WASTE MANAGEMENT

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February 5, 2019

Mr. Tim O'Connor LG, LHG
Washington State Department of Ecology
Solid Waste Management Program
3190 160th Ave SE
Bellevue, WA 98008-5452

Ms. Janet Brower
Kitsap Public Health District
Solid & Hazardous Waste Program
345 6th Street, Suite 300
Bremerton, WA 98337

Subject: Application to Modify Permit (Monitoring Program Reduction) - Olympic View Sanitary Landfill, Kitsap County Washington

Dear Tim and Janet,

Waste Management Environmental Legacy Management Group (ELMG) has prepared this Permit Modification Application to reduce the frequency of groundwater monitoring at the Olympic View Sanitary Landfill (OVSL) located in Kitsap County, Washington. The facility is implementing a post-closure groundwater monitoring program under Washington Administrative Code (WAC) 173-351.

Currently, the facility performs quarterly groundwater sampling at 11 monitoring wells and one leachate pond liquid recovery monitoring station. Five additional groundwater wells are also sampled on a semi-annual basis, and two leachate monitoring stations are sampled annually. Modification of the sampling program is proposed in accordance with WAC-351-450 and WAC-351-720, with the regulatory and technical basis provided below.

Summary of Proposed Permit Modification

Based on the rational outlined below, OVSL is requesting that the Washington Department of Ecology (Ecology) and the Kitsap Public Health District (KPHD) approve the following modifications to the existing OVSL groundwater monitoring program:

- Reduction of the monitoring frequency at the six compliance monitoring wells (MW-15R, MW-34A, MW-34C, MW-39, MW-42 and MW-43) from quarterly to semi-annual.

- Reduction of the monitoring frequency at the five downgradient monitoring wells (MW-29A, MW-32, MW-33A, MW-33C and MW-36A) from quarterly to semi-annual.

- Reduction of the monitoring frequency at the four upgradient monitoring wells (MW-13A, MW-13B, MW-16 and MW-35) from quarterly to annual.

- Reduction of water level monitoring for all wells included in this program from quarterly to semi-annual.

The rationale for the proposed reductions is described below.

Adequate Characterization of Hydrostratigraphic Units

The site-specific hydrogeologic characteristics at OVSL are well understood, and are documented in a Remedial Investigation (RI) Report (Parametrix, 2007) and by over a decade of subsequent groundwater investigation and monitoring efforts. The 2007 RI included a comprehensive evaluation of the unsaturated zone and uppermost hydrostratigraphic unit (HSU), which are comprised of alluvial and Vashon glaciofluvial sediments, as well as the hydraulic properties (hydraulic conductivities and groundwater flow velocities) of the shallow aquifer.

Groundwater Flow and Velocity are Well Understood

Groundwater flow direction (west-northwest) and gradients (ranging between 0.01 and 0.04 feet/feet) measured at OVSL have remained consistent throughout the post-closure monitoring period. In fact, review of forty groundwater elevation maps generated over the last ten years indicates that the direction and magnitude of the hydraulic gradient has remained essentially unchanged, with the general flow direction always being to the west-northwest. Given the overall consistency of the observed groundwater flow direction, ELMG is proposing that water level data be collected semi-annually during the spring and fall monitoring events.

Groundwater flow velocities across the site are calculated routinely (twice a year) and have remained generally consistent over the historical record. Calculated groundwater velocities have typically ranged between 2.5 and 7.5 feet/day, with the highest velocities being reported on the western half of the facility. These velocities equate to groundwater movement ranging between 900 to 2,700 feet/year (or 450 to 1,350 feet/180 days). The downgradient well field ranges between 700 and 1,500 feet west-northwest (downgradient) of the edge of the Barney White cell. Given the maximum distance of groundwater movement over a period of 180 days, and the distances to downgradient wells, modification of the sampling frequency to semi-annual should not compromise the effectiveness of early detection of a potential new release.

Fate and Transport Characteristics and Time Series Graphs

An important consideration in developing the detection monitoring network at the OVSL includes an understanding of the contaminant source and migration pathways at the site. A wealth of information is available for the site regarding the most likely mechanism for potential groundwater impacts. Although the facility was formerly closed under WAC 173-351 in 2004, it is important to

note that the older Barney White cell was constructed prior to current Federal and State landfill design requirements, and without a WAC 173-351 bottom liner system.

As a result, certain volatile organic compounds (VOCs) and select inorganic compounds have been detected in groundwater at concentrations above site-specific cleanup goals. However, as well documented in over a decade of post-closure monitoring reports (including the 2017 OVSL Annual Report), the contaminant concentrations reported at the site have either stabilized and/or show decreasing concentration trends. Trend information for both VOCs and inorganic water quality parameters is provided below.

Greatly Reduced Levels of VOCs in Groundwater

As discussed with Ecology and KPHD in the recent past, corrective action measures taken over the past many years have greatly reduced the levels of VOCs in groundwater. Currently, there is only one well (MW-32) with a MTCA VOC exceedance (vinyl chloride). With the exception of MW-32, there has not been a vinyl chloride exceedance in any other well on site since 2011. Aside from vinyl chloride, the last occurrence of any other VOC above a cleanup goal was in 2009, when trichloroethene exceeded the cleanup criteria in MW-32.

Review of historical data indicates that vinyl chloride concentrations in MW-32 have decreased significantly since the mid-1990s (Attachment 1a). As described in the 2017 annual report, the most recent 95% upper confidence level (UCL) for vinyl chloride in MW-32 (0.38 ug/L) is approaching the cleanup goal of 0.20 ug/L. In fact, during the May 2017 sampling event the vinyl chloride concentration in MW-32 (0.18 ug/L) was actually below the cleanup goal. It is also noted that there are two additional monitoring wells (MW-33A and MW-33C) located downgradient of MW-32 that have never had vinyl chloride detections. Lastly, MW-32 is located approximately 1000 feet from the downgradient OVSL property boundary, and it is considered extremely unlikely that the very low levels of vinyl chloride currently observed in MW-32 could ever migrate off site.

Changing the sampling frequency for downgradient and compliance wells to a semi-annual schedule will not compromise the effectiveness of the monitoring program with regard to VOC testing.

Inorganic Water Quality Parameter Exceedances

For the inorganic compounds, there are four parameters (arsenic, iron, manganese and ammonia) that exceed current cleanup goals at several downgradient wells. As discussed with Ecology and KPHD, the occurrence of arsenic, iron, manganese and ammonia at concentrations greater than the cleanup standards may reflect an inherently flawed methodology for establishing "background" levels. The current cleanup standards for inorganic compounds is based in large part on upgradient prediction limits. However, it is well-documented that groundwater conditions change across the site from upgradient to downgradient locations.

Shallow groundwater in the upgradient portion of the site is subject to a geochemically oxidizing (i.e., aerobic) environment due to the percolation of recharge water with high dissolved oxygen. As groundwater flows downgradient, recharge is restricted by the final cover system installed over the landfill and oxygen is consumed by aerobic microbial conditions. At the downgradient margins

of the site where wetland conditions develop, further reduced (i.e., anaerobic) geochemical conditions prevail. Under reducing conditions observed downgradient of the landfill, the concentrations of arsenic, iron, manganese and ammonia are elevated compared to upgradient conditions. Hence, it is unlikely that the current cleanup goals (developed based on upgradient prediction limits) will ever be achieved for redox-sensitive inorganic parameters.

Attachment 1b provides a summary table of the inorganic parameters (arsenic, iron, manganese and ammonia) detected above current cleanup goals in both the compliance and downgradient monitoring wells. (Note: these data are from Appendix C of the most current annual report dated March 26, 2018). The summary table includes statistical trend information showing that the parameter concentrations are generally stable, or in a few cases (most notably MW-32), the concentrations are decreasing.

Attachment 1c provides time-series graphs for the wells that have exceedances of the current cleanup goals for arsenic, iron, manganese and ammonia. Review of these graphs shows that parameter concentrations overall are generally stable or decreasing, as indicated above in the statistical trend analysis discussion. Many wells show fluctuations in parameter concentrations, and this is most likely related to either seasonal changes in redox conditions and/or varying degrees of particulate matter in the samples collected. The latter condition, as discussed recently with Ecology, can be seen in the distinctly divergent concentrations of dissolved versus total metals in some samples.

Regardless of the parameter concentration fluctuations observed in some wells, changing the sampling frequency for downgradient and compliance wells to semi-annual should not compromise the effectiveness of the monitoring program.

Adequate Characterization of Upgradient Groundwater Quality

Groundwater quality in the upgradient (background) monitoring wells is well established, and prediction limit-based, site-specific groundwater limits have been developed consistent with the current methodology for establishing background water quality. The current prediction limits are based on a substantial amount of data, including 18 years of quarterly data from a pooled dataset of four upgradient wells (nearly 300 measurements for many parameters). These prediction limits, which are recalculated on an annual basis, have remained very stable as documented in prior annual reports.

Given the significant amount of pooled data available and the consistency of the prediction limit calculation results, a transition to annual monitoring of the upgradient wells should not compromise the effectiveness of post-closure care at the landfill. Additionally, use of upgradient data to establish background limits for the site is inherently problematic as discussed above.

Summary

The long history of quarterly monitoring data for both the compliance and downgradient wells (and several other wells monitored historically), provides a wealth of information regarding groundwater conditions at the site. Given the greatly reduced levels of VOCs in groundwater at the facility (with only one well currently above a cleanup goal for one parameter), and the overall statistically

stable concentrations of inorganic parameters, transition to semi-annual monitoring for the compliance and downgradient wells should not compromise the effectiveness of post-closure care at the landfill. Continued implementation of a quarterly groundwater sampling frequency at the facility is an unnecessary use of ELMG and regulatory resources. A change to semi-annual sampling will not result in any impacts to either human health or the environment, and is compliant with the regulations.

ELMG appreciates the support provided by Ecology and KPHD in review of the information contained herein and thoughtful consideration of the recommended changes to the groundwater monitoring program. WMW will amend the Sampling and Analysis Program accordingly based upon agency concurrence with the changes recommended herein.

If you have any questions regarding the information provided, please contact me at (818) 252-3202.

Sincerely,

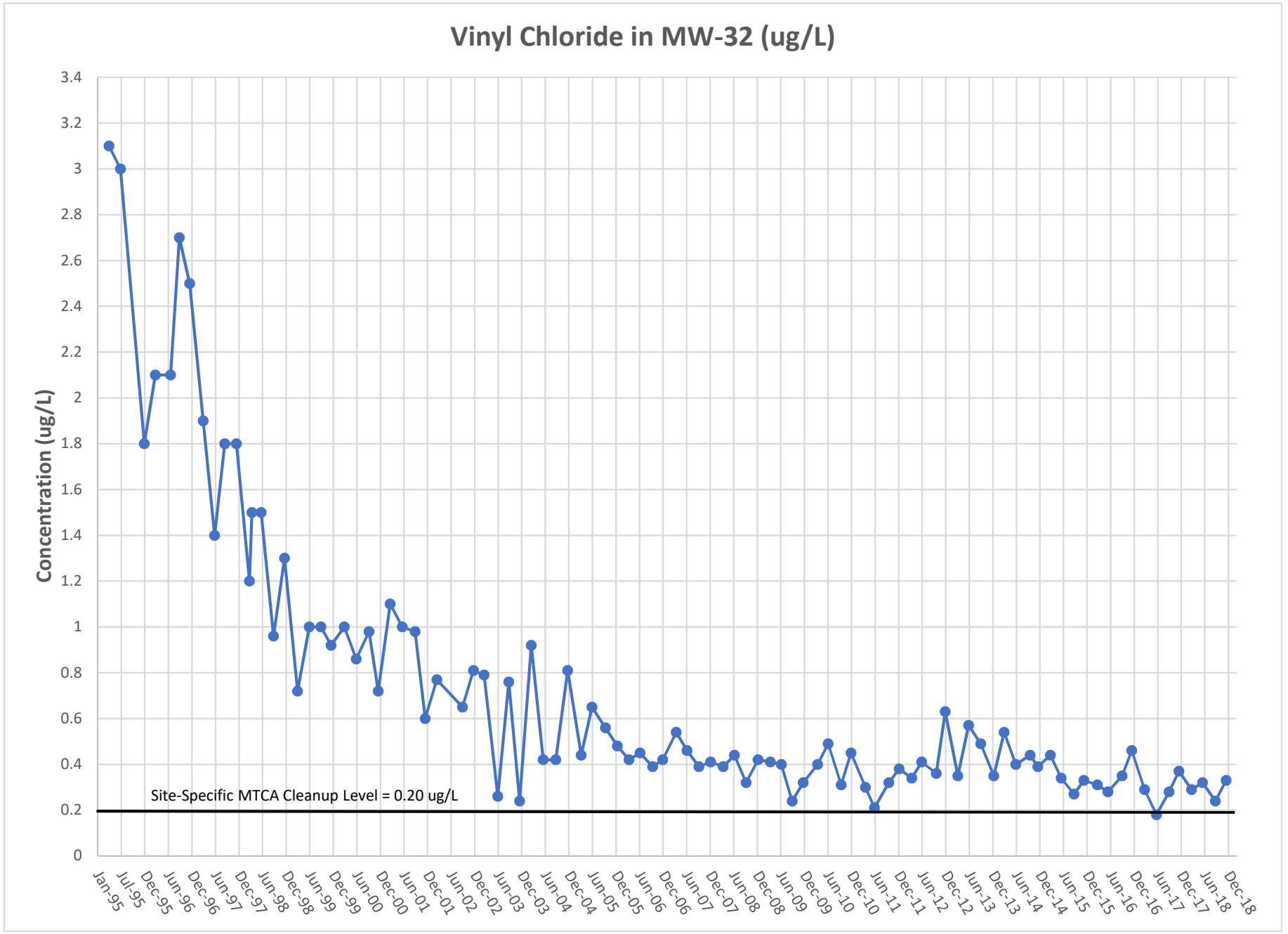
Waste Management of Washington

Philip C. Perley
Senior District Manager

cc: Alan Noell, Ecology
Dan Venchiarutti, SCS Engineers
Will Neal, GeoChem Applications
James Obereiner, JMO Consulting

ATTACHMENT 1A

Vinyl Chloride Time-Series


Vinyl Chloride in MW-32 (ug/L)
Concentration (ug/L)
3.4
3.2
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
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0.4
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0
Site-Specific MTCA Cleanup Level = 0.20 ug/L
Jan-95
Jul-95
Dec-95
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ATTACHMENT 1B

2017 Exceedance and Trend Information (GeoChem Applications)

3. Annual UCL Calculations using Preliminary Groundwater Cleanup Goals

- 2017 Annual Preliminary Groundwater Cleanup Goals Statistical Evaluation Summary (Table 3-1)

TABLE 3-1: 2017 Annual Groundwater Cleanup Level Statistical Evaluation Summary

Olympic View Sanitary Landfill

Statistical Methodology: calculation of 95% UCL of mean per MTCAStat

Data Input (general): 3-year "moving window", updated annually

Data Input (specific): January 1, 2015 through December 31, 2017

Wells Evaluated: (1) Compliance -- MW-15R, MW-34A, MW-34C, MW-39, MW-42, MW-43; (2) Downgradient -- MW-29A, MW-32, MW-33A, MW-33C, MW-36A

Monitoring Well	Monitoring Well Type	Corrective Action Monitoring Parameter	N[1]	% Detect	Max[2]	95% UCL of Mean[3]	Units[4]	Note	Groundwater Cleanup Level[5]	Units[4]	Does 95% UCL Exceed Cleanup Level?	Significant Trend?[6]
MW-15R	Compliance	1,1-Dichloroethane	12	0%	0.38 (ND)	0.38	ug/L	B	50	ug/L	No	No
MW-15R	Compliance	1,4-Dichlorobenzene	12	0%	0.84 (ND)	0.84	ug/L	B	2.0	ug/L	No	No
MW-15R	Compliance	Arsenic, total	12	100%	0.258	0.23	ug/L	LN	0.462	ug/L	No	No
MW-15R	Compliance	Iron, total	11[7]	9.1%	0.11	0.11	mg/L	A	0.30	mg/L	No	No
MW-15R	Compliance	Manganese, total	12	100%	0.021	0.01	mg/L	LN	0.05	mg/L	No	No
MW-15R	Compliance	cis-1,2-dichloroethene	12	0%	0.81 (ND)	0.81	ug/L	B	35	ug/L	No	No
MW-15R	Compliance	Ethyl ether	12	0%	0.72 (ND)	0.72	ug/L	B	50	ug/L	No	No
MW-15R	Compliance	Trichloroethene	12	0%	0.46 (ND)	0.46	ug/L	B	1.0	ug/L	No	No
MW-15R	Compliance	Vinyl Chloride	12	0%	0.02 (ND)	0.02	ug/L	B	0.20	ug/L	No	No
MW-15R	Compliance	Ammonia as N	12	0%	0.03 (ND)	0.03	mg/L	B	0.19	mg/L	No	No
MW-34A	Compliance	1,1-Dichloroethane	12	0%	0.38 (ND)	0.38	ug/L	B	50	ug/L	No	No
MW-34A	Compliance	1,4-Dichlorobenzene	12	0%	0.84 (ND)	0.84	ug/L	B	2.0	ug/L	No	No
MW-34A	Compliance	Arsenic, total	12	100%	0.478	0.452	ug/L	LN	0.462	ug/L	No	No
MW-34A	Compliance	Iron, total	12	8.3%	0.06	0.06	mg/L	A	0.30	mg/L	No	No
MW-34A	Compliance	Manganese, total	12	75%	0.0044	0.002	mg/L	LN	0.05	mg/L	No	No
MW-34A	Compliance	cis-1,2-dichloroethene	12	0%	0.81 (ND)	0.81	ug/L	B	35	ug/L	No	No
MW-34A	Compliance	Ethyl ether	12	0%	0.72 (ND)	0.72	ug/L	B	50	ug/L	No	No
MW-34A	Compliance	Trichloroethene	12	0%	0.46 (ND)	0.46	ug/L	B	1.0	ug/L	No	No
MW-34A	Compliance	Vinyl Chloride	12	0%	0.02 (ND)	0.03	ug/L	B	0.20	ug/L	No	No
MW-34A	Compliance	Ammonia as N	12	8.3%	0.035	0.04	mg/L	A	0.19	mg/L	No	No
MW-34C	Compliance	1,1-Dichloroethane	12	0%	0.38 (ND)	0.38	ug/L	B	50	ug/L	No	No
MW-34C	Compliance	1,4-Dichlorobenzene	12	0%	0.84 (ND)	0.84	ug/L	B	2.0	ug/L	No	No
MW-34C	Compliance	Arsenic, total	12	100%	84.6	84.6	ug/L	A**	0.462	ug/L	**Yes**	No
MW-34C	Compliance	Iron, total	12	100%	100	155	mg/L	LN	0.30	mg/L	**Yes**	No
MW-34C	Compliance	Manganese, total	12	100%	14	5.5	mg/L	Z	0.05	mg/L	**Yes**	No
MW-34C	Compliance	cis-1,2-dichloroethene	12	0%	0.81 (ND)	0.81	ug/L	B	35	ug/L	No	No

