Horn Rapids Landfill
Remedial Investigation Report

Prepared for
City of Richland Public Works Department

January 2021

Prepared by
Parametrix

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City of Richland
Public Works Department

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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.

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ACRONYMS AND ABBREVIATIONS

µg/L	micrograms per liter
µmhos/cm	micromhos per centimeter
BFHD	Benton-Franklin Health District
bgs	below ground surface
City	City of Richland
City Facility	275-acre permitted waste facility, including the landfill
City Property	Contiguous property owned by the City of Richland, including the City Facility (approximately 2,306 total acres)
CLARC	Ecology's Cleanup Level and Risk Calculation database
cm/sec	centimeters per second
CO	carbon dioxide
COCs	Contaminants of Concern
CSM	conceptual site model
CUL	cleanup level
DCA	dichloroethane
DCE	dichloroethene
DO	dissolved oxygen
Ecology	Washington Department of Ecology
EPA	U.S. Environmental Protection Agency
Expansion	104-acre expansion of the Horn Rapids Landfill located within the City Facility east of the landfill
FOD	frequency of detection
FS	feasibility study
ft	feet
ft/min	feet per minute
GWQSs	groundwater quality standards (WAC 173-200)
IHS	indicator hazardous substance
Koc	organic carbon-water partition co-efficient
Landfill	46-acre permitted area where municipal solid waste has been placed within the City Facility

ACRONYMS AND ABBREVIATIONS (CONTINUED)

LFG	landfill gas
MCL	Maximum Contaminant Level (WAC 246-290)
mg/L	milligrams per liter
MSW	municipal solid waste
MTCA	Model Toxics Control Act (WAC 173-340)
NAVD88	North American Vertical Datum of 1988
ORP	oxidation-reduction potential
ORV	off-road vehicle
PCE	tetrachloroethene
POC	point of compliance
PP	push probe
QAPP	Quality Assurance Project Plan
RI	remedial investigation
scfpm	standard cubic feet per minute
SFV	MTCA standard formula value
SIM	Selective Ion Monitoring
TCE	trichloroethene
TCFM	trichlorofluoromethane
TDS	total dissolved solids
TEE	Terrestrial Ecological Evaluation
TOC	total organic carbon
UTL	upper tolerance limit
VC	vinyl chloride
VI	vapor intrusion
VOCs	volatile organic compounds
WAC	Washington Administrative Code
WRIA	Water Resource Inventory Area

1. INTRODUCTION

1.1 Objectives

This remedial investigation (RI) report for the Horn Rapids Landfill has been prepared in accordance with the Agreed Order (No. DE 13717), entered into between the City of Richland (City) and the Washington State Department of Ecology (Ecology), and the Model Toxics Control Act (Revised Code of Washington [RCW] Chapter 70A.305) and its implementing regulations (Washington Administrative Code [WAC] 173-340) (collectively MTCA). The objective of the report is to summarize existing data, define the nature and extent of contamination, and define preliminary cleanup levels (CULs) to be further developed in the Feasibility Study (FS).

For the purposes of this report, the following terminology related to the Horn Rapids Landfill has been developed, as further described in Sections 1.2 and 1.3:

- City Facility: 275-acre permitted waste site, including landfill, customer transfer station, and compost facility on a parcel dedicated to these uses
- Landfill: 46-acre permitted area where municipal solid waste (MSW) has been placed since the 1970's within the City Facility
- City Property: Contiguous property owned by the City of Richland, including the City Facility (approximately 1,820 total acres), most of which is being marketed for various forms of development
- Expansion: 104-acre expansion of the Horn Rapids Landfill located within the City Facility east of the Landfill

1.2 Horn Rapids Landfill Setting

The Horn Rapids Landfill is owned and operated by the City Public Works Department. It is located near the northwest corner boundary of and within the City limits of Richland, Washington, in an area bounded by Twin Bridges Road on the west, Horn Rapids Road on the north, and State Route 240 on the south. The Landfill is located within the southwest quadrant of a larger 275-acre parcel of City-owned property (City Facility, see Figure 1) that includes the 46-acre existing landfill (Landfill) permitted for disposal of MSW, a support facility, a 9-acre composting facility, a customer service transfer station that includes a small household hazardous waste receiving area, and the landfill Expansion, which began operation in the fall of 2020..

As shown on Figure 2, the City also owns contiguous property (City Property) to the west, south and east of the City Facility (a total of approximately 1,820 total acres), with the exception of several small privately owned parcels: two located along the southwest corner of the City Facility, and one within the northeast corner of the City Facility. East of the City Facility are circle-irrigated agricultural fields used to grow alfalfa hay, corn, and potatoes. Irrigation water for these fields is obtained from the Columbia River and not from a groundwater source. Irrigated fields are also located west of the City Facility across State Highway 240. These fields have been in use since 1987, with irrigation occurring between the months of April and October (Shaw Environmental Inc. 2003). The remaining City Property south and southeast of the Landfill is undeveloped.

As shown on the Vicinity Plan (Figure 2), the City Property immediately west of the City Facility has been developed as an off-road vehicle (ORV) park, which includes a road-racing track and a motocross track facility. A portion of the ORV park is designated as public facilities with restrooms and picnic areas.

Figure 3 shows the City Facility boundary, the Landfill and other City Facility features, and monitoring locations including gas probes, groundwater monitoring wells, and lysimeters. The area within the City Facility east of the currently permitted 46 acres is the Horn Rapids Landfill Expansion (Expansion). A new scale house/office building has recently been constructed near the City Facility entrance and began operation in November 2020.

1.3 Landfill Description

The Landfill began receiving MSW in 1974. The Landfill historically accepted only municipal wastes and was initially developed by placing waste into a series of north-south oriented trenches in the Phase 1 western portion of the Landfill (see Appendix A1). The waste depths in the trenches ranged from 12 to 30 feet (ft). The Landfill is unlined.

The Landfill (refuse) boundary is shown on Figure 3. Phase 1 (the western portion of the permitted area) was closed in 2011 and included installation of an active landfill gas (LFG) collection system. Following closure of Phase 1, MSW was placed in Phase 2 (the eastern portion) of the permitted area, and closure of Phase 2 is expected to occur in 2021. The waste ranges in thickness from approximately 60 to 100 ft. As of September 2020, MSW is being placed in Phase IE of the Expansion. The 104-acre Horn Rapids Landfill Expansion is located east of the permitted 46 acres. Engineering plans for the Expansion are presented in the Preliminary Conceptual Engineering Report (Parametrix 2017a).

The City has operated a compost facility at the City Facility since 2010. The Compost Facility is situated on 9 acres just north of the Landfill, approximately 500 ft south of Horn Rapids Road, and was permitted under WAC 173-350-220, WAC 173-350-710, and WAC 173-350-715. The compost facility receives and processes regional municipal and commercial green waste materials and produces compost from acceptable materials such as vegetative yard or agricultural waste, wood waste, lawn clippings, sawdust, straw, manure, Class B biosolids, and compostable winery waste.

The waste accepted at Horn Rapids Landfill, referred to as mixed MSW, includes industrial, commercial, and residential wastes (Parametrix 2017b). Wastes consisting of free liquids, sludge containing free liquids, sewage sludge, and septage are not accepted. Inspection and acceptance or rejection of unacceptable waste is the responsibility of the entrance facility attendant and the fill operator. In accordance with the Richland Municipal Code 15.08.04, all residential and commercial liquid wastes are prohibited from disposal in the Horn Rapids Landfill.

1.4 Regulatory History and Interim Actions

The Horn Rapids Landfill was originally permitted under WAC 173-301 and currently operates under the Criteria for Municipal Solid Waste Landfills (WAC 173-351) and the current Solid Waste Permit (Permit) issued by the Benton-Franklin Health District (BFHD).

Concentrations of volatile organic compounds (VOCs) were detected above the WAC 173-200-040 Groundwater Quality Criteria and included tetrachloroethene (PCE), trichloroethene (TCE), and vinyl chloride (VC) in groundwater monitoring wells MW-5 and MW-6 installed in 1998 (Shannon & Wilson 1998). By letter dated February 18, 2000, the City notified BFHD and Ecology that statistically significant increases in groundwater contaminants were confirmed during monitoring activities and that the increase in concentration would be addressed through a formal corrective action process under MTCA. Ecology sent the City a MTCA Early Notice letter on March 6, 2000, and the Richland Horn Rapids Landfill was placed on Ecology's Confirmed or Suspected Contaminated Sites list for groundwater contamination (Facility/Site No. 308).

In order to comply with MTCA requirements, the City chose to conduct a MTCA independent cleanup of the groundwater by performing an RI and FS. From 2001 through 2004, the City performed an independent, two-phased remedial investigation (Shaw Environmental Inc. 2003, 2004), and in 2004, they performed a LFG pilot study/FS (Shaw EMCON/OWT, Inc. 2005). The RI determined that LFG is the likely source of the VOCs impacting groundwater. A LFG extraction system was designed (Parametrix 2005) based on pilot study results that showed LFG extraction would effectively remove VOCs from the subsurface, and closure, which will include an LFG extraction system, is being implemented in two phases (Parametrix 2011, 2012a, 2012b). The RI and LFG pilot study are described further in Sections 2.1 and 2.2.

Between 2005 and 2010, Phase 1 (the western portion of the permitted area) of the Landfill was filled and graded to approved closure grading plans (EMCON 1999; Parametrix 2006, 2008a, 2011) and was closed in 2011 (Parametrix 2011, 2012a, 2012b) as an independent remedial action in accordance with WAC 173-340. The Phase 1 closure included a final cover and gas collection system consisting of in-refuse wells, collection manifold and laterals, a condensate manhole, and a flare station (see Appendix A2).

Twenty-six vertical gas collection wells were installed as part of the Phase 1 landfill closure. The wells range in depth from 43 to 87 ft and are typically spaced 150 ft apart around the perimeter and 200 ft apart in the interior of the landfill. The gas collection system was started up in September 2011 to prevent subsurface LFG migration beyond the landfill perimeter and to remove VOCs from groundwater beneath the landfill. The collection system has operated 24 hours a day since startup. The applied vacuum from the permanent blower/flare facility produces a pressure gradient within the MSW that causes LFG to flow into the collection field rather than migrate.

Phase 2 (the eastern portion of the permitted area) was filled to grade in September 2020 and closure is expected to occur in 2021. The draft Phase 2 gas collection and closure system construction drawings (Sanborn Head 2019) are included in Appendix A3.

Since the 2004 RI/FS, quarterly environmental monitoring has been conducted in accordance with WAC 173-351, including Assessment Monitoring, and the current Permit. Periodic monitoring that has been performed at the Landfill is described in more detail in Section 1.5.

In July 2017, the City entered into an Agreed Order (No. DE 13717) with Ecology in accordance with MTCA to complete an updated RI/FS. An RI Work Plan (Parametrix 2017d) was approved by Ecology (Ecology 2017) and Phases 1 and 2 of the Work Plan were completed in November 2017 (Parametrix 2018) and November 2018 (Parametrix 2019a). The quarterly monitoring performed between Fourth Quarter 2018 and Second Quarter 2020 (Parametrix 2020a, 2020b) included the newly installed well MW-12, and the data are included in this RI report.

1.5 History of Environmental Monitoring

Environmental monitoring at the City Facility has included groundwater, leachate, and LFG at the locations shown on Figure 3. No surface water monitoring is conducted because any surface runoff is collected in perimeter ditches and routed to infiltration facilities discussed in the Permanent Stormwater Control Plan (Parametrix 2008).

1.5.1 Groundwater Monitoring

Groundwater monitoring has been performed at the Landfill since 1987 and is currently documented in quarterly and annual groundwater monitoring reports in accordance with WAC 173-351. Results of the groundwater monitoring are discussed in Section 2.5.

The initial groundwater monitoring network consisted of one upgradient well (MW-1) located on the western boundary of the City Facility and three downgradient monitoring wells (MW-2, MW-3, and MW-4) located along the eastern boundary of the City Facility, approximately 1,400 ft east of the Landfill. Groundwater monitoring was conducted in accordance with a groundwater monitoring plan (SCS Engineers 1996). In 1998, two additional wells (MW-5 and MW-6) were installed less than 50 ft from the eastern edge of the Landfill, and VOCs were detected in these wells. Additional downgradient wells MW-7 through MW-10 were installed in 2001 (Shaw Environmental, Inc. 2003, 2004). A summary of each phase of the 2001–2004 RI is presented in Section 2.1.

Groundwater monitoring well MW-7 was decommissioned in May 2010 because it was located within the construction footprint of the closure of the Phase 1 portion of the Landfill. Well MW-7, although in an upgradient position with respect to groundwater flow, had not been used to characterize upgradient groundwater quality because it showed Landfill impacts due to its close proximity to the MSW. Instead, MW-1, located west of the Landfill, has been used to characterize upgradient groundwater quality, although it also shows some water quality impacts, including those seen area-wide.

An additional upgradient well, MW-11, was installed in May 2010 at the location shown on Figure 4. Groundwater flow is toward the southeast, and this location was selected to be upgradient of the Landfill and the Expansion. The City Facility extends approximate 2,800 ft to the north of the Landfill and is vacant except for the shooting range just northwest of the Landfill.

One additional groundwater well, MW-12, was installed on the City Property southeast of the Facility in 2018 as part of the 2017-2018 RI investigation (Parametrix 2019) and was added to the quarterly monitoring program beginning in the Fourth Quarter of 2018.

Monitoring well construction details are shown on Table 1 and monitoring well logs are presented in Appendix B1. Wells MW-7 through MW-12 are constructed with screened intervals across the water table, and the other wells are constructed with the top of their screen between approximately 7 to 16 ft below the top of the water table.

As required in WAC 173-351, groundwater data collected are compared to the Water Quality Standards for Groundwaters of the State of Washington (GWQSs; WAC 173-200) and State Drinking Water Regulations (Maximum Contaminant Levels [MCLs]; WAC 246-290).

1.5.2 Leachate Monitoring

Leachate is collected in four lysimeters that monitor the vadose zone directly beneath the MSW in the northeast corner of the Landfill. Drains from each lysimeter are connected to a common sampling vault where discrete samples of leachate are collected from four sampling ports. The approximate location of the lysimeters and sampling vault are shown in Figure 3. Lysimeter construction is further discussed in Section 2.6.

The lysimeters were installed in 1993, and samples of leachate were collected and analyzed between 1994 and 2002 (Shaw Environmental 2004). Initially, the monitoring frequency was quarterly but was decreased to semiannually in 1995 due to the declining volumes of leachate observed. No leachate was collected in the lysimeters between 2006 and 2014. In November 2014, June 2015, and June 2016, small quantities of leachate were observed in one of the lysimeter ports, and samples were collected. No leachate has been observed since 2016. Leachate quality is discussed in Section 2.6.

1.5.3 Landfill Gas Probe Monitoring

LFG probes (currently GP-1 through GP-4 and GP-7 through GP-12) are used to monitor the potential for subsurface LFG migration adjacent to the waste and along the Landfill and City Facility boundary (see locations on Figure 3). Results of quarterly LFG monitoring are described in Section 2.7.

Construction details for each gas probe, including the depth relationship of each screened interval to the adjacent waste, are presented in Table 2. The gas probe log for GP-12 is provided in Appendix B2. All gas probes are completed in alluvium outside the Landfill, and each gas probe is screened at two subsurface intervals, with the exception of GP-12, which is screened at three separate intervals. Gas probes GP-5 and GP-6 were decommissioned in May 2010 because they were located within the construction footprint of the closure of the Phase 1 portion of the Landfill.

1.6 Hydrogeologic Setting

The hydrogeologic setting in the vicinity of the Landfill is described below and includes a description of the hydrogeologic units, groundwater flow, and groundwater flow direction and gradient. The local and regional geology and hydrogeology in the vicinity of the Landfill is detailed in reports documenting previous investigations (Hong West 1991; Shannon & Wilson 1998; Shaw Environmental Inc. 2003) and the Hydrogeologic Report (Parametrix 2017c) summarized in the following paragraphs.

1.6.1 Geology

1.6.1.1 Regional Geology

The City Facility is located in the southeast Pasco Basin, a northwest/southeast trending structural depression formed by the faulting and folding of the Columbia River Basalts. Near the City Facility, the depression is filled with approximately 150 to 200 ft of alluvial and glacio-fluvial sediments (silt, sand, and gravel) with dune sand occurring at the surface.

The geology, as observed in on-facility and adjacent well borings, consists of approximately 170 feet of Hanford Formation and Ringold Formation Sediments overlying basalts of the Columbia River Basalt Group. The Hanford Formation is a sequence of sediments deposited during the numerous episodes of catastrophic rapid draining of glacial Lake Missoula in western Montana and northern Idaho.

The upper 45 to 100 ft of unsaturated material below the landfill are part of the Hanford formation, fine to silty sand representing slack water deposits and/or dune sand. The numerous silt-filled seams observed in the 15 to 45 ft sand are characteristic of Hanford Formation clastic dikes. The underlying gravel and sand unit appears characteristic of the Ringold Formation. The widespread sand and gravel beds, laid down during the late Pliocene epoch by the shifting Columbia River, and the deposits that formed in the lakes of its drainage system remain today as the Ringold Formation. Throughout most of the Pasco Basin, the Ringold Formation includes a middle unit of sand and gravel (typically water bearing) and a lower unit of blue clay. The distinction between the Hanford formation from the less consolidated portions and coarser lenses of the Ringold Formation is often difficult to distinguish due to the similar gravelly nature.

There are no mapped Quaternary Faults in the vicinity of the City Facility. The closest Quaternary Fault is an inferred extension of a fault south of Kennewick with activity greater than 1.6 million years ago. Peak acceleration expressed as a percent of gravity in the vicinity of the City Facility is 7 to 8 (U.S. Geological Survey Seismic Hazards website (https://earthquake.usgs.gov/).

1.6.1.2 Site Geology

Geologic cross sections (A-A' through E-E') are presented in Appendix C. Geologic cross section B-B' extends through the off-site wells illustrating deeper subsurface units. Geologic information is available from the following subsurface explorations:

- Twelve on-site groundwater monitoring wells and one deep gas probe drilled to total depths of 102 to 139 ft (see well locations on Figure 4).
- Landfill Water supply well (non-potable use; decommissioned in June 2020) drilled to a depth of 312 ft, located in the southwest corner of the City Facility.
- Two water supply wells (non-potable use) constructed for the ORV park west of the City Facility: ORV-1 drilled to a depth of 386 ft, and ORV-2 drilled to a depth of 485 ft. ORV-1 is located approximately 2,400 ft west of the City Facility and ORV-2 is located approximately 400 ft west of the City Facility (see well locations on Figure 2).

The uppermost geologic unit consists of sand, varying from fine to coarse with some silt, to depths varying from 68 to 101 ft below ground surface. The upper portion of this unit is dominantly fine-grained silty sand, followed by fine- to medium-grained sand with silt filled seams, medium- to coarse-grained sand with trace gravel, and finally fine to silty sand.

The sand unit is underlain by a unit consisting of gravel with varying proportions of sand and some silt to the total depths of the monitoring wells. The landfill water supply well encountered sand to a depth of 86 ft, underlain by water-bearing gravel to a depth of 171 ft. Below the gravel is broken basalt and clay to a depth of 202 ft, underlain by clay to a depth of 248 ft, followed by basalt.

The stratigraphy encountered in the upper portions of the adjacent ORV-1 and ORV-2 wells is relatively consistent with the on-facility monitoring wells and the on-facility former water supply well. The adjacent ORV-2 well encountered sand to a depth of 60 ft, underlain by sand and gravel to 90 ft and gravel to 120 ft. Below the gravel is water bearing basalt and gravel underlain by clay at 160 ft to a depth of 200 ft. Deeper stratigraphy consists of interbedded basalt and clay to a total depth of 485 ft.

The ORV-1 well boring encountered sand and silty sand to a depth of 75 ft and gravel to a depth of 158 ft. As observed in the on-facility water supply well, this unit is underlain by a 42-ft thick layer of clay with some basalt fragments, which serves as an aquitard separating the uppermost aquifer from underlying basalt aquifers. Deeper stratigraphy consists of interbedded basalt and clay to a total depth of 386 ft.

Testing of surface and subsurface soils was conducted by Hong West (1991) and Shannon & Wilson (1998). Hong West conducted testing of soils from the original landfill pit area, including grain size analysis (ASTM D422), moisture content (ASTM D2216), moisture-density relationship (ASTM D1557), and constant head permeability. Tests were conducted on samples from the following depths: surface (silty sand - SM); 15 ft (poorly graded sand with silt – SP-SM); 35 ft (poorly graded sand – SP); and 45 ft (poorly graded sand - SP).

The sands had a moderate permeability of 10^{-2} to 10^{-3} cm/sec. The only high permeability material identified on the City Facility was the medium to coarse sand from about 45 ft deep in the main pit. This material has a natural permeability of about 0.15 cm/sec (0.3 ft/min). Upon compaction, the surficial silty sand had a permeability of 10^{-5} to 10^{-6} cm/sec, and the underlying silty sand at 35 ft and the fine to medium sand at 35 ft had permeabilities ranging from 10^{-4} to 10^{-5} cm/sec.

1.6.2 Hydrogeology

1.6.2.1 Regional Hydrogeology

Regionally, groundwater flow has been documented to be eastward toward the Columbia River about 3 miles east of the Landfill (Shaw 2003; Liikala 1994). Insufficient data are available to determine the hydraulic relationship between the uppermost aquifer and the deeper basalt aquifers. However, Liikala (1994) described the aquitard underlying the uppermost aquifer as being regionally present and calculated an overall upward vertical gradient in the vicinity of the Landfill based on a measured hydraulic head in the upper confined aquifer that was higher than in the uppermost unconfined aquifer. The uppermost aquifer thins toward the east. This upward migration is consistent with hydraulic heads recorded in the deeper basalt completed wells (ORV-1 and ORV-2) and the former landfill well when compared to the hydraulic head observed in the landfill monitoring wells of the shallow unconfined aquifer.

Regionally, groundwater is recharged by depletion of the Yakima River west and southwest of the landfill and through precipitation. Artificial recharge from irrigation is also significant regionally. However, actual recharge to the water table from precipitation is significantly less due to the high rate of evapotranspiration. Precipitation in the Richland area from May 1944 to March 2013 indicate an average annual precipitation of 7.15 inches and an average total annual snowfall of 7.1 inches (Western Regional Climate Center 2016).

Hydraulic conductivity of the shallow aquifer regionally has been estimated at 20 to 600 ft/day (Gephart et al. 1979 as cited in Hong West 1991).

1.6.2.2 Site Hydrogeology

Hydrogeologic Units

Groundwater in the uppermost aquifer occurs under water table conditions in the sand, silt and gravel sediments of the middle Ringold Formation. The water table beneath the Landfill occurs at depths of approximately 75 to 105 ft below ground surface (bgs) and elevations of approximately 385 to 388 ft NAVD88 and typically fluctuates less than a foot throughout the year. Based on the geologic logs of the on-site water well and the adjacent ORV-2 well, the aquifer thickness is approximately 80 to 110 ft. A 40-ft thick clay and silt layer forms the base of the uppermost aquifer at a depth of 160 ft and has been interpreted as the lower member of the Ringold Formation (Hong West 1991).

Groundwater Flow Direction

Regionally, groundwater flow has been documented to be eastward toward the Columbia River (Newcomb et al. 1972; Liikala 1994 Shaw 2003; Newcomber 2007, DOE 2011). However, artificial recharge due to irrigation is significant in the area and historical groundwater measurements have indicated the flow direction at the Landfill to be locally influenced by groundwater mounding from irrigated crop circles on the City Facility’s eastern boundary, deflecting the flow in the eastern portion of the City Facility seasonally toward the southeast.

Irrigated crop circles are present west of Highway 240 and immediately adjacent to the Expansion Area along the eastern City Facility boundary. East of the City Facility are circle-irrigated agricultural fields used to grow alfalfa hay, corn, and potatoes. Irrigation water for these fields is obtained from the Columbia River and not from a groundwater source. Irrigated fields are also located west of the City Facility across State Highway 240. These fields have been in use since 1987, with irrigation occurring between the months of April and October (Shaw Environmental Inc. 2003).

Hydrographs presented in the Phase 1 RI (Shaw 2003) indicate a steady rise in water-level elevations from 1986 through 2002 with observed increases of approximately 5 to 7 ft. These changes were attributed to influences from irrigated crop circles on the City Facility's eastern boundary. Historical potentiometric surface maps (presented in Appendix D) also show that the flow direction and gradient have changed in response to these increasing water levels. In 1987, the flow direction was eastward with a gradient of approximately 0.001 ft/ft, consistent with the regional groundwater flow direction. In 1995, the flow direction changed to southeasterly, with a gradient of 0.0004 ft/ft. The additional wells installed in 2002 allowed further refinement of the flow direction and gradient, and the data showed easterly flow in the western portion of the City Facility, changing to southeasterly flow in the central portion of the City Facility, a pattern that continues to be observed.

Historical influences at the ORV park west of the City Facility may have also temporarily altered local flow direction by periodically flooding shallow unlined waterways for boat racing, allowing the water to seep out after each race. The ponds were constructed in 1999 and racing was discontinued in the mid 2000's. Other sources of artificial recharge include four septic systems at the ORV park, one recently installed for a new bathroom/shower facility designed for 4,000 uses per day.

Potentiometric surface maps are provided in Appendix D for the 2015 wet (First Quarter) and dry (Third Quarter) seasons. Although groundwater flow across the City Facility is generally toward the southeast, during the dry season groundwater flow in the eastern portion of the City Facility shifts slightly more toward the south-southeast due to the mounding effect of the crop circles on the eastern edge of the City Facility.

Groundwater Hydraulic Conductivity and Flow Rate

Slug tests were performed on wells MW-5 and MW-6 (Shannon & Wilson 1998) and wells MW-7, MW-8, MW-9, and MW-10 (Shaw Environmental, Inc. 2002) to obtain estimates of aquifer hydraulic conductivity. Analysis of the data for MW-5 and MW-6 indicated a hydraulic conductivity with a range of 6.1×10^{-4} to 5.5×10^{-3} cm/sec, or 1.7 to 15.6 ft/day. Analysis of the data for MW-7, MW-8, MW-9, and MW-10 indicated a hydraulic conductivity of 3.1 ft/day, 3.0 ft/day, 7.8 ft/day, and 3.8 ft/day, respectively. Based on the slug test data, the average hydraulic conductivity for the aquifer is 5.8 ft/day with the median hydraulic conductivity of 3.45 ft/day.

Walton (1985) has listed representative porosities for varying material types. Based on this information and the assumption that the aquifer consists of sand and gravel as observed in well logs, a reasonable range for porosity (n) is 25 to 35 percent.

The measured groundwater gradient in 2019 ranged from 0.00044 to 0.0061 ft/ft. The overall groundwater gradient at the City Facility is low, approximately 0.0005 ft/ft over the past few years.

The velocity of groundwater flow is calculated using a modification of Darcy's Law, where:

- $V = Ki/n$
- V = velocity/flow rate in ft/day
- K = hydraulic conductivity in ft/day
- i = hydraulic gradient
- n = porosity

Using the range of hydraulic conductivity values 1.7 to 15.6 ft/day, average gradient of 0.0005 ft/ft, and a porosity of 30 percent, the approximate velocity of rate of groundwater flow is 0.0028 to 0.026 ft/day, or 1.0 to 10.0 ft/year.

The calculated rate of flow during 2019 ranged from 0.003 to 0.046 ft/day or 1.0 to 17.0 ft/year, based on the measured range of groundwater gradients (0.00044 to 0.00061 ft/ft), hydraulic conductivity values of 2 to 15 ft/day (Shaw Environmental, Inc. 2003; Shannon & Wilson 1998) and estimated porosities between 20 and 35 percent (Walton 1985).

1.7 Beneficial Water Use

WAC 173-160-171 prohibits installation of wells within 1,000 ft of a permitted or previously permitted solid waste landfill. Logs for existing water wells within 2,000 ft of the Landfill were researched on the Ecology website. Their locations are on Figure 2 and a table summarizing their properties is presented in Appendix B3. The only wells within 2,000 ft of the Landfill are the two wells in the ORV park west of the Landfill in an upgradient direction, which are not used for drinking and the on-site water well that was decommissioned in June 2020.

Ecology well log and water rights records were searched for wells located within a distance of approximately 2 miles of the City Facility in a cross-gradient or downgradient direction. Well logs and a map showing their locations are presented in Appendix B3. The closest water wells identified in the Ecology database are located approximately 1 mile from the City Facility to the south in a cross-gradient direction and are used for domestic purposes. These domestic wells are located in the same neighborhood as well W-1 that was previously sampled (Ecology 2008; Parametrix 2014), as described in Section 2.3. Water right information is presented in Appendix B4.

In a downgradient direction, the closest water wells are two wells for the City of Richland and one well for American Rock Products located in Section 27, approximately 2.3 miles downgradient. The City wells are not in active production and the American Rock Products well is used for non-potable purposes. A map showing the location of surrounding wells is provided in Appendix B.

The City of Richland operates a potable water supply facility located approximately 3 miles to the east of the Facility. This facility, the North Richland Well Field, is operated as a slow sand filtration facility and relies on a mixture of artificially recharged Columbia River water and local groundwater for its source water.

The project area is located on the border of Water Resource Inventory Area (WRIA) 37 – Lower Yakima and WRIA 40 - Alkali/Squilchuck. No on-site water features were identified on the U.S. Geological Survey map and the nearest adjacent surface water features are the Yakima River located approximately 1.3 miles to the south and the Columbia River approximately 3.5 miles to the east. According to US Department of Interior National Wetland Inventory maps, no wetlands are located in the vicinity of the Landfill and it is assumed that all water on the Landfill infiltrates based on the National Resources Conservation Service Soil Survey Drainage Class Rating (excessively drained).

1.8 Local and Regional Groundwater Quality

Regional groundwater quality has been substantially impacted by the Hanford Nuclear Reservation bordering the Landfill to the north. The local impacts related to the Hanford facility appear to be limited to the adjacent property northeast (current HAMMER federal training center) which was used as the Hanford Patrol Academy Demolition Site (HPADS).

The HPADS facility was utilized to explode a variety of waste chemicals that had passed their historical shelf life by detonation in two areas of excavated explosion pits (DOE 1994). The explosive detonation vaporized a majority of the hazardous chemicals; however, due to the prolonged period of the practice localized soil and potential groundwater contamination was suspected. Groundwater quality was monitored at the HPADs facility in the late 1980's and early 1990's which showed no detections of chlorinated solvents in the local groundwater. A site closure plan was implemented for the HPADS site in 1994. Groundwater contamination suspected for the adjacent HPADS site appears to not affect the groundwater quality below the Landfill.

There are currently no known off-site historical sources of contamination affecting the groundwater quality below the landfill. Shaw Environmental (2002) previously suspected an undocumented disposal area northwest of the Landfill was a potential source of groundwater contaminants below the site. Subsequent investigations have shown the local impacts below the landfill are related to the release mechanisms from the burial of MSW at the landfill and not related to other sources.

2. FIELD INVESTIGATIONS

As described in Section 1.5.1, quarterly environmental monitoring has been performed at the Landfill since 1987, and the current program has been conducted in accordance with WAC 173-351 since 1993. Additional field investigations include the 2001–2004 RI conducted in two phases: a pilot study/FS, assessment monitoring activities conducted in accordance with WAC 173-351, and the 2017-2018 RI. Interim independent cleanup actions have been implemented, including landfill closure and LFG collection. The findings of these previous studies and a summary of the current status of the environmental monitoring data are described in the following sections.

2.1 2001–2004 Remedial Investigation

In 1998, the City installed two additional groundwater monitoring wells (MW-05 and MW-06; Shannon & Wilson, Inc. 1998). VOCs were detected above GWQSs, and in 2000, the Landfill was listed by Ecology on the Confirmed or Suspected Contaminated Sites List. The City chose to conduct a MTCA independent cleanup of the groundwater by performing an RI and FS, beginning with a phased RI/FS (Shaw Environmental, Inc. 2003, 2004) over the next approximately 5 years. The 2001–2004 RI and 2004 FS are discussed in the following sections.

2.1.1 Phase 1

Phase 1 of the 2001–2004 RI (Shaw Environmental, Inc. 2003) included installing and sampling four additional groundwater monitoring wells, performing aquifer slug tests to determine hydraulic parameters, and performing groundwater sampling and analysis for five consecutive quarters. The new wells were MW-7 upgradient of the Landfill’s waste cells to refine the upgradient groundwater flow direction, MW-8 and MW-9 along the southern City Facility boundary to determine whether VOCs had migrated off the City Facility, and MW-10 north of wells MW-5 and MW-6 to further evaluate the extent of groundwater impacts. The four wells were screened approximately 10 ft below the top of the upper water-bearing zone to 5 ft above it.

Hydrographs presented in the Phase 1 RI (Shaw 2003) indicated a steady increase in water-level elevations from 1986 through 2002 with observed increases of approximately 5 to 7 ft. These changes were attributed to influences from irrigated crop circles on the City Facility’s eastern boundary. The agricultural irrigation east of the landfill causes groundwater mounding with the effect of deflecting the flow direction to the southeast and lowering the gradient.

Historical water elevation maps (presented in Appendix D) also show that the flow direction and gradient have changed in response to these increasing water levels. In 1987, the flow direction was eastward with a gradient of approximately 0.001 ft/ft, consistent with the regional groundwater flow direction. In 1995, the flow direction changed to southeasterly, with a gradient of 0.0004 ft/ft. The additional wells installed in 2002 allowed further refinement of the flow direction and gradient, and the data showed easterly flow in the western portion of the City Facility, changing to southeasterly flow in the central portion of the City Facility, a pattern that continues to be observed.

The Phase I RI included analysis and measurement of natural attenuation parameters, including methane, ethane, ethene, dissolved oxygen, oxidation-reduction potential (ORP), and ferrous iron. Although the results were inconclusive, methane was detected in wells MW-5, MW-6, MW-7, and MW-10, where VOCs have historically been detected.

Slug tests calculated hydraulic conductivities ranging from 3.0 to 7.8 ft per day, within the range previously measured of 1.7 to 15.0 ft/day at MW-5 and MW-6 by Shannon & Wilson (1998).

Concentrations of the most commonly detected VOCs (1,1-DCA, PCE, TCE, cis-1,2-DCE, and VC) were plotted using data from March 2002 (see Appendix F), indicating that 1,1-DCA showed the most widespread distribution, and both 1,1-DCA and PCE were detected in well MW-9, located at the City Facility boundary.

The data collected during the Phase I RI were the first to identify impacts to groundwater quality due to the irrigated fields at well MW-2 along the northeast site boundary. The data identified chloride, nitrate, sulfate, and Total Dissolved Solids (TDS). The Phase I RI included evaluating a potential undocumented upgradient waste disposal site located approximately 1,200 ft northwest of the northwest corner of the Landfill as a potential source. The undocumented disposal site was found to be limited in extent, with an estimated MSW volume of 4,800 cubic yards, and it was concluded that the undocumented waste site was likely not the source of the VOCs impacting groundwater.

2.1.2 Phase 2

Phase 2 of the RI (Shaw Environmental Inc. 2004) included an assessment of whether leachate and/or LFG were the source of VOCs impacting groundwater. Selected data from Phase 2 are presented in Appendix E1. Phase 2 activities included:

- Installing multilevel deep gas probe GP-12, with three completion depths.
- Measuring LFG concentrations (pressure, methane, oxygen, and carbon dioxide [CO_2]) in multilevel gas probes GP-1, GP-2, GP-5, GP-6, GP-9, and GP-12.
- Performing depth-discrete LFG monitoring in wells MW-5, MW-6, and MW-7.
- Collecting headspace gas samples from just above the water table in wells MW-5, MW-6, and MW-7 and in gas probe GP-12-2 (intermediate depth) and analyzing them for VOCs and fixed gases (hydrogen, oxygen+argon, nitrogen, carbon monoxide, methane, and CO_2).
- Evaluating groundwater and lysimeter liquid chemistry.

2.1.2.1 Gas Probe Monitoring

LFG concentrations (pressure, methane, oxygen, and CO_2) were measured in multilevel gas probes GP-1, GP-2, GP-5, GP-6, GP-9, and GP-12 (see Appendix E1). The highest methane concentrations were observed in GP-2-2 (25 percent), GP-12-2 (16.2 percent), and GP-12-3 (11.9 percent).

2.1.2.2 Depth-Discrete LFG Monitoring in Wells

Depth-discrete LFG monitoring was performed in wells MW-5, MW-6, and MW-7 (see Appendix E1). Methane was detected in the well casings of all three wells (1.2 to 3.1 percent at MW-5; 2.3 to 5.5 percent at MW-6; 14.5 to 16.6 percent at MW-7), including directly above the top of the groundwater surface. The lower concentrations measured in wells MW-5 and MW-6 were attributed to their screens being below the top of the water table, whereas the screen was exposed at MW-7.

2.1.2.3 Analytical Results of Headspace Gas Samples

Headspace gas samples were collected from just above the water table in wells MW-5, MW-6, and MW-7 and in gas probe GP-12-2 (intermediate depth) and analyzed for VOCs and fixed gases (hydrogen, oxygen+argon, nitrogen, carbon monoxide, methane, and CO_2). Methane was detected in MW-7 (11.9 percent) and GP-12-2 (16.7 percent). VOCs that were detected in high concentrations in all samples included 1,1-dichloroethane (DCA), cis-1,2-dichloroethene (DCE), methylene chloride, PCE, TCE, and VC, with lower concentrations detected of benzene, chloroethane, 1,1-DCE, trans-1,2-DCE and trichlorofluoromethane (TCFM).

Methane, oxygen, and CO^2 were measured at 10-ft depth intervals within each monitoring well casing. Methane concentrations showed relatively uniform methane concentrations throughout each well casing, ranging from 1.2 to 3.1 percent in MW-5, 2.3 to 5.5 percent in MW-6, and 14.5 to 16.6 percent in MW-7.

2.1.2.4 Evaluation of Groundwater and Lysimeter Liquid Chemistry

Trilinear diagrams showed that groundwater samples from all wells except MW-2 were relatively consistent and the dominant cations and anions were calcium and bicarbonate (see Appendix E1). Well MW-2 showed a spike in chloride concentrations beginning in 1999. Leachate samples, by contrast, had significantly higher concentrations and a distinct ionic chemistry characterized by a relatively higher percentage of chloride.

Trends in constituents detected at elevated concentrations in lysimeter liquid were evaluated in groundwater, including chloride, nitrate (ammonia in leachate oxidizes to nitrate), sodium, and total organic carbon (TOC). Nitrate, ammonia, and TOC were non-detected in groundwater or were detected only in low concentrations. However, the study noted that these parameters cannot be used to definitively demonstrate leachate impacts since the trends in chloride, nitrate, and sodium observed in MW-2 were likely attributable to agricultural influences. Continuing agricultural influences have been documented by more recent data in wells MW-2 and upgradient well MW-11.

