

Kent Highlands Landfill 2014-2018 Remedial Action Status Report

Prepared for



May 2019

Prepared by

Parametrix

Kent Highlands Landfill

2014-2018 Remedial Action Status Report

Prepared for

Seattle Public Utilities

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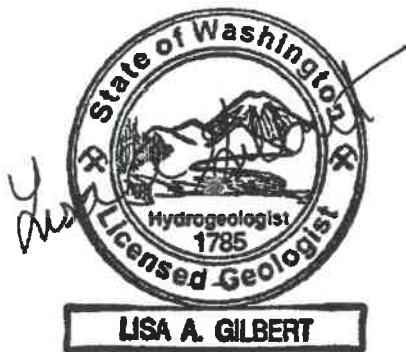
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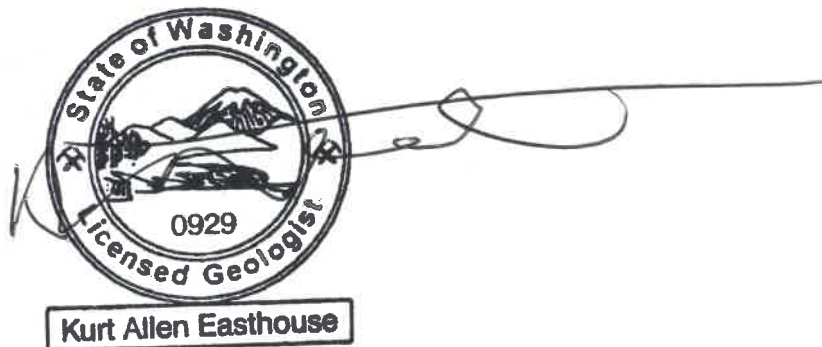
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2014-2018 Remedial Action Status Report.
Prepared by Parametrix, Seattle, WA
May 2019.

CERTIFICATION

The technical material and data contained in this document were prepared under the supervision and direction of the undersigned, whose seal, as a professional hydrogeologist licensed to practice as such, is affixed below.



Prepared by Lisa Gilbert



Reviewed by Kurt Easthouse



Approved by Laura Lee

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ACRONYMS AND ABBREVIATIONS

ARAR	applicable or relevant and appropriate requirement
BOD	biological oxygen demand
CAP	Cleanup Action Plan
CCL	cumulative sum control limit
CFR	Code of Federal Regulations
City	City of Seattle
COD	chemical oxygen demand
CUSUM	cumulative sum
DO	dissolved oxygen
Ecology	Washington State Department of Ecology
GCMP	Groundwater Compliance Monitoring Plan
Metro	King County Metro
mg/L	milligrams per liter
MNA	Monitored Natural Attenuation
MTCA	Model Toxics Control Act
NEHRP	National Earthquake Hazard Reduction Program
NMOCs	non-methane organic compounds
NOCOA	Notice of Construction Order of Approval
NPDES	National Pollutant Discharge Elimination System
ORC	Oxygen Release Compound
ppm	parts per million
PSCAA	Puget Sound Clean Air Agency
redox	oxidation-reduction potential
RI	remedial investigation
RV	regulatory value
SCL	Shewhart control limit
SIU	Significant Industrial User
SPU	Seattle Public Utilities
SR	State Route
SSM	Startup, Shutdown and Malfunction
Superfund	Comprehensive Environmental Response, Compensation, and Liability Act
SWQS	Water Quality Standards for Surface Waters of the State of Washington

ACRONYMS AND ABBREVIATIONS (CONTINUED)

TL	tolerance limit
TM	Technical Memorandum
TOC	total organic carbon
UCL	upper confidence limit
USEPA	U.S. Environmental Protection Agency
WAC	Washington Administrative Code
WHO	World Health Organization

1. BACKGROUND

1.1 Introduction

Reporting Period: 2014 through 2018

Name of Site: Kent Highlands Landfill

Address: 23076 Military Road South, Kent, Washington 98032

Facility Site ID: 2042

Project Contacts: Jeff Neuner and Min-Soon Yim

This remedial action status report presents a summary of remedial action system changes and events, and monitoring programs and results conducted at the Seattle Public Utilities (SPU) Kent Highlands Landfill (Facility Site ID #2042) for the years 2014 through 2018, in preparation for the Fifth Periodic Review to be conducted by the Washington State Department of Ecology (Ecology). In addition, this report identifies modifications and changes planned for the next 5-year period.

1.2 Site Description

The Kent Highlands Landfill is located at 23076 Military Road South, Kent, Washington 98032 and is bounded to the south by State Route (SR) 516, to the west by private commercial property and vacant land, to the north by residential property and vacant land, and to the east by the Green River (see Figure 1). Midway Creek is also located east of the landfill and discharges into the Green River. The landfill is situated within a natural ravine on the eastern flank of the Des Moines upland where it adjoins the Green River valley. Landfilling operations by the Seattle Solid Waste Utility began in 1969 and were terminated in 1986, and the landfill accepted mostly municipal waste with some industrial waste and construction debris.

A brief description of the hydrogeologic setting, and spring drain and surface water, leachate control, and landfill gas control systems are provided in the following sections.

1.2.1 Hydrogeologic Setting

The Kent Highlands Landfill is located on the eastern flank of the Des Moines Drift Plain within the Puget Lowland. The sediments underlying the site are diverse and complexly interbedded. These sediments were deposited during what is interpreted to be the Vashon Stade and Salmon Springs glaciations, and also fluvial and lacustrine sediments, possibly part of the Puyallup Formation, deposited during an older interglacial period. These sediments can be divided into three major groups. Within these three major groups are nine distinct deposits, listed below from youngest to oldest:

Man-made fill and Kent Highlands Landfill refuse

- Fill
- Landfill Refuse

Recent alluvium that fills the Green River Valley

- Recent Alluvium

Pleistocene glacial and interglacial deposits that underlie the Green River Valley alluvium and adjoining Des Moines Drift Plain

- Vashon Recessional Outwash
- Vashon Till
- Outwash Sand (possibly Vashon Drift)
- Outwash Gravels (pre-Vashon; possibly Salmon Springs Drift)
- Deltaic Sediments (possibly Salmon Springs Drift)
- Nonglacial Sediments (possibly Puyallup Formation)

Groundwater occurrence and movement beneath the site and the adjoining sections of the Des Moines Drift Plain and Green River Valley are variable and complex. Distinct hydrostratigraphic units composed of aquifers and aquitards have been defined and are listed below in the order that they occur in the site area from west to east:

- Landfill Aquifer
- Upper Aquifer
- Middle Outwash Aquifer
- Lower Outwash Aquifer
- Upper Silt Aquitard
- Sand Aquifer
- Lower Silt Aquitard
- Gravel Aquifer
- Recent Alluvium Aquitard
- Recent Alluvium Aquifer

The two aquifers affected by the landfill include the Sand Aquifer and the Recent Alluvium Aquifer. A detailed description of these two aquifers is presented below.

Sand Aquifer. The Sand Aquifer exists beneath essentially the entire site area and apparently extends throughout a large area of the Des Moines Drift Plain. The aquifer consists of sand in the lower portion of the Deltaic Sediments and sand and gravel in the upper part of the Nonglacial Sediments. These two geologic units are hydraulically coupled beneath the site but have different hydraulic properties and estimated horizontal hydraulic conductivities. The Sand Aquifer is one continuous unit near the toe of the landfill. To the west, the saturated portion of the aquifer becomes interbedded with thick deposits of fine-grained silt and clay. The aquifer is unconfined beneath the base of the landfill but is confined by the overlying Upper Silt Aquitard at the west end of the site.

The Sand Aquifer is recharged through vertical flow from the overlying Lower Outwash Aquifer but mostly through lateral flow from the west. Groundwater from the Sand Aquifer discharges to the Recent Alluvium Aquifer, although within the landfill area, a small amount is intercepted by the leachate collection system.

Recent Alluvium Aquifer. The Recent Alluvium Aquifer consists of saturated sand and silty sand. Except for local areas where silt beds confine the aquifer, the Recent Alluvium Aquifer is generally under water table conditions. The Recent Alluvium Aquifer is recharged by the following:

- Sand Aquifer
- Gravel Aquifer
- Landfill Aquifer
- Infiltration of precipitation
- Green River (under flooding conditions only)
- Part of Midway Creek
- Seeps or springs

Groundwater flow in the Recent Alluvium Aquifer is generally from west to east, toward the Green River. Horizontal hydraulic gradients in the aquifer increase under low water conditions (summer) over high water (winter). Vertical hydraulic gradients in the aquifer are generally upward but may reverse to a downward gradient under high water (winter) conditions (CH2M HILL 1996b). Locations of the groundwater monitoring wells are shown on Figure 2.

1.2.2 Spring Drain and Surface Water

Flow from the spring drain normally is discharged to the surface water treatment pond and then to the Green River. Water quality of the combined surface water and spring drain flow is measured at the outlet structure of the surface water treatment pond. Once a month the flow rate is measured by diverting the spring drain flow through a flow measurement flume into the leachate treatment pond (Ecology 2003).

1.2.3 Leachate Control

Leachate generated by the landfill is collected from two separate systems (south leachate system and toe buttress system) and discharged into the King County sewer. Flows from the south leachate systems are measured by a flume in the monitoring and diversion structure. A flow meter on the toe buttress system force main measures flows from that system. The total leachate discharged to the King County Metro (Metro) system is measured by a flow meter in the leachate transmission pump station. Leachate quality samples are collected monthly from the leachate transmission pump station wet well (Ecology 2003).

1.2.4 Landfill Gas Control

The design of the Kent Highlands Landfill gas control system includes five basic elements:

1. An enclosed John Zinc flare is used to incinerate the landfill gas in a controlled environmental manner.
2. Collection System – includes all the piping, valves, and mechanical equipment to create a vacuum on the landfill to draw landfill gas to the flare.
3. Interior control wells are intended to extract most of the landfill gas created as waste decomposes.

4. Perimeter control wells are intended to create a vacuum curtain around the landfill that captures any landfill gas not controlled by the interior system.
5. Landfill gas compliance probes are outside of the perimeter collection and near the facility's property boundary to confirm that the system is controlling subsurface migrating landfill gas.

1.3 Regulatory Status

A Consent Order was established between SPU and Ecology on May 27, 1987, and amended May 22, 1989, December 3, 1990, and again in 1996. The Kent Highlands Landfill was placed on the National Priorities List on August 30, 1990 for cleanup under the Comprehensive Environmental Response, Compensation and Liability Act (Superfund). Ecology is the lead agency as stipulated by an agreement with Region 10 of the U.S. Environmental Protection Agency (EPA). Cleanup was implemented under Washington Administrative Code (WAC) Chapter 173-340, the Model Toxics Control Act (MTCA).

The remedial investigation (CH2M HILL 1991a) found off-site landfill gas migration and leachate impacts to groundwater that is in hydraulic connection with the Green River. The remedy to be implemented was specified in the Kent Highlands Landfill Cleanup Action Plan (Ecology 1993). The remedy included access controls, site grading, a geomembrane landfill cover, a surface water conveyance system, a leachate collection system, and a landfill gas collection system. A Restrictive Covenant (Ecology 1993) was placed on the property to ensure the continued integrity of the cleanup action.

SPU oversees maintenance of landfill closure systems in accordance with the Post-Closure Operations and Maintenance Manual (CH2M HILL 1996a). Ongoing monitoring programs are in place including groundwater quality, fluid level monitoring for slope stability, surface water (spring drain discharge), leachate, landfill gas, and cap/cover integrity. Periodic Reviews are conducted by Ecology every 5 years to determine whether the cleanup remedy continues to be protective of human health and the environment.

2. PREVIOUS FIVE-YEAR REVIEW ISSUES AND RESOLUTIONS

The Fourth Periodic Review was prepared by Ecology in 2014 (Ecology 2014) based on the Five-Year Groundwater Monitoring Summary (2009–2013) (Parametrix 2014). The Fourth Periodic Review identified the issues outlined below to be addressed in the 2014 through 2018 reporting period. Actions taken by SPU to address these issues are summarized in Sections 2.1 through 2.7.

Ecology or SPU-requested changes during the 2014 through 2018 reporting period:

- Modify Future Reporting Format

Ecology is requesting the City replace the existing ground water monitoring and quarterly progress reports with a broader status report issued at five-year intervals to coincide with Ecology's periodic review. The change is advisable given the long-term care that will be required for this site, and the need to keep track of more than just monitoring data. A proposed annotated outline for the status report is attached. The final outline will be established in 2015 and used for the next submittal in 2019 (covering the 2014-2018 reporting period).

- Conduct Probe 35S Investigation

Ecology is requesting the gas probe investigation described previously be completed in 2015, and the results provided in one of the quarterly reports.

- Improve Quarterly Report Formats

Ecology is requesting improved gas distribution maps in the quarterly reports so that it is clear that landfill gas is being retained within the extraction well network and is not migrating off-property. We are recommending this be accomplished through separate 11-by-17 figures maps showing methane concentrations and gas pressures/contours.

- Revise Property Boundary and Groundwater Point of Compliance

The City is requesting that the property boundary along the Green River side of the site be adjusted based on historical research conducted by the City. The effect of the proposed adjustment would be to move the property line closer to the river. If Ecology agrees with the adjustment, based on review by the Attorney General's office, the City requests that well KMW-17Z be substituted for KMW-17 as the compliance well in this part of the site. The proposed replacement well is further downgradient, and typically has lower contaminant concentrations.

- Evaluate Additional Cleanup Measures for Ongoing Exceedances of Regulatory Values in Groundwater

Ecology is requesting that further engineering evaluations be conducted to determine ways to reduce ongoing ground water quality exceedances at various downgradient points of compliance. Although there has been some decline in contaminant concentrations with time, it is now clear that the existing leachate collection system is not going to be able to reduce vinyl chloride, manganese, and iron concentrations to applicable cleanup levels (regulatory values) at the point of compliance within a reasonable time frame.

- Update Water Well Inventory

Ecology is requesting a well survey be conducted across the river from the landfill to confirm that new water wells have not been installed in this area. We are requesting the scope of work be developed and the work accomplished in 2015. The results can be provided as a memorandum, initially directly to Ecology in 2015 or 2016, and later included as an appendix to the 2018 status report.

- Update Stability Analysis

Ecology is requesting a completely redone landfill stability analysis in the 2018 status report, to be based on the new topographic data obtained in 2016, new information on seismic loadings available for the Puget Sound area, and the water level data obtained during the 2014-2018 period.

2.1 Comprehensive Five-Year Reporting Format

The format of this report has been modified to include additional elements as requested by Ecology. The report has been expanded beyond the previously presented information (groundwater, spring drain, and leachate) to incorporate additional elements of the landfill monitoring and compliance including landfill gas, cap/cover and slope stability.

2.2 Probe KGP-35S Investigation

In 2010, methane concentrations approaching 5 percent by volume were detected in probe KGP-35S located near the Metro park-and-ride directly across Military Road from the landfill. The source of the combustible gas is not known but is thought to be related to organic deposits. High methane levels have not been detected in probes KGP-36 and KGP-40, located between probe KGP-35 and the landfill, and the shallow extraction wells closest to probe KGP-35 do not show elevated gas concentrations and have high negative pressures.

The KGP-35S investigation was completed in 2014 and included in the Fourth Quarter 2014 Report to Ecology (provided in Appendix D). A procedure was established for monitoring KGP-35 that included an initial survey of subsurface structures between the landfill and KGP-35S to check for elevated methane levels. Additional tests will be triggered if the quarterly measurement of methane is higher than 3.5 percent by volume. The initial survey was conducted in December 2014 and the results were presented in the Fourth Quarter Report. No methane was detected in these structures at five locations. Since 2014, methane concentrations in KGP-35S have been at or below 3.5 percent. Methane concentrations measured in the gas probes are discussed further in Section 7.

2.3 Improve Quarterly Gas Report Format

SPU worked with Ecology to change the format of quarterly reports, including implementing changes recommended in the Northwest Landfill Boundary Property Redevelopment Gas Evaluation Report (Gas Evaluation Report, EHSI and Parametrix 2019; described further in Section 7). Based on an evaluation of synoptic static pressures presented in the Gas Evaluation Report, contour maps of static pressure are no longer being presented per Ecology's concurrence.

Data from the gas extraction wells and operational probes along the northwestern property boundary are being evaluated to confirm that negative pressures are occurring in and between extraction wells, thereby providing a perimeter curtain surrounding the landfill to prevent gas migration. Data from the

perimeter gas probes are being evaluated to confirm that methane migration is not occurring beyond the property boundary.

The key parameters to demonstrate control as agreed by Ecology are: 1) consistent, continuous negative static pressures in the line of perimeter gas extraction wells and operational gas probes, and 2) consistent and continuous “zero” gas concentrations measured in perimeter/outside probes. To provide this evaluation, the revised quarterly report presents methane, pressure, and oxygen monitoring data for gas extraction wells and operational probes, and methane data for perimeter gas probes.

2.4 Revise Property Boundary and Groundwater Point of Compliance

A memorandum from the City of Seattle (City) Law Department was prepared providing documentation of the legal boundary for the Kent Highlands Landfill site, and this information was provided to the state of Washington in the Second Periodic Review Response (Floyd|Snider 2007). The memorandum concluded that the eastern boundary of the Kent Highlands Landfill is defined by the ordinary high-water mark of the Green River. Well KMW-17Z was installed in 2007 closer to the Green River, and SPU recommended that KMW-17Z be used as the compliance well in place of KMW-17. SPU is awaiting final confirmation from the Washington State Attorney General’s office but is proceeding as if the request has been approved, with KMW-17Z replacing replaced KMW-17 as a compliance monitoring well.

2.5 Evaluate Additional Cleanup Measures for Ongoing Exceedances of Regulatory Values in Groundwater

A compliance evaluation (Parametrix and EHSI 2019b) was prepared to evaluate remedial options for reducing exceedances of groundwater quality criteria at the point of compliance. The compliance evaluation summarized findings of the remedial investigation and risk assessment used to establish site compliance criteria and reviewed current site conditions and applicable or relevant and appropriate requirements (ARARs) to assess whether any changes have occurred that could affect the compliance determination. Current groundwater quality data for manganese, iron, and vinyl chloride were summarized, current remediation status and additional potential remedial options and their costs and benefits were evaluated, and recommendations were provided.

2.5.1 Results

Vinyl chloride, iron, and manganese remain out of compliance at the landfill. Of these parameters, only the vinyl chloride regulatory value (RV) is based on human health. Ecology requirements prohibit completion of any new groundwater wells within 1,000 feet of landfills (WAC 173-160), and this limits the potential for human exposure through drinking water. Current data indicate that vinyl chloride concentrations are decreasing due to natural attenuation, and updated BIOSCREEN and BIOCHLOR modeling results (EPA 1996, 2000) indicate that concentrations are expected to be in compliance at the Green River in as little as 4 years (see Figure 3). Compliance at well KMW-17Z could be achieved in approximately 15 years.

Manganese and iron are naturally occurring elements that are released from soils. Elevated concentrations in site wells are likely due to a combination of geochemical processes, including their location in the wetland area between the landfill and the Green River that is naturally low in oxygen and rich in organic materials. Iron increases in the Recent Alluvium Aquifer wells over the past few years, including KMW-19A and background well KMW-15A, may be related to increased beaver activity that

has created wetland areas. Manganese and iron are expected to precipitate when they encounter the more oxygenated waters of the Green River.

The current RVs for manganese and iron were established based on secondary criteria that are not related to human health or environmental risks, although there are no exposures prior to discharge to the Green River. Health criteria for manganese and iron are further discussed in the Drinking Water Health Advisory for Manganese (EPA 2004) and the Iron in Drinking-water Background Document and Manganese in Drinking-water Background Document (World Health Organization [WHO] 2003; 2011).

Four potential remedial approaches were discussed: Monitored Natural Attenuation (MNA), implementation of Oxygen Release Compound (ORC)-A socks, implementation of Plumestop™, and air sparging/air stripping and vapor extraction. All approaches are feasible at the site under the current biologic and hydrogeologic conditions.

MNA combined with development restrictions appears to be the most cost-effective methodology and is anticipated to achieve compliance with necessary RVs within a reasonable timeframe. MNA would solely address vinyl chloride, whereas the other remedial options presented would degrade vinyl chloride while simultaneously causing manganese and iron to precipitate and reduce groundwater concentrations.

Secondarily, ORC-A injection via canisters of unused wells near the toe of the landfill may assist in aerobic degradation of primary contaminants and precipitation of secondary contaminants to more rapidly reduce vinyl chloride concentrations. ORC-A socks would be highly localized and not likely to create a necessary reactive barrier. Plumestop implementation is more proactive in creating such a reactive barrier, but costs again are likely to exceed \$200,000 within the first year of implementation. Another expensive approach (>\$180,000 initially) is to institute an air sparging/air stripping and vapor extraction system at the site. However, the costs of these additional technologies likely outweigh their advantages based on the current state of the groundwater plume, natural degradation processes, and future risk near and surrounding the landfill.

2.5.2 Recommendations

It is recommended that the RVs for manganese and iron be modified. For manganese, it is recommended that the MTCA Method B groundwater value of 2.2 milligrams per liter (mg/L) be used as the RV instead of the secondary criteria of 0.05 mg/L. For iron, it is recommended that the MTCA Method B groundwater value of 11.2 mg/L be used as the RV instead of the secondary criteria of 0.3 mg/L.

Updated groundwater modeling predicts that vinyl chloride concentrations at the Green River will be in compliance with current RVs through continued MNA in as little as 4 years; therefore, continued use of MNA as a remedial approach is recommended. For vinyl chloride, MNA has been implemented at the site since the closure of the landfill, and substantial decreases in concentrations have been observed near the point of compliance. Overall, human health risks have been mitigated by SPU's remedial approach along with restrictions on development and installation of new wells placed by Ecology and the City of Kent.

To provide further evaluation of the effectiveness of ongoing MNA, SPU plans to measure additional parameters including dissolved oxygen (DO) and oxidation-reduction potential (redox) in routine groundwater monitoring well samples and analyze the data using EPA guidance (EPA 1998; 1999) to further confirm that MNA is occurring consistent with the conceptual site model. Testing for additional EPA-required natural attenuation screening parameters is also recommended to demonstrate that

attenuation of the site contaminants is occurring at rates sufficient to be protective of human health and the environment.

2.6 Well Inventory

Ecology requested a well record search to determine whether new water supply wells have been installed downgradient of the landfill within a 1,000-foot radius on the east side of the Green River (Ecology 2015). The updated well inventory was requested by Ecology following the discovery of an unknown well (15J1) encountered east of the Green River near Russell Woods Park (see Figure 4). Ecology was concerned the unknown well may have been a new well drilled since the remedial investigation (RI) was completed (CH2M HILL 1991a).

To address this objective, an updated well inventory was prepared (Parametrix and EHSI 2019a) for an approximate 1,000-foot radius around the landfill. Additional wells downgradient of the landfill outside of the 1,000-foot radius were also included in the evaluation.

2.6.1 Results

The locations of water wells in the vicinity of Kent Highlands Landfill are shown on Figure 4. Ecology databases show one well has been drilled within 1,000 feet of the landfill since the RI. The City of Kent's well (15H1) was reported as a water well in Ecology databases, but it was a monitoring well for the Veterans Drive improvement project. It is unknown whether the well remains in use as a monitoring well.

Well 15J1 was discovered within 1,000 feet of the landfill on the opposite side of the Green River shortly after the last Periodic Review. The only documented information for this well is related to SPU's characterization performed following its discovery. Information suggests this is not a new well and was likely drilled before the RI.

A new active domestic well (22A2/Stearns well) drilled in 2016 approximately 1,200 to 1,400 feet south of the landfill is serving a newly constructed residence. The well was drilled within the Recent Alluvium Aquifer on the west side of the Green River.

Three historical wells located outside the 1,000-foot radius for the Lakes Development on the opposite side of the Green River may still be in use for irrigation purposes (wells 14L1, 14L2, and 14Q1; see Figure 4). One of the wells was deepened in 2004, suggesting the well remains in use. Water quality concerns from the landfill are limited based upon recent monitoring, but if the wells remain active they could provide additional confirmation points, if needed, for future characterization of existing or emerging contaminants.

2.6.2 Recommendations

Additional groundwater monitoring of existing site wells or additional sampling of surrounding wells beyond the 2014 sampling of well 15J1 does not appear to be necessary. However, based upon the results of the updated well inventory, the project team developed the following recommendations:

- Confirm with the City of Kent that well 15H1 is solely used for groundwater monitoring or has been properly decommissioned.
- Contact the owner of well 22A2 to confirm use and discuss sampling of the well and risks associated with wells within 1,000 feet of closed landfills.

- Contact the Lakes Development on the opposite side of the Green River to identify active surface water or groundwater withdrawal points to evaluate current or future risks related to the landfill.
- Each year check Ecology's well database to determine whether any new wells have been installed within 1,000 feet of the landfill. These findings will be reported in each 5-year status report, or sooner if any high-capacity wells have been put into use.
- Confirm the owner of the property on which well 15J1 is located and notify them that the well is within 1,000 feet of the landfill and should not be used. Ideally, the owner would decommission this well or, at a minimum, seal it off.

2.7 Update Slope Stability Analysis

An updated slope stability analysis was completed (Soil & Environmental Engineers, Inc. 2019) that consisted of the following evaluations. The findings of the updated slope stability analysis are summarized in Section 8.1.2 and recommended related activities for the next 5-year period are provided in Section 8.3.

1. A site reconnaissance at the east slope where the side slope is steepest compared to the rest of the landfill slope. Due to its steepness, this portion of the landfill is the most critical area in terms of slope stability. The reconnaissance reveals no signs of slope movement which typically include slump, ground crack and uneven slope grade.
2. A comparison of the east slope surface topography between 1991 (CH2M HILL 1991b) and the 2016 topographic survey. The results show no substantial difference, and more importantly, no over-steepening of east slope since 1991. The 1991 report concludes that the east slope is stable under static-state/gravity loading. Assuming that the groundwater condition is unchanged, such conclusion should remain the same since there is no significant change in surface topography.
3. Evaluation of slope stability under updated seismic load. The 1991 report considered a peak ground acceleration (PGA) of 0.3g for the stability analysis. This value is based on National Earthquake Hazard Reduction Program (NEHRP). The 1991 report concludes that the east slope will experience less than 2 inches of displacement under the seismic load. The most recent published (2015 NEHRP) PGA value at the site is 0.564g. Using this updated seismic load and a recent methodology (Bray and Travarasrou 2007) the estimated displacement is 12 inches. We believe that this displacement, when it occurs, will require some re-grading for the slope and repair for the cover system.
4. Performance of slope stability analyses. The east slope composes a lower and upper slope. The lower slope rises from the toe buttress for a height of about 60 feet at 2.5H:1V slope angle. The upper slope rises from the top of lower slope for a height of about 50 feet at 3H:1V slope angle. In the 1991 report, only the global stability evaluation was performed, that is, the stability of the slope encompassing both the lower and upper slopes. In addition to global stability, we performed local stability analyses where the stability of the lower and upper slopes was evaluated separately.

Using two sets of refuse strength stated in the 1991 report - conservative and more probable - our slope stability analyses found that the slope has a satisfactory factor of safety ($FS > 1.5$) for a global configuration. This is consistent with the 1991 report. The same conclusions can be drawn for local stability when more probably refuse strength is used. However, when a

conservative refuse strength is used, we found that the factor of safety drops below 1.5 for the lower slope.

5. Document review. The 1991 report (CH2MHILL 1991b) shows perched groundwater in the refuse, and the referenced 1982 report by Golder Associates (Golder 1982) indicates possible plugging of the spring drain line. These conditions would lead to the possibility of elevated groundwater/leachate in the refuse, resulting in risk of slope instability. We therefore recommend two groundwater monitoring wells be installed.

3. LAND USE CHANGES

3.1 Remedial Action System Changes and Events

The Grandview Apartments were constructed north of Veterans Way by the developer Devco. Construction started in the third quarter of 2015 and was completed in 2018. The location of the Grandview Apartments is shown on Figure 1. Changes in land use are shown in a comparison between the 2013 and 2017 aerial photographs presented in Figure 5.

No other changes in land use at the landfill or at properties adjacent to the landfill occurred during this 5-year period.

3.2 Modifications or Changes Planned for the Next 5-Year Period

The following land use changes are planned for the next 5-year period:

- The Washington State Department of Transportation is designing the SR 509 project, which may increase flow to Midway Creek.
- The Washington State Department of Transportation SR 509 project will change land use west of the landfill.
- A market evaluation at Kent Highlands Landfill may be conducted in 2019.

No other modifications or changes to land use are planned during the next 5-year period.

4. GROUNDWATER

4.1 Remedial Action System Changes and Events

A previously unidentified well (15J1) encountered east of the Green River near Russell Woods Park was sampled on November 10, 2014. SPU staff collected samples from the well's artesian flow for water quality testing and measured the depth of the well to be 353 feet. The well water quality analyses for well 15J1 are provided in Appendix A. The laboratory analyses did not detect any volatile organic compounds that would indicate degraded water quality due to the landfill.

4.2 Remedial Action Monitoring Program and Results

The groundwater monitoring program includes sampling of wells for groundwater quality and measurements of groundwater elevations as described in Section 11.1 of the Post-Closure Operations and Maintenance Manual and the Kent Highlands Landfill Groundwater Compliance Monitoring Plan (GCMP) prepared by CH2M HILL (1996b) and approved by Ecology. Confirmational monitoring has been conducted since completion of baseline monitoring in the fourth quarter of 1996. The baseline data were compared to the RI data and the results were presented in the Kent Highlands Landfill 1996 Groundwater Monitoring Report (CH2M HILL 1997). The groundwater compliance monitoring objectives, monitoring network, data collection methods, and data analysis procedures are explained in detail in the GCMP.

4.2.1 Groundwater Quality

Groundwater monitoring was conducted annually during the third quarter of each year in accordance with the GCMP. Groundwater samples were collected from background, indicator, and compliance monitoring wells in the Sand Aquifer and the Recent Alluvium Aquifer. Samples from each well were analyzed for field parameters, conventionals, metals, and volatile organic compounds. Groundwater sampling locations in the Sand Aquifer and Recent Alluvium Aquifer are presented in Figure 2. Analytical results for each monitoring event are summarized in Table 1.

The data evaluation process during confirmational monitoring, as modified to reflect the monitoring reduction to an annual frequency, is shown in Figure 6. Statistical evaluations are discussed in the following sections and presented in Appendix A (Summary Statistics, Shewhart Control Charts, CUSUM Calculations, Vinyl Chloride Upper Confidence Limit Calculations, Time-Series Plots, and Tolerance Limit Calculations).

4.2.1.1 Summary Statistics and Comparison with Regulatory Values

Summary statistics for all well data (background, indicator, and compliance wells) were generated for the 2014 through 2018 monitoring results and are shown in Appendix A. The statistics for each monitoring parameter include the number of samples, the number of detects, and the detection frequency (i.e., the percentage of samples in which the given parameter was detected). The statistics also include the minimum and maximum values for detected parameters, the minimum and maximum values for non-detects (the quantitation limit), and the sample mean (assuming a value of one-half the quantitation limit for non-detects). The last two columns list the RV and the number of samples in which each parameter was detected at a level above its RV.

None of the volatile organic compounds other than vinyl chloride exceeded RVs in any well. Vinyl chloride concentrations exceeding the RV (0.025 µg/L) were detected in wells KMW-10A, KMW-17, KMW-17Z, and KMW-12A during each sampling event except for KMW-10A in 2018 where the vinyl chloride concentration was below the RV.

4.2.2 Comparison of Groundwater Data to Statistical Limits

Approach

The detailed approach for statistical analysis of post-closure groundwater monitoring data is presented in the GCMP (CH2M HILL 1996b). Because the Cleanup Action Plan (Ecology 1993) states that MTCA cleanup standards have been met at this site, groundwater leaving the site will continue to be in compliance unless its quality deteriorates from the groundwater quality measured during the RI. The Kent Highlands post-closure groundwater monitoring data are compared to the following three criteria:

- Baseline water quality monitoring data measured at the same well using Shewhart-cumulative sum (CUSUM) control charts
- Recent water quality data from the background well in the same aquifer using tolerance limits (TLs)
- RVs

The GCMP states that an out-of-compliance condition for groundwater would occur for conventional and inorganic parameters if the baseline conditions (Shewhart control limit [SCL]), background conditions (TL), and RV were all exceeded in any of the compliance wells (Recent Alluvium Aquifer wells KMW-10A, KMW-17 [now KMW-17Z], and KMW-19A) for two consecutive events. For organic parameters, compliance is determined by comparing the upper 95 percent confidence limit of the mean of the most recent eight data points to the RV. Vinyl chloride is the only organic parameter for which concentrations exceeded the RV during 2014 through 2018 (see Table 1), and an evaluation of vinyl chloride is discussed in Section 4.2.2.2.

For conventional and inorganic parameters, intra-well comparisons using control charts are the primary statistical tool to detect any changes in groundwater quality over time. Since the number of data points measured during the RI were not sufficient to develop control charts, the data used to develop the control limits included both RI data (1989 to 1990) and baseline monitoring data (1994 to 1996). Before constructing the control charts, the initial compliance monitoring data were compared to the RI data using boxplots, time-series plots, and summary statistics. Shewhart-CUSUM control charts were developed only for those well-parameter cases where the initial compliance monitoring data had not increased compared to the RI data (CH2M HILL 1997).

Control charts were constructed for well-parameter combinations that had not increased since the RI following the end of baseline monitoring in the fourth quarter of 1996 (CH2M HILL 1997). The control charts compare the compliance data to the SCL, and the CUSUM of the data to the cumulative sum control limit (CCL) for parameters with data that fit a normal or lognormal distribution. Control limits for the well-parameter combinations that were not lognormally or normally distributed were estimated using a nonparametric method and no CUSUM control limits were generated.

Analysis of 2014 through 2018 Data

The Shewhart and CUSUM control charts were updated through 2018 and are presented in Appendix A. CUSUM calculations are presented in Appendix A. In each appendix, the charts for the Recent Alluvium

Aquifer are presented before the Sand Aquifer charts. Control charts and comparisons to statistical limits are not presented for well KMW-17Z because the well was installed after the baseline period.

A comparison of the 2014 through 2018 data to groundwater quality limits is presented in Table 2. A check in the SCL, TL, RV, or CCL column indicates that the value is greater than the limit. If the SCL, TL, and RV are all exceeded at a compliance well (Recent Alluvium Aquifer wells KMW-10A, KMW-17, and KMW-19A), the GCMP states that Ecology will be notified, and a verification sample will be collected during the next monitoring event. If the exceedance is verified, the landfill is out of compliance, and the agencies will determine appropriate actions on a case-by-case basis. Exceedances of limits in background or indicator wells do not constitute out-of-compliance conditions. The comparison of the CUSUM to the CCL is used for information only, not as a measure of compliance. Exceedance of the CCL is an indication that parameter values have increased consistently over several monitoring events.

There were no cases during 2014- through 2018 where the SCL, TL, and RV were all exceeded in a compliance well for two consecutive events (see Table 2). However, the manganese and iron concentrations in well KMW-19A exceeded the TL and RV (based on secondary drinking water maximum contaminant levels for aesthetics), and no SCL was established for these parameters. Ecology's position as stated in the third Periodic Review Report (Ecology 2009) is that, regardless of the SCL comparisons, manganese concentrations in downgradient wells are higher than in the background wells by a factor of two or more, and therefore Ecology considers the site to be out of compliance for manganese. Concentrations of iron decreased following the baseline period through 2011, but since 2012 have increased and are currently in the range of those in the baseline period.

Although not an out-of-compliance condition, concentrations of cadmium exceeded the SCL, TL, and RV in indicator well KMW-12A for more than two consecutive quarters. Concentrations of manganese in indicator wells KMW-16A and KMW-16B also exceeded the RV and the TL for more than two consecutive events (see Table 2 and the control charts in Appendix A). According to the GCMP, concentrations are not compared to SCLs in these cases because the values measured during the baseline period were higher than those measured during the RI. However, since the baseline period, manganese concentrations have decreased in these wells and are currently less than the concentrations measured during the RI (see time-series plot in Appendix A).

The Shewhart and CUSUM control charts (Appendix A) and CUSUM analysis (Appendix A) show several cases where the CUSUM exceeded the CCL, indicating consistent increases over several monitoring events. Increases were observed for sulfate in Recent Alluvium Aquifer well KMW-19A and Sand Aquifer wells KMW-8A and KMW-18A. Sulfate concentrations have also increased in Sand Aquifer background well KMW-13, and the actual concentrations remained below the RV (250 mg/L).

Increases were also observed for ammonia in Recent Alluvium Aquifer wells KMW-10A and Sand Aquifer well KMW-16B, pH in Sand Aquifer well KMW-12A, and chloride in Recent Alluvium Aquifer well KMW-19A. Slight increases in pH were also measured in Sand Aquifer background well KMW-13. Exceedances of the CCL for manganese in Sand Aquifer well KMW-8A were not observed after 2014. The exceedances of the CCLs are not a compliance issue because the comparison of the CUSUM to the CCL is used for information only, not as a measure of compliance.

4.2.2.2 Statistical Evaluation for Vinyl Chloride

Vinyl chloride was the only volatile organic compound detected during 2014 through 2018 where concentrations were detected above the RV (see Table 1). Vinyl chloride concentrations were above the RV in two compliance wells (KMW-10A and KMW-17) during the period between 2014 and 2018.

The 95 percent upper confidence limits (UCLs) for wells where vinyl chloride was detected between 2014 and 2018 (KMW-10A, KMW-17, KMW-17Z, KMW-12A, and KMW-18A) were calculated using data from the most recent eight events (2011 through 2018). The resulting calculations are presented in Appendix A. The UCLs for all five wells were above the RV of 0.025 µg/L, including compliance wells KMW-10A (0.045 µg/L), KMW-17 (0.66 µg/L), and KMW-17Z (0.14 µg/L). Monitoring for vinyl chloride in these wells will continue during the next five-year period.

Because monitoring occurs only once per year instead of quarterly as initially assumed in the GCMP, the resulting UCLs calculated for vinyl chloride are conservative due to the overall decreasing trends in vinyl chloride concentrations.

WAC Chapter 173-340-720(9)(v)(B) states that “For cleanup levels based on chronic or carcinogenic threats, the true mean concentration shall be used to evaluate compliance with groundwater cleanup levels.” It is not possible to determine the true mean concentration of a population. The UCL provides a conservative estimate of the true mean because there is only a 5 percent chance that the true mean of the population will be greater than the UCL.

4.2.2.3 Time-Series Analysis

Time-series plots were updated to include the 2014 through 2018 data and are presented in Appendix A. These plots may be used to compare parameter values between wells. For the parameters without control limits (SCLs and CCLs), a time-series analysis is the primary tool for detecting changes in parameter values over time.

The time-series plots were prepared showing data for the RI period (1989 to 1990), the baseline period (1994 to 1996), and the compliance monitoring period (1997 to present). For parameters with a high degree of variability in the data (total coliform, nitrate, nitrate-nitrite, and total organic carbon [TOC]), a second plot was prepared on which outlying data points (more than three times the standard deviation above the mean of the baseline data) are not shown to improve the ability to view the majority of the data. Vinyl chloride concentrations measured in the Recent Alluvium Aquifer are also further evaluated in Figure 7, which also presents data for fall monitoring events only to reduce the variability due to seasonal effects. The following observations were noted based on the time-series plots.

In the Recent Alluvium Aquifer:

- In compliance well KMW-10A, specific conductivity and concentrations of chloride, iron, manganese, TOC, and chemical oxygen demand (COD) continued to be stable and lower than historical measurements. Slight increases were observed in the concentrations of ammonia.
- Slightly higher concentrations of iron and specific conductivity were measured in compliance well KMW-19A but were also observed in background well KMW-15A.
- In well KMW-17, annual sampling during the third quarter has reduced the seasonal variability that had been previously observed. Vinyl chloride continued to be detected but concentrations are decreasing. Concentrations of specific conductivity, TOC, and COD continued to decrease.
- In farther downgradient monitoring well KMW-17Z, vinyl chloride concentrations were consistently slightly lower than in well KMW-17.
- In indicator well KMW-16A, specific conductivity and concentrations of ammonia, COD, chloride, iron, manganese, and TOC continued to be stable and lower than historical measurements.

In the Sand Aquifer:

- In well KMW-12A, the specific conductivity and concentrations of ammonia, COD, chloride, iron, manganese, sulfate, and TOC remained stable or continued to decrease. Vinyl chloride was detected at concentrations slightly above the RV, and the concentrations are decreasing. Concentrations of cadmium, copper, and zinc showed increases, but were lower during the past 2 years.
- In well KMW-16B, concentrations of sulfate increased slightly. A slight increasing trend was also observed in background well KMW-13.
- In background well KMW-13, slightly increasing trends in some parameters (chloride, specific conductivity, iron, and sulfate) continued to be observed. Chloride, iron, and sulfate concentrations were higher in upgradient well KMW-13 than in the downgradient wells.
- In wells KMW-08A, KMW-16B, and KMW-18A, concentrations of other parameters continued to be stable or slightly decreasing.

4.2.2.4 Calculation of Revised Tolerance Limits

TLs are used to compare downgradient groundwater quality to background water quality. At the end of the baseline monitoring period, in the fourth quarter of 1996, TLs were generated for each monitoring parameter in each of the two background wells—KMW-13 in the Sand Aquifer and KMW-15A in the Recent Alluvium Aquifer. The limits were originally calculated using 1995 and 1996 data and were applied to the control charts for the four quarters of 1997. As specified in the GCMP, the TLs are meant to be representative of current groundwater quality; therefore, 2014 through 2018 data were compared to TLs (Table 2) calculated using the 2009 through 2013 data (Parametrix 2014) as presented in the 2009 to 2013 Status Report.

Updated TLs were calculated using data for the most recent eight events (2011 through 2018) and are presented in Appendix A. The revised TLs will be used for data comparisons between 2019 and 2023. Concentrations measured in Sand Aquifer wells will be compared to TLs for well KMW-13, and concentrations measured in Recent Alluvium Aquifer wells will be compared to TLs for well KMW-15A.

4.2.2.5 Groundwater Compliance Status Summary

Information presented in this status report indicates that groundwater quality has remained generally stable or improved since landfill closure. During the period between 2014 and 2018, the landfill has been in compliance with the conditions stated in the GCMP, except for manganese and iron in well KMW-19A (where statistical limits were not established), and vinyl chloride in wells KMW-10A and KMW-17Z where the UCLs of the most recent eight data points exceed the RV.

The observed concentrations in well KMW-19A are believed to be related to its location adjacent to wetland areas that have continued to expand during this 5-year period. Exceedances of the RVs for manganese and iron do not present a risk to human health or the environment because their RVs are not health-based. The iron concentrations in KMW-19A are above the recommended revised MTCA Method B-based RV (11.2 mg/L), but the manganese concentrations are still slightly below recommended revised MTCA Method B-based RV (2.2 mg/L).

Decreasing trends in vinyl chloride concentrations continue to be observed in the compliance wells. Concentrations are lower at well KMW-17Z than at KMW-17, indicating that continued degradation is occurring between these wells. Updated BIOSCREEN and BIOCHLOR modeling results indicate that vinyl

chloride concentrations are expected to be in compliance at the Green River in as little as 4 years, and compliance at well KMW-17Z could be achieved in approximately 15 years.

4.2.3 Groundwater Hydraulic Monitoring Results

SPU staff measure water levels annually in the third quarter at 40 monitoring wells, piezometers, gas probes, and gas extraction wells; surface water station KWSW-1; and Manholes A and B. Manholes A and B are part of the leachate collection system. The groundwater elevation data are presented in Table 3. Monitoring of the east slope piezometers to evaluate slope stability is discussed in Section 8.2.1.

Using the 2018 groundwater elevation data, contour maps of the potentiometric surfaces were generated to represent current conditions for the Sand Aquifer and the Recent Alluvium Aquifer. The maps are presented in Figures 8 and 9 and indicate flow directions consistent with historical data. Figure 8 illustrates that the direction of groundwater flow in the Sand Aquifer is generally east, towards the Green River. Figure 9 shows that the direction of groundwater flow in the Recent Alluvium Aquifer is generally east, and that groundwater discharges into the Green River.

4.3 Modifications or Changes Planned for the Next Five-Year Period

In 2019, to ensure that representative groundwater samples are being collected, SPU plans to conduct a trial using low-flow groundwater monitoring procedures at the compliance wells in accordance with EPA and Ecology guidelines (EPA 2017; Puls and Barcelona 1996; Ecology 2012). The low-flow data will be compared to the results of the samples collected using the typical procedures during the 2019 annual event. If the data are comparable, future implementation of low-flow for all wells will be recommended.

To provide further evaluation of the effectiveness of ongoing MNA, SPU plans to measure additional parameters including DO and redox during routine groundwater monitoring well sampling events beginning in 2019. Data will be analyzed using EPA guidance to further confirm that MNA is occurring consistent with the conceptual site model (Parametrix and EHSI 2019b). Additional EPA-required natural attenuation screening parameters (EPA 1998; 1999) will also be tested to demonstrate that attenuation of the site contaminants is occurring at rates sufficient to be protective of human health and the environment.

5. STORMWATER CAPTURE AND QUALITY – SPRING DRAIN

The spring drain system is described in the Kent Highlands Landfill Spring Drain Separation Technical Memorandum (CH2M HILL 1995). This document was incorporated in the third amendment to the Consent Order as Exhibit A. Since 1996, flow from the spring drain has been diverted to the stormwater detention pond for treatment prior to discharge into the Green River. Spring drain flow has historically been measured at a relatively constant rate of approximately 99 gallons per minute.

The treatment system is described in the Spring Drain Separation Technical Memorandum and consists of a cascade-type aerator at the pond outlet. Aeration may result in ammonia reduction due either to volatilization or nitrification—a natural process whereby ammonia is biologically converted to nitrate in the presence of nutrients and nitrifying bacteria.

5.1 Remedial Action System Changes and Events

Since landfill closure, SPU monitored the spring drain in accordance with the requirements of the Spring Drain Separation Technical Memorandum (TM). To verify that these requirements are sufficient, the City Attorney conducted an analysis and confirmed that a National Pollutant Discharge Elimination System (NPDES) Permit is not required for stormwater discharges resulting from the implementation of corrective actions performed at solid waste handling facilities to comply with a state and/or federal cleanup order. However, the Consent Decree and the Cleanup Action Plan (CAP) incorporated in the Consent Order require the “substantive requirements” that would have been imposed via any permits. For example, the Third Amendment to the Consent Order expressly states, “Seattle must comply with the substantive requirements of the NPDES program. In order to comply with these substantive requirements, Seattle shall comply with the provisions of Exhibit A, Technical Memorandum, Kent Highlands Landfill Spring Drain Separation.” The City Attorney’s analysis and conclusions are presented in Appendix B.

To confirm the hardness-dependent receiving water criteria (previously measured in the RI at 20 mg/L based on samples collected at the Green River), samples were collected on April 15, 2019 from the Green River at three locations along the pedestrian bridge upstream of the landfill and tested for hardness. The laboratory report is presented in Appendix B. Hardness results ranged from 19.0 to 20.5 mg/L, with a mean of 19.5 mg/L, confirming that the Green River receiving water hardness measured during the RI is appropriate for updating the hardness-dependent Water Quality Standards for Surface Waters of the State of Washington (SWQS) (WAC 173-201A; Ecology 2016), as discussed in Section 5.2.2.

No other changes were made to the stormwater capture or monitoring system during this period.

5.2 Remedial Action Monitoring Program and Results

Spring drain monitoring was conducted as described in the Spring Drain Separation TM and in Section 4 of the Post-Closure Operations and Maintenance Manual. Results of monthly inspections are now being documented on the Kent Highlands landfill general inspection and maintenance monthly log sheet established in 2016. An example of the log sheet is provided in Appendix E.

5.2.1 Sampling Procedures

Procedures for sampling and analysis of the spring drain are outlined in the Spring Drain Separation TM. The objective of the spring drain discharge water quality monitoring is to verify that the discharge to the Green River complies with applicable surface water quality standards.

Samples of treated spring drain water were collected quarterly from the Pond Outfall (see Figure 10). Samples were tested in the field for DO, pH, temperature, and turbidity, and tested by a laboratory for biological oxygen demand (BOD), total suspended solids, and ammonia. Annually during the third quarter, samples were tested for priority pollutant metals (total and dissolved) and volatile organic compounds. The sample to be tested for metals is collected as a 24-hour composite, instead of an 8-hour composite as described in the Spring Drain Separation TM.

5.2.2 Sampling Results and Compliance Evaluation

The results of spring drain monitoring for field and conventional parameters and metals are presented in Table 4a along with the surface water quality criteria (SWQS) (WAC 173-201A; Ecology 2016). Spring drain results for volatile organic compounds are presented in Table 4b. The compliance of the 2014 through 2018 spring drain data with the SWQS was determined using the process outlined in the Spring Drain Separation TM.

All results for volatile organic compounds were below laboratory reporting limits. Some of the laboratory reporting limits for metals were higher than the SWQS (cadmium, lead, mercury, and selenium), and in 2018 the concentrations of these metals were reported above the Method Detection Limit, with detections flagged as estimated.

Evaluation of compliance with the Washington State Freshwater Criteria for discharge to the Green River is presented in Table 5. Water quality criteria for temperature, DO, and pH are driven by designation of this reach of the Green River for salmon and trout spawning, noncore rearing, and migration. The dilutions required to meet SWQS are below the lowest maximum allowable dilutions calculated in the Spring Drain Separation TM. In addition, the aeration system is expected to increase the DO prior to discharge to the Green River.

The ammonia criteria were calculated using temperatures measured in the Green River between 2014 and 2018 (King County 2018). All spring drain ammonia results were below the criteria. As shown in Figure 11, the ammonia concentrations continued to show an overall decreasing trend compared to those measured at the Pond Outfall in previous years. The continued decreasing trend in ammonia concentrations compared to pretreatment concentrations (i.e., 20 mg/L; CH2M HILL 1995) shows the treatment system is functioning to reduce ammonia concentrations. Although the Spring Drain Separation TM did not expect that retention time would be long enough for significant nitrification of ammonia to occur, the data collected demonstrate that reduction of ammonia is occurring compared to previously observed concentrations.

Evaluation of compliance with SWQS and dilution requirements for discharge to the Green River is presented in Table 6. Table 6 includes parameters where the maximum concentration multiplied by the multiplication factor exceeds the SWQS. The minimum dilutions required to meet water quality standards at the acute or mixing zone boundary are below the lowest maximum allowable dilutions calculated in the Spring Drain Separation TM.

5.2.3 Modifications or Changes Planned for the Next 5-Year Period

The analytical method for some of the metals will be changed to achieve lower reporting limits that are below SWQS. The revised methods will include EPA Method 6020A for cadmium, lead, and selenium, and EPA 7470A low-level for mercury.

According to the Spring Drain Separation TM, the annual sampling for volatile organic compounds and metals will be varied by quarter each year. Beginning in 2020, the quarter for this activity will be rotated instead of consistently conducted in the third quarter.

No other modifications or changes to the stormwater capture and quality spring drain system are planned during the next 5-year period.

6. LEACHATE CAPTURE AND DISCHARGE

6.1 Remedial Action System Changes and Events

The Wastewater Discharge Permit No. 7115-04 renewal application was submitted on September 8, 2018 and the renewed Waste Discharge Permit No. 7115-05 was issued on March 27, 2019. Permit No. 7115-05 is provided in Appendix C and supersedes and cancels Permit No 7115-04 effective April 3, 2019 and has an expiration date of April 2, 2024.

The renewed permit contains the following major changes since the last issuance:

- The renewed permit added updated standard language requiring the annual calibration or verification of flow meter calibration (see Section 3.A).
- The requirement to evaluate the need for flow-proportional composite was removed because this report has been received.
- The requirement to submit a new updated Slug Control Plan was removed because it has been received.

Leachate gravity line jet-cleaning and TV inspection were performed in August 2017 and the report is provided in Appendix C. No abnormalities or defects were noted in the piping. This inspection will be performed once every 3 years.

6.2 Remedial Action Monitoring Program and Results

Leachate monitoring during 2014 through 2018 was conducted in accordance with Industrial Waste Program Wastewater Discharge Permit No. 7115-04. Kent Highlands Landfill is regulated as a non-categorical Significant Industrial User (SIU) because it discharges an average of 25,000 gallons per day or more of process wastewater, and therefore King County's Local Limits apply.

Inspection, maintenance, and monitoring of the leachate collection and pretreatment system were conducted as described in Sections 5 and 6 of the Post-Closure Operations and Maintenance Manual. Results of monthly inspections are now being documented on the Kent Highlands Landfill general inspection and maintenance monthly log sheet established in 2016 (see Appendix E).

6.2.1 Leachate Quality

Leachate samples were collected monthly from the leachate transmission pump station (wet well sampling station). Samples were analyzed in the laboratory for pH, total dissolved solids, and eight metals (cadmium, chromium, copper, lead, nickel, and zinc), and tested in the field for pH and temperature. The individual monthly sample results are included in Table 7, and time-series plots are presented in Appendix C.

Copper and nickel were routinely detected in leachate. Cadmium, chromium, lead, and zinc were detected sporadically. All concentrations were below the daily average and instantaneous maximum criteria. Total dissolved sulfides were not detected, and pH measurements were below the daily minimum.

No discharge violations occurred during the period between 2014 and 2018. The landfill received the King County Metro Industrial Wastewater Discharge Gold Award, indicating excellent compliance with permit

conditions and discharge limitations, and the Commitment-to-Compliance Award in 2016 honoring companies that earn the Gold Award for 5 consecutive years.

6.2.2 Leachate Flow

Historically, leachate flow data have been measured at four monitoring locations: the toe buttress pump station (see Figure 2), the leachate pond pump station, the south leachate line, and the spring drain. Leachate flow data have been collected daily at the toe buttress and leachate pond, weekly at the south leachate line, and monthly at the spring drain.

Flow from the spring drain collection system previously flowed to the leachate pond, but it was diverted to the stormwater detention pond in November 1996. Since that time the spring drain flow has no longer been included in the leachate pond flow, with one exception. Once a month, for approximately 4 hours, the spring drain flow was routed for measurement to the leachate pond via the south leachate collection location.

Leachate from the south leachate line and the toe buttress collection system flows into the pretreatment pond, from which leachate is pumped to the Metro System. Flow measured at the leachate pond pump station (see Figure 10) is the total leachate flow from the leachate pretreatment pond and represents the most meaningful indicator of the amount of leachate being generated at the landfill. Beginning in June 2015, flow data are only being reported for the toe buttress and leachate pond (Ecology 2015). Data from the toe buttress and Manholes A and B are continuing to be monitored to evaluate whether leachate pump systems are operating properly.

Leachate flow data from each measuring location are used to calculate an average daily flow for each month. The results are presented in Table 8 and shown on Figure 12. Table 9 and Figure 13 present the total leachate flow measured during each month. Total monthly flows were calculated using flow data collected on the last working day of each month; therefore, the number of days included in a month may be slightly higher or lower than the number of calendar days in the month.

The leachate flow is directly correlated with the months that typically have higher rainfall in the area.

6.3 Modifications or Changes Planned for the Next 5-Year Period

During the next 5-year period the following activities will be conducted:

- Monitoring will be conducted in accordance with Industrial Waste Program Wastewater Discharge Permit Renewal Application of Permit No. 7115-05 (see Appendix C). Iron and manganese testing will be discontinued.
- The flow meter will be replaced in 2019 with a Stearns-type flow meter because the calibration service on the current meter as required by the Permit is not supported.
- The next Leachate Gravity Line jet-cleaning and TV inspection will take place in 2020.

No other modifications or changes to the leachate control system are planned during the next 5-year period.

7. LANDFILL GAS CONTROL

7.1 Remedial Action System Changes and Events

Landfill gas control system changes during this 5-year period consisted of installing additional gas probes at the KGP-200 location near the northwest landfill boundary (see Section 7.1.1) and improving the flare system (see Section 7.1.2). Additionally, Chapter 7 of the Post-Closure Operations and Maintenance Manual was revised and included as an appendix in the Gas Evaluation Report (EHSI and Parametrix 2019).

7.1.1 Installation of Additional Gas Probes at Northwest Property Boundary

The construction plans for the Grandview Apartments on the northwestern property boundary north of Veterans Way were modified to upgrade the vapor barriers for occupied structures by increasing the thickness, sealing penetrations, and venting above the roof line to mitigate potential landfill gas migration. The developer added methane mitigation systems to the buildings at SPU's expense. All methane mitigation measures incorporated into the occupied spaces are complete.

Additional gas probes were installed in March 2018 at the KGP-200 location between the landfill and the new Grandview Apartments, as documented in the Gas Evaluation Report (EHSI and Parametrix 2019). The locations of gas extraction wells and gas monitoring probes are shown on Figures 14 and 15.

Following installation, methane monitoring was conducted at new gas probes KGP-200-S, M, and D. Some of the initial methane readings were above the limit of 5 percent by volume as shown on the figure in Appendix D, and SPU initiated more frequent monitoring of the new gas probes and surrounding probes and wells. SPU attempted to increase the vacuum in adjacent extraction well KGW-97A but found that the well was not functioning. Well KGW-97A was repaired and placed under vacuum on March 27, 2018, and subsequent methane measurements have been zero at all the KGP-200 probes.

The most likely reason gas was initially detected in KGP-200-M was that it had migrated beyond the landfill due to throttling back the nearby gas wells to enrich the overall gas concentration reaching the flare. The gas disappeared after the extraction rate was increased and the probe vented. There will be no further throttling of these wells.

Ongoing methane data measured at the northwest property boundary gas probes, including new probe KGP-200, provide evidence that the extraction wells are providing a continuous vacuum along the property boundary and preventing methane migration off-site. The overall vacuum from the landfill gas extraction wells extends north beyond the property boundary with approximately 2 feet of vacuum pressure near the gas extraction wells.

7.1.2 Flare System Improvements

The following improvements were implemented at the flare system during this 5-year period:

- A flare source test was performed on March 2, 2016 as part of the Puget Sound Clean Air Agency (PSCAA) flare operating temperature requirements. The flare emissions source test was repeated in the second quarter of 2016. The tests demonstrated compliance with the emissions limit of 20 parts per million (ppm) of non-methane organic compounds (NMOCs) as hexane at 3 percent oxygen at an average flare temperature of 1237 °F.

- In the third quarter of 2016, a construction permit was received for the natural gas supply line to the flare station to add supplemental fuel to improve flare reliability. Construction was completed in the fourth quarter of 2016.
- The supplemental gas line for the flare system was tested during the first quarter of 2017 and the results were presented to PSCAA for approval.
- A Notice of Construction Application for Permit Modification to Notice of Construction Order of Approval (NOCOA) 10440 (Parametrix 2017) was prepared and delivered to PSCAA on June 6, 2017. Due to decreasing landfill gas generation and methane concentration, SPU was unable to continuously maintain the flare operation temperature at or above the 1548-degree Fahrenheit average temperature observed during the 2013 source test. The NOCOA 10440 modifications include lowering the operating temperature restriction based on the most recent successful source test results and allowing the injection of natural gas into the landfill gas stream to ensure stable flare operation. The Order of Approval 11399 was awarded by PSCAA on October 11, 2017 and is presented in Appendix D.
- In the first quarter of 2018 the Startup, Shutdown, and Malfunction (SSM) Plan for the Landfill Flare Supplemented with Natural Gas (SPU 2018) was completed to comply with Condition 10 of the new PSCAA Order of Approval Notice of Construction No. 11399 and the requirements of 40 Code of Federal Regulations (CFR) 63.6(e)(3). The final plan is posted at the flare station.

7.2 Remedial Action Monitoring Program and Results

Inspection, maintenance, and monitoring for the landfill gas collection and transmission system and the flare were conducted as described in Chapters 7 and 8 of the Post-Closure Operations and Maintenance Manual (CH2M HILL 1996a). Monitoring of landfill gas was conducted as described in Section 11.2 of the Post-Closure Operations and Maintenance Manual and in the new PSCAA permit for landfill gas. Monitoring includes monthly sampling and daily flow monitoring. Results of monthly inspections are now being documented on the Kent Highlands Landfill general inspection and maintenance monthly log sheet established in 2016 (see Appendix E).

The gas system status was described in quarterly Solid Waste Landfill Closure Reports prepared by SPU and submitted to Ecology. Each quarterly report includes a summary of combustible gas and pressure data measured in shallow and deep gas probes.

The following routine monitoring is conducted in accordance with the Post-Closure Operations and Maintenance Manual.

- Flares are continuously monitored to ensure that the mechanical systems are operating properly. Landfill staff routinely inspect the facility 5 days a week and respond to off-hour system alarms such as flame failure or temperatures out of permitted range on the enclosed flare.
- The collection system is inspected monthly.
- The interior and perimeter control wells are monitored monthly.
- Landfill gas compliance probes are monitored either monthly or quarterly depending on the compliance status of the probe.

Methane data measured in the gas probes during 2014 through 2018 are summarized in Table 10. No methane above 5 percent by volume was detected in any of the probes.

The only probes that showed significant detections of methane were KGP-8S and KGP-35S. Methane concentrations measured in these probes are plotted on figures presented in Appendix D. Methane was consistently detected in probe KGP-35S and a process is in place in the event that increases are observed, as discussed in Section 2.2. In KGP-8S, sporadic detections of methane were observed, including a measurement of 3.5 percent in November 2015. The methane at KGP-8S is not believed to be related to the landfill and may be associated with the presence of organic soils.

Static pressures measured in gas extraction wells during the period between 2014 and 2018 are summarized in Table 11 and a plot of the pressures is presented in Appendix D. The majority of pressures were negative, indicating operation of the extraction system is creating a consistent vacuum at the perimeter of the landfill, preventing gas migration. Static pressures in some of the extraction wells were less negative beginning in August 2015 due to modifications made to the blower and subsequent rebalancing of the well field.

7.3 Modifications or Changes Planned for the Next 5-Year Period

7.3.1 Northwest Boundary Gas Operational Probe Monitoring

In accordance with recommendations made in the Gas Evaluation Report (EHSI and Parametrix 2019), SPU will conduct quarterly monitoring of available operational probes along the northern site perimeter for 1 year to supplement monthly monitoring at gas extraction wells and gas monitoring probes. The operational probes along the northwest boundary originally included KDGP-95, KDGP-98, KSGP-101, and KDGP-101. The locations of these probes are shown on Figure 15. KDGP-98 was originally intended as an operational probe, but it was installed outside the line of extraction wells and therefore is currently used as a perimeter gas probe. The other three operational probes, KDGP-95, KSGP-101, and KDGP-101 are all located in-line close to the gas extraction wells. Further information about the operational probes is provided in Chapter 7 of the Post-Closure Operations and Maintenance Manual.

The objective of the operational probe monitoring will be to confirm that negative pressures are occurring in between extraction wells, thereby providing a perimeter curtain surrounding the landfill to prevent gas migration. Monitoring will be discontinued after 1 year at all operational probes that have no detected methane and where consistently negative static pressures are observed.

7.3.2 Additional Gas Probes

The existing gas monitoring probes, including new probe KGP-200, are currently providing suitable coverage to monitor the presence of methane along the northern landfill border in the vicinity of the Grandview Apartments. However, if future property development is planned between the landfill and Veterans Drive, additional probes may be necessary. In particular, an additional set of probes should be considered along the property boundary between existing probes KGP-32A and KGP-98. Although probe KGP-38B currently provides coverage in this area and is between the site and the Grandview Apartments, this probe is located approximately 200 feet from the property boundary. This issue will be revisited once development plans are known for the adjoining City of Kent property.

7.3.3 Flare Station Operation

The following activities will be conducted at the flare station during the next 5-year period:

- The flare station will be operated using a supplemental natural gas system under the PSCAA permit for landfill gas to accommodate lower-temperature operation.
- The PSCAA permit for landfill gas will be renewed as long as the flare continues to control emissions at less than 20 ppm of NMOCs at 3 percent oxygen.

8. CAP/COVER INTEGRITY AND SLOPE STABILITY

8.1 Remedial Action System Changes and Events

8.1.1 Settlement Evaluation

The Second Periodic Review Response (Floyd|Snider 2007) stated that SPU will evaluate settlement by conducting aerial topographic surveys with 2-foot contour intervals every 10 years. A topographic survey was completed in 2016, and SPU prepared an updated elevation contour map of the landfill in 2016 for comparison with one prepared in 2005 (Figure 16). The comparison showed between 0 and 3 feet of differential settlement over most of the landfill, with up to 5 feet near the central portion where the refuse is thickest. SPU determined the settlement has not adversely impacted stormwater drainage or other landfill systems, and it is not yet necessary to regrade the surface of the landfill. As the landfill continues to settle in the future, it may be necessary to do so.

8.1.2 Slope Stability

An updated slope stability analysis was completed (Soil & Environmental Engineers, Inc. 2019) as requested in the Fourth Periodic Review and the findings are summarized in Section 2.7. The 2016 topographic survey shows no over-steepening of east slope since 1991 and therefore, as long as the groundwater conditions are unchanged, the conclusions of the previous slope stability evaluation should remain the same.

8.1.3 Monthly Log Sheet

A Kent Highlands Landfill general inspection and maintenance monthly log sheet was established in 2016 to document the activities required in the Post-Closure Operations and Maintenance Manual. The log was submitted to Ecology for review and is now in use (see Appendix E).

8.2 Remedial Action Monitoring Program and Results

Monitoring, maintenance and repair, and troubleshooting were conducted as described in Chapter 3 of the Post-Closure Operations and Maintenance Manual.

Minor grading was conducted to eliminate standing water in two areas in the northwest quadrant of the landfill. Fill placed was less than 6 inches in depth and each of the areas was approximately 100 square feet in dimension.

8.2.1 East Slope Water Levels

The stability of the eastern slope of the landfill with respect to potential water buildup in the refuse was evaluated during the Kent Highlands Landfill final closure (CH2M HILL 1991b). The stability analysis included a high-water condition reflecting the highest level of groundwater observed during field measurements. A factor of safety of 1.7 or greater was calculated for the high-water condition, indicating stable slope conditions under long-term loading.

The Second Periodic Review Response (Floyd|Snider 2007) stated that SPU will annually monitor water levels in refuse on the east slope. If water levels in the refuse remain sufficiently low so as not to contribute to instability of the eastern slope, and as long as surface grades do not exceed original grades, the landfill should be stable for both the static and seismic loading conditions evaluated for final closure.

A trend plot showing water level measurements collected between 2005 and 2018 at landfill gas extraction wells screened in the refuse (KIGW-1, KIGW-3, KIGW-23, and KIGW-24) and Manholes A and B relative to previous measurements is presented in Figure 17. The water level elevations measured during this period were similar to or slightly lower than previous water levels and remain well below the calculated high-water conditions used to establish an acceptable slope stability factor of safety in the geotechnical study, although the 2015 and 2017 KIGW-3 water levels were slightly higher compared to the past few years.

8.3 Modifications or Changes Planned for the Next 5-Year Period

As described in Section 2.7, there is a possibility that groundwater levels could be higher than that assumed in the stability evaluation, and this condition would incur the risk of slope instability. To mitigate such risk, two groundwater monitoring wells installed in the refuse are recommended. The water levels should be measured using vibrating wire piezometers.

As described in the Second Periodic Review Response (Floyd|Snider 2007), at least 10 years prior to SPU's anticipated date for applying to discontinue post-closure care, SPU will locate at least one permanent monument per acre on the landfill, and will survey monument locations and elevations every 2 years with ground survey instruments to assess the rate at which settlement is occurring.

9. OTHER FEATURES (FENCING, ALARMS, LANDSCAPING)

9.1 Remedial Action System Changes and Events

No substantial events or changes to site features occurred during this 5-year period.

9.2 Remedial Action Monitoring Program and Results

Inspection and maintenance of other landfill features such as fencing, alarms, and landscaping were conducted as described in Chapter 10 of the Post-Closure Operations and Maintenance Manual. Results of monthly inspections are now being documented on the Kent Highlands Landfill general inspection and maintenance monthly log sheet established in 2016 (see Appendix E).

General repairs were made after windstorm damage.

9.3 Modifications or Changes Planned for the Next 5-Year Period

A new landfill alarm monitoring system for the combined Kent and Midway Landfills will be installed at the main office.

10. ACCIDENTS OR UPSETS

10.1 Remedial Action System Changes and Events

No accidents or upsets occurred during this 5-year period.

10.2 Remedial Action Monitoring Program and Results

Emergency response procedures are described in Section 13 of the Post-Closure Operations and Maintenance Manual.

10.3 Modifications or Changes Planned for the Next 5-Year Period

No modifications or changes to emergency management procedures are planned during the next 5-year period.

11. SUMMARY OF RECOMMENDATIONS

SPU will continue ongoing monitoring as described in the Post-Closure Operations and Maintenance Plan and in accordance with the GCMP for groundwater, Spring Drain Separation TM for surface water, Wastewater Discharge Permit for leachate, and PSCAA permit for landfill gas. The next comprehensive status report will be prepared summarizing data collected during the period between 2019 and 2023 to support the Sixth Five-Year Periodic Review in 2024.

In 2019, to ensure that representative groundwater samples are being collected, SPU plans to conduct a trial using low-flow groundwater monitoring procedures at the compliance wells in accordance with EPA and Ecology guidelines (EPA 2017; Puls and Barcelona 1996; Ecology 2012). The low-flow data will be compared to the results of the samples collected using the typical procedures during the 2019 annual event. If the data are comparable, future implementation of low-flow sampling for all wells will be recommended.

MNA has been shown to be an effective remedy based on the observed decreases in vinyl chloride concentrations. To provide further evaluation of the effectiveness of ongoing MNA, SPU plans to measure additional parameters including DO and redox during routine groundwater monitoring well sampling events beginning in 2019. Data will be analyzed using EPA guidance to further confirm that MNA is occurring consistent with the conceptual site model (Parametrix and EHSI 2019b). Additional EPA-required natural attenuation screening parameters (EPA 1998; 1999) will also be tested to demonstrate that attenuation of the site contaminants is occurring at rates sufficient to be protective of human health and the environment.

It is recommended that the RVs be modified for manganese and iron. For manganese, it is recommended that the MTCA Method B groundwater value of 2.2 mg/L be used as the RV instead of the secondary criteria of 0.05 mg/L. For iron, it is recommended that the MTCA Method B groundwater value of 11.2 mg/L be used as the RV instead of the secondary criteria of 0.3 mg/L.

The project team developed the following recommendations based upon the results of the updated well inventory:

- Confirm with the City of Kent that well 15H1 is used solely for groundwater monitoring or has been properly decommissioned.
- Contact the owner of well 22A2 to confirm use and discuss sampling of the well and risks associated with wells within 1,000 feet of closed landfills.
- Contact the Lakes Development on the opposite side of the Green River to identify active surface water or groundwater withdrawal points to evaluate current or future risks related to the landfill.
- Each year check Ecology's well database to determine whether any new wells have been installed within 1,000 feet of the landfill. These findings will be reported in each 5-year status report, or sooner if any high-capacity wells have been put into use.
- Confirm the owner of the property on which well 15J1 is located and notify them that the well is within 1,000 feet of the landfill and should not be used. Ideally, the owner would decommission this well or, at a minimum, seal it off.

As described in Section 2.7, there is a possibility that groundwater levels could be higher than that assumed in the stability evaluation, and this condition would incur the risk of slope instability. To mitigate such risk, two groundwater monitoring wells installed in the refuse are recommended. The water levels should be measured using vibrating wire piezometers.

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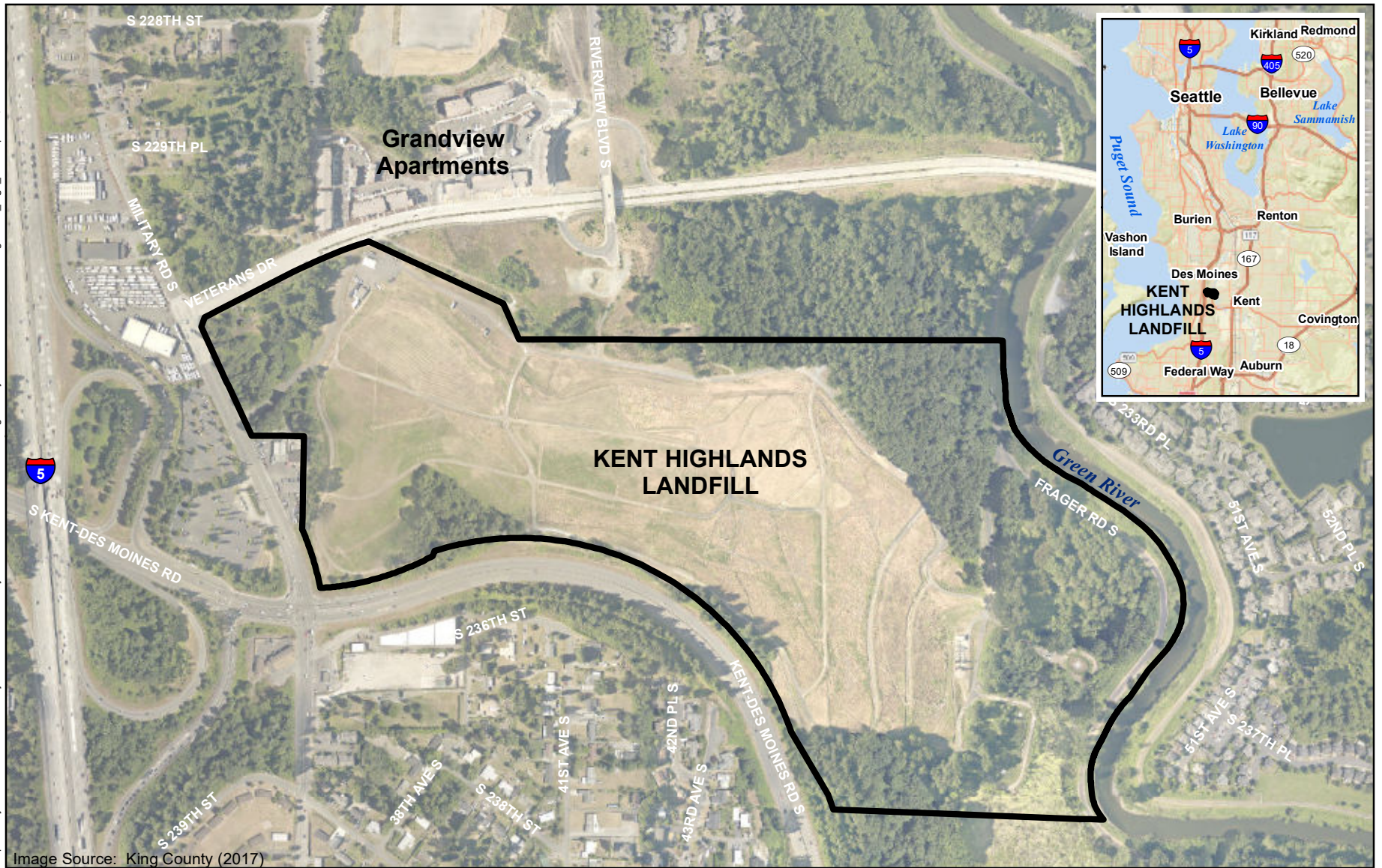
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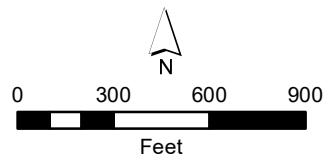
Figures



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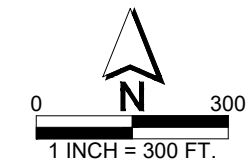
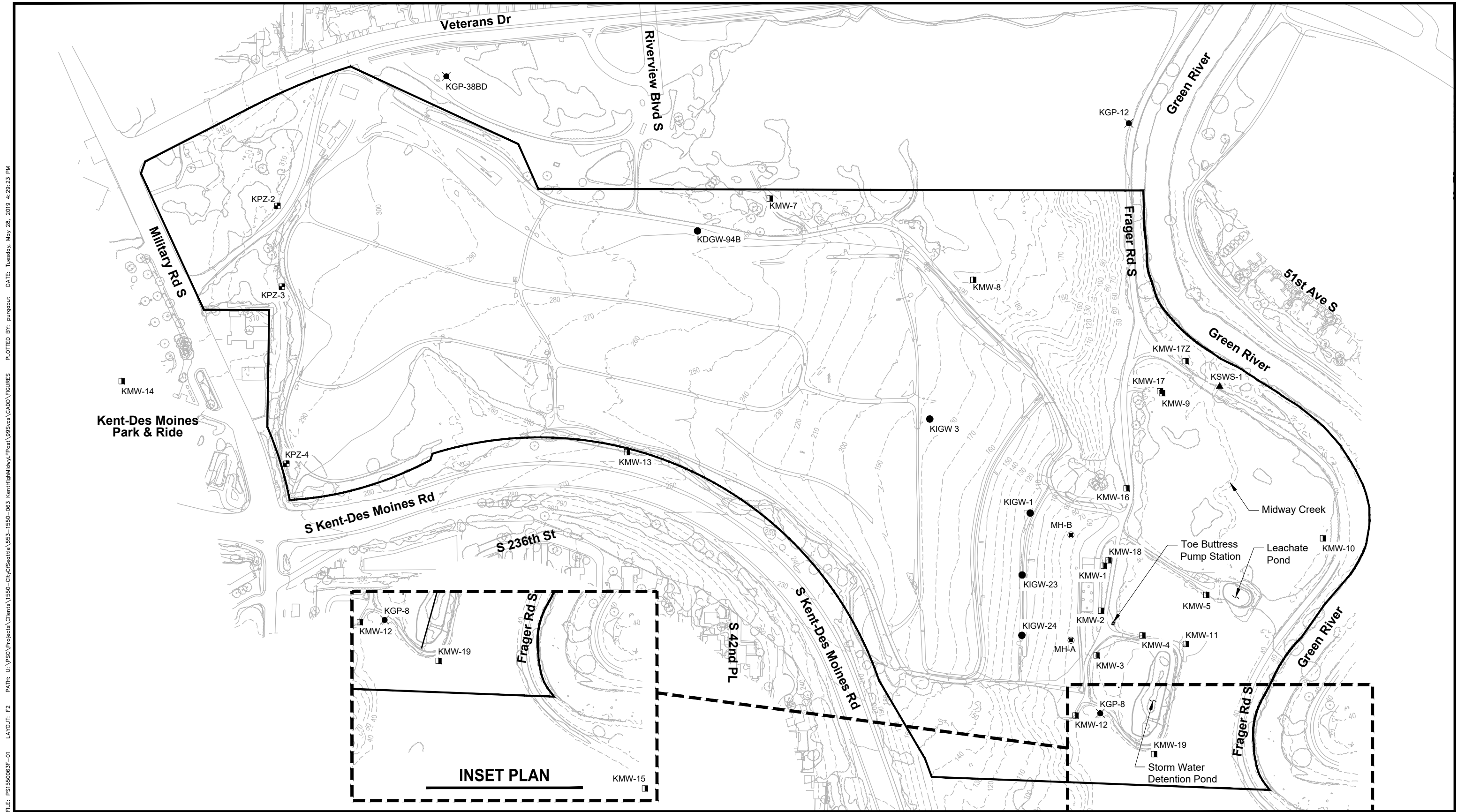
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 City of Seattle, Seattle Public Utilities Owned Parcel
Boundary That Includes Kent Highlands Landfill

Figure 1
Site Location Map
Kent Highlands Landfill
Kent, Washington

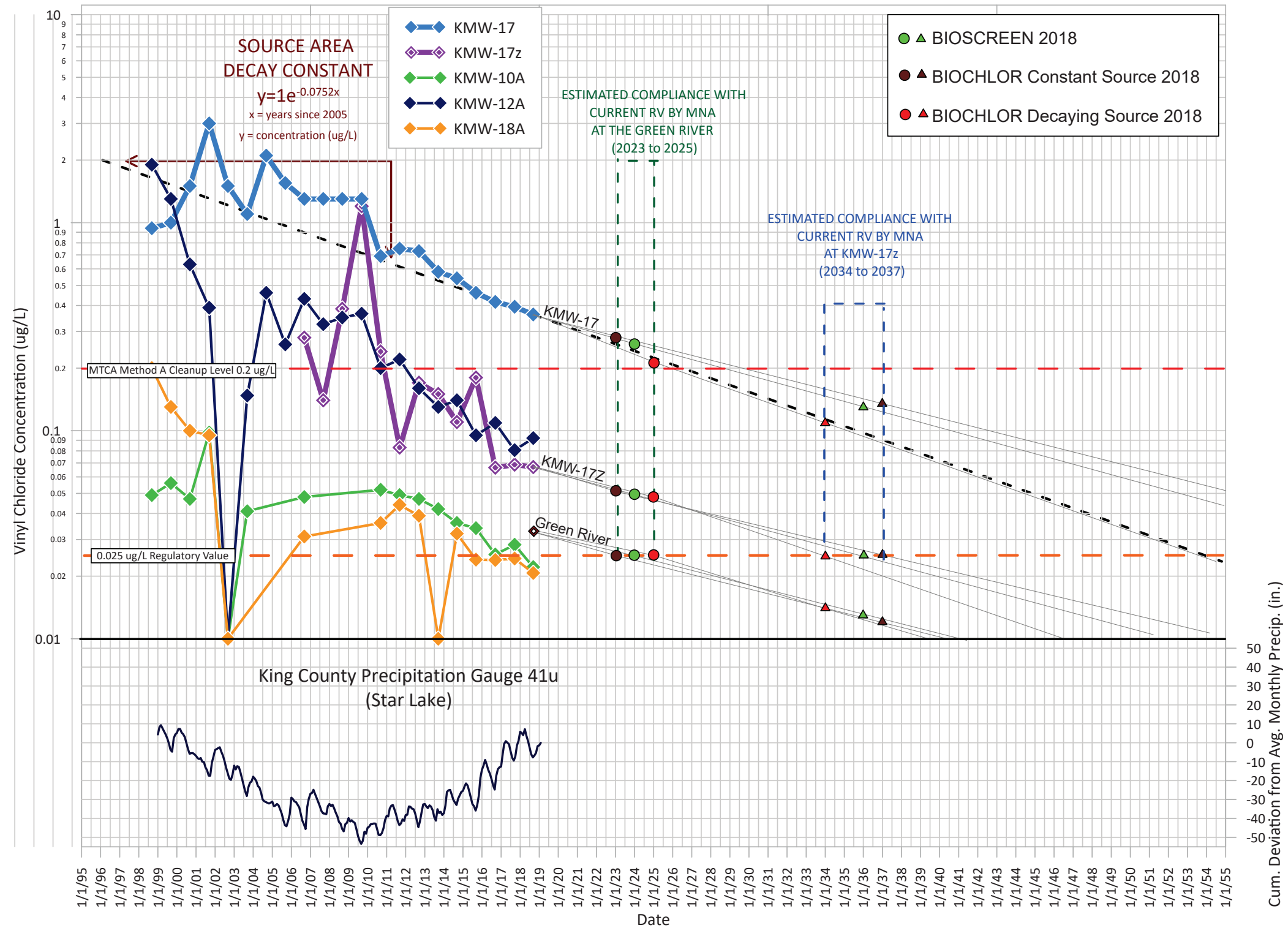
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Legend:

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| | Groundwater Monitoring Well (MW) | | Surface Water Station |
| | Piezometer (PZ) | | Manhole (MH) |
| | Gas Probe (GP) | | City of Seattle, Seattle Public Utilities Owned Parcel Boundary That Includes Kent Highlands Landfill |
| | Gas Extraction Well (GW) | | |

Figure 2
Monitoring Well
Location Map
Kent Highlands Landfill



EHS-International, Inc.

1011 SW Klickitat Way, Suite 104
 Seattle, Washington 98134
 Ph: 206.381.1128
 Fax: 206.254.4279

KENT HIGHLANDS LANDFILL Compliance Analysis

SEATTLE PUBLIC UTILITIES
 Kent, Washington

PROJECT MANAGER:
K. EASTHOUSE

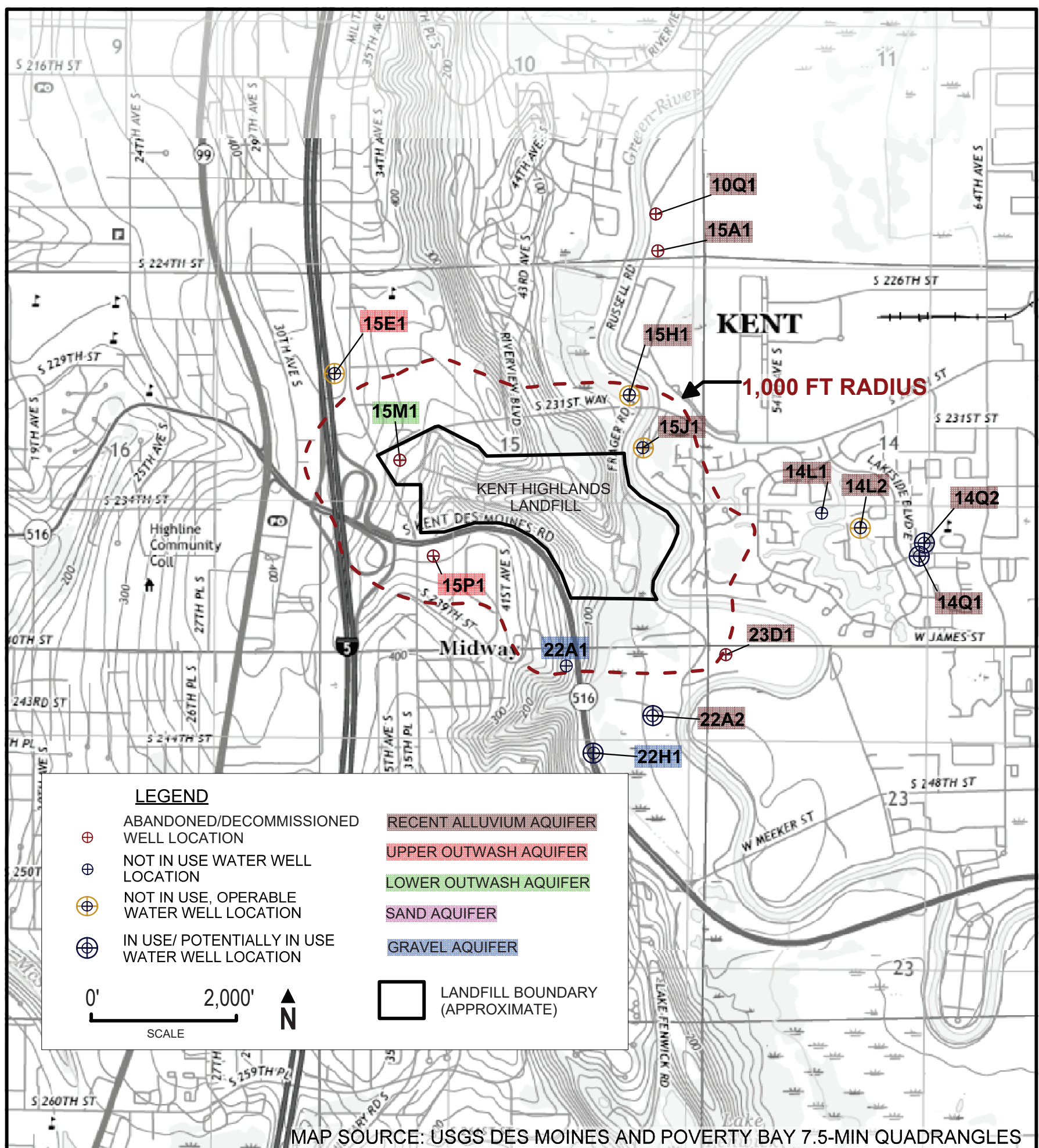
CREATED BY:
M. BRADY

DATE:
1999 - 2018 DATA

EHSI PROJECT #:
10887

ISSUE DATE:
MARCH 2019

Figure 3
Vinyl Chloride Degradation Hydrograph
 Kent Highlands Landfill



2013



Image Source: King County (2013)

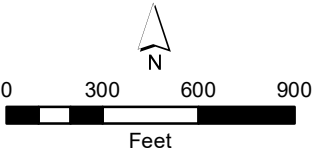
2017



Image Source: King County (2017)

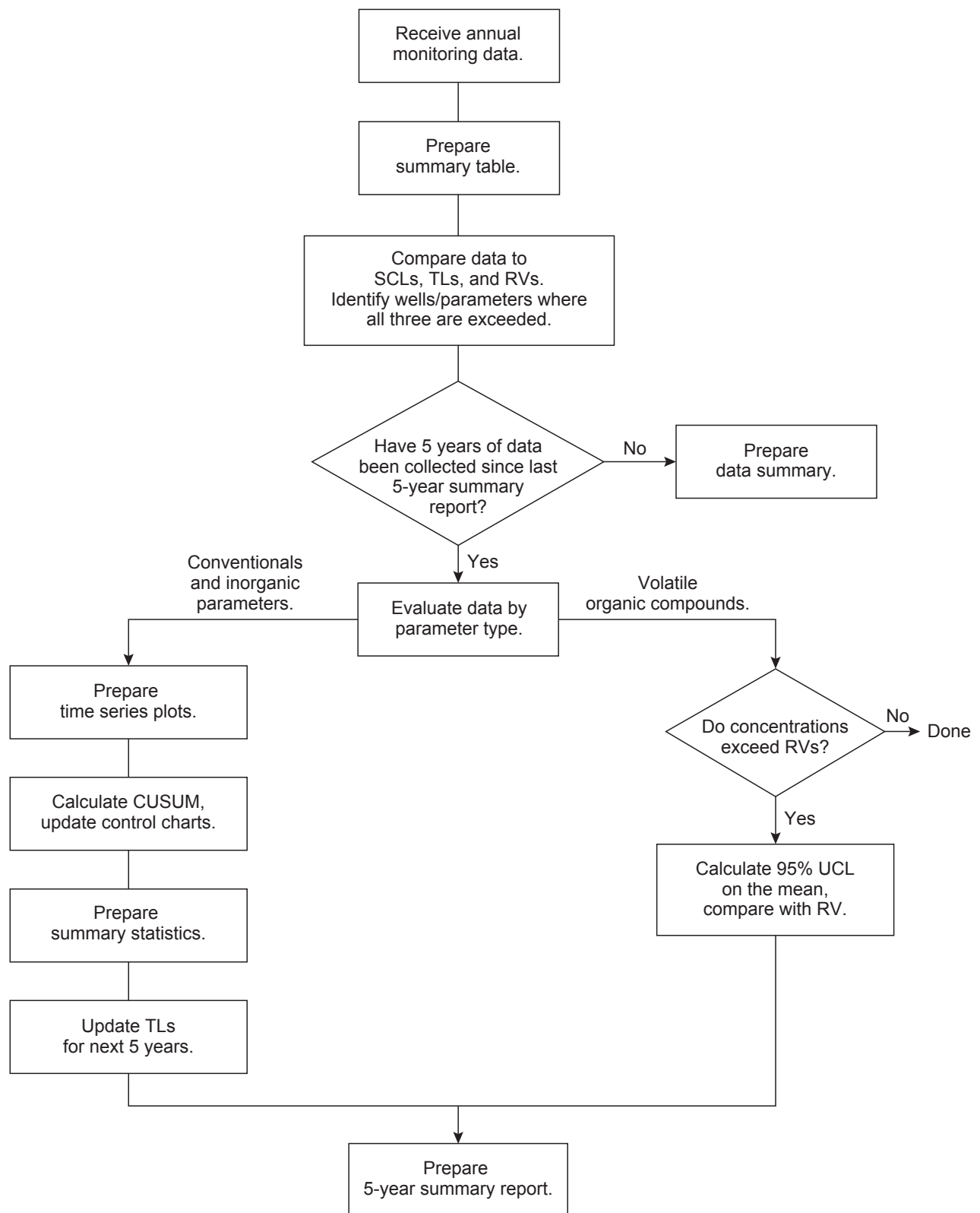
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 City of Seattle, Seattle Public Utilities Owned Parcel Boundary That Includes Kent Highlands Landfill

Figure 5
Changes in Land Use
Between 2013 and 2017
Kent Highlands Landfill



Reference: Modified from CH2M Hill (1996), Groundwater Compliance Monitoring Plan

Figure 6
Water Quality Data Evaluation
During Confirmational Monitoring
Kent Highlands Landfill

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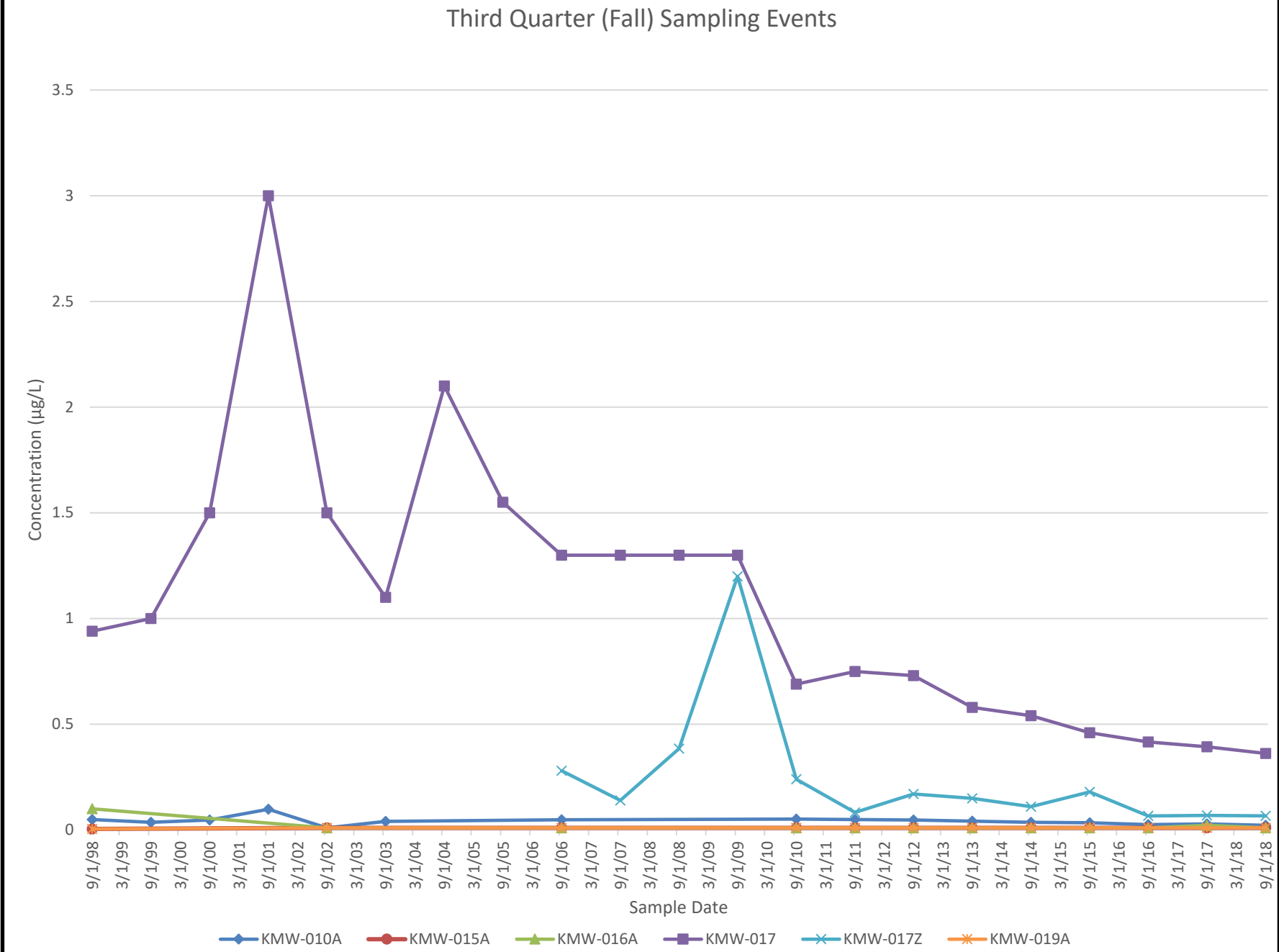
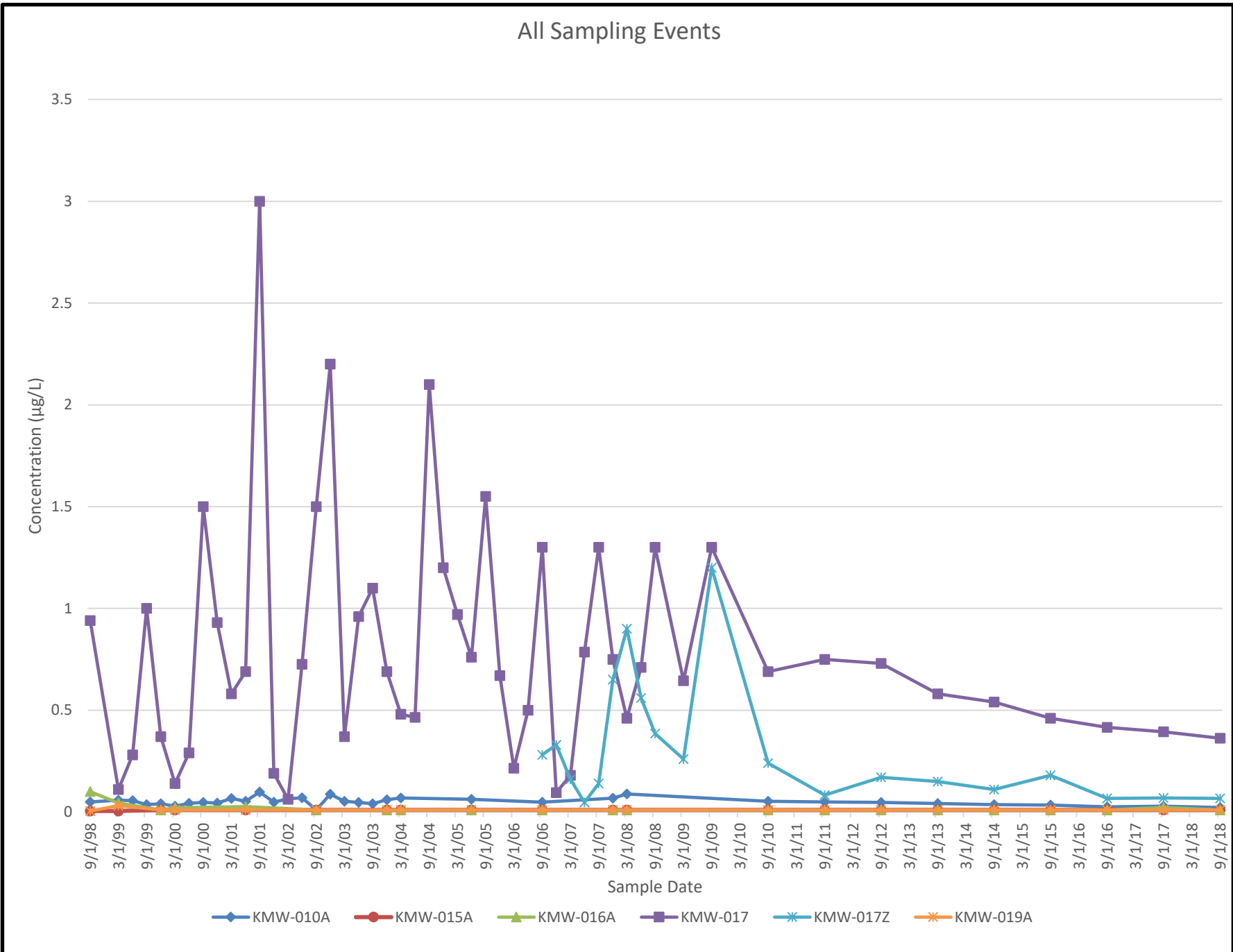
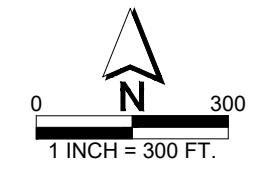
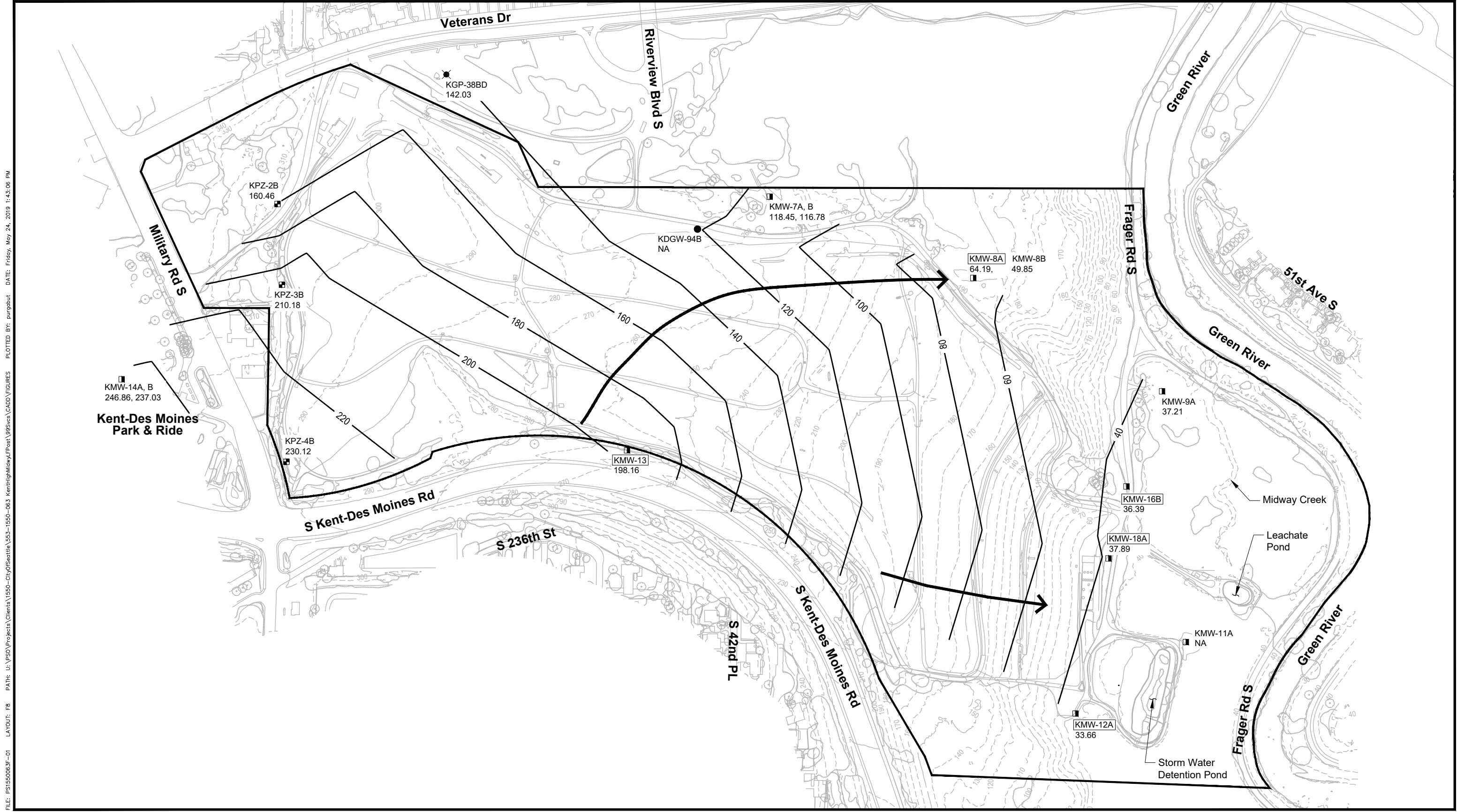


Figure 7
Vinyl Chloride Results
Recent Alluvium Aquifer
Kent Highlands Landfill

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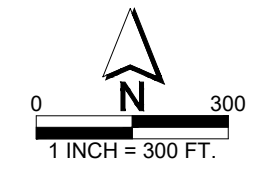
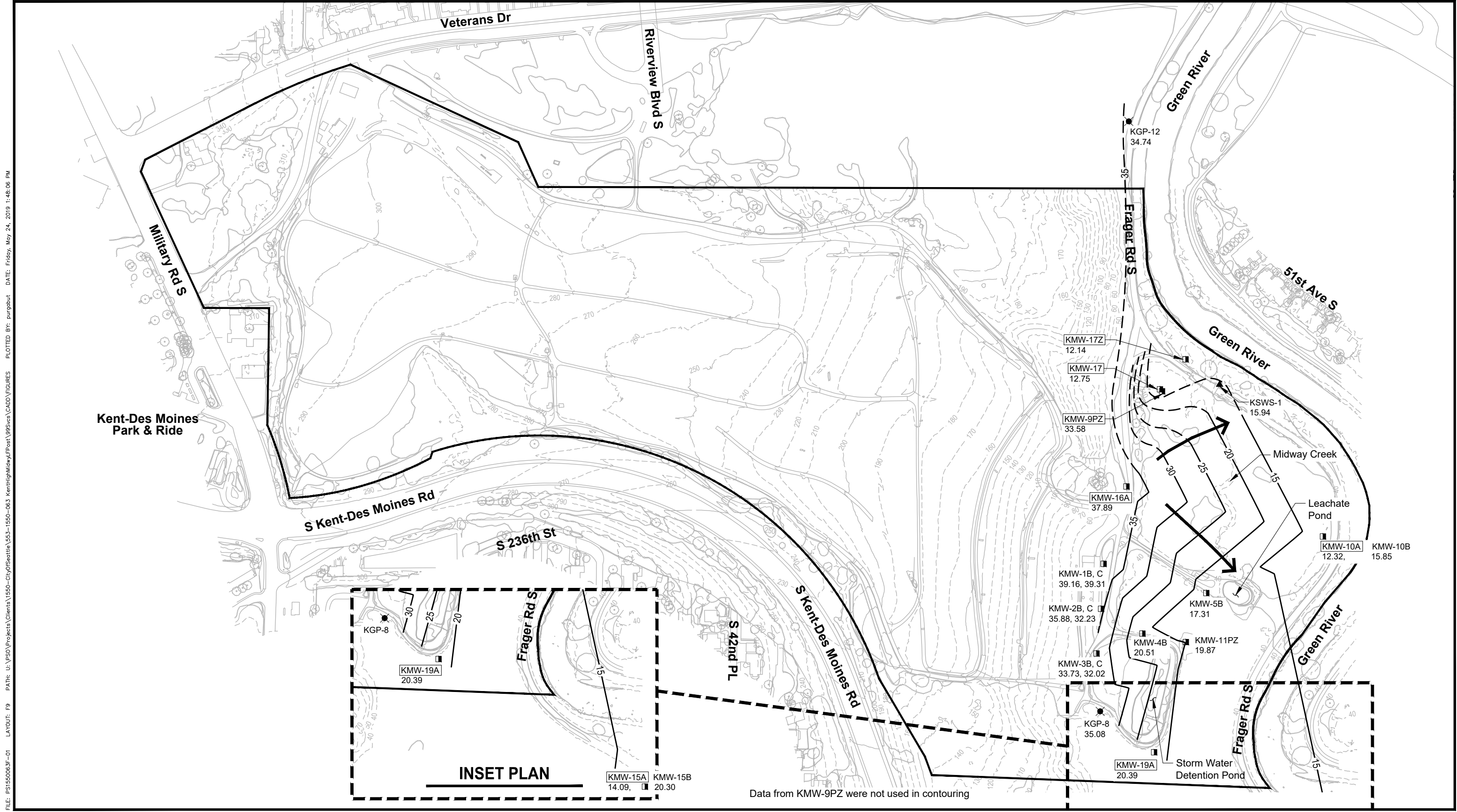


Legend:

- | | | |
|--|----------------------------|---|
| ■ Groundwater Monitoring Well (MW)
A=Shallow completion
B=Intermediate completion
C=Deep completion | ● Gas Extraction Well (GW) | — City of Seattle, Seattle Public Utilities Owned Parcel Boundary That Includes Kent Highlands Landfill |
| ■ Piezometer (PZ) | ▲ Surface Water Station | — 100 — Potentiometric Surface Elevation Contour |
| ⊙ Gas Probe (GP) | ● Manhole (MH) | → General Direction of Groundwater Flow |
| | | NA Water Level Data Not Available |

Figure 8
Potentiometric Surface Map of
the Sand Aquifer
September 4, 2018
Kent Highlands Landfill

FILE: PS1550063F-01 LAYOUT: F9 PATH: U:\PSO\Projects\Clients\1550-CityOfSeattle\553-1550-063 KentHighMidway\FPost\99Sves\CAOD\FIGURES PLOTTED BY: purgubut DATE: Friday, May 24, 2019 1:46:06 PM



Legend:

- | | | |
|--|---------------------------------------|---|
| ■ Groundwater Monitoring Well (MW)
A=Shallow completion
B=Intermediate completion
C=Deep completion | ⊗ Gas Probe (GP) | — City of Seattle, Seattle Public Utilities Owned Parcel Boundary That Includes Kent Highlands Landfill |
| ■ Piezometer (PZ) | □ Groundwater Quality Monitoring Well | — 100 — Potentiometric Surface Elevation Contour |
| | ▲ Surface Water Station | → General Direction of Groundwater Flow |
| | ● Manhole (MH) | |

Figure 9
Potentiometric Surface Map
of the Recent Alluvium Aquifer
September 4, 2018
Kent Highlands Landfill

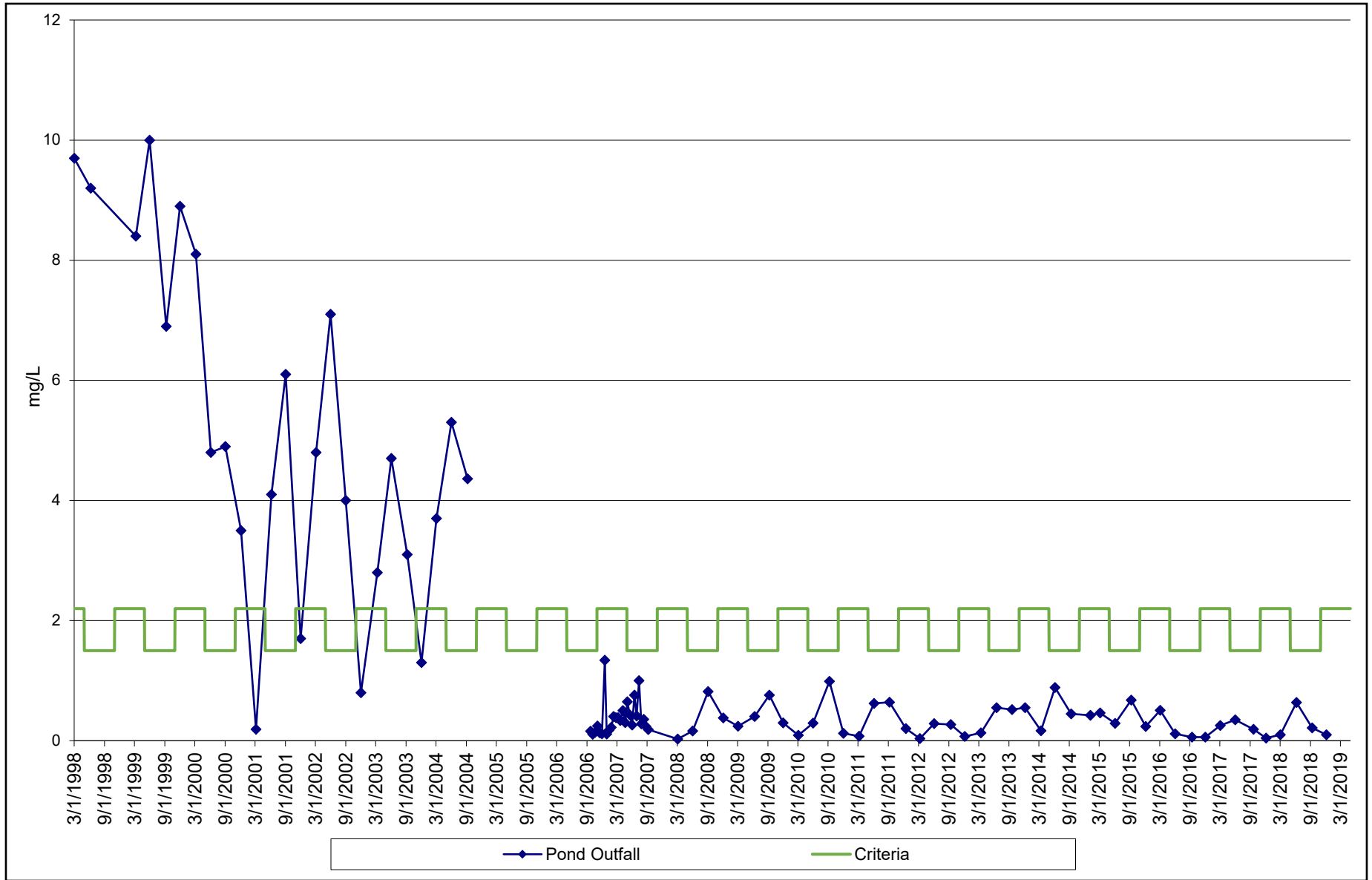
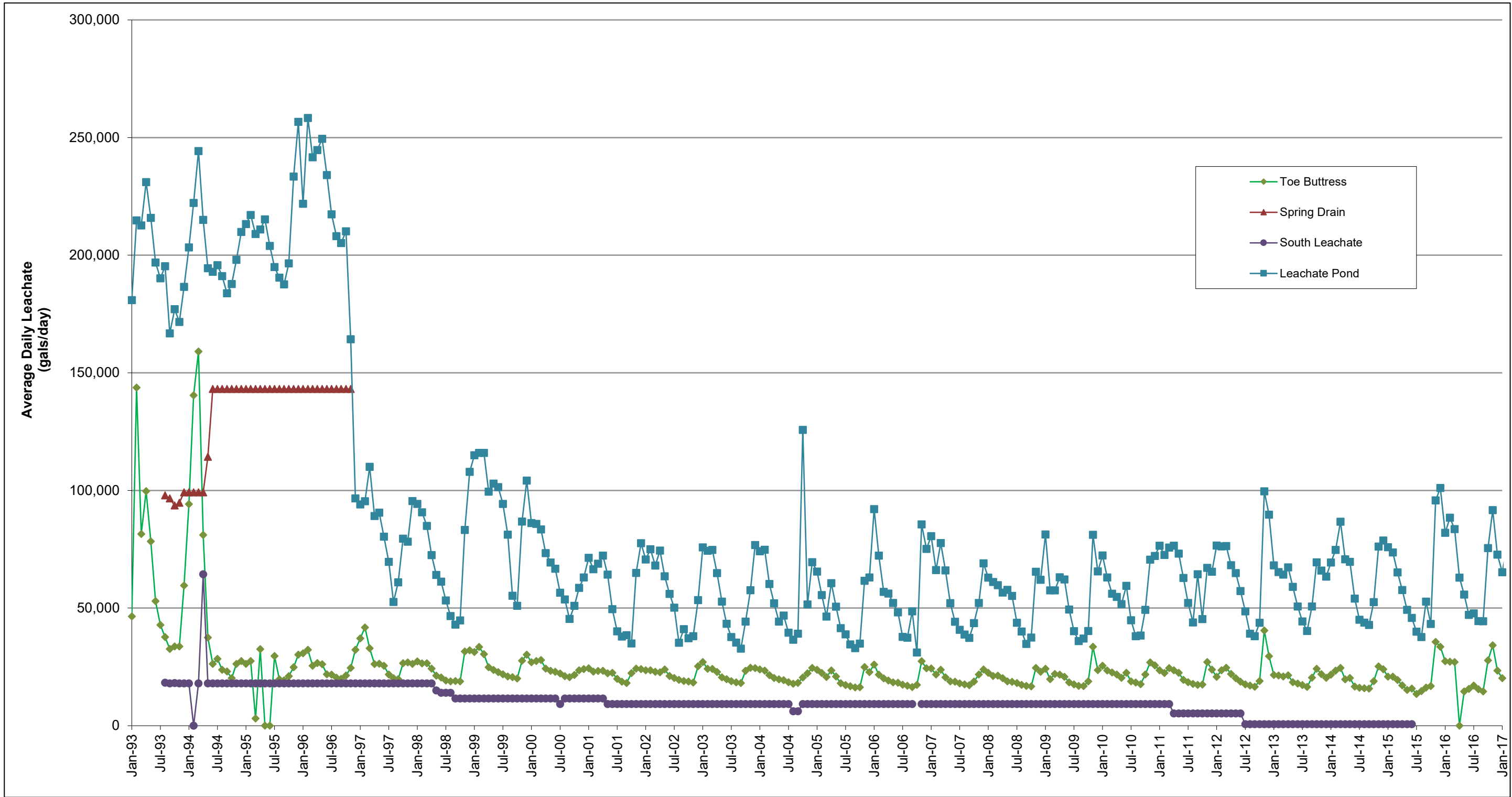


Figure 11
Ammonia Trends in Spring
Drain Samples
Kent Highlands Landfill

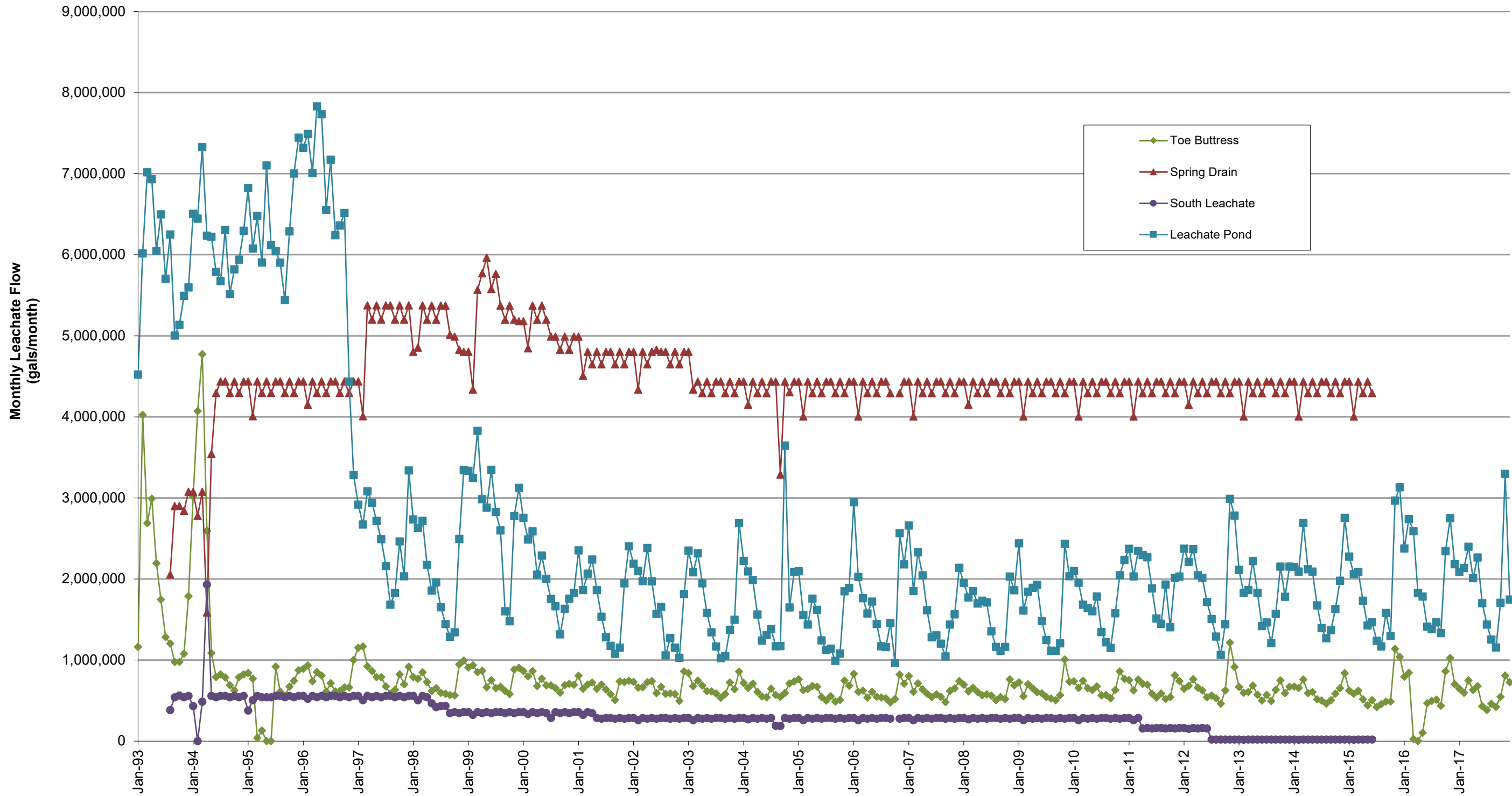
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Note: In mid-November 1996, Spring Drain leachate was rerouted to the surface water lagoon.

Figure 12
Average Daily Leachate
Flows by Month
Kent Highlands Landfill

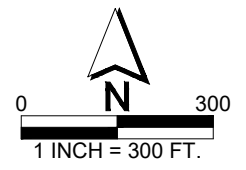
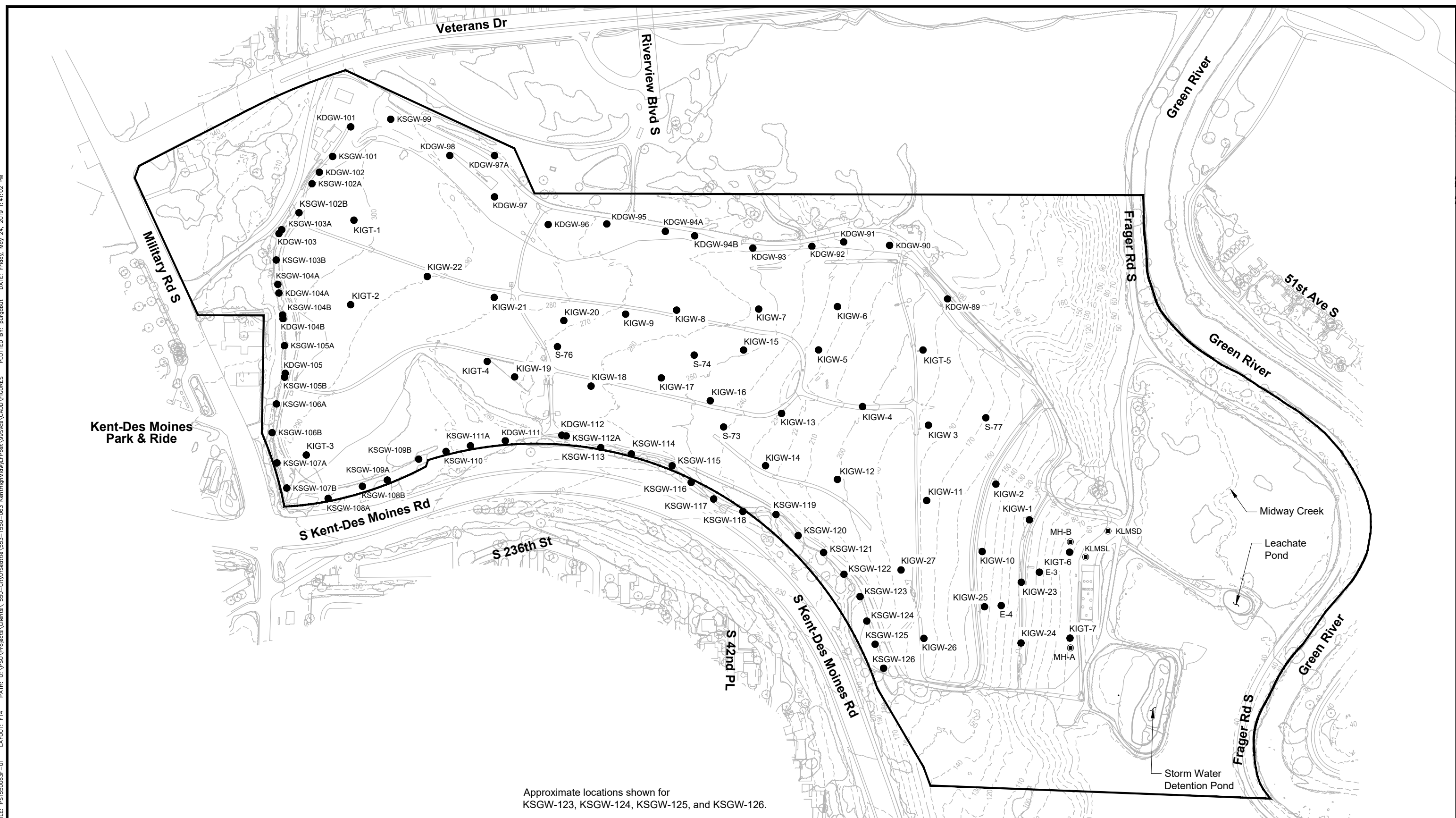
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Note: Total leachate flow is calculated using flow data collected on the last working day of each month; therefore, the number of days included in each month will vary depending on when the week-ends occur. In mid-November 1996, Spring Drain leachate was rerouted to the surface water lagoon.