TABLE 3-1: 2017 Annual Groundwater Cleanup Level Statistical Evaluation Summary

Olympic View Sanitary Landfill

Statistical Methodology: calculation of 95% UCL of mean per MTCAStat

Data Input (general): 3-year "moving window", updated annually

Data Input (specific): January 1, 2015 through December 31, 2017

Wells Evaluated: (1) Compliance -- MW-15R, MW-34A, MW-34C, MW-39, MW-42, MW-43; (2) Downgradient -- MW-29A, MW-32, MW-33A, MW-33C, MW-36A

Monitoring Well	Monitoring Well Type	Corrective Action Monitoring Parameter	N[1]	% Detect	Max[2]	95% UCL of Mean[3]	Units[4]	Note	Groundwater Cleanup Level[5]	Units[4]	Does 95% UCL Exceed Cleanup Level?	Significant Trend?[6]
MW-34C	Compliance	Ethyl ether	12	0%	0.72 (ND)	0.72	ug/L	B	50	ug/L	No	No
MW-34C	Compliance	Trichloroethene	12	0%	0.46 (ND)	0.46	ug/L	B	1.0	ug/L	No	No
MW-34C	Compliance	Vinyl Chloride	12	100%	0.11	0.09	ug/L	LN	0.20	ug/L	No	Yes (▼)
MW-34C	Compliance	Ammonia as N	12	25%	0.034	0.034	mg/L	A	0.19	mg/L	No	No
MW-39	Compliance	1,1-Dichloroethane	12	0%	0.38 (ND)	0.38	ug/L	B	50	ug/L	No	No
MW-39	Compliance	1,4-Dichlorobenzene	12	0%	0.84 (ND)	0.84	ug/L	B	2.0	ug/L	No	No
MW-39	Compliance	Arsenic, total	12	100%	2.16	1.77	ug/L	Z	0.462	ug/L	Yes	No
MW-39	Compliance	Iron, total	12	100%	40	33.7	mg/L	Z	0.30	mg/L	Yes	No
MW-39	Compliance	Manganese, total	12	100%	0.66	0.46	mg/L	N	0.05	mg/L	Yes	No
MW-39	Compliance	cis-1,2-dichloroethene	12	0%	0.81 (ND)	0.81	ug/L	B	35	ug/L	No	No
MW-39	Compliance	Ethyl ether	12	0%	0.72 (ND)	0.72	ug/L	B	50	ug/L	No	No
MW-39	Compliance	Trichloroethene	12	0%	0.46 (ND)	0.46	ug/L	B	1.0	ug/L	No	No
MW-39	Compliance	Vinyl Chloride	12	0%	0.02 (ND)	0.02	ug/L	B	0.20	ug/L	No	No
MW-39	Compliance	Ammonia as N	12	92%	0.63	0.44	mg/L	Z	0.19	mg/L	Yes	No
MW-42	Compliance	1,1-Dichloroethane	12	0%	0.38 (ND)	0.38	ug/L	B	50	ug/L	No	No
MW-42	Compliance	1,4-Dichlorobenzene	12	0%	0.84 (ND)	0.84	ug/L	B	2.0	ug/L	No	No
MW-42	Compliance	Arsenic, total	12	100%	1.93	1.78	ug/L	LN	0.462	ug/L	Yes	No
MW-42	Compliance	Iron, total	12	100%	27	24.9	mg/L	LN	0.30	mg/L	Yes	No
MW-42	Compliance	Manganese, total	12	100%	4.8	4.5	mg/L	LN	0.05	mg/L	Yes	No
MW-42	Compliance	cis-1,2-dichloroethene	12	0%	0.81 (ND)	0.81	ug/L	B	35	ug/L	No	No
MW-42	Compliance	Ethyl ether	12	0%	0.72 (ND)	0.72	ug/L	B	50	ug/L	No	No
MW-42	Compliance	Trichloroethene	12	8.3%	0.58	0.58	ug/L	A	1.0	ug/L	No	No
MW-42	Compliance	Vinyl Chloride	12	83%	0.12	0.09	ug/L	LN	0.20	ug/L	No	No
MW-42	Compliance	Ammonia as N	12	100%	6.7	5.9	mg/L	LN	0.19	mg/L	Yes	No
MW-43	Compliance	1,1-Dichloroethane	12	0%	0.38 (ND)	0.38	ug/L	B	50	ug/L	No	No
MW-43	Compliance	1,4-Dichlorobenzene	12	0%	0.84 (ND)	0.84	ug/L	B	2.0	ug/L	No	No

TABLE 3-1: 2017 Annual Groundwater Cleanup Level Statistical Evaluation Summary

Olympic View Sanitary Landfill

Statistical Methodology: calculation of 95% UCL of mean per MTCAStat

Data Input (general): 3-year "moving window", updated annually

Data Input (specific): January 1, 2015 through December 31, 2017

Wells Evaluated: (1) Compliance -- MW-15R, MW-34A, MW-34C, MW-39, MW-42, MW-43; (2) Downgradient -- MW-29A, MW-32, MW-33A, MW-33C, MW-36A

Monitoring Well	Monitoring Well Type	Corrective Action Monitoring Parameter	N[1]	% Detect	Max[2]	95% UCL of Mean[3]	Units[4]	Note	Groundwater Cleanup Level[5]	Units[4]	Does 95% UCL Exceed Cleanup Level?	Significant Trend?[6]
MW-43	Compliance	Arsenic, total	12	17%	0.0562	0.056	ug/L	A	0.462	ug/L	No	No
MW-43	Compliance	Iron, total	12	100%	2.5	1.51	mg/L	LN	0.30	mg/L	**Yes**	No
MW-43	Compliance	Manganese, total	12	100%	0.12	0.10	mg/L	N	0.05	mg/L	**Yes**	No
MW-43	Compliance	cis-1,2-dichloroethene	12	0%	0.81 (ND)	0.81	ug/L	B	35	ug/L	No	No
MW-43	Compliance	Ethyl ether	12	0%	0.72 (ND)	0.72	ug/L	B	50	ug/L	No	No
MW-43	Compliance	Trichloroethene	12	0%	0.46 (ND)	0.46	ug/L	B	1.0	ug/L	No	No
MW-43	Compliance	Vinyl Chloride	12	0%	0.02 (ND)	0.02	ug/L	B	0.20	ug/L	No	No
MW-43	Compliance	Ammonia as N	12	67%	0.06	0.05	mg/L	LN	0.19	mg/L	No	**Yes (▼)**
MW-29A	Downgradient	1,1-Dichloroethane	6	0%	0.38 (ND)	0.38	ug/L	B	50	ug/L	No	No
MW-29A	Downgradient	1,4-Dichlorobenzene	6	0%	0.84 (ND)	0.84	ug/L	B	2.0	ug/L	No	No
MW-29A	Downgradient	Arsenic, total	6	100%	2.13	2.04	ug/L	LN	0.462	ug/L	**Yes**	No
MW-29A	Downgradient	Iron, total	6	100%	4.6	4.26	mg/L	LN	0.30	mg/L	**Yes**	No
MW-29A	Downgradient	Manganese, total	6	100%	1.4	1.35	mg/L	Z	0.05	mg/L	**Yes**	No
MW-29A	Downgradient	cis-1,2-dichloroethene	6	0%	0.81 (ND)	0.81	ug/L	B	35	ug/L	No	No
MW-29A	Downgradient	Ethyl ether	6	0%	0.72 (ND)	0.72	ug/L	B	50	ug/L	No	No
MW-29A	Downgradient	Trichloroethene	6	0%	0.46 (ND)	0.46	ug/L	B	1.0	ug/L	No	No
MW-29A	Downgradient	Vinyl Chloride	6	0%	0.02 (ND)	0.02	ug/L	B	0.20	ug/L	No	No
MW-29A	Downgradient	Ammonia as N	6	100%	0.095	0.08	mg/L	Z	0.19	mg/L	No	**Yes (▼)**
MW-32	Downgradient	1,1-Dichloroethane	12	0%	0.38 (ND)	0.38	ug/L	B	50	ug/L	No	No
MW-32	Downgradient	1,4-Dichlorobenzene	12	0%	0.84 (ND)	0.84	ug/L	B	2.0	ug/L	No	No
MW-32	Downgradient	Arsenic, total	12	100%	10.7	10.2	ug/L	LN	0.462	ug/L	**Yes**	No
MW-32	Downgradient	Iron, total	12	100%	0.94	0.75	mg/L	LN	0.30	mg/L	**Yes**	**Yes (▼)**
MW-32	Downgradient	Manganese, total	12	100%	2.9	2.3	mg/L	Z	0.05	mg/L	**Yes**	**Yes (▼)**
MW-32	Downgradient	cis-1,2-dichloroethene	12	8.3%	0.81 (ND)	0.81	ug/L	A*	35	ug/L	No	No
MW-32	Downgradient	Ethyl ether	11	0%	0.72 (ND)	0.72	ug/L	B	50	ug/L	No	No
MW-32	Downgradient	Trichloroethene	12	42%	0.66	0.66	ug/L	A***	1.0	ug/L	No	No
MW-32	Downgradient	Vinyl Chloride	12	100%	0.46	0.38	ug/L	LN	0.20	ug/L	**Yes**	**Yes (▼)**

TABLE 3-1: 2017 Annual Groundwater Cleanup Level Statistical Evaluation Summary

Olympic View Sanitary Landfill

Statistical Methodology: calculation of 95% UCL of mean per MTCAStat

Data Input (general): 3-year "moving window", updated annually

Data Input (specific): January 1, 2015 through December 31, 2017

Wells Evaluated: (1) Compliance -- MW-15R, MW-34A, MW-34C, MW-39, MW-42, MW-43; (2) Downgradient -- MW-29A, MW-32, MW-33A, MW-33C, MW-36A

Monitoring Well	Monitoring Well Type	Corrective Action Monitoring Parameter	N[1]	% Detect	Max[2]	95% UCL of Mean[3]	Units[4]	Note	Groundwater Cleanup Level[5]	Units[4]	Does 95% UCL Exceed Cleanup Level?	Significant Trend?[6]
MW-32	Downgradient	Ammonia as N	11	18%	0.039	0.039	mg/L	A	0.19	mg/L	No	No
MW-33A	Downgradient	1,1-Dichloroethane	6	0%	0.38 (ND)	0.38	ug/L	B	50	ug/L	No	No
MW-33A	Downgradient	1,4-Dichlorobenzene	6	0%	0.84 (ND)	0.84	ug/L	B	2.0	ug/L	No	No
MW-33A	Downgradient	Arsenic, total	6	100%	0.610	0.618	ug/L	LN	0.462	ug/L	**Yes**	No
MW-33A	Downgradient	Iron, total	6	100%	2.5	2.2	mg/L	Z	0.30	mg/L	**Yes**	No
MW-33A	Downgradient	Manganese, total	6	100%	0.09	0.20	mg/L	LN	0.05	mg/L	**Yes**	No
MW-33A	Downgradient	cis-1,2-dichloroethene	6	0%	0.81 (ND)	0.81	ug/L	B	35	ug/L	No	No
MW-33A	Downgradient	Ethyl ether	6	0%	0.72 (ND)	0.72	ug/L	B	50	ug/L	No	No
MW-33A	Downgradient	Trichloroethene	6	0%	0.46 (ND)	0.46	ug/L	B	1.0	ug/L	No	No
MW-33A	Downgradient	Vinyl Chloride	6	0%	0.02 (ND)	0.02	ug/L	B	0.20	ug/L	No	No
MW-33A	Downgradient	Ammonia as N	6	50%	0.30	0.30	mg/L	A	0.19	mg/L	**Yes**	No
MW-33C	Downgradient	1,1-Dichloroethane	10	0%	0.38 (ND)	0.38	ug/L	B	50	ug/L	No	No
MW-33C	Downgradient	1,4-Dichlorobenzene	10	0%	0.84 (ND)	0.84	ug/L	B	2.0	ug/L	No	No
MW-33C	Downgradient	Arsenic, total	10	100%	2.67	2.60	ug/L	LN	0.462	ug/L	**Yes**	No
MW-33C	Downgradient	Iron, total	10	80%	0.33	0.29	mg/L	LN	0.3	mg/L	No	No
MW-33C	Downgradient	Manganese, total	10	100%	0.29	0.21	mg/L	Z	0.05	mg/L	**Yes**	No
MW-33C	Downgradient	cis-1,2-dichloroethene	10	0%	0.81 (ND)	0.81	ug/L	B	35	ug/L	No	No
MW-33C	Downgradient	Ethyl ether	10	0%	0.72 (ND)	0.72	ug/L	B	50	ug/L	No	No
MW-33C	Downgradient	Trichloroethene	10	0%	0.46 (ND)	0.46	ug/L	B	1.0	ug/L	No	No
MW-33C	Downgradient	Vinyl Chloride	10	0%	0.02 (ND)	0.02	ug/L	B	0.20	ug/L	No	No
MW-33C	Downgradient	Ammonia as N	10	0%	0.03 (ND)	0.03	mg/L	B	0.19	mg/L	No	No
MW-36A	Downgradient	1,1-Dichloroethane	10	0%	0.38 (ND)	0.38	ug/L	B	50	ug/L	No	No
MW-36A	Downgradient	1,4-Dichlorobenzene	10	0%	0.84 (ND)	0.84	ug/L	B	2.0	ug/L	No	No
MW-36A	Downgradient	Arsenic, total	10	100%	0.616	0.580	ug/L	LN	0.462	ug/L	**Yes**	No
MW-36A	Downgradient	Iron, total	10	40%	0.11	0.11	mg/L	A	0.3	mg/L	No	No
MW-36A	Downgradient	Manganese, total	10	70%	0.0034	0.003	mg/L	A***	0.05	mg/L	No	No

TABLE 3-1: 2017 Annual Groundwater Cleanup Level Statistical Evaluation Summary

Olympic View Sanitary Landfill

Statistical Methodology: calculation of 95% UCL of mean per MTCAStat

Data Input (general): 3-year "moving window", updated annually

Data Input (specific): January 1, 2015 through December 31, 2017

Wells Evaluated: (1) Compliance -- MW-15R, MW-34A, MW-34C, MW-39, MW-42, MW-43; (2) Downgradient -- MW-29A, MW-32, MW-33A, MW-33C, MW-36A

Monitoring Well	Monitoring Well Type	Corrective Action Monitoring Parameter	N[1]	% Detect	Max[2]	95% UCL of Mean[3]	Units[4]	Note	Groundwater Cleanup Level[5]	Units[4]	Does 95% UCL Exceed Cleanup Level?	Significant Trend?[6]
MW-36A	Downgradient	cis-1,2-dichloroethene	10	0%	0.81 (ND)	0.81	ug/L	B	35	ug/L	No	No
MW-36A	Downgradient	Ethyl ether	10	0%	0.72 (ND)	0.72	ug/L	B	50	ug/L	No	No
MW-36A	Downgradient	Trichloroethene	10	0%	0.46 (ND)	0.46	ug/L	B	1.0	ug/L	No	No
MW-36A	Downgradient	Vinyl Chloride	10	0%	0.02 (ND)	0.02	ug/L	B	0.20	ug/L	No	No
MW-36A	Downgradient	Ammonia as N	10	10%	0.03	0.03	mg/L	A	0.19	mg/L	No	No

NOTES:

[1] N = number of data points used for UCL calculation of the mean; only SIM results used for Vinyl Chloride (e.g., duplicate results with higher RLs by non-SIM were omitted).

[2] MAX = maximum detected result in the data set; if no detected results, then = maximum reporting limit for non-detect results (indicated with ND).

