND to 0.06**	**ND**	0.02 µg/L	Primary GW Standard
Vinyl Chloride	**ND**	**ND**	**ND**	**ND**	**ND**	**ND to 0.06**	**ND**	0.29 µg/L	Site-Specific Cleanup Level
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)

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= 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

Appendix D:
Inspection, Maintenance, and Engineering Summary for 2018

Inspection, Maintenance, and Engineering Summary for 2018

The bulleted items below present a summary of the inspection, maintenance, and engineering tasks that were performed by SWD during 2018 at the Olalla Landfill.

- EPI conducted groundwater and landfill gas monitoring activities in all four quarters of 2018. 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 2018, 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 2018, routine maintenance was required including mowing of the cap and removal of vegetation.

Appendix E:
Activities Planned for 2019

Activities Planned for 2019

The bulleted items below present a summary of the planned inspections, maintenance and engineering activities planned for 2019 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 2019.

- 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:
2018 Quarterly Monitoring Analytical Data Sheets
(Provided on attached CD-ROM)