Figure 13
Monthly Total Leachate and
Spring Drain Flows
Kent Highlands Landfill

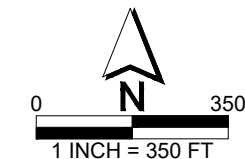
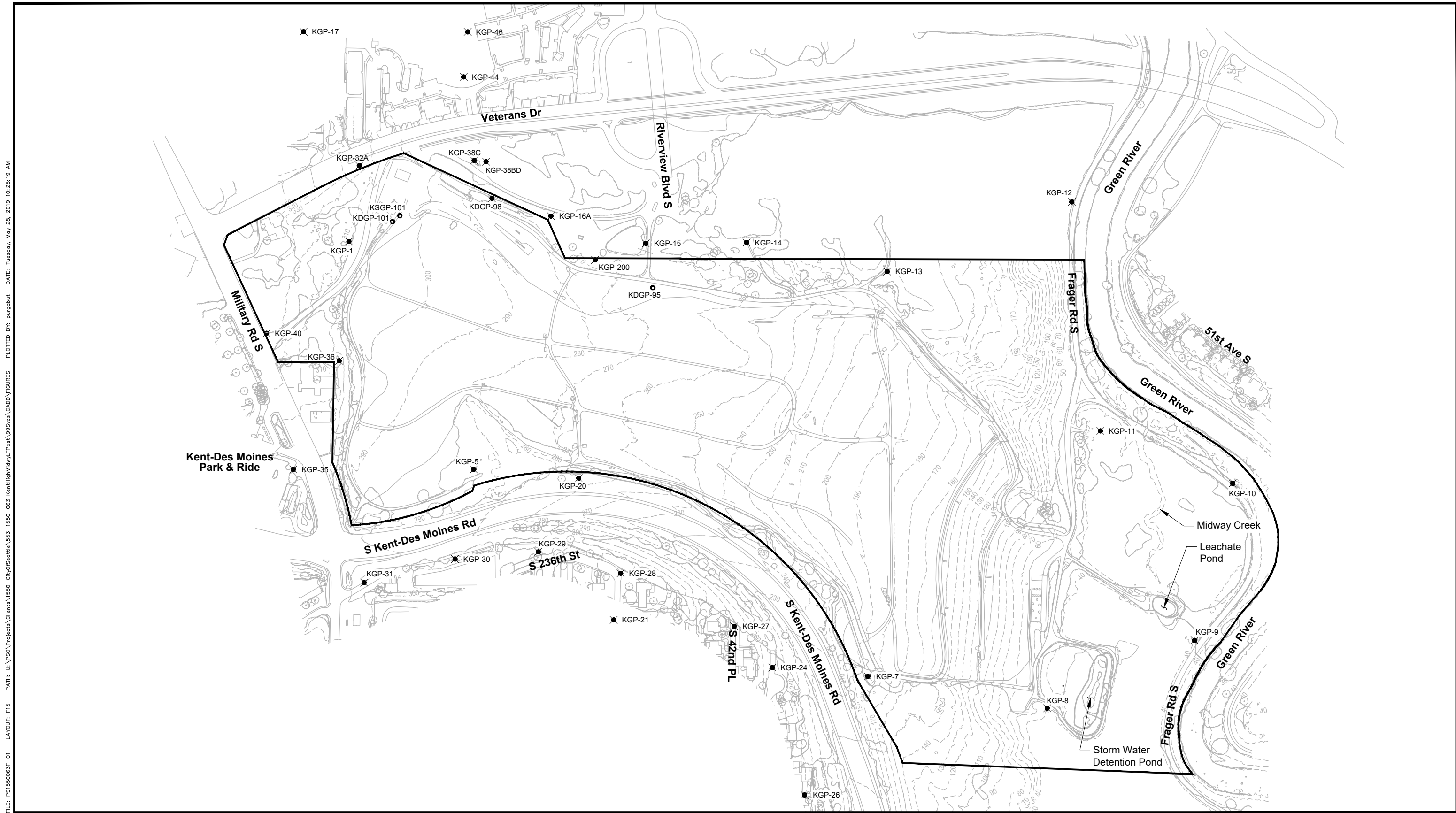
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- Legend:**
- Gas Extraction Well
 - ⊙ Manhole (MH)
 - City of Seattle, Seattle Public Utilities Owned Parcel Boundary That Includes Kent Highlands Landfill

Figure 14
Landfill Gas Well Locations
Kent Highlands Landfill

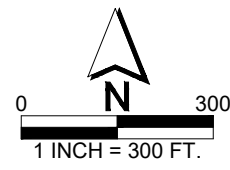
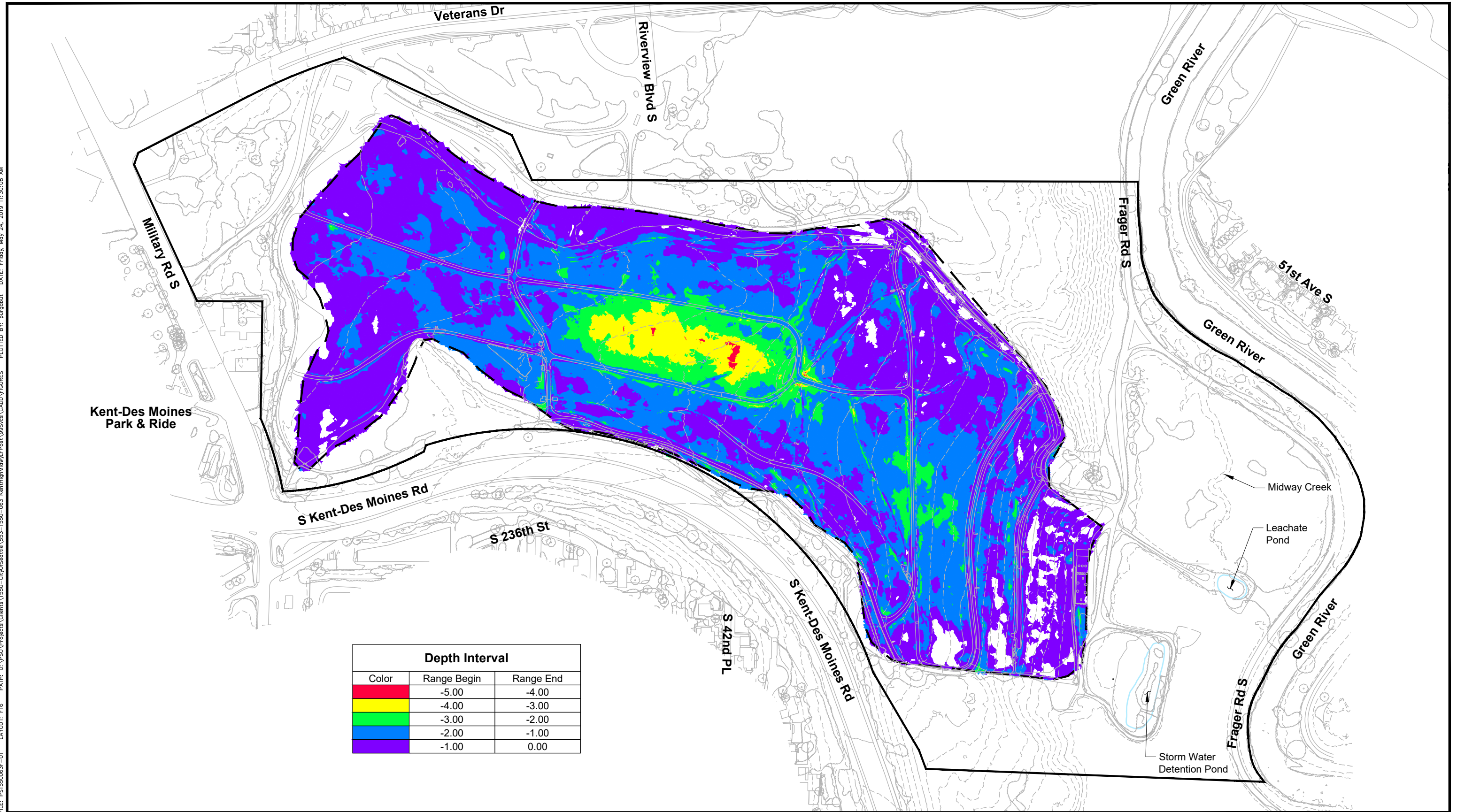
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- Legend:**
- ★ Gas Probe (GP)
 - Operational Gas Probe
 - City of Seattle, Seattle Public Utilities Owned Parcel Boundary That Includes Kent Highlands Landfill

Figure 15
Landfill Gas Probe Locations
Kent Highlands Landfill

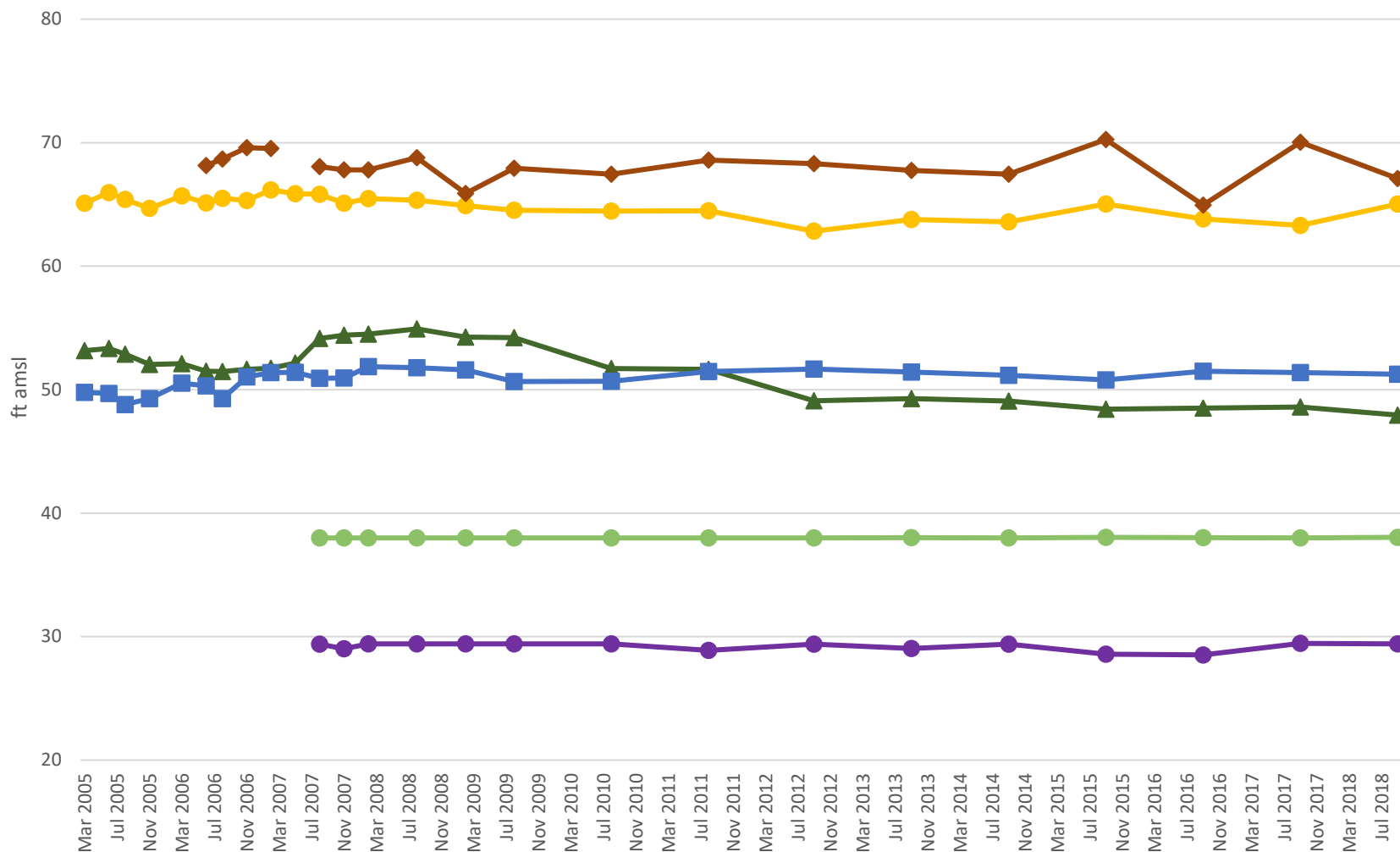
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Legend:
— City of Seattle, Seattle Public Utilities Owned Parcel
— Boundary That Includes Kent Highlands Landfill

Figure 16
Settlement Depth Between 2005-2016
Kent Highlands Landfill

U:\PSO\Projects\Clients\1550-063 KentHighMidwyl\Exst\02\WBS\PH02_Kent HL\02_Annual Rpts\2018\2014-18_Report\Figures\F17 KHL water elev plots thru 2018.xlsx



	Mar 2005	Jun 2005	Aug 2005	Nov 2005	Mar 2006	Jun 2006	Aug 2006	Nov 2006	Feb 2007	May 2007	Aug 2007	Nov 2007	Feb 2008	Aug 2008	Feb 2009	Aug 2009	Aug 2010	Aug 2011	Sep 2012	Sep 2013	Sep 2014	Sep 2015	Sep 2016	Sep 2017	Sep 2018
 KIGW-1	65.10	65.95	65.40	64.68	65.68	65.13	65.50	65.32	66.18	65.86	65.83	65.10	65.47	65.33	64.91	64.52	64.46	64.48	62.83	63.78	63.58	65.04	63.83	63.30	65.03
 KIGW-3						68.14	68.67	69.59	69.54		68.06	67.80	67.80	68.79	65.89	67.93	67.44	68.59	68.30	67.76	67.44	70.26	64.95	70.03	67.09
 KIGW-23	53.16	53.34	52.88	52.05	52.10	51.50	51.47	51.65	51.73	52.15	54.15	54.40	54.50	54.92	54.26	54.22	51.70	51.65	49.10	49.28	49.07	48.42	48.51	48.60	47.94
 KIGW-24	49.77	49.68	48.80	49.27	50.53	50.30	49.27	51.02	51.37	51.41	50.93	50.95	51.86	51.78	51.59	50.65	50.67	51.47	51.67	51.43	51.17	50.78	51.48	51.37	51.25
 Manhole A											29.39	29.01	29.41	29.40	29.41	29.41	29.40	28.89	29.39	29.03	29.38	28.57	28.52	29.45	29.41
 Manhole B											37.99	37.99	38.00	37.99	38.00	38.00	37.99	37.99	37.99	38.01	37.99	38.03	38.01	38.00	38.04

Figure 17
East Slope Water Elevations
Kent Highlands Landfill

Tables

Table 1. Groundwater Quality Data Summary 2014-2018, Kent Highlands Landfill

ParameterUnitsRegulatory Value			Recent Alluvium Aquifer																
			KMW-010A Compliance						KMW-015A Background					KMW-016A Indicator					
			9/9/2014	Duplicate 9/9/2014	9/8/2015	9/12/2016	9/18/2017	9/10/2018	9/9/2014	9/8/2015	9/12/2016	9/18/2017	9/10/2018	9/10/2014	9/9/2015	Duplicate 9/9/2015	9/13/2016	9/19/2017	9/10/2018
Field Parameters																			
pH	s.u.		6.44	--	6.69	6.70	6.91	7.01	6.18	6.53	6.60	6.81	6.92	6.37	6.77	--	6.76	6.84	7.10
Conductivity	µmhos/cm	700	396	--	304	336	365	311.2	219	217	239	252	271.7	247	309	--	299	336	293.7
Temperature	C		11.6	--	12.0	12.1	12.0	12.2	11.1	11.4	11.5	11.3	12.1	13.8	15.0	--	13.9	13.4	14.0
Conventional Parameters																			
Chloride	mg/L	250	11.3	11.2	9.9	9.19	9.82	8.42	4.8	6.1	13.8	7.94	10.5	6.1	7.6	7.6	8.47	7.25	5.84
Ammonia	mg-N/L		2.28	2.25	1.87	2.28	2.73	2.41	1.01	1.00	0.878	1.11	1.06	2.44	3.71	3.67	2.71	2.91	2.20
N-Nitrate	mg-N/L	10	0.010 U	0.010 U	0.010 U	0.001 U	0.0200 U	0.020 U	0.010 U	0.020 U	0.020	0.0400 U	0.020 U	1.02	0.010 U	0.010 U	0.010 U	0.0658	0.0408
N-Nitrite	mg-N/L	1	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.020 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Nitrate + Nitrite	mg-N/L		0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.020 U	0.025	0.020 U	0.010 U	1.02	0.010 U	0.010 U	0.010	0.066	0.041
Sulfate	mg/L	250	7.7	7.7	5.3	5.65	4.12	8.14	11.0	10.1	8.22	10.0 U	5.98	9.1	8.8	8.7	7.10	10.2	10.2
Chemical Oxygen Demand	mg/L		10.0 U	10.0 U	12.7	10.0 U	12.5	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	11.6	15.2	12.9	10.0 U	13.6	10.9
Total Organic Carbon	mg/L		4.50	4.51	3.75	4.31	4.44	2.84	2.08	2.67	1.95	2.16	1.79	6.10	5.99	6.08	5.73	5.31	4.66
Total Coliform	CFU/100 mL	1	1 U	1 U	1 U	1 U	1 H,U	1 U	1 UJ	1 U	1 U	1 H, U	1 U	380 J	1 U	1 U	1 H,U	1 H, U	1 U
Dissolved Metals																			
Cadmium	mg/L	0.005	0.002 U	0.002 U	0.002 U	0.0020 U	0.0020 U	0.0020 U	0.002 U	0.002 U	0.0020 U	0.0020 U	0.0020 U	0.002 U	0.002 U	0.002 U	0.0020 U	0.0020 U	0.0020 U
Chromium	mg/L	0.1	0.005 U	0.005 U	0.005 U	0.0050 U	0.0050 U	0.0050 U	0.005 U	0.005	0.0050 U	0.0050 U	0.0050 U	0.005 U	0.005 U	0.005 U	0.0050 U	0.0050 U	0.0050 U
Copper	mg/L	0.59	0.002 U	0.002 U	0.002 U	0.0020 U	0.0020 U	0.0020 U	0.002 U	0.002 U	0.0020 U	0.0020 U	0.0020 U	0.002 U	0.002 U	0.002 U	0.0020 U	0.0020 U	0.0020 U
Iron	mg/L	0.3	5.65	5.58	4.65	5.21	5.96	4.92	9.38	8.55	7.77	10.2	9.22	1.11	1.19	1.17	1.57	1.45	1.35
Lead	mg/L	0.005	0.0001 U	0.0001	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U
Manganese	mg/L	0.05	1.69	1.71	1.22	1.35	1.55	1.21	0.421	0.394	0.403	0.457	0.432	1.05	1.49	1.48	1.45	1.75	1.42
Nickel	mg/L	0.1	0.01 U	0.01 U	0.01 U	0.010 U	0.0100 U	0.0100 U	0.01 U	0.01 U	0.010 U	0.0100 U	0.0100 U	0.01 U	0.01 U	0.01 U	0.010 U	0.0100 U	0.0100 U
Zinc	mg/L	4.8	0.01 U	0.01 U	0.01 U	0.010 U	0.0100 U	0.0100 U	0.01 U	0.01 U	0.010 U	0.0100 U	0.0100 U	0.01 U	0.01 U	0.01 U	0.010 U	0.0104	0.0244
Volatile Organics																			
Chloromethane	µg/L	3.37	0.5 U	0.5 U	0.5 U	0.50 U	0.50 U	0.50 U	0.5 U	0.5 U	0.50 U	0.50 U	0.50 U	0.5 U	0.5 U	0.5 U	0.50 U	0.50 U	0.50 U
Vinyl Chloride	µg/L	0.025	0.036	0.037	0.034 M	0.0254	0.0283	0.0221 J	0.020 U	0.020 U	0.02 U	0.020 U	0.02 U	0.020 U	0.020 U	0.020 U	0.02 U	0.0219	0.020 U
Bromomethane	µg/L	11.2	1.0 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U
Chloroethane	µg/L		0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Trichlorofluoromethane	µg/L	2400	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Acrolein	µg/L		5.0 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U
1,1,2-Trichloro-1,2,2-trifluoroethane	µg/L	480000	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Acetone	µg/L	800	5.0 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U
1,1-Dichloroethene	µg/L	0.2	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Methylene Chloride	µg/L	5	1.0 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U
Acrylonitrile	µg/L	1	1.0 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U
Carbon Disulfide	µg/L	800	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
trans-1,2-Dichloroethene	µg/L	100	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Vinyl Acetate	µg/L	8000	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
1,1-Dichloroethane	µg/L	800	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
2-Butanone	µg/L	4800	5.0 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U
cis-1,2-Dichloroethene	µg/L	70	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Chloroform	µg/L	7.17	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
1,1,1-Trichloroethane	µg/L	200	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Carbon Tetrachloride	µg/L	0.34	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
1,2-Dichloroethane	µg/L	0.48	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Benzene	µg/L	1.51	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Trichloroethene	µg/L	3.98	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U

Table 1. Groundwater Quality Data Summary 2014-2018, Kent Highlands Landfill

ParameterUnitsRegulatory Value			Recent Alluvium Aquifer (Cont.)														
			KMW-017 Compliance					KMW-017Z Indicator					KMW-019A Compliance				
			9/9/2014	9/8/2015	9/12/2016	9/18/2017	9/10/2018	9/9/2014	9/8/2015	9/12/2016	9/18/2017	9/10/2018	9/11/2014	9/10/2015	9/12/2016	9/18/2017	9/10/2018
Field Parameters																	
pH	s.u.		6.31	6.60	6.56	6.61	6.97	5.86	6.17	6.22	6.30	6.40	5.94	6.39	6.49	6.49	6.78
Conductivity	µmhos/cm	700	365	344	319	303	295.3	295	343	340	227	353.4	331	322	330	323	347.3
Temperature	C		12.0	12.7	12.0	11.3	11.8	12.1	12.7	12.1	11.3	11.7	11.4	11.5	12.8	12.0	12.9
Conventional Parameters																	
Chloride	mg/L	250	9.4	8.7	7.90	6.88	7.67	4.4	7.5	6.68	3.66	5.98	12.5	12.6	13.9	11.3	15.6
Ammonia	mg-N/L		0.342	0.312	0.283	0.252	0.278	0.355	0.332	0.311	0.255	0.256	1.18	1.12	1.11	1.34	1.29
N-Nitrate	mg-N/L	10	0.010 U	0.020 U	0.010 U	0.0400 U	0.020 U	0.010 U	0.100 U	0.010 U	0.100 U	0.250 U	0.010 U	0.050 U	0.010 U	0.100 U	0.020 U
N-Nitrite	mg-N/L	1	0.010 U	0.010 U	0.010 U	0.020 U	0.010 U	0.010 U	0.010 U	0.010 U	0.050 U	0.050 U	0.010 U	0.010 U	0.010 U	0.050 U	0.010 U
Nitrate + Nitrite	mg-N/L		0.010 U	0.020 U	0.010 U	0.020 U	0.010 U	0.010 U	0.100 U	0.010 U	0.050 U	0.200 U	0.010 U	0.050 U	0.010 U	0.050 U	0.016
Sulfate	mg/L	250	16.3	15.8	14.3	13.1	14.5	12.5	15.0	19.4	6.24	10.3	14.4	10.1	10.9	3.14	4.61
Chemical Oxygen Demand	mg/L		10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	12.0	10.0 U	10.0 U	10.0 U	12.3	15.8	10.0 U	12.4	10.0 U
Total Organic Carbon	mg/L		1.50 U	1.40	1.18	1.33	1.06	2.59	3.78	3.71	2.20	2.70	4.64	5.42	4.92	4.78	3.66
Total Coliform	CFU/100 mL	1	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Dissolved Metals																	
Cadmium	mg/L	0.005	0.002 U	0.002 U	0.0020 U	0.0020 U	0.0020 U	0.002 U	0.002 U	0.0020 U	0.0020 U	0.0020 U	0.002 U	0.002 U	0.0020 U	0.0020 U	0.0020 U
Chromium	mg/L	0.1	0.005 U	0.005	0.0050 U	0.0050 U	0.0050 U	0.005 U	0.007	0.0050 U	0.0050 U	0.0050 U	0.005 U	0.005 U	0.0050 U	0.0050 U	0.0050 U
Copper	mg/L	0.59	0.002 U	0.002 U	0.0020 U	0.0020 U	0.0020 U	0.002 U	0.002 U	0.0020 U	0.0020 U	0.0020 U	0.002 U	0.002 U	0.0020 U	0.0020 U	0.0020 U
Iron	mg/L	0.3	6.29	5.38	5.12	4.74	4.48	7.96	8.77	8.29	6.77	10.7	14.3	14.3	13.7	14.6	14.8
Lead	mg/L	0.005	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U
Manganese	mg/L	0.05	0.201	0.228	0.191	0.176	0.165	0.236	0.256	0.231	0.176	0.279	1.31	1.24	1.45	1.36	1.39
Nickel	mg/L	0.1	0.01 U	0.01 U	0.010 U	0.0100 U	0.0100 U	0.01 U	0.01 U	0.010 U	0.0100 U	0.0100 U	0.01 U	0.01 U	0.010 U	0.0100 U	0.0100 U
Zinc	mg/L	4.8	0.01 U	0.01 U	0.010 U	0.0100 U	0.0100 U	0.01 U	0.01 U	0.010 U	0.0100 U	0.0100 U	0.01	0.01 U	0.010	0.0100 U	0.0100 U
Volatile Organics																	
Chloromethane	µg/L	3.37	0.5 U	0.5 U	0.50 U	0.50 U	0.50 U	0.5 U	0.5 U	0.50 U	0.50 U	0.50 U	0.5 U	0.5 U	0.50 U	0.50 U	0.50 U
Vinyl Chloride	µg/L	0.025	0.54	0.46 M	0.416	0.394	0.362 J	0.11	0.18 M	0.0664	0.0687	0.0669 J	0.020 U	0.020 U	0.02 U	0.020 U	0.02 U
Bromomethane	µg/L	11.2	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U
Chloroethane	µg/L		0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Trichlorofluoromethane	µg/L	2400	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Acrolein	µg/L		5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U
1,1,2-Trichloro-1,2,2-trifluoroethane	µg/L	480000	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Acetone	µg/L	800	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U
1,1-Dichloroethene	µg/L	0.2	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Methylene Chloride	µg/L	5	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U
Acrylonitrile	µg/L	1	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U
Carbon Disulfide	µg/L	800	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
trans-1,2-Dichloroethene	µg/L	100	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Vinyl Acetate	µg/L	8000	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
1,1-Dichloroethane	µg/L	800	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
2-Butanone	µg/L	4800	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U
cis-1,2-Dichloroethene	µg/L	70	3.2	3.1	3.16	2.17	2.32	0.69	0.6	0.48	0.43	0.40	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Chloroform	µg/L	7.17	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
1,1,1-Trichloroethane	µg/L	200	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Carbon Tetrachloride	µg/L	0.34	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
1,2-Dichloroethane	µg/L	0.48	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Benzene	µg/L	1.51	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Trichloroethene	µg/L	3.98	0.26	0.3	0.23	0.26	0.26	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U

Table 1. Groundwater Quality Data Summary 2014-2018, Kent Highlands Landfill

Parameter			Sand Aquifer																
			KMW-008A						KMW-012A						KMW-013				
			Indicator						Indicator						Background				
Units	Regulatory Value	9/10/2014	9/9/2015	9/13/2016	9/19/2017	9/11/2018	Duplicate 9/11/2018	9/10/2014	9/9/2015	9/13/2016	9/19/2017	Duplicate 9/19/2017	9/11/2018	9/9/2014	9/8/2015	9/12/2016	9/18/2017	9/10/2018	
Field Parameters																			
pH	s.u.		7.48	7.81	7.78	8.05	8.31	--	6.71	6.91	6.95	7.08	--	7.23	6.93	7.14	7.21	7.29	7.56
Conductivity	µmhos/cm	700	179	172	183	192	176.0	--	316	308	326	302	--	309.3	337	336	346	350	350.1
Temperature	C		10.8	11.1	10.8	10.4	10.5	--	11.0	11.3	11.6	11.3	--	10.9	13.4	13.5	13.3	13.2	13.5
Conventional Parameters																			
Chloride	mg/L	250	3.4	3.3	3.82	4.11	3.30	3.35	2.0	1.7	1.57	1.15	1.10	1.01	45.9	49.2	50.7	18.5	43.4
Ammonia	mg-N/L		0.113	0.063	0.077	0.095	0.105	0.077	0.443	0.467	0.436	0.463	0.459	0.523	0.344	0.266	0.257	0.299	0.245
N-Nitrate	mg-N/L	10	0.010 U	0.010 U	0.010 U	0.0200 U	0.0200 U	0.0200 U	0.010 U	0.010 U	0.010 U	0.0200 U	0.0200 U	0.0200 U	0.010 U	0.010 U	0.010 U	0.0200 U	0.020 U
N-Nitrite	mg-N/L	1	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Nitrate + Nitrite	mg-N/L		0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Sulfate	mg/L	250	11.9	10.5	12.8	14.8	12.4	12.4	18.3	16.1	17.5	13.7	13.9	16.4	21.4	21.1	22.6	22.0	25.0
Chemical Oxygen Demand	mg/L		10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	12.2	10.0 U	10.0 U	13.7	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U
Total Organic Carbon	mg/L		1.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	4.80	5.08	4.73	4.43	4.47	3.67	1.50 U	2.10	0.50 U	0.50 U	0.50
Total Coliform	CFU/100 mL	1	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 H, U	1 U
Dissolved Metals																			
Cadmium	mg/L	0.005	0.002 U	0.002 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.013	0.014	0.0157	0.0078	0.0068	0.0060	0.002 U	0.002 U	0.0020 U	0.0020 U	0.0020 U
Chromium	mg/L	0.1	0.005 U	0.005 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.005 U	0.005 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.005 U	0.005 U	0.0050 U	0.0050 U	0.0050 U
Copper	mg/L	0.59	0.002 U	0.002 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.006	0.005	0.0053	0.0037	0.0031	0.0020 U	0.002 U	0.002 U	0.0020 U	0.0020 U	0.0020 U
Iron	mg/L	0.3	0.05 U	0.050 U	0.050 U	0.0500 U	0.0500 U	0.0500 U	0.16	0.11	0.201	0.141	0.169	0.212	1.00	1.01	0.924	1.07	1.03
Lead	mg/L	0.005	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.000162	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U
Manganese	mg/L	0.05	0.135	0.124	0.142	0.147	0.130	0.130	1.61	1.61	1.59	1.45	1.45	1.46	0.630	0.625	0.592	0.653	0.642
Nickel	mg/L	0.1	0.01 U	0.01 U	0.010 U	0.0100 U	0.0100 U	0.0100 U	0.01 U	0.01 U	0.010 U	0.0100 U	0.0100 U	0.0100 U	0.01 U	0.01 U	0.010 U	0.0100 U	0.0100 U
Zinc	mg/L	4.8	0.01 U	0.01 U	0.010 U	0.0100 U	0.0100 U	0.0100 U	0.04	0.04	0.038	0.0272	0.0255	0.0190	0.01 U	0.01 U	0.010 U	0.0100 U	0.0100 U
Volatile Organics																			
Chloromethane	µg/L	3.37	0.5 U	0.5 U	0.50 U	0.50 U	0.50 U	0.50 U	0.5 U	0.5 U	0.50 U	0.50 U	0.50 U	0.50 U	0.5 U	0.5 U	0.50 U	0.50 U	0.50 U
Vinyl Chloride	µg/L	0.025	0.020 U	0.020 U	0.02 U	0.02 U	0.02 U	0.02 U	0.14	0.095 M	0.109	0.0806	0.0786	0.0921	0.020 U	0.020 U	0.02 U	0.020 U	0.020 U
Bromomethane	µg/L	11.2	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U
Chloroethane	µg/L		0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Trichlorofluoromethane	µg/L	2400	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Acrolein	µg/L		5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U
1,1,2-Trichloro-1,2,2-trifluoroethane	µg/L	480000	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Acetone	µg/L	800	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U
1,1-Dichloroethene	µg/L	0.2	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Methylene Chloride	µg/L	5	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U
Acrylonitrile	µg/L	1	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U
Carbon Disulfide	µg/L	800	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
trans-1,2-Dichloroethene	µg/L	100	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Vinyl Acetate	µg/L	8000	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
1,1-Dichloroethane	µg/L	800	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
2-Butanone	µg/L	4800	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U
cis-1,2-Dichloroethene	µg/L	70	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	1.1	0.9	0.94	0.77	0.69	0.76	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Chloroform	µg/L	7.17	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
1,1,1-Trichloroethane	µg/L	200	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Carbon Tetrachloride	µg/L	0.34	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
1,2-Dichloroethane	µg/L	0.48	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Benzene	µg/L	1.51	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Trichloroethene	µg/L	3.98	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.39	0.4	0.39	0.40	0.38	0.34	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U

Table 1. Groundwater Quality Data Summary 2014-2018, Kent Highlands Landfill

ParameterUnitsRegulatory Value			Sand Aquifer (Cont.)										Trip Blanks			
			KMW-016B Indicator						KMW-018A Indicator					KMW-401	KMW-402	KMW-403
			9/10/2014	9/9/2015	9/13/2016	Duplicate 9/13/2016	9/19/2017	9/10/2018	9/10/2014	9/9/2015	9/13/2016	9/19/2017	9/11/2018	9/9/2014	9/10/2014	9/11/2014
Field Parameters																
pH	s.u.		6.54	7.04	7.15	--	7.28	7.51	6.60	6.94	6.90	6.99	7.13	--	--	--
Conductivity	µmhos/cm	700	174	183	188	--	209	208.3	606	593	580	587	557.9	--	--	--
Temperature	C		15.1	15.2	14.6	--	14.5	14.9	17.9	18.1	17.8	17.2	17.4	--	--	--
Conventional Parameters																
Chloride	mg/L	250	2.8	2.9	2.92	3.24	3.22	2.85	10.9	11.5	11.3	12.2	11.6	--	--	--
Ammonia	mg-N/L		0.437	0.522	0.438	0.422	0.516	0.503	0.674	0.626	0.591	0.590	0.603	--	--	--
N-Nitrate	mg-N/L	10	0.010 U	0.010 U	0.010 U	0.010 U	0.0200 U	0.020 U	0.010 U	0.010 U	0.010 U	0.0200 U	0.0200 U	--	--	--
N-Nitrite	mg-N/L	1	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	--	--	--
Nitrate + Nitrite	mg-N/L		0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	--	--	--
Sulfate	mg/L	250	6.5	7.1	7.73	7.98	10.7	11.6	11.0	10.1	10.8	9.91	11.7	--	--	--
Chemical Oxygen Demand	mg/L		10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	10.0 U	--	--	--
Total Organic Carbon	mg/L		1.50 U	0.56	0.50 U	0.50 U	0.58	0.5 U	1.50 U	1.29	1.18	1.30	1.15	--	--	--
Total Coliform	CFU/100 mL	1	1 U	1 U	1 H,U	1 H,U	1 H, U	1 U	1 U	1 U	1 U	1 U	1 U	--	--	--
Dissolved Metals																
Cadmium	mg/L	0.005	0.002 U	0.002 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.002 U	0.002 U	0.0020 U	0.0020 U	0.0020 U	--	--	--
Chromium	mg/L	0.1	0.005 U	0.006	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.005 U	0.005 U	0.0050 U	0.0050 U	0.0050 U	--	--	--
Copper	mg/L	0.59	0.002 U	0.002 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.002 U	0.002 U	0.0020 U	0.0020 U	0.0020 U	--	--	--
Iron	mg/L	0.3	0.05 U	0.050 U	0.050 U	0.050 U	0.0500 U	0.0500 U	0.05 U	0.050 U	0.050 U	0.0500 U	0.0500 U	--	--	--
Lead	mg/L	0.005	0.0001 U	0.0001	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	--	--	--
Manganese	mg/L	0.05	1.31	1.54	1.50	1.51	1.76	1.73	3.39	3.30	3.32	3.17	3.13	--	--	--
Nickel	mg/L	0.1	0.01 U	0.01 U	0.010 U	0.010 U	0.0100 U	0.0100 U	0.01 U	0.01 U	0.010 U	0.0100 U	0.0100 U	--	--	--
Zinc	mg/L	4.8	0.01 U	0.01 U	0.010 U	0.010 U	0.0100 U	0.0100 U	0.01 U	0.01 U	0.010 U	0.0100 U	0.0100 U	--	--	--
Volatile Organics																
Chloromethane	µg/L	3.37	0.5 U	0.5 U	0.50 U	0.50 U	0.50 U	0.50 U	0.5 U	0.5 U	0.50 U	0.50 U	0.50 U	0.5 U	0.5 U	0.5 U
Vinyl Chloride	µg/L	0.025	0.020 U	0.020 U	0.02 U	0.02 U	0.020 U	0.020 U	0.032	0.024 M	0.0239	0.0243	0.0207	0.020 U	0.020 U	0.020 U
Bromomethane	µg/L	11.2	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.0 U
Chloroethane	µg/L		0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
Trichlorofluoromethane	µg/L	2400	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
Acrolein	µg/L		5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.0 U
1,1,2-Trichloro-1,2,2-trifluoroethane	µg/L	480000	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
Acetone	µg/L	800	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.0 U
1,1-Dichloroethene	µg/L	0.2	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
Methylene Chloride	µg/L	5	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.0 U
Acrylonitrile	µg/L	1	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.0 U
Carbon Disulfide	µg/L	800	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
trans-1,2-Dichloroethene	µg/L	100	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
Vinyl Acetate	µg/L	8000	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
1,1-Dichloroethane	µg/L	800	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
2-Butanone	µg/L	4800	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.0 U
cis-1,2-Dichloroethene	µg/L	70	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
Chloroform	µg/L	7.17	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
1,1,1-Trichloroethane	µg/L	200	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
Carbon Tetrachloride	µg/L	0.34	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
1,2-Dichloroethane	µg/L	0.48	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
Benzene	µg/L	1.51	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
Trichloroethene	µg/L	3.98	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U

Table 1. Groundwater Quality Data Summary 2014-2018, Kent Highlands Landfill

ParameterUnitsRegulatory Value			Trip Blanks (Cont.)								
			KMW-401	KMW-402	KMW-403	KMW-401	KMW-402	KMW-401	KMW-402	KMW-401	KMW-402
			9/8/2015	9/9/2015	9/10/2015	9/12/2016	9/13/2016	9/18/2017	9/19/2017	9/10/2018	9/11/2018
Field Parameters											
pH	s.u.		--	--	--	--	--	--	--	--	--
Conductivity	µmhos/cm	700	--	--	--	--	--	--	--	--	--
Temperature	C		--	--	--	--	--	--	--	--	--
Conventional Parameters											
Chloride	mg/L	250	--	--	--	--	--	--	--	--	--
Ammonia	mg-N/L		--	--	--	--	--	--	--	--	--
N-Nitrate	mg-N/L	10	--	--	--	--	--	--	--	--	--
N-Nitrite	mg-N/L	1	--	--	--	--	--	--	--	--	--
Nitrate + Nitrite	mg-N/L		--	--	--	--	--	--	--	--	--
Sulfate	mg/L	250	--	--	--	--	--	--	--	--	--
Chemical Oxygen Demand	mg/L		--	--	--	--	--	--	--	--	--
Total Organic Carbon	mg/L		--	--	--	--	--	--	--	--	--
Total Coliform	CFU/100 mL	1	--	--	--	--	--	--	--	--	--
Dissolved Metals											
Cadmium	mg/L	0.005	--	--	--	--	--	--	--	--	--
Chromium	mg/L	0.1	--	--	--	--	--	--	--	--	--
Copper	mg/L	0.59	--	--	--	--	--	--	--	--	--
Iron	mg/L	0.3	--	--	--	--	--	--	--	--	--
Lead	mg/L	0.005	--	--	--	--	--	--	--	--	--
Manganese	mg/L	0.05	--	--	--	--	--	--	--	--	--
Nickel	mg/L	0.1	--	--	--	--	--	--	--	--	--
Zinc	mg/L	4.8	--	--	--	--	--	--	--	--	--
Volatile Organics											
Chloromethane	µg/L	3.37	0.5 U	0.5 U	0.5 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Vinyl Chloride	µg/L	0.025	0.020 U	0.020 U	0.020 U	0.02 U	0.02 U	0.020 U	0.020 U	0.020 U	0.02 U
Bromomethane	µg/L	11.2	1.0 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
Chloroethane	µg/L		0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Trichlorofluoromethane	µg/L	2400	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Acrolein	µg/L		5.0 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
1,1,2-Trichloro-1,2,2-trifluoroethane	µg/L	480000	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Acetone	µg/L	800	5.0 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
1,1-Dichloroethene	µg/L	0.2	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Methylene Chloride	µg/L	5	1.0 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
Acrylonitrile	µg/L	1	1.0 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
Carbon Disulfide	µg/L	800	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
trans-1,2-Dichloroethene	µg/L	100	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Vinyl Acetate	µg/L	8000	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
1,1-Dichloroethane	µg/L	800	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
2-Butanone	µg/L	4800	5.0 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
cis-1,2-Dichloroethene	µg/L	70	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Chloroform	µg/L	7.17	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
1,1,1-Trichloroethane	µg/L	200	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Carbon Tetrachloride	µg/L	0.34	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
1,2-Dichloroethane	µg/L	0.48	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Benzene	µg/L	1.51	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Trichloroethene	µg/L	3.98	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U

Table 1. Groundwater Quality Data Summary 2014-2018, Kent Highlands Landfill

Parameter			Recent Alluvium Aquifer																
			KMW-010A						KMW-015A					KMW-016A					
			Compliance						Background					Indicator					
			9/9/2014	Duplicate 9/9/2014	9/8/2015	9/12/2016	9/18/2017	9/10/2018	9/9/2014	9/8/2015	9/12/2016	9/18/2017	9/10/2018	9/10/2014	9/9/2015	Duplicate 9/9/2015	9/13/2016	9/19/2017	9/10/2018
	Units	Regulatory Value																	
1,2-Dichloropropane	µg/L	0.64	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Bromodichloromethane	µg/L	0.71	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
2-Chloroethylvinylether	µg/L		1.0 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U
4-Methyl-2-Pentanone (MIBK)	µg/L	400	5.0 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U
cis-1,3-Dichloropropene	µg/L	0.24	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Toluene	µg/L	1000	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
trans-1,3-Dichloropropene	µg/L	0.24	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
2-Hexanone	µg/L		5.0 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U
1,1,2-Trichloroethane	µg/L	0.77	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Tetrachloroethene	µg/L	0.86	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Dibromochloromethane	µg/L	0.52	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Chlorobenzene	µg/L	100	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Ethylbenzene	µg/L	700	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
o-Xylene	µg/L	10000	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Xylenes, total	µg/L		--	--	--	0.60 U	0.60 U	0.60 U	--	--	0.60 U	0.60 U	0.60 U	--	--	--	0.60 U	0.60 U	0.60 U
Styrene	µg/L	1.46	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Bromoform	µg/L	5.54	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
1,1,2,2-Tetrachloroethane	µg/L	0.22	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
1,3-Dichlorobenzene	µg/L	712	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
1,4-Dichlorobenzene	µg/L	1.8	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
1,2-Dichlorobenzene	µg/L	600	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U

Table 1. Groundwater Quality Data Summary 2014-2018, Kent Highlands Landfill

ParameterUnitsRegulatory Value			Recent Alluvium Aquifer (Cont.)														
			KMW-017 Compliance					KMW-017Z Indicator					KMW-019A Compliance				
			9/9/2014	9/8/2015	9/12/2016	9/18/2017	9/10/2018	9/9/2014	9/8/2015	9/12/2016	9/18/2017	9/10/2018	9/11/2014	9/10/2015	9/12/2016	9/18/2017	9/10/2018
1,2-Dichloropropane	µg/L	0.64	0.27	0.3	0.24	0.29	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Bromodichloromethane	µg/L	0.71	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
2-Chloroethylvinylether	µg/L		1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U
4-Methyl-2-Pentanone (MIBK)	µg/L	400	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U
cis-1,3-Dichloropropene	µg/L	0.24	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Toluene	µg/L	1000	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
trans-1,3-Dichloropropene	µg/L	0.24	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
2-Hexanone	µg/L		5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U
1,1,2-Trichloroethane	µg/L	0.77	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Tetrachloroethene	µg/L	0.86	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Dibromochloromethane	µg/L	0.52	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Chlorobenzene	µg/L	100	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Ethylbenzene	µg/L	700	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
o-Xylene	µg/L	10000	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Xylenes, total	µg/L		--	--	0.60 U	0.60 U	0.60 U	--	--	0.60 U	0.60 U	0.60 U	--	--	0.60 U	0.60 U	0.60 U
Styrene	µg/L	1.46	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Bromoform	µg/L	5.54	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
1,1,2,2-Tetrachloroethane	µg/L	0.22	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
1,3-Dichlorobenzene	µg/L	712	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
1,4-Dichlorobenzene	µg/L	1.8	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
1,2-Dichlorobenzene	µg/L	600	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U

Table 1. Groundwater Quality Data Summary 2014-2018, Kent Highlands Landfill

Parameter			Sand Aquifer																
			KMW-008A						KMW-012A						KMW-013				
			Indicator						Indicator						Background				
Units	Regulatory Value	9/10/2014	9/9/2015	9/13/2016	9/19/2017	9/11/2018	Duplicate 9/11/2018	9/10/2014	9/9/2015	9/13/2016	9/19/2017	Duplicate 9/19/2017	9/11/2018	9/9/2014	9/8/2015	9/12/2016	9/18/2017	9/10/2018	
1,2-Dichloropropane	µg/L	0.64	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Bromodichloromethane	µg/L	0.71	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
2-Chloroethylvinylether	µg/L		1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U
4-Methyl-2-Pentanone (MIBK)	µg/L	400	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U
cis-1,3-Dichloropropene	µg/L	0.24	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Toluene	µg/L	1000	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
trans-1,3-Dichloropropene	µg/L	0.24	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
2-Hexanone	µg/L		5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U
1,1,2-Trichloroethane	µg/L	0.77	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Tetrachloroethene	µg/L	0.86	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Dibromochloromethane	µg/L	0.52	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Chlorobenzene	µg/L	100	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	1.3	1.2	1.23	1.14	1.18	1.09	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Ethylbenzene	µg/L	700	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
o-Xylene	µg/L	10000	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Xylenes, total	µg/L		--	--	0.60 U	0.60 U	0.60 U	0.60 U	--	--	0.60 U	0.60 U	0.60 U	0.60 U	--	--	0.60 U	0.60 U	0.60 U
Styrene	µg/L	1.46	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
Bromoform	µg/L	5.54	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
1,1,2,2-Tetrachloroethane	µg/L	0.22	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
1,3-Dichlorobenzene	µg/L	712	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
1,4-Dichlorobenzene	µg/L	1.8	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2	0.29	0.29	0.31	0.33	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U
1,2-Dichlorobenzene	µg/L	600	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U

Table 1. Groundwater Quality Data Summary 2014-2018, Kent Highlands Landfill

Parameter			Sand Aquifer (Cont.)											Trip Blanks		
			KMW-016B Indicator						KMW-018A Indicator					KMW-401	KMW-402	KMW-403
			9/10/2014	9/9/2015	9/13/2016	Duplicate 9/13/2016	9/19/2017	9/10/2018	9/10/2014	9/9/2015	9/13/2016	9/19/2017	9/11/2018			
Units	Regulatory Value	9/10/2014	9/9/2015	9/13/2016	Duplicate 9/13/2016	9/19/2017	9/10/2018	9/10/2014	9/9/2015	9/13/2016	9/19/2017	9/11/2018	9/9/2014	9/10/2014	9/11/2014	
1,2-Dichloropropane	µg/L	0.64	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
Bromodichloromethane	µg/L	0.71	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
2-Chloroethylvinylether	µg/L		1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.0 U	1.0 U	1.0 U
4-Methyl-2-Pentanone (MIBK)	µg/L	400	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.0 U
cis-1,3-Dichloropropene	µg/L	0.24	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
Toluene	µg/L	1000	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
trans-1,3-Dichloropropene	µg/L	0.24	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
2-Hexanone	µg/L		5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.0 U	5.0 U	5.0 U
1,1,2-Trichloroethane	µg/L	0.77	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
Tetrachloroethene	µg/L	0.86	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
Dibromochloromethane	µg/L	0.52	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
Chlorobenzene	µg/L	100	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
Ethylbenzene	µg/L	700	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
o-Xylene	µg/L	10000	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
Xylenes, total	µg/L		--	--	0.60 U	0.60 U	0.60 U	0.60 U	--	--	0.60 U	0.60 U	0.60 U	--	--	--
Styrene	µg/L	1.46	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
Bromoform	µg/L	5.54	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
1,1,2,2-Tetrachloroethane	µg/L	0.22	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
1,3-Dichlorobenzene	µg/L	712	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
1,4-Dichlorobenzene	µg/L	1.8	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U
1,2-Dichlorobenzene	µg/L	600	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.2 U	0.2 U	0.2 U

Table 1. Groundwater Quality Data Summary 2014-2018, Kent Highlands Landfill

			Trip Blanks (Cont.)								
			KMW-401	KMW-402	KMW-403	KMW-401	KMW-402	KMW-401	KMW-402	KMW-401	KMW-402
Parameter	Units	Regulatory Value	9/8/2015	9/9/2015	9/10/2015	9/12/2016	9/13/2016	9/18/2017	9/19/2017	9/10/2018	9/11/2018
1,2-Dichloropropane	µg/L	0.64	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Bromodichloromethane	µg/L	0.71	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
2-Chloroethylvinylether	µg/L		1.0 U	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U
4-Methyl-2-Pentanone (MIBK)	µg/L	400	5.0 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
cis-1,3-Dichloropropene	µg/L	0.24	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Toluene	µg/L	1000	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
trans-1,3-Dichloropropene	µg/L	0.24	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
2-Hexanone	µg/L		5.0 U	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U
1,1,2-Trichloroethane	µg/L	0.77	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Tetrachloroethene	µg/L	0.86	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Dibromochloromethane	µg/L	0.52	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Chlorobenzene	µg/L	100	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Ethylbenzene	µg/L	700	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
o-Xylene	µg/L	10000	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Xylenes, total	µg/L		--	--	--	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U	0.60 U
Styrene	µg/L	1.46	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Bromoform	µg/L	5.54	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
1,1,2,2-Tetrachloroethane	µg/L	0.22	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
1,3-Dichlorobenzene	µg/L	712	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
1,4-Dichlorobenzene	µg/L	1.8	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
1,2-Dichlorobenzene	µg/L	600	0.2 U	0.2 U	0.2 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U

Notes:

-
- = Exceeds regulatory value
 - = Not analyzed
 - U = Not detected
 - J = Estimated value
 - M = Estimated values for an analyte detected and confirmed by an analyst but with low spectral match parameters. This flag is used only for GC-MS analyses.
 - H = Estimated value, holding time exceeded

Table 2. Comparison of 2014-2018 Groundwater Quality Data to Groundwater Quality Limits, Kent Highlands Landfill

		Units	SCL	TL (2014-2018)	RV	CCL	Third Quarter 2014					Third Quarter 2015					Third Quarter 2016					Third Quarter 2017					Third Quarter 2018				
							Value	SCL	TL	RV	CCL	Value	SCL	TL	RV	CCL	Value	SCL	TL	RV	CCL	Value	SCL	TL	RV	CCL	Value	SCL	TL	RV	CCL
KMW-008A (Indicator)																															
Sand Aquifer	pH	s.u.	9.41	7.82	--	9.60	7.48					7.81					7.78					8.05			√		8.31			√	
	Conductivity	µmhos/cm	257	362	700	--	179					172					183					192					176.0				
	Ammonia	mg-N/L	0.35	0.333	--	0.42	0.113					0.063					0.077					0.095					0.091				
	Chloride	mg/L	8	50.2	250	--	3.4					3.3					3.82					4.11					3.325				
	Chemical Oxygen Demand	mg/L	5	5.125	--	--	10.0 U					10.0 U					10.0 U					10.0 U					10.0 U				
	N-Nitrate	mg-N/L	0.046	0.012	10	--	0.010 U					0.010 U					0.010 U					0.0200 U					0.0200 U				
	N-Nitrite	mg-N/L	0.01	0.01	1	--	0.010 U					0.010 U					0.010 U					0.010 U					0.010 U				
	Sulfate	mg/L	12.31	27.4	250	13.19	11.9				√	10.5				√	12.8	√			√	14.8	√			√	12.4	√			√
	Total Organic Carbon	mg/L	3	1.5	--	--	1.50 U					0.50 U					0.50 U					0.50 U					0.50 U				
	Total Coliform	CFU/100 mL	80	1	1	--	1 U					1 U					1 U					1 U					1 U				
	Cadmium	mg/L	0.002	0.002	0.005	--	0.002 U					0.002 U					0.0020 U					0.0020 U					0.0020 U				
	Chromium	mg/L	0.005	0.005	0.1	--	0.005 U					0.005 U					0.0050 U					0.0050 U					0.0050 U				
	Copper	mg/L	0.003	0.002	0.59	--	0.002 U					0.002 U					0.0020 U					0.0020 U					0.0020 U				
	Iron	mg/L	0.07	1.10	0.3	0.08	0.05 U					0.050 U					0.050 U					0.0500 U					0.0500 U				
	Lead	mg/L	0.02	0.001	0.005	--	0.0001 U					0.0001 U					0.0001 U					0.0001 U					0.0001 U				
	Manganese	mg/L	0.17	0.623	0.05	0.17	0.135				√	0.124			√		0.142				√	0.147			√		0.130			√	
	Nickel	mg/L	0.01	0.01	0.1	--	0.01 U					0.01 U					0.010 U					0.0100 U					0.0100 U				
	Zinc	mg/L	0.004	0.01	4.8	--	0.01 U					0.01 U					0.010 U					0.0100 U					0.0100 U				
	Vinyl Chloride	µg/L	--	--	0.025	--	0.020 U					0.020 U					0.02 U					0.02 U					0.02 U				
KMW-012A (Indicator)																															
Sand Aquifer	pH	s.u.	7.79	7.82	--	7.93	6.71				√	6.91				√	6.95				√	7.08				√	7.23				√
	Conductivity	µmhos/cm	5762.66	362	700	6211.16	316					308					326					302					309.3				
	Ammonia	mg-N/L	--	0.333	--	--	0.443			√		0.467			√		0.436			√		0.461			√		0.523			√	
	Chloride	mg/L	1173.42	50.2	250	1514.48	2.0					1.7					1.57				√	1.125					1.01				
	Chemical Oxygen Demand	mg/L	1153.39	5.125	--	1542.02	10.0 U					12.2			√		10.0 U					11.85			√		10.0 U				
	N-Nitrate	mg-N/L	3.1	0.012	10	--	0.010 U					0.010 U					0.010 U					0.0200 U					0.0200 U				
	N-Nitrite	mg-N/L	0.01	0.01	1	--	0.010 U					0.010 U					0.010 U					0.010 U					0.010 U				
	Sulfate	mg/L	802.56	27.4	250	1292.64	18.3					16.1					17.5					13.8					16.4				
	Total Organic Carbon	mg/L	288.14	1.5	--	370.58	4.80			√		5.08			√		4.73			√		4.45			√		3.67			√	
	Total Coliform	CFU/100 mL	1	1	1	--	1 U					1 U					1 U					1 U					1 U				
	Cadmium	mg/L	0.002	0.002	0.005	--	0.013	√	√	√		0.014	√	√	√		0.0157	√	√	√		0.0073	√	√	√		0.0060	√	√	√	
	Chromium	mg/L	0.005	0.005	0.1	--	0.005 U					0.005 U					0.0050 U					0.0050 U					0.0050 U				
	Copper	mg/L	0.002	0.002	0.59	--	0.006	√	√			0.005	√	√			0.0053	√	√			0.0034	√	√			0.0020 U				
	Iron	mg/L	--	1.1	0.3	--	0.16					0.11					0.201					0.155					0.212				
	Lead	mg/L	0.02	0.001	0.005	--	0.0001 U					0.0001 U					0.000162					0.0001 U					0.0001 U				
	Manganese	mg/L	16.5	0.623	0.05	--	1.61			√	√	1.61			√	√	1.59			√	√	1.45			√	√	1.46			√	√
	Nickel	mg/L	0.96	0.01	0.1	1.48	0.01 U					0.01 U					0.010 U					0.0100 U					0.0100 U				
	Zinc	mg/L	0.004	0.01	4.8	--	0.04	√	√			0.04	√	√			0.038	√	√			0.0264	√	√			0.0190	√	√		
	Vinyl Chloride	µg/L	--	--	0.025	--	0.14				√	0.095 M				√	0.109				√	0.0796				√	0.0921				√
KMW-013 (Background)																															
Sand Aquifer	pH	s.u.	8.2	7.82	--	--	6.93					7.14					7.21					7.29					7.56				
	Conductivity	µmhos/cm	--	362	700	--	337					336					346					350					350.1				
	Ammonia	mg-N/L	0.25	0.333	--	--	0.344	√	√			0.266	√				0.257	√				0.299	√				0.245				
	Chloride	mg/L	--	50.2	250	--	45.9					49.2					50.7			√		18.5					43.4				
	Chemical Oxygen Demand	mg/L	8.5	5.125	--	--	10.0 U					10.0 U					10.0 U					10.0 U					10.0 U				
	N-Nitrate	mg-N/L	1.38	0.012	10	--	0.010 U					0.010 U					0.010 U					0.0200 U					0.020 U				
	N-Nitrite	mg-N/L	0.01	0.01	1	--	0.010 U					0.010 U					0.010 U					0.010 U					0.010 U				
	Sulfate	mg/L	--	27.4	250	--	21.4					21.1					22.6					22.0					25.0				
	Total Organic Carbon	mg/L	1.65	1.5	--	--	1.50 U					2.10	√	√			0.50 U					0.50 U					0.50				
	Total Coliform	CFU/100 mL	1	1	1	--	1 U					1 U					1 U					1 H, U					1 U				
	Cadmium	mg/L	0.002	0.002	0.005	--	0.002 U					0.002 U					0.0020 U					0.0020 U					0.0020 U				
	Chromium	mg/L	0.005	0.005	0.1	--	0.005 U					0.005 U					0.0050 U					0.0050 U					0.0050 U				
	Copper	mg/L	0.002	0.002	0.59	--	0.002 U					0.002 U					0.0020 U														

Table 2. Comparison of 2014-2018 Groundwater Quality Data to Groundwater Quality Limits, Kent Highlands Landfill

		Units	SCL	TL (2014-2018)	RV	CCL	Third Quarter 2014					Third Quarter 2015					Third Quarter 2016					Third Quarter 2017					Third Quarter 2018																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
							Value	SCL	TL	RV	CCL	Value	SCL	TL	RV	CCL	Value	SCL	TL	RV	CCL	Value	SCL	TL	RV	CCL	Value	SCL	TL	RV	CCL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
KMW-016B (Indicator)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													

Table 2. Comparison of 2014-2018 Groundwater Quality Data to Groundwater Quality Limits, Kent Highlands Landfill

		Units	SCL	TL (2014-2018)	RV	CCL	Third Quarter 2014					Third Quarter 2015					Third Quarter 2016					Third Quarter 2017					Third Quarter 2018				
							Value	SCL	TL	RV	CCL	Value	SCL	TL	RV	CCL	Value	SCL	TL	RV	CCL	Value	SCL	TL	RV	CCL	Value	SCL	TL	RV	CCL
KMW-015A (Background)																															
Recent Alluvium Aquifer	pH	s.u.	8.29	7.24	--	8.44	6.18					6.53					6.60					6.81					6.92				
	Conductivity	µmhos/cm	283.75	221	700	292.02	219					217					239			√		252			√		271.7			√	
	Ammonia	mg-N/L	1.53	1.303	--	1.64	1.01					1.00					0.878					1.11					1.06				
	Chloride	mg/L	5.5	8.5	250	--	4.8					6.1	√				13.8	√	√			7.94	√				10.5	√	√		
	Chemical Oxygen Demand	mg/L	108.91	10.3	--	148.43	10.0 U					10.0 U					10.0 U					10.0 U					10.0 U				
	N-Nitrate	mg-N/L	0.36	0.057	10	--	0.010 U					0.020 U					0.020					0.0400 U					0.020 U				
	N-Nitrite	mg-N/L	0.01	0.017	1	--	0.010 U					0.010 U					0.010 U					0.020 U					0.010 U				
	Sulfate	mg/L	8.8	22.1	250	--	11.0	√				10.1	√				8.22					10.0 U					5.98				
	Total Organic Carbon	mg/L	6.73	2.52	--	7.17	2.08					2.67			√		1.95					2.16					1.79				
	Total Coliform	CFU/100 mL	1	49	1	--	1 UJ					1 U					1 U					1 H, U					1 U				
	Cadmium	mg/L	0.002	0.002	0.005	--	0.002 U					0.002 U					0.0020 U					0.0020 U					0.0020 U				
	Chromium	mg/L	0.005	0.005	0.1	--	0.005 U					0.005 U					0.0050 U					0.0050 U					0.0050 U				
	Copper	mg/L	0.003	0.002	0.59	--	0.002 U					0.002 U					0.0020 U					0.0020 U					0.0020 U				
	Iron	mg/L	--	9.81	0.3	--	9.38				√	8.55				√	7.77				√	10.2			√	√	9.22			√	
	Lead	mg/L	0.03	0.0002	0.005	--	0.0001 U					0.0001 U					0.0001 U					0.0001 U					0.0001 U				
	Manganese	mg/L	0.61	0.602	0.05	0.63	0.421				√	0.394				√	0.403				√	0.457				√	0.432			√	
	Nickel	mg/L	0.01	0.01	0.1	--	0.01 U					0.01 U					0.010 U					0.0100 U					0.0100 U				
	Zinc	mg/L	0.0045	0.01	4.8	--	0.01 U					0.01 U					0.010 U					0.0100 U					0.0100 U				
	Vinyl Chloride	µg/L	--	--	0.025	--	0.020 U					0.020 U					0.02 U					0.020 U					0.020 U				
KMW-016A (Indicator)																															
Recent Alluvium Aquifer	pH	s.u.	7.84	7.24	--	7.96	6.37					6.77					6.76					6.84					7.10				
	Conductivity	µmhos/cm	--	221	700	--	247			√		309			√		299			√		336			√		293.7			√	
	Ammonia	mg-N/L	--	1.303	--	--	2.44			√		3.69			√		2.71			√		2.91			√		2.20			√	
	Chloride	mg/L	1784.95	8.5	250	2645.31	6.1					7.6					8.47					7.25					5.84				
	Chemical Oxygen Demand	mg/L	175.06	10.3	--	206.48	11.6			√		14.05			√		10.0 U					13.6			√		10.9			√	
	N-Nitrate	mg-N/L	3.4	0.057	10	--	1.02			√		0.010 U					0.010 U					0.0658			√		0.0408				
	N-Nitrite	mg-N/L	0.012	0.017	1	--	0.010 U					0.010 U					0.010 U					0.010 U					0.010 U				
	Sulfate	mg/L	445.40	22.1	250	714.82	9.1					8.75					7.10					10.2					10.2				
	Total Organic Carbon	mg/L	47.35	2.52	--	51.03	6.10			√		6.035			√		5.73			√		5.31			√		4.66			√	
	Total Coliform	CFU/100 mL	--	49	1	--	380 J			√	√	1 U					1 H, U					1 H, U					1 U				
	Cadmium	mg/L	0.002	0.002	0.005	--	0.002 U					0.002 U					0.0020 U					0.0020 U					0.0020 U				
	Chromium	mg/L	0.005	0.005	0.1	--	0.005 U					0.005 U					0.0050 U					0.0050 U					0.0050 U				
	Copper	mg/L	0.002	0.002	0.59	--	0.002 U					0.002 U					0.0020 U					0.0020 U					0.0020 U				
	Iron	mg/L	--	9.81	0.3	--	1.11				√	1.18				√	1.57				√	1.45				√	1.35			√	
	Lead	mg/L	0.02	0.0002	0.005	--	0.0001 U					0.0001 U					0.0001 U					0.0001 U					0.0001 U				
	Manganese*	mg/L	--	0.602	0.05	--	1.05			√	√	1.485			√	√	1.45			√	√	1.75			√	√	1.42			√	√
	Nickel	mg/L	0.02	0.01	0.1	--	0.01 U					0.01 U					0.010 U					0.0100 U					0.0100 U				
	Zinc	mg/L	0.004	0.01	4.8	--	0.01 U					0.01 U					0.010 U					0.0104	√	√			0.0244	√	√		
	Vinyl Chloride	µg/L	--	--	0.025	--	0.020 U					0.020 U					0.02 U					0.0219					0.020 U				
KMW-017 (Compliance)																															
Recent Alluvium Aquifer	pH	s.u.	8.09	7.24	--	8.25	6.31					6.60					6.56					6.61					6.97				
	Conductivity	µmhos/cm	1395.47	221	700	1472.87	365			√		344			√		319			√		303			√		295.3			√	
	Ammonia	mg-N/L	1.56	1.303	--	1.81	0.342					0.312					0.283					0.252					0.278				
	Chloride	mg/L	67.69	8.5	250	82.78	9.4			√		8.7			√		7.90					6.88					7.67				
	Chemical Oxygen Demand	mg/L	23	10.3	--	--	10.0 U					10.0 U					10.0 U					10.0 U					10.0 U				
	N-Nitrate	mg-N/L	3	0.057	10	--	0.010 U					0.020 U					0.010 U					0.0400 U					0.020 U				
	N-Nitrite	mg-N/L	0.041	0.017	1	--	0.010 U					0.010 U					0.010 U					0.020 U					0.010 U				
	Sulfate	mg/L	1455.38	22.1	250	2546.98	16.3					15.8					14.3					13.1					14.5				
	Total Organic Carbon	mg/L	--	2.52	--	--	1.50 U					1.40					1.18					1.33					1.06				
	Total Coliform	CFU/100 mL	1	49	1	--	1 U					1 U					1 U					1 U					1 U				
	Cadmium	mg/L	0.002	0.002	0.005	--	0.002 U					0.002 U					0.0020 U					0.0020 U					0.0020 U				
	Chromium	mg/L	0.005	0.005	0.1	--	0.005 U					0.005					0.0050 U					0.0050 U					0.0050 U				
	Copper	mg/L	0.003	0.002	0.59	--																									

Table 2. Comparison of 2014-2018 Groundwater Quality Data to Groundwater Quality Limits, Kent Highlands Landfill

		Units	SCL	TL (2014-2018)	RV	CCL	Third Quarter 2014					Third Quarter 2015					Third Quarter 2016					Third Quarter 2017					Third Quarter 2018																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
							Value	SCL	TL	RV	CCL	Value	SCL	TL	RV	CCL	Value	SCL	TL	RV	CCL	Value	SCL	TL	RV	CCL	Value	SCL	TL	RV	CCL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
KMW-017Z (Indicator)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						

Notes:
SCL = Shewhart Control Limit
TL = Tolerance Limit
RV = Regulatory Value
CCL = Cumulative Sum Control Limit (compared with CUSUM [cumulative sum] data presented in Appendix A3 tables)
-- = No SCL, TL, or RV established.
U = Not detected
J = Estimated value
M = Estimated value for an analyte detected and confirmed by an analyst but with low spectral match parameters. This flag is used only for GC-MS analyses
H = Estimated value, holding time exceeded
√ Value exceeded this criterion.
* **Exceeded TL and RV for two or more consecutive quarters, no SCL established. (BOLD for compliance wells)**

3Q 2014: KMW-010A data averaged with field duplicate
3Q 2015: KMW-016A data averaged with field duplicate
3Q 2016: KMW-016B data averaged with field duplicate
3Q 2017: KMW-012A data averaged with field duplicate
3Q 2018: KMW-008A data averaged with field duplicate

Table 3. Groundwater Elevations 2014-2018, Kent Highlands Landfill

Well	Reference Elevation (ft amsl)	2014				2015				2016				2017				2018			
		Date Sampled	Time	Depth to Water	Groundwater	Date	Time	Depth to Water	Groundwater	Date	Time	Depth to Water	Groundwater	Date	Time	Depth to Water	Groundwater	Date	Time	Depth to Water	Groundwater
				(ft)	Elevation (ft amsl)			(ft)	Elevation (ft amsl)			(ft)	Elevation (ft amsl)			(ft)	Elevation (ft amsl)			(ft)	Elevation (ft amsl)
KIGW-1	109.78	9/3/2014	11:30	46.20	63.58	9/1/2015	10:53	44.74	65.04	9/6/2016	11:40	45.95	63.83	9/12/2017	10:51	46.48	63.30	9/4/2018	10:56	44.75	65.03
KIGW-3	188.64	9/3/2014	11:37	121.20	67.44	9/1/2015	11:00	118.38	70.26	9/7/2016	8:18	123.69	64.95	9/12/2017	12:50	118.61	70.03	9/4/2018	10:48	121.55	67.09
KIGW-23	112.85	9/3/2014	11:27	63.78	49.07	9/1/2015	10:47	64.43	48.42	9/6/2016	11:45	64.34	48.51	9/12/2017	10:47	64.25	48.60	9/4/2018	10:30	64.91	47.94
KIGW-24	105.27	9/3/2014	11:24	54.10	51.17	9/1/2015	10:43	54.49	50.78	9/6/2016	11:49	53.79	51.48	9/12/2017	10:42	53.90	51.37	9/4/2018	10:27	54.02	51.25
KDGW-94B	264.99	9/3/2014	11:50	142.62	122.37	8/31/2015	13:25	143.98	121.01	9/7/2016	07:27	blocked @ 100 ft	NA	9/12/2017	09:54	blocked @ 100 ft	NA	9/4/2018	08:16	blocked @ 100 ft	NA
KGP-08	41.30	9/3/2014	08:32	8.43	32.87	8/31/2015	11:02	8.67	32.63	9/6/2016	13:24	9.13	32.17	9/12/2017	11:35	8.98	32.32	9/4/2018	09:37	6.22	35.08
KGP-12	41.76	9/3/2014	08:59	6.58	35.18	8/31/2015	12:58	6.67	35.09	9/6/2016	08:25	6.28	35.48	9/12/2017	08:55	6.85	34.91	9/4/2018	12:20	7.02	34.74
KGP-38BD	291.03	9/3/2014	12:02	149.25	141.78	8/31/2015	13:50	149.63	141.40	9/7/2016	07:20	148.21	142.82	9/12/2017	13:19	148.98	142.05	9/4/2018	01:00	149.00	142.03
KMW-01B	49.76	9/3/2014	08:22	10.35	39.41	8/31/2015	12:35	10.56	39.20	9/6/2016	13:52	10.21	39.55	9/12/2017	11:02	10.53	39.23	9/4/2018	09:10	10.60	39.16
KMW-01C	49.76	9/3/2014	08:22	10.25	39.51	8/31/2015	12:36	10.41	39.35	9/6/2016	13:55	9.99	39.77	9/12/2017	11:03	10.38	39.38	9/4/2018	09:12	10.45	39.31
KMW-02B	49.11	9/3/2014	08:24	12.58	36.53	8/31/2015	10:28	12.84	36.27	9/6/2016	13:06	12.61	36.50	9/12/2017	11:05	12.99	36.12	9/4/2018	09:14	13.23	35.88
KMW-02C	49.11	9/3/2014	08:25	16.35	32.76	8/31/2015	10:29	16.58	32.53	9/6/2016	13:09	16.23	32.88	9/12/2017	11:06	16.68	32.43	9/4/2018	09:16	16.88	32.23
KMW-03B	41.66	9/3/2014	08:28	7.65	34.01	8/31/2015	10:34	8.11	33.55	9/6/2016	13:40	7.84	33.82	9/12/2017	11:49	7.94	33.72	9/4/2018	09:54	7.93	33.73
KMW-03C	41.66	9/3/2014	08:30	10.00	31.66	8/31/2015	10:35	10.43	31.23	9/6/2016	13:44	9.93	31.73	9/12/2017	11:52	9.58	32.08	9/4/2018	09:56	9.64	32.02
KMW-04B	38.06	9/3/2014	08:45	16.82	21.24	8/31/2015	11:16	17.15	20.91	9/7/2016	08:26	16.89	21.17	9/12/2017	11:45	17.39	20.67	9/4/2018	09:18	17.55	20.51
KMW-05B	38.46	9/3/2014	08:53	20.46	18.00	8/31/2015	11:20	20.77	17.69	9/6/2016	13:02	20.47	17.99	9/12/2017	10:57	20.93	17.53	9/4/2018	09:05	21.15	17.31
KMW-07A	255.11	9/3/2014	09:48	137.60	117.51	9/1/2015	07:45	137.29	117.82	9/6/2016	11:15	136.83	118.28	9/12/2017	10:15	136.41	118.70	9/4/2018	08:48	136.66	118.45
KMW-07B	255.11	9/3/2014	09:48	139.13	115.98	9/1/2015	07:55	140.82	114.29	9/6/2016	11:20	139.87	115.24	9/12/2017	10:19	139.09	116.02	9/4/2018	08:52	138.33	116.78
KMW-08A	202.73	9/3/2014	10:00	138.86	63.87	9/1/2015	08:07	144.03	58.70	9/6/2016	11:27	138.47	64.26	9/12/2017	10:21	138.19	64.54	9/4/2018	08:56	138.54	64.19
KMW-08B	202.73	9/3/2014	10:00	153.04	49.69	9/1/2015	08:10	153.41	49.32	9/6/2016	11:33	152.53	50.20	9/12/2017	10:25	144.14	58.59	9/4/2018	09:02	152.88	49.85
KMW-09A	38.31	9/3/2014	10:47	3.85	34.46	8/31/2015	11:28	4.21	34.10	9/6/2016	12:34	3.73	34.58	9/12/2017	09:07	4.98	33.33	9/4/2018	12:12	1.10	37.21
KMW-09PZ	38.31	9/3/2014	10:48	0.90	37.41	8/31/2015	11:29	1.00	37.31	9/6/2016	12:36	1.01	37.30	9/12/2017	09:09	3.80	34.51	9/4/2018	12:15	4.73	33.58
KMW-10A	38.99	9/3/2014	09:13	26.16	12.83	9/1/2015	08:28	26.35	12.64	9/6/2016	09:00	26.16	12.83	9/12/2017	08:40	26.55	12.44	9/4/2018	12:44	26.67	12.32
KMW-10B	38.99	9/3/2014	09:13	22.65	16.34	9/1/2015	08:25	22.87	16.12	9/6/2016	09:10	22.61	16.38	9/12/2017	08:36	22.93	16.06	9/4/2018	12:40	23.14	15.85
KMW-11A	38.82	9/3/2014	10:08	11.80	27.02	8/31/2015	11:07	11.20	27.62	9/6/2016	13:20	12.44	26.38	9/12/2017	13:29	10.98	27.84	9/4/2018	11:54	Into mud, no reading	
KMW-11PZ	38.82	9/3/2014	10:08	14.60	24.22	8/31/2015	11:09	19.25	19.57	9/6/2016	13:47	19.19	19.63	9/12/2017	13:39	17.00	21.82	9/4/2018	11:58	18.95	19.87
KMW-12A	53.58	9/3/2014	11:13	28.25	25.33	9/1/2015	09:50	27.12	26.46	9/7/2016	08:30	29.82	23.76	9/12/2017	11:24	29.80	23.78	9/4/2018	09:47	19.92	33.66
KMW-13	273.75	9/3/2014	09:41	77.35	196.40	9/1/2015	10:05	77.05	196.70	9/6/2016	10:15	76.40	197.35	9/12/2017	09:42	75.43	198.32	9/4/2018	08:01	75.59	198.16
KMW-14A	321.73	9/3/2014	08:00	76.84	244.89	8/31/2015	09:15	76.31	245.42	9/6/2016	09:40	75.55	246.18	9/12/2017	07:54	74.16	247.57	9/4/2018	07:16	74.87	246.86
KMW-14B	321.73	9/3/2014	08:03	86.50	235.23	8/31/2015	09:17	86.12	235.61	9/6/2016	09:43	85.22	236.51	9/12/2017	07:57	84.37	237.36	9/4/2018	07:18	84.70	237.03
KMW-15A	40.30	9/3/2014	10:23	28.93	11.37	9/1/2015	08:58	28.79	11.51	9/6/2016	09:15	29.18	11.12	9/12/2017	08:30	29.09	11.21	9/4/2018	13:20	26.21	14.09
KMW-15B	40.30	9/3/2014	10:24	19.00	21.30	9/1/2015	08:55	19.63	20.67	9/6/2016	09:19	19.49	20.81	9/12/2017	08:25	19.69	20.61	9/4/2018	13:23	20.00	20.30
KMW-16A	47.56	9/3/2014	10:55	9.53	38.03	9/1/2015	09:20	9.20	38.36	9/6/2016	12:42	8.88	38.68	9/12/2017	13:00	9.57	37.99	9/4/2018	12:07	9.67	37.89
KMW-16B	47.56	9/3/2014	10:55	10.80	36.76	9/1/2015	09:24	10.99	36.57	9/6/2016	12:45	11.59	35.97	9/12/2017	13:08	11.26	36.30	9/4/2018	12:10	11.17	36.39
KMW-17	38.42	9/3/2014	10:46	25.17	13.25	9/1/2015	09:10	25.30	13.12	9/6/2016	12:30	24.98	13.44	9/12/2017	08:52	25.42	13.00	9/4/2018	12:11	25.67	12.75
KMW-17Z	39.33	9/3/2014	10:38	28.04	11.29	9/1/2015	09:05	28.06	11.27	9/6/2016	08:40	26.59	12.74	9/12/2017	08:49	27.00	12.33	9/4/2018	12:26	27.19	12.14
KMW-18A	48.94	9/3/2014	10:57	12.15	36.79	9/1/2015	09:40	10.15	38.79	9/6/2016	12:57	10.33	38.61	9/12/2017	11:00	10.45	38.49	9/4/2018	11:02	11.05	37.89
KMW-19A	37.68	9/3/2014	11:18	16.07	21.61	9/1/2015	10:21	16.16	21.52	9/7/2016	08:32	16.03	21.65	9/12/2017	13:44	16.33	21.35	9/4/2018	12:01	17.29	20.39
KPZ-02B	308.21	9/3/2014	08:07	149.40	158.81	8/31/2015	09:50	153.35	154.86	9/6/2016	09:45	148.72	159.49	9/12/2017	09:23	147.95	160.26	9/4/2018	07:26	147.75	160.46
KPZ-03B	297.92	9/3/2014	08:12	90.25	207.67	8/31/2015	10:09	89.59	208.33	9/6/2016	10:07	88.89	209.03	9/12/2017	13:12	87.76	210.16	9/4/2018	07:37	87.74	210.18
KPZ-04B	284.97	9/3/2014	08:15	54.14	230.83	8/31/2015	10:14	54.46	230.51	9/6/2016	10:11	54.98	229.99	9/12/2017	09:36	52.34	232.63	9/4/2018	07:45	54.85	230.12
KSWS-1	37.89	9/3/2014	09:06	21.76	16.13	8/31/2015	NS	NS	NA	9/6/2016	08:57	21.64	16.25	9/12/2017	08:45	22.27	15.62	9/4/2018	12:36	21.95	15.94
A(South)	55.83	9/3/2014	11:05	26.45	29.38	8/31/2015	13:17	27.26	28.57	9/6/2016	14:02	27.31	28.52	9/12/2017	11:23	26.38	29.45	9/4/2018	11:18	26.42	29.41
B(North)	64.04	9/3/2014	11:00	26.05	37.99	8/31/2015	13:13	26.01	38.03	9/6/2016	14:05	26.03	38.01	9/12/2017	11:15	26.04	38.00	9/4/2018	11:12	26.00	38.04

Notes: All elevations are groundwater elevations on the Green River, except for surface water station KSWS-1.
ft amsl = feet above mean sea level
Elevation datum NAVD 83

NA = Not available
NS = Not sampled

Table 4a. Spring Drain Quality Data 2014-2018, Field and Conventional Parameters and Metals, Kent Highlands Landfill

			WAC 173-201A					Pond Outfall																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
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			Chronic		Acute		Human Health		3/13/14		6/6/14		9/11/14		1/6/15		3/6/15		6/5/15		9/10/15		12/7/15		3/4/16		6/3/16		9/13/16		12/2/16		3/3/17		6/2/17		9/20/17		12/5/17		3/2/18		6/8/18		9/11/18		12/6/18																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
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¹ Dissolved Oxygen (DO) shall exceed 8.0 mg/L. When water body DO is lower than the criteria due to natural conditions, then human actions considered cumulatively may not cause the DO of that water body to decrease by more than 0.2 mg/L.

² Human-caused pH variations must be within a range of less than 0.5 units.

³ When natural conditions exceed 17.5 C, no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3 C.

Incremental temperature increases resulting from individual point sources must not exceed 28/(T+7) as measured at the edge of the mixing zone (where T is the background temperature).

⁴ Turbidity shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 10 percent increase in turbidity when the background turbidity is more than 50 NTU.

-- = Not analyzed

U = Compound undetected at the specified detection limit

H = Hold time was exceeded

J = Estimated concentration below reporting limit

Table 4a. Spring Drain Quality Data 2014-2018, Field and Conventional Parameters and Metals, Kent Highlands Landfill

Assumptions:

Hardness = 20 mg/L

pH = 7.6 summer season/7.5 winter season (average of 2014-2018 maximum values for Green River Station 3106 and Station 0311)

T = 20.3 degrees C summer season/10.1 degrees C winter season (average of 2014-2018 maximum values for Green River Station 3106 and Station 0311)
(King County. 2019. <http://green2.kingcounty.gov/streamsdata/DataDownload.aspx>)

Summer season = 5/1 through 10/31

Winter season = 11/1 through 4/30

Notes from Table 240(3) Chapter 173-201A WAC

-240 (Toxic Substances) for aquatic life criteria

- a. An instantaneous concentration not to be exceeded at any time.
- c. A 1-hour average concentration not to be exceeded more than once every three years on the average.
- d. A 4-day average concentration not to be exceeded more than once every three years on the average.
- f. Shall not exceed the numerical value in total ammonia nitrogen (mg N/L) given by formula listed in WAC 173-201A-240 (for salmonids present).
- g. Unionized ammonia concentration for waters where salmonid habitat is an existing or designated use.
See formula based on pH, T
- i. $\leq (0.944)(e^{(1.128[\ln(\text{hardness})]-3.828)})$ at hardness = 100. Conversion factor (CF) of 0.944 is hardness dependent. CF is calculated for other hardnesses as follows: $CF = 1.136672 - [(\ln \text{ hardness})(0.041838)]$.
- j. $\leq (0.909)(e^{(0.7852[\ln(\text{hardness})]-3.490)})$ at hardness = 100. Conversion factor (CF) of 0.909 is hardness dependent. CF is calculated for other hardnesses as follows: $CF = 1.101672 - [(\ln \text{ hardness})(0.041838)]$.
- l. Salinity dependent effects. At low salinity the 1-hour average may not be sufficiently protective.
- m. $\leq (0.316)(e^{(0.8190[\ln(\text{hardness})] + 3.688)})$
- n. $\leq (0.860)(e^{(0.8190[\ln(\text{hardness})] + 1.561)})$
- o. $\leq (0.960)(e^{(0.9422[\ln(\text{hardness})] - 1.464)})$
- p. $\leq (0.960)(e^{(0.8545[\ln(\text{hardness})] - 1.465)})$
- q. $\leq (0.791)(e^{(1.273[\ln(\text{hardness})] - 1.460)})$ at hardness = 100. Conversion factor (CF) of 0.791 is hardness dependent. CF is calculated for other hardnesses as follows: $CF = 1.46203 - [(\ln \text{ hardness})(0.145712)]$.
- r. $\leq (0.791)(e^{(1.273[\ln(\text{hardness})] - 4.705)})$ at hardness = 100. Conversion factor (CF) of 0.791 is hardness dependent. CF is calculated for other hardnesses as follows: $CF = 1.46203 - [(\ln \text{ hardness})(0.145712)]$.
- s. If the four-day average chronic concentration is exceeded more than once in a three-year period, the edible portion of the consumed species should be analyzed. Said edible tissue concentrations shall not be allowed to exceed 1.0 mg/kg of methylmercury.
- t. $\leq (0.998)(e^{(0.8460[\ln(\text{hardness})] + 3.3612)})$
- u. $\leq (0.997)(e^{(0.8460[\ln(\text{hardness})] + 1.1645)})$
- y. $\leq (0.85)(e^{(1.72[\ln(\text{hardness})] - 6.52)})$
- aa. $\leq (0.978)(e^{(0.8473[\ln(\text{hardness})] + 0.8604)})$
- bb. $\leq (0.986)(e^{(0.8473[\ln(\text{hardness})] + 0.7614)})$
- dd. These ambient criteria in the table are for the dissolved fraction. The cyanide criteria are based on the weak acid dissociable method. The metals criteria may not be used to calculate total recoverable effluent limits unless the seasonal partitioning of the dissolved to total metals in the ambient water are known. When this information is absent, these metals criteria shall be applied as total recoverable values, determined by back-calculation, using the conversion factors incorporated in the criterion equations. Metals criteria may be adjusted on a site-specific basis when data are made available to the department clearly demonstrating the effective use of the water effects ratio approach established by USEPA, as generally guided by the procedures in USEPA Water Quality Standards Handbook, December 1983, as supplemented or replaced by USEPA or ecology. Information which is used to develop effluent limits based on applying metals partitioning studies or the water effects ratio approach shall be identified in the permit fact sheet developed pursuant to WAC 173-220-060 or 173-226-110, as appropriate, and shall be made available for the public comment period required pursuant to WAC 173-220-050 or 173-226-130(3), as appropriate. Ecology has developed supplemental guidance for conducting water effect ratio studies.
- ff. These criteria are based on the total-recoverable fraction of the metal.
- gg. Where methods to measure trivalent chromium are unavailable, these criteria are to be represented by total-recoverable chromium.

Table 4a. Spring Drain Quality Data 2014-2018, Field and Conventional Parameters and Metals, Kent Highlands Landfill

- ii. The conversion factor used to calculate the dissolved metal concentration was 0.982.
- jj. The conversion factor used to calculate the dissolved metal concentration was 0.962.
- kk. The conversion factor used to calculate the dissolved metal concentration was 0.85.

-240 (Toxic Substances) for human health criteria

- A. This criterion for total arsenic is the maximum contaminant level (MCL) developed under the Safe Drinking Water Act. The MCL for total arsenic is applied to surface waters where consumption of organisms-only and where consumption of water + organisms reflect the designated uses. When the department determines that a direct or indirect industrial discharge to surface waters designated for domestic water supply may be adding arsenic to its wastewater, the department will require the discharger to develop and implement a pollution prevention plan to reduce arsenic through the use of AKART. Industrial wastewater discharges to a privately or publicly owned wastewater treatment facility are considered indirect discharges.
- C. This criterion is based on a regulatory level developed under the Safe Drinking Water Act.
- G. The human health criteria for mercury are contained in 40 C.F.R. 131.36.

* USEPA. 2016. Aquatic Life Ambient Water Quality Criteria, Cadmium -- 2016, EPA 820-R-16-002.

**Table 4b. Spring Drain Quality Data 2014-2018, Volatile Organic Compounds,
Kent Highlands Landfill**

Analyte	Units	Pond Outfall				
		9/11/14	9/10/15	9/13/16	9/20/17	9/11/18
Volatile Organic Compounds						
Chloromethane	µg/L	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Vinyl Chloride	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Bromomethane	µg/L	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U
Chloroethane	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Trichlorofluoromethane	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Acrolein	µg/L	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U
1,1,2-Trichloro-1,2,2-trifluoroeth	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Acetone	µg/L	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U
1,1-Dichloroethene	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Methylene Chloride	µg/L	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U
Acrylonitrile	µg/L	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U
Carbon Disulfide	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
trans-1,2-Dichloroethene	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Vinyl Acetate	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
1,1-Dichloroethane	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
2-Butanone	µg/L	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U
cis-1,2-Dichloroethene	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Chloroform	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
1,1,1-Trichloroethane	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Carbon Tetrachloride	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
1,2-Dichloroethane	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Benzene	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Trichloroethene	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
1,2-Dichloropropane	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Bromodichloromethane	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
2-Chloroethyl vinyl ether	µg/L	1.0 U	1.0 U	1.00 U	1.00 U	1.00 U
4-Methyl-2-Pentanone (MIBK)	µg/L	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U
cis-1,3-Dichloropropene	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Toluene	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
trans-1,3-Dichloropropene	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
2-Hexanone	µg/L	5.0 U	5.0 U	5.00 U	5.00 U	5.00 U
1,1,2-Trichloroethane	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Tetrachloroethene	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Dibromochloromethane	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Chlorobenzene	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Ethylbenzene	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
o-Xylene	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Xylenes, total	µg/L	--	--	0.60 U	0.60 U	0.60 U
Styrene	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Bromoform	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
1,1,2,2-Tetrachloroethane	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
1,3-Dichlorobenzene	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
1,4-Dichlorobenzene	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
1,2-Dichlorobenzene	µg/L	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U

-- = Not analyzed

U = Compound undetected at the specified detection limit

Table 5. Evaluation of Spring Drain Compliance with Washington State Freshwater Criteria

Parameter	Units	Aquatic Life Criteria ^a	Number of Samples	Spring Drain Water Quality Concentrations ^a			Green River Stations 3106 and 0311			Dilution Required to Meet State Water Quality Standards	
				Maximum	Average	Minimum	Maximum	Average	Minimum		
Dissolved Oxygen	mg/L	8.0 b	20	14.17	10.11	7.72	12.4	9.97	7.20	11	g
pH	s.u.	6.5 - 8.5 c	20	8.32	7.79	7.10	7.57	7.23	6.75	none	h
Temperature	C	17.5 d, e	20	18.7	11.9	3.3	20.3	11.3	2.8	5	i
Turbidity	NTU	5 f	20	9.40	3.87	1.30	108	7.32	1.46	none	j

- a. Criteria from WAC 173-201A-200 for Salmonid Spawning, Rearing and Migration Category
- b. Dissolved Oxygen (DO) shall exceed 8.0 mg/L. When water body DO is lower than the criteria due to natural conditions, then human actions considered cumulatively may not cause the DO of that water body to decrease by more than 0.2 mg/L.
- c. Human-caused pH variations must be within a range of less than 0.5 units.
- d. When natural conditions exceed 17.5 C, no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3 C.
- e. Incremental temperature increases resulting from individual point sources must not exceed $28/(T+7)$ as measured at the edge of the mixing zone (where T is the background temperature).
- f. Turbidity shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 10 percent increase in turbidity when the background turbidity is more than 50 NTU.
- g. Dilution calculated for 0.2 mg/L decrease in average DO concentration in the Green River when Spring Drain DO is at the minimum value (7.72 mg/L). The maximum, average and minimum DO concentrations for the Spring Drain are higher than those respective concentrations in the Green River, so no dilution is required when comparing those conditions.
- h. Spring Drain pH measurements are all within the criteria range, as are the data for the Green River.
- i. Dilution calculated for a $28/(T+7)$ increase in the average Green River temperature based on the maximum Spring Drain temperature (18.7 C). Temperature criteria are met when comparing minimum, average, and maximum temperatures for the Spring Drain to those respective temperatures in the Green River, so no dilution is required under those conditions.
- j. The maximum, average and minimum turbidity values for the Spring Drain are lower than those respective values in the Green River, so no dilution is required when comparing those conditions. Turbidity does not have a linear response to dilution, so analyses of other scenarios were not conducted.

Table 6. Evaluation of Spring Drain Compliance with Surface Water Quality Standards and Dilution Requirements^a

Parameter	Units	Washington State Acute	Washington State Chronic	Human Health Criteria	Number of Samples	Maximum Concentration ^b	Multiplier Factor for Acute and Chronic Criteria ^c	Multiplier Factor for Human Health Criteria ^d	Green River Background Concentration ^e	Dilution to Meet WQ Standards at Acute Zone Boundary ^{f,g}	Minimum Dilution to Meet WQ Standards at Mixing Zone Boundary ^{f,h}
N-Ammonia (summer)	mg-N/L	11.4	1.5	----	10	0.884	1.9	----	0.0001	----	1
Cadmium, Dissolved	mg/L	0.0018	0.00072	----	5	0.001	2.3	----	0	1	3
Chromium, Dissolved	mg/L	0.015	0.01	----	5	0.007	2.3	----	0	1	2
Lead, Dissolved	mg/L	0.01079	0.00042	----	5	0.01	2.3	----	0	2	55
Silver, Dissolved	mg/L	0.00022	----	----	5	0.0015	2.3	----	0	16	----
Zinc, Dissolved	mg/L	0.02927	0.02672	----	5	0.0164	2.3	----	0	1	1
Arsenic, Total	mg/L	----	----	0.01	5	0.0121	----	0.9	0.001	----	1
Selenium, Total	mg/L	0.02	0.005	0.12	5	0.0315	2.3	0.9	0.001	4	18
Thallium, Total	mg/L	----	----	0.00024	5	0.0039	----	0.9	0	----	15

a Parameters are not listed if the effluent with multiplier factor met WQS, if detection limit is too high to assess non-detects against WQS, or if no WQS criteria exists

b Maximum of detected concentrations or 1/2 of highest detection limit if no detections occurred

c The reasonable potential multiplier factor for ammonia is based on a calculated coefficient of variation. A coefficient of variation of 0.6 (n>10) was used for all other parameters based on guidance in the Technical Support Document, TSD (EPA 1991)

d Human health criteria multiplier factor based on guidance in Section 4.2 of Ecology Permit Writer's Manual (Ecology 2018)

e Background concentrations from Spring Drain Separation TM

f Calculated using mass balance water quality equation from Chapter 6 of EPA NPDES Permit Writer's Manual (EPA 2010)

g Maximum allowable dilution at the acute zone boundary is 22, under 7Q10 flow conditions in the Green River and high Spring Drain flows per Spring Drain Separation TM

h Maximum allowable dilution at the mixing zone boundary is 210, under 7Q10 flow conditions in the Green River and high Spring Drain flows per Spring Drain Separation TM

Table 7. Leachate Quality Data 2014-2018, Kent Highlands Landfill

Date	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Lead (mg/L)	Nickel (mg/L)	Zinc (mg/L)	Total Dissolved	pH (s.u.)	Temperature (C)
							Sulfides (TDS) (mg/L)		
EFFLUENT LIMITATIONS FROM WATER DISCHARGE PERMIT									
	Daily Average (mg/L)							Min.	
	0.5	2.75	3.0	2.0	2.5	5.0	NA	5.0	
	Instantaneous Maximum (mg/L)							Max.	
	0.6	5.0	8.0	4.0	5.0	10.0	0.1	12.0	
1/14/2014	0.002 U	0.005 U	0.005	0.02 U	0.02	0.01 U	0.1 U	8.01	12.8
2/14/2014	0.002 U	0.005 U	0.006	0.02 U	0.02	0.01 U	0.1 U	7.82	11.9
3/7/2014	0.002 U	0.005 U	0.005	0.02 U	0.02	0.01 U	0.1 U	8.01	15.3
4/4/2014	0.002 U	0.005 U	0.003	0.02 U	0.02	0.01 U	0.1 U	7.97	13.8
5/9/2014	0.002 U	0.005 U	0.175	0.06	0.02	0.14	0.1 U	7.93	16.0
6/6/2014	0.002 U	0.005 U	0.033	0.02 U	0.02	0.06	0.1 U	7.69	18.8
7/11/2014	0.002 U	0.005 U	0.020	0.02 U	0.02	0.06	0.1 U	7.64	22.1
8/8/2014	0.002 U	0.005 U	0.090	0.02	0.03	0.22	0.1 U	7.84	20.7
9/5/2014	0.002 U	0.005 U	0.149	0.06	0.03	0.45	0.1 U	7.9	18.3
10/3/2014	0.002 U	0.005 U	0.003	0.02 U	0.03	0.01 U	0.1 U	7.83	16.1
11/7/2014	0.002 U	0.005	0.007	0.02 U	0.02	0.01 U	0.1 U	7.53	15.1
12/5/2014	0.002 U	0.005 U	0.005	0.02 U	0.02	0.01 U	0.1 U	7.92	12.0
1/9/2015	0.002 U	0.005 U	0.004	0.02 U	0.02	0.01 U	0.1 U	7.85	10.7
2/6/2015	0.002 U	0.005 U	0.004	0.02 U	0.02	0.01 U	0.1 U	7.73	15.2
3/6/2015	0.002 U	0.005 U	0.004	0.02 U	0.02	0.01 U	0.1 U	7.81	12.6
4/3/2015	0.002 U	0.005 U	0.003	0.02 U	0.02	0.01 U	0.1 U	7.91	13.6
5/8/2015	0.002 U	0.005 U	0.003	0.02 U	0.02	0.01 U	0.1 U	7.88	16.5
6/5/2015	0.002 U	0.005 U	0.002 U	0.02 U	0.02	0.01 U	0.1 U	7.93	21.0
7/8/2015	0.002 U	0.007	0.002	0.02 U	0.02	0.04	0.1 U	7.88	21.8
8/7/2015	0.002 U	0.005 U	0.002 U	0.02 U	0.02	0.01 U	0.1 U	7.84	20.2
9/4/2015	0.002 U	0.007	0.002 U	0.02 U	0.03	0.01 U	0.1 U	7.98	16.3
10/2/2015	0.002 U	0.008	0.002 U	0.02 U	0.02	0.01 U	0.1 U	7.93	16.4
11/6/2015	0.002 U	0.005 U	0.010	0.02 U	0.02	0.01 U	0.1 U	7.66	14.1
12/4/2015	0.002 U	0.005 U	0.006	0.02 U	0.02	0.01 U	0.1 U	7.72	12.9
1/8/2016	0.002 U	0.005	0.004	0.02 U	0.02	0.01 U	0.1 U	7.08	11.8
2/5/2016	0.002 U	0.005 U	0.004	0.02 U	0.02	0.01 U	0.1 U	7.87	11.8
3/4/2016	0.002 U	0.005 U	0.005	0.02 U	0.01	0.01 U	0.1 U	7.74	13.1
4/8/2016	0.002 U	0.005 U	0.004	0.02 U	0.02	0.01 U	0.1 U	7.84	16.1
5/6/2016	0.002 U	0.005 U	0.003	0.02 U	0.02	0.01 U	0.1 U	7.98	17.9
6/3/2016	0.006	0.005 U	0.003	0.02 U	0.02	0.01 U	0.1 U	7.72	18.9
7/8/2016	0.002 U	0.006	0.002 U	0.02 U	0.02	0.01 U	0.1 U	7.74	19.6
8/5/2016	0.002 U	0.005 U	0.002 U	0.02 U	0.02	0.01 U	0.1 U	7.61	20.3
9/2/2016	0.002 U	0.007	0.001 J	0.02 U	0.022	0.01 U	0.1 U	7.68	18.9
10/7/2016	0.002 U	0.006	0.002 U	0.02 U	0.024	0.01 U	0.1 U	7.88	17.0
11/4/2016	0.002 U	0.005 U	0.0112	0.02 U	0.0186	0.01 U	0.1 U	7.67	13.1
12/2/2016	0.002 U	0.005 U	0.0049	0.02 U	0.0169	0.01 U	0.1 U	7.89	13.3
1/6/2017	0.0020 U	0.0050 U	0.0039	0.0200 U	0.0200	0.0100 U	0.1 U	7.87	7.3
2/3/2017	0.0020 U	0.0050 U	0.0026	0.0200 U	0.0149	0.0100 U	0.1 U	7.88	10.2
3/3/2017	0.0020 U	0.0050 U	0.0037	0.0200 U	0.0163	0.0100 U	0.1 U	8.03	10.2
4/7/2017	0.0020 U	0.0050 U	0.0031	0.0200 U	0.0162	0.0100 U	0.1 U	7.87	14.8
5/9/2017	0.0020 U	0.0050 U	0.0026	0.0200 U	0.0101	0.0100 U	0.1 U	7.90	15.5
6/2/2017	0.0020 U	0.0050 U	0.0021	0.0200 U	0.0185	0.0100 U	0.1 U	7.90	18.2
7/7/2017	0.0020 U	0.0050 U	0.0020 U	0.0200 U	0.0205	0.0100 U	0.1 U	7.62	20.4
8/8/2017	0.0020 U	0.0050 U	0.0020 U	0.0200 U	0.0186	0.0100 U	0.1 U	7.89	20.5
9/8/2017	0.0020 U	0.0050 U	0.0020 U	0.0200 U	0.0185	0.0100 U	0.1 U	8.06	19.0
10/6/2017	0.0020 U	0.0050 U	0.0020 U	0.0200 U	0.0221	0.0100 U	0.1 U	7.81	15.4
11/3/2017	0.0020 U	0.0096	0.0037	0.0200 U	0.0166	0.0100 U	0.1 U	7.98	13.2
12/5/2017	0.0020 U	0.0050 U	0.0075	0.0200 U	0.0161	0.0100 U	0.1 U	7.87	12.8
1/5/2018	0.0020 U	0.0052	0.0046	0.0200 U	0.0155	0.0100 U	0.1 U	8.09	11.2
2/2/2018	0.0020 U	0.0050 U	0.0054	0.0200 U	0.0174	0.0100 U	0.1 U	7.93	13.9
3/2/2018	0.0020 U	0.0050 U	0.0038	0.0200 U	0.0128	0.0100 U	0.1 U	8.18	11.1
4/6/2018	0.0020 U	0.0050 U	0.0035	0.0200 U	0.0163	0.0100 U	0.1 U	8.12	15.2
5/4/2018	0.0020 U	0.0050 U	0.0031	0.0200 U	0.0166	0.0100 U	0.1 U	8.11	17.1
6/8/2018	0.0020 U	0.0050 U	0.0023	0.0200 U	0.0201	0.0100 U	0.1 U	8.10	17.6
7/6/2018	0.0020 U	0.0050 U	0.0020 U	0.0200 U	0.0182	0.0100 U	0.1 U	8.04	20.9
8/2/2018	0.0020 U	0.0050 U	0.0020 U	0.0200 U	0.0182	0.0100 U	0.1 U	8.05	20.0
9/7/2018	0.0020 U	0.0055	0.0020 U	0.0200 U	0.0205	0.0100 U	0.1 U	8.13	19.0
10/5/2018	0.0020 U	0.0050 U	0.0020 U	0.0200 U	0.0197	0.0100 U	0.1 U	8.14	25
11/6/2018	0.0020 U	0.0050 U	0.0038	0.0200 U	0.0193	0.0100 U	0.1 U	8.02	16.3
12/6/2018	0.0020 U	0.0050 U	0.0058	0.0200 U	0.0164	0.0100 U	0.1 U	8.02	7.1

U = Compound undetected at the specified detection limit

Table 8. Average Daily Leachate Flows 2014-2018, Kent Highlands Landfill

Year	Month	Toe Buttress* (gals)	South Leachate (gals)	Leachate Pond (gals)
2014	January	21,681	663	69,347
	February	23,440	663	74,693
	March	24,538	663	86,714
	April	19,699	663	70,735
	May	20,255	663	69,684
	June	16,609	663	54,003
	July	16,119	663	45,029
	August	15,927	663	43,823
	September	15,754	663	42,805
	October	18,894	663	52,559
	November	25,175	663	76,119
	December	23,991	663	78,727
2015	January	20,820	663	75,852
	February	20,836	663	73,620
	March	19,400	663	65,161
	April	17,172	663	57,701
	May	15,208	663	49,269
	June	15,790	663	45,788
	July	13,530	--	39,935
	August	14,692	--	37,660
	September	16,243	--	52,727
	October	16,817	--	43,265
	November	35,599	--	95,767
	December	33,515	--	101,038
2016	January	27,403	--	81,963
	February	27,194	--	88,386
	March	27,070	--	83,545
	April	0	--	62,936
	May	14,570	--	55,705
	June	15,614	--	47,091
	July	17,100	--	47,731
	August	15,505	--	44,433
	September	14,578	--	44,387
	October	27,794	--	75,538
	November	34,170	--	91,664
	December	23,407	--	72,740
2017	January	20,222	--	65,221
	February	21,286	--	76,278
	March	24,168	--	77,331
	April	22,497	--	71,820
	May	20,571	--	68,685
	June	14,358	--	56,738
	July	12,362	--	46,387
	August	14,838	--	40,460
	September	14,568	--	39,856
	October	17,108	--	53,351
	November	26,959	--	109,897
	December	25,022	--	60,255
2018	January	25,192	--	86,072
	February	22,113	--	82,744
	March	19,435	--	66,690
	April	19,659	--	78,916
	May	15,444	--	63,016
	June	11,113	--	52,946
	July	14,788	--	46,740
	August	14,242	--	42,021
	September	14,110	--	44,071
	October	14,366	--	45,353
	November	21,787	--	65,329
	December	32,203	--	92,750

Table 8. Average Daily Leachate Flows 2014-2018, Kent Highlands Landfill

Notes:

- - = Data not reported after June 2016.

Leachate Pond includes Toe Buttress and South Leachate.

* The flow meter at Toe Buttress (station 104-B) was out of order from March 2 through May 24, 2016. It was replaced on May 25, 2016.

Table 9. Total Leachate and Spring Drain Flows by Month 2014-2018, Kent Highlands Landfill

Year	Month	Toe Buttress* (gals)	South Leachate (gals)	Leachate Pond (gals)	Spring Drain (gals)
2014	January	672,096	20,539	2,149,755	4,435,609
	February	656,317	18,551	2,091,407	4,006,356
	March	760,664	20,539	2,688,123	4,435,609
	April	590,981	19,876	2,122,056	4,292,525
	May	607,664	20,539	2,090,518	4,435,609
	June	514,868	19,876	1,674,093	4,292,525
	July	499,699	20,539	1,395,900	4,435,609
	August	461,869	20,539	1,270,869	4,435,609
	September	504,141	19,876	1,369,766	4,292,525
	October	585,710	20,539	1,629,318	4,435,609
	November	654,555	19,876	1,979,100	4,292,525
	December	839,674	20,539	2,755,447	4,435,609
2015	January	624,605	20,539	2,275,550	4,435,609
	February	583,421	18,551	2,061,358	4,006,356
	March	620,801	20,539	2,085,146	4,435,609
	April	515,155	19,876	1,731,027	4,292,525
	May	441,019	20,539	1,428,812	4,435,609
	June	505,275	19,876	1,465,228	4,292,525
	July	419,425	--	1,237,973	--
	August	455,454	--	1,167,451	--
	September	487,296	--	1,581,801	--
	October	487,690	--	1,297,942	--
	November	1,139,170	--	2,968,776	--
	December	1,038,971	--	3,132,184	--
2016	January	794,684	--	2,376,933	--
	February	843,009	--	2,739,974	--
	March	27,070	--	2,589,890	--
	April	0	--	1,825,145	--
	May	101,991	--	1,782,560	--
	June	468,409	--	1,412,740	--
	July	495,900	--	1,384,200	--
	August	511,650	--	1,466,300	--
	September	437,350	--	1,331,600	--
	October	861,600	--	2,341,675	--
	November	1,025,100	--	2,749,915	--
	December	702,200	--	2,182,210	--
2017	January	647,100	--	2,087,056	--
	February	596,000	--	2,135,794	--
	March	749,200	--	2,397,250	--
	April	629,912	--	2,010,950	--
	May	678,838	--	2,266,593	--
	June	430,750	--	1,702,132	--
	July	383,219	--	1,438,007	--
	August	459,964	--	1,254,266	--
	September	422,460	--	1,155,824	--
	October	547,457	--	1,707,228	--
	November	808,769	--	3,296,908	--
	December	725,631	--	1,747,402	--
2018	January	831,339	--	2,840,361	--
	February	619,161	--	2,316,827	--
	March	583,062	--	2,000,707	--
	April	609,438	--	2,446,395	--
	May	478,750	--	1,953,500	--
	June	322,289	--	1,535,424	--
	July	473,211	--	1,495,676	--
	August	441,500	--	1,302,650	--
	September	395,070	--	1,234,001	--
	October	474,080	--	1,496,649	--
	November	653,600	--	1,959,860	--
	December	998,300	--	2,875,240	--

Table 9. Total Leachate and Spring Drain Flows by Month 2014-2018, Kent Highlands Landfill

Notes:

South Leachate and Spring Drain flow is calculated using flow data collected on the last working day of each month; therefore, the number of days included in each month will vary slightly depending on when the weekends occur.

Leachate Pond includes Toe Buttress and South Leachate.

-- = Data not reported after June 2016.

* The flow meter at Toe Buttress (station 104-B) was out of order from March 2 through May 24, 2016. It was replaced on May 25, 2016.

Table 10. Methane in Landfill Gas Probes 2014 - 2018, Kent Highlands Landfill

Probe	Maximum CH4 Measurement (%)	No. of Sampling Events	No. of Detections	No. of LEL Exceedances
10-S	0	21	0	0
11-S	0.1	22	2	0
12-S	0	21	0	0
13-D	0	64	0	0
13-M	0.1	64	1	0
13-S	0.1	64	1	0
14-D	0.1	65	3	0
14-M	0.1	65	2	0
15-D	0	1	0	0
15-M	0	1	0	0
15-S	0.1	65	1	0
16A-D	0.2	65	2	0
16A-M	0.2	65	2	0
16A-S	0.1	65	2	0
17-D	0	22	0	0
17-M	0	22	0	0
17-S	0	22	0	0
1-D	0.8	65	3	0
1-M	0	1	0	0
1-S	0.1	65	2	0
200-D	0.1	12	1	0
200-M	0	12	0	0
200-S	0.1	12	1	0
20-D	0.2	64	6	0
20-I	0.6	64	2	0
20-M	0.1	64	2	0
20-S	0.2	64	3	0
21-D	0	21	0	0
21-M	0	21	0	0
21-S	0	21	0	0
24-D	0.1	63	2	0
24-M	0.1	64	1	0
24-S	1	64	2	0
26-D	0.1	63	1	0
26-M	0.1	63	2	0
26-S	0.1	63	3	0
27-D	0.1	64	2	0
27-M	0	64	0	0
27-S	0	64	0	0
28-D	0.2	64	5	0
28-M	0.1	64	3	0
28-S	0.2	64	5	0
29-D	0	21	0	0
29-M	0	21	0	0
29-S	0	21	0	0
30-D	0	21	0	0
30-M	0	21	0	0
30-S	0	21	0	0
31-D	0.1	21	1	0
31-M	0	21	0	0
31-S	0	21	0	0
32A-D	0.1	65	2	0
32A-I	0	1	0	0
32A-M	0.1	65	1	0
32A-S	0.1	65	1	0
35-S	3.5	64	60	0
36-D	0.1	63	1	0
36-M	0	63	0	0
36-S	0	63	0	0
38B-D	0	1	0	0
38B-M	0	65	0	0
38B-S	0.1	65	1	0
38C-D	0.1	64	2	0
40-D	0.2	64	3	0
40-M	0.2	64	2	0
40-S	0.1	64	2	0
44-M	0	1	0	0
44-S	0	1	0	0
46-M	0	1	0	0
46-S	0	1	0	0
5-D	0.1	64	1	0
5-M	0.1	64	1	0
5-S	0.2	64	2	0
7A-D	0	64	0	0
7A-S	0	64	0	0
8-S	3.4	64	8	0
9-S	0	21	0	0

Table 11. Static Pressure Data, Landfill Gas Extraction Wells 2014-2018, Kent Highlands Landfill

Well	Maximum	Minimum	Average
E3	0.60	-0.90	-0.08
E4	0.50	-1.00	-0.12
KDGW101	0.10	-9.50	-2.04
KDGW102	-21.20	-57.00	-31.77
KDGW103	-21.10	-46.30	-28.64
KDGW104A	-21.20	-57.10	-31.87
KDGW104B	-3.10	-27.20	-11.76
KDGW105	-21.20	-57.10	-31.83
KDGW111	-5.90	-24.50	-19.52
KDGW112	-2.10	-46.20	-20.01
KDGW89	0.70	-1.60	-0.19
KDGW90	0.70	-0.80	-0.06
KDGW91	0.80	-1.70	-0.25
KDGW92	0.70	-23.40	-0.44
KDGW93	-0.30	-11.60	-5.59
KDGW94A	-0.50	-21.70	-12.77
KDGW94B	0.00	-55.10	-29.19
KDGW95	-1.50	-24.20	-13.56
KDGW96	-0.60	-22.60	-7.80
KDGW97	-18.40	-57.20	-31.36
KDGW97A	0.20	-22.70	-4.32
KDGW98	0.00	-57.20	-31.12
KIGT1	0.20	-1.50	-0.48
KIGT2	0.20	-1.50	-0.30
KIGT3	0.40	-0.60	-0.10
KIGT4	-0.10	-2.30	-1.32
KIGT5	0.60	-1.00	-0.13
KIGT6	0.30	-0.50	-0.04
KIGT7	0.40	-0.40	-0.04
KIGW1	0.70	-1.00	-0.07
KIGW10	0.40	-1.20	-0.30
KIGW11	0.40	-1.10	-0.30
KIGW12	0.10	-2.50	-1.15
KIGW13	0.20	-1.10	-0.39
KIGW14	0.10	-1.20	-0.53
KIGW15	0.20	-1.30	-0.47
KIGW16	0.10	-0.40	-0.09
KIGW17	0.00	-1.90	-0.68
KIGW18	-3.10	-5.80	-4.61
KIGW19	-6.60	-13.90	-10.23
KIGW2	0.60	-1.40	-0.33
KIGW20	0.20	-2.00	-0.93
KIGW21	-0.70	-5.10	-2.75
KIGW22	-12.10	-20.30	-15.26
KIGW23	0.70	-0.90	-0.10
KIGW24	0.70	-1.00	-0.12
KIGW25	0.70	-1.00	-0.12
KIGW26	0.10	-0.90	-0.22
KIGW27	0.50	-0.90	-0.15
KIGW3	0.60	-0.90	-0.10
KIGW4	-1.40	-5.30	-3.52
KIGW5	0.40	-1.10	-0.28
KIGW6	0.50	-2.20	-0.90
KIGW7	-0.30	-2.30	-1.43
KIGW8	0.10	-3.30	-2.02
KIGW9	0.00	-7.20	-4.66
KLMA	0.30	-11.90	-0.18
KLMB	0.10	-3.10	-0.56
KLMSD	0.10	-1.10	-0.12
KLMSL	0.20	-0.90	-0.19
KSGW101	0.00	-24.50	-13.49
KSGW102A	0.10	-24.60	-13.63
KSGW102B	0.00	-39.10	-16.41
KSGW103A	0.20	-2.20	-0.19
KSGW103B	0.20	-1.50	-0.18
KSGW104A	0.70	-2.90	-0.76
KSGW104B	0.80	-2.10	-0.34
KSGW105A	0.20	-3.60	-0.64
KSGW105B	0.20	-46.50	-5.57
KSGW106A	0.10	-57.00	-7.65
KSGW106B	0.10	-3.30	-0.54
KSGW107A	0.00	-3.20	-1.06
KSGW107B	0.00	-6.10	-1.32
KSGW108A	0.10	-3.30	-0.63
KSGW108B	0.10	-1.90	-0.59
KSGW109A	0.20	-0.10	0.01
KSGW109B	0.50	-0.80	-0.02
KSGW110	0.40	-0.60	-0.07
KSGW111A	0.10	-0.40	-0.08
KSGW112A	0.00	-24.00	-11.09
KSGW113	0.70	-7.00	-3.55

Table 11. Static Pressure Data, Landfill Gas Extraction Wells 2014-2018, Kent Highlands Landfill

Well	Maximum	Minimum	Average
KSGW114	0.70	-4.70	-1.95
KSGW115	0.50	-1.80	-0.39
KSGW116	0.20	-0.50	-0.10
KSGW117	-4.20	-20.00	-8.82
KSGW118	0.30	-3.20	-1.14
KSGW119	-1.60	-24.00	-8.95
KSGW120	-1.50	-9.80	-6.28
KSGW121	0.70	-1.10	-0.27
KSGW122	0.00	-3.90	-1.97
KSGW123	0.30	-2.10	-0.61
KSGW124	-2.30	-11.50	-6.65
KSGW125	0.20	-3.00	-0.32
KSGW126	0.60	-2.50	-0.55
KSGW99	0.40	-0.50	-0.05
S73	0.10	-0.50	-0.11
S74	0.00	-24.20	-3.02
S76	0.30	-1.50	-0.70
S77	0.60	-1.00	-0.11

Appendix A

Groundwater



Statistics



Summary Statistics



Summary Statistics for 2014-2018, Kent Highlands Landfill

Parameter	Units	Frequency				Minimum Nondetect	Maximum Nondetect	Minimum Detected	Maximum Detected	Arithmetic Mean	Geometric Mean	Regulatory Value	# RV Exceedances
		# Detects	# Samples	of Detection									
FIELD PARAMETERS													
pH	s.u.	55	55	100%	0	0	5.86	8.31	6.86	6.841731486			
Specific Conductivity	µmhos/cm	55	55	100%	0	0	172	606	314.5854545	299.2249677	700	0	
Temperature	C	55	55	100%	0	0	10.4	18.1	12.85454545	12.71856926			
CONVENTIONAL PARAMETERS													
Chloride	mg/L	55	55	100%	0	0	1.01	50.7	10.31018182	7.051419676	250	0	
N-Ammonia	mg-N/L	55	55	100%	0	0	0.063	3.69	0.895472727	0.573677531			
N-Nitrate	mg-N/L	4	55	7%	0.001	0.25	0.02	1.02	0.032492727	0.009511831	10	0	
Nitrate-Nitrite	mg-N/L	6	55	11%	0.01	0.2	0.01	1.02	0.029872727	0.008075588			
N-Nitrite	mg-N/L	0	55	0%	0.01	0.05	0	0	0.006272727	0.00559812	1	0	
Sulfate	mg/L	54	55	98%	10	10	3.14	25	11.83663636	10.75964173	250	0	
Chemical Oxygen Demand	mg/L	12	55	22%	10	10	10.9	15.8	6.670909091	6.117294644			
Total Organic Carbon	mg/L	42	55	76%	0.5	1.5	0.5	6.1	2.524363636	1.656998088			
Total Coliform	CFU/100 mL	1	55	2%	1	1	380	380	7.4	0.564090042	1	1	
DISSOLVED METALS													
Cadmium, Dissolved	mg/L	5	55	9%	0.002	0.002	0.006	0.0157	0.001927273	0.001237886	0.005	5	
Chromium, Dissolved	mg/L	4	55	7%	0.005	0.005	0.005	0.007	0.002736364	0.002654175	0.1	0	
Copper, Dissolved	mg/L	4	55	7%	0.002	0.002	0.0034	0.006	0.001285455	0.001121214	0.59	0	
Iron, Dissolved	mg/L	40	55	73%	0.05	0.05	0.11	14.8	4.083309091	0.810807482	0.3	35	
Lead, Dissolved	mg/L	3	55	5%	0.0001	0.0001	0.0001	0.000162	0.000053855	0.000052384	0.005	0	
Manganese, Dissolved	mg/L	55	55	100%	0	0	0.124	3.39	1.106836364	0.73360473	0.05	55	
Nickel, Dissolved	mg/L	0	55	0%	0.01	0.01	0	0	0.005	0.005	0.1	0	
Zinc, Dissolved	mg/L	9	55	16%	0.01	0.01	0.01	0.04	0.008148182	0.006320276	4.8	0	
VOLATILE ORGANICS													
1,1,1-Trichloroethane	ug/L	0	55	0%	0.2	0.2	0	0	0.1	0.1	200	0	
1,1,2,2-Tetrachloroethane	ug/L	0	55	0%	0.2	0.2	0	0	0.1	0.1	0.22	0	
1,1,2-Trichloro-1,2,2-trifluoroethane	ug/L	0	55	0%	0.2	0.2	0	0	0.1	0.1	480000	0	
1,1,2-Trichloroethane	ug/L	0	55	0%	0.2	0.2	0	0	0.1	0.1	0.77	0	
1,1-Dichloroethane	ug/L	0	55	0%	0.2	0.2	0	0	0.1	0.1	800	0	
1,1-Dichloroethene	ug/L	0	55	0%	0.2	0.2	0	0	0.1	0.1	0.2	0	
1,2-Dichlorobenzene	ug/L	0	55	0%	0.2	0.2	0	0	0.1	0.1	600	0	
1,2-Dichloroethane	ug/L	0	55	0%	0.2	0.2	0	0	0.1	0.1	0.48	0	
1,2-Dichloropropane	ug/L	4	55	7%	0.2	0.2	0.24	0.3	0.112727273	0.107606394	0.64	0	
1,3-Dichlorobenzene	ug/L	0	55	0%	0.2	0.2	0	0	0.1	0.1	712	0	
1,4-Dichlorobenzene	ug/L	4	55	7%	0.2	0.2	0.2	0.33	0.113090909	0.1076423	1.8	0	
2-Butanone	ug/L	0	55	0%	5	5	0	0	2.5	2.5	4800	0	
2-Chloroethylvinylether	ug/L	0	55	0%	1	1	0	0	0.5	0.5			
2-Hexanone	ug/L	0	55	0%	5	5	0	0	2.5	2.5			
4-Methyl-2-Pentanone (MIBK)	ug/L	0	55	0%	5	5	0	0	2.5	2.5	400	0	
Acetone	ug/L	0	55	0%	5	5	0	0	2.5	2.5	800	0	

Summary Statistics for 2014-2018, Kent Highlands Landfill

Parameter	Units	Frequency				Minimum Nondetect	Maximum Nondetect	Minimum Detected	Maximum Detected	Arithmetic Mean	Geometric Mean	Regulatory Value	# RV Exceedances
		# Detects	# Samples	of Detection									
Acrolein	ug/L	0	55	0%		5	5	0	0	2.5	2.5		
Acrylonitrile	ug/L	0	55	0%		1	1	0	0	0.5	0.5	1	0
Benzene	ug/L	0	55	0%		0.2	0.2	0	0	0.1	0.1	1.51	0
Bromodichloromethane	ug/L	0	55	0%		0.2	0.2	0	0	0.1	0.1	0.71	0
Bromoform	ug/L	0	55	0%		0.2	0.2	0	0	0.1	0.1	5.54	0
Bromomethane	ug/L	0	55	0%		1	1	0	0	0.5	0.5	11.2	0
Carbon Disulfide	ug/L	0	55	0%		0.2	0.2	0	0	0.1	0.1	800	0
Carbon Tetrachloride	ug/L	0	55	0%		0.2	0.2	0	0	0.1	0.1	0.34	0
Chlorobenzene	ug/L	5	55	9%		0.2	0.2	1.09	1.3	0.199636364	0.125287439	100	0
Chloroethane	ug/L	0	55	0%		0.2	0.2	0	0	0.1	0.1		
Chloroform	ug/L	0	55	0%		0.2	0.2	0	0	0.1	0.1	7.17	0
Chloromethane	ug/L	0	55	0%		0.5	0.5	0	0	0.25	0.25	3.37	0
cis-1,2-Dichloroethene	ug/L	15	55	27%		0.2	0.2	0.4	3.2	0.454181818	0.190903916	70	0
cis-1,3-Dichloropropene	ug/L	0	55	0%		0.2	0.2	0	0	0.1	0.1	0.24	0
Dibromochloromethane	ug/L	0	55	0%		0.2	0.2	0	0	0.1	0.1	0.52	0
Ethylbenzene	ug/L	0	55	0%		0.2	0.2	0	0	0.1	0.1	700	0
Methylene Chloride	ug/L	0	55	0%		1	1	0	0	0.5	0.5	5	0
o-Xylene	ug/L	0	55	0%		0.2	0.2	0	0	0.1	0.1	10000	0
Styrene	ug/L	0	55	0%		0.2	0.2	0	0	0.1	0.1	1.46	0
Tetrachloroethene	ug/L	0	55	0%		0.2	0.2	0	0	0.1	0.1	0.86	0
Toluene	ug/L	0	55	0%		0.2	0.2	0	0	0.1	0.1	1000	0
trans-1,2-Dichloroethene	ug/L	0	55	0%		0.2	0.2	0	0	0.1	0.1	100	0
trans-1,3-Dichloropropene	ug/L	0	55	0%		0.2	0.2	0	0	0.1	0.1	0.24	0
Trichloroethene	ug/L	10	55	18%		0.2	0.2	0.23	0.4	0.140363636	0.123235661	3.98	0
Trichlorofluoromethane	ug/L	0	55	0%		0.2	0.2	0	0	0.1	0.1	2400	0
Vinyl Acetate	ug/L	0	55	0%		0.2	0.2	0	0	0.1	0.1	8000	0
Vinyl Chloride	ug/L	26	55	47%		0.02	0.02	0.0207	0.54	0.068414545	0.025732685	0.025	20
Xylenes, total	ug/L	0	33	0%		0.6	0.6	0	0	0.3	0.3		

s.u. = Standard units

µmhos/cm = Unit of electrical conductivity

CFU = Colony forming units

mg/L = milligrams per liter

µg/L = micrograms per liter

C = Centigrade

Shewhart Control Charts

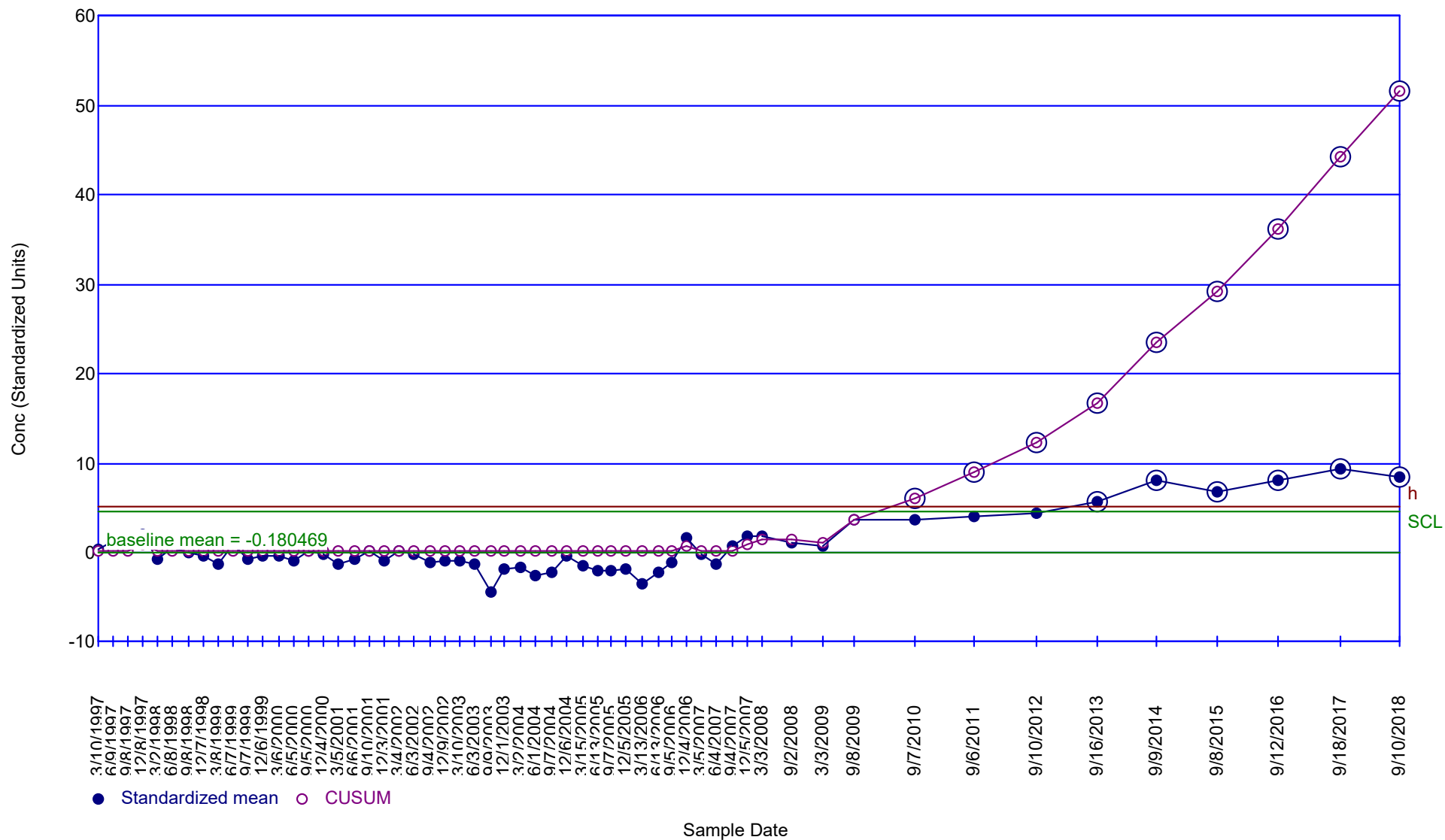
Recent Alluvium Aquifer



CCL (h) = 1.44; SCL = 1.33

Kent Highlands Landfill

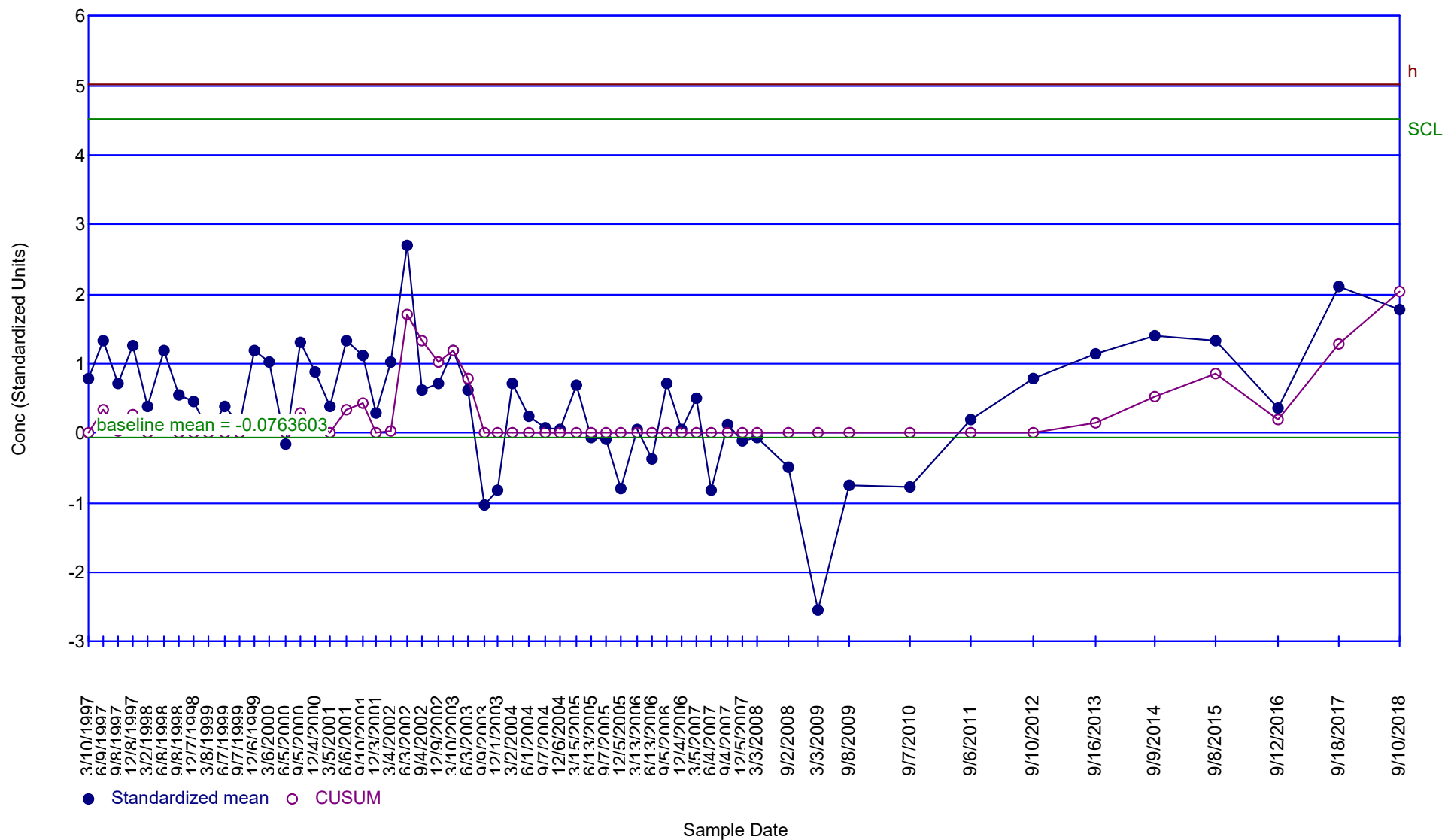
Intra-Well Shewhart-CUSUM Control Chart for Ammonia-N at KMW-010A