[3] A 3-year moving data set is used for calculation of the UCL.

[4] ug/L - micrograms per liter; mg/L = milligrams per liter.

[5] Groundwater Cleanup Levels are listed on Table 3 of the October 2010 Draft Cleanup Action Plan.

[6] Trend analysis results are based on data for the period January 2005 through December 2017; arrows indicated increasing (▲) or decreasing (▼) trends.

[7] For MW-15R, outlier of 0.41 mg/L from 2-24-15 sampling event was removed prior to UCL calculation

A = Detection frequency of data set too low and/or N too few to calculate 95% UCL of mean; therefore, the highest detected result in the data set used to represent 95% UCL of mean.

A* = Same as note "A" except that the highest value in the data set is below the reporting limit of one or more non-detected results; therefore, the highest reporting limit is used to represent the 95% UCL of the mean.

A** = MTCAStat suggests use of lognormal formula but calculation of 95% UCL of mean by Land's formula provides unrealistic result; therefore, the highest detected result is used to represent the 95% UCL of the mean.

A*** = MTCAStat suggests use of the Z-score method but then cites inability to calculate due to presence of censored values; therefore, the highest detected result is used to represent the 95% UCL of the mean.

B = Detection frequency = 0; therefore, the highest reporting limit in the data set is used to represent the 95% UCL of mean.

LN = The 95% UCL of the mean is calculated using Land's formula since lognormal distribution is indicated.

N = The 95% UCL of the mean is calculated using a normal-based t-statistic since a normal distribution is indicated.

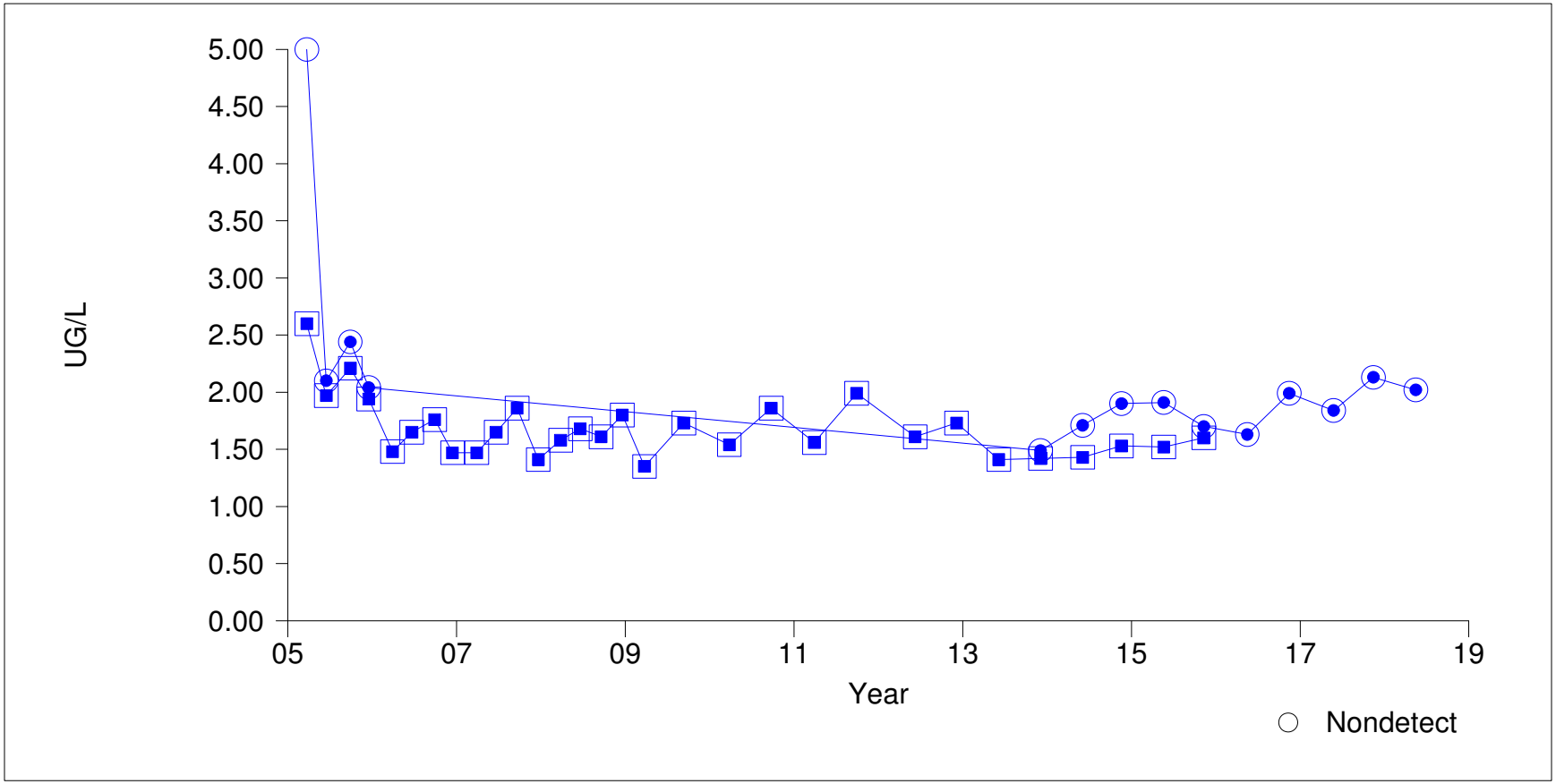
Z = the 95% UCL of the mean is calculated using the Z-score method in MTCAStat since neither normal nor lognormal distribution can be determined.

ATTACHMENT 1C

Time-Series Graphs

Waters

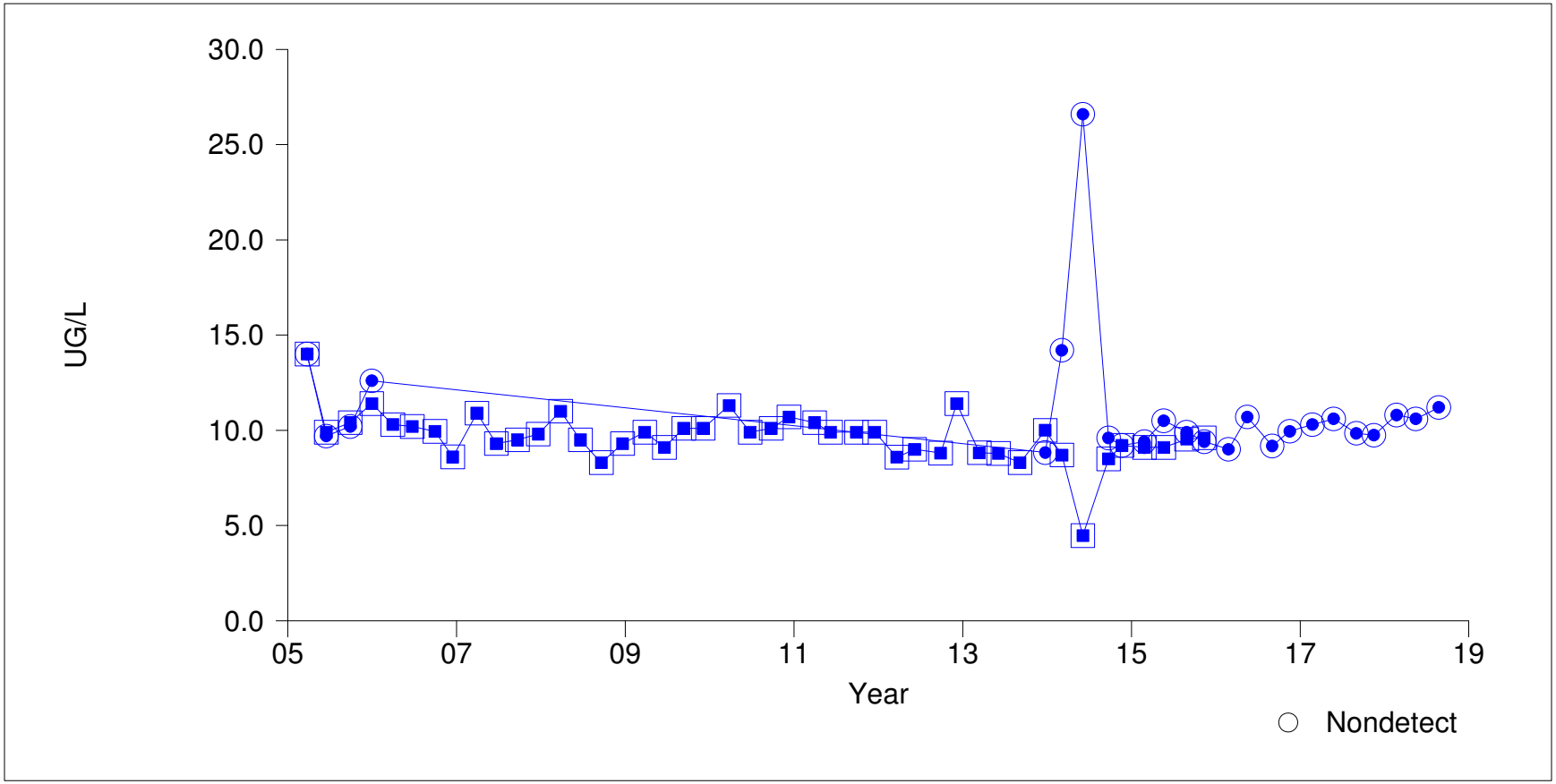
Time Series Plot for MW-29A



Prepared by: Waste Management, Inc.

Waters

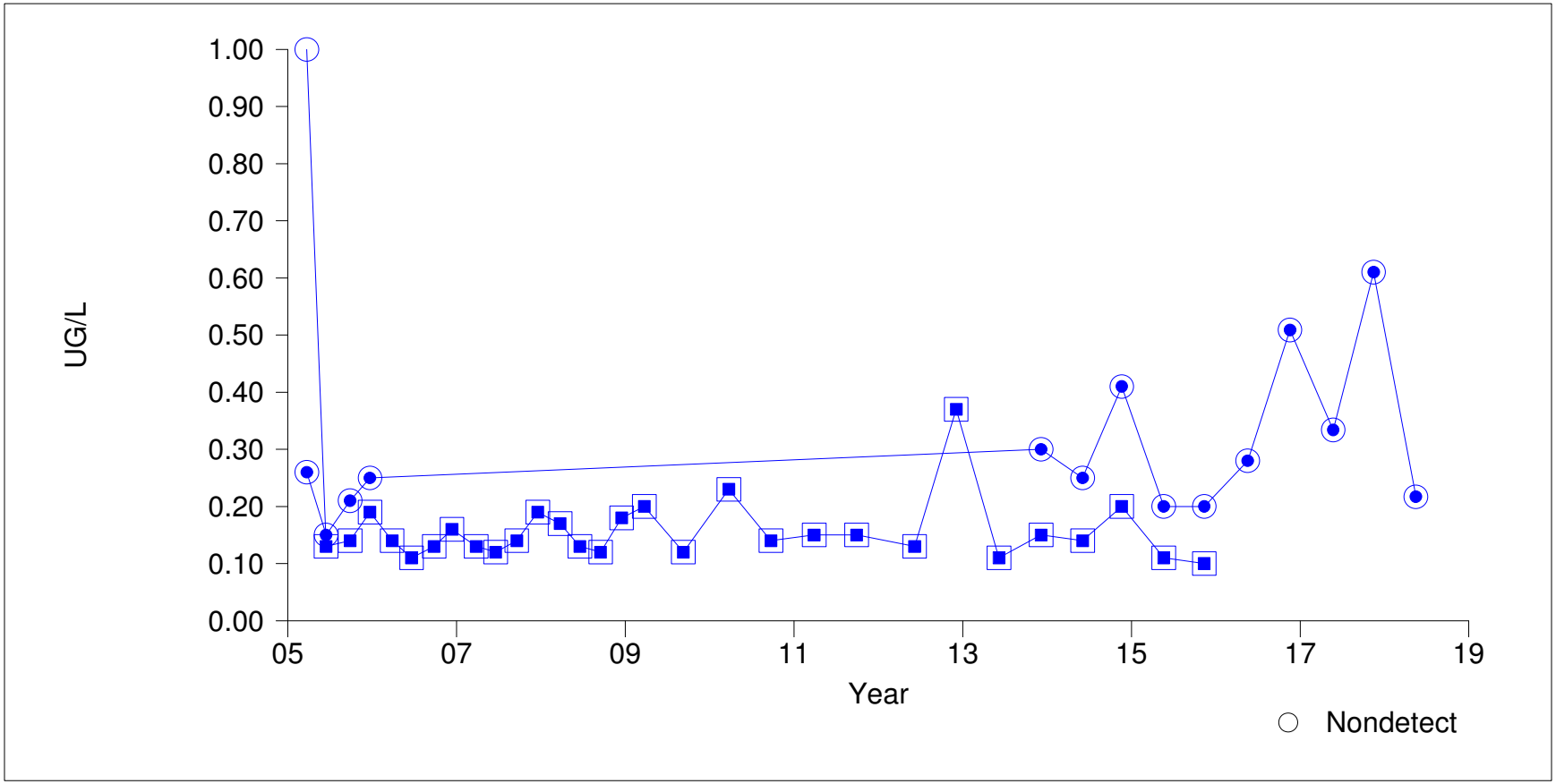
Time Series Plot for MW-32



Prepared by: Waste Management, Inc.

Waters

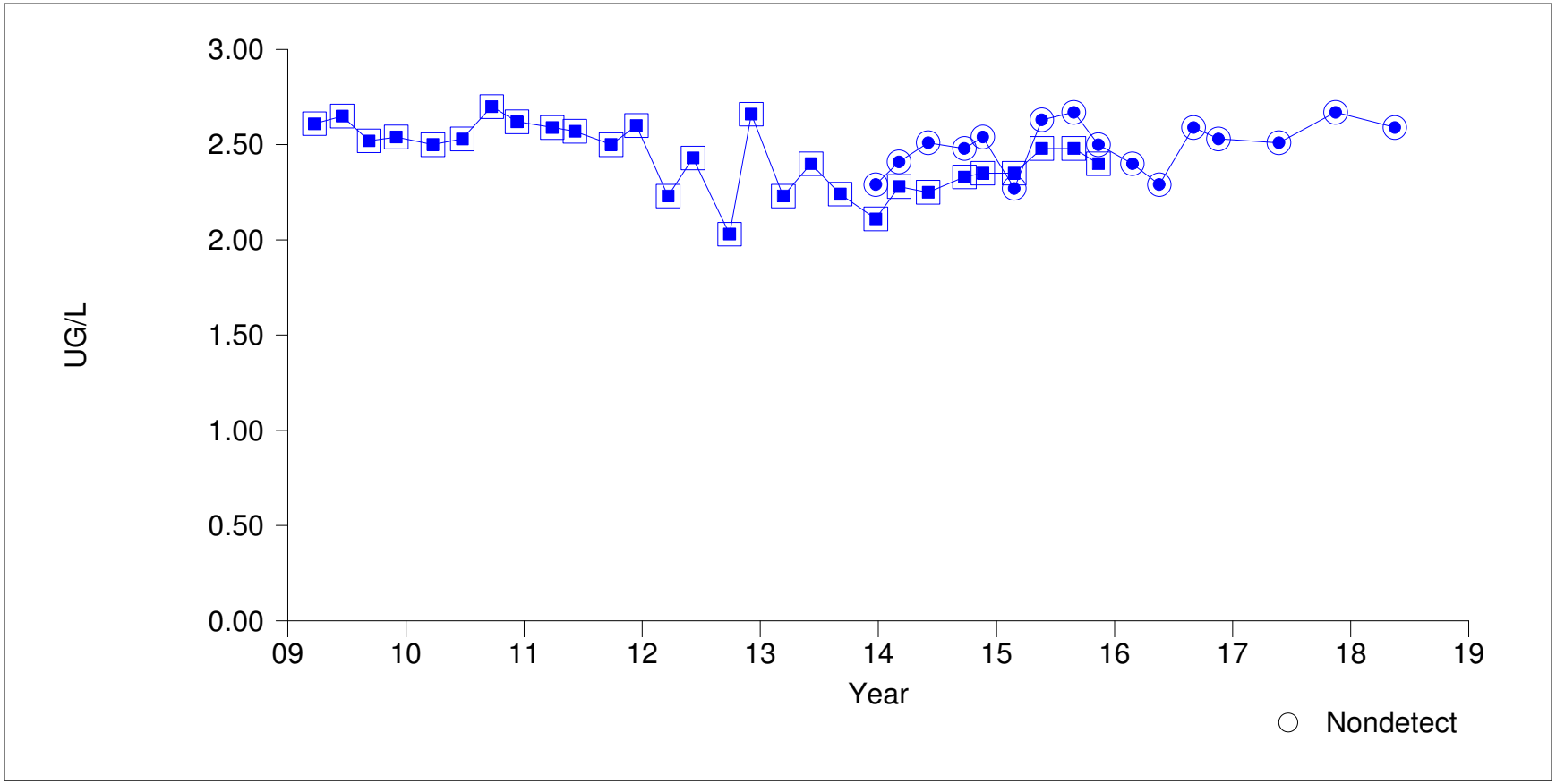
Time Series Plot for MW-33A



Prepared by: Waste Management, Inc.