Constituents whose concentrations could be affected by the interaction of LFG and groundwater are pH, alkalinity, and calcium. The observed trends in these parameters in VOC-impacted wells MW-5, MW-6, and MW-7 were believed to be potentially indicative of interaction of LFG and groundwater. However, trends in calcium concentrations were also observed in MW-2 that were likely attributable to agricultural influences. Continuing agricultural influences have been documented by more recent data in wells MW-2 and upgradient well MW-11.

The VOCs detected most frequently and in the highest concentrations in the groundwater samples (PCE, cis-1,2-DCE, 1,1-DCA, TCE, VC, methylene chloride, benzene, and TCFM) were also detected most frequently and in the highest concentrations in headspace gas samples collected from the monitoring wells and GP-12 (see Appendix E1). A subset of VOCs frequently detected in the lysimeters at high concentrations were either not detected in any of the groundwater or headspace gas samples, or detected infrequently at low concentrations (2-butanone, carbon disulfide, ethyl benzene, 4-methyl-2-pentanone, toluene, and total xylenes).

2.1.2.5 2001–2004 RI Conclusions

The 2001–2004 RI concluded that LFG is the likely source of the VOCs impacting groundwater via vertical migration of LFG through the unsaturated soil to the capillary fringe zone. This conclusion was based on the presence of the same suite of VOCs detected in groundwater in hydraulically upgradient wells and in the vapor phase in the vadose zone including the deep screened zone of GP-12 immediately above the water table. The findings of the RI are summarized as follows:

- Significant concentrations of LFG, as measured in GP-12, occur in the shallow unsaturated subsurface to a depth of at least 90 ft bgs in the MW-6 area and high concentrations of LFG were detected in the casings of MW-5, MW-6, and MW-7.

- The same suite of VOCs detected in headspace gas samples from the monitoring wells and gas probe GP-12 were also detected in groundwater, even though MW-7 is located hydraulically upgradient from the waste cells.
- Dissolved methane was present in groundwater samples.
- A subset of VOCs frequently detected in the lysimeters representative of Landfill leachate at high concentrations were either not detected in any of the groundwater samples or detected infrequently at low concentrations.
- Geochemistry of the groundwater samples has a different chemical composition than the leachate. The observed decreases in pH and increases in alkalinity and calcium may be indicative of the interaction of LFG and groundwater.

2.2 Pilot Study/Feasibility Study

Based on the findings of the Phase 2 RI, a pilot-scale LFG extraction test was performed to assess the feasibility of implementing an active LFG collection system as a method for mitigating the LFG source of vapor-phase VOCs (Shaw EMCON/OWT, Inc. 2005), and ultimately reducing VOC concentrations in groundwater. One LFG extraction well was drilled to the bottom of waste and three LFG observation wells were installed in waste surrounding the new extraction well. Twelve temporary bar hole probes were also installed at variable horizontal distances from the extraction well covering an approximate 200-ft radius circular area centered on the extraction wells at 50 ft spacings.

A pilot extraction test was conducted by applying a vacuum with a temporary blower and monitoring gas composition. A steady state extraction rate was reached after approximately 15 days at a methane concentration of approximately 45 percent. At 17 days, the new steady-state condition of 39 percent methane was established, and the test was run for an additional week.

A sample of the vapor (and duplicate) was collected and analyzed for fixed gases and VOCs. The methane concentration was 50.7 percent. VOCs detected included VC, benzene, cis-1,2-DCE, TCE, and PCE but also other compounds that had been detected in lower concentrations in LFG and in leachate, including acetone, 2-butanone, toluene, ethylbenzene, and xylenes. The results of the tests are presented in Appendix E2.

The results of the pilot extraction test indicated an average radius of influence of 150 ft and calculated annual recovery for total VOCs would be approximately 63 pounds per year at a flow rate of 23 standard cubic feet per minute (scfpm).

The results of the extraction test indicated that LFG collection would be effective as a remedy to remove vapor phase VOCs within the waste before they migrate vertically through the underlying subsurface soil and partition into groundwater.

2.3 Assessment Monitoring Program

In 2013, Ecology requested that additional activities be conducted to comply with the assessment monitoring requirements of WAC 173-351-440. Assessment monitoring is required whenever statistical increases and concentrations above the criteria in WAC 173-200, Water Quality Standards for Groundwaters of the State of Washington, have been detected for one or more of the constituents listed in WAC 173-351 Appendix I. The following activities were completed:

- During the first quarter of 2014, in addition to the landfill monitoring wells, samples were collected from an additional monitoring well (W-1) located on the east side of the Weidle neighborhood, south of and more than a mile from the Landfill (Parametrix 2014). Although well W-1 is located in a direction that is not downgradient of the landfill, the sample was collected to confirm that the Landfill was not impacting drinking water wells in the Weidle neighborhood. The groundwater quality data are presented in Appendix G1, Table G-1 and did not indicate any impacts from the Landfill. Well W-1 was installed in 1993 as part of the Horn Rapids Triangle Development and sampled by the City of Richland during the 1990s as part of a State Environmental Policy Act review for the proposed golf course. Ecology conducted sampling at additional wells in the Weidle neighborhood as part of a Site Hazard Assessment (Ecology 2008) and recommended No Further Action.

- Testing for Appendix III parameters has been conducted annually in phases beginning in 2014. Initially, testing included one well near the active cell and one well at the City Facility boundary in the second quarter of each year. The tested wells were MW-6 and MW-9 (2014), MW-5 and MW-8 (2015), and MW-4 and MW-10 (2016). The results of the testing did not detect any Appendix III compounds other than the VOCs identified during the RI. Therefore, beginning in 2017, testing for the additional Appendix III parameters is being conducted annually on a rotating schedule at one of the three wells located closest to the Landfill (MW-5, MW-6, and MW-10), or at wells MW-8 and MW-9 located at the City Facility boundary. Testing was conducted at well MW-6 in 2017, MW-10 in 2018, MW-5 in 2019 and at MW-9 in 2020. The Appendix III results are further discussed in Section 2.5.

2.4 2017-2018 Remedial Investigation

Two additional phases of RI activities were conducted in 2017 and 2018 in accordance with a Work Plan approved by Ecology (Parametrix 2017). The objective of the Phase 1 push probe sampling was to evaluate the furthest extent of the contamination directly downgradient from the central portion of the contaminant plume so that a permanent groundwater monitoring well could be installed during Phase 2 at a location beyond the area of impact to be used as a sentinel well for the assessment monitoring program.

The Phase 1 push probe investigation is described in Section 2.4.1, and findings presented in Appendix F. The monitoring well installation is described in Section 2.4.2.

2.4.1 Phase 1 - Direct Push Probes

The push probe locations proposed in the Work Plan were selected based on the distribution of VOCs measured in City Facility monitoring wells during 2015. The Horn Rapids Landfill Environmental Monitoring Report for 2015, dated March 2016, identified the following VOCs as present in groundwater wells located downgradient of the Landfill in concentrations above Groundwater Quality Standards (WAC 173-200): 1,1-DCA; 1,2-DCA; PCE; TCE; and VC. Based on the measured concentrations at the City Facility boundary, VOCs present in concentrations greater than GWQSs were considered to be the preliminary contaminants of concern (COC) for the Landfill, as shown in Appendix F, Table F-1.

Since the groundwater flow direction is generally toward the southeast but varies seasonally from east-southeast to south-southeast, the impacted area downgradient from the Landfill is expected to extend from south of MW-9 to east-southeast of MW-4. The contaminant distribution indicated that concentrations exceeding GWQSs were expected to be limited to an estimated distance of approximately 500 ft from the City Facility boundary. This area was explored by push probe (PP) locations PP-2 through PP-5 on City Property.

Gas probe data have indicated that LFG is present only in close proximity to the Landfill and only in gas probes GP-2, GP-9, and GP-12. Groundwater impacted by LFG in this area would generally flow toward existing wells MW-8 and MW-9. However, due to groundwater impacts observed in MW-1 and lack of deeper screened gas probes in the southwestern portion of the City Facility, the push probe investigation was also planned to evaluate potential LFG impacts to groundwater in the area near the southwestern City Facility boundary at location PP-1 and downgradient of this area on City Property at location PP-4.

The Phase 1 investigation consisted of the following sequence of activities:

- Five push-probe installations were completed until groundwater was encountered to approximate depths of 100 ft.
- Groundwater samples were collected from each push probe at total depth using a portable bladder pump.
- The groundwater samples were tested for VOCs and natural attenuation parameters.

The results of the push probe investigation are presented in the push probe report (Parametrix 2018) and summarized in the following sections. The final locations of the five push probes are shown on Figure 5 and investigation findings are provided in Appendix F.

2.4.1.1 Push Probe Installation Procedures

The push probes were installed by Atkins (formerly EnergySolutions, Inc.) with oversight by a Parametrix hydrogeologist. Construction information and depth to groundwater measurements for the push probes are presented in Appendix F, Table F2. A variance from WAC 173-160-451(d) was obtained from Ecology because the probes exceeded the maximum allowed depth of 30 ft.

Atkins collected groundwater samples using direct push technology (EPA 2005) at five locations downgradient of the Landfill. One location (PP-1) was in the City Facility and four of the locations (PP-2 through PP-5) were on City Property. Atkins employed their hydraulic hammer probe driving unit that is mounted on a backhoe tractor. The direct push tooling method for the Horn Rapids Landfill investigation project was as follows.

- Drive down to target depth.
- Knock out drive tip (drive tip remains in the hole) and pull back a few inches to ensure tip is free.
- Run in a standard stainless steel well screen on tubing and place on the bottom of hole.
- Pull back direct push tubing approximately 5 ft.
- Run sampling pump and collect groundwater sample.
- Remove screen and tubing.
- Decommission push hole by introducing grout as drive tubing is removed.

Groundwater elevations at each of the proposed locations were estimated in advance based on projections from the calculated potentiometric groundwater surface using measurements from nearby groundwater monitoring wells. The tooling was driven to a targeted depth approximately 10 ft deeper than the anticipated groundwater

A 10-ft temporary standard stainless steel screen was installed into each probe prior to groundwater sample collection. The purpose of the screen was to ensure that the hole remained open and to filter some particulates to reduce turbidity since the formation was expected to contain approximately

10 to 15 percent fine-grained sand and/or silt. The slot size of the screen was 20 slot (0.2 inch) based on the anticipated sediment size in the screened zone. The screen was decontaminated between push probe installations using the procedures described in the Quality Assurance Project Plan (QAPP; Parametrix 2017d).

2.4.1.2 Phasing and Selection of Push Probe Locations

The push probe locations were selected to fill data gaps in the southwest portion of the City Facility (PP-1) and on City Property further downgradient from existing monitoring well locations (PP-2 through PP-5). The objective of the investigation was to define the downgradient extent of contaminants in groundwater originating from the Landfill and to document decreases in measured VOC concentrations with distance from the Landfill to demonstrate that natural attenuation is occurring.

The first two push probes were installed at the PP-2 and PP-3 pre-selected locations, hydraulically downgradient from monitoring wells MW-9 and MW-8, respectively. Prior to confirming the third push probe location, laboratory data from PP-2 and PP-3 were reviewed and Ecology was consulted. The PP-2 results showed lower VOC concentrations than those observed in MW-9, consistent with expectations based on the 2015 isoconcentration maps. Specifically, the PP-2 concentration of 1,1-DCA was only slightly above the GWQS, PCE and TCE were not detected, and VC was below the GWQS. The observed concentrations at PP-3 were similar to the results from PP-2 and also consistent with expectations based on the 2015 isoconcentration maps.

The PP-1 location within the City Facility had to be adjusted from the original planned location due to the presence of water lines, and it was decided to install the third push probe at the PP-4 location while waiting for utility clearance and consultation with Ecology to confirm the final placement of PP-1 at the fourth location.

Based on data collected from PP-1 through PP-4, site conditions, and consultation with Ecology, the Work Plan was altered to install one additional push probe rather than two. The objective of PP-5 was to confirm VOC concentrations downgradient from MW-4. Since the observed concentrations at previous push probes PP-2, PP-3, and PP-4 showed only low concentrations of VOCs, it was decided that this location for PP-5 would provide more information toward the project objectives than the alternate proposed location that was further downgradient from PP-2 and PP-3.

2.4.1.3 Sampling Procedures

Groundwater samples were collected at each probe location using a 0.75-inch diameter portable bladder pump. Stainless steel weights were attached to the bottom of the pump to facilitate introduction to the bottom of the hole. Although full development of the probe was not possible, the portable bladder pump was used to purge some water prior to sampling to reduce the amounts of fines. However, the low pumping rate of the small diameter pump (approximately 20 to 25 ml/min) only allowed a small quantity of water to be purged prior to sampling. The portable bladder pump was decontaminated between push probe locations using the procedures described in the QAPP.

Groundwater sampling was conducted using low-flow purging techniques as detailed in SOPs presented in the QAPP. The rate of flow during purging and sampling was approximately 20 to 25 ml/min, lower than typical purge rates of 300 to 500 ml/min described in the QAPP. Field parameters (conductivity, pH, temperature, dissolved oxygen [DO], and ORP) were measured during sampling using a flow through cell.

Some of the groundwater samples were observed to have significant turbidity that was likely related to the pulverized sediment that was removed from the casing at the bottom of each probe prior to introducing the screen. Turbidity present within the samples is not expected to cause significant bias in concentrations of VOCs or dissolved gases (EPA 2005).

2.4.1.4 Groundwater Analyses

Groundwater samples collected from the push probes were hand delivered to a local analytical laboratory, Energy Northwest, located in Richland, WA, and tested for VOCs (EPA Method 8260C and 8260C SIM for selected VOCs with low GWQSs) with a 24-hour turnaround so that the results could be used to confirm the location of subsequent push probes. Laboratory procedures and analytical methods are presented in the QAPP.

In addition, groundwater samples were tested for the natural attenuation parameters methane, ethane, and ethene (Method RSK 175). Energy Northwest subcontracted these analyses to ALS Environmental.

In accordance with the QAPP, duplicate samples collected at selected locations were analyzed as shown on Appendix F, Table F-2 to evaluate the quality and reproducibility of the data. Duplicate samples were analyzed by Energy Northwest and also by TestAmerica, the lab that conducts the routine quarterly groundwater monitoring well sample analyses. The TestAmerica samples were hand delivered to the lab in Tacoma, WA, along with the Fourth Quarter 2017 monitoring well samples that were collected on November 14 and 15, 2017.

Specific conductivity, pH, temperature, DO, and ORP were measured in the field.

2.4.1.5 Groundwater Quality Data

The groundwater quality results are summarized in Tables F-4 (VOCs), F-5 (natural attenuation parameters), and F-6 (field data) in Appendix F. Table E-4 presents a summary of the 2017 groundwater monitoring well results including the Fourth Quarter monitoring conducted on November 14 and 15 for comparison with the push probe results (samples collected between November 7 and 16).

For PP-1, although the concentrations reported by Energy Northwest for VC using Method 8260 (less than 0.5 µg/L) and 8260 SIM (0.35 µg/L) were internally consistent, the 8260 SIM result was much higher than the Method 8260 result reported by TestAmerica (less than 0.02 µg/L). Although Energy Northwest's 8260 SIM result of 0.35 µg/L for PP-1 was used to prepare the isoconcentration map discussed in Section 2.4.1, this value and associated interpretation are considered an estimate that is potentially biased high.

VOCs

VOC results are presented in Appendix F, Table F-3. Concentrations of 1,1-DCA, TCE, PCE, and VC were above the GWQS at PP-1, located in the southwestern portion of the City Facility. The concentrations observed at PP-1 were generally in the range of typical concentrations observed at MW-9 in routine and periodic groundwater monitoring performed at the Landfill over the past few years.

The only concentration above a GWQS detected in any of the push probes outside the City Facility boundary on City Property was 1,1-DCA in the sample from PP-2 at a concentration of 1.1 µg/L, slightly above the GWQS of 1.0 µg/L.

The chemical acrylonitrile was also detected in the samples from PP-2, PP-3, and PP-5, with the concentration at PP-5 (0.0705 µg/L) slightly above the GWQS (0.07 µg/L). However, all concentrations were below the MTCA Method B cleanup level of 0.081 µg/L. Routine analyses from the monitoring wells on the City Facility for acrylonitrile have not shown detections, although the reporting limit during routine monitoring is higher (5.0 µg/L compared to 0.02 µg/L for the push probe investigation) because the selective ion monitoring (SIM) method is not used.

Acetone was detected in all five push probe samples, and the concentrations in PP-2 (46 µg/L), PP-4 (39 µg/L), and PP-5 (11 µg/L) were higher than the range of concentrations measured in Landfill monitoring wells (2.3 to 9.0 µg/L). The duplicate samples tested at PP-1 (5.0 compared to 4.5 µg/L) and PP-3 (32 compared to 39 µg/L) indicated the acetone results were generally reproducible between both laboratories, although the concentration measured at PP-3 (8.8 µg/L) was not confirmed by its duplicate result of less than 2 µg/L.

Low concentrations of acetone could potentially be attributed to its presence as a trace contaminant associated with products employed during drilling operations. However, acetone is not identified as a component of any of the materials used during the field portion of this investigation. During the push probe installation, pipe lubricant (Jet Lube's Well Guard) was used for the threading on the drill rods, and sealant (RTV Red High Temp Silicon Sealant) was used to secure the knock-out tips. Prior to deployment, the tools (pipe, etc.) were first cleaned with Simple Green then steam cleaned. The rig was also steam cleaned before deployment. And, although not introduced into the borehole, grease (Redtac grease and Lagermeister 3000 Plus) was used to lubricate the pulley system and the drive hammer. Detergent (ALCONOX) was used to clean the screen.

Acetone in trace concentrations is also sometimes present as a contaminant in preservatives added to sample vials, and acetone is also a contaminant that can be introduced during laboratory sample preparation and analysis. For this project, the vials used were certified to be free of acetone above a quantitation limit of 2 µg /L. No acetone was detected in any of the trip blanks, method blanks, or matrix spikes/matrix spike duplicates.

In conclusion, although it is not possible to identify any specific source that introduced acetone as a contaminant, higher acetone concentrations in push probe samples compared to well samples suggest there could be a possible source related to some aspect of this specific investigation. No GWQS has been established for acetone, and the acetone results are not believed to impact the other results of this study since the COC concentrations are consistent with expectations based on the monitoring well data.

Natural Attenuation Parameters

Natural attenuation parameter (methane, ethane, and ethene) results are presented in Appendix F, Table F-4. Methane was detected at low concentrations in all the push probes at concentrations ranging from 2.6 to 19 µg/L (23 µg/L in PP-3 duplicate). Methane is routinely detected at concentrations between 1,000 and 5,000 µg/L in monitoring wells along the downgradient edge of the Landfill (MW-5, MW-6, and MW-10) and sporadically at concentrations less than 5 µg/L in monitoring wells along the City Facility boundary (MW-8 and MW-9).

Ethane (0.68 to 7.3 µg/L) and ethene (1.2 to 5.7 µg/L) were also detected in the push probe groundwater samples. Ethane and ethene have not been detected during routine groundwater monitoring, although the reporting limits for this push probe investigation were lower (1.0 µg/L compared to 10 µg/L during the routine groundwater well monitoring). These detections support the occurrence of natural attenuation that would be expected to result in production of ethene and ethane.

Field Data

The field data are presented in Appendix F, Table F-5. The specific conductivity data are generally consistent with expectations based on typical results in the monitoring wells. The specific conductivity measured at PP-1 (1,100 µmhos/cm) was slightly above typical ranges observed in upgradient monitoring well MW-1 and in monitoring wells MW-8 and MW-9 located downgradient of the Landfill along the City Facility boundary. Lower specific conductivity measurements (370 to 551 µmhos/cm) were observed in push probes PP-2 through PP-5 located within City Property outside the City Facility boundary; these specific conductivity measurements are comparable with monitoring well MW-4, which is further from the Landfill and not impacted by area-wide background influences.

DO and ORP measurements in push probe samples were more difficult to interpret compared to the routine monitoring well data. The DO results for the push probe samples ranged from 0.36 to 3.11 mg/L and were lower than or generally consistent with the DO typically observed at MW-9 near the City Facility boundary. ORP results were all negative and lower than typically observed in monitoring wells and did not show any clear pattern.

2.4.1.6 Groundwater Elevations

Groundwater elevations calculated at each push probe using final depth to water measurements (presented on Appendix F, Table F-6) were generally consistent with what would be expected based on the elevations measured in nearby monitoring wells. The push probe water level data were not included on a potentiometric surface map since they were measured immediately following probe installation and may not reflect complete equilibration at the time of measurement.

2.4.1.7 Distribution of Contaminants

Isoconcentration maps of the maximum concentrations of VOCs detected in 2015 (1,1-DCA, PCE, TCE, cis 1,2-DCE, and VC) were previously presented in the Work Plan. These maps were updated using data collected during the push probe investigation (November 7–16, 2017) and Fourth Quarter 2017 data collected at the groundwater monitoring wells (November 14 and 15, 2017). Data used to prepare the isoconcentration maps are presented in Appendix F, Table F-7. The updated isoconcentration maps are presented in Figures 6 through 10.

Areas estimated to be impacted by VOCs extend to the southeast of the Landfill in a direction generally consistent with the direction of flow indicated by recent groundwater flow contours. The isoconcentration maps include estimated contours of concentrations equal to GWQSs (“GWQS isocontours”). Areas with concentrations above GWQSs are limited to approximately 500 feet beyond the City Facility boundary. The downgradient limits of concentrations above GWQSs have been defined for PCE, TCE, and VC. The VC isoconcentration map uses the higher of the two measured concentrations for PP-1 and is considered a conservative estimate; the actual area where VC concentrations are above the GWQS may be less extensive than shown.

For 1,1-DCA, the isoconcentration contours suggest that concentrations likely decrease to below the GWQS just beyond the location of PP-2. 1,1-DCA was detected at PP-2 at a concentration of 1.1 µg/L, only slightly above the GWQS of 1.0 µg/L

The detections of VOCs above GWQSs at PP-1 are consistent with its location downgradient from the southwestern corner of the Landfill and near gas probes GP-2, GP-9, and GP-12 where subsurface LFG has routinely been detected. GWQS isocontours have been estimated west of PP-1 using data from well MW-1 and further downgradient PP-4 and suggest that concentrations in the southwestern most corner of the City Facility are likely below GWQSs. This area is not downgradient of the Landfill and LFG has not routinely been detected in gas probes along the southwestern City Facility boundary (GP-3, GP,4, GP-8, and GP-10).

Based on the overall flow direction toward the southeast, the data from the push probes and monitoring wells can generally be considered to fall along one of four predicted general flow paths extending downgradient from the Landfill onto adjacent City Property, as detailed in Appendix F, Table F-8. The COC concentrations measured along each of these groundwater flow paths show consistent decreases with distance from the Landfill, demonstrating that natural attenuation is occurring as groundwater flows away from the Landfill.

2.4.1.8 Conclusions

As shown on isoconcentration maps presented in Figure 6 through 10, the areal extent of groundwater downgradient from the Landfill where COC concentrations exceed GWQSs is limited to a distance of approximately 500 ft from the City Facility boundary. Concentrations below GWQSs have been delineated for PCE, TCE, and VC. For 1,1-DCA the area exceeding the GWQS is expected to be limited to just beyond the location of PP-2, but not beyond the other areas explored in this investigation.

The presence of low levels of methane, ethane, and ethene in the push probe groundwater samples indicates that natural attenuation is likely occurring and indicates further that conditions in groundwater are consistent and favorable for biodegradation of chlorinated hydrocarbons.

Approximate groundwater elevations measured at the push probes are consistent with the expected flow direction as measured in the City Facility monitoring wells. The areas impacted by VOCs extend from south of MW-9 to east-southeast of MW-4 in a direction generally consistent with the direction of flow indicated by recent groundwater flow contours, and the measured concentrations show attenuation with distance from the Landfill along four general groundwater flow paths as shown on Appendix F, Table F-8.

2.4.2 Phase 2 - Groundwater Monitoring Well

The conclusions of the push probe investigation supported installing one downgradient monitoring well on City Property southeast of the Horn Rapids Landfill at the approximate location shown on Figure 5.

The location of the monitoring well was selected with a data quality objective to confirm the absence of contamination downgradient from the Landfill, at a distance that is sufficient to allow additional actions to be taken in the event that contaminants are identified, based on the calculated flow rate of approximately 20 ft per year.

The location is downgradient from the approximate center of the contaminant plume at well MW-9 along the City Facility boundary that has shown the highest concentrations of VOCs and the area outside the City Facility that has been defined by the push probe investigation to have VOC concentrations above GWQSs as shown on isoconcentration maps (see Figure 6 through 10). It is downgradient from push probe PP-2 where 1,1-DCA was detected at a concentration slightly above the GWQS. The new well will be used as a sentinel well to identify potential contamination releases from the existing Landfill. It is also downgradient from the Expansion Area and can be used as an uncontaminated well for detection monitoring.

Monitoring well MW-12 was installed by Carpenter Drilling, a licensed driller in the state of Washington, with oversight by a Parametrix hydrogeologist. The City selected the drilling contractor based on the City of Richland, Washington, Small Works Invitation to Quote No. 18-0114. Drilling and well installation took place between October 29 and November 14, 2018. The well is located to the south of the Landfill on City property, as shown on Figure 5.

A geologic and well construction log prepared by Parametrix for well MW-12 is presented in Appendix B1. Well MW-12 was drilled using a cable tool drilling rig to a total depth of 102.5 ft below ground surface (bgs). The well was constructed to a depth of 101 ft bgs with 2-in diameter Schedule 40 PVC casing and screen of 15 ft length and completed with an above ground surface monument surrounded by three protective posts.

The geologic formation was noted to be primarily sand, ranging from fine to coarse, with silty sand between depths of 61 and 71 ft bgs and sand with gravel between depths of 91 to 101 ft bgs.

The monitoring well was developed on November 19, 2018, by surging with a surge block in 5 ft intervals, beginning at the bottom of the well and working upward. After surging, the monitoring well was bailed of coarse sediment using a stainless-steel bailer.

Well MW-12 was initially sampled on November 27, 2018, as part of the landfill's Fourth Quarter 2018 monitoring event. A dedicated Grundfos Redi-Flo2 electrical submersible sampling pump and DEDICATOR Groundwater Sampling System was installed in MW-12 on December 10, 2018. The pump intake was set at 99 ft below the top of the well casing, approximately 5 ft above the bottom of the well.

As further described in Section 2.5, quarterly sampling of well MW-12 through the Second Quarter 2020 has detected low concentrations of the VOCs 1,1-DCA and cis-1,2-DCE below the GWQS. Arsenic concentrations are above GWQS but are within the range of the other upgradient and downgradient wells.

2.5 Quarterly Groundwater Monitoring

Groundwater monitoring has been conducted at the Landfill since 1987. The current monitoring program, in accordance with WAC 173-351, consists of quarterly detection monitoring (Appendix I and II parameters and additional natural attenuation parameters) at two upgradient wells (MW-1 and MW-11) and nine downgradient wells, and annual assessment monitoring (Appendix III parameters) at selected wells. This section presents a summary of the groundwater quality monitoring data collected through Second Quarter 2020 (Parametrix 2020b).

2.5.1 Groundwater Quality Results and Comparison to Criteria

Appendix G1, Table G-2 provides a summary of the groundwater monitoring results for WAC 173-351 Appendix I and II and natural attenuation parameters for the period since installation of well MW-12 (Fourth Quarter 2018 through Second Quarter 2020). The groundwater results are compared to the Water Quality Standards for Groundwaters of the State of Washington (WAC 173-200) and State Drinking Water Regulations (MCLs, WAC 246-290). A summary of the wells with parameters above GWQSs and the highest concentrations of parameters above GWQSs for the most recent Second Quarter 2020 are presented in Tables 3 and 4.

Appendix G1, Table G-3 provides a summary of the results for WAC 173-351 Appendix III parameters that were tested between 2014 and 2020. None of the additional WAC 173-351 Appendix III parameters were detected in the any of the samples.

2.5.2 Groundwater Data Evaluation Approach

Statistical analysis procedures for evaluation of groundwater monitoring data collected at the Horn Rapids Landfill are outlined in the QAPP (Parametrix 2017d) and are summarized in the following paragraphs. The procedures were developed in accordance with U.S. Environmental Protection Agency (EPA) Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities—Unified Guidance (EPA 2009) as recommended in Ecology guidance documents (Ecology 2012).

Corrective action in the form of final Landfill closure construction is not anticipated to be completed until 2021, and it is not expected that the VOC source will be fully controlled until that time. Data is continuing to be collected from groundwater wells to assess trends during implementation of closure construction. Monitoring wells in close proximity to the eastern edge of the Landfill (MW-5, MW-6, and MW-10) that have shown significant impacts will continue to be monitored for evidence that the LFG system is affecting VOCs that are impacting groundwater. Wells at the City Facility boundary (MW-3, MW-4, MW-8, and MW-9) will continue to be monitored to assess the degree of attenuation of VOCs.

During the period prior to final closure, the statistical evaluation approach for these wells will consist of evaluating trends qualitatively using time-series plots and quantitatively using Sen's slope and Mann-Kendall tests. Once closure is complete, statistical evaluation procedures appropriate for corrective action monitoring will be conducted at wells along the City Facility boundary that are currently impacted (wells MW-3, MW-4, MW-8, and MW-9) and new well MW-12 further downgradient on City Property.

2.5.3 Time-Series Plots

Time-series plots are presented in Appendix G2 for constituents with concentrations exceeding groundwater quality criteria or that historically exceeded upper tolerance limits (UTLs). Data collected prior to Third Quarter 1998 were not used in analysis due to uncertainty in data collection procedures and the variable and often higher reporting limits for the volatile organic data. In the case where a parameter is tested for but not detected, the "concentration" of that parameter is plotted as one-half of the detection limit and a hollow symbol is shown.

The data are separated into two groups: one group with wells along the edge of the active Landfill (MW-5, MW-6, former well MW-7 [historical data], and MW-10), and a second group with wells along the City Facility boundary (MW-2, MW-3, MW-4, MW-8, and MW-9) and well MW-12 on further downgradient City Property. Upgradient wells MW-1 and MW-11 are included on both sets of plots.

The observed trends are discussed separately in the following sections for VOCs and inorganic parameters.

2.5.3.1 Volatile Organic Compounds

VOCs are an unambiguous indicator of landfill impacts since the typical landfill indicator parameters have been impacted by upgradient sources. The greatest number and highest concentrations of VOCs were detected in the monitoring wells immediately downgradient of the Landfill (MW-5, MW-6, and MW-10), with the highest concentrations of many VOCs detected in well MW-6. Detected VOCs in these wells included 1,1-DCA, cis-1,2-DCE, trans-1,2-DCE, PCE, TCE, and VC. Overall decreasing trends have occurred in all three wells for 1,1-DCA, and in wells MW-5 and MW-6 for PCE, TCE, and VC. A similar suite of VOCs was also detected in well MW-9 and concentrations of some VOCs have shown increases including PCE.

PCE in concentrations above the GWQS have consistently been detected in upgradient well MW-1, and its presence is likely related to transport by LFG. VOCs were not detected in upgradient well MW-11.

Along the eastern City Facility boundary, concentrations of 1,1-DCA in MW-4 continued to be above the GWQS. Over the past few years, 1,1-DCA concentrations have shown an overall increase in MW-4 but have decreased in MW-3. Chloroform and bromodichloromethane continued to be routinely detected in wells MW-3 and MW-8 and have increased over the past few years.

In new well MW-12, 1,1-DCA and cis-1,2-DCE were detected at concentrations below the GWQS.

2.5.3.2 Inorganic Parameters

Groundwater quality data collected from wells in the northern portion of the Landfill, in particular upgradient well MW-11, former upgradient well MW-7 (decommissioned due to Phase 1 closure construction), and cross gradient well MW-2, indicate that sources upgradient of the Landfill are contributing to an area-wide background of elevated concentrations of inorganic compounds, including TDS, chloride, nitrate, and cations.

Data spikes observed in these wells (such as nitrate in MW-7 and MW-2 in 2003 and 2008 respectively) suggest that more than one source may have contributed pulses of contaminants over time. Likely potential upgradient sources are those that involve application of water, such as the agricultural irrigation at the crop circles and septic systems in the adjacent ORV park. Ongoing groundwater monitoring related to the Hanford Reservation has documented occurrences of nitrate plumes with concentrations of greater than the GWQS and MCL (10 mg/L nitrate as N) in the Richland area, with sources attributed to agricultural applications of fertilizer to irrigated fields (CH2M Hill 2015). Biosolids applications in the northern portion of the City Facility have also been considered as a source but are not presently believed to have had substantial impacts since precipitation at the City Facility is low, and the biosolids are dry and applied in thin layers and have largely already been scraped off for other City Facility uses.

In upgradient well MW-1, concentrations of some parameters (including alkalinity, calcium, chloride, magnesium, nitrate, potassium, sodium, sulfate, TOC, TDS, and conductivity) increased beginning in 2000, but stabilized over the past approximately 12 years.

In upgradient well MW-11, increasing trends in conductivity and TDS, and in concentrations of some inorganic parameters (including calcium, chloride, magnesium, nitrate, and sulfate) have been observed since its installation in 2010, although concentrations have stabilized during the past approximately 5 years.

In cross-gradient well MW-2, located in the northeastern corner of the City Facility, conductivity and TDS and the concentrations of some inorganic parameters (nitrate, calcium, sodium, chloride, magnesium, potassium, and sulfate) have been higher than observed historically since the Third Quarter of 2008, although concentrations have decreased over the past approximately 8 years.

Concentrations of inorganic parameters in wells located immediately downgradient of the Landfill (MW-5, MW-6, and MW-10) were generally higher than in wells located along the southern City Facility boundary (MW-8 and MW-9). However, concentrations of a number of inorganic parameters have shown increasing trends in wells MW-8 and MW-9 over the past few years, including calcium, chloride, magnesium, nitrate, and sulfate.

Concentrations of inorganic parameters in downgradient wells along the eastern City Facility boundary (MW-3 and MW-4) were comparatively low. Some parameters (including chloride, nitrate, potassium, sulfate, and TDS) have shown upward trends but have decreased over the past approximately 5 years in MW-3. It is not possible to determine if these trends represent natural changes in local groundwater or landfill impacts since the upgradient wells have shown area-wide impacts by outside sources.

In new well MW-12, decreasing total suspended solids and concentrations of manganese and sodium have been observed since installation.

2.5.4 Sen’s Slope Plots and Mann-Kendall Tests

Potential trends in the groundwater data were evaluated using the Mann-Kendall test for trend and Sen’s nonparametric estimator of slope (EPA 2009) with the Sanitas software (Sanitas Technologies 2019). These tests are well suited to environmental data because there are no distributional assumptions, and missing data (non-detects) or irregularly spaced measurement periods are permitted. The Mann-Kendall test was used to identify whether or not a trend exists, and then the Sen’s slope test was used to determine how steeply the concentration levels are changing.

The nonparametric Mann-Kendall test evaluates the significance of temporal trends at the 95 percent confidence level. A negative value for the Mann Kendall S statistic implies that a majority of the differences between earlier and later values are negative, suggestive of a decreasing trend. An S value near zero indicates a roughly equal number of positive and negative differences. This would be expected if the measurements were randomly fluctuating about a constant mean with no apparent trend.

The Sen's slope test is a nonparametric procedure used to estimate the true slope of the data. The advantage of the Sen's slope test over linear regression methods is that it is not greatly affected by gross data errors or outliers and can be computed when data are missing.

Sen's slope and Mann Kendall tests were analyzed for VOCs (see Appendix G3) using data for the past 10 years (Third Quarter 2010 through Second Quarter 2020) and 5 years (Third Quarter 2015 through Second Quarter 2020). A summary of statistically significant trends in parameter concentrations for VOCs are presented in Table 5. Only well/parameter cases with greater than 50 percent non-detected values are included in the trend evaluations.

2.5.4.1 Volatile Organic Compounds (Past 5 and 10 Years)

As shown in Table 5, statistically significant downward trends were observed over the past 5 and 10 years for 1,1-DCA in downgradient wells MW-3, MW-5, and MW-6; 1,2-DCA in MW-6; 1,2-dichloropropane in MW-5 and MW-6; benzene in MW-10; and chloroform in MW-4. Statistically significant upward trends were observed in well MW-3 for chloroform and MW-4 for 1,1-DCA. For the chlorinated ethenes, statistically significant downward trends were observed for TCE and vinyl chloride in MW-5; and PCE, trans-1,2-DCE, and TCE in MW-6.

Additional statistically significant downward trends that have emerged over the past 5 years include 1,1-DCE, 1,2-DCA, cis-1,2-DCE, trans-1,2-DCE and PCE in MW-5; 1,1-DCE in MW-6; and 1,1-DCE and VC in well MW-10. A statistically significant upward trend has been observed in well MW-3 for bromodichloromethane.

2.5.4.2 Trend Summary

A summary of statistically significant trends that were observed in VOC concentrations during both the past 5 and 10 years is presented below:

- Well MW-3 showed downward trends in 1,1-DCA and an upward trend in chloroform. MW-3 is along the eastern City Facility boundary.
- Well MW-4 showed a downward trend in chloroform and an upward trend in 1,1-DCA. MW-4 is along the eastern City Facility boundary.
- Well MW-5 showed downward trends in 1,1-DCA, 1,2-dichloropropane, TCE, and VC. MW-5 is close to the currently active cell.
- Well MW-6 showed downward trends in 1,1-DCA, 1,2-DCA, 1,2-dichloropropane, PCE, trans-1,2-DCE, and TCE. MW-6 is near the currently active cell.
- Well MW-10 showed a downward trend in benzene. MW-10 is close to the currently active cell.

Additional statistically significant trends present over the past 5 years include:

- Well MW-3 showed an upward trend in bromodichloromethane.
- Well MW-5 showed downward trends in 1,1-DCE, 1,2-DCA, cis-1,2-DCE, PCE, and trans-1,2-DCE.
- Well MW-6 showed a downward trend in 1,1-DCE.
- MW-10 showed downward trends in 1,1-DCE and VC.

2.5.5 Background Statistics

Background statistics (i.e. mean, variance, standard deviation, coefficient of variation, and standard error) for upgradient wells MW-1 and MW-11 for the period since Third Quarter 1998 are presented in Appendix G4 in accordance with WAC 173-351-420(1).

2.5.6 Natural Attenuation Parameters

Analysis and measurement of additional parameters (methane, ethane, ethene, DO, and ORP) is being performed to evaluate whether VOCs are degrading through either biological or chemical processes (Shaw Environmental, Inc. 2003). Natural attenuation of VOCs would be indicated by elevated concentrations of ethene or ethane and decreases in DO and ORP.