CCL (h) = 1.64; SCL = 1.53

Kent Highlands Landfill

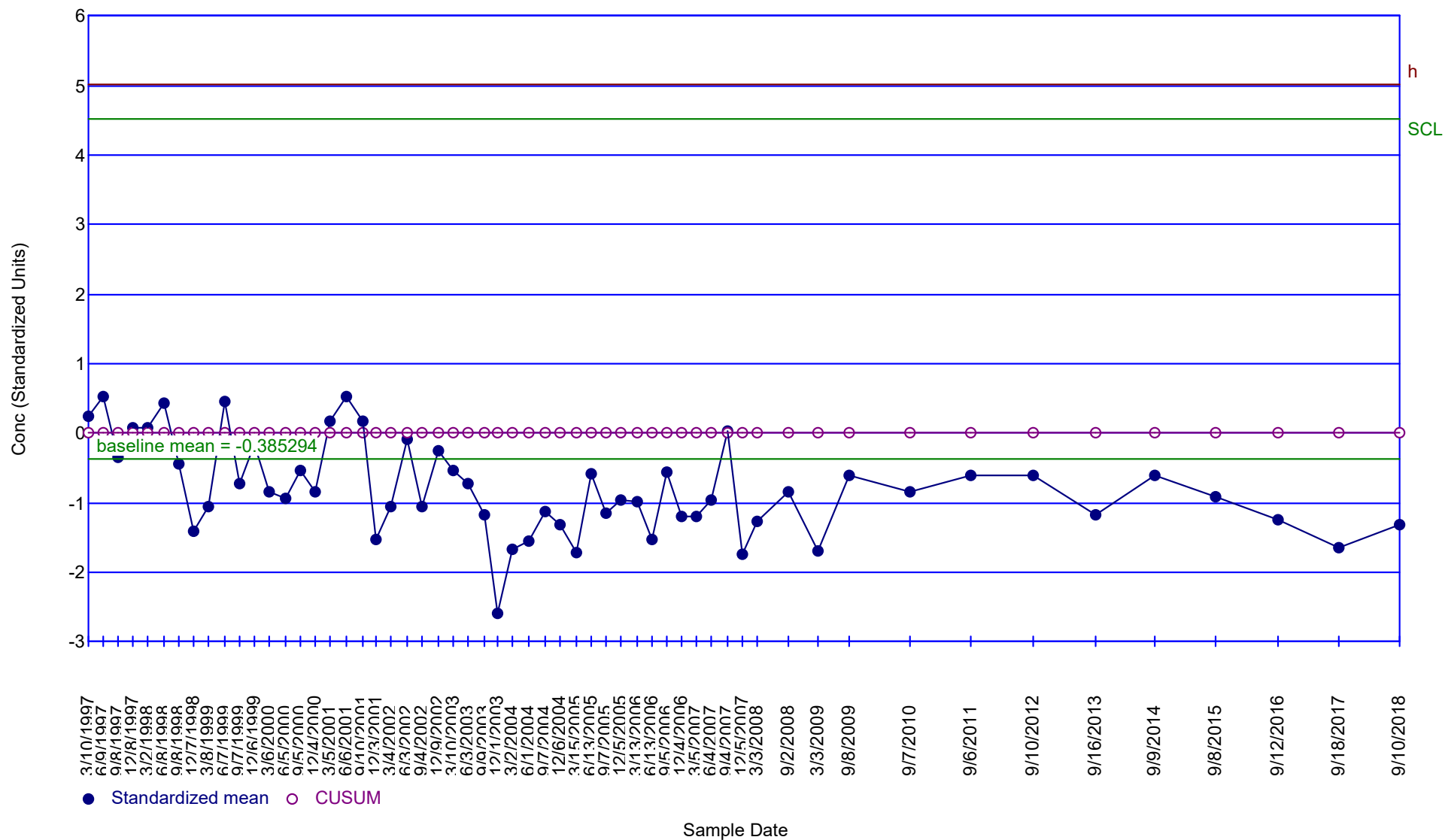
Intra-Well Shewhart-CUSUM Control Chart for Ammonia-N at KMW-015A



CCL (h) = 1.81; SCL = 1.56

Kent Highlands Landfill

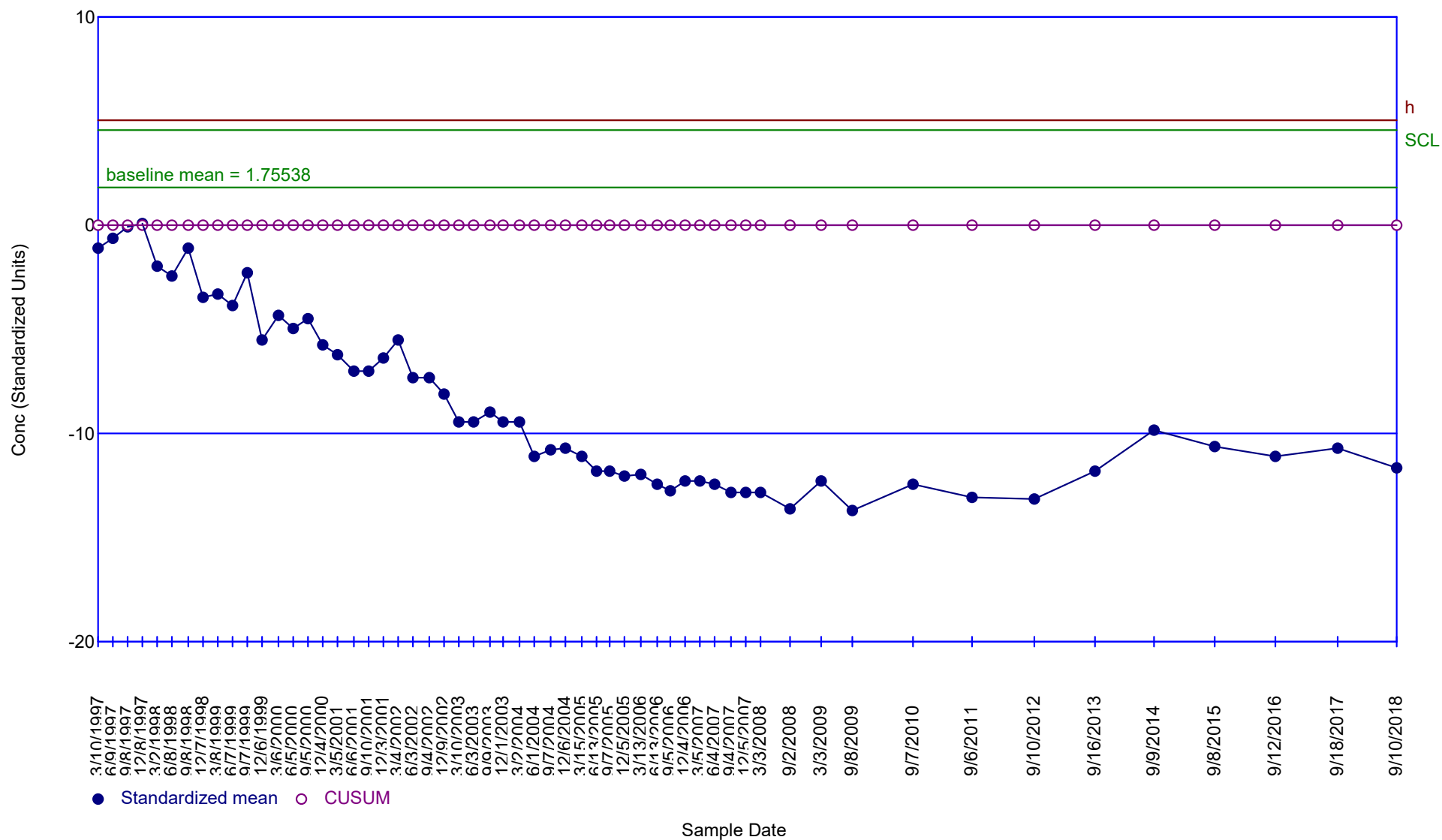
Intra-Well Shewhart-CUSUM Control Chart for Ammonia-N at KMW-017



CCL (h) = 131.60; SCL = 120.95

Kent Highlands Landfill

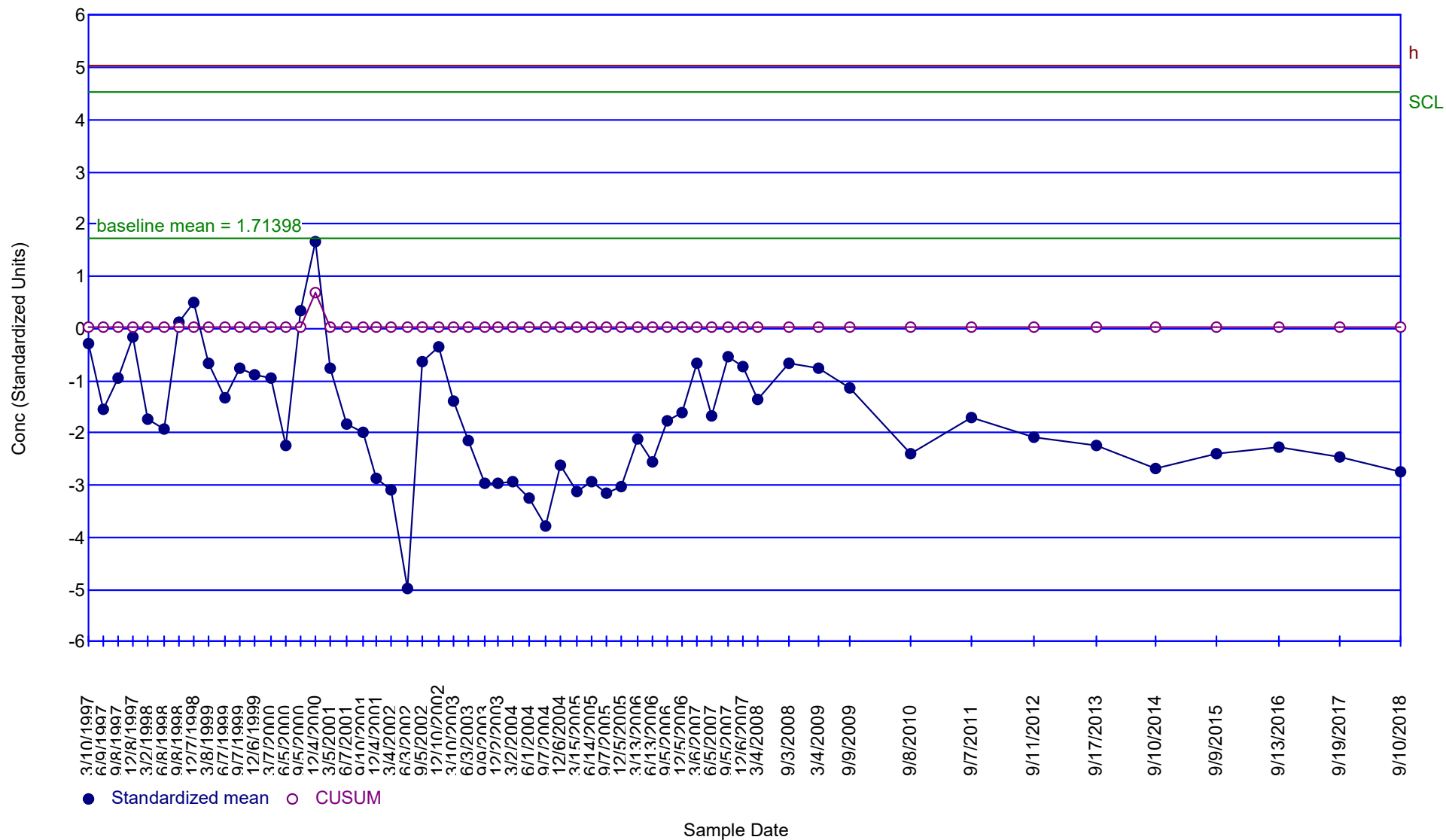
Intra-Well Shewhart-CUSUM Control Chart for Chloride at KMW-010A



CCL (h) = 2645.3; SCL = 1785.0

Kent Highlands Landfill

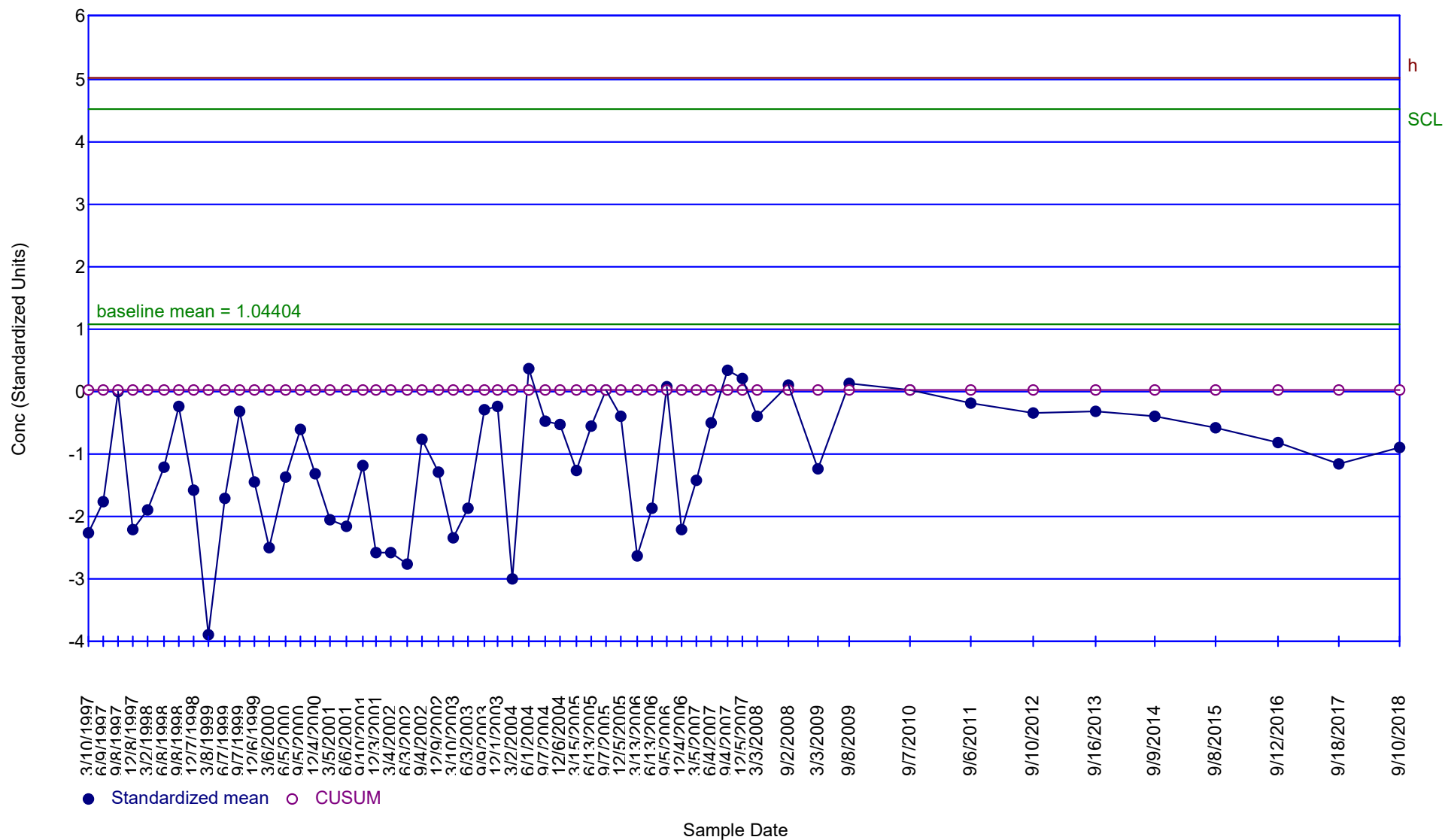
Intra-Well Shewhart-CUSUM Control Chart for Chloride at KMW-016A



CCL (h) = 82.78; SCL = 67.69

Kent Highlands Landfill

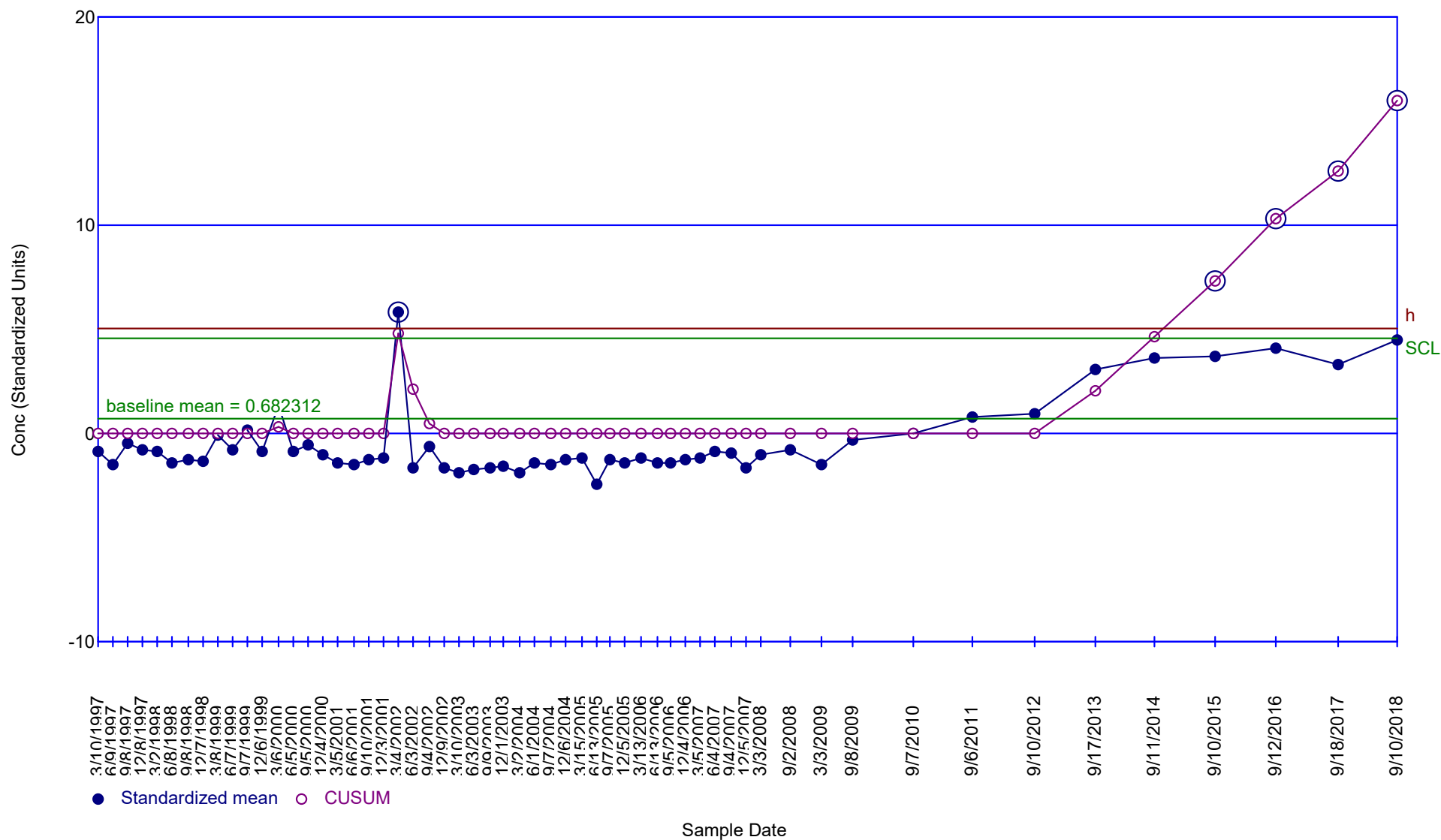
Intra-Well Shewhart-CUSUM Control Chart for Chloride at KMW-017



CCL (h) = 17.99; SCL = 15.77

Kent Highlands Landfill

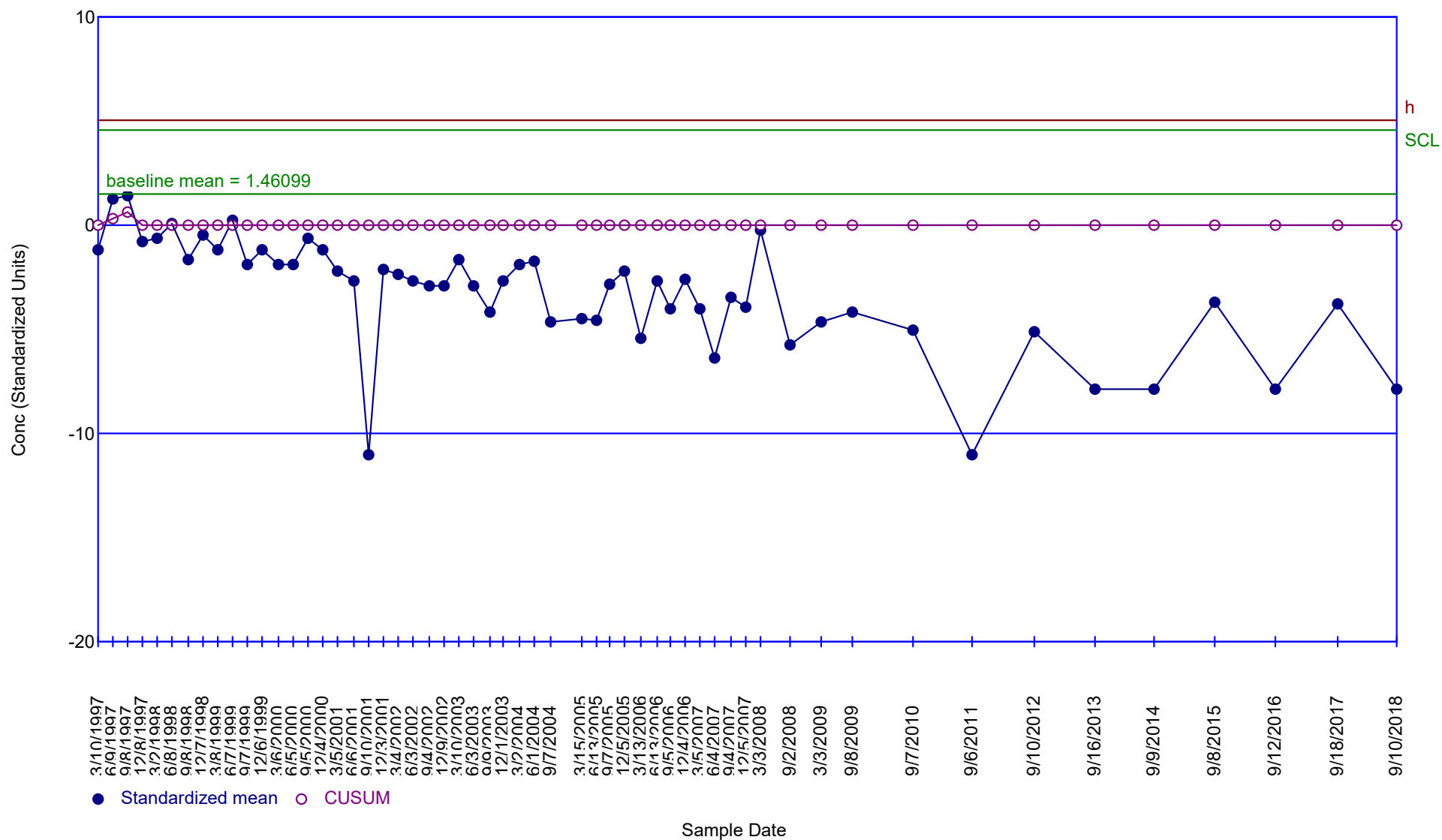
Intra-Well Shewhart-CUSUM Control Chart for Chloride at KMW-019A



CCL (h) = 88.14; SCL = 78.81

Kent Highlands Landfill

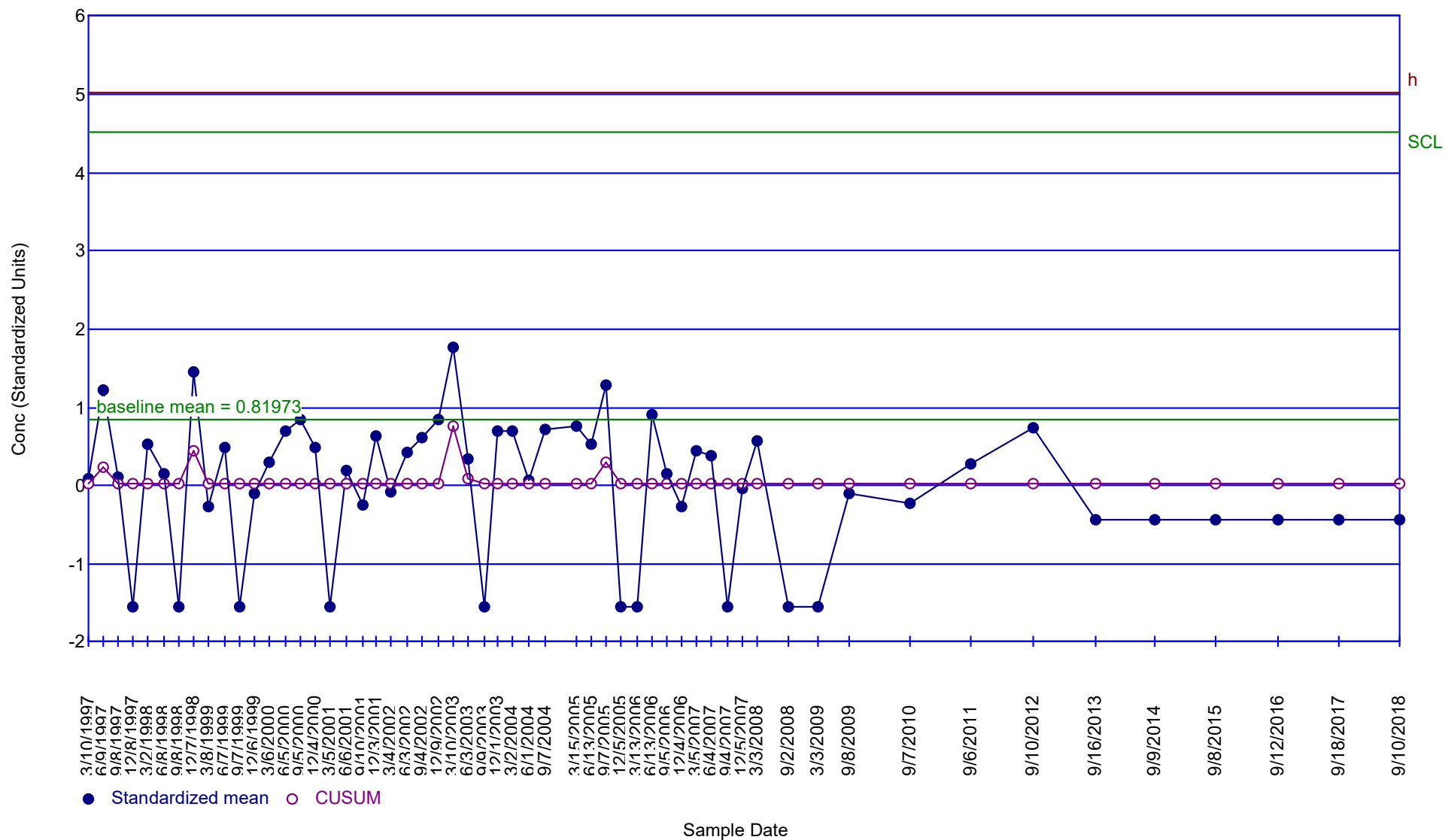
Intra-Well Shewhart-CUSUM Control Chart for Chemical Oxygen Demand at KMW-010A



CCL (h) = 148.43; SCL = 108.91

Kent Highlands Landfill

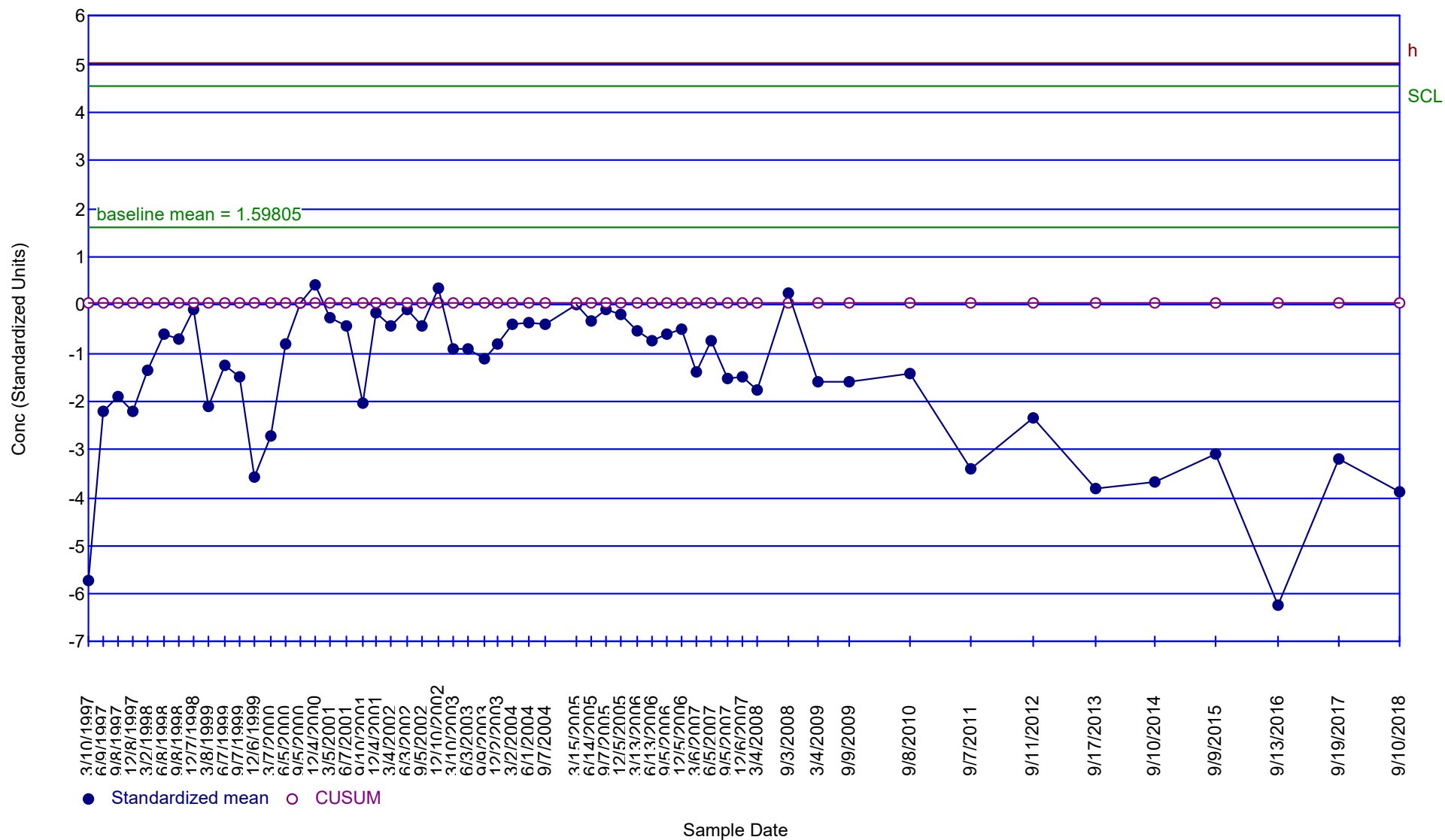
Intra-Well Shewhart-CUSUM Control Chart for Chemical Oxygen Demand at KMW-015A



CCL (h) = 206.48; SCL = 175.06

Kent Highlands Landfill

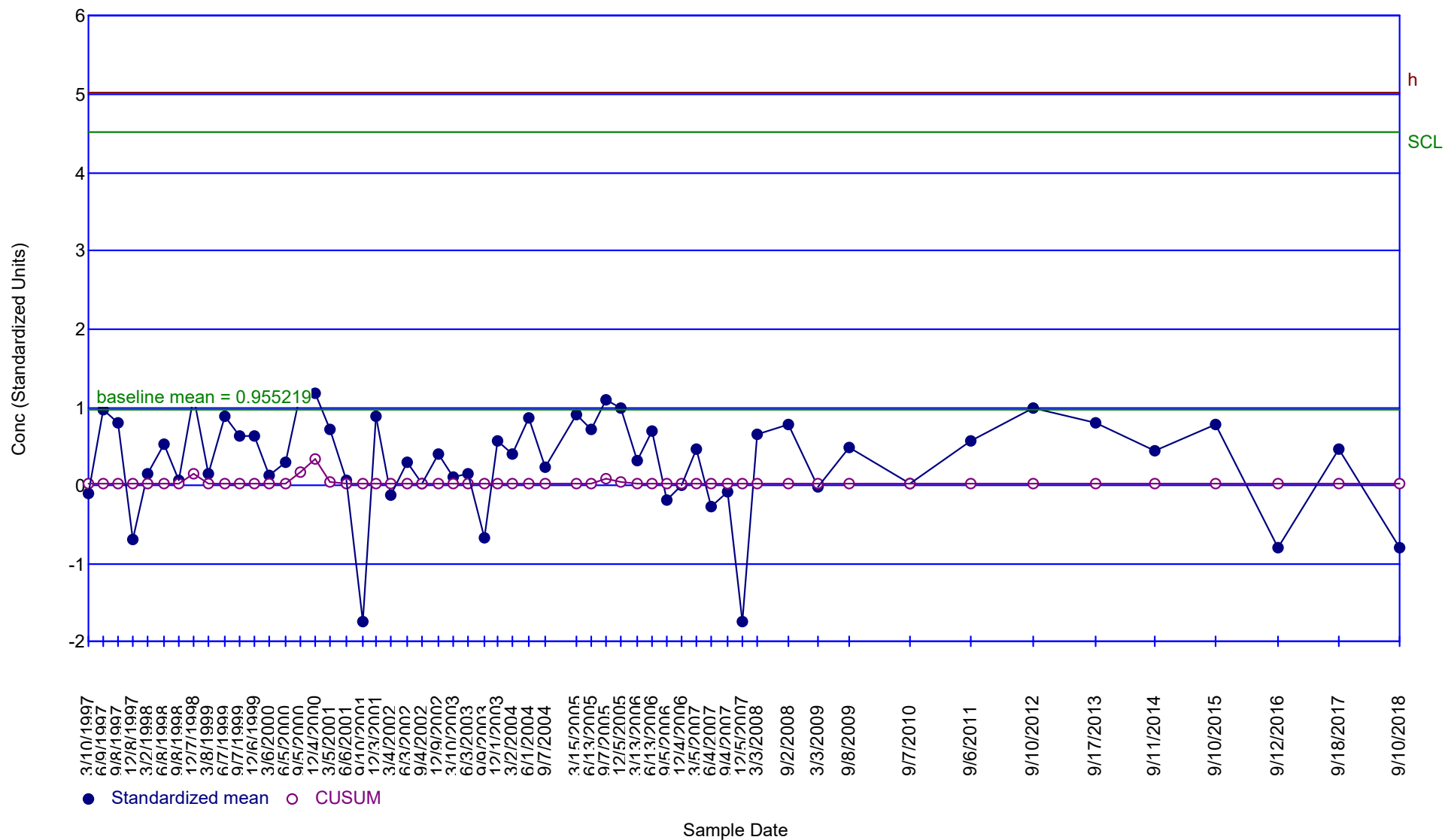
Intra-Well Shewhart-CUSUM Control Chart for Chemical Oxygen Demand at KMW-016A



CCL (h) = 331.06; SCL = 231.76

Kent Highlands Landfill

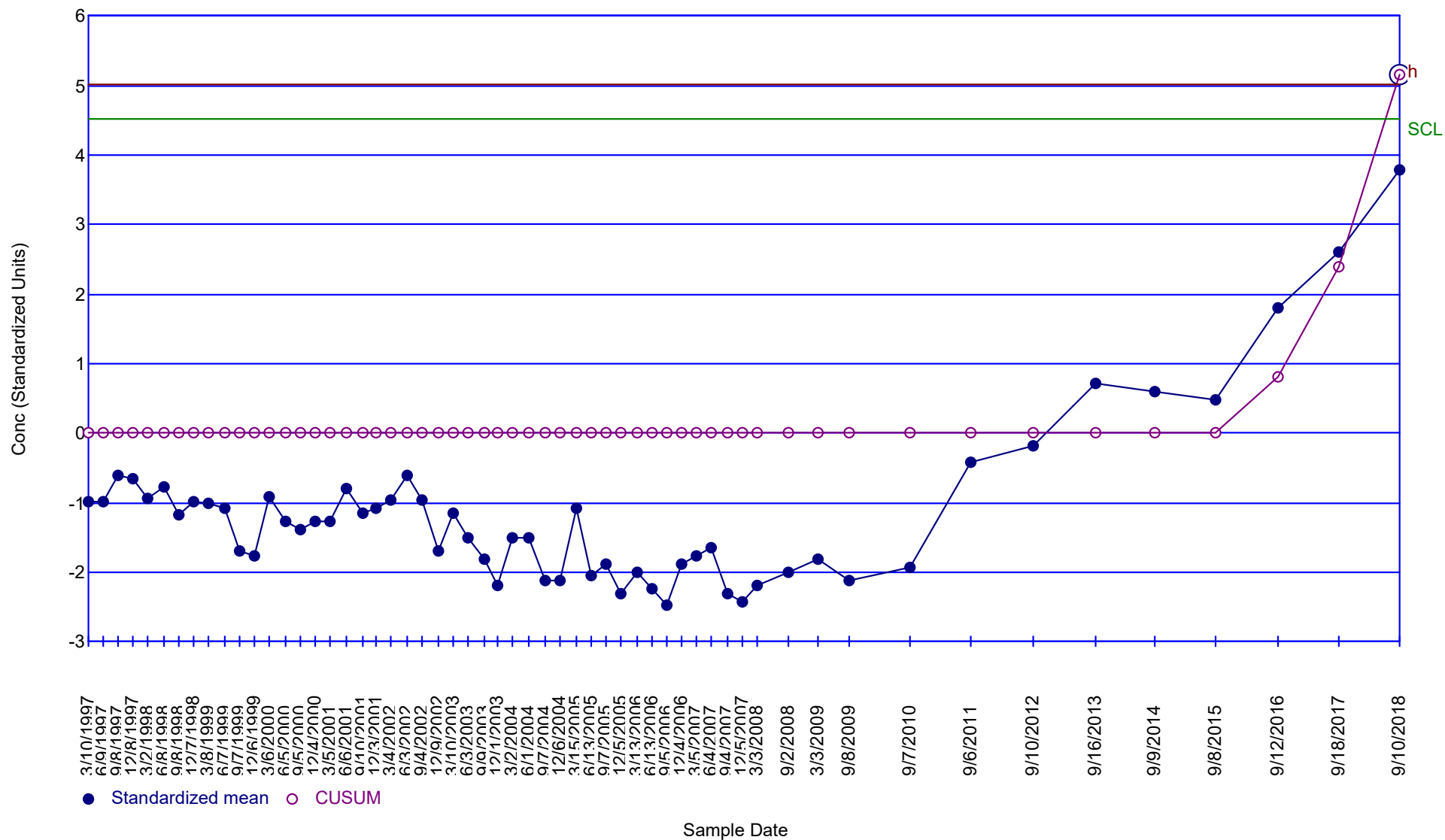
Intra-Well Shewhart-CUSUM Control Chart for Chemical Oxygen Demand at KMW-019A



CCL (h) = 292.0; SCL = 283.8

Kent Highlands Landfill

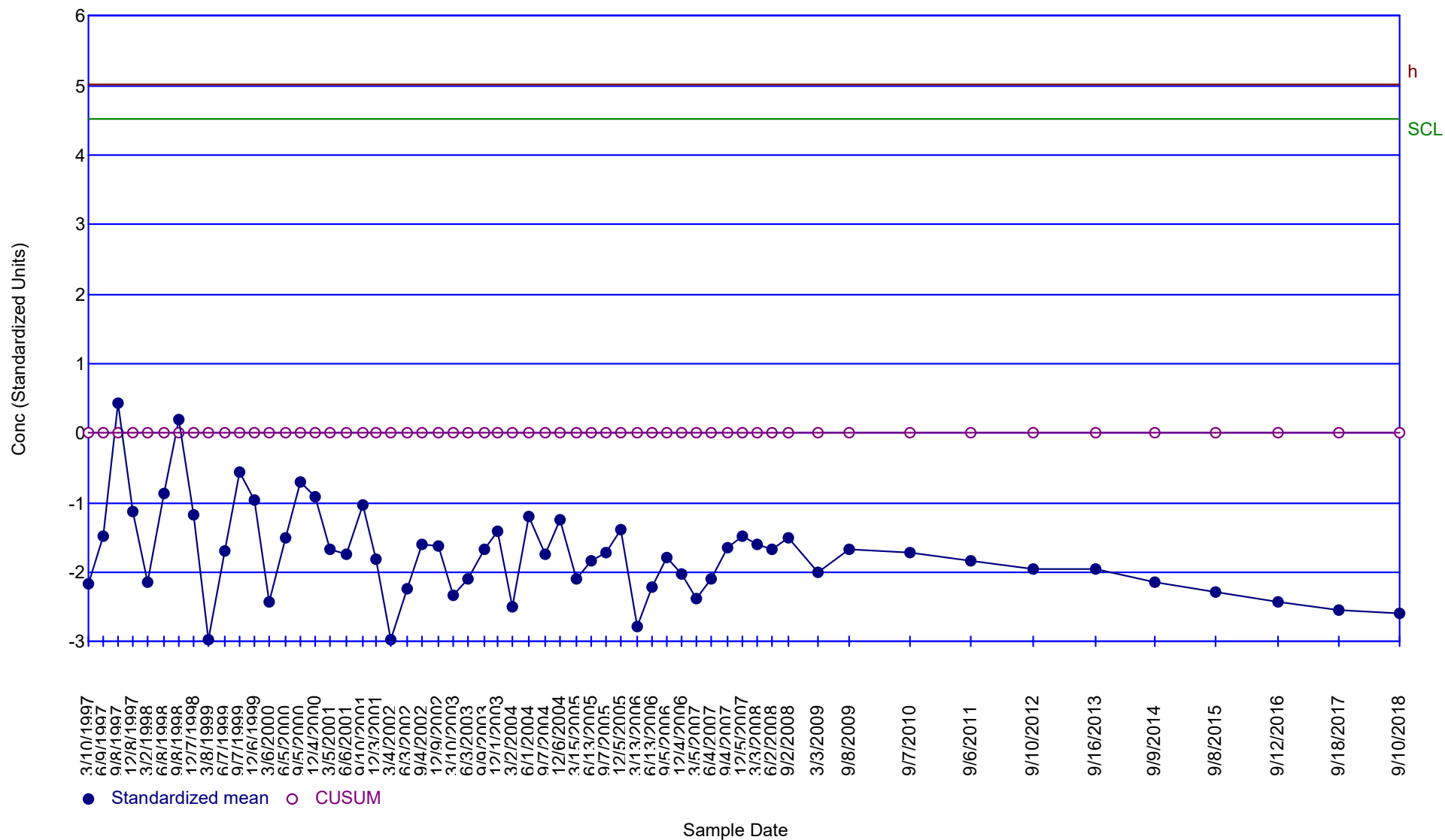
Intra-Well Shewhart-CUSUM Control Chart for Specific Conductivity at KMW-015A



CCL (h) = 1472.9; SCL = 1395.5

Kent Highlands Landfill

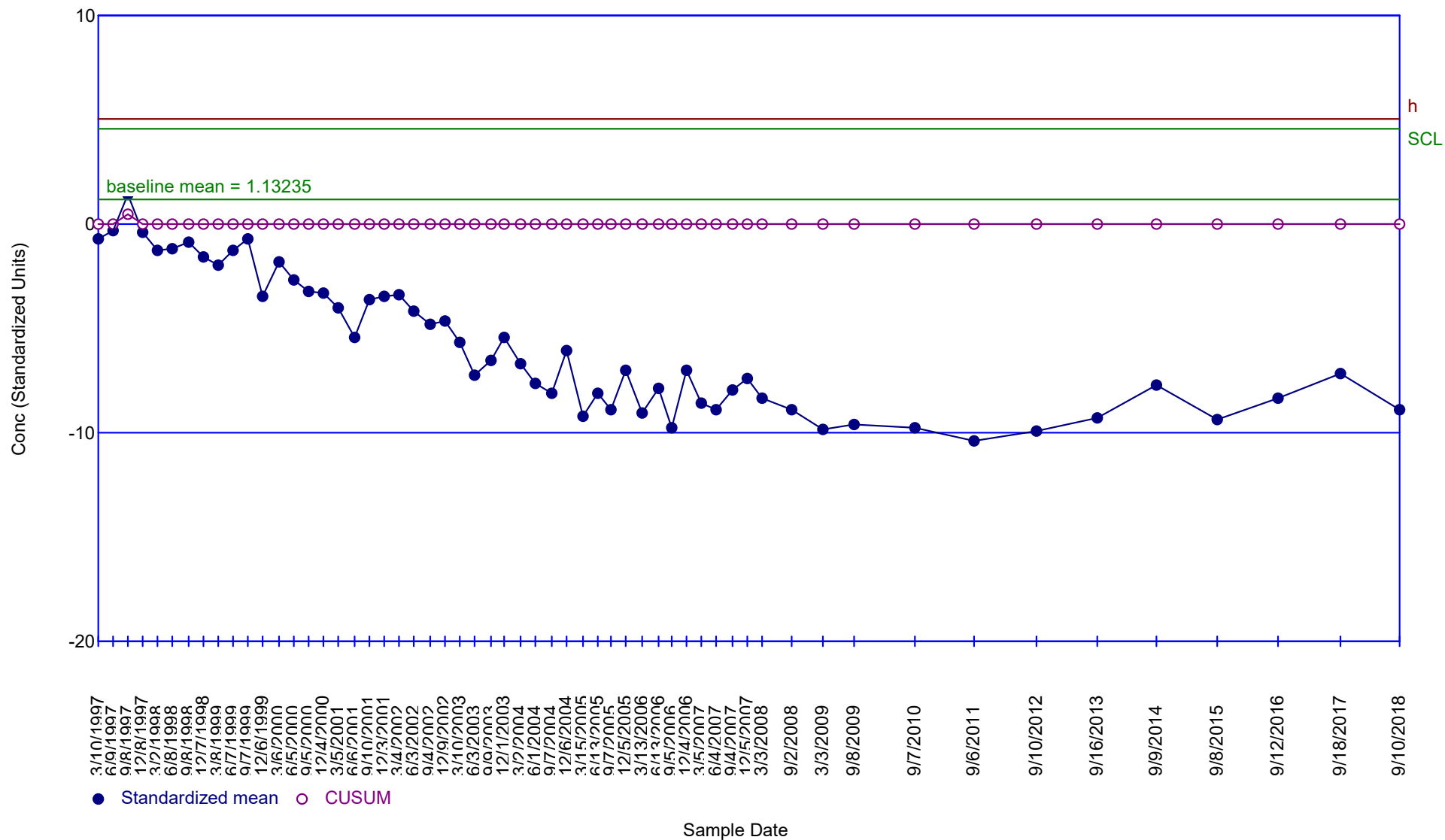
Intra-Well Shewhart-CUSUM Control Chart for Specific Conductivity at KMW-017



CCL (h) = 24.02; SCL = 22.68

Kent Highlands Landfill

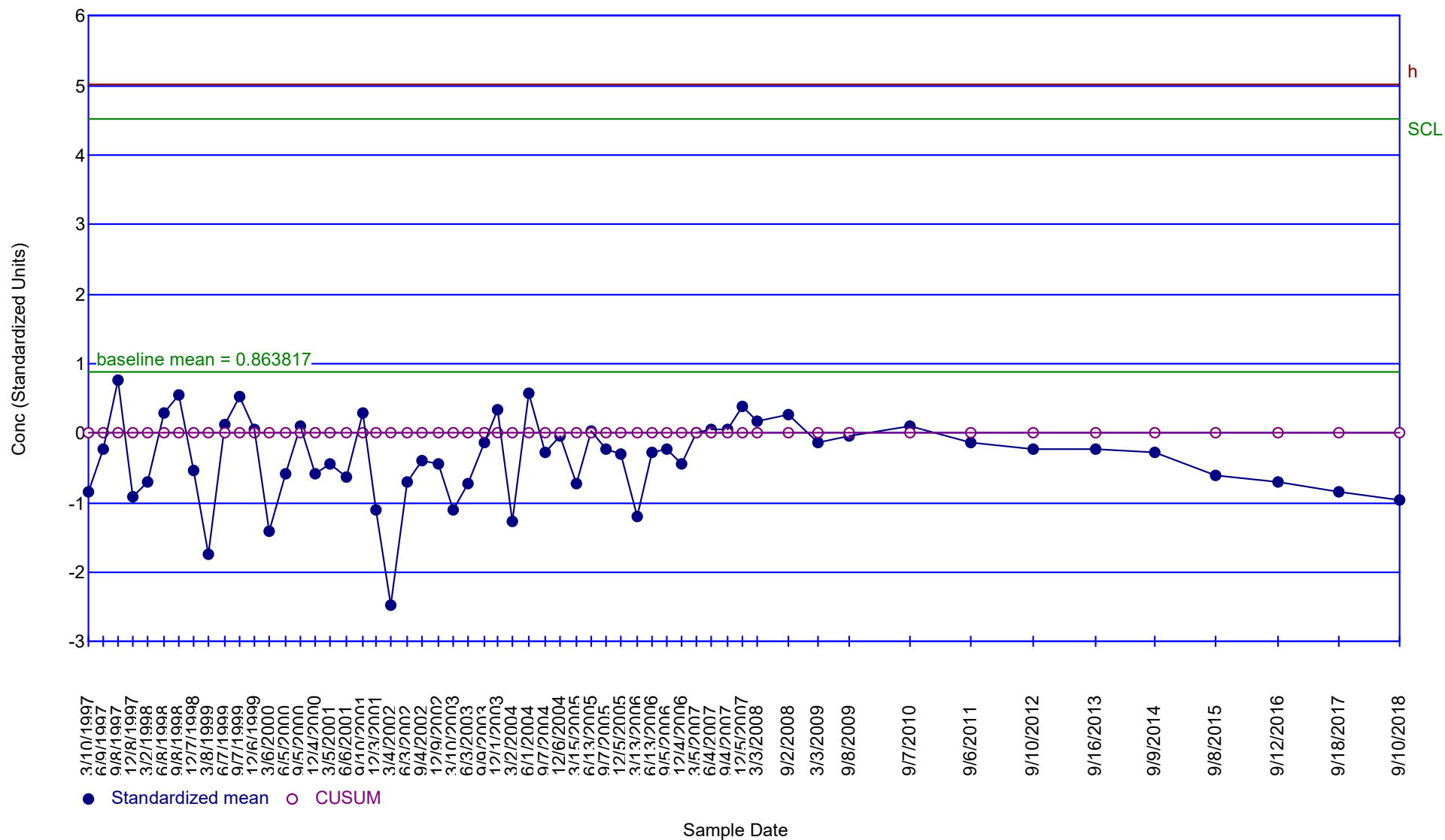
Intra-Well Shewhart-CUSUM Control Chart for Iron, Dissolved at KMW-010A



CCL (h) = 87.59; SCL = 68.32

Kent Highlands Landfill

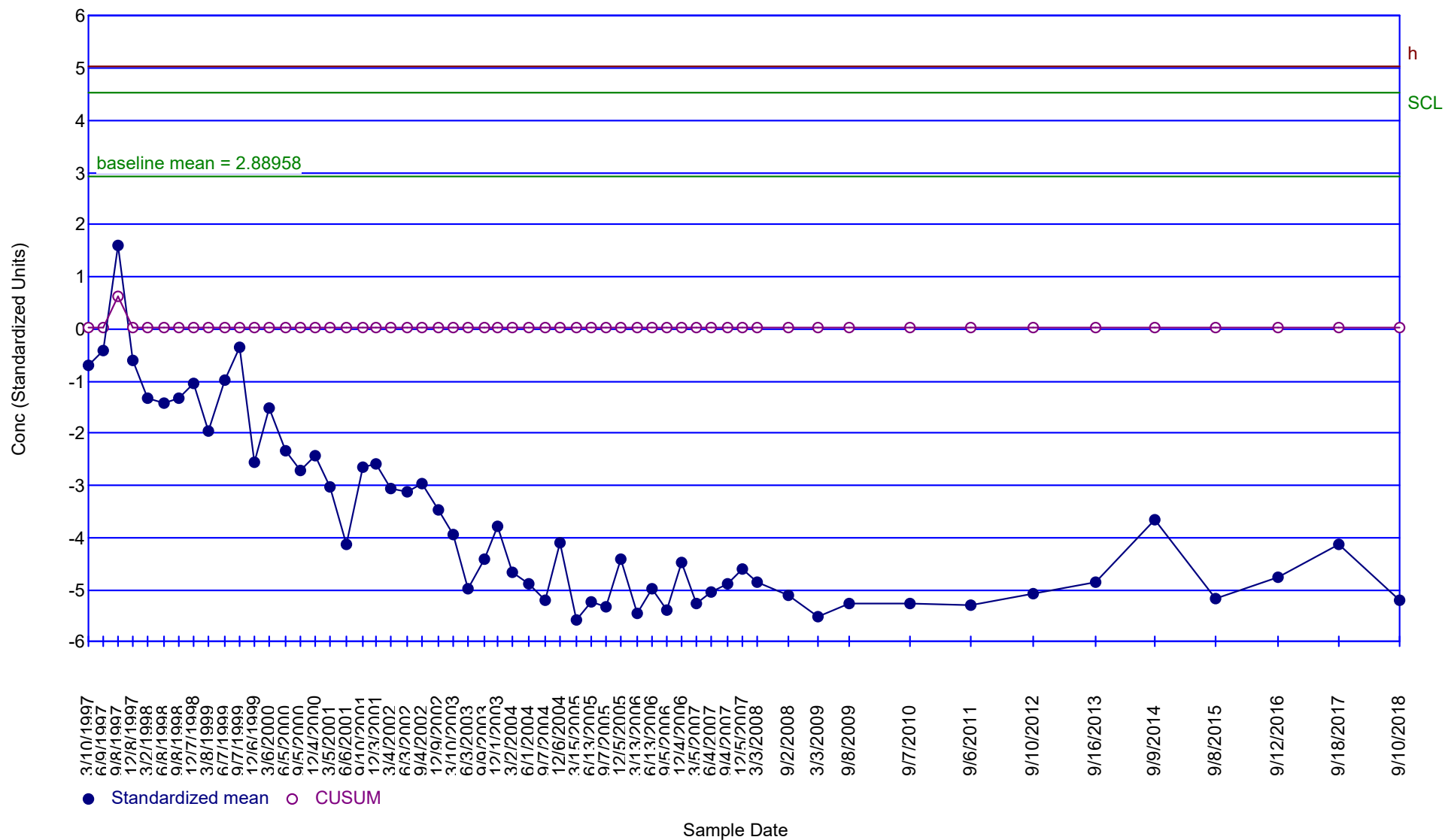
Intra-Well Shewhart-CUSUM Control Chart for Iron, Dissolved at KMW-017



CCL (h) = 4.51; SCL = 4.35

Kent Highlands Landfill

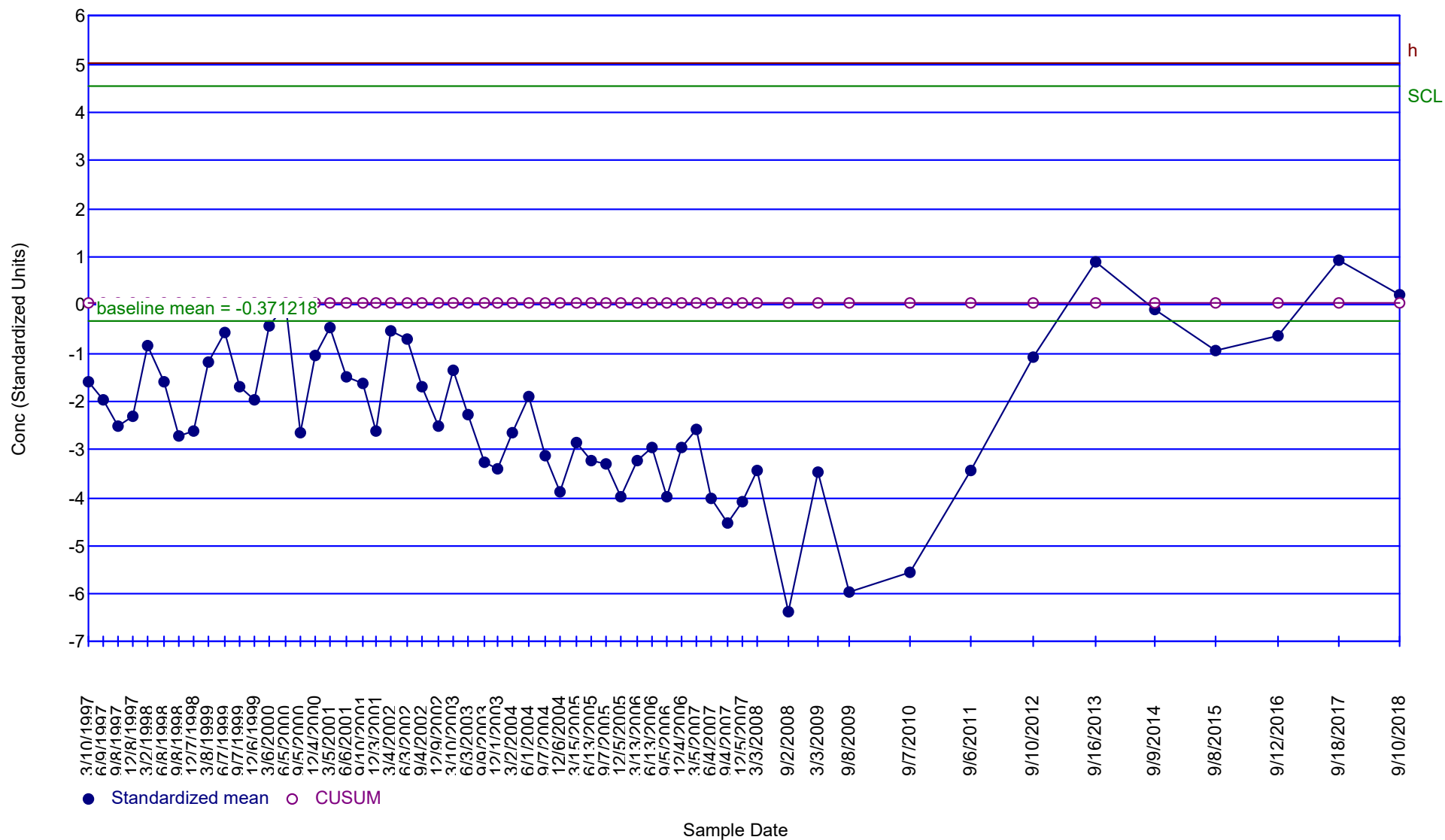
Intra-Well Shewhart-CUSUM Control Chart for Manganese, Dissolved at KMW-010A



CCL (h) = 0.633; SCL = 0.608

Kent Highlands Landfill

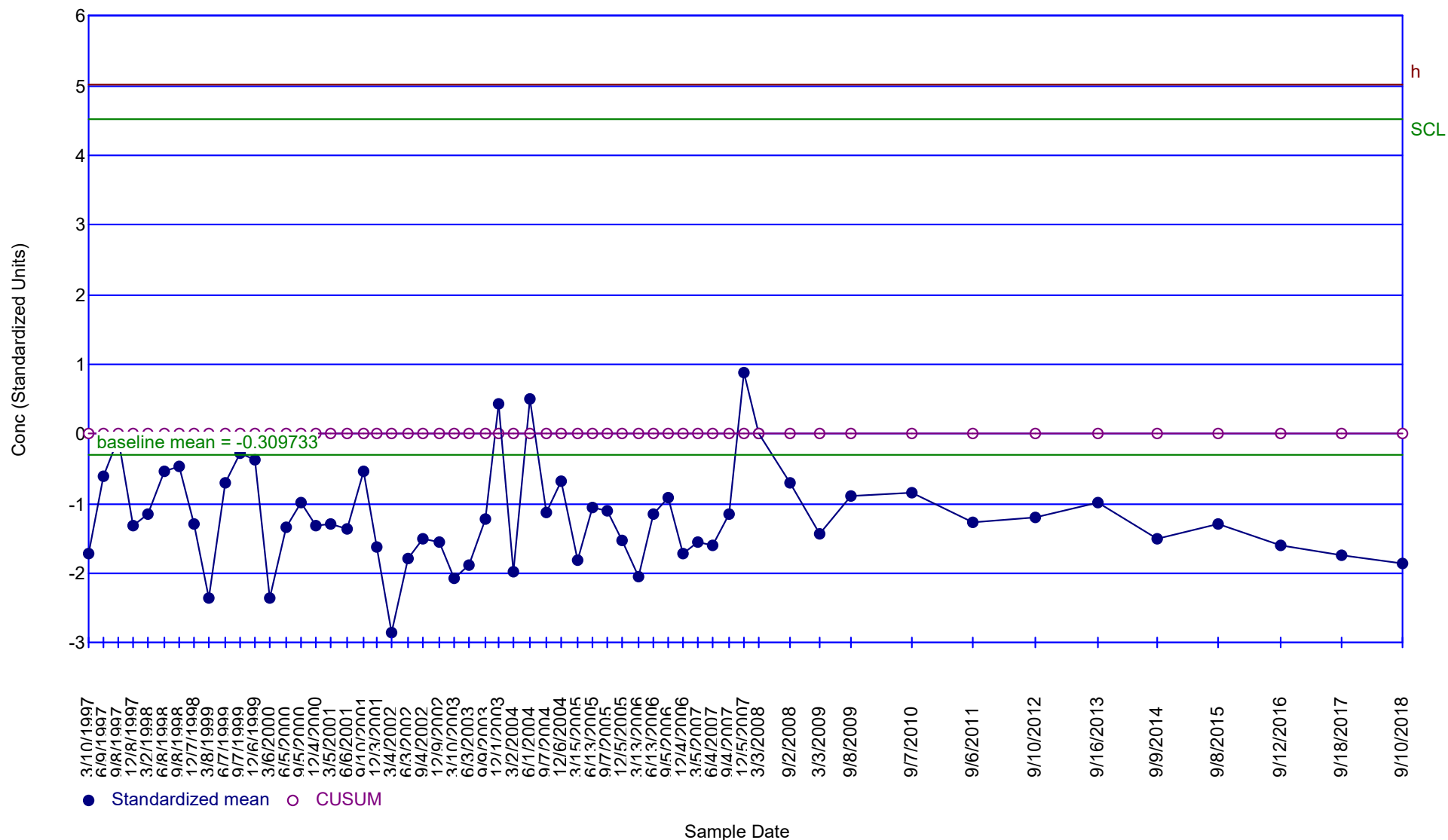
Intra-Well Shewhart-CUSUM Control Chart for Manganese, Dissolved at KMW-015A



CCL (h) = 8.97; SCL = 6.71

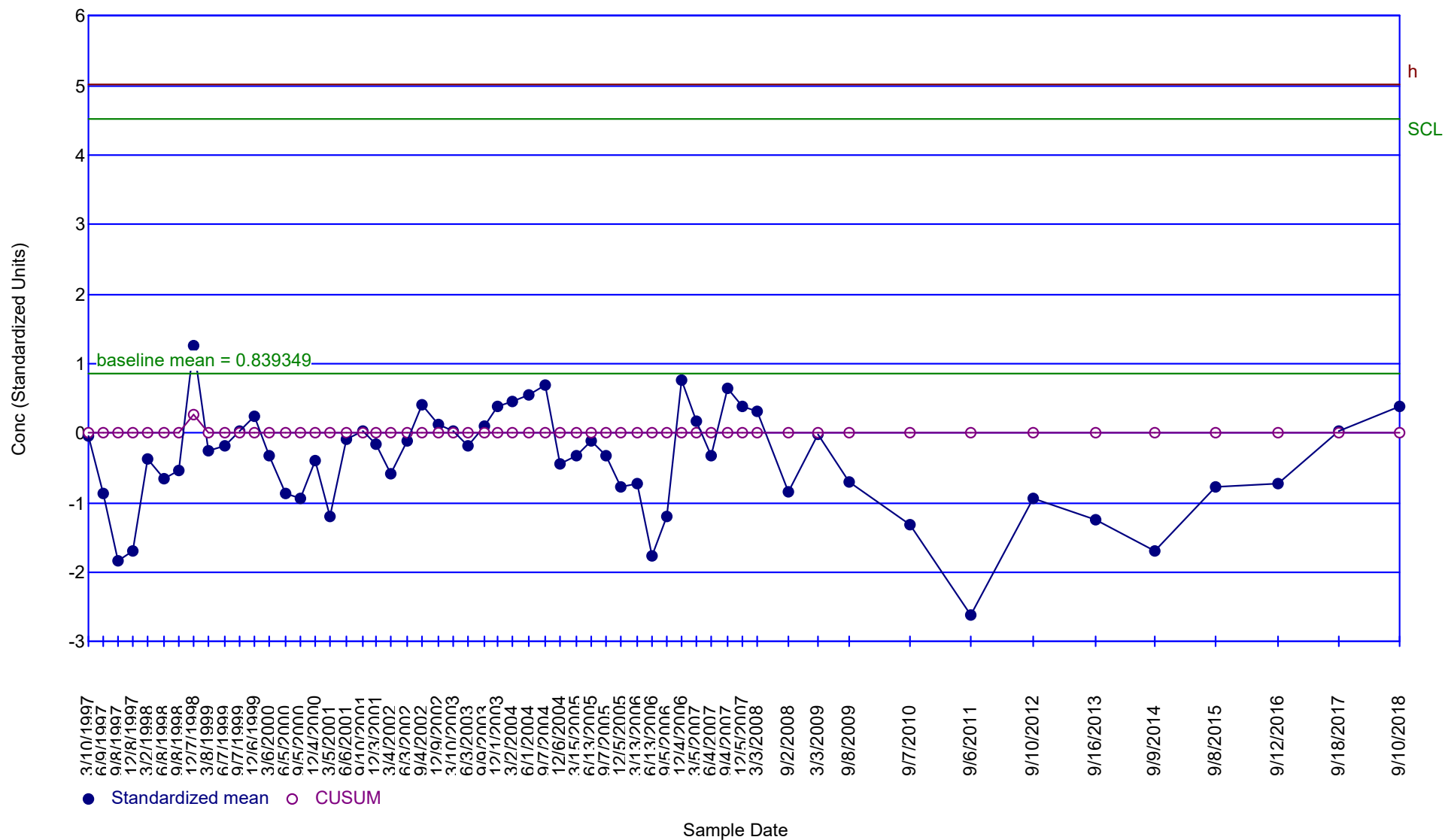
Kent Highlands Landfill

Intra-Well Shewhart-CUSUM Control Chart for Manganese, Dissolved at KMW-017



CCL (h) = 8.48; SCL = 8.31

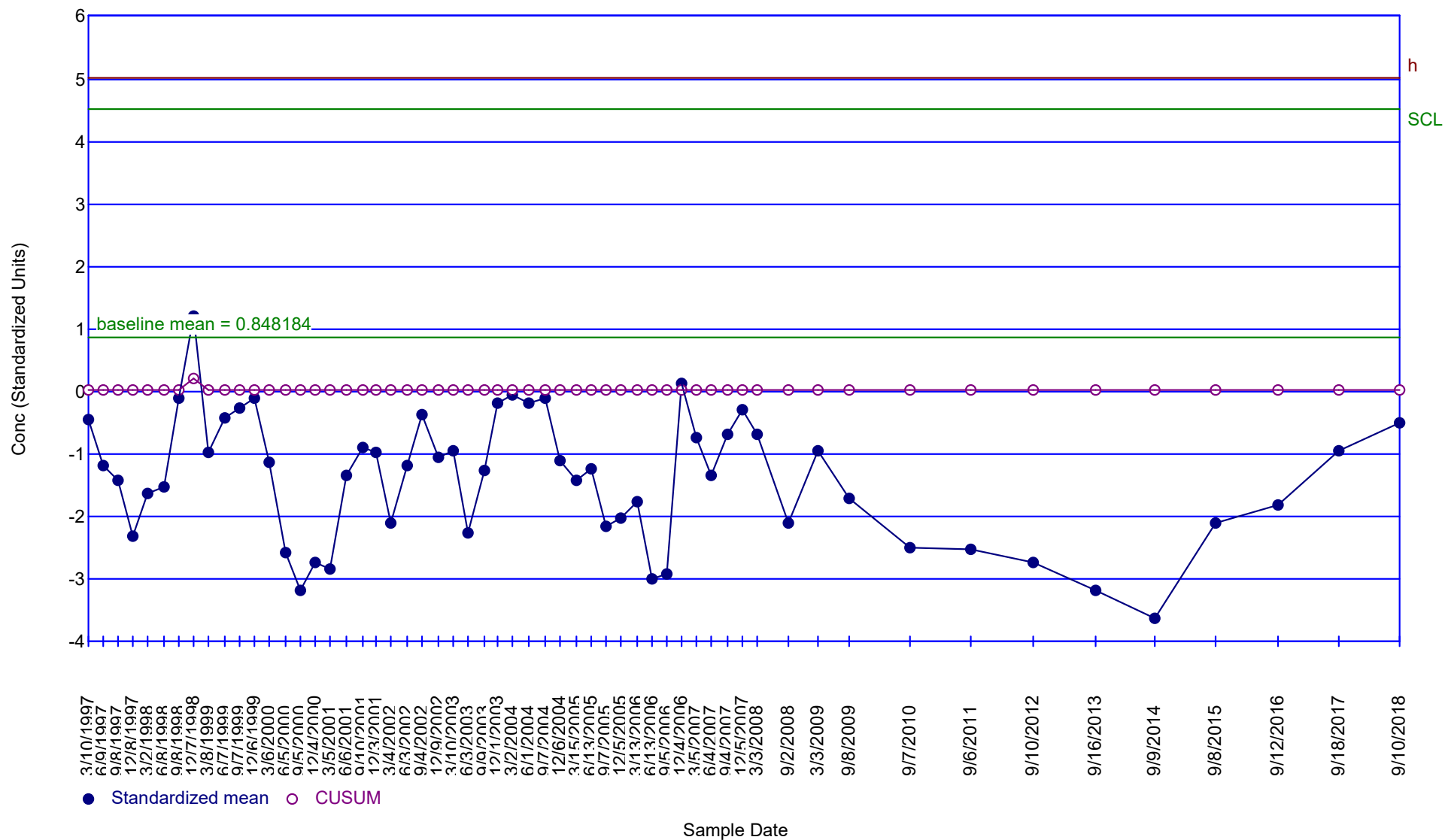
Kent Highlands Landfill Intra-Well Shewhart-CUSUM Control Chart for pH at KMW-010A



CCL (h) = 8.44; SCL = 8.29

Kent Highlands Landfill

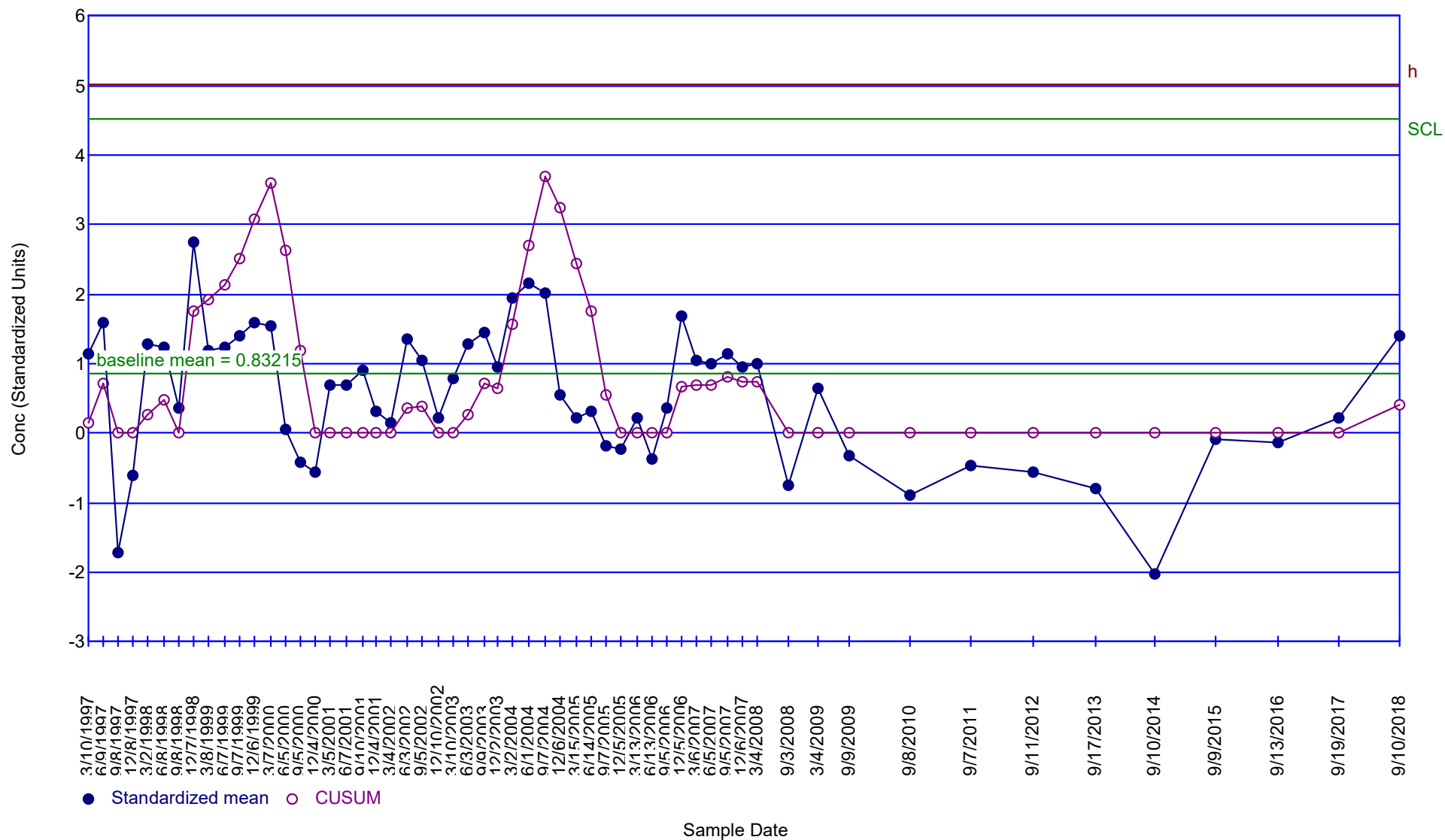
Intra-Well Shewhart-CUSUM Control Chart for pH at KMW-015A



CCL (h) = 7.96; SCL = 7.84

Kent Highlands Landfill

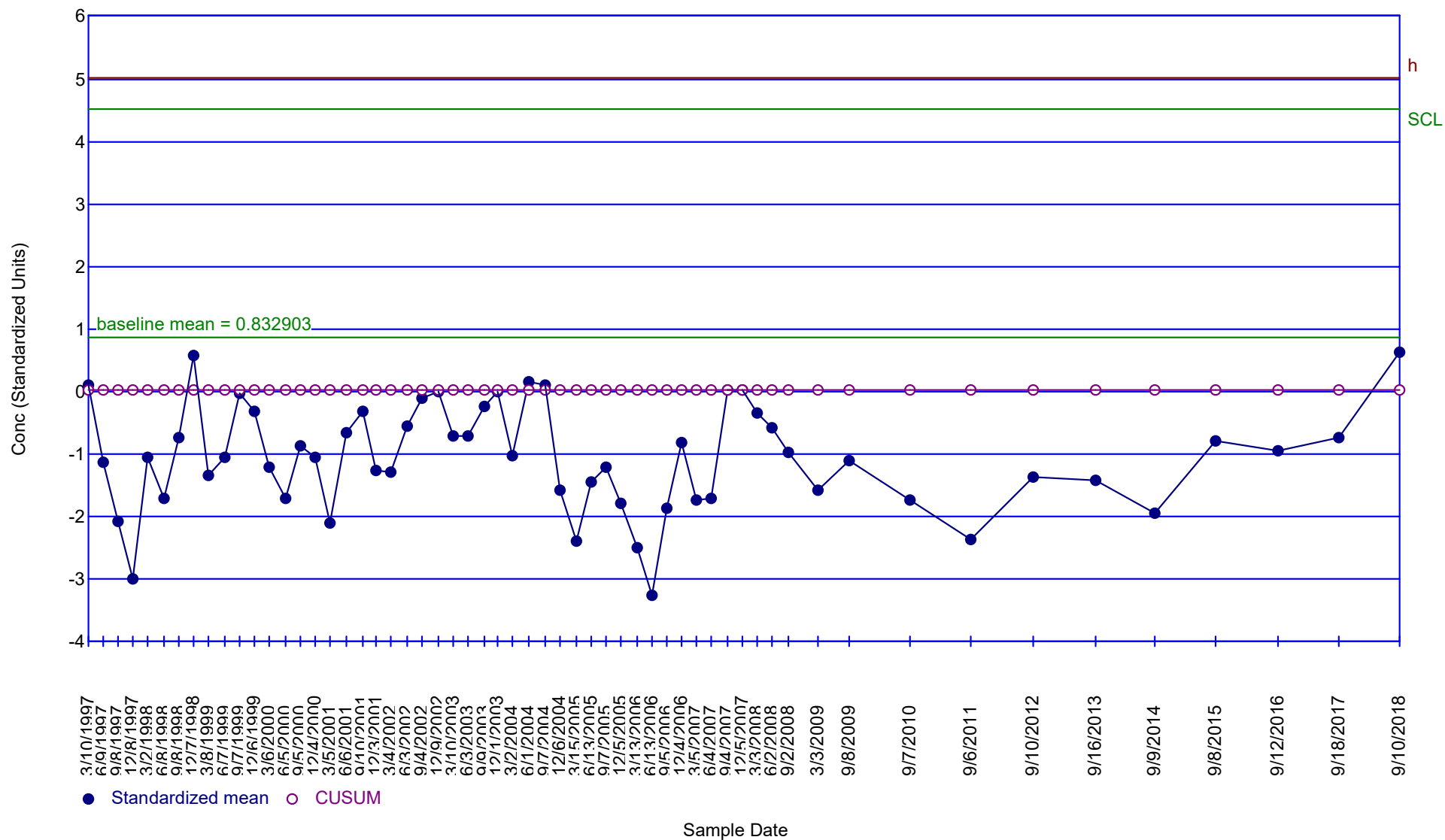
Intra-Well Shewhart-CUSUM Control Chart for pH at KMW-016A



CCL (h) = 8.25; SCL = 8.09

Kent Highlands Landfill

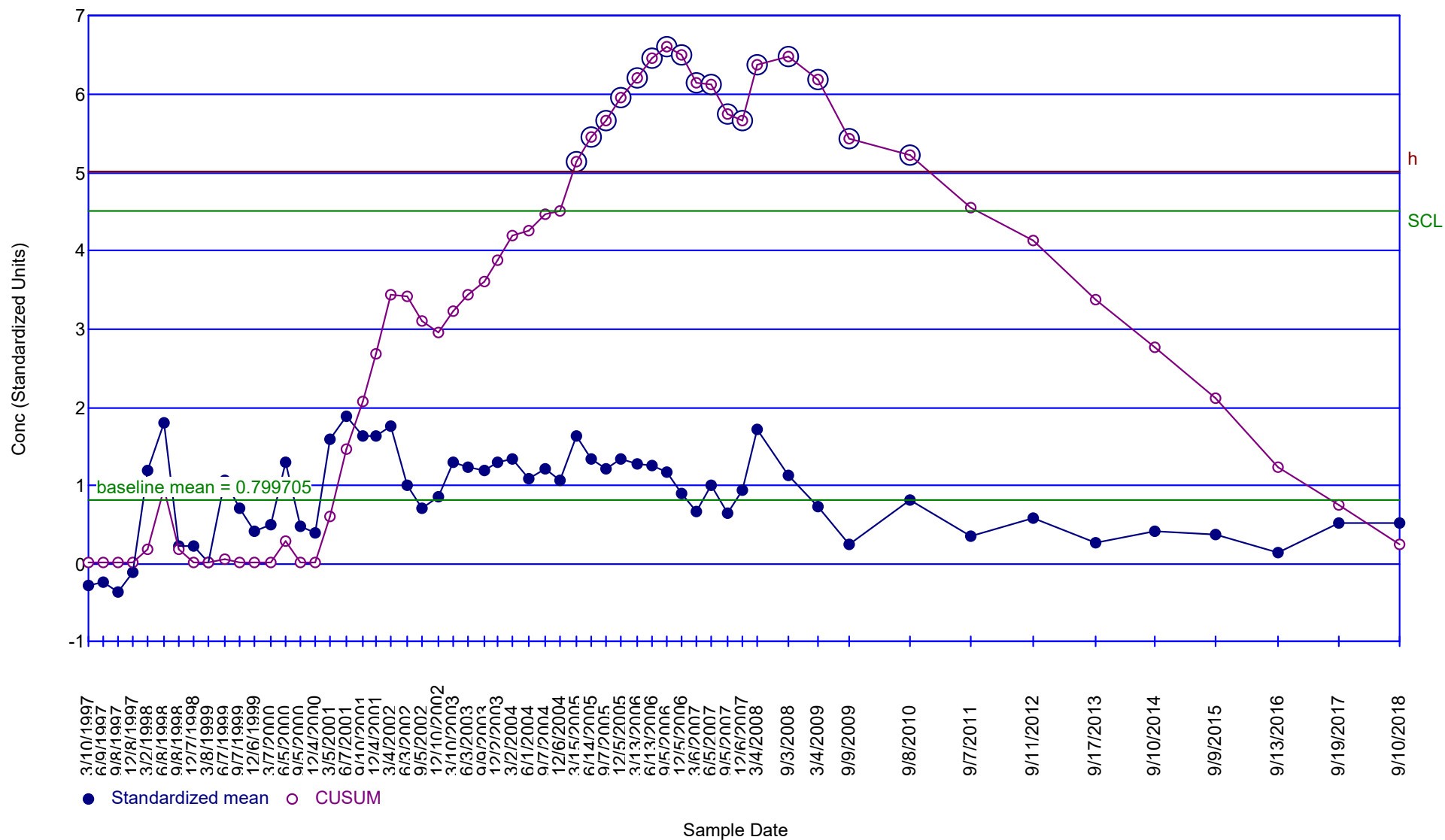
Intra-Well Shewhart-CUSUM Control Chart for pH at KMW-017



CCL (h) = 714.82; SCL = 445.40

Kent Highlands Landfill

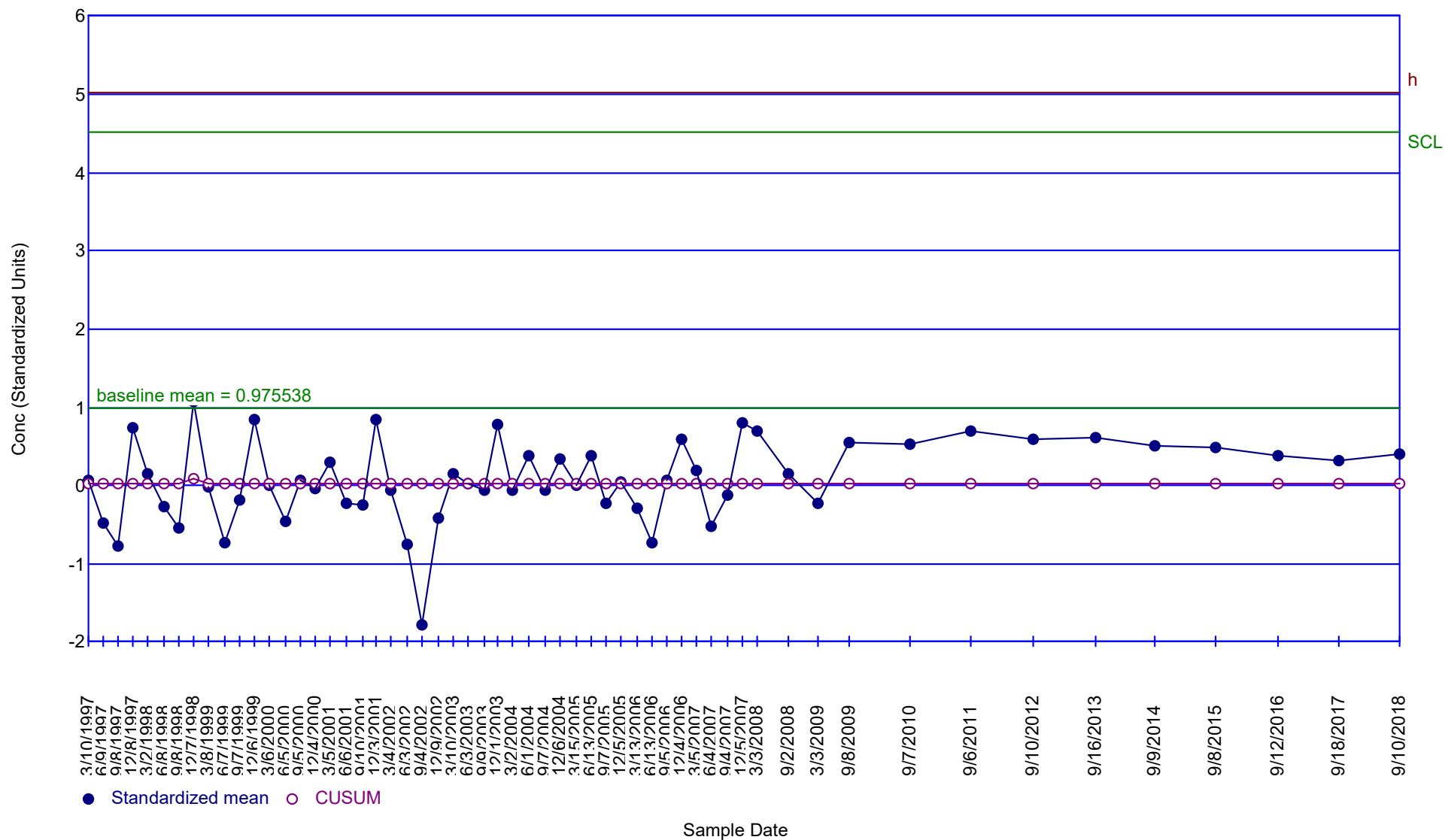
Intra-Well Shewhart-CUSUM Control Chart for Sulfate at KMW-016A



CCL (h) = 2547.0; SCL = 1455.4

Kent Highlands Landfill

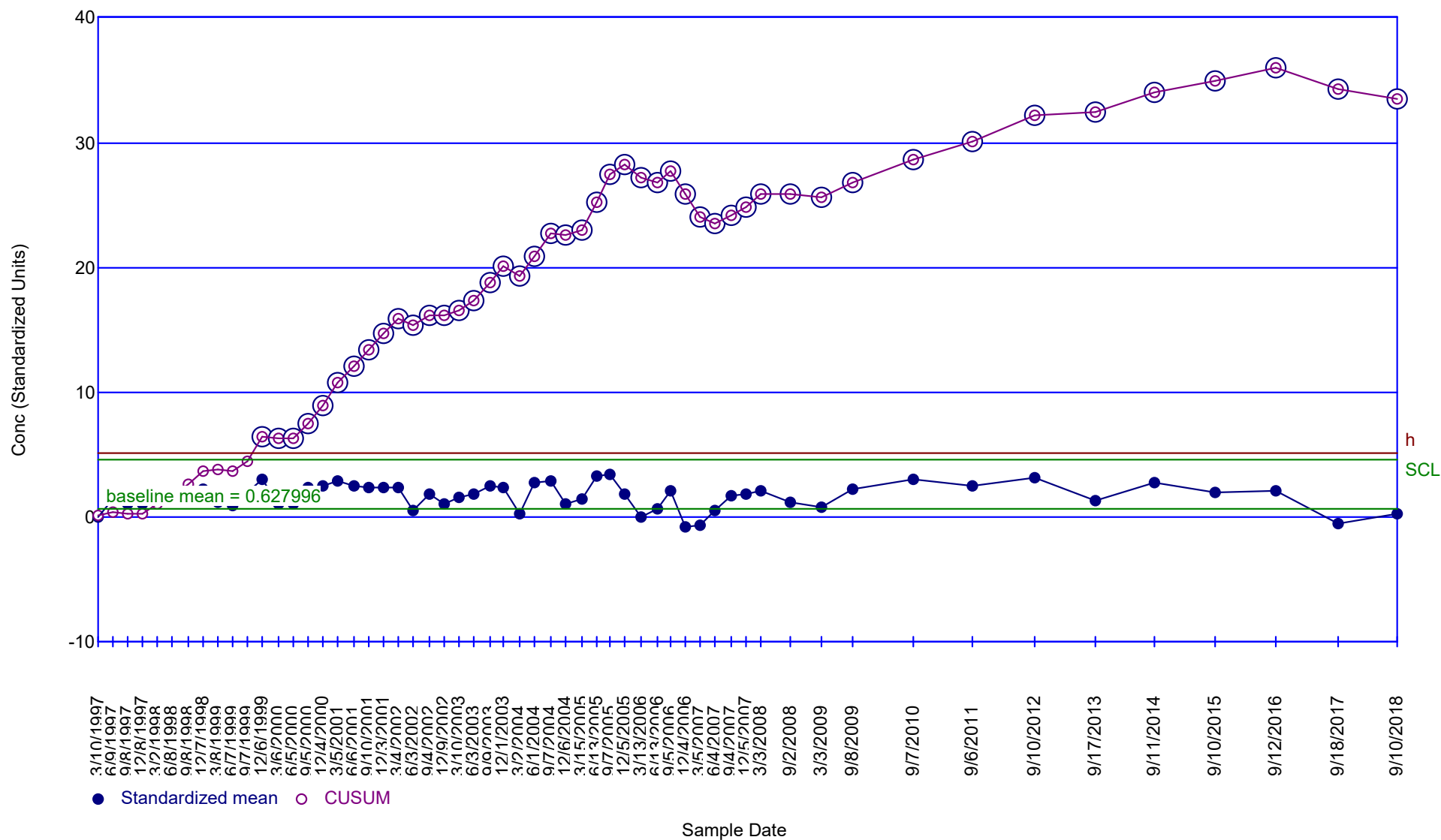
Intra-Well Shewhart-CUSUM Control Chart for Sulfate at KMW-017



CCL (h) = 41.84; SCL = 33.28

Kent Highlands Landfill

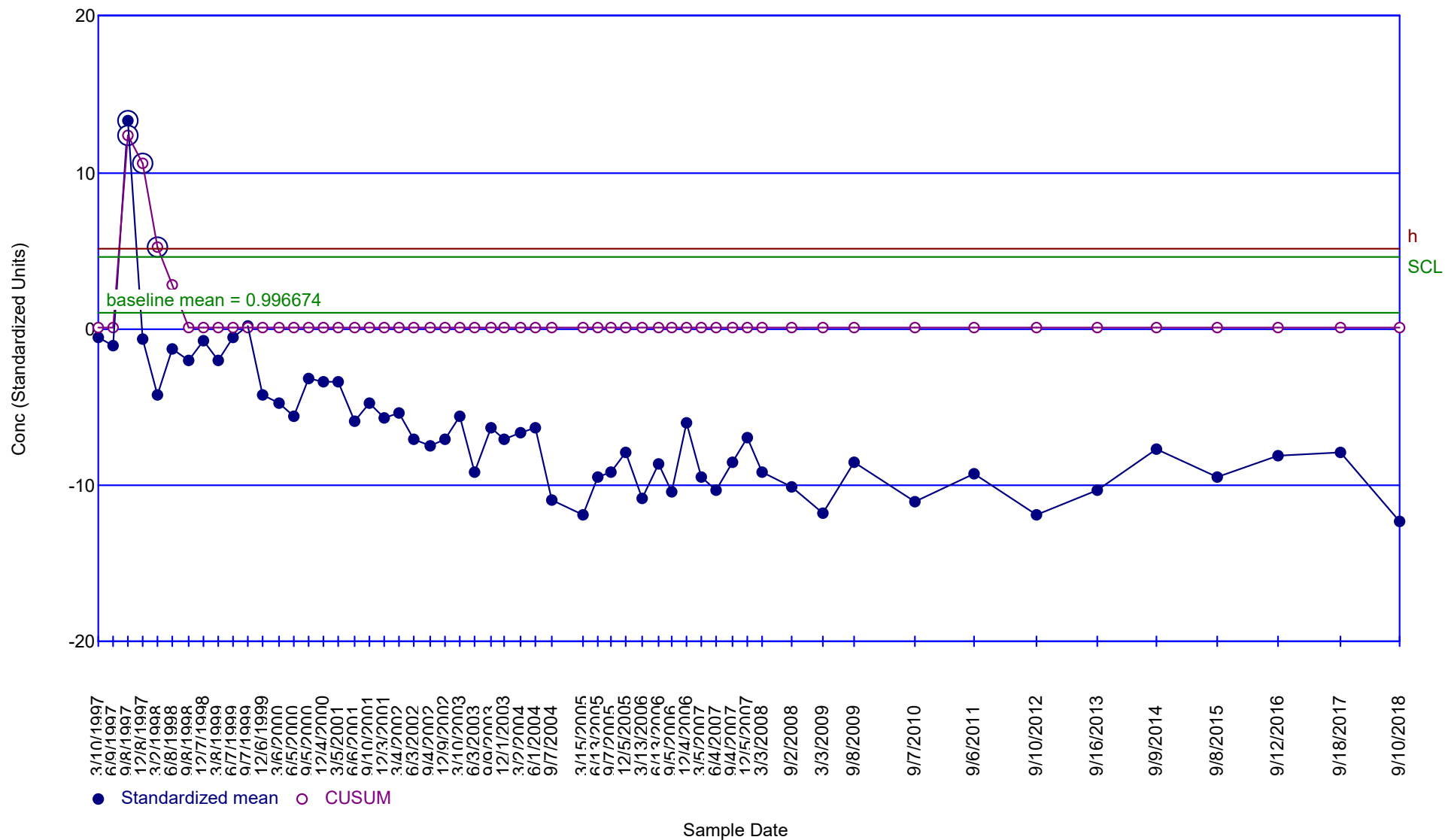
Intra-Well Shewhart-CUSUM Control Chart for Sulfate at KMW-019A



CCL (h) = 16.50; SCL = 15.68

Kent Highlands Landfill

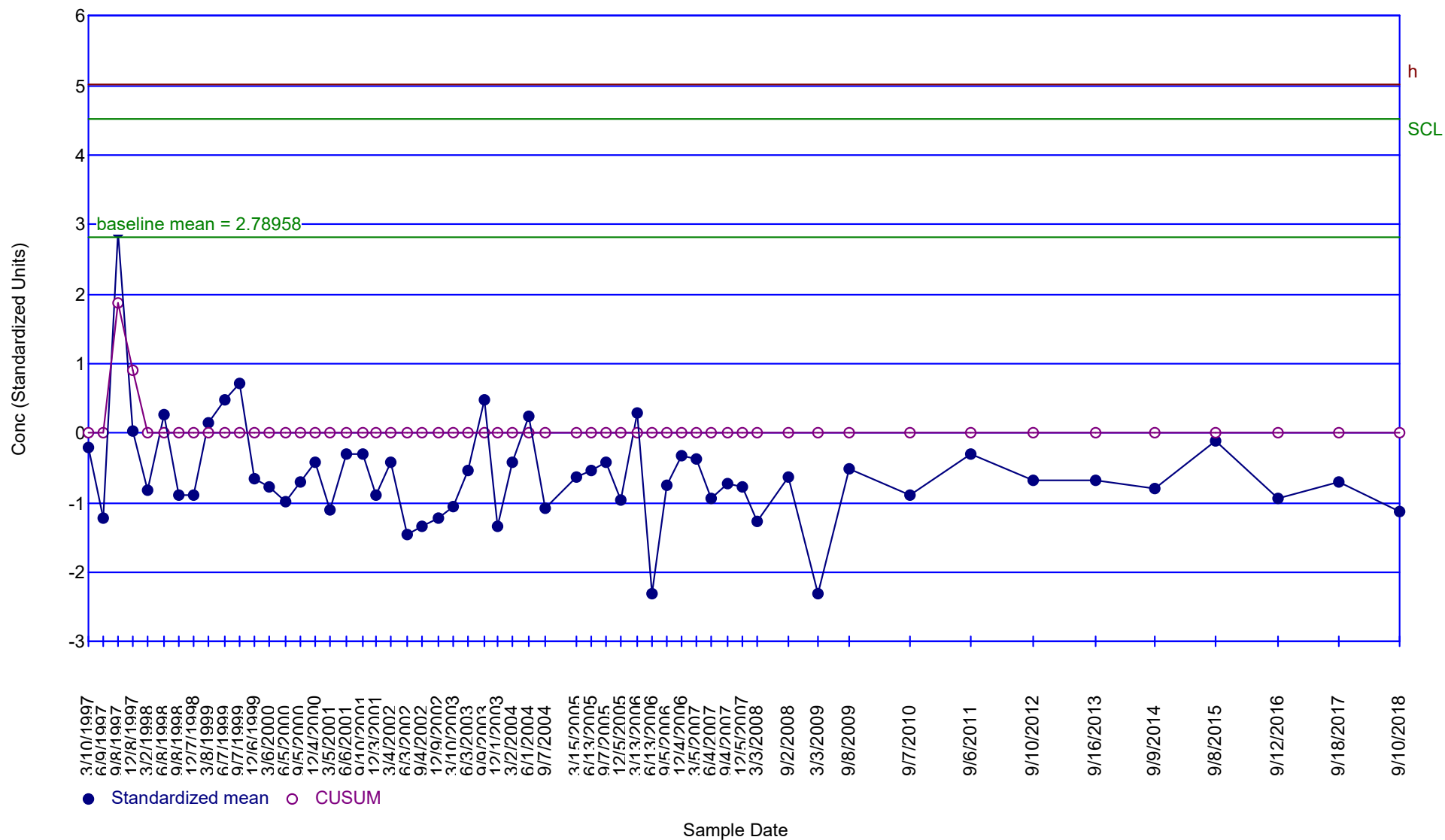
Intra-Well Shewhart-CUSUM Control Chart for Total Organic Carbon at KMW-010A



CCL (h) = 7.17; SCL = 6.73

Kent Highlands Landfill

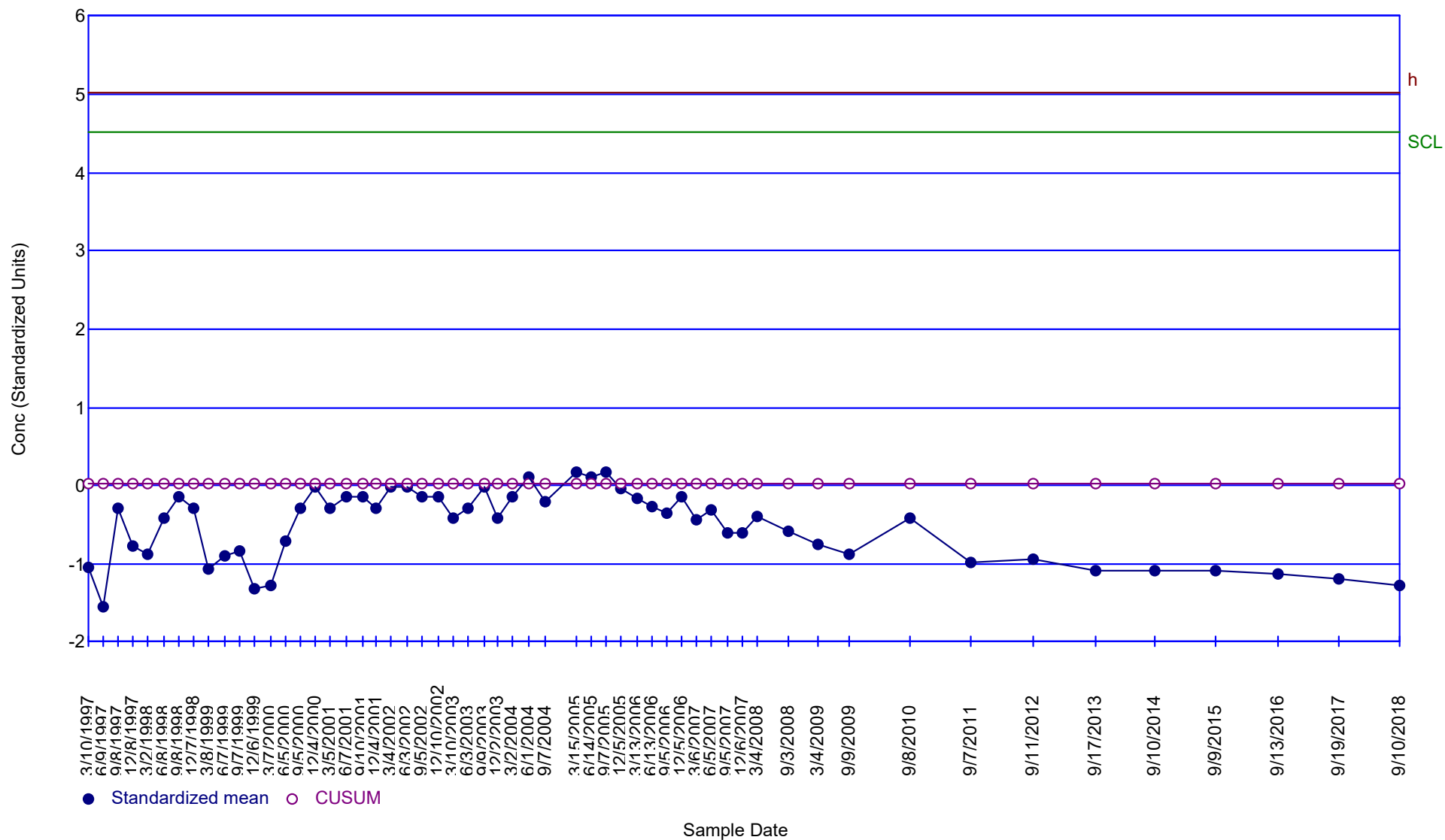
Intra-Well Shewhart-CUSUM Control Chart for Total Organic Carbon at KMW-015A



CCL (h) = 51.03; SCL = 47.35

Kent Highlands Landfill

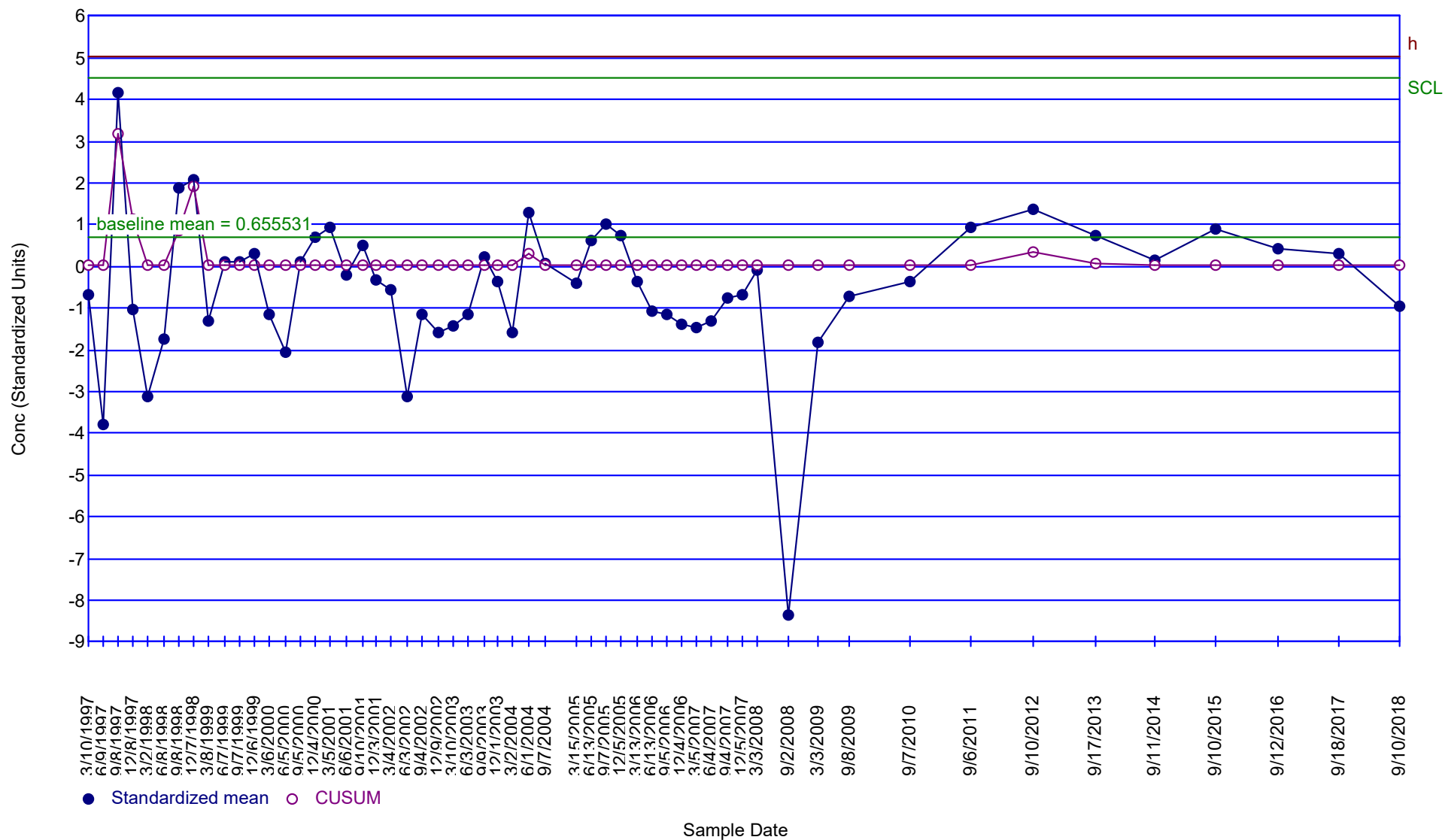
Intra-Well Shewhart-CUSUM Control Chart for Total Organic Carbon at KMW-016A



CCL (h) = 13.20; SCL = 11.86

Kent Highlands Landfill

Intra-Well Shewhart-CUSUM Control Chart for Total Organic Carbon at KMW-019A



Shewhart Control Charts

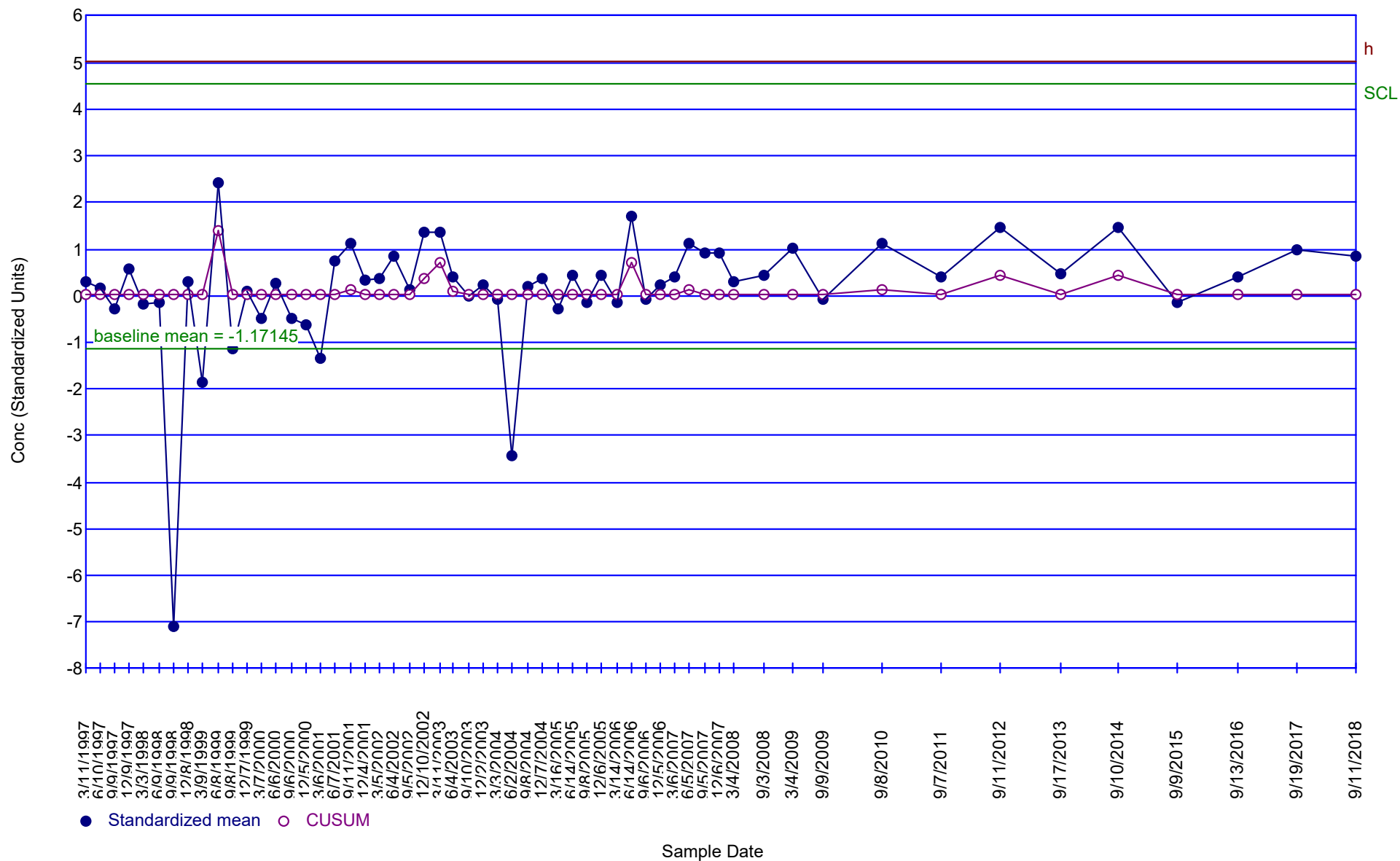
Sand Aquifer



CCL (h) = 0.417; SCL = 0.347

Kent Highlands Landfill

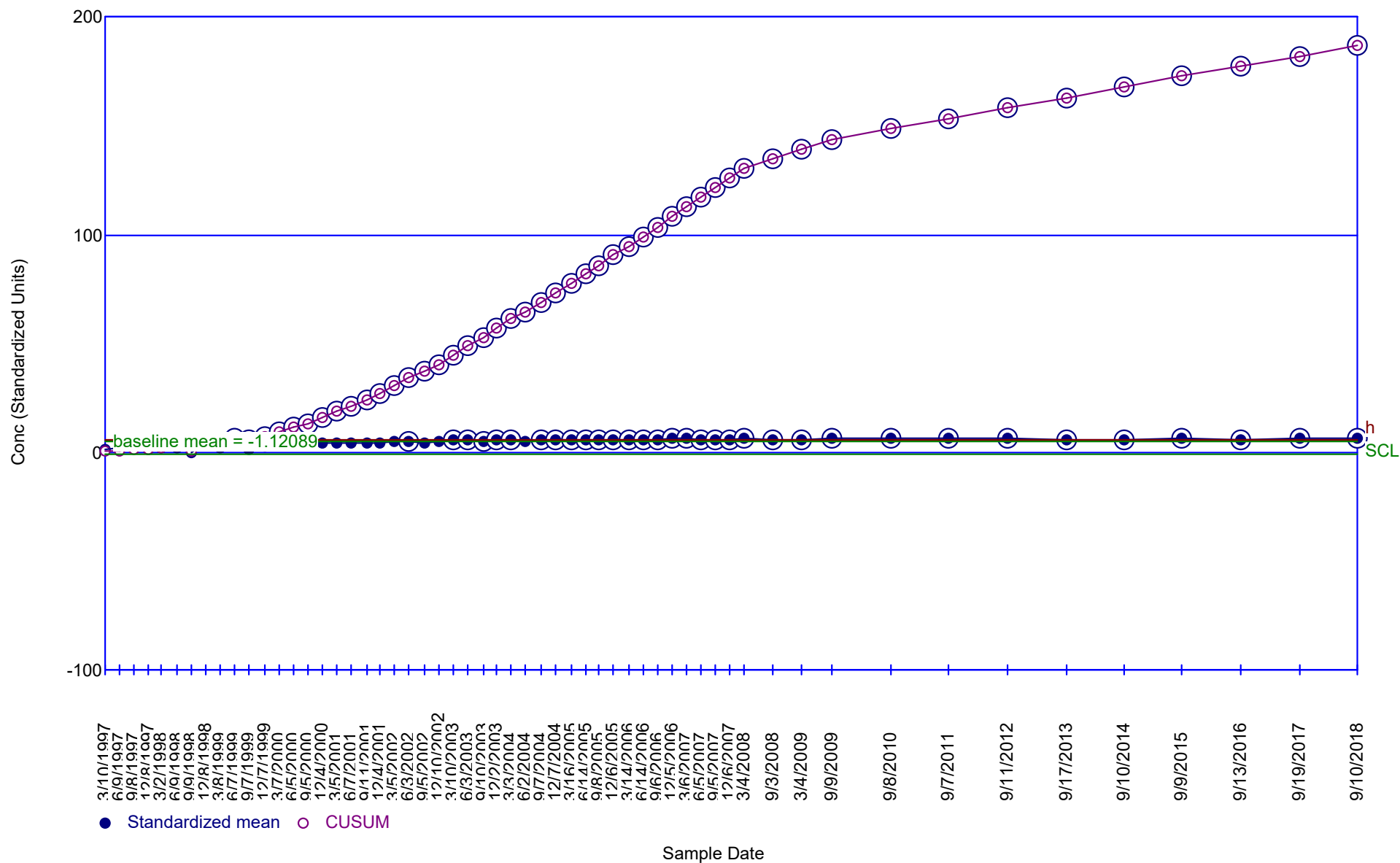
Intra-Well Shewhart-CUSUM Control Chart for Ammonia-N at KMW-008A



CCL (h) = 0.372; SCL = 0.317

Kent Highlands Landfill

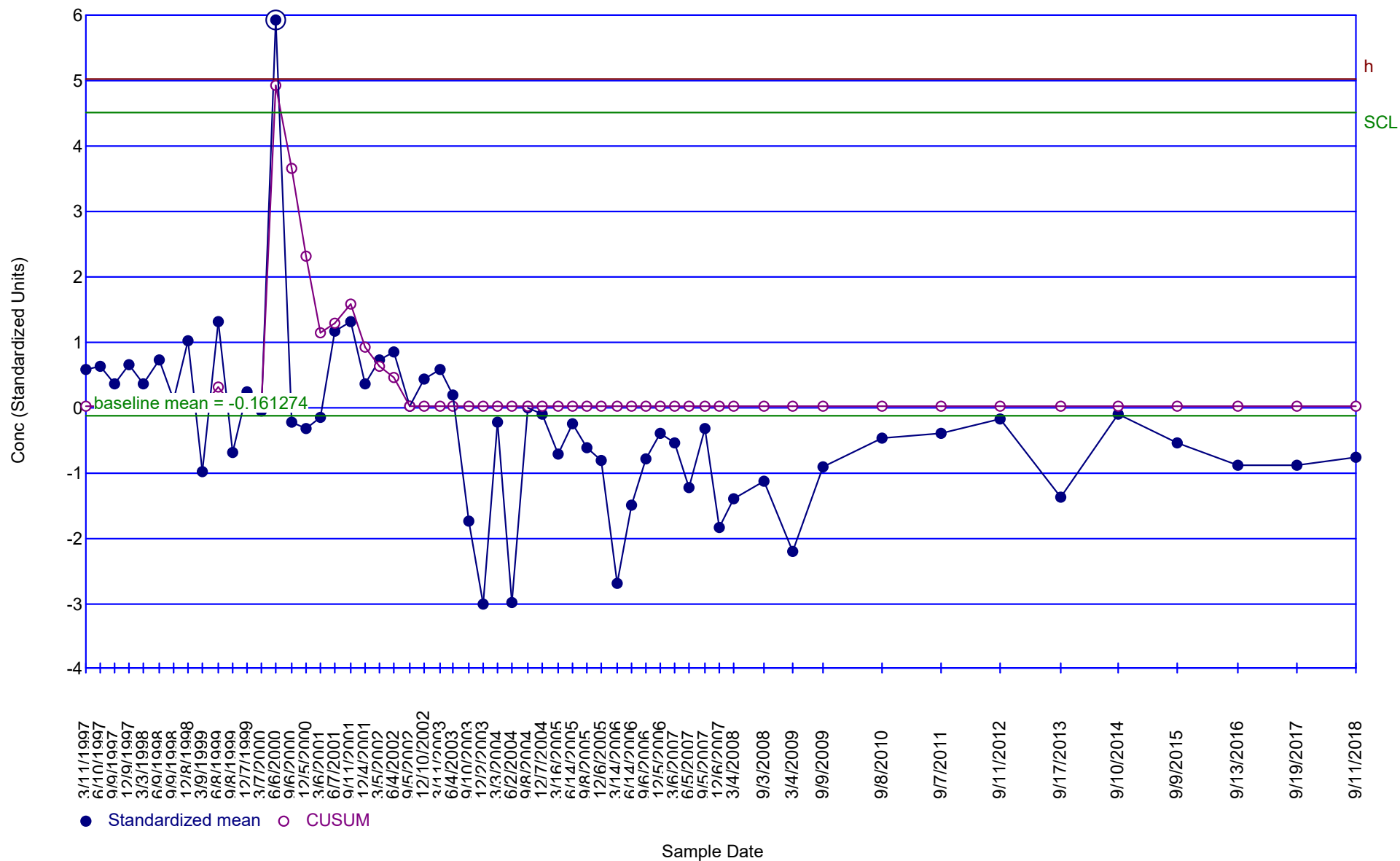
Intra-Well Shewhart-CUSUM Control Chart for Ammonia-N at KMW-016B



CCL (h) = 1.63; SCL = 1.49

Kent Highlands Landfill

Intra-Well Shewhart-CUSUM Control Chart for Ammonia-N at KMW-018A

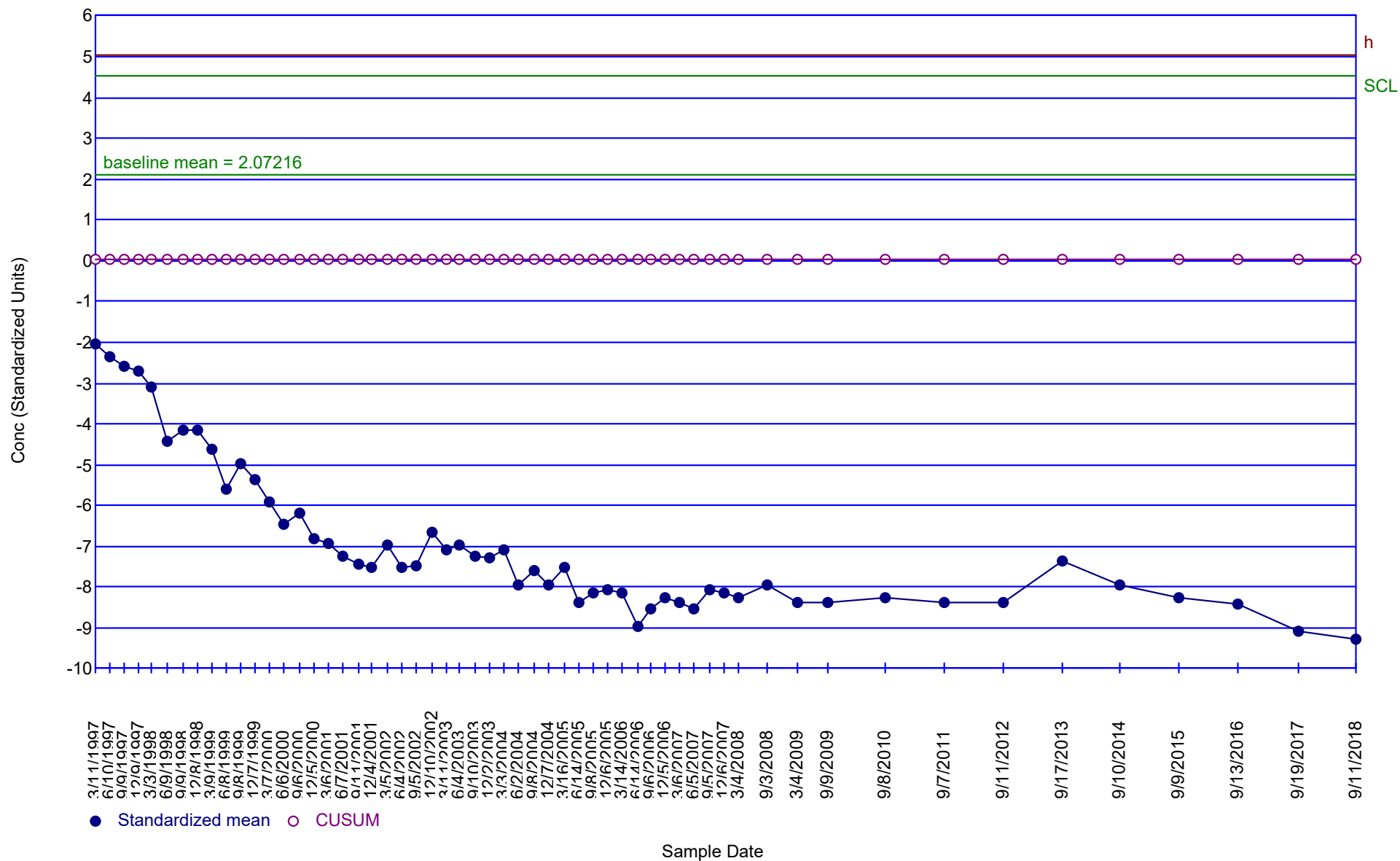


Non-Detects Replaced with 1/2 DL

Log Base 10 Transformation

CCL (h) = 15 14.5; SCL = 1173.4

Kent Highlands Landfill Intra-Well Shewhart-CUSUM Control Chart for Chloride at KMW-012A

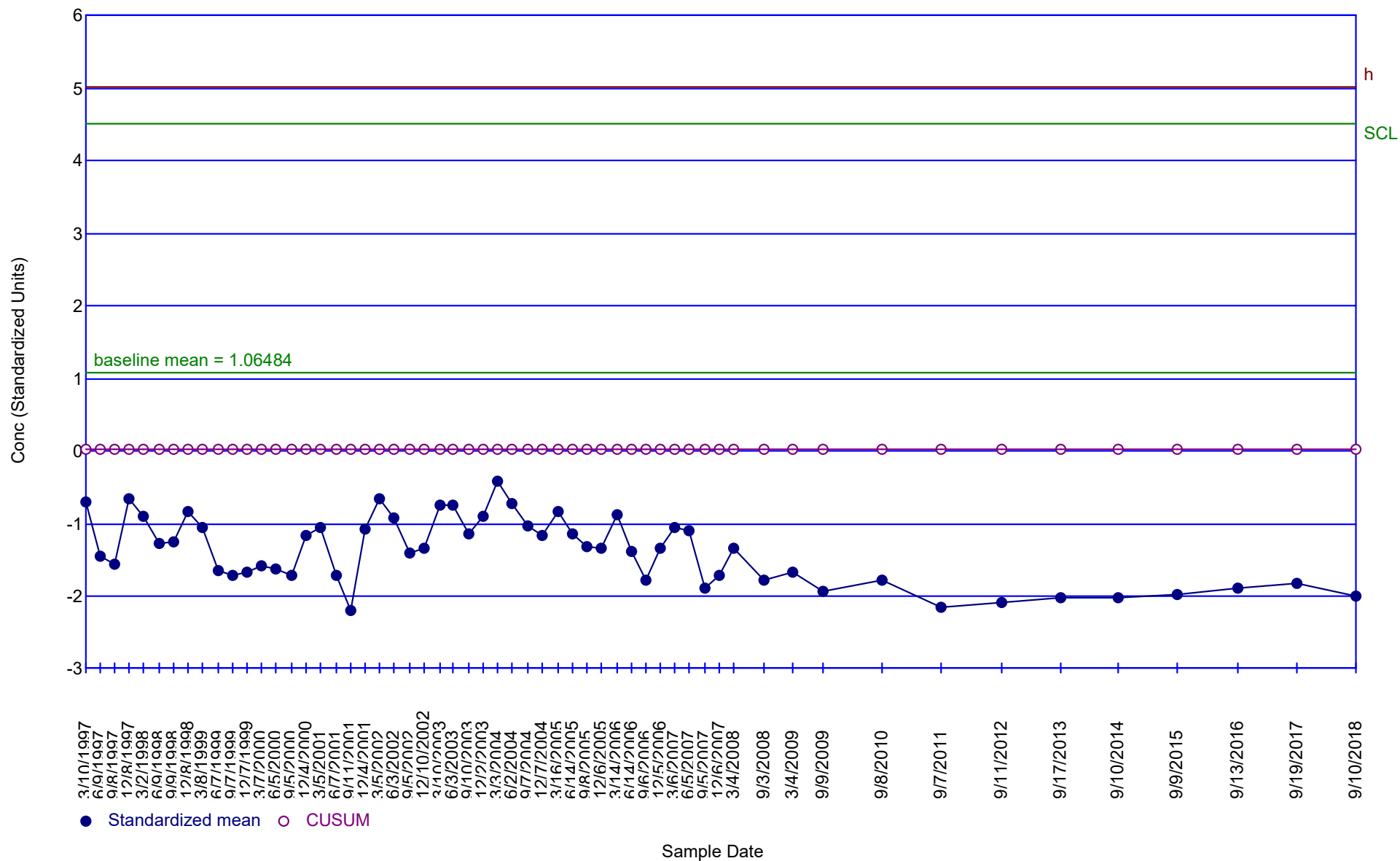


Non-Detects Replaced with 1/2 DL

Log Base 10 Transformation

CCL (h) = 374.55; SCL = 264.63

Kent Highlands Landfill Intra-Well Shewhart-CUSUM Control Chart for Chloride at KMW-016B

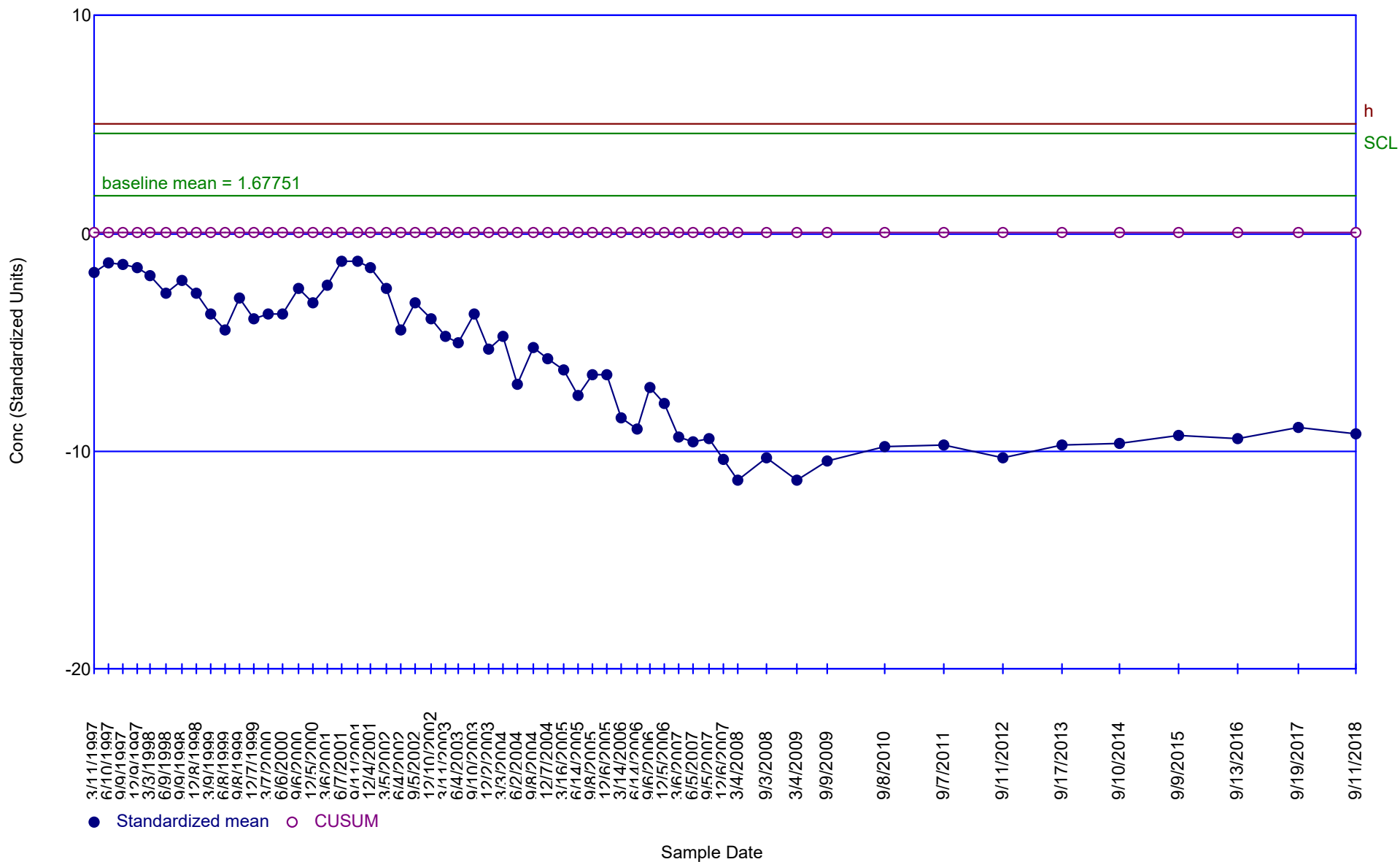


Non-Detects Replaced with 1/2 DL

Log Base 10 Transformation

CCL (h) = 10 1.80; SCL = 94.35

Kent Highlands Landfill Intra-Well Shewhart-CUSUM Control Chart for Chloride at KMW-018A