Waters

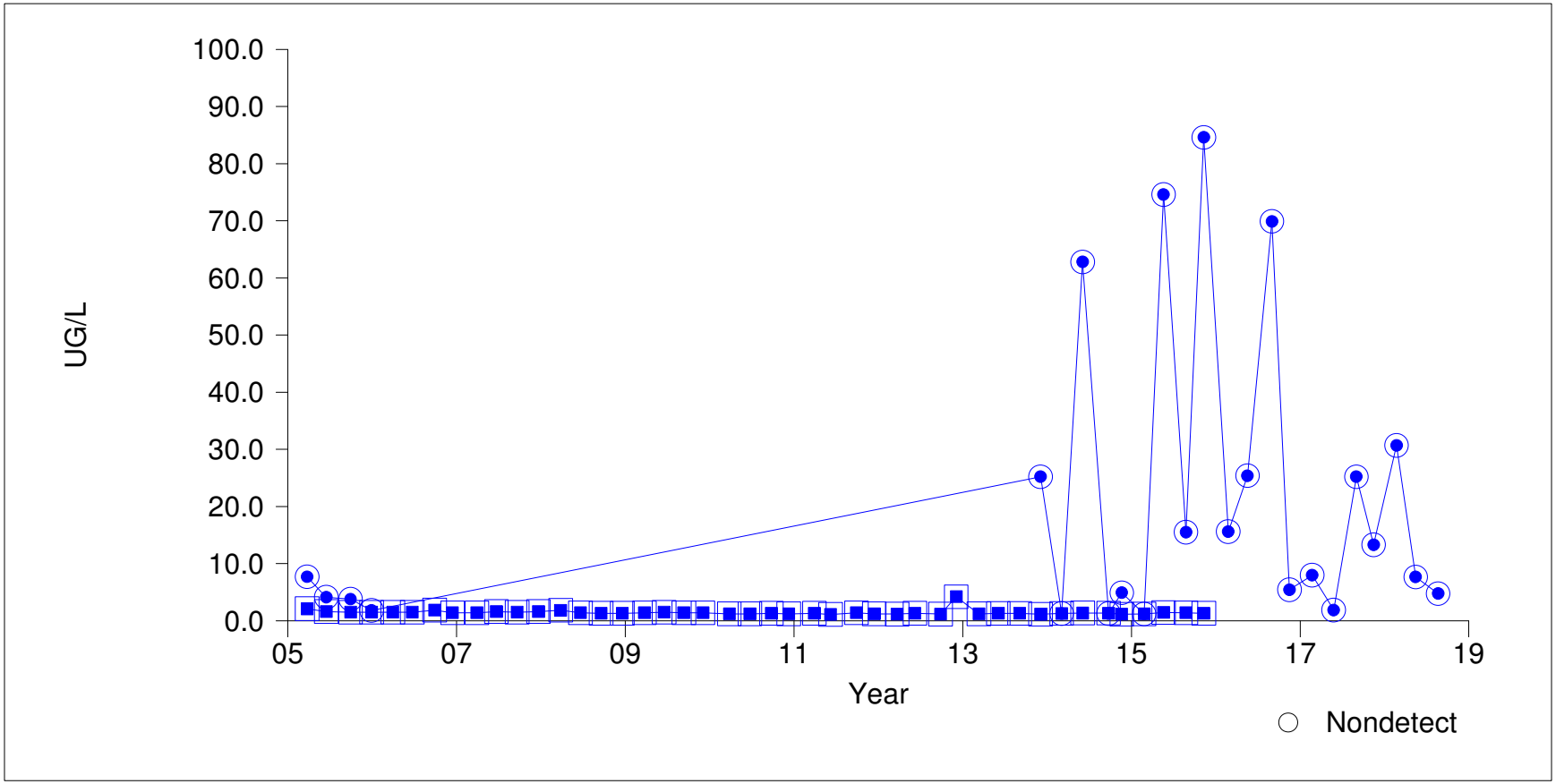
Time Series Plot for MW-33C



Prepared by: Waste Management, Inc.

Waters

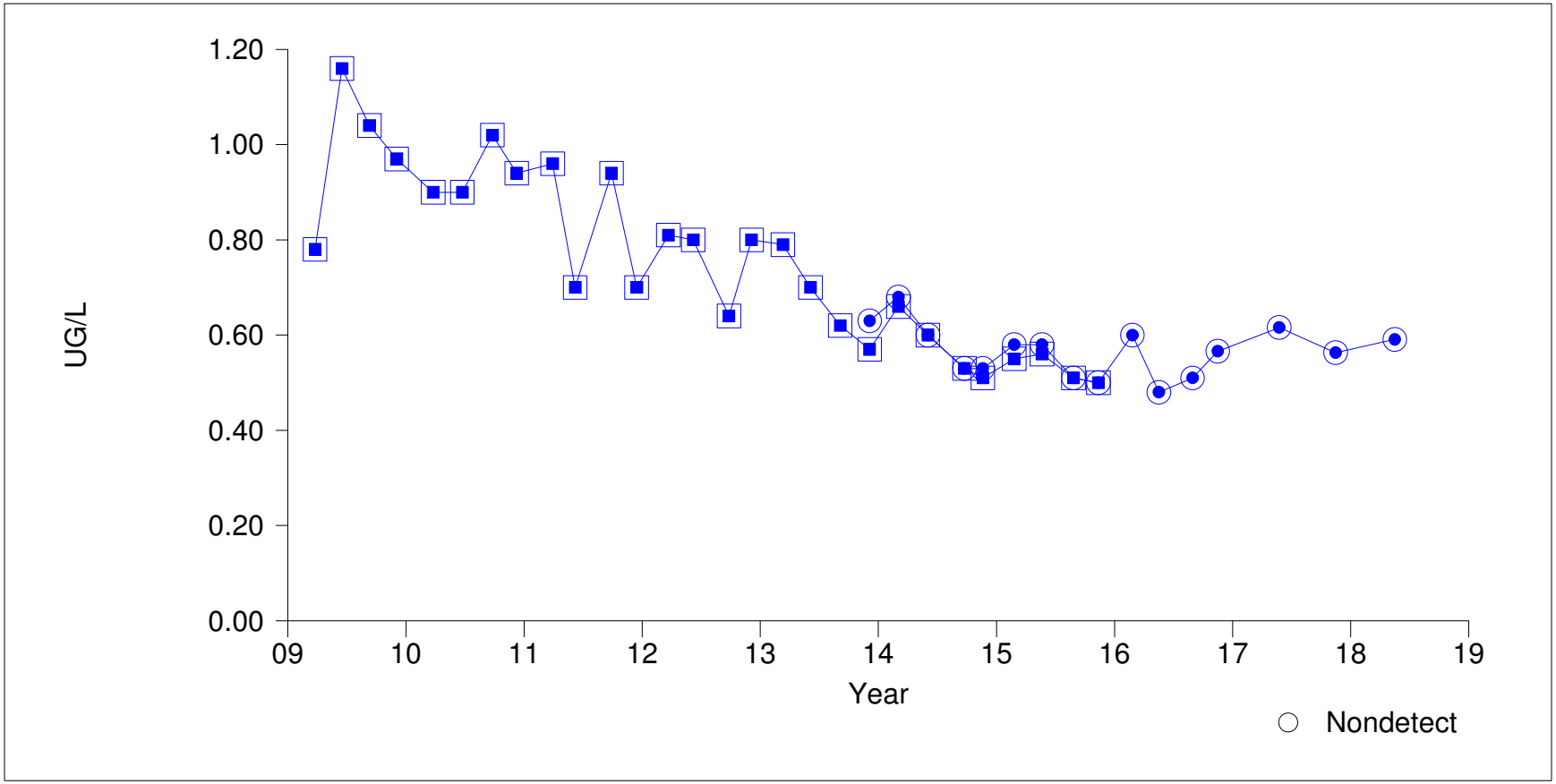
Time Series Plot for MW-34C



Prepared by: Waste Management, Inc.

Waters

Time Series Plot for MW-36A



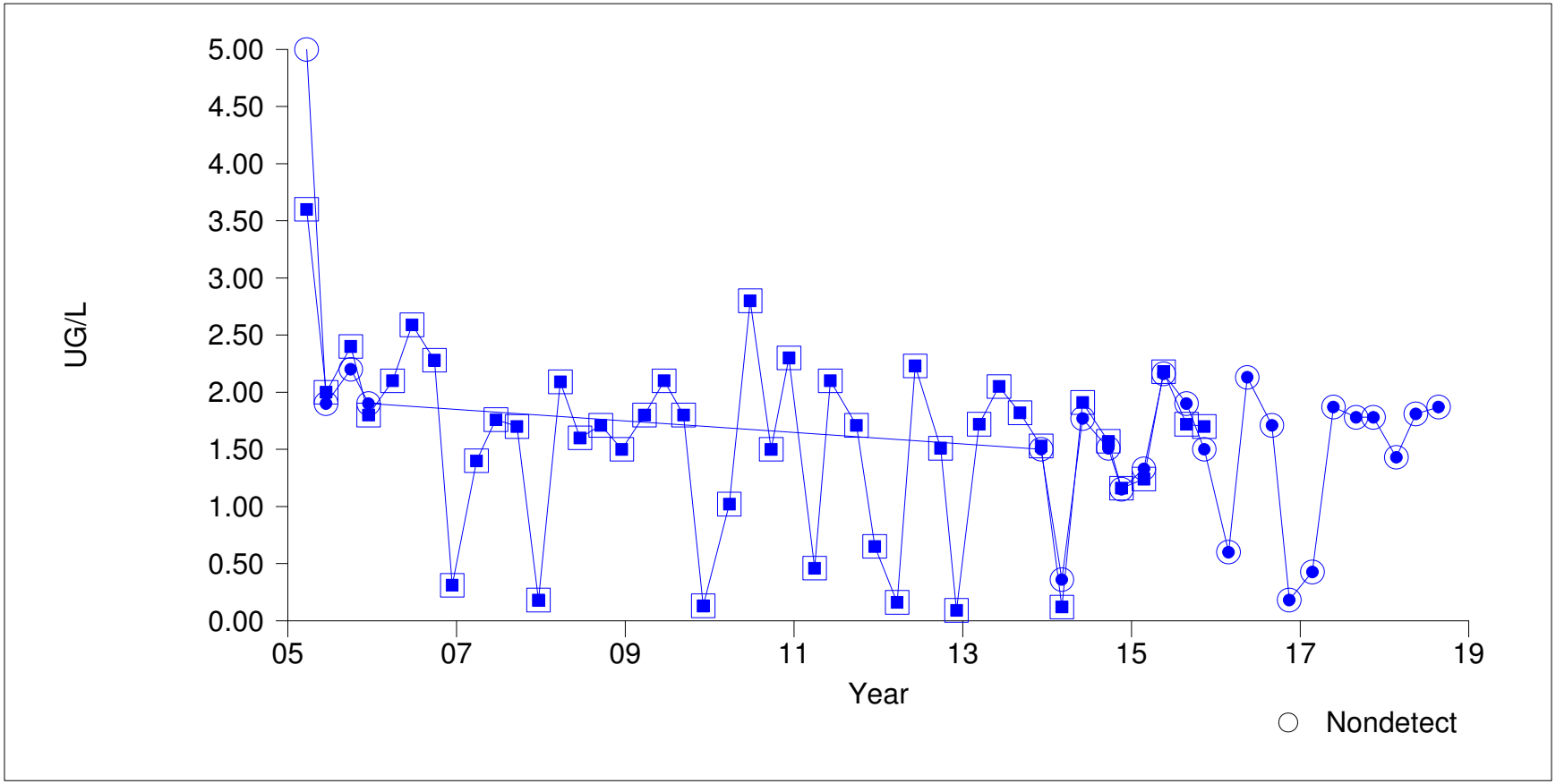
Arsenic, dissolved
Arsenic, total

CL = 0.462 ug/L

Prepared by: Waste Management, Inc.

Waters

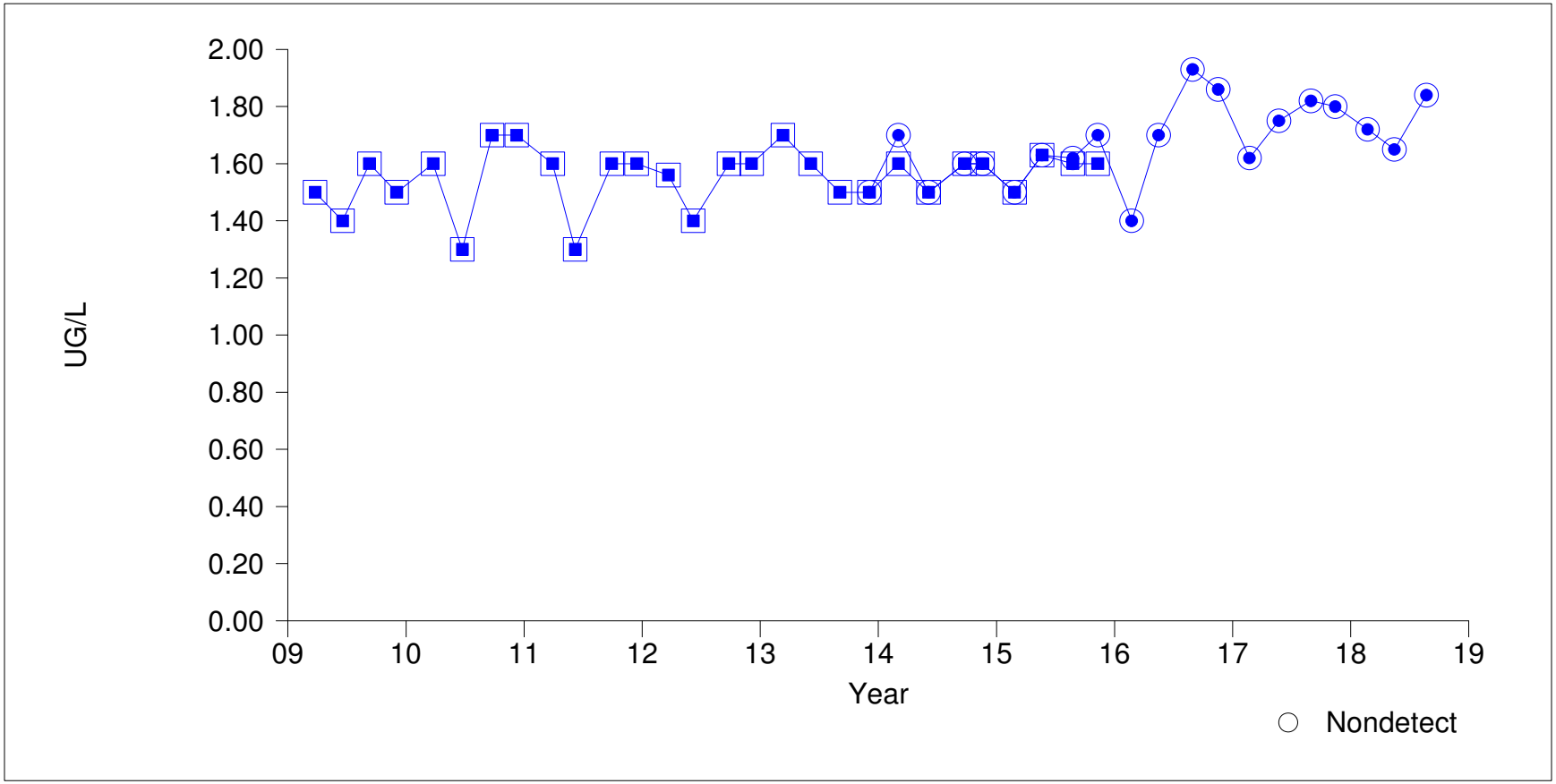
Time Series Plot for MW-39



Prepared by: Waste Management, Inc.