Some of the data (see Appendix G1, Table G-2) indicate that natural attenuation may be occurring. DO measurements were lower in downgradient wells MW-5, MW-6, and MW-10 (generally about 2 mg/L or less) and in MW-4 and MW-9 (about 3 to 4 mg/L) than in the remaining wells (generally between about 4 and 9 mg/L). Decreased levels of DO are consistent with the breakdown of contaminants in groundwater (EPA 1998). The ORP measurements generally followed this pattern with more negative values observed in wells with lower DO.

Dissolved methane continued to be detected in downgradient wells along the edge of the Landfill: MW-5, MW-6, and MW-10 at concentrations of up to approximately 5 mg/L. The highest concentrations of methane were observed in well MW-6, located in close proximity to the Landfill and to GP-2 and GP-12 where high methane is observed. Much lower concentrations of methane were detected at wells MW-8, MW-9, and MW-12. The occurrence of dissolved methane in the wells with the highest concentrations of VOCs continues to support the hypothesis that LFG generated by the decomposition of solid waste within the Landfill is the source and transport mechanism for the VOCs impacting groundwater (Shaw Environmental, Inc. 2003).

Evaluation of indicator and natural attenuation parameters indicates biodegradation of chlorinated hydrocarbons is likely occurring in groundwater near the Landfill source. The positive evidence that biodegradation is occurring includes reduced DO and ORP. However, quantitative analysis of other evidence is inconclusive. Trends in other parameters that might indicate that degradation is occurring (EPA 1998; Jurgens et al. 2009), such as increases in chloride, alkalinity, and methane, or decreases in nitrate and sulfate, are somewhat ambiguous because concentrations of these parameters have been affected by contributions from upgradient sources, and methane is also contributed directly by LFG.

2.5.7 Geochemical Evaluation

The geochemical evaluation (see Appendix G5) included preparing trilinear and Stiff diagrams to illustrate major ion geochemistry and calculating cation/anion balances.

2.5.7.1 Trilinear and Stiff Diagrams

Trilinear and Stiff diagrams are presented for the most recent four quarters (Third Quarter 2019 through Second Quarter 2020). The trilinear and Stiff diagrams indicate that in most of the wells the dominant anion was bicarbonate, and the dominant cation was calcium, followed by magnesium. However, the proportions of sulfate and chloride with respect to bicarbonate are typically higher in upgradient well MW-11 and cross gradient well MW-2 and periodically in downgradient well MW-8. Wells MW-3, MW-8, and MW-12 typically have slightly higher proportions of sodium and potassium with respect to magnesium and calcium than in the other downgradient wells. The geochemical variability between wells likely represents a combination of area-wide or Landfill impacts and natural variation due to individual geochemistry of the aquifer materials.

2.5.7.2 Cation/Anion Balance Calculations

Cation/anion balance calculations for the most recent four quarters (Third Quarter 2019 through Second Quarter 2020) are presented in Appendix G5. All groundwater charge balance differences were less than 10 percent, except for wells MW-10 and MW-11 in the Third Quarter. Charge balance differences of over 10 percent have been periodically observed during the history of monitoring. As stated in WAC 173-351-430-5(a), charge balance differences of greater than 5 to 10 percent (5 percent for cation/anion sums of greater than 5 milliequivalents per liter) could indicate laboratory error, poor well conditions, or other ions not accounted for in natural or impacted groundwater conditions. Actions taken to improve charge balance differences beginning in 2007 consisted of changing analytical laboratories and reviewing quality assurance records provided by the laboratory to monitor data quality.

2.6 Leachate Monitoring

Leachate is collected from four lysimeters that monitor the vadose zone directly beneath the MSW located in the northeast corner of the Landfill. Drains from each lysimeter are connected to a common sampling vault where discrete samples of leachate are collected from four sampling ports. The approximate location of the lysimeters and sampling vault are identified in Figure 3.

The lysimeters were installed in 1993 and monitoring began in 1994. Information regarding lysimeter construction and correspondence related to leachate quantities observed during the initial years following lysimeter installation is presented in Appendix H1. Correspondence between the City and the Health District discussing the lysimeters indicates that the lowest elevation of waste is approximately 422 ft mean sea level, and the lysimeters were installed below that elevation. The final elevation of the Phase 2 portion of the Landfill is approximately 500 ft, and therefore the lysimeters are covered by over 70 ft of waste.

The Phase 2 2001–2004 RI Report as described in Section 2.1.2 included a summary of leachate data collected between 1993 and 2002 and a comparison of the data to groundwater and LFG, as previously presented in Appendix E1. Geochemistry of the leachate was determined to be different than typical groundwater samples as shown on geochemical plots.

Further analysis of the leachate data collected between 2000 and 2002 were presented to determine an appropriate shortlist of parameters for statistical comparisons (Parametrix 2017d). Groundwater concentrations in upgradient well MW-1 (as represented by the UTL recalculated at the end of 2013) were compared to the average Landfill leachate quality from all four ports during the period between 2000 and 2002 and are presented in Appendix H2. The early data were not used since minimal waste had been placed over the lysimeters and the leachate was relatively dilute. The following constituents had substantially elevated concentrations in historical Landfill leachate (by a factor of greater than five) compared to upgradient groundwater: TOC, chloride, ammonia, nitrate and manganese. VOCs are also routinely detected in the leachate, but not in upgradient well MW-11. VOCs have been detected in upgradient well MW-1, particularly tetrachloroethene.

In accordance with the Permit and WAC 173-351-990, samples from the four vadose monitoring ports are to be analyzed for leachate parameters listed in Appendix I and II. However, no leachate was observed in the leachate ports between 2006 and 2014. The most likely scenario for the observed lack of leachate in the lysimeters during the period beginning in 2006 is as follows: Leachate was initially generated due to infiltrating precipitation while the waste was thin, and as additional waste was placed the increasing thickness of waste became adequate to absorb the small amount of infiltrating precipitation. This eventually resulted in leachate not reaching the lysimeters. The correspondence between the City and the Health District, presented in Appendix H, documents the gradual difficulty in getting samples and indicates that the volume of leachate diminished as the waste depth increased over the lysimeters.

In the Fourth Quarter of 2014, liquid was observed in one of the ports, designated Port 3, and samples of the liquid were collected and analyzed for Appendix I and II parameters. The volume of the liquid drained was approximately 2 liters. The geochemical plot for this sample, presented in Appendix H2, confirmed the findings of the 2001–2004 RI that the geochemistry of the leachate was different than typical groundwater samples. The Fourth Quarter 2014 leachate sample had a very low concentration of sulfate, and a higher proportion of chloride than in the groundwater samples, and the proportion of magnesium was higher with respect to calcium than in the groundwater samples. Some parameter concentrations in the leachate sample were higher than in the groundwater samples, notably ammonia, chloride, and TOC, and the total metals barium, iron, manganese, and zinc. Concentrations of nitrate and sulfate were lower than in the groundwater samples. The leachate contained concentrations of some volatile organic compounds that were comparable to groundwater samples from wells near the active landfill (including 1,1-DCA, cis-1,3-DCE, and VC), but had lower concentrations of some other VOCs (including TCE and PCE).

The ports continued to be rechecked semiannually, and only small quantities of liquid (less than a liter) were present in the second quarters of 2015 and 2016. Samples were collected and tested for VOCs. The 2014 through 2016 Port 3 leachate data were compared to groundwater quality data as shown on the time-series plots presented in Appendix G2 and the tables in Appendix H2. Concentrations of some VOCs in the leachate were comparable to those in groundwater samples from wells near the active landfill (including 1,1-DCA, 1,2-DCA, cis 1,2-DCE, and VC). However, relative to groundwater, the leachate had lower concentrations of TCE and PCE, and higher concentrations of BTEX (benzene, ethylbenzene, toluene, total xylenes) and ketones (acetone and 4-methyl-2-pentanone).

Due to the minimal quantities of liquid observed, the Health District approved an annual inspection and sampling frequency for the lysimeter ports during the second quarter of each year beginning in 2017. No leachate was present in any of the ports in a sufficient quantity to collect a sample between 2017 and 2020.

The minimal quantity of leachate currently produced supports the conclusion of the 2001–2004 RI that leachate is not a significant ongoing source of contaminants to groundwater.

2.7 Quarterly Landfill Gas Monitoring

Each gas probe is screened at two subsurface intervals, with the exception of GP-12, which is screened at three separate intervals, including one deep probe just above groundwater. The gas probes are completed in alluvium outside the Landfill. A cross section showing the typical configuration of the LFG probes and extraction wells with respect to the waste is presented in Appendix I1. Historical LFG measurements collected from ten LFG monitoring probes (see Figure 3 or 4) are presented in Appendix I2 of this report.

MSW in the Phase 1 area was placed in north-south trending trenches and the waste varied in thickness from 12 ft along the western edge to 30 ft along the eastern edge (Shaw 2005). Most of the LFG probes have one screened interval near the center of the waste thickness and one at the approximate elevation of the bottom of the waste.

LFG has never been detected in probes along the City Facility boundary or in on-site buildings. LFG in the vadose zone has historically been present only within close proximity to the MSW, in gas probes GP-2, GP5 (now decommissioned), GP-9, and GP-12, all located less than 100 ft from the MSW boundary. No methane has been detected in probes along the western (GP-3, -4, -7, or -8) or southern (GP-1, -10, -11) City Facility boundary over the history of monitoring.

Comparing methane levels between multi-screened probes suggests that LFG is present in the entire zone between the base of the MSW to the surface of the groundwater, with the highest concentrations typically observed in the zone near the bottom of the MSW. Phase 2 of the RI found LFG present within the screened interval of MW-7 (83.5 to 105 ft bgs) and GP-12-3. These data indicate that LFG and groundwater have historically interacted only in a limited area immediately beneath the waste and in a limited zone surrounding the waste. LFG is expected to migrate laterally and upward through the sandy unsaturated soils due to pressure and concentration gradients and discharge to the atmosphere.

LFG trends in probes where methane has historically been observed (GP-2, GP-9, and GP-12) are shown on the time-series plot in Figure 11. These gas probes are all located in close proximity to the MSW. The data indicate that despite limited spikes, overall substantial decreases have been observed since the closure activities started in 2011 that included installation and operation of an active LFG control system. For example, methane concentrations in GP-12 have decreased from over 30 percent by volume prior to the 2011 Phase 1 Closure to about 15 percent, and methane concentrations in GP-2 have decreased from over 45 percent by volume to about 20 percent.

Since its startup in 2011, the Phase 1 LFG extraction system and cover are effectively removing the LFG within close proximity of the bottom of the MSW and the Landfill's downgradient lateral perimeter as demonstrated by the sharp decreases in methane concentrations observed at multilevel gas probes GP2 and GP-12, including deep probe GP-12-3, screened immediately above the water table. The LFG source is expected to be further reduced upon closure of the Phase 2 portion of the Landfill that is anticipated in 2021, which will include an expanded LFG extraction system, thus reducing or eliminating future VOC impacts to groundwater.

3. CONCEPTUAL SITE MODEL

This section presents a conceptual site model (CSM) describing contaminant sources and release mechanisms and evaluating potential exposure pathways and the mechanisms, media, and routes by which receptors have the potential to be exposed to hazardous substances. The CSM was used to determine exposure potential in development of screening levels. Screening levels were developed to evaluate data, based on potential exposure pathways identified in the CSM, MTCA requirements, and Ecology's Cleanup Levels and Risk Calculations (CLARC) spreadsheets. Data were compared to screening levels to determine which compounds contribute the majority of the risk at the City Facility, and to identify indicator hazardous substances (IHSs), as described in Section 4. IHSs will be used in the FS to inform CUL development.

A diagram showing the conceptual migration pathways for hazardous substances is shown on Figure 12. The conceptual site model projection is shown on Figure 2. The conceptual migration pathways diagram displays the interaction of the Landfill with the underlying hydrostratigraphy. Historically, minor amounts of leachate released from the Landfill likely entered the water table, but as previously noted, the quantities of leachate observed in the lysimeters have been significantly reduced and none has been observed during recent monitoring years. Although LFG migrates away from the refuse in the subsurface, it is currently being controlled by the active Phase 1 LFG extraction system. Contaminated groundwater migrates away from the landfill and contaminants are largely attenuated prior to reaching well MW-12 on City Property southeast of the Landfill. There is no release of contaminants to the lower basalt aquifer as the clay layer acts as a lower confining layer and groundwater from the basalt aquifer has upward migration. Contaminants within the groundwater also volatilize into the vapor phase.

A diagram showing the CSM for release of hazardous substances is shown in Figure 13. This diagram summarizes the conceptual migration pathways and potential routes of exposure related to the Landfill.

3.1 Contaminant Source

The source of contaminants is the MSW that has been placed in the Landfill between 1974 and 2020, as described in Section 1.3. The Landfill is unlined. Phase 1 of the Landfill has been closed since 2011, and closure of Phase 2 is expected in 2021. Closure for both phases will include an engineered cover system and active LFG control system.

3.2 Release Mechanisms

There are two primary release mechanism for contaminants: dissolution/leaching and volatilization.

3.2.1 Dissolution/Leaching

Leachate generation is believed to be minimal. Although small quantities of leachate were observed in the on-site lysimeters during the initial phases of landfilling as described in Section 1.5.2, more recent data indicate that little to no leachate is currently being accumulated below the waste due to the arid conditions and the ability of the waste to store the moisture that is generated.

However, minor amounts of leachate may be generated when precipitation infiltrates through the MSW and dissolves contaminants. Since the Landfill is unlined, release of contaminants by leaching could result in direct percolation to groundwater after moving through the vadose zone, followed by transport within groundwater in the dissolved phase.

3.2.2 Volatilization

Volatilization of organic chemicals from the MSW is believed to be the primary release mechanism for the observed contaminants in groundwater. The volatilized organic chemicals are subject to vapor transport through the vadose zone where they partition into groundwater either within the vadose zone or at the water table.

The 2001–2004 RI concluded that LFG was the primary source of the contaminants observed in groundwater. LFG interacts with moisture in the vadose zone and with groundwater in the capillary zone of the water table, where it becomes dissolved in groundwater and subsequently transported by groundwater flow. The 2001–2004 Phase 2 RI demonstrated that the contaminants present in LFG were consistent with the contaminants present in groundwater, and that the concentrations of VOCs measured in LFG were high enough to comprise the primary source of VOCs in groundwater. Methane has been measured in vapor samples collected directly above the water table in GP-12 and is consistently measured in the groundwater wells located in close proximity to the Landfill.

Decomposition in the landfill mass typically causes an increase in pressure and the LFG moves from higher to lower pressure areas. Landfill closure will include placement of an impermeable cover that will block release of LFG to the atmosphere. However, since the Landfill is unlined, volatilization may still result in the release of some contaminants to the atmosphere that migrate through vapor transport laterally and upward through the sandy unsaturated soils due to pressure and concentration gradients.

3.3 Exposure Pathways and Media

WAC 173-240-200 defines an exposure pathway as the path a hazardous substance takes or could take from a source to an exposed organism. An exposure pathway describes the mechanism by which an individual or population is exposed or has the potential to be exposed to hazardous substances at or originating from a site. Each exposure pathway includes an actual or potential source or release from a source, an exposure point, and an exposure route. If the exposure point differs from the source of the hazardous substance, the exposure pathway also includes a transport/exposure medium.

Potential exposure pathways and media considered included groundwater, air, surface water, and soil.

3.3.1 Groundwater

Groundwater contamination can occur through dissolution/percolation or partitioning from vapor. Groundwater that has been impacted by contamination moves downgradient through transport processes such as advection, diffusion, and hydrodynamic dispersion and will be naturally attenuated through processes such as sorption and biodegradation.

Due to the relatively low rainfall and high evapotranspiration, dilution is not expected to be significant, and sorption is likely to be low due to the low organic carbon in soils (typical total organic carbon concentrations are less than 5 mg/L).

The primary VOCs of concern in groundwater at the Landfill are chlorinated ethenes (PCE, TCE, DCEs, and VC) and ethanes (1,1-DCA). An important potential mechanism for biodegradation of these compounds is reductive dechlorination whereby the more highly chlorinated compounds are reduced to less chlorinated compounds (EPA 1998; Jurgens et al. 2009). Evaluation of natural attenuation parameters including reduced DO and ORP indicates degradation of chlorinated hydrocarbons is occurring at least near the Landfill source, although analysis of other indicator parameters is inconclusive.

Since installation of the Phase I gas collection system, concentrations of some VOCs in groundwater close to the Landfill have decreased, but the impacted area has expanded in the downgradient flow direction. The observed changes in impacted area dimensions are consistent with the measured flow direction, and the downgradient extent of impacts are consistent with the calculated groundwater flow rate of approximately 20 ft per year, or about 250 ft over the last 13 years. Monitoring data show that VOC impacts are limited to the hydraulically downgradient area in close proximity to the City Facility boundary, consistent with the low rate of groundwater flow.

3.3.2 Landfill Gas

Air contamination can occur directly through vapor transport. However, the gas probe monitoring data show that LFG is only present in a limited area of the vadose zone immediately beneath and surrounding the MSW. Uncontrolled LFG would be expected to migrate laterally and upward through the sandy unsaturated soils due to pressure and concentration gradients and discharge to the atmosphere.

3.3.3 Surface Water

There is no off-site runoff, and the closest surface waters to the City Facility are the Yakima River, over 1 mile from the City Facility, and the Columbia River, over 3 miles from the City Facility. Therefore, there are no surface water exposure pathways.

3.3.4 Soil

There is no known soil contamination at the City Facility other than the MSW. The MSW was buried below grade within trenches, and the base of the MSW is greater than 15 ft below grade. The surface of the MSW will be separated from terrestrial exposures by an engineered cover and therefore there is no exposure pathway.

3.4 Exposure Routes and Receptors

3.4.1 Groundwater

Although there are no downgradient users of groundwater within over 2 miles of the Landfill, as discussed in Section 1.7, this exposure pathway is considered complete for future groundwater users. Drinking water is considered the highest beneficial use for groundwater. Potential receptors for contaminated groundwater include humans and terrestrial and aquatic organisms. Possible human receptors would be downgradient domestic well users, either via drinking water or inhalation of VOCs. While this pathway is considered complete its activation is extremely unlikely. All current and anticipated future potable and non-potable water use in this area will occur through the City's distribution systems supplied with water from the Columbia River. It is highly speculative to consider that local and state level water resource policy will turn to local shallow aquifer water as a resource for uses within the City limits for anytime in the foreseeable future.

However, as shown on Figure 14, the approximate extent of impacted groundwater in the upper aquifer is limited to an area within approximately 500 ft from the City Facility boundary. Natural attenuation is occurring in the impacted area and the low rate of groundwater flow will minimize further downgradient movement of contaminated groundwater. Regional groundwater vertical gradients in the underlying basalt aquifer are believed to be upward, restricting the downward movement of contaminants to lower aquifers.

There are currently no impacts to groundwater users. The 2014 sampling of a well on the east side of the Weidle neighborhood located about 1 mile south of the Landfill in a cross-gradient direction did not detect any concentrations above screening levels (see Section 2.3).

Due to the great distance between the Landfill and the nearest drinking water wells, and the depth to groundwater of approximately 100 ft below ground surface, the inhalation pathway is potentially complete but does not present a health concern.

Because groundwater occurs at a depth of approximately 100 ft below ground surface and there is no groundwater discharge to surface water within over a mile, the exposure pathway for terrestrial and aquatic organisms is incomplete.

3.4.2 Air

Volatilization of contaminants could result in exposure to human receptors in indoor or outdoor air or terrestrial receptors in outdoor air.

For the indoor air exposure air pathway, potentially impacted buildings could include on-site buildings at the City Facility as well as off-site buildings. Public access to the City Facility is limited to short-term exposures. Buildings occupied by on-site workers at the City Facility include the scale house/office and the shop. Quarterly monitoring of indoor air is conducted inside these buildings as well as other unoccupied buildings and facilities, including the transfer building oil shed, compressor shed, storage building and fuel station, and toe drains. No methane has been detected in any of these structures.

The scale house/office building is routinely occupied during business hours and is located approximately 280 ft from the Phase I Landfill where the active LFG system is currently operating and no methane has been detected in nearby subsurface gas probes (GP-1, GP-9, and GP-10). The new scale house/office building has a continuous methane monitoring device.

The shop building is only sporadically occupied during business hours and is located approximately 350 ft from the Phase 2 Landfill and from gas probe GP-2 where subsurface methane is routinely detected at depths of approximately 20 ft bgs. However, no methane is detected at GP-11, located along the City Facility boundary, at the same approximate distance from the Landfill as the shop building. The shop building has a continuous methane monitoring device in the lunch room.

The primary pathway for potential vapor intrusion (VI) in the on-site buildings is contaminants present within LFG. The lateral distance between the source of contamination and a building can limit the potential for VI, and generally, buildings located more than 100 feet, horizontally, from the edge of the subsurface contamination are unlikely to experience unacceptable VI impacts (Ecology 2009, 2019). Since the on-site buildings are located further than 100 ft from the LFG source and methane that could be associated with other contaminants is not detected in the buildings, the indoor air exposure pathway for on-site buildings is considered complete but minor.

Although likely a less important pathway than LFG, Ecology (2009, 2019) recommends screening for potential VI due to contaminated groundwater by comparing maximum measured shallow groundwater concentrations to screening levels. The City Facility is zoned as Industrial under WAC 173-340-745, and therefore MTCA Method C groundwater screening levels for VI are appropriate. These concentrations are based on chronic exposures, and Ecology has also developed guidance for TCE VI (Ecology 2018) due to specific short-term effects of this chemical which are higher than CLARC's VI TCE screening levels.

TCE and VC at the concentrations observed in groundwater are the chemicals with the greatest potential to cause VI. The highest concentrations of TCE and VC are observed in wells MW-6 and MW-5, respectively, located adjacent to the Phase 2 Landfill. Since September 2011, the highest TCE concentration (23 µg/L in MW-6, First Quarter 2013) was below the minimum MTCA Method C groundwater screening level for VI (26 µg/L). However, the highest VC concentrations (8.3 µg/L in MW-5, Second Quarter 2013 and Third Quarter 2014) were above the minimum MTCA Method C groundwater screening level for VI (3.5 µg/L), although concentrations of VC have shown statistically significant decreases and are currently below the screening level. At the City Facility boundary near the on-site buildings, the highest TCE concentration measured since September 2011 was 6.8 µg/L in MW-9 in the Fourth Quarter 2015, and VC is not routinely detected. Due to the great depth of groundwater and the concentrations below screening levels in wells near the on-site buildings, VI due to contaminants in groundwater is not expected to occur in the indoor air of on-site buildings.

MTCA Method B groundwater screening levels for VI are appropriate for indoor air in downgradient off-site buildings. The highest TCE concentration observed at the City Facility boundary in MW-9 (6.8 µg/L) was greater than the Method B screening level of 1.4 µg/L. However, no TCE has been detected at further downgradient well MW-12 on City Property, so the exposure pathway for indoor air in downgradient off-site buildings is considered complete but extremely minor.

Since current LFG monitoring in perimeter probes has shown that LFG is currently limited to the area in close proximity to the Landfill and the impacted area is expected to be further reduced with closure of Phase 2, and groundwater is at a depth of approximately 100 ft below ground surface; the outdoor air exposure pathway for humans and terrestrial receptors is considered complete but extremely minor.

3.5 Conceptual Site Model Summary

The only non-minor complete exposure pathway is the potential for ingestion of groundwater by humans. Therefore, this exposure route has been evaluated to identify IHSs in Section 4 using MTCA Method B standard formula values (SFVs) for groundwater as screening levels as described in WAC 173-340-720(4):

> *(iii) Human health protection. For hazardous substances for which sufficiently protective, health-based criteria or standards have not been established under applicable state and federal laws, those concentrations which protect human health as determined by the following methods:*
>
> > *(A) Noncarcinogens. Concentrations that are estimated to result in no acute or chronic toxic effects on human health as determined using Equation 720-1.*
> >
> > *(B) Carcinogens. For known or suspected carcinogens, concentrations for which the upper bound on the estimated excess cancer risk is less than or equal to one in one million (1 x 10^{-6}) as determined using Equation 720-2.*

3.6 Point of Compliance

Point of compliance (POC) means the point or points where CULs established in accordance with WAC 173-340-720 through 173-340-760 shall be attained.

3.6.1 Groundwater

For groundwater, the applicable POC is described in 173-340-720(8):

> *(b) Standard point of compliance for all sites. The standard point of compliance shall be established throughout the site from the uppermost level of the saturated zone extending vertically to the lowest most depth which could potentially be affected by the site.*

> *(c) Conditional point of compliance. Where it can be demonstrated under WAC 173-340-350 through 173-340-390 that it is not practicable to meet the CUL throughout the site within a reasonable restoration time frame, the department may approve a conditional point of compliance that shall be as close as practicable to the source of hazardous substances, and except as provided under (d) of this subsection, not to exceed the property boundary. Where a conditional point of compliance is proposed, the person responsible for undertaking the cleanup action shall demonstrate that all practicable methods of treatment are to be used in the site cleanup.*

The recommended point of compliance POC for groundwater is the City Facility boundary, approximately 500 ft from the Landfill. The recommended POC is consistent with WAC 173-351 which specifies that the point of compliance be located on land owned by the landfill owner and that it be no more than 150 meters (492 ft) from the waste management unit boundary. Beyond this, WAC 173-351-300(6) describes a number of factors that must be considered when determining a point of compliance. In approving the relevant point of compliance, the jurisdictional health department must consider at least the following factors:

- (a) The hydrogeologic characteristics of the facility and surrounding land;
- (b) The volume and physical/chemical characteristics of the leachate;
- (c) The quantity, quality, and direction of flow of groundwater;
- (d) The proximity and withdrawal rate of the groundwater users;
- (e) The availability of alternative drinking water supplies;
- (f) The existing quality of the groundwater, including other sources of contamination and their cumulative impacts on the groundwater, and whether the groundwater is currently used or reasonably expected to be used for drinking water;
- (g) Public health, safety, and welfare effects; and
- (h) Practical capability of the owner or operator.

The push probe investigation determined that concentrations of contaminants in groundwater above GWQSs are currently limited to a distance of approximately 500 ft beyond the proposed POC, and these findings have been confirmed by subsequent monitoring results at sentinel well MW-12. The low rate of groundwater flow will minimize further downgradient movement of contaminated groundwater that is undergoing natural attenuation. The impacted area is within adjacent City Property that currently extends 1,500 to 2,000 ft beyond the City Facility boundary. If the City should transfer ownership of adjacent City Properties or portions thereof, institutional controls in the form of an environmental covenant precluding the use of groundwater for domestic purposes will be put in place.

3.6.2 Soil

For soil, the applicable POC is described in 173-340-740(6)(d):

> *For soil cleanup levels based on human exposure via direct contact or other exposure pathways where contact with the soil is required to complete the pathway, the point of compliance shall be established in the soils throughout the site from the ground surface to fifteen feet below the ground surface. This represents a reasonable estimate of the depth of soil that could be excavated and distributed at the soil surface as a result of site development activities.*

The MSW in the Phase 1 and Phase 2 areas was buried below grade within trenches, and the base of the MSW is greater than 15 ft below grade (see cross Section C-C' in Appendix C). Since the refuse will be capped by engineered geomembrane liner systems, the base of the Landfill is proposed as the soil POC.

3.7 Terrestrial Ecological Evaluation

WAC 173-340-7490 defines the goals and procedures the department will use for (i) determining whether a release of hazardous substances to soil may pose a threat to the terrestrial environment; (ii) characterizing existing or potential threats to terrestrial plants or animals exposed to hazardous substances in soil; and (iii) establishing site-specific cleanup standards for the protection of terrestrial plants and animals.

Under WAC 173-340-7491, a site may qualify for an exclusion to the terrestrial ecological evaluation (TEE) requirement because:

> *(a) All soil contaminated with hazardous substances is, or will be, located below the point of compliance established under WAC 173-340-7490(4). To qualify for this exclusion, an institutional control shall be required by the department under WAC 173-340-440. An institutional control is not required if the contamination is at least 15 ft below the ground surface (WAC 173-340-7490 (4)(b)). An exclusion based on planned future land use shall include a completion date for such future development that is acceptable to the department.*
>
> *(b) All soil contaminated with hazardous substances is, or will be, covered by buildings, paved roads, pavement, or other physical barriers that will prevent plants or wildlife from being exposed to the soil contamination. To qualify for this exclusion, an institutional control shall be required by the department under WAC 173-340-440. An exclusion based on planned future land use shall include a completion date for such future development that is acceptable to the department.*

As described in Section 3.6.2, The surface of the MSW will be separated from terrestrial exposures by an engineered cover (landfill cap) to be constructed following closure of the Phase 2 area in 2021. Following completion of the engineered cover, there will be no exposure pathway to the closed portions of the Landfill due to the physical barrier. Any potential soil contamination associated with contaminated groundwater would be located at a depth below the point of compliance of 15 ft bgs. Therefore, the site qualifies for an exclusion to the TEE requirement. The exclusion to the TEE based on the engineered soil cover would require an institutional control in the form of a restrictive covenant and is based on the planned future land use to be completed following closure of the Phase 2 area in 2021.

4. INDICATOR HAZARDOUS SUBSTANCES

WAC 173-340 defines IHSs as the subset of hazardous substances present at a site selected under WAC 173-340-708 for monitoring and analysis during any phase of remedial action for the purpose of characterizing the site or establishing cleanup requirements for that site. When defining cleanup requirements at a site that is contaminated with a large number of hazardous substances, the department may eliminate from consideration those hazardous substances that contribute a small percentage of the overall threat to human health and the environment. The remaining hazardous substances shall serve as indicator hazardous substances for purposes of defining site cleanup requirements.

The procedures for determining IHSs are described in WAC 173-340-703. The IHSs will be used in the FS to evaluate cleanup requirements, including development of cleanup levels. The process for selecting IHSs is detailed in WAC 173-340-703, "Selection of indicator hazardous substances," as follows:

> *(2) Approach. If the department considers this approach appropriate for a particular site, the factors evaluated when eliminating individual hazardous substances from further consideration shall include:*
>
> *(a) The toxicological characteristics of the hazardous substance that influence its ability to adversely affect human health or the environment relative to the concentration of the hazardous substance at the site, including consideration of essential nutrient requirements;*
>
> *(b) The chemical and physical characteristics of the hazardous substance which govern its tendency to persist in the environment;*
>
> *(c) The chemical and physical characteristics of the hazardous substance which govern its tendency to move into and through environmental media;*
>
> *(d) The natural background concentrations of the hazardous substance;*
>
> *(e) The thoroughness of testing for the hazardous substance at the site;*
>
> *(f) The frequency that the hazardous substance has been detected at the site; and*
>
> *(g) Degradation by-products of the hazardous substance.*

4.1 Data Selection

The data selected for use in identifying initial IHSs were the quarterly monitoring data for the eight downgradient monitoring wells (MW-3, MW-4, MW-5, MW-6, MW-8, MW-9, MW-10, and MW-12) collected between Third Quarter 2011 and Second Quarter 2020. This timeframe includes 9 years of data (36 quarterly events). The rationale for selecting these data include the following:

- This selected timeframe begins with the initial operation of the Phase I Landfill LFG collection system as an interim remedial action. Observations since that interim remedial action are important to consider because there have been significant trends in the concentrations of some chemicals during the period following this interim remedy, as described in Section 2.5.4.
- In addition to upgradient well MW-1, this period also includes an equal number of data points for the second upgradient well, MW-11, that was installed in the Second Quarter of 2010. Because there are substantial differences in concentrations of some chemicals across the site due to effects of agricultural irrigation, it is helpful to have a complete set of data for two upgradient wells in different locations.

- For total metals, this period includes the 7 years (28 quarterly events) beginning in the Third Quarter of 2013 when total metals were first analyzed, replacing dissolved metals, per revisions to WAC 173-351.
- This period features stable and lower reporting limits for VOCs compared to older data.
- Data from well MW-2 were not considered because this well is located in a cross-gradient direction from the Landfill, and there have been spikes in the data, as discussed in Section 2.5.3.2, that are likely attributable to its location immediately adjacent to an irrigation circle.
- The selected data set is sufficient to address the thoroughness of testing requirement. For downgradient wells it includes a total of 247 data points for most chemicals and 198 data points for total metals. For upgradient wells, it includes 64 data points for most chemicals and 56 data points for total metals.

4.2 Initial IHS Identification

The selected data were evaluated based on the WAC 173-340-703(2) factors to be evaluated when eliminating individual hazardous substances from further consideration: toxicity (i.e., carcinogenicity), persistence, mobility, background, thoroughness of testing, detection frequency, and degradation Identification of IHSs for groundwater was conducted using the selected data in a tiered fashion in accordance with the WAC 173-340-703 criteria.

Chemicals were first screened for their frequency of detection (FOD) and then by comparing to toxicological characteristics as described in the following sections. The resulting initial IHSs were further evaluated to identify any substances that contribute only a small portion of the overall threat to human health and the environment at the site and that could therefore be eliminated from consideration as IHSs. Background concentrations were calculated for inorganic chemicals because there have been documented occurrences of area-wide background due to agricultural influences. The chemical and physical properties of each chemical were evaluated based on their mobility and persistence, and then site-specific observations such as trends and spatial distribution were considered to develop a final list of recommended IHSs.

4.2.1 Frequency of Detection and Toxicological Evaluation

The data set was first analyzed to determine the FOD and maximum concentration for each chemical. The FOD and the maximum concentration for each chemical for the combined data set is presented in Appendix J1, Table J-1. For the WAC 173-351 Appendix I metals, only measurements of the total fraction are considered. For those chemicals with FODs of at least 5 percent, the maximum concentration was compared to the cancer and non-cancer Method B groundwater SFVs for residential exposure in Ecology's Cleanup Level and Risk Calculation (CLARC) data tables (updated in 2020). Chemicals without SFVs were eliminated as potential IHSs. Chemicals with groundwater concentrations meeting the following criteria were identified as initial (i.e., potential) IHSs:

1. FOD of at least 5%, and
2. Maximum concentration at least twice the minimum MTCA Method B SFV, or
3. At least two concentrations above the SFV.

Summary statistics (i.e. mean, variance, standard deviation, coefficient of variation, and standard error) for chemicals measured in each individual upgradient and downgradient well for the period since Third Quarter 2011 are presented in Appendix J2.

Chemicals not meeting the above criteria were excluded from further consideration. The following thirteen chemicals were retained as initial IHSs following this first tier of analysis as presented in Appendix J1, Table J-2.

- Nitrate Nitrogen
- Arsenic, Total
- Cobalt, Total
- 1,1-Dichloroethane
- 1,2-Dichloroethane
- Benzene
- Bromodichloromethane
- Chloroform
- cis-1,2-Dichloroethene
- Methylene Chloride
- Tetrachloroethene
- Trichloroethene
- Vinyl Chloride

4.2.2 Background Evaluation of Inorganic IHSs

The initial IHSs include 10 VOCs and 3 inorganic parameters (nitrate, arsenic, and cobalt). For the VOCs, background levels were assumed to be zero. For the inorganic parameters, background levels were considered in the selection of IHSs. Arsenic is a naturally occurring substance in Washington, and concentrations in groundwater are influenced by the composition of surrounding bedrock and soils. Applied nitrogen fertilizers from irrigated agriculture are a major source of nitrate in groundwater (Morgan 2016; Ebbert et al. 1995). The elevated levels of nitrate and other constituents observed at the City Facility are believed to be due to the agricultural influences of the adjacent irrigation circles as discussed in Section 2.5.3.2.

For nitrate, arsenic, and cobalt, background levels were calculated using data from the upgradient wells MW-1 and MW-11 and Ecology's MTCAStat program to help determine whether these constituents should be included as IHSs. The calculations are presented in Appendix J3. Concentrations of Nitrate, Total Arsenic, and Total Cobalt were used to calculate background levels following WAC 173-340-709. Nitrate concentrations from Third Quarter 2011 through Second Quarter 2020 were used, and Total Arsenic and Total Cobalt concentrations from Second Quarter 2013 through Third Quarter 2020 were used. These concentrations are from samples collected after the interim remedial action was implemented. The calculations were performed using Ecology's MTCAStat97 Site Module and MTCAStat97 Background Module (Excel spreadsheets available at https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Contamination-clean-up-tools).

- Nitrate: The Normal Probability Plot distribution test calculated by the Background Module was close to the threshold for a lognormal distribution. The Site Module was then used to test for the lognormal distribution using D'Agostino's test. Based on this test, the Nitrate data were assumed to be lognormally distributed, and the background value was set as the 90th percentile of the data (44 mg/L).

- Arsenic: Based on the distribution test calculated by the Background Module, the data were not lognormally or normally distributed. Using the nonparametric method, the background value was set as the maximum value (12 µg/L).
- Cobalt: Based on the distribution test calculated by the Background Module, the data were assumed to be normally distributed, and the background value was set as the 80th percentile of the data (26 µg/L).

4.2.3 Chemical and Physical Characteristics of Initial IHSs

The twelve initial IHSs were further evaluated based on their persistence, mobility, and degradation, which are listed in WAC 173-340-703(2) as factors evaluated when eliminating individual hazardous substances from further consideration. The evaluation and resulting IHS recommendations are summarized below and summarized in Appendix J1, Table J-3.

4.2.3.1 Persistence

Persistence of individual chemicals can be evaluated by their chemical and physical properties such as degradation rates, and through their frequency of detection at locations throughout the site and trends over time. For its pesticide and chemical registration programs, EPA categorizes persistence based on half-life in environmental media (EPA 2018). For water, chemicals with half-lives less than 60 days are considered not persistent, those with half-lives ranging from 60 days to less than 180 days are considered persistent, and those with half-lives of 180 days or more are considered very persistent.

All the initial IHSs are considered persistent, which is consistent with their observed distribution in groundwater as described in Section 2.4.1.7 and Section 2.5.

4.2.3.2 Environmental Mobility

The environmental mobility of individual chemicals can be evaluated by their chemical and physical properties including solubility and partitioning to organic carbon, as well as considering the spatial distribution within wells across the site and trends in concentrations over time.

The aqueous solubility and soil-organic carbon water partition coefficient (Koc) for each chemical from the CLARC database are shown on Appendix J1, Table J-3. Generally, poorly soluble compounds in water are identified as those with a solubility of < 1 mg/L (EPA 2018). Chemicals with Kocs of below 10 are considered highly mobile, those with Kocs of 10 to 100 are considered mobile, and those with Kocs of 100 to 1,000 are considered moderately mobile (EPA 2009). All the initial IHSs are soluble and mobile or moderately mobile. Their properties are consistent with their observed distribution in groundwater as described in Section 2.4.1.7 and Section 2.5.