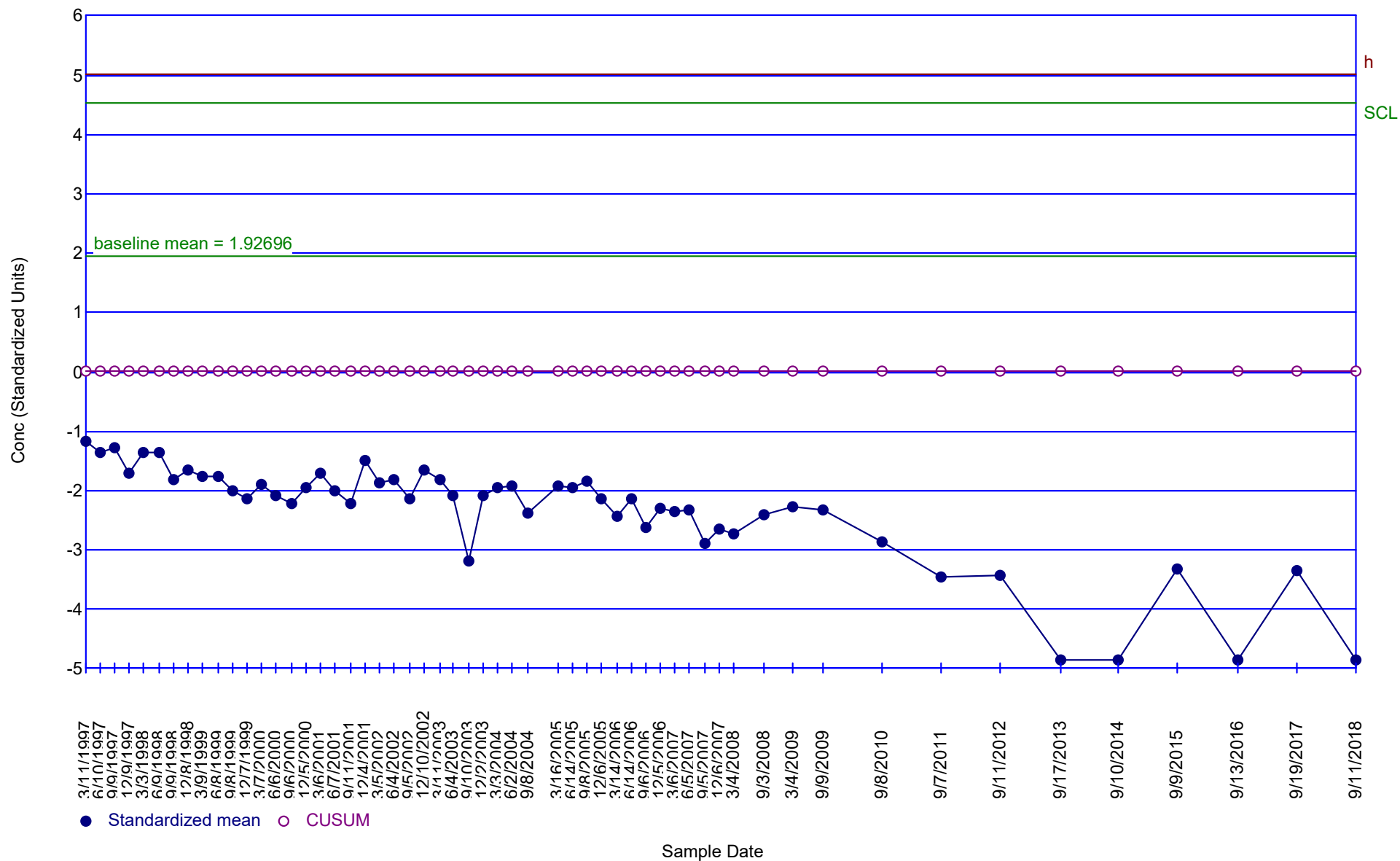
Non-Detects Replaced with 1/2 DL

Log Base 10 Transformation

CCL (h) = 1542.0; SCL = 1153.4

Kent Highlands Landfill

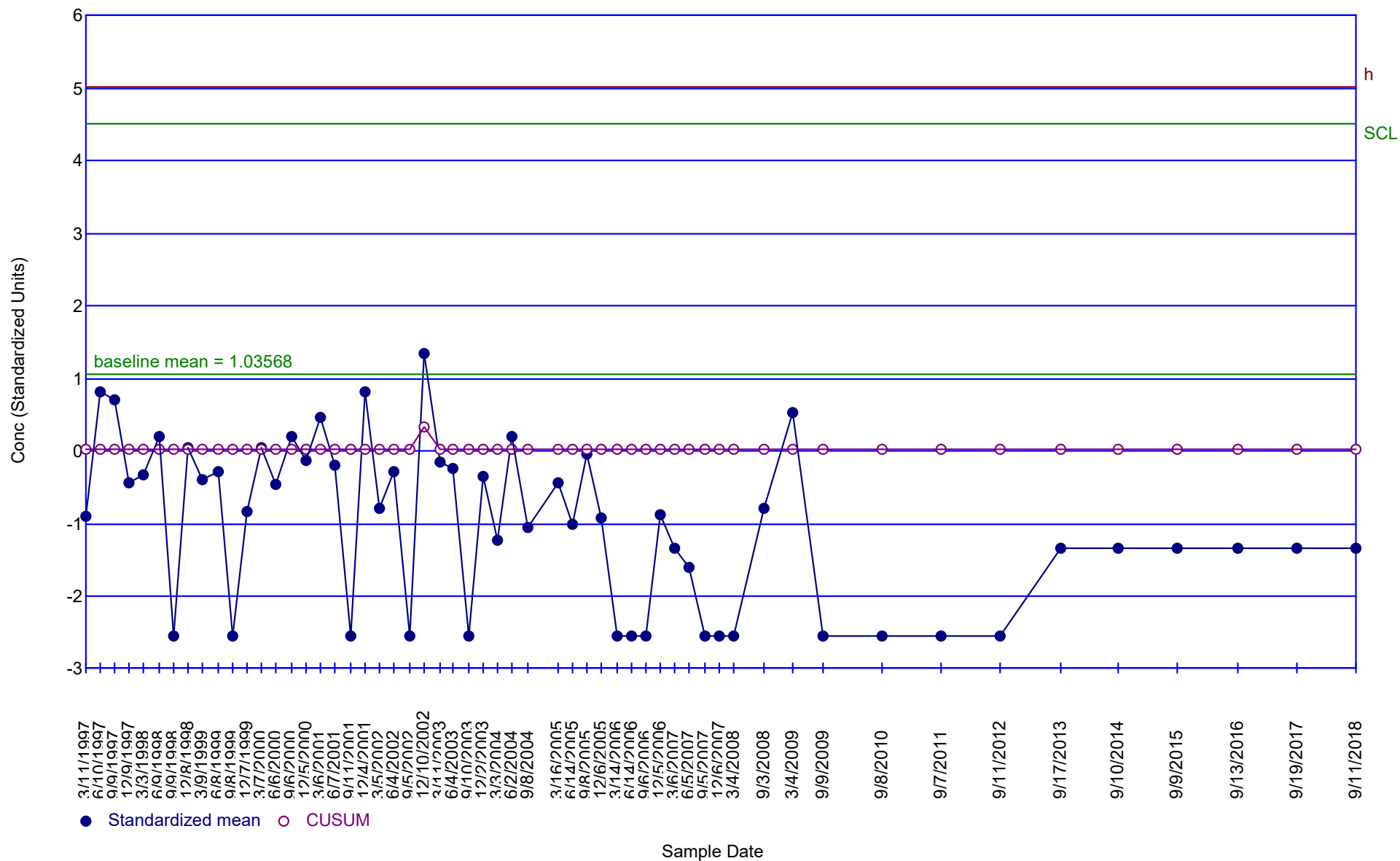
Intra-Well Shewhart-CUSUM Control Chart for Chemical Oxygen Demand at KMW-012A



CCL (h) = 188.78; SCL = 141.88

Kent Highlands Landfill

Intra-Well Shewhart-CUSUM Control Chart for Chemical Oxygen Demand at KMW-018A



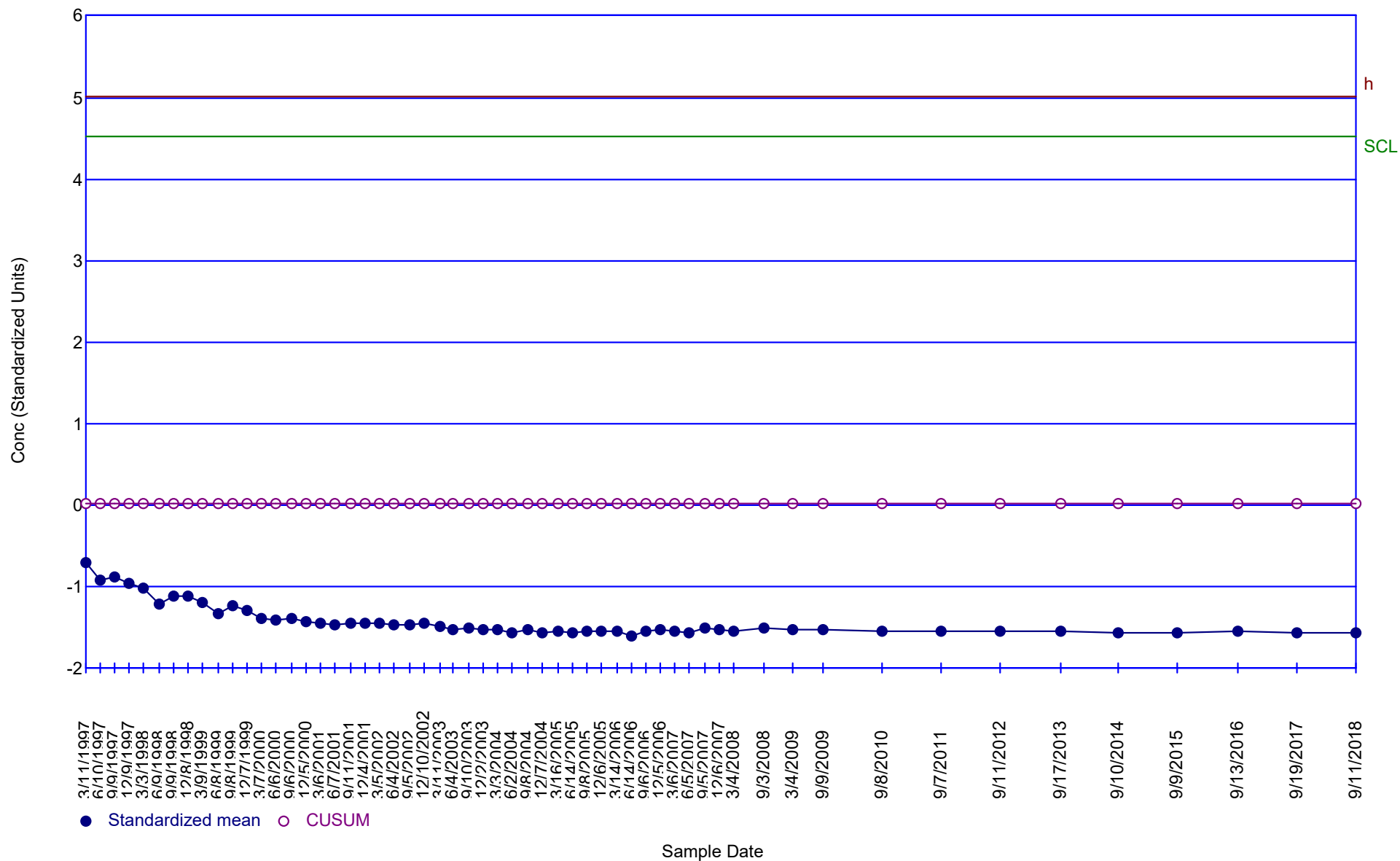
Non-Detects Replaced with 1/2 DL

Log Base 10 Transformation

CCL (h) = 6211.2; SCL = 5762.7

Kent Highlands Landfill

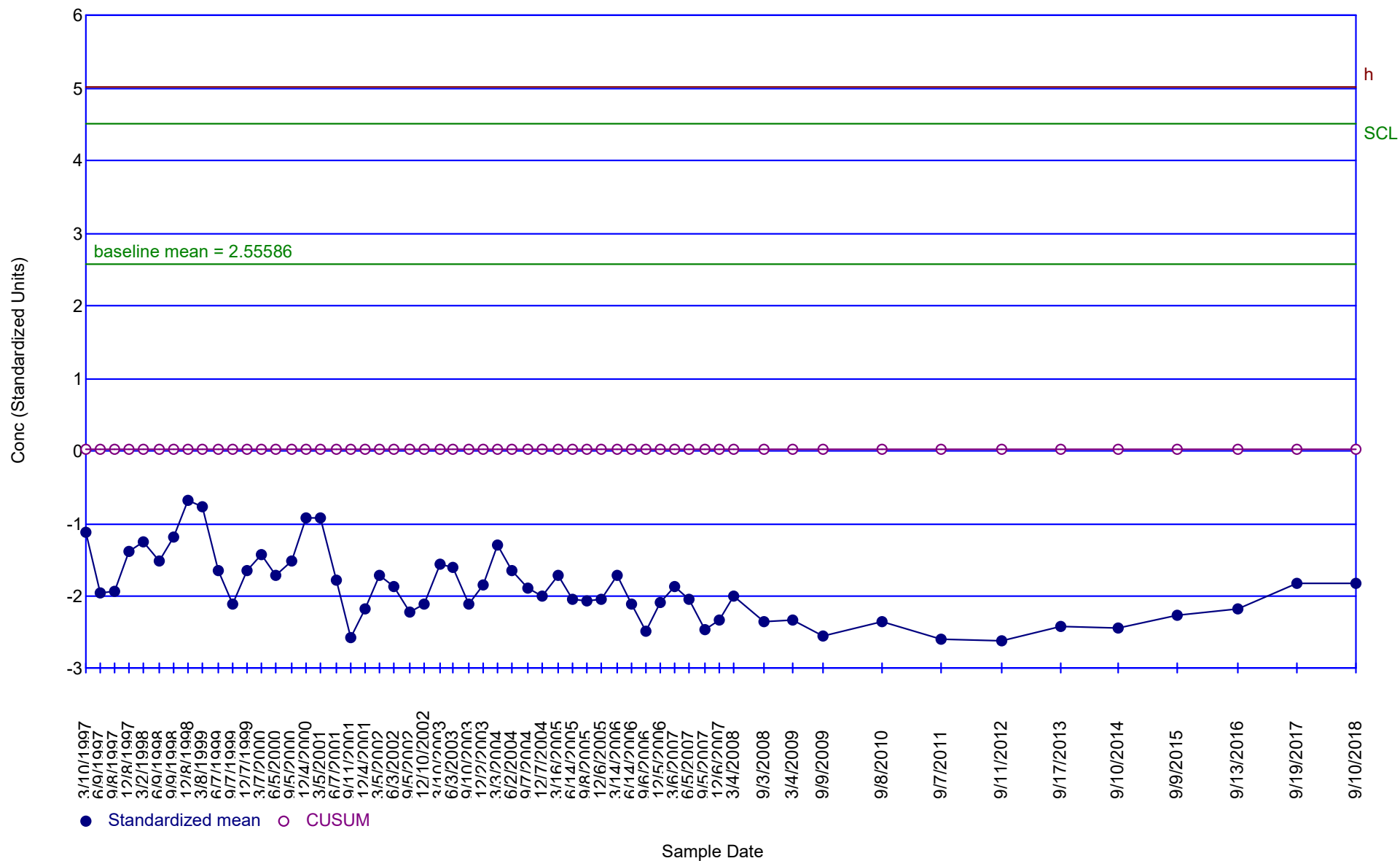
Intra-Well Shewhart-CUSUM Control Chart for Specific Conductivity at KMW-012A



CCL (h) = 1575.9; SCL = 1359.5

Kent Highlands Landfill

Intra-Well Shewhart-CUSUM Control Chart for Specific Conductivity at KMW-016B



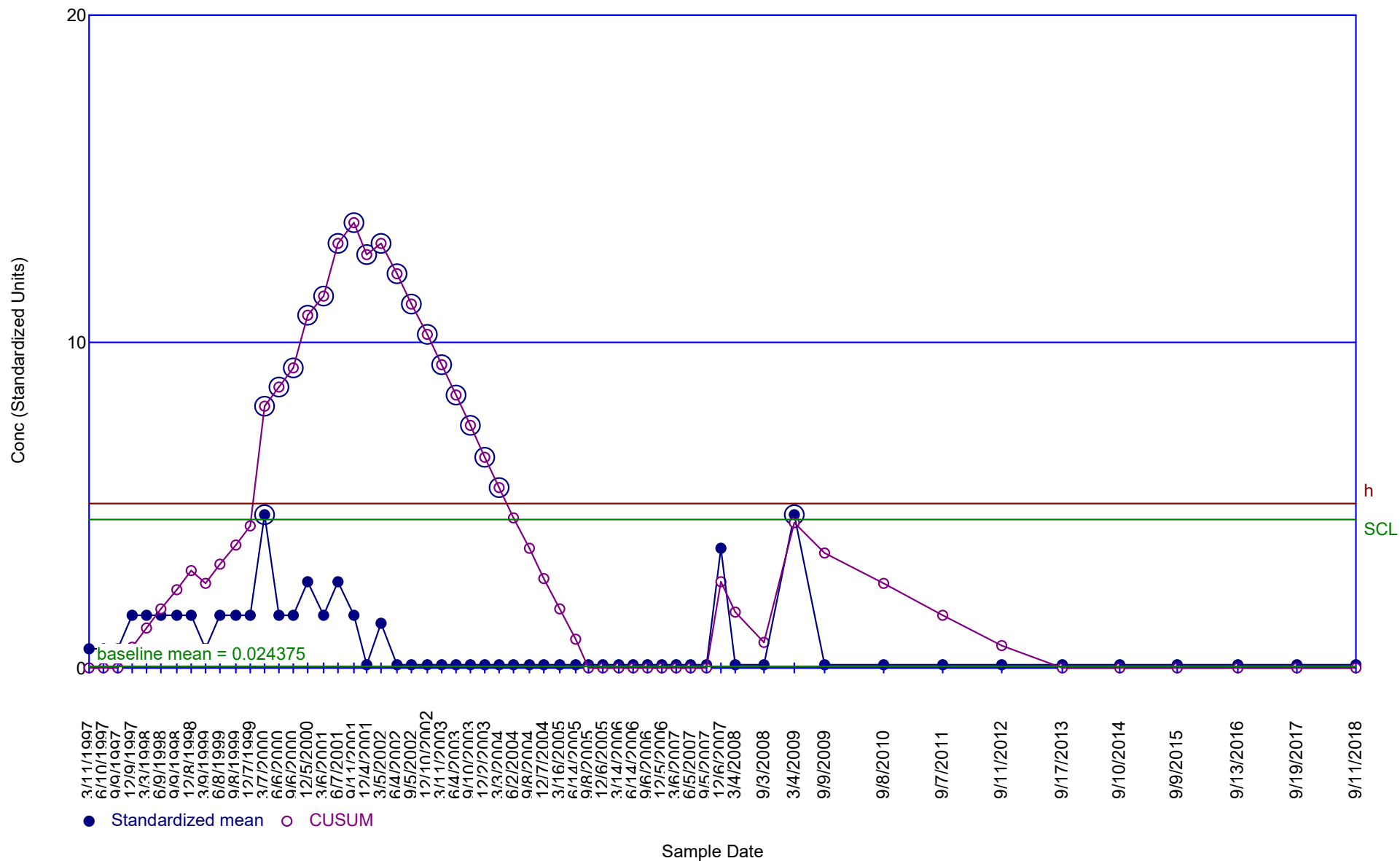
Non-Detects Replaced with 1/2 DL

Log Base 10 Transformation

CCL (h) = 0.0784; SCL = 0.0730

Kent Highlands Landfill

Intra-Well Shewhart-CUSUM Control Chart for Iron, Dissolved at KMW-008A

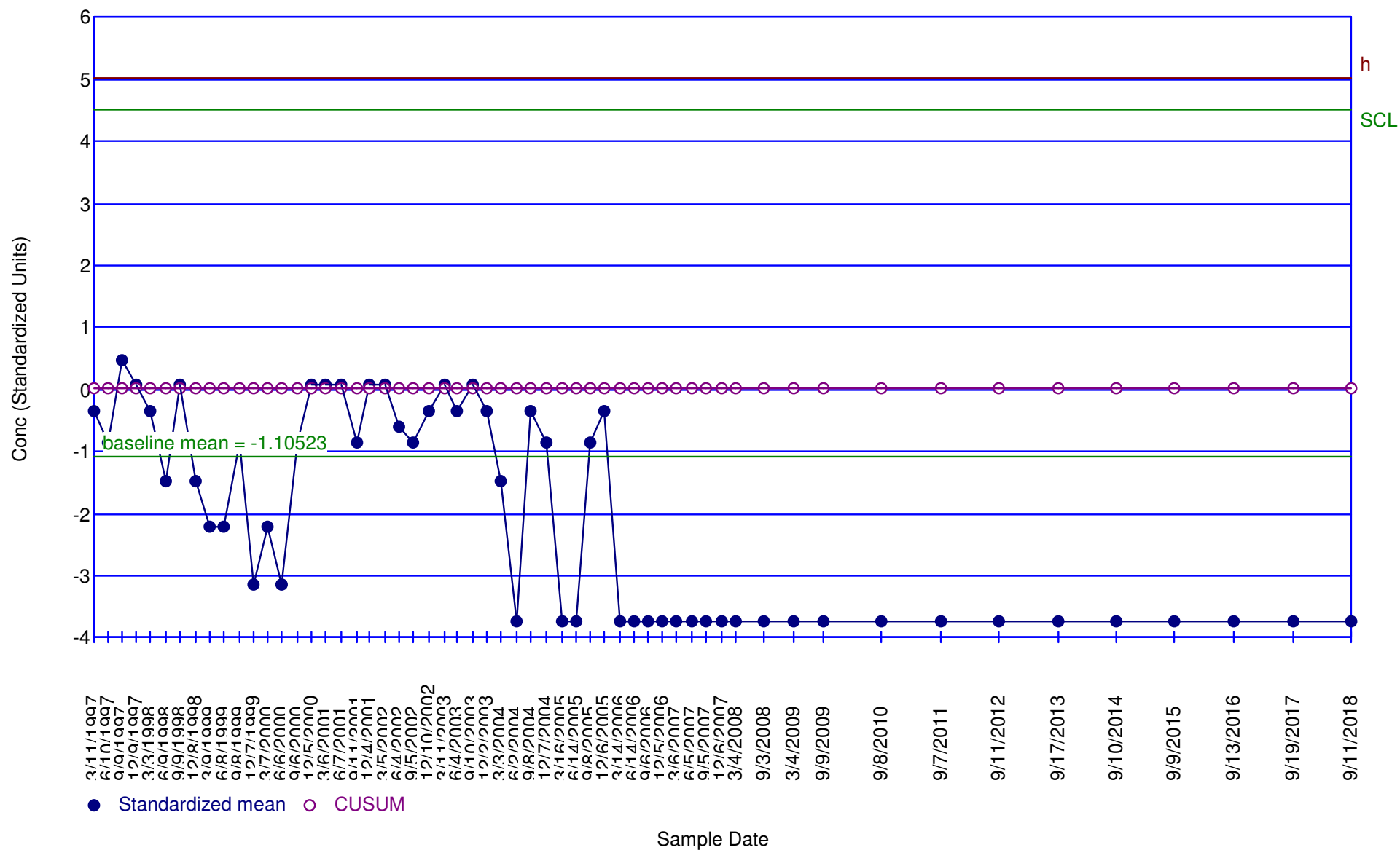


Non-Detects Replaced with 1/2 DL

Original Data (Not Transformed)

CCL (h) = 0.357; SCL = 0.307

Kent Highlands Landfill Intra-Well Shewhart-CUSUM Control Chart for Iron, Dissolved at KMW-018A



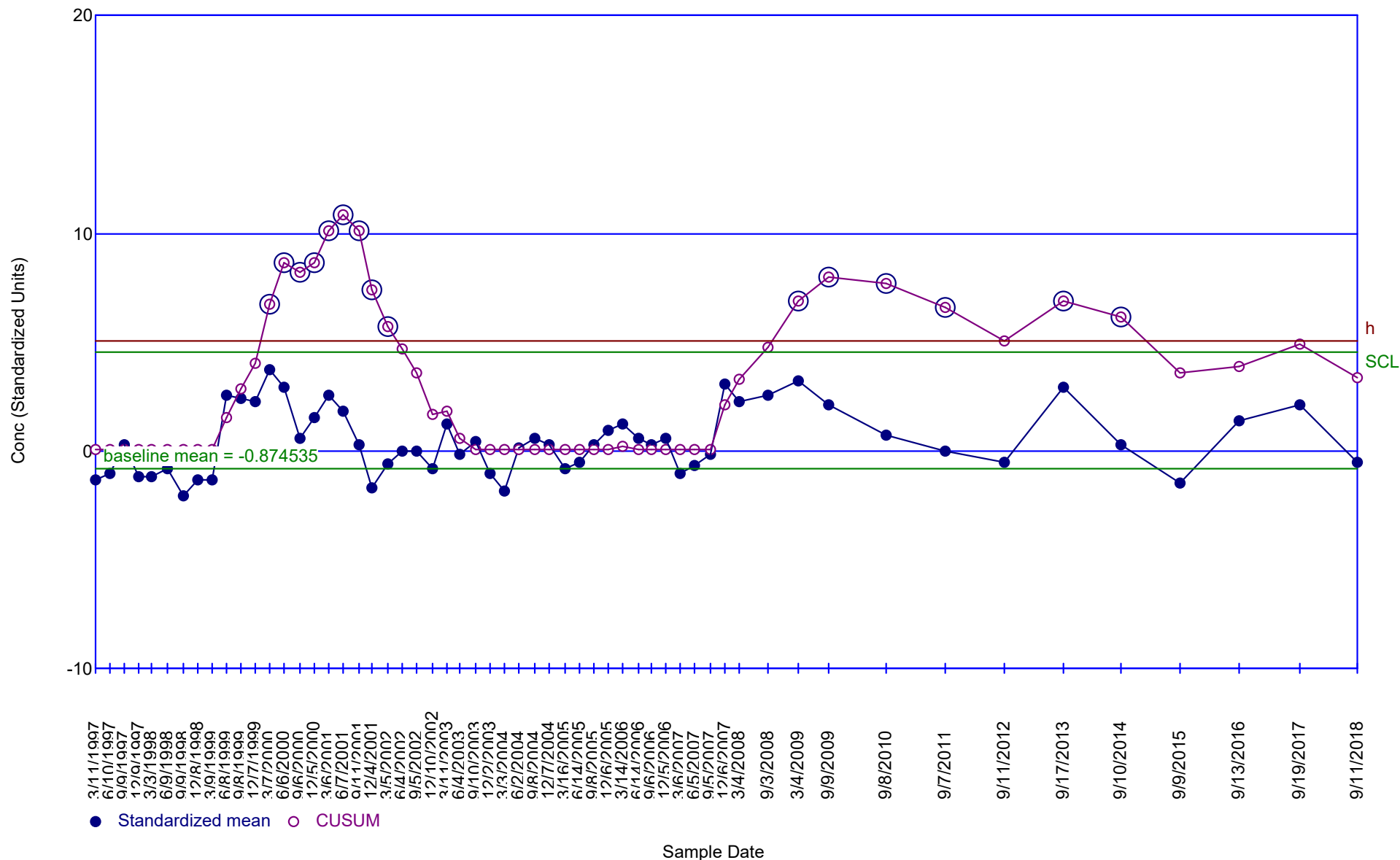
Non-Detects Replaced with 1/2 DL

Log Base 10 Transformation

CCL (h) = 0.169; SCL = 0.165

Kent Highlands Landfill

Intra-Well Shewhart-CUSUM Control Chart for Manganese, Dissolved at KMW-008A



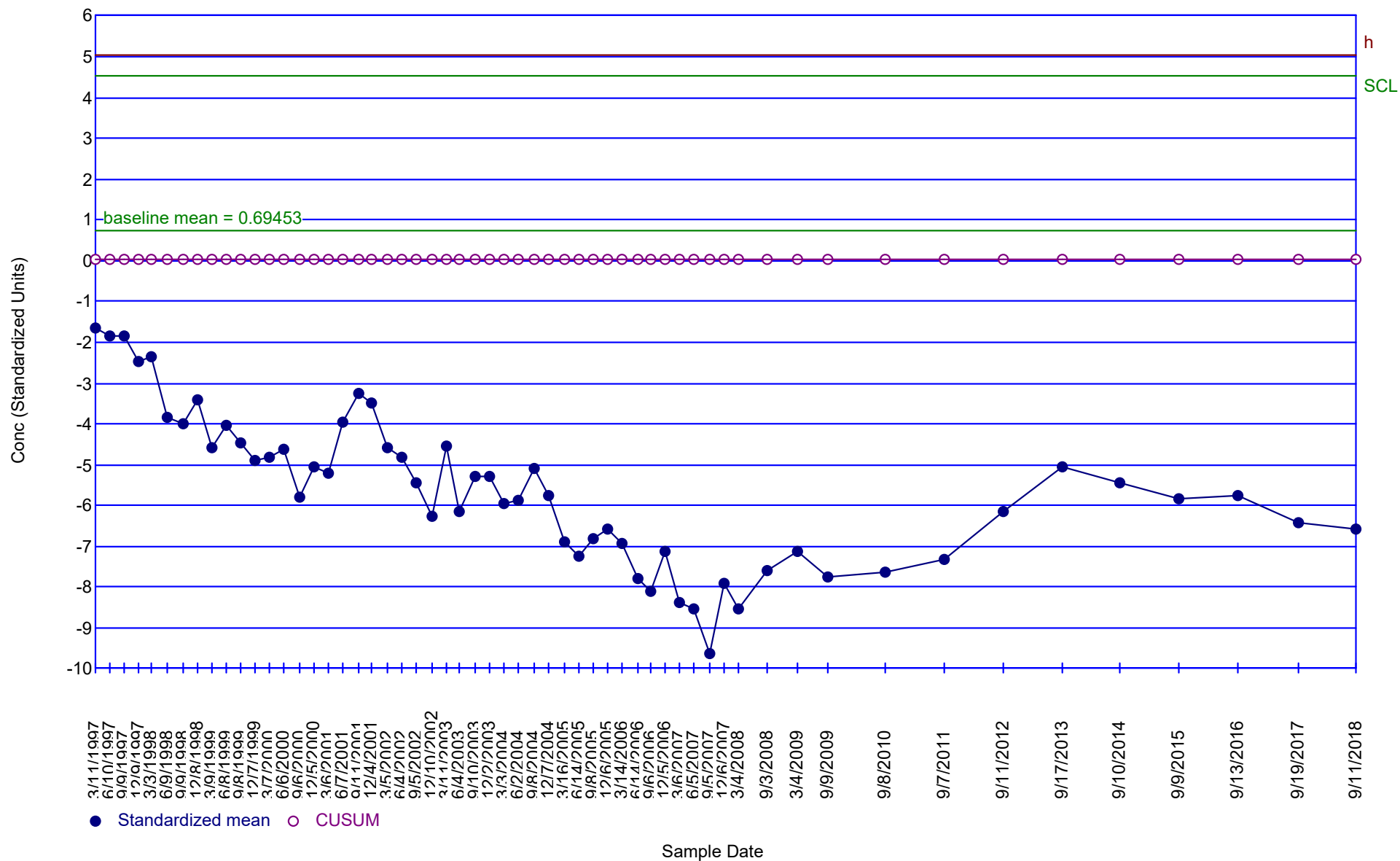
Non-Detects Replaced with 1/2 DL

Log Base 10 Transformation

CCL (h) = 6.99; SCL = 6.75

Kent Highlands Landfill

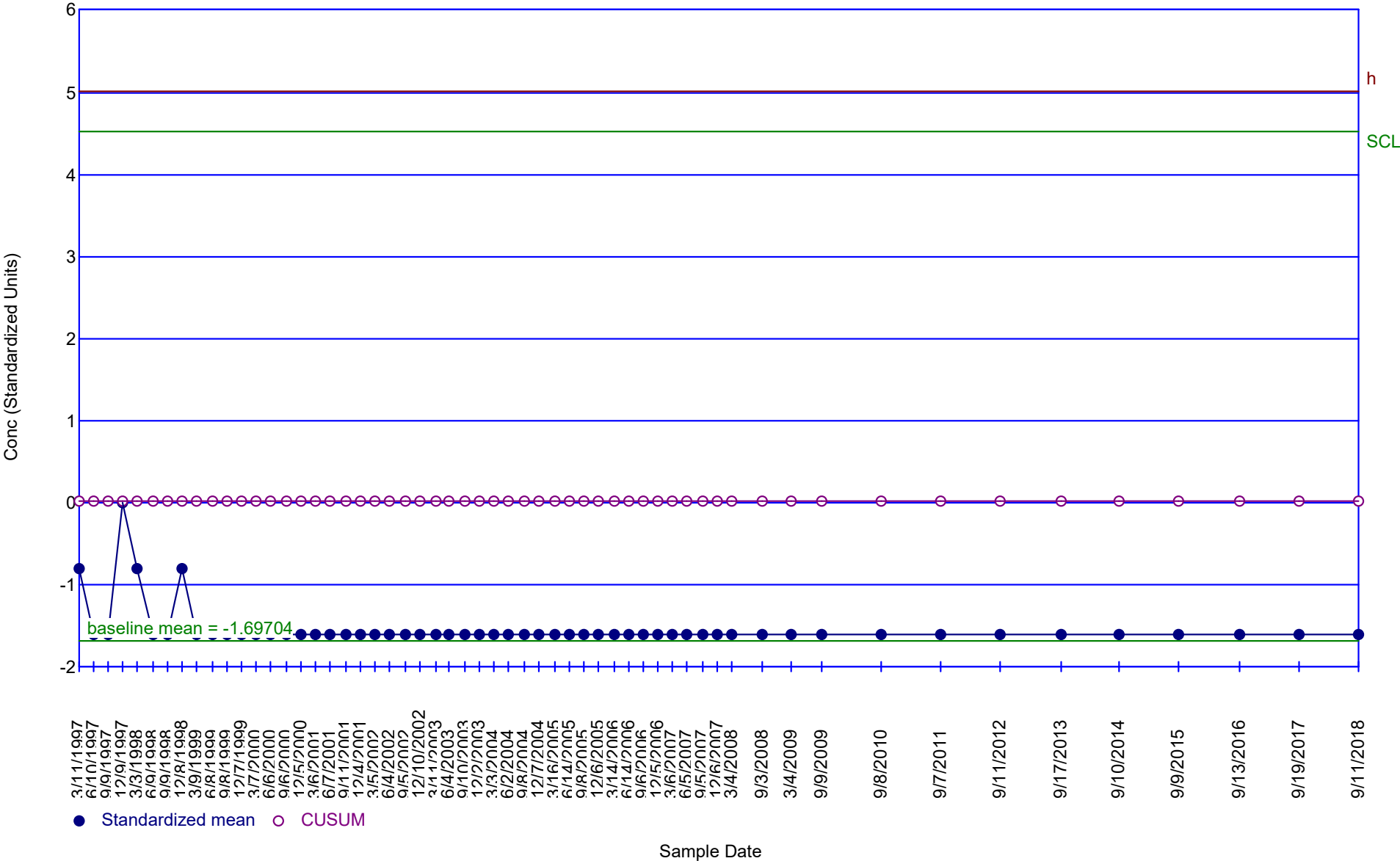
Intra-Well Shewhart-CUSUM Control Chart for Manganese, Dissolved at KMW-018A



Non-Detects Replaced with 1/2 DL

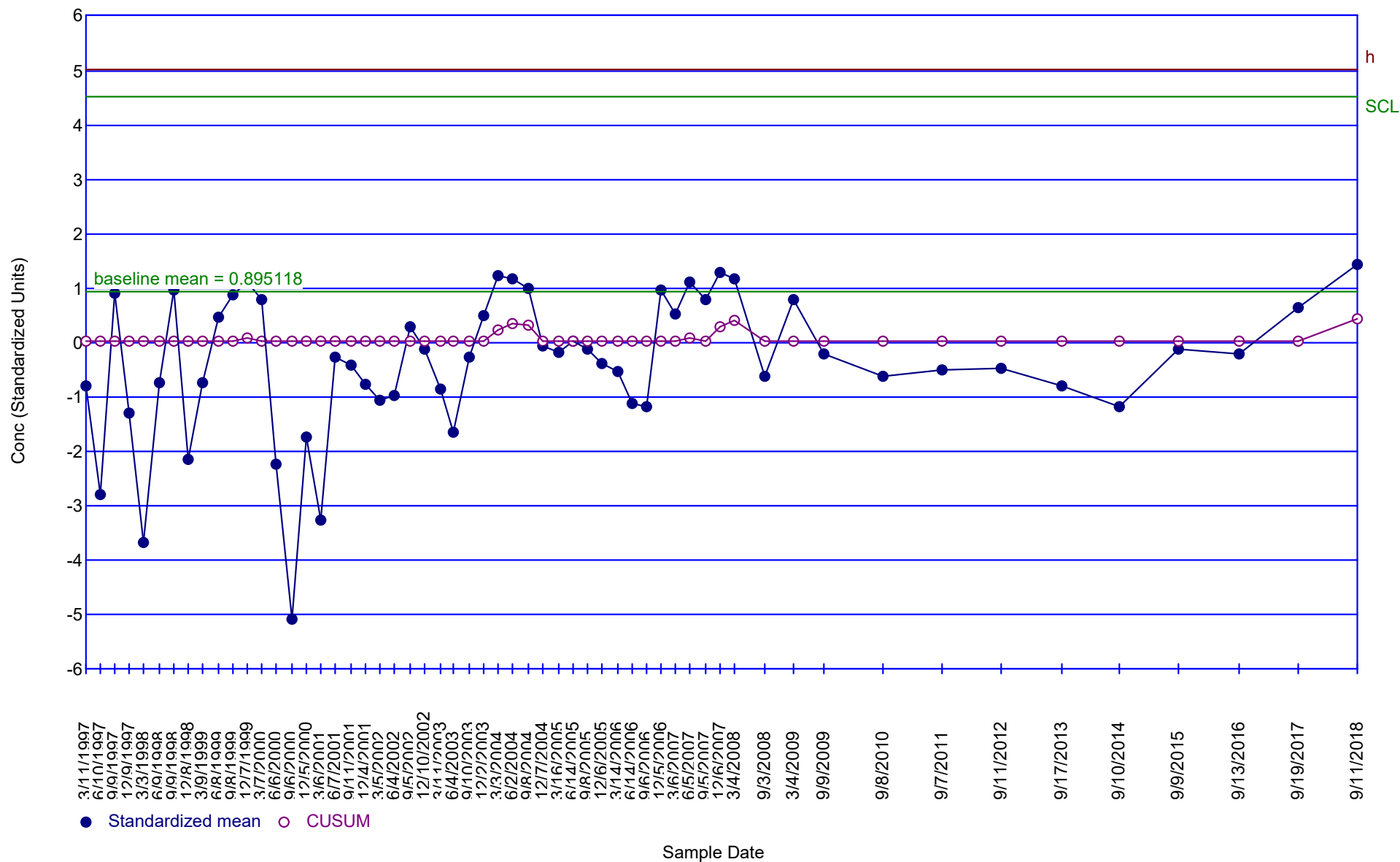
Log Base 10 Transformation

Kent Highlands Landfill
Intra-Well Shewhart-CUSUM Control Chart for Nickel, Dissolved at KMW-012A



CCL (h) = 9.60; SCL = 9.41

Kent Highlands Landfill Intra-Well Shewhart-CUSUM Control Chart for pH at KMW-008A

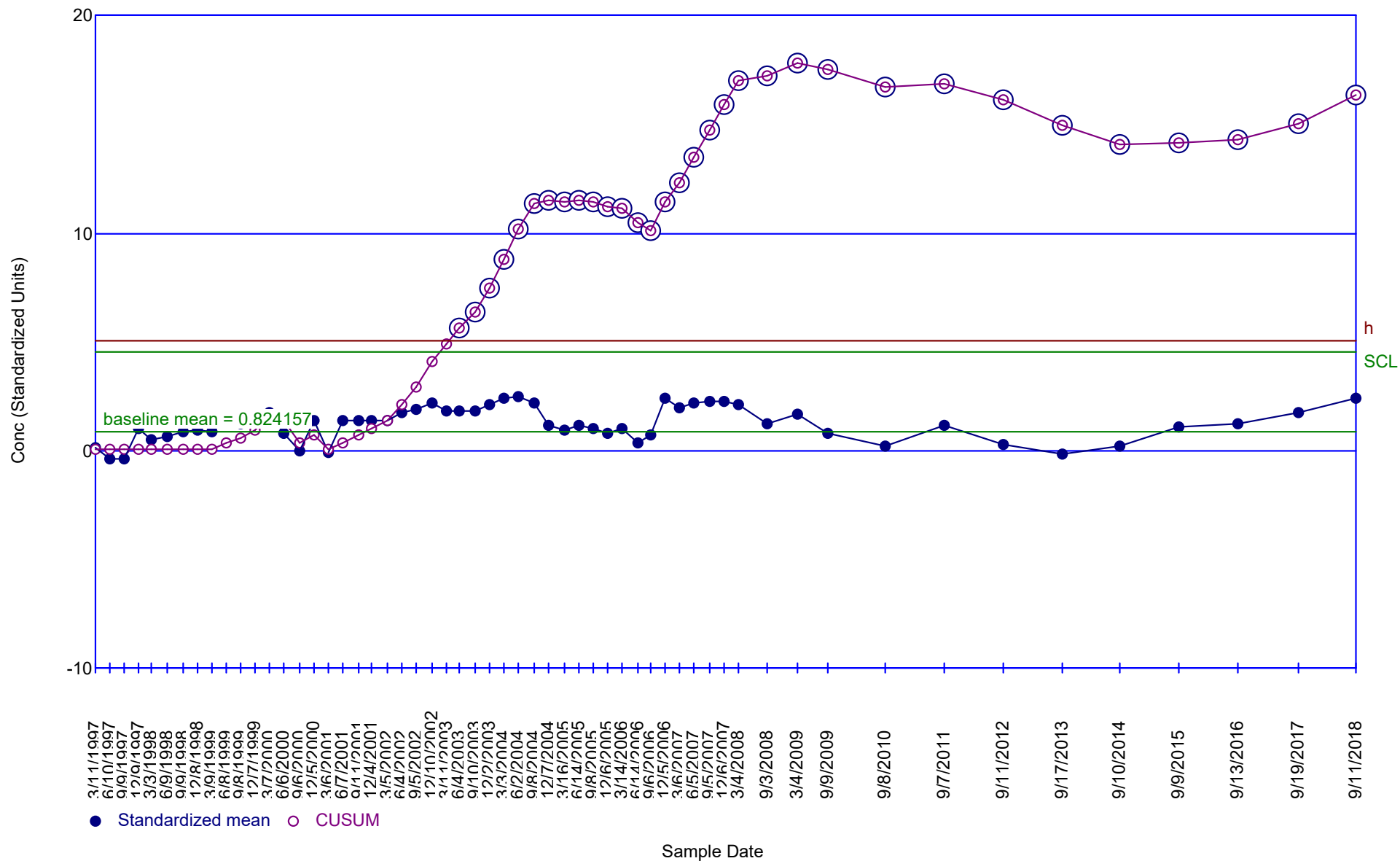


Non-Detects Replaced with 1/2 DL

Log Base 10 Transformation

CCL (h) = 7.93; SCL = 7.79

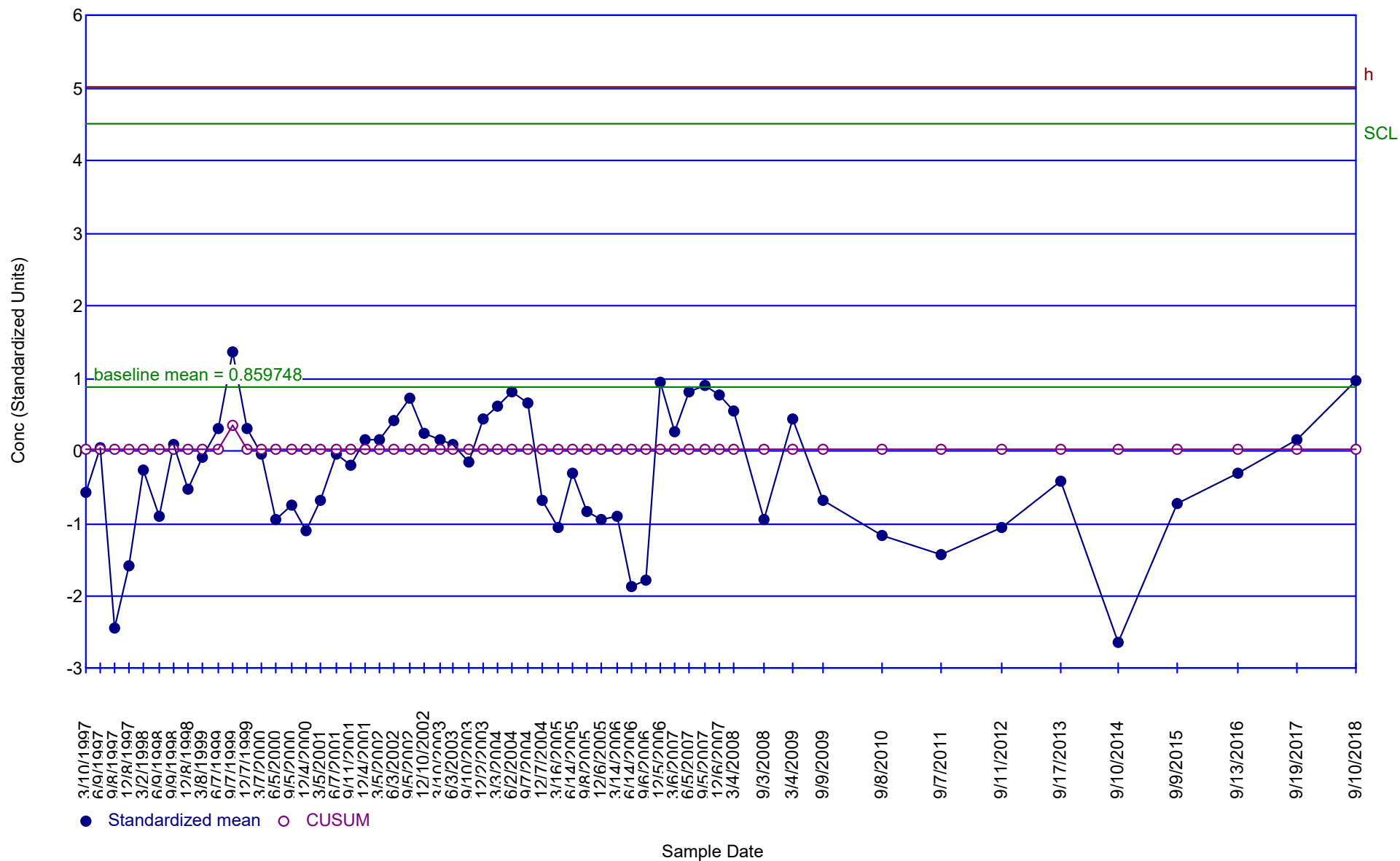
Kent Highlands Landfill Intra-Well Shewhart-CUSUM Control Chart for pH at KMW-012A



CCL (h) = 8.76; SCL = 8.59

Kent Highlands Landfill

Intra-Well Shewhart-CUSUM Control Chart for pH at KMW-016B

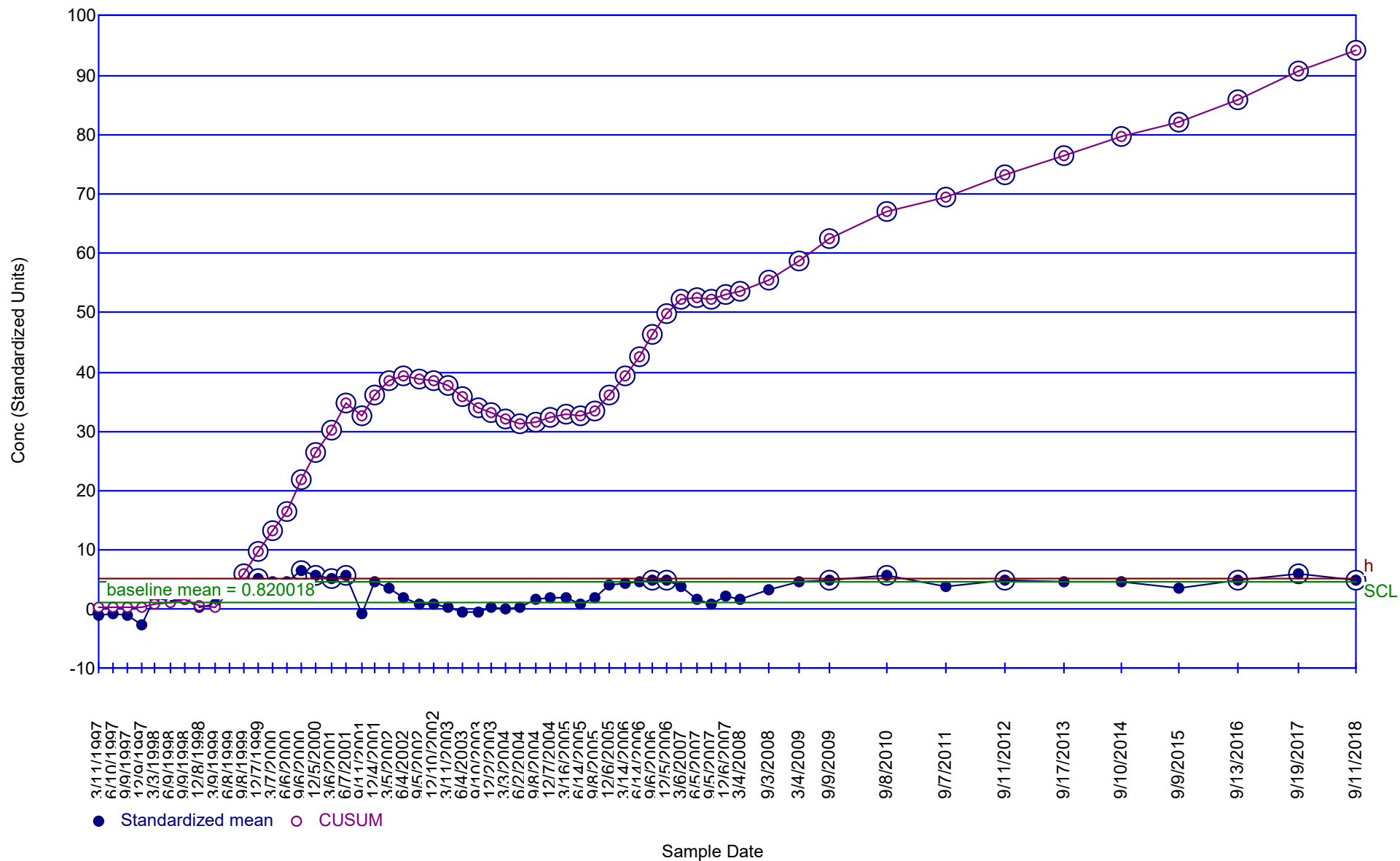


Non-Detects Replaced with 1/2 DL

Log Base 10 Transformation

CCL (h) = 13.19; SCL = 12.31

Kent Highlands Landfill Intra-Well Shewhart-CUSUM Control Chart for Sulfate at KMW-008A



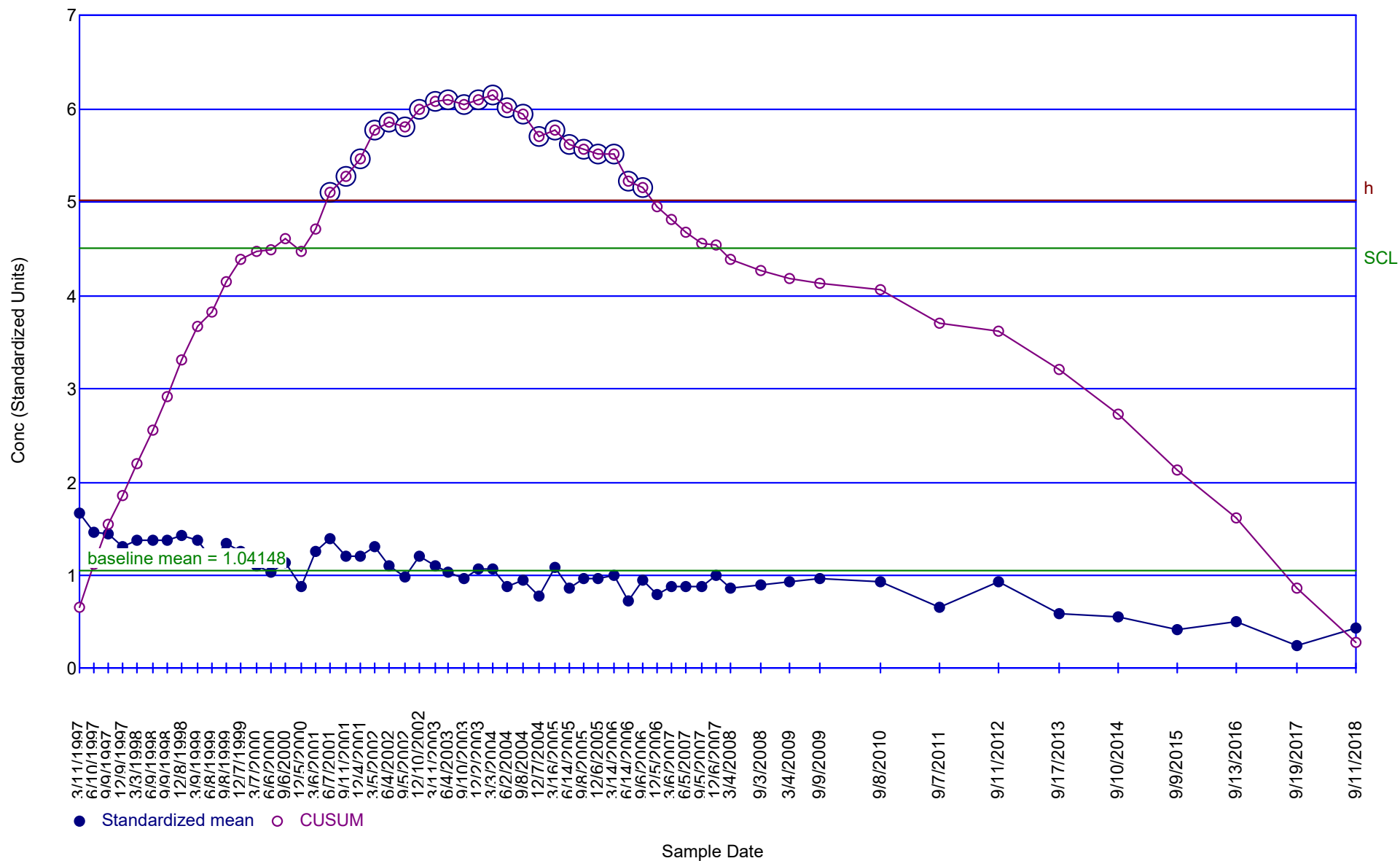
Non-Detects Replaced with 1/2 DL

Log Base 10 Transformation

CCL (h) = 1292.6; SCL = 802.56

Kent Highlands Landfill

Intra-Well Shewhart-CUSUM Control Chart for Sulfate at KMW-012A

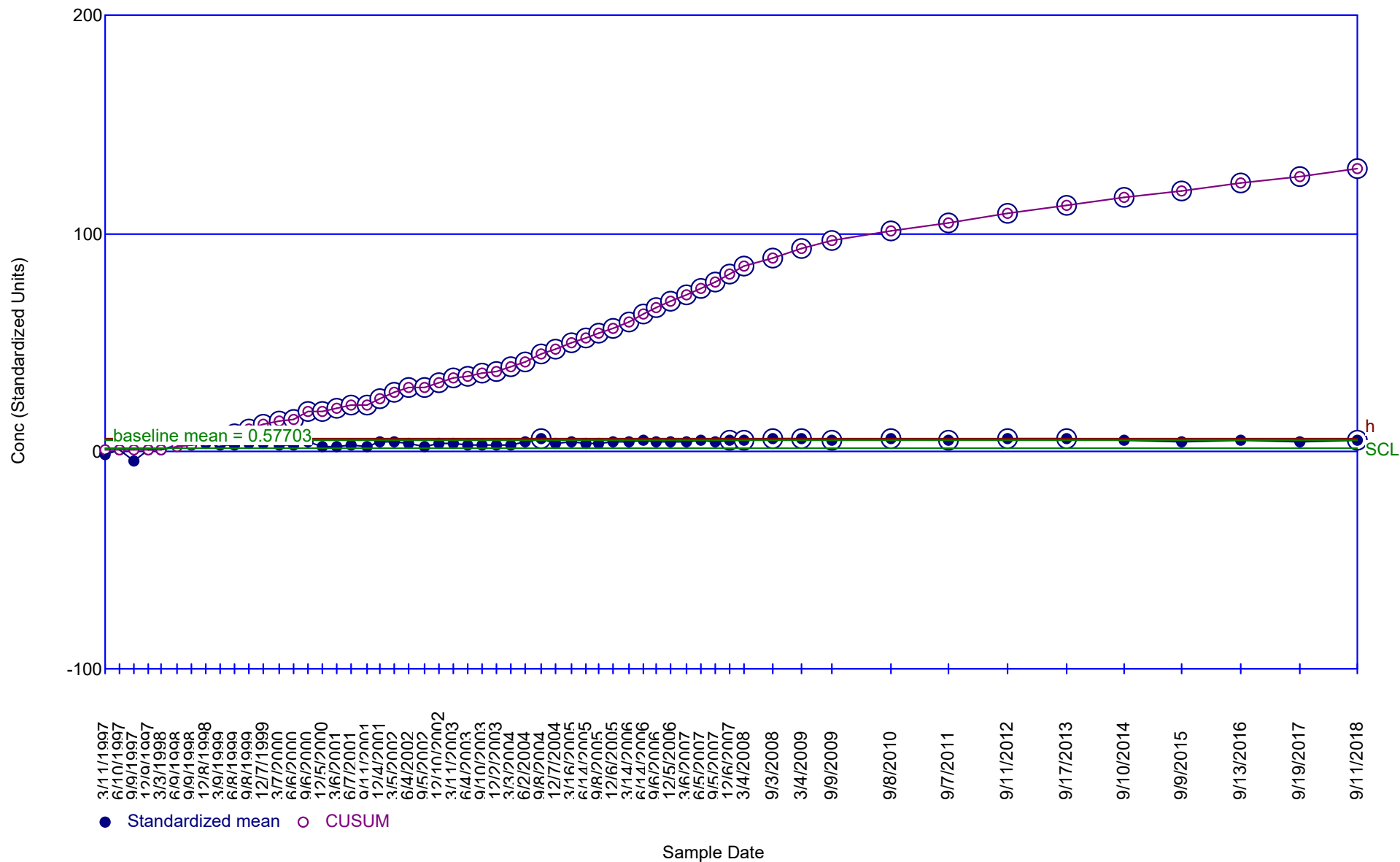


Non-Detects Replaced with 1/2 DL

Log Base 10 Transformation

CCL (h) = 12.39; SCL = 11.00

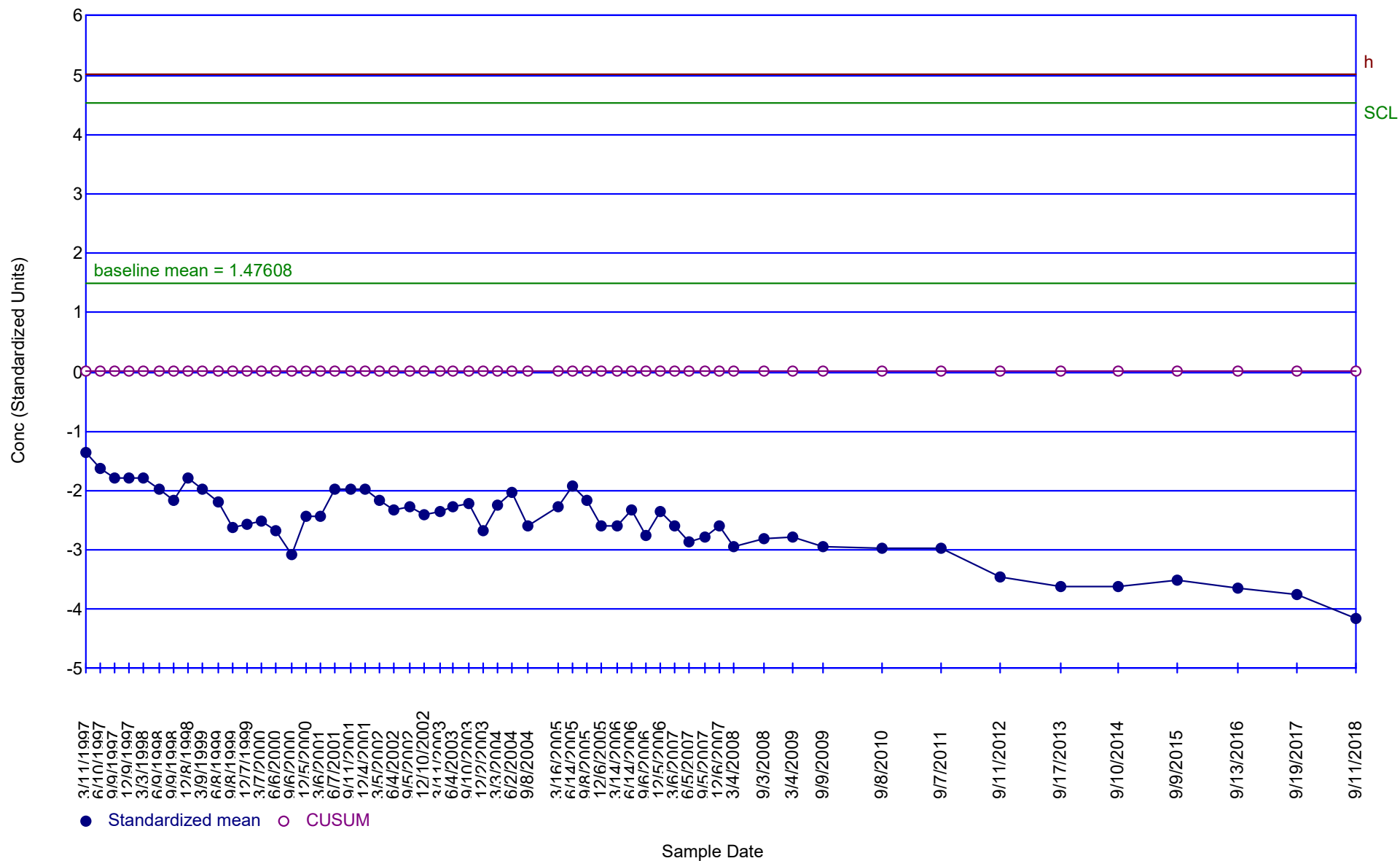
Kent Highlands Landfill Intra-Well Shewhart-CUSUM Control Chart for Sulfate at KMW-018A



CCL (h) = 370.58; SCL = 288.14

Kent Highlands Landfill

Intra-Well Shewhart-CUSUM Control Chart for Total Organic Carbon at KMW-012A



CUSUM Calculations

Calculation of Quarterly Cumulative Sums, Third Quarter 2014
Kent Highlands Landfill

Chemical	Aquifer	Well ID	Distribution	Units	3rd QTR 2013 Standardzd S	3rd QTR 14 Value	Inorm arith mean/ norm arith mean	Inorm stdev/ norm stdev	Transformed Value	Stdzd Z	Stdzd S (New)	New Stdzd S Adjust for <0	Unstdzd S (New)	Untransf. CUSUM	SCL	CCL
Conventional Parameters																
Ammonia-N	Sand	KMW-008A	Lognormal	mg/L	0	0.113	-1.171453964	0.158306581	-0.946921557	1.418339058	0.418339058	0.418339058	-1.105228138	0.0785	0.3475	0.4169
Ammonia-N	Sand	KMW-016B	Lognormal	mg/L	162.5823202	0.437	-1.120890532	0.138324089	-0.359518563	5.504261565	167.0865818	167.0865818	21.99120874	9799608928764620000000.0000	0.3174	0.3722
Ammonia-N	Sand	KMW-018A	Lognormal	mg/L	0	0.674	-0.161274007	0.074550853	-0.171340103	-0.13502323	-1.13502323	0	-0.161274007	0.6898	1.4935	1.6273
Ammonia-N	Alluvium	KMW-010A	Lognormal	mg/L	16.48155905	2.265	-0.180189091	0.067663117	0.355068206	7.910621343	23.3921804	23.3921804	1.402598747	25.2696	1.3314	1.4392
Ammonia-N	Alluvium	KMW-015A	Lognormal	mg/L	0.123004614	1.01	-0.076360289	0.058007003	0.004321374	1.390895205	0.513899818	0.513899818	-0.0465505	0.8984	1.5299	1.6356
Ammonia-N	Alluvium	KMW-017	Lognormal	mg/L	0	0.342	-0.385294118	0.128712285	-0.465973894	-0.626822651	-1.626822651	0	-0.385294118	0.4118	1.5628	1.8125
Chloride	Sand	KMW-012A	Lognormal	mg/L	0	2	2.072157882	0.221620922	0.301029996	-7.99169985	-8.99169985	0	2.072157882	118.0750	1173.4161	1514.4763
Chloride	Sand	KMW-016B	Lognormal	mg/L	0	2.8	1.064838774	0.301733962	0.447158031	-2.047103808	-3.047103808	0	1.064838774	11.6102	264.6315	374.5489
Chloride	Sand	KMW-018A	Lognormal	mg/L	0	10.9	1.677506723	0.066047712	1.037426498	-9.691179369	-10.69117937	0	1.677506723	47.5890	94.3456	101.7994
Chloride	Alluvium	KMW-010A	Lognormal	mg/L	0	11.25	1.752830821	0.073284875	1.051152522	-9.57466737	-10.57466737	0	1.752830821	56.6019	120.9519	131.5998
Chloride	Alluvium	KMW-016A	Lognormal	mg/L	0	6.1	1.713983086	0.34169858	0.785329835	-2.717755664	-3.717755664	0	1.713983086	51.7587	1784.9526	2645.3064
Chloride	Alluvium	KMW-017	Lognormal	mg/L	0	9.4	1.044036468	0.1747782	0.973127854	-0.405706286	-1.405706286	0	1.044036468	11.0672	67.6922	82.7804
Chloride	Alluvium	KMW-019A	Lognormal	mg/L	1.994108803	12.5	0.682311548	0.114556397	1.096910013	3.619164665	4.613273468	4.613273468	1.210791536	16.2477	15.7694	17.9926
COD	Sand	KMW-012A	Lognormal	mg/L	0	5	1.926956259	0.252226879	0.698970004	-4.868578071	-5.868578071	0	1.926956259	84.5194	1153.3927	1542.0223
COD	Sand	KMW-018A	Lognormal	mg/L	0	5	1.035680713	0.248052905	0.698970004	-1.3574149	-2.3574149	0	1.035680713	10.8563	141.8792	188.7753
COD	Alluvium	KMW-010A	Lognormal	mg/L	0	5	1.459510404	0.097131998	0.698970004	-7.829967594	-8.829967594	0	1.459510404	28.8078	78.8142	88.1395
COD	Alluvium	KMW-015A	Lognormal	mg/L	0	5	0.826793123	0.26894552	0.698970004	-0.475275138	-1.475275138	0	0.826793123	6.7111	108.9050	148.4297
COD	Alluvium	KMW-016A	Lognormal	mg/L	0	11.6	1.598050409	0.143364753	1.064457989	-3.721921936	-4.721921936	0	1.598050409	39.6324	175.0620	206.4782
COD	Alluvium	KMW-019A	Lognormal	mg/L	0	12.3	0.971254815	0.309729349	1.089905111	0.383077345	-0.616922655	0	0.971254815	9.3595	231.7591	331.0561
Sulfate	Sand	KMW-008A	Lognormal	mg/L	76.28078511	11.9	0.820018088	0.060024417	1.075546961	4.2570821	79.53786721	79.53786721	5.594232232	392854.9517	12.3063	13.1868
Sulfate	Sand	KMW-012A	Lognormal	mg/L	3.188851613	18.3	1.041482789	0.413998697	1.26245109	0.533741535	2.722593148	2.722593148	2.168632806	147.4459	802.5589	1292.6361
Sulfate	Sand	KMW-018A	Lognormal	mg/L	112.3173274	11	0.577030182	0.103215202	1.041392685	4.49897391	115.8163013	115.8163013	12.53103317	3396512118052.8700	11.0027	12.3910
Sulfate	Alluvium	KMW-016A	Lognormal	mg/L	3.358126074	9.1	0.799705139	0.410898734	0.959041392	0.387774991	2.745901065	2.745901065	1.927992411	84.7213	445.3992	714.8235
Sulfate	Alluvium	KMW-017	Lognormal	mg/L	0	16.3	0.975537612	0.486097726	1.212187604	0.486836247	-0.513163753	0	0.975537612	9.4523	1455.3833	2546.9841
Sulfate	Alluvium	KMW-019A	Lognormal	mg/L	32.26007906	14.4	0.627995919	0.198711376	1.158362492	2.669029745	33.9291088	33.9291088	7.370095818	23447460.7871	33.2811	41.8363
TOC	Sand	KMW-012A	Lognormal	mg/L	0	4.8	1.476078352	0.218561503	0.681241237	-3.636674817	-4.636674817	0	1.476078352	29.9280	288.1410	370.5833
TOC	Alluvium	KMW-010A	Lognormal	mg/L	0	4.505	0.996475832	0.044208746	0.653694795	-7.753692758	-8.753692758	0	0.996475832	9.9192	15.6825	16.5014
TOC	Alluvium	KMW-015A	Normal	mg/L	0	2.08	2.789583333	0.876154974	N/Ap	-0.809883359	-1.809883359	0	2.789583333	2.7896	6.7323	7.1704
TOC	Alluvium	KMW-016A	Normal	mg/L	0	6.1	14.21	7.364442829	N/Ap	-1.101237417	-2.101237417	0	14.21	14.2100	47.3500	51.0322
TOC	Alluvium	KMW-019A	Lognormal	mg/L	0.02093012	4.64	0.655530874	0.093012631	0.666517981	0.118124884	-0.860944996	0	0.655530874	4.5241	11.8601	13.2006
Field Parameters																
pH	Sand	KMW-008A	Lognormal	su	0	7.48	0.895117672	0.017454069	0.873901598	-1.215537378	-2.215537378	0	0.895117672	7.8545	9.4115	9.6026
pH	Sand	KMW-012A	Lognormal	su	14.87251104	6.71	0.824156669	0.015020394	0.82672252	0.170824511	14.04333555	14.04333555	1.035093102	10.8416	7.7938	7.9297
pH	Sand	KMW-016B	Lognormal	su	0	6.54	0.859747744	0.016546467	0.815577748	-2.669451799	-3.669451799	0	0.859747744	7.2402	8.5942	8.7595
pH	Alluvium	KMW-010A	Lognormal	su	0	6.44	0.83934857	0.017808927	0.808885867	-1.710529964	-2.710529964	0	0.83934857	6.9079	8.3079	8.4799
pH	Alluvium	KMW-015A	Lognormal	su	0	6.18	0.848183581	0.015679841	0.790988475	-3.647684034	-4.647684034	0	0.848183581	7.0499	8.2936	8.4447
pH	Alluvium	KMW-016A	Lognormal	su	0	6.37	0.832149564	0.013763931	0.804139432	-2.035038613	-3.035038613	0	0.832149564	6.7944	7.8359	7.9610
pH	Alluvium	KMW-017	Lognormal	su	0	6.31	0.832902893	0.016711852	0.800029359	-1.967079061	-2.967079061	0	0.832902893	6.8062	8.0929	8.2502
Specific Conductivity	Sand	KMW-012A	Normal	umhos/cm	0	316	1726.169167	896.997528	N/Ap	-1.572099279	-2.572099279	0	1726.169167	1726.1692	5762.6580	6211.1568
Specific Conductivity	Sand	KMW-016B	Lognormal	umhos/cm	0	174	2.555857045	0.128335046	2.240549248	-2.456911075	-3.456911075	0	2.555857045	359.6309	1359.4547	1575.9131
Specific Conductivity	Alluvium	KMW-015A	Normal	umhos/cm	0	219	209.35	16.53335472	N/Ap	0.5836686	-0.4163314	0	209.35	209.3500	283.7501	292.0168
Specific Conductivity	Alluvium	KMW-017	Normal	umhos/cm	0	365	698.8333333	154.8077008	N/Ap	-2.156438804	-3.156438804	0	698.8333333	698.8333	1395.4680	1472.8718
Dissolved Metals																
Iron, Dissolved	Sand	KMW-008A	Normal	mg/L	0	0.025	0.02375	0.010938138	N/Ap	0.114279051	-0.885720949	0	0.02375	0.0238	0.0730	0.0784
Iron, Dissolved	Sand	KMW-018A	Lognormal	mg/L	0	0.025	-1.105226103	0.13165808	-1.602059991	-3.773668035	-4.773668035	0	-1.105226103	0.0785	0.3071	0.3573
Iron, Dissolved	Alluvium	KMW-010A	Lognormal	mg/L	0	5.615	1.132201969	0.049664737	0.749349761	-7.708733243	-8.708733243	0	1.132201969	13.5582	22.6826	24.0174
Iron, Dissolved	Alluvium	KMW-017	Lognormal	mg/L	0	6.29	0.863817235	0.215724563	0.798650645	-0.30208238	-1.30208238	0	0.863817235	7.3083	68.3247	87.5871
Manganese, Dissolved	Sand	KMW-008A	Lognormal	mg/L	6.855976481	0.135	-0.874534705	0.02047812	-0.869666232	0.237740264	6.093716745	6.093716745	-0.749746844	0.1779	0.1651	0.1690
Manganese, Dissolved	Sand	KMW-018A	Lognormal	mg/L	0	3.39	0.694529706	0.03000995	0.530199698	-5.475850791	-6.475850791	0	0.694529706	4.9491	6.7542	6.9916
Manganese, Dissolved	Alluvium	KMW-010A	Normal	mg/L	0	1.7	2.888333333	0.324200649	N/Ap	-3.665425526	-4.665425526	0	2.888333333	2.8883	4.3472	4.5093
Manganese, Dissolved	Alluvium	KMW-015A	Lognormal	mg/L	0	0.421	-0.371218447	0.034521047	-0.375717904	-0.130339532	-1.130339532	0	-0.371218447	0.4254	0.6083	0.6330
Manganese, Dissolved	Alluvium	KMW-017	Lognormal	mg/L	0	0.201	-0.309732898	0.252545843	-0.696803943	-1.532676364	-2.532676364	0	-0.309732898	0.4901	6.7100	8.9742
Nickel, Dissolved	Sand	KMW-012A	Lognormal	mg/L	0	0.005	-1.697043021	0.373606665	-2.301029996	-1.616638648	-2.616638648	0	-1.697043021	0.0201	0.9642	1.4825

Bold = ND (1/2 MDL)

Calculation of Quarterly Cumulative Sums, Third Quarter 2015
Kent Highlands Landfill

Chemical	Aquifer	Well ID	Distribution	Units	3rd QTR 2014 Standardzd S	3rd QTR 15 Value	Inorm arith mean/ norm arith mean	Inorm stdev/ norm stdev	Transformed Value	Stdzd Z	Stdzd S (New)	New Stdzd S Adjust for <0	Unstdzd S (New)	Untransf. CUSUM	SCL	CCL
Conventional Parameters																
Ammonia-N	Sand	KMW-008A	Lognormal	mg/L	0.418339058	0.063	-1.171453964	0.158306581	-1.200659451	-0.184486875	-0.766147817	0	-1.171453964	0.0674	0.3475	0.4169
Ammonia-N	Sand	KMW-016B	Lognormal	mg/L	167.0865818	0.522	-1.120890532	0.138324089	-0.282329497	6.062292103	172.1488739	172.1488739	22.69144569	49141192388731700000000.0000	0.3174	0.3722
Ammonia-N	Sand	KMW-018A	Lognormal	mg/L	0	0.626	-0.161274007	0.074550853	-0.203425667	-0.565408158	-1.565408158	0	-0.161274007	0.6898	1.4935	1.6273
Ammonia-N	Alluvium	KMW-010A	Lognormal	mg/L	23.3921804	1.87	-0.180189091	0.067663117	0.271841607	6.680607067	29.07278746	29.07278746	1.786966328	61.2303	1.3314	1.4392
Ammonia-N	Alluvium	KMW-015A	Lognormal	mg/L	0.513899818	1	-0.076360289	0.058007003	0	1.316397755	0.830297574	0.830297574	-0.028197215	0.9371	1.5299	1.6356
Ammonia-N	Alluvium	KMW-017	Lognormal	mg/L	0	0.312	-0.385294118	0.128712285	-0.505845406	-0.93659504	-1.93659504	0	-0.385294118	0.4118	1.5628	1.8125
Chloride	Sand	KMW-012A	Lognormal	mg/L	0	1.7	2.072157882	0.221620922	0.230448921	-8.310176435	-9.310176435	0	2.072157882	118.0750	1173.4161	1514.4763
Chloride	Sand	KMW-016B	Lognormal	mg/L	0	2.9	1.064838774	0.301733962	0.462397998	-1.996595849	-2.996595849	0	1.064838774	11.6102	264.6315	374.5489
Chloride	Sand	KMW-018A	Lognormal	mg/L	0	11.5	1.677506723	0.066047712	1.06069784	-9.338837983	-10.33883798	0	1.677506723	47.5890	94.3456	101.7994
Chloride	Alluvium	KMW-010A	Lognormal	mg/L	0	9.9	1.752830821	0.073284875	0.995635195	-10.33222243	-11.33222243	0	1.752830821	56.6019	120.9519	131.5998
Chloride	Alluvium	KMW-016A	Lognormal	mg/L	0	7.6	1.713983086	0.34169858	0.880813592	-2.43831711	-3.43831711	0	1.713983086	51.7587	1784.9526	2645.3064
Chloride	Alluvium	KMW-017	Lognormal	mg/L	0	8.7	1.044036468	0.1747782	0.939519253	-0.597999152	-1.597999152	0	1.044036468	11.0672	67.6922	82.7804
Chloride	Alluvium	KMW-019A	Lognormal	mg/L	4.613273468	12.6	0.682311548	0.114556397	1.100370545	3.649372774	7.262646242	7.262646242	1.514294136	32.6809	15.7694	17.9926
COD	Sand	KMW-012A	Lognormal	mg/L	0	12.2	1.926956259	0.252226879	1.086359831	-3.33269963	-4.33269963	0	1.926956259	84.5194	1153.3927	1542.0223
COD	Sand	KMW-018A	Lognormal	mg/L	0	5	1.035680713	0.248052905	0.698970004	-1.3574149	-2.3574149	0	1.035680713	10.8563	141.8792	188.7753
COD	Alluvium	KMW-010A	Lognormal	mg/L	0	12.7	1.459510404	0.097131998	1.103803721	-3.662095797	-4.662095797	0	1.459510404	28.8078	78.8142	88.1395
COD	Alluvium	KMW-015A	Lognormal	mg/L	0	5	0.826793123	0.26894552	0.698970004	-0.475275138	-1.475275138	0	0.826793123	6.7111	108.9050	148.4297
COD	Alluvium	KMW-016A	Lognormal	mg/L	0	14.05	1.598050409	0.143364753	1.147676324	-3.141456144	-4.141456144	0	1.598050409	39.6324	175.0620	206.4782
COD	Alluvium	KMW-019A	Lognormal	mg/L	0	15.8	0.971254815	0.309729349	1.198657087	0.73419672	-0.26580328	0	0.971254815	9.3595	231.7591	331.0561
Sulfate	Sand	KMW-008A	Lognormal	mg/L	79.53786721	10.5	0.820018088	0.060024417	1.021189299	3.351489599	81.88935681	81.88935681	5.735379025	543724.6530	12.3063	13.1868
Sulfate	Sand	KMW-012A	Lognormal	mg/L	2.722593148	16.1	1.041482789	0.413998697	1.206825876	0.399380693	2.121973841	2.121973841	1.919977196	83.1720	802.5589	1292.6361
Sulfate	Sand	KMW-018A	Lognormal	mg/L	115.8163013	10.1	0.577030182	0.103215202	1.004321374	4.139808685	118.95611	118.95611	12.85510916	7163234316010.1300	11.0027	12.3910
Sulfate	Alluvium	KMW-016A	Lognormal	mg/L	2.745901065	8.75	0.799705139	0.410898734	0.942008053	0.346321129	2.092222194	2.092222194	1.65939659	45.6454	445.3992	714.8235
Sulfate	Alluvium	KMW-017	Lognormal	mg/L	0	15.8	0.975537612	0.486097726	1.198657087	0.459001273	-0.540998727	0	0.975537612	9.4523	1455.3833	2546.9841
Sulfate	Alluvium	KMW-019A	Lognormal	mg/L	33.9291088	10.1	0.627995919	0.198711376	1.004321374	1.893829445	34.82293825	34.82293825	7.547709897	35294732.7015	33.2811	41.8363
TOC	Sand	KMW-012A	Lognormal	mg/L	0	5.08	1.476078352	0.218561503	0.705863712	-3.524017855	-4.524017855	0	1.476078352	29.9280	288.1410	370.5833
TOC	Alluvium	KMW-010A	Lognormal	mg/L	0	3.75	0.996475832	0.044208746	0.574031268	-9.555678432	-10.55567843	0	0.996475832	9.9192	15.6825	16.5014
TOC	Alluvium	KMW-015A	Normal	mg/L	0	2.67	2.789583333	0.876154974	N/Ap	-0.136486509	-1.136486509	0	2.789583333	2.7896	6.7323	7.1704
TOC	Alluvium	KMW-016A	Normal	mg/L	0	6.035	14.21	7.364442829	N/Ap	-1.110063611	-2.110063611	0	14.21	14.2100	47.3500	51.0322
TOC	Alluvium	KMW-019A	Lognormal	mg/L	0	5.42	0.655530874	0.093012631	0.733999287	0.843631792	-0.156368208	0	0.655530874	4.5241	11.8601	13.2006
Field Parameters																
pH	Sand	KMW-008A	Lognormal	su	0	7.81	0.895117672	0.017454069	0.892651034	-0.141321636	-1.141321636	0	0.895117672	7.8545	9.4115	9.6026
pH	Sand	KMW-012A	Lognormal	su	14.04333555	6.91	0.824156669	0.015020394	0.839478047	1.0200384	14.06337395	14.06337395	1.035394086	10.8491	7.7938	7.9297
pH	Sand	KMW-016B	Lognormal	su	0	7.04	0.859747744	0.016546467	0.847572659	-0.735811778	-1.735811778	0	0.859747744	7.2402	8.5942	8.7595
pH	Alluvium	KMW-010A	Lognormal	su	0	6.69	0.83934857	0.017808927	0.825426118	-0.781768197	-1.781768197	0	0.83934857	6.9079	8.3079	8.4799
pH	Alluvium	KMW-015A	Lognormal	su	0	6.53	0.848183581	0.015679841	0.814913181	-2.121858227	-3.121858227	0	0.848183581	7.0499	8.2936	8.4447
pH	Alluvium	KMW-016A	Lognormal	su	0	6.77	0.832149564	0.013763931	0.830588669	-0.113404779	-1.113404779	0	0.832149564	6.7944	7.8359	7.9610
pH	Alluvium	KMW-017	Lognormal	su	0	6.6	0.832902893	0.016711852	0.819543936	-0.799370269	-1.799370269	0	0.832902893	6.8062	8.0929	8.2502
Specific Conductivity	Sand	KMW-012A	Normal	umhos/cm	0	308	1726.169167	896.997528	N/Ap	-1.581017921	-2.581017921	0	1726.169167	1726.1692	5762.6580	6211.1568
Specific Conductivity	Sand	KMW-016B	Lognormal	umhos/cm	0	183	2.555857045	0.128335046	2.26245109	-2.286249653	-3.286249653	0	2.555857045	359.6309	1359.4547	1575.9131
Specific Conductivity	Alluvium	KMW-015A	Normal	umhos/cm	0	217	209.35	16.53335472	N/Ap	0.462701014	-0.537298986	0	209.35	209.3500	283.7501	292.0168
Specific Conductivity	Alluvium	KMW-017	Normal	umhos/cm	0	344	698.8333333	154.8077008	N/Ap	-2.292090971	-3.292090971	0	698.8333333	698.8333	1395.4680	1472.8718
Dissolved Metals																
Iron, Dissolved	Sand	KMW-008A	Normal	mg/L	0	0.025	0.02375	0.010938138	N/Ap	0.114279051	-0.885720949	0	0.02375	0.0238	0.0730	0.0784
Iron, Dissolved	Sand	KMW-018A	Lognormal	mg/L	0	0.025	-1.105226103	0.13165808	-1.602059991	-3.773668035	-4.773668035	0	-1.105226103	0.0785	0.3071	0.3573
Iron, Dissolved	Alluvium	KMW-010A	Lognormal	mg/L	0	4.65	1.132201969	0.049664737	0.667452953	-9.357726326	-10.35772633	0	1.132201969	13.5582	22.6826	24.0174
Iron, Dissolved	Alluvium	KMW-017	Lognormal	mg/L	0	5.38	0.863817235	0.215724563	0.730782276	-0.616688972	-1.616688972	0	0.863817235	7.3083	68.3247	87.5871
Manganese, Dissolved	Sand	KMW-008A	Lognormal	mg/L	6.093716745	0.124	-0.874534705	0.02047812	-0.906578315	-1.564773046	3.528943699	3.528943699	-0.802268574	0.1577	0.1651	0.1690
Manganese, Dissolved	Sand	KMW-018A	Lognormal	mg/L	0	3.3	0.694529706	0.03000995	0.51851394	-5.865246922	-6.865246922	0	0.694529706	4.9491	6.7542	6.9916
Manganese, Dissolved	Alluvium	KMW-010A	Normal	mg/L	0	1.22	2.888333333	0.324200649	N/Ap	-5.145990115	-6.145990115	0	2.888333333	2.8883	4.3472	4.5093
Manganese, Dissolved	Alluvium	KMW-015A	Lognormal	mg/L	0	0.394	-0.371218447	0.034521047	-0.404503778	-0.964203991	-1.964203991	0	-0.371218447	0.4254	0.6083	0.6330
Manganese, Dissolved	Alluvium	KMW-017	Lognormal	mg/L	0	0.228	-0.309732898	0.252545843	-0.642065153	-1.315928431	-2.315928431	0	-0.309732898	0.4901	6.7100	8.9742
Nickel, Dissolved	Sand	KMW-012A	Lognormal	mg/L	0	0.005	-1.697043021	0.373606665	-2.301029996	-1.616638648	-2.616638648	0	-1.697043021	0.0201	0.9642	1.4825

Bold = ND (1/2 MDL)

Calculation of Quarterly Cumulative Sums, Third Quarter 2016
Kent Highlands Landfill

Chemical	Aquifer	Well ID	Distribution	Units	3rd QTR 2015 Standardzd S	3rd QTR 16 Value	Inorm arith mean/ norm arith mean	Inorm stdev/ norm stdev	Transformed Value	Stdzd Z	Stdzd S (New)	New Stdzd S Adjust for <0	Unstdzd S (New)	Untransf. CUSUM	SCL	CCL
Conventional Parameters																
Ammonia-N	Sand	KMW-008A	Lognormal	mg/L	0	0.077	-1.171453964	0.158306581	-1.113509275	0.366028302	-0.633971698	0	-1.171453964	0.0674	0.3475	0.4169
Ammonia-N	Sand	KMW-016B	Lognormal	mg/L	172.1488739	0.43	-1.120890532	0.138324089	-0.366531544	5.453561926	176.6024358	176.6024358	23.30748059	202992778602019000000000.0000	0.3174	0.3722
Ammonia-N	Sand	KMW-018A	Lognormal	mg/L	0	0.591	-0.161274007	0.074550853	-0.228412519	-0.90057337	-1.90057337	0	-0.161274007	0.6898	1.4935	1.6273
Ammonia-N	Alluvium	KMW-010A	Lognormal	mg/L	29.07278746	2.28	-0.180189091	0.067663117	0.357934847	7.952987713	36.02577518	36.02577518	2.257427149	180.8952	1.3314	1.4392
Ammonia-N	Alluvium	KMW-015A	Lognormal	mg/L	0.830297574	0.878	-0.076360289	0.058007003	-0.056505484	0.342282887	0.17258046	0.17258046	-0.066349413	0.8583	1.5299	1.6356
Ammonia-N	Alluvium	KMW-017	Lognormal	mg/L	0	0.283	-0.385294118	0.128712285	-0.548213564	-1.26576454	-2.26576454	0	-0.385294118	0.4118	1.5628	1.8125
Chloride	Sand	KMW-012A	Lognormal	mg/L	0	1.57	2.072157882	0.221620922	0.195899652	-8.46606997	-9.46606997	0	2.072157882	118.0750	1173.4161	1514.4763
Chloride	Sand	KMW-016B	Lognormal	mg/L	0	3.08	1.064838774	0.301733962	0.488550717	-1.909921089	-2.909921089	0	1.064838774	11.6102	264.6315	374.5489
Chloride	Sand	KMW-018A	Lognormal	mg/L	0	11.3	1.677506723	0.066047712	1.053078443	-9.454199994	-10.45419999	0	1.677506723	47.5890	94.3456	101.7994
Chloride	Alluvium	KMW-010A	Lognormal	mg/L	0	9.19	1.752830821	0.073284875	0.963315511	-10.77323681	-11.77323681	0	1.752830821	56.6019	120.9519	131.5998
Chloride	Alluvium	KMW-016A	Lognormal	mg/L	0	8.47	1.713983086	0.34169858	0.92788341	-2.300564655	-3.300564655	0	1.713983086	51.7587	1784.9526	2645.3064
Chloride	Alluvium	KMW-017	Lognormal	mg/L	0	7.9	1.044036468	0.1747782	0.897627091	-0.837686718	-1.837686718	0	1.044036468	11.0672	67.6922	82.7804
Chloride	Alluvium	KMW-019A	Lognormal	mg/L	7.262646242	13.9	0.682311548	0.114556397	1.1430148	4.021628328	10.28427457	10.28427457	1.860440992	72.5172	15.7694	17.9926
COD	Sand	KMW-012A	Lognormal	mg/L	0	5	1.926956259	0.252226879	0.698970004	-4.868578071	-5.868578071	0	1.926956259	84.5194	1153.3927	1542.0223
COD	Sand	KMW-018A	Lognormal	mg/L	0	5	1.035680713	0.248052905	0.698970004	-1.3574149	-2.3574149	0	1.035680713	10.8563	141.8792	188.7753
COD	Alluvium	KMW-010A	Lognormal	mg/L	0	5	1.459510404	0.097131998	0.698970004	-7.829967594	-8.829967594	0	1.459510404	28.8078	78.8142	88.1395
COD	Alluvium	KMW-015A	Lognormal	mg/L	0	5	0.826793123	0.26894552	0.698970004	-0.475275138	-1.475275138	0	0.826793123	6.7111	108.9050	148.4297
COD	Alluvium	KMW-016A	Lognormal	mg/L	0	5	1.598050409	0.143364753	0.698970004	-6.271279271	-7.271279271	0	1.598050409	39.6324	175.0620	206.4782
COD	Alluvium	KMW-019A	Lognormal	mg/L	0	5	0.971254815	0.309729349	0.698970004	-0.879105618	-1.879105618	0	0.971254815	9.3595	231.7591	331.0561
Sulfate	Sand	KMW-008A	Lognormal	mg/L	81.88935681	12.8	0.820018088	0.060024417	1.10720997	4.784584233	85.67394104	85.67394104	5.962546489	917374.1295	12.3063	13.1868
Sulfate	Sand	KMW-012A	Lognormal	mg/L	2.121973841	17.5	1.041482789	0.413998697	1.243038049	0.486849984	1.608823825	1.608823825	1.707533757	50.9957	802.5589	1292.6361
Sulfate	Sand	KMW-018A	Lognormal	mg/L	118.95611	10.8	0.577030182	0.103215202	1.033423755	4.421766972	122.3778769	122.3778769	13.20828753	16154277108025.4000	11.0027	12.3910
Sulfate	Alluvium	KMW-016A	Lognormal	mg/L	2.092222194	7.1	0.799705139	0.410898734	0.851258349	0.125464513	1.217686707	1.217686707	1.300051066	19.9550	445.3992	714.8235
Sulfate	Alluvium	KMW-017	Lognormal	mg/L	0	14.3	0.975537612	0.486097726	1.155336037	0.369881232	-0.630118768	0	0.975537612	9.4523	1455.3833	2546.9841
Sulfate	Alluvium	KMW-019A	Lognormal	mg/L	34.82293825	10.9	0.627995919	0.198711376	1.037426498	2.060428483	35.88336673	35.88336673	7.7584291	57336225.6042	33.2811	41.8363
TOC	Sand	KMW-012A	Lognormal	mg/L	0	4.73	1.476078352	0.218561503	0.674861141	-3.665866127	-4.665866127	0	1.476078352	29.9280	288.1410	370.5833
TOC	Alluvium	KMW-010A	Lognormal	mg/L	0	4.31	0.996475832	0.044208746	0.63447727	-8.188392376	-9.188392376	0	0.996475832	9.9192	15.6825	16.5014
TOC	Alluvium	KMW-015A	Normal	mg/L	0	1.95	2.789583333	0.876154974	N/Ap	-0.958258937	-1.958258937	0	2.789583333	2.7896	6.7323	7.1704
TOC	Alluvium	KMW-016A	Normal	mg/L	0	5.73	14.21	7.364442829	N/Ap	-1.151478828	-2.151478828	0	14.21	14.2100	47.3500	51.0322
TOC	Alluvium	KMW-019A	Lognormal	mg/L	0	4.92	0.655530874	0.093012631	0.691965103	0.391712697	-0.608287303	0	0.655530874	4.5241	11.8601	13.2006
Field Parameters																
pH	Sand	KMW-008A	Lognormal	su	0	7.78	0.895117672	0.017454069	0.890979597	-0.237083653	-1.237083653	0	0.895117672	7.8545	9.4115	9.6026
pH	Sand	KMW-012A	Lognormal	su	14.06337395	6.95	0.824156669	0.015020394	0.841984805	1.186928644	14.25030259	14.25030259	1.038201828	10.9195	7.7938	7.9297
pH	Sand	KMW-016B	Lognormal	su	0	7.15	0.859747744	0.016546467	0.854306042	-0.328873992	-1.328873992	0	0.859747744	7.2402	8.5942	8.7595
pH	Alluvium	KMW-010A	Lognormal	su	0	6.7	0.83934857	0.017808927	0.826074803	-0.745343491	-1.745343491	0	0.83934857	6.9079	8.3079	8.4799
pH	Alluvium	KMW-015A	Lognormal	su	0	6.6	0.848183581	0.015679841	0.819543936	-1.826526517	-2.826526517	0	0.848183581	7.0499	8.2936	8.4447
pH	Alluvium	KMW-016A	Lognormal	su	0	6.76	0.832149564	0.013763931	0.829946696	-0.160046449	-1.160046449	0	0.832149564	6.7944	7.8359	7.9610
pH	Alluvium	KMW-017	Lognormal	su	0	6.56	0.832902893	0.016711852	0.816903839	-0.957347745	-1.957347745	0	0.832902893	6.8062	8.0929	8.2502
Specific Conductivity	Sand	KMW-012A	Normal	umhos/cm	0	326	1726.169167	896.997528	N/Ap	-1.560950976	-2.560950976	0	1726.169167	1726.1692	5762.6580	6211.1568
Specific Conductivity	Sand	KMW-016B	Lognormal	umhos/cm	0	188	2.555857045	0.128335046	2.274157849	-2.195029368	-3.195029368	0	2.555857045	359.6309	1359.4547	1575.9131
Specific Conductivity	Alluvium	KMW-015A	Normal	umhos/cm	0	239	209.35	16.53335472	N/Ap	1.793344455	0.793344455	0.793344455	222.4666453	222.4666	283.7501	292.0168
Specific Conductivity	Alluvium	KMW-017	Normal	umhos/cm	0	319	698.8333333	154.8077008	N/Ap	-2.453581645	-3.453581645	0	698.8333333	698.8333	1395.4680	1472.8718
Dissolved Metals																
Iron, Dissolved	Sand	KMW-008A	Normal	mg/L	0	0.025	0.02375	0.010938138	N/Ap	0.114279051	-0.885720949	0	0.02375	0.0238	0.0730	0.0784
Iron, Dissolved	Sand	KMW-018A	Lognormal	mg/L	0	0.025	-1.105226103	0.13165808	-1.602059991	-3.773668035	-4.773668035	0	-1.105226103	0.0785	0.3071	0.3573
Iron, Dissolved	Alluvium	KMW-010A	Lognormal	mg/L	0	5.21	1.132201969	0.049664737	0.716837723	-8.363363456	-9.363363456	0	1.132201969	13.5582	22.6826	24.0174
Iron, Dissolved	Alluvium	KMW-017	Lognormal	mg/L	0	5.12	0.863817235	0.215724563	0.709269961	-0.716410183	-1.716410183	0	0.863817235	7.3083	68.3247	87.5871
Manganese, Dissolved	Sand	KMW-008A	Lognormal	mg/L	3.528943699	0.142	-0.874534705	0.02047812	-0.847711656	1.30983947	3.83878317	3.83878317	-0.795923644	0.1600	0.1651	0.1690
Manganese, Dissolved	Sand	KMW-018A	Lognormal	mg/L	0	3.32	0.694529706	0.03000995	0.521138084	-5.777804462	-6.777804462	0	0.694529706	4.9491	6.7542	6.9916
Manganese, Dissolved	Alluvium	KMW-010A	Normal	mg/L	0	1.35	2.888333333	0.324200649	N/Ap	-4.745003872	-5.745003872	0	2.888333333	2.8883	4.3472	4.5093
Manganese, Dissolved	Alluvium	KMW-015A	Lognormal	mg/L	0	0.403	-0.371218447	0.034521047	-0.394694954	-0.680063583	-1.680063583	0	-0.371218447	0.4254	0.6083	0.6330
Manganese, Dissolved	Alluvium	KMW-017	Lognormal	mg/L	0	0.191	-0.309732898	0.252545843	-0.718966633	-1.620433462	-2.620433462	0	-0.309732898	0.4901	6.7100	8.9742
Nickel, Dissolved	Sand	KMW-012A	Lognormal	mg/L	0	0.005	-1.697043021	0.373606665	-2.301029996	-1.616638648	-2.616638648	0	-1.697043021	0.0201	0.9642	1.4825

Bold = ND (1/2 MDL)

Calculation of Quarterly Cumulative Sums, Third Quarter 2017
Kent Highlands Landfill

Chemical	Aquifer	Well ID	Distribution	Units	3rd QTR 2016 Standardzd S	3rd QTR 17 Value	Inorm arith mean/ norm arith mean	Inorm stdev/ norm stdev	Transformed Value	Stdzd Z	Stdzd S (New)	New Stdzd S Adjust for <0	Unstdzd S (New)	Untransf. CUSUM	SCL	CCL
Conventional Parameters																
Ammonia-N	Sand	KMW-008A	Lognormal	mg/L	0	0.095	-1.171453964	0.158306581	-1.022276395	0.942333339	-0.057666661	0	-1.171453964	0.0674	0.3475	0.4169
Ammonia-N	Sand	KMW-016B	Lognormal	mg/L	176.6024358	0.516	-1.120890532	0.138324089	-0.287350298	6.025994728	181.6284305	181.6284305	24.00269673	1006228774554940000000000.0000	0.3174	0.3722
Ammonia-N	Sand	KMW-018A	Lognormal	mg/L	0	0.59	-0.161274007	0.074550853	-0.229147988	-0.910438706	-1.910438706	0	-0.161274007	0.6898	1.4935	1.6273
Ammonia-N	Alluvium	KMW-010A	Lognormal	mg/L	36.02577518	2.73	-0.180189091	0.067663117	0.436162647	9.109124225	44.1348994	44.1348994	2.80611577	639.9054	1.3314	1.4392
Ammonia-N	Alluvium	KMW-015A	Lognormal	mg/L	0.17258046	1.11	-0.076360289	0.058007003	0.045322979	2.097734084	1.270314545	1.270314545	-0.002673149	0.9939	1.5299	1.6356
Ammonia-N	Alluvium	KMW-017	Lognormal	mg/L	0	0.252	-0.385294118	0.128712285	-0.598599459	-1.657225967	-2.657225967	0	-0.385294118	0.4118	1.5628	1.8125
Chloride	Sand	KMW-012A	Lognormal	mg/L	0	1.055	2.072157882	0.221620922	0.02325246	-9.245090252	-10.24509025	0	2.072157882	118.0750	1173.4161	1514.4763
Chloride	Sand	KMW-016B	Lognormal	mg/L	0	3.22	1.064838774	0.301733962	0.507855872	-1.845940372	-2.845940372	0	1.064838774	11.6102	264.6315	374.5489
Chloride	Sand	KMW-018A	Lognormal	mg/L	0	12.2	1.677506723	0.066047712	1.086359831	-8.950300826	-9.950300826	0	1.677506723	47.5890	94.3456	101.7994
Chloride	Alluvium	KMW-010A	Lognormal	mg/L	0	9.82	1.752830821	0.073284875	0.992111488	-10.38030475	-11.38030475	0	1.752830821	56.6019	120.9519	131.5998
Chloride	Alluvium	KMW-016A	Lognormal	mg/L	0	7.25	1.713983086	0.34169858	0.860338007	-2.498240056	-3.498240056	0	1.713983086	51.7587	1784.9526	2645.3064
Chloride	Alluvium	KMW-017	Lognormal	mg/L	0	6.88	1.044036468	0.1747782	0.837588438	-1.181200115	-2.181200115	0	1.044036468	11.0672	67.6922	82.7804
Chloride	Alluvium	KMW-019A	Lognormal	mg/L	10.28427457	11.3	0.682311548	0.114556397	1.053078443	3.236544659	12.52081923	12.52081923	2.11665149	130.8132	15.7694	17.9926
COD	Sand	KMW-012A	Lognormal	mg/L	0	11.85	1.926956259	0.252226879	1.07371835	-3.382819111	-4.382819111	0	1.926956259	84.5194	1153.3927	1542.0223
COD	Sand	KMW-018A	Lognormal	mg/L	0	5	1.035680713	0.248052905	0.698970004	-1.3574149	-2.3574149	0	1.035680713	10.8563	141.8792	188.7753
COD	Alluvium	KMW-010A	Lognormal	mg/L	0	12.5	1.459510404	0.097131998	1.096910013	-3.733068371	-4.733068371	0	1.459510404	28.8078	78.8142	88.1395
COD	Alluvium	KMW-015A	Lognormal	mg/L	0	5	0.826793123	0.26894552	0.698970004	-0.475275138	-1.475275138	0	0.826793123	6.7111	108.9050	148.4297
COD	Alluvium	KMW-016A	Lognormal	mg/L	0	13.6	1.598050409	0.143364753	1.133538908	-3.240067661	-4.240067661	0	1.598050409	39.6324	175.0620	206.4782
COD	Alluvium	KMW-019A	Lognormal	mg/L	0	12.4	0.971254815	0.309729349	1.093421685	0.394314044	-0.605568956	0	0.971254815	9.3595	231.7591	331.0561
Sulfate	Sand	KMW-008A	Lognormal	mg/L	85.67394104	14.8	0.820018088	0.060024417	1.170261715	5.83501918	90.50896022	90.50896022	6.252765698	1789640.0829	12.3063	13.1868
Sulfate	Sand	KMW-012A	Lognormal	mg/L	1.608823825	15.15	1.041482789	0.413998697	1.180412633	0.335580388	0.944404212	0.944404212	1.432464903	27.0685	802.5589	1292.6361
Sulfate	Sand	KMW-018A	Lognormal	mg/L	122.3778769	9.91	0.577030182	0.103215202	0.996073654	4.059900696	125.4377776	125.4377776	13.5241158	33428416014500.8000	11.0027	12.3910
Sulfate	Alluvium	KMW-016A	Lognormal	mg/L	1.217686707	10.2	0.799705139	0.410898734	1.008600172	0.50838568	0.726072387	0.726072387	1.098047364	12.5328	445.3992	714.8235
Sulfate	Alluvium	KMW-017	Lognormal	mg/L	0	13.1	0.975537612	0.486097726	1.117271296	0.291574464	-0.708425536	0	0.975537612	9.4523	1455.3833	2546.9841
Sulfate	Alluvium	KMW-019A	Lognormal	mg/L	35.88336673	3.14	0.627995919	0.198711376	0.496929648	-0.659581113	34.22378562	34.22378562	7.428651454	26831901.6601	33.2811	41.8363
TOC	Sand	KMW-012A	Lognormal	mg/L	0	4.07	1.476078352	0.218561503	0.609594409	-3.964485648	-4.964485648	0	1.476078352	29.9280	288.1410	370.5833
TOC	Alluvium	KMW-010A	Lognormal	mg/L	0	4.44	0.996475832	0.044208746	0.64738297	-7.896465981	-8.896465981	0	0.996475832	9.9192	15.6825	16.5014
TOC	Alluvium	KMW-015A	Normal	mg/L	0	2.16	2.789583333	0.876154974	N/Ap	-0.718575312	-1.718575312	0	2.789583333	2.7896	6.7323	7.1704
TOC	Alluvium	KMW-016A	Normal	mg/L	0	5.31	14.21	7.364442829	N/Ap	-1.208509619	-2.208509619	0	14.21	14.2100	47.3500	51.0322
TOC	Alluvium	KMW-019A	Lognormal	mg/L	0	4.78	0.655530874	0.093012631	0.679427897	0.256922335	-0.743077665	0	0.655530874	4.5241	11.8601	13.2006
Field Parameters																
pH	Sand	KMW-008A	Lognormal	su	0	8.05	0.895117672	0.017454069	0.90579588	0.611789072	-0.388210928	0	0.895117672	7.8545	9.4115	9.6026
pH	Sand	KMW-012A	Lognormal	su	14.25030259	7.08	0.824156669	0.015020394	0.850033258	1.722763663	14.97306626	14.97306626	1.049058023	11.1959	7.7938	7.9297
pH	Sand	KMW-016B	Lognormal	su	0	7.28	0.859747744	0.016546467	0.862131379	0.144057028	-0.855942972	0	0.859747744	7.2402	8.5942	8.7595
pH	Alluvium	KMW-010A	Lognormal	su	0	6.91	0.83934857	0.017808927	0.839478047	0.007270339	-0.992729661	0	0.83934857	6.9079	8.3079	8.4799
pH	Alluvium	KMW-015A	Lognormal	su	0	6.81	0.848183581	0.015679841	0.833147112	-0.958968211	-1.958968211	0	0.848183581	7.0499	8.2936	8.4447
pH	Alluvium	KMW-016A	Lognormal	su	0	6.84	0.832149564	0.013763931	0.835056102	0.211170583	-0.788829417	0	0.832149564	6.7944	7.8359	7.9610
pH	Alluvium	KMW-017	Lognormal	su	0	6.61	0.832902893	0.016711852	0.820201459	-0.7600255	-1.7600255	0	0.832902893	6.8062	8.0929	8.2502
Specific Conductivity	Sand	KMW-012A	Normal	umhos/cm	0	302	1726.169167	896.997528	N/Ap	-1.587706902	-2.587706902	0	1726.169167	1726.1692	5762.6580	6211.1568
Specific Conductivity	Sand	KMW-016B	Lognormal	umhos/cm	0	209	2.555857045	0.128335046	2.320146286	-1.836682696	-2.836682696	0	2.555857045	359.6309	1359.4547	1575.9131
Specific Conductivity	Alluvium	KMW-015A	Normal	umhos/cm	0.793344455	252	209.35	16.53335472	N/Ap	2.57963376	2.372978215	2.372978215	248.5832906	248.5833	283.7501	292.0168
Specific Conductivity	Alluvium	KMW-017	Normal	umhos/cm	0	303	698.8333333	154.8077008	N/Ap	-2.556935677	-3.556935677	0	698.8333333	698.8333	1395.4680	1472.8718
Dissolved Metals																
Iron, Dissolved	Sand	KMW-008A	Normal	mg/L	0	0.025	0.02375	0.010938138	N/Ap	0.114279051	-0.885720949	0	0.02375	0.0238	0.0730	0.0784
Iron, Dissolved	Sand	KMW-018A	Lognormal	mg/L	0	0.025	-1.105226103	0.13165808	-1.602059991	-3.773668035	-4.773668035	0	-1.105226103	0.0785	0.3071	0.3573
Iron, Dissolved	Alluvium	KMW-010A	Lognormal	mg/L	0	5.96	1.132201969	0.049664737	0.77524626	-7.187306961	-8.187306961	0	1.132201969	13.5582	22.6826	24.0174
Iron, Dissolved	Alluvium	KMW-017	Lognormal	mg/L	0	4.74	0.863817235	0.215724563	0.675778342	-0.871661948	-1.871661948	0	0.863817235	7.3083	68.3247	87.5871
Manganese, Dissolved	Sand	KMW-008A	Lognormal	mg/L	3.83878317	0.147	-0.874534705	0.02047812	-0.832682665	2.043744271	4.882527441	4.882527441	-0.774549724	0.1681	0.1651	0.1690
Manganese, Dissolved	Sand	KMW-018A	Lognormal	mg/L	0	3.17	0.694529706	0.03000995	0.501059262	-6.446876607	-7.446876607	0	0.694529706	4.9491	6.7542	6.9916
Manganese, Dissolved	Alluvium	KMW-010A	Normal	mg/L	0	1.55	2.888333333	0.324200649	N/Ap	-4.12810196	-5.12810196	0	2.888333333	2.8883	4.3472	4.5093
Manganese, Dissolved	Alluvium	KMW-015A	Lognormal	mg/L	0	0.457	-0.371218447	0.034521047	-0.3400838	0.901903333	-0.098096667	0	-0.371218447	0.4254	0.6083	0.6330
Manganese, Dissolved	Alluvium	KMW-017	Lognormal	mg/L	0	0.176	-0.309732898	0.252545843	-0.754487332	-1.761083963	-2.761083963	0	-0.309732898	0.4901	6.7100	8.9742
Nickel, Dissolved	Sand	KMW-012A	Lognormal	mg/L	0	0.005	-1.697043021	0.373606665	-2.301029996	-1.616638648	-2.616638648	0	-1.697043021	0.0201	0.9642	1.4825

Bold = ND (1/2 MDL)

Calculation of Quarterly Cumulative Sums, Third Quarter 2018
Kent Highlands Landfill

Chemical	Aquifer	Well ID	Distribution	Units	3rd QTR 2017 Standardzd S	3rd QTR 18 Value	Inorm arith mean/ norm arith mean	Inorm stdev/ norm stdev	Transformed Value	Stdzd Z	Stdzd S (New)	New Stdzd S Adjust for <0	Unstdzd S (New)	Untransf. CUSUM	SCL	CCL
Conventional Parameters																
Ammonia-N	Sand	KMW-008A	Lognormal	mg/L	0	0.091	-1.171453964	0.158306581	-1.040958608	0.824320475	-0.175679525	0	-1.171453964	0.0674	0.3475	0.4169
Ammonia-N	Sand	KMW-016B	Lognormal	mg/L	181.6284305	0.503	-1.120890532	0.138324089	-0.298432015	5.94588058	186.5743111	186.5743111	24.68683116	4862181426594430000000000.0000	0.3174	0.3722
Ammonia-N	Sand	KMW-018A	Lognormal	mg/L	0	0.603	-0.161274007	0.074550853	-0.219682688	-0.783474357	-1.783474357	0	-0.161274007	0.6898	1.4935	1.6273
Ammonia-N	Alluvium	KMW-010A	Lognormal	mg/L	44.1348994	2.41	-0.180189091	0.067663117	0.382017043	8.3089009	51.4438003	51.4438003	3.300658786	1998.2912	1.3314	1.4392
Ammonia-N	Alluvium	KMW-015A	Lognormal	mg/L	1.270314545	1.06	-0.076360289	0.058007003	0.025305865	1.752653103	2.022967648	2.022967648	0.040986002	1.0990	1.5299	1.6356
Ammonia-N	Alluvium	KMW-017	Lognormal	mg/L	0	0.278	-0.385294118	0.128712285	-0.555955204	-1.325911399	-2.325911399	0	-0.385294118	0.4118	1.5628	1.8125
Chloride	Sand	KMW-012A	Lognormal	mg/L	0	1.01	2.072157882	0.221620922	0.004321374	-9.330511275	-10.33051128	0	2.072157882	118.0750	1173.4161	1514.4763
Chloride	Sand	KMW-016B	Lognormal	mg/L	0	2.85	1.064838774	0.301733962	0.45484486	-2.021628291	-3.021628291	0	1.064838774	11.6102	264.6315	374.5489
Chloride	Sand	KMW-018A	Lognormal	mg/L	0	11.6	1.677506723	0.066047712	1.064457989	-9.281907187	-10.28190719	0	1.677506723	47.5890	94.3456	101.7994
Chloride	Alluvium	KMW-010A	Lognormal	mg/L	0	8.42	1.752830821	0.073284875	0.925312091	-11.29180793	-12.29180793	0	1.752830821	56.6019	120.9519	131.5998
Chloride	Alluvium	KMW-016A	Lognormal	mg/L	0	5.84	1.713983086	0.34169858	0.766412847	-2.773117287	-3.773117287	0	1.713983086	51.7587	1784.9526	2645.3064
Chloride	Alluvium	KMW-017	Lognormal	mg/L	0	7.67	1.044036468	0.1747782	0.884795364	-0.911103926	-1.911103926	0	1.044036468	11.0672	67.6922	82.7804
Chloride	Alluvium	KMW-019A	Lognormal	mg/L	12.52081923	15.6	0.682311548	0.114556397	1.193124598	4.459053031	15.97987226	15.97987226	2.512908144	325.7678	15.7694	17.9926
COD	Sand	KMW-012A	Lognormal	mg/L	0	5	1.926956259	0.252226879	0.698970004	-4.868578071	-5.868578071	0	1.926956259	84.5194	1153.3927	1542.0223
COD	Sand	KMW-018A	Lognormal	mg/L	0	5	1.035680713	0.248052905	0.698970004	-1.3574149	-2.3574149	0	1.035680713	10.8563	141.8792	188.7753
COD	Alluvium	KMW-010A	Lognormal	mg/L	0	5	1.459510404	0.097131998	0.698970004	-7.829967594	-8.829967594	0	1.459510404	28.8078	78.8142	88.1395
COD	Alluvium	KMW-015A	Lognormal	mg/L	0	5	0.826793123	0.26894552	0.698970004	-0.475275138	-1.475275138	0	0.826793123	6.7111	108.9050	148.4297
COD	Alluvium	KMW-016A	Lognormal	mg/L	0	10.9	1.598050409	0.143364753	1.037426498	-3.910472404	-4.910472404	0	1.598050409	39.6324	175.0620	206.4782
COD	Alluvium	KMW-019A	Lognormal	mg/L	0	5	0.971254815	0.309729349	0.698970004	-0.879105618	-1.879105618	0	0.971254815	9.3595	231.7591	331.0561
Sulfate	Sand	KMW-008A	Lognormal	mg/L	90.50896022	12.4	0.820018088	0.060024417	1.093421685	4.554872975	94.0638332	94.0638332	6.466144878	2925128.0167	12.3063	13.1868
Sulfate	Sand	KMW-012A	Lognormal	mg/L	0.944404212	16.4	1.041482789	0.413998697	1.214843848	0.418747836	0.363152048	0.363152048	1.191827264	15.5535	802.5589	1292.6361
Sulfate	Sand	KMW-018A	Lognormal	mg/L	125.4377776	11.7	0.577030182	0.103215202	1.068185862	4.758559474	129.1963371	129.1963371	13.91205628	81668819009794.9000	11.0027	12.3910
Sulfate	Alluvium	KMW-016A	Lognormal	mg/L	0.726072387	10.2	0.799705139	0.410898734	1.008600172	0.50838568	0.234458067	0.234458067	0.896043662	7.8712	445.3992	714.8235
Sulfate	Alluvium	KMW-017	Lognormal	mg/L	0	14.5	0.975537612	0.486097726	1.161368002	0.382290187	-0.617709813	0	0.975537612	9.4523	1455.3833	2546.9841
Sulfate	Alluvium	KMW-019A	Lognormal	mg/L	34.22378562	4.61	0.627995919	0.198711376	0.663700925	0.179682751	33.40346837	33.40346837	7.265645084	18435082.4424	33.2811	41.8363
TOC	Sand	KMW-012A	Lognormal	mg/L	0	3.67	1.476078352	0.218561503	0.564666064	-4.170049502	-5.170049502	0	1.476078352	29.9280	288.1410	370.5833
TOC	Alluvium	KMW-010A	Lognormal	mg/L	0	2.84	0.996475832	0.044208746	0.45331834	-12.28619983	-13.28619983	0	0.996475832	9.9192	15.6825	16.5014
TOC	Alluvium	KMW-015A	Normal	mg/L	0	1.79	2.789583333	0.876154974	N/Ap	-1.140875032	-2.140875032	0	2.789583333	2.7896	6.7323	7.1704
TOC	Alluvium	KMW-016A	Normal	mg/L	0	4.66	14.21	7.364442829	N/Ap	-1.296771558	-2.296771558	0	14.21	14.2100	47.3500	51.0322
TOC	Alluvium	KMW-019A	Lognormal	mg/L	0	3.66	0.655530874	0.093012631	0.563481085	-0.98964827	-1.98964827	0	0.655530874	4.5241	11.8601	13.2006
Field Parameters																
pH	Sand	KMW-008A	Lognormal	su	0	8.31	0.895117672	0.017454069	0.919601024	1.402730324	0.402730324	0.402730324	0.902146954	7.9826	9.4115	9.6026
pH	Sand	KMW-012A	Lognormal	su	14.97306626	7.23	0.824156669	0.015020394	0.859138297	2.328942144	16.3020084	16.3020084	1.069019258	11.7225	7.7938	7.9297
pH	Sand	KMW-016B	Lognormal	su	0	7.51	0.859747744	0.016546467	0.875639937	0.960458359	-0.039541641	0	0.859747744	7.2402	8.5942	8.7595
pH	Alluvium	KMW-010A	Lognormal	su	0	7.01	0.83934857	0.017808927	0.845718018	0.357654763	-0.642345237	0	0.83934857	6.9079	8.3079	8.4799
pH	Alluvium	KMW-015A	Lognormal	su	0	6.92	0.848183581	0.015679841	0.840106094	-0.515151051	-1.515151051	0	0.848183581	7.0499	8.2936	8.4447
pH	Alluvium	KMW-016A	Lognormal	su	0	7.1	0.832149564	0.013763931	0.851258349	1.388323133	0.388323133	0.388323133	0.837494417	6.8785	7.8359	7.9610
pH	Alluvium	KMW-017	Lognormal	su	0	6.97	0.832902893	0.016711852	0.843232778	0.618117321	-0.381882679	0	0.832902893	6.8062	8.0929	8.2502
Specific Conductivity	Sand	KMW-012A	Normal	umhos/cm	0	309.3	1726.169167	896.997528	N/Ap	-1.579568641	-2.579568641	0	1726.169167	1726.1692	5762.6580	6211.1568
Specific Conductivity	Sand	KMW-016B	Lognormal	umhos/cm	0	208.3	2.555857045	0.128335046	2.31868927	-1.848035917	-2.848035917	0	2.555857045	359.6309	1359.4547	1575.9131
Specific Conductivity	Alluvium	KMW-015A	Normal	umhos/cm	2.372978215	271.7	209.35	16.53335472	N/Ap	3.771164477	5.144142693	5.144142693	294.3999359	294.3999	283.7501	292.0168
Specific Conductivity	Alluvium	KMW-017	Normal	umhos/cm	0	295.3	698.8333333	154.8077008	N/Ap	-2.606674804	-3.606674804	0	698.8333333	698.8333	1395.4680	1472.8718
Dissolved Metals																
Iron, Dissolved	Sand	KMW-008A	Normal	mg/L	0	0.025	0.02375	0.010938138	N/Ap	0.114279051	-0.885720949	0	0.02375	0.0238	0.0730	0.0784
Iron, Dissolved	Sand	KMW-018A	Lognormal	mg/L	0	0.025	-1.105226103	0.13165808	-1.602059991	-3.773668035	-4.773668035	0	-1.105226103	0.0785	0.3071	0.3573
Iron, Dissolved	Alluvium	KMW-010A	Lognormal	mg/L	0	4.92	1.132201969	0.049664737	0.691965103	-8.864173931	-9.864173931	0	1.132201969	13.5582	22.6826	24.0174
Iron, Dissolved	Alluvium	KMW-017	Lognormal	mg/L	0	4.48	0.863817235	0.215724563	0.651278014	-0.985234215	-1.985234215	0	0.863817235	7.3083	68.3247	87.5871
Manganese, Dissolved	Sand	KMW-008A	Lognormal	mg/L	4.882527441	0.13	-0.874534705	0.02047812	-0.886056648	-0.562646511	3.31988093	3.31988093	-0.806549786	0.1561	0.1651	0.1690
Manganese, Dissolved	Sand	KMW-018A	Lognormal	mg/L	0	3.13	0.694529706	0.03000995	0.495544338	-6.630646481	-7.630646481	0	0.694529706	4.9491	6.7542	6.9916
Manganese, Dissolved	Alluvium	KMW-010A	Normal	mg/L	0	1.21	2.888333333	0.324200649	N/Ap	-5.17683521	-6.17683521	0	2.888333333	2.8883	4.3472	4.5093
Manganese, Dissolved	Alluvium	KMW-015A	Lognormal	mg/L	0	0.432	-0.371218447	0.034521047	-0.364516253	0.194148049	-0.805851951	0	-0.371218447	0.4254	0.6083	0.6330
Manganese, Dissolved	Alluvium	KMW-017	Lognormal	mg/L	0	0.165	-0.309732898	0.252545843	-0.782516056	-1.872068659	-2.872068659	0	-0.309732898	0.4901	6.7100	8.9742
Nickel, Dissolved	Sand	KMW-012A	Lognormal	mg/L	0	0.005	-1.697043021	0.373606665	-2.301029996	-1.616638648	-2.616638648	0	-1.697043021	0.0201	0.9642	1.4825

Bold = ND (1/2 MDL)

Vinyl Chloride Upper Confidence Limit Calculations



Kent Highlands Landfill

Calculation of Upper Confidence Limits for 2011-2018 Vinyl Chloride Data

Sample Date	Well ID	Chemical	Value	Q	1/2 MDL	Units		
9/6/2011	KMW-010A	Vinyl Chloride	0.049		0.049	ug/L	Mean	0.0355
9/10/2012	KMW-010A	Vinyl Chloride	0.047		0.047	ug/L	Lognormal mean	0.0358
9/16/2013	KMW-010A	Vinyl Chloride	0.042		0.042	ug/L	Standard Deviation	0.00995274
9/9/2014	KMW-010A	Vinyl Chloride	0.0365		0.0365	ug/L	Median	0.0353
9/8/2015	KMW-010A	Vinyl Chloride	0.034 M		0.034	ug/L	Minimum	0.0221
9/12/2016	KMW-010A	Vinyl Chloride	0.0254		0.0254	ug/L	Maximum	0.049
9/18/2017	KMW-010A	Vinyl Chloride	0.0283		0.0283	ug/L	Count	8
9/10/2018	KMW-010A	Vinyl Chloride	0.0221 J		0.0221	ug/L		
							Lognormal Calculation	
							95% UCL = 0.045	
9/7/2011	KMW-012A	Vinyl Chloride	0.22		0.22	ug/L	Mean	0.128
9/11/2012	KMW-012A	Vinyl Chloride	0.16		0.16	ug/L	Lognormal mean	0.129
9/17/2013	KMW-012A	Vinyl Chloride	0.13		0.13	ug/L	Standard Deviation	0.0458523
9/10/2014	KMW-012A	Vinyl Chloride	0.14		0.14	ug/L	Median	0.1195
9/9/2015	KMW-012A	Vinyl Chloride	0.095 M		0.095	ug/L	Minimum	0.0796
9/13/2016	KMW-012A	Vinyl Chloride	0.109		0.109	ug/L	Maximum	0.22
9/19/2017	KMW-012A	Vinyl Chloride	0.0796		0.0796	ug/L	Count	8
9/11/2018	KMW-012A	Vinyl Chloride	0.0921		0.0921	ug/L		
							Lognormal Calculation	
							95% UCL = 0.168	
9/6/2011	KMW-017	Vinyl Chloride	0.75		0.75	ug/L	Mean	0.529
9/10/2012	KMW-017	Vinyl Chloride	0.73		0.73	ug/L	Lognormal mean	0.531
9/16/2013	KMW-017	Vinyl Chloride	0.58		0.58	ug/L	Standard Deviation	0.149096
9/9/2014	KMW-017	Vinyl Chloride	0.54		0.54	ug/L	Median	0.500
9/8/2015	KMW-017	Vinyl Chloride	0.46 M		0.46	ug/L	Minimum	0.362
9/12/2016	KMW-017	Vinyl Chloride	0.416		0.416	ug/L	Maximum	0.75
9/18/2017	KMW-017	Vinyl Chloride	0.394		0.394	ug/L	Count	8
9/10/2018	KMW-017	Vinyl Chloride	0.362 J		0.362	ug/L		
							Lognormal Calculation	
							95% UCL = 0.657	

Kent Highlands Landfill

Calculation of Upper Confidence Limits for 2011-2018 Vinyl Chloride Data

Sample Date	Well ID	Chemical	Value	Q	1/2 MDL	Units		
9/6/2011	KMW-017Z	Vinyl Chloride	0.083		0.083	ug/L	Mean	0.112
9/10/2012	KMW-017Z	Vinyl Chloride	0.17		0.17	ug/L	Lognormal mean	0.113
9/16/2013	KMW-017Z	Vinyl Chloride	0.15		0.15	ug/L	Standard Deviation	0.048203638
9/9/2014	KMW-017Z	Vinyl Chloride	0.11		0.11	ug/L	Median	0.0965
9/8/2015	KMW-017Z	Vinyl Chloride	0.18 M		0.18	ug/L	Minimum	0.0664
9/12/2016	KMW-017Z	Vinyl Chloride	0.0664		0.0664	ug/L	Maximum	0.18
9/18/2017	KMW-017Z	Vinyl Chloride	0.0687		0.0687	ug/L	Count	8
9/10/2018	KMW-017Z	Vinyl Chloride	0.0669 J		0.0669	ug/L		
Neither Lognormally nor Normally Distributed¹								
95% UCL = 0.14								
9/7/2011	KMW-018A	Vinyl Chloride	0.044		0.044	ug/L	Mean ²	0.0297
9/11/2012	KMW-018A	Vinyl Chloride	0.039		0.039	ug/L	Lognormal mean	0.0298
9/17/2013	KMW-018A	Vinyl Chloride	0.02 U		0.01	ug/L	Standard Deviation	0.00887468
9/10/2014	KMW-018A	Vinyl Chloride	0.032		0.032	ug/L	Median	0.0243
9/9/2015	KMW-018A	Vinyl Chloride	0.024 M		0.024	ug/L	Minimum	0.0207
9/13/2016	KMW-018A	Vinyl Chloride	0.0239		0.0239	ug/L	Maximum	0.044
9/19/2017	KMW-018A	Vinyl Chloride	0.0243		0.0243	ug/L	Count	8
9/11/2018	KMW-018A	Vinyl Chloride	0.0207		0.0207	ug/L		
Lognormal Calculation								
95% UCL = 0.041								

¹ Based on the Z-statistic.