Waters

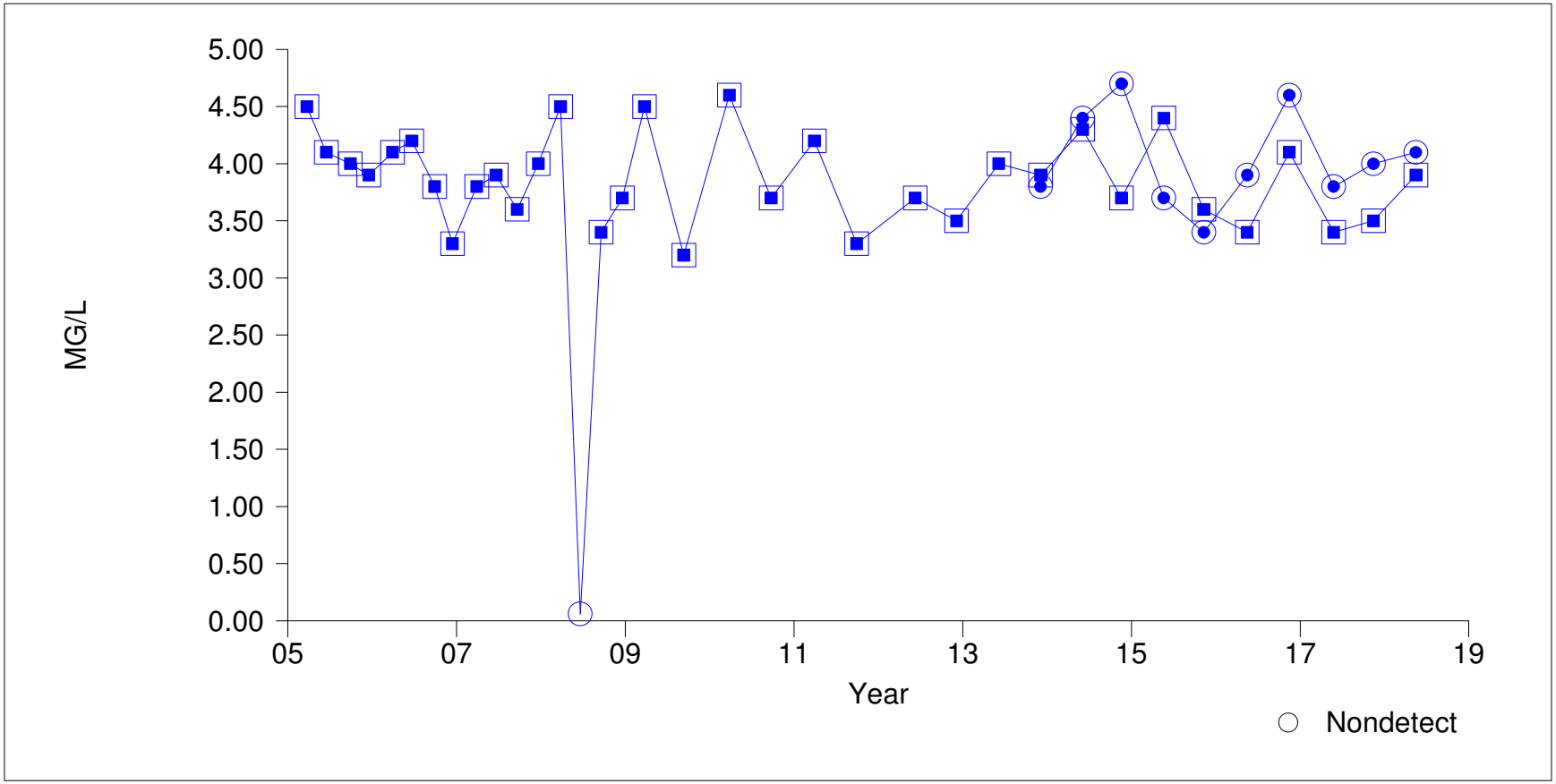
Time Series Plot for MW-42



Prepared by: Waste Management, Inc.

Waters

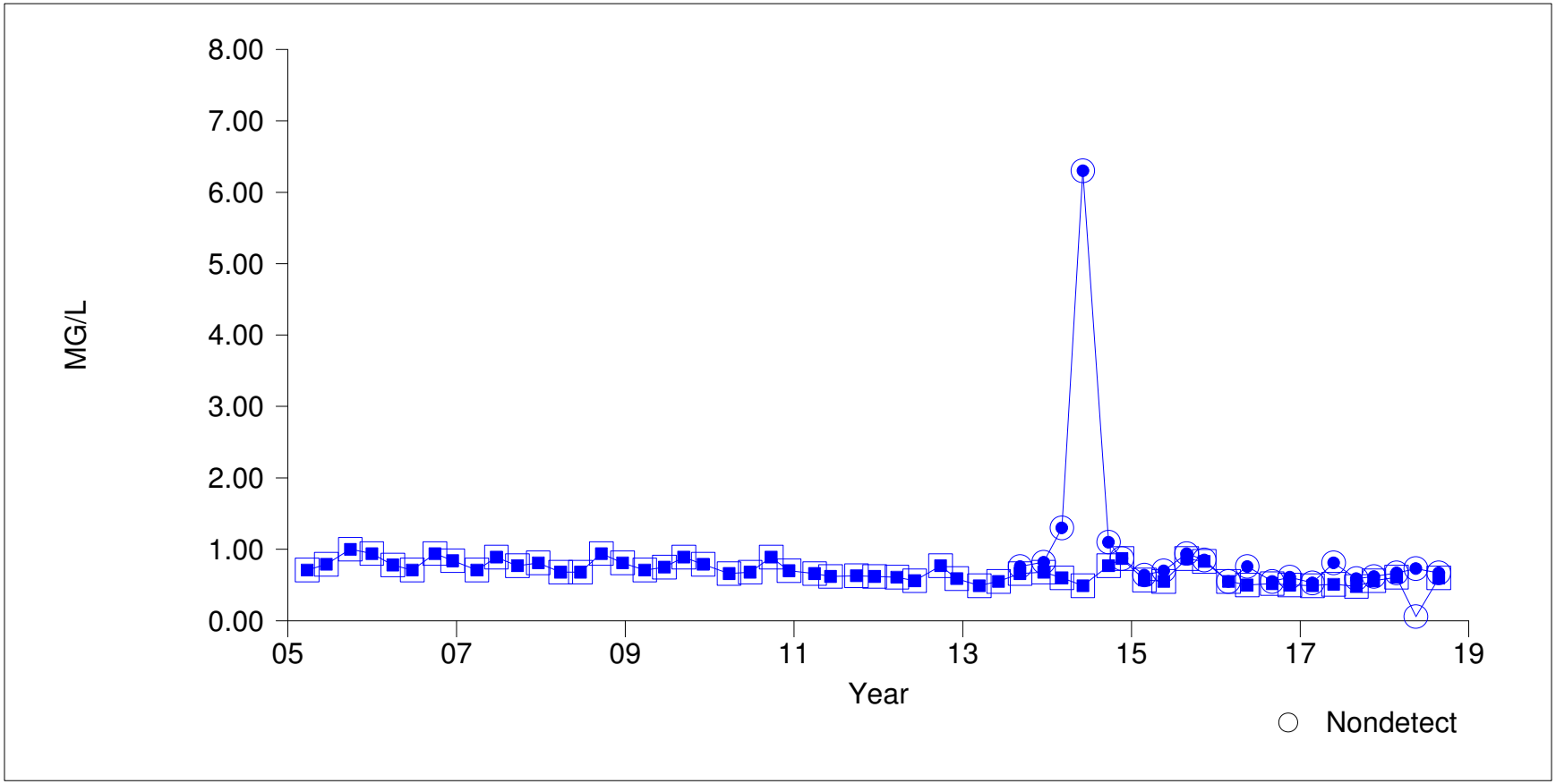
Time Series Plot for MW-29A



Prepared by: Waste Management, Inc.

Waters

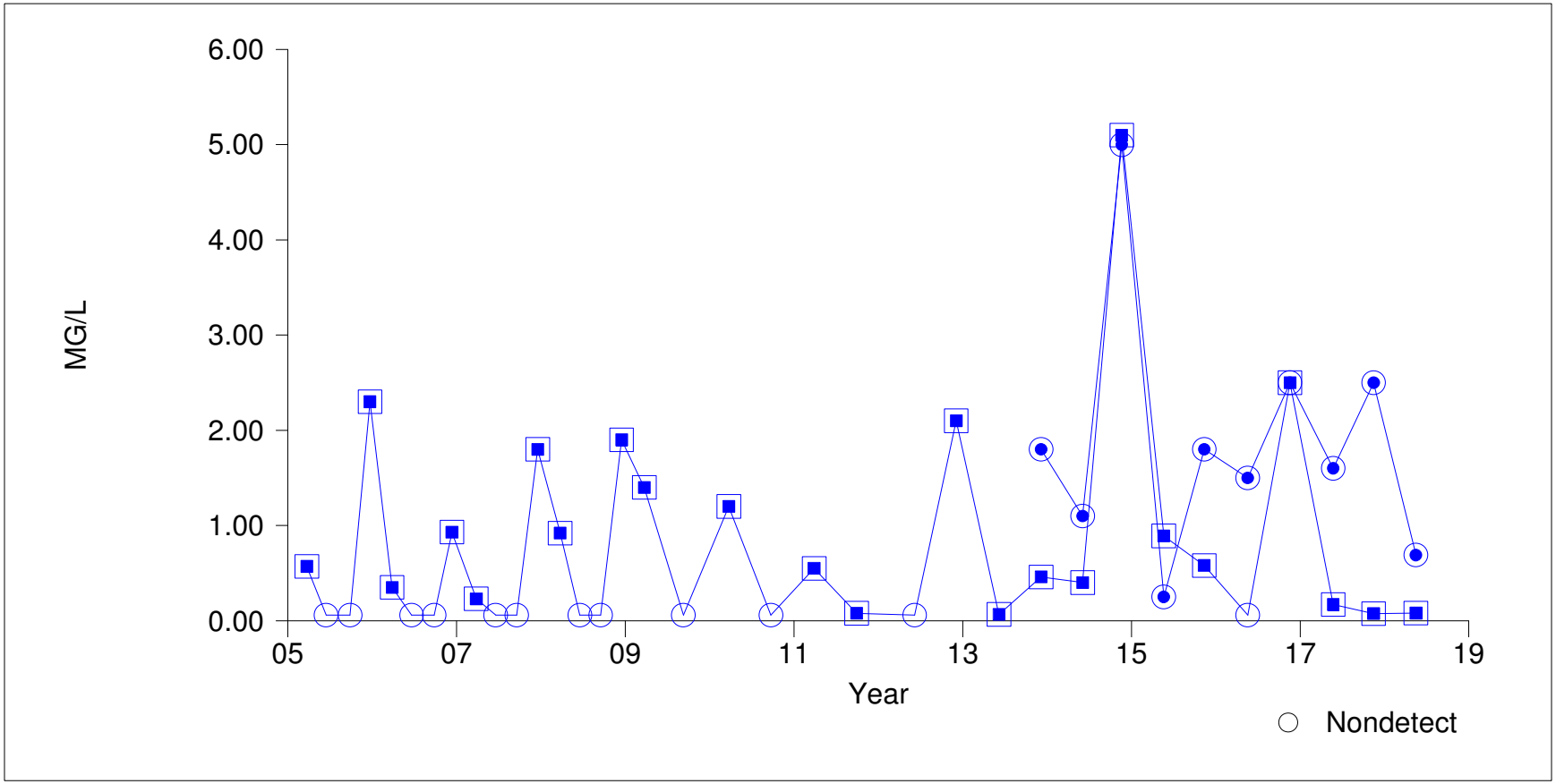
Time Series Plot for MW-32



Prepared by: Waste Management, Inc.

Waters

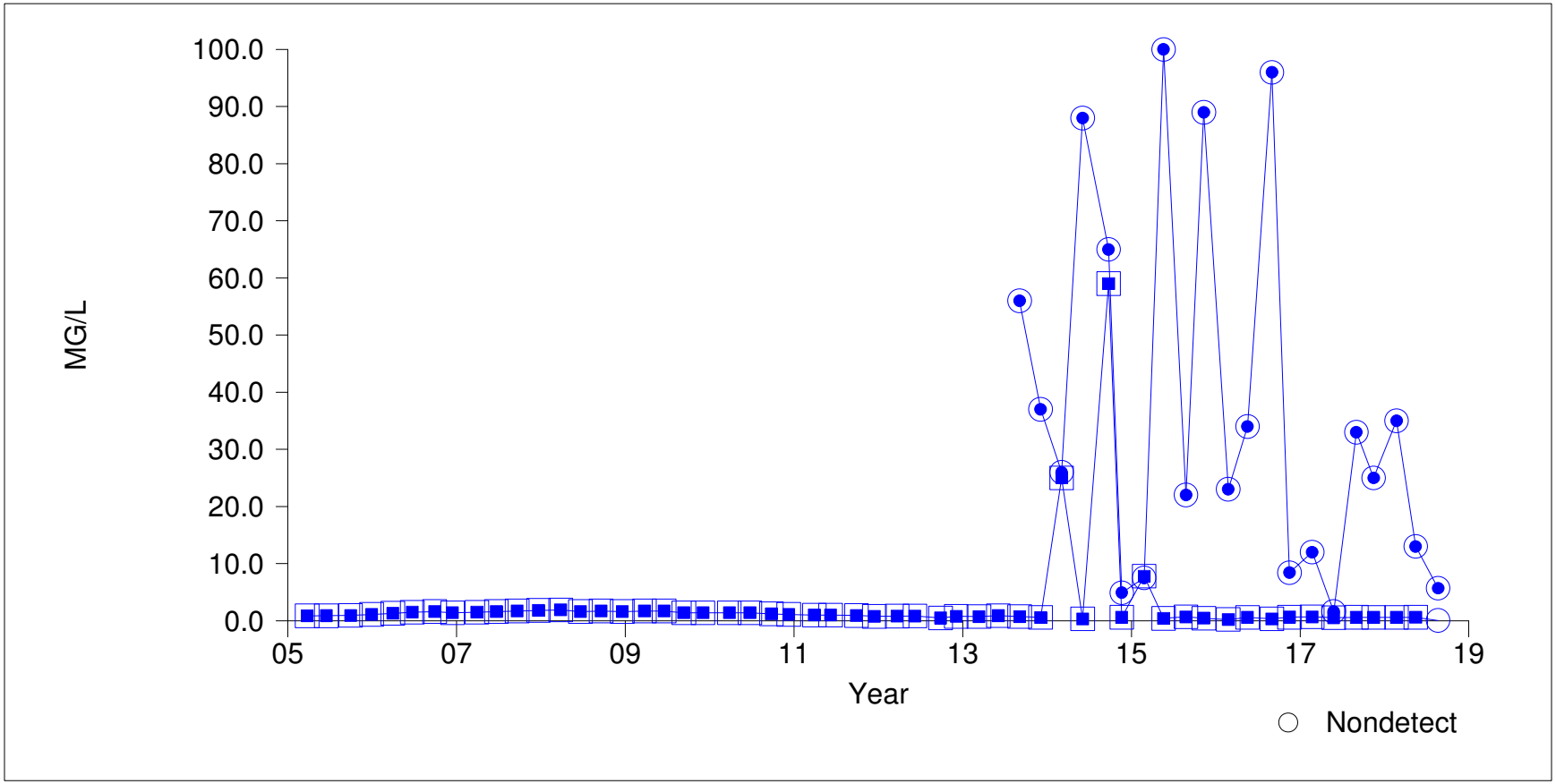
Time Series Plot for MW-33A



Prepared by: Waste Management, Inc.

Waters

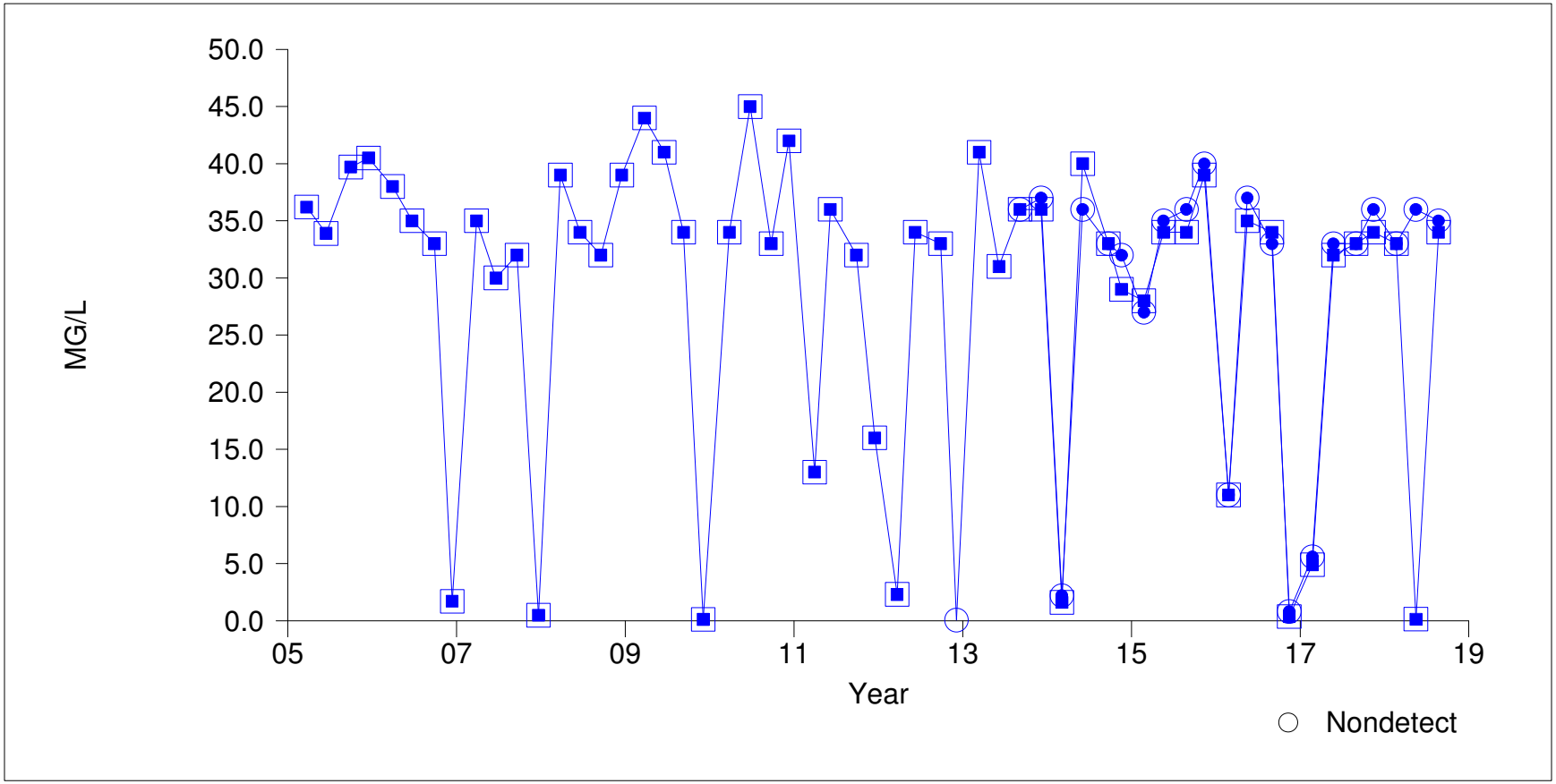
Time Series Plot for MW-34C



Prepared by: Waste Management, Inc.