4.2.3.3 Degradation By-Products

Degradation by-products may be considered when eliminating individual hazardous substances. The primary VOCs of concern in groundwater at the Landfill are chlorinated ethenes (PCE, TCE, DCEs, and VC) and ethanes (1,1-DCA). An important potential mechanism for biodegradation of these compounds is reductive dechlorination whereby the more highly chlorinated compounds are reduced to less chlorinated compounds (EPA 1998; Jurgens et al. 2009). The following anaerobic degradation sequence is known to occur in the VOCs detected at the site: PCE → TCE → DCE → Vinyl Chloride → Ethene.

Evaluation of indicator and natural attenuation parameters indicates biodegradation of chlorinated hydrocarbons is likely occurring in groundwater near the Landfill source, as described in Section 2.5.6.

4.2.4 Site-Specific Observations for Each Initial IHS

Each of the 12 initial IHSs was further evaluated considering site-specific occurrences and trends in the data, as discussed in the following sections. A summary of the final recommendations is presented in Table 6. The following chemical-specific evaluations are based on review of the time-series plots and trend analyses previously discussed in Sections 2.5.3 and 2.5.4 and presented in Appendix G.

4.2.4.1 Inorganic Constituents

Nitrate Nitrogen

Concentrations of nitrate above the SFV of 26 mg/L have been observed in upgradient well MW-11, and in downgradient wells MW-2 and MW-8 located near the City Facility boundary. In upgradient well MW-11, increasing concentrations of nitrate have been observed since its installation in 2010, although concentrations have stabilized during the past approximately 5 years. In cross-gradient well MW-2, located in the northeastern corner of the City Facility near the irrigation circles, concentrations of nitrate were higher than previous historical observation beginning in the Third Quarter of 2008, although concentrations have decreased over the past approximately 8 years and are currently lower than in well MW-11. Concentrations of nitrate have been increasing in well MW-8 over the past 10 years.

Because all downgradient concentrations are currently lower than the area-wide background concentration of 44 mg/L and nitrate is believed to be contributed by agricultural influences, nitrate is not recommended as an IHS.

Arsenic, Total

Concentrations of total arsenic above the SFV of 0.058 µg/L have been observed in all upgradient and downgradient wells. Concentrations in the upgradient wells are generally higher than in the downgradient wells except at wells MW-3 and MW-8, located along the City Facility boundary. Concentrations in all wells have remained relatively consistent over time.

Arsenic is carcinogenic, and site groundwater concentrations frequently exceed the SFV. Concentrations in two wells at the City Facility boundary regularly exceed the area-wide background concentration (12 µg/L). Due to these factors, arsenic is recommended as an IHS.

Cobalt, Total (mg/L)

One concentration of total cobalt was observed greater than two times the SFV of 4.8 µg/L in well MW-6, and a number of concentrations slightly above the SFV have been observed in wells MW-3 and MW-4. However, the highest concentrations have been observed in upgradient well MW-1, and the concentrations have shown variability over time.

Because all downgradient concentrations are currently lower than the area-wide background concentration of 26 µg/L, cobalt is not recommended as an IHS.

4.2.4.2 Organic Constituents

1,1-Dichloroethane

1,1-DCA is a known carcinogen and is persistent and mobile. Concentrations of 1,1-DCA are consistently above the SFV of 7.7 µg/L in wells MW-5 and MW-6 adjacent to the Landfill, although statistically significant downward trends were observed over the past 10 years in downgradient wells MW-5, MW-6, and MW-10 adjacent to the Landfill and wells MW-3 and MW-9 along the City Facility boundary.

Although the concentrations in MW-4 are currently below the SFV, statistically significant upward trends were observed in well MW-4 over the past 5 and 10 years. Therefore, 1,1-DCA is recommended as an IHS.

1,2-Dichloroethane

1,2-DCA is a known carcinogen and is persistent and mobile. Although many of the measured concentrations in wells MW-5 and MW-6 adjacent to the Landfill remain above the SFV of 0.48 µg/L, statistically significant downward trends were observed over the past 10 years in these two wells, and 1,2-DCA concentrations have not been observed above the SFV in wells located at the City Facility boundary. Therefore, 1,2-DCA is not recommended as an IHS.

Benzene

Benzene is a known carcinogen and is persistent and mobile. Concentrations in all wells have all been below the SFV of 5 µg/L since 2013. Statistically significant downward trends were observed over the past 10 years in well MW-6 and also over the past 5 years in well MW-5 adjacent to the Landfill. Therefore, benzene is not recommended as an IHS.

Bromodichloromethane

Bromodichloromethane has been detected in two wells near the City Facility boundary, MW-3 and MW-8. All concentrations have been below the SFV of 0.71 µg/L, except for three values in well MW-8. However, over the past 5 years a statistically significant upward trend has been observed in well MW-3. Therefore, bromodichloromethane is recommended as an IHS.

Chloroform

Chloroform is a known carcinogen and is persistent and mobile. Statistically significant downward trends were observed over the past 10 years in well MW-4 near the City Facility boundary and well MW-10 adjacent to the Landfill. However, concentrations in wells MW-3 and MW-8 near the City Facility boundary are consistently above the SFV of 1.4 µg/L, and statistically significant upward trends have been observed over the past 5 and 10 years in MW-3. Therefore, chloroform is recommended as an IHS.

cis-1,2-Dichloroethene

cis-1,2-DCE is non-carcinogenic; however, this chemical frequently exceeds the SFV of 16 µg/L, is persistent and mobile, and degrades to VC. Concentrations have consistently been above the SFV in wells MW-5 and MW-6 adjacent to the Landfill, although statistically significant downward trends were observed over the past 5 years in well MW-5. Although cis-1,2-DCE concentrations have not been observed above the SFV in wells located at the City Facility boundary, cis-1,2-DCE is recommended as an IHS.

Methylene Chloride

All concentrations have been below the SFV of 5 µg/L since 2014, and statistically significant downward trends were observed over the past 5 years in well MW-10 adjacent to the Landfill. Therefore, methylene chloride is not recommended as an IHS.

Tetrachloroethene

PCE is a known carcinogen, frequently exceeds the SFV of 21 µg/L, is persistent and mobile, and degrades to VC. Concentrations in well MW-6 adjacent to the Landfill are currently above the SFV, although statistically significant downward trends were observed over the past 5 and 10 years. Concentrations of PCE in other monitoring wells are currently below the SFV, although statistically significant upward trends have been observed in wells MW-9 and MW-10 over the past 10 years. Therefore, PCE is recommended as an IHS.

Trichloroethene

TCE is a known carcinogen, frequently exceeds the SFV of 0.54 µg/L, is persistent and mobile, and degrades to VC. Concentrations in wells MW-5, MW-6, and MW-10 along the edge of the Landfill and well MW-9 near the City Facility boundary are consistently above the SFV, although statistically significant downward trends were observed in well MW-5 and MW-6 over the past 5 and 10 years. The TCE concentration in PP-1 along the City Facility boundary also exceeded the SFV. Therefore, TCE is recommended as an IHS.

Vinyl Chloride

VC is a known carcinogen, frequently exceeds the SFV of 0.029 µg/L, and is persistent and mobile. Concentrations are consistently observed above the SFV in wells MW-5, MW-6, MW-10 adjacent to the Landfill, although statistically significant downward trends were observed in wells MW-5 and MW-6 over the past 5 and 10 years. VC concentrations have been sporadically observed slightly above the SFV at the City Facility boundary in well MW-4 and were also observed in PP-1. Therefore, VC is recommended as an IHS.

4.3 Final Recommended IHSs

Based on the background evaluation and site-specific evaluation of the initial IHSs, nitrate, cobalt, benzene, 1,2-DCA, and methylene chloride contribute only a small percentage of the overall threat to humans and the environment and are not recommended as final IHSs. Nitrate and cobalt concentrations in downgradient wells are below area-wide background concentrations. Benzene, 1,2-DCA, and methylene chloride concentrations have shown statistically significant decreasing trends and concentrations in all wells have been below the SFVs for over 5 years.

The following eight parameters are recommended as IHSs as summarized in Table 6:

- Arsenic
- 1,1-Dichloroethane
- Bromodichloromethane
- Chloroform
- cis-1,2-Dichloroethene
- Tetrachloroethene
- Trichloroethene
- Vinyl Chloride

The seven organic chemicals are persistent and mobile and have a high percentage of concentrations exceeding SFVs. All are carcinogenic with the exception of cis-1,2-DCE. Vinyl chloride represents a daughter product of anerobic biodegradation processes.

5. SUMMARY, CONCLUSIONS, RECOMMENDATIONS

5.1 Summary and Conclusions

Groundwater has been impacted primarily through contact with LFG and contaminants have moved beyond the City Facility boundary into an area of contiguous additional City Property (see Figure 14). As shown on isoconcentration maps based on the push probe investigation (Figure 6 through 10), the areal extent of groundwater downgradient from the Landfill where VOC concentrations exceed GWQSs is limited to a distance of approximately 500 ft from the City Facility boundary. A further downgradient sentinel well, MW-12, is in place on City Property to monitor future trends in concentrations and to provide an "early warning" of expansion of the plume and possible increased risk to downgradient receptors.

The presence of low levels of methane, ethane, and ethene in groundwater samples collected in monitoring wells and push probe samples indicates that natural attenuation is likely occurring and indicates that conditions in groundwater are consistent and favorable for biodegradation of chlorinated hydrocarbons. The low flow rates will restrict further downgradient migration of contaminated groundwater beyond the Facility boundary. The current landfill gas extraction system, future engineered soil cover, and future Phase II LFG extraction system will further diminish LFG and leachate source migration to groundwater reducing or eliminating any potential on-going loading to groundwater and preventing vapor and soil exposure routes.

There are no beneficial users of groundwater within over 2 miles downgradient of the Landfill, and there are no current risks to human health or the environment based on the data obtained to date. However, future risks to humans from groundwater ingestion were evaluated using screening levels based on MTCA Method B SFVs to evaluate IHSs.

5.2 Recommendations

The following IHSs are recommended for further evaluation in the FS to determine cleanup criteria:

- Total Arsenic
- 1,1-Dichloroethane
- Bromodichloromethane
- Chloroform
- cis-1,2-Dichloroethene
- Tetrachloroethene
- Trichloroethene
- Vinyl Chloride

It is recommended that the POC be set at the City Facility boundary. If the City transfers ownership of adjacent properties in the future, institutional controls including a restrictive covenant will be put in place.

An interim remedy in the form of Phase I Landfill Closure has been implemented to remove the source of LFG, and decreasing trends have been observed in LFG and concentrations in groundwater. The presumptive remedy is considered to be continuing to remove LFG and leachate sources through the systems already in place and currently operating. The upcoming Phase II Landfill closure project, planned for 2021, will extend these systems. The closure will include installation of an engineered cover (landfill cap) and landfill gas system extension and long-term monitoring.

It is recommended that a focused FS be prepared that evaluates landfill closure and natural attenuation as the presumptive remedy and that a disproportionate cost analysis not be completed. The draft focused FS report will focus on the planned closure as the remedy and will include the following sections:

- Cover Letter
- Introduction
- Alternatives (identify remedial action objectives; identify a reasonable number and type of alternatives)
- Detailed Evaluation of Alternatives (threshold and other requirements)
- Remedy Selection

Figures will include a Vicinity Map, Site Maps, and a Conceptual Site Model.

Tables will include Applicable or Relevant and Appropriate Requirements (ARARs), Evaluation of Remedial Alternatives, Cost/Quantity Summary, and Cost Details for Alternatives.

Appendices will include Contractor Plans and Bids.

6. REFERENCES

CH2M 2015. Hanford Groundwater Monitoring Report for 2014. Prepared for Department of Energy. DOE/RL-2015-07. July 2015.

DOE (U.S. Department of Energy). 1994. Hanford Patrol Academy Demolition Sites Closure Plan. DOE/RL-82-39 Revision 1. December.

DOE. 2011. Hanford Site Groundwater Monitoring for 2011. DOE/RL-2011-118, Rev 0.

Ebbert, J.C., S.E. Cox, B.W. Drost, and K.M. Schurr. 1995. Distribution and Sources of Nitrate, and Presence of Fluoride and Pesticides, in Parts of the Pasco Basin, Washington, 1986-1988. U.S. Geological Survey Water-Resources Investigations Report 93-4197.

Ecology (Washington Department of Ecology). 2008. Site Hazard Assessment, Recommendation for No Further Action, Horn Rapids Triangle Development/Weidle Neighborhood, Near Intersection of North Weidle Road and E 811 PR NE, West Richland, Benton County, WA, 99353, Ecology Site Facility ID No. 63597765. August 1, 2008.

Ecology. 2009. Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action. Publication no 09-09-047. Review Draft October 2009. Revised February 2016 and April 2018.

Ecology. 2018. Implementation Memorandum No. 21, Frequently Asked Questions (FAQs) Regarding Vapor Intrusion (VI) and Ecology's 2009 Draft VI Guidance. Publication No. 17-09-046. November.

Ecology. 2019. Implementation Memorandum No. 22, Vapor Intrusion (VI) Investigations and Short-term Trichloroethene (TCE) Toxicity. Publication No. 17-09-047. January.

EMCON. 1999. Closure and Post-Closure Plan, Horn Rapids Landfill, Richland, Washington. Prepared for City of Richland. March 26, 1999.

EPA (U.S. Environmental Protection Agency). 1998. Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water. EPA/600/R-98/128. September 1998.

EPA. 2005. Groundwater Sampling and Monitoring with Direct Push Technologies. OSWER No. 9200.1-51 EPA 540/R-04/005 August.

EPA. 2009. Guidance for Reporting on the Environmental Fate and Transport of the Stressors of Concern in Problem Formulations for Registration Review, Registration Review Risk Assessments, Listed Species Litigation Assessments, New Chemical Risk Assessments, and Other Relevant Risk Assessments. U.S. EPA Office of Pesticide Programs. Available at https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/guidance-reporting-environmental-fate-and-transport.

EPA. 2018. Points to Consider When Preparing TSCA New Chemical Notifications. Office of Pollution Prevention and Toxics. OMB Control No.: 2070-0012. June. 38 pages.

Hong West & Associates. 1991. Geotechnical Report, Richland Landfill. Prepared for R.W. Beck and Associates. February 1991.

Jurgens, B.C., P.B. McMahon, F.H. Chapelle, and S.M. Eberts. 2009. An Excel Workbook for Identifying Redox Processes in Ground Water. U.S. Geological Survey Open File Report 2009-1004.

Liikala, T. J. 1994. Hydrogeology along the Southern Boundary of the Hanford Site Between the Yakima and Columbia Rivers, Washington. Prepared for the U.S. Department of Energy. September 1994.

Morgan, L. 2016. Washington Nitrate Prioritization Project. Washington State Department of Ecology (Ecology) Water Quality Program, Olympia, WA. Publication No. 16-10-011. May 2016. Available at: https://fortress.wa.gov/ecy/publications/documents/1610011.pdf.

Newcomb, R.C., J.R. Strand, and F.J. Frank. 1972. Geology and Ground-Water Characteristics of the Hanford Reservation of the U.S. Atomic Energy Commission, Washington. Geological Survey Professional Paper 717.

Newcomber. D.R. 2007. Groundwater monitoring at the 1100-EM-1 Operable Unit. Prepared by Pacific Northwest National Laboratory for the U.S. Department of Energy. PNNL-16528. April 2007.

Parametrix. 2005. Horn Rapids Landfill, Landfill Gas Control System (LFGCS) Preliminary Design Technical Memorandum. Prepared for City of Richland Public Works Department by Parametrix, Seattle, WA. October 2005.

Parametrix. 2006. Horn Rapids Landfill Closure and Post-Closure Plan Addendum. Prepared for City of Richland Public Works by Parametrix, Seattle, WA. October 17, 2006.

Parametrix. 2008a. Revised Landfill Closure Plan, Horn Rapids Landfill. Prepared for City of Richland Public Works Department by Parametrix, Seattle, WA. December 2008.

Parametrix. 2008b. Horn Rapids Landfill Stormwater Site Plan. Prepared by Parametrix, Seattle, WA. August 5, 2008.

Parametrix. 2011. Horn Rapids Landfill Contract Documents and Specifications, Phase 1 Closure Project Contract SB 11-01PW. Prepared for City of Richland Public Works Department by Parametrix, Seattle, WA. March 2011.

Parametrix. 2012a. Horn Rapids Landfill Phase 1 Closure Construction Quality Assurance Report. Prepared for City of Richland Public Works Department by Parametrix, Seattle, WA. March 2012.

Parametrix. 2012b. Horn Rapids Landfill, Landfill Gas Collection System Operation and Maintenance Manual. Prepared for City of Richland Public Works Department by Parametrix, Seattle, WA. May 2012.

Parametrix. 2014. Horn Rapids Landfill Environmental Monitoring Report, First Quarter 2014. Prepared for City of Richland by Parametrix, Seattle, WA. July 2014.

Parametrix. 2016. Horn Rapids Landfill Environmental Monitoring Report, Calendar Year 2015. Prepared for City of Richland by Parametrix, Seattle, WA. March 2016.

Parametrix. 2017a. Horn Rapids Landfill Expansion Preliminary Engineering Report. Prepared for City of Richland Public Works Department by Parametrix, Seattle, WA. January 2017.

Parametrix. 2017b. Horn Rapids Landfill Operations Plan. Prepared for City of Richland Public Works Department by Parametrix, Seattle, WA. January 2017.

Parametrix. 2017c. Horn Rapids Landfill Hydrogeologic Report. Prepared for City of Richland by Parametrix, Seattle, WA. January 2017.

Parametrix. 2017d. Horn Rapids Landfill Quality Assurance Project Plan. Prepared for City of Richland by Parametrix, Seattle, WA. January 2017.

Parametrix. 2017e. Horn Rapids Landfill Remedial Investigation Work Plan. Prepared for City of Richland by Parametrix, Seattle, WA. April 2017.

Parametrix. 2018. Horn Rapids Landfill Remedial Investigation Phase I Push Probe Investigation. Prepared for City of Richland by Parametrix, Seattle, WA. February 2018.

Parametrix. 2019. Horn Rapids Landfill Technical Memorandum Installation of Well MW-12. Prepared for City of Richland by Parametrix, Seattle, WA. February 2019.

Parametrix. 2020a. Horn Rapids Landfill Calendar Year 2019 Environmental Monitoring Report. Prepared for City of Richland by Parametrix, Seattle, WA. March 2020.

Parametrix. 2020b. Horn Rapids Landfill Second Quarter 2020 Environmental Monitoring Report. Prepared for City of Richland by Parametrix, Seattle, WA. September 2020.

Sanborn Head. 2019. Draft Phase 2 Gas Collection and Control System Construction Drawings, Horn Rapids Landfill, Richland, WA. Prepared for WRH Horn Rapids LLC. September 2019.

SCS Engineers. 1996. Groundwater Monitoring Plan for the Horn Rapids Landfill. Prepared for the City of Richland by SCS, Bellevue, WA. August 1996.

Shannon & Wilson. 1998. Results of Hydrogeologic Services for the Richland Landfill, Richland, Washington. Prepared for City of Richland. June 1998.

Shaw Environmental, Inc. 2003. Phase I Remedial Investigation Summary Report. Horn Rapids Landfill, Richland, Washington. Prepared for City of Richland Department of Public Works. June 16, 2003.

Shaw Environmental, Inc. 2004. Phase 2 Remedial Investigation Summary Report. Horn Rapids Landfill, Richland, Washington. Prepared for City of Richland Department of Public Works. April 2, 2004.

Shaw EMCON/OWT, Inc. 2005. Results of Pilot-Scale Landfill Gas Extraction Test, Horn Rapids Landfill, Richland, Washington. Prepared for Mr. Steve McNutt, Horn Rapids Landfill. May 25, 2005.

Western Regional Climate Center. 2016. Data for Richland, Washington (457015), Monthly Climate Summary, Period of Record: 05/19/1944 to 06/08/2016. wrcc@dri.edu.

Figures

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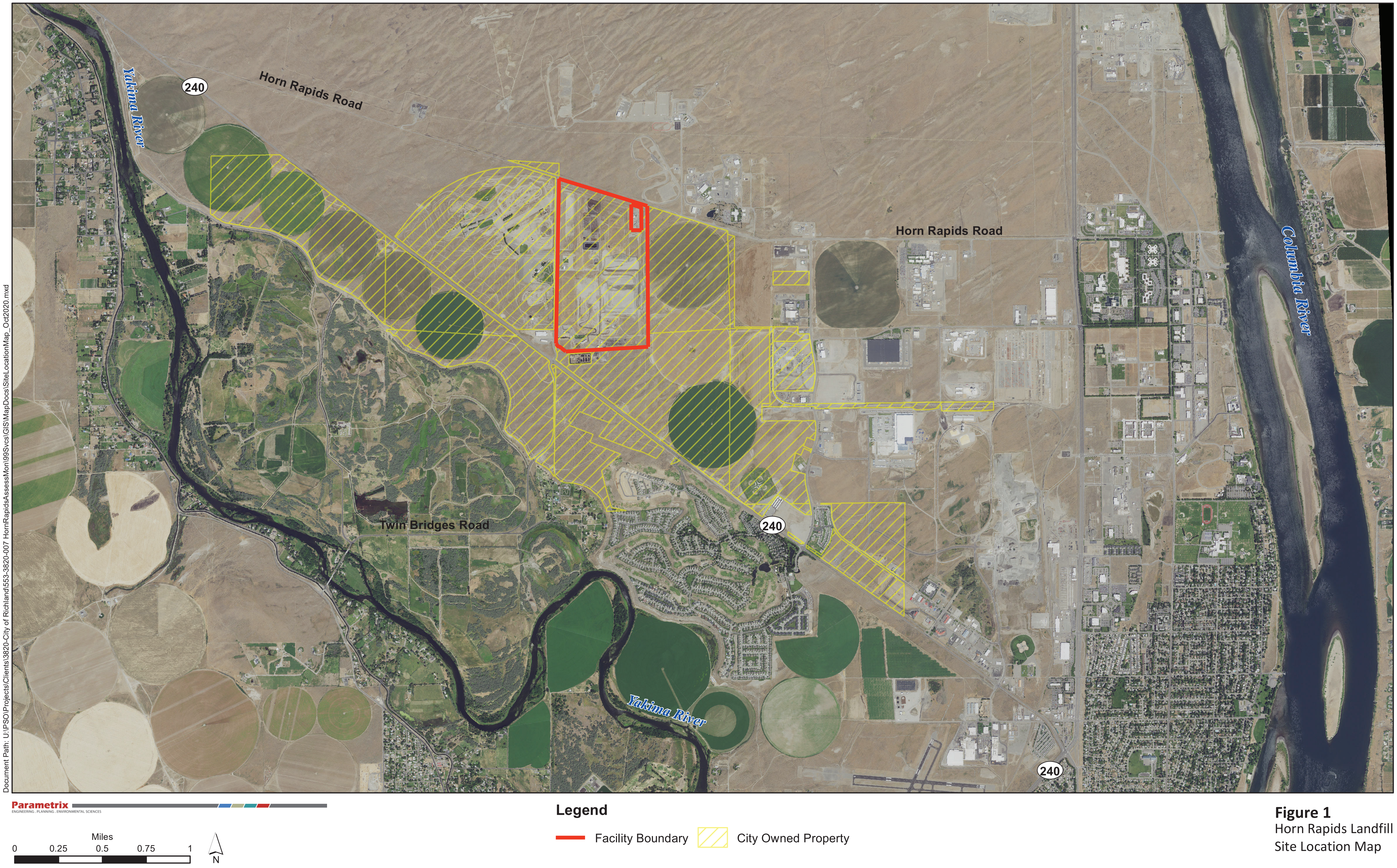

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Image Source: NAIP (2019 Imagery)

Legend

🟥	Facility Boundary
▨	City Owned Property

Figure 1
Horn Rapids Landfill
Site Location Map

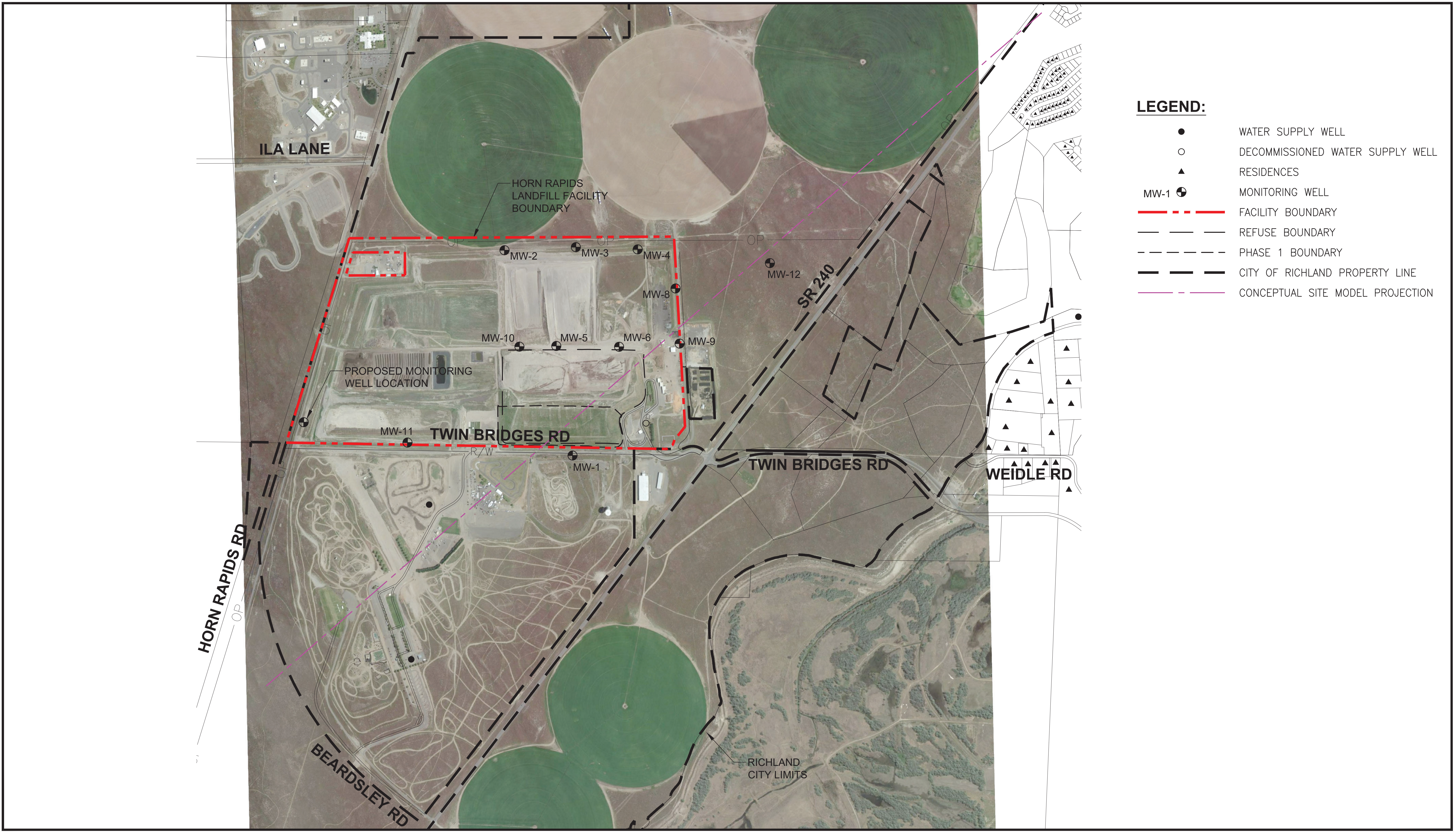

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Figure 2
Horn Rapids Landfill
Vicinity Plan

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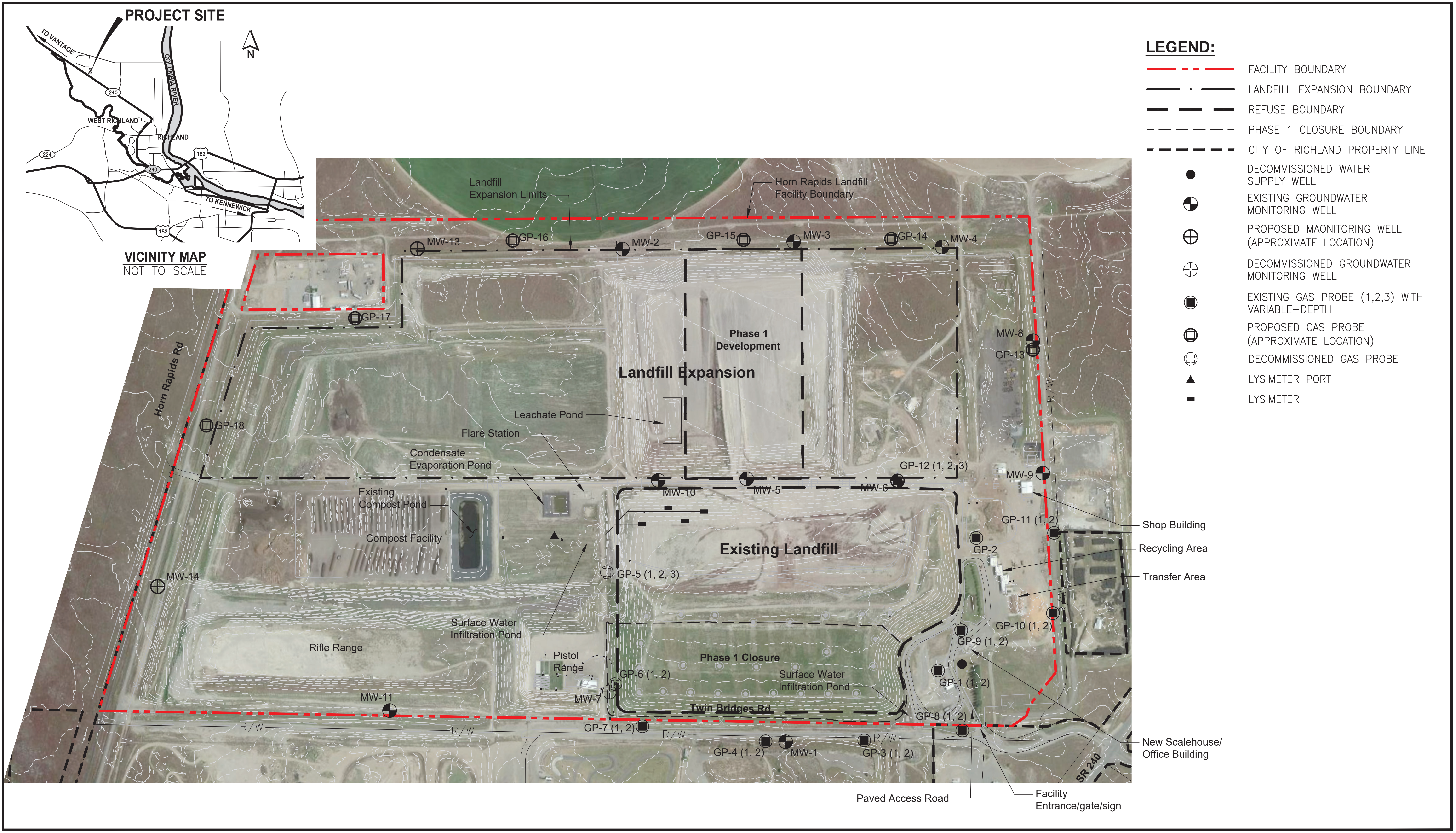

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Figure 3
Horn Rapids Landfill
Facility Plan

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Legend:

○	Decommissioned Water Supply Well	⊡	Proposed Gas Probe (Approximate Location)	— · · —	Facility Boundary
◐	Existing Groundwater Monitoring Well	■	Existing Gas Probe	— — —	City of Richland Property Line
⊕	Decommissioned Groundwater Monitoring Well	⬚	Decommissioned Gas Probe	― ― ―	Refuse Boundary
				- - - -	Phase 1 Closure Boundary

Figure 4
Groundwater Monitoring Well and Gas Probe Locations
Horn Rapids Landfill

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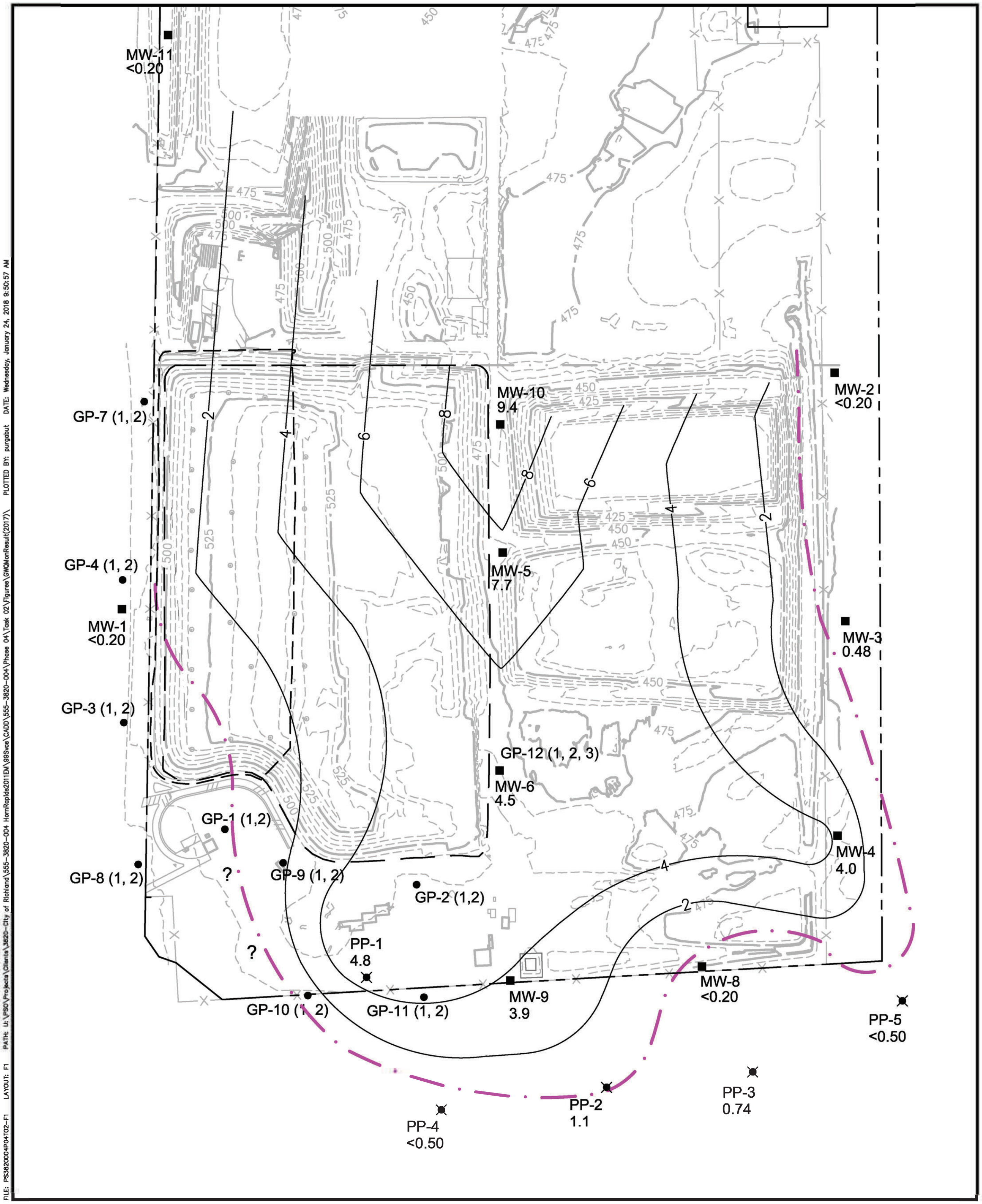
Legend:

○ Decommissioned Water Supply Well
◐ Monitoring Well
▣ Gas Probe
✖ Push Probe Locations
Facility Boundary
City of Richland Property Line
Groundwater Elevation Contour December 2018
Groundwater Flow Direction
Refuse Boundary
Phase 1 Boundary

Figure 5
Push Probe and
Monitoring Well Locations
Horn Rapids Landfill



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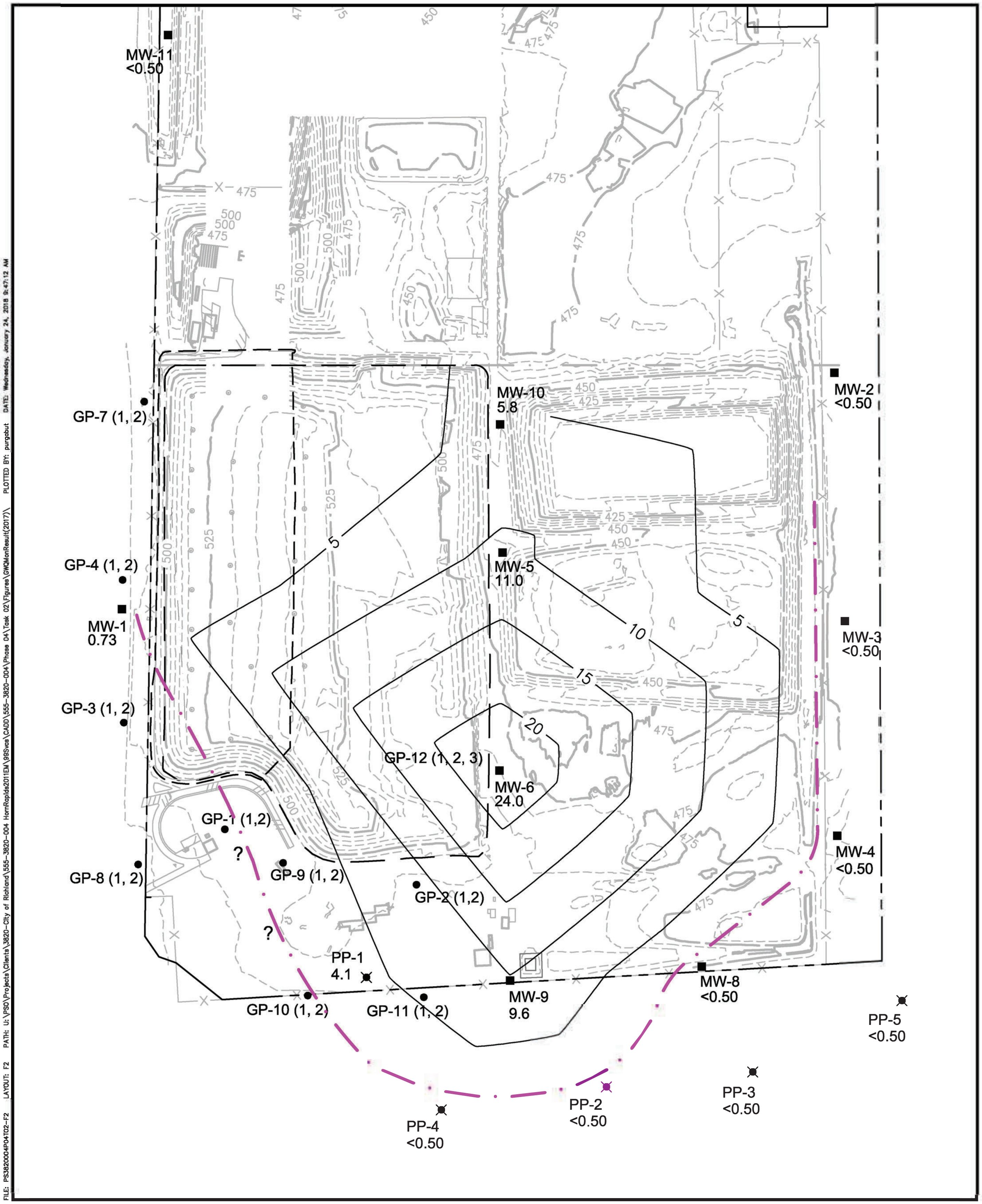
Legend:

Facility Boundary
Refuse Limit
Closure Limit
—2— Isoconcentration Contour
1,1-Dichloroethane GWQS = 1 µg/L

Figure 6
November 2017 Concentrations of 1,1-Dichloroethane (µg/L) in Groundwater Horn Rapids Landfill



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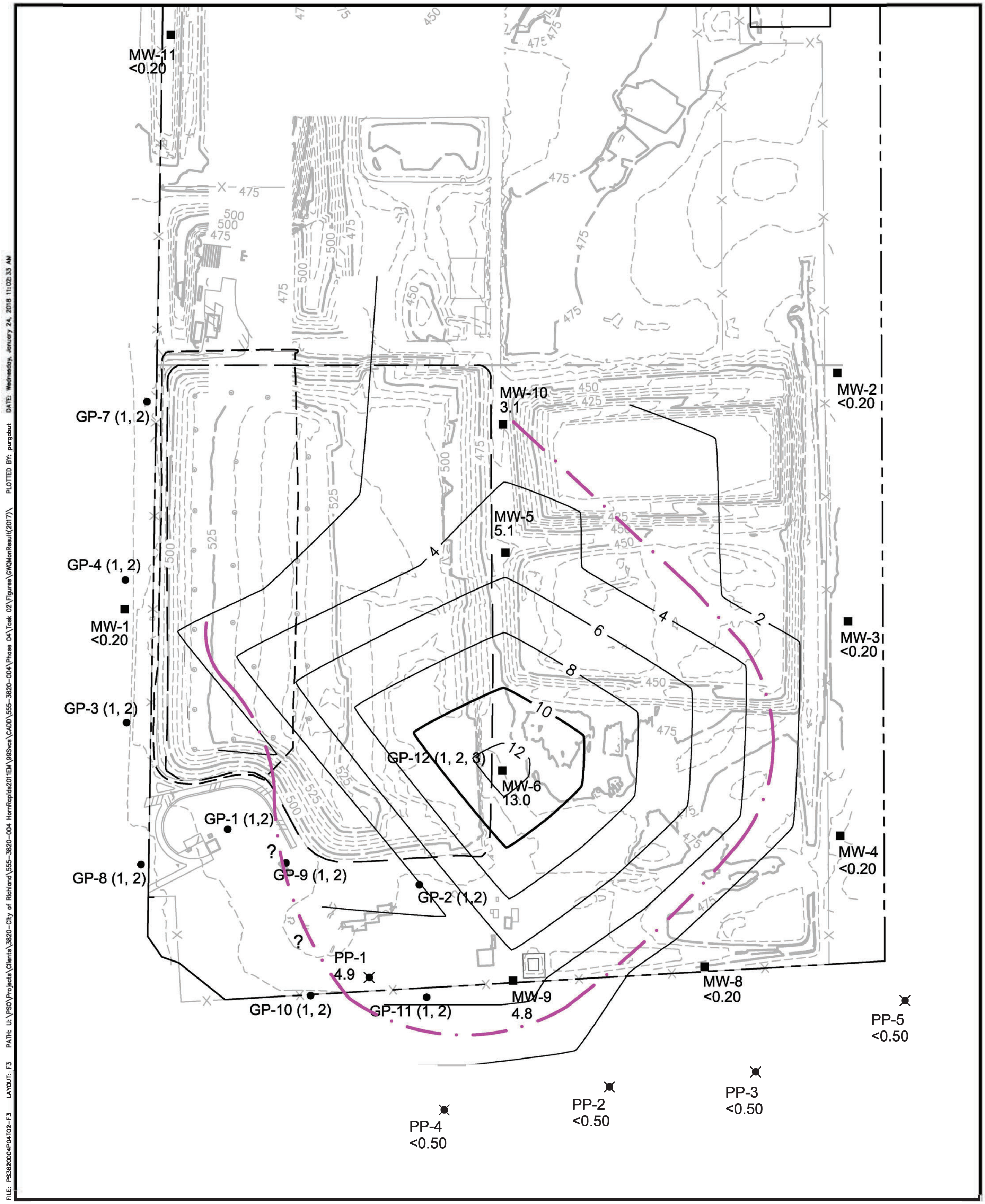
Legend:

- Facility Boundary
- Refuse Limit
- Closure Limit
- Isoconcentration Contour
- Tetrachloroethene GWQS = 0.8 μg/L

Figure 7
November 2017 Concentrations of Tetrachloroethene (μg/L) in Groundwater
Horn Rapids Landfill



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Legend:

Facility Boundary

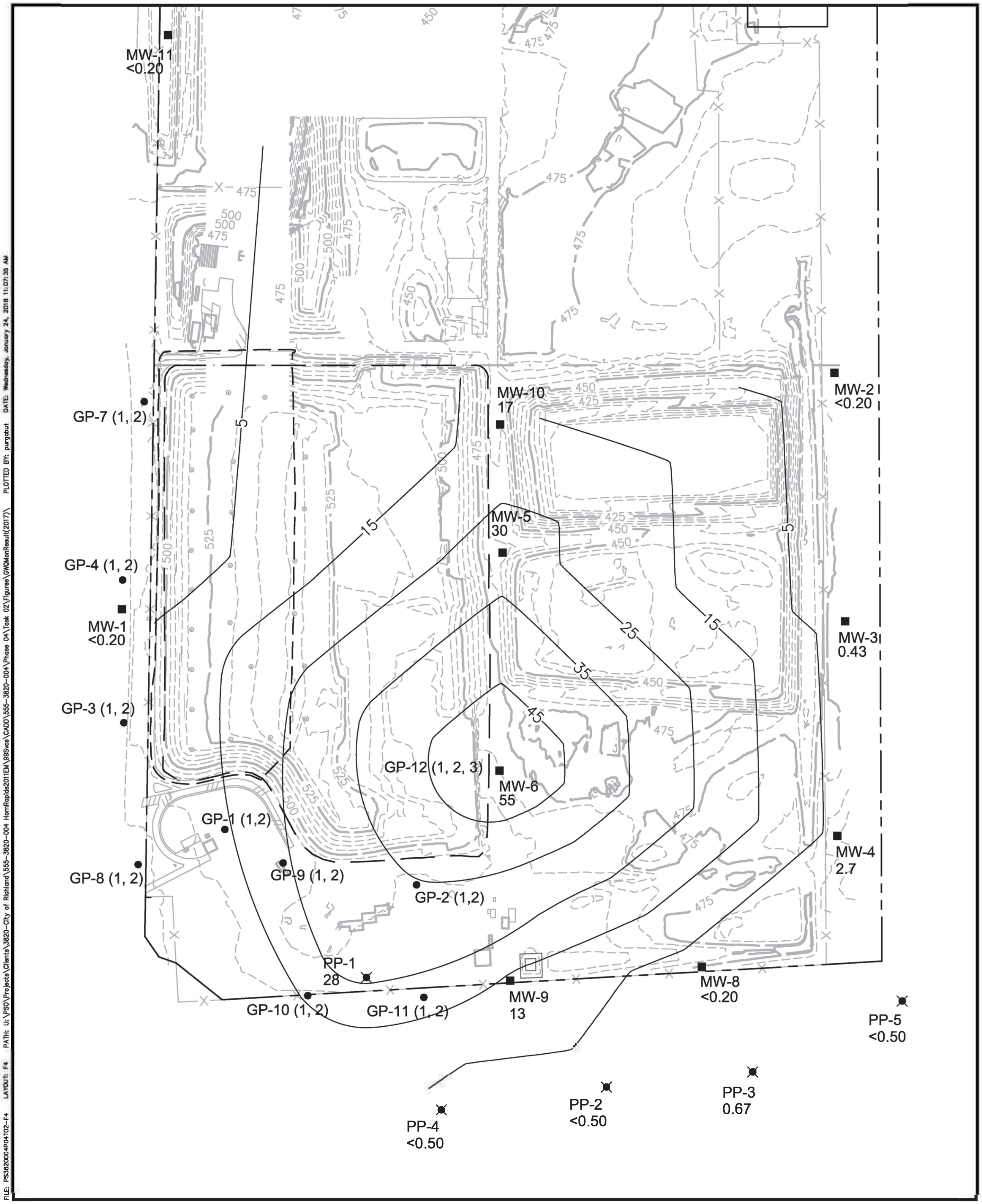
Refuse Limit

Closure Limit

———2——— Isoconcentration Contour

Trichloroethene
GWQS = 3 µg/L

Figure 8
November 2017 Concentrations of Trichloroethene (µg/L) in Groundwater
Horn Rapids Landfill



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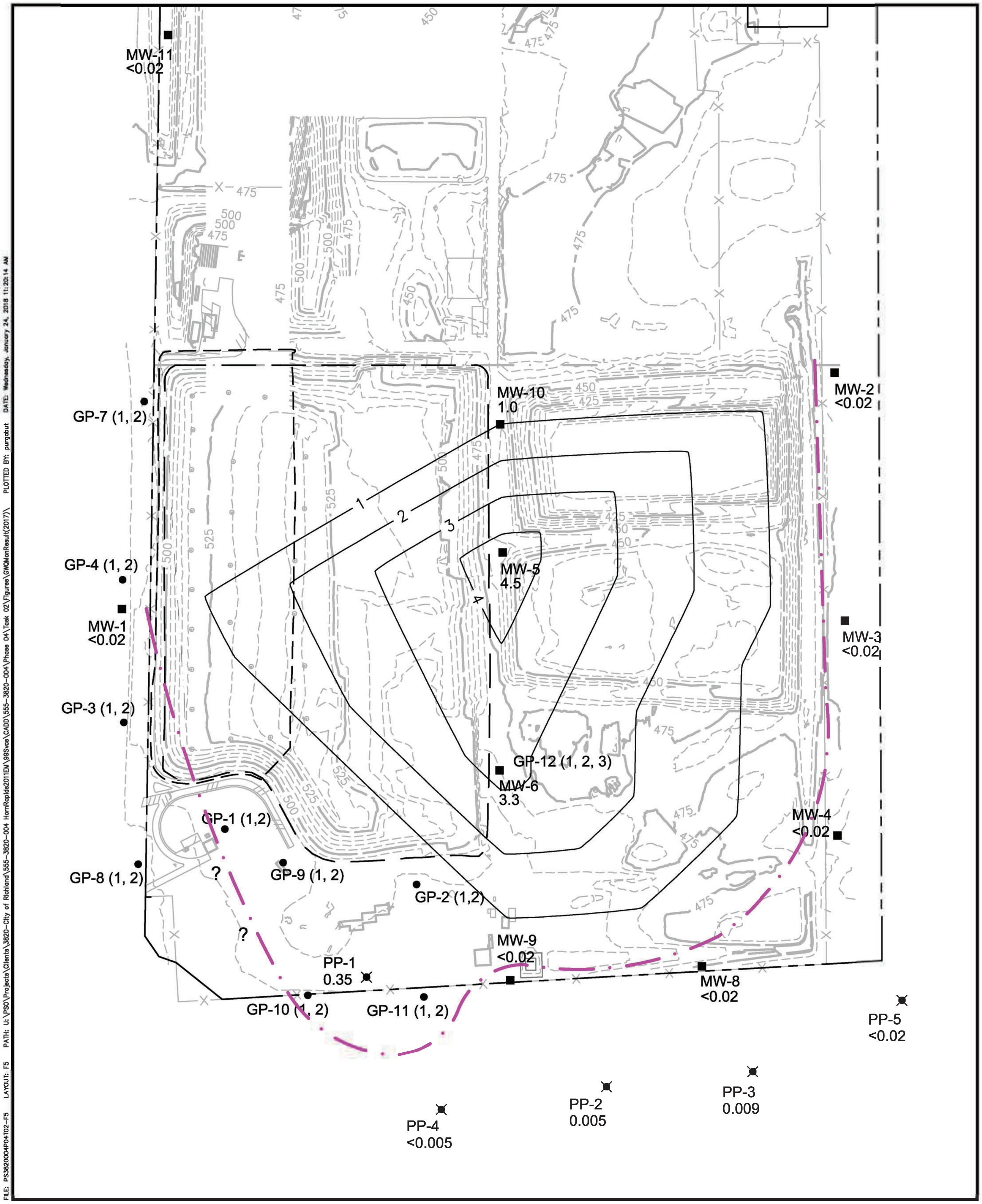
SCALE IN FEET

Legend:

- Facility Boundary
- Refuse Limit
- Closure Limit
- ——2—— Isoconcentration Contour
- cis-1, 2-Dichloroethene MCL = 70 µg/L

Figure 9
November 2017 Concentrations of cis-1, 2-Dichloroethene (µg/L) in Groundwater Horn Rapids Landfill



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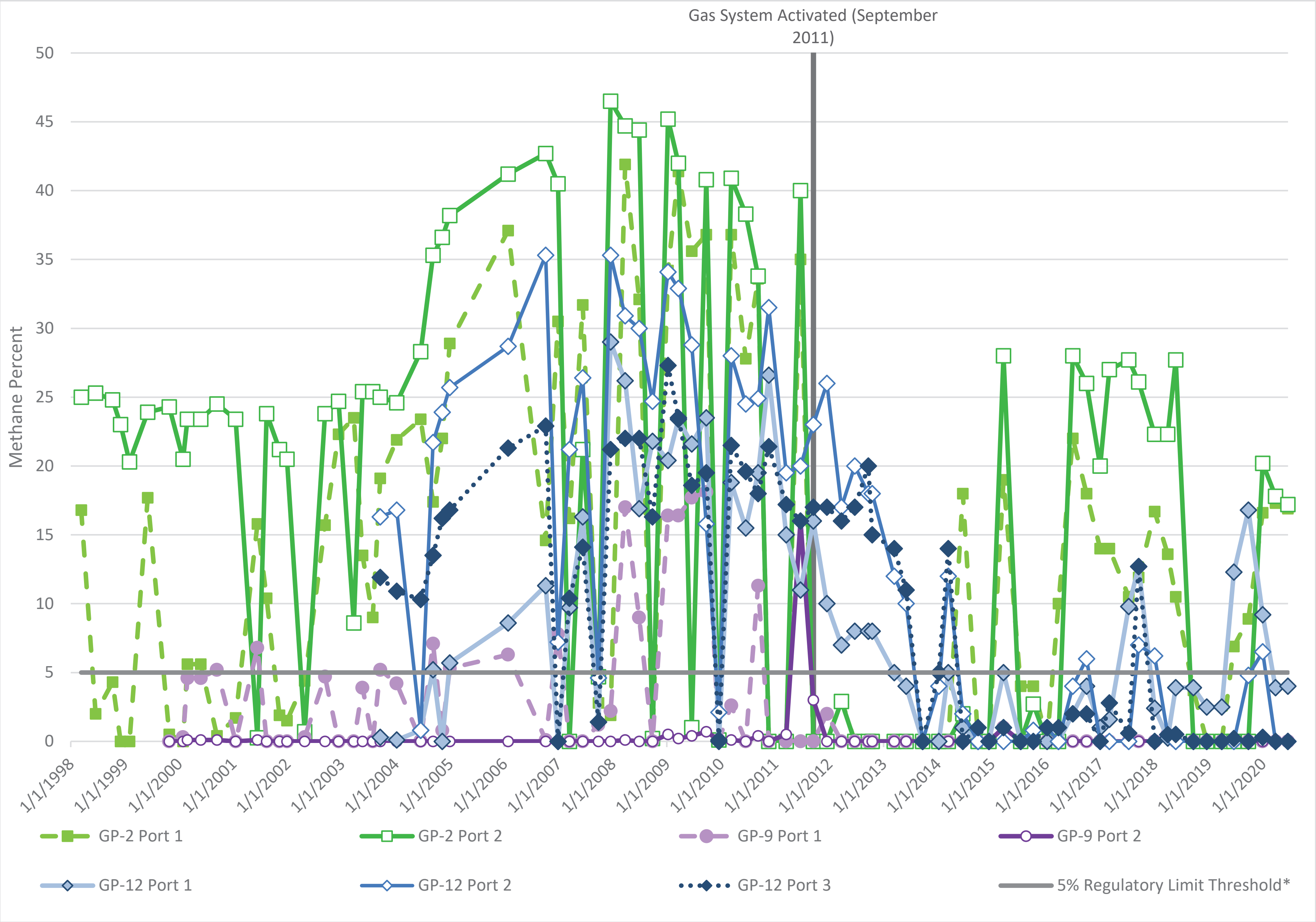
SCALE IN FEET

Legend:

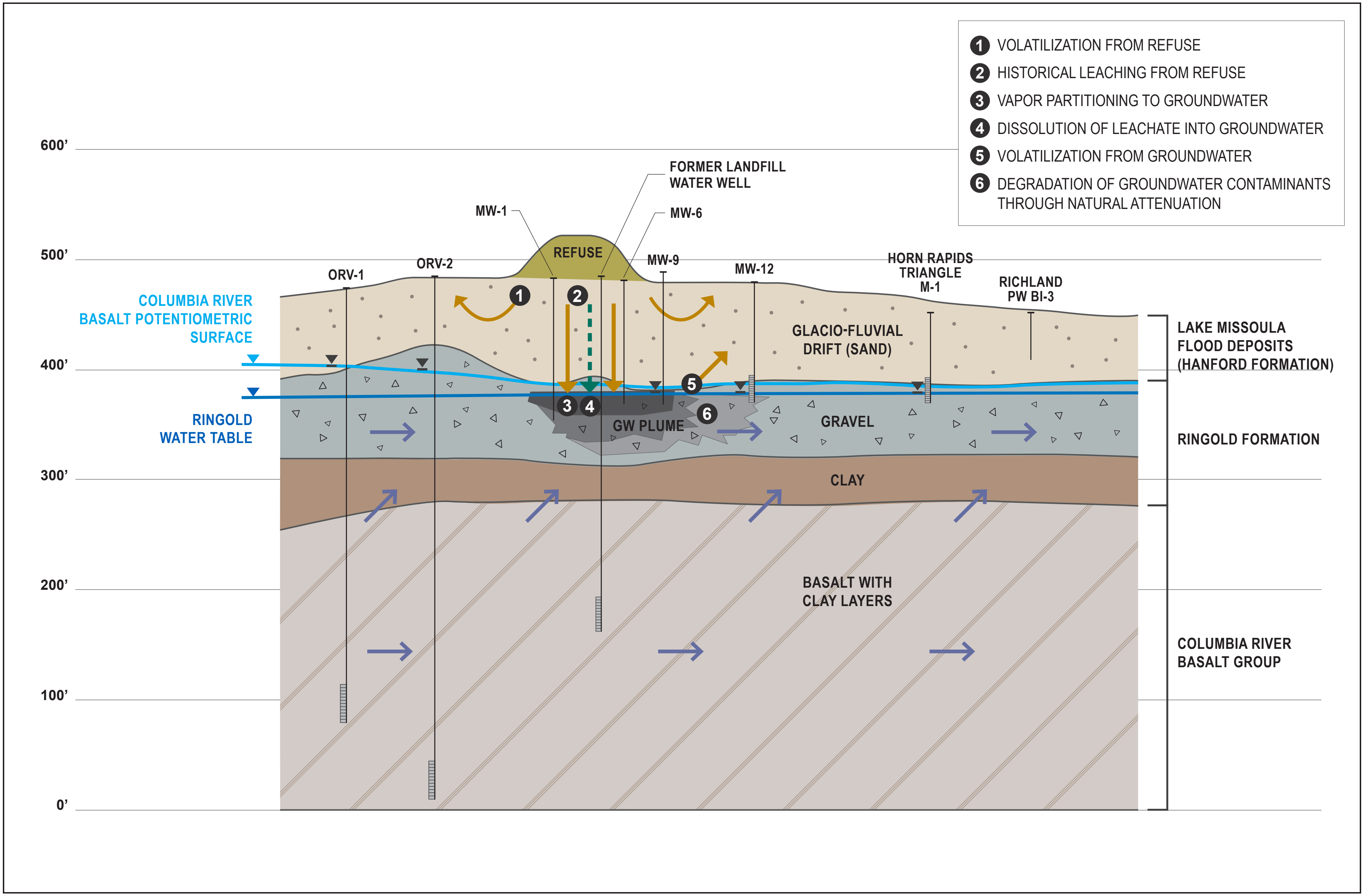
Facility Boundary
Refuse Limit
Closure Limit
—2— Isoconcentration Contour
Vinyl Chloride
GWQS = 0.02 µg/L

Figure 10
November 2017 Concentrations of Vinyl Chloride (µg/L) in Groundwater
Horn Rapids Landfill



*WAC 173-351 (Threshold for reference only, applies at City Facility Boundary)

Figure 11
Methane in Landfill Gas Probes, Horn Rapids Landfill

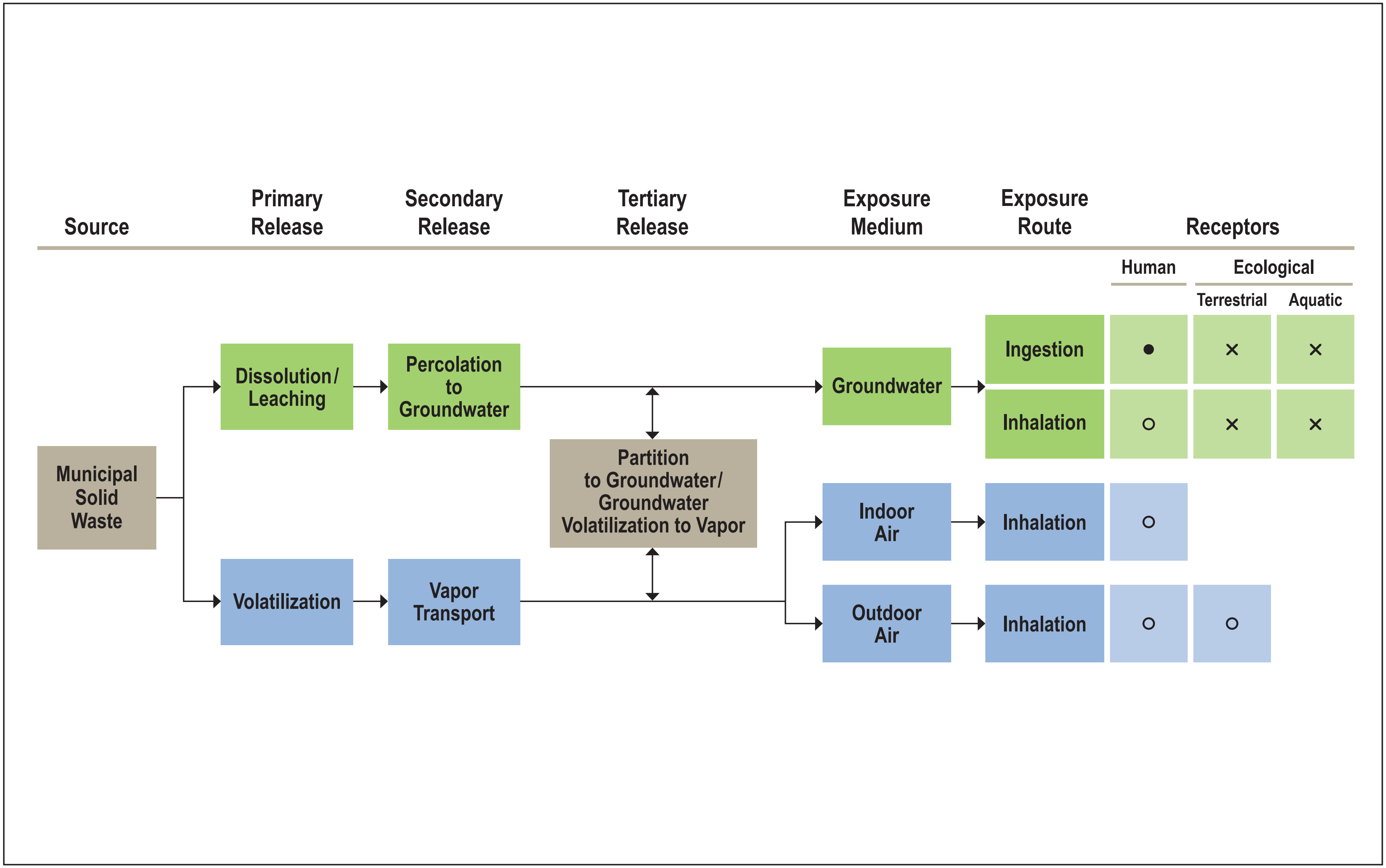


Parametrix

Figure 12

Conceptual Migration Pathways

Horn Rapids Landfill



Parametrix

● Complete exposure pathway
○ Complete but minor exposure pathway
✕ Incomplete exposure pathway

Figure 13
Conceptual Site Model
for Release of Hazardous Substances
Horn Rapids Landfill

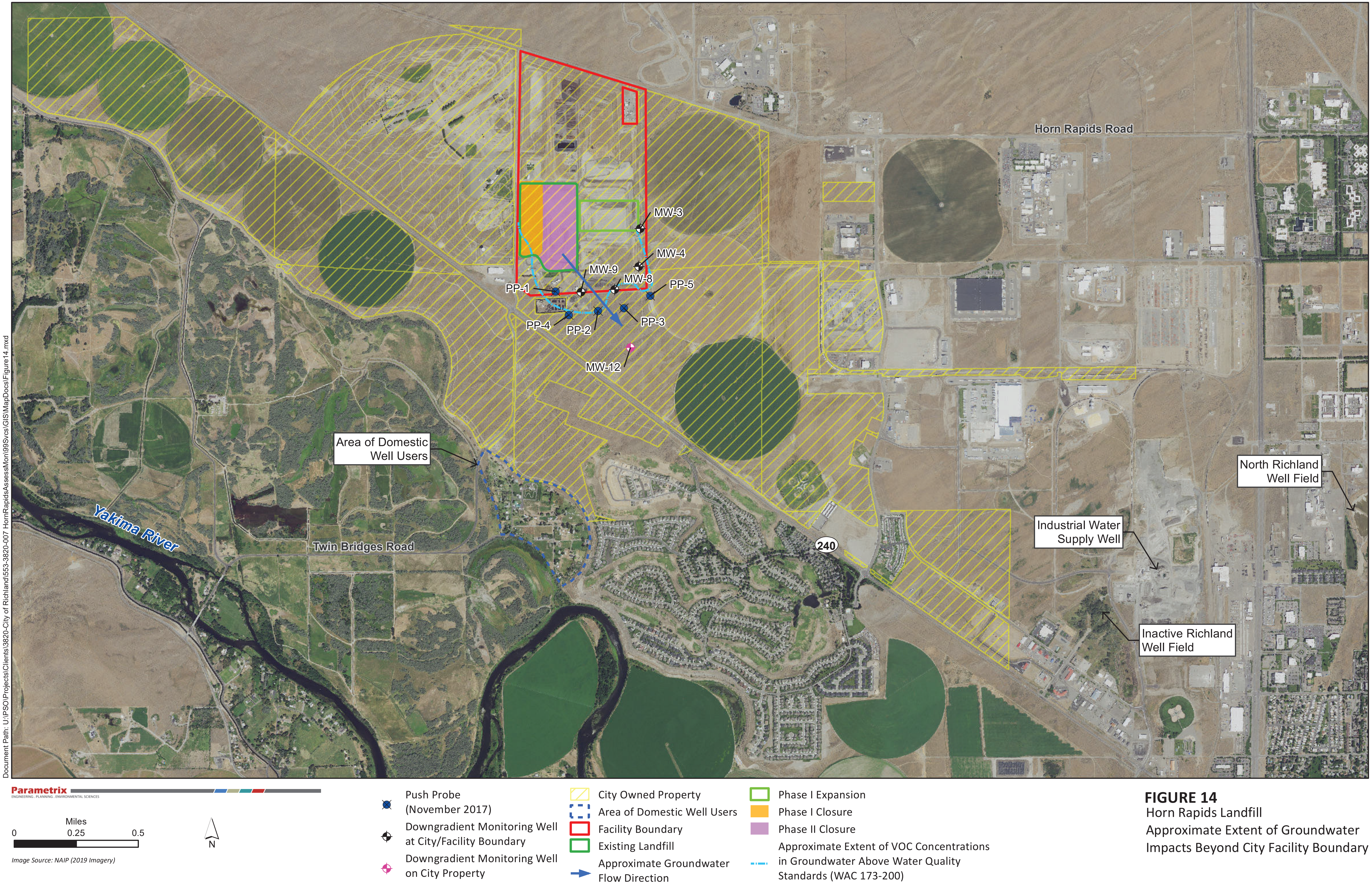


Image Source: NAIP (2019 Imagery)

Document Path: U:\PSO\Projects\Clients\3820-City of Richland\553-3820-007 HornRapidsAssessMon\99Svcs\GIS\MapDocs\Figure14.mxd

FIGURE 14
Horn Rapids Landfill
Approximate Extent of Groundwater
Impacts Beyond City Facility Boundary

Tables

Table 1. Groundwater Monitoring Well Construction Information, Horn Rapids Landfill

Monitoring Well	Northing	Easting	Elevation of TOC (ft NAVD88)	Screen Length (ft)	Screened Interval (ft below top of well seal[a])	Depth to Groundwater June 2020 (ft)	Groundwater Elevation June 2020 (ft NAVD88)	Difference Between Water Level and Top of Screen [negative is below top of screen] ft
MW-1	371,572.00	2,291,691.97	489.68	25	114-139	102.71	386.97	11.3
MW-2	372,460.09	2,294,368.28	469.73	25	98-123	83.73	386	14.3
MW-3	371,529.10	2,294,408.23	481.28	25	111-136	95.44	385.84	15.6
MW-4	370,722.92	2,294,379.43	462.52	25	90-115	76.87	385.65	13.1
MW-5	371,784.64	2,293,120.19	469.94	10	91-101	83.88	386.06	7.1
MW-6	370,965.00	2,293,109.43	484.54	10	106-116	98.51	386.03	7.5
MW-7 (former)	NA	NA	479.03	15	90.5-105.5	91[b]	NA	NA
MW-8	370,228.88	2,293,869.87	476.47	15	87.5-102.5	90.81	385.66	-3.3
MW-9	370,175.53	2,293,150.76	490.75	15	100.5-115.5	104.83	385.92	-4.3
MW-10	372,265.23	2,293,111.61	464.08[c]	15	72.5-87.5	77.10	386.98	-4.6
MW-11	373,725.48	2,291,860.98	481.16	15	90-105	94.21	386.953	-4.2
MW-12	368,946.27	1,934,322.73	477.63	15	88.5-103.5	92.28	385.35	-3.8

Notes: All wells are constructed of 2-inch-diameter PVC casing and slotted well screen.

TOC - Top of PVC casing.

[a] Assumes 3 ft of stickup above ground surface

[b] Typical historical value (well decommissioned)

[c] Resurveyed in December 2019 to reflect monument adjustment during expansion area construction

Table 2. Landfill Gas Probe Construction, Horn Rapids Landfill

Probe	Port	Ground Surface Elevation (ft)	Top of Screen Depth (ft bgs)	Bottom of Screen Depth (ft bgs)	Bottom Elevation of Probe (ft bgs)	Waste Depth (ft bgs)	Bottom Elevation of Waste (ft bgs)	Probe Depth Below Waste (ft bgs)	Probe Depth Above Groundwater (ft bgs)
GP-1	**1**	485.3	18.5	20.0	465.3	25	460.3	-5.0	79.3
	2	485.3	8.5	10.0	475.3	25	460.3	-15.0	89.3
GP-2	**1**	489.1	36.5	38.0	451.1	30	459.1	8.0	65.1
	2	489.1	18.5	20.0	469.1	30	459.1	-10.0	83.1
GP-3	**1**	477.1	36.5	38.0	439.1	12	465.1	26.0	53.1
	2	477.1	18.5	20.0	457.1	12	465.1	8.0	71.1
GP-4	**1**	477.5	36.5	38.0	439.5	12	465.5	26.0	53.5
	2	477.5	18.5	20.0	457.5	12	465.5	8.0	71.5
GP-5 (former)	**1**	479.4	56.5	58.0	421.4	25	454.4	33.0	35.4
	2	479.4	36.5	38.0	441.4	25	454.4	13.0	55.4
	3	479.4	18.5	20.0	459.4	25	454.4	-5.0	73.4
GP-6 (former)	**1**	479.4	36.5	38.0	441.4	25	454.4	13.0	55.4
	2	479.4	18.5	20.0	459.4	25	454.4	-5.0	73.4
GP-7	**1**	479.4	24.0	28.0	451.4	12	467.4	16.0	65.4
	2	479.4	11.0	15.0	464.4	12	467.4	3.0	78.4
GP-8	**1**	478.8	26.0	30.0	448.8	12	466.8	18.0	62.8
	2	478.8	11.0	15.0	463.8	12	466.8	3.0	77.8
GP-9	**1**	489.3	26.0	30.0	459.3	25	464.3	5.0	73.3
	2	489.3	11.0	16.0	473.3	25	464.3	-9.0	87.3
GP-10	**1**	484.5	26.0	30.0	454.5	30	454.5	0.0	68.5
	2	484.5	11.0	15.0	469.5	30	454.5	-15.0	83.5
GP-11	**1**	486.0	36.0	39.0	447.0	30	456.0	9.0	61.0
	2	486.0	14.0	17.0	469.0	30	456.0	-13.0	83.0
GP-12	**1**	480.3	22.5	32.5	447.8	30	450.3	2.5	61.8
	2	480.3	49.5	59.5	420.8	30	450.3	29.5	34.8
	3	480.3	76.5	86.5	393.8	30	450.3	56.5	7.8

Table 3. Wells with Parameters above Groundwater Quality Criteria Second Quarter 2020, Horn Rapids Landfill

	Upgradient or Cross Gradient	**Downgradient**	**Upgradient or Cross Gradient**	**Downgradient**
FIELD PARAMETERS				
Conductivity			MW-1, MW-11	MW-5, MW-6, MW-8, MW-9, MW-10
INORGANICS				
Arsenic	MW-1, MW-2, MW-11	MW-3 through MW-6, MW-8 through MW-10, MW-12		
Chromium	MW-2		MW-2	
Nitrate	MW-2, MW-11	MW-8	MW-2, MW-11	MW-8
Iron		MW-10		MW-10
Manganese		MW-5, MW-10		MW-5, MW-10
Sulfate	MW-11		MW-11	
Total Dissolved Solids (TDS)	MW-1, MW-11	MW-5, MW-6, MW-8, MW-9, MW-10	MW-1, MW-11	MW-5, MW-6, MW-8, MW-9, MW-10
VOCS				
1,1-Dichloroethane (1,1-DCA)		MW-4, MW-5, MW-6, MW-9, MW-10		
1,2-Dichloroethae (1,2-DCA)		MW-5		
Tetrachloroethene (PCE)	MW-1	MW-5, MW-6, MW-9, MW-10		MW-5, MW-6, MW-9, MW-10
Trichloroethene (TCE)		MW-5, MW-6, MW-9, MW-10		MW-6
Vinyl Chloride (VC)		MW-4, MW-5, MW-6, MW-9, MW-10		MW-6

MW-1 and MW-11 are upgradient from the Landfill; MW-2 is cross-gradient from the Landfill

Groundwater criteria consist of Maximum Contaminant Levels (MCLs; WAC 246-290) and Water Quality Standards for Groundwaters of the State of Washington (GWQSs; WAC 173-200).