² All results are for the uncensored values

Compliance calculations

0.049
0.047
0.042
0.0365
0.034
0.0254
0.0283
0.0221

KMW-010A 2011-2018 Vinyl Chloride Data

Number of samples		Uncensored values	
Uncensored	8	Mean	0.04
Censored		Lognormal mean	0.04
Detection limit or PQL		Std. devn.	0.00995274
Method detection limit		Median	0.03525
TOTAL	8	Min.	0.0221
		Max.	0.049
Lognormal distribution?			
r-squared is:	0.969	Normal distribution?	
		r-squared is:	0.970
Recommendations:			
Use lognormal distribution.			
UCL (Land's method) is 0.0447837260994114			

Compliance calculations

0.75
0.73
0.58
0.54
0.46
0.416
0.394
0.362

KMW-017 2011-2018 Vinyl Chloride Data

Number of samples		Uncensored values	
Uncensored	8	Mean	0.53
Censored		Lognormal mean	0.53
Detection limit or PQL		Std. devn.	0.14909633
Method detection limit		Median	0.5
TOTAL	8	Min.	0.362
		Max.	0.75
Lognormal distribution?			
r-squared is:	0.950	Normal distribution?	
		r-squared is:	0.922
Recommendations:			
Use lognormal distribution.			
UCL (Land's method) is 0.656635860807927			

Compliance calculations

0.083
0.17
0.15
0.11
0.18
0.0664
0.0687
0.0669

KMW-017Z 2011-2018 Vinyl Chloride Data

Number of samples		Uncensored values	
Uncensored	8	Mean	0.11
Censored		Lognormal mean	0.11
Detection limit or PQL		Std. devn.	0.04820364
Method detection limit		Median	0.0965
TOTAL	8	Min.	0.0664
		Max.	0.18
Lognormal distribution?			
r-squared is:	0.884	Normal distribution?	
		r-squared is:	0.873
Recommendations:			
Reject BOTH lognormal and normal distributions. See Statistics Guidance.			
UCL (based on Z-statistic) is 0.14			

Compliance calculations

0.22
0.16
0.13
0.14
0.095
0.109
0.0796
0.0921

KMW-012A 2011-2018 Vinyl Chloride Data

Number of samples		Uncensored values	
Uncensored	8	Mean	0.13
Censored		Lognormal mean	0.13
Detection limit or PQL		Std. devn.	0.04585226
Method detection limit		Median	0.1195
TOTAL	8	Min.	0.0796
		Max.	0.22
Lognormal distribution?			
r-squared is:	0.967	Normal distribution?	
		r-squared is:	0.902
Recommendations:			
Use lognormal distribution.			
UCL (Land's method) is 0.168058566336579			

Compliance calculations

0.044
0.039
0.032
0.024
0.0239
0.0243
0.0207

KMW-018A 2011-2018 Vinyl Chloride Data

Number of samples		Uncensored values	
Uncensored	7	Mean	0.03
Censored	1	Lognormal mean	0.03
Detection limit or PQL	0.02	Std. devn.	0.00887468
Method detection limit		Median	0.0243
TOTAL	8	Min.	0.0207
		Max.	0.044
Lognormal distribution?			
r-squared is:	0.926	Normal distribution?	
		r-squared is:	0.912
Recommendations:			
Use lognormal distribution.			
UCL (Land's method) is 0.0413372399568758			
Simple substitution used with censored values.			

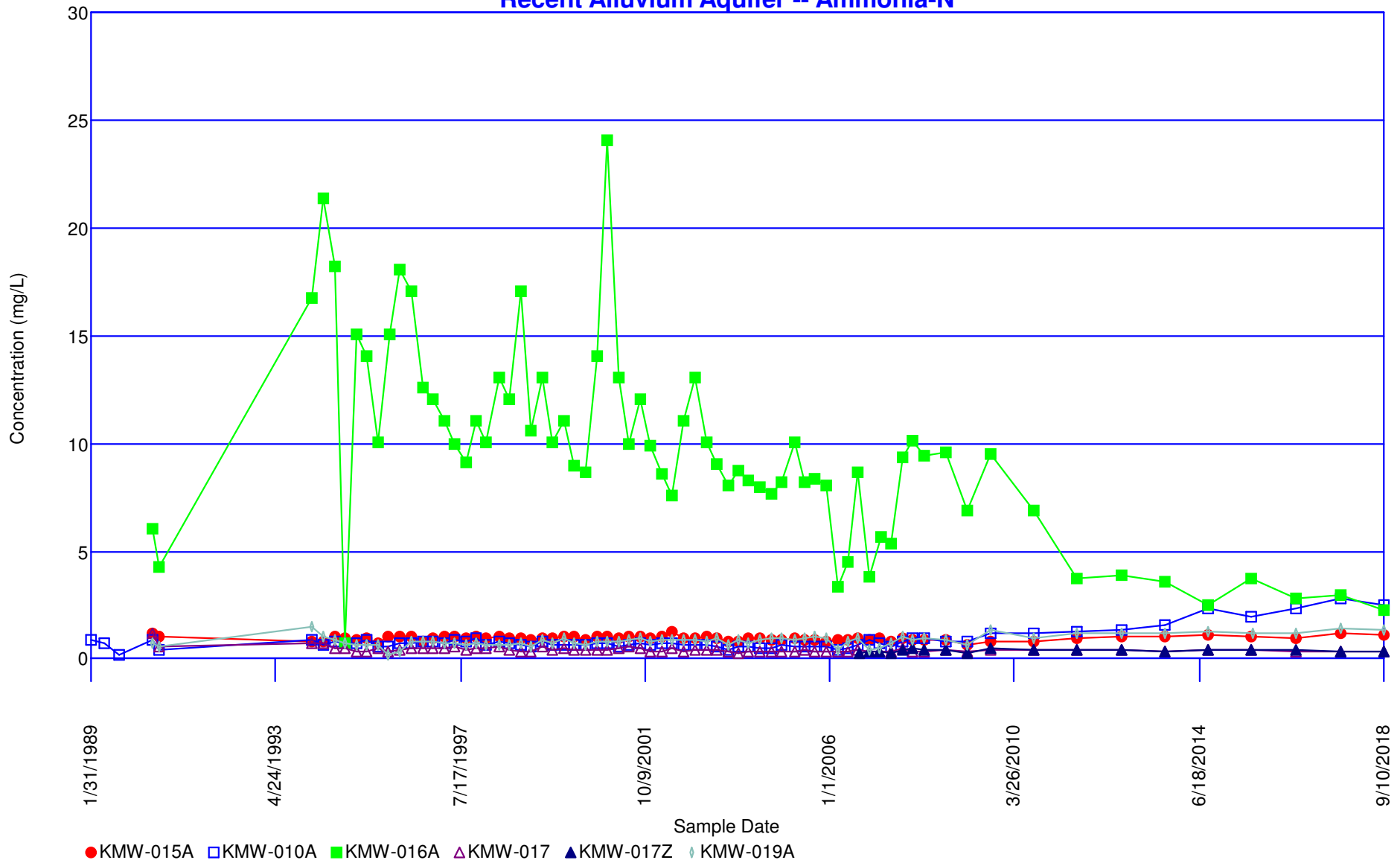
Time-Series Plots

Recent Alluvium Aquifer



No data collected between September 1990 and January 1994

Kent Highlands Landfill
Recent Alluvium Aquifer -- Ammonia-N

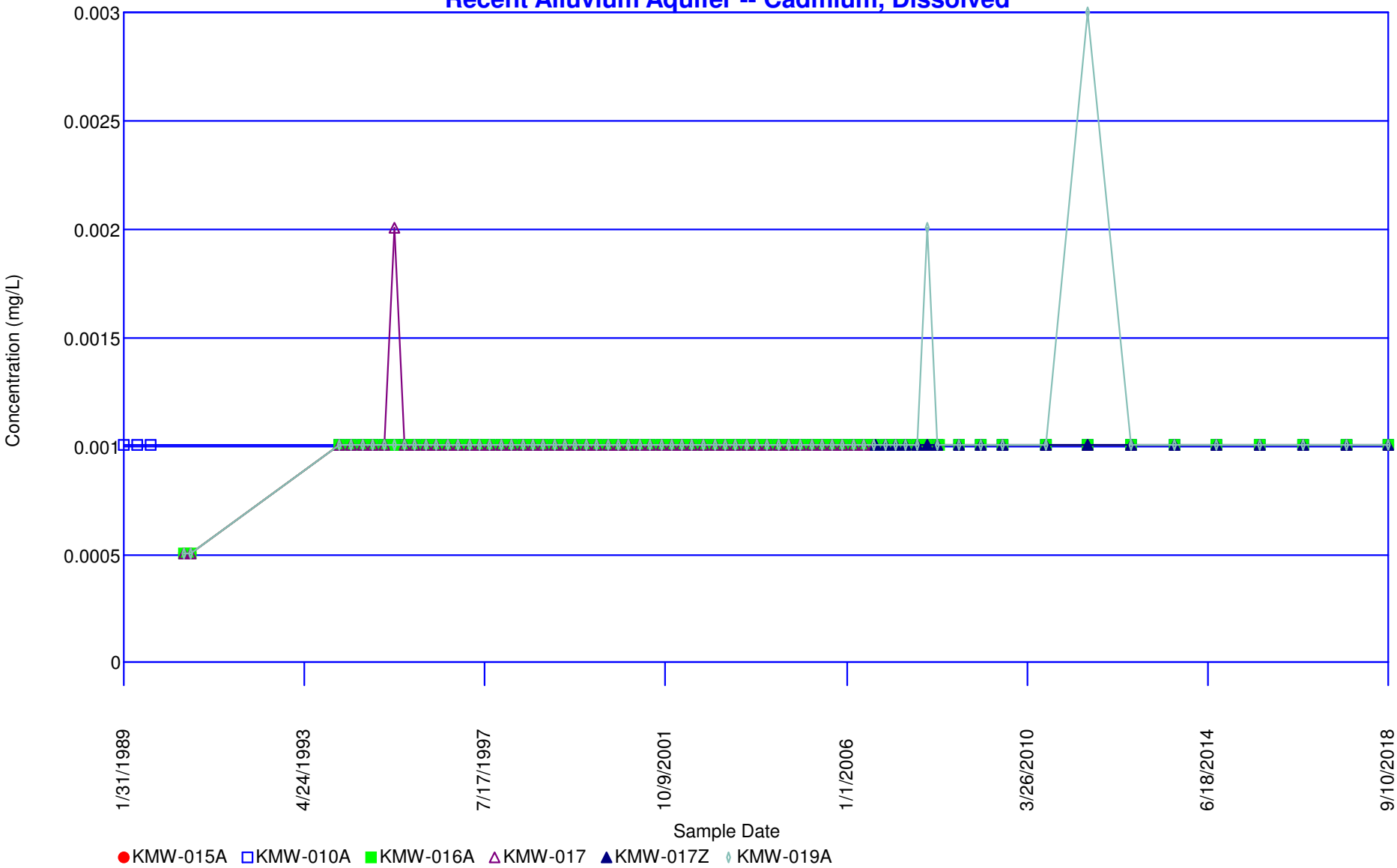


No Regulatory Value

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill
Recent Alluvium Aquifer -- Cadmium, Dissolved



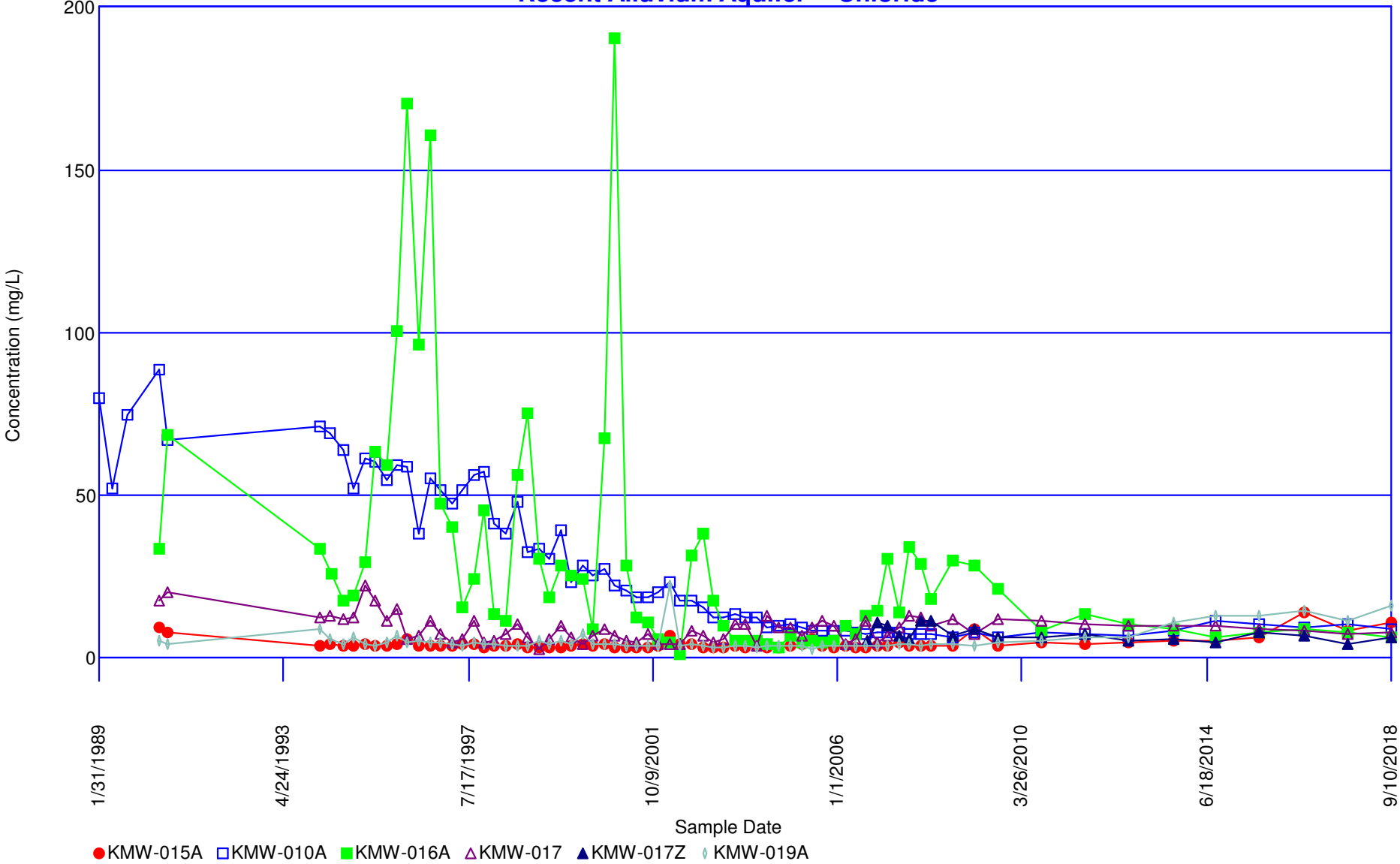
Regulatory Value = 0.0005 mg/L (not shown)

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill

Recent Alluvium Aquifer -- Chloride



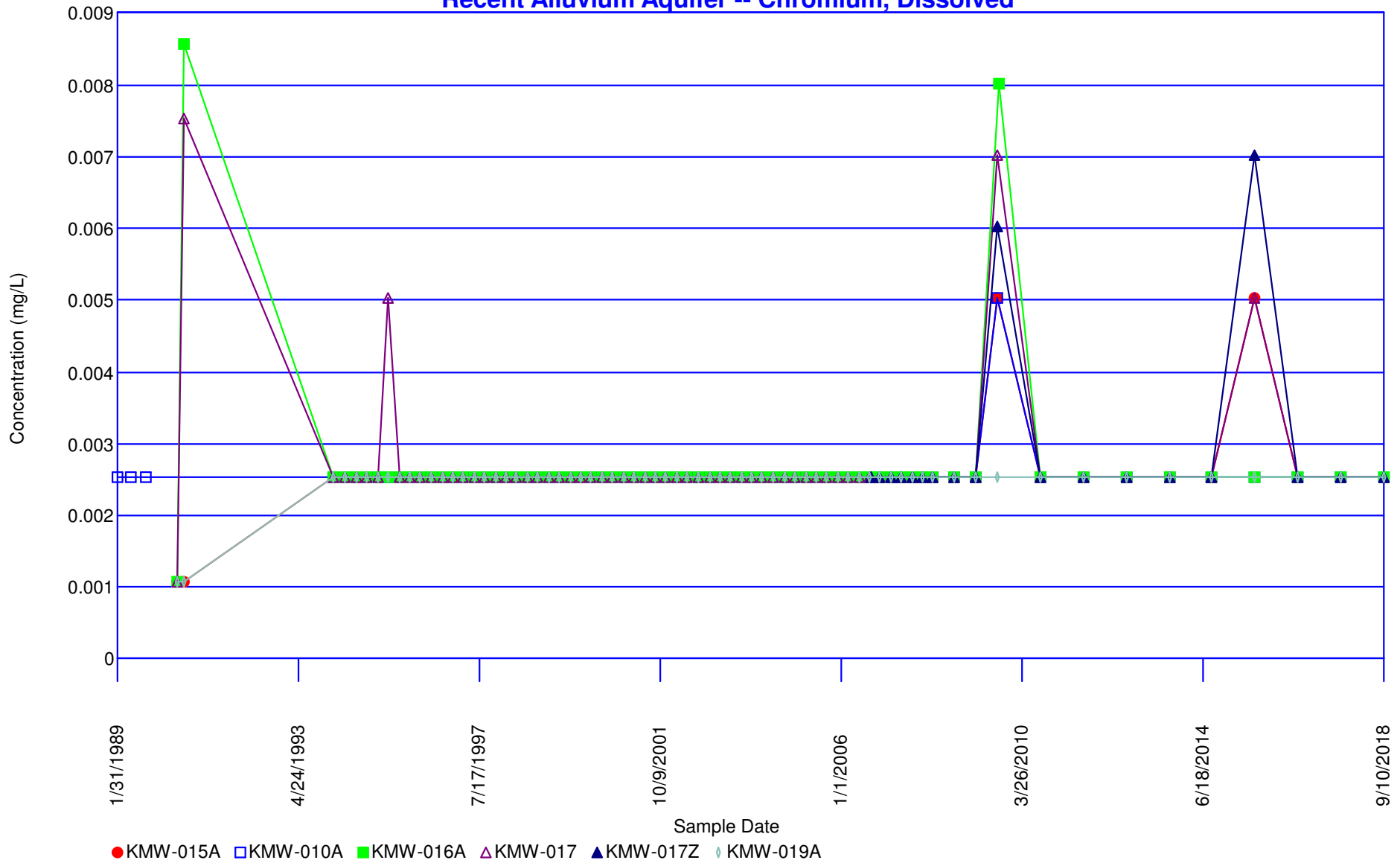
Regulatory Value = 250 mg/L (not shown)

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill

Recent Alluvium Aquifer -- Chromium, Dissolved

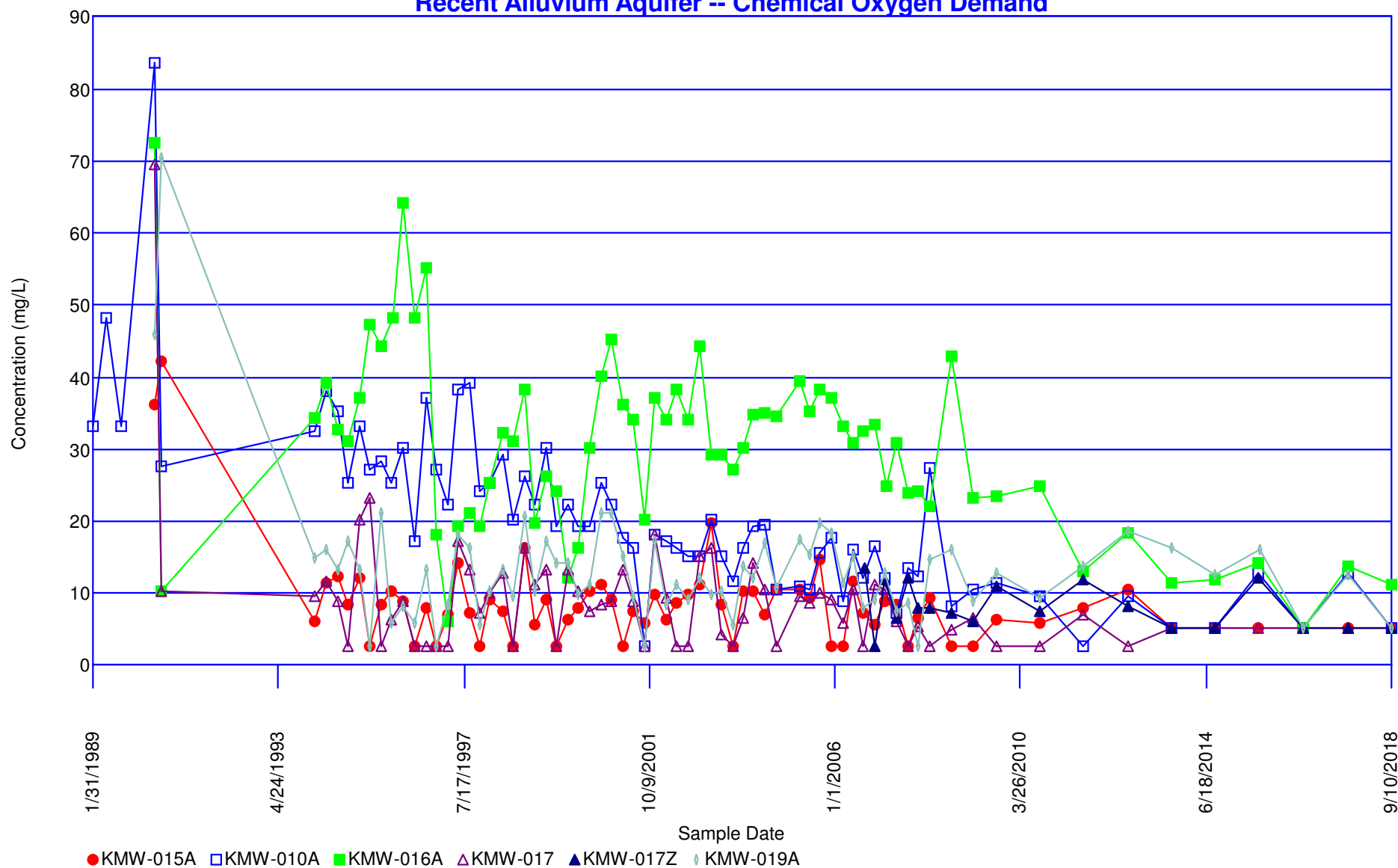


Regulatory Value = 0.1 mg/L (not shown)

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill Recent Alluvium Aquifer -- Chemical Oxygen Demand



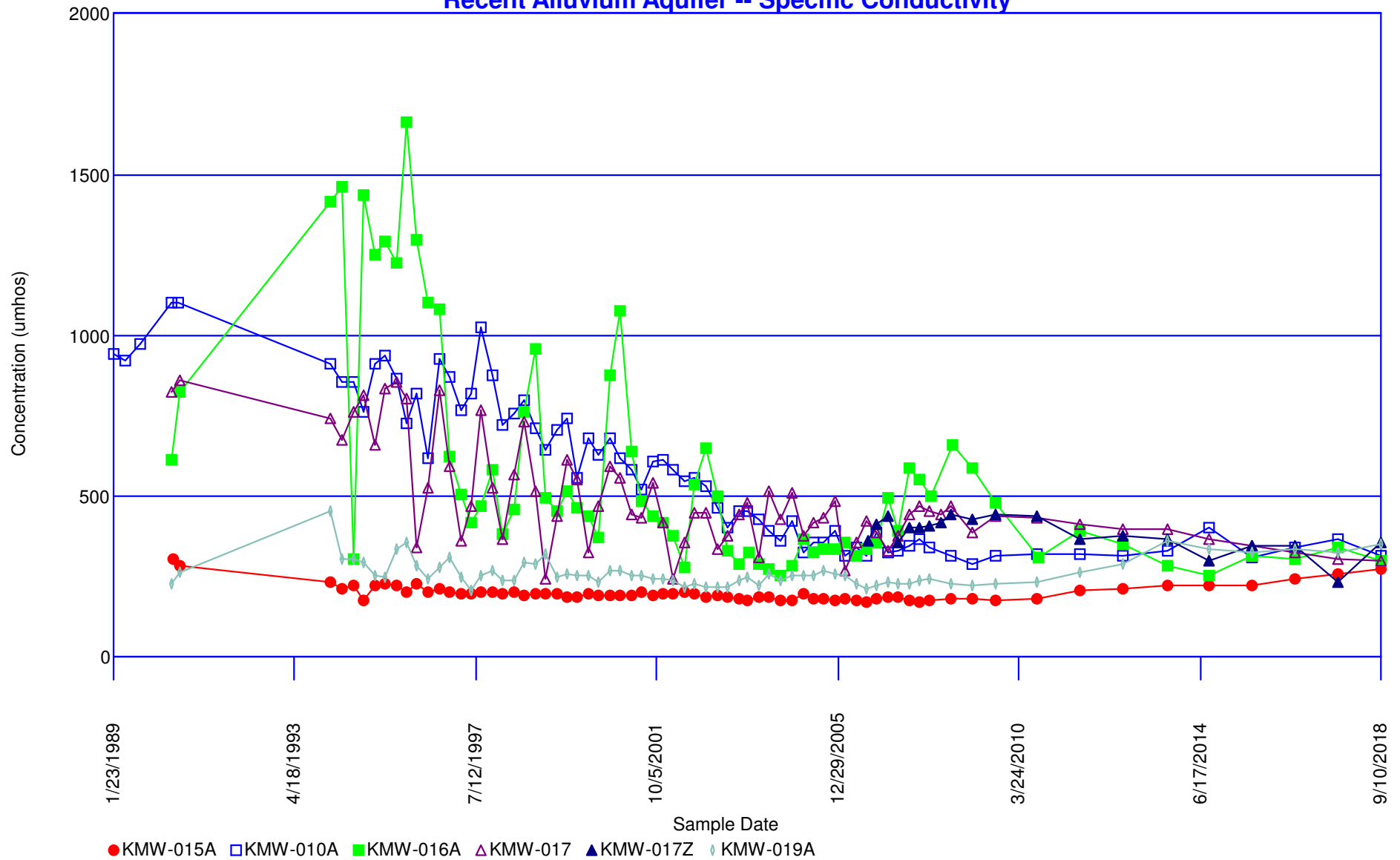
No Regulatory Value

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill

Recent Alluvium Aquifer -- Specific Conductivity



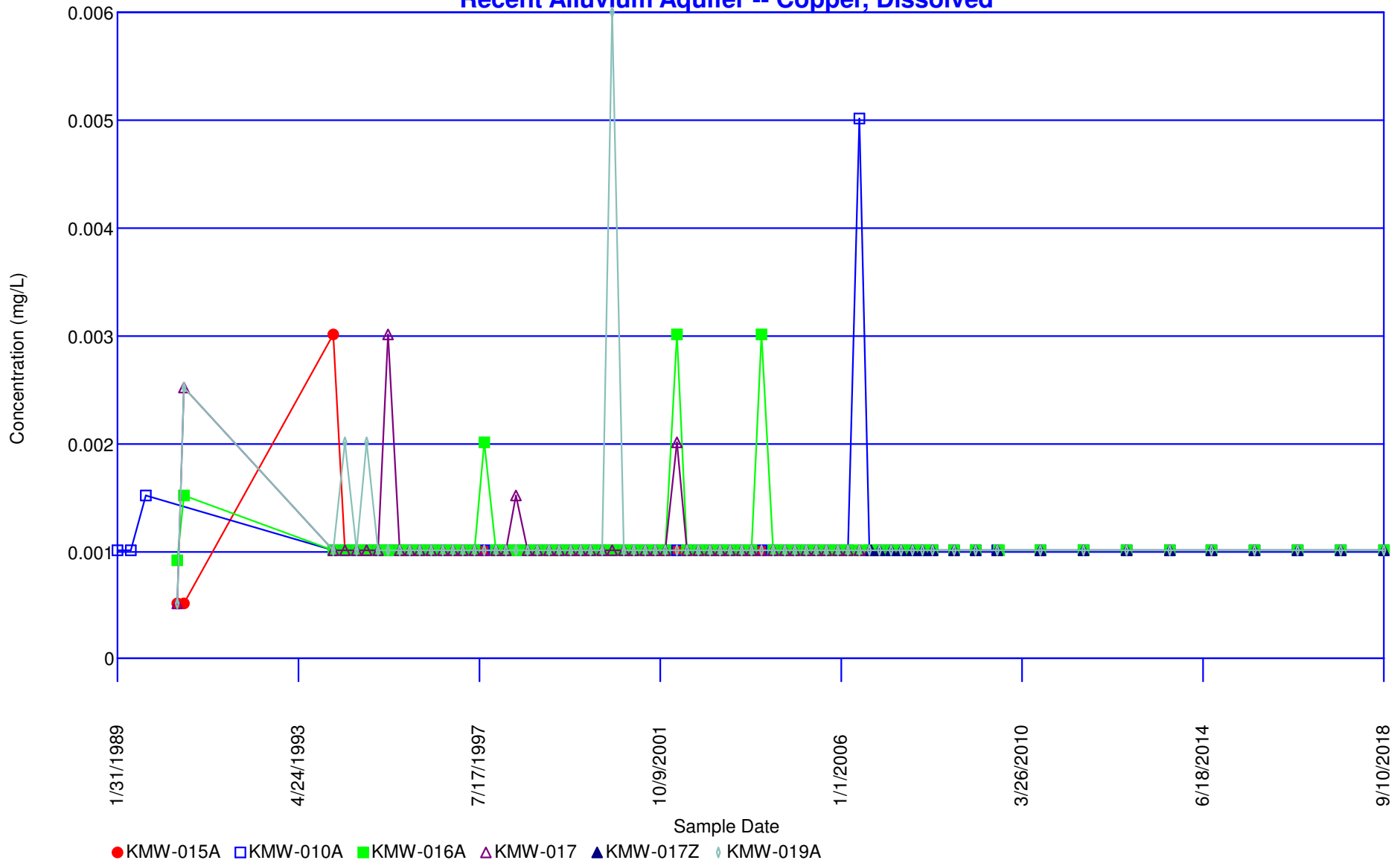
Regulatory Value = 700 umhos/cm (not shown)

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill

Recent Alluvium Aquifer -- Copper, Dissolved

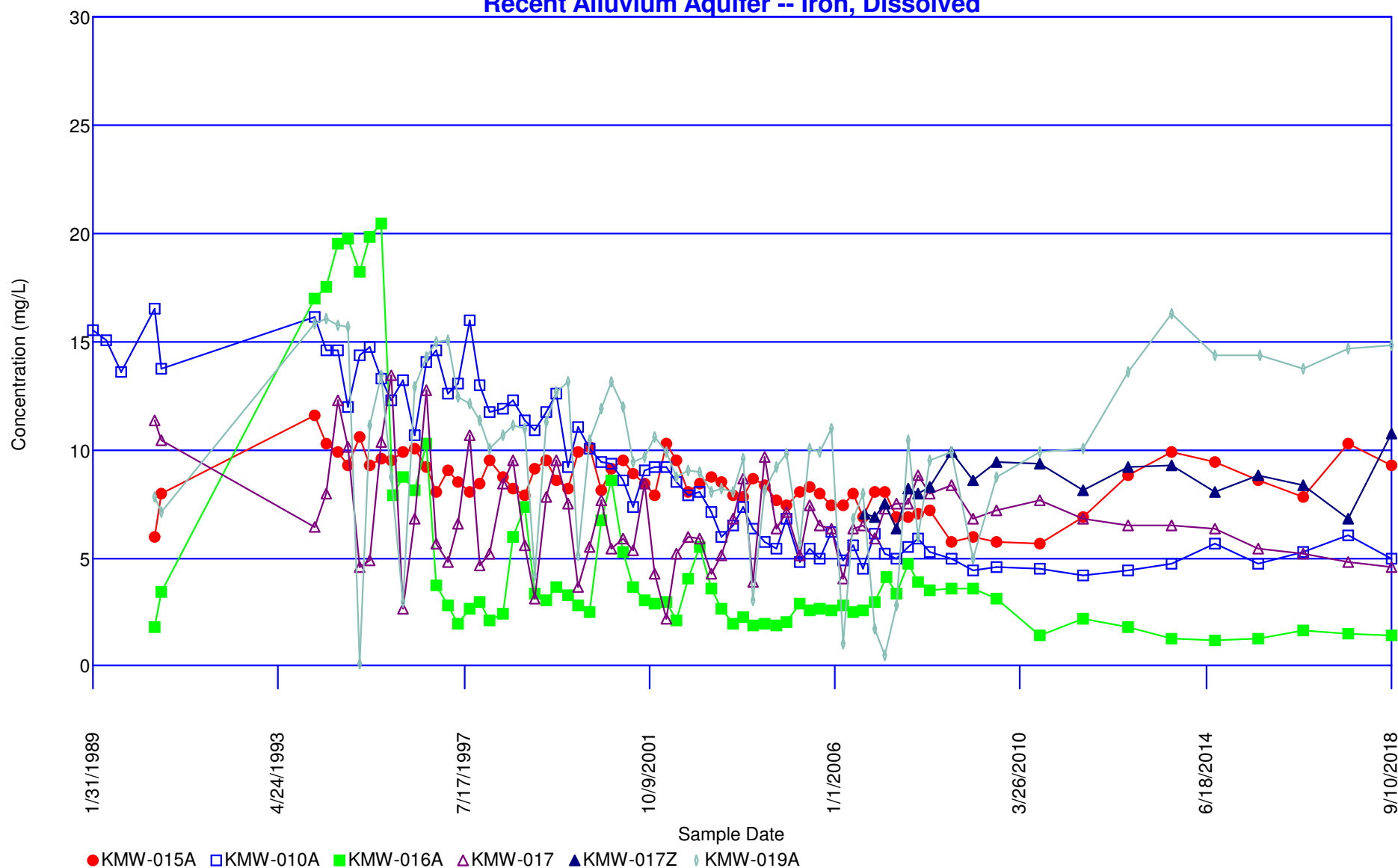


Regulatory Value = 0.59 mg/L (not shown)

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill Recent Alluvium Aquifer -- Iron, Dissolved



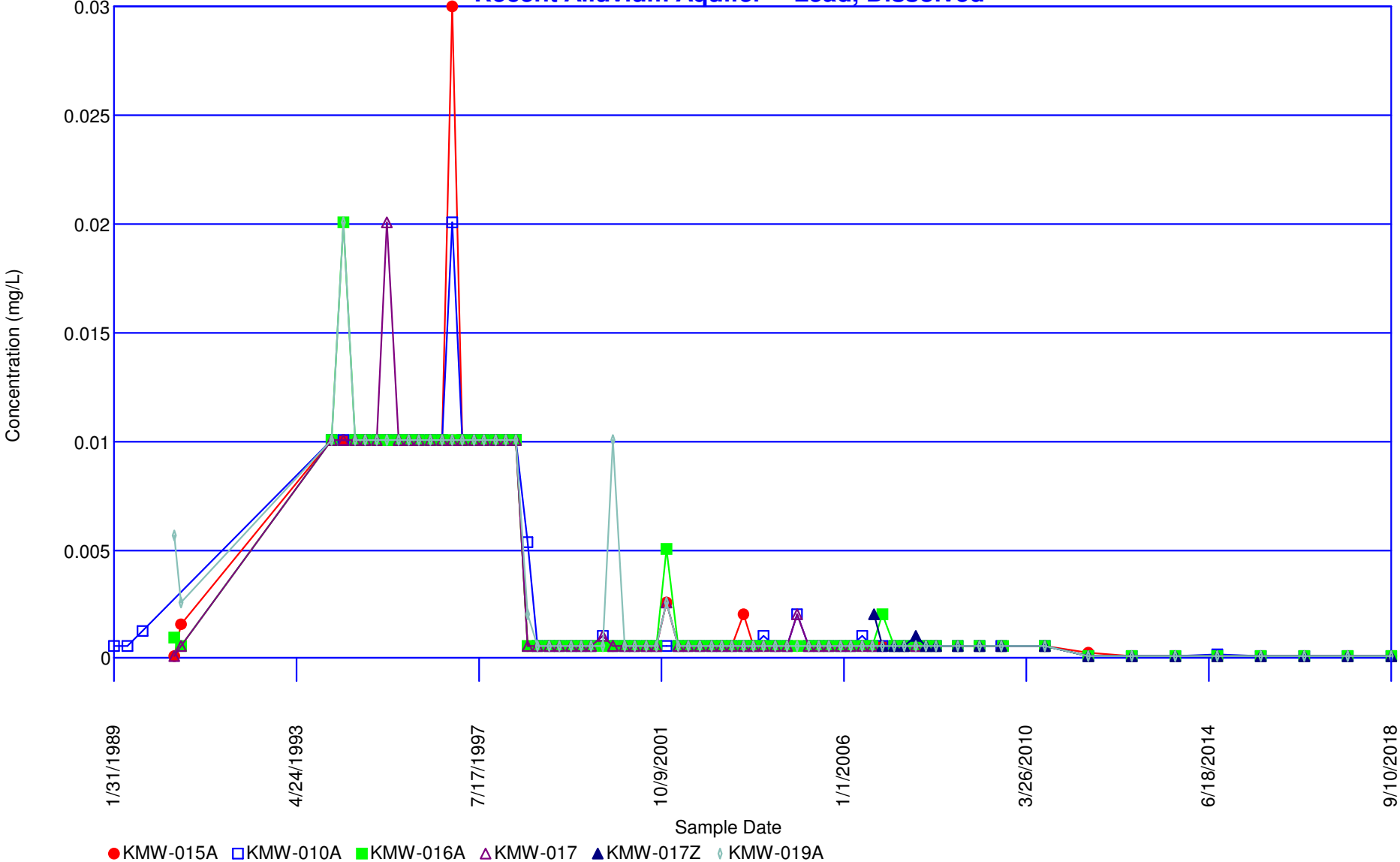
Regulatory Value = 0.3 mg/L (not shown)

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill

Recent Alluvium Aquifer -- Lead, Dissolved

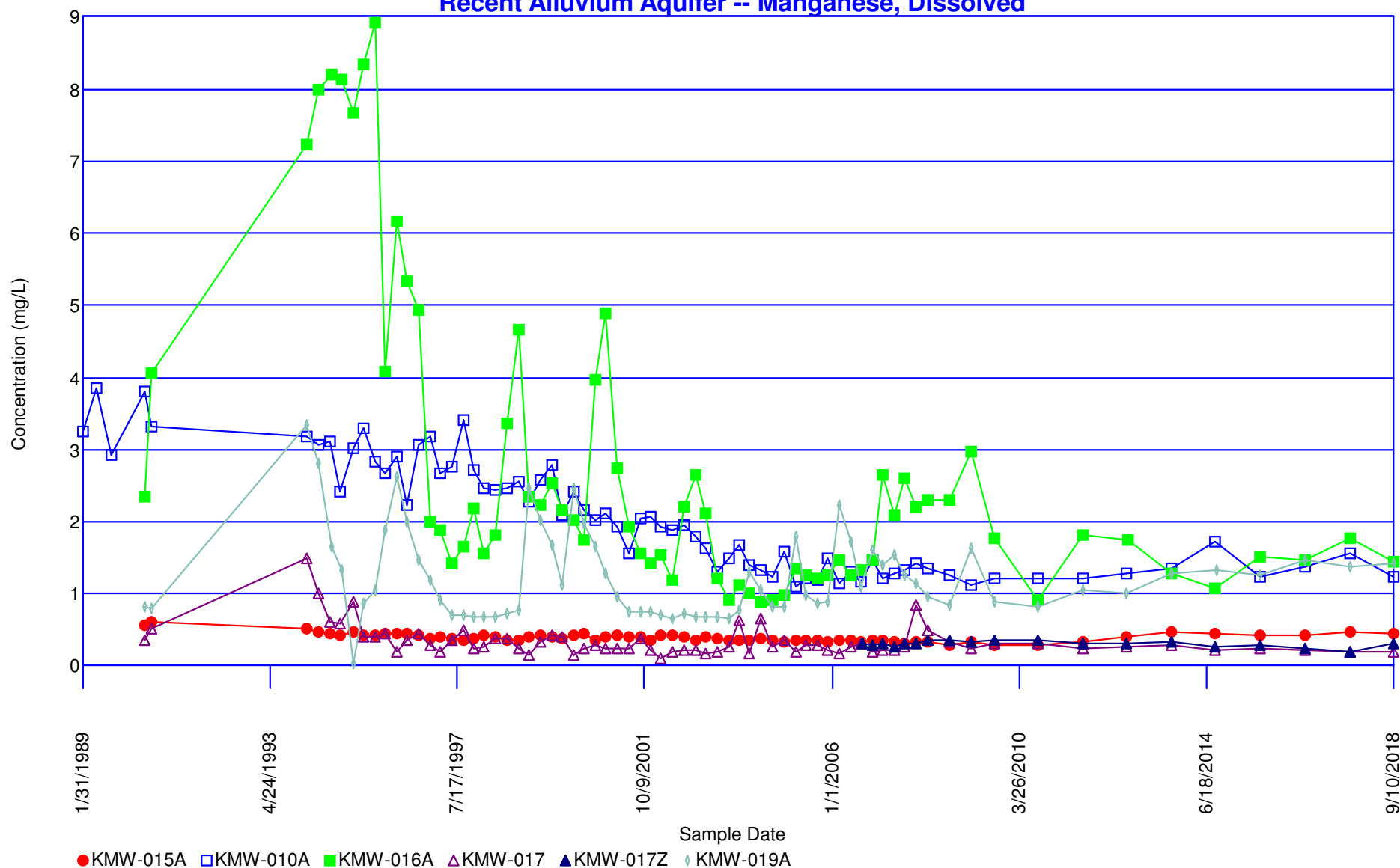


Regulatory Value = 0.005 mg/L (not shown)

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill Recent Alluvium Aquifer -- Manganese, Dissolved

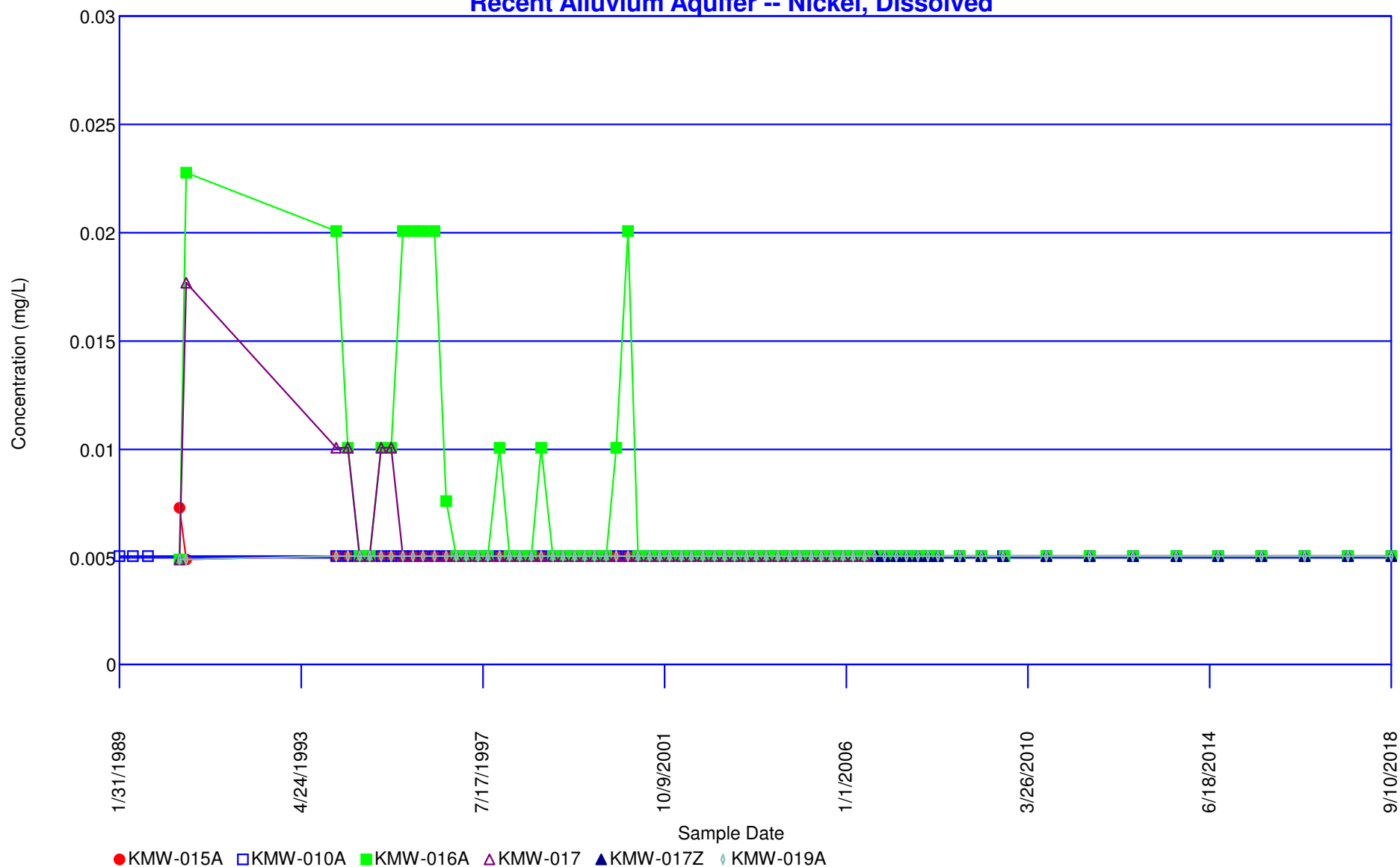


Regulatory Value = 0.05 mg/L (not shown)

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill Recent Alluvium Aquifer -- Nickel, Dissolved

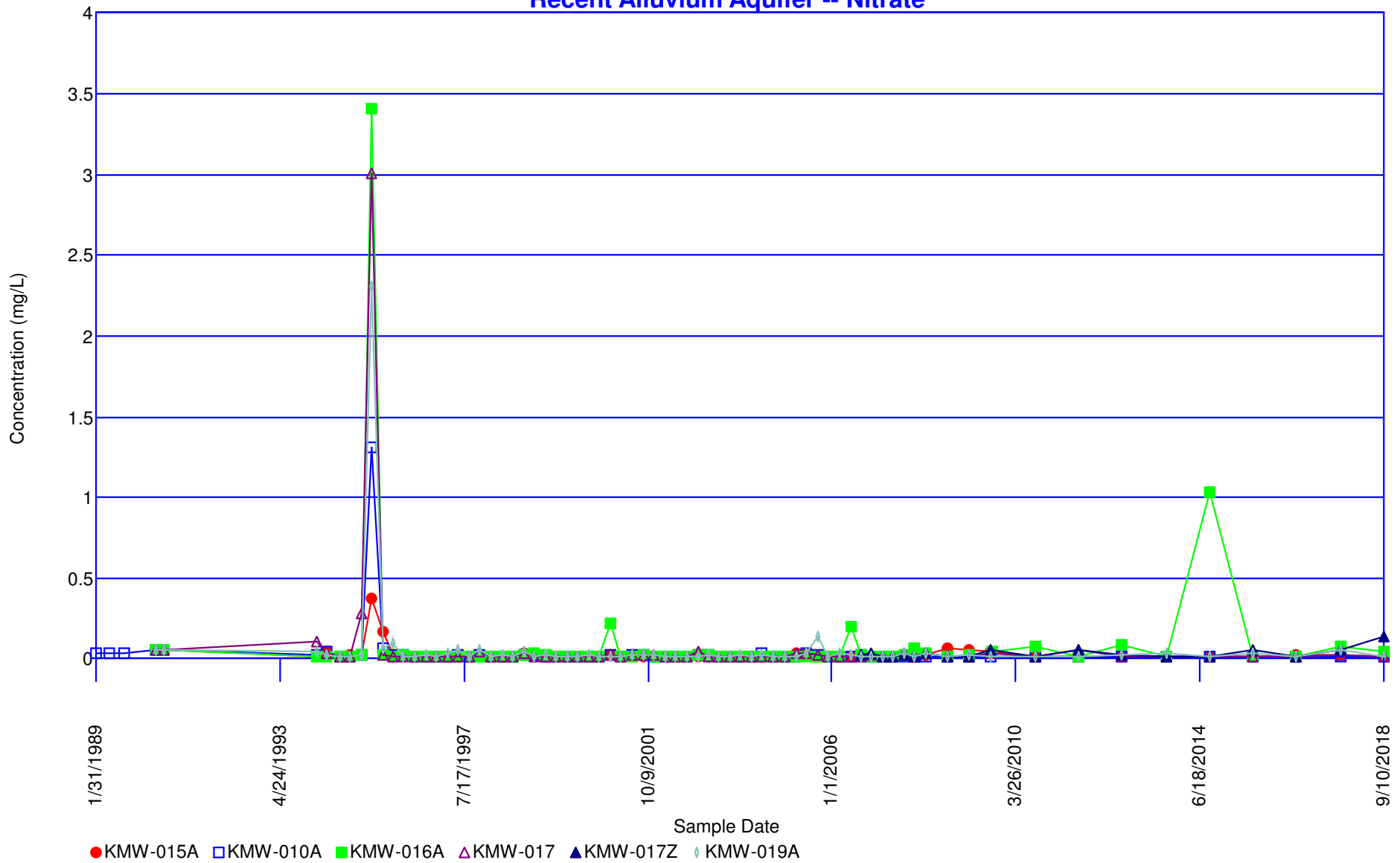


Regulatory Value = 0.1 mg/L (not shown)

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill
Recent Alluvium Aquifer -- Nitrate

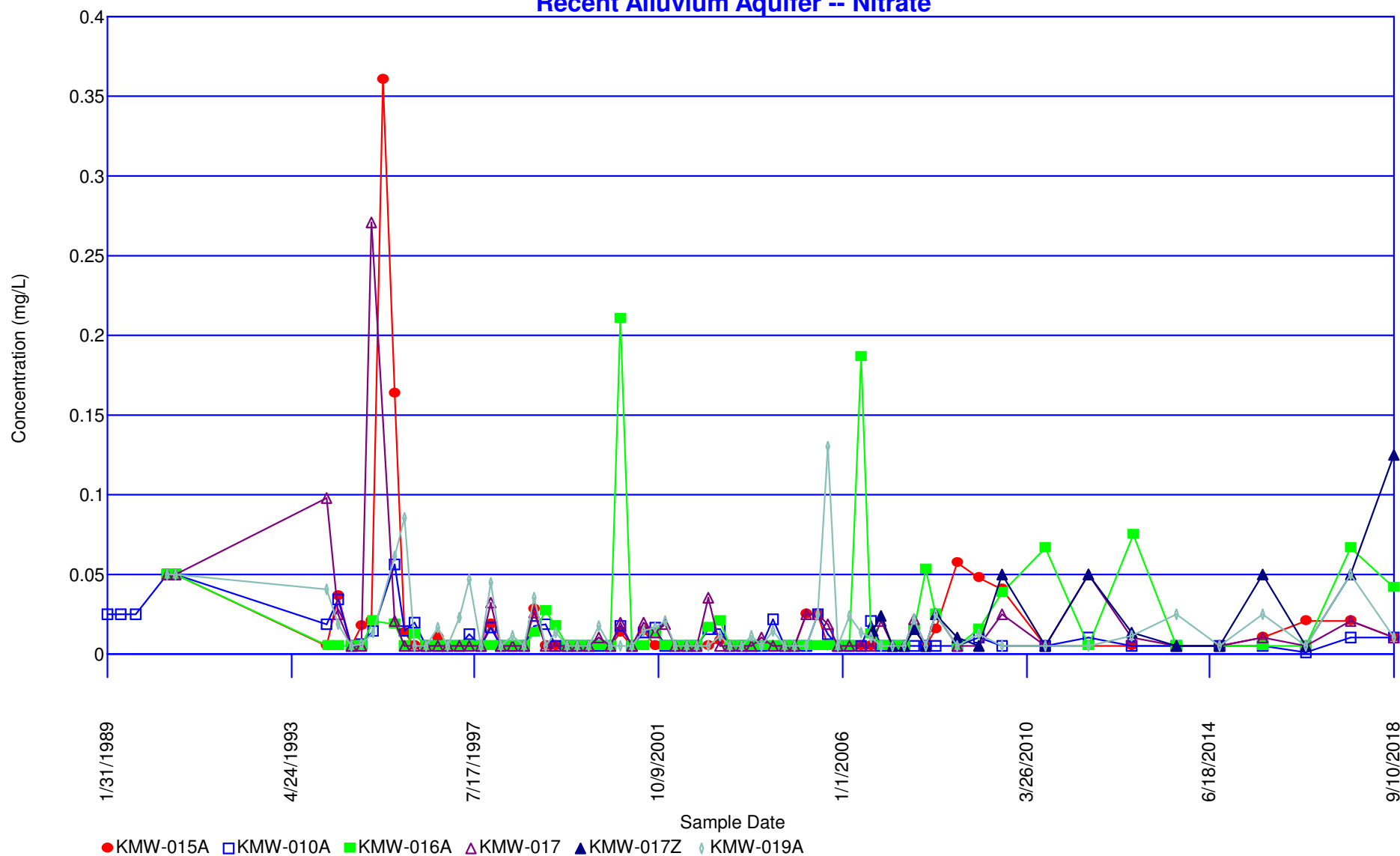


Regulatory Value = 10 mg/L (not shown)

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill Recent Alluvium Aquifer -- Nitrate



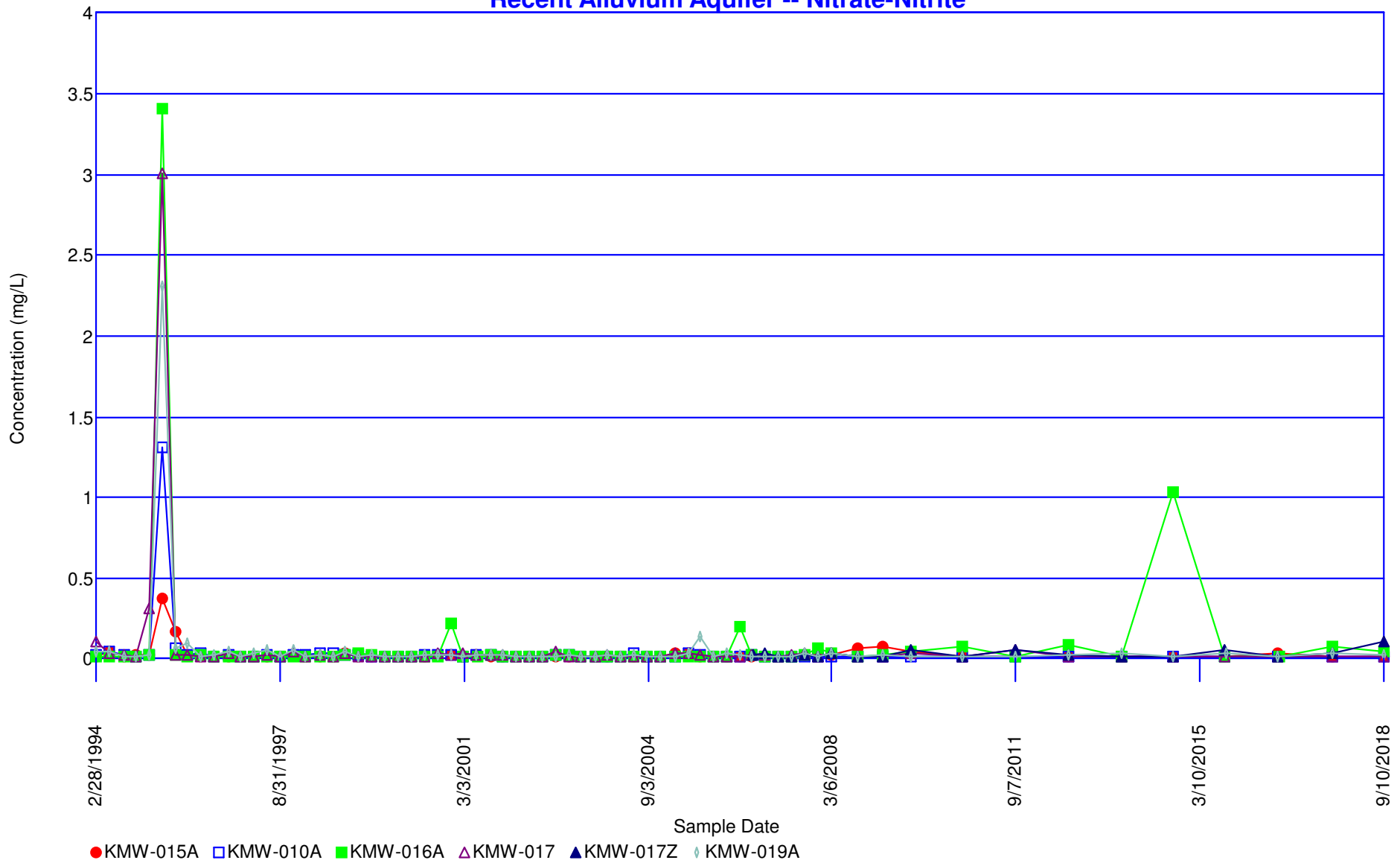
Regulatory Value = 10 mg/L (not shown)

Values > 3 standard deviations above the mean are not plotted

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill
Recent Alluvium Aquifer -- Nitrate-Nitrite

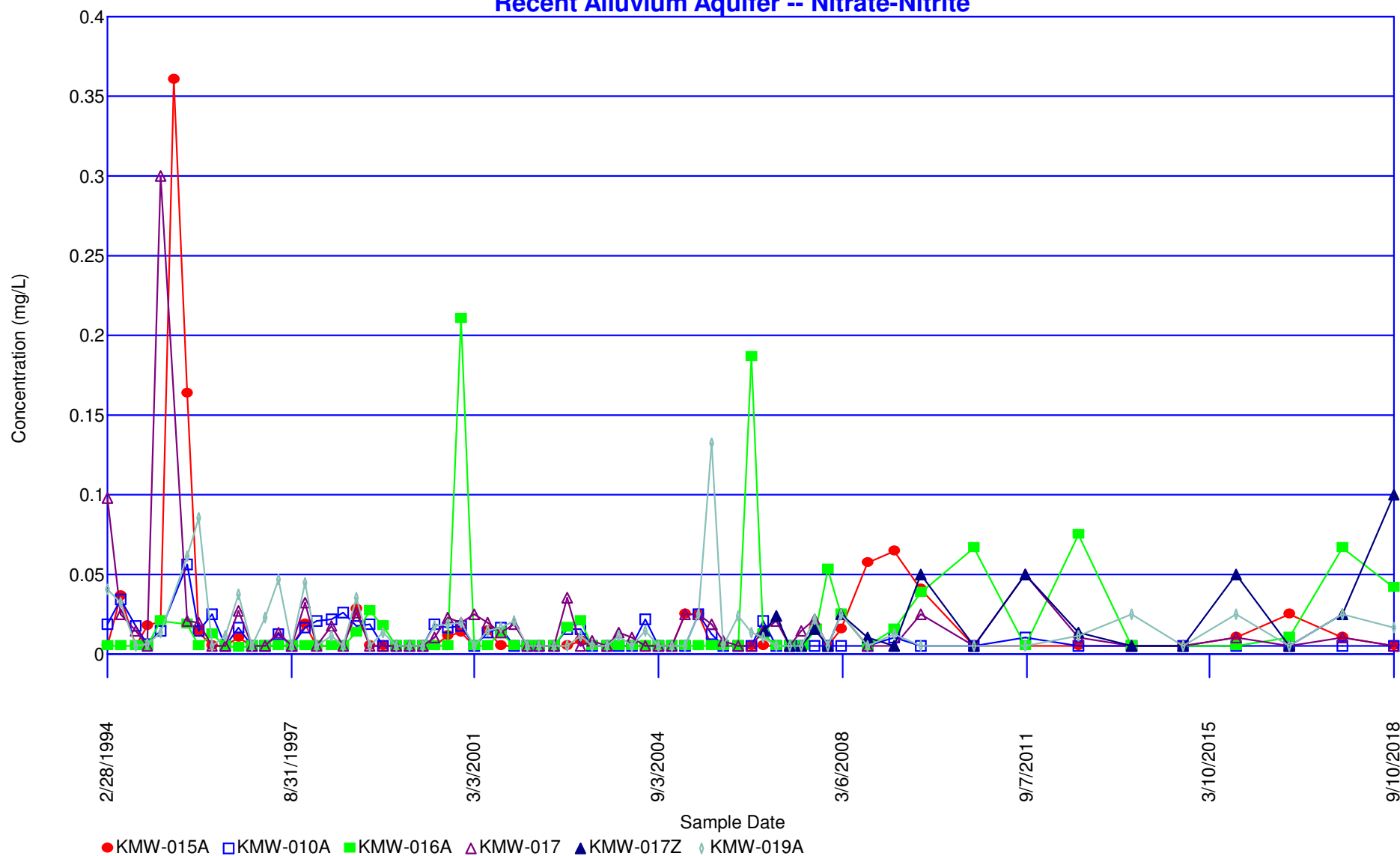


No Regulatory Value

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill Recent Alluvium Aquifer -- Nitrate-Nitrite



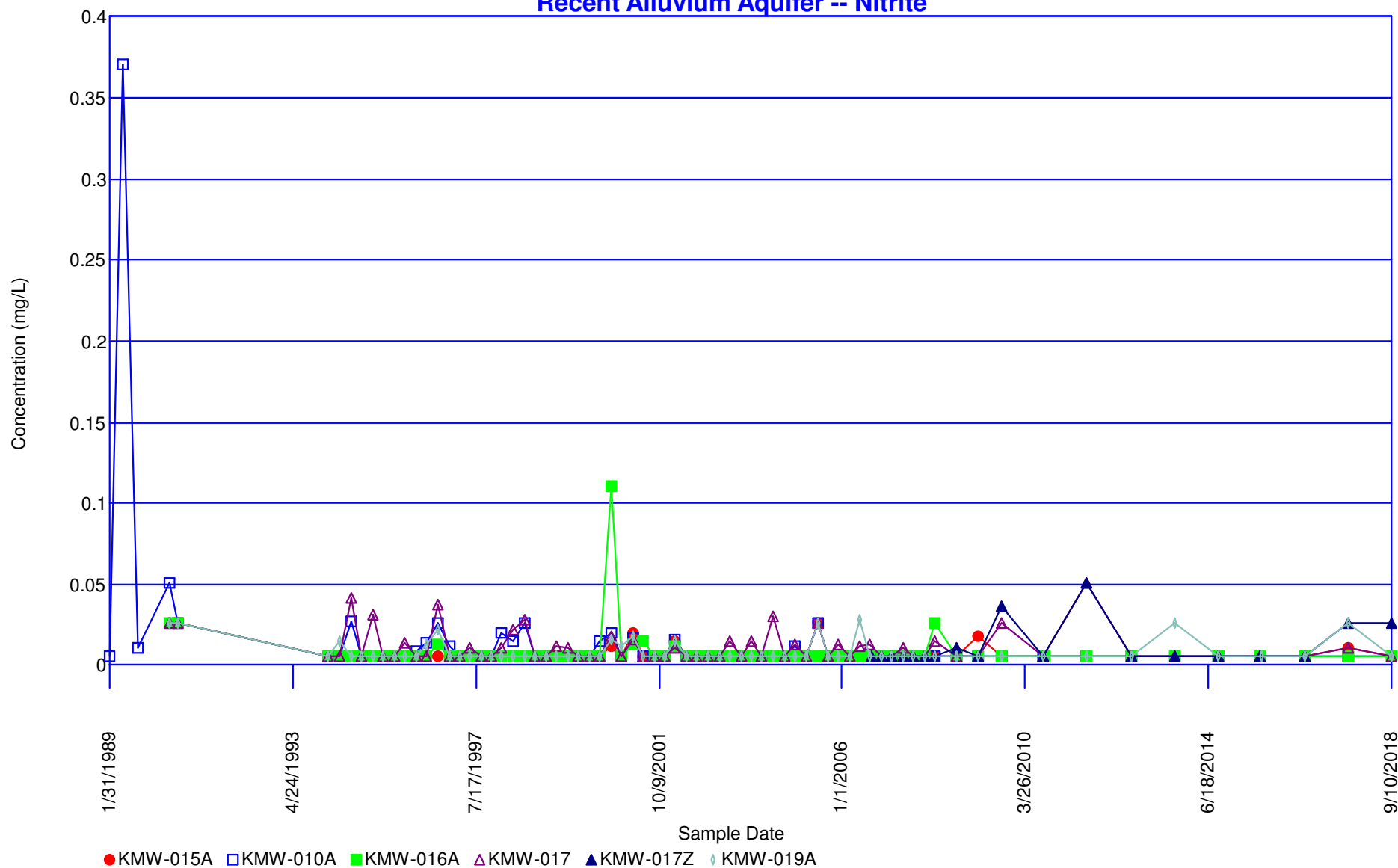
No Regulatory Value

Values > 3 standard deviations above the mean are not plotted

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill Recent Alluvium Aquifer -- Nitrite

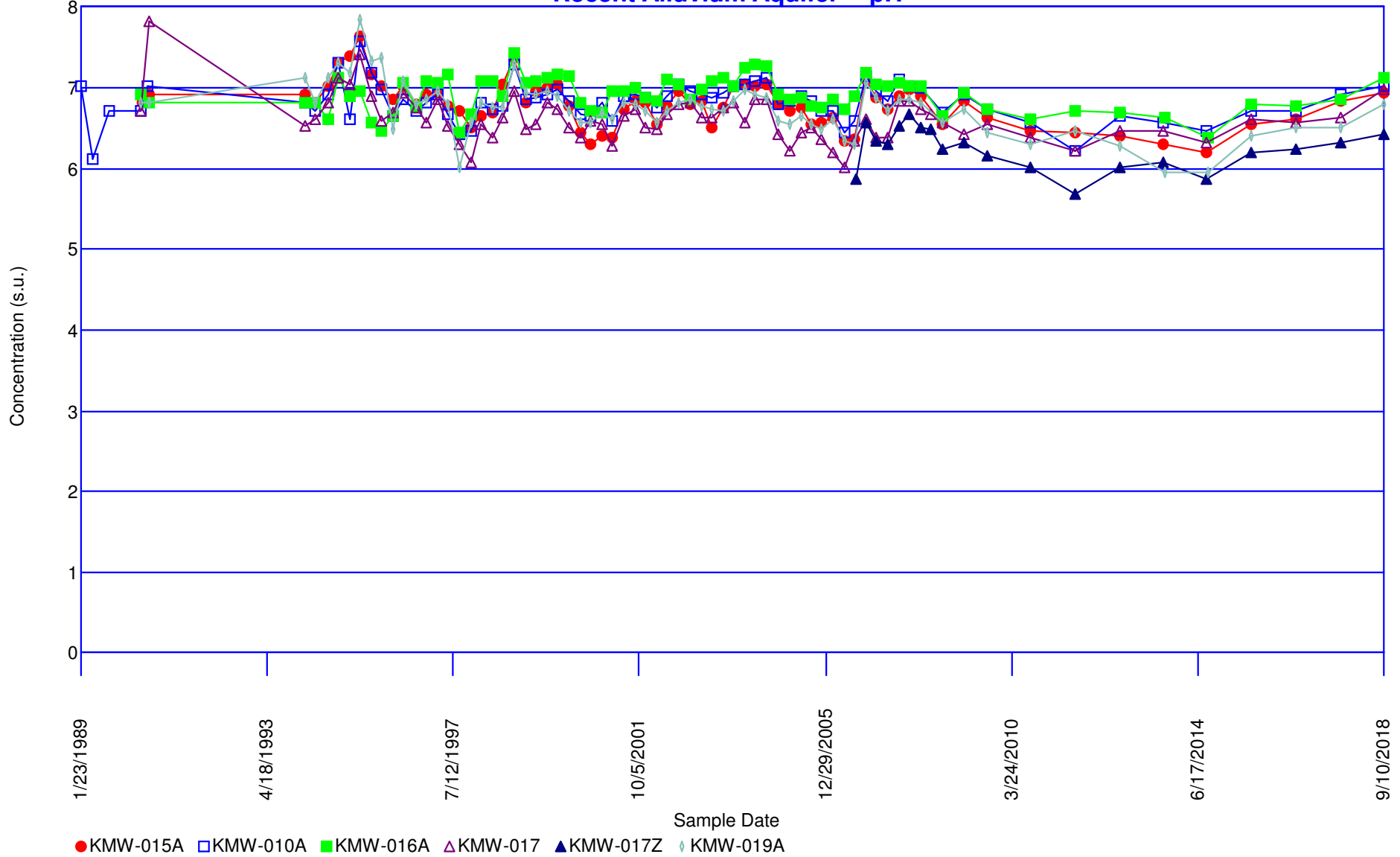


Regulatory Value = 1 mg/L (not shown)

Non-Detects Replaced with 1/2 DL

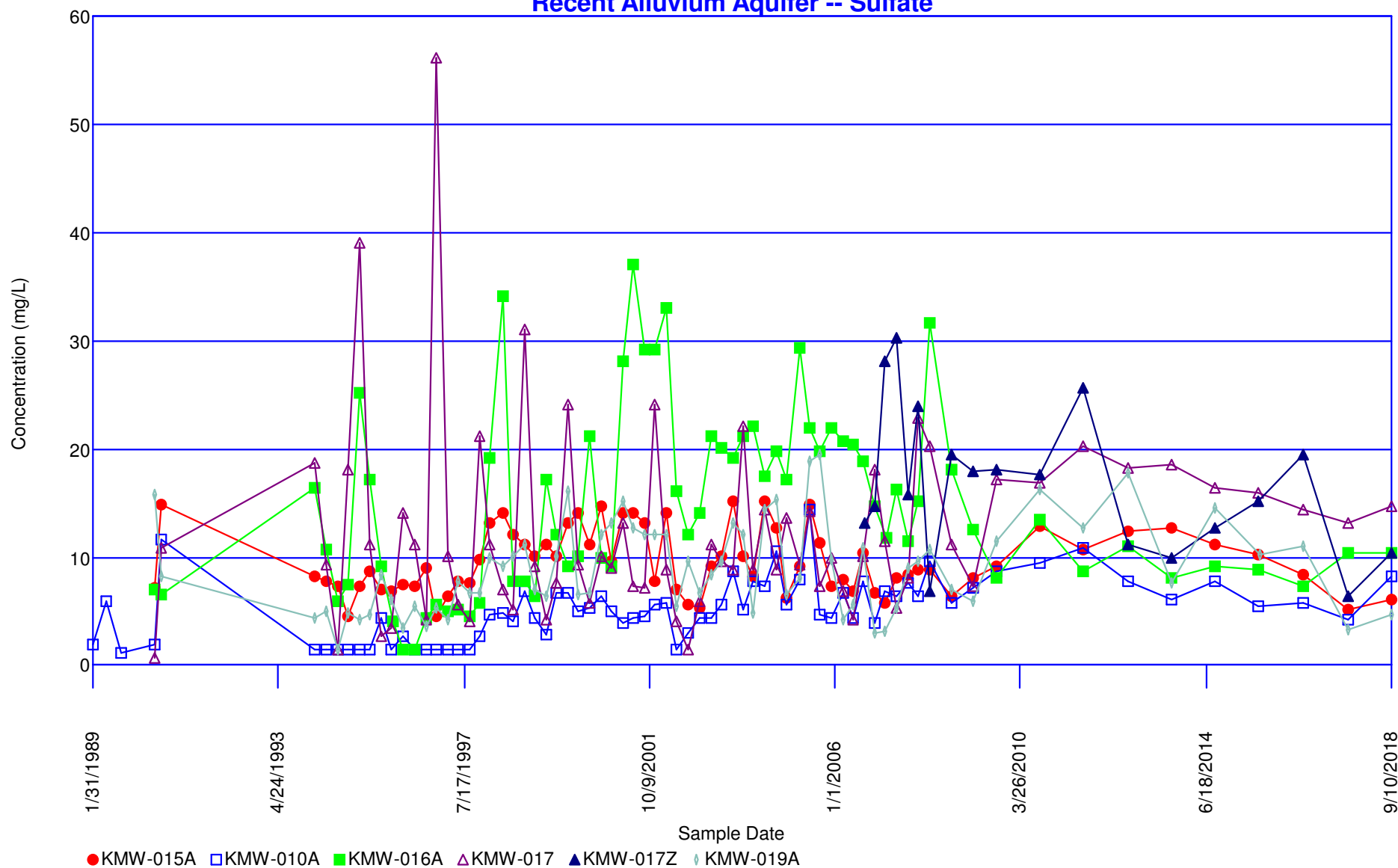
No data collected between September 1990 and January 1994

Kent Highlands Landfill Recent Alluvium Aquifer -- pH



No data collected between September 1990 and January 1994

Kent Highlands Landfill Recent Alluvium Aquifer -- Sulfate

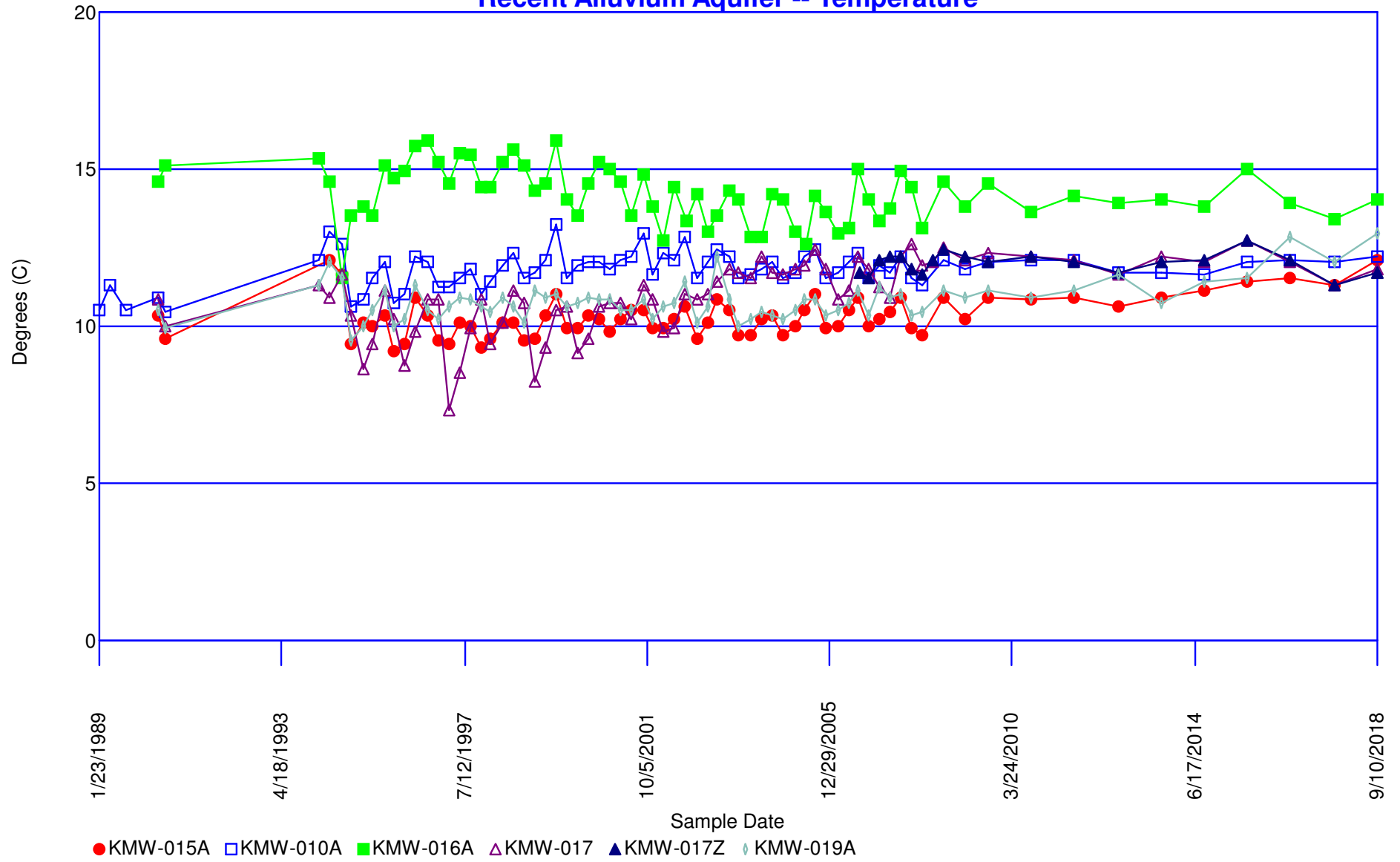


Regulatory Value = 250 mg/L (not shown)

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

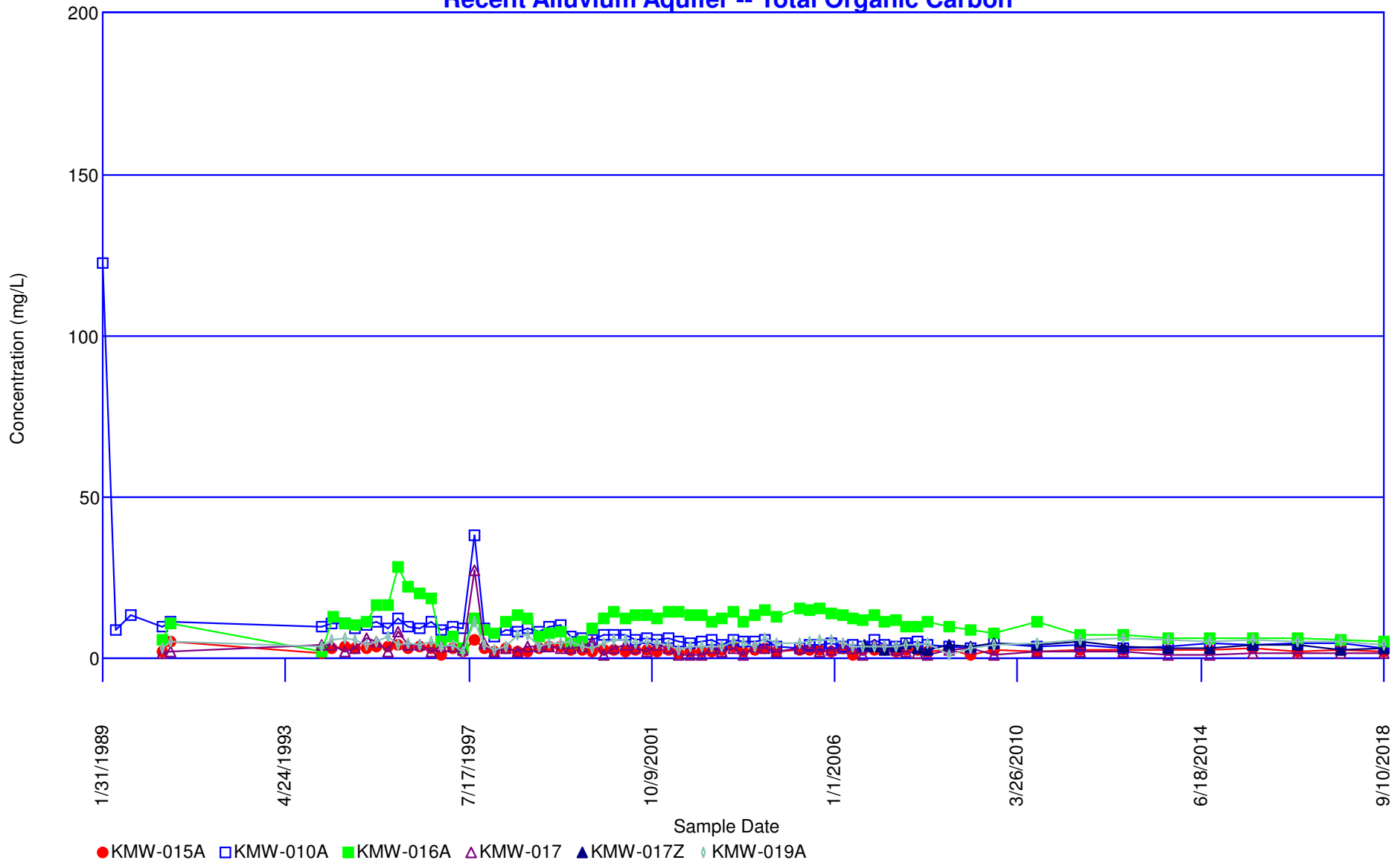
Kent Highlands Landfill Recent Alluvium Aquifer -- Temperature



No data collected between September 1990 and January 1994

Kent Highlands Landfill

Recent Alluvium Aquifer -- Total Organic Carbon

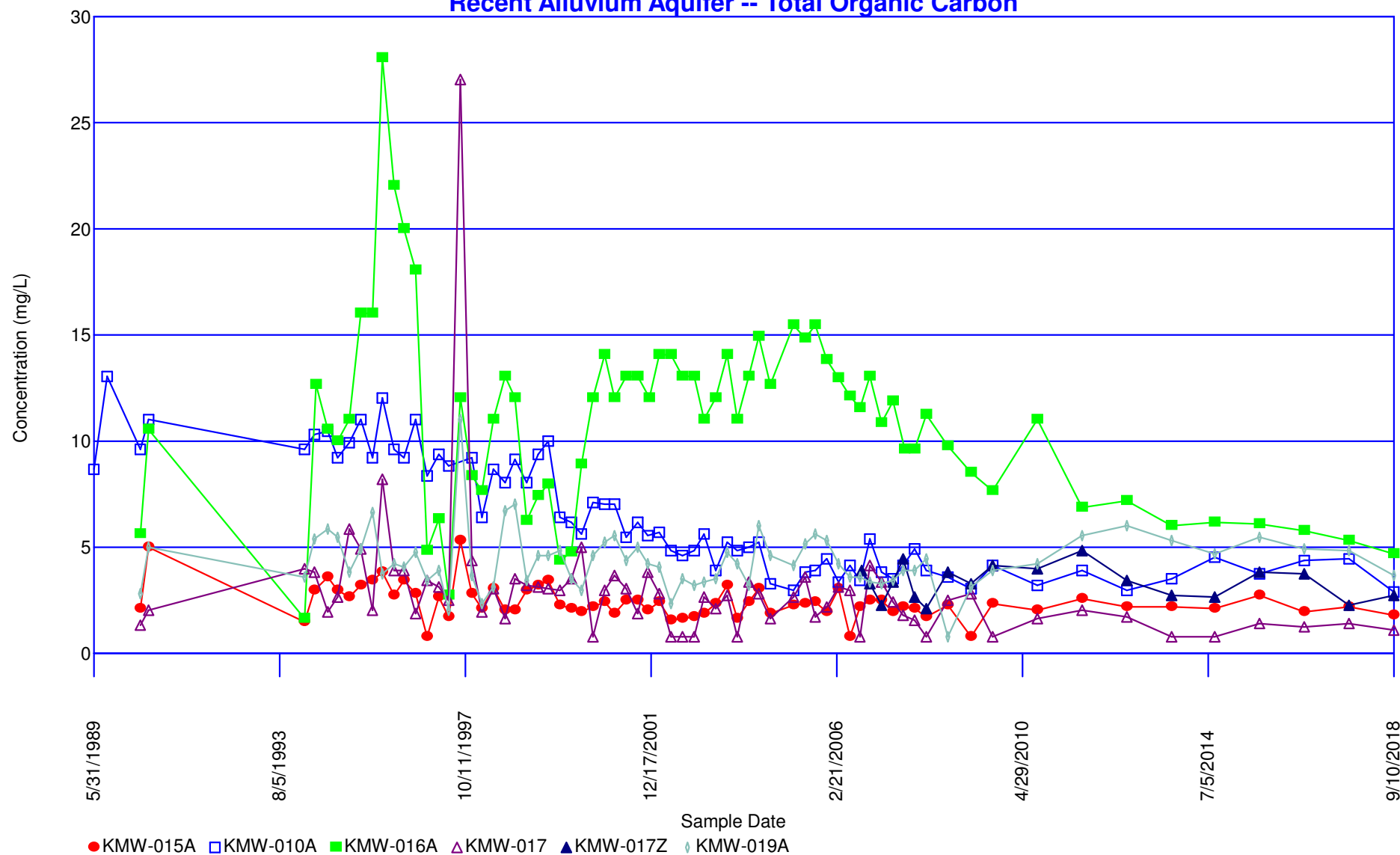


No Regulatory Value

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill Recent Alluvium Aquifer -- Total Organic Carbon



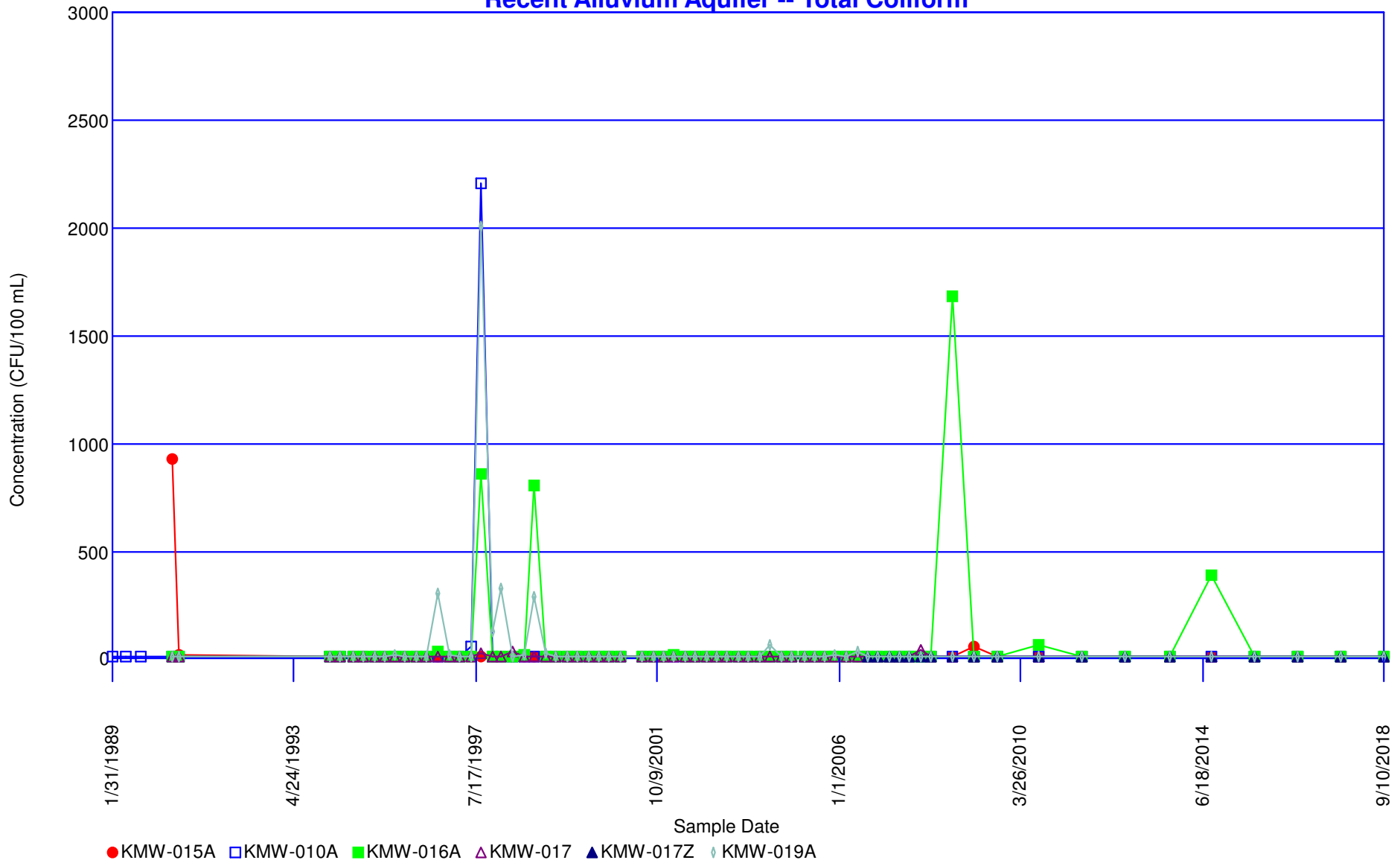
No Regulatory Value

Values > 3 standard deviations above the mean are not plotted

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill
Recent Alluvium Aquifer -- Total Coliform

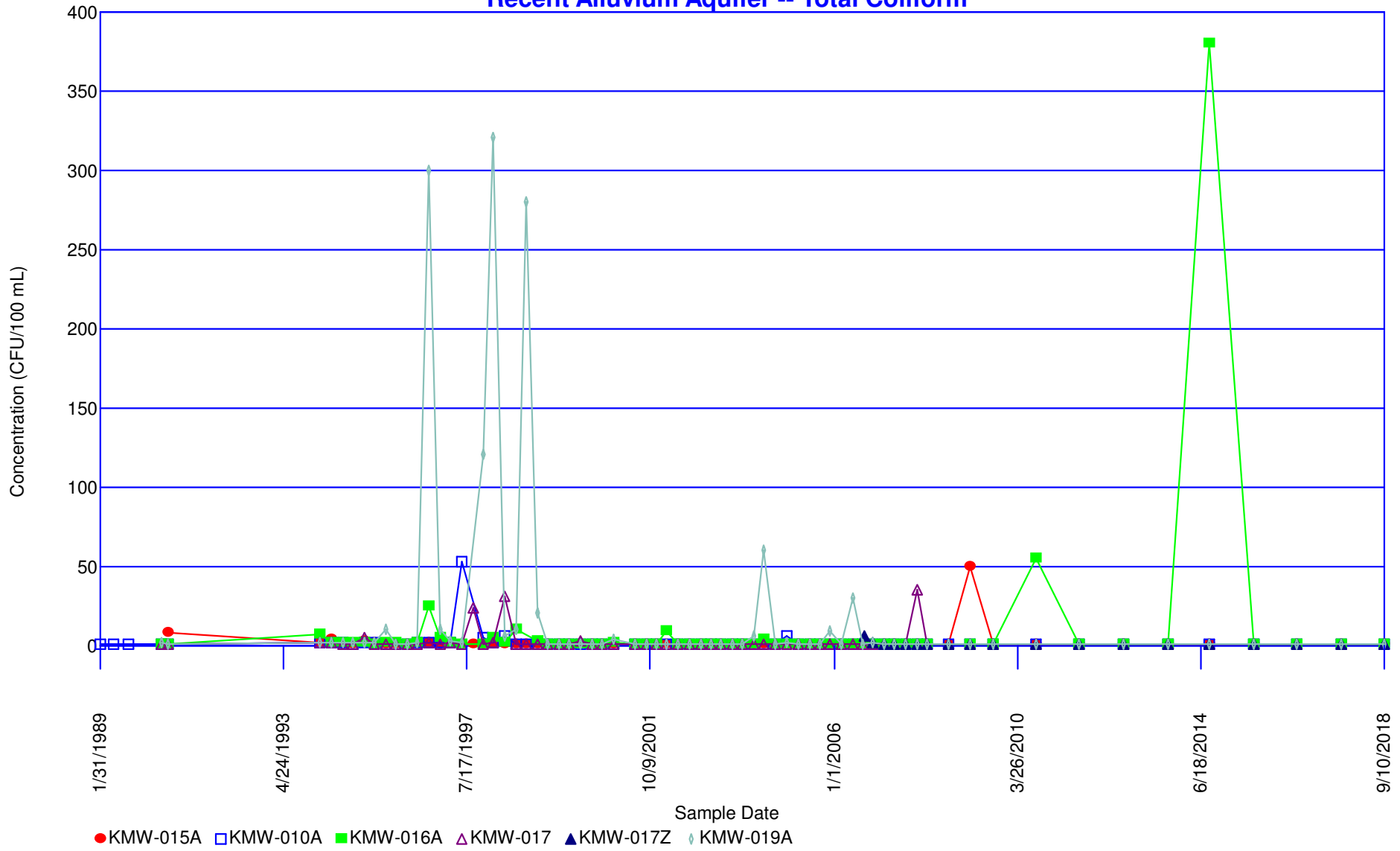


Regulatory Value = 1 CFU/100 mL (not shown)

Non-Detects Replaced with 1/2 DL

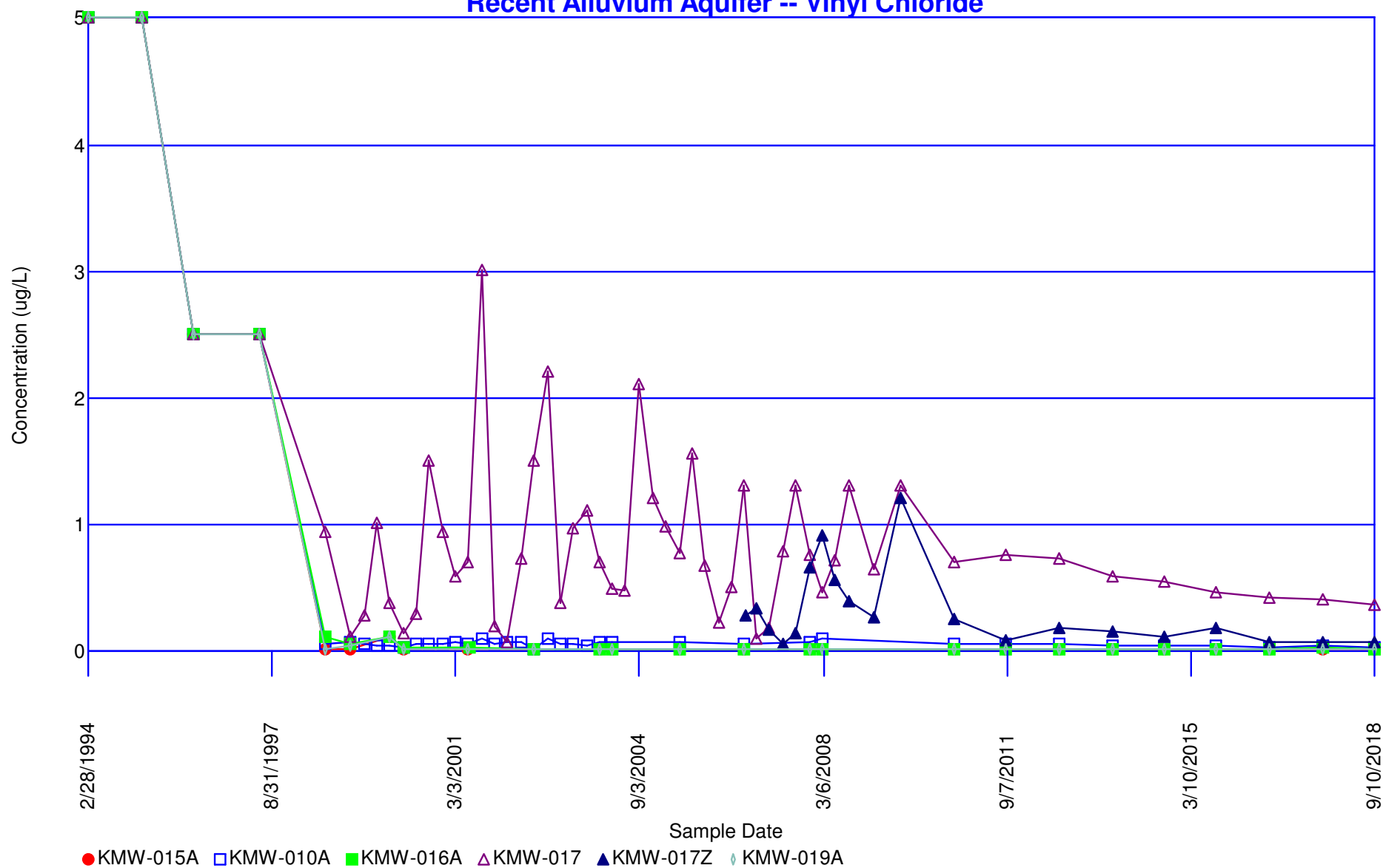
No data collected between September 1990 and January 1994

Kent Highlands Landfill
Recent Alluvium Aquifer -- Total Coliform



No data collected between September 1990 and January 1994

Kent Highlands Landfill Recent Alluvium Aquifer -- Vinyl Chloride

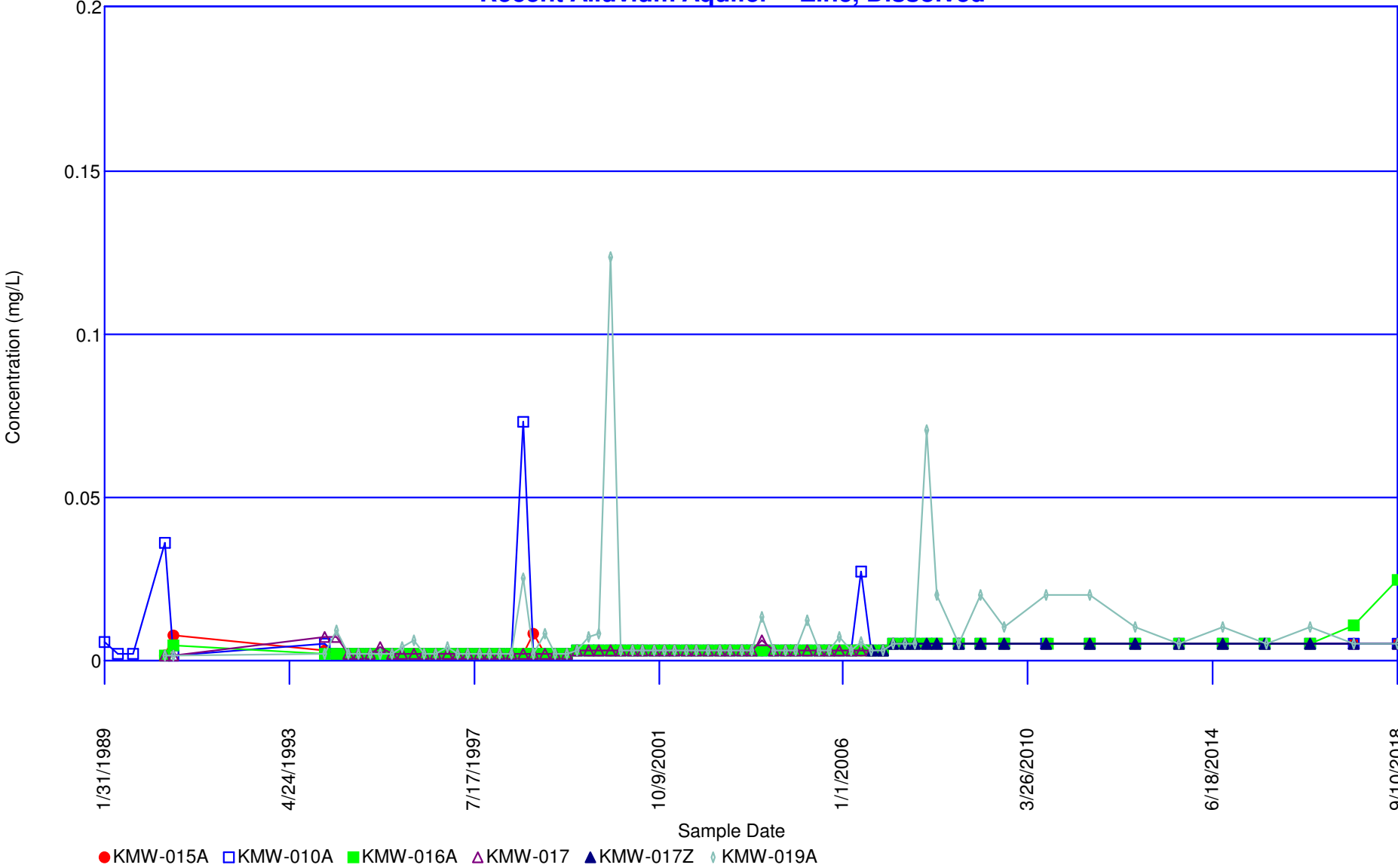


Regulatory Value = 0.025 ug/L (not shown)

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill
Recent Alluvium Aquifer -- Zinc, Dissolved



Regulatory Value = 4.8 mg/L (not shown)

Non-Detects Replaced with 1/2 DL

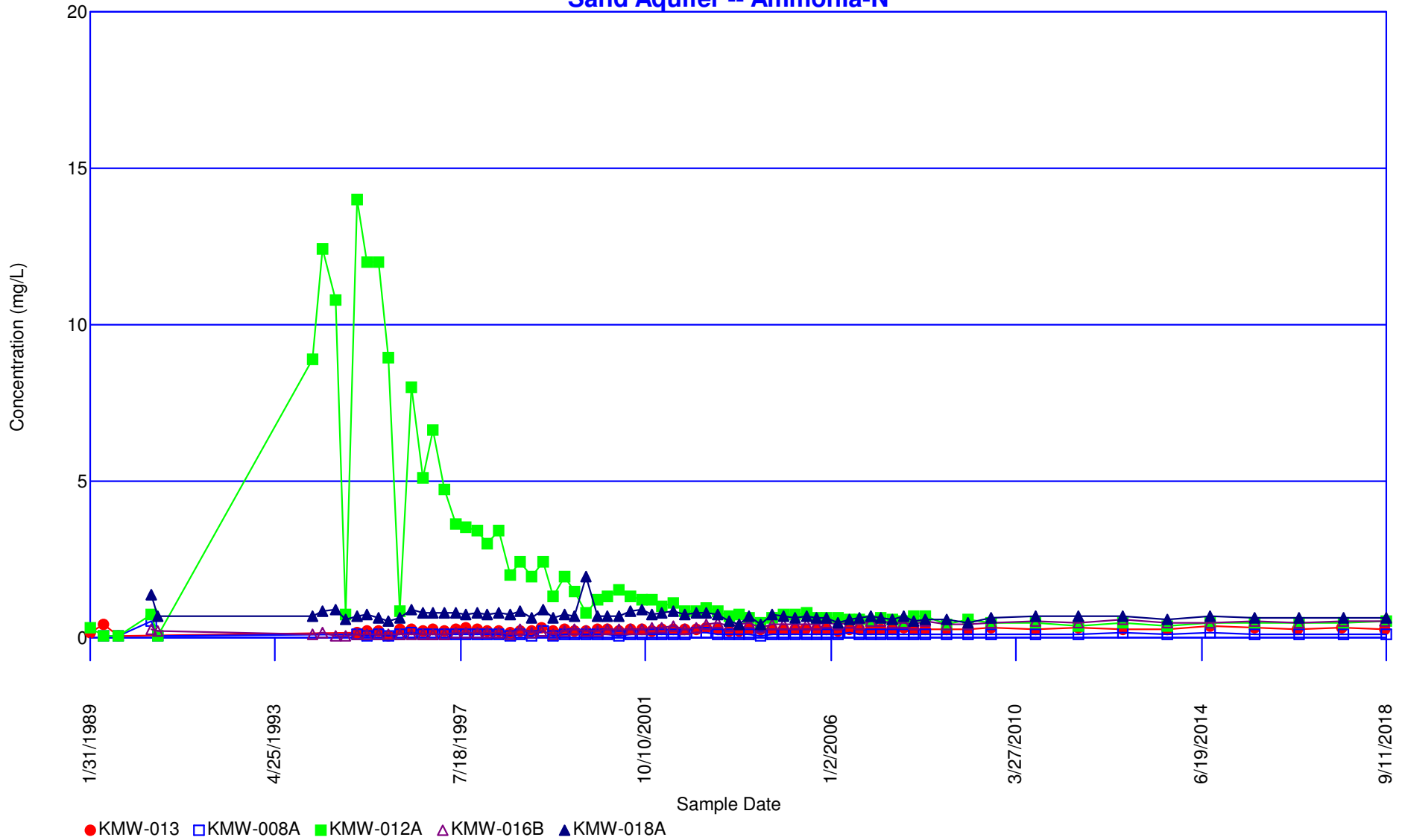
Time-Series Plots

Sand Aquifer



No data collected between September 1990 and January 1994

**Kent Highlands Landfill
Sand Aquifer -- Ammonia-N**

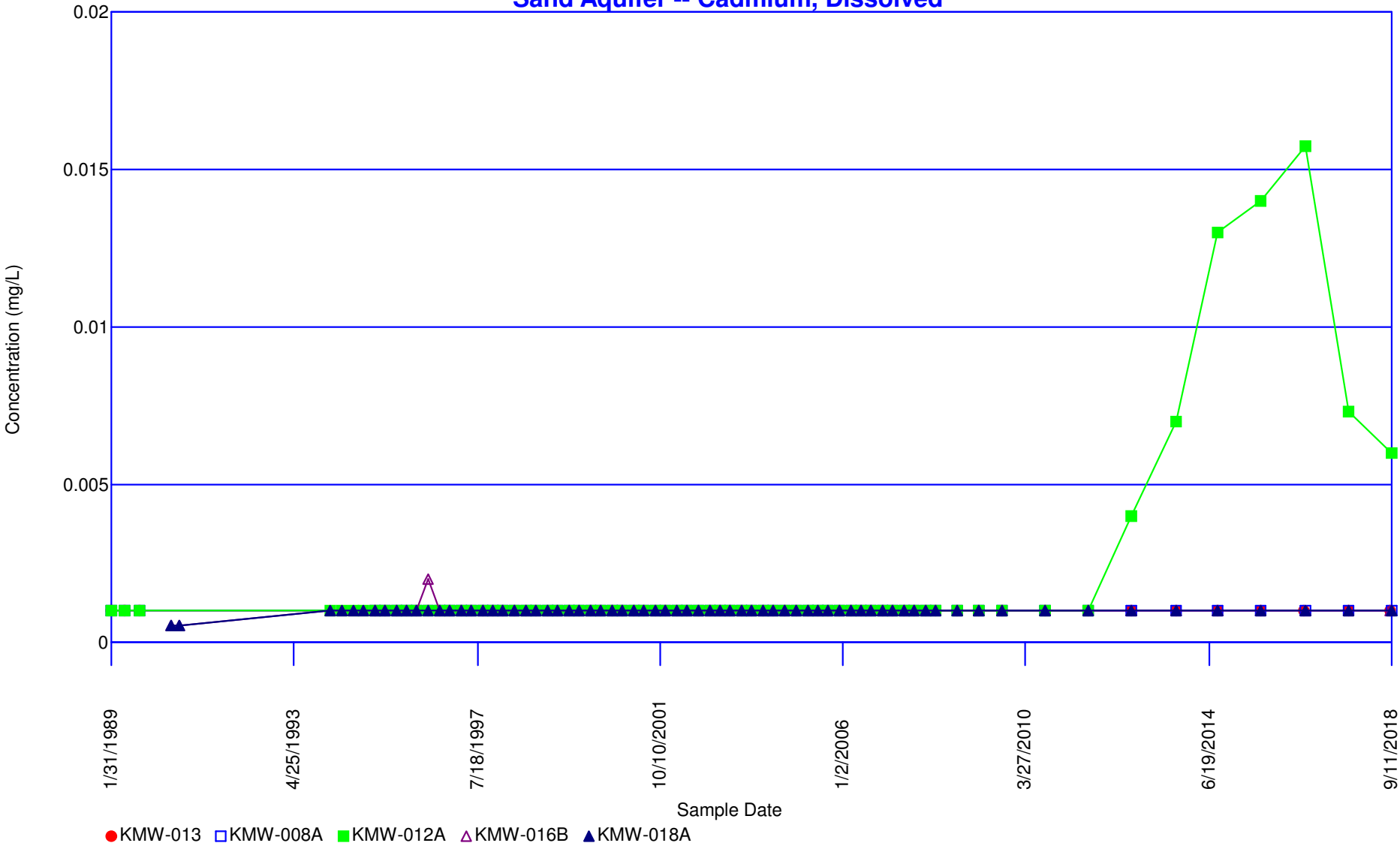


No Regulatory Value

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill
Sand Aquifer -- Cadmium, Dissolved

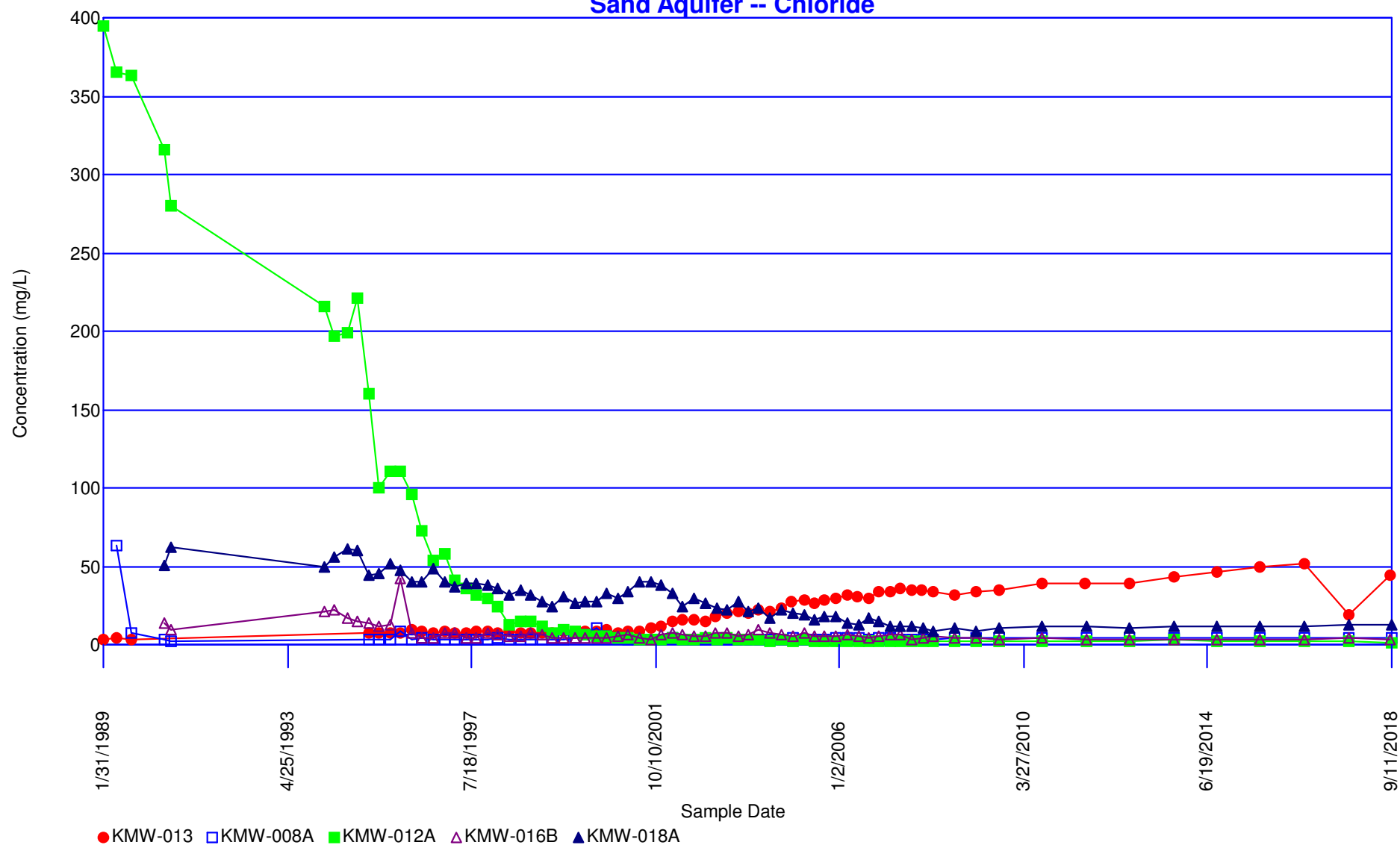


Regulatory Value = 0.005 mg/L (not shown)

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill Sand Aquifer -- Chloride

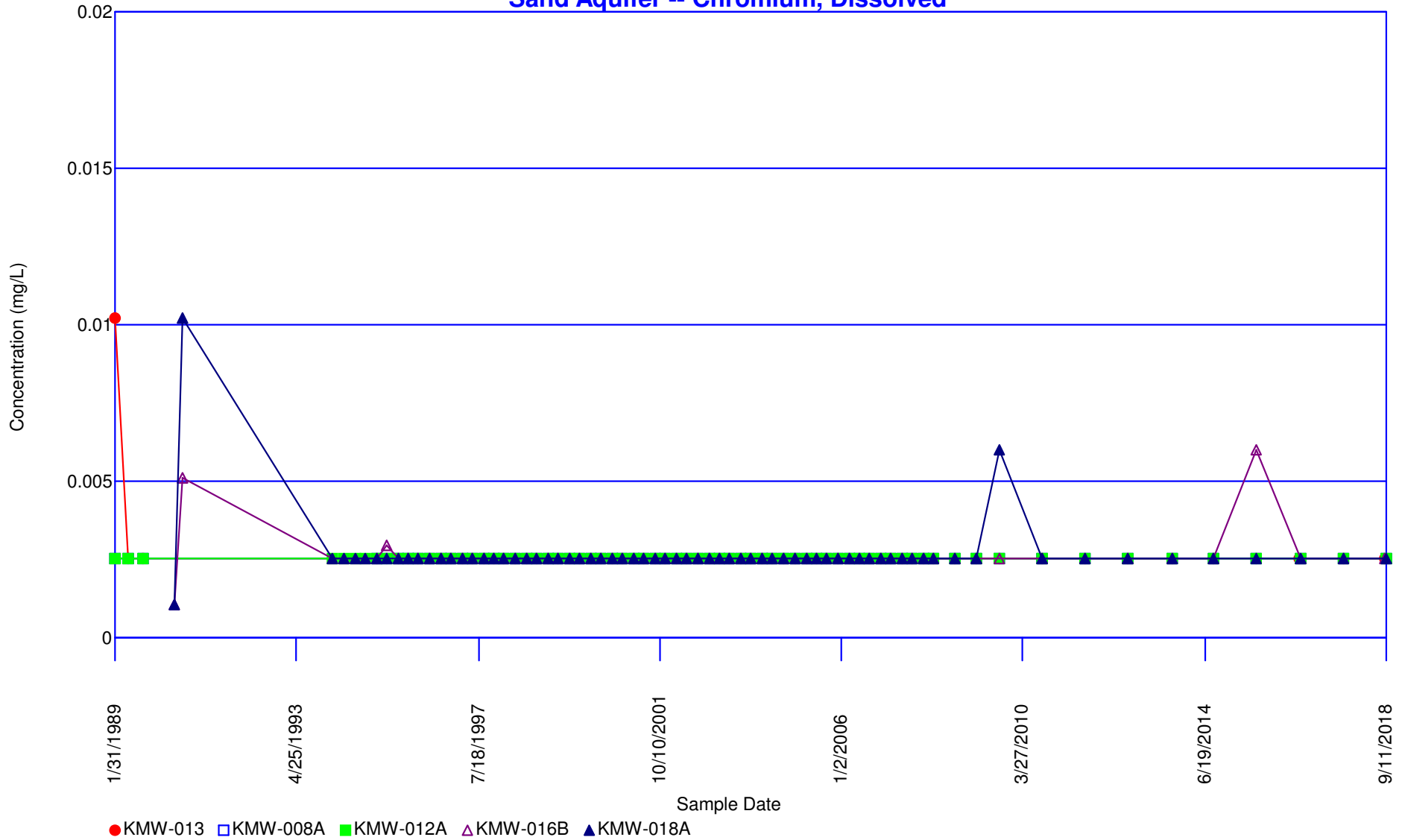


Regulatory Value = 250 mg/L (not shown)

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill
Sand Aquifer -- Chromium, Dissolved

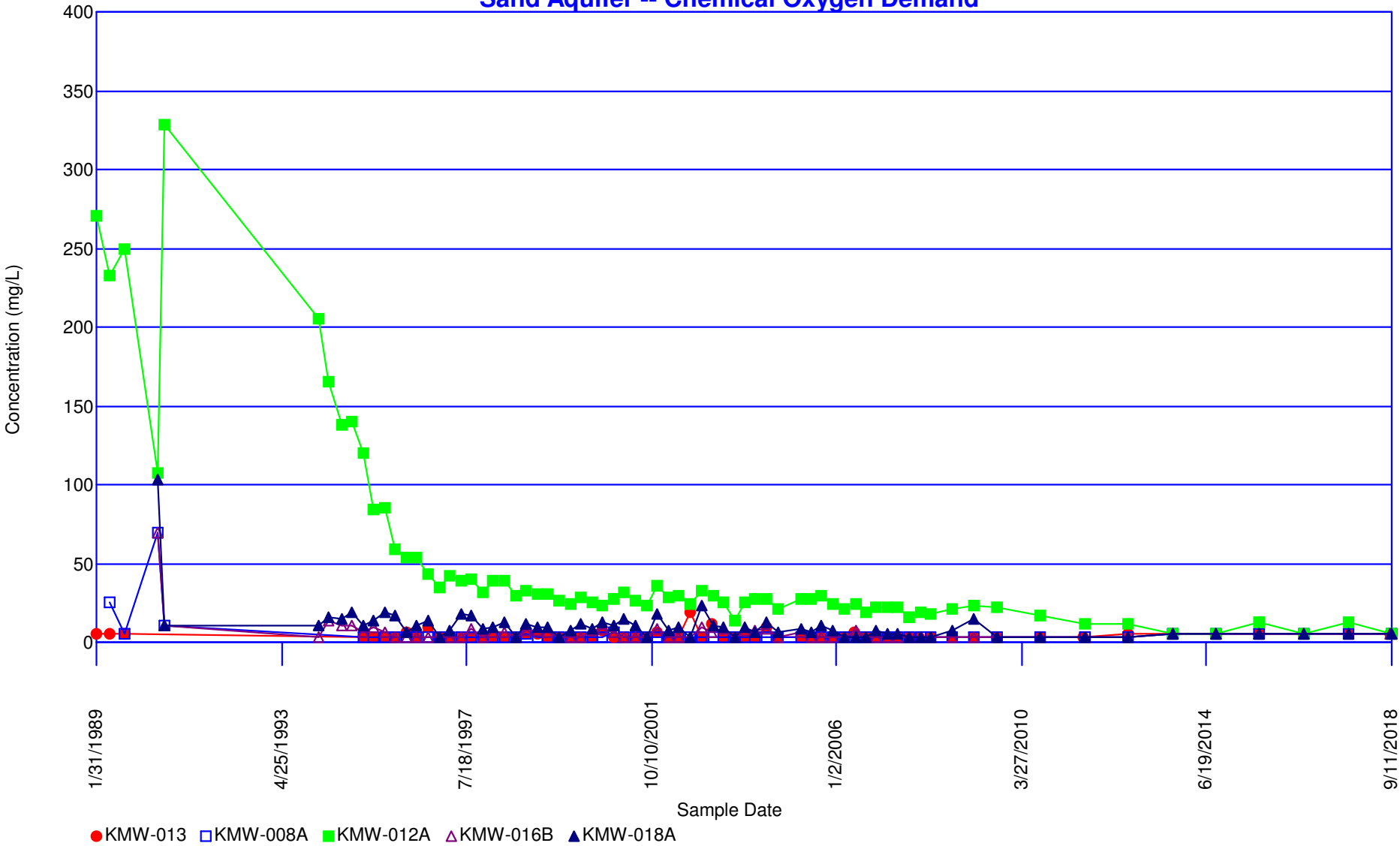


Regulatory Value = 0.1 mg/L (not shown)

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill
Sand Aquifer -- Chemical Oxygen Demand

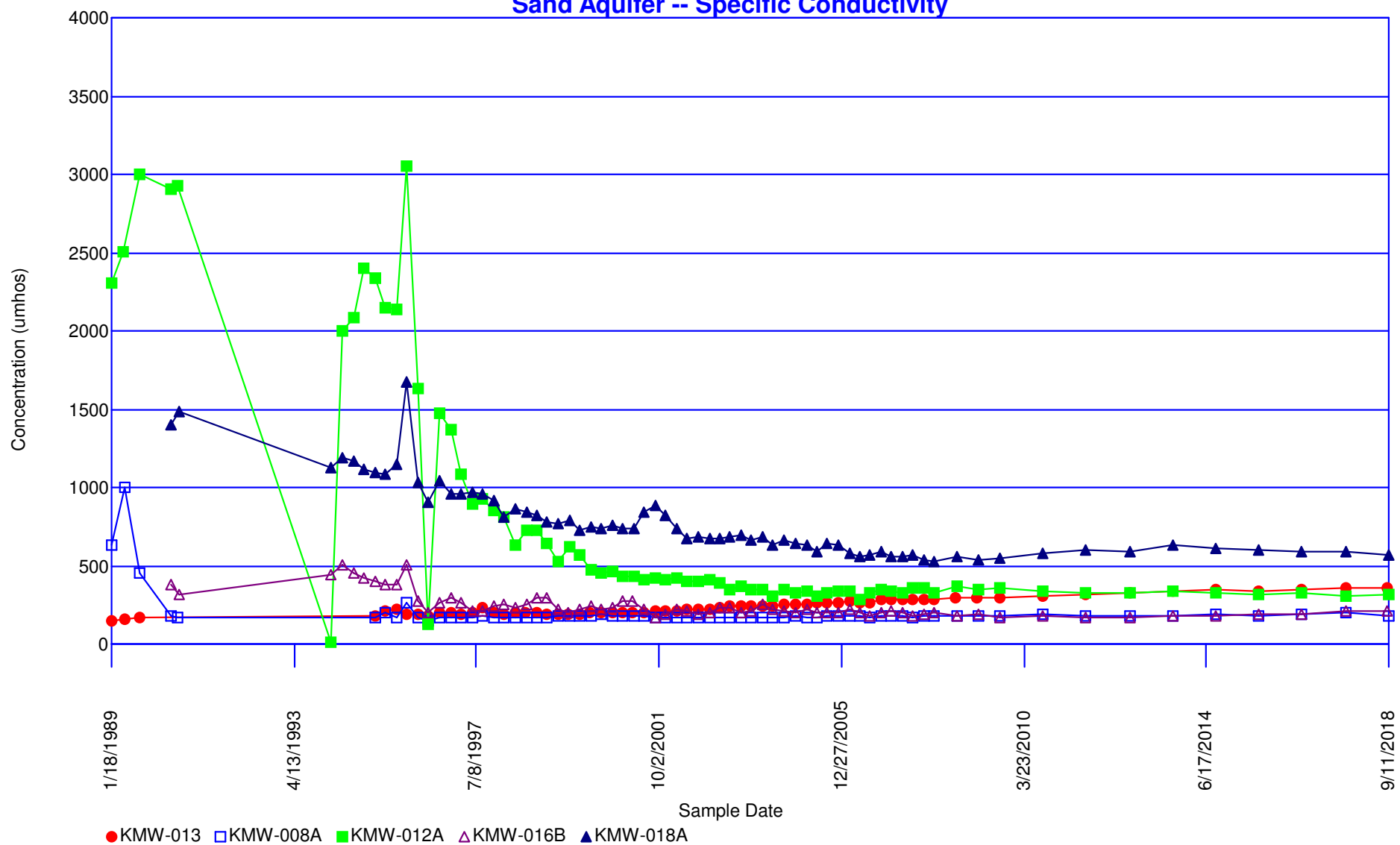


No Regulatory Value

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill Sand Aquifer -- Specific Conductivity

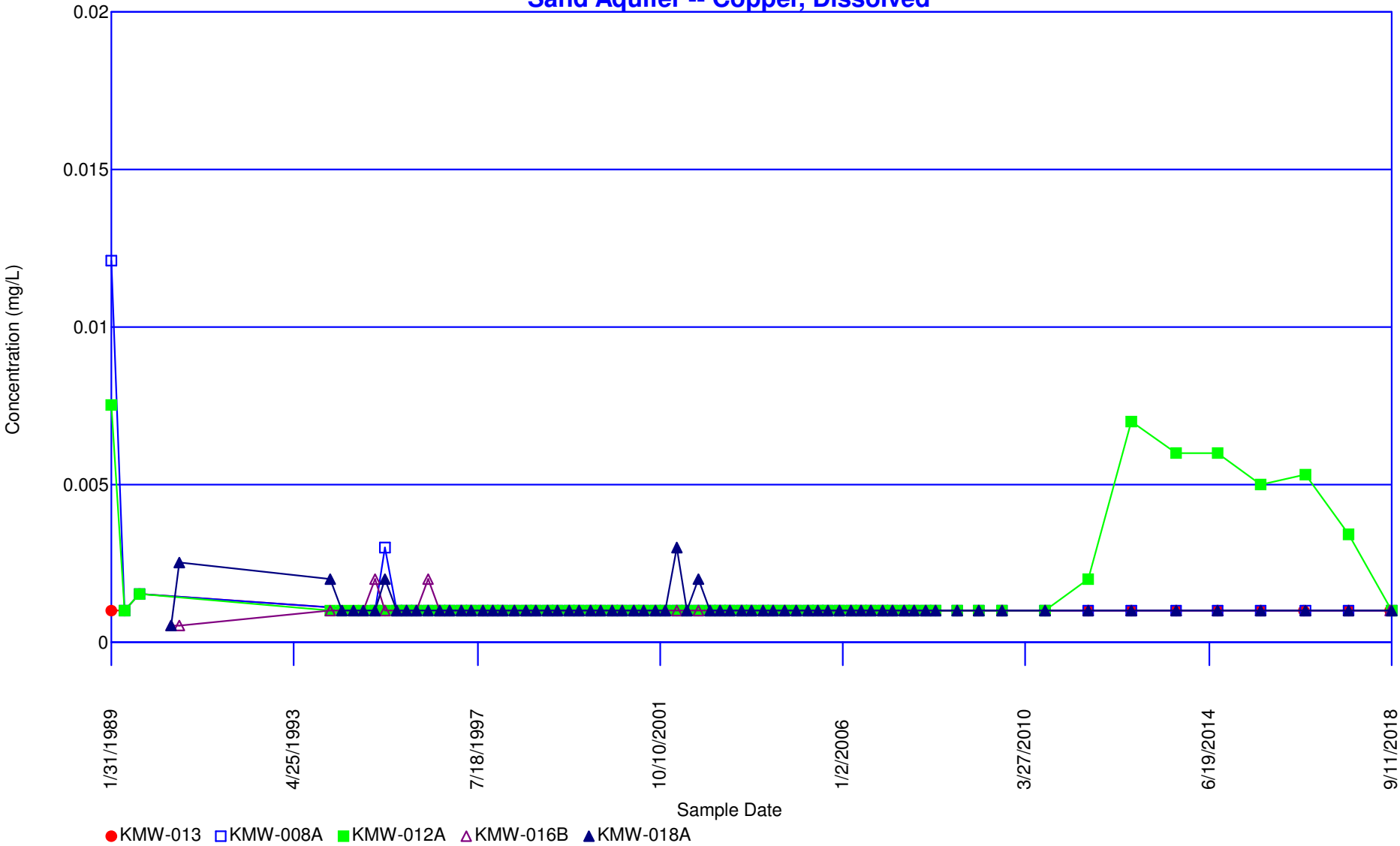


Regulatory Value = 700 umhos/cm (not shown)

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill
Sand Aquifer -- Copper, Dissolved