Waters

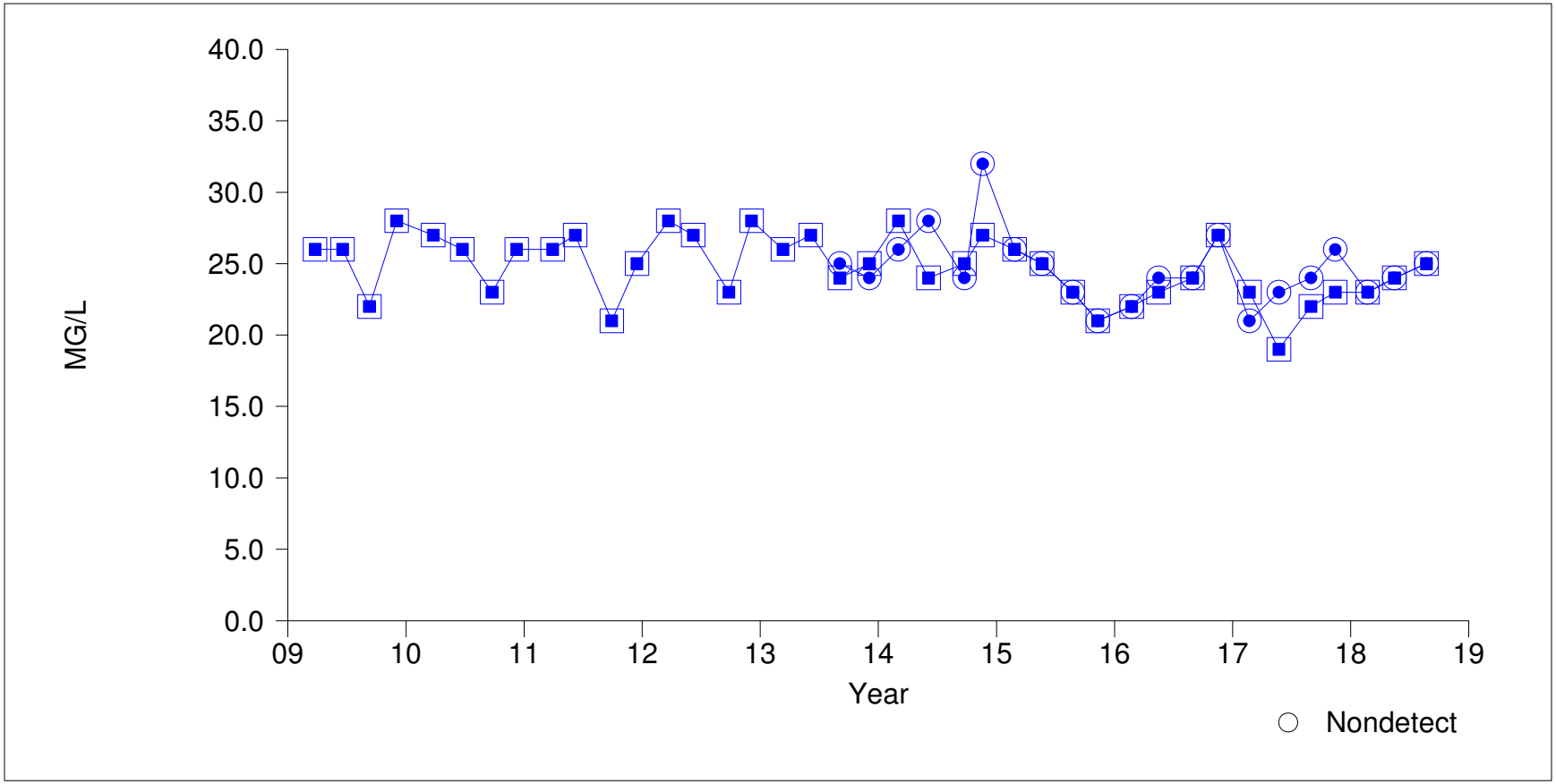
Time Series Plot for MW-39



Prepared by: Waste Management, Inc.

Waters

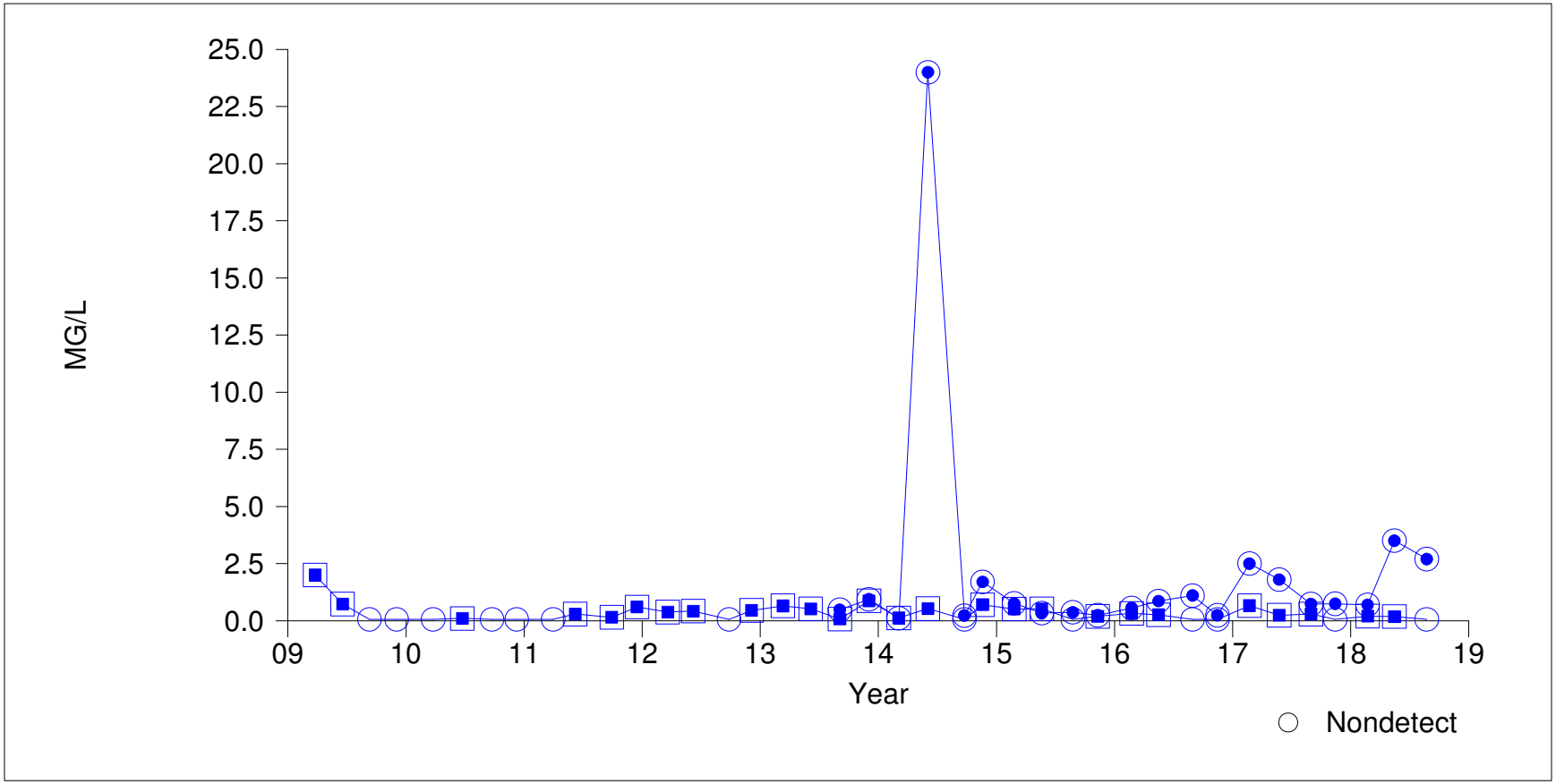
Time Series Plot for MW-42



Prepared by: Waste Management, Inc.

Waters

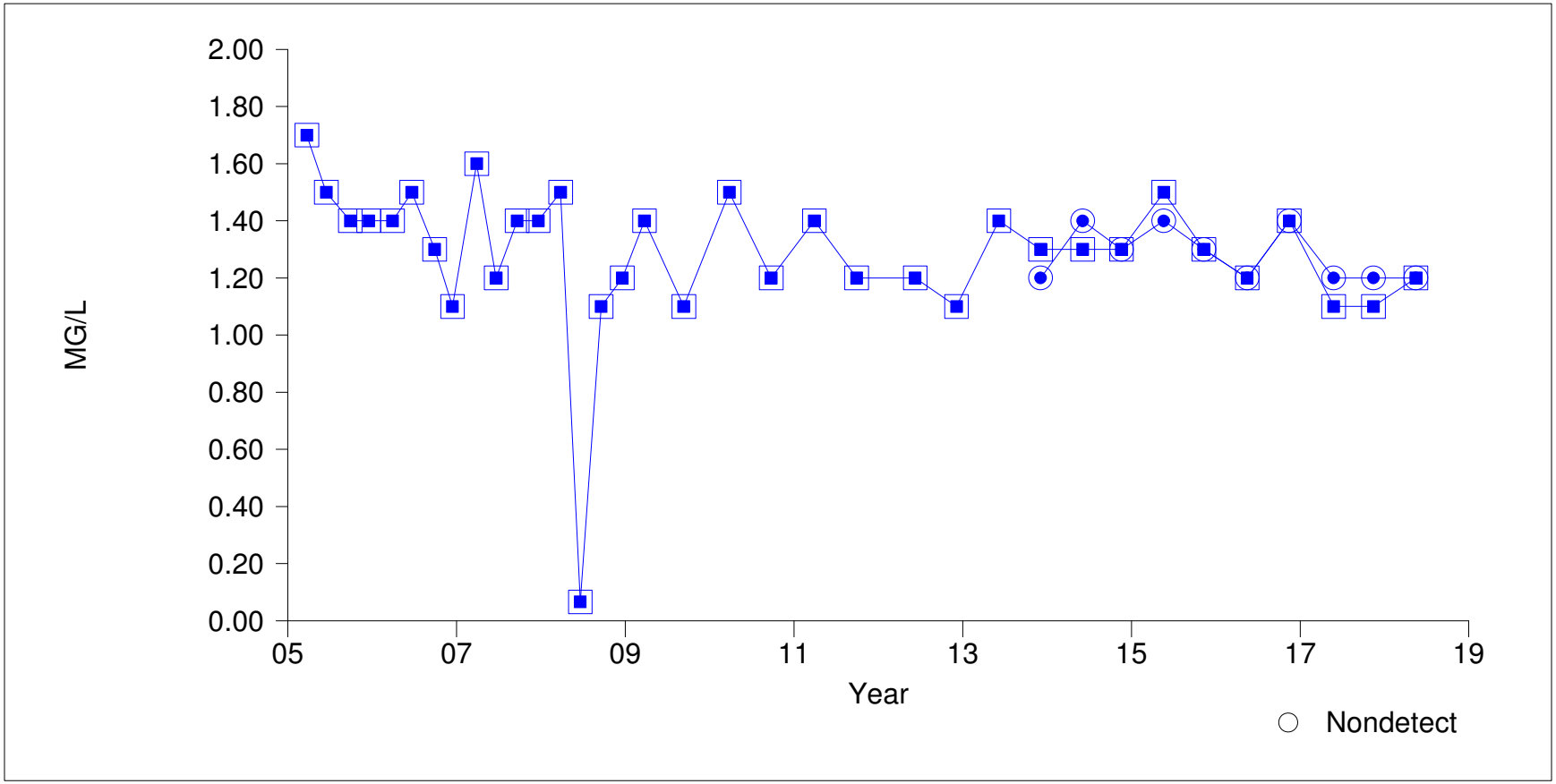
Time Series Plot for MW-43



Prepared by: Waste Management, Inc.

Waters

Time Series Plot for MW-29A



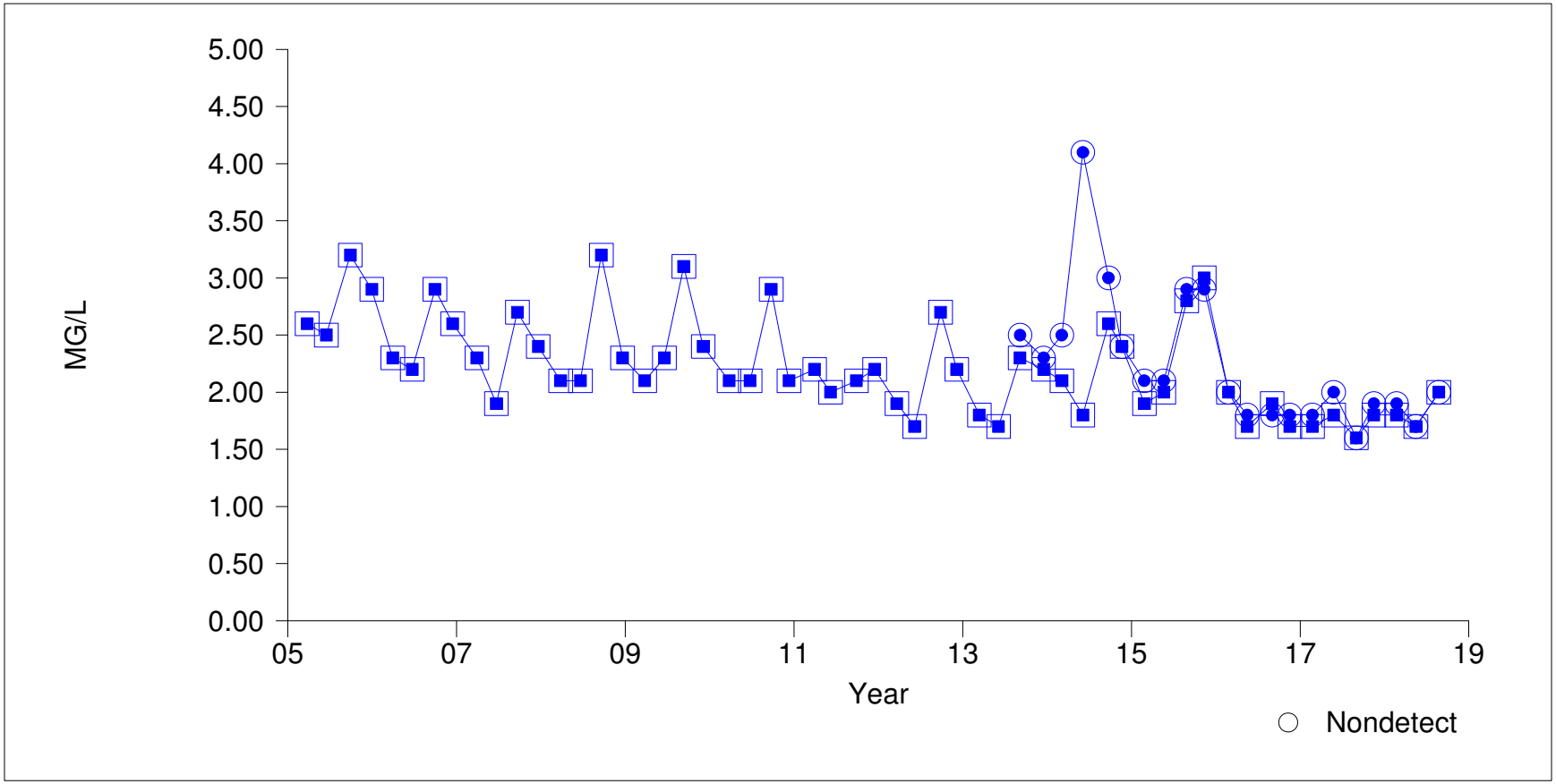
Manganese, dissolved
Manganese, total

CL = 0.05 mg/L

Prepared by: Waste Management, Inc.