Table 4. Highest Concentrations of Parameters above Groundwater Quality Criteria, Second Quarter 2020, Horn Rapids Landfill

Parameter	Units	GWQS	MCL	Highest Second Quarter 2020 Observed Concentration Above Criteria						
				Upgradient or Cross Gradient (MW-1, -2, -11)		Downgradient				
						Adjacent to Landfill (MW-5, -6, -10)		City Facility Boundary (MW -3, -4, -8, -9)		City Property (MW-12)
				Concentration	Well	Concentration	Well	Concentration	Well	
FIELD PARAMETERS										
Conductivity	µmhos/cm	NA	700	1,760	MW-11	1,762	MW-5	1,198	MW-9	
INORGANICS										
Arsenic	mg/l	0.00005	0.01	0.0045	MW-11	0.0022	MW-5	0.0085	MW-3	0.0077
Chromium	mg/L	0.05	0.1	0.063	MW-2					
Nitrate	mg/L	10	10	33	MW-11			24	MW-8	
Iron						0.33	MW-10			
Manganese	mg/L					0.17	MW-5			
Sulfate	mg/L	250	250.	300	MW-11					
Total Dissolved Solids (TDS)	mg/L	500	500	1,300	MW-11	1,100	MW-5	790	MW-8	
VOCS										
1,1-Dichloroethane (1,1-DCA)	µg/L	1	NA			6.1	MW-10	5.7	MW-4	
1,2-Dichloroethane (1,2-DCA)	µg/L	0.3	80			0.61	MW-5			
Tetrachloroethene (PCE)	µg/L	0.8	5	4.7	MW-1	18	MW-6	11	MW-9	
Trichloroethene (TCE)	µg/L	3	5			11	MW-6	4.0	MW-9	
Vinyl Chloride (VC)	µg/L	0.02	2			2.4	MW-6	0.048	MW-4	

MW-1 and MW-11 are upgradient from the Landfill; MW-2 is cross-gradient from the Landfill

Table 5. Statistically Significant Trends in Volatile Organic Compounds Calculated Using the Sen's Slope and Mann-Kendall Test (3Q2010-2Q2020 and 3Q2015-2Q20120, Horn Rapids Landfill

Parameter	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-8	MW-9	MW-10	MW-11
Past 10 Years 3Q2010-2Q2020										
1,1-DCA			↓	↑	↓	↓		↓	↓	
1,2-DCA						↓				
1,2-Dichloropropane					↓	↓				
Benzene					↓	↓			↓	
Chloroform			↑	↓					↓	
cis-1,2-DCE			↓	↑		↓			↑	
Methylene Chloride									↓	
PCE						↓		↑	↑	
trans-1,2-DCE						↓		↓		
TCE					↓	↓				
Trichlorofluoromethane			↓	↑						
Vinyl Chloride					↓	↓				
Past 5 Years 3Q2015-2Q2020										
1,1-DCA			↓	↑	↓	↓				
1,1-DCE					↓	↓			↓	
1,2-DCA					↓	↓				
1,2-Dichloropropane					↓	↓				
Bromodichloromethane			↑							
Benzene									↓	
Chloroform			↑	↓						
cis-1,2-DCE				↑	↓					
PCE					↓	↓				
trans-1,2-DCE					↓	↓				
TCE					↓	↓				
Vinyl Chloride					↓				↓	

↑ = Statistically significant upward trend (positive Mann-Kendall and Sen's slope)

↓ = Statistically significant downward trend (negative Mann-Kendall and Sen's slope)

Table 6. Recommended Initial Hazardous Substances, Horn Rapids Landfill

Constituent Name	Maximum Concentration (µg/L)	Second Highest Concentration (µg/L)	Background Concentration (µg/L)	Groundwater MTCA Method B Noncancer (µg/L)	Groundwater MTCA Method B Cancer (µg/L)
Metals					
Arsenic, Total	12		12	4.8	0.058
VOCs					
1,1-Dichloroethane	12	11		1600	7.7
Bromodichloromethane	1	0.87		160	0.71
Chloroform	15			80	1.4
cis-1,2-Dichloroethene	120			16	
Tetrachloroethene	48			48	21
Trichloroethene	23			4	0.54
Vinyl Chloride	8.3			24	0.029

Includes September 2011 through June 2020 data for downgradient wells MW-3, -4, -5, -6, -8, -9, -10, and -12

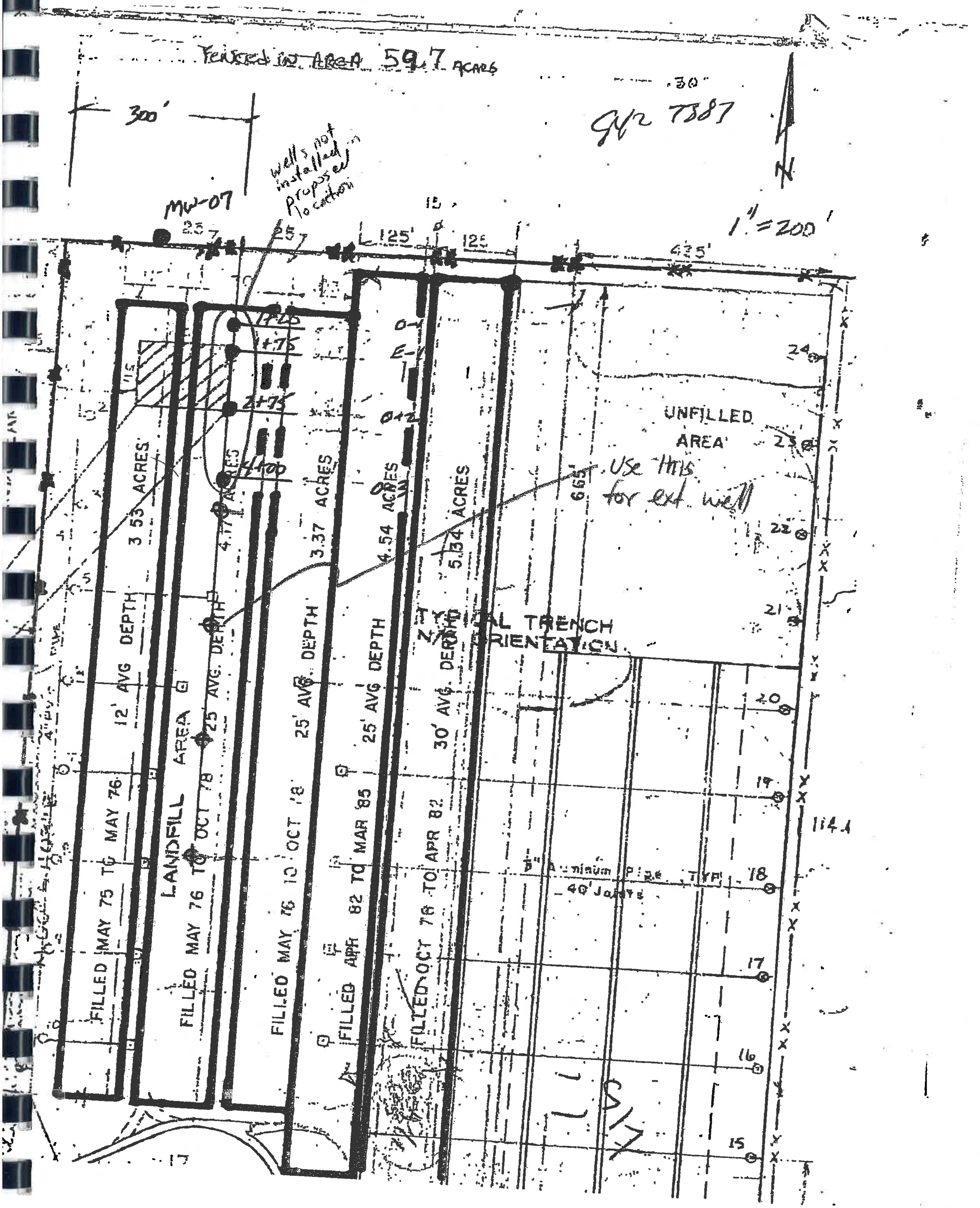
Criteria from Ecology's Cleanup Level and Risk Calculation database (updated January 2020)

Appendix A

Landfill Construction and Closure Information

A-1

Initial Landfill Construction


Fenced in Area 59.7 acres
300'
SW2 7387
N
1" = 200'
MW-07
wells not installed in proposed location
25
25
125'
125
435'
30
15
1+25
1+75
2+75
4+00
0+1
E-1
0+2
0+3
665'
Use this for ext well
UNFILLED AREA
24
23
22
21
20
19
18
17
16
15
TYPICAL TRENCH N/S ORIENTATION
3.53 ACRES
12' AVG DEPTH
FILLED MAY 75 TO MAY 76
LANDFILL AREA
FILLED MAY 76 TO OCT 78
4.17 ACRES
25' AVG. DEPTH
3.37 ACRES
25' AVG. DEPTH
FILLED MAY 76 TO OCT 78
4.54 ACRES
25' AVG DEPTH
FILLED APR 82 TO MAR 85
5.34 ACRES
30' AVG. DEPTH
FILLED OCT 78 TO APR 82
8" Aluminum Pipe TYP
40' Joints
114.4
L-5/7
17

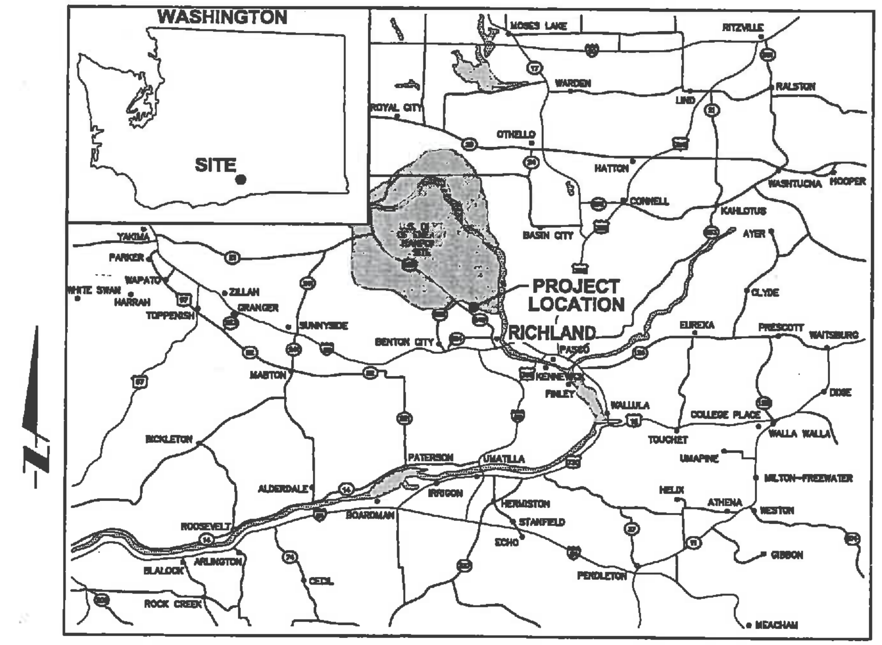
A-2

Phase 1 Closure

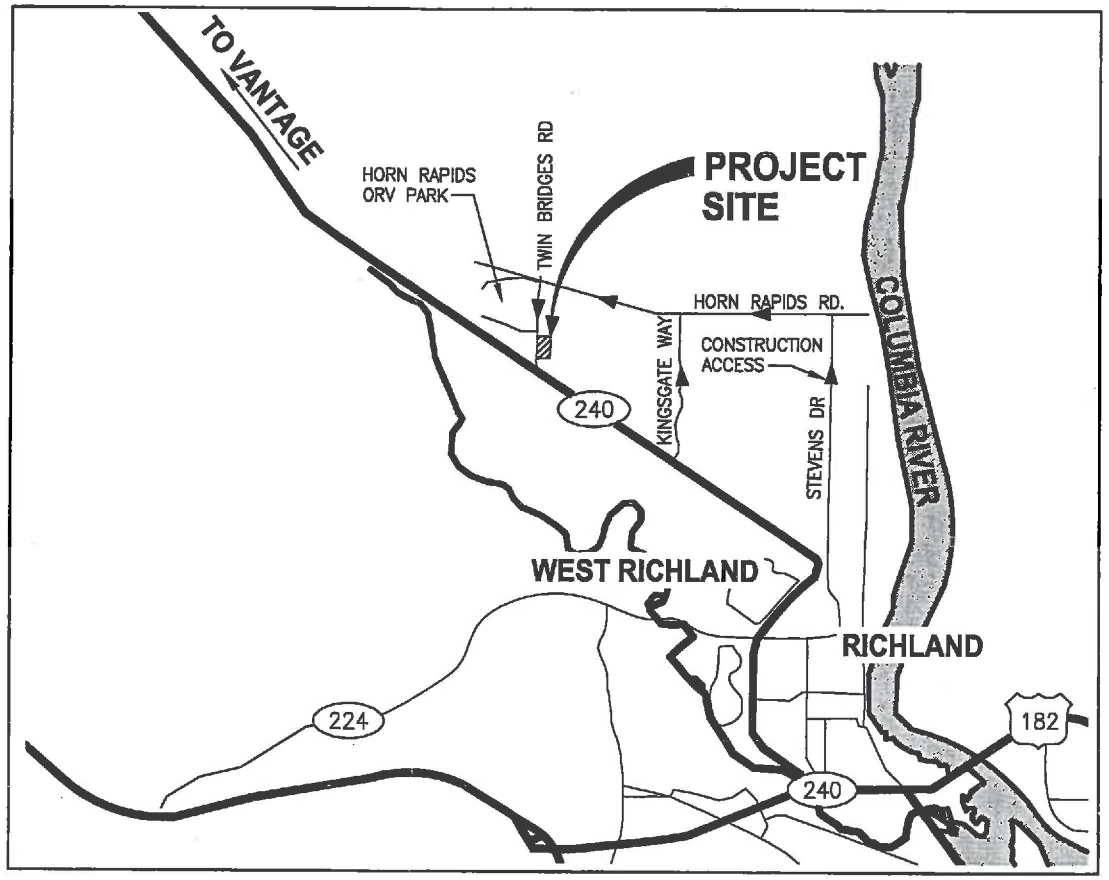
HORN RAPIDS LANDFILL
PHASE 1 CLOSURE PROJECT
RECORD DRAWINGS
CONTRACT NO. SB 11-01PW

OWNED AND OPERATED BY:

CITY OF RICHLAND PUBLIC WORKS DEPARTMENT
840 NORTHGATE DRIVE
PO BOX 190
RICHLAND, WASHINGTON 99352



LOCATION MAP
NOT TO SCALE



VICINITY MAP
NOT TO SCALE

SHEET INDEX

SHEET No.	TITLE
C1	COVER SHEET
C2	ABBREVIATION, LEGEND and GENERAL NOTES
C3	PHASE 1 OVERALL SITE PLAN
C4	PHASE 1 GRADING PLAN–NORTH
C5	PHASE 1 GRADING PLAN–SOUTH
C6	LANDFILL GEOMEMBRANE LAYOUT
C7	DETAILS
C8	DETAILS
C9	DETAILS
C10	LANDFILL GAS PLAN
C11	DETAILS
C12	DETAILS
C13	FLARE FACILITY PLAN
C14	FLARE FACILITY PLAN
C15	DETAILS
C16	DETAILS
C17	DETAILS
C18	CONDENSATE EVAPORATION POND PLAN
C19	DETAILS
E1	FLARE FACILITY PLAN
E2	FLARE FACILITY PLAN
E3	ELECTRICAL DETAILS
E4	ONE–LINE DIAGRAM AND CONDUIT AND CABLE SCHEDULE

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△	REVISIONS	DATE	BY
	RECORD DRAWINGS	MAR. 2012	S.M.E.

DESIGNED S. EMGE
DRAWN S. SIRES
CADD CHECKED
CHECKED
APPROVED

ONE INCH AT FULL SCALE. IF NOT, SCALE ACCORDINGLY
FILE NAME BL3820003P01T03–C01
JOB No. 555–3820–003
DATE MARCH 2012

STEPHEN M. EMGE
34389
3/14/12

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PROJECT NAME
HORN RAPIDS LANDFILL
PHASE 1 CLOSURE PROJECT
CONTRACT No. SB 11-01PW
RICHLAND, WA

COVER SHEET

DRAWING NO.
1 OF 23
C1

DATE: Mar 16, 2012 – 10:19am
PLOTTED BY: sirassto
LAYOUT: C1
IMAGES:
XREF'S: XBL28000003P01T03–TBLK | Steve Emge seal

LEGEND:

●	SURVEY CONTROL LOCATIONS
GP-6 ✦	EXISTING GAS PROBE
◎	EXISTING WATER SUPPLY WELL
GE-1 ◎	VERTICAL LFG GAS WELL
MW-1 ●	EXISTING GROUNDWATER MONITORING WELL LOCATION
··········	SURFACE WATER DITCH
———	EXISTING WATER LINE
—×—×—	EXISTING FENCE
——x——	CHAIN LINK FENCE
———— – –	PROPERTY BOUNDARY
– – – – – –	LIMIT OF REFUSE (PLAN)
— · — · —	GEOTEXTILE
━━━━━	GEOMEMBRANE (SECTION)
—— ——	GEOMEMBRANE (PLAN)
——x——	GEONET
—1200—	EXISTING CONTOUR
—1200—	PROPOSED SUBGRADE CONTOUR
————	CONSTRUCTION PHASE LIMITS
—— – —	ROAD CENTERLINE
2%	GRADE OR SURFACE SLOPE
3:1	SLOPE DESIGNATION AND DIRECTION
1 4	SLOPE DESIGNATION (IN ELEVATION)
3	KEY NOTE NUMBER REFERENCE THAT CORRELATES NOTE CALLOUT TO NOTE THAT APPLIES
105	COORDINATE SCHEDULE POINT NUMBER
>—<	CULVERT
Ⓜ	MOTOR
(LS)	LEVEL SWITCH
(FM)	FLOW METER
▨	PREPARED SUBGRADE
▨	BEDDING LAYER/BENTONITE
▨	CRUSHED SURFACING (SECTION)
▨	CRUSHED SURFACING (PLAN)
▨	TOPSOIL
▨	CONCRETE
▨	EMBANKMENT
▨	STRUCTURAL BACKFILL
▨	ROCK ARMOUR
▨	REFUSE
▨	DRAINAGE SOIL LAYER
▨	ASPHALT REMOVAL (PLAN)

LIST OF ABBREVIATIONS:

CCW	COUNTER CLOCKWISE
CLR	CLEAR
EL	ELEVATION
FB	FREE BOARD
FLG	FLANGED
FT	FERRULE THREAD
GB	GRADE BREAK
GE	GAS EXTRACTION WELL
GP	EXISTING GAS PROBE
GW	GROUND WATER
HDPE	HIGH DENSITY POLYETHYLENE
IE	INVERT ELEVATION
HP	HIGH POINT
LFG	LANDFILL GAS
LP	LOW POINT
MAX./MIN.	MAXIMUM/MINIMUM
MW	EXISTING GROUNDWATER MONITORING WELL
NIC	NOT IN CONTRACT
O.C.	ON-CENTER
PERF	PERFORATED
PVC	POLYVINYL CHLORIDE
SDR	STANDARD DIMENSION RATIO
SQ	SQUARE
SS	STAINLESS STEEL
SW	SOLID WALL/STORMWATER
THD	THREADED
TYP	TYPICAL
UV	ULTRA VIOLET
&	AND
℄	CENTERLINE
ø/DIA	DIAMETER
=	EQUALS
'	FEET
"	INCHES

GENERAL NOTES:

1. EXISTING CONTOURS OF LANDFILL AREA ARE BASED ON TOPOGRAPHIC SURVEY DATA SUPPLIED BY THE CITY OF RICHLAND PUBLIC WORKS, IN MARCH 2003 AND FEBRUARY 2010.
2. THE LANDFILL IS BEING ACTIVELY FILLED ON THE EAST SIDE. SOIL IS BEING REMOVED FROM THE BORROW AREA, AS INDICATED ON THE PLAN AND HAULED TO THE LANDFILL'S WORKING FACE. CONTRACTOR SHALL NOT INTERRUPT LANDFILL OPERATIONS AND SHALL COORDINATE CONSTRUCTION ACTIVITIES TO MINIMIZE IMPACT TO ONGOING LANDFILL OPERATIONS.

3 SURVEY CONTROL:
HORIZONTAL DATUM IS NAD 1927
VERTICAL DATUM IS NGVD 1929

4 CONTRACTOR SHALL REMOVE SOIL FROM BORROW AREA AS DIRECTED BY OWNER.

5. SITE ACCESS IS LIMITED. CONTRACTOR SHALL RESTRICT CONSTRUCTION ACCESS TO THE WORK AREA. CONTRACTOR'S EMPLOYEE VEHICLES ARE NOT ALLOWED IN THE ACTIVE OPERATIONS AREA. CONTRACTOR'S EMPLOYEES VEHICLES SHALL BE PARKED AS DIRECTED BY OWNER.
6. THE LOCATIONS OF ALL EXISTING UTILITIES ARE NOT SHOWN. UTILITIES AND LOCATIONS SHALL BE CONFIRMED BY CONTRACTOR PRIOR TO CONSTRUCTION.

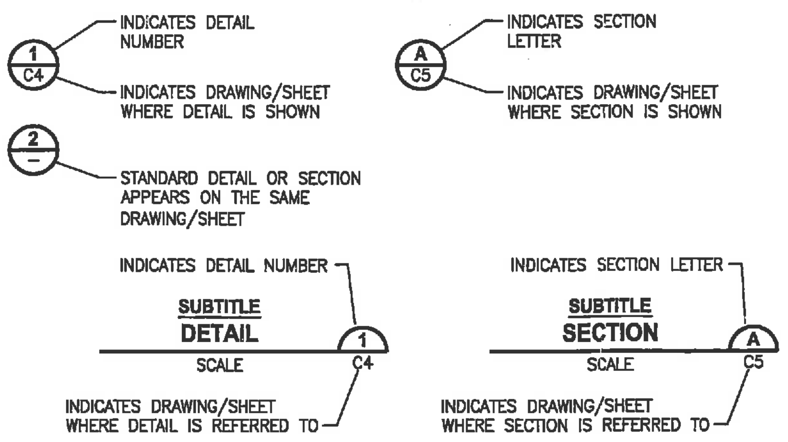
7 CONTRACTOR SHALL ATTAIN BEDDING LAYER FROM THIS AREA. ANY ADDITIONAL BEDDING LAYER SHALL BE ATTAINED FROM THE BORROW AREA.

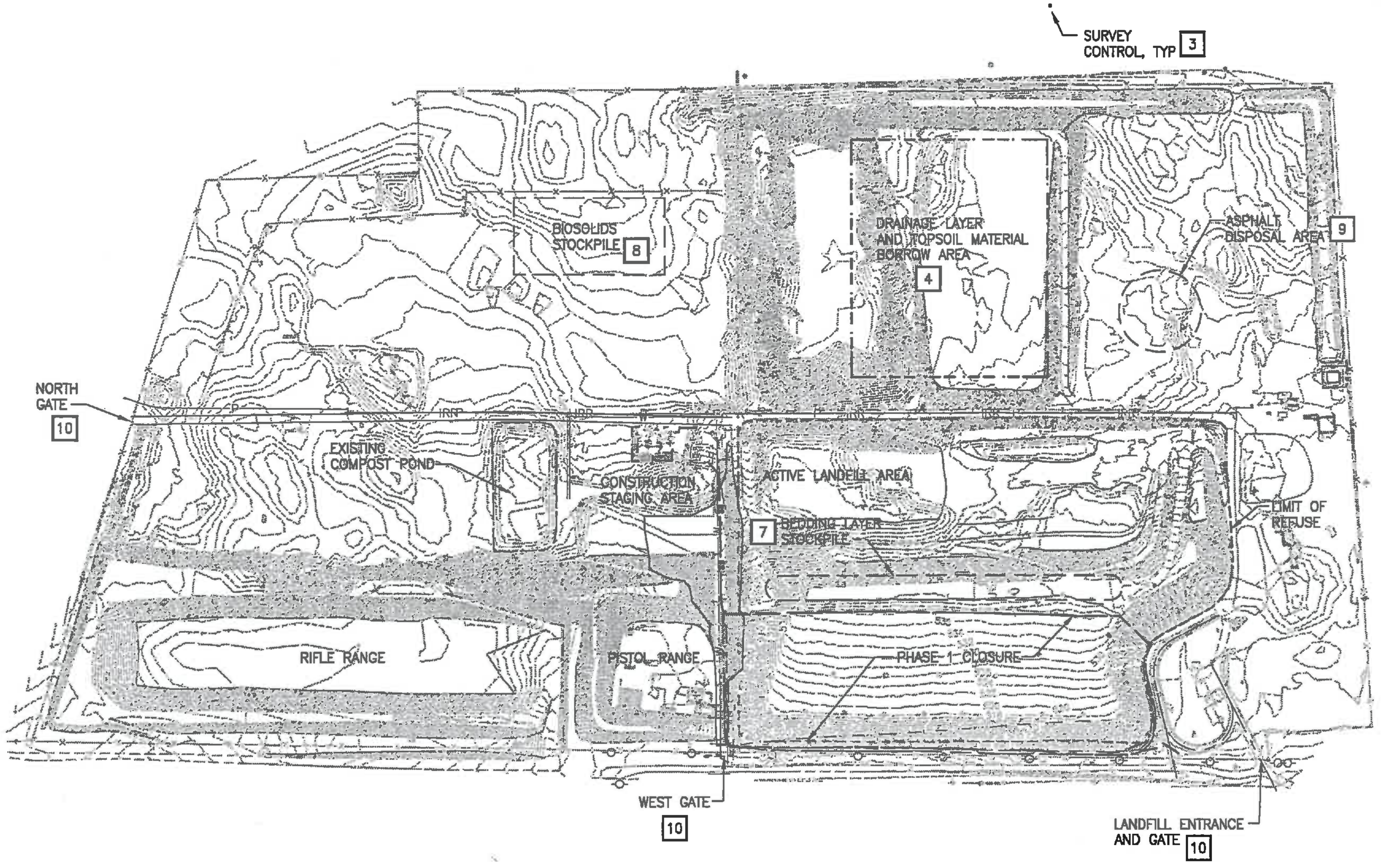
8 THIS IS THE LOCATION OF THE BIOSOLIDS STOCKPILE THAT SHALL BE USED FOR THE TOPSOIL MIX. CONTRACTOR SHALL MIX TOPSOIL ADJACENT TO THIS AREA, AS DIRECTED BY THE OWNER.

9 CONTRACTOR SHALL DISPOSAL OF REMOVED ASPHALT FROM THE SOUTH LANDFILL ENTRANE, AS DIRECTED BY THE OWNER, IN THIS APPROXIMATE AREA

10 CONTRACTOR ACCESS SHALL BE THROUGH THE NORTH GATE VIA HORN RAPIDS ROAD (SEE SHEET C-1 FOR ROUTE) WHICH IS A CONTROLLED GATE ACCESS, AS DIRECTED BY THE OWNER.

DETAIL AND SECTION DESIGNATION





OVERALL SITE PLAN
SCALE IN FEET
0 300 600
N

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△	REVISIONS	DATE	BY
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DATE MARCH 2012

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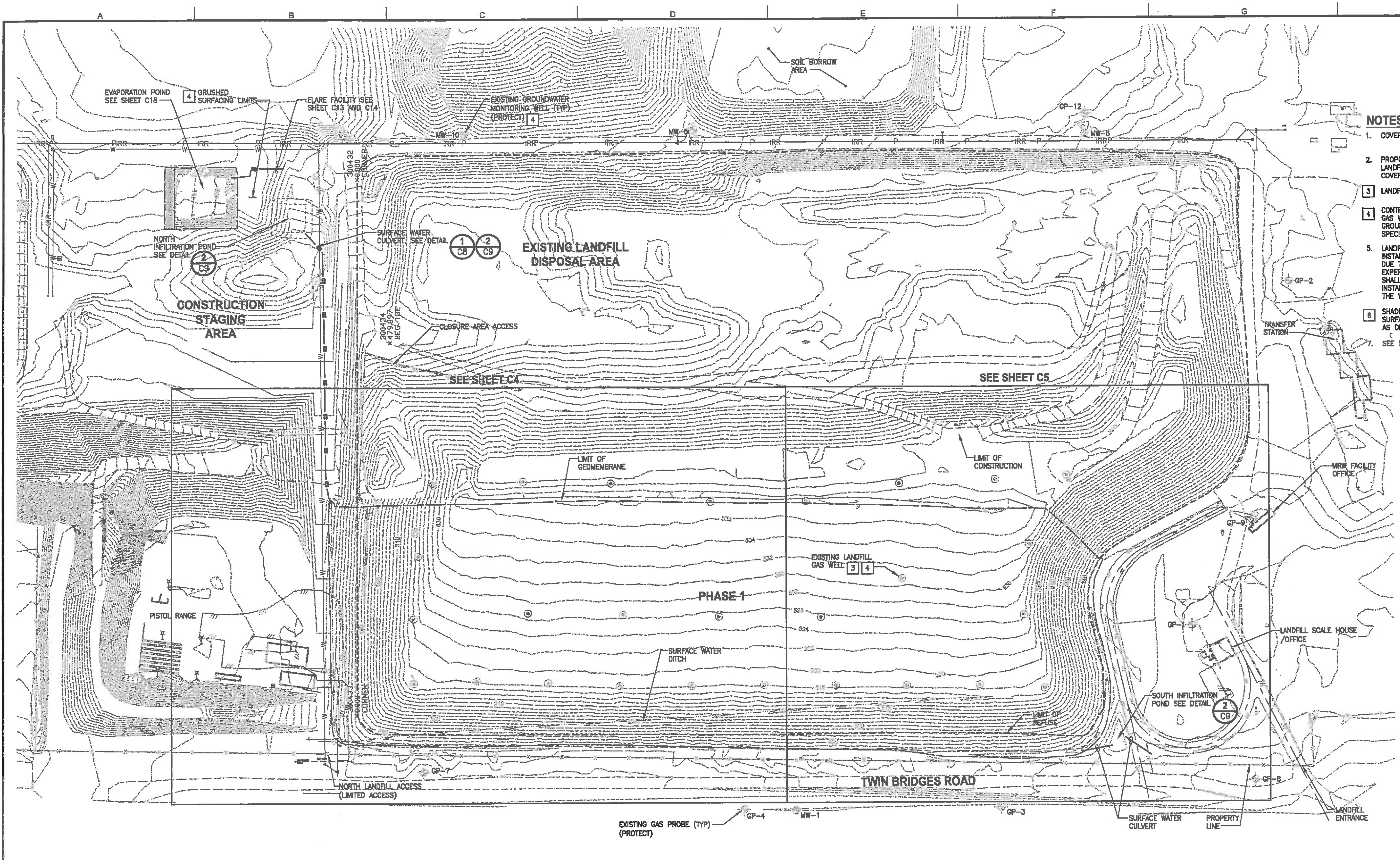
PROJECT NAME
HORN RAPIDS LANDFILL
PHASE 1 CLOSURE PROJECT
CONTRACT No. SB 11-01PW
RICHLAND, WA

ABBREVIATIONS, LEGEND and GENERAL NOTES

DRAWING NO. 2 OF 23
C2

DATE: Mar 16, 2012 - 12:20pm LAYOUT: C2
PLOTTED BY: siresste
IMAGES:
XREFS: XBL3820003P01T03-TBLK | XBL3820003P01T02BA-OTHERS | Steve Emge seal



NOTES:

1. COVER SYSTEM, SEE DETAIL 1/C7
2. PROPOSED CONTOURS REPRESENT LANDFILL GRADES PRIOR TO FINAL COVER PLACEMENT.
3. LANDFILL GAS PLAN, SEE SHEET C10.
4. CONTRACTOR SHALL PROTECT EXISTING GAS WELLS, GAS PROBES AND GROUNDWATER WELLS PER SPECIFICATIONS.
5. LANDFILL LINER INSTALLATION SHALL BE INSTALLED IN A WEST TO EAST DIRECTION DUE TO POTENTIAL HIGH WINDS EXPERIENCED AT THE SITE. CONTRACTOR SHALL COORDINATE DRAINAGE LAYER INSTALLATION TO LESSEN EFFECTS FROM THE WIND.
6. SHADING INDICATES LIMIT OF CRUSHED SURFACING AT/WITHIN FLARE FACILITY, OR AS DIRECTED BY ENGINEER.
7. SEE SHEET C6 FOR CONTROL SCHEDULE.

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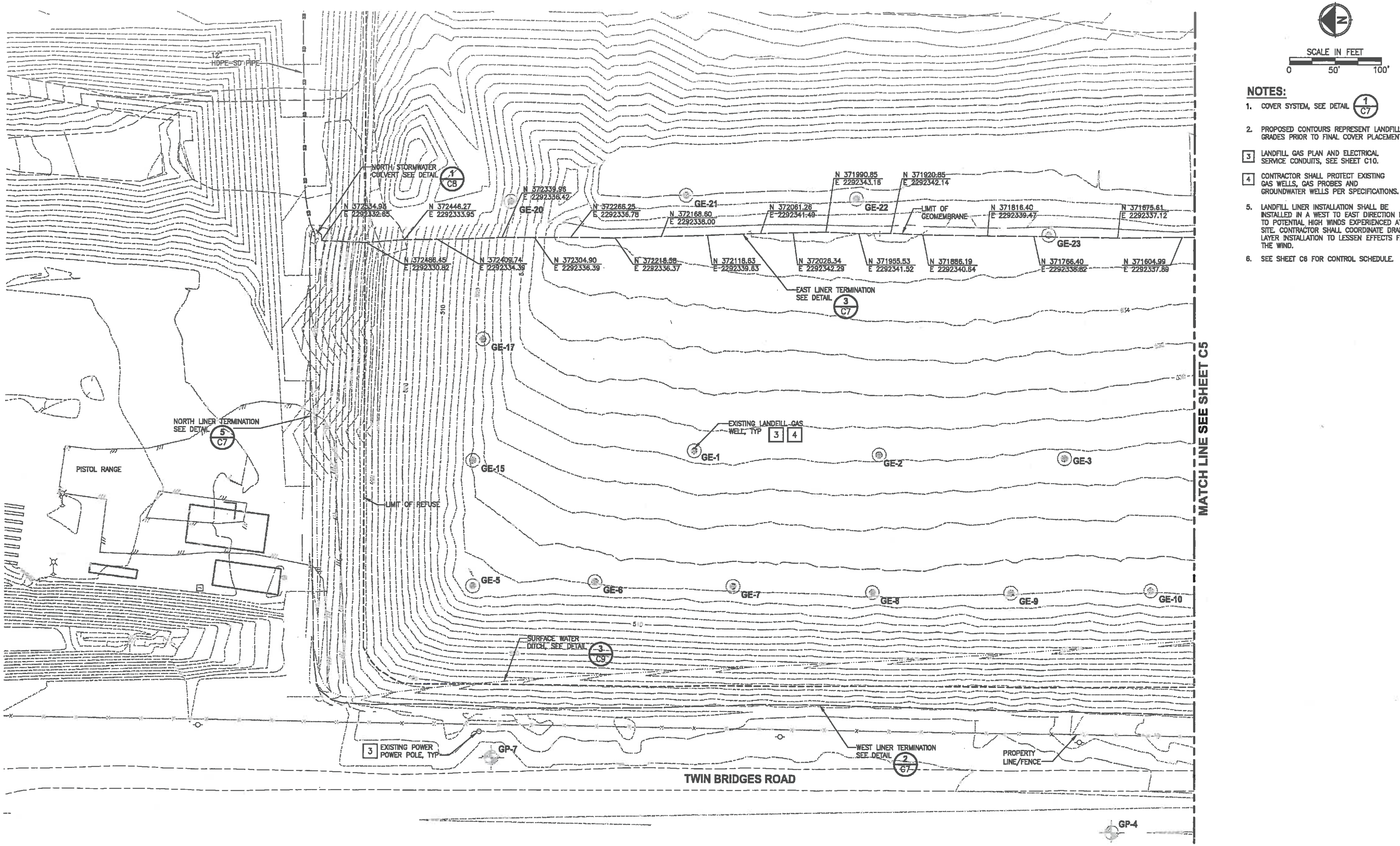
PROJECT NAME
HORN RAPIDS LANDFILL
PHASE 1 CLOSURE PROJECT
CONTRACT No. SB 11-01PW
RICHLAND, WA

PHASE 1
OVERALL SITE PLAN

DRAWING NO.
3 OF 23
C3

DATE: Mar 16, 2012 – 10:20am
PLOTTED BY: alrasste
LAYOUT: C3
IMAGES:
XREF'S: XBL2800003P01T03–TBLK | XBL3920003P01T02BA–OTHERS | Steve Emge seal



NOTES:

1. COVER SYSTEM, SEE DETAIL 1/C7
2. PROPOSED CONTOURS REPRESENT LANDFILL GRADES PRIOR TO FINAL COVER PLACEMENT.
3. LANDFILL GAS PLAN AND ELECTRICAL SERVICE CONDUITS, SEE SHEET C10.
4. CONTRACTOR SHALL PROTECT EXISTING GAS WELLS, GAS PROBES AND GROUNDWATER WELLS PER SPECIFICATIONS.
5. LANDFILL LINER INSTALLATION SHALL BE INSTALLED IN A WEST TO EAST DIRECTION DUE TO POTENTIAL HIGH WINDS EXPERIENCED AT THE SITE. CONTRACTOR SHALL COORDINATE DRAINAGE LAYER INSTALLATION TO LESSEN EFFECTS FROM THE WIND.
6. SEE SHEET C6 FOR CONTROL SCHEDULE.

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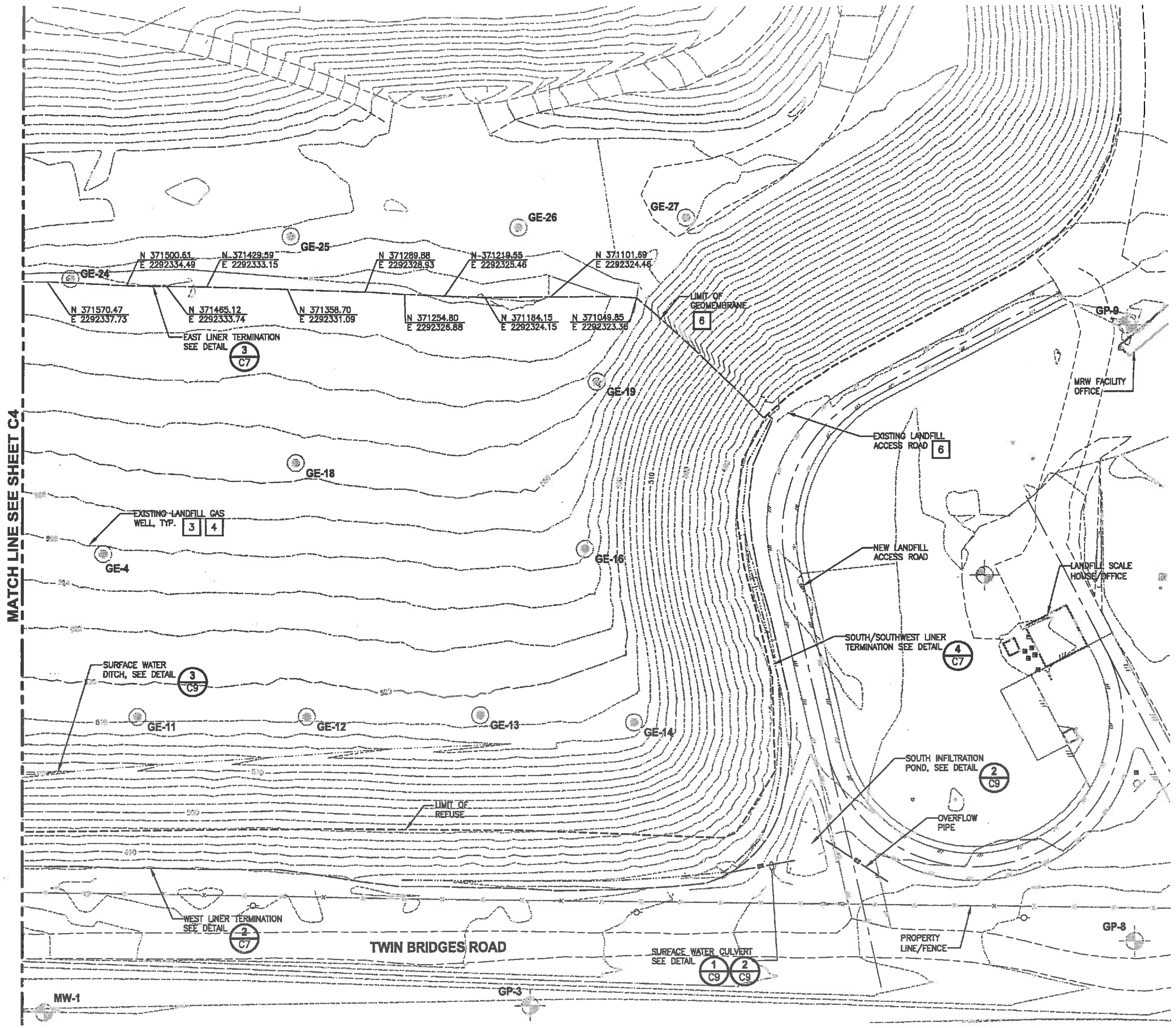
PROJECT NAME
HORN RAPIDS LANDFILL
PHASE 1 CLOSURE PROJECT
CONTRACT No. SB 11-01PW
RICHLAND, WA

PHASE 1
FINAL GRADING PLAN-NORTH

DRAWING NO.
4 OF 23
C4

DATE: Mar 16, 2012 – 10:20am PLOTTED BY: dreeste
IMAGES:
XREF'S: XBL3820003P01T03–TBLK | XBL3820003P01T02BA–OTHERS | XBL–NEWROADPOND | Steve Emge seal



N

SCALE IN FEET

0 50' 100'

NOTES:

1. COVER SYSTEM, SEE DETAIL 1/C7
2. PROPOSED CONTOURS REPRESENT LANDFILL GRADES PRIOR TO FINAL COVER PLACEMENT.
3. LANDFILL GAS PLAN AND ELECTRICAL SERVICE CONDUITS, SEE SHEET C10.
4. CONTRACTOR SHALL PROTECT EXISTING GAS WELLS, GAS PROBES AND GROUNDWATER WELLS PER SPECIFICATIONS.
5. LANDFILL LINER INSTALLATION SHALL BE INSTALLED IN A WEST TO EAST DIRECTION DUE TO POTENTIAL HIGH WINDS EXPERIENCED AT THE SITE. CONTRACTOR SHALL COORDINATE DRAINAGE LAYER INSTALLATION TO LESSEN EFFECTS FROM THE WIND.
6. THE EXISTING ASPHALT LANDFILL ACCESS ROAD SHALL BE REMOVED WITHIN THE LIMIT OF CONSTRUCTION AS INDICATED BY SHADING, TO THE DEPTH OF ASPHALT AND DISPOSED OF ONSITE IN ACCORDANCE WITH CITY DIRECTIONS. AREA SHALL BE GRADED AS DIRECTED BY THE ENGINEER.
7. SEE SHEET C6 FOR CONTROL SCHEDULE.