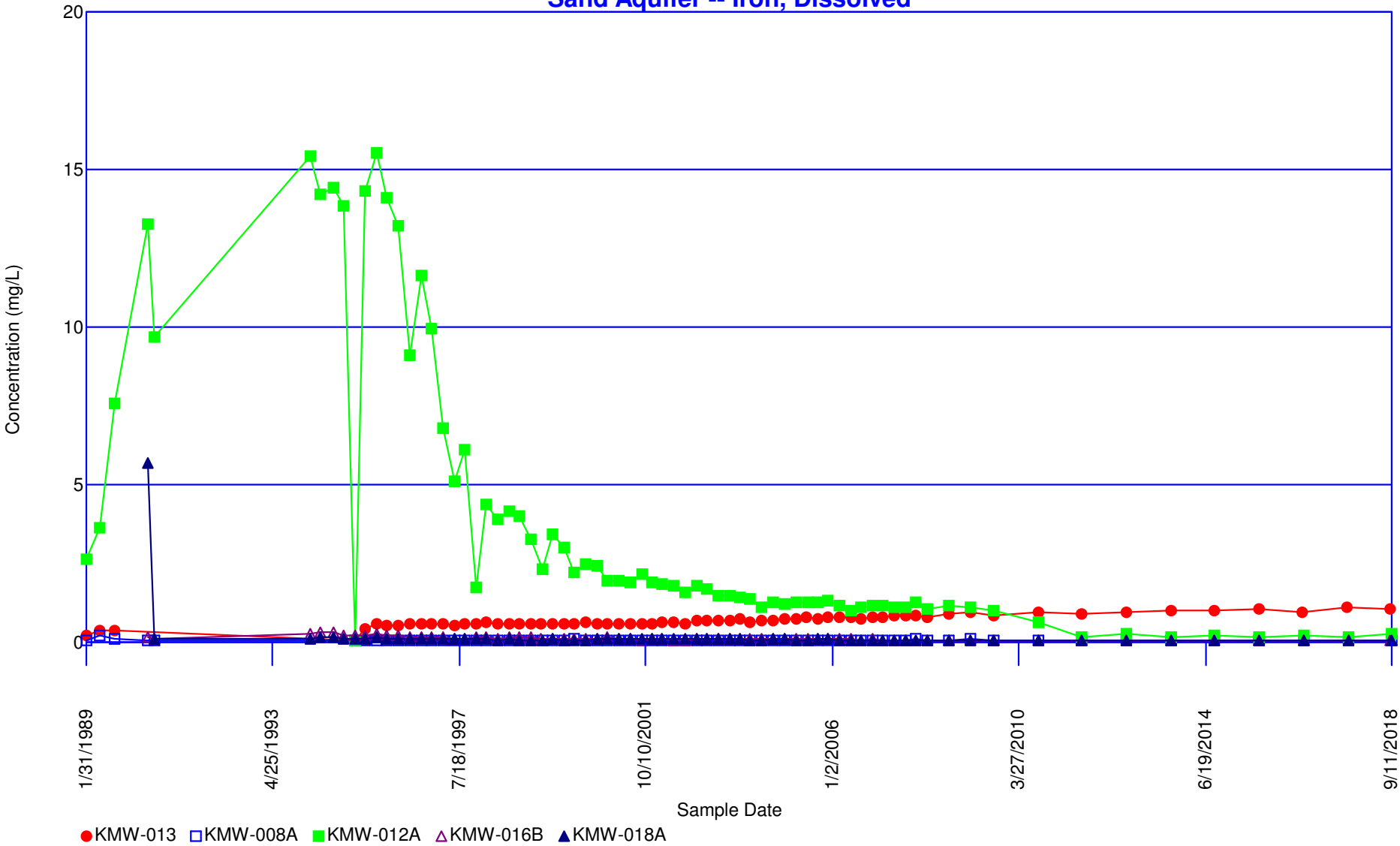


Regulatory Value = 0.59 mg/L (not shown)

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

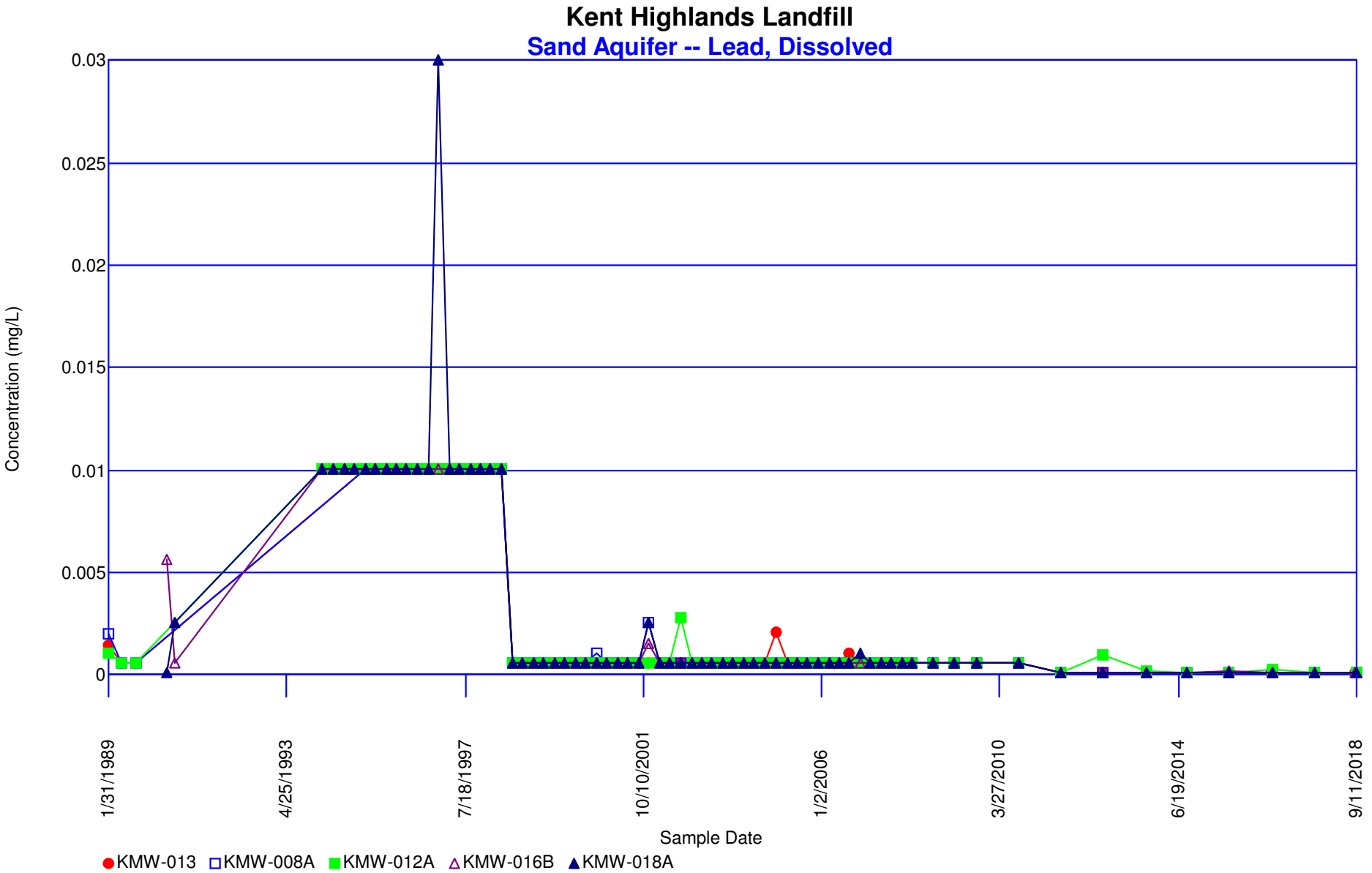
Kent Highlands Landfill Sand Aquifer -- Iron, Dissolved



Regulatory Value = 0.3 mg/L (not shown)

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

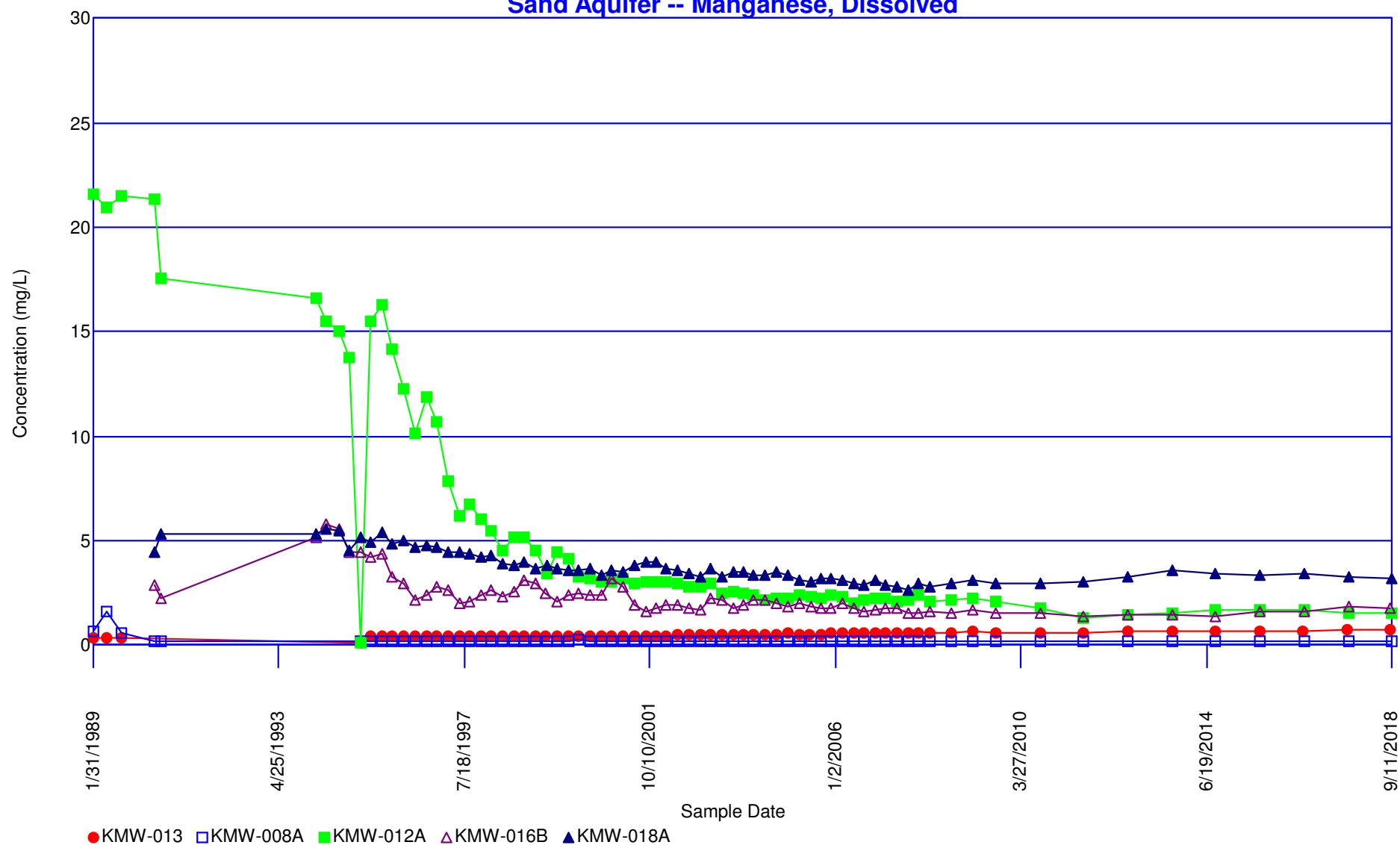


Regulatory Value = 0.005 mg/L (not shown)

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill Sand Aquifer -- Manganese, Dissolved

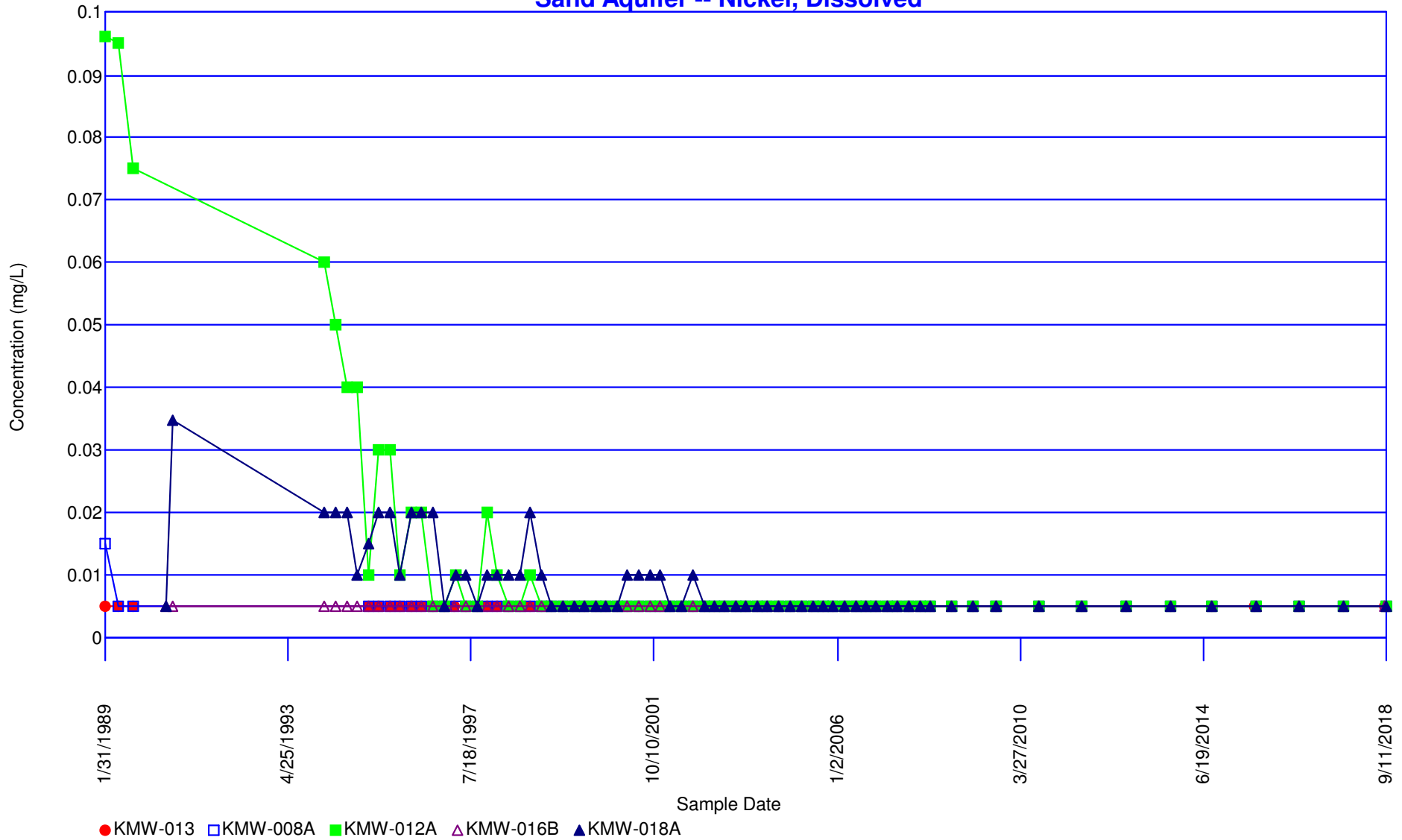


Regulatory Value = 0.05 mg/L (not shown)

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill
Sand Aquifer -- Nickel, Dissolved

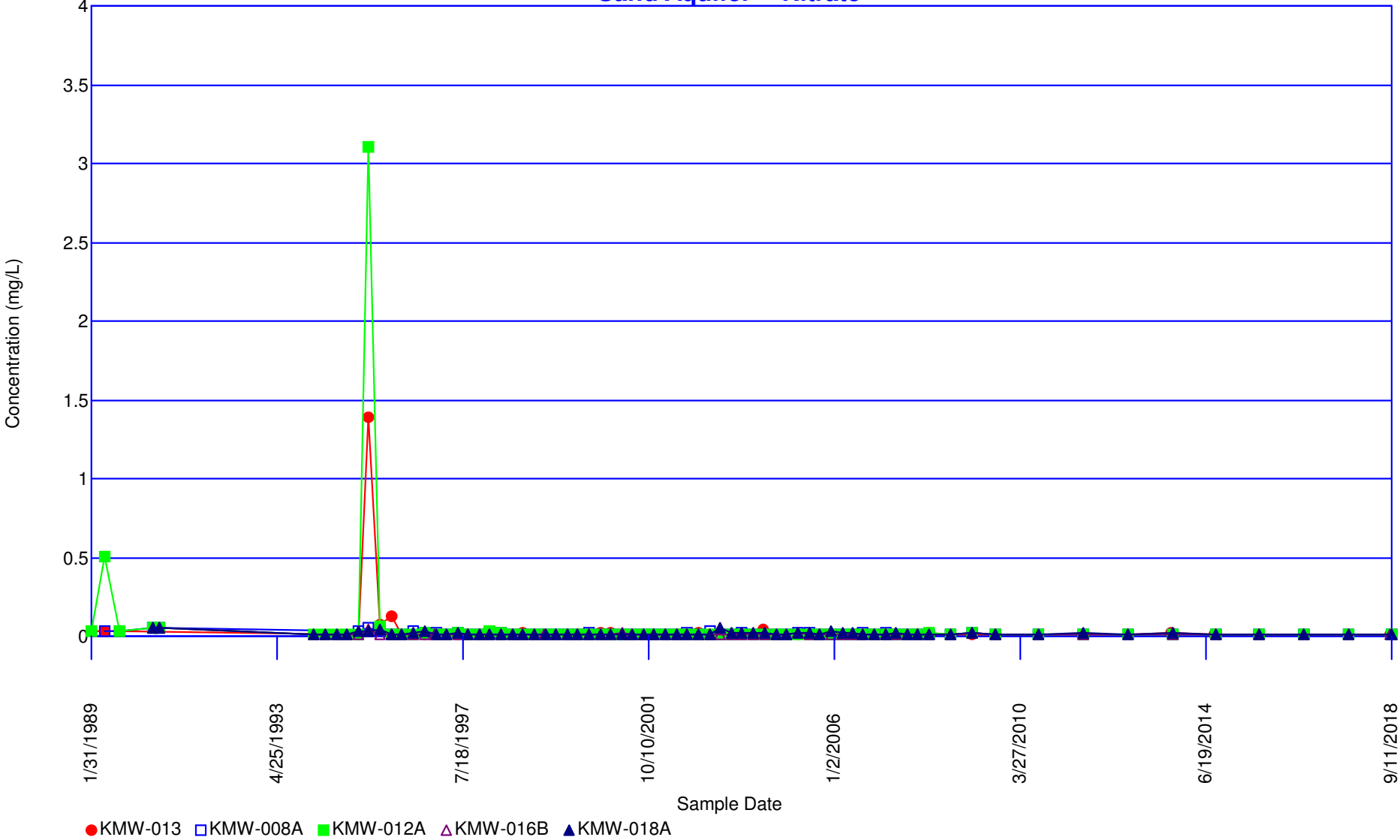


Regulatory Value = 0.1 mg/L (not shown)

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill Sand Aquifer -- Nitrate

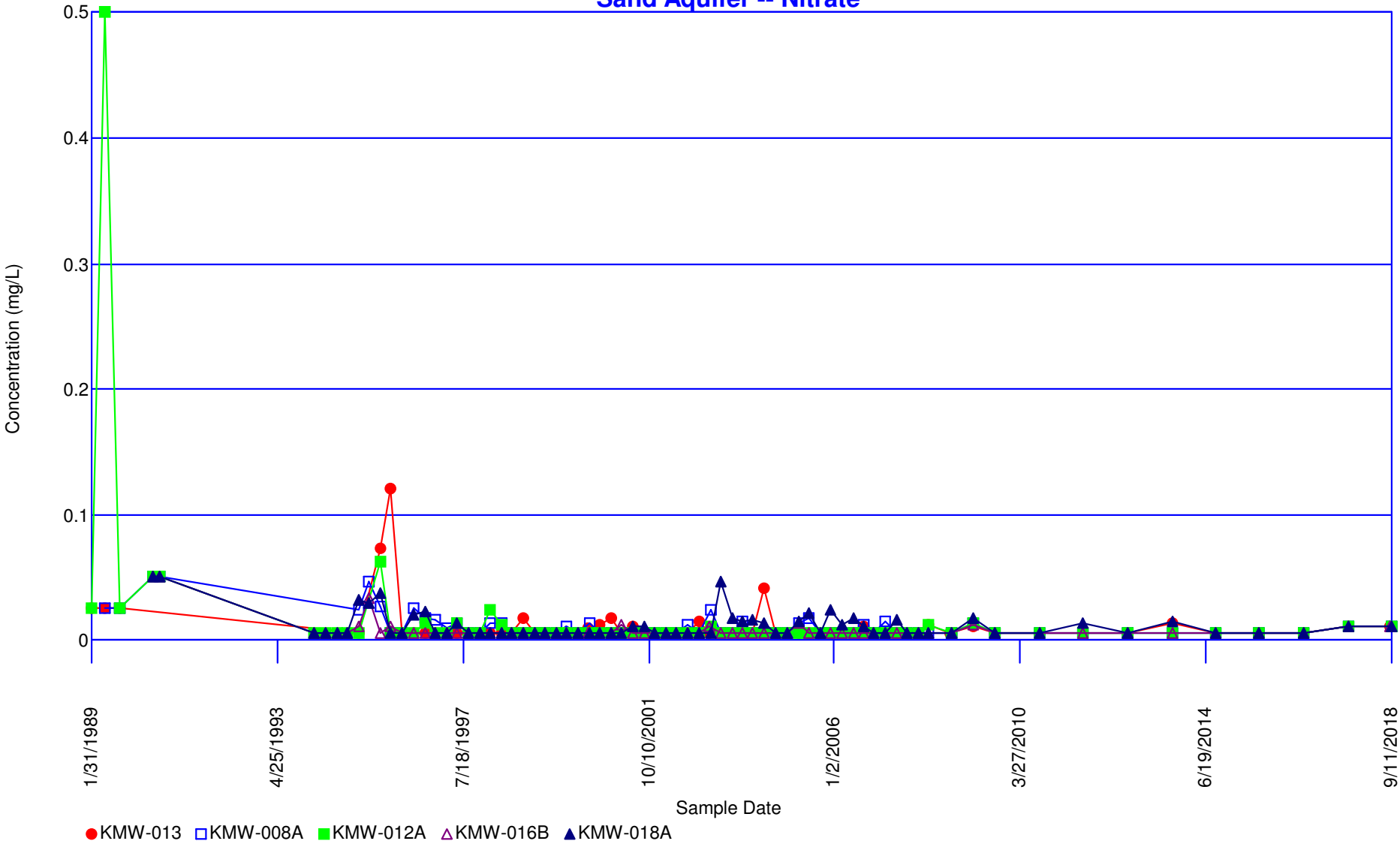


Regulatory Value = 10 mg/L (not shown)

Non-Detects Replaced with 1/2 DL

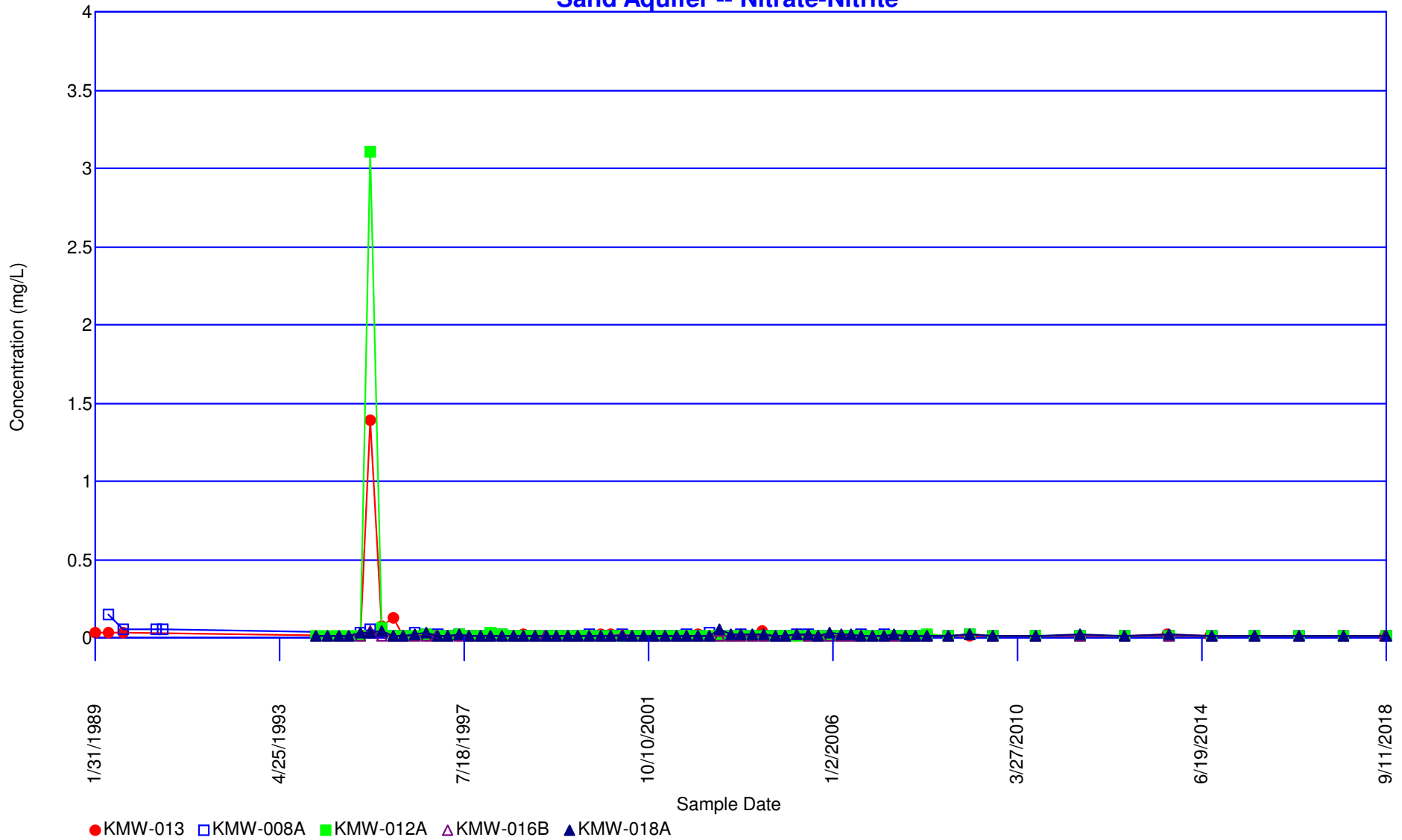
No data collected between September 1990 and January 1994

Kent Highlands Landfill Sand Aquifer -- Nitrate



No data collected between September 1990 and January 1994

Kent Highlands Landfill
Sand Aquifer -- Nitrate-Nitrite

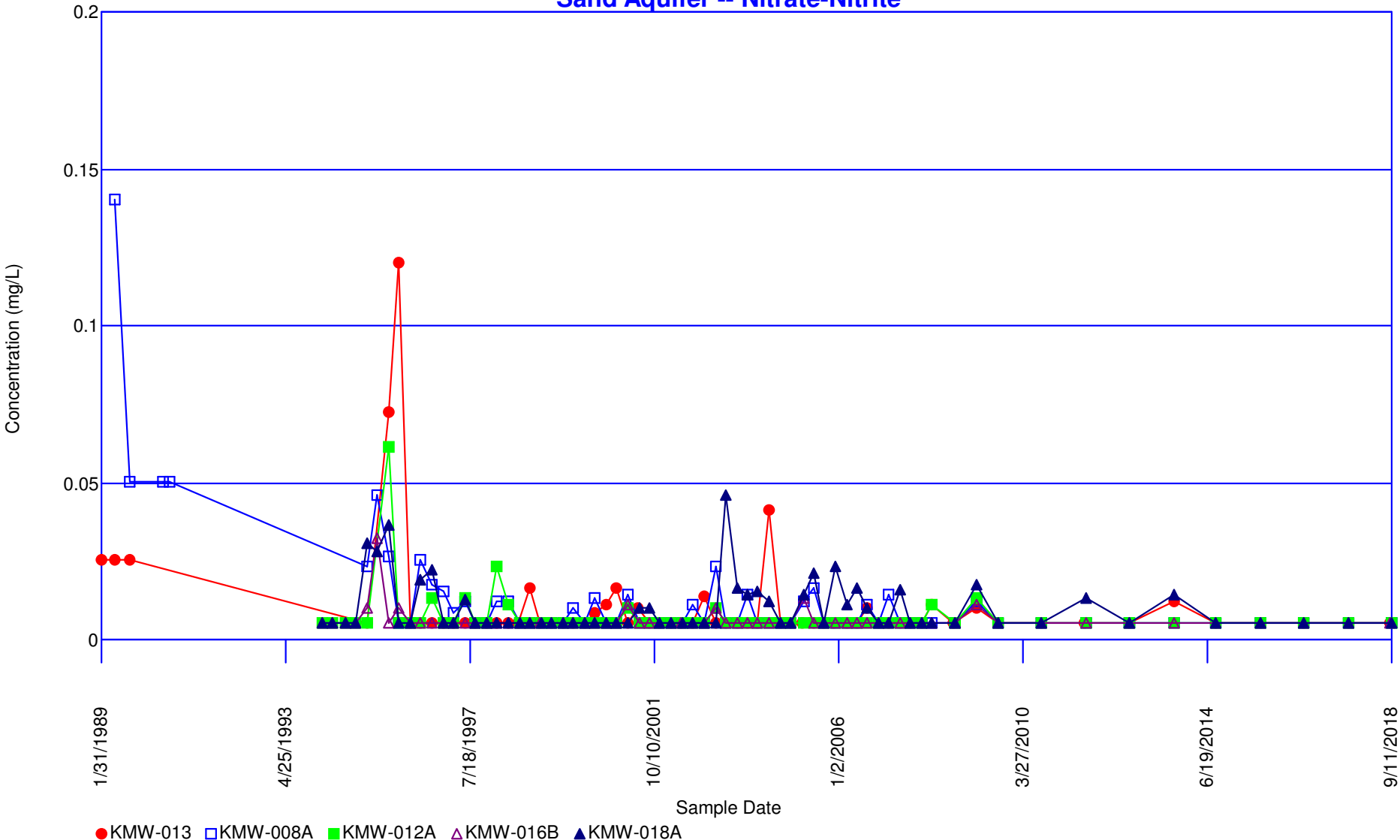


No Regulatory Value

Non-Detects Replaced with 1/2 DL

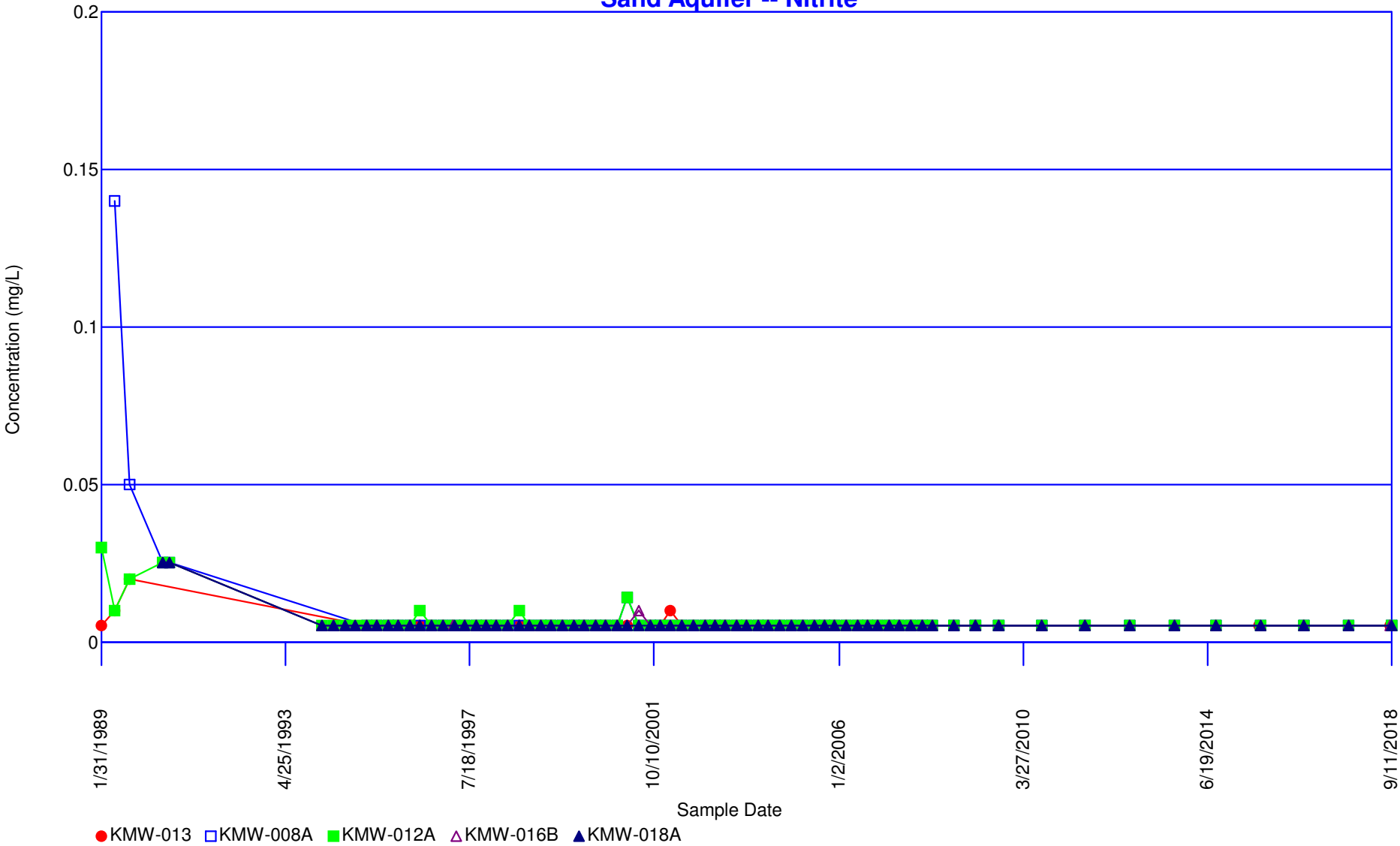
No data collected between September 1990 and January 1994

Kent Highlands Landfill
Sand Aquifer -- Nitrate-Nitrite



No data collected between September 1990 and January 1994

Kent Highlands Landfill
Sand Aquifer -- Nitrite

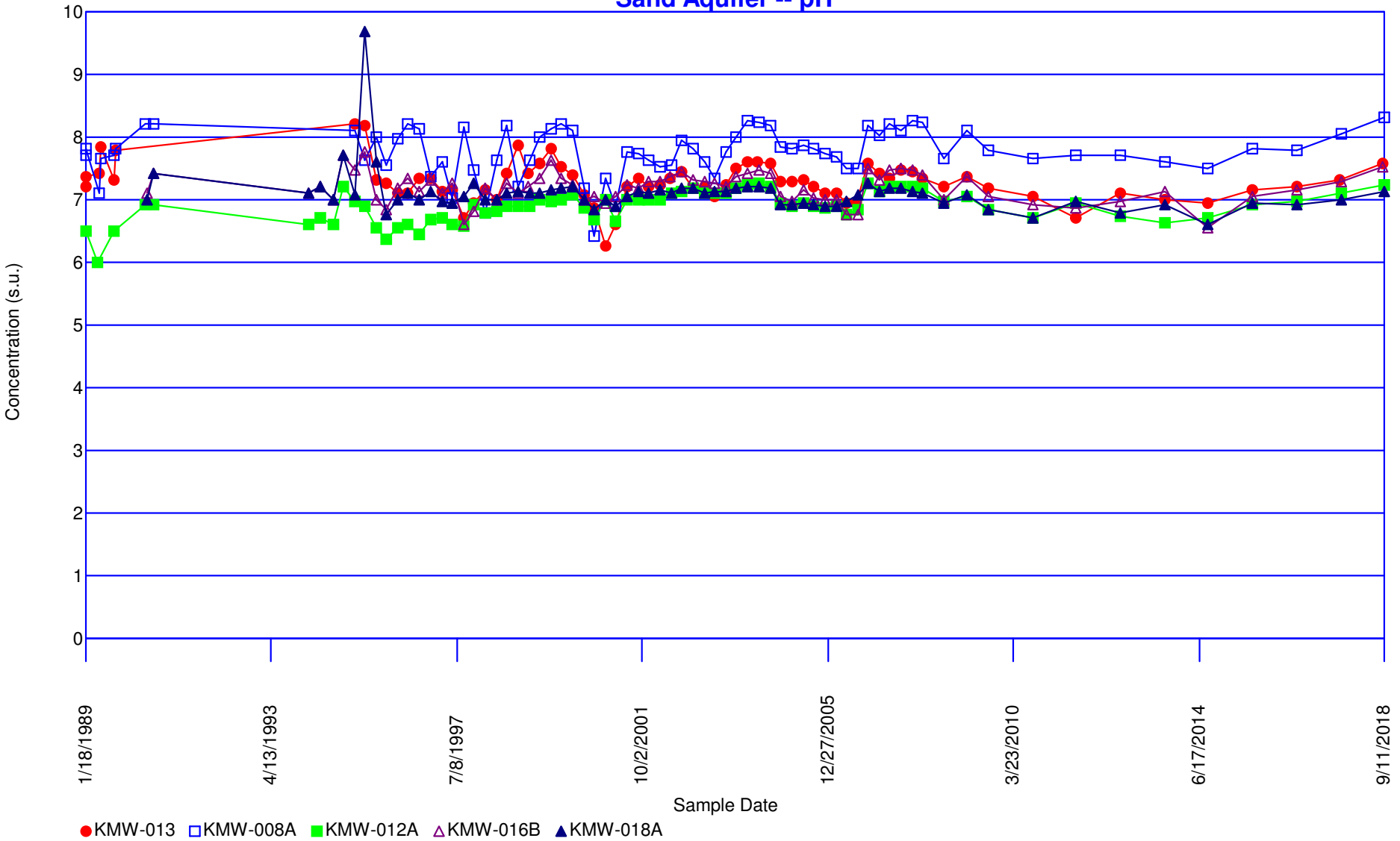


Regulatory Value = 1 mg/L (not shown)

Non-Detects Replaced with 1/2 DL

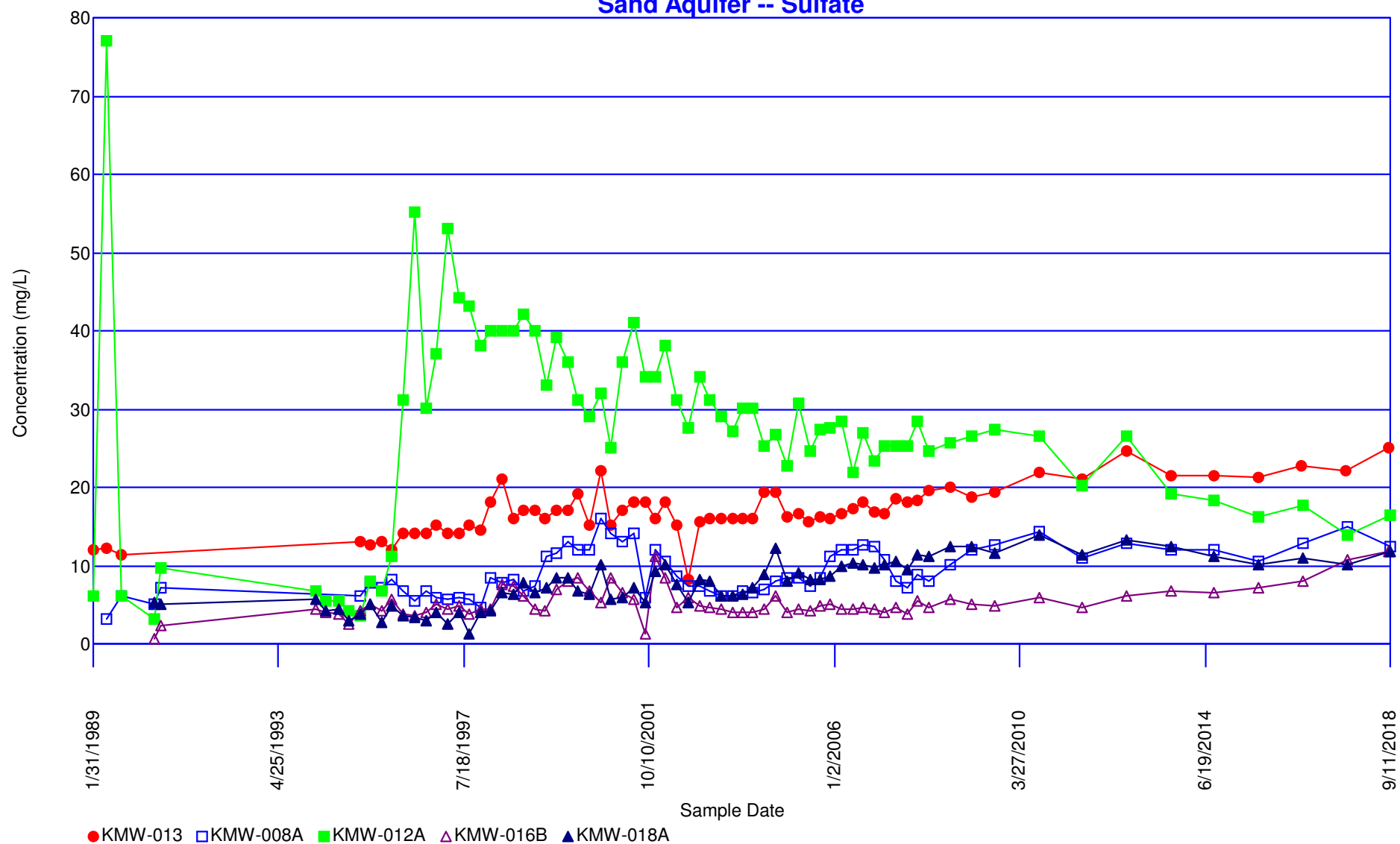
No data collected between September 1990 and January 1994

Kent Highlands Landfill Sand Aquifer -- pH



No data collected between September 1990 and January 1994

Kent Highlands Landfill Sand Aquifer -- Sulfate

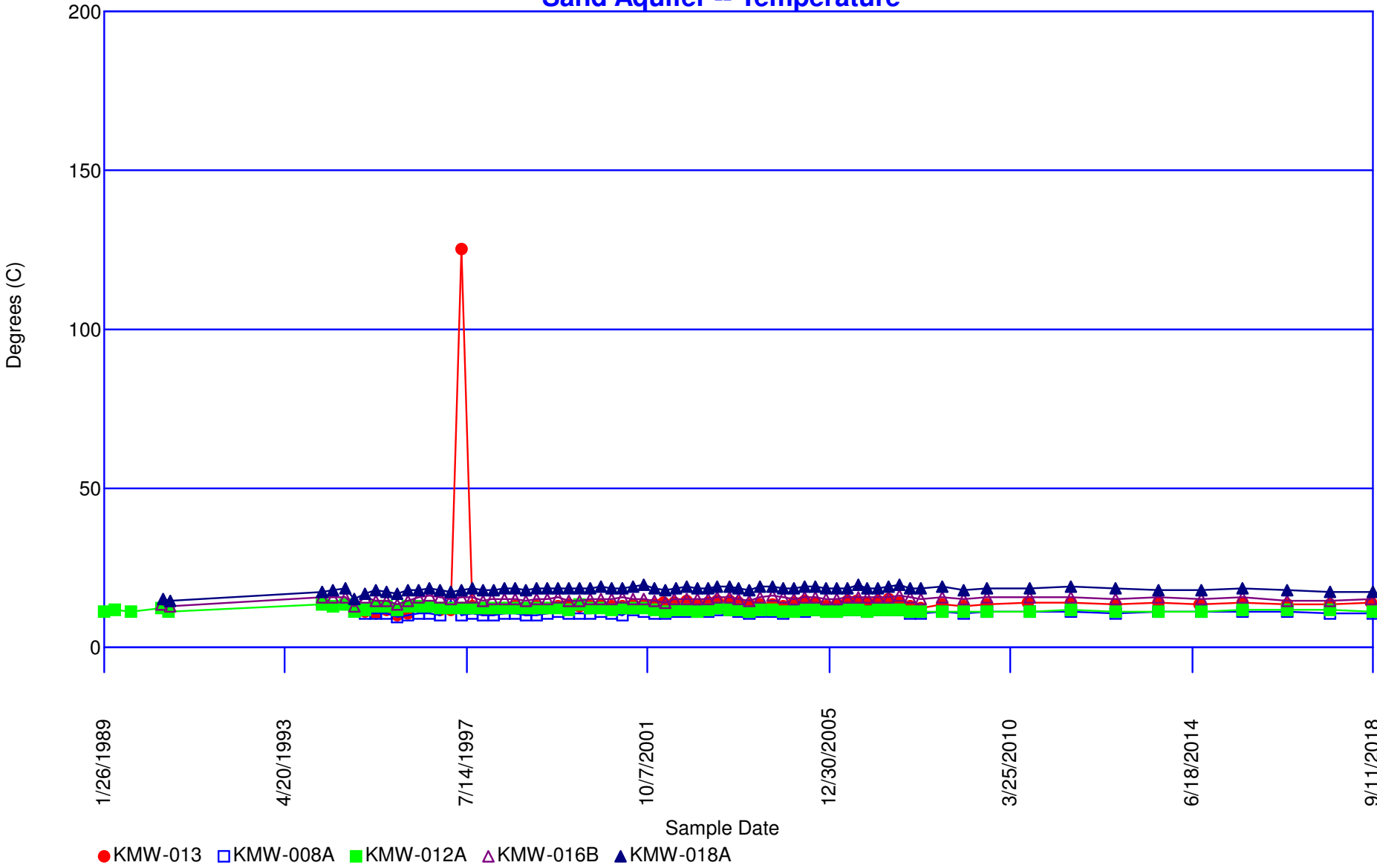


Regulatory Value = 250 mg/L (not shown)

Non-Detects Replaced with 1/2 DL

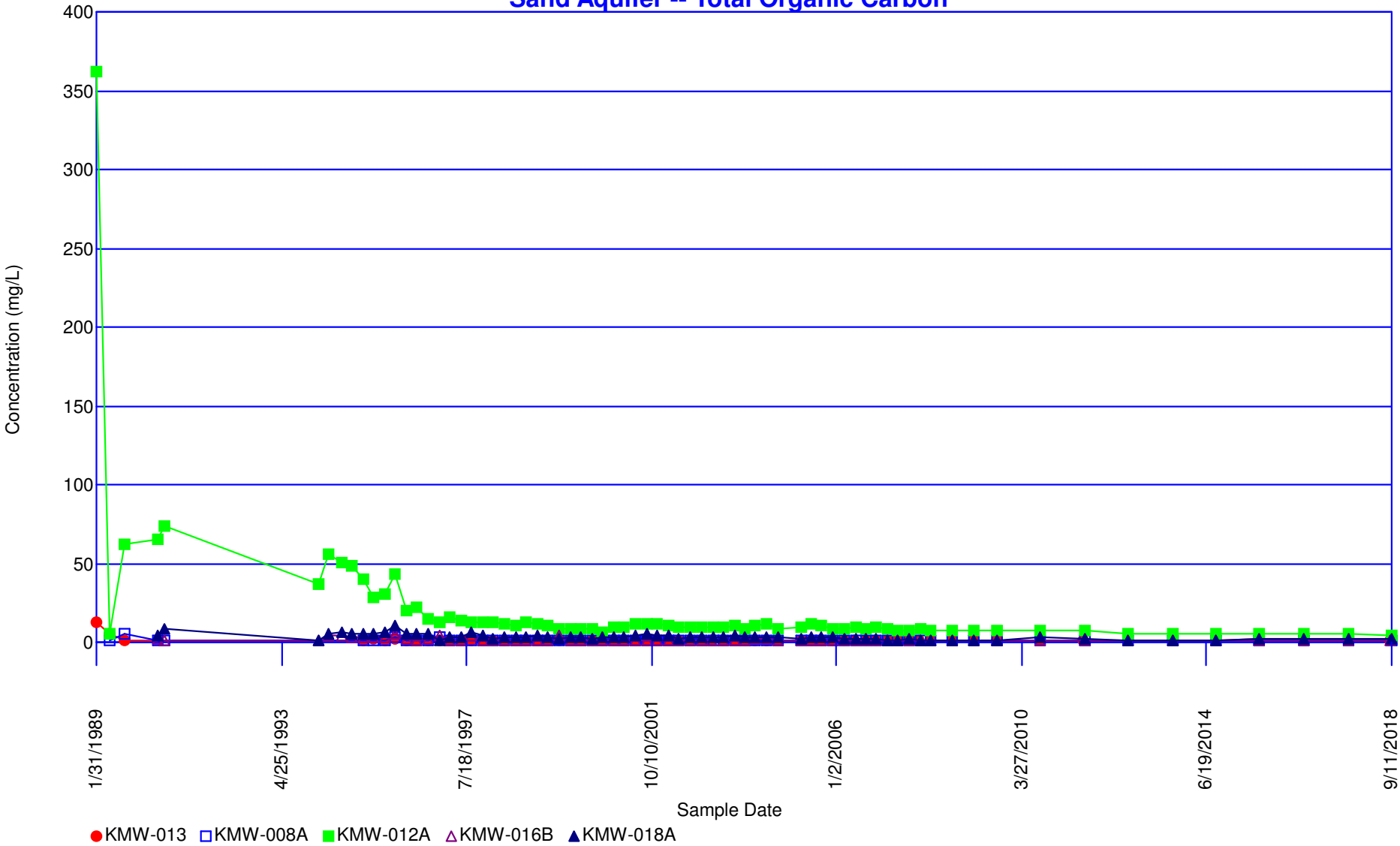
No data collected between September 1990 and January 1994

Kent Highlands Landfill Sand Aquifer -- Temperature



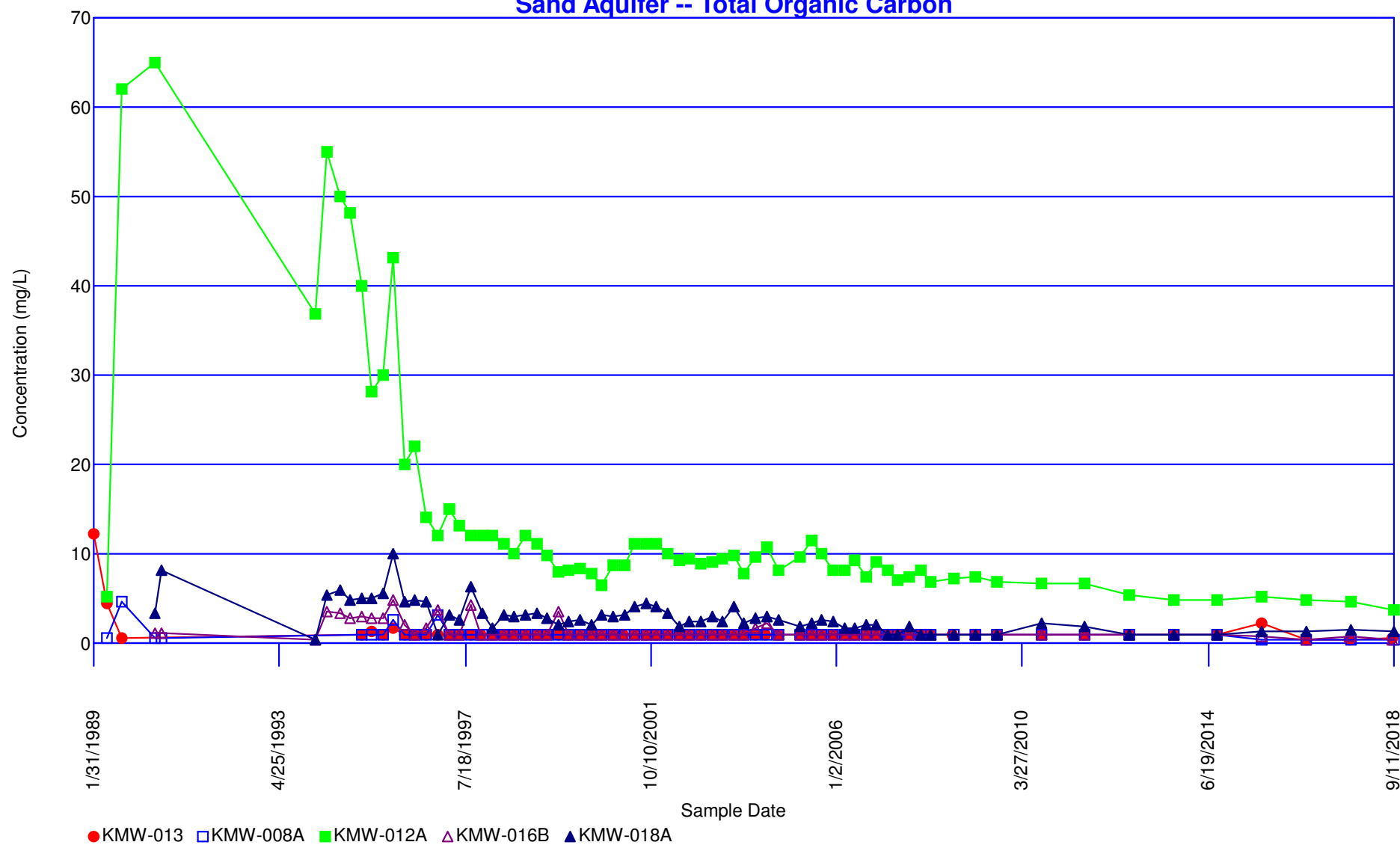
No data collected between September 1990 and January 1994

Kent Highlands Landfill
Sand Aquifer -- Total Organic Carbon



No data collected between September 1990 and January 1994

Kent Highlands Landfill Sand Aquifer -- Total Organic Carbon



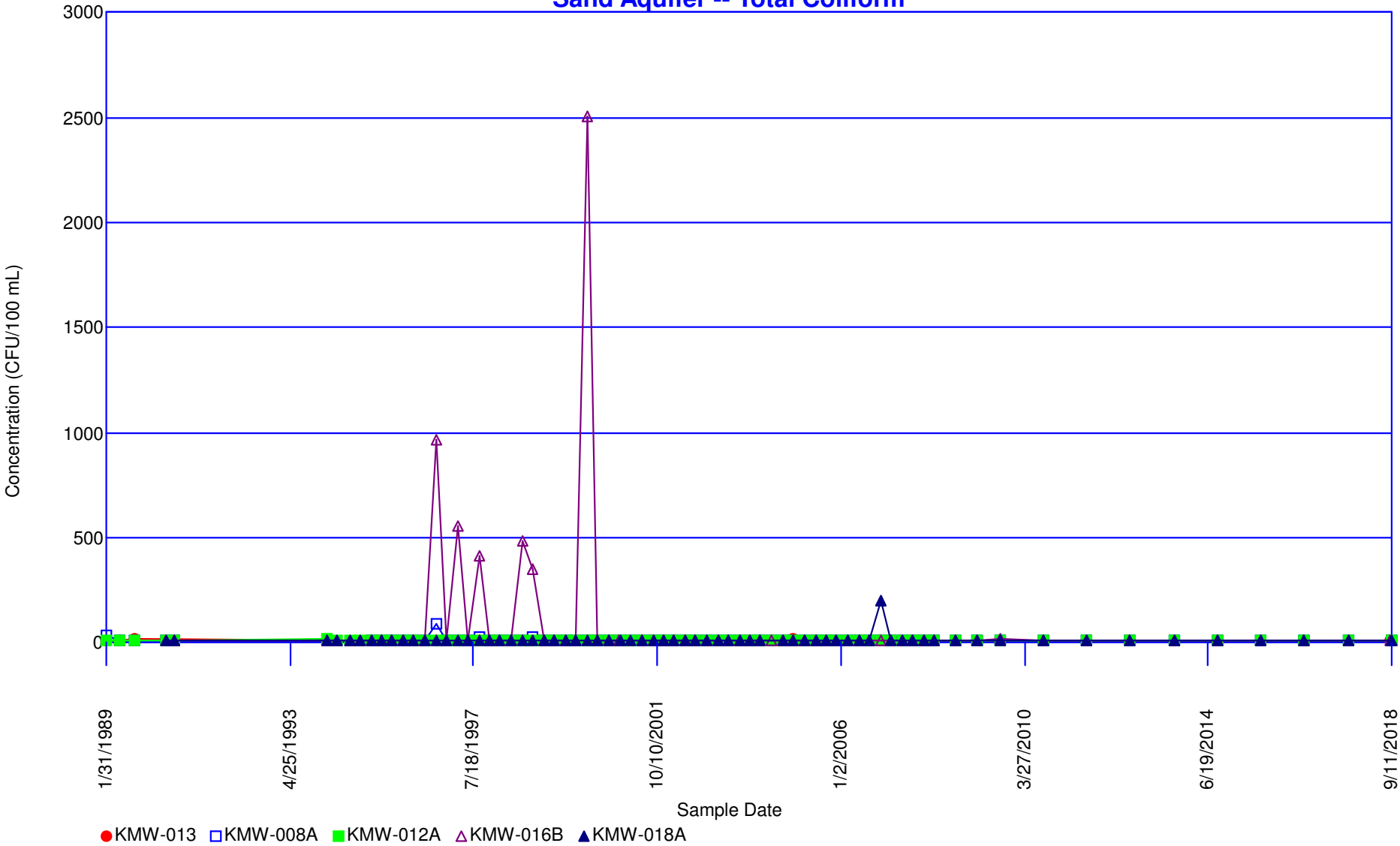
No Regulatory Value

Values > 3 standard deviations above the mean are not plotted

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill
Sand Aquifer -- Total Coliform

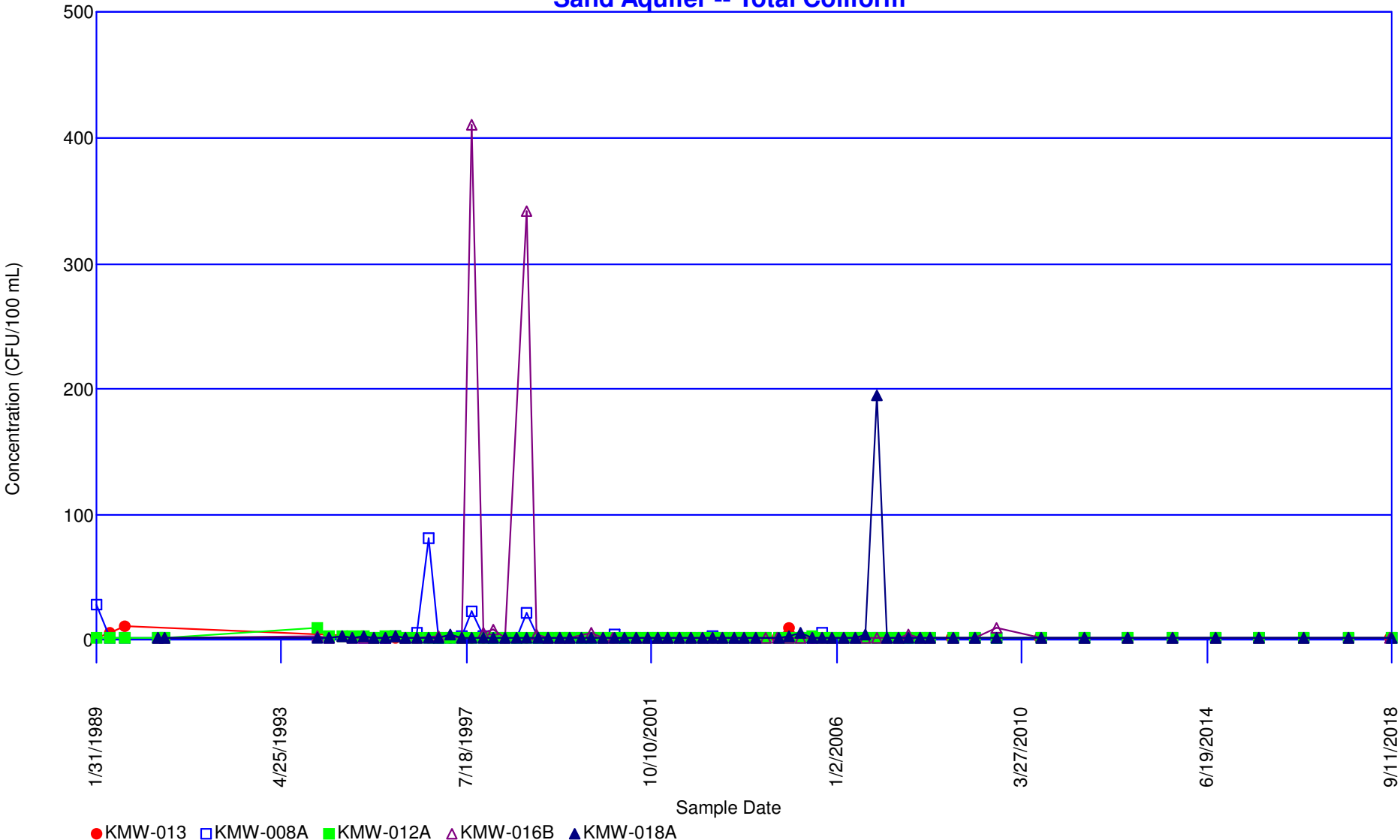


Regulatory Value = 1 CFU/100 mL (not shown)

Non-Detects Replaced with 1/2 DL

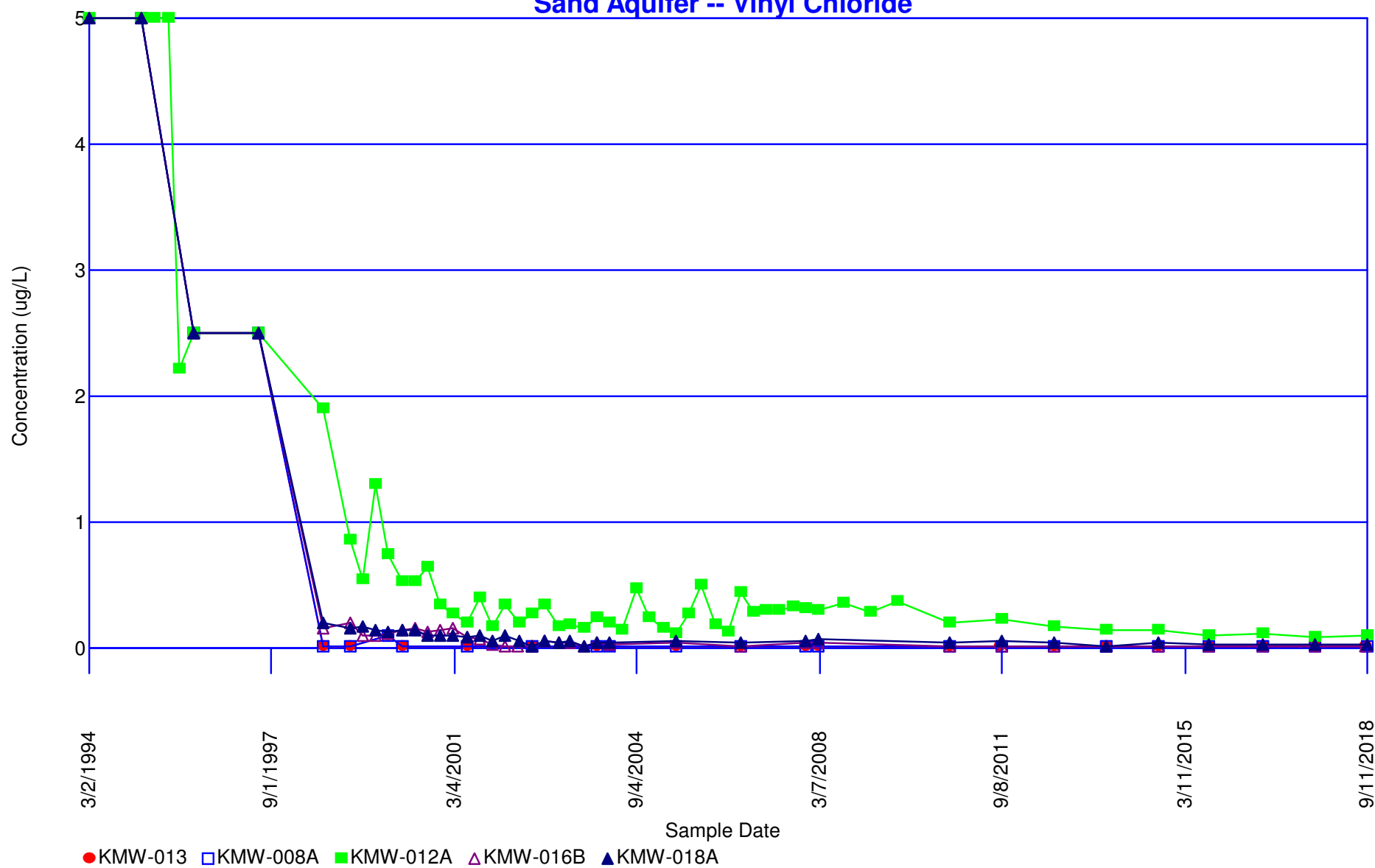
No data collected between September 1990 and January 1994

Kent Highlands Landfill Sand Aquifer -- Total Coliform



No data collected between September 1990 and January 1994

Kent Highlands Landfill Sand Aquifer -- Vinyl Chloride

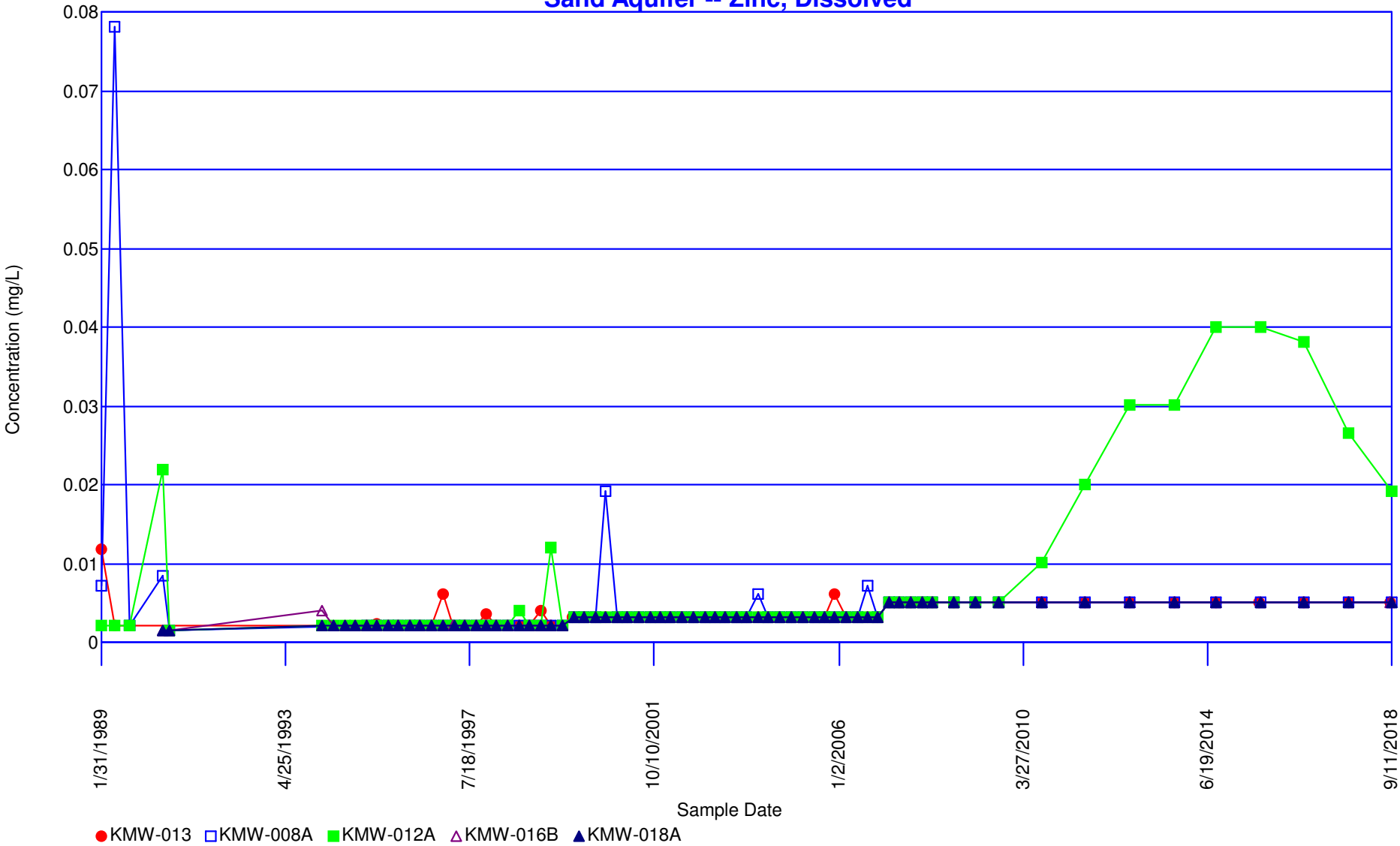


Regulatory Value = 0.025 ug/L (not shown)

Non-Detects Replaced with 1/2 DL

No data collected between September 1990 and January 1994

Kent Highlands Landfill
Sand Aquifer -- Zinc, Dissolved



Regulatory Value = 4.8 mg/L (not shown)

Non-Detects Replaced with 1/2 DL

Tolerance Limit Calculations



TECHNICAL MEMORANDUM

DATE: April 25, 2019
TO: File
FROM: Margaret Spence
SUBJECT: Tolerance Limit Calculations
CC: Laura Lee
PROJECT NUMBER: 554-1550-063
PROJECT NAME: Kent Highlands Landfill

This technical memorandum describes the approach for updating the tolerance limit (TL) calculations using the data from 2014 through 2018, to be used in data evaluations for the period between 2019 and 2023. The data from 2011 through 2013 were also included so that the eight most recent values were used for each TL calculation. Further information is provided in the *Kent Highlands Landfill Groundwater Compliance Monitoring Plan* (GCMP) prepared by CH2M HILL (1996) and summarized in Figure 1.

Statistically derived TLs were calculated when the data met two conditions:

1. The frequency of detection was equal to or greater than 75 percent.
2. The data fit a lognormal or normal distribution.

If either of the two conditions was not met, then a nonparametric method was applied to estimate the TL, as specified in the GCMP. The results of these analyses are presented below.

Tolerance Limit Distribution Analysis

The frequencies of detection for the 2011 through 2018 monitoring data were calculated and are shown in the fourth column of Table 1. Cases for which the detection frequency is 75 percent or higher are identified in the table; for these cases, the distribution analysis was performed.

Distribution analysis was conducted in accordance with Ecology guidance (Ecology 1993). To quantify the goodness of fit to a given distribution model, a linear regression was performed on the data. Per the GCMP and Ecology guidance, the data were initially assumed to be lognormally distributed. If the lognormal distribution was rejected, then the data were tested for fitting a normal distribution. If the normal distribution was rejected, then a nonparametric method was applied to establish TLs following the method specified in the GCMP.

The criteria for fitting a given distribution model include a probability ≤ 0.05 and a squared correlation coefficient (R^2) ≥ 0.90 . The R^2 for a lognormal distribution is shown in Table 1 as " R^2 Lognormal." If R^2 was greater than or equal to 0.90, then the lognormal distribution was accepted. For the cases where R^2 was less than 0.90, the regression was repeated assuming the normal distribution. These R^2 values are shown in Table 1 under the heading " R^2 Normal." The same cutoff criterion was applied to these values. Based on the results of the regression, a data distribution was assigned and appears in Table 1. Of the parameter/well cases with a frequency

of detection of at least 75 percent, the data for 10 cases were lognormally distributed, 2 cases were normally distributed, and the remaining 3 cases did not fit a lognormal or normal distribution. The last column of Table 1 identifies the method that was used to derive each TL.

Calculation of Background Tolerance Limits

Using the parametric method, TLs were calculated for the lognormally and normally distributed cases using the estimated mean and standard deviation for the appropriate distribution, as summarized in Table 2. For lognormally distributed parameters, the estimated mean and standard deviation were calculated using the log-transformed 2014 through 2018 monitoring data. Non-detects were assigned a value of one half the quantitation limit (prior to log-transformation). TLs were calculated from the log-transformed data and then back-transformed to arithmetic values.

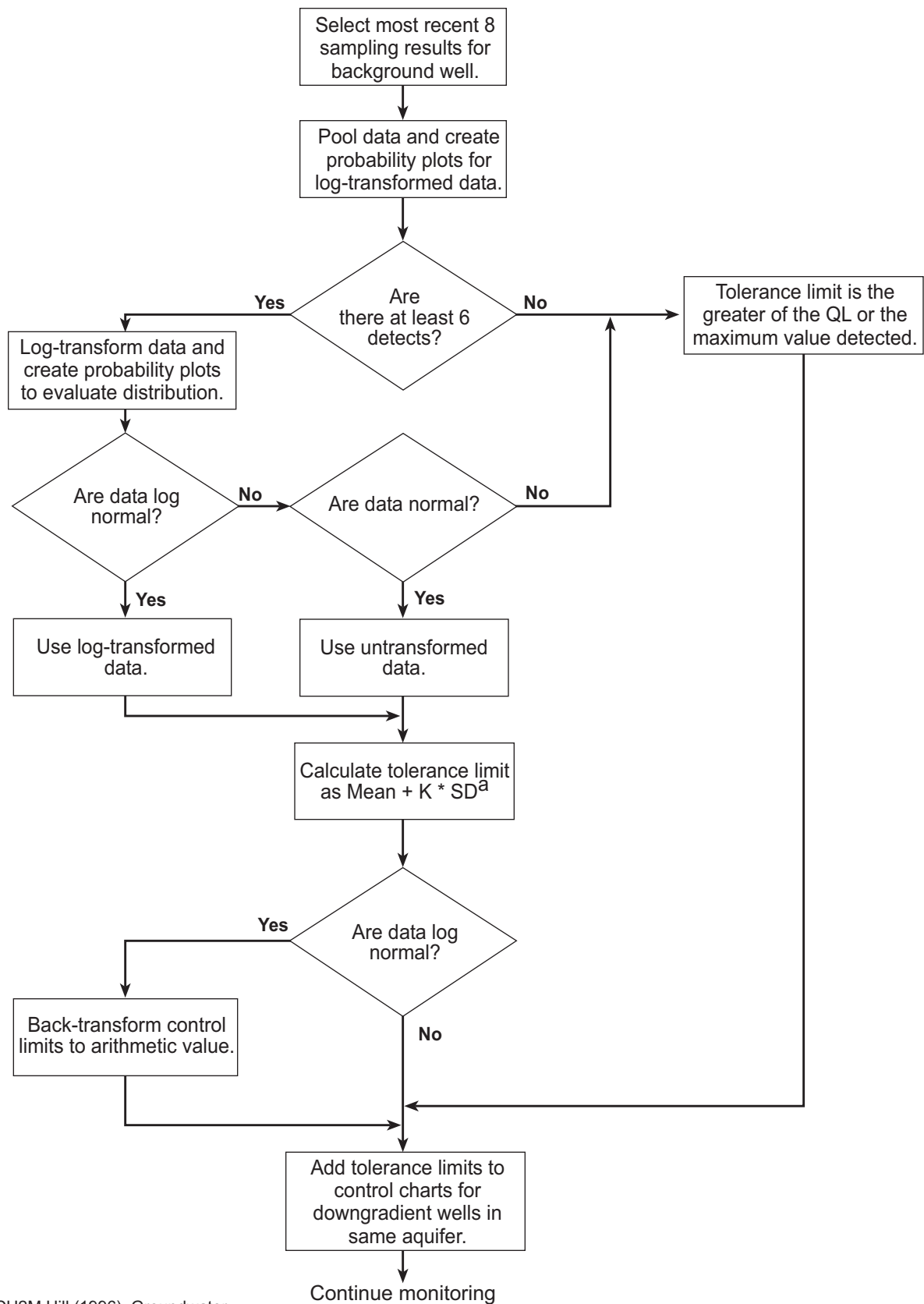
TLs for the parameter and well combinations that were not lognormally or normally distributed (E in the last column of Table 1) were estimated using a nonparametric method. The TLs for these cases were set equal to the higher of the maximum value detected and the quantitation limit (QL). These values are summarized in Table 3.

The TL calculations are summarized in Table 4.

REFERENCES

CH2M HILL. 1996. Kent Highlands Landfill Groundwater Compliance Monitoring Plan. Prepared for the City of Seattle. February 1996.

Ecology. 1993. Statistical Guidance for Ecology Site Managers Supplement S-6. August 1993.



Reference: CH2M Hill (1996), Groundwater Compliance Monitoring Plan

Parametrix Kent Highlands/555-1550-039(01B2) 5/00 (K)

Figure 1
Calculation of Tolerance Limits
for Background Wells

^a K = 3.188 for 95% coverage and 95% confidence
Total sample size = 8
SD = Standard deviation
QL = Quantitation limit

Table 1. Tolerance Limits Distribution Analysis, Kent Highlands Landfill

Parameters	Aquifer	Well	FoD	FoD ≥ 75%?	Distribution of Data	Prob./R ² Lognormal*	Prob./R ² Normal*	Tolerance Limit Method
Conventional Parameters								
Ammonia (N)	Sand	KMW-013	100%	Yes	Neither	0.00064/0.88	0.0013/0.84	E
Ammonia (N)	Alluvium	KMW-015A	100%	Yes	Lognormal	0.0000028/0.98	---	C
COD	Sand	KMW-013	12.5%	No	NA	---	---	E
COD	Alluvium	KMW-015A	25%	No	NA	---	---	E
Chloride	Sand	KMW-013	100%	Yes	Neither	0.012/0.68	.0029/0.80	E
Chloride	Alluvium	KMW-015A	100%	Yes	Lognormal	0.00017/0.92	---	C
Nitrate (N)	Sand	KMW-013	12.5%	No	NA	---	---	E
Nitrate (N)	Alluvium	KMW-015A	12.5%	No	NA	---	---	E
Nitrate/Nitrite (N)	Sand	KMW-013	12.5%	No	NA	---	---	E
Nitrate/Nitrite (N)	Alluvium	KMW-015A	12.5%	No	NA	---	---	E
Nitrite (N)	Sand	KMW-013	0%	No	NA	---	---	E
Nitrite (N)	Alluvium	KMW-015A	0%	No	NA	---	---	E
pH	Sand	KMW-013	100%	Yes	Lognormal	0.0000025/0.98	---	C
pH	Alluvium	KMW-015A	100%	Yes	Lognormal	0.0000034/0.98	---	C
Specific Conductivity	Sand	KMW-013	100%	Yes	Lognormal	0.00027/0.91	---	C
Specific Conductivity	Alluvium	KMW-015A	100%	Yes	Lognormal	0.000075/0.94	---	C
Sulfate	Sand	KMW-013	100%	Yes	Neither	0.0012/0.84	0.0015/0.83	E
Sulfate	Alluvium	KMW-015A	87.5%	Yes	Normal	0.00051/0.88	0.00012/0.93	C
Total Coliform	Sand	KMW-013	0%	No	NA	---	---	E
Total Coliform	Alluvium	KMW-015A	0%	No	NA	---	---	E
TOC	Sand	KMW-013	25%	No	NA	---	---	E
TOC	Alluvium	KMW-015A	100%	Yes	Lognormal	0.000053/0.95	---	C
Dissolved Metals								
Cadmium	Sand	KMW-013	0%	No	NA	---	---	E
Cadmium	Alluvium	KMW-015A	0%	No	NA	---	---	E
Chromium	Sand	KMW-013	0%	No	NA	---	---	E
Chromium	Alluvium	KMW-015A	12.5%	No	NA	---	---	E
Copper	Sand	KMW-013	0%	No	NA	---	---	E
Copper	Alluvium	KMW-015A	0%	No	NA	---	---	E
Iron	Sand	KMW-013	100%	Yes	Lognormal	0.0000022/0.98	---	C
Iron	Alluvium	KMW-015A	100%	Yes	Lognormal	0.000075/0.94	---	C
Lead	Sand	KMW-013	0%	No	NA	---	---	E
Lead	Alluvium	KMW-015A	12.5%	No	NA	---	---	E
Manganese	Sand	KMW-013	100%	Yes	Lognormal	0.00027/0.91	---	C
Manganese	Alluvium	KMW-015A	100%	Yes	Normal	0.00058/0.88	0.00025/0.91	C
Nickel	Sand	KMW-013	0%	No	NA	---	---	E
Nickel	Alluvium	KMW-015A	0%	No	NA	---	---	E
Zinc	Sand	KMW-013	0%	No	NA	---	---	E
Zinc	Alluvium	KMW-015A	0%	No	NA	---	---	E

* Criteria for Lognormal or normal distribution: Prob. ≤ 0.05 and R² ≥ 0.90 (WA DOE, 1993, Supplement S-6).

FoD = Frequency of detection

NA = Not Applicable

C = Parametric statistical calculation

E = Estimated using nonparametric method

Note: tolerance limits and distribution tests were calculated using log base e (ln).

Table 2. Parametric Calculation of Tolerance Limits for 2019 through 2023, Kent Highlands Landfill

Parameters	Aquifer	Well	Distribution of Data	Lognormal Distribution				Normal Distribution			Units
				Arithmetic Mean ²	Standard Deviation ²	Tolerance Limit ²	Tolerance Limit (Back-Transformed)	Arithmetic Mean	Standard Deviation	Tolerance Limit	
Conventional Parameters											
Ammonia-N	Alluvium	KMW-015A	Lognormal	2.2767	0.0884	2.5584	1.292	---	---	---	mg-N/L
Chloride	Alluvium	KMW-015A	Lognormal	1.8490	0.4575	3.3077	27.3	---	---	---	mg/L
Conductivity, Specific	Sand	KMW-013	Lognormal	5.8129	0.0451	5.9566	386.3	---	---	---	µmhos/cm
Conductivity, Specific	Alluvium	KMW-015A	Lognormal	5.4267	0.1021	5.7521	314.9	---	---	---	µmhos/cm
pH	Sand	KMW-013	Lognormal	1.9613	0.0358	2.0754	7.97	---	---	---	s.u.
pH	Alluvium	KMW-015A	Lognormal	1.8736	0.0388	1.9972	7.37	---	---	---	s.u.
Sulfate	Alluvium	KMW-015A	Normal	---	---	---	---	9.4563	2.8035	18.39	mg/L
Total Organic Carbon	Alluvium	KMW-015A	Lognormal	0.7763	0.1285	1.1861	3.27	---	---	---	mg/L
Dissolved Metals											
Iron	Sand	KMW-013	Lognormal	2.2772	0.0646	2.4831	1.20	---	---	---	mg/L
Iron	Alluvium	KMW-015A	Lognormal	2.1693	0.1302	2.5845	13.26	---	---	---	mg/L
Manganese	Sand	KMW-013	Lognormal	1.8047	0.0662	2.0156	0.75	---	---	---	mg/L
Manganese	Alluvium	KMW-015A	Normal	---	---	---	---	0.4094	0.0435	0.548	mg/L

¹ Tolerance limits, means, and standard deviations were calculated assuming a value of one half the detection limit for nondetects.

² Values are Ln transformed (natural log).

Note: tolerance limits and distribution tests were calculated using log base e (ln).

Table 3. Nonparametric Tolerance Limits for 2019 through 2023, Kent Highlands Landfill

Parameters	Aquifer	Well	Units	Maximum Detected Value	Maximum Quantitation Limit ¹	Tolerance Limit
Conventional Parameters						
Ammonia-N	Sand	KMW-013	mg-N/L	0.344	0.04	0.344
COD	Sand	KMW-013	mg/L	5.125	10	10
COD	Alluvium	KMW-015A	mg/L	10.3	10	10.3
Chloride	Sand	KMW-013	mg/L	50.7	1.0	50.7
Nitrate-N	Sand	KMW-013	mg-N/L	0.012	0.02	0.02
Nitrate-N	Alluvium	KMW-015A	mg-N/L	0.02	0.02 ²	0.02
Nitrate/Nitrite (N)	Sand	KMW-013	mg-N/L	0.012	0.01	0.012
Nitrate/Nitrite (N)	Alluvium	KMW-015A	mg-N/L	0.025	0.02	0.025
Nitrite-N	Sand	KMW-013	mg-N/L	NA	0.01	0.01
Nitrite-N	Alluvium	KMW-015A	mg-N/L	NA	0.02	0.020
Sulfate	Sand	KMW-013	mg/L	25	2.0	25
Total Coliform	Sand	KMW-013	#/100	NA	1.0	1.0
Total Coliform	Alluvium	KMW-015A	#/100	NA	1.0	1.0
TOC	Sand	KMW-013	mg/L	2.1	1.5	2.1
Dissolved Metals						
Cadmium	Sand	KMW-013	mg/L	NA	0.002	0.002
Cadmium	Alluvium	KMW-015A	mg/L	NA	0.002	0.002
Chromium	Sand	KMW-013	mg/L	NA	0.005	0.005
Chromium	Alluvium	KMW-015A	mg/L	0.005	0.005	0.005
Copper	Sand	KMW-013	mg/L	NA	0.002	0.002
Copper	Alluvium	KMW-015A	mg/L	NA	0.002	0.002
Lead	Sand	KMW-013	mg/L	NA	0.0001	0.0001
Lead	Alluvium	KMW-015A	mg/L	0.0002	0.0001	0.0002
Nickel	Sand	KMW-013	mg/L	NA	0.01	0.01
Nickel	Alluvium	KMW-015A	mg/L	NA	0.01	0.01
Zinc	Sand	KMW-013	mg/L	NA	0.01	0.01
Zinc	Alluvium	KMW-015A	mg/L	NA	0.01	0.01

¹ Lower quantitation limits (QLs) were reported for the following wells and parameters:

KMW-013: the QL for COD was 5 mg/L in 2011.

KMW-013: the QL for Nitrate-N was 0.01 for 2011-2016.

KMW-015A: the QL for Nitrate-N was 0.01 for 2011-2014.

KMW-015A: the QL for Nitrate/Nitrite (N) was 0.01 for 2011-2014 and 2018.

KMW-015A: the QL for Nitrite-N was 0.01 for 2011-2016 and 2018.

KMW-013: the QL for TOC was 0.5 for 2016-2017.

² The QL of 0.04 for KMW-015A Nitrate-N in 2017 was not used as the maximum QL because the sample was diluted.

NA = Not Applicable - There were no detects in the data set.

Table 4. Calculation of Upper Tolerance Limits for 2019 through 2023 Evaluations, Kent Highlands Landfill

Well ID	CAS_no	Date	Value Q	MDL Value (NDs=1/2 MDL)	Index	ln(x), ln(x+1), or ln(x*10)	Normality test (if applicable) and UTL Computations
KMW-013	7664-41-7	10-Sep-18	0.245	0.245	8	0.89608802	Ammonia (N) n = 8 % Ds = 100.0 Normality tests failed $r^2 = 0.88/\text{Ln Transformed}$ $r^2 = 0.84/\text{Untransformed}$ Non-parametric Tolerance Limit Calculated UTL = 0.344 Calculated UTL $\geq$ Maximum QL (0.04) New UTL = 0.344 Minimum Coverage = 68.8%
	7664-41-7	16-Sep-13	0.252	0.252	3	0.92425890	
	7664-41-7	12-Sep-16	0.257	0.257	6	0.94390590	
	7664-41-7	10-Sep-12	0.2625	0.2625	2	0.96508090	
	7664-41-7	8-Sep-15	0.266	0.266	5	0.97832612	
	7664-41-7	6-Sep-11	0.281	0.281	1	1.03318448	
	7664-41-7	18-Sep-17	0.299	0.299	7	1.09527339	
	7664-41-7	9-Sep-14	0.344	0.344	4	1.23547147	
KMW-013	COD	6-Sep-11	5 U	2.5	1	N/Ap	COD n = 8 % Ds = 12.5 FoD < 75% Non-parametric Tolerance Limit Calculated UTL = 5.125 Calculated UTL < Maximum QL (10) New UTL = 10 Minimum Coverage = 68.8%
	COD	16-Sep-13	10 U	5	3		
	COD	9-Sep-14	10 U	5	4		
	COD	8-Sep-15	10 U	5	5		
	COD	12-Sep-16	10 U	5	6		
	COD	18-Sep-17	10 U	5	7		
	COD	10-Sep-18	10 U	5	8		
	COD	10-Sep-12	5.125	5.125	2		

Table 4. Calculation of Upper Tolerance Limits for 2019 through 2023 Evaluations, Kent Highlands Landfill

Well ID	CAS_no	Date	Value Q	MDL Value (NDs=1/2 MDL)	Index	ln(x), ln(x+1), or ln(x*10)	Normality test (if applicable) and UTL Computations
KMW-013	16887-00-6	18-Sep-17	18.5	18.5	7	2.91777073	Chloride n = 8 % Ds = 100.0 Normality tests failed $r^2 = 0.68/\text{Ln Transformed}$ $r^2 = 0.80/\text{Untransformed}$ Non-parametric Tolerance Limit Calculated UTL = 50.7 Calculated UTL $\geq$ Maximum QL (1.0) New UTL = 50.7 Minimum Coverage = 68.8%
	16887-00-6	6-Sep-11	38.7	38.7	1	3.65583960	
	16887-00-6	10-Sep-12	38.9	38.9	2	3.66099425	
	16887-00-6	16-Sep-13	42.8	42.8	3	3.75653810	
	16887-00-6	4-Sep-18	43.4	43.4	8	3.77045944	
	16887-00-6	9-Sep-14	45.9	45.9	4	3.82646512	
	16887-00-6	8-Sep-15	49.2	49.2	5	3.89589362	
	16887-00-6	12-Sep-16	50.7	50.7	6	3.92592591	
KMW-013	SPCOND	6-Sep-11	309	309	1	5.73334128	Specific Conductivity n = 8 % Ds = 100.0 Normality tests passed $r^2 = 0.91/\text{Ln Transformed}$ $r^2 = 0.91/\text{Untransformed}$ Parametric Tolerance Limit 95% UTL on ln(x) scale: mean = 5.8129 sd = 0.0451 K = 3.188 UTL = 5.9566 UTL* = 386.3 * = Back-transformed UTL
	SPCOND	10-Sep-12	318	318	2	5.76205138	
	SPCOND	16-Sep-13	333	333	3	5.80814249	
	SPCOND	8-Sep-15	336	336	5	5.81711116	
	SPCOND	9-Sep-14	337	337	4	5.82008293	
	SPCOND	12-Sep-16	346	346	6	5.84643878	
	SPCOND	18-Sep-17	350	350	7	5.85793315	
	SPCOND	10-Sep-18	350.1	350.1	8	5.85821883	

Table 4. Calculation of Upper Tolerance Limits for 2019 through 2023 Evaluations, Kent Highlands Landfill

Well ID	CAS_no	Date	Value Q	MDL Value (NDs=1/2 MDL)	Index	ln(x), ln(x+1), or ln(x*10)	Normality test (if applicable) and UTL Computations
KMW-013	14797-55-8	6-Sep-11	0.01 U	0.005	1	N/Ap	Nitrate-N n = 8 % Ds = 12.5 FoD < 75% Non-parametric Tolerance Limit Calculated UTL = 0.012 Calculated UTL < Maximum QL (0.02) New UTL = 0.02 Minimum Coverage = 68.8%
	14797-55-8	10-Sep-12	0.01 U	0.005	2		
	14797-55-8	9-Sep-14	0.01 U	0.005	4		
	14797-55-8	8-Sep-15	0.01 U	0.005	5		
	14797-55-8	12-Sep-16	0.01 U	0.005	6		
	14797-55-8	18-Sep-17	0.02 U	0.01	7		
	14797-55-8	10-Sep-18	0.02 U	0.01	8		
	14797-55-8	16-Sep-13	0.012	0.012	3		
KMW-013	NITRATE-NITRITE	6-Sep-11	0.01 U	0.005	1	N/Ap	Nitrate/Nitrite (N) n = 8 % Ds = 12.5 FoD < 75% Non-parametric Tolerance Limit Calculated UTL = 0.012 Calculated UTL ≥ Maximum QL (0.01) New UTL = 0.012 Minimum Coverage = 68.8%
	NITRATE-NITRITE	10-Sep-12	0.01 U	0.005	2		
	NITRATE-NITRITE	9-Sep-14	0.01 U	0.005	4		
	NITRATE-NITRITE	8-Sep-15	0.01 U	0.005	5		
	NITRATE-NITRITE	12-Sep-16	0.01 U	0.005	6		
	NITRATE-NITRITE	18-Sep-17	0.01 U	0.005	7		
	NITRATE-NITRITE	10-Sep-18	0.01 U	0.005	8		
	NITRATE-NITRITE	16-Sep-13	0.012	0.012	3		
KMW-013	14797-65-0	6-Sep-11	0.01 U	0.005	1	N/Ap	Nitrite-N n = 8 % Ds = 0.0 FoD < 75% Non-parametric Tolerance Limit UTL = 0.01 Minimum Coverage = 68.8%
	14797-65-0	10-Sep-12	0.01 U	0.005	2		
	14797-65-0	16-Sep-13	0.01 U	0.005	3		
	14797-65-0	9-Sep-14	0.01 U	0.005	4		
	14797-65-0	8-Sep-15	0.01 U	0.005	5		
	14797-65-0	12-Sep-16	0.01 U	0.005	6		
	14797-65-0	18-Sep-17	0.01 U	0.005	7		
	14797-65-0	10-Sep-18	0.01	U	0.005	8	

Table 4. Calculation of Upper Tolerance Limits for 2019 through 2023 Evaluations, Kent Highlands Landfill

Well ID	CAS_no	Date	Value Q	MDL Value (NDs=1/2 MDL)	Index	ln(x), ln(x+1), or ln(x*10)	Normality test (if applicable) and UTL Computations
KMW-013	PH	6-Sep-11	6.71	6.71	1	1.90359895	pH n = 8 % Ds = 100.0 Normality tests passed $r^2 = 0.98$/Ln Transformed $r^2 = 0.98$/Untransformed Parametric Tolerance Limit 95% UTL on ln(x) scale: mean = 1.9613 sd = 0.0358 K = 3.188 UTL = 2.0754 UTL* = 7.97 * = Back-transformed UTL
	PH	9-Sep-14	6.93	6.93	4	1.93585981	
	PH	16-Sep-13	6.98	6.98	3	1.94304892	
	PH	10-Sep-12	7.08	7.08	2	1.95727391	
	PH	8-Sep-15	7.14	7.14	5	1.96571278	
	PH	12-Sep-16	7.21	7.21	6	1.97546895	
	PH	18-Sep-17	7.29	7.29	7	1.98650355	
	PH	10-Sep-18	7.56	7.56	8	2.02287119	
KMW-013	14808-79-8	6-Sep-11	21	21	1	3.04452244	Sulfate n = 8 % Ds = 100.0 Normality tests failed $r^2 = 0.84$/Ln Transformed $r^2 = 0.83$/Untransformed Non-parametric Tolerance Limit UTL = 25 Calculated UTL $\geq$ Maximum QL (2.0) New UTL = 25 Minimum Coverage = 68.8%
	14808-79-8	8-Sep-15	21.1	21.1	5	3.04927304	
	14808-79-8	16-Sep-13	21.4	21.4	3	3.06339092	
	14808-79-8	9-Sep-14	21.4	21.4	4	3.06339092	
	14808-79-8	18-Sep-17	22	22	7	3.09104245	
	14808-79-8	12-Sep-16	22.6	22.6	6	3.11794991	
	14808-79-8	10-Sep-12	24.55	24.55	2	3.20071185	
	14808-79-8	10-Sep-18	25	25	8	3.21887582	

Table 4. Calculation of Upper Tolerance Limits for 2019 through 2023 Evaluations, Kent Highlands Landfill

Well ID	CAS_no	Date	Value Q	MDL Value (NDs=1/2 MDL)	Index	ln(x), ln(x+1), or ln(x*10)	Normality test (if applicable) and UTL Computations
KMW-013	TOTAL-COLIFORM	6-Sep-11	1 U	0.5	1	N/Ap	Total Coliform n = 8 % Ds = 0.0 FoD < 75% Non-parametric Tolerance Limit UTL = 1 Minimum Coverage = 68.8%
	TOTAL-COLIFORM	10-Sep-12	1 U	0.5	2		
	TOTAL-COLIFORM	16-Sep-13	1 U	0.5	3		
	TOTAL-COLIFORM	9-Sep-14	1 UJ	0.5	4		
	TOTAL-COLIFORM	8-Sep-15	1 U	0.5	5		
	TOTAL-COLIFORM	12-Sep-16	1 U	0.5	6		
	TOTAL-COLIFORM	18-Sep-17	1 HU	0.5	7		
	TOTAL-COLIFORM	10-Sep-18	1 U	0.5	8		
KMW-013	TOC	12-Sep-16	0.5 U	0.025	6	N/Ap	TOC n = 8 % Ds = 25.0 FoD < 75% Non-parametric Tolerance Limit Calculated UTL = 2.1 Calculated UTL ≥ Maximum QL (1.5) New UTL = 2.1 Minimum Coverage = 68.8%
	TOC	18-Sep-17	0.5 U	0.025	7		
	TOC	6-Sep-11	1.5 U	0.75	1		
	TOC	10-Sep-12	1.5 U	0.75	2		
	TOC	16-Sep-13	1.5 U	0.75	3		
	TOC	9-Sep-14	1.5 U	0.75	4		
	TOC	10-Sep-18	0.5	0.5	8		
	TOC	8-Sep-15	2.1	2.1	5		
KMW-013	7440-43-9-D	6-Sep-11	0.002 U	0.001	1	N/Ap	Cadmium, Dissolved n = 8 % Ds = 0.0 FoD < 75% Non-parametric Tolerance Limit UTL = 0.002 Minimum Coverage = 68.8%
	7440-43-9-D	10-Sep-12	0.002 U	0.001	2		
	7440-43-9-D	16-Sep-13	0.002 U	0.001	3		
	7440-43-9-D	9-Sep-14	0.002 U	0.001	4		
	7440-43-9-D	8-Sep-15	0.002 U	0.001	5		
	7440-43-9-D	12-Sep-16	0.002 U	0.001	6		
	7440-43-9-D	18-Sep-17	0.002 U	0.001	7		
	7440-43-9-D	10-Sep-18	0.002 U	0.001	8		

Table 4. Calculation of Upper Tolerance Limits for 2019 through 2023 Evaluations, Kent Highlands Landfill

Well ID	CAS_no	Date	Value Q	MDL Value (NDs=1/2 MDL)	Index	ln(x), ln(x+1), or ln(x*10)	Normality test (if applicable) and UTL Computations
KMW-013	7440-47-3-D	6-Sep-11	0.005 U	0.0025	1	N/Ap	Chromium, Dissolved n = 8 % Ds = 0.0 FoD < 75% Non-parametric Tolerance Limit UTL = 0.005 Minimum Coverage = 68.8%
	7440-47-3-D	10-Sep-12	0.005 U	0.0025	2		
	7440-47-3-D	16-Sep-13	0.005 U	0.0025	3		
	7440-47-3-D	9-Sep-14	0.005 U	0.0025	4		
	7440-47-3-D	8-Sep-15	0.005 U	0.0025	5		
	7440-47-3-D	12-Sep-16	0.005 U	0.0025	6		
	7440-47-3-D	18-Sep-17	0.005 U	0.0025	7		
	7440-47-3-D	10-Sep-18	0.005 U	0.0025	8		
KMW-013	7440-50-8-D	6-Sep-11	0.002 U	0.001	1	N/Ap	Copper, Dissolved n = 8 % Ds = 0.0 FoD < 75% Non-parametric Tolerance Limit UTL = 0.002 Minimum Coverage = 68.8%
	7440-50-8-D	10-Sep-12	0.002 U	0.001	2		
	7440-50-8-D	16-Sep-13	0.002 U	0.001	3		
	7440-50-8-D	9-Sep-14	0.002 U	0.001	4		
	7440-50-8-D	8-Sep-15	0.002 U	0.001	5		
	7440-50-8-D	12-Sep-16	0.002 U	0.001	6		
	7440-50-8-D	18-Sep-17	0.002 U	0.001	7		
	7440-50-8-D	10-Sep-18	0.002 U	0.001	8		
KMW-013	7439-89-6-D	6-Sep-11	0.88	0.88	1	2.17475172	Iron, Dissolved n = 8 % Ds = 100.0 Normality tests passed r² = 0.98/Ln Transformed r² = 0.98/Untransformed Parametric Tolerance Limit 95% UTL on ln(x*10) scale: mean = 2.2772 sd = 0.0646 K = 3.188 UTL = 2.4831 UTL* = 1.20 * = Back-transformed UTL
	7439-89-6-D	12-Sep-16	0.924	0.924	6	2.22354189	
	7439-89-6-D	10-Sep-12	0.93	0.93	2	2.23001440	
	7439-89-6-D	16-Sep-13	0.97	0.97	3	2.27212589	
	7439-89-6-D	9-Sep-14	1.00	1	4	2.30258509	
	7439-89-6-D	8-Sep-15	1.01	1.01	5	2.31253542	
	7439-89-6-D	10-Sep-18	1.03	1.03	8	2.33214390	
	7439-89-6-D	18-Sep-17	1.07	1.07	7	2.37024374	

Table 4. Calculation of Upper Tolerance Limits for 2019 through 2023 Evaluations, Kent Highlands Landfill

Well ID	CAS_no	Date	Value Q	MDL Value (NDs=1/2 MDL)	Index	ln(x), ln(x+1), or ln(x*10)	Normality test (if applicable) and UTL Computations
KMW-013	7439-92-1-D	6-Sep-11	0.0001 U	0.00005	1	N/Ap	Lead, Dissolved n = 8 % Ds = 0.0 FoD < 75% Non-parametric Tolerance Limit UTL = 0.0001 Minimum Coverage = 68.8%
	7439-92-1-D	10-Sep-12	0.0001 U	0.00005	2		
	7439-92-1-D	16-Sep-13	0.0001 U	0.00005	3		
	7439-92-1-D	9-Sep-14	0.0001 U	0.00005	4		
	7439-92-1-D	8-Sep-15	0.0001 U	0.00005	5		
	7439-92-1-D	12-Sep-16	0.0001 U	0.00005	6		
	7439-92-1-D	18-Sep-17	0.0001 U	0.00005	7		
	7439-92-1-D	10-Sep-18	0.0001 U	0.00005	8		
KMW-013	7439-96-5-D	6-Sep-11	0.539	0.539	1	1.68454538	Manganese, Dissolved n = 8 % Ds = 100.0 Normality tests passed r² = 0.91/Ln Transformed r² = 0.92/Untransformed Parametric Tolerance Limit 95% UTL on ln(x*10) scale: mean = 1.8047 sd = 0.0662 K = 3.188 UTL = 2.0156 UTL* = 0.75 * = Back-transformed UTL
	7439-96-5-D	10-Sep-12	0.5675	0.5675	2	1.73607056	
	7439-96-5-D	12-Sep-16	0.592	0.592	6	1.77833645	
	7439-96-5-D	16-Sep-13	0.623	0.623	3	1.82937633	
	7439-96-5-D	8-Sep-15	0.625	0.625	5	1.83258146	
	7439-96-5-D	9-Sep-14	0.630	0.63	4	1.84054963	
	7439-96-5-D	10-Sep-18	0.642	0.642	8	1.85941812	
	7439-96-5-D	18-Sep-17	0.653	0.653	7	1.87640694	
KMW-013	7440-02-0-D	6-Sep-11	0.01 U	0.005	1	N/Ap	Nickel, Dissolved n = 8 % Ds = 0.0 FoD < 75% Non-parametric Tolerance Limit UTL = 0.01 Minimum Coverage = 68.8%
	7440-02-0-D	10-Sep-12	0.01 U	0.005	2		
	7440-02-0-D	16-Sep-13	0.01 U	0.005	3		
	7440-02-0-D	9-Sep-14	0.01 U	0.005	4		
	7440-02-0-D	8-Sep-15	0.01 U	0.005	5		
	7440-02-0-D	12-Sep-16	0.01 U	0.005	6		
	7440-02-0-D	18-Sep-17	0.01 U	0.005	7		
	7440-02-0-D	10-Sep-18	0.01 U	0.005	8		

Table 4. Calculation of Upper Tolerance Limits for 2019 through 2023 Evaluations, Kent Highlands Landfill

Well ID	CAS_no	Date	Value Q	MDL Value (NDs=1/2 MDL)	Index	ln(x), ln(x+1), or ln(x*10)	Normality test (if applicable) and UTL Computations
KMW-013	7440-66-6-D	6-Sep-11	0.01 U	0.005	1	N/Ap	Zinc, Dissolved n = 8 % Ds = 0.0 FoD < 75% Non-parametric Tolerance Limit UTL = 0.01 Minimum Coverage = 68.8%
	7440-66-6-D	10-Sep-12	0.01 U	0.005	2		
	7440-66-6-D	16-Sep-13	0.01 U	0.005	3		
	7440-66-6-D	9-Sep-14	0.01 U	0.005	4		
	7440-66-6-D	8-Sep-15	0.01 U	0.005	5		
	7440-66-6-D	12-Sep-16	0.01 U	0.005	6		
	7440-66-6-D	18-Sep-17	0.01 U	0.005	7		
	7440-66-6-D	10-Sep-18	0.01 U	0.005	8		
KMW-015A	7664-41-7	6-Sep-11	0.86	0.86	1	2.15176220	Ammonia (N) n = 8 % Ds = 100.0 Normality tests passed r² =0.98/Ln Transformed r² =0.98/Untransformed Parametric Tolerance Limit 95% UTL on ln(x*10) scale: mean = 2.2767 sd = 0.0884 K = 3.188 UTL = 2.5584 UTL* = 1.292 * = Back-transformed UTL
	7664-41-7	12-Sep-16	0.878	0.878	6	2.17247641	
	7664-41-7	10-Sep-12	0.93	0.93	2	2.23001440	
	7664-41-7	16-Sep-13	0.9745	0.9745	3	2.27675433	
	7664-41-7	8-Sep-15	1.00	1.00	5	2.30258509	
	7664-41-7	9-Sep-14	1.01	1.01	4	2.31253542	
	7664-41-7	10-Sep-18	1.06	1.06	8	2.36085400	
	7664-41-7	18-Sep-17	1.11	1.11	7	2.40694511	

Table 4. Calculation of Upper Tolerance Limits for 2019 through 2023 Evaluations, Kent Highlands Landfill

Well ID	CAS_no	Date	Value Q	MDL Value (NDs=1/2 MDL)	Index	ln(x), ln(x+1), or ln(x*10)	Normality test (if applicable) and UTL Computations
KMW-015A	COD	16-Sep-13	10 U	5	3	N/Ap	COD n = 8 % Ds = 25.0 FoD < 75% Non-parametric Tolerance Limit Calculated UTL = 10.3 Calculated UTL ≥ Maximum QL (10) New UTL = 10.3 Minimum Coverage = 68.8%
	COD	9-Sep-14	10 U	5	4		
	COD	8-Sep-15	10 U	5	5		
	COD	12-Sep-16	10 U	5	6		
	COD	18-Sep-17	10 U	5	7		
	COD	10-Sep-18	10 U	5	8		
	COD	6-Sep-11	7.71	7.71	1		
	COD	10-Sep-12	10.3	10.3	2		
KMW-015A	16887-00-6	6-Sep-11	3.9	3.9	1	1.36097655	Chloride n = 8 % Ds = 100.0 Ln transformed normality test passed r² = 0.92/Ln Transformed r² = 0.85/Untransformed Parametric Tolerance Limit 95% UTL on ln(x) scale: mean = 1.8490 sd = 0.4575 K = 3.188 UTL = 3.3077 UTL* = 27.3 * = Back-transformed UTL
	16887-00-6	10-Sep-12	4.3	4.3	2	1.45861502	
	16887-00-6	16-Sep-13	4.7	4.7	3	1.54756251	
	16887-00-6	9-Sep-14	4.8	4.8	4	1.56861592	
	16887-00-6	8-Sep-15	6.1	6.1	5	1.80828877	
	16887-00-6	18-Sep-17	7.94	7.94	7	2.07191328	
	16887-00-6	10-Sep-18	10.5	10.5	8	2.35137526	
	16887-00-6	12-Sep-16	13.8	13.8	6	2.62466859	

Table 4. Calculation of Upper Tolerance Limits for 2019 through 2023 Evaluations, Kent Highlands Landfill

Well ID	CAS_no	Date	Value Q	MDL Value (NDs=1/2 MDL)	Index	ln(x), ln(x+1), or ln(x*10)	Normality test (if applicable) and UTL Computations
KMW-015A	SPCOND	6-Sep-11	202	202	1	5.30826770	Specific Conductivity n = 8 % Ds = 100.0 Normality tests passed $r^2 = 0.94/\text{Ln Transformed}$ $r^2 = 0.92/\text{Untransformed}$ Parametric Tolerance Limit 95% UTL on ln(x) scale: mean = 5.4267 sd = 0.1021 K = 3.188 UTL = 5.7521 UTL* = 314.9 * = Back-transformed UTL
	SPCOND	10-Sep-12	206	206	2	5.32787617	
	SPCOND	8-Sep-15	217	217	5	5.37989735	
	SPCOND	9-Sep-14	219	219	4	5.38907173	
	SPCOND	16-Sep-13	221	221	3	5.39816270	
	SPCOND	12-Sep-16	239	239	6	5.47646355	
	SPCOND	18-Sep-17	252	252	7	5.52942909	
	SPCOND	10-Sep-18	271.7	271.7	8	5.60469852	
KMW-015A	14797-55-8	6-Sep-11	0.01 U	0.005	1	N/Ap	Nitrate-N n = 8 % Ds = 12.5 FoD < 75% Non-parametric Tolerance Limit Calculated UTL = 0.02 Calculated UTL ≥ Maximum QL (0.02) New UTL = 0.02 Minimum Coverage = 68.8%
	14797-55-8	10-Sep-12	0.01 U	0.005	2		
	14797-55-8	16-Sep-13	0.01 U	0.005	3		
	14797-55-8	9-Sep-14	0.01 U	0.005	4		
	14797-55-8	8-Sep-15	0.02 U	0.01	5		
	14797-55-8	10-Sep-18	0.02 U	0.01	8		
	14797-55-8	18-Sep-17	0.04* U	0.02	7		
	14797-55-8	12-Sep-16	0.02	0.02	6		
* Not used as maximum QL; elevated due to sample dilution.							

Table 4. Calculation of Upper Tolerance Limits for 2019 through 2023 Evaluations, Kent Highlands Landfill

Well ID	CAS_no	Date	Value Q	MDL Value (NDs=1/2 MDL)	Index	ln(x), ln(x+1), or ln(x*10)	Normality test (if applicable) and UTL Computations
KMW-015A	NITRATE-NITRITE	6-Sep-11	0.01 U	0.005	1	N/Ap	Nitrate/Nitrite (N) n = 8 % Ds = 12.5 FoD < 75% Non-parametric Tolerance Limit UTL = 0.025 Calculated UTL ≥ Maximum QL (0.02) New UTL = 0.025 Minimum Coverage = 68.8%
	NITRATE-NITRITE	10-Sep-12	0.01 U	0.005	2		
	NITRATE-NITRITE	16-Sep-13	0.01 U	0.005	3		
	NITRATE-NITRITE	9-Sep-14	0.01 U	0.005	4		
	NITRATE-NITRITE	10-Sep-18	0.01 U	0.005	8		
	NITRATE-NITRITE	8-Sep-15	0.02 U	0.01	5		
	NITRATE-NITRITE	18-Sep-17	0.02 U	0.01	7		
	NITRATE-NITRITE	12-Sep-16	0.025	0.025	6		
KMW-015A	14797-65-0	6-Sep-11	0.01 U	0.005	1	N/Ap	Nitrite-N n = 8 % Ds = 0.0 FoD < 75% Non-parametric Tolerance Limit UTL = 0.02 Minimum Coverage = 68.8%
	14797-65-0	10-Sep-12	0.01 U	0.005	2		
	14797-65-0	16-Sep-13	0.01 U	0.005	3		
	14797-65-0	9-Sep-14	0.01 U	0.005	4		
	14797-65-0	8-Sep-15	0.01 U	0.005	5		
	14797-65-0	12-Sep-16	0.01 U	0.005	6		
	14797-65-0	10-Sep-18	0.01 U	0.005	8		
	14797-65-0	18-Sep-17	0.02	0.01	7		

Table 4. Calculation of Upper Tolerance Limits for 2019 through 2023 Evaluations, Kent Highlands Landfill

Well ID	CAS_no	Date	Value Q	MDL Value (NDs=1/2 MDL)	Index	ln(x), ln(x+1), or ln(x*10)	Normality test (if applicable) and UTL Computations
KMW-015A	PH	9-Sep-14	6.18	6.18	4	1.82131827	pH n = 8 % Ds = 100.0 Normality tests passed r² = 0.98/Ln Transformed r² = 0.97/Untransformed Parametric Tolerance Limit 95% UTL on ln(x) scale: mean = 1.8736 sd = 0.0388 K = 3.188 UTL = 1.997 UTL* = 7.37 * = Back-transformed UTL
	PH	16-Sep-13	6.28	6.28	3	1.83736998	
	PH	10-Sep-12	6.38	6.38	2	1.85316810	
	PH	6-Sep-11	6.43	6.43	1	1.86097454	
	PH	8-Sep-15	6.53	6.53	5	1.87640694	
	PH	12-Sep-16	6.60	6.6	6	1.88706965	
	PH	18-Sep-17	6.81	6.81	7	1.91839212	
	PH	10-Sep-18	6.92	6.92	8	1.93441577	
KMW-015A	14808-79-8	18-Sep-17	10.0 U	5	7	1.60943791	Sulfate n = 8 % Ds = 87.5 Untransformed normality test passed r² = 0.88/Ln Transformed r² = 0.93/Untransformed Parametric Tolerance Limit 95% UTL on untransformed scale: mean = 9.4563 sd = 2.8035 K = 3.1880 UTL = 18.39
	14808-79-8	10-Sep-18	5.98	5.98	8	1.78842057	
	14808-79-8	12-Sep-16	8.22	8.22	6	2.10657021	
	14808-79-8	8-Sep-15	10.1	10.1	5	2.31253542	
	14808-79-8	6-Sep-11	10.5	10.5	1	2.35137526	
	14808-79-8	9-Sep-14	11.0	11	4	2.39789527	
	14808-79-8	10-Sep-12	12.3	12.3	2	2.50959926	
	14808-79-8	16-Sep-13	12.55	12.55	3	2.52972067	

Table 4. Calculation of Upper Tolerance Limits for 2019 through 2023 Evaluations, Kent Highlands Landfill

Well ID	CAS_no	Date	Value Q	MDL Value (NDs=1/2 MDL)	Index	ln(x), ln(x+1), or ln(x*10)	Normality test (if applicable) and UTL Computations
KMW-015A	TOTAL-COLIFORM	6-Sep-11	1 U	0.5	1	N/Ap	Total Coliform n = 8 % Ds = 0.0 FoD < 75% Non-parametric Tolerance Limit UTL = 1 Minimum Coverage = 68.8%
	TOTAL-COLIFORM	10-Sep-12	1 U	0.5	2		
	TOTAL-COLIFORM	16-Sep-13	1 U	0.5	3		
	TOTAL-COLIFORM	9-Sep-14	1 UJ	0.5	4		
	TOTAL-COLIFORM	8-Sep-15	1 U	0.5	5		
	TOTAL-COLIFORM	12-Sep-16	1 U	0.5	6		
	TOTAL-COLIFORM	18-Sep-17	1 HU	0.5	7		
	TOTAL-COLIFORM	10-Sep-18	1 U	0.5	8		
KMW-015A	TOC	10-Sep-18	1.79	1.79	8	0.58221562	TOC n = 8 % Ds = 100.0 Normality tests passed r² = 0.95/Ln Transformed r² = 0.93/Untransformed Parametric Tolerance Limit 95% UTL on ln(x) scale: mean = 0.7763 sd = 0.1285 K = 3.188 UTL = 1.1861 UTL* = 3.27 * = Back-transformed UTL
	TOC	12-Sep-16	1.95	1.95	6	0.66782937	
	TOC	9-Sep-14	2.08	2.08	4	0.73236789	
	TOC	18-Sep-17	2.16	2.16	7	0.77010822	
	TOC	10-Sep-12	2.17	2.17	2	0.77472717	
	TOC	16-Sep-13	2.175	2.175	3	0.77702866	
	TOC	6-Sep-11	2.52	2.52	1	0.92425890	
	TOC	8-Sep-15	2.67	2.67	5	0.98207847	
KMW-015A	7440-43-9-D	6-Sep-11	0.002 U	0.001	1	N/Ap	Cadmium, Dissolved n = 8 % Ds = 0.0 FoD < 75% Non-parametric Tolerance Limit UTL = 0.002 Minimum Coverage = 68.8%
	7440-43-9-D	10-Sep-12	0.002 U	0.001	2		
	7440-43-9-D	16-Sep-13	0.002 U	0.001	3		
	7440-43-9-D	9-Sep-14	0.002 U	0.001	4		
	7440-43-9-D	8-Sep-15	0.002 U	0.001	5		
	7440-43-9-D	12-Sep-16	0.002 U	0.001	6		
	7440-43-9-D	18-Sep-17	0.002 U	0.001	7		
	7440-43-9-D	10-Sep-18	0.002 U	0.001	8		

Table 4. Calculation of Upper Tolerance Limits for 2019 through 2023 Evaluations, Kent Highlands Landfill

Well ID	CAS_no	Date	Value Q	MDL Value (NDs=1/2 MDL)	Index	ln(x), ln(x+1), or ln(x*10)	Normality test (if applicable) and UTL Computations
KMW-015A	7440-47-3-D	6-Sep-11	0.005 U	0.0025	1	N/Ap	<u>Chromium, Dissolved</u> n = 8 % Ds = 12.5 FoD < 75% Non-parametric Tolerance Limit Calculated UTL = 0.005 Calculated UTL ≥ Maximum QL (0.005) <u>New UTL = 0.005</u> Minimum Coverage = 68.8%
	7440-47-3-D	10-Sep-12	0.005 U	0.0025	2		
	7440-47-3-D	16-Sep-13	0.005 U	0.0025	3		
	7440-47-3-D	9-Sep-14	0.005 U	0.0025	4		
	7440-47-3-D	12-Sep-16	0.005 U	0.0025	6		
	7440-47-3-D	18-Sep-17	0.005 U	0.0025	7		
	7440-47-3-D	10-Sep-18	0.005 U	0.0025	8		
	7440-47-3-D	8-Sep-15	0.005	<u>0.005</u>	5		
KMW-015A	7440-50-8-D	6-Sep-11	0.002 U	0.001	1	N/Ap	<u>Copper, Dissolved</u> n = 8 % Ds = 0.0 FoD < 75% Non-parametric Tolerance Limit <u>UTL = 0.002</u> Minimum Coverage = 68.8%
	7440-50-8-D	10-Sep-12	0.002 U	0.001	2		
	7440-50-8-D	16-Sep-13	0.002 U	0.001	3		
	7440-50-8-D	9-Sep-14	0.002 U	0.001	4		
	7440-50-8-D	8-Sep-15	0.002 U	0.001	5		
	7440-50-8-D	12-Sep-16	0.002 U	0.001	6		
	7440-50-8-D	18-Sep-17	0.002 U	0.001	7		
	7440-50-8-D	10-Sep-18	<u>0.002</u> U	0.001	8		

Table 4. Calculation of Upper Tolerance Limits for 2019 through 2023 Evaluations, Kent Highlands Landfill

Well ID	CAS_no	Date	Value Q	MDL Value (NDs=1/2 MDL)	Index	ln(x), ln(x+1), or ln(x*10)	Normality test (if applicable) and UTL Computations
KMW-015A	7439-89-6-D	6-Sep-11	6.85	6.85	1	1.92424865	Iron, Dissolved n = 8 % Ds = 100.0 Normality tests passed $r^2 = 0.94/\text{Ln Transformed}$ $r^2 = 0.96/\text{Untransformed}$ Parametric Tolerance Limit 95% UTL on ln(x) scale: mean = 2.1693 sd = 0.1302 K = 3.188 UTL = 2.5845 UTL* = 13.26 * = Back-transformed UTL
	7439-89-6-D	12-Sep-16	7.77	7.77	6	2.05027016	
	7439-89-6-D	8-Sep-15	8.55	8.55	5	2.14593128	
	7439-89-6-D	10-Sep-12	8.74	8.74	2	2.16791019	
	7439-89-6-D	10-Sep-18	9.22	9.22	8	2.22137504	
	7439-89-6-D	9-Sep-14	9.38	9.38	4	2.23857976	
	7439-89-6-D	16-Sep-13	9.81	9.81	3	2.28340227	
	7439-89-6-D	18-Sep-17	10.2	10.2	7	2.32238772	
KMW-015A	7439-92-1-D	10-Sep-12	0.0001 U	0.00005	2	N/Ap	Lead, Dissolved n = 8 % Ds = 12.5 FoD < 75% Non-parametric Tolerance Limit Calculated UTL = 0.0002 Calculated UTL $\geq$ Maximum QL (0.0001) New UTL = 0.0002 Minimum Coverage = 68.8%
	7439-92-1-D	16-Sep-13	0.0001 U	0.00005	3		
	7439-92-1-D	9-Sep-14	0.0001 U	0.00005	4		
	7439-92-1-D	8-Sep-15	0.0001 U	0.00005	5		
	7439-92-1-D	12-Sep-16	0.0001 U	0.00005	6		
	7439-92-1-D	18-Sep-17	0.0001 U	0.00005	7		
	7439-92-1-D	10-Sep-18	0.0001 U	0.00005	8		
	7439-92-1-D	6-Sep-11	0.0002	0.0002	1		

Table 4. Calculation of Upper Tolerance Limits for 2019 through 2023 Evaluations, Kent Highlands Landfill

Well ID	CAS_no	Date	Value Q	MDL Value (NDs=1/2 MDL)	Index	ln(x), ln(x+1), or ln(x*10)	Normality test (if applicable) and UTL Computations
KMW-015A	7439-96-5-D	6-Sep-11	0.323	0.323	1	1.17248214	<u>Manganese, Dissolved</u> n = 8 % Ds = 100.0 Untransformed normality test passed $r^2 = 0.88/\text{Ln Transformed}$ $r^2 = 0.91/\text{Untransformed}$ Parametric Tolerance Limit 95% UTL on untransformed scale: mean = 0.4094 sd = 0.0435 K = 3.188 UTL = 0.548
	7439-96-5-D	10-Sep-12	0.389	0.389	2	1.35840916	
	7439-96-5-D	8-Sep-15	0.394	0.394	5	1.37118072	
	7439-96-5-D	12-Sep-16	0.403	0.403	6	1.39376638	
	7439-96-5-D	9-Sep-14	0.421	0.421	4	1.43746265	
	7439-96-5-D	10-Sep-18	0.432	0.432	8	1.46325540	
	7439-96-5-D	16-Sep-13	0.456	0.456	3	1.51732262	
	7439-96-5-D	18-Sep-17	0.457	0.457	7	1.51951320	
KMW-015A	7440-02-0-D	6-Sep-11	0.01 U	0.005	1	N/Ap	<u>Nickel, Dissolved</u> n = 8 % Ds = 0.0 FoD < 75% Non-parametric Tolerance Limit UTL = 0.01 Minimum Coverage = 68.8%
	7440-02-0-D	10-Sep-12	0.01 U	0.005	2		
	7440-02-0-D	16-Sep-13	0.01 U	0.005	3		
	7440-02-0-D	9-Sep-14	0.01 U	0.005	4		
	7440-02-0-D	8-Sep-15	0.01 U	0.005	5		
	7440-02-0-D	12-Sep-16	0.01 U	0.005	6		
	7440-02-0-D	18-Sep-17	0.01 U	0.005	7		
	7440-02-0-D	10-Sep-18	0.01 U	0.005	8		
KMW-015A	7440-66-6-D	6-Sep-11	0.01 U	0.005	1	N/Ap	<u>Zinc, Dissolved</u> n = 8 % Ds = 0.0 FoD < 75% Non-parametric Tolerance Limit UTL = 0.01 Minimum Coverage = 68.8%
	7440-66-6-D	10-Sep-12	0.01 U	0.005	2		
	7440-66-6-D	16-Sep-13	0.01 U	0.005	3		
	7440-66-6-D	9-Sep-14	0.01 U	0.005	4		
	7440-66-6-D	8-Sep-15	0.01 U	0.005	5		
	7440-66-6-D	12-Sep-16	0.01 U	0.005	6		
	7440-66-6-D	18-Sep-17	0.01 U	0.005	7		
	7440-66-6-D	10-Sep-18	0.01 U	0.005	8		

Lab Report for Well 15J1





Analytical Resources, Incorporated

Analytical Chemists and Consultants

19 November 2014

Min-Soon Yim
Seattle Public Utilities
23076 Military Road South
Kent, WA 98032

RE: Client Project: Mysterious Well
ARI Job: ZJ68

Dear Min:

Please find enclosed the original chain of custody record and the final results for the sample from the project referenced above. One water sample was received on November 10, 2014. The sample was analyzed for VOAs, vinyl chloride, alkalinity, anions and cations as requested.

The percent differences (%Ds) for several compounds were not within control limits for the CCAL that bracketed the VOA analysis of this sample. All positive results for these compounds have been flagged with a "Q" qualifier to denote the high %Ds.

The RPD for vinyl chloride was high following the analyses of the LCS/LCSD associated with the SIM-vinyl chloride analysis of this sample. This was due to the high percent recovery for the LCSD. Since vinyl chloride was not detected in sample 'Kent-Mysterious Well', the high bias does not compromise the RL. No corrective actions were taken.

A matrix duplicate (MD) was prepared and analyzed for nitrate+nitrite in conjunction with this sample. The RPD for nitrate+nitrite was high following the analysis of the MD. Since the concentrations of nitrate+nitrite detected in the sample and the MD were close to reporting limit, no corrective actions were taken.

There were no further analytical problems noted.

A copy of these reports and all supporting data will be kept on file with ARI. Should you have any questions please feel free to call me at any time.

Sincerely,

ANALYTICAL RESOURCES, INC.

Mark D. Harris
Project Manager
206/695-6210
markh@arilabs.com

Enclosures

cc: File ZJ68

MDH/mdh

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

ARI Assigned Number: 7368	Turn-around Requested:	
ARI Client Company: City of Seattle/ Seattle Public Utilities	Phone: (206) 233-2629	
Client Contact:		
Date:	11/10/14	
Page:	1 of	1
No. of	Cooler:	2

[illegible]

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

Sample Retention Policy: Unless specified by workorder or contract, all water/soil samples submitted to ARI will be discarded or returned, no sooner than 90 days after submission of hardcopy data, whichever is longer. Sediment s



Cooler Receipt Form

ARI Client: SPU

COC No(s): _____ NA

Assigned ARI Job No: 2368

Project Name: Kent Highlands LF

Delivered by: Fed-Ex UPS Courier Hand Delivered Other: _____

Tracking No: _____ NA

Preliminary Examination Phase:

Were intact, properly signed and dated custody seals attached to the outside of to cooler? _____

YES ☒ NO ☐

Were custody papers included with the cooler? _____

YES ☒ NO ☐

Were custody papers properly filled out (ink, signed, etc.) _____

YES ☒ NO ☐

Temperature of Cooler(s) (°C) (recommended 2.0-6.0 °C for chemistry)

Time: _____

If cooler temperature is out of compliance fill out form 00070F

Temp Gun ID#: 9087932

Cooler Accepted by: JS Date: 11-10-14 Time: 10:35

Complete custody forms and attach all shipping documents

Log-In Phase:

Was a temperature blank included in the cooler? _____

YES ☐ NO ☒

What kind of packing material was used? ... Bubble Wrap ☒ Wet Ice ☒ Gel Packs ☒ Baggies ☒ Foam Block ☒ Paper ☒ Other: _____

Was sufficient ice used (if appropriate)? _____

NA ☐ YES ☒ NO ☐

Were all bottles sealed in individual plastic bags? _____

YES ☐ NO ☒

Did all bottles arrive in good condition (unbroken)? _____

YES ☒ NO ☐

Were all bottle labels complete and legible? _____

YES ☒ NO ☐

Did the number of containers listed on COC match with the number of containers received? _____

YES ☒ NO ☐

Did all bottle labels and tags agree with custody papers? _____

YES ☒ NO ☐

Were all bottles used correct for the requested analyses? _____

YES ☒ NO ☐

Do any of the analyses (bottles) require preservation? (attach preservation sheet, excluding VOCs)...