Waters

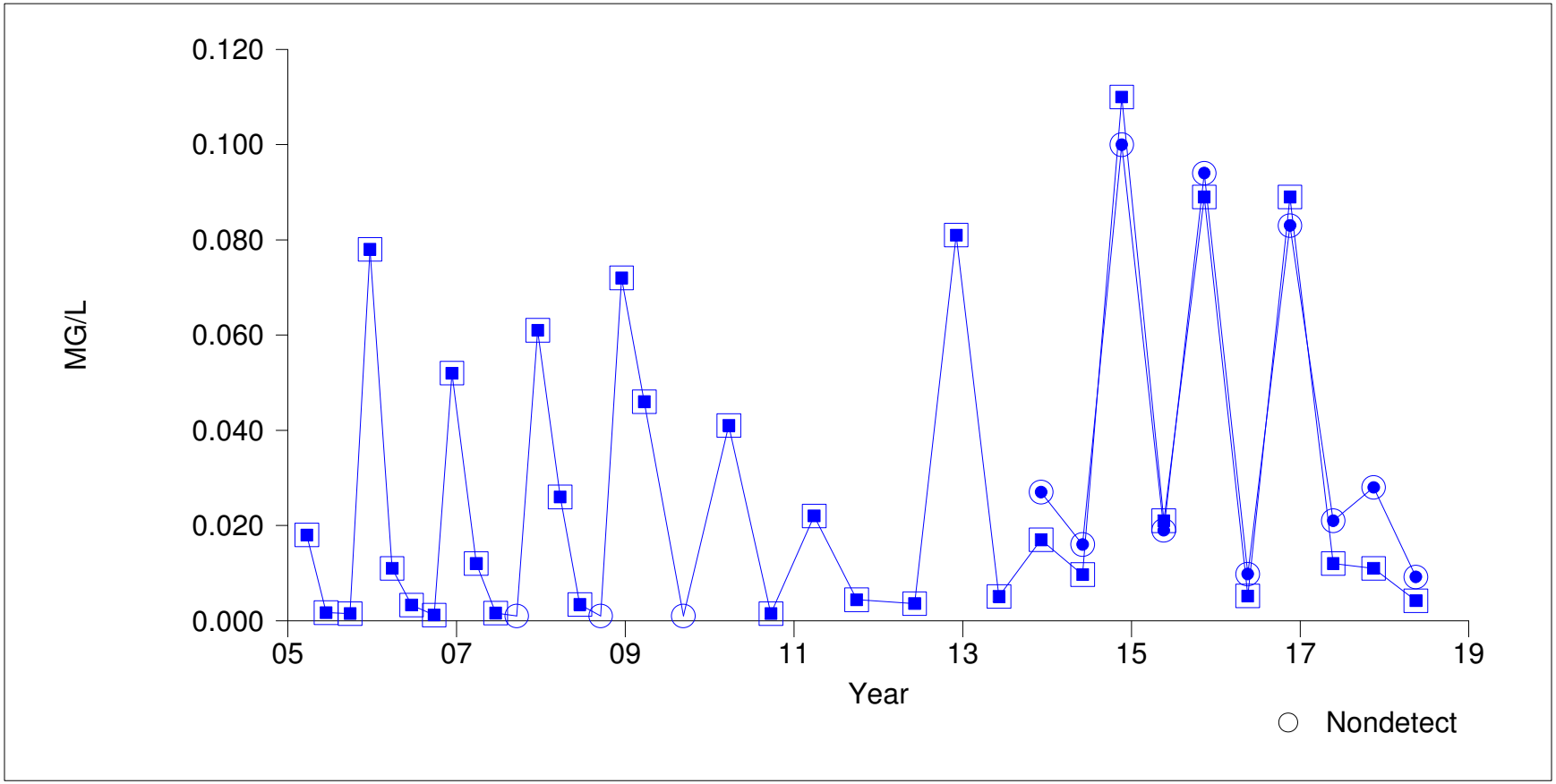
Time Series Plot for MW-32



Prepared by: Waste Management, Inc.

Waters

Time Series Plot for MW-33A



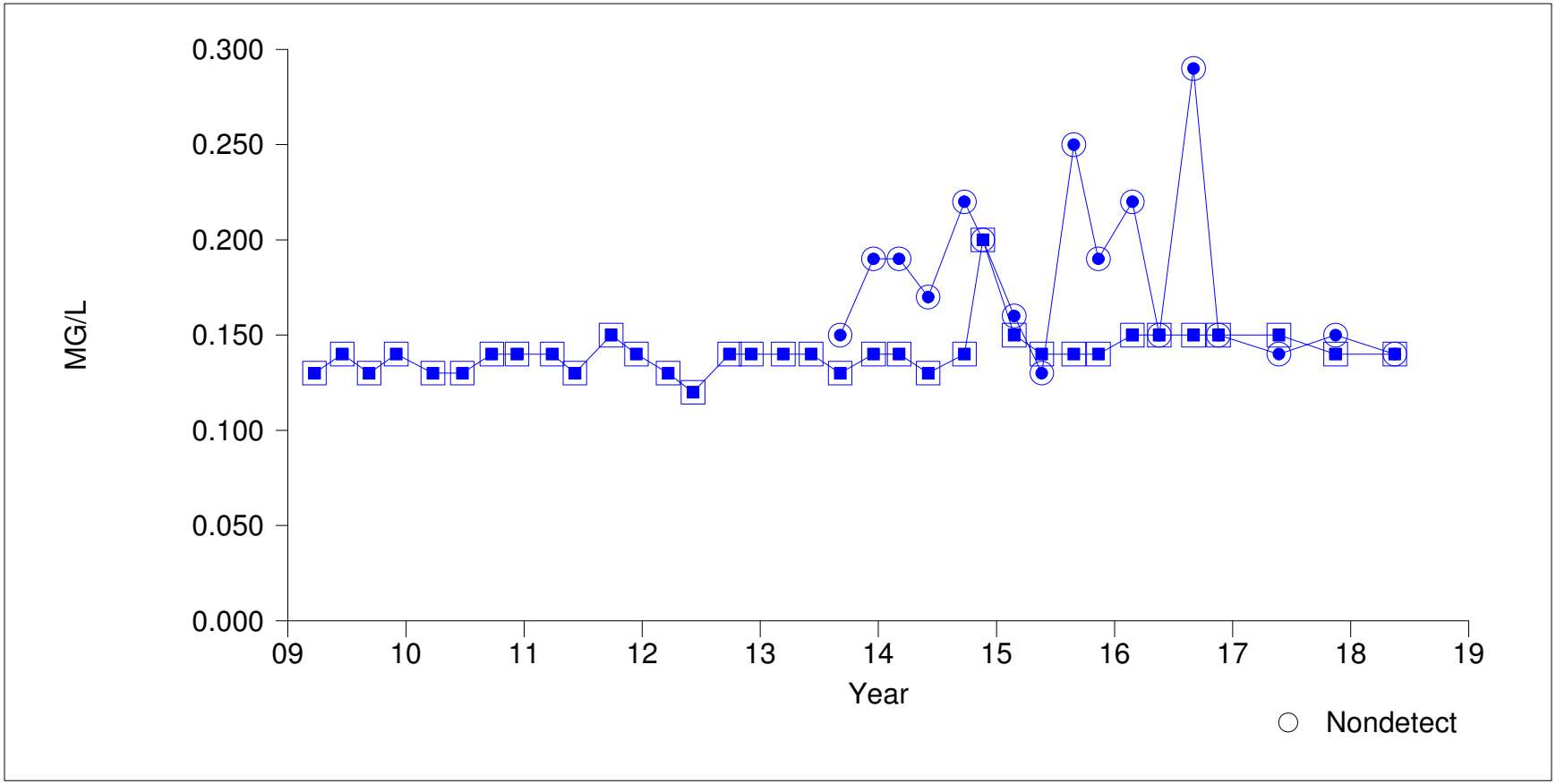
Manganese, dissolved
Manganese, total

CL = 0.05 mg/L

Prepared by: Waste Management, Inc.

Waters

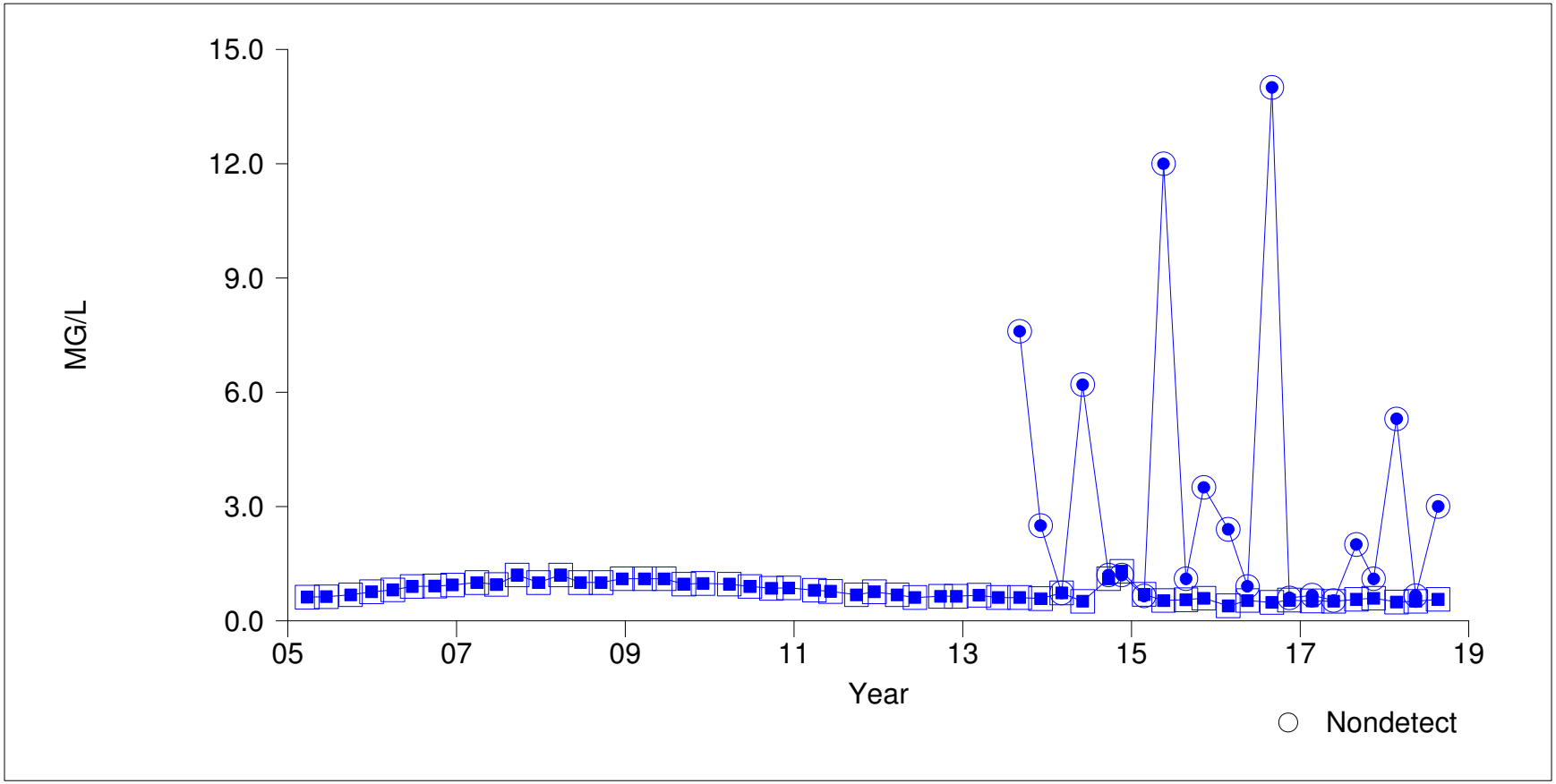
Time Series Plot for MW-33C



Prepared by: Waste Management, Inc.

Waters

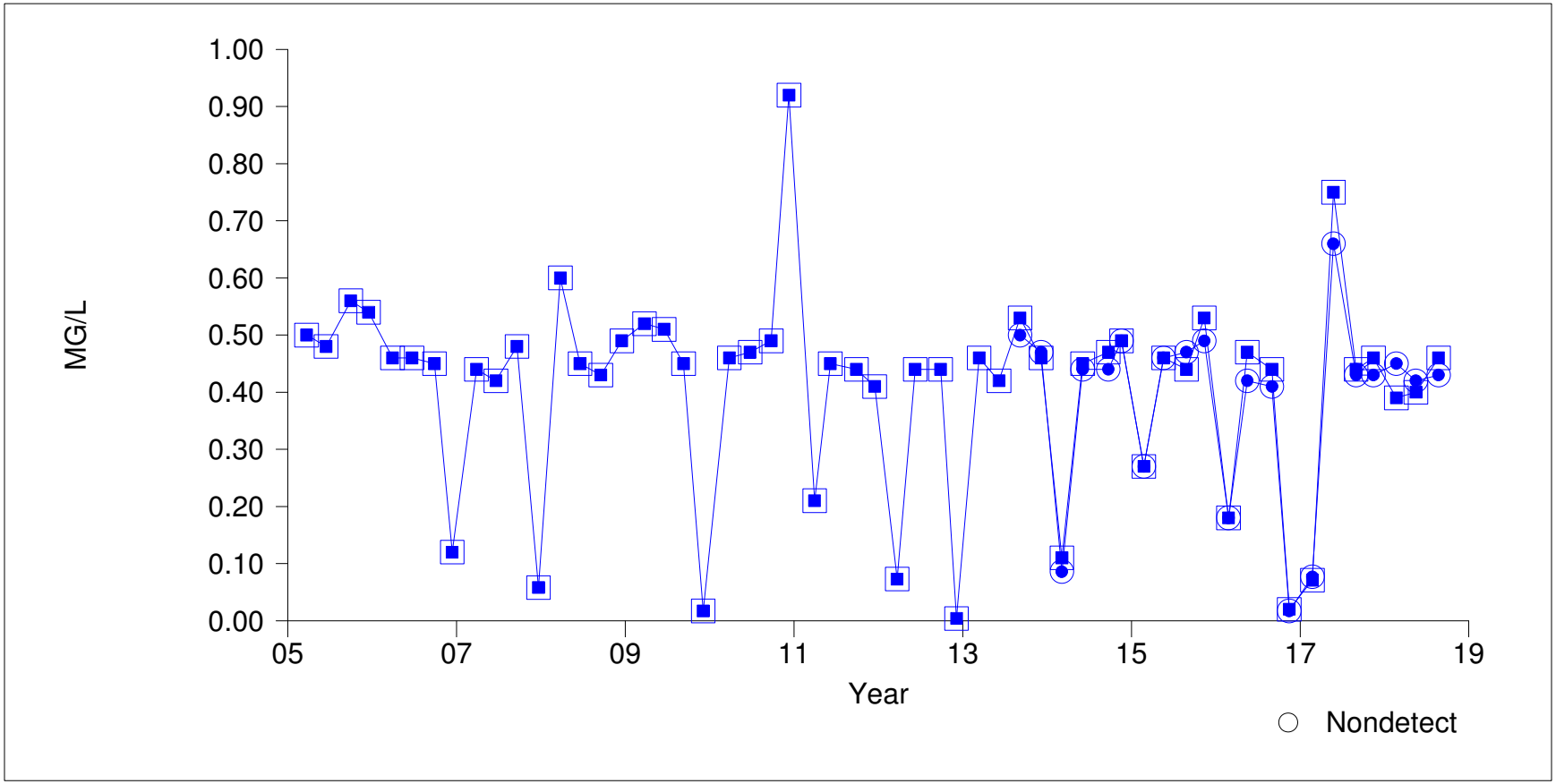
Time Series Plot for MW-34C



Prepared by: Waste Management, Inc.

Waters

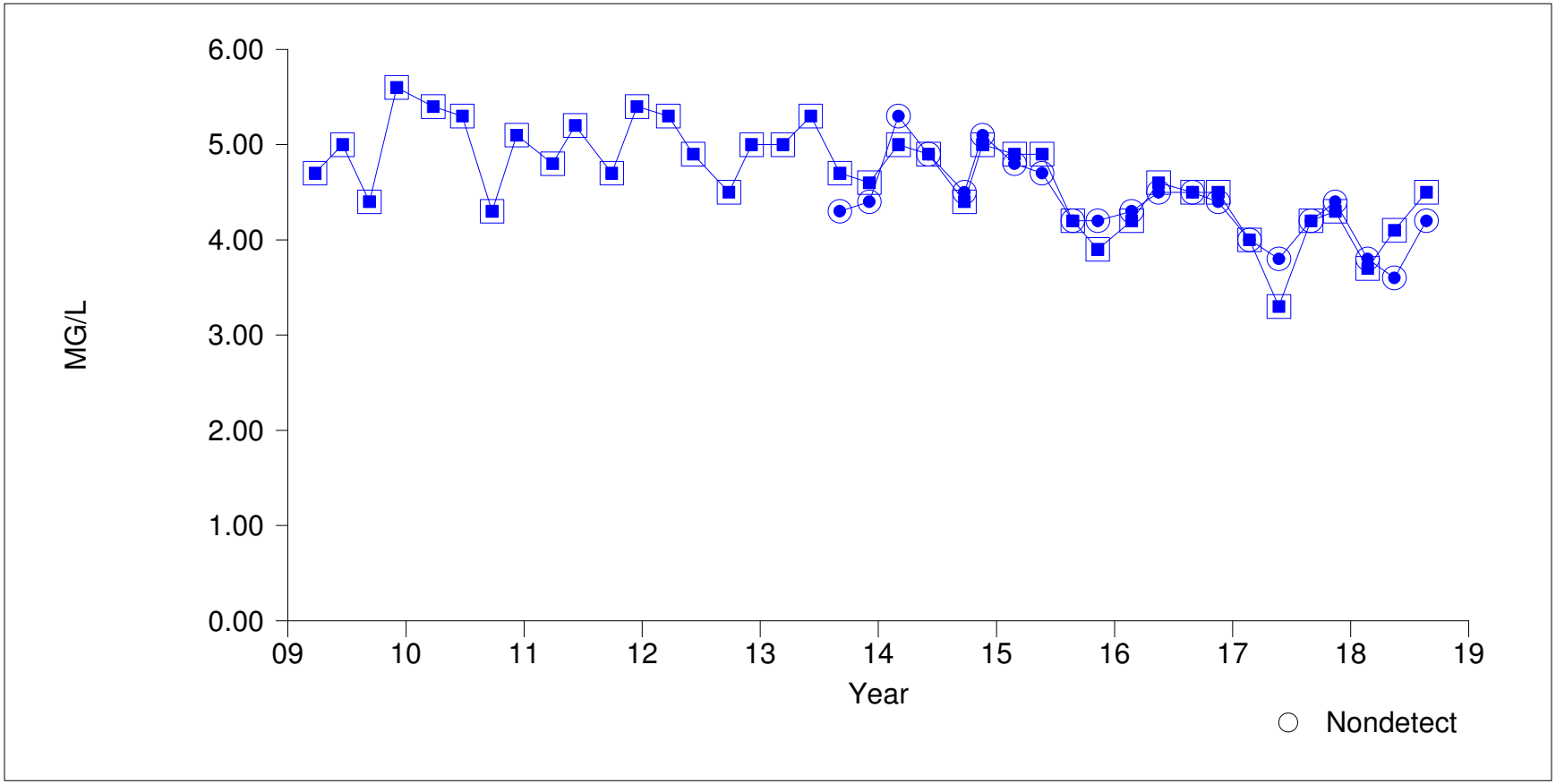
Time Series Plot for MW-39



Prepared by: Waste Management, Inc.