DATE: Mar 16, 2012 - 10:20am PLOTTED BY: sireste IMAGES: XREF'S: XBL2820003P01T03-TBLK | XBL3820003P01T02BA-OTHERS | XBL-NEWROADPOND | Steve Emge and

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JOB No. 555-3820-003
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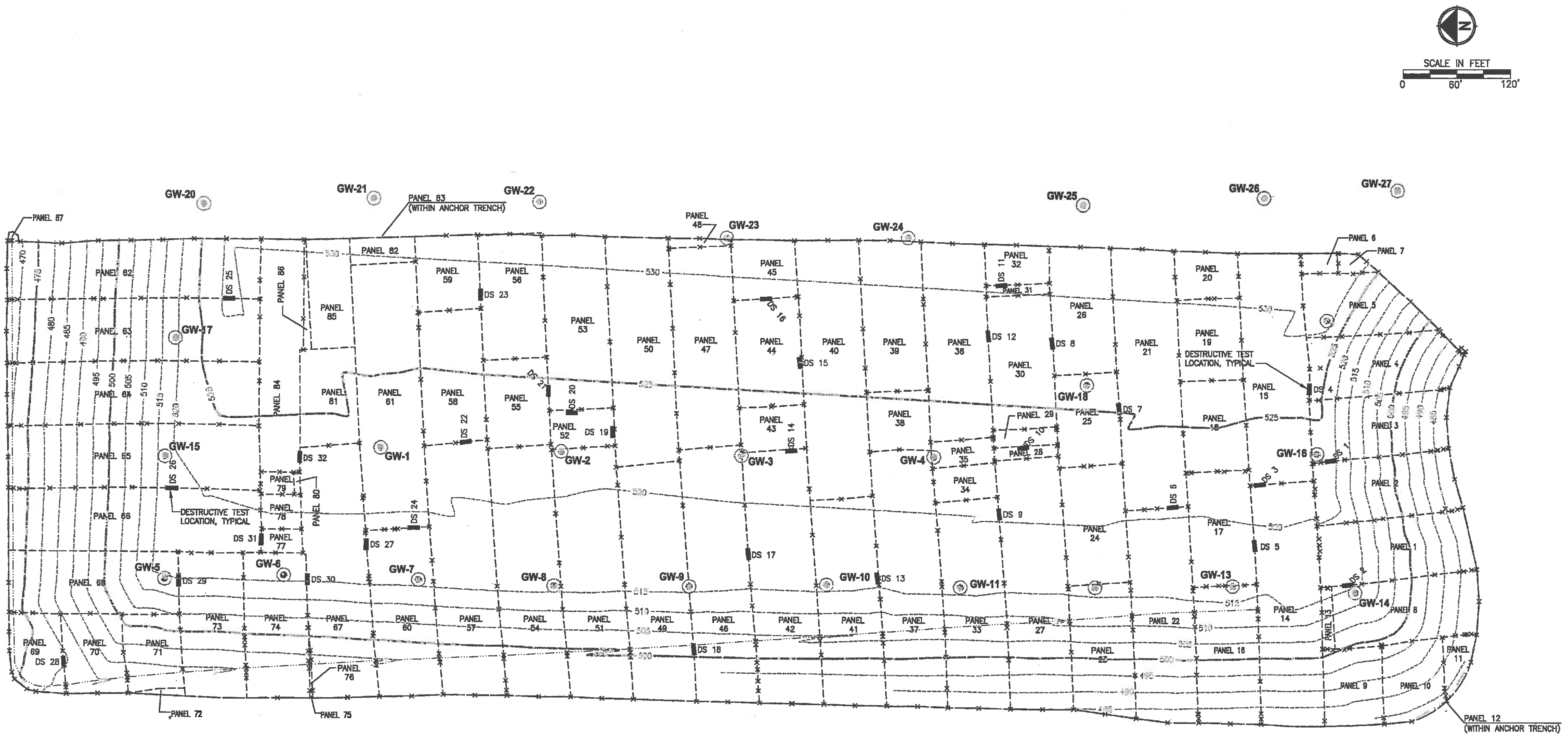
PROJECT NAME
HORN RAPIDS LANDFILL
PHASE 1 CLOSURE PROJECT
CONTRACT No. SB 11-01PW
RICHLAND, WA

PHASE 1
FINAL GRADING PLAN-SOUTH

DRAWING NO.
5 OF 23
C5



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JOB No. 555-3820-003

DATE MARCH 2012

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PROJECT NAME

HORN RAPIDS LANDFILL
PHASE 1 CLOSURE PROJECT
CONTRACT No. SB 11-01PW

RICHLAND, WA

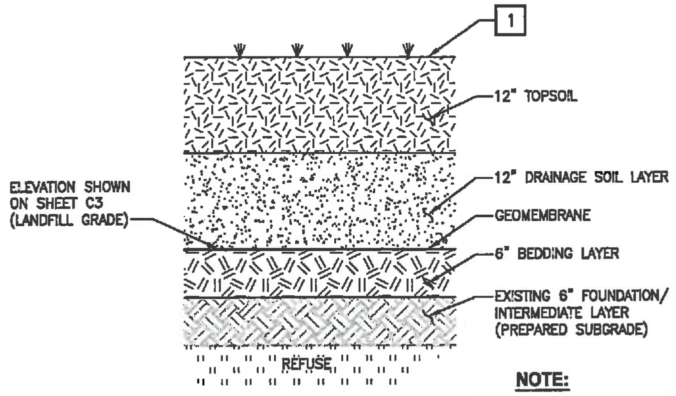
LANDFILL GEOMEMBRANE LAYOUT

DRAWING NO.
6 OF 23

C6

IMAGES:
XREFS: XBL3820003P01T03-TBLK | XBL-Liner-Pond Asbuilt-pmx | XBL3820003P01T03BA-OTHERS | Steve Emge seal

DATE: Mar 16, 2012 – 10:21am LAYOUT: C6
PLOTTED BY: alreaste

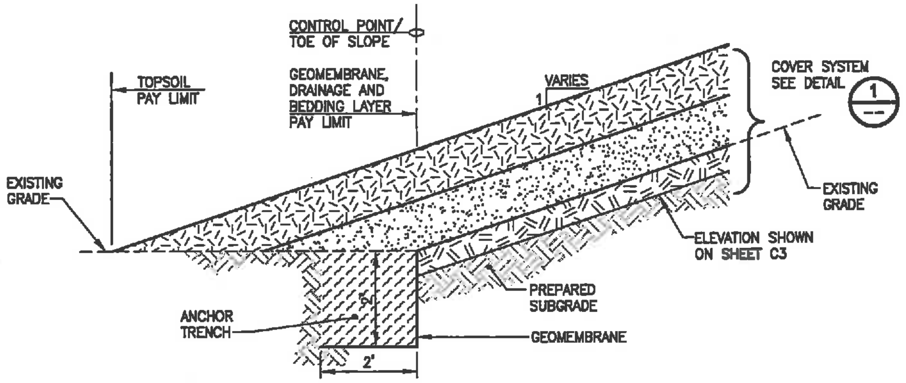


NOTE:

1 HYDRO SEEDING AND IRRIGATION (NIC) TO BE PERFORMED BY OWNER.

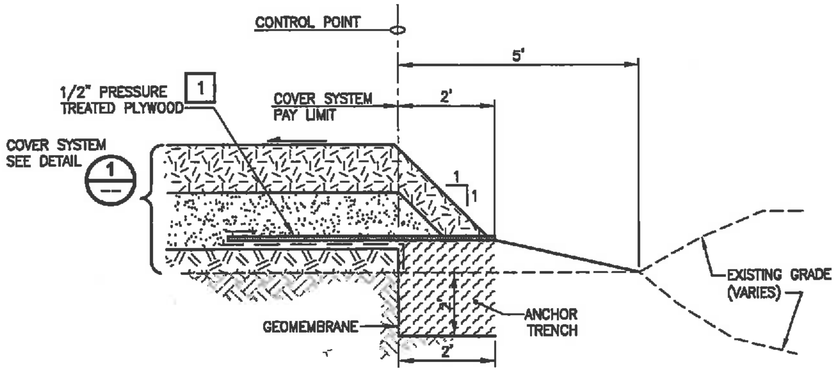
FINAL COVER SYSTEM
DETAIL 1

NO SCALE C3,C4,C5,C7,C8,C9,C11,C12



WEST LINER TERMINATION
BETWEEN POINTS 129 TO 140
DETAIL 2

NO SCALE C3,C4

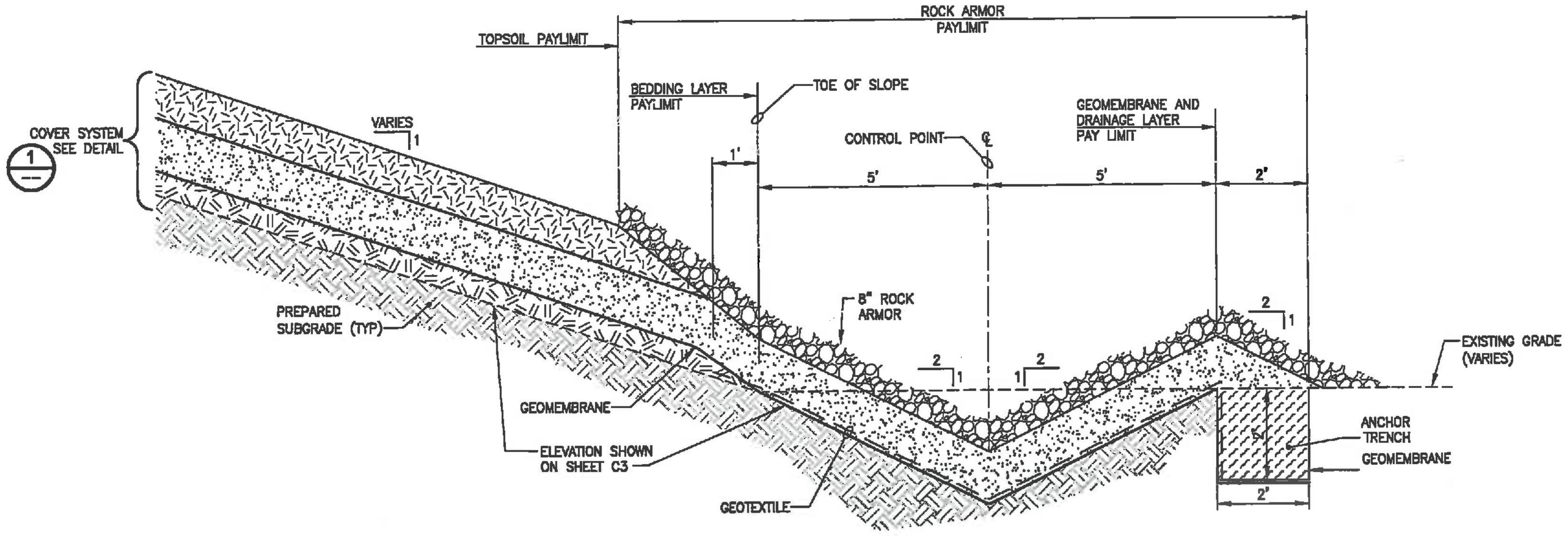


NOTE:

1 PLYWOOD SHALL LAY CONTINUOUSLY ALONG EDGE. PLYWOOD SHALL EXTEND 2' MINIMUM PAST EDGE OF LINER. PROVIDE GEOTEXTILE BETWEEN PLYWOOD AND GEOMEMBRANE. GEOTEXTILE SHALL OVERLAP ONTO PLYWOOD 1-FOOT ALONG WEST EDGE.

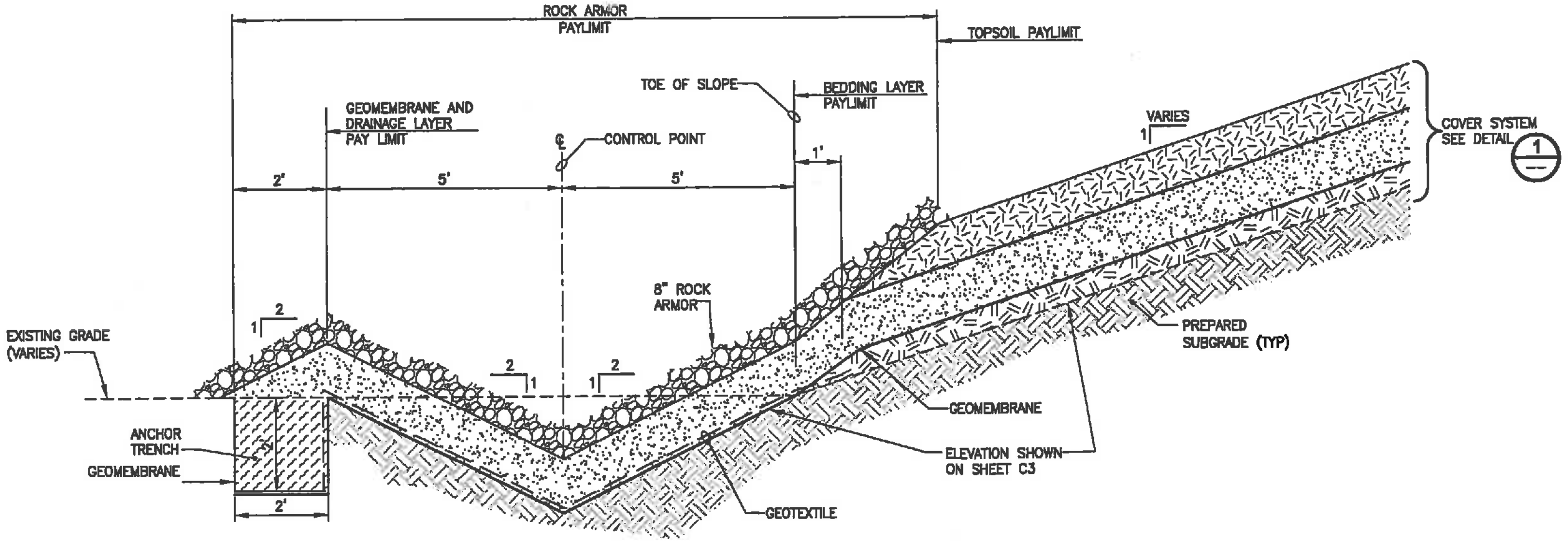
EAST LINER TERMINATION
BETWEEN POINTS 102 TO 111
DETAIL 3

NO. SCALE C4,C5,C12



SOUTH/SOUTHWEST LINER TERMINATION
BETWEEN POINTS 501 TO 514
DETAIL 4

NO SCALE C3,C4



NORTH LINER TERMINATION
BETWEEN POINTS 521 TO 525
DETAIL 5

NO SCALE C3,C4

IMAGES:
XREF'S: XBL2800003P01T03-TBLK | Steve Emge seal

DATE: Mar 16, 2012 - 10:21am
PLOTTED BY: siressa LAYOUT: C7

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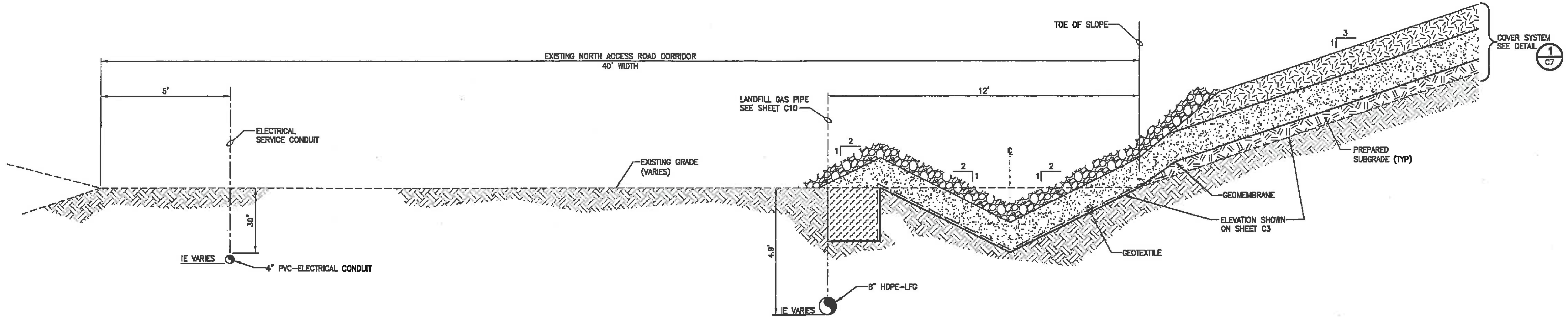
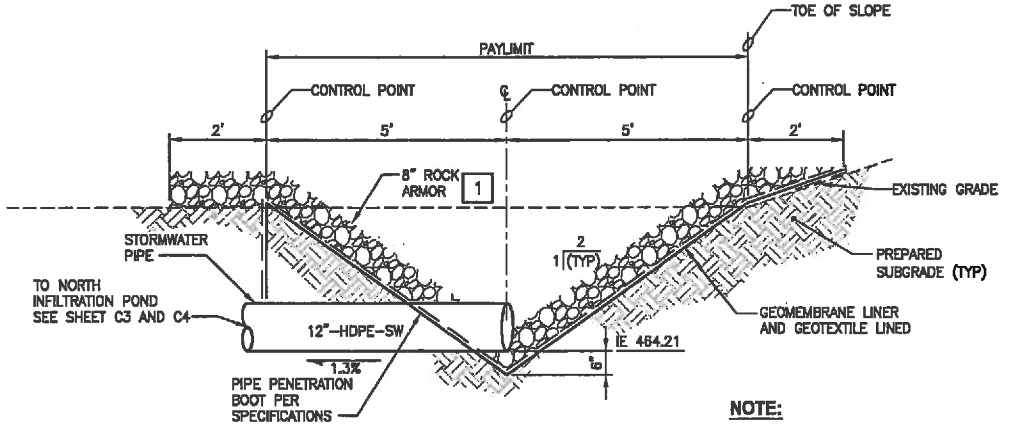
PROJECT NAME
HORN RAPIDS LANDFILL
PHASE 1 CLOSURE PROJECT
CONTRACT No. SB 11-01PW
RICHLAND, WA

DETAILS

DRAWING NO.
7 OF 23
C7



NORTH ACCESS ROAD CORRIDOR
BETWEEN POINTS 523 TO 525
DETAIL A C3,C4
NO SCALE



NOTE:

1 DRAINAGE LAYER SHALL BE OMITTED 5 FEET WITHIN CULVERT PIPE.

NORTH STORM WATER CULVERT
AT POINT 525
DETAIL 1 C3,C4
NO SCALE

DATE: Mar 16, 2012 – 10:21am LAYOUT: C8
PLOTTED BY: slreaste

IMAGES:
XREF'S: XBL2800003P01T03–TBLK | Steve Emge seal

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				CADD CHECKED
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DATE MARCH 2012

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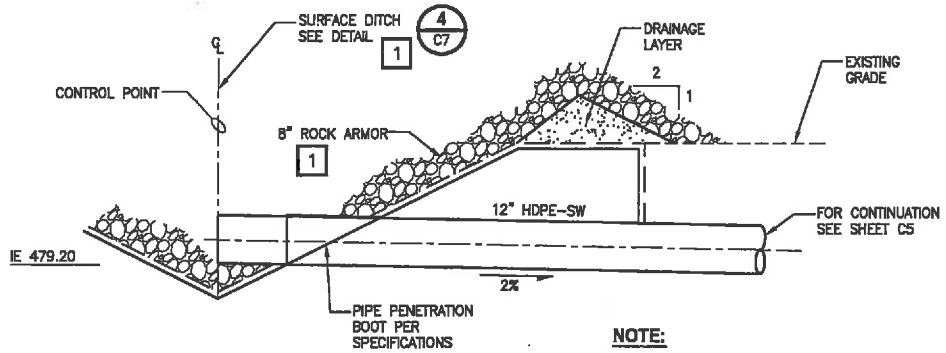
PROJECT NAME
HORN RAPIDS LANDFILL
PHASE 1 CLOSURE PROJECT
CONTRACT No. SB 11-01PW
RICHLAND, WA

DETAILS

DRAWING NO.
8 OF 23
C8



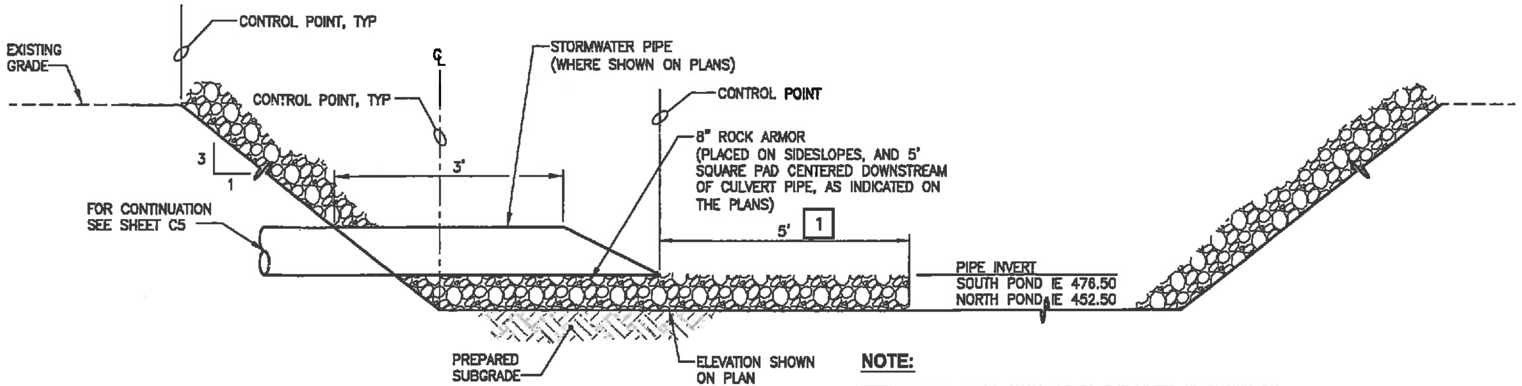
NOTE:

1 DRAINAGE LAYER SHALL BE OMITTED 5 FEET WITHIN CULVERT PIPE.

SOUTH SURFACE WATER CULVERT AT POINT 510

DETAIL 1 C5

NO SCALE



NOTE:

1 ROCK ARMOR SHALL BE TO THE LIMITS AS SHOWN ON THE PLANS, OR AS DIRECTED BY ENGINEER. POND BOTTOM SHALL NOT BE COVERED WITH ROCK ARMOR EXPECT REQUIRED AT PIPE DISCHARGE.

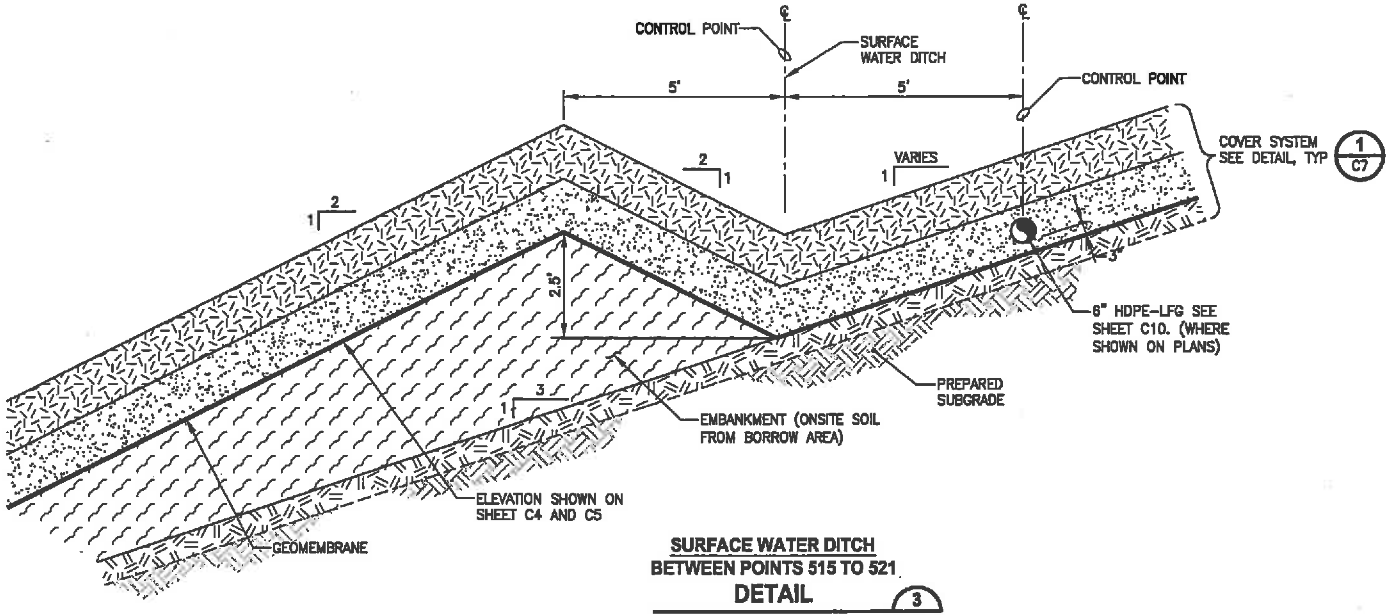
2. FOR THE SOUTH POND, THE AREA BETWEEN THE POND AND DITCH AS SHOWN ON THE PLANS, AS DIRECTED BY THE ENGINEER, SHALL BE COVERED WITH ROCK ARMOR.

3. SOUTH POND WAS OVER EXCAVATED TO REMOVE SILT MATERIAL. APPROXIMATLEY 4 FEET OF SILT MATERIAL WAS REMOVED TO EXPOSE EXISTING SAND AND REPLACED WITH SAND.

INFILTRATION POND COVER SYSTEM

DETAIL 2 C3,C5

NO SCALE



SURFACE WATER DITCH BETWEEN POINTS 515 TO 521

DETAIL 3 C4,C5,C8

NO SCALE

DATE: Mar 16, 2012 - 10:21am LAYOUT: C9
PLOTTED BY: siressta

IMAGES:
XREFS: XBL2800003P01T03-TBLK | Steve Emge seal

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				CHECKED
				APPROVED

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STEPHEN M. EMGE
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PROJECT NAME
HORN RAPIDS LANDFILL
PHASE 1 CLOSURE PROJECT
CONTRACT No. SB 11-01PW
RICHLAND, WA

DETAILS

DRAWING NO.
9 OF 23
C9

DATE: Mar 16, 2012 - 10:22am LAYOUT: C10
PLOTTED BY: siresste

IMAGES:
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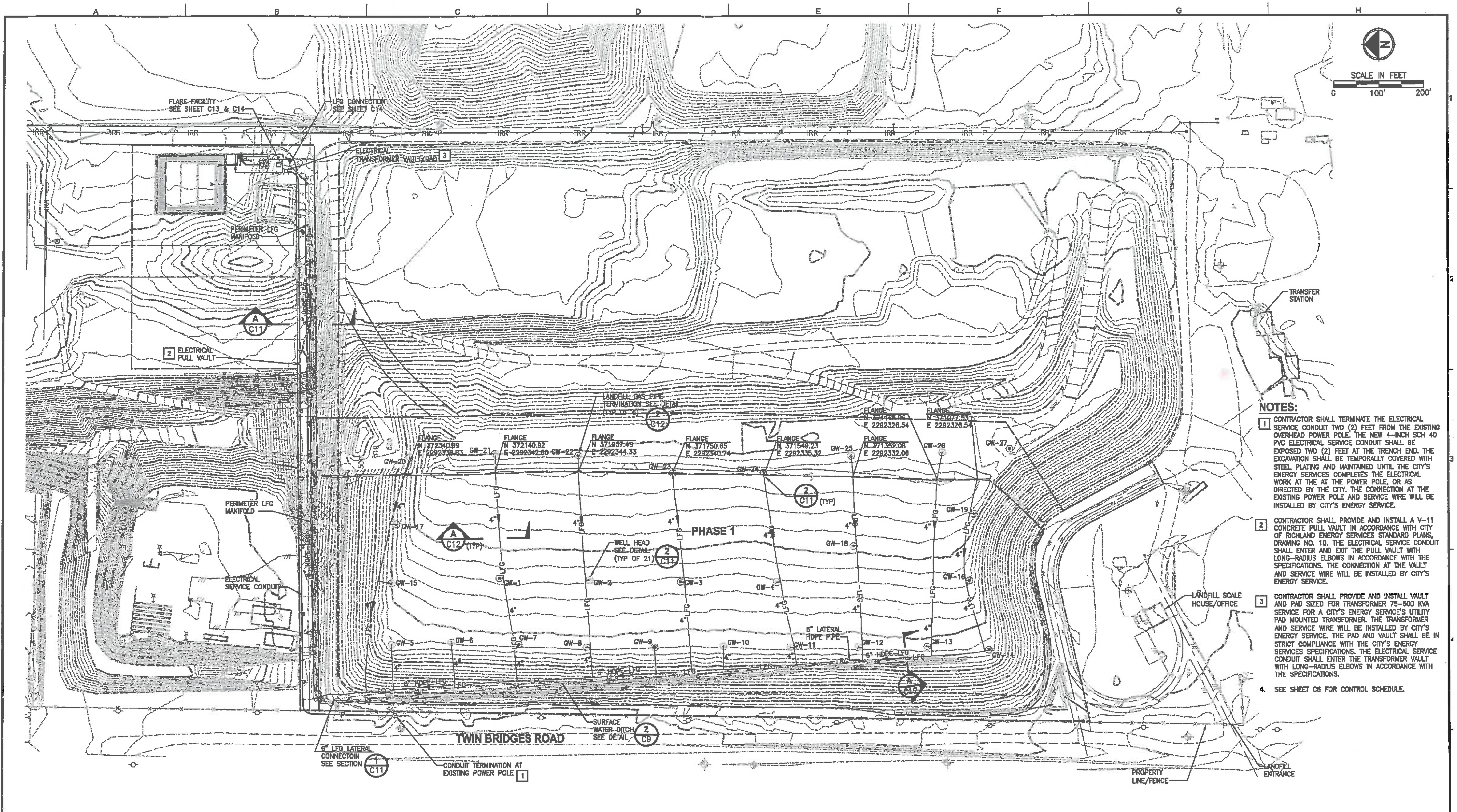

NOTES:

1. CONTRACTOR SHALL TERMINATE THE ELECTRICAL SERVICE CONDUIT TWO (2) FEET FROM THE EXISTING OVERHEAD POWER POLE. THE NEW 4-INCH SCH 40 PVC ELECTRICAL SERVICE CONDUIT SHALL BE EXPOSED TWO (2) FEET AT THE TRENCH END. THE EXCAVATION SHALL BE TEMPORALLY COVERED WITH STEEL PLATING AND MAINTAINED UNTIL THE CITY'S ENERGY SERVICES COMPLETES THE ELECTRICAL WORK AT THE AT THE POWER POLE, OR AS DIRECTED BY THE CITY. THE CONNECTION AT THE EXISTING POWER POLE AND SERVICE WIRE WILL BE INSTALLED BY CITY'S ENERGY SERVICE.

2. CONTRACTOR SHALL PROVIDE AND INSTALL A V-11 CONCRETE PULL VAULT IN ACCORDANCE WITH CITY OF RICHLAND ENERGY SERVICES STANDARD PLANS, DRAWING NO. 10. THE ELECTRICAL SERVICE CONDUIT SHALL ENTER AND EXIT THE PULL VAULT WITH LONG-RADIUS ELBOWS IN ACCORDANCE WITH THE SPECIFICATIONS. THE CONNECTION AT THE VAULT AND SERVICE WIRE WILL BE INSTALLED BY CITY'S ENERGY SERVICE.

3. CONTRACTOR SHALL PROVIDE AND INSTALL VAULT AND PAD SIZED FOR TRANSFORMER 75-500 KVA SERVICE FOR A CITY'S ENERGY SERVICE'S UTILITY PAD MOUNTED TRANSFORMER. THE TRANSFORMER AND SERVICE WIRE WILL BE INSTALLED BY CITY'S ENERGY SERVICE. THE PAD AND VAULT SHALL BE IN STRICT COMPLIANCE WITH THE CITY'S ENERGY SERVICES SPECIFICATIONS. THE ELECTRICAL SERVICE CONDUIT SHALL ENTER THE TRANSFORMER VAULT WITH LONG-RADIUS ELBOWS IN ACCORDANCE WITH THE SPECIFICATIONS.

4. SEE SHEET C6 FOR CONTROL SCHEDULE.

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				CADD CHECKED
				CHECKED
				APPROVED

ONE INCH AT FULL SCALE. IF NOT, SCALE ACCORDINGLY
FILE NAME BL3820003P01T03-C10
JOB No. 555-3820-003
DATE MARCH 2012

STEPHEN M. EMGE
34389
3/14/12

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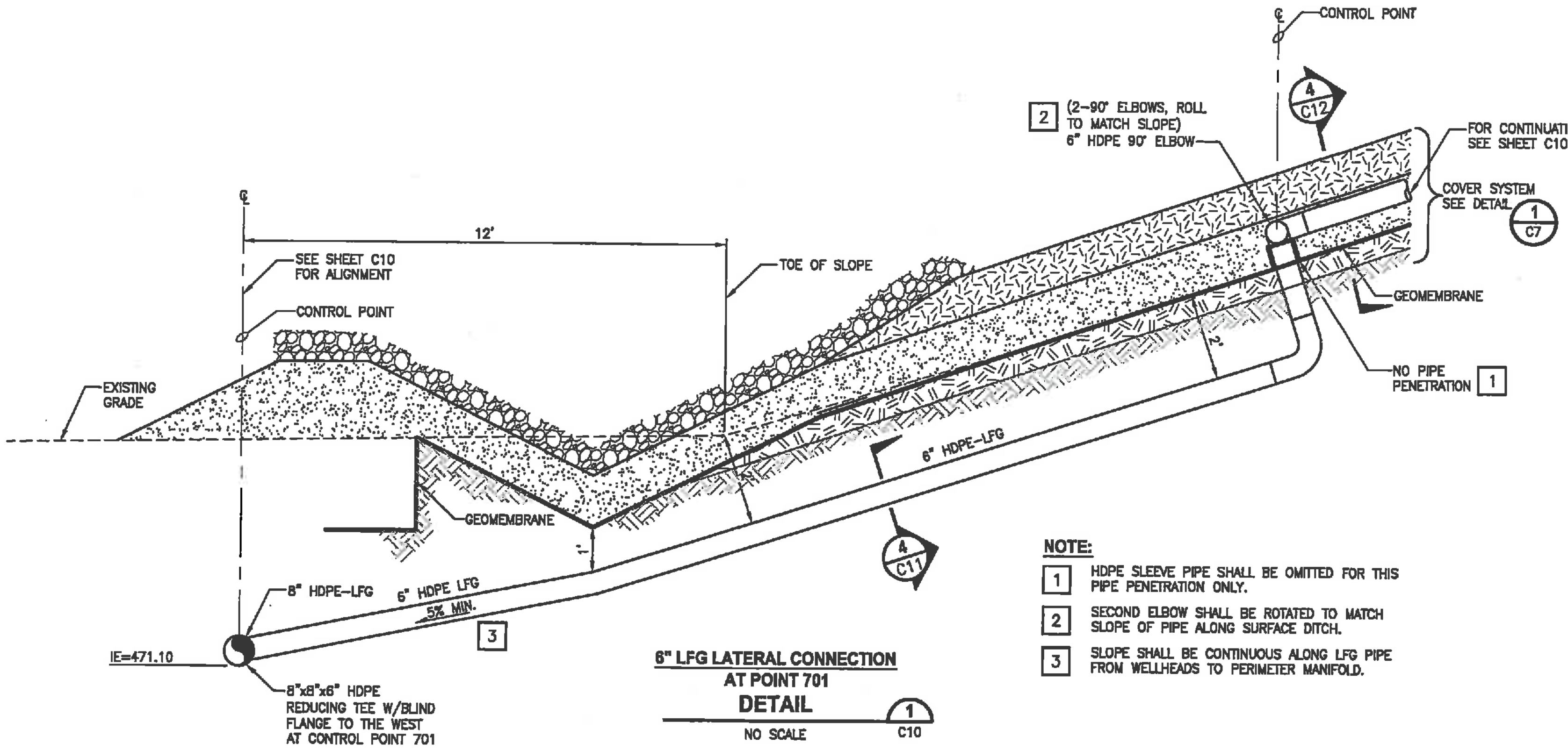
PROJECT NAME
HORN RAPIDS LANDFILL
PHASE 1 CLOSURE PROJECT
CONTRACT No. SB 11-01PW
RICHLAND, WA

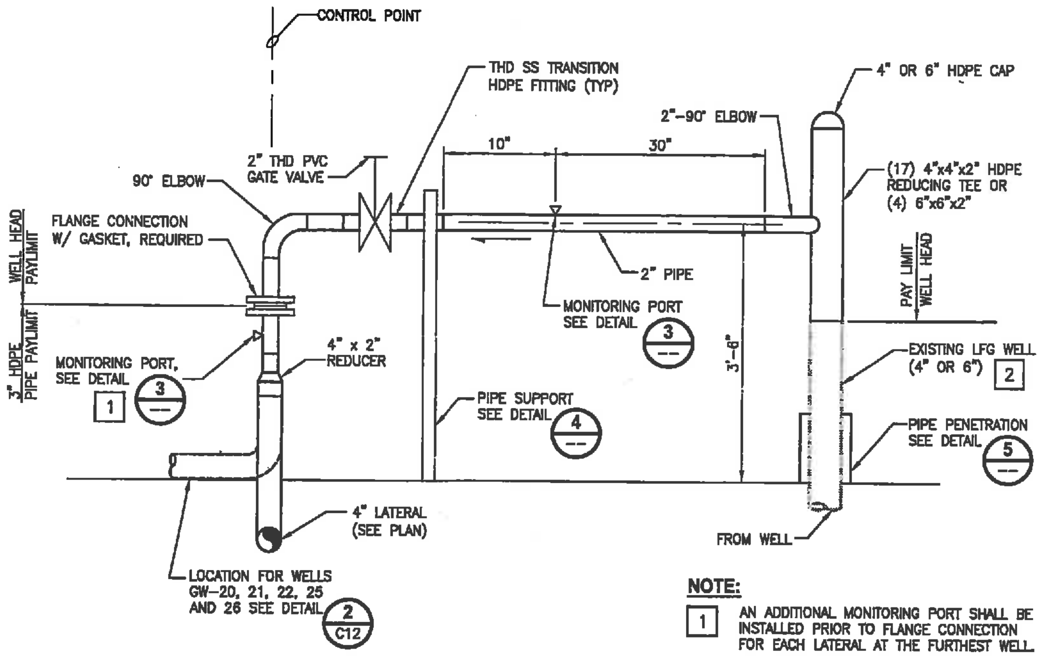
LANDFILL GAS PLAN

DRAWING NO.
10 OF 23
C10



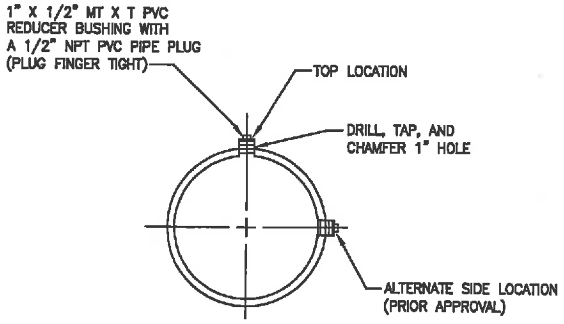
NOTE:
1. HDPE SLEEVE PIPE SHALL BE OMITTED FOR THIS PIPE PENETRATION ONLY.
2. SECOND ELBOW SHALL BE ROTATED TO MATCH SLOPE OF PIPE ALONG SURFACE DITCH.
3. SLOPE SHALL BE CONTINUOUS ALONG LFG PIPE FROM WELLHEADS TO PERIMETER MANIFOLD.