NA ☐ YES ☒ NO ☐

Were all VOC vials free of air bubbles? _____

NA ☐ YES ☐ NO ☒

Was sufficient amount of sample sent in each bottle? _____

YES ☒ NO ☐

Date VOC Trip Blank was made at ARI: _____

NA ☐

Was Sample Split by ARI: ☒ YES ☐ NO Date/Time: _____ Equipment: _____ Split by: _____

Samples Logged by: JS Date: _____ Time: _____

**** Notify Project Manager of discrepancies or concerns ****

Sample ID on Bottle	Sample ID on COC	Sample ID on Bottle	Sample ID on COC

Additional Notes, Discrepancies, & Resolutions: TB 2 "pb"

By: JS Date: 11-10-14

Small Air Bubbles ~2mm 	Peabubbles 2-4 mm 	LARGE Air Bubbles > 4 mm 	Small → "sm" (< 2 mm)
			Peabubbles → "pb" (2 to < 4 mm)
			Large → "lg" (4 to < 6 mm)
			Headspace → "hs" (> 6 mm)

PRESERVATION VERIFICATION 11/10/14

Page 1 of 1

Inquiry Number: NONE
 Analysis Requested: 11/10/14
 Contact: Yim, Min-Soon
 Client: SPU
 Logged by: TS
 Sample Set Used: Yes-481
 Validatable Package: No
 Deliverables:



ARI Job No: ZJ68

PC: Mark
 VTSR: 11/10/14

Project #:
 Project: Kent Highlands Landfill
 Sample Site:
 SDG No:
 Analytical Protocol: In-house

LOGNUM ARI ID	CLIENT ID	CN	WAD	NH3	COD	FOG	MET	PHEN	PHOS	TKN	NO23	TOC	S2	TPHD	Fe2+	DMET DOC FLT FLT	PARAMETER	ADJUSTED TO	LOT NUMBER	AMOUNT ADDED	DATE/BY
14-24417 ZJ68A	Kent-Mysterious Well	>12	>12	<2	<2	<2	TOT 2.15	<2	<2	<2	<2	<2	>9	<2	<2						

Checked By TS Date 11-10-14

Sample ID Cross Reference Report



ARI Job No: ZJ68
Client: SPU
Project Event: N/A
Project Name: Kent Highlands Landfill

Sample ID	ARI Lab ID	ARI LIMS ID	Matrix	Sample Date/Time	VTSR
1. Kent-Mysterious Well	ZJ68A	14-24417	Water	11/10/14 10:00	11/10/14 10:35
2. Trip Blanks	ZJ68B	14-24418	Water	11/10/14	11/10/14 10:35



Data Reporting Qualifiers

Effective 12/31/13

Inorganic Data

- U Indicates that the target analyte was not detected at the reported concentration
- * Duplicate RPD is not within established control limits
- B Reported value is less than the CRDL but $\geq$ the Reporting Limit
- N Matrix Spike recovery not within established control limits
- NA Not Applicable, analyte not spiked
- H The natural concentration of the spiked element is so much greater than the concentration spiked that an accurate determination of spike recovery is not possible
- L Analyte concentration is ≤ 5 times the Reporting Limit and the replicate control limit defaults to ± 1 RL instead of the normal 20% RPD

Organic Data

- U Indicates that the target analyte was not detected at the reported concentration
- * Flagged value is not within established control limits
- B Analyte detected in an associated Method Blank at a concentration greater than one-half of ARI's Reporting Limit or 5% of the regulatory limit or 5% of the analyte concentration in the sample.
- J Estimated concentration when the value is less than ARI's established reporting limits
- D The spiked compound was not detected due to sample extract dilution
- E Estimated concentration calculated for an analyte response above the valid instrument calibration range. A dilution is required to obtain an accurate quantification of the analyte.



Analytical Resources,
Incorporated
Analytical Chemists and
Consultants

- Q Indicates a detected analyte with an initial or continuing calibration that does not meet established acceptance criteria (<20%RSD, <20%Drift or minimum RRF).
- S Indicates an analyte response that has saturated the detector. The calculated concentration is not valid; a dilution is required to obtain valid quantification of the analyte
- NA The flagged analyte was not analyzed for
- NR Spiked compound recovery is not reported due to chromatographic interference
- NS The flagged analyte was not spiked into the sample
- M Estimated value for an analyte detected and confirmed by an analyst but with low spectral match parameters. This flag is used only for GC-MS analyses
- N The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification"
- Y The analyte is not detected at or above the reported concentration. The reporting limit is raised due to chromatographic interference. The Y flag is equivalent to the U flag with a raised reporting limit.
- EMPC Estimated Maximum Possible Concentration (EMPC) defined in EPA Statement of Work DLM02.2 as a value "calculated for 2,3,7,8-substituted isomers for which the quantitation and /or confirmation ion(s) has signal to noise in excess of 2.5, but does not meet identification criteria" (**Dioxin/Furan analysis only**)
- C The analyte was positively identified on only one of two chromatographic columns. Chromatographic interference prevented a positive identification on the second column
- P The analyte was detected on both chromatographic columns but the quantified values differ by $\geq 40\%$ RPD with no obvious chromatographic interference
- X Analyte signal includes interference from polychlorinated diphenyl ethers. (**Dioxin/Furan analysis only**)
- Z Analyte signal includes interference from the sample matrix or perfluorokerosene ions. (**Dioxin/Furan analysis only**)



Geotechnical Data

- A The total of all fines fractions. This flag is used to report total fines when only sieve analysis is requested and balances total grain size with sample weight.
- F Samples were frozen prior to particle size determination
- SM Sample matrix was not appropriate for the requested analysis. This normally refers to samples contaminated with an organic product that interferes with the sieving process and/or moisture content, porosity and saturation calculations
- SS Sample did not contain the proportion of "fines" required to perform the pipette portion of the grain size analysis
- W Weight of sample in some pipette aliquots was below the level required for accurate weighting

ORGANICS ANALYSIS DATA SHEET

Volatiles by Purge & Trap GC/MS-Method SW8260C

Page 1 of 2

Sample ID: MB-111114A

METHOD BLANK

Lab Sample ID: MB-111114A

LIMS ID: 14-24417

Matrix: Water

Data Release Authorized: *mw*

Reported: 11/13/14

QC Report No: ZJ68-SPU

Project: Kent Highlands Landfill

Date Sampled: NA

Date Received: NA

Instrument/Analyst: NT2/PAB

Date Analyzed: 11/11/14 14:13

Sample Amount: 10.0 mL

Purge Volume: 10.0 mL

CAS Number	Analyte	LOQ	Result	Q
74-87-3	Chloromethane	0.50	< 0.50	U
74-83-9	Bromomethane	1.0	< 1.0	U
75-01-4	Vinyl Chloride	0.20	< 0.20	U
75-00-3	Chloroethane	0.20	< 0.20	U
75-09-2	Methylene Chloride	1.0	< 1.0	U
67-64-1	Acetone	5.0	< 5.0	U
75-15-0	Carbon Disulfide	0.20	< 0.20	U
75-35-4	1,1-Dichloroethene	0.20	< 0.20	U
75-34-3	1,1-Dichloroethane	0.20	< 0.20	U
156-60-5	trans-1,2-Dichloroethene	0.20	< 0.20	U
156-59-2	cis-1,2-Dichloroethene	0.20	< 0.20	U
67-66-3	Chloroform	0.20	< 0.20	U
107-06-2	1,2-Dichloroethane	0.20	< 0.20	U
78-93-3	2-Butanone	5.0	< 5.0	U
71-55-6	1,1,1-Trichloroethane	0.20	< 0.20	U
56-23-5	Carbon Tetrachloride	0.20	< 0.20	U
108-05-4	Vinyl Acetate	0.20	< 0.20	U
75-27-4	Bromodichloromethane	0.20	< 0.20	U
78-87-5	1,2-Dichloropropane	0.20	< 0.20	U
10061-01-5	cis-1,3-Dichloropropene	0.20	< 0.20	U
79-01-6	Trichloroethene	0.20	< 0.20	U
124-48-1	Dibromochloromethane	0.20	< 0.20	U
79-00-5	1,1,2-Trichloroethane	0.20	< 0.20	U
71-43-2	Benzene	0.20	< 0.20	U
10061-02-6	trans-1,3-Dichloropropene	0.20	< 0.20	U
110-75-8	2-Chloroethylvinylether	1.0	< 1.0	U
75-25-2	Bromoform	0.20	< 0.20	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.0	< 5.0	U
591-78-6	2-Hexanone	5.0	< 5.0	U
127-18-4	Tetrachloroethene	0.20	< 0.20	U
79-34-5	1,1,2,2-Tetrachloroethane	0.20	< 0.20	U
108-88-3	Toluene	0.20	< 0.20	U
108-90-7	Chlorobenzene	0.20	< 0.20	U
100-41-4	Ethylbenzene	0.20	< 0.20	U
100-42-5	Styrene	0.20	< 0.20	U
75-69-4	Trichlorofluoromethane	0.20	< 0.20	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane	0.20	< 0.20	U
179601-23-1	m,p-Xylene	0.40	< 0.40	U
95-47-6	o-Xylene	0.20	< 0.20	U
95-50-1	1,2-Dichlorobenzene	0.20	< 0.20	U
541-73-1	1,3-Dichlorobenzene	0.20	< 0.20	U
106-46-7	1,4-Dichlorobenzene	0.20	< 0.20	U

ORGANICS ANALYSIS DATA SHEET

Volatiles by Purge & Trap GC/MS-Method SW8260C

Page 2 of 2

Sample ID: MB-111114A

METHOD BLANK

Lab Sample ID: MB-111114A

LIMS ID: 14-24417

Matrix: Water

Date Analyzed: 11/11/14 14:13

QC Report No: ZJ68-SPU

Project: Kent Highlands Landfill

CAS Number	Analyte	LOQ	Result	Q
107-02-8	Acrolein	5.0	< 5.0	U
74-88-4	Iodomethane	1.0	< 1.0	U
74-96-4	Bromoethane	0.20	< 0.20	U
107-13-1	Acrylonitrile	1.0	< 1.0	U
563-58-6	1,1-Dichloropropene	0.20	< 0.20	U
74-95-3	Dibromomethane	0.20	< 0.20	U
630-20-6	1,1,1,2-Tetrachloroethane	0.20	< 0.20	U
96-12-8	1,2-Dibromo-3-chloropropane	0.50	< 0.50	U
96-18-4	1,2,3-Trichloropropane	0.50	< 0.50	U
110-57-6	trans-1,4-Dichloro-2-butene	1.0	< 1.0	U
108-67-8	1,3,5-Trimethylbenzene	0.20	< 0.20	U
95-63-6	1,2,4-Trimethylbenzene	0.20	< 0.20	U
87-68-3	Hexachlorobutadiene	0.50	< 0.50	U
106-93-4	1,2-Dibromoethane	0.20	< 0.20	U
74-97-5	Bromochloromethane	0.20	< 0.20	U
594-20-7	2,2-Dichloropropane	0.20	< 0.20	U
142-28-9	1,3-Dichloropropane	0.20	< 0.20	U
98-82-8	Isopropylbenzene	0.20	< 0.20	U
103-65-1	n-Propylbenzene	0.20	< 0.20	U
108-86-1	Bromobenzene	0.20	< 0.20	U
95-49-8	2-Chlorotoluene	0.20	< 0.20	U
106-43-4	4-Chlorotoluene	0.20	< 0.20	U
98-06-6	tert-Butylbenzene	0.20	< 0.20	U
135-98-8	sec-Butylbenzene	0.20	< 0.20	U
99-87-6	4-Isopropyltoluene	0.20	< 0.20	U
104-51-8	n-Butylbenzene	0.20	< 0.20	U
120-82-1	1,2,4-Trichlorobenzene	0.50	< 0.50	U
91-20-3	Naphthalene	0.50	< 0.50	U
87-61-6	1,2,3-Trichlorobenzene	0.50	< 0.50	U

Reported in µg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	99.5%
d8-Toluene	97.3%
Bromofluorobenzene	99.8%
d4-1,2-Dichlorobenzene	102%

ORGANICS ANALYSIS DATA SHEET

Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: Kent-Mysterious Well

Page 1 of 2

SAMPLE

Lab Sample ID: ZJ68A

QC Report No: ZJ68-SPU

LIMS ID: 14-24417

Project: Kent Highlands Landfill

Matrix: Water

Data Release Authorized: *mm*

Date Sampled: 11/10/14

Reported: 11/13/14

Date Received: 11/10/14

Instrument/Analyst: NT2/PAB

Sample Amount: 10.0 mL

Date Analyzed: 11/11/14 16:58

Purge Volume: 10.0 mL

CAS Number	Analyte	LOQ	Result	Q
74-87-3	Chloromethane	0.50	< 0.50	U
74-83-9	Bromomethane	1.0	< 1.0	U
75-01-4	Vinyl Chloride	0.20	< 0.20	U
75-00-3	Chloroethane	0.20	< 0.20	U
75-09-2	Methylene Chloride	1.0	< 1.0	U
67-64-1	Acetone	5.0	< 5.0	U
75-15-0	Carbon Disulfide	0.20	< 0.20	U
75-35-4	1,1-Dichloroethene	0.20	< 0.20	U
75-34-3	1,1-Dichloroethane	0.20	< 0.20	U
156-60-5	trans-1,2-Dichloroethene	0.20	< 0.20	U
156-59-2	cis-1,2-Dichloroethene	0.20	< 0.20	U
67-66-3	Chloroform	0.20	< 0.20	U
107-06-2	1,2-Dichloroethane	0.20	< 0.20	U
78-93-3	2-Butanone	5.0	< 5.0	U
71-55-6	1,1,1-Trichloroethane	0.20	< 0.20	U
56-23-5	Carbon Tetrachloride	0.20	< 0.20	U
108-05-4	Vinyl Acetate	0.20	< 0.20	U
75-27-4	Bromodichloromethane	0.20	< 0.20	U
78-87-5	1,2-Dichloropropane	0.20	< 0.20	U
10061-01-5	cis-1,3-Dichloropropene	0.20	< 0.20	U
79-01-6	Trichloroethene	0.20	< 0.20	U
124-48-1	Dibromochloromethane	0.20	< 0.20	U
79-00-5	1,1,2-Trichloroethane	0.20	< 0.20	U
71-43-2	Benzene	0.20	< 0.20	U
10061-02-6	trans-1,3-Dichloropropene	0.20	< 0.20	U
110-75-8	2-Chloroethylvinylether	1.0	< 1.0	U
75-25-2	Bromoform	0.20	< 0.20	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.0	< 5.0	U
591-78-6	2-Hexanone	5.0	< 5.0	U
127-18-4	Tetrachloroethene	0.20	< 0.20	U
79-34-5	1,1,2,2-Tetrachloroethane	0.20	< 0.20	U
108-88-3	Toluene	0.20	< 0.20	U
108-90-7	Chlorobenzene	0.20	< 0.20	U
100-41-4	Ethylbenzene	0.20	< 0.20	U
100-42-5	Styrene	0.20	< 0.20	U
75-69-4	Trichlorofluoromethane	0.20	< 0.20	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane	0.20	< 0.20	U
179601-23-1	m,p-Xylene	0.40	< 0.40	U
95-47-6	o-Xylene	0.20	< 0.20	U
95-50-1	1,2-Dichlorobenzene	0.20	< 0.20	U
541-73-1	1,3-Dichlorobenzene	0.20	< 0.20	U
106-46-7	1,4-Dichlorobenzene	0.20	< 0.20	U

ORGANICS ANALYSIS DATA SHEET

Volatiles by Purge & Trap GC/MS-Method SW8260C

Page 2 of 2

Sample ID: Kent-Mysterious Well
SAMPLE

Lab Sample ID: ZJ68A

LIMS ID: 14-24417

Matrix: Water

Date Analyzed: 11/11/14 16:58

QC Report No: ZJ68-SPU

Project: Kent Highlands Landfill

CAS Number	Analyte	LOQ	Result	Q
107-02-8	Acrolein	5.0	< 5.0	U
74-88-4	Iodomethane	1.0	< 1.0	U
74-96-4	Bromoethane	0.20	< 0.20	U
107-13-1	Acrylonitrile	1.0	< 1.0	U
563-58-6	1,1-Dichloropropene	0.20	< 0.20	U
74-95-3	Dibromomethane	0.20	< 0.20	U
630-20-6	1,1,1,2-Tetrachloroethane	0.20	< 0.20	U
96-12-8	1,2-Dibromo-3-chloropropane	0.50	< 0.50	U
96-18-4	1,2,3-Trichloropropane	0.50	< 0.50	U
110-57-6	trans-1,4-Dichloro-2-butene	1.0	< 1.0	U
108-67-8	1,3,5-Trimethylbenzene	0.20	< 0.20	U
95-63-6	1,2,4-Trimethylbenzene	0.20	< 0.20	U
87-68-3	Hexachlorobutadiene	0.50	< 0.50	U
106-93-4	1,2-Dibromoethane	0.20	< 0.20	U
74-97-5	Bromochloromethane	0.20	< 0.20	U
594-20-7	2,2-Dichloropropane	0.20	< 0.20	U
142-28-9	1,3-Dichloropropane	0.20	< 0.20	U
98-82-8	Isopropylbenzene	0.20	< 0.20	U
103-65-1	n-Propylbenzene	0.20	< 0.20	U
108-86-1	Bromobenzene	0.20	< 0.20	U
95-49-8	2-Chlorotoluene	0.20	< 0.20	U
106-43-4	4-Chlorotoluene	0.20	< 0.20	U
98-06-6	tert-Butylbenzene	0.20	< 0.20	U
135-98-8	sec-Butylbenzene	0.20	< 0.20	U
99-87-6	4-Isopropyltoluene	0.20	< 0.20	U
104-51-8	n-Butylbenzene	0.20	< 0.20	U
120-82-1	1,2,4-Trichlorobenzene	0.50	< 0.50	U
91-20-3	Naphthalene	0.50	< 0.50	U
87-61-6	1,2,3-Trichlorobenzene	0.50	< 0.50	U

Reported in µg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	99.0%
d8-Toluene	99.3%
Bromofluorobenzene	97.2%
d4-1,2-Dichlorobenzene	101%

2-Chloroethylvinylether is an acid labile compound and may not be recovered from an acid preserved sample.

EPA SW-846 indicates that vinyl chloride and styrene may degrade in the presence of acid preservative.

ORGANICS ANALYSIS DATA SHEET

Volatiles by Purge & Trap GC/MS-Method SW8260C
Page 1 of 2Sample ID: Trip Blanks
SAMPLE

Lab Sample ID: ZJ68B

QC Report No: ZJ68-SPU

LIMS ID: 14-24418

Project: Kent Highlands Landfill

Matrix: Water

Data Release Authorized: *mw*

Date Sampled: 11/10/14

Reported: 11/13/14

Date Received: 11/10/14

Instrument/Analyst: NT2/PAB

Sample Amount: 10.0 mL

Date Analyzed: 11/11/14 17:25

Purge Volume: 10.0 mL

CAS Number	Analyte	LOQ	Result	Q
74-87-3	Chloromethane	0.50	< 0.50	U
74-83-9	Bromomethane	1.0	< 1.0	U
75-01-4	Vinyl Chloride	0.20	< 0.20	U
75-00-3	Chloroethane	0.20	< 0.20	U
75-09-2	Methylene Chloride	1.0	< 1.0	U
67-64-1	Acetone	5.0	< 5.0	U
75-15-0	Carbon Disulfide	0.20	< 0.20	U
75-35-4	1,1-Dichloroethene	0.20	< 0.20	U
75-34-3	1,1-Dichloroethane	0.20	< 0.20	U
156-60-5	trans-1,2-Dichloroethene	0.20	< 0.20	U
156-59-2	cis-1,2-Dichloroethene	0.20	< 0.20	U
67-66-3	Chloroform	0.20	< 0.20	U
107-06-2	1,2-Dichloroethane	0.20	< 0.20	U
78-93-3	2-Butanone	5.0	< 5.0	U
71-55-6	1,1,1-Trichloroethane	0.20	< 0.20	U
56-23-5	Carbon Tetrachloride	0.20	< 0.20	U
108-05-4	Vinyl Acetate	0.20	< 0.20	U
75-27-4	Bromodichloromethane	0.20	< 0.20	U
78-87-5	1,2-Dichloropropane	0.20	< 0.20	U
10061-01-5	cis-1,3-Dichloropropene	0.20	< 0.20	U
79-01-6	Trichloroethene	0.20	< 0.20	U
124-48-1	Dibromochloromethane	0.20	< 0.20	U
79-00-5	1,1,2-Trichloroethane	0.20	< 0.20	U
71-43-2	Benzene	0.20	< 0.20	U
10061-02-6	trans-1,3-Dichloropropene	0.20	< 0.20	U
110-75-8	2-Chloroethylvinylether	1.0	< 1.0	U
75-25-2	Bromoform	0.20	< 0.20	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.0	< 5.0	U
591-78-6	2-Hexanone	5.0	< 5.0	U
127-18-4	Tetrachloroethene	0.20	< 0.20	U
79-34-5	1,1,2,2-Tetrachloroethane	0.20	< 0.20	U
108-88-3	Toluene	0.20	< 0.20	U
108-90-7	Chlorobenzene	0.20	< 0.20	U
100-41-4	Ethylbenzene	0.20	< 0.20	U
100-42-5	Styrene	0.20	< 0.20	U
75-69-4	Trichlorofluoromethane	0.20	< 0.20	U
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane	0.20	< 0.20	U
179601-23-1	m,p-Xylene	0.40	< 0.40	U
95-47-6	o-Xylene	0.20	< 0.20	U
95-50-1	1,2-Dichlorobenzene	0.20	< 0.20	U
541-73-1	1,3-Dichlorobenzene	0.20	< 0.20	U
106-46-7	1,4-Dichlorobenzene	0.20	< 0.20	U

ORGANICS ANALYSIS DATA SHEET

Volatiles by Purge & Trap GC/MS-Method SW8260C

Page 2 of 2

Sample ID: Trip Blanks
SAMPLE

Lab Sample ID: ZJ68B

QC Report No: ZJ68-SPU

LIMS ID: 14-24418

Project: Kent Highlands Landfill

Matrix: Water

Date Analyzed: 11/11/14 17:25

CAS Number	Analyte	LOQ	Result	Q
107-02-8	Acrolein	5.0	< 5.0	U
74-88-4	Iodomethane	1.0	< 1.0	U
74-96-4	Bromoethane	0.20	< 0.20	U
107-13-1	Acrylonitrile	1.0	< 1.0	U
563-58-6	1,1-Dichloropropene	0.20	< 0.20	U
74-95-3	Dibromomethane	0.20	< 0.20	U
630-20-6	1,1,1,2-Tetrachloroethane	0.20	< 0.20	U
96-12-8	1,2-Dibromo-3-chloropropane	0.50	< 0.50	U
96-18-4	1,2,3-Trichloropropane	0.50	< 0.50	U
110-57-6	trans-1,4-Dichloro-2-butene	1.0	< 1.0	U
108-67-8	1,3,5-Trimethylbenzene	0.20	< 0.20	U
95-63-6	1,2,4-Trimethylbenzene	0.20	< 0.20	U
87-68-3	Hexachlorobutadiene	0.50	< 0.50	U
106-93-4	1,2-Dibromoethane	0.20	< 0.20	U
74-97-5	Bromochloromethane	0.20	< 0.20	U
594-20-7	2,2-Dichloropropane	0.20	< 0.20	U
142-28-9	1,3-Dichloropropane	0.20	< 0.20	U
98-82-8	Isopropylbenzene	0.20	< 0.20	U
103-65-1	n-Propylbenzene	0.20	< 0.20	U
108-86-1	Bromobenzene	0.20	< 0.20	U
95-49-8	2-Chlorotoluene	0.20	< 0.20	U
106-43-4	4-Chlorotoluene	0.20	< 0.20	U
98-06-6	tert-Butylbenzene	0.20	< 0.20	U
135-98-8	sec-Butylbenzene	0.20	< 0.20	U
99-87-6	4-Isopropyltoluene	0.20	< 0.20	U
104-51-8	n-Butylbenzene	0.20	< 0.20	U
120-82-1	1,2,4-Trichlorobenzene	0.50	< 0.50	U
91-20-3	Naphthalene	0.50	< 0.50	U
87-61-6	1,2,3-Trichlorobenzene	0.50	< 0.50	U

Reported in µg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	99.2%
d8-Toluene	99.0%
Bromofluorobenzene	94.4%
d4-1,2-Dichlorobenzene	103%

2-Chloroethylvinylether is an acid labile compound and may not be recovered from an acid preserved sample.

EPA SW-846 indicates that vinyl chloride and styrene may degrade in the presence of acid preservative.

ORGANICS ANALYSIS DATA SHEET

Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: LCS-111114A

Page 1 of 2

LAB CONTROL SAMPLE

Lab Sample ID: LCS-111114A

QC Report No: ZJ68-SPU

LIMS ID: 14-24417

Project: Kent Highlands Landfill

Matrix: Water

Data Release Authorized: *mw*

Date Sampled: NA

Reported: 11/13/14

Date Received: NA

Instrument/Analyst LCS: NT2/PAB

Sample Amount LCS: 10.0 mL

LCSD: NT2/PAB

LCSD: 10.0 mL

Date Analyzed LCS: 11/11/14 13:20

Purge Volume LCS: 10.0 mL

LCSD: 11/11/14 13:46

LCSD: 10.0 mL

Analyte	LCS	Spike Added-LCS	LCS Recovery	LCSD	Spike Added-LCSD	LCSD Recovery	RPD
Chloromethane	8.83	10.0	88.3%	8.65	10.0	86.5%	2.1%
Bromomethane	8.75	10.0	87.5%	8.65	10.0	86.5%	1.1%
Vinyl Chloride	8.85	10.0	88.5%	8.77	10.0	87.7%	0.9%
Chloroethane	9.30	10.0	93.0%	9.13	10.0	91.3%	1.8%
Methylene Chloride	9.22	10.0	92.2%	9.01	10.0	90.1%	2.3%
Acetone	46.0	50.0	92.0%	46.6	50.0	93.2%	1.3%
Carbon Disulfide	9.49	10.0	94.9%	9.35	10.0	93.5%	1.5%
1,1-Dichloroethene	9.20	10.0	92.0%	9.18	10.0	91.8%	0.2%
1,1-Dichloroethane	9.71	10.0	97.1%	9.65	10.0	96.5%	0.6%
trans-1,2-Dichloroethene	9.19	10.0	91.9%	9.05	10.0	90.5%	1.5%
cis-1,2-Dichloroethene	9.60	10.0	96.0%	9.52	10.0	95.2%	0.8%
Chloroform	9.72	10.0	97.2%	9.58	10.0	95.8%	1.5%
1,2-Dichloroethane	9.68	10.0	96.8%	9.53	10.0	95.3%	1.6%
2-Butanone	49.8	50.0	99.6%	49.5	50.0	99.0%	0.6%
1,1,1-Trichloroethane	9.25	10.0	92.5%	9.27	10.0	92.7%	0.2%
Carbon Tetrachloride	9.53	10.0	95.3%	9.64	10.0	96.4%	1.1%
Vinyl Acetate	4.49 Q	10.0	44.9%	4.37 Q	10.0	43.7%	2.7%
Bromodichloromethane	9.91	10.0	99.1%	9.47	10.0	94.7%	4.5%
1,2-Dichloropropane	9.60	10.0	96.0%	9.57	10.0	95.7%	0.3%
cis-1,3-Dichloropropene	9.54	10.0	95.4%	9.62	10.0	96.2%	0.8%
Trichloroethene	9.73	10.0	97.3%	9.66	10.0	96.6%	0.7%
Dibromochloromethane	9.53	10.0	95.3%	9.36	10.0	93.6%	1.8%
1,1,2-Trichloroethane	9.34	10.0	93.4%	9.21	10.0	92.1%	1.4%
Benzene	9.73	10.0	97.3%	9.72	10.0	97.2%	0.1%
trans-1,3-Dichloropropene	9.88	10.0	98.8%	9.67	10.0	96.7%	2.1%
2-Chloroethylvinylether	8.73	10.0	87.3%	8.90	10.0	89.0%	1.9%
Bromoform	9.12	10.0	91.2%	8.94	10.0	89.4%	2.0%
4-Methyl-2-Pentanone (MIBK)	49.4	50.0	98.8%	49.9	50.0	99.8%	1.0%
2-Hexanone	46.5	50.0	93.0%	45.9	50.0	91.8%	1.3%
Tetrachloroethene	8.85	10.0	88.5%	8.97	10.0	89.7%	1.3%
1,1,2,2-Tetrachloroethane	8.35 Q	10.0	83.5%	8.48 Q	10.0	84.8%	1.5%
Toluene	9.24	10.0	92.4%	9.15	10.0	91.5%	1.0%
Chlorobenzene	8.90	10.0	89.0%	8.85	10.0	88.5%	0.6%
Ethylbenzene	8.90	10.0	89.0%	9.00	10.0	90.0%	1.1%
Styrene	9.31	10.0	93.1%	9.37	10.0	93.7%	0.6%
Trichlorofluoromethane	9.58	10.0	95.8%	9.37	10.0	93.7%	2.2%
1,1,2-Trichloro-1,2,2-trifluoroethane	8.85	10.0	88.5%	8.77	10.0	87.7%	0.9%
m,p-Xylene	18.6	20.0	93.0%	18.6	20.0	93.0%	0.0%

ORGANICS ANALYSIS DATA SHEET

Volatiles by Purge & Trap GC/MS-Method SW8260C

Sample ID: LCS-111114A

Page 2 of 2

LAB CONTROL SAMPLE

Lab Sample ID: LCS-111114A

QC Report No: ZJ68-SPU

LIMS ID: 14-24417

Project: Kent Highlands Landfill

Matrix: Water

Analyte	LCS	Spike Added-LCS	LCS Recovery	LCSD	Spike Added-LCSD	LCSD Recovery	RPD
o-Xylene	9.48	10.0	94.8%	9.38	10.0	93.8%	1.1%
1,2-Dichlorobenzene	8.28	10.0	82.8%	8.34	10.0	83.4%	0.7%
1,3-Dichlorobenzene	8.39	10.0	83.9%	8.35	10.0	83.5%	0.5%
1,4-Dichlorobenzene	8.18	10.0	81.8%	8.26	10.0	82.6%	1.0%
Acrolein	44.8	50.0	89.6%	44.2	50.0	88.4%	1.3%
Iodomethane	9.07	10.0	90.7%	8.93	10.0	89.3%	1.6%
Bromoethane	9.26	10.0	92.6%	9.33	10.0	93.3%	0.8%
Acrylonitrile	9.93	10.0	99.3%	9.72	10.0	97.2%	2.1%
1,1-Dichloropropene	9.67	10.0	96.7%	9.83	10.0	98.3%	1.6%
Dibromomethane	9.48	10.0	94.8%	9.38	10.0	93.8%	1.1%
1,1,1,2-Tetrachloroethane	9.33	10.0	93.3%	9.31	10.0	93.1%	0.2%
1,2-Dibromo-3-chloropropane	8.93	10.0	89.3%	8.77	10.0	87.7%	1.8%
1,2,3-Trichloropropane	8.74	10.0	87.4%	8.73	10.0	87.3%	0.1%
trans-1,4-Dichloro-2-butene	8.44	10.0	84.4%	8.42	10.0	84.2%	0.2%
1,3,5-Trimethylbenzene	8.72	10.0	87.2%	8.79	10.0	87.9%	0.8%
1,2,4-Trimethylbenzene	8.75	10.0	87.5%	8.76	10.0	87.6%	0.1%
Hexachlorobutadiene	6.85 Q	10.0	68.5%	7.02 Q	10.0	70.2%	2.5%
1,2-Dibromoethane	9.22	10.0	92.2%	9.11	10.0	91.1%	1.2%
Bromochloromethane	9.86	10.0	98.6%	9.66	10.0	96.6%	2.0%
2,2-Dichloropropane	9.34	10.0	93.4%	9.30	10.0	93.0%	0.4%
1,3-Dichloropropane	8.94	10.0	89.4%	8.91	10.0	89.1%	0.3%
Isopropylbenzene	8.65	10.0	86.5%	8.67	10.0	86.7%	0.2%
n-Propylbenzene	8.26	10.0	82.6%	8.29	10.0	82.9%	0.4%
Bromobenzene	8.09	10.0	80.9%	8.26	10.0	82.6%	2.1%
2-Chlorotoluene	8.28	10.0	82.8%	8.38	10.0	83.8%	1.2%
4-Chlorotoluene	8.32	10.0	83.2%	8.23	10.0	82.3%	1.1%
tert-Butylbenzene	8.70	10.0	87.0%	8.78	10.0	87.8%	0.9%
sec-Butylbenzene	8.57	10.0	85.7%	8.68	10.0	86.8%	1.3%
4-Isopropyltoluene	8.68	10.0	86.8%	8.65	10.0	86.5%	0.3%
n-Butylbenzene	8.38	10.0	83.8%	8.37	10.0	83.7%	0.1%
1,2,4-Trichlorobenzene	8.11 Q	10.0	81.1%	8.05 Q	10.0	80.5%	0.7%
Naphthalene	8.82	10.0	88.2%	9.00	10.0	90.0%	2.0%
1,2,3-Trichlorobenzene	8.29 Q	10.0	82.9%	7.99 Q	10.0	79.9%	3.7%

Reported in µg/L (ppb)

RPD calculated using sample concentrations per SW846.

Volatile Surrogate Recovery

	LCS	LCSD
d4-1,2-Dichloroethane	97.0%	96.7%
d8-Toluene	98.1%	98.1%
Bromofluorobenzene	100%	101%
d4-1,2-Dichlorobenzene	101%	98.5%

VOA SURROGATE RECOVERY SUMMARY



Matrix: Water

QC Report No: ZJ68-SPU

Project: Kent Highlands Landfill

ARI ID	Client ID	PV	DCE	TOL	BFB	DCB	TOT OUT
MB-111114A	Method Blank	10	99.5%	97.3%	99.8%	102%	0
LCS-111114A	Lab Control	10	97.0%	98.1%	100%	101%	0
LCSD-111114A	Lab Control Dup	10	96.7%	98.1%	101%	98.5%	0
ZJ68A	Kent-Mysterious Well	10	99.0%	99.3%	97.2%	101%	0
ZJ68B	Trip Blanks	10	99.2%	99.0%	94.4%	103%	0

LCS/MB LIMITS

QC LIMITS

SW8260C

(DCE) = d4-1,2-Dichloroethane	(80-120)	(80-120)
(TOL) = d8-Toluene	(80-120)	(80-120)
(BFB) = Bromofluorobenzene	(80-120)	(80-120)
(DCB) = d4-1,2-Dichlorobenzene	(80-120)	(80-120)

Prep Method: SW5030B

Log Number Range: 14-24417 to 14-24418

ZJ68: 00017

Analytical Resources, Inc.

CONTINUING CALIBRATION COMPOUNDS

Instrument ID: nt2.i
Lab File ID: cc1111.d
Analysis Type: WATER
Lab Sample ID: CC1111
Method: /chem3/nt2.i/20141111.b/82601002L.m

Injection Date: 11-NOV-2014 10:20
Init. Cal. Date(s): 02-OCT-2014 02-OCT-2014
Init. Cal. Times: 10:14 13:32
Quant Type: ISTD

COMPOUND	RRF / AMOUNT	RF10	MIN	MAX		CURVE TYPE
			RRF	%D / %DRIFT	%D / %DRIFT	
1 Dichlorodifluoromethane	0.83040	0.69391	0.010	-16.43648	20.00000	Averaged
2 Chloromethane	1.23478	1.12795	0.100	-8.65193	20.00000	Averaged
3 Vinyl Chloride	1.11661	1.03041	0.100	-7.71968	20.00000	Averaged
4 Bromomethane	0.45893	0.44797	0.100	-2.38945	20.00000	Averaged
5 Chloroethane	0.58036	0.58788	0.010	1.29639	20.00000	Averaged
6 Trichlorofluoromethane	0.76176	0.82836	0.010	8.74280	20.00000	Averaged
7 1,1-Dichloroethene	1.40387	1.33955	0.100	-4.58150	20.00000	Averaged
8 Carbon Disulfide	2.45764	2.44433	0.010	-0.54156	20.00000	Averaged
9 112Trichloro122Trifluoroeth	0.71992	0.65811	0.010	-8.58565	20.00000	Averaged
10 Iodomethane	1.04651	0.97588	0.010	-6.74913	20.00000	Averaged
11 Bromoethane	0.54500	0.52533	0.100	-3.60850	20.00000	Averaged
12 Acrolein	0.08396	0.06933	0.000	-17.42206	20.00000	Averaged
13 Methylene Chloride	0.80780	0.76022	0.010	-5.88991	20.00000	Averaged
14 Acetone	0.12406	0.10358	0.001	-16.51377	20.00000	Averaged
15 Trans-1,2-Dichloroethene	0.76774	0.73165	0.010	-4.70111	20.00000	Averaged
17 Methyl tert butyl ether	1.61437	1.51666	0.100	-6.05289	20.00000	Averaged
18 1,1-Dichloroethane	1.47084	1.47562	0.200	0.32486	20.00000	Averaged
19 Acrylonitrile	0.15535	0.14267	0.001	-8.16446	20.00000	Averaged
20 Vinyl Acetate	0.42520	0.17041	0.010	-59.92274	20.00000	Averaged
22 Cis-1,2-Dichloroethene	0.74565	0.73459	0.010	-1.48226	20.00000	Averaged
23 2,2-Dichloropropane	0.80190	0.79687	0.010	-0.62653	20.00000	Averaged
24 Bromochloromethane	0.27604	0.27081	0.050	-1.89391	20.00000	Averaged
25 Chloroform	1.19294	1.15395	0.200	-3.26856	20.00000	Averaged
26 Carbon Tetrachloride	0.46632	0.47451	0.100	1.75551	20.00000	Averaged
27 Dibromofluoromethane	0.58740	0.58854	0.100	0.19494	20.00000	Averaged
28 1,1,1-Trichloroethane	1.05910	1.03436	0.100	-2.33626	20.00000	Averaged
29 2-Butanone	0.18190	0.15664	0.001	-13.88757	20.00000	Averaged
30 1,1-Dichloropropene	0.52833	0.53417	0.010	1.10494	20.00000	Averaged
31 Benzene	1.49606	1.49344	0.500	-0.17513	20.00000	Averaged
33 d4-1,2-Dichloroethane	0.69025	0.63525	0.010	-7.96749	20.00000	Averaged
34 1,2-Dichloroethane	0.43456	0.41116	0.100	-5.38460	20.00000	Averaged
36 Trichloroethene	0.33072	0.32554	0.100	-1.56500	20.00000	Averaged
38 Dibromomethane	0.16204	0.14792	0.010	-8.71354	20.00000	Averaged
39 1,2-Dichloropropane	0.37854	0.36798	0.100	-2.79007	20.00000	Averaged
40 Bromodichloromethane	0.39898	0.39307	0.100	-1.48048	20.00000	Averaged

Analytical Resources, Inc.

CONTINUING CALIBRATION COMPOUNDS

Instrument ID: nt2.i
Lab File ID: cc1111.d
Analysis Type: WATER
Lab Sample ID: CC1111
Method: /chem3/nt2.i/20141111.b/82601002L.m

Injection Date: 11-NOV-2014 10:20
Init. Cal. Date(s): 02-OCT-2014 02-OCT-2014
Init. Cal. Times: 10:14 13:32
Quant Type: ISTD

COMPOUND	RRF / AMOUNT	RF10	MIN RRF	%D / %DRIFT	MAX %D / %DRIFT	CURVE TYPE
=====	=====	=====	=====	=====	=====	=====
41 2-Chloroethyl Vinyl Ether	0.12595	0.10534	0.000	-16.36189	20.00000	Averaged
42 Cis 1,3-dichloropropene	0.49287	0.47534	0.200	-3.55556	20.00000	Averaged
\$ 43 d8-Toluene	1.26968	1.24183	0.010	-2.19356	20.00000	Averaged
44 Toluene	0.91610	0.87538	0.400	-4.44581	20.00000	Averaged
45 4-Methyl-2-Pentanone	0.09030	0.08252	0.000	-8.61984	20.00000	Averaged
46 Tetrachloroethene	0.32427	0.29173	0.200	-10.03517	20.00000	Averaged
47 Trans 1,3-Dichloropropene	0.41084	0.40628	0.010	-1.10940	20.00000	Averaged
48 1,1,2-Trichloroethane	0.21487	0.19683	0.100	-8.39371	20.00000	Averaged
49 Chlorodibromomethane	0.23175	0.21798	0.100	-5.94094	20.00000	Averaged
50 1,3-Dichloropropane	0.44202	0.38462	0.100	-12.98538	20.00000	Averaged
51 1,2-Dibromoethane	0.20655	0.18693	0.010	-9.49870	20.00000	Averaged
52 2-Hexanone	0.16379	0.13209	0.010	-19.35624	20.00000	Averaged
54 Chlorobenzene	0.96901	0.87415	0.500	-9.78941	20.00000	Averaged
55 Ethyl Benzene	0.55790	0.51467	0.100	-7.74850	20.00000	Averaged
56 1,1,1,2-Tetrachloroethane	0.30753	0.29391	0.010	-4.42916	20.00000	Averaged
57 m,p-xylene	0.66991	0.63887	0.300	-4.63358	20.00000	Averaged
58 o-Xylene	0.65155	0.62718	0.300	-3.73999	20.00000	Averaged
59 Styrene	1.01922	0.98037	0.300	-3.81130	20.00000	Averaged
60 Bromoform	0.23953	0.21625	0.010	-9.71900	20.00000	Averaged
61 Isopropyl Benzene	3.57413	3.22812	0.010	-9.68107	20.00000	Averaged
\$ 62 4-Bromofluorobenzene	0.54370	0.54797	0.200	0.78418	20.00000	Averaged
63 Bromobenzene	0.73767	0.62469	0.010	-15.31580	20.00000	Averaged
64 N-Propyl Benzene	4.30486	3.72822	0.010	-13.39510	20.00000	Averaged
65 1,1,2,2-Tetrachloroethane	0.57078	0.44821	0.100	-21.47405	20.00000	Averaged
66 2-Chloro Toluene	2.96746	2.58660	0.010	-12.83457	20.00000	Averaged
67 1,3,5-Trimethyl Benzene	2.97546	2.73611	0.010	-8.04427	20.00000	Averaged
68 1,2,3-Trichloropropane	0.16336	0.14142	0.010	-13.43014	20.00000	Averaged
69 Trans-1,4-Dichloro 2-Butene	0.19108	0.16266	0.001	-14.87083	20.00000	Averaged
70 4-Chloro Toluene	2.76033	2.38989	0.010	-13.42022	20.00000	Averaged
71 T-Butyl Benzene	2.37055	2.16923	0.010	-8.49248	20.00000	Averaged
72 1,2,4-Trimethylbenzene	2.97486	2.75367	0.010	-7.43551	20.00000	Averaged
73 S-Butyl Benzene	3.73844	3.37619	0.010	-9.68981	20.00000	Averaged
74 4-Isopropyl Toluene	2.84221	2.58209	0.010	-9.15193	20.00000	Averaged
75 1,3-Dichlorobenzene	1.48771	1.28917	0.600	-13.34502	20.00000	Averaged
77 1,4-Dichlorobenzene	1.52085	1.26867	0.500	-16.58123	20.00000	Averaged

Analytical Resources, Inc.

CONTINUING CALIBRATION COMPOUNDS

Instrument ID: nt2.i
Lab File ID: cc1111.d
Analysis Type: WATER
Lab Sample ID: CC1111
Method: /chem3/nt2.i/20141111.b/82601002L.m

Injection Date: 11-NOV-2014 10:20
Init. Cal. Date(s): 02-OCT-2014 02-OCT-2014
Init. Cal. Times: 10:14 13:32
Quant Type: ISTD

COMPOUND	RRF / AMOUNT	RF10	MIN	MAX	CURVE TYPE
=====	=====	=====	=====	=====	=====
78 N-Butyl Benzene	2.86678	2.52352	0.010	-11.97365	20.00000
\$ 79 d4-1,2-Dichlorobenzene	0.85894	0.83095	0.010	-3.25798	20.00000
80 1,2-Dichlorobenzene	1.32789	1.10466	0.400	-16.81122	20.00000
81 1,2-Dibromo 3-Chloropropane	0.07669	0.06771	0.010	-11.71262	20.00000
83 Hexachloro 1,3-Butadiene	0.37281	0.26858	0.010	-27.95734	20.00000
84 1,2,4-Trichlorobenzene	0.65868	0.52603	0.010	-20.13882	20.00000
85 Naphthalene	1.01974	0.85633	0.010	-16.02410	20.00000
86 1,2,3-Trichlorobenzene	0.45786	0.36376	0.010	-20.55206	20.00000
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ORGANICS ANALYSIS DATA SHEET

Volatiles by Purge & Trap GC/MS-Method SW8260C-SIM Sample ID: Kent-Mysterious Well
Page 1 of 1 SAMPLE

Lab Sample ID: ZJ68A

QC Report No: ZJ68-SPU

LIMS ID: 14-24417

Project: Kent Highlands Landfill

Matrix: Water

Data Release Authorized: 

Date Sampled: 11/10/14

Reported: 11/14/14

Date Received: 11/10/14

Instrument/Analyst: NT7/PAB

Sample Amount: 10.0 mL

Date Analyzed: 11/11/14 17:13

Purge Volume: 10.0 mL

CAS Number	Analyte	RL	Result	Q
75-01-4	Vinyl Chloride	0.020	< 0.020	U

Reported in µg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	93.7%
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ORGANICS ANALYSIS DATA SHEET

Volatiles by Purge & Trap GC/MS-Method SW8260C-SIM Sample ID: Trip Blanks
Page 1 of 1 SAMPLE

Lab Sample ID: ZJ68B

QC Report No: ZJ68-SPU

LIMS ID: 14-24418

Project: Kent Highlands Landfill

Matrix: Water

Data Release Authorized: *MS*

Date Sampled: 11/10/14

Reported: 11/14/14

Date Received: 11/10/14

Instrument/Analyst: NT7/PAB

Sample Amount: 10.0 mL

Date Analyzed: 11/11/14 17:36

Purge Volume: 10.0 mL

CAS Number	Analyte	RL	Result	Q
75-01-4	Vinyl Chloride	0.020	< 0.020	U

Reported in µg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	92.7%
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ORGANICS ANALYSIS DATA SHEET

Volatiles by Purge & Trap GC/MS-Method SW8260C-SIM Sample ID: MB-111114

Page 1 of 1

METHOD BLANK

Lab Sample ID: MB-111114

QC Report No: ZJ68-SPU

LIMS ID: 14-24417

Project: Kent Highlands Landfill

Matrix: Water

Data Release Authorized: 

Date Sampled: NA

Reported: 11/14/14

Date Received: NA

Instrument/Analyst: NT7/PAB

Sample Amount: 10.0 mL

Date Analyzed: 11/11/14 16:02

Purge Volume: 10.0 mL

CAS Number	Analyte	RL	Result	Q
75-01-4	Vinyl Chloride	0.020	< 0.020	U

Reported in µg/L (ppb)

Volatile Surrogate Recovery

d4-1,2-Dichloroethane	95.9%
-----------------------	-------

ORGANICS ANALYSIS DATA SHEET

Volatiles by Purge & Trap GC/MS-Method SW8260C-SIM Sample ID: LCS-111114

Page 1 of 1

LAB CONTROL SAMPLE

Lab Sample ID: LCS-111114

QC Report No: ZJ68-SPU

LIMS ID: 14-24417

Project: Kent Highlands Landfill

Matrix: Water

Data Release Authorized: *[Signature]*

Date Sampled: NA

Reported: 11/14/14

Date Received: NA

Instrument/Analyst LCS: NT7/PAB

Sample Amount LCS: 10.0 mL

LCSD: NT7/PAB

LCSD: 10.0 mL

Date Analyzed LCS: 11/11/14 15:06

Purge Volume LCS: 10.0 mL

LCSD: 11/11/14 15:39

LCSD: 10.0 mL

Analyte	LCS	Spike Added-LCS	LCS Recovery	LCSD	Spike Added-LCSD	LCSD Recovery	RPD
Vinyl Chloride	0.839	1.00	83.9%	1.28	1.00	128%	41.6%

Reported in µg/L (ppb)

RPD calculated using sample concentrations per SW846.

Volatile Surrogate Recovery

	LCS	LCSD
d4-1,2-Dichloroethane	95.7%	96.3%

SW8260-SIM SURROGATE RECOVERY SUMMARY

Matrix: Water

QC Report No: ZJ68-SPU
Project: Kent Highlands Landfill

<u>Client ID</u>	<u>DCE</u>	<u>TOT OUT</u>
MB-111114	95.9%	0
LCS-111114	95.7%	0
LCSD-111114	96.3%	0
Kent-Mysterious Well	93.7%	0
Trip Blanks	92.7%	0

LCS/MB LIMITS QC LIMITS

(DCE) = d4-1,2-Dichloroethane (80-129) (80-129)

Prep Method: SW5030
Log Number Range: 14-24417 to 14-24418

SAMPLE RESULTS-CONVENTIONALS
ZJ68-SPU



Matrix: Water
Data Release Authorized:
Reported: 11/19/14

Project: Kent Highlands Landfill
Event: NA
Date Sampled: 11/10/14
Date Received: 11/10/14

Client ID: Kent-Mysterious Well
ARI ID: 14-24417 ZJ68A

Analyte	Date Batch	Method	Units	RL	Sample
Alkalinity	11/18/14 111814#1	SM 2320	mg/L CaCO3	1.0	268
Carbonate	11/18/14	SM 2320	mg/L CaCO3	1.0	< 1.0 U
Bicarbonate	11/18/14	SM 2320	mg/L CaCO3	1.0	268
Hydroxide	11/18/14	SM 2320	mg/L CaCO3	1.0	< 1.0 U
Chloride	11/10/14 111014#1	EPA 325.2	mg/L	50.0	405
N-Nitrate	11/11/14	Calculated	mg-N/L	0.010	0.018
N-Nitrite	11/11/14 111114#1	EPA 353.2	mg-N/L	0.010	< 0.010 U
Nitrate + Nitrite	11/11/14 111114#1	EPA 353.2	mg-N/L	0.010	0.018
Sulfate	11/13/14 111314#1	EPA 375.2	mg/L	2.0	3.8

RL Analytical reporting limit
U Undetected at reported detection limit

METHOD BLANK RESULTS-CONVENTIONALS
ZJ68-SPU



Matrix: Water
Data Release Authorized: 
Reported: 11/19/14

Project: Kent Highlands Landfill
Event: NA
Date Sampled: NA
Date Received: NA

Analyte	Method	Date	Units	Blank	ID
Chloride	EPA 325.2	11/10/14	mg/L	< 1.0 U	FB
N-Nitrite	EPA 353.2	11/11/14	mg-N/L	< 0.010 U	FB
Nitrate + Nitrite	EPA 353.2	11/11/14	mg-N/L	< 0.010 U	FB
Sulfate	EPA 375.2	11/13/14	mg/L	< 2.0 U	FB

FB Filtration Blank

STANDARD REFERENCE RESULTS-CONVENTIONALS
ZJ68-SPU



Matrix: Water
Data Release Authorized: 
Reported: 11/19/14

Project: Kent Highlands Landfill
Event: NA
Date Sampled: NA
Date Received: NA

Analyte/SRM ID	Method	Date	Units	SRM	True Value	Recovery
Alkalinity ERA #P114506	SM 2320	11/18/14	mg/L CaCO3	59.3	61.7	96.1%
Chloride ERA #290313	EPA 325.2	11/10/14	mg/L	4.8	5.0	96.0%
N-Nitrite ERA #141113	EPA 353.2	11/11/14	mg-N/L	0.493	0.500	98.6%
Nitrate + Nitrite ERA #320614	EPA 353.2	11/11/14	mg-N/L	0.499	0.500	99.8%
Sulfate ERA 131013	EPA 375.2	11/13/14	mg/L	15.0	15.0	100.0%

REPLICATE RESULTS-CONVENTIONALS
ZJ68-SPU



Matrix: Water
Data Release Authorized:
Reported: 11/19/14

A handwritten signature in black ink, appearing to be 'JL' or similar, written over the 'Data Release Authorized' line.

Project: Kent Highlands Landfill
Event: NA
Date Sampled: 11/10/14
Date Received: 11/10/14

Analyte	Method	Date	Units	Sample	Replicate(s)	RPD/RSD
ARI ID: ZJ68A Client ID: Kent-Mysterious Well						
Alkalinity	SM 2320	11/18/14	mg/L CaCO3	268	267	0.4%
Carbonate	SM 2320	11/18/14	mg/L CaCO3	< 1.0	< 1.0	NA
Bicarbonate	SM 2320	11/18/14	mg/L CaCO3	268	267	0.4%
Hydroxide	SM 2320	11/18/14	mg/L CaCO3	< 1.0	< 1.0	NA
N-Nitrite	EPA 353.2	11/11/14	mg-N/L	< 0.010	< 0.010	NA
Nitrate + Nitrite	EPA 353.2	11/11/14	mg-N/L	0.018	0.011	48.3%
Sulfate	EPA 375.2	11/13/14	mg/L	3.8	3.8	0.0%

MS/MSD RESULTS-CONVENTIONALS
ZJ68-SPU



Matrix: Water
Data Release Authorized: 
Reported: 11/19/14

Project: Kent Highlands Landfill
Event: NA
Date Sampled: 11/10/14
Date Received: 11/10/14

Analyte	Method	Date	Units	Sample	Spike	Spike Added	Recovery
ARI ID: ZJ68A Client ID: Kent-Mysterious Well							
N-Nitrite	EPA 353.2	11/11/14	mg-N/L < 0.010	0.510	0.510	0.500	102.0%
Nitrate + Nitrite	EPA 353.2	11/11/14	mg-N/L 0.018	0.515	0.515	0.500	99.4%
Sulfate	EPA 375.2	11/13/14	mg/L 3.8	16.7	16.7	15.0	86.0%

INORGANICS ANALYSIS DATA SHEET

TOTAL METALS

Page 1 of 1

Sample ID: Kent-Mysterious Well
SAMPLE

Lab Sample ID: ZJ68A

LIMS ID: 14-24417

Matrix: Water

Data Release Authorized:

Reported: 11/13/14

QC Report No: ZJ68-SPU

Project: Kent Highlands Landfill

Date Sampled: 11/10/14

Date Received: 11/10/14

Prep Meth	Prep Date	Analysis Method	Analysis Date	CAS Number	Analyte	LOQ	mg/L	Q
3010A	11/11/14	6010C	11/12/14	7440-70-2	Calcium	0.05	7.80	
3010A	11/11/14	6010C	11/12/14	7439-95-4	Magnesium	0.05	16.6	
3010A	11/11/14	6010C	11/12/14	7440-09-7	Potassium	0.5	15.4	
3010A	11/11/14	6010C	11/12/14	7440-23-5	Sodium	0.5	331	

U-Analyte undetected at given LOQ
LOQ-Reporting Limit

INORGANICS ANALYSIS DATA SHEET

TOTAL METALS

Page 1 of 1

Sample ID: METHOD BLANK

Lab Sample ID: ZJ68MB

LIMS ID: 14-24417

Matrix: Water

Data Release Authorized:

Reported: 11/13/14

QC Report No: ZJ68-SPU

Project: Kent Highlands Landfill

Date Sampled: NA

Date Received: NA

Prep Meth	Prep Date	Analysis Method	Analysis Date	CAS Number	Analyte	LOQ	mg/L	Q
3010A	11/11/14	6010C	11/12/14	7440-70-2	Calcium	0.05	0.05	U
3010A	11/11/14	6010C	11/12/14	7439-95-4	Magnesium	0.05	0.05	U
3010A	11/11/14	6010C	11/12/14	7440-09-7	Potassium	0.5	0.5	U
3010A	11/11/14	6010C	11/12/14	7440-23-5	Sodium	0.5	0.5	U

U-Analyte undetected at given LOQ

LOQ-Reporting Limit

INORGANICS ANALYSIS DATA SHEET

TOTAL METALS

Page 1 of 1

Sample ID: LAB CONTROL

Lab Sample ID: ZJ68LCS

LIMS ID: 14-24417

Matrix: Water

Data Release Authorized: 

Reported: 11/13/14

QC Report No: ZJ68-SPU

Project: Kent Highlands Landfill

Date Sampled: NA

Date Received: NA

BLANK SPIKE QUALITY CONTROL REPORT

Analyte	Analysis Method	Spike Found	Spike Added	% Recovery	Q
Calcium	6010C	10.2	10.0	102%	
Magnesium	6010C	10.9	10.0	109%	
Potassium	6010C	10.7	10.0	107%	
Sodium	6010C	10.3	10.0	103%	

Reported in mg/L

N-Control limit not met

Control Limits: 80-120%

Appendix B

Spring Drain



City Attorney Analysis of NPDES Requirements



MEMORANDUM

To: Jeff Neuner

From: Tad H. Shimazu, Assistant City Attorney

Date: May 29, 2019

RE: NPDES Requirements at Midway and Kent Highlands Landfills

ISSUE

You requested an analysis regarding the issue paraphrased as follows:

ISSUE: Whether the City must obtain National Pollutant Discharge Elimination System (“NPDES”) permits at the Midway and Kent Highlands Landfills for stormwater discharges resulting from the implementation of required remedial actions at the landfills?

SHORT ANSWER: NO. The Minimum Functional Standards for landfills, the Model Toxics Control Act and a memorandum from the Assistant Attorney General representing the State Department of Ecology dictate that NPDES Permits are not required at Midway and Kent Highlands Landfill.

ANALYSIS

I. MTCA and CERCLA have express permit exemption provisions

Washington State’s Model Toxics Control Act (“MTCA”) at RCW 70.105D.090, expressly states:

- (1) A person conducting a remedial action at a facility under a consent decree, order, or agreed order... [is] exempt from the procedural requirements of chapters [70.94](#), 70.95, 70.105, 77.55, 90.48, and [90.58](#) RCW, and the procedural requirements of any laws requiring or authorizing local government permits or approvals for the remedial action. The department shall ensure compliance with the substantive provisions of chapters [70.94](#), 70.95, 70.105, 77.55, 90.48, and [90.58](#) RCW, and the substantive provisions of any laws requiring or authorizing local government permits of approvals.

Similarly, CERCLA, at 42 USC §9621(e) states:

No Federal, State, or local permit shall be required for the portion of any removal or remedial action conducted entirely onsite where such remedial action is selected and carried out in compliance with this section.

Both Federal and State hazardous substances cleanup laws exempt remedial actions from the necessity of obtaining permits, **BUT REQUIRE SUBSTANTIVE COMPLIANCE WITH APPROPRIATE CONDITIONS.**

II. Cleanup Action Plans Incorporated into the Consent Decrees Impose Substantive Requirements Specifically Designed for the Landfill Sites

The Consent Decrees issued at Kent Highlands and Midway expressly recite that the orders are based, in part, on the authority granted by the state Water Pollution Control Act (Ch. 90.48 RCW), which is the statute that governs the state's NPDES permit program. Thus, the Consent Decrees impose conditions that are required under the Water Pollution Control Act, just as a NPDES Permit would impose such conditions.

The Cleanup Action Plans (CAPs) for the landfills have been reviewed and approved by the agencies (as well as undergoing public comment) and are incorporated into the Consent Decrees. These required CAPs are developed and designed to address the specific characteristics and contaminants at these specific Sites. Quite simply, the Consent Decrees and the CAPs require the "substantive requirements" that would have been imposed via any permits.

For example, the Third Amendment to Consent Order at Kent Highlands expressly states: "Seattle must comply with the substantive requirements of the NPDES program . . . In order to comply with these substantive requirements, Seattle shall comply with the provisions of Exhibit A, Technical Memorandum, Kent Highlands Landfill Spring Drain Separation." (Third Amendment, p. 2)

At the Midway Landfill, the CAP incorporates EPA's Record of Decision, which **requires Seattle to "construct a 10-million-gallon stormwater detention pond with permanent dewater system."**

Ecology's Ching Pi Wang confirmed that the MTCA exemption applies to this activity, and that the City is required to comply with the substantive requirements of the ROD, but no NPDES permit is required.

As described, the CAP imposes necessary measures to "ensure the protection of human health and the environment" at this specific site. For that reason, the CAP is equivalent to, and in fact, more suitably and stringent, than the usual construction/development permits that might be required.

In addition to the inclusion of the substantive requirements in the CAP and Consent Orders, these landfills are subject to continuing "5 Year Reviews" that ensure that the CAP is still functioning as designed and that it is still protective of Human Health and the Environment. If the CAP is not protective, then it will be modified to ensure compliance with any updated standards to ensure protection of human health and the environment.

III. 1987 Assistant Attorney General Memo: No Permit Required on Closed Landfills Complying with Consent Order

T.C. Richmond, Assistant Attorney General for the Department of Ecology, wrote a memorandum dated 10/28/1987, in which she cited WAC 173-304-600(1)(b):

“Permits are not required for corrective actions at solid waste handling facilities performed . . . to comply with a state and/or federal cleanup order...”

WAC 173-304-600(1)(b) has not changed since Ms. Richmond’s memorandum was written. The memo goes on to state:

“Corrective Action ... is meant to encompass the activities normally done during the closure of the landfill. It would be reasonable to interpret this to include ... remedial actions which are undertaken as corrective action in leu of or jointly with closure.”

“If a consent order or decree covering the corrective action is currently being implemented at a landfill addressing WAC 173-304-600(1)(b), then no permit is required. (Kent Highlands Landfill Consent Order covers remedial action and, therefore, no permit is required.”

The AAG’s determination that permits are not required at Kent Highlands is underscored by the 1996 Amendment to the Kent Highlands Consent Order, which states: “subsequent remedial actions will likely be exempt from the procedural or permit requirement of applicable state or local laws.”

Although this 1987 memo distinguished Midway Landfill from Kent Highlands Landfill by pointing out that the (then existing) Midway Consent Decree covered “only Remedial Investigation and Feasibility Study,” and not the cleanup itself. However, the AAG stated that “if a consent decree under the new Toxic Bill [*the bill that eventually became MTCA*] is issued, then no permit is required.” In 2006, a Midway Consent Decree Amendment (King Co. No. 90-2-13283-8SEA) was entered imposing remedial actions to be performed as part of landfill closure. Therefore, the AG memo also applies to Midway.

IV. CONCLUSION

Based on the foregoing analysis, neither Midway Landfill nor the Kent Highlands Landfill is required to obtain NPDES permits for the stormwater discharges resulting from implementation of remedial actions at the Sites.

Hardness Results for Green River





Analytical Resources, Incorporated
Analytical Chemists and Consultants

22 April 2019

Min-Soon Yim
City of Seattle
Public Utilities 23076 Military Road South
Kent, WA 98032

RE: Kent Highlands Landfill

Please find enclosed sample receipt documentation and analytical results for samples from the project referenced above.

Sample analyses were performed according to ARI's Quality Assurance Plan and any provided project specific Quality Assurance Plan. Each analytical section of this report has been approved and reviewed by an analytical peer, the appropriate Laboratory Supervisor or qualified substitute, and a technical reviewer.

Should you have any questions or problems, please feel free to contact us at your convenience.

Associated Work Order(s)
19D0210

Associated SDG ID(s)
N/A

I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed in the enclose Narrative. ARI, an accredited laboratory, certifies that the report results for which ARI is accredited meets all the requirements of the accrediting body. A list of certified analyses, accreditations, and expiration dates is included in this report.

Release of the data contained in this hardcopy data package has been authorized by the Laboratory Manager or his/her designee, as verified by the following signature.

Analytical Resources, Inc.

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.



ARI Assigned Number: 1970210		Turn-around Requested: 1-Week		Date: 4/15/19		Analytical Resources, Incorporated Analytical Chemists and Consultants 4611 South 134th Place, Suite 100 Tukwila, WA 98168 206-695-6200 206-695-6201 (fax)							
ARI Client Company: City of Seattle/ Seattle Public Utilities		Phone: (206) 233-2629		Page: 1 of 1									
Client Contact: Min-Soon Yim		No. of Coolers: 7.1		Cooler Temps: 7.1									
Client Project Name: Kent Highlands Landfill				Analysis Requested				Notes/Comments					
Client Project #:		Samplers: Min-Soon Yim		Hardness									Metals are field filtered
Sample ID	Date	Time	Matrix		No. Containers								
West	4/15/2019	12:20	Water		1	1							
Middle	4/15/2019	12:23	Water		1	1							
East	4/15/2019	12:26	Water		1	1							
Comments/Special Instructions				Relinquished by: (Signature)		Received by: (Signature)		Relinquished by: (Signature)		Received by: (Signature)			
				Printed Name: Min-Soon Yim		Printed Name: A. Volgardsen		Printed Name:		Printed Name:			
				Company: City of Seattle/ Seattle Public Utilities		Company: AR		Company:		Company:			
				Date & Time: 4/15/19 1307		Date & Time: 4/15/19 1307		Date & Time:		Date & Time:			

Sample Retention Policy: Unless specified by workorder or contract, all water/soil samples submitted to ARI will be discarded or returned, no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer. Sediment s



City of Seattle

Public Utilities 23076 Military Road South

Kent WA, 98032

Project: Kent Highlands Landfill

Project Number: [none]

Project Manager: Min-Soon Yim

Reported:

22-Apr-2019 11:11

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
West	19D0210-01	Water	15-Apr-2019 12:20	15-Apr-2019 13:07
Middle	19D0210-02	Water	15-Apr-2019 12:23	15-Apr-2019 13:07
East	19D0210-03	Water	15-Apr-2019 12:26	15-Apr-2019 13:07



City of Seattle

Public Utilities 23076 Military Road South

Kent WA, 98032

Project: Kent Highlands Landfill

Project Number: [none]

Project Manager: Min-Soon Yim

Reported:

22-Apr-2019 11:11

Work Order Case Narrative

Sample receipt

Samples as listed on the preceding page were received April 15, 2019 under ARI work order 19D0210. For details regarding sample receipt, please refer to the Cooler Receipt Form.

Total Metals - EPA Method 6010C

The sample(s) were digested and analyzed within the recommended holding times.

Initial and continuing calibrations were within method requirements.

The method blank(s) were clean at the reporting limits.

The LCS percent recoveries were within control limits.



WORK ORDER

19D0210

Client: City of Seattle

Project Manager: Shelly Fishel

Project: Kent Highlands Landfill

Project Number: [none]

Preservation Confirmation

Container ID	Container Type	pH
19D0210-01 A	HDPE NM, 500 mL, 1:1 HNO ₃	L2pass
19D0210-02 A	HDPE NM, 500 mL, 1:1 HNO ₃	L2pass
19D0210-03 A	HDPE NM, 500 mL, 1:1 HNO ₃	L2pass

Preservation Confirmed By

Date



Cooler Receipt Form

ARI Client: SPU

COC No(s): _____ (NA)

Assigned ARI Job No: 19D0210

Project Name: _____

Delivered by: Fed-Ex UPS Courier Hand Delivered Other: _____

Tracking No: _____ (NA)

Preliminary Examination Phase:

Were intact, properly signed and dated custody seals attached to the outside of to cooler? YES NO

Were custody papers included with the cooler? YES YES NO

Were custody papers properly filled out (ink, signed, etc.) YES YES NO

Temperature of Cooler(s) (°C) (recommended 2.0-6.0 °C for chemistry)

Time _____

If cooler temperature is out of compliance fill out form 00070F

Temp Gun ID#: 0003505

Cooler Accepted by: AV Date: 4/15/19 Time: 1307

Complete custody forms and attach all shipping documents

Log-In Phase:

Was a temperature blank included in the cooler? YES NO

What kind of packing material was used? ... Bubble Wrap Wet Ice Gel Packs Baggies Foam Block Paper Other: _____

Was sufficient ice used (if appropriate)? NA YES NO

Were all bottles sealed in individual plastic bags? YES NO

Did all bottles arrive in good condition (unbroken)? YES NO

Were all bottle labels complete and legible? YES NO

Did the number of containers listed on COC match with the number of containers received? YES NO

Did all bottle labels and tags agree with custody papers? YES NO

Were all bottles used correct for the requested analyses? YES NO

Do any of the analyses (bottles) require preservation? (attach preservation sheet, excluding VOCs)... NA YES NO

Were all VOC vials free of air bubbles? NA YES NO

Was sufficient amount of sample sent in each bottle? YES NO

Date VOC Trip Blank was made at ARI..... NA

Was Sample Split by ARI : NA YES Date/Time: _____ Equipment: _____ Split by: _____

Samples Logged by: Set Date: 4-15-19 Time: 1350 Labels checked by: Set

**** Notify Project Manager of discrepancies or concerns ****

Sample ID on Bottle	Sample ID on COC	Sample ID on Bottle	Sample ID on COC

Additional Notes, Discrepancies, & Resolutions:

By: _____ Date: _____



City of Seattle

Public Utilities 23076 Military Road South

Kent WA, 98032

Project: Kent Highlands Landfill

Project Number: [none]

Project Manager: Min-Soon Yim

Reported:

22-Apr-2019 11:11

West

19D0210-01 (Water)

Metals and Metallic Compounds

Method: EPA 6010C

Sampled: 04/15/2019 12:20

Instrument: ICP2 Analyst: TCH

Analyzed: 04/17/2019 17:47

Sample Preparation:

Preparation Method: TWC EPA 3010A

Extract ID: 19D0210-01 A 01

Preparation Batch: BHD0424

Sample Size: 25 mL

Prepared: 16-Apr-2019

Final Volume: 25 mL

Analyte	CAS Number	Dilution	Detection Limit	Reporting Limit	Result	Units	Notes
Calcium	7440-70-2	1	0.0051	0.0500	5.72	mg/L	
Magnesium	7439-95-4	1	0.0160	0.0500	1.49	mg/L	



City of Seattle

Public Utilities 23076 Military Road South

Kent WA, 98032

Project: Kent Highlands Landfill

Project Number: [none]

Project Manager: Min-Soon Yim

Reported:

22-Apr-2019 11:11

West

19D0210-01 (Water)

Calculation

Method: SM 2340 B-97

Sampled: 04/15/2019 12:20

Instrument: [CALC] Analyst: TCH

Analyzed: 04/17/2019 17:47

Sample Preparation:

Preparation Method: [CALC]

Extract ID: 19D0210-01

Preparation Batch: [CALC]

Prepared: 16-Apr-2019

Final Volume: 1

Analyte	CAS Number	Dilution	Reporting Limit	Result	Units	Notes
Hardness		1	0.331	20.4	mg/L CaCO ₃	



City of Seattle

Public Utilities 23076 Military Road South

Kent WA, 98032

Project: Kent Highlands Landfill

Project Number: [none]

Project Manager: Min-Soon Yim

Reported:

22-Apr-2019 11:11

Middle

19D0210-02 (Water)

Metals and Metallic Compounds

Method: EPA 6010C

Sampled: 04/15/2019 12:23

Instrument: ICP2 Analyst: TCH

Analyzed: 04/18/2019 14:25

Sample Preparation:

Preparation Method: TWC EPA 3010A

Extract ID: 19D0210-02 A 01

Preparation Batch: BHD0424

Sample Size: 25 mL

Prepared: 16-Apr-2019

Final Volume: 25 mL

Analyte	CAS Number	Dilution	Detection Limit	Reporting Limit	Result	Units	Notes
Calcium	7440-70-2	1	0.0051	0.0500	5.37	mg/L	
Magnesium	7439-95-4	1	0.0160	0.0500	1.38	mg/L	



City of Seattle

Public Utilities 23076 Military Road South

Kent WA, 98032

Project: Kent Highlands Landfill

Project Number: [none]

Project Manager: Min-Soon Yim

Reported:

22-Apr-2019 11:11

Middle

19D0210-02 (Water)

Calculation

Method: SM 2340 B-97

Sampled: 04/15/2019 12:23

Instrument: [CALC] Analyst: TCH

Analyzed: 04/18/2019 14:25

Sample Preparation:

Preparation Method: [CALC]

Extract ID: 19D0210-02

Preparation Batch: [CALC]

Prepared: 16-Apr-2019

Final Volume: 1

Analyte	CAS Number	Dilution	Reporting Limit	Result	Units	Notes
Hardness		1	0.331	19.1	mg/L CaCO ₃	



City of Seattle

Public Utilities 23076 Military Road South

Kent WA, 98032

Project: Kent Highlands Landfill

Project Number: [none]

Project Manager: Min-Soon Yim

Reported:

22-Apr-2019 11:11

East

19D0210-03 (Water)

Metals and Metallic Compounds

Method: EPA 6010C

Sampled: 04/15/2019 12:26

Instrument: ICP2 Analyst: TCH

Analyzed: 04/18/2019 14:29

Sample Preparation:

Preparation Method: TWC EPA 3010A

Extract ID: 19D0210-03 A 01

Preparation Batch: BHD0424

Sample Size: 25 mL

Prepared: 16-Apr-2019

Final Volume: 25 mL

Analyte	CAS Number	Dilution	Detection Limit	Reporting Limit	Result	Units	Notes
Calcium	7440-70-2	1	0.0051	0.0500	5.33	mg/L	
Magnesium	7439-95-4	1	0.0160	0.0500	1.38	mg/L	



City of Seattle

Public Utilities 23076 Military Road South

Kent WA, 98032

Project: Kent Highlands Landfill

Project Number: [none]

Project Manager: Min-Soon Yim

Reported:

22-Apr-2019 11:11

East

19D0210-03 (Water)

Calculation

Method: SM 2340 B-97

Sampled: 04/15/2019 12:26

Instrument: [CALC] Analyst: TCH

Analyzed: 04/18/2019 14:29

Sample Preparation:

Preparation Method: [CALC]

Extract ID: 19D0210-03

Preparation Batch: [CALC]

Prepared: 16-Apr-2019

Final Volume: 1

Analyte	CAS Number	Dilution	Reporting Limit	Result	Units	Notes
Hardness		1	0.331	19.0	mg/L CaCO ₃	



City of Seattle

Public Utilities 23076 Military Road South

Kent WA, 98032

Project: Kent Highlands Landfill

Project Number: [none]

Project Manager: Min-Soon Yim

Reported:

22-Apr-2019 11:11

Metals and Metallic Compounds - Quality Control

Batch BHD0424 - TWC EPA 3010A

Instrument: ICP2 Analyst: TCH

QC Sample/Analyte	Result	Detection Limit	Reporting Limit	Units	Spike Level	Source Result	%REC Limits	RPD	RPD Limit	Notes
Blank (BHD0424-BLK1)										
Prepared: 16-Apr-2019 Analyzed: 17-Apr-2019 12:46										
Calcium	ND	0.0051	0.0500	mg/L						U
Magnesium	ND	0.0160	0.0500	mg/L						U
LCS (BHD0424-BS1)										
Prepared: 16-Apr-2019 Analyzed: 17-Apr-2019 13:20										
Calcium	10.5	0.0051	0.0500	mg/L	10.0		105 80-120			
Magnesium	10.8	0.0160	0.0500	mg/L	10.0		108 80-120			



City of Seattle

Public Utilities 23076 Military Road South

Kent WA, 98032

Project: Kent Highlands Landfill

Project Number: [none]

Project Manager: Min-Soon Yim

Reported:

22-Apr-2019 11:11

Certified Analyses included in this Report

Analyte	Certifications
EPA 6010C in Water	
Calcium	WADOE, NELAP, DoD-ELAP
Magnesium	WADOE, NELAP, DoD-ELAP

Code	Description	Number	Expires
ADEC	Alaska Dept of Environmental Conservation	17-015	01/31/2021
CALAP	California Department of Public Health CAELAP	2748	06/30/2019
DoD-ELAP	DoD-Environmental Laboratory Accreditation Program	66169	01/01/2021
NELAP	ORELAP - Oregon Laboratory Accreditation Program	WA100006-011	05/12/2019
WADOE	WA Dept of Ecology	C558	06/30/2019
WA-DW	Ecology - Drinking Water	C558	06/30/2019



City of Seattle

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Notes and Definitions

B	This analyte was detected in the method blank.
D	The reported value is from a dilution
J	Estimated concentration value detected below the reporting limit.
U	This analyte is not detected above the reporting limit (RL) or if noted, not detected above the limit of detection (LOD).
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference
[2C]	Indicates this result was quantified on the second column on a dual column analysis.

Appendix C

Leachate

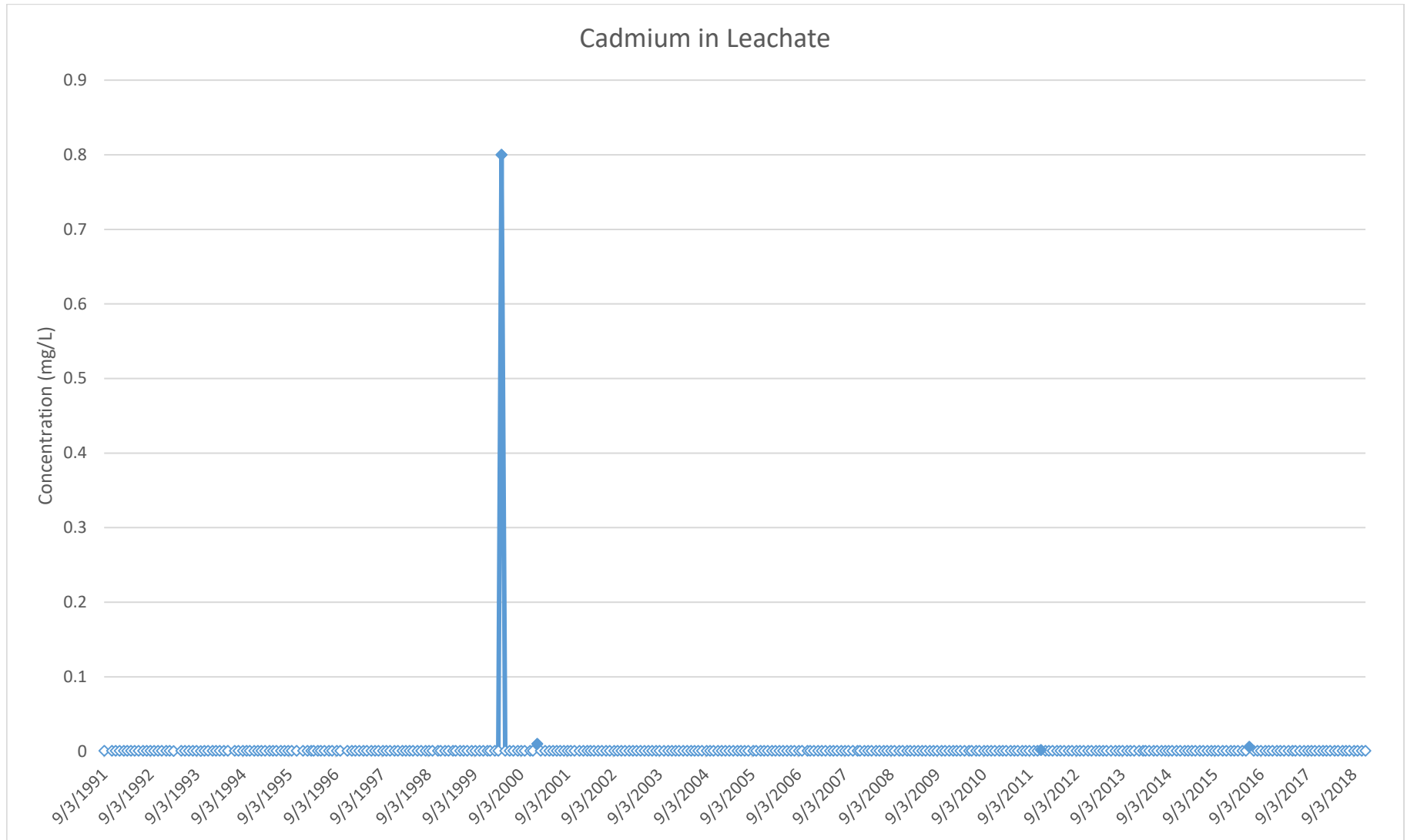


Time-Series Plots



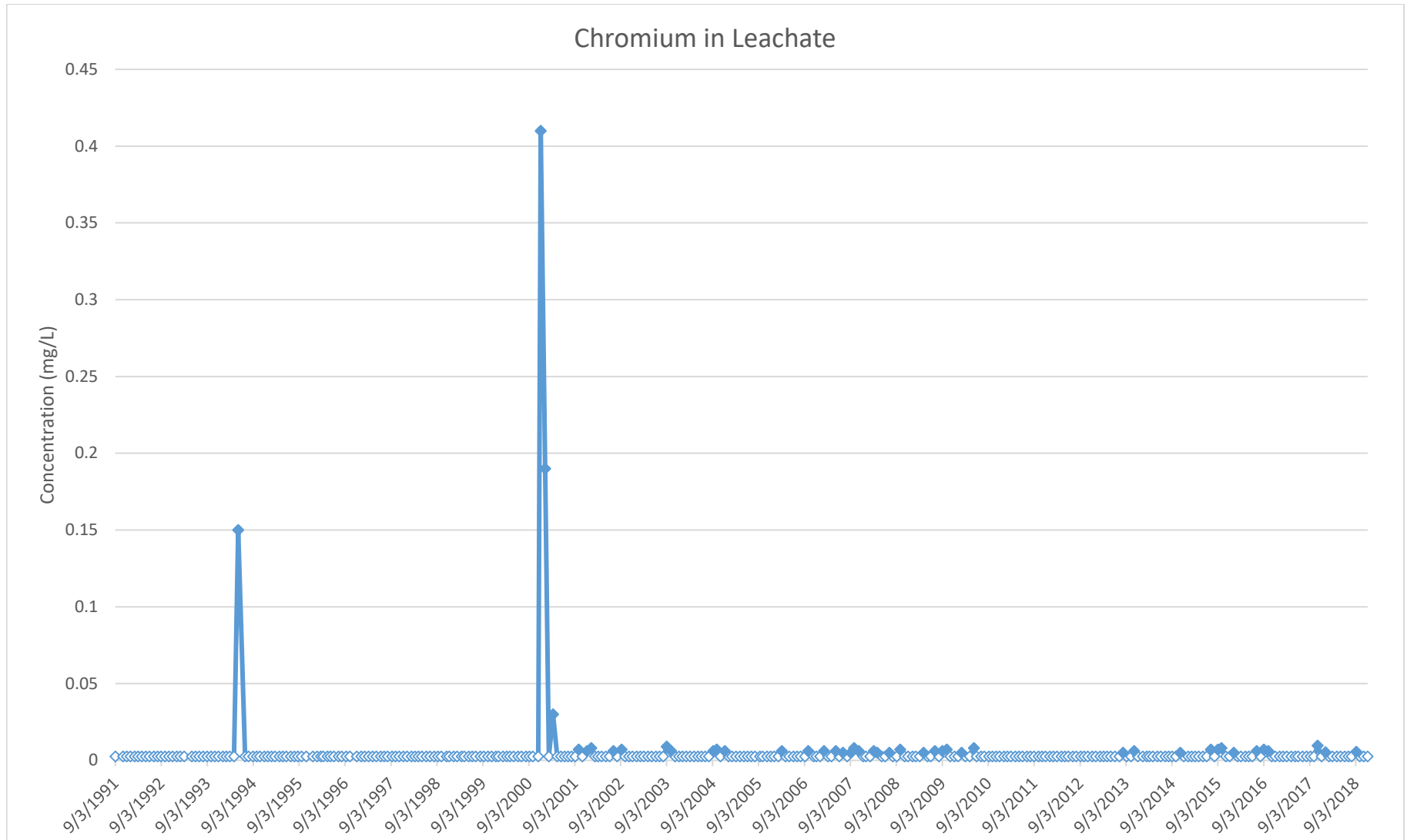
Kent Highlands Landfill Leachate Quality Wet Well Sampling Station

Non-detected values are shown with hollow symbols and at half the detection limit.



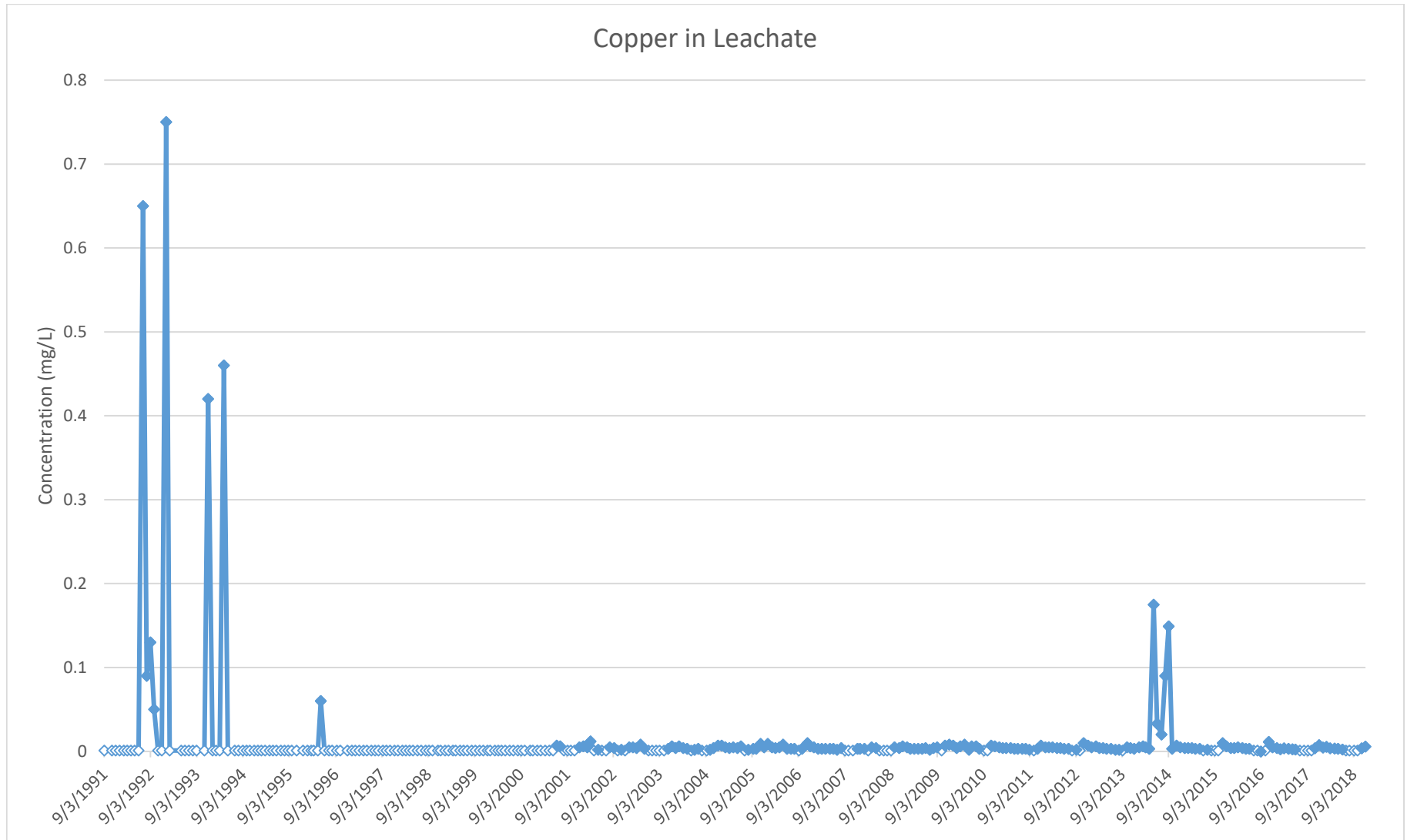
Kent Highlands Landfill Leachate Quality Wet Well Sampling Station

Non-detected values are shown with hollow symbols and at half the detection limit.

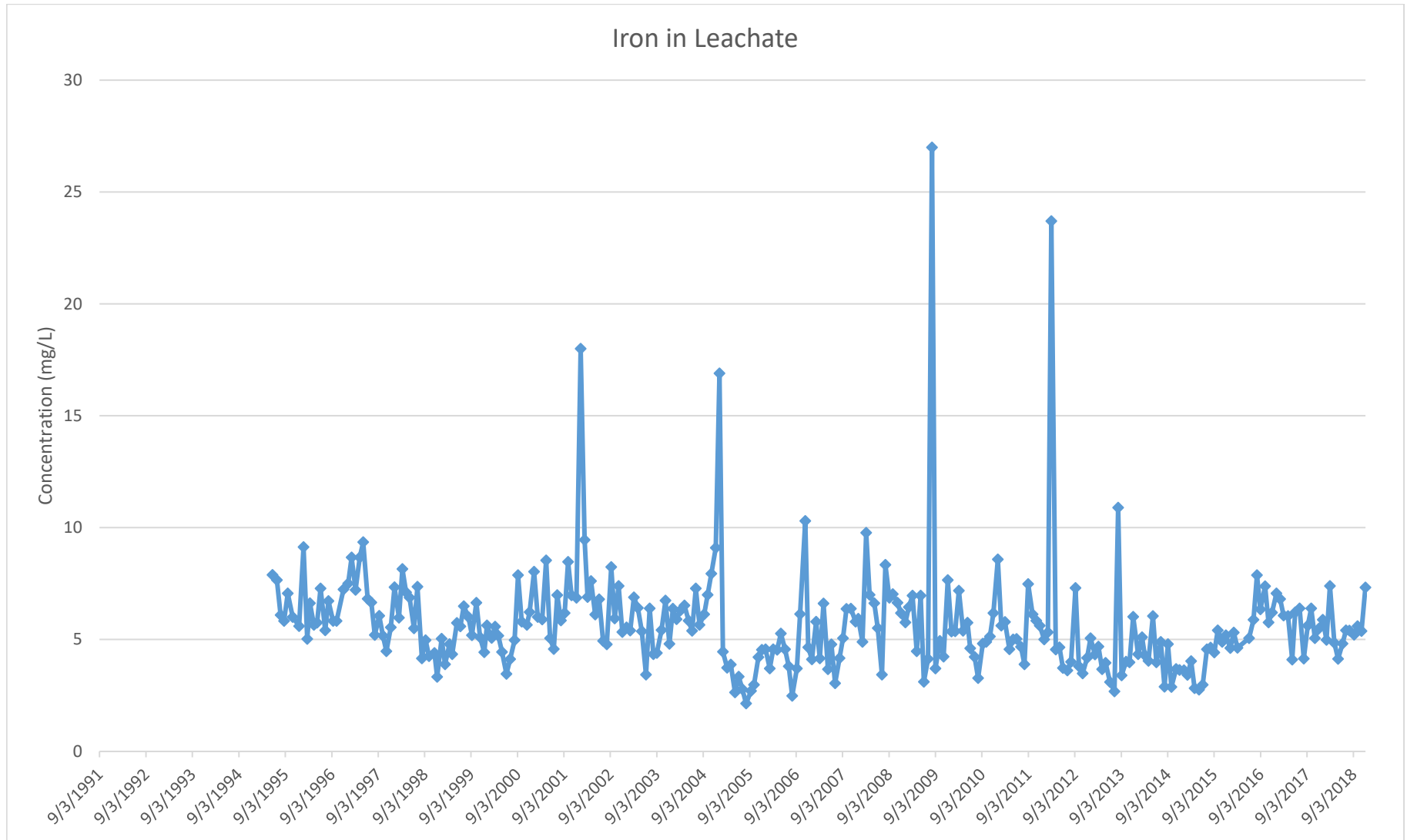


Kent Highlands Landfill Leachate Quality Wet Well Sampling Station

Non-detected values are shown with hollow symbols and at half the detection limit.

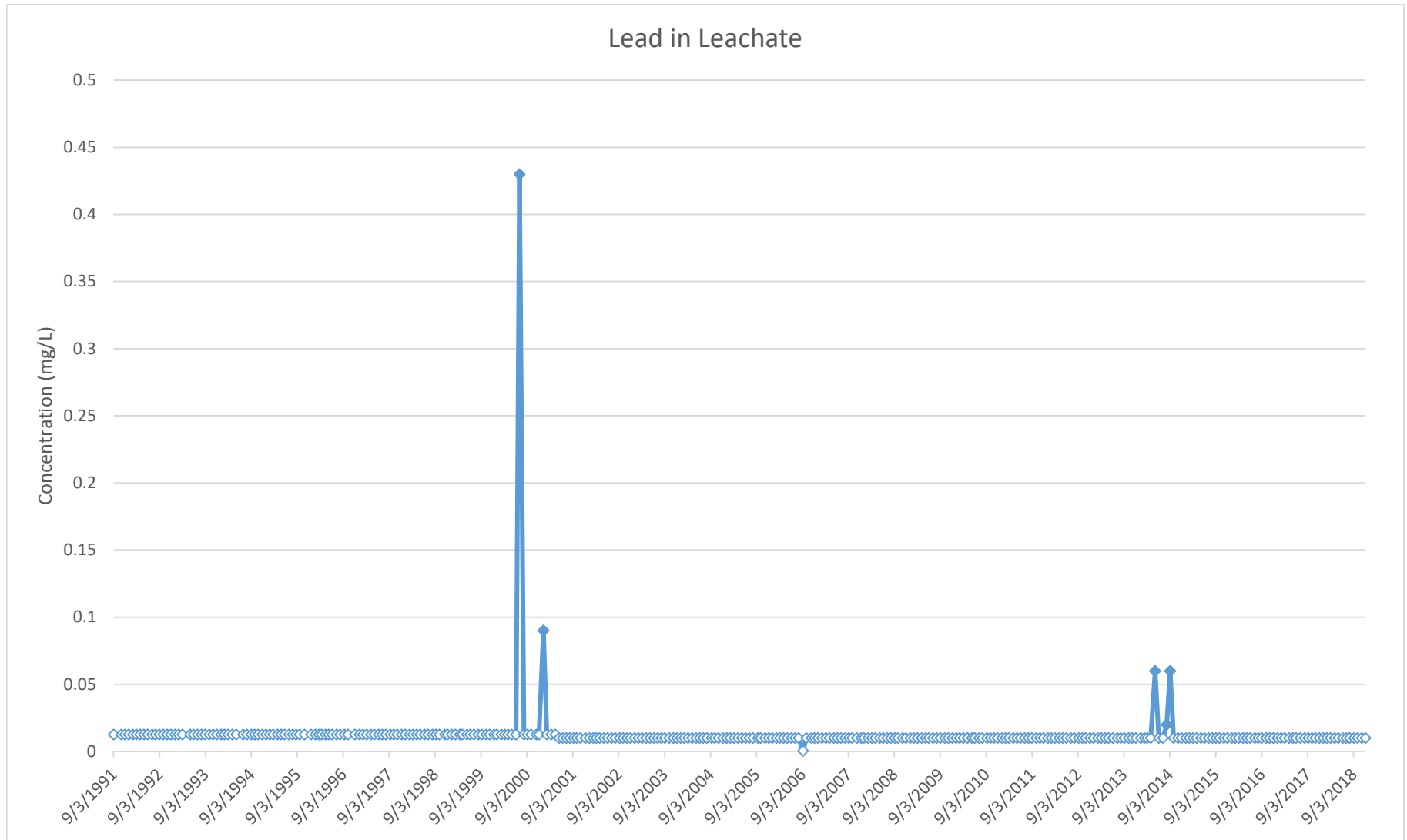


**Kent Highlands Landfill Leachate Quality
Wet Well Sampling Station**

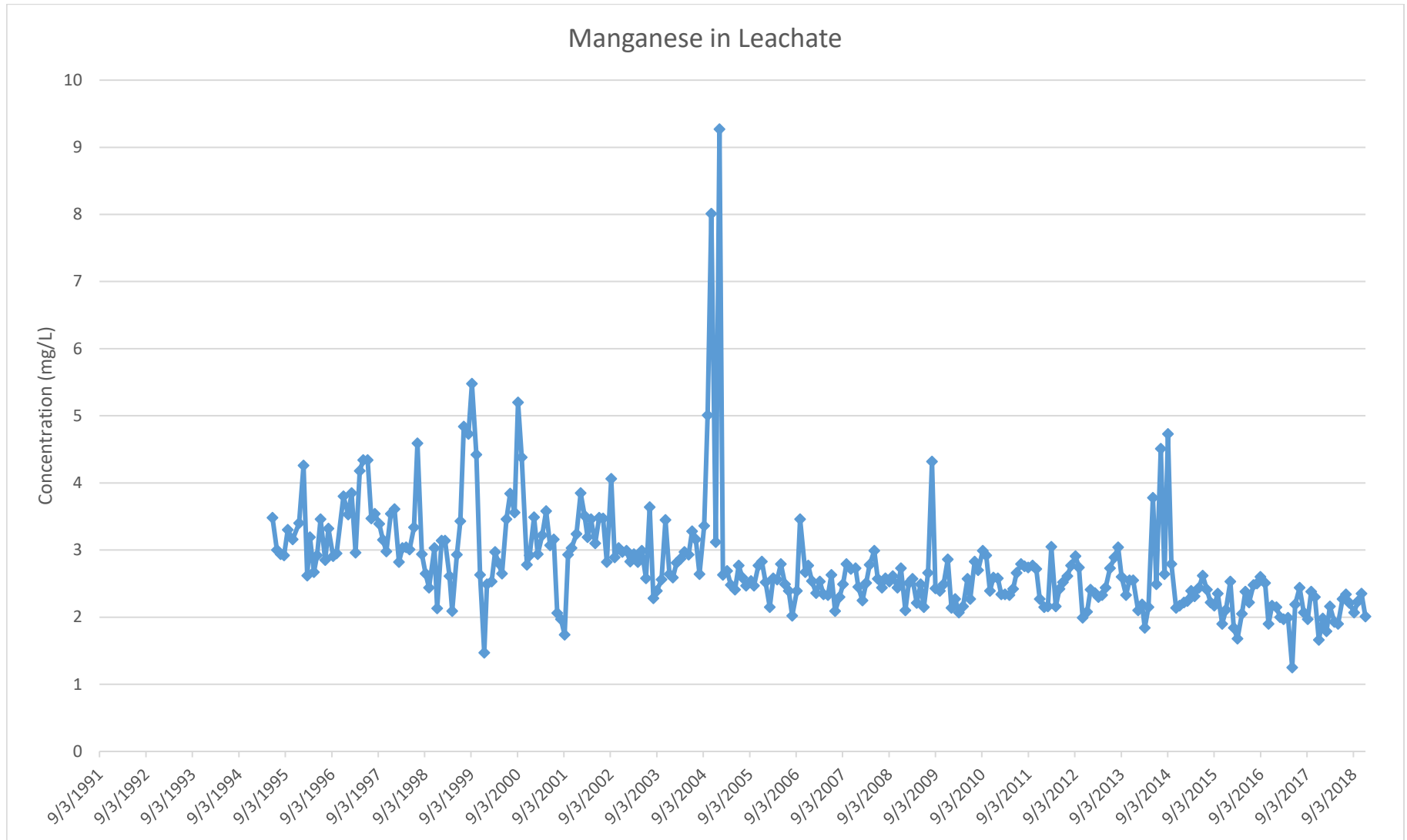


Kent Highlands Landfill Leachate Quality Wet Well Sampling Station

Non-detected values are shown with hollow symbols and at half the detection limit.

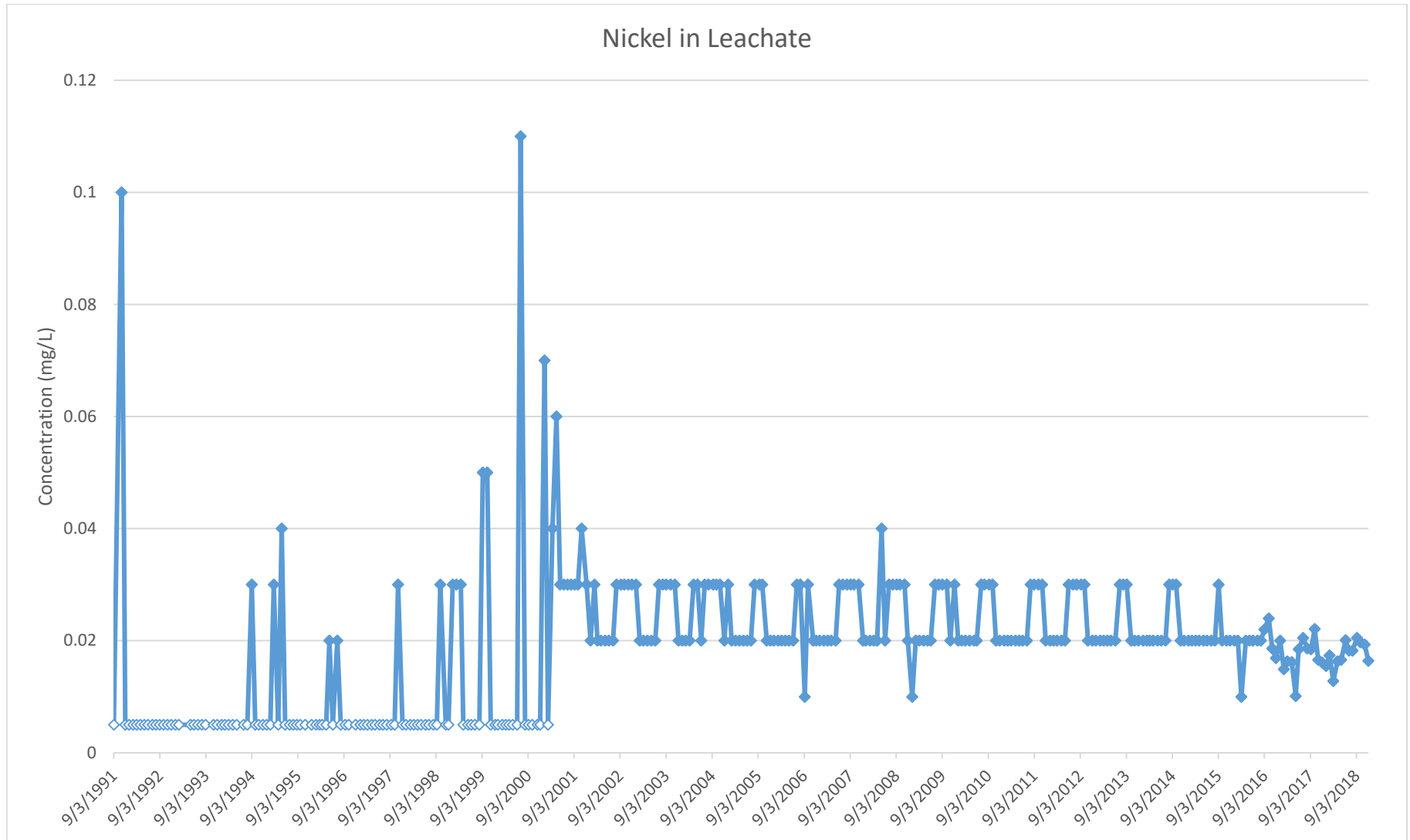


**Kent Highlands Landfill Leachate Quality
Wet Well Sampling Station**

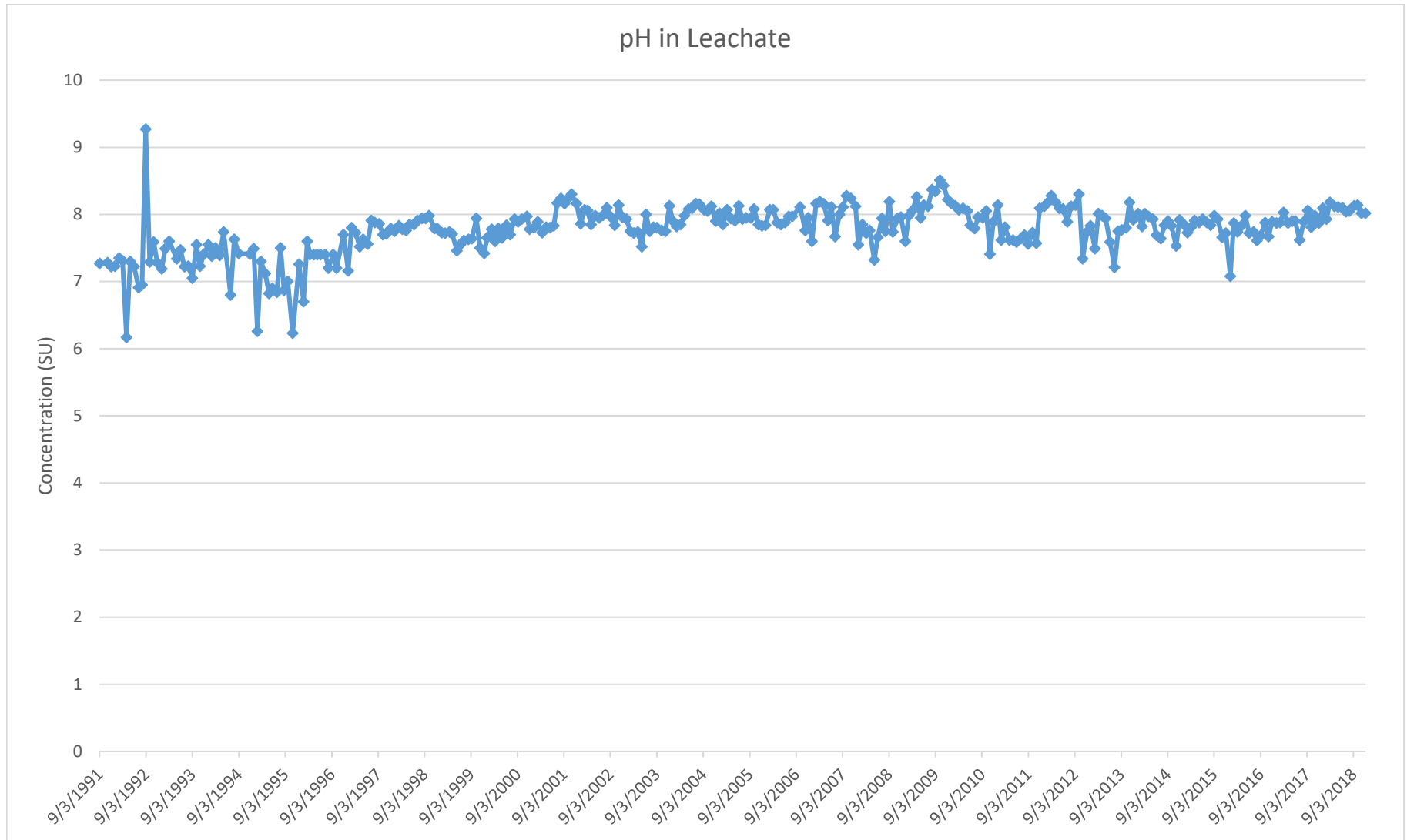


Kent Highlands Landfill Leachate Quality Wet Well Sampling Station

Non-detected values are shown with hollow symbols and at half the detection limit.

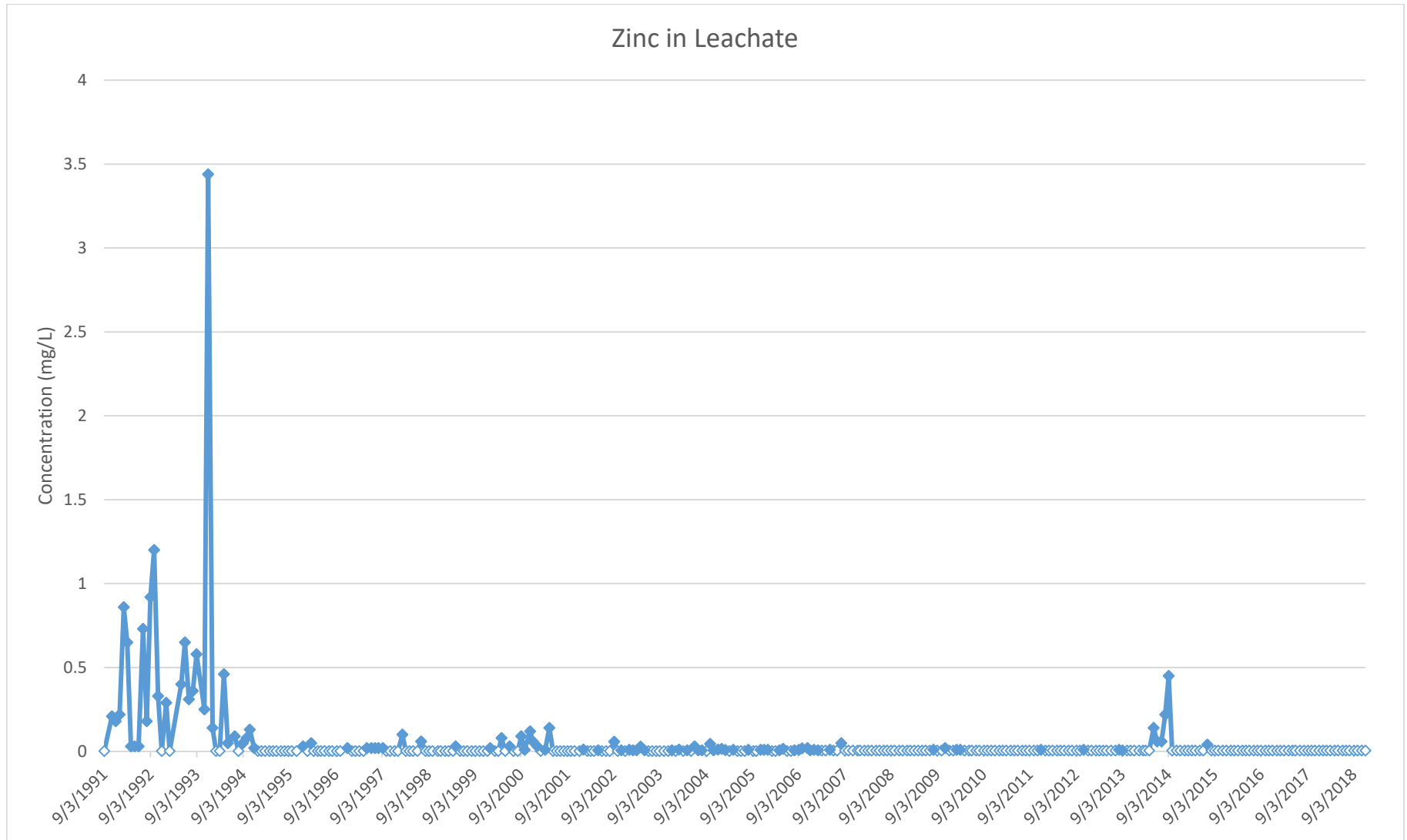


**Kent Highlands Landfill Leachate Quality
Wet Well Sampling Station**



Kent Highlands Landfill Leachate Quality Wet Well Sampling Station

Non-detected values are shown with hollow symbols and at half the detection limit.



Wastewater Discharge Permit





King County

Wastewater Treatment Division

Industrial Waste Program

Department of Natural Resources and Parks

201 South Jackson Street, Suite 513

Seattle, WA 98104-3855

206-477-5300 Fax 206-263-3001

TTY Relay: 711

March 27, 2019

CERTIFIED MAIL

RETURN RECEIPT REQUESTED

Min-Soon Yim
Seattle Public Utilities
23076 Military Road S.
Kent, WA 98032

Issuance of Renewed Wastewater Discharge Permit No. 7115-05 to Seattle Public Utilities by the King County Department of Natural Resources and Parks

Dear Mr. Min-Soon Yim:

The King County Industrial Waste Program (KCIW) has reviewed and processed your application for issuance of an industrial wastewater discharge permit in accordance with Chapter 90.48 RCW as Amended, Public Law 92-500, and King County Code 28.84.060.

The enclosed issued Permit No. 7115-05 covers the wastewater discharge from the Seattle, City of - SPU - Kent Highlands Landfill operation located at 23240 Military Road S., Kent, Washington. All discharges from this facility, and actions and reports relating thereto, shall be in accordance with the terms and conditions of this permit.

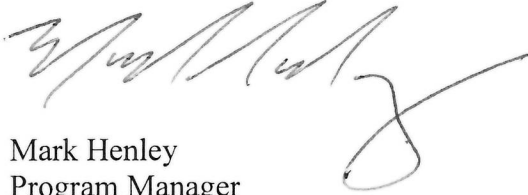
The enclosed Permit No. 7115-05 supersedes and cancels Permit No. 7115-04 effective April 3, 2019. King County Code 28.84 authorizes a fee for each Permit issued by the King County Department of Natural Resources and Parks. The current fee for issuance of a Permit is \$6000. King County will send an invoice for this amount.

If you have any questions about this permit or your wastewater discharge, please call Dana Heinz at 206-477-5457 or email her at dana.heinz@kingcounty.gov. You may also wish to visit our program's Internet pages at: www.kingcounty.gov/industrialwaste.

Min-Soon Yim
March 27, 2019
Page 2

Thank you for helping support our mission to protect public health and enhance the environment.

Sincerely,

A handwritten signature in black ink, appearing to read 'Mark Henley', with a long, sweeping horizontal stroke extending to the right.

Mark Henley
Program Manager

Enclosures

cc: Biniam Zelelow, Washington State Department of Ecology
Mark Lampard, K.C. WTD (Interceptor Discharge)

Permit No.: 7115-05
Issuance Date: March 27, 2019
Effective Date: April 3, 2019
Expiration Date: April 2, 2024



King County

WASTE DISCHARGE PERMIT

Department of Natural Resources and Parks
Industrial Waste Program
201 S. Jackson Street, Suite 513
Seattle, WA 98104-3855

In accordance with the provisions of Chapter 90.48 RCW as amended,
Public Law 92-500, and King County Code 28.84.060,
a Waste Discharge Permit is issued to:

Seattle, City of - SPU - Kent Highlands Landfill

Facility location: 23240 Military Road S.
Kent, WA 98032

Business hours phone: 206-233-2629

Emergency (24-hour) phone: 206-233-2629

Mailing address: 23076 Military Road S.
Kent, WA 98032

Permission is hereby granted to discharge industrial wastewater from the above-identified facility into the King County sewerage system in accordance with the effluent limitations and monitoring requirements set forth in this permit.

This permit is based on information provided in the permit application, which together with the following conditions and requirements are considered part of the permit. All requirements and ordinances of King County pertaining to the discharge of wastes into the King County sewerage system are hereby made a condition of this permit. All discharges and activities authorized herein shall be consistent with the terms and conditions of this permit.

This permit is not transferable without authorization from the King County Industrial Waste Program (KCIW). Failure to provide advance notice of a transfer renders this waste discharge permit voidable on the date of facility transfer.

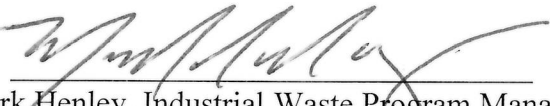
By 
Mark Henley, Industrial Waste Program Manager

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S2	Permit Summary and Company Identification
S3	Special Conditions or Compliance Schedule
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S5	Sample Site Access and Identification
S6	Notification Requirements
S7	Monitoring and Record Keeping
S8	Operations and Maintenance
S9	General Conditions
S10	Washington State Department of Ecology Conditions
	Company Fact Sheet
	King County Code – Title 28
	King County Local Limits

S1. EMERGENCY CONTACTS

KING COUNTY

Industrial Waste Program (8 a.m. – 5 p.m., weekdays):	206-477-5300
Dana Heinz, Industrial Waste Compliance Investigator:	206-477-5457
Mark Henley, Industrial Waste Program Manager:	206-263-6994

Your emergency contact after 5 p.m. weekdays and on weekends is:

South Treatment Plant:	206-263-1760
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If unable to reach anyone at this number call:

West Point Treatment Plant:	206-263-3801
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WASHINGTON STATE DEPARTMENT OF ECOLOGY

24-Hour emergency spill phone number:	425-649-7000
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S2. PERMIT SUMMARY AND COMPANY IDENTIFICATION

A. Summary Information

The following industrial waste discharge sites have been identified for this facility:

<i>Sample Site No.</i>	<i>Limit Type</i>	<i>Daily Maximum Discharge Volume (gpd)</i>	<i>Description</i>
A8019	King County Local Limits	175,000	Wet Well
A80192	King County Local Limits	NA	South 228th Street Manhole #2

Effluent limitations and self-monitoring requirements for this sample site are detailed in S4.A of this permit.

B. Reports

<i>Report Name</i>	<i>Section(s)</i>	<i>Due Date</i>
Monthly self-monitoring reports	S4.A	15th day of each month
14-Day Report: Discharge or permit violation	S4.D	Within 14 days after a discharge or permit violation becomes known
Slug/Spill Control Plan	S6.A	As requested by KCIW
5-Day Report: Slug discharge or spill	S6.A	Within five days after a slug discharge or spill
Installation/Upgrade of Pretreatment System Report	S6.C	Prior to installation or upgrade
Hazardous waste discharge notification	S6.D	Within 90 days after waste is identified through RCRA.
Washington State Department of Ecology Dangerous Waste Reports	S6.D	As requested by KCIW

C. Major Changes in the Renewed Permit

This renewed permit contains the following major changes since last issuance:

1. Since the last issuance of this permit, the renewed permit added updated standard language requiring the annual calibration or verification of flow meter calibration (see S3.A).
 2. The requirement to evaluate the need for flow-proportional composite was removed because this report has been received.
-
3. The requirement to submit a new and updated Slug Control Plan was removed because it has been received.

D. Company Identification

SIC Code No.:	4953
Hazardous Waste Generator No.:	WA0000013516
Industry Type:	Solid Waste - Landfill

S3. SPECIAL CONDITIONS OR COMPLIANCE SCHEDULE

A. Flow Meter Calibration and Calibration Verification

The following are requirements for the calibration and calibration verification of flow meters.

1. The permittee must use calibrated flow meters to measure discharge volume and follow the manufacturer's specification for calibration.
2. At least annually, the permittee shall verify the calibration of the flow meter(s) used to calculate the discharge volume from the industrial wastewater treatment systems.
 - a. The verification must be performed by qualified staff. This could be either permittee's employee or third party.
 - b. The verification may be performed on site or at a vendor site.
 - c. At a minimum flow meter verification must be conducted, either a) by discharge to or from a vessel of known volume, b) by use of another flow meter that is calibrated by an independent third party, or c) by recalibration by the original manufacturer or another vendor.
 - d. The acceptance limit for calibration verification is 90% -110% of the reference measurement. The permittee must re-calibrate the flow meter(s) per manufacturer's specifications if the verification fails. All self-monitoring data taken with flow meters that fail verification must be noted on self-monitoring reports until the subject flow meter is back within acceptance limits.
3. Flow meter calibration and verification must be documented and records must be obtained and be maintained on site for a minimum of three years.

B. Screening Level for Soluble Sulfide

1. Discharges that exceed the soluble sulfide screening level of 0.1 milligrams per liter (mg/L) have the potential to cause occupational health hazards in the sewage collection system or indicate that treatment has not been sufficient enough to remove hazardous waste characteristics.

2. Determination of the soluble sulfide concentration using an approved field test kit is acceptable.
3. For each exceedance of the screening level the permittee shall:
 - a. Take immediate action to stop the exceedance and notify KCIW within 24 hours of learning of the exceedance
 - b. Collect a sample and submit new data to KCIW within 14 days of becoming aware of the exceedance (or the next time discharge occurs if greater than 14 days)
 - c. Submit a written report within 14 days of learning of the exceedance (14-Day Report)
 - d. The report should explain the cause of the exceedance and corrective actions taken to respond to the sulfide exceedance and ensure ongoing compliance
4. The following conditions apply whenever KCIW monitoring or the permittee's self-monitoring results exceed the screening level for three out of four consecutive sampling events:
 - a. The permittee shall submit a plan indicating the steps that will be taken to ensure that discharges do not exceed screening levels.
 - b. This plan shall be submitted within 30 days from the third measurement indicating that the discharge exceeded the screening level, and indicate the steps that will be taken to reduce soluble sulfide concentrations so that they remain consistently below screening levels within 60 days.
5. If the submitted plan (required in Item 4) does not result in continued compliance with the screening limit, KCIW may require further action, which may include performing atmospheric hydrogen sulfide monitoring at a manhole designated by KCIW to assess for compliance with the King County local discharge limit of 10.0 parts per million, and/or establishing a soluble sulfide limit.

S4. EFFLUENT LIMITATIONS & SELF-MONITORING REQUIREMENTS

A. Effluent Limitations and Self-Monitoring Requirements:

1. The permittee shall comply with the following discharge limits and monitor its discharges to the King County sewerage system as specified below.

<i>Sample Site No.</i>	<i>Limit Type</i>	<i>Sample Site Description</i>			
A8019	King County Local Limits	Wet Well			
<i>Parameter</i>	<i>Daily Average (mg/L)</i>	<i>Instantaneous Maximum (mg/L)</i>	<i>Maximum Loading¹ (lbs/day)</i>	<i>Sampling Frequency</i>	<i>Sample Type</i>
Arsenic, Total ²	1.0	4.0	0.27	NA	NA
Cadmium, Total	0.5	0.6	0.17	Monthly	Composite
Chromium, Total	2.75	5.0	1.20	Monthly	Composite
Copper, Total	3.0	8.0	4.38	Monthly	Composite
Lead, Total	2.0	4.0	1.20	Monthly	Composite
Mercury, Total	0.1	0.2	0.06	NA	NA
Nickel, Total	2.5	5.0	2.49	Monthly	Composite
Silver, Total	1.0	3.0	0.44	NA	NA
Zinc, Total	5.0	10.0	7.30	Monthly	Composite
Soluble Sulfide	NA	0.1 ³	NA	Monthly	Grab
Cyanide, Amenable	2.0	3.0	NA	NA	NA
Nonpolar FOG	100	NA	NA	NA	NA
<i>pH (s.u.)</i>	<i>Daily Minimum</i>	<i>Minimum</i>	<i>Maximum</i>	Monthly	Grab
	5.5	5.0	12.0		
<i>Daily Maximum Discharge Volume (gpd)</i>	<i>Total Industrial Discharge Volume</i> 175, 000			Continuous	In-line Meter

¹ Applicable poundage limit copper and zinc equals the daily average concentration in mg/L, multiplied by the flow in million gallons per day, multiplied by 8.34. Applicable poundage limit for arsenic, cadmium, chromium, lead, mercury, nickel and silver have been adjusted to prevent significant increase of pollutants at South Treatment Plant influent.

² For the determination of total metals (which are equivalent to total recoverable metals) the sample is not filtered before processing.

³ Screening limit, see section S3.B for more information on how to respond to exceedances.

S4. EFFLUENT LIMITATIONS & SELF-MONITORING REQUIREMENTS

A. Effluent Limitations and Self-Monitoring Requirements (continued):

1. The permittee shall comply with the following discharge limits and monitor its discharges to the King County sewerage system as specified below.

<i>Sample Site No.</i>	<i>Limit Type</i>	<i>Sample Site Description</i>			
A80192	King County Limits	S. 228th St. MH No. 2 (second MH west of 68th Ave. S.)			
<i>Parameter</i>	<i>Daily Average (mg/L)</i>	<i>Instantaneous Maximum (mg/L)</i>	<i>Maximum Loading¹ (lb./day)</i>	<i>Sampling Frequency</i>	<i>Sample Type</i>
Atmospheric H ₂ S	NA	10.0	NA	NA	NA

2. A self-monitoring report of all required and non-required sampling must be filed no later than the 15th day of the time period following the reporting period (i.e., the 15th day of the following month for monthly reports). The permittee shall use the KCIW self-monitoring form to submit results unless an alternate form is approved by KCIW. If no discharge has occurred during the sampling period, the report shall be submitted notifying KCIW that no discharge has occurred.
3. The total volume discharged for any processing day shall be calculated by reading the volume passing through a flow meter, or shall be estimated using another KCIW approved method. The total volume for each processing day on which metal samples are collected shall be reported on self-monitoring reports. The total monthly discharge volume shall be reported on self-monitoring reports.
4. Volume and waste type from all batch discharges shall be recorded on the self-monitoring form.
5. For self-monitoring, the permittee shall collect composite samples in accordance with the following methods:
 - a. Heavy metals and organics parameters (other than volatile organics):
 - i. If time-proportioned composite sampling is authorized, a composite sample shall consist of four or more grab samples of equal volume collected at least 15 minutes apart and no more than two hours apart throughout the processing day from a well-mixed effluent chamber.

- ii. A flow-proportioned composite sample shall mean a sample composed of grab samples collected continuously or discretely, by hand or machine, in proportion to the flow at the time of collection or to the total flow since collection of the previous grab sample. The grab sample volume or frequency of grab collection may be varied in proportion to flow.
 - b. A cyanide composite sample shall consist of four grab samples of equal volume collected at least 15 minutes apart and no more than two hours apart from a well-mixed effluent chamber. Each aliquot shall be collected, treated, and preserved in the field in accordance with 40 CFR 136 and 403 appendix E. Treated aliquots may be collected into a single container and analyzed as one sample.
 - c. For volatile organic analysis (VOA), a composite sample shall consist of four grab samples of equal volume collected at least 15 minutes apart and no more than two hours apart from a well-mixed effluent chamber. Each aliquot shall be collected and preserved in the field in accordance with 40 CFR 136. The individual grab samples may be composited (at the laboratory) prior to analysis.
 - d. The three nonpolar fats, oils, and grease (FOG) grab samples shall be of equal volume, collected at least five minutes apart, and analyzed separately. When using U.S. EPA approved protocols specified in 40 CFR Part 136, the individual grab samples may be composited (at the laboratory) prior to analysis. The result of the composite sample or the average of the concentrations of the three grab samples may be reported as Total FOG unless the value is 100 mg/L or greater, in which case the concentration of nonpolar FOG must be reported.
 - e. For situations where the only discharge for the 24-hour period is of short duration (e.g., batch discharge), resulting in the inability to collect composite samples that meet the definitions described in Number 5.a-c above, the permittee shall collect grab samples every 15 minutes during the duration of the discharge. Regardless of the number of aliquots making up this sample, it will be used to evaluate compliance with daily average limits.
6. Discharges of greater than pH 12 are prohibited unless the permittee obtains written approval (email is sufficient) from KCIW prior to discharge and is subject to special conditions to protect worker safety, the collection system and treatment works.

7. Should an automatic pH recording system fail (if required by permit or compliance order), the permittee shall manually check the pH at least four times per hour. Any discharge without a pH record shall be considered a violation of this permit.

B. Non-required Self-Monitoring

All sampling data collected by the permittee and analyzed using procedures approved by 40 CFR 136 or approved alternatives shall be submitted to KCIW whether required as part of this permit or done voluntarily by the permittee.

C. Violation Criteria

1. Wastewater from regulated processes shall comply with the effluent limitations prior to dilution with other wastewaters unless a fixed alternative discharge limit is approved by KCIW. (See Section S8.C.4 for further information about dilution.)
2. A review of any violation will include consideration of testing accuracy prior to enforcement action.
3. The more restrictive limitation (concentration or mass) shall prevail for determining violations.
4. Daily average and maximum monthly average limits apply to composite samples and to grab samples from short-term batch discharges.
5. Instantaneous maximum limits apply to grab samples, with the exception of grab samples from short-term batch discharges.
6. The instantaneous minimum pH limit is violated whenever any single grab sample or any instantaneous recording is less than pH 5. The daily minimum pH limit is violated whenever any continuous recording of 15 minutes or longer remains below pH 5.5 or when each pH value of four consecutive grab samples collected at 15-minute intervals or longer within a 24-hour period remains below pH 5.5.
7. The limit for nonpolar FOG (mineral origin) is violated when the arithmetic mean of the concentration of three grab samples (taken no more frequently than in five minute intervals), or when the result of a composite sample exceeds 100 mg/L.

D. Response when Violations are Detected

1. When monitoring data shows a violation, the permittee shall:
 - a. Take immediate action to stop the violation and notify KCIW within 24 hours of learning of the violation.
 - b. Collect a sample and submit new data to KCIW within 14 days of becoming aware of the violation.
 - c. Submit a written report within 14 days of learning of the violation (*14-Day Report*). The report should explain the cause of the violation and corrective actions taken to respond to the violation and ensure ongoing compliance.
2. In the event the permittee is unable to comply with any of the conditions of this permit because of a breakdown of equipment or facilities, an accident caused by human error, negligence, or any other cause, such as an act of nature, the permittee shall:
 - a. Take immediate action to stop, contain, and clean up the unauthorized discharges and correct the problem.
 - b. Immediately notify KCIW and, if after 5 p.m. weekdays and on weekends, call the emergency King County treatment plant phone number in Section S1 so steps can be taken to prevent damage to the sewerage system.
 - c. Submit a written report within 14 days of the event (*14-Day Report*) describing the breakdown, the actual quantity and quality of resulting waste discharged, corrective action taken, and the steps taken to prevent a recurrence.
3. Whenever an effluent check shows a pH violation, as defined in King County Code 28.84.060.N "Violations," the permittee shall take immediate steps to bring the discharge back into compliance. If this is not possible, the permittee shall cease discharge.
4. Compliance with these requirements does not relieve the permittee from responsibility to maintain continuous compliance with the conditions of this permit or the resulting liability for failure to comply.

E. Limitations Applicable to All Sites

1. General

The permittee's discharge shall not interfere with the operation of the King County sewerage system, cause King County to exceed its NPDES permit limits, or endanger local utility or King County sewer workers.

The permittee's discharge shall not violate any discharge standard, limitation, or specific prohibition of King County Code 28.84.060 or local discharge limits applicable on the date of discharge. (See Section 28.84.060.D-F of King County Code.)

Prohibitions previously referenced include, but are not limited to, substances causing fire or explosion hazard, flow obstruction, excess oxygen demand, and toxic vapors.

Limitations listed in Section S4 include, but are not limited to, restrictions on settleable solids, organic compounds, hydrogen sulfide, and polar FOG.

2. Organic compounds

No person shall discharge any organic pollutants that result in the presence of toxic gases, vapors, or fumes within a public or private sewer or treatment works in a quantity that may cause acute worker health and safety problems.