Waters

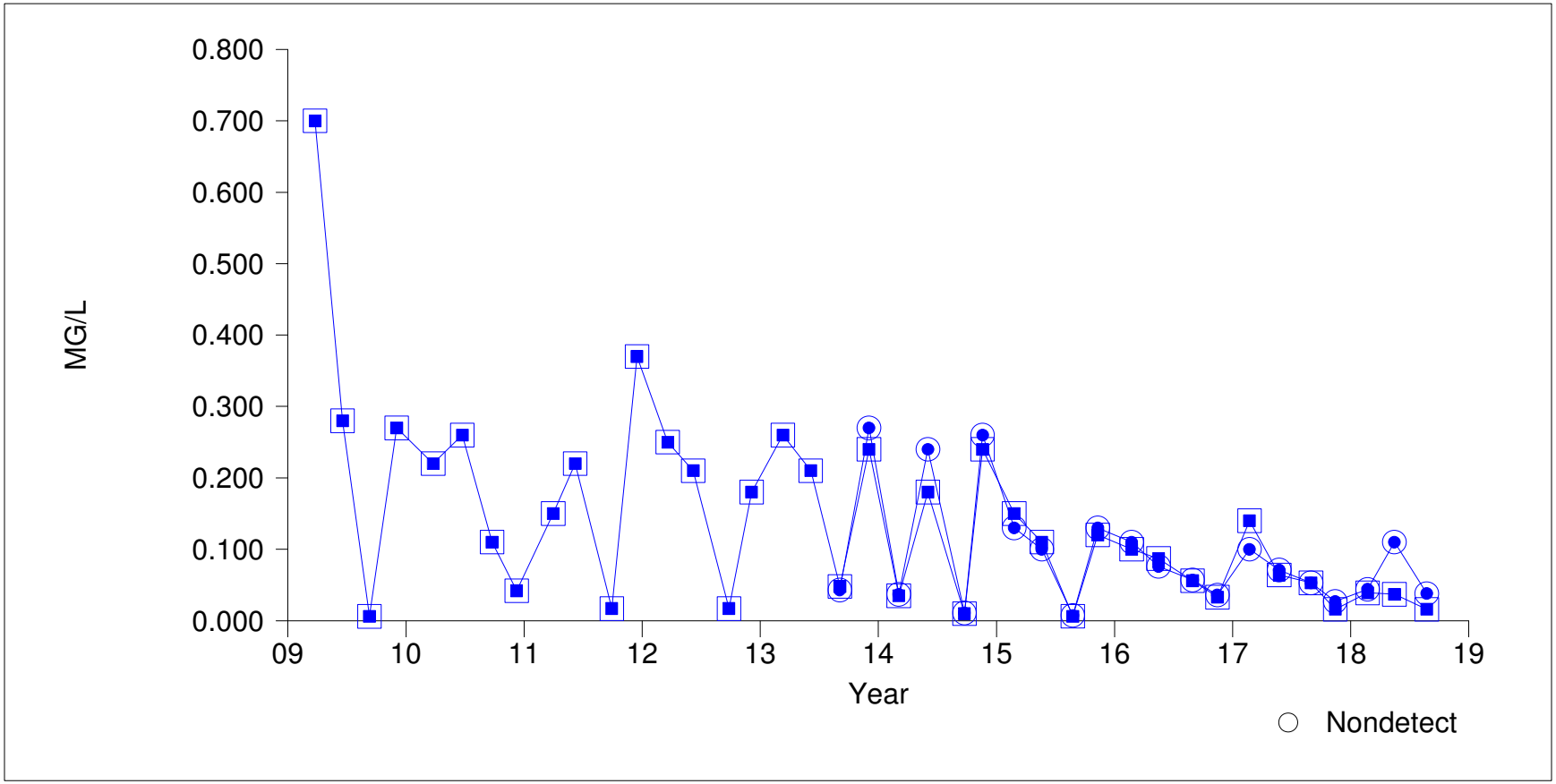
Time Series Plot for MW-42



Prepared by: Waste Management, Inc.

Waters

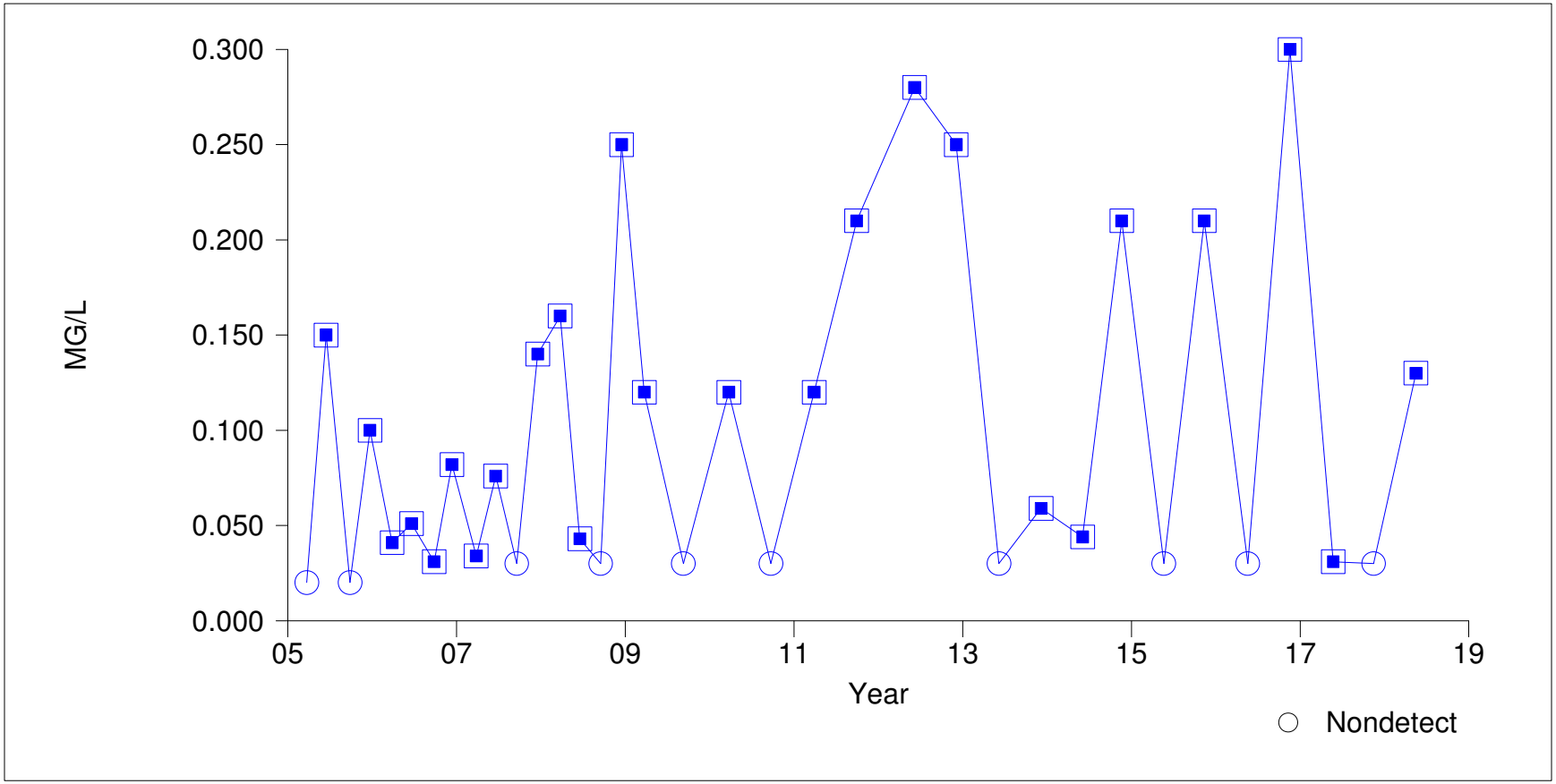
Time Series Plot for MW-43



Prepared by: Waste Management, Inc.

Waters

Time Series Plot for MW-33A

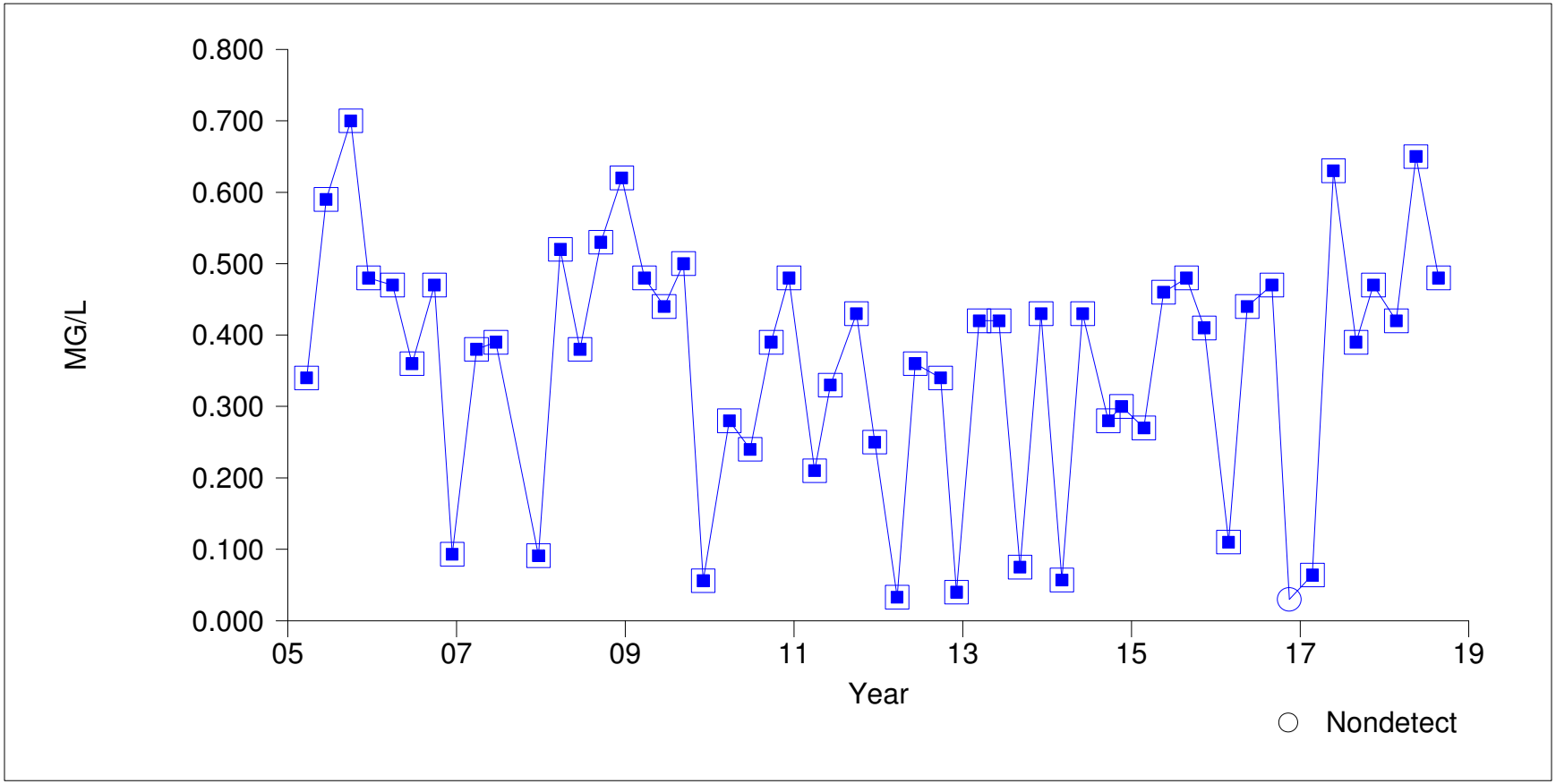


Ammonia (as n) CL = 0.190 mg/L

Prepared by: Waste Management, Inc.

Waters

Time Series Plot for MW-39

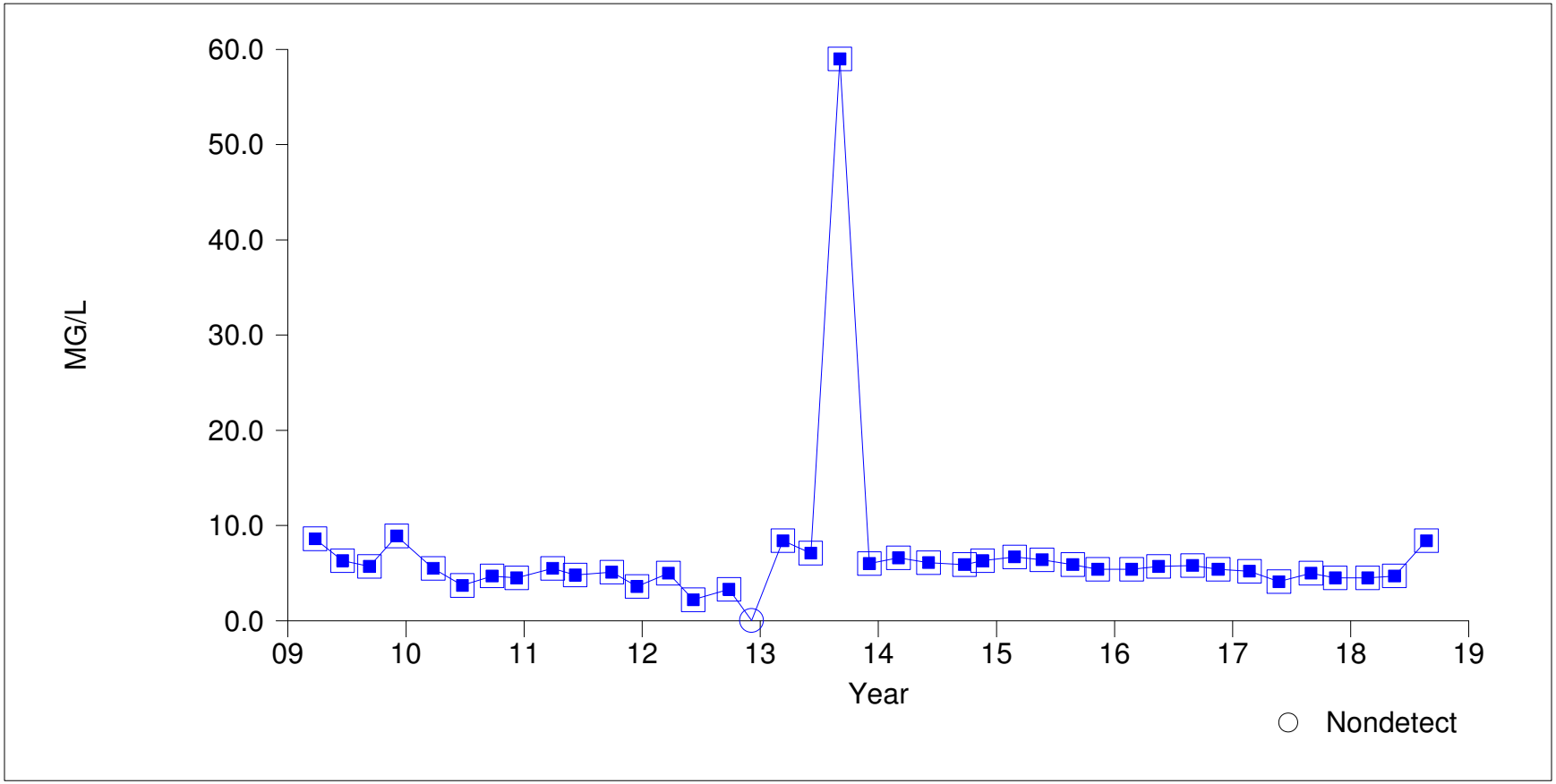


Ammonia (as n) CL = 0.190 mg/L

Prepared by: Waste Management, Inc.

Waters

Time Series Plot for MW-42



Ammonia (as n) CL = 0.190 mg/L

Prepared by: Waste Management, Inc.