Organic pollutants subject to this restriction include, but are not limited to any organic compound listed in 40 CFR 433.11 (e) Total Toxic Organics (TTO) definition, acetone, 2-butanone (MEK), 4-methyl-2-pentanone (MIBK), and xylenes.

Dischargers are required to implement good "housekeeping" and best management practices in order to prevent the discharge of a concentrated form of any of the preceding organic pollutants.

3. Lower explosive limit (LEL)

At no time shall two successive readings on an explosive hazard meter at the point of discharge into the King County sewerage system (or at any point in the system) be more than 5 percent of the LEL. No single reading shall exceed 10 percent of the LEL.

4. Closed cup flashpoint

Discharges shall not have a closed cup flashpoint of less than 140° Fahrenheit or 60° Centigrade using test methods specified in 40 CFR 261.21.

5. Polar fats, oils, and grease

Dischargers of polar fats, oils, and grease (animal and/or vegetable origin) shall minimize free-floating polar fats, oils, and grease (FOG). Dischargers may not add emulsifying agents exclusively for the purposes of emulsifying free-floating FOG.

Discharges of polar FOG shall not result in significant accumulations, which either alone or in combination with other wastes are capable of obstructing flow or interfering with the operation or performance of sewer works or treatment facilities.

6. Temperature

Discharge shall not cause the temperature of the influent at the King County treatment works to exceed 40° C (104° F). The temperature shall not exceed 65° C (150° F) at the point of discharge from the industrial source to public sewers and/or the metropolitan sewerage system.

7. Settleable Solids

Discharge shall not have a settleable solids volume greater than 7 ml/L.

F. Responsibility for Compliance

It is the responsibility of the permittee to ensure that all effluent limitations of this permit are met whether or not self-monitoring for the parameter is required.

S5. SAMPLE SITE ACCESS AND IDENTIFICATION

- A. Unobstructed access to sample sites shall be available to authorized KCIW personnel during normal operating hours. The permittee shall be responsible for providing alternate sample sites in the event of obstruction of access or upon evidence of tampering with the monitoring equipment.
 - B. The permittee shall allow KCIW to permanently label the sample sites used to collect wastewater samples.
-
- C. The permittee shall, at all reasonable times, allow authorized representatives of KCIW to enter, inspect, and sample as specified in King County Code 28.84.060.L, "Inspection and Sampling of Industrial Users."

S6. NOTIFICATION REQUIREMENTS

A. Spills and Slug Discharges

1. The permittee shall notify KCIW immediately in the event of a spill or slug discharge to the sanitary sewer. A written report regarding the cause of the spill and/or slug discharge shall be submitted to KCIW within five days of the date of occurrence. The report should explain the cause of the violation and corrective actions taken to respond to the violation and ensure ongoing compliance. (See Section S8.B for spill and slug discharge control procedures.)
2. Following a spill and/or slug discharge, KCIW may require the submission or modification of a spill/slug control plan.

B. Changes in Discharge Characteristics

The permittee shall inform KCIW prior to any facility or manufacturing changes that will result in:

1. Introduction of new wastewater pollutants
2. Significant alteration in the volume (greater than 20 percent increase from permit application) or character of the pollutants discharged to the King County sewerage system
3. Discharge of waste streams not listed in the permit application
4. Addition of a new point of discharge or a new chemical, process, product, manufacturing line, or waste processing activity
5. Changes in the potential for spill or slug discharges

No change shall be made until plans have been approved and either written permission or a new or modified permit has been received. In no case are any changes permitted that will cause violation of the effluent limitations specified herein.

C. Installation/Upgrade of Pretreatment System

A Professional Engineer's report per WAC 173-240 must be approved prior to installation or upgrade of pretreatment system.

D. Hazardous Wastes

1. Within 180 days following commencement of discharge or permit issuance, whichever is later, the permittee must notify KCIW, the U.S. EPA, and the Washington State Department of Ecology of any discharge of a listed or characteristic RCRA hazardous waste. Identifying the listed or characteristic RCRA hazardous wastes on the permittee's wastewater discharge permit application serves as notice to KCIW. This is a one-time notification requirement. The contents of the notification may vary according to the quantity of waste discharged. (See "Notification of the Discharge of Hazardous Wastes" in King County Code 28.84.060.)
2. Whenever the U.S. EPA publishes new RCRA rules identifying additional hazardous wastes or new characteristics of hazardous wastes, the permittee must notify KCIW, the U.S. EPA, and the Washington State Department of Ecology if any of these wastes are discharged to the King County sewerage system. Notification must occur within 90 days of the effective date of the published regulation.

E. Continuing Discharge after Permit Expiration Date

This permit does not authorize discharge after its expiration date. If the permittee wishes to continue discharge after the expiration date, an application must be filed for reissuance of this permit at least 180 days prior to the expiration date. If the permittee submits its re-application in the time specified herein, the permittee shall be deemed to have an effective waste discharge permit or authorization until KCIW issues or denies the new waste discharge permit. If the permittee fails to file its re-application in the time period specified herein, the permittee will be deemed to be discharging without a discharge permit after the current permit's expiration date.

S7. MONITORING AND RECORD KEEPING

A. Record Keeping and Retention

1. The permittee shall maintain records relating to all permitted discharges to the King County sewerage system including routine maintenance, waste disposal dates, manifests, self-monitoring reports, analytical lab results, pH monitoring records, and flow records.
2. All records required by the permit shall be available for review at reasonable times by authorized representatives of KCIW.
3. Records of all such testing shall be retained for a period of three years unless litigation or the direction of KCIW requires an extension of that time.

B. Recording of Results

For each measurement or sample taken to comply with this permit, the permittee shall record the following information:

1. Date, exact place, and time of sampling
2. Dates the analyses were performed
3. Person who performed the analyses
4. Analytical techniques or methods used
5. Results of all analyses

C. Representative Sampling

Samples and measurements taken to meet the requirements of this condition shall be representative of the volume and nature of the monitored discharge.

D. Test Procedures

All analyses shall be performed in accordance with procedures established by the administrator of the U.S. EPA pursuant to Section 304(g) of the federal Clean Water Act and contained in 40 CFR Part 136 and amendments thereto or with any other test procedure approved in writing by the U.S. EPA administrator, and/or KCIW. In all cases, except total dissolved sulfide, the detection limit shall be well below the discharge limit. Where 40 CFR Part 136 does not include a sampling or

analytical technique for the pollutant in question, sampling and analysis shall be performed in accordance with the procedures set forth in the U.S. EPA publication entitled *Sampling and Analysis Procedures for Screening of Industrial Effluents or Priority Pollutants*, April 1977 or *Standard Methods*, latest edition and amendments thereto, or with any other sampling and analytical procedures approved by the U.S. EPA.

E. Lab Accreditation

All self-monitoring data submitted to KCIW that required a laboratory analysis must have been performed by a laboratory accredited by the Washington State Department of Ecology for each parameter tested. This does not apply to field measurements performed by the permittee such as pH, temperature, flow, atmospheric hydrogen sulfide, total dissolved sulfides, settleable solids by Imhoff cone, or process control information.

F. Falsifying Information

The act of knowingly falsifying, tampering with, or knowingly rendering inaccurate any monitoring device, report, or method required pursuant to the federal pretreatment standards, King County Code 28.84.060, or special conditions of this permit shall constitute a violation of this permit, and shall be subject to the legal remedies available under "Revocation of Permit or Authorization" and "Penalties and Enforcements" in King County Code 28.84.060.

G. Toxicity Testing

If KCIW is required by the Washington State Department of Ecology to determine the source of a pattern of acute toxicity pursuant to its treatment plant NPDES permit, the permittee may be required to test its effluent for toxicity according to procedures to be determined by KCIW.

H. Signatory Requirements for Industrial User Reports

Any report required by this permit shall meet the signatory and certification requirements listed in King County Code 28.84.060 and King County Code 28.82.

S8. OPERATIONS AND MAINTENANCE

The permittee shall use waste preventative practices to reduce or eliminate contaminant loading to the King County sewerage system. These practices shall include proper chemical storage, spill prevention and notification, and maintenance and operation of any required pretreatment equipment.

A. Chemical Storage

Chemical solutions, solid chemicals, waste materials, oils, and solvents shall be stored in a manner that will prevent the entry of these materials into the King County sewerage system.

1. Non-compatible chemicals shall be segregated and securely stored in separate containment areas that prevent mixing of incompatible or reactive materials.
2. The permittee shall install shut-off devices to all drains in any hazardous waste storage areas.
3. Chemicals shall be dispensed only in roofed and bermed areas that eliminate potential spills to the King County sewerage system.
4. All empty barrels that have not been cleaned (steam-cleaned or triple-rinsed) shall be adequately stoppered and stored in an upright position.
5. Process tanks shall be located in a bermed, roofed, secured area capable of containing 110 percent of the volume of the largest tank. The permittee shall ensure that process solutions are used and stored in such a manner as to minimize spills of concentrated solutions to the sanitary sewer.

B. Spill or Slug Discharge Control Procedures (See Section S6.A)

1. In the event of a concentrated solution spill such as a tank failure, the permittee shall not discharge any spilled solution to the metropolitan sewer system unless laboratory test results indicate that the substance meets the conditions of this permit and the permittee receives approval from KCIW.
2. Concentrated waste or spilled chemicals that do not meet, or are not treated to meet, the discharge conditions of this permit shall be transported off site for disposal at a facility approved by the Washington State Department of Ecology or appropriate county health department.

3. The permittee shall maintain and inspect all process solution tanks on a regular basis. Any leaks shall be repaired promptly.
4. The permittee shall use spill prevention practices to preclude the discharge of liquids, solids, or gases which by reason of their nature or quantity are, or may be, sufficient either alone or by interaction with other substances to cause fire or explosion.
5. All process tanks and chemical storage containers shall be accurately labeled. Emergency phone numbers of King County, the fire department, the permittee's 24-hour corporate contact, and Washington State Department of Ecology shall be posted at all sites that KCIW requires.
6. The permittee shall ensure that concentrated waste from process tank filters and other equipment is prevented from entering the sanitary sewer unless it is treated to meet the discharge conditions of this permit.
7. The permittee shall maintain and use product recovery options such as drag-out rinses for each plating bath or process as required to meet the discharge conditions of this permit. Recovered materials shall not be discharged to the sanitary sewer unless they are treated to meet the discharge conditions of this permit.

C. Pretreatment Equipment Maintenance and Operations

1. All pretreatment systems used to bring the permittee's discharge into compliance with King County's discharge limitations shall be maintained continuously in satisfactory and effective operations by the permittee at the permittee's expense, and shall be subject to periodic inspections by authorized KCIW personnel. These systems shall be attended at all times during discharge to the King County sewerage system. In the event that such equipment fails, the permittee must notify KCIW immediately and take spill prevention precautions.
2. The permittee shall not initiate construction or modification of a pretreatment system prior to receiving KCIW approval of plans and specifications per WAC 173-240. In addition, KCIW may require an engineering report and an operations and maintenance manual.
3. KCIW shall be contacted before the beginning of any limited experimental modifications or new equipment testing that could reasonably be expected to affect effluent quality or quantity. This experimental work shall proceed only after securing written approval from KCIW and following the permittee's adherence to any applicable special conditions.

4. The effluent limitations specified in this permit are to be met by treatment of the wastes for pollutant removal. The use of municipal water, groundwater, seawater, stormwater, or other materials, including waste products, for the purpose of diluting a waste to achieve those limitations is prohibited.
5. The permittee shall adequately maintain and efficiently operate all treatment or control facilities or systems installed or used by the permittee to achieve compliance with the terms and conditions of this permit.

D. Water/Sewer Meter Requirements

The permittee shall obtain or maintain access to a water or sewer meter that can provide accurate information regarding industrial process wastewater and cooling water discharge to the sewer. Another method of volume determination may be used only upon approval by KCIW.

E. Solid Waste

1. The permittee shall handle and dispose of all solid waste material (as defined in WAC 173-304-100) not otherwise authorized by this permit in such a manner as to prevent its entry into the King County sewerage system.
2. All covers, screening devices, sumps, hoppers, conveyors, and other facilities provided for the recovery and handling of solid wastes are to be maintained in an efficient operating condition.

F. Stormwater

Stormwater, surface water, groundwater, and roof runoff shall be excluded, except where specifically authorized by this permit or King County Code 28.84.060, from the King County sewerage system.

S9. GENERAL CONDITIONS

- A.** The discharge of any pollutant more frequently than, or at a level in excess of, that identified and authorized by this permit shall constitute a violation of the terms and conditions of this permit. Whenever the permittee refuses to take corrective action or continues the violating condition, the imposition of civil penalties including fines up to \$10,000 for each violation per day and/or termination of this permit may result. Termination of this permit may require disposal of the industrial waste in some manner other than into the public sewer, private sewer, or side sewer tributary to the King County sewerage system at the expense of the person holding the permit. Any person causing damage to a public sewer or treatment facility by discharges in violation of the terms and conditions of this permit shall be liable for any such damage incurred by King County as a result of such damage or discharge. Where criminal enforcement action is considered in a particular case, that case may be referred to state or federal authorities.
- B.** The diversion or bypass of any discharge from any pretreatment facility utilized by the permittee to maintain compliance with the terms of this permit is prohibited except where unavoidable to prevent loss of life or severe property damage. The procedure outlined in Section S4.D shall be followed in case of such a diversion or bypass.
- C.** After notice and opportunity for a hearing, this permit may be modified, suspended, or revoked in whole or in part during its terms for those causes cited in King County Code 28.84.060.
- D.** If a toxic standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established under Section 307(a) of the federal Clean Water Act for a toxic pollutant, which is present in the discharge authorized herein, and such standard or prohibition is more stringent than any limitation upon such pollutant in this permit, this permit will be revised or modified in accordance with the toxic effluent standard or prohibition and the permittee shall be so notified. Section 307(a) requires that the administrator of the U.S. EPA shall promulgate effluent standards (or prohibitions) for toxic pollutants that he or she has listed as such.
- E.** Nothing in this permit shall be construed as excusing the permittee from compliance with any applicable federal, state, or local statutes, ordinances, or regulations.
- F.** All requirements and ordinances of the U.S. EPA and the Washington State Department of Ecology pertaining to hazardous and toxic wastes, disposal facilities, and discharge of wastes into the King County sewerage system, are hereby made a condition of this permit.

S10. WASHINGTON STATE DEPARTMENT OF ECOLOGY CONDITIONS

This permit does not constitute authority for discharge into waters of the state. Any such discharge is subject to enforcement action by the Washington State Department of Ecology.

Upon issuance of this permit, the permittee assumes the responsibility to abide by the following environmental requirements and any other appropriate regulations stipulated by the Department of Ecology. **The Department of Ecology retains authority to enforce these permit conditions (RCW 70.105 and RCW 90.48).**

A. Conditions to Protect Ground and Surface Waters

1. Contaminated waters or wastes shall not be discharged to state waters.
2. Boiler blow down and water shall not be discharged to state waters.
3. Solid chemicals, chemical solutions, waste materials, oils, and solvents shall be stored in a manner that will prevent the entry of these materials into state, ground, or surface waters, and in a manner that will prevent spillage by overfilling, tipping, or rupture.
4. The permittee shall handle and dispose of all solid waste material in such a manner as to not cause any adverse effect on ground or surface water quality.
5. Filtered solids or sludge shall be stored in such a manner that drainage from this material is prevented from either draining across public rights-of-way or entering the local storm drain system or the groundwater.
6. No emulsifiers or dispersants are to be used on waters of the state without approval from the Department of Ecology.
7. If corrosive processing solutions are used, the processing/plating floor shall be sealed with corrosion resistant material that prevents leakage. This coating shall be repaired or replaced as needed.

Questions regarding the implementation of conditions outlined in Section S10 should be directed to the regulatory authority, the Washington State Department of Ecology, at 425-649-7000 (Northwest Regional Office, 3190 160th Avenue SE, Bellevue, Washington 98008-5452).



Industrial Waste Program Company Fact Sheet

March 27, 2019

COMPANY INFORMATION

Company/Agency name: Seattle, City of - SPU - Kent Highlands Landfill
Facility address: 23240 Military Road S.
Kent, WA 98032
Mailing address: 23076 Military Road S.
Kent, WA 98032
Treatment plant: South Treatment Plant
Corp. contact & phone: Min-Soon Yim, 206-233-2629
Site contact & phone: Min-Soon Yim, 206-233-2629
Company/Agency type: Solid Waste - Landfill
Days operating: 365
SIC number: 4953
EPA ID number: WA0000013516
Compliance investigator: Dana Heinz

PERMIT INFORMATION

Permit number: 7115-05
Effective date: April 3, 2019
Expiration date: April 2, 2024

Description of sample sites, limit types, and discharge volumes:

Sample Site No.	Description	Limit Type	Maximum Discharge Volume (gallons per day)
A8019	Wet Well	King County Local Limits	175,000
A80192	South 228th Street Manhole #2	King County Local Limits	NA

MONITORING FEE PARAMETER

Sample Site No.	Fee Type
A8019	Heavy Metals Fee Parameter (ICR)

PERMIT PROCESSING

Permit number: 7115-05

Action	Date
Application due	October 04, 2018
Application received	September 07, 2018
Application sent to local sewer agency	September 17, 2018
Inspection date	October 9, 2018
Final publication date	June 29, 1978
Published volume	400,000 gallons per day
Draft issued	March 13, 2019
Final issued	March 27, 2019

COMMENTS

Nature of Business

Kent Highlands Landfill was an active municipal garbage landfill until 1986. The site was closed and covered at that time and monitored for leachate that is produced by rainfall. Originally permitted to discharge 400,000 gallons per day (gpd), this figure was reduced to 200,000 gpd after on-site spring water drainage was segregated from the leachate waste stream and diverted to the Green River. The company requested that the flow rate be reduced to 175,000 gpd.

Sources of Wastewater

Biotic decomposition of landfilled materials generates landfill leachate.

Treatment System

Landfill leachate is collected via a system of pipes and directed to a settling aeration pond and pumped via an on-site force main to the local sewer line.

Compliance History

Compliance with permit conditions and discharge limitations over the past permit cycle has been excellent. Concentrations of all metals are consistently much lower than discharge limits or non-detect. (See attached graphs.) Over the last five-year permit cycle, Kent Highlands Landfill has received the following awards:

2014: Gold

2015: Gold

2016: Gold and Commitment-to-Compliance

- (The Commitment-to-Compliance Award honors companies that earn the Gold Award for five consecutive years.)

2017: Gold

2018: To be determined

King County Monitoring: In the last five years, KCIW did not report any discharge violations.

Self-Monitoring: In the last five years, Kent Highlands Landfill did not self-report any discharge violations and submitted all reports on time.

Trends in Discharge of Pollutants of Concern

A compliance review of Kent Highlands Landfill for the past five years indicated that cadmium, chromium, copper, lead, nickel, zinc, pH and sulfides are the primary pollutants of concern. A review of Kent Highlands Landfill self-monitoring and KCIW's monitoring data over the last five years indicates excellent compliance with pollutants of concern, as indicated and required by KCIW local discharge limits.

- **Total Monthly Flow:**

The total monthly flow data collected by Kent Highlands Landfill over the last five years indicates the flow is directly correlated with the months that typically have higher rainfall in the area. During these months the flow increases. (See attached graph). **Note:** there were no daily discharge exceedances during this period.

- **pH:**

Over the last five years, Kent Highlands Landfill has not self-reported any pH violations. KCIW collects a grab pH sample twice per year. In the past five years, KCIW has not collected any pH discharge violations. (See attached graphs).

- **Metals:**

Over the past five years, the following metals were analyzed by KCIW and all results were within discharge limits (See attached graphs).

Parameter	Composite Results (mg/L)	Composite Limits (mg/L)	Grab Results (mg/L)	Grab Limits (mg/L)
Arsenic	Non-Detect – 0.019	1.0	Non-Detect – 0.021	4.0
Cadmium	Non-Detect	0.5	Non-Detect	0.6
Chromium	Non-Detect – 0.0032	2.75	Non-Detect – 0.0035	5.0
Copper	0.0031 – 0.0089	3.0	0.0023 – 0.006	8.0
Lead	Non-Detect	2.0	Non-Detect	4.0
Nickel	0.015 – 0.022	2.5	0.015 – 0.024	5.0
Silver	Non-Detect	1.0	Non-Detect	3.0
Zinc	Non-Detect – 0.008	5.0	Non-Detect - 0.0086	10.0

Over the past five years, the following metals were self-monitored by Kent Highlands Landfill all results were within discharge limits (See attached graph).

Parameter	Composite Results (mg/L)	Composite Limit (mg/L)
Cadmium	Non-Detect – 0.006	0.5
Chromium	Non-Detect – 0.0096	2.75
Copper	Non-Detect – 0.175	3.0

Lead	Non-Detect – 0.06	2.0
Nickel	0.01 – 0.03	2.5
Zinc	Non-Detect – 0.45	5.0

- **Total Toxic Organics:**

KCIW conducts total toxic organics (TTO) sampling, consisting of volatile organic compounds (VOCs) and base neutral acids (BNAs). These compounds were consistently reported below the detection limits. There was one detection of Diethyl Phthalate in the effluent from site A8019 during King County monitoring. This sample was below screening levels.

Collect Date	Parameter	Composite Results (mg/L)	Discharge Screening Limits (mg/L)
19-Mar-18	Diethyl Phthalate (CAS) 84-66-2	0.011	N/A

- **Sulfides (Atmospheric H₂S and Soluble):**

KCIW conducts annual atmospheric H₂S monitoring from sample site A80192 located on South 228th Street, Manhole #2 and Kent Highlands Landfill collects monthly soluble sulfides (grab) from sample site A8019. Over the last five years the data suggests no change in these pollutants.

Monitoring Type	Number of Samples (2014 – 2018)	Highest Value	Limit	Date(s)
Atmospheric H ₂ S (KCIW sampling)	10	0.0 ppm	10 ppm	Various
Soluble sulfide (Self-monitoring sampling)	67	0.1	0.1 mg/L ¹	Various

¹ 0.1 mg/L is the accuracy of the field test for soluble sulfide, also known as Total Dissolved Sulfides (TDS)

Slug and/or Spill Control Plan

As a federally regulated Significant Industrial User, Kent Highlands Landfill is required to have a Slug Discharge Control Plan. This requirement is in accordance with 40 CFR 403.8(f)(2)(vi) of the federal pretreatment regulations. The purpose of this requirement is to ensure that the permittee has appropriate measures in place to prevent and respond to potential spills and slug discharges to the sanitary sewer system. Kent Highlands Landfill submitted a Slug Discharge Control Plan on May 29, 2014. The Slug Discharge Control Plan was reviewed by KCIW and found to be sufficient.

Self-Monitoring Requirements

Kent Highlands Landfill is required to submit monthly self-monitoring reports for metals (Cd, Cr, Cu, Pb, Ni and Zn), soluble sulfide, pH, daily discharge volume, maximum daily discharge volume, and the total monthly discharge volume.

King County Compliance Monitoring Program

Monitoring Methods

Physical samples: Time composite is representative for daily average limits. Both KCIW and self-monitoring composite samples are collected by time composite sampling method.

In 2014, KCIW approved time-based composite sampling for this facility under their existing Permit No. 7114-04. Based on Kent Highland Landfill's submittals and review of the processes, King County determined that time-based composite sampling yielded representative samples. The processes and pretreatment remain the same in this new permit. With this permit, time-based composite sampling remains an approved sampling method to determine compliance.

pH monitoring: grab pH samples. Kent Highlands Landfill collects a grab pH each month. KCIW collects a grab pH sample twice per year.

Flow monitoring: Effluent meter.

Special Conditions

Condition A: The permittee is required to verify the calibration of the effluent flow meter annually to ensure that the meter is operating accurately.

Condition B: Clarifies the sampling and reporting requirements for soluble sulfide testing.

Limit Calculations

Kent Highlands Landfill is regulated as a non-categorical Significant Industrial User (SIU), therefore King County's Local Limits apply. Kent Highlands Landfill is considered an SIU because they discharge an average of 25,000 gallons per day or more of process wastewater. Applicable mass loading limits for arsenic, cadmium, chromium, lead, mercury, nickel and silver have been adjusted to prevent significant increase in pollutants at South Treatment Plant.

Changes since the Last Permit

Since the last issuance of this permit, the renewed permit includes updated standard language requiring the annual calibration or verification of flow meter calibration (see S3.A).

The requirement to submit a flow-proportional composite evaluation was removed because the report was received by KCIW, and a determination of the applicable composite sampling method was approved.

The requirement to submit a new and updated Slug Control Plan was removed because it has been received and deemed to be sufficient by KCIW staff.

Comments

Publication: NA

Application: There were no comments from the component agency.

First draft: March 18, 2019 - Min-Soon Yim, Utility Manager for the Kent Highlands Landfill, informed KCIW via email that City of Seattle Public Utilities had no comments on the draft permit. In addition, there were no comments made by the component agency.

March 27, 2019 – Biniam Zelelow, Environmental Engineer, WA Dept. of Ecology, commented via email:

“This permit should provide more than enough protection for KC’s infrastructure from landfill leachate. The only thing I can add is one of our landfill permits just for you guys reference. The fact sheet has some really good reference material. Otherwise, your permit is in fact much more stringent than Ecology’s permit the same pollutant point source.”

KCIW Response - none

Second draft: NA

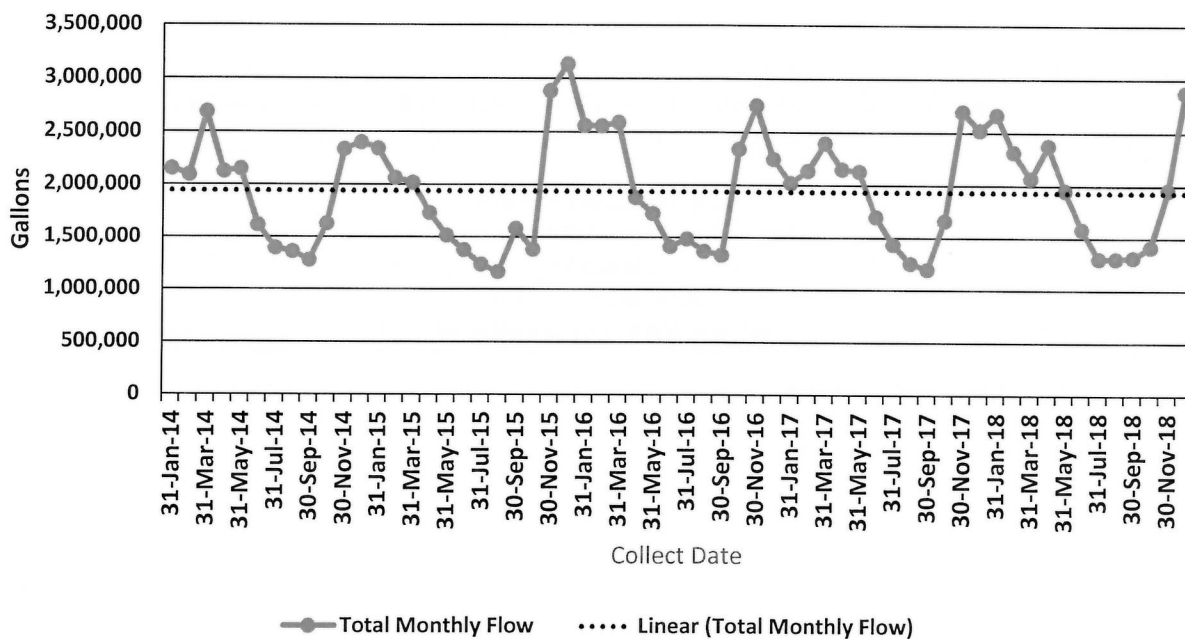
Safety

This facility has potentially hazardous conditions including, but not limited to:

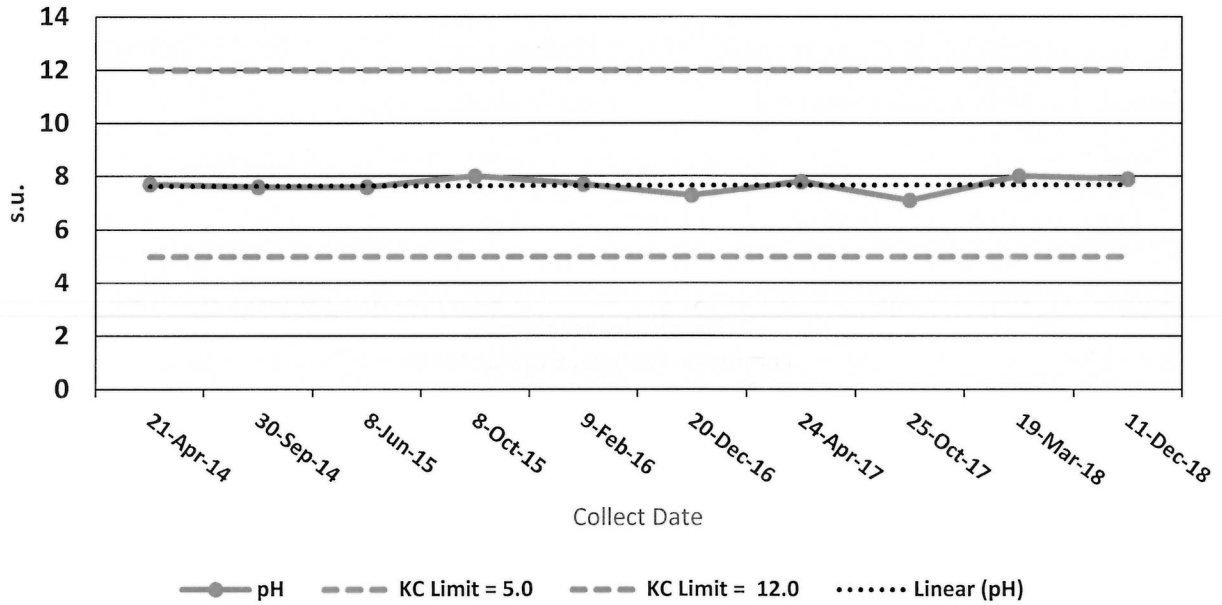
1. Water – Aeration pond with steep sides
2. Methane gas generating and burning
3. Steep and uneven surfaces
4. Electrical equipment
5. Possible vehicle and heavy equipment on narrow roadways

Site appropriate PPE should include, but not be limited to steel-toe shoes, safety vest, hard hat, and safety glasses.

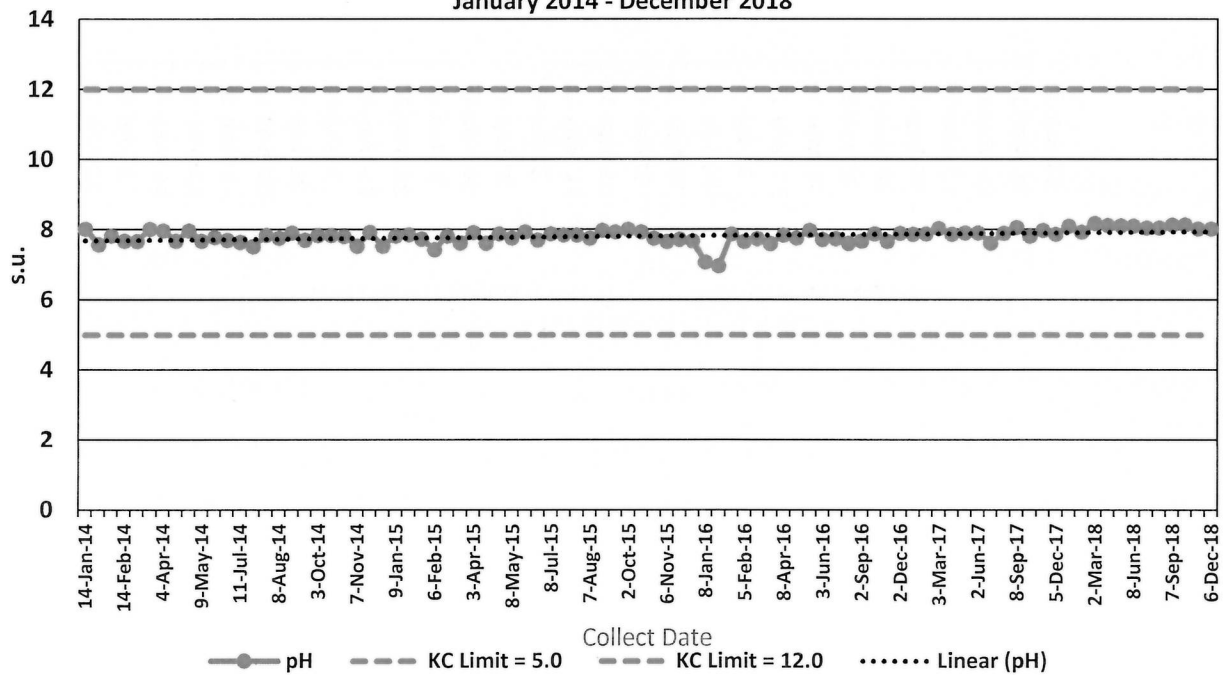
Kent Highlands Landfill
 Permit No. 7714-05, Site No. A8019
 Total Monthly Flow (gallons)
 Self-monitoring only
 January 2014 - December 2018



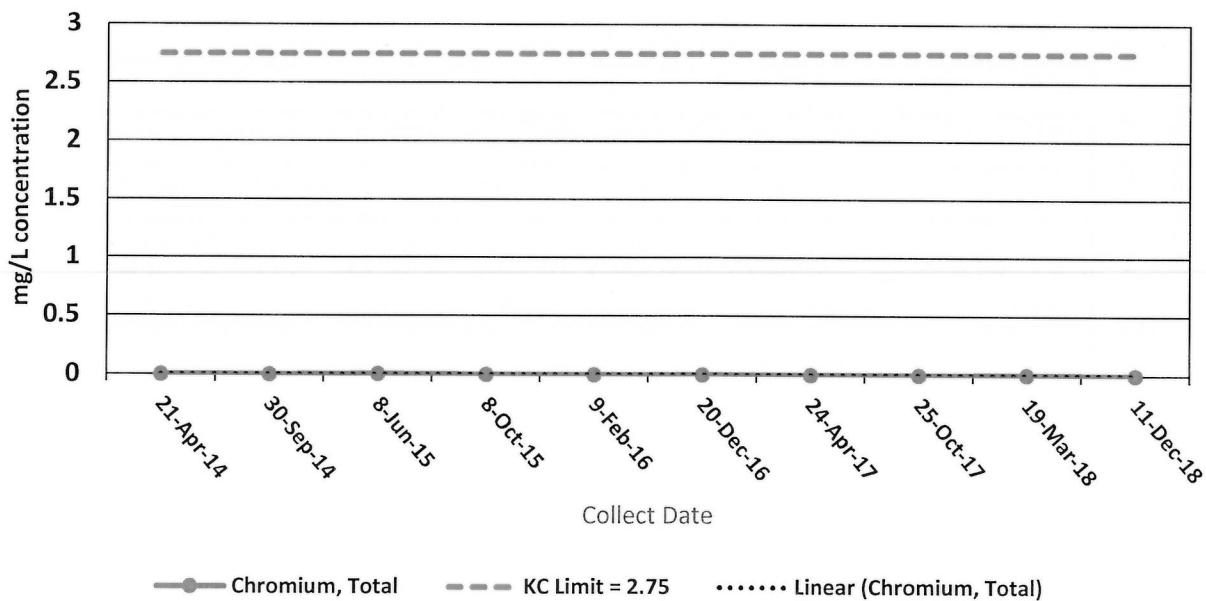
Kent Highlands Landfill
 Permit No. 7714-05, Site No. A8019
 pH (grab)
 KCIW monitoring only
 January 2014 - December 2018



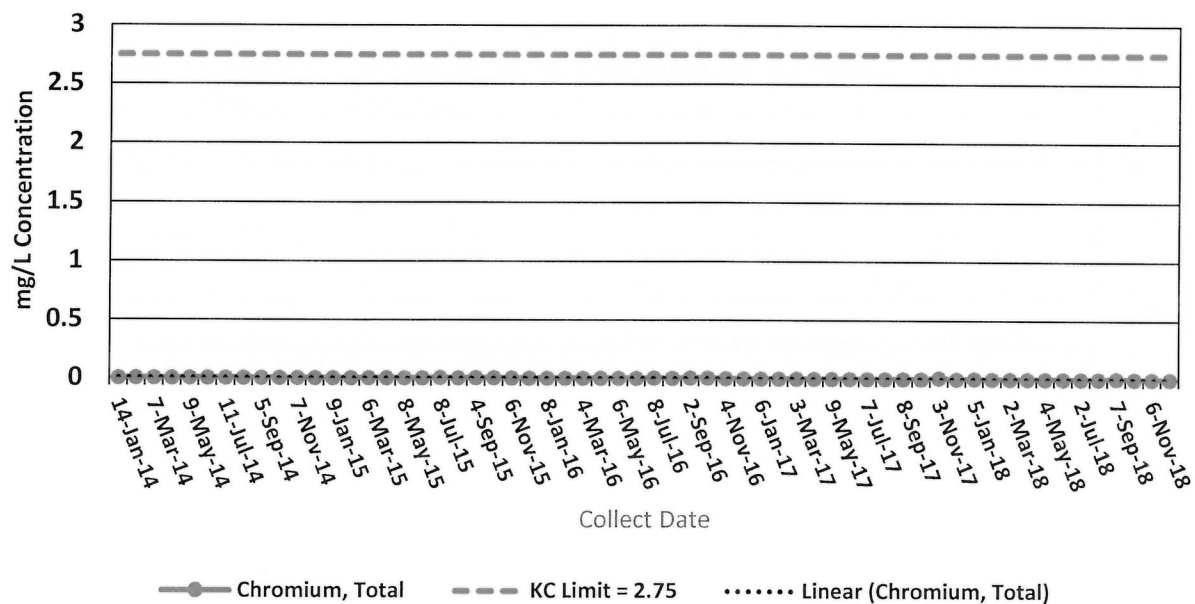
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 Permit No. 7714-05, Site No. A8019
 pH (grab)
 Self-monitoring only
 January 2014 - December 2018



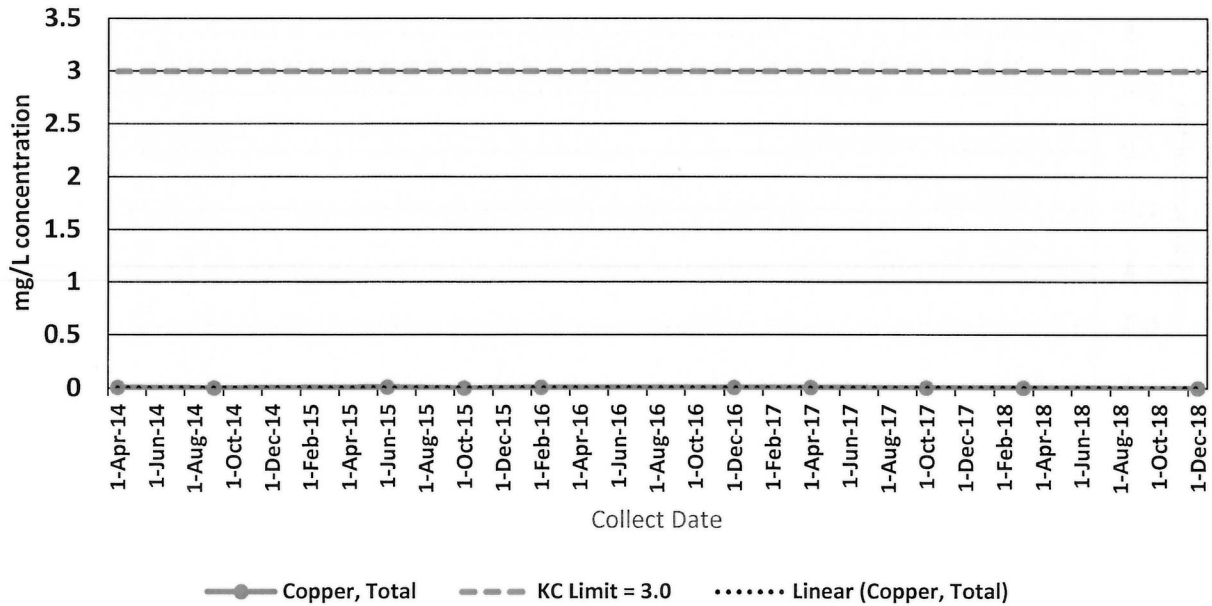
Kent Highlands Landfill
 Permit No. 7115-05, Site No. A8019
 Chromium, total (composite)
 KCIW data only
 January 2014 - December 2018



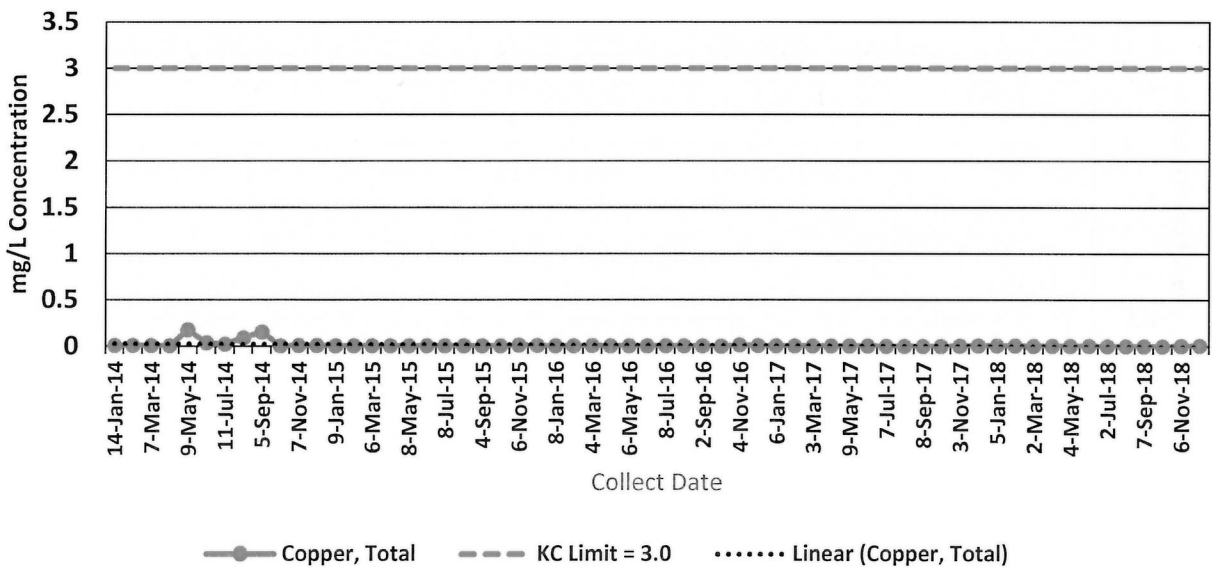
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 Chromium, total (composite)
 Self-monitoring data only
 January 2014 - December 2018



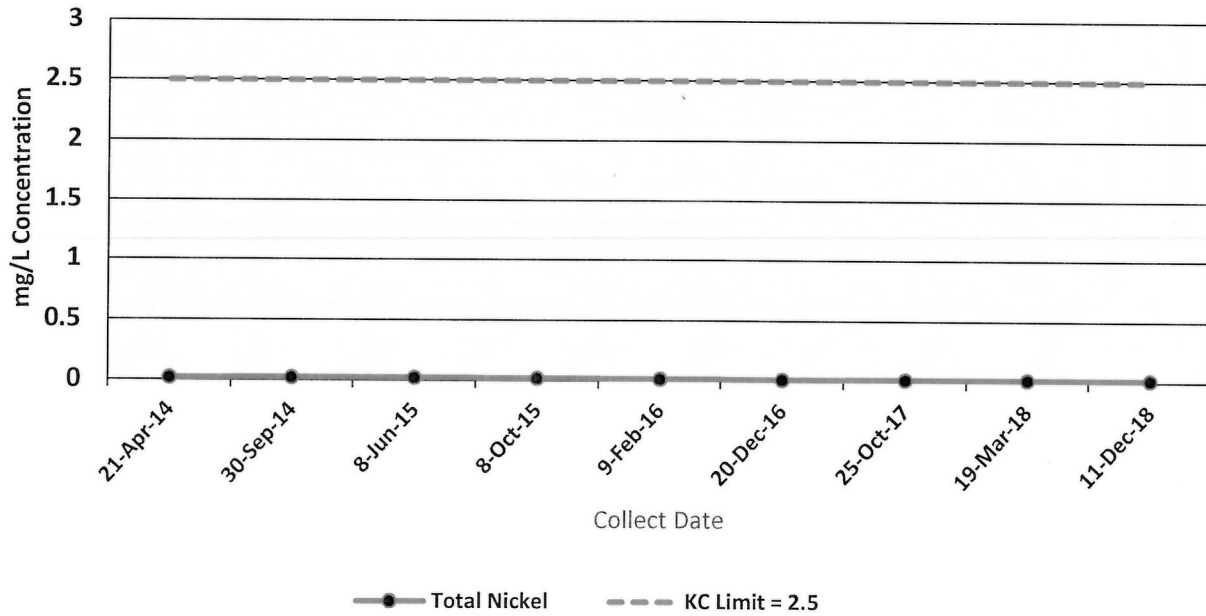
Kent Highlands Landfill
 Permit No. 7115-05, Site No. A8019
 Copper, total (composite)
 KCIW data only
 January 2014 - December 2018



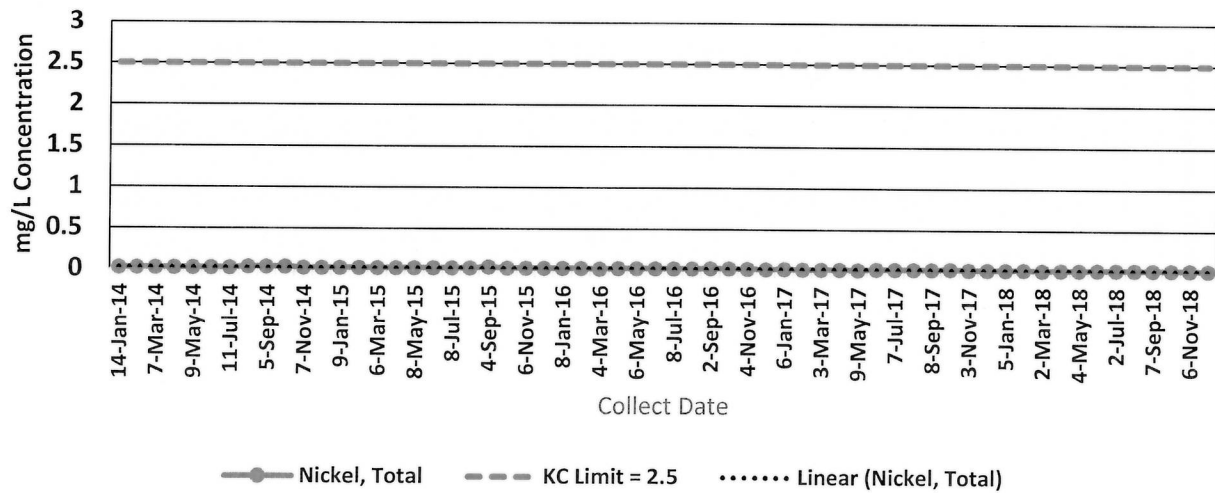
Kent Highlands Landfill
 Permit No. 7714-05, Site No. A8019
 Copper, total (composite)
 Self-monitoring data only
 January 2014 - December 2018



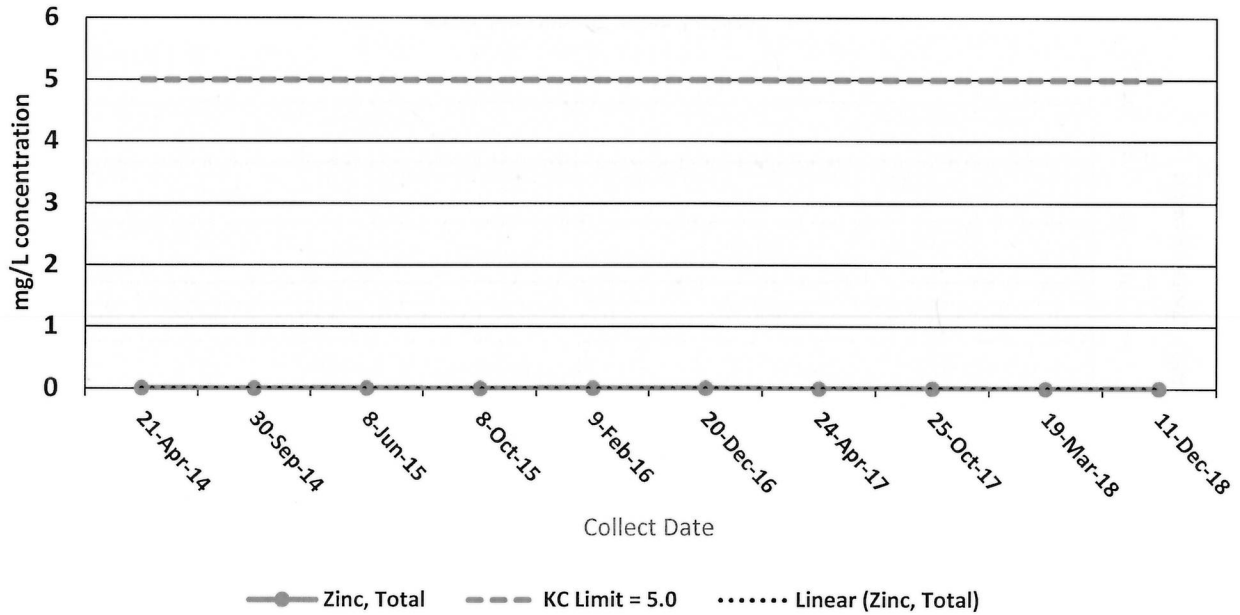
Kent Highlands Landfill
 Permit No. 7115-05, Site No. A8019
 Nickel, total (composite)
 KCIW data only
 January 2014 - December 2018



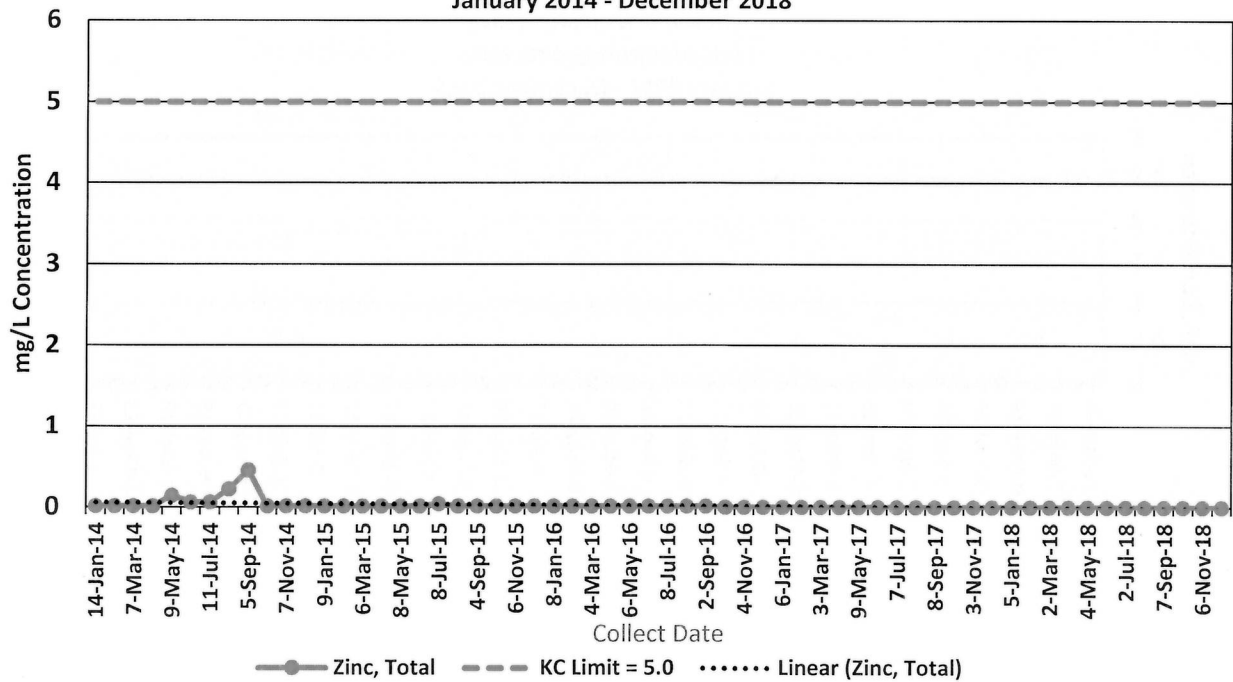
Kent Highlands Landfill
 Permit No. 7714-05, Site No. A8019
 Nickel, total (composite)
 Self-monitoring data only
 January 2014 - December 2018



Kent Highlands Landfill
 Permit No. 7115-05, Site No. A8019
 Zinc, total (composite)
 KCIW data only
 January 2014 - December 2018



Kent Highlands Landfill
 Permit No. 7714-05, Site No. A8019
 Zinc, total (composite)
 Self-monitoring data only
 January 2014 - December 2018



Leachate Gravity Line Jet-Cleaning and TV Inspection Report



Pro-Vac
6622 112TH ST E
PUYALLUP, WA 98367
253-432-4328
888-565-5665



PACP Sewer Report

Surveyed by: Luis Parada	Certificate No: U-212-14605	Owner:	Survey Customer: SPU	Drainage area:	Sheet number:				
Work order:	Pipeline segment ref: SPU-GI12	Start date/time: 2017/08/01 09:47	Street: 58th AVE S & S 228th ST	City: KENT					
Location details:			Upstream manhole No: 12	Rim to invert:	Grade to invert:	Rim to grade:			
Downstream manhole No: 11			Rim to invert:	Grade to invert:	Rim to grade:	Sewer use:	Direction: D	Flow control:	Height: 8
Width:	Shape: C	Material: PVC	Ln. method:	Pipe joint length:	Total length: 328.8	Length surveyed: 328.8	Year laid:	Year renewed:	Media label: 001
Purpose: F	Sewer category:	Pre-cleaning J	Date cleaned:	Weather: 1	Location code: B	Additional info:			
Starting access point:			Easting:	Northing:	Elevation:	Coordinate system:	GPS accuracy:		

Distance (Feet) (Meters)	Video Ref.	Group/ Descriptor	Modifier/ Severity	Continuous Defect S/M/L	Value		%	Joint	Circumferential Location		Image Ref.	Remarks
					1st	2nd			At/From	to		
0.0	27	AMH										MH 12
0.0	46	MWL					5					
328.8	770	AMH										MH 11

Pro-Vac
6622 112TH ST E
PUYALLUP, WA 98367
253-432-4328
888-565-5665



PACP Sewer Report

Surveyed by: Luis Parada	Certificate No: U-212-14605	Owner:	Survey Customer: SPU	Drainage area:	Sheet number:				
Work order:	Pipeline segment ref: SPU-GI11	Start date/time: 2017/08/01 11:07	Street: 58th AVE S & S 228th ST	City: KENT					
Location details:			Upstream manhole No: 11	Rim to invert:	Grade to invert:	Rim to grade:			
Downstream manhole No: 10	Rim to invert:	Grade to invert:	Rim to grade:	Sewer use:	Direction: U	Flow control:	Height: 8		
Width:	Shape: C	Material: PVC	Ln. method:	Pipe joint length:	Total length: 325.4	Length surveyed: 325.4	Year laid:	Year renewed:	Media label: 001
Purpose: F	Sewer category:	Pre-cleaning J	Date cleaned:	Weather: 1	Location code: B	Additional info:			

Starting access point:

Easting:	Northing:	Elevation:	Coordinate system:	GPS accuracy:
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Distance (Feet) (Meters)	Video Ref.	Group/ Descriptor	Modifier/ Severity	Continuous Defect S/M/L	Value		%	Joint	Circumferential Location		Image Ref.	Remarks
					1st	2nd			At/From	to		
0.0	13	AMH										10
0.0	28	MWL					5					
325.4	565	AMH										11

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PACP Sewer Report

Surveyed by: Luis Parada	Certificate No: U-212-14605	Owner:	Survey Customer: SPU	Drainage area:	Sheet number:				
Work order:	Pipeline segment ref: SPU-GI10	Start date/time: 2017/08/01 11:29	Street: 58th AVE S & S 228th ST	City: KENT					
Location details:			Upstream manhole No: 10	Rim to invert:	Grade to invert:	Rim to grade:			
Downstream manhole No: 9	Rim to invert:	Grade to invert:	Rim to grade:	Sewer use:	Direction: D	Flow control:	Height: 8		
Width:	Shape: C	Material: PVC	Ln. method:	Pipe joint length:	Total length: 171.2	Length surveyed: 171.2	Year laid:	Year renewed:	Media label: 001
Purpose: F	Sewer category:	Pre-cleaning J	Date cleaned:	Weather: 1	Location code: B	Additional info:			
Starting access point:		Easting:	Northing:	Elevation:	Coordinate system:	GPS accuracy:			

Distance (Feet) (Meters)	Video Ref.	Group/ Descriptor	Modifier/ Severity	Continuous Defect S/M/L	Value Inches (mm)		%	Joint	Circumferential Location		Image Ref.	Remarks
					1st	2nd			At/From	to		
0.0	1	AMH										10
0.0	14	MWL					5					
171.2	419	AMH										9

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PACP Sewer Report

Surveyed by: Luis Parada	Certificate No: U-212-14605	Owner:	Survey Customer: SPU	Drainage area:	Sheet number:				
Work order:	Pipeline segment ref: SPU-GI9	Start date/time: 2017/08/01 11:38	Street: 58th AVE S & S 228th ST	City: KENT					
Location details:			Upstream manhole No: 9	Rim to invert:	Grade to invert:	Rim to grade:			
Downstream manhole No: 8	Rim to invert:	Grade to invert:	Rim to grade:	Sewer use:	Direction: D	Flow control:	Height: 8		
Width:	Shape: C	Material: PVC	Ln. method:	Pipe joint length:	Total length: 355.7	Length surveyed: 355.7	Year laid:	Year renewed:	Media label: 001
Purpose: F	Sewer category:	Pre-cleaning J	Date cleaned:	Weather: 1	Location code: B	Additional info:			
Starting access point:		Easting:	Northing:	Elevation:	Coordinate system:	GPS accuracy:			

Distance (Feet) (Meters)	Video Ref.	Group/ Descriptor	Modifier/ Severity	Continuous Defect S/M/L	Value Inches (mm)		%	Joint	Circumferential Location		Image Ref.	Remarks
					1st	2nd			At/From	to		
0.0	1	AMH										9
0.0	13	MWL					0					
200.0	421	JOM		M								
305.0	1478	MWL S					30					
355.7	2258	AMH										8

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Surveyed by: Luis Parada	Certificate No: U-212-14605	Owner:	Survey Customer: SPU	Drainage area:	Sheet number:				
Work order:	Pipeline segment ref: SPU-GI8	Start date/time: 2017/08/01 13:27	Street: 64th ST S & S 228th AVE	City: KENT					
Location details:			Upstream manhole No: 8	Rim to invert:	Grade to invert:	Rim to grade:			
Downstream manhole No: 7	Rim to invert:	Grade to invert:	Rim to grade:	Sewer use:	Direction: D	Flow control:	Height: 8		
Width:	Shape: C	Material: PVC	Ln. method:	Pipe joint length:	Total length: 358.8	Length surveyed: 358.8	Year laid:	Year renewed:	Media label: 001
Purpose: F	Sewer category:	Pre-cleaning J	Date cleaned:	Weather: 1	Location code: B	Additional info:			
Starting access point:		Easting:	Northing:	Elevation:	Coordinate system:	GPS accuracy:			

Distance (Feet) (Meters)	Video Ref.	Group/ Descriptor	Modifier/ Severity	Continuous Defect S/M/L	Value		%	Joint	Circumferential Location		Image Ref.	Remarks
					1st	2nd			At/From	to		
0.0	2	AMH										8
0.0	15	MWL					0					
358.8	916	AMH										7

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PACP Sewer Report

Surveyed by: Luis Parada	Certificate No: U-212-14605	Owner:	Survey Customer: SPU	Drainage area:	Sheet number:				
Work order:	Pipeline segment ref: SPU-GI7	Start date/time: 2017/08/01 15:07	Street: 64th ST S & S 228th AVE	City: KENT					
Location details:			Upstream manhole No: 7	Rim to invert:	Grade to invert:	Rim to grade:			
Downstream manhole No: 6			Rim to invert:	Grade to invert:	Rim to grade:	Sewer use:	Direction: D	Flow control:	Height: 8
Width:	Shape: C	Material: PVC	Ln. method:	Pipe joint length:	Total length: 360.2	Length surveyed: 360.2	Year laid:	Year renewed:	Media label: 001
Purpose: F	Sewer category:	Pre-cleaning J	Date cleaned:	Weather: 1	Location code: B	Additional info:			
Starting access point:			Easting:	Northing:	Elevation:	Coordinate system:	GPS accuracy:		

Distance (Feet) (Meters)	Video Ref.	Group/ Descriptor	Modifier/ Severity	Continuous Defect S/M/L	Value		%	Joint	Circumferential Location		Image Ref.	Remarks
					1st	2nd			At/From	to		
0.0	4	AMH										7
0.0	16	MWL					5					
286.8	702	JSM		M								
360.2	895	AMH										6

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PACP Sewer Report

Surveyed by: Luis Parada	Certificate No: U-212-14605	Owner:	Survey Customer: SPU	Drainage area:	Sheet number:				
Work order:	Pipeline segment ref: SPU-GI5	Start date/time: 2017/08/02 10:14	Street: 64th ST S & S 228th AVE	City: KENT					
Location details:			Upstream manhole No: 5	Rim to invert:	Grade to invert:	Rim to grade:			
Downstream manhole No: 4B	Rim to invert:	Grade to invert:	Rim to grade:	Sewer use:	Direction: U	Flow control:	Height: 8		
Width:	Shape: C	Material: PVC	Ln. method:	Pipe joint length:	Total length: 57.7	Length surveyed: 57.7	Year laid:	Year renewed:	Media label: 001
Purpose: F	Sewer category:	Pre-cleaning J	Date cleaned:	Weather: 1	Location code: B	Additional info:			
Starting access point:		Easting:	Northing:	Elevation:	Coordinate system:	GPS accuracy:			

Distance (Feet) (Meters)	Video Ref.	Group/ Descriptor	Modifier/ Severity	Continuous Defect S/M/L	Value Inches (mm)		%	Joint	Circumferential Location		Image Ref.	Remarks
					1st	2nd			At/From	to		
0.0	18	AMH										4B
0.0	28	MWL					15					
57.7	151	AMH										5

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Surveyed by: Luis Parada	Certificate No: U-212-14605	Owner:	Survey Customer: SPU	Drainage area:	Sheet number:				
Work order:	Pipeline segment ref: SPU-GI6	Start date/time: 2017/08/02 10:17	Street: 64th ST S & S 228th AVE	City: KENT					
Location details:			Upstream manhole No: 6	Rim to invert:	Grade to invert:	Rim to grade:			
Downstream manhole No: 5	Rim to invert:	Grade to invert:	Rim to grade:	Sewer use:	Direction: U	Flow control:	Height: 8		
Width:	Shape: C	Material: PVC	Ln. method:	Pipe joint length:	Total length: 374.0	Length surveyed: 374.0	Year laid:	Year renewed:	Media label: 001
Purpose: F	Sewer category:	Pre-cleaning J	Date cleaned:	Weather: 1	Location code: B	Additional info:			
Starting access point:			Easting:	Northing:	Elevation:	Coordinate system:	GPS accuracy:		

Distance (Feet) (Meters)	Video Ref.	Group/ Descriptor	Modifier/ Severity	Continuous Defect S/M/L	Value Inches (mm)		%	Joint	Circumferential Location		Image Ref.	Remarks
					1st	2nd			At/From	to		
0.0	7	AMH										5
0.0	14	MWL					0					
374.0	1033	AMH										6

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PACP Sewer Report

Surveyed by: Luis Parada	Certificate No: U-212-14605	Owner:	Survey Customer: SPU	Drainage area:	Sheet number:				
Work order:	Pipeline segment ref: SPU-GI4B	Start date/time: 2017/08/02 11:00	Street: 64th ST S & S 228th AVE	City: KENT					
Location details:			Upstream manhole No: 4B	Rim to invert:	Grade to invert:	Rim to grade:			
Downstream manhole No: 4A			Rim to invert:	Grade to invert:	Rim to grade:	Sewer use:	Direction: D	Flow control:	Height: 8
Width:	Shape: C	Material: PE	Ln. method:	Pipe joint length:	Total length: 45.3	Length surveyed: 45.3	Year laid:	Year renewed:	Media label: 001
Purpose: F	Sewer category:	Pre-cleaning: J	Date cleaned:	Weather: 1	Location code: B	Additional info:			
Starting access point:			Easting:	Northing:	Elevation:	Coordinate system:	GPS accuracy:		

Distance (Feet) (Meters)	Video Ref.	Group/ Descriptor	Modifier/ Severity	Continuous Defect S/M/L	Value		%	Joint	Circumferential Location		Image Ref.	Remarks
					1st	2nd			At/From	to		
0.0	2	AMH										4B
0.0	14	MWL					5					
45.3	137	AMH										4A

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PACP Sewer Report

Surveyed by: Luis Parada	Certificate No: U-212-14605	Owner:	Survey Customer: SPU	Drainage area:	Sheet number:				
Work order:	Pipeline segment ref: SPU-GI4A	Start date/time: 2017/08/02 11:52	Street: 64th ST S & S 228th AVE	City: KENT					
Location details:			Upstream manhole No: 4A	Rim to invert:	Grade to invert:	Rim to grade:			
Downstream manhole No: 4	Rim to invert:	Grade to invert:	Rim to grade:	Sewer use:	Direction: U	Flow control:	Height: 8		
Width:	Shape: C	Material: PVC	Ln. method:	Pipe joint length:	Total length: 197.8	Length surveyed: 197.8	Year laid:	Year renewed:	Media label: 001
Purpose: F	Sewer category:	Pre-cleaning: J	Date cleaned:	Weather: 1	Location code: B	Additional info:			
Starting access point:		Easting:	Northing:	Elevation:	Coordinate system:	GPS accuracy:			

Distance (Feet) (Meters)	Video Ref.	Group/ Descriptor	Modifier/ Severity	Continuous Defect S/M/L	Value		%	Joint	Circumferential Location		Image Ref.	Remarks
					1st	2nd			At/From	to		
0.0	1	AMH										4
0.0	13	MWL					0					
197.8	588	AMH										4A

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PACP Sewer Report

Surveyed by: Luis Parada	Certificate No: U-212-14605	Owner:	Survey Customer: SPU	Drainage area:	Sheet number:				
Work order:	Pipeline segment ref: SPU-GI4	Start date/time: 2017/08/02 12:11	Street: 64th ST S & S 228th AVE	City: KENT					
Location details:			Upstream manhole No: 4	Rim to invert:	Grade to invert:	Rim to grade:			
Downstream manhole No: 3	Rim to invert:	Grade to invert:	Rim to grade:	Sewer use:	Direction: D	Flow control:	Height: 8		
Width:	Shape: C	Material: PVC	Ln. method:	Pipe joint length:	Total length: 313.6	Length surveyed: 313.6	Year laid:	Year renewed:	Media label: 001
Purpose: F	Sewer category:	Pre-cleaning: J	Date cleaned:	Weather: 1	Location code: B	Additional info:			
Starting access point:		Easting:	Northing:	Elevation:	Coordinate system:	GPS accuracy:			

Distance (Feet) (Meters)	Video Ref.	Group/ Descriptor	Modifier/ Severity	Continuous Defect		S/M/L	Value		%	Joint	Circumferential Location		Image Ref.	Remarks
							1st	2nd			At/From	to		
0.0	3	AMH												4
0.0	16	MWL							0					
313.6	934	AMH												3

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PACP Sewer Report

Surveyed by: Luis Parada	Certificate No: U-212-14605	Owner:	Survey Customer: SPU	Drainage area:	Sheet number:				
Work order:	Pipeline segment ref: SPU-GI3	Start date/time: 2017/08/02 15:20	Street: 68 AVE S & S 228th ST	City: KENT					
Location details:			Upstream manhole No: 3	Rim to invert:	Grade to invert:	Rim to grade:			
Downstream manhole No: 2	Rim to invert:	Grade to invert:	Rim to grade:	Sewer use:	Direction: U	Flow control:	Height: 8		
Width:	Shape: C	Material: PVC	Ln. method:	Pipe joint length:	Total length: 313.0	Length surveyed: 312.9	Year laid:	Year renewed:	Media label: 001
Purpose: F	Sewer category:	Pre-cleaning J	Date cleaned:	Weather: 1	Location code: B	Additional info:			
Starting access point:		Easting:	Northing:	Elevation:	Coordinate system:	GPS accuracy:			

Distance (Feet) (Meters)	Video Ref.	Group/ Descriptor	Modifier/ Severity	Continuous Defect S/M/L	Value Inches (mm)		%	Joint	Circumferential Location		Image Ref.	Remarks
					1st	2nd			At/From	to		
0.0	6	AMH										2
0.0	23	MWL					0					
312.9	738	AMH										3

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PACP Sewer Report

Surveyed by: Luis Parada	Certificate No: U-212-14605	Owner:	Survey Customer: SPU	Drainage area:	Sheet number:				
Work order:	Pipeline segment ref: SPU-GI2	Start date/time: 2017/08/02 15:42	Street: 68 AVE S & S 228th ST	City: KENT					
Location details:			Upstream manhole No: 2	Rim to invert:	Grade to invert:	Rim to grade:			
Downstream manhole No: 1	Rim to invert:	Grade to invert:	Rim to grade:	Sewer use:	Direction: D	Flow control:	Height: 8		
Width:	Shape: C	Material: PVC	Ln. method:	Pipe joint length:	Total length: 307.0	Length surveyed: 307.0	Year laid:	Year renewed:	Media label: 001
Purpose: F	Sewer category:	Pre-cleaning J	Date cleaned:	Weather: 1	Location code: B	Additional info:			
Starting access point:			Easting:	Northing:	Elevation:	Coordinate system:	GPS accuracy:		

Distance (Feet) (Meters)	Video Ref.	Group/ Descriptor	Modifier/ Severity	Continuous Defect S/M/L	Value Inches (mm)		%	Joint	Circumferential Location		Image Ref.	Remarks
					1st	2nd			At/From	to		
0.0	20	AMH										2
0.0	28	MWL					0					
307.0	617	AMH										1

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PACP Sewer Report

Surveyed by: Luis Parada	Certificate No: U-212-14605	Owner:	Survey Customer: SPU	Drainage area:	Sheet number:				
Work order:	Pipeline segment ref: SPU-GI1	Start date/time: 2017/08/02 15:52	Street: 68 AVE S & S 228th ST	City: KENT					
Location details:			Upstream manhole No: 1	Rim to invert:	Grade to invert:	Rim to grade:			
Downstream manhole No: METRO SEWER			Rim to invert:	Grade to invert:	Rim to grade:	Sewer use:	Direction: D	Flow control:	Height: 8
Width:	Shape: C	Material: PVC	Ln. method:	Pipe joint length:	Total length:	Length surveyed: 5.7	Year laid:	Year renewed:	Media label: 001
Purpose: F	Sewer category:	Pre-cleaning Z	Date cleaned:	Weather: 1	Location code: B	Additional info:			
Starting access point:			Easting:	Northing:	Elevation:	Coordinate system:	GPS accuracy:		

Distance (Feet) (Meters)	Video Ref.	Group/ Descriptor	Modifier/ Severity	Continuous Defect S/M/L	Value		%	Joint	Circumferential Location		Image Ref.	Remarks
					1st	2nd			At/From	to		
0.0	2	AMH										1
0.0	14	MWL					0					
5.7	84	AEP										

Appendix D

Landfill Gas



KGP-35S Investigation Report
(Fourth Quarter 2014 Report to Ecology)



Probe 35-S Analysis

1. Background

The depth of the shallow level (35-S) is 30 feet, with the screen starting 10 feet under the ground level. This probe is located 62 feet west, at the edge of the METRO park and ride lot, directly across Military Road from the landfill. The drilling log mentioned soil conditions as “Brown and Grey Gravelly Sand” until 30 feet. Unfortunately, 35-M and 35-D are now saturated. Therefore, we do not think there is a gas passageway from the middle/deep level due to high groundwater elevation.

Historically, we have detected slightly elevated gas concentrations at probe 35-S compared with other probes in the vicinity of the Kent-Highlands Landfill. The average gas concentration is 1.00% and the maximum value has been 4.7% since the year 2001.

2. Possibilities

We are not sure of the source of the combustible gas. One possible explanation is gas generated by organic deposits near probe 35, which would appear identical to landfill gas. The pathway to probe 35 from the landfill appears to be fully saturated in the medium and deep zones. Between the landfill and probe 35, we had probe 34 which was abandoned in 2006 as a result of the South 228th roadway project by the City of Kent. Probes 34-M and 34-D were saturated/flooded the same as probes 35-M and 35-D. There has always been a small wetland in the southeast corner of the park and ride near probe 35.

If historic wetland deposits generate a small amount of methane gas, it would be detected at the shallow probe.

3. DOE Concerns

Concentrations of methane ranging from 0.5 to 3.5% by volume have been routinely detected in a gas probe located at the edge of a METRO park and ride lot directly across Military Road from the landfill. Although this issue was not addressed in the Third Periodic Review, it has been an ongoing topic of discussions between Ecology and Seattle.

In 2013, Seattle increased extraction rates in nearby gas extraction wells to see if the methane concentrations would decrease at 35-S. The result was more oxygen (atmospheric air) being pulled into the gas system. Seattle also re-examined geologic logs from the area and conducted a visual reconnaissance to evaluate whether a preferential gas transport pathway might exist between the probe location and the landfill. None was apparent.

A plan was then developed for addressing the situation over time. It included an initial survey of underground structures in the area (catch basins, manholes, etc.) to check for

elevated methane levels. If high levels were detected, remedial measures would be implemented immediately. If they were not elevated, subsequent surveys of underground structures would be conducted whenever gas concentrations reached 3.5% at 35-S. The initial survey has yet to be conducted.

4. Statistical Approach

Since we could not identify the origin of the gas at probe 35-S, we tried to come up with a simple statistical approach to estimate probable gas concentrations at probe 35-S.

Table 1

	35-S	34-S	36-S	36-M	36-D	40-S	40-M	40-D
Ave.	1.00	0.01	0.02	0.00	0.00	0.01	0.01	0.01
SD	0.67	0.02	0.02	0.01	0.02	0.02	0.01	0.02
84.13% Confidence	1.67	0.03	0.04	0.01	0.02	0.03	0.02	0.03
97.72% Confidence	2.34	0.05	0.06	0.02	0.04	0.05	0.03	0.05
99.87% Confidence	3.01	0.07	0.08	0.03	0.06	0.07	0.04	0.07

The regulatory value for gas concentration is 5% by volume at the site boundary. If the Kent-Highlands Landfill gas system operational conditions are not changed, the gas concentration for probe 35-S, as you see in Table 1, will not go higher than 3.01 % by volume with a 99.87% confidence rate.

If there is more than 3.01% of Ch4, this incident will be isolated as a very rare case beyond analytical value.

Table 2

	Pr	Both side(%)	One side(%)
1 SD	0.1587	68.26	84.13
2 SD	0.0228	95.44	97.72
3 SD	0.0013	99.74	99.87

We don't need to worry about the lower half of the data population where lesser concentrations of gas were found, so only the upper end was calculated.

Ex) With 3 times the standard deviation

$$\text{Ave.} - (3 * \text{SD}) < \text{Future gas concentration} < \text{Ave.} + (3 * \text{SD})$$

----- Lower half Upper half

Based on these calculations, our confidence level will be increased.

Another important point, we didn't detect high gas concentrations in probes 34, 36, and 40 (as shown in Table 1) which are located between probe 35 and the landfill.

Additionally, the shallow extraction wells which are closest to probe 35 don't show any elevated gas concentrations and very big negative pressure. These wells are KSGW106A

through KSGW111A as shown on the attached Surfer Map (Pressure gradient potentiometric Map).

5. Work plan to comply with DOE

We measured Ch4 concentration in repeatable locations in the vicinity of 35-S to create a base line data set.

Table 3

Sample Collection Date: 12/3/2014					
Sample Collection Time: 09:20 AM					
BP: 29.83 (falling)					
Sample Collected by: Frank McKenzie, Jessica Atlakson					
Site	Site and Sample Port Description	CH4%	CO2%	O2%	Balance
35S	Probe	0.9	4.0	10.1	84.9
A	Metal vault with no lid, potentially irrigation system. Sample collected from PVC pipe in middle of vault.	0	0	21.2	78.7
B	Metal vault, potentially irrigation system control. Sample collected from hole in metal lid.	0	0	20.9	79.1
C	PVC pipe protruding from ground, no cover or vault. Sample collected from end of PVC pipe.	0	0	20.9	79.1
D	Electrical vault on sidewalk. Sample collected from joint in metal lid.	0	0	20.9	79.1
E	Storm drain catch basin. Sample collected from space between grates.	0	0	20.9	79.1

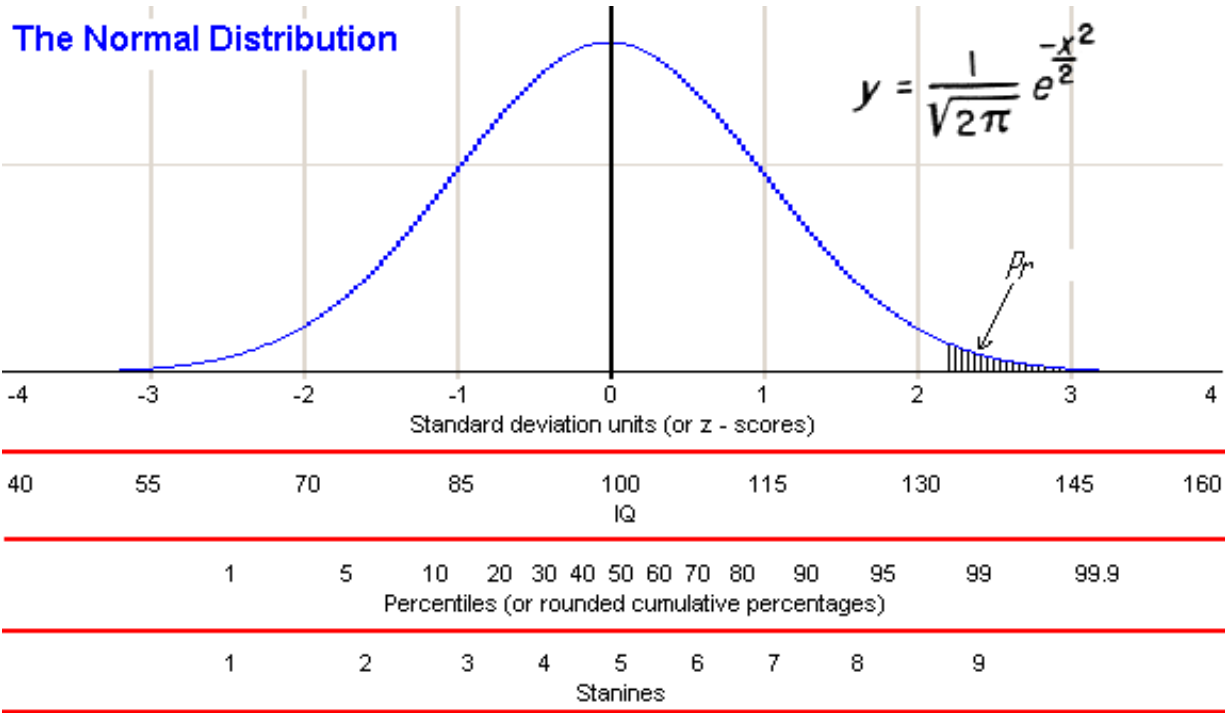
We will measure the base line locations whenever 35-S data is more than 3.5% and report to DOE. If we find any gas concentration at substructures A-E, we will perform a detailed investigation to find possible gas migration route or origination of gas.

Please see attached testing locations in the vicinity of 35-S.

Attachment:

1. Probe 35-S Drilling Log.
2. Gas probe 35-S Ch4 data Trend Graph from 2001 to 2014
3. Pressure gradient potentiometric Map from 2001 to 2014
4. Probe 35-S and A-E testing location Map
5. Testing data form

Reference

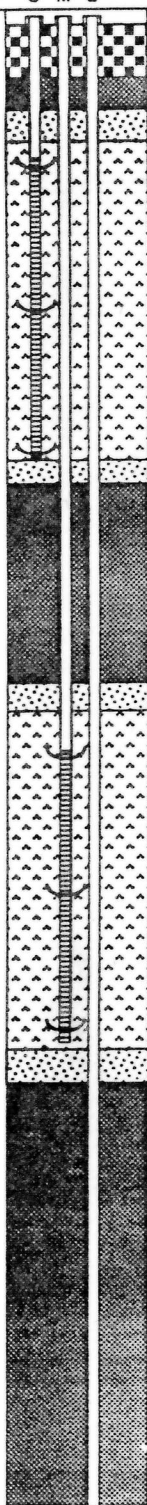


$$\beta_r = \frac{1}{\sqrt{2\pi}} \int_0^z e^{-x^2/2} dx$$

GAS PROBE CONSTRUCTION DETAILS

L.S. Elev.
000.00'

U M L

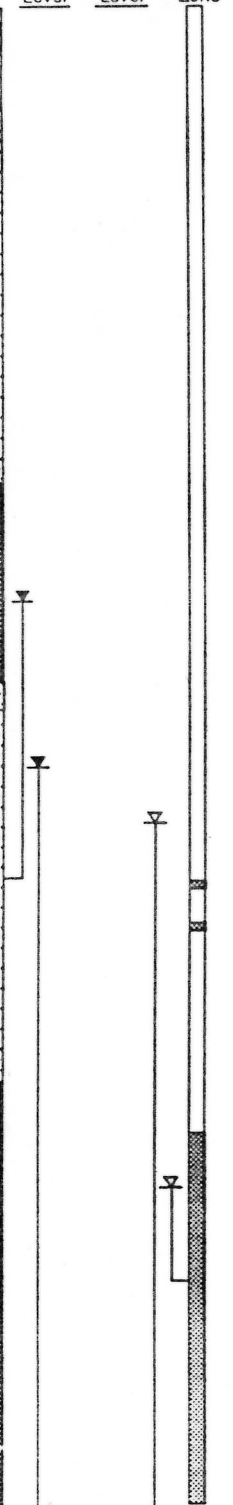


GROUNDWATER OBSERVATIONS

Static
Water
Level

Drilling
Water
Level

Water-
Bearing
Zone



GEOLOGIC LOG

Note:
Detailed logs follow
summary logs.

Depth (feet)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100

Brown and Gray Gravelly
Sand (SP)

Brown Silty Sand (SM)

Gray Silt (ML)

Gray Gravelly Sand (SP)

Gray Silty Sandy Gravel
(GM)

Gray Sandy Gravel (GP)

Greenish Gray Sand (SP)

GAS MEASUREMENTS

OVM
(ppm)

H₂S
(ppm)

HCN
(ppm)

% LEL

0 20 40 60 80 100

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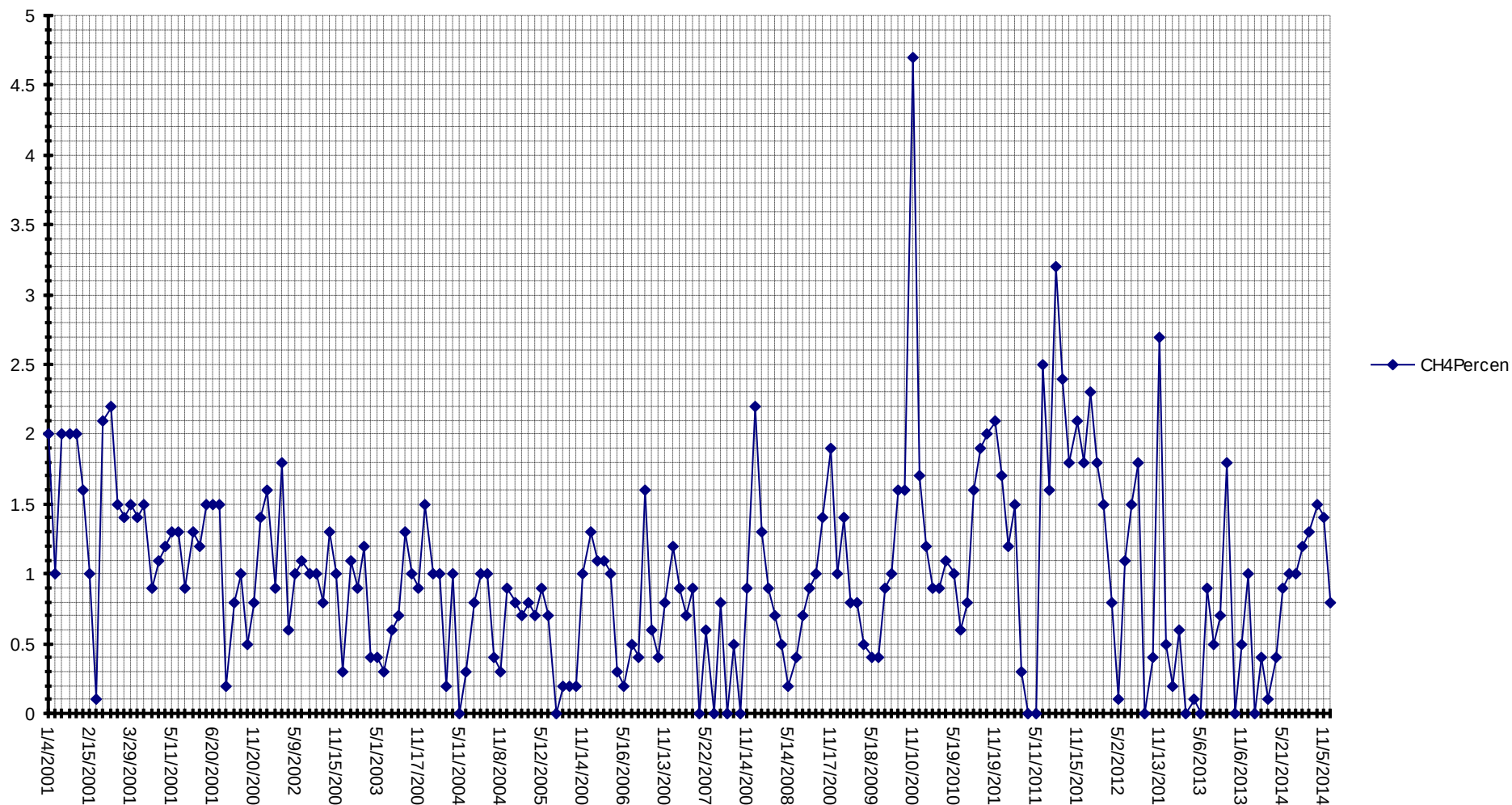
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Final Gas Results Graph for Kent Highlands from 01/01/2001 to 12/31/2014

Probe : 35-S

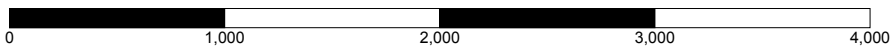
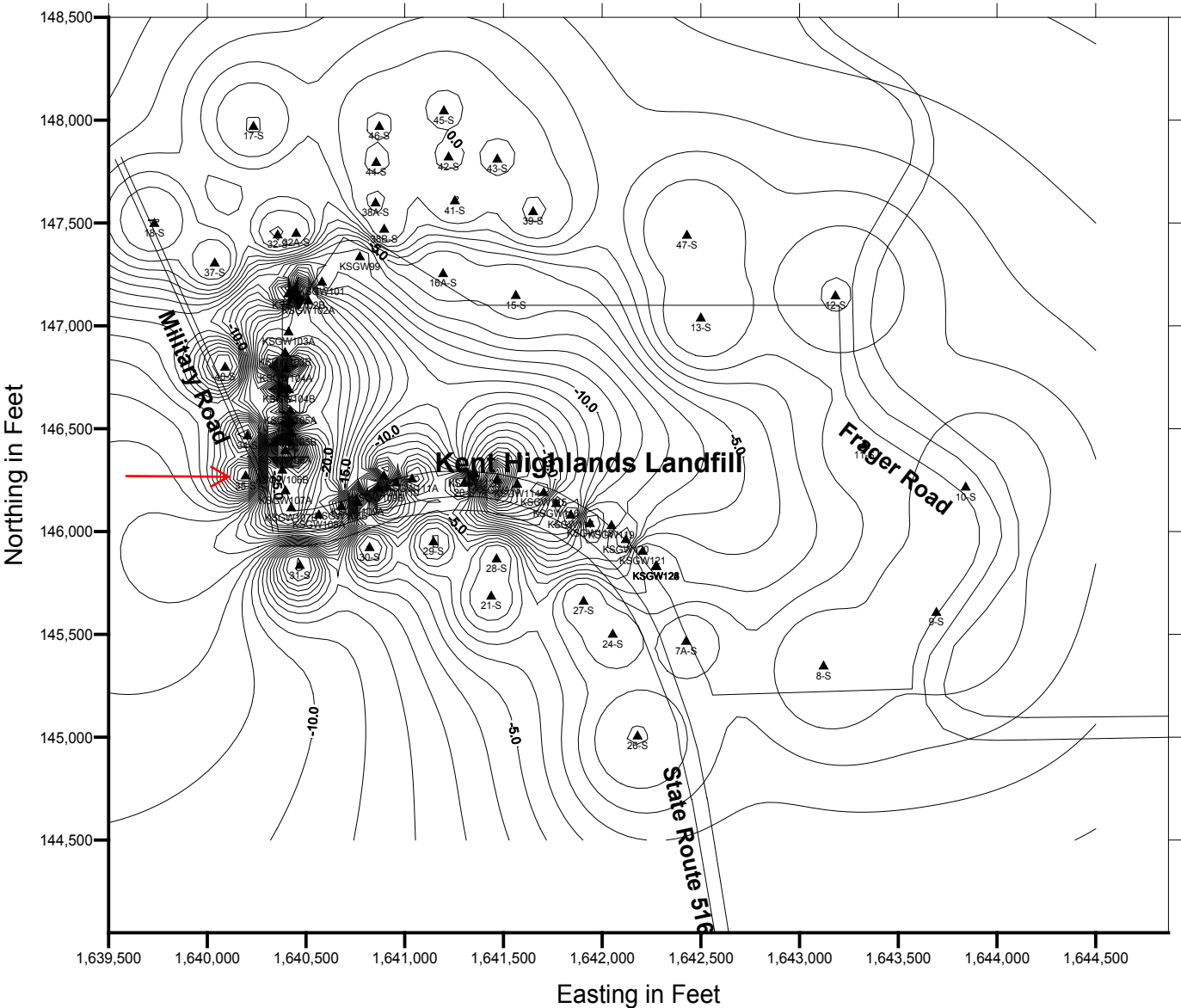
	CH4Percent	CH4PPM	CO2	O2	SP	Temperature	Velocity	BP
Average	1.00							
Standard Deviation	0.67							
Minimum	0.00							
Maximum	4.70							



Kent Highlands Composite Map for Pressure for Shallow Wells and Probes

(From 01/01/2001 To 12/31/2014)

Map Generated on 12/15/2014





KENT HIGHLAND PROBE 35S FOLLOW-UP DATA

NAME: _____

WEATHER: _____

DATE: _____

BARO START: _____

METER: _____

BARO END: _____

SAMPLE LOCATION	CH4%	CO2%	O2%	BALANCE	COMMENTS
35S probe					
A* metal vault, no lid					
B* metal vault					
C* PVC pipe, no cover					
D* electrical vault					
E* catch basin					

*When probe reading is 3.5% or greater, sample the following locations:

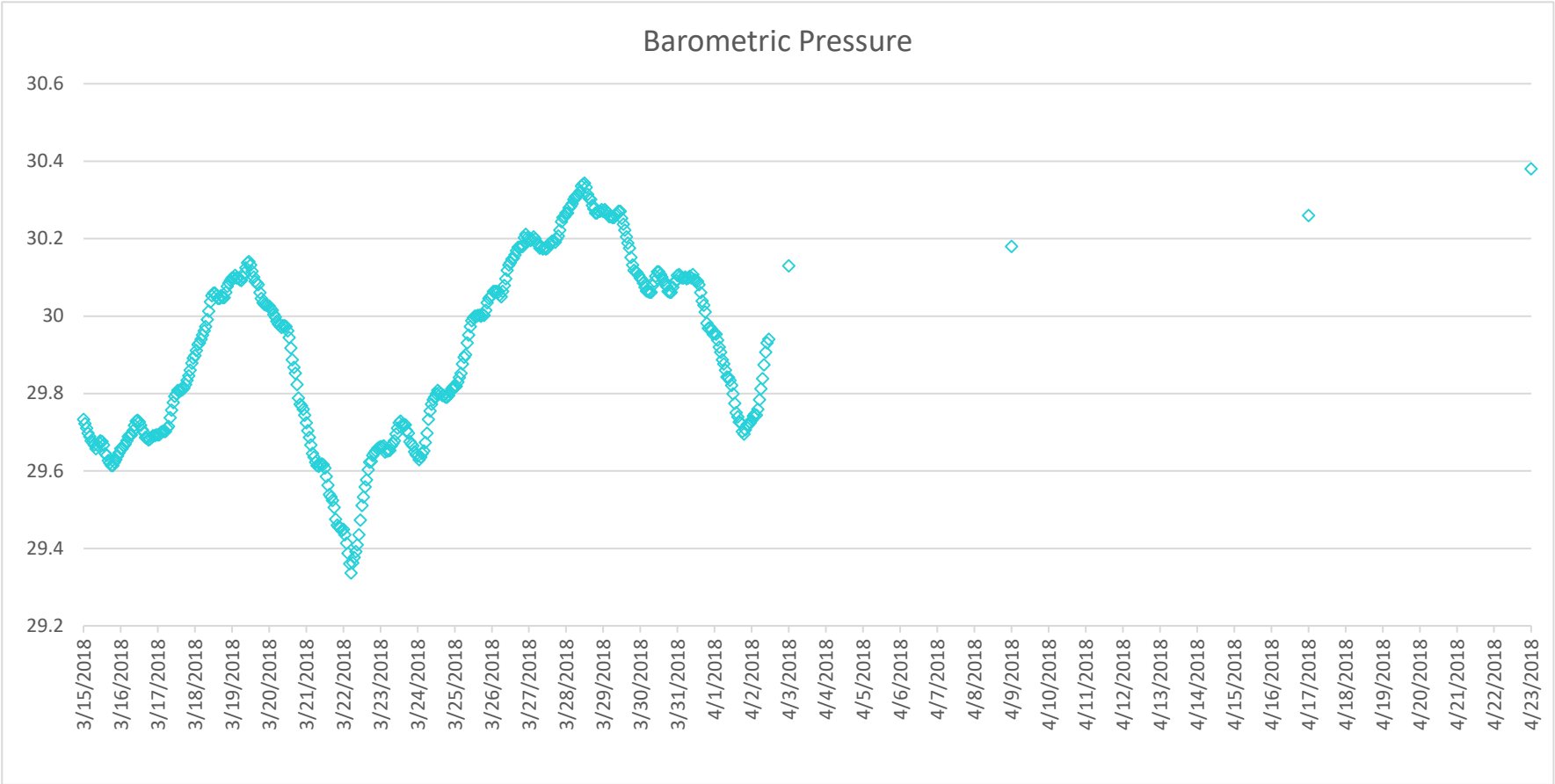
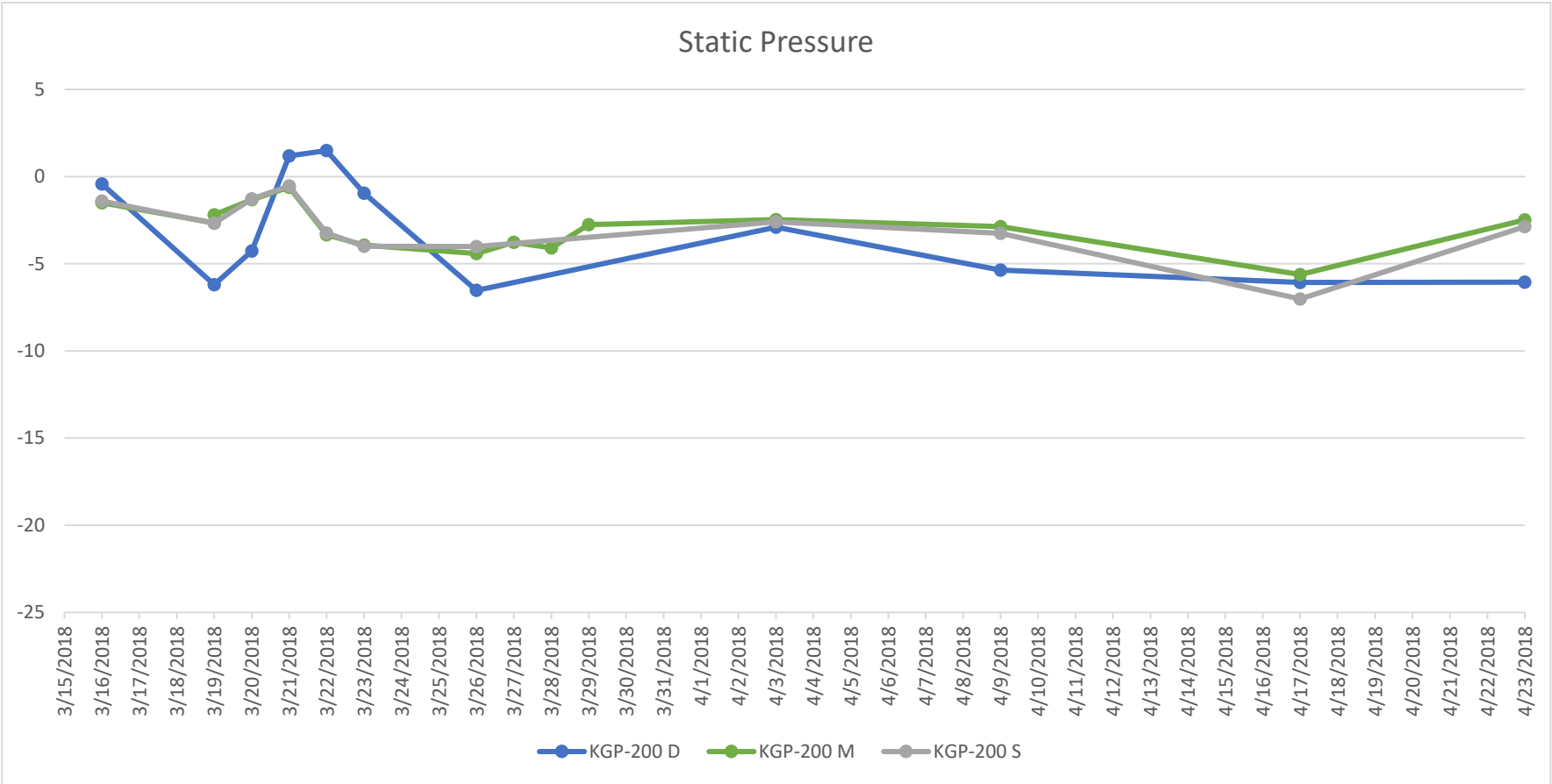
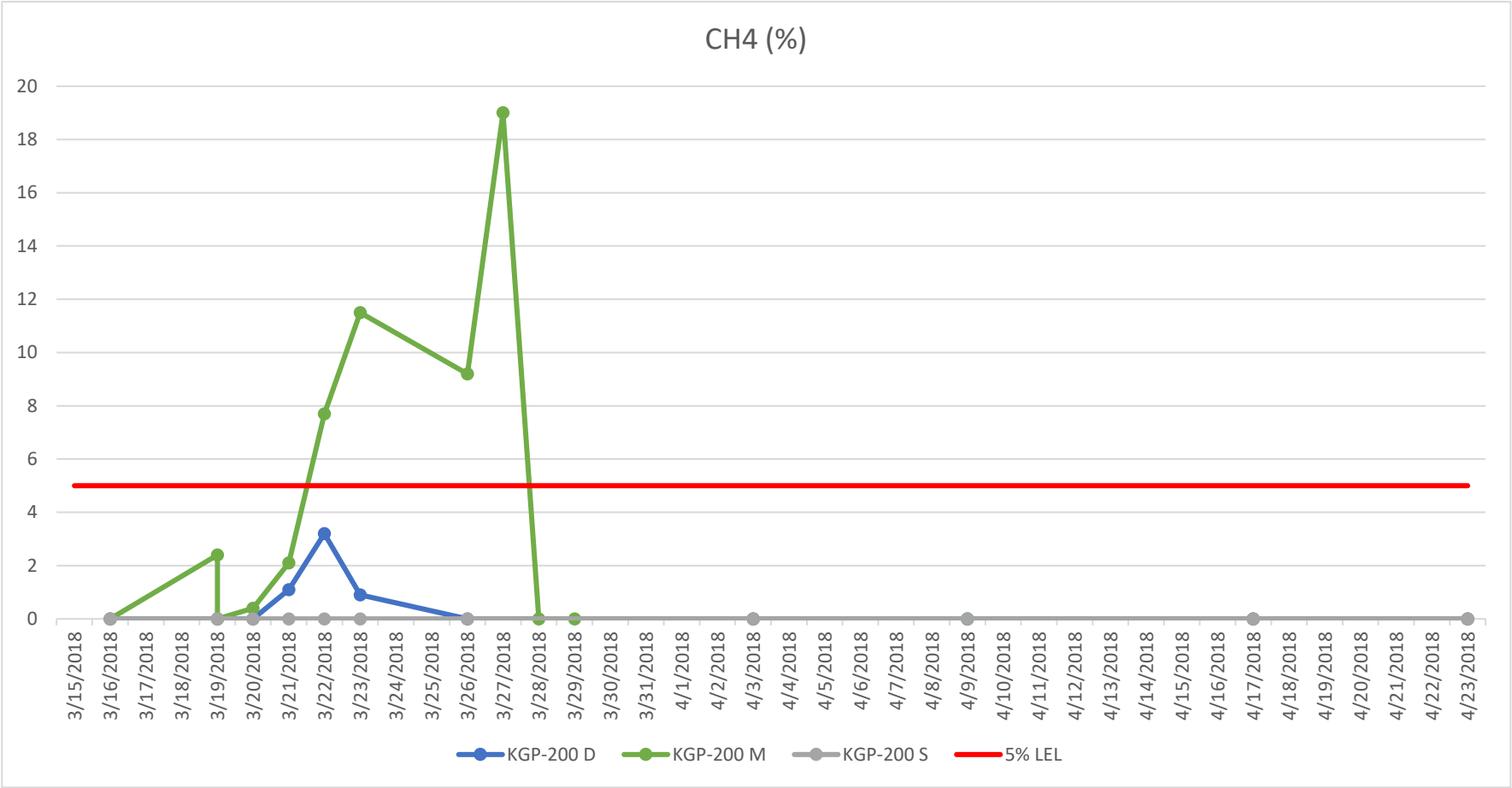
- A. Sample collected from PVC pipe in middle of vault.
- B. Sample collected from hole in metal lid.
- C. Sample collected from end of PVC pipe.
- D. Sample collected from joint in metal lid.
- E. Sample collected from space between grates.

Additional comments: _____

KGP-200 Methane Data



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New PSCAA Permit

**HEREBY ISSUES AN ORDER OF APPROVAL
TO CONSTRUCT, INSTALL, OR ESTABLISH**

Registration No. **11040**

Date
OCT 11 2017

One (1) John Zink Landfill Gas Flare, Model ZTOF, rated for 340 cfm supplemented with natural gas. This NOC cancels and supersedes NOC 10440, dated 3/6/12.

APPLICANT

**Jeff Neuner
Seattle Public Utilities
P.O. Box 34018
Seattle, WA 98124-4018**

OWNER

**Seattle Public Utilities
P.O. Box 34018
Seattle, WA 98124-4018**

INSTALLATION ADDRESS

Kent Highlands Landfill, 23076 Military Rd S, Kent, WA 98032

THIS ORDER IS ISSUED SUBJECT TO THE FOLLOWING RESTRICTIONS AND CONDITIONS

1. Approval is hereby granted as provided in Article 6 of Regulation I of the Puget Sound Clean Air Agency to the applicant to install or establish the equipment, device or process described hereon at the INSTALLATION ADDRESS in accordance with the plans and specifications on file in the Engineering Division of the Puget Sound Clean Air Agency.
2. This approval does not relieve the applicant or owner of any requirement of any other governmental agency.
3. The owner and/or operator shall ensure the flare operated under this NOC achieves a minimum of 98% destruction of all non-methane organic compounds or reduce the outlet NMOC concentration to less than 20 ppm by volume, dry basis as hexane at 3 percent oxygen.
4. The owner and/or operator shall install and operate a continuous temperature indicator and recorder on the flare. Temperature records shall be maintained on file and made available upon the request of Agency personnel.
5. The owner and/or operator shall either remove or seal in the closed position any valve that has the potential to bypass the flare. Any bypasses of the flare shall be measured and logged. The records shall be maintained on file and made available upon request of Agency personnel.
6. The owner and/or operator may test emissions from the flare at any time in order to demonstrate compliance with Condition 3, using the test methods specified in 40 CFR 60.754(d) and must submit the test report to the Puget Sound Clean Air Agency within 60 days after the testing.
7. The owner and/or operator shall submit a test notification to the Puget Sound Clean Air Agency in accordance with Section 3.07 of Regulation I before a source test is conducted.
8. The owner and/or operator shall operate the flare at an average set point temperature at or above the temperature range recorded during the most recent source test showing compliance with Condition No. 3.

Order of Approval for NC No. 11399

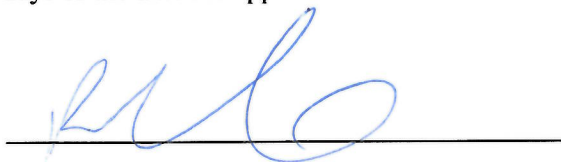
OCT 11 2017

The owner or operator must collect at least one measured data point for each 15-minute monitoring period in every hour the flare is receiving landfill gas. For the purposes of this condition, flare operating temperature shall be based on a rolling 3-hour average and shall only include hourly data which has at least one measured data point during three 15-minute monitoring periods during each hour. The flare operating temperature requirement does not apply to periods of start-ups, shutdowns and/or malfunctions provided that these events are not actively processing landfill gas and do not last for more than 1 hour.

9. The owner and/or operator shall report to the agency no later than 30 days after the violation is discovered all instances when either:
 - a. The 3-hour rolling average flare temperature readings were below the set point.
 - b. Startup, shutdown or malfunction events lasted longer than an hour and the flare was actively receiving landfill gas.
10. The owner/or operator shall develop a written start-up, shutdown, and malfunction plan according to the provisions of 40 CFR 63.6(e)(3). A copy of the plan must be maintained on site at all times.
11. The owner and/or operator may supplement the LFG piping connection to the flare inlet with no more than 20 scfm of natural gas during any 12-consecutive month period.
12. The owner and/or operator shall take corrective action whenever the flare temperature drops below the set point temperature determined during the most recent performance test.
13. Records demonstrating compliance with this order must be kept and maintained onsite for at least 2 years. Such records and the O&M plan shall be made available for review by the Puget Sound Clean Air Agency upon request.
14. This Order of Approval NO. 11399 hereby cancels and supersedes Order of Approval NO. 10440, issued 3/6/12.

APPEAL RIGHTS

Pursuant to Puget Sound Clean Air Agency's Regulation I, Section 3.17 and RCW 43.21B.310, this Order may be appealed to the Pollution Control Hearings Board (PCHB). To appeal to the PCHB, a written notice of appeal must be filed with the PCHB and a copy served upon Puget Sound Clean Air Agency within 30 days of the date the applicant receives this Order.



Ralph Munoz
Reviewing Engineer

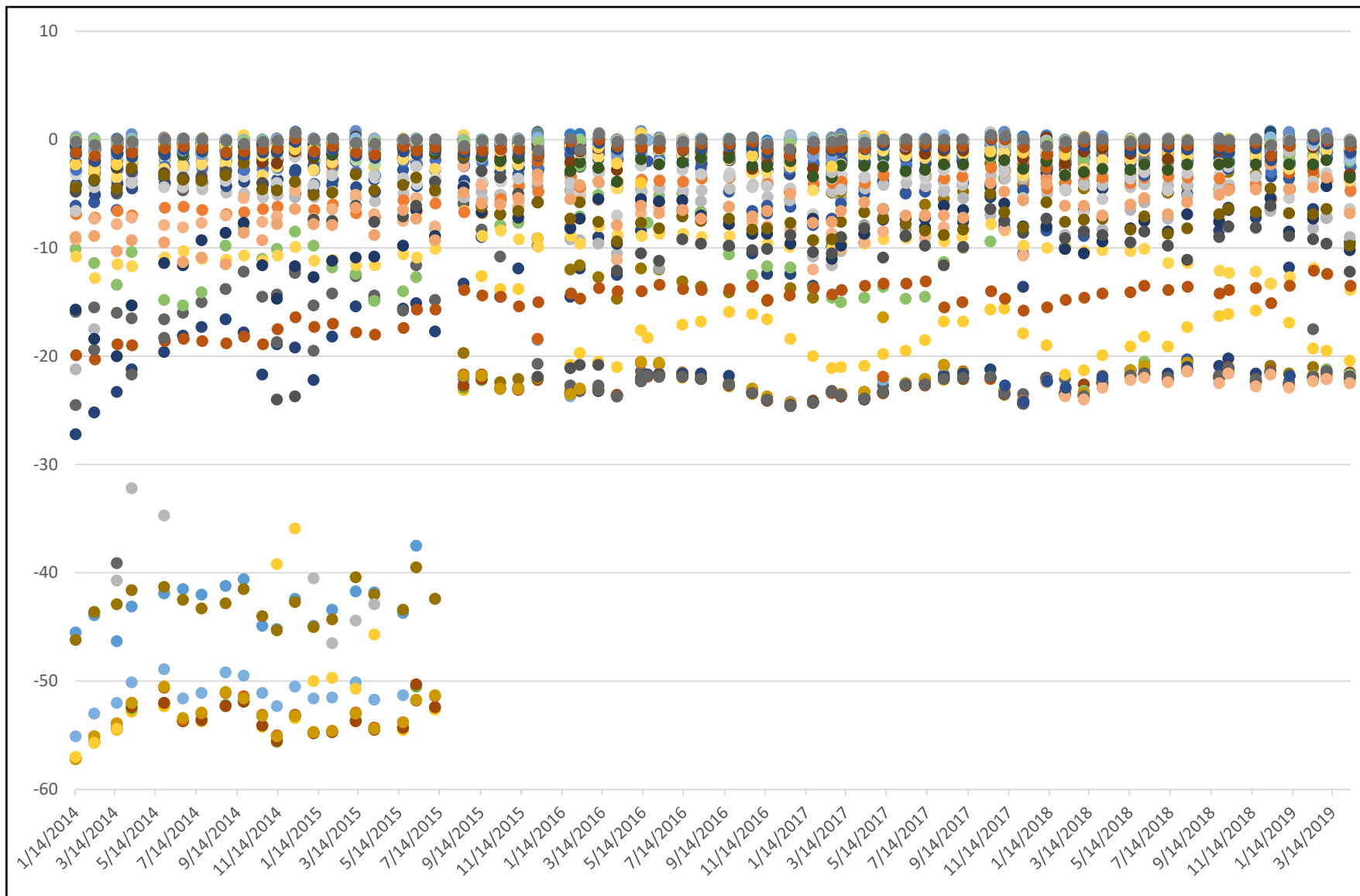


Carole Cenci
Compliance Manager

Static Pressure Plots



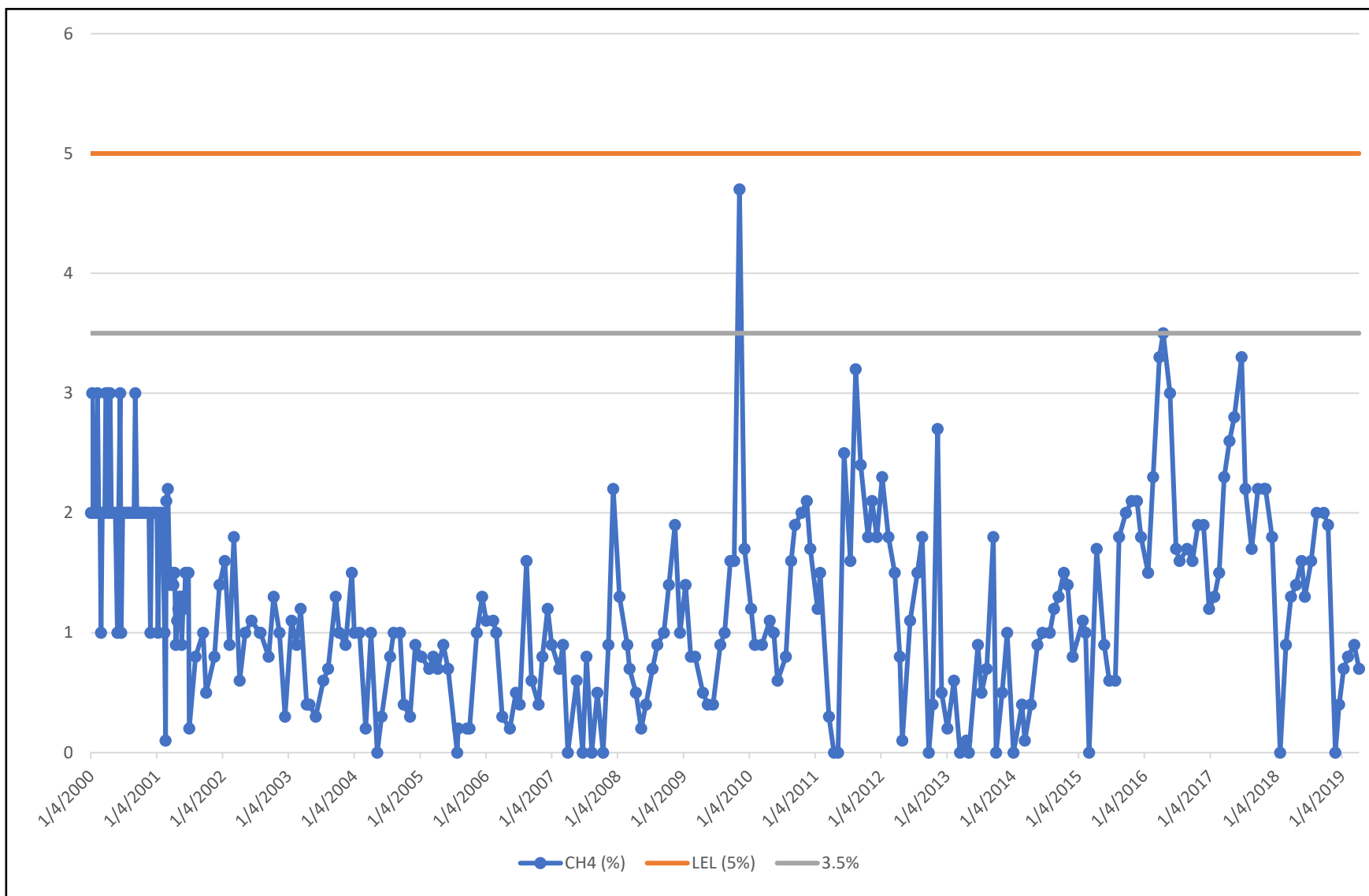
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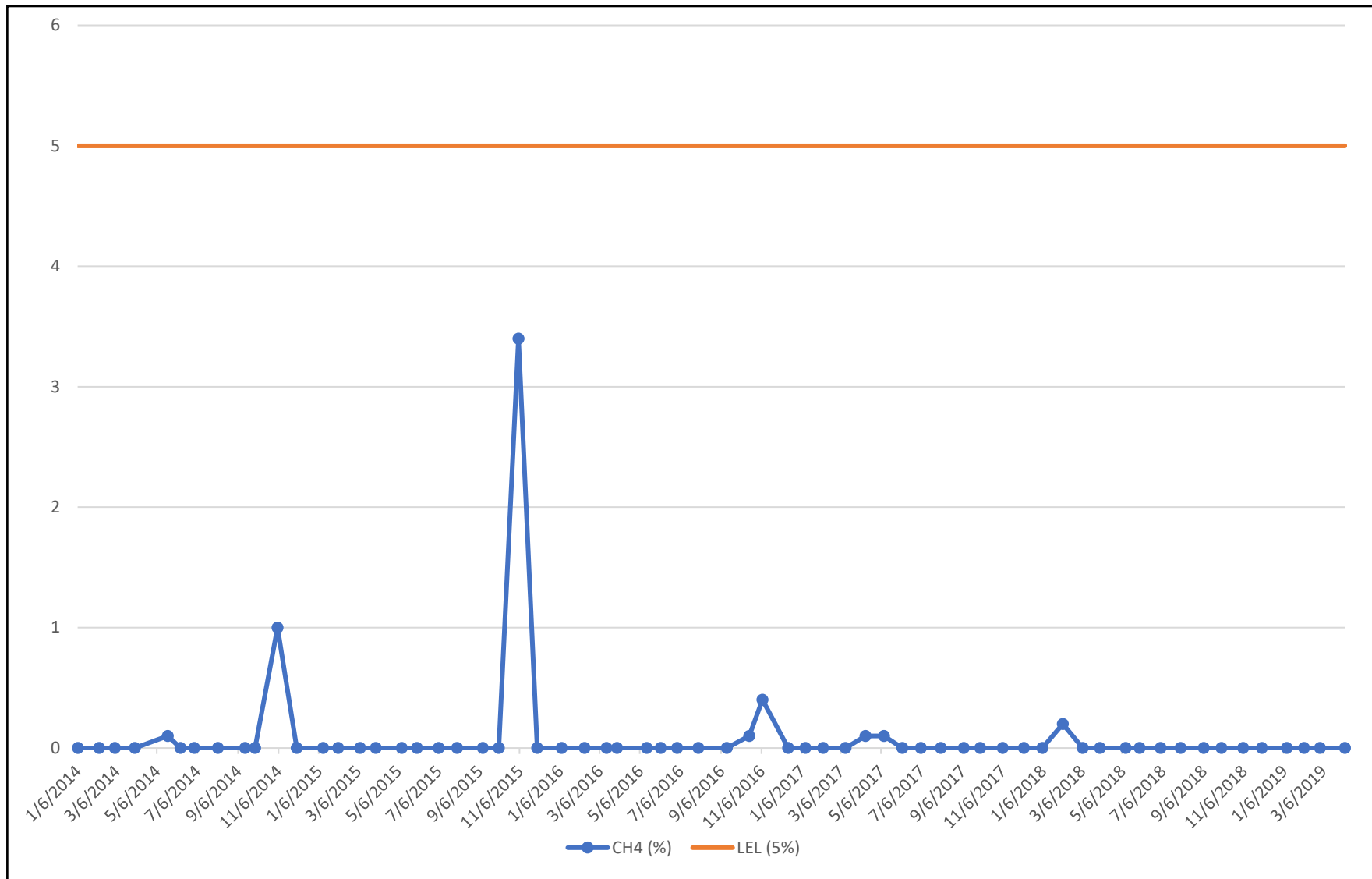
Methane in GP-35S and GP-8S



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Appendix E

Cap/Cover



Example of Monthly Log



Kent Highland General Inspection and Maintenance Sheet - Monthly.

Month/Year :		By:	Jason Miller		
Item	Description	OK	Not OK	Any maintenance record or remark	
1.4	Office				
	1	First aid supply	☐	☐	
	2	AED	☐	☐	
	3	Fire extinguisher and sign	☐	☐	
	4	Permits	☐	☐	
	5	Lighting system	☐	☐	
	6	Lab ventilation fan	☐	☐	
2.4	Equipment				
	1	Spill kit	☐	☐	
	2	Backhoe	☐	☐	
	3	Water truck	☐	☐	
	4	Dump truck	☐	☐	
3.4	Landfill Cover System				
	1	Any erosion or cracks?	☐	☐	
	2	Any trees or brush in the cover system	☐	☐	
	3	Vegetation control	☐	☐	
4.4	Surface Water & Road System				
	1	Storm water drainage system integrity	☐	☐	
	2	Any erosion or cracks?	☐	☐	
	3	Any trees or brush in the drain system	☐	☐	
	4	Detention pond integrity	☐	☐	
	5	Detention Pond Surface Aerator(N)	☐	☐	
	6	Detention Pond Surface Aerator(S)	☐	☐	
	7	Broken or cracked road	☐	☐	
	8	Slope Stability	☐	☐	
5.4	Leachate Collection System				
	1	Toe buttress pump	☐	☐	
	2	Toe buttress flow meter	☐	☐	
	3	Toe buttress pump station valve vault	☐	☐	
	4	Toe buttress vent fan system	☐	☐	
	5	Toe buttress alarm system	☐	☐	

Kent-High Landfill Maintenance Log from O & M Manual

			Frequency								Comments
Ref.	Items		Daily	Weekly	2-Wk	Monthly	Quarterly	Semi-yearly	Yearly	As needed	
3.4	Landfill cover system										
	A	Vegetated topsoil layer									
		A-1 Kill Noxious Weed								X	
		A-2 Remove any brush and tree								X	
		A-3 Fill buttow hole								X	
		A-4 Remove dying plans								X	
		A-5 Fill depress area								X	
		A-6 Fill depress creaks								X	
		A-7 Fill erosion rill & gullies								X	
		A-8 Kill insects								X	
		A-9 Apply fertilizer								X	
		A-10 Mow vegetation								X	
4.4	Surface water & road system										
	A	Runoff controll berm									
		A-1 Restore berm								X	
		A-2 Fill depress berm								X	
		A-3 Replace slope								X	
	B	Ditch behind runoff control									
		B-1 Remove vegetation								X	
		B-2 Remove sediment								X	
		B-3 Remove trash & debris								X	
	C	Ditch created by runoff control berm									
		C-1 Restore positive drain								X	
		C-2 Fill erosion rill								X	
		C-3 Remove any brush and tree								X	
		C-4 Remove dying plans								X	
		C-5 Replace or realign erosion control matting								X	
	D	Quarry spall surface water ditch locate on cover									
		D-1 Kill all vegetation								X	
		D-2 Replace quarry spall								X	
	E	Culverts and Storm drain pipes									
		E-1 Remove sediment								X	
		E-2 Replace quarry spall								X	
	F	Trash rack and inlet									
		F-1 Remove trash & debris								X	
	G	Utilityhole and structure									
		G-1 Remove trash & debris								X	
	H	Detention pond									
		H-1 Restore quarry spall								X	
		H-2 Fill erosion rill								X	
		H-3 Restore settle areas								X	
		H-4 Remove sediment								X	
		H-5 Remove any brush and tree								X	
		H-6 Kill Noxious Weed								X	

Kent-High Landfill Maintenance Log from O & M Manual

				Frequency									
Ref.	Items			Daily	Weekly	2-Wk	Monthly	Quarterly	Semi-yearly	Yearly	As needed	Comments	
		H-7	Fill buttow hole								X		
	I	Floating aerator											
		I-1	Lubricate bearing							X			
		I-2	Check Ice building up and remove									X	
		I-3	Adust mooring lines									X	
	J	Outlet control											
		J-1	Raise and lower shear gate									X	
		J-2	Check the structure integrity									X	
		J-3	Check the errosion									X	
	K	Backflow control structure											
		K-1	Verify operation of valve									X	
		K-2	Crean debris									X	
	L	Storm outfall											
		L-1	Repair geotextile									X	
		L-2	Restore quarry spall									X	
	M	Access Roads											
		M-1	Remove trash & debris									X	
		M-2	Restore access road									X	
		M-3	Fill pot hole									X	
		M-4	Restore road sholder									X	
		M-5	Kill weed									X	
	N	Gravel walkway											
		N-1	Fill errosion									X	
		N-2	When errosion noticed, install temporary errosion-control									X	
5.4	Leachate collection system												
	A	Leachate collection pipes											
		A-1	Clear pipe inlet and outlet									X	
		A-2	Clean pipes using sewer cleaning method									X	
	B	Leachate collection system utilityholes											
		B-1	Remove litter, debris, and sediment									X	
		B-2	Wash down structures									X	
	C	Toe buttress pump station											
		C-1	Remove litter, debris, and sediment			X							
		C-2	Wash down structures			X							
		C-3	Toe buttress pump station blower						X				
	D	Toe buttress pump station pump											Replace with submersible pump
		D-1	Clean motor starter								X		
		D-2	Change oil								X		
		D-3	Adjust screw								X		
		D-4	Drain water								X		
D-5		Replace worn parts								X			
E	Toe buttress pump station valve vault												
	E-1	Check drain line			X								

Kent-High Landfill Maintenance Log from O & M Manual

			Frequency								Comments
Ref.	Items		Daily	Weekly	2-Wk	Monthly	Quarterly	Semi-yearly	Yearly	As needed	
	F	Toe buttress pump station flow monotoring									
	F-1	Get the reading	X								Please check daily log
	G	Toe buttressforce main									
	G-1	Clean force main								X	
	H	North pond valve manhole									Operation is change to open operation to the Leachate pond
	H-1	Close valve		X							
	I	Leachate collection system valves									System changed to new pumping system in 2005
	I-1	Move valve thorough full range		X							
6.4	Leachate Transmission system										
	A	Leachate pretreatment pond									
	A-1	Close and open all pond valves			X						
	A-2	Clean out flow pipes						X			
	B	Leachate transmission pump station wet well									
	B-1	Remove litter, debris, and sediment								X	
	B-2	Wash down structures				X					
	C	Leachate transmission pump station blower									System changed, No geasing and no brush
	C-1	Grease fan						X			
	C-2	Inspect & clean						X			
	C-3	Replace brush						X			
	D	Leachate Transmission pump station pump									System changed to submersible pump.
	D-1	Clean motor starter					X				
	D-2	Greaseor motor bearing						X			
	D-3	Replace pump packing						X			
	D-4	Check motor hardware						X			
	D-5	Close and open pump inlet and outlet						X			
	E	Leachate force main bypass vault									
	E-1	Close and reopen gate valve			X						
	E-2	Calibrate flow meter							X		
	E-3	Take flow data	X								Please check daily log
	F	Leachate force access vault									
	F-1	Pump water out					X				
	F-2	Adjust tighten coupling					X				
	G	Leachate force discharge utilityhole (MH12)									
	G-1	Vactor the line		X							If overflow
	H	Leachate transmission gravity pipeline									
	G-1	Clean the line						X			Changed every 3 years
7.4	LFG collection system										
	A	Leachate transmission gravity pipeline									
	A-1	Control valve					X				
	A-2	PVC pipe and fittings at the wells			X						Changed to monthly monitoring
	A-3	Control valve supporting						X			
	A-4	Mainfold pipe support						X			
	A-5	Flexible hose							X		
	A-6	PVC pipe and fittings at the wells							X		No more PVC piping

Kent-High Landfill Maintenance Log from O & M Manual

				Frequency									
Ref.	Items			Daily	Weekly	2-Wk	Monthly	Quarterly	Semi-yearly	Yearly	As needed	Comments	
		A-7	Grit screen on condensate trap								X		
8.4	LFG flare facility system												
	A	Flare											
		A-1	Paint									X	
		A-2	Inside burner							X			
		A-3	Back-wash burner head								X		
		A-4	UV-sensor								X		
		A-5	Flame arrestore								X		
		A-6	Pilot gas solenoid valve				X						
	B	Flare											
		B-1	Rotate off line flare		X								System changed to 10 HP
		B-2	Lubricate bearing					X					Every 1500Hr
		B-3	Inspect foundation					X					
		B-4	Drain the housing								X		
		B-5	Adjust velt tention								X		
		B-6	Remove and Replace seal								X		
		B-7	Robricant motor					X					Changed 10 HP, no grease required
	C	Methane analyzer										No more use	
		C-1	Calibration		X								
		C-2	Change dessicant		X								
		C-3	Replace filter							X			
		C-4	Rotameter								X		
	D	Mass flow meter											
		D-1	Calibration									X	
	E	Control panel											
		E-1	Replace fan filter					X					Change to as need
		E-2	Replace processor battery							X			New PLC, no battery
	F	UPS											
F-1		Test function				X							
F-2		Complete maintenance							X				
F-3		Replace batteries								X		Every 5 years	
9.4	Back-up system											No more.	
	A	Flame arrestors											
		A-1	Cleaning							X			
	B	Diesel blower											
		B-1	Change oil		X								
		B-2	Drain water				X						
		B-3	Recharge starter					X					
		B-4	Change velt										