6" LFG LATERAL CONNECTION AT POINT 701
DETAIL 1 C10
NO SCALE

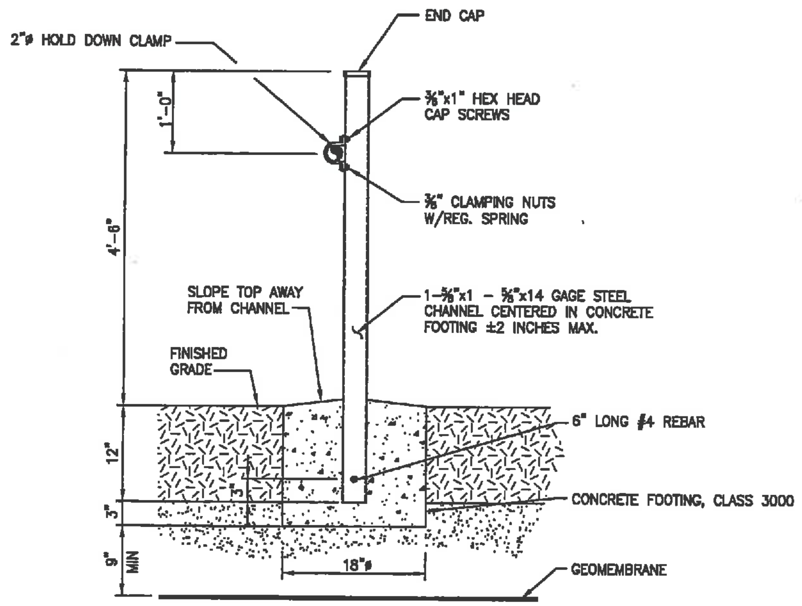


NOTE:
1. AN ADDITIONAL MONITORING PORT SHALL BE INSTALLED PRIOR TO FLANGE CONNECTION FOR EACH LATERAL AT THE FURTHEST WELL.
2. WELLS GW–20, 21, 22, 25 AND 26 REQUIRE EXTENSION PER DETAIL 2 C12

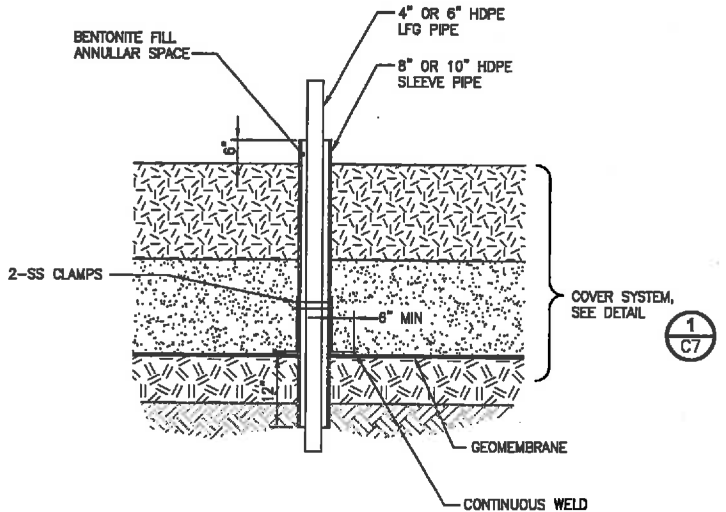
WELLHEAD
DETAIL 2 C10,C12
NO SCALE



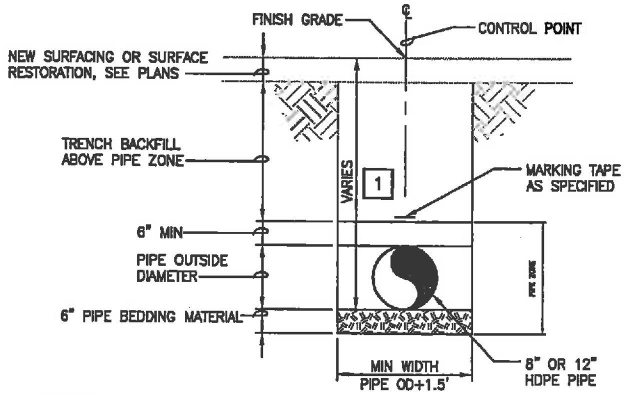
MONITORING PORT
DETAIL 3 C10,C11,C12,C13,C14,C17
NO SCALE



PIPE SUPPORT AT WELL CONNECTION
DETAIL 4 C11
NO SCALE



PASSING PIPE PENETRATION
DETAIL 5 C9, C11
NO SCALE



NOTE:
1. DEPTH OF THE MAIN LFG PIPE VARIES WITH A MINIMUM DEPTH OF 24 INCHES, SEE SHEET C10.
2. SECTION IS NOT APPLICABLE TO THE LFG PIPES WITHIN THE ACTUAL LANDFILL LIMITS.
3. PIPE SLOPE SHALL BE CONTINUOUS ALONG BURIED PIPE FROM THE NORTHWEST CORNER TO THE CONDENSATE MANHOLE WITHIN THE FLARE FACILITY.

BURIED MAIN LANDFILL GAS PIPE TRENCH
SECTION A C9,C10,C15
NO SCALE

IMAGES:
XREFS: XBL2800003P01T03–TBLK | Steve Emge seal

DATE: Mar 16, 2012 – 10:22am LAYOUT: C11
PLOTTED BY: sfreeste

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JOB No. 555–3820–003
DATE MARCH 2012

STEPHEN M. EMGE 34380
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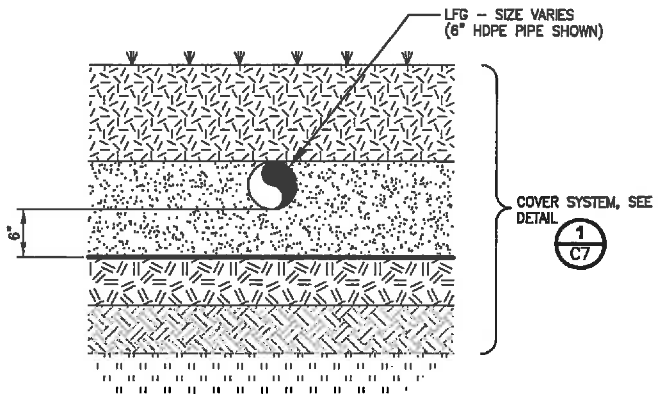
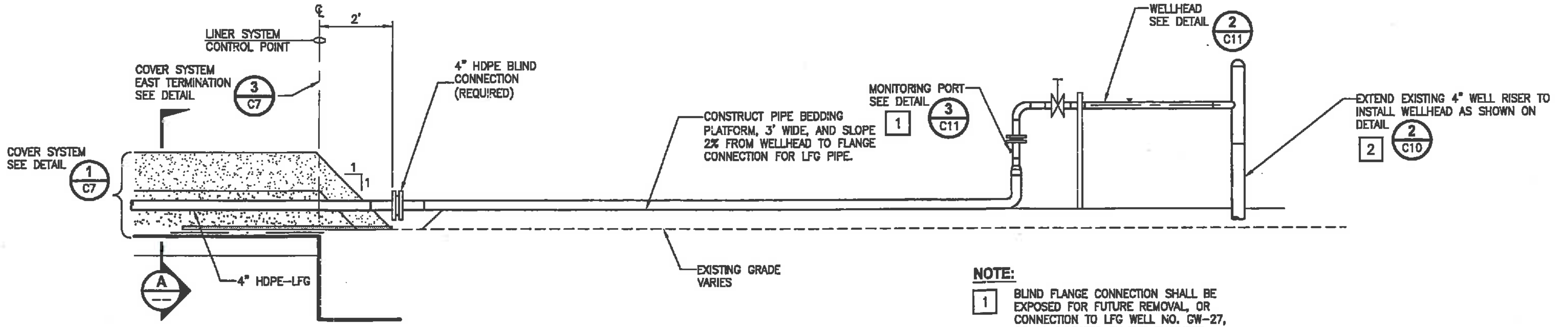
PROJECT NAME
HORN RAPIDS LANDFILL
PHASE 1 CLOSURE PROJECT
CONTRACT No. SB 11-01PW
RICHLAND, WA

DETAILS

DRAWING NO.
11 OF 23
C11



BURIED PIPE
SECTION A
NO SCALE C10,C11,C12



NOTE:

1. BLIND FLANGE CONNECTION SHALL BE EXPOSED FOR FUTURE REMOVAL, OR CONNECTION TO LFG WELL NO. GW-27, OR AS DIRECTED BY THE ENGINEER.
2. EXTENSION PIPE LENGTH SHALL BE INCLUDED IN 4" HDPE PIPE BID ITEM.

3-INCH LANDFILL GAS PIPE TERMINATION
DETAIL 2
NO SCALE C10

DATE: Mar 16, 2012 – 10:22am PLOTTED BY: siresste LAYOUT: C12
IMAGES:
XREF'S: XBL28000003P01T03–TBLK | Steve Emge seal

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JOB No. 555–3820–003
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STEPHEN M. EMGE 34389
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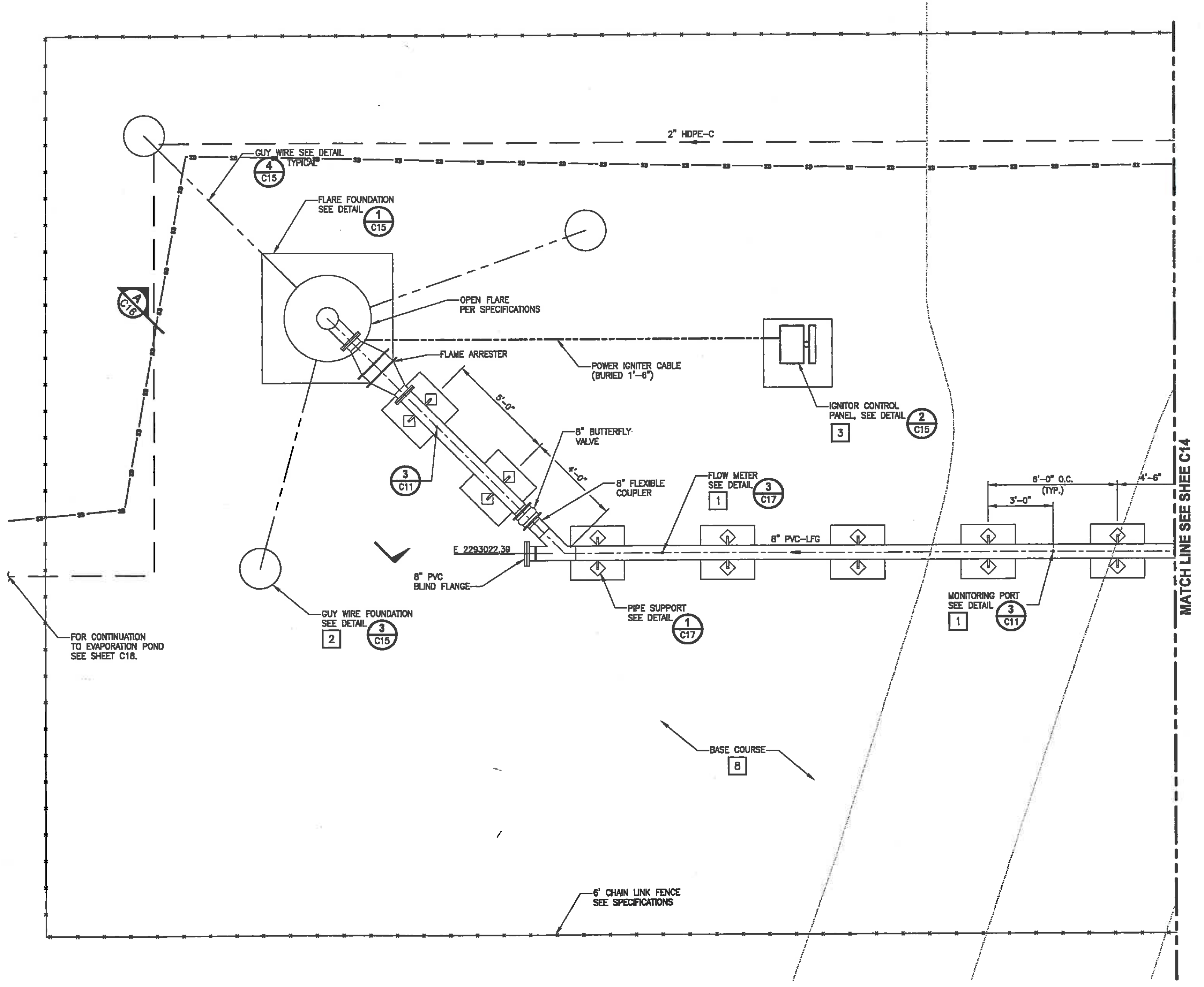
PROJECT NAME
HORN RAPIDS LANDFILL
PHASE 1 CLOSURE PROJECT
CONTRACT No. SB 11-01PW
RICHLAND, WA

DETAILS

DRAWING NO.
12 OF 23
C12



PLAN
3/8" = 1'

NOTES: (SHEETS C13 AND C14)

1. NO FITTINGS SHALL BE WITHIN 80" UPSTREAM OR 24" DOWNSTREAM OF FLOW METER AND/OR MONITORING PORT.
2. SPACE EVENLY, 3 GUY WIRE FOUNDATIONS 12 FEET FROM FLARE FOUNDATION CENTER AND ALIGN DIRECTLY OUT FROM SHROUD LUGS.
3. PANEL FOUNDATION SHALL BE 25 FEET DIRECTLY SOUTH OF FLARE FOUNDATION CENTERLINE.
4. SEE SHEET E1 THROUGH E4 FOR ELECTRICAL.
5. GAS SYSTEM PIPING SHALL BE CONTINUOUS ALONG THE LENGTH OF PIPE, AS SHOWN ON THE PLANS.
6. SEE SPECIFICATIONS ON ELECTRICAL PAD.
7. FIELD VERIFY ACCORDING TO ACTUAL BURNER DIMENSIONS.
8. AREA WITHIN THE FLARE FACILITY AND DIRECTLY SOUTH OF THE WEST AND EAST FENCE LINE TO THE ACCESS ROAD SHALL BE COVERED WITH 4 INCHES OF BASE COURSE MATERIAL PER THE SPECIFICATIONS.

IMAGES:
XREF'S: XBL2B0003P01T03-TBLK | XBL3820003P01T02BA-OTHERS | XBL3820003P01T03-DE-1 | Steve Emge seal

DATE: Mar 16, 2012 - 10:22am
PLOTTED BY: alreeste LAYOUT: C13

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JOB No. 555-3820-003
DATE MARCH 2012

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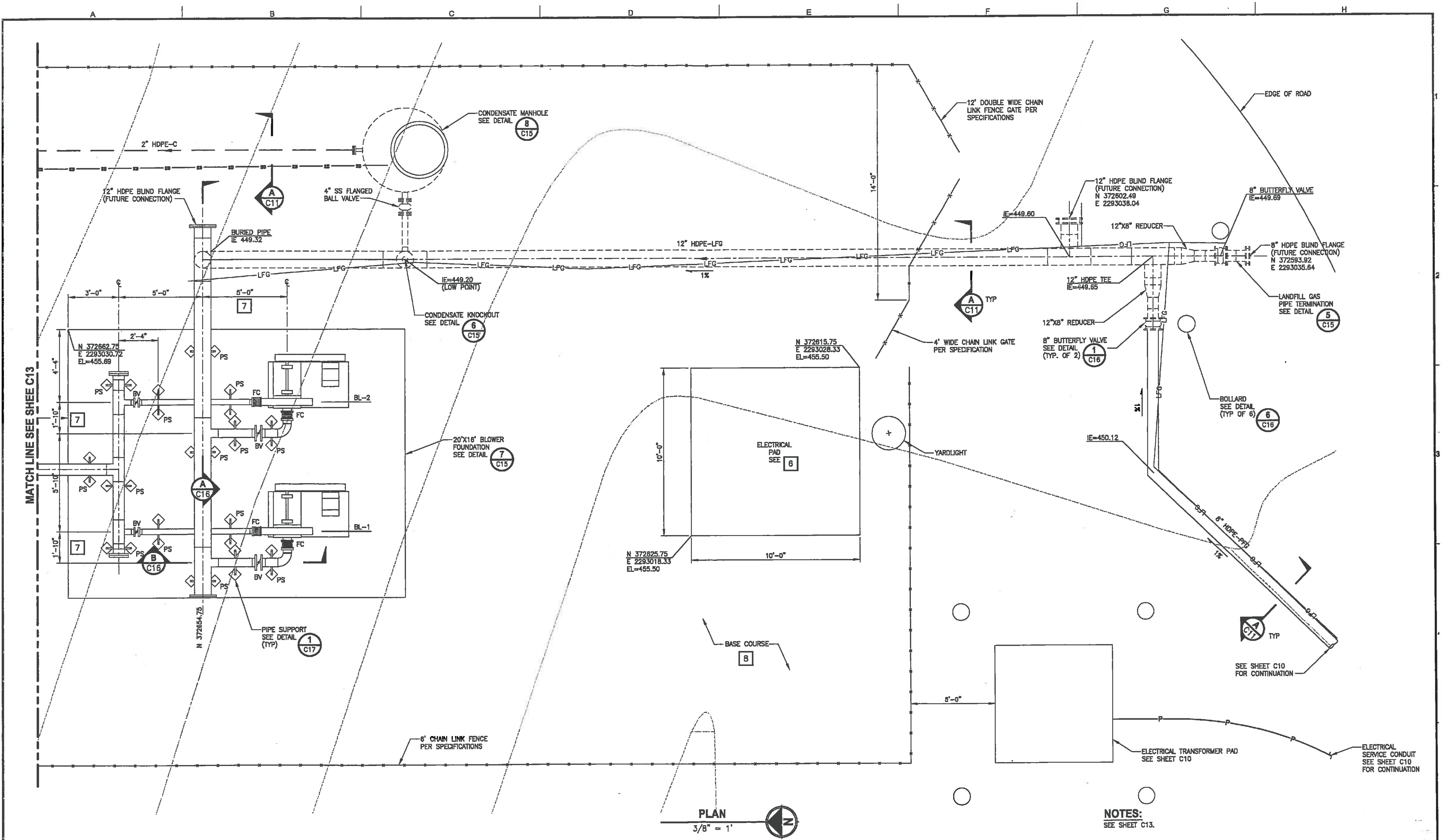
PROJECT NAME
HORN RAPIDS LANDFILL
PHASE 1 CLOSURE PROJECT
CONTRACT No. SB 11-01PW
RICHLAND, WA

FLARE FACILITY PLAN

DRAWING NO.
13 OF 23
C13



PLAN
3/8" = 1'

NOTES:
SEE SHEET C13.

DATE: Mar 16, 2012 - 10:22am LAYOUT: C14
PLOTTED BY: siresste

IMAGES:
XREF'S: XBL2800003P01T03-TBLK | XBL3820003P01T02BA-OTHERS | XBL3820003P01T03-DE-1 | Steve Emge seal

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PHASE 1 CLOSURE PROJECT
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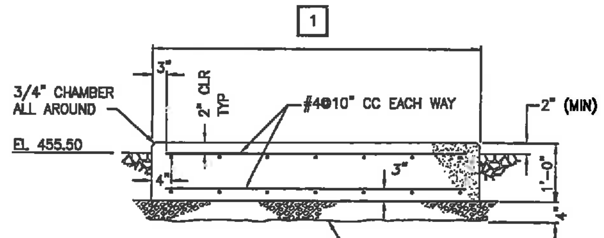
RICHLAND, WA

FLARE FACILITY PLAN

DRAWING NO.
14 OF 23
C14

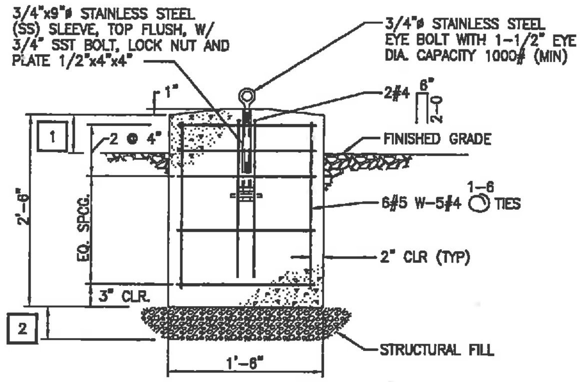


NOTE:

1 FOUNDATION SIZE ACCORDING TO SERVICES AS REFERENCED ON PLANS:

- OPEN FLARE: 6'-0" SQ
- IGNITOR CONTROL PANEL: 2'-0" SQ
- PIPE SUPPORTS: 2'-6" SQ

FLARE / PIPE SUPPORT FOUNDATION
DETAIL 1
SCALE: 3/4"=1'-0" C13,C15,C16,C17

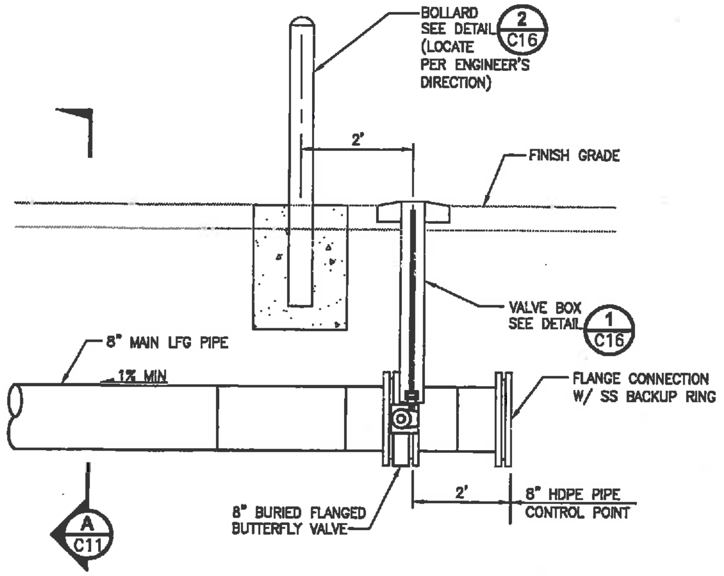


NOTES:

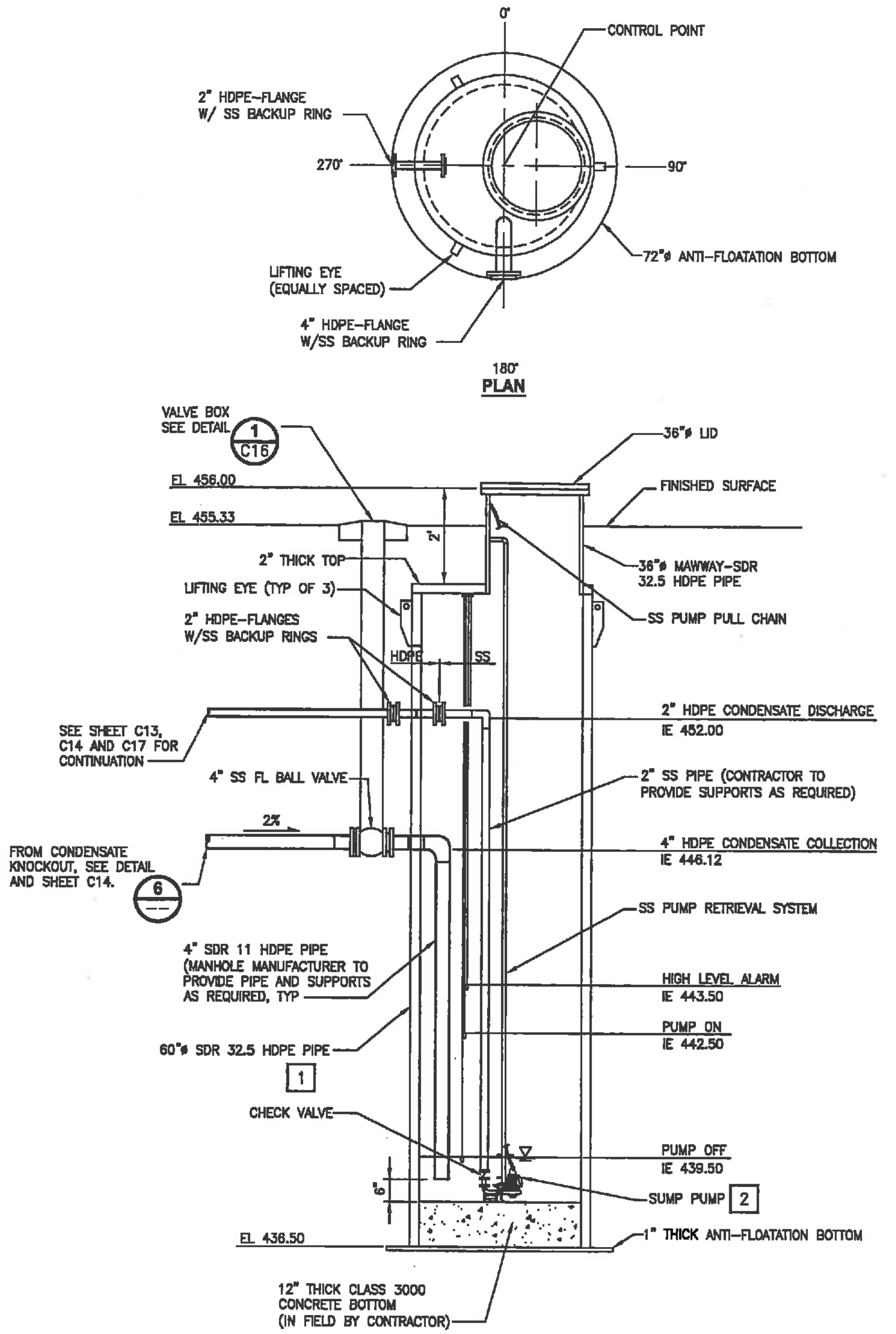
1 DIMENSION VARIES FROM 3" TO 9" DEPENDING ON THE GROUND SURFACE ELEVATION.

2 OVER EXCAVATE 4" AND BACKFILL WITH STRUCTURAL FILL.

GUY WIRE ANCHOR
DETAIL 3
NO SCALE C13,C15



BURIED LANDFILL GAS PIPE TERMINATION
DETAIL 5
NO SCALE C14



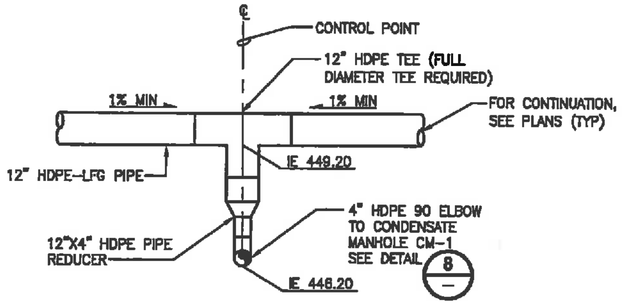
CONDENSATE MANHOLE (CM-1) 3
DETAIL 8
NO SCALE C15

NOTES:

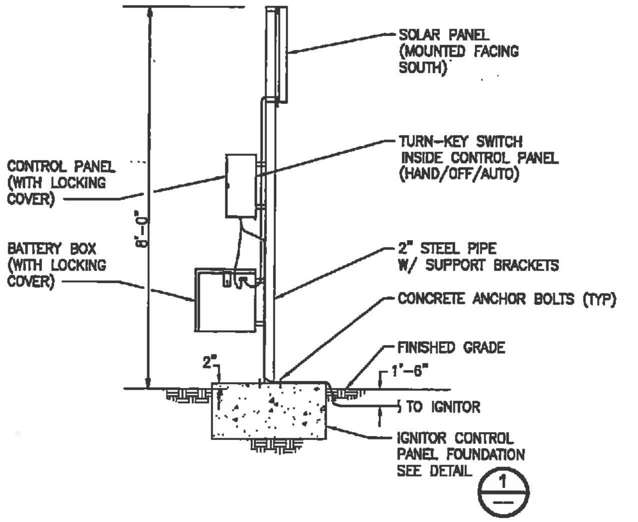
1 THE ENTIRE HDPE CONDENSATE MANHOLE SHALL BE CONSTRUCTED FOR WATER TIGHTNESS.

2 CONDENSATE MANHOLES SHALL BE FILLED WITH WATER 2-FOOT ABOVE THE TOP OF CONCRETE.

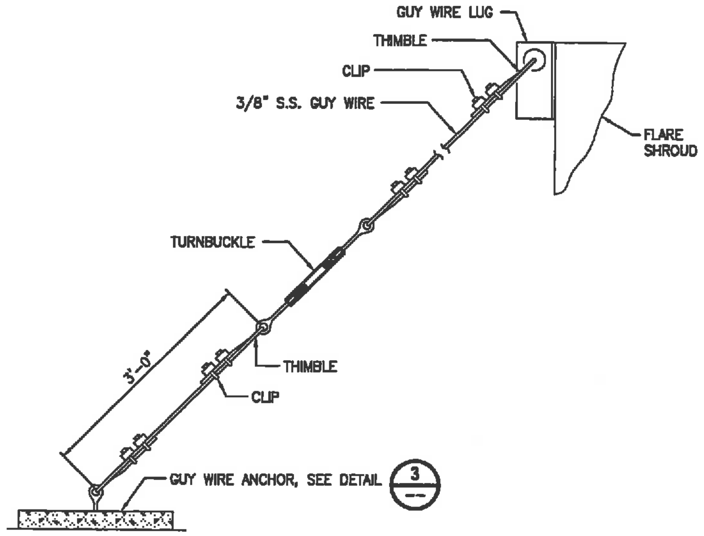
3 CONDENSATE MANHOLE SHALL BE AIR-TESTED AND CERTIFIED BY MANUFACTURER PRIOR TO SHIPMENT.



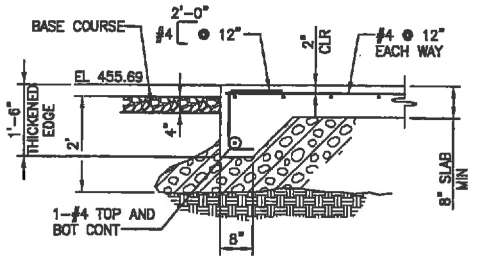
CONDENSATE KNOCKOUT
DETAIL 6
NO SCALE C14,C15



IGNITOR CONTROL PANEL
DETAIL 2
SCALE: 3/4"=1'-0" C13



GUY WIRE
DETAIL 4
NO SCALE C13



BLOWER SLAB
DETAIL 7
NO SCALE C14,C16

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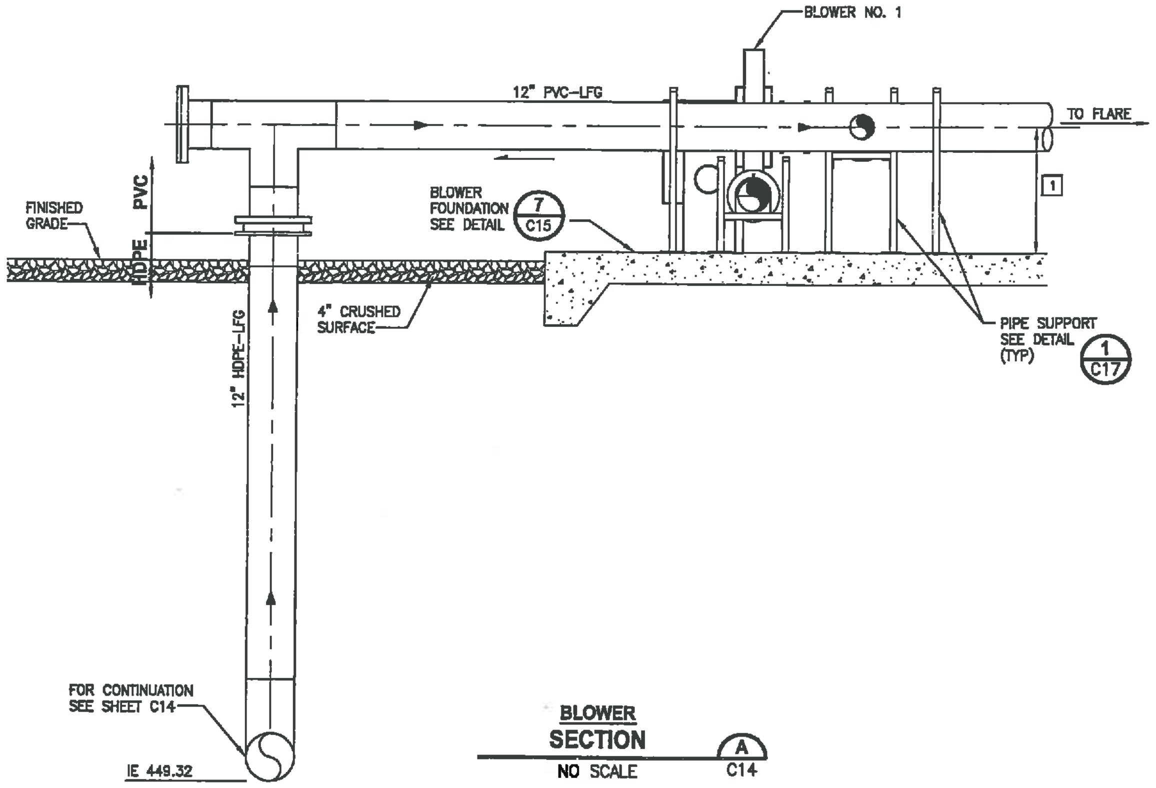
PHASE 1 CLOSURE PROJECT
CONTRACT No. SB 11-01PW
RICHLAND, WA

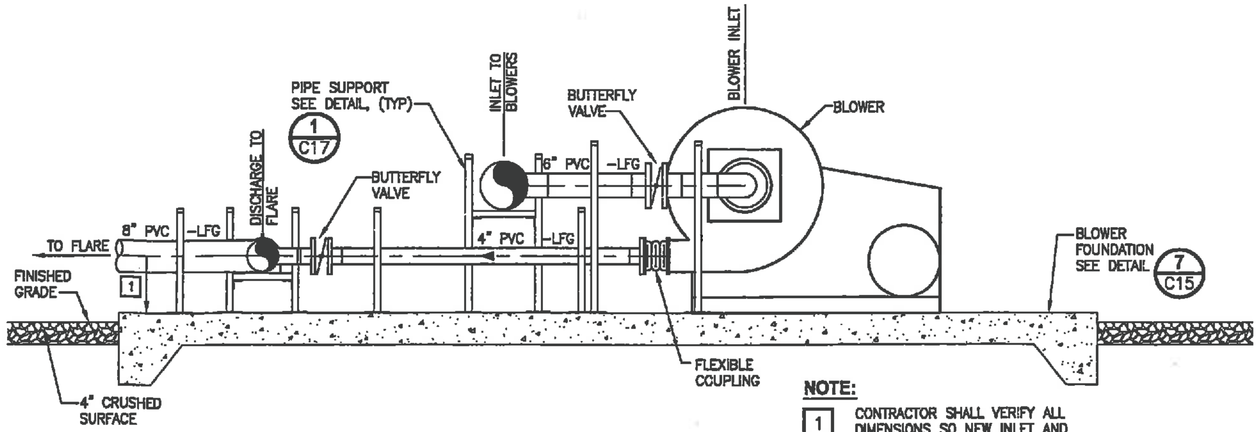
DETAILS

DRAWING NO.
15 OF 23
C15

DATE: Mar 16, 2012 - 10:22am LAYOUT: C15
PLOTTED BY: siressta
IMAGES:
XREFS: XBL3820003P01T03-TBLK | Steve Emge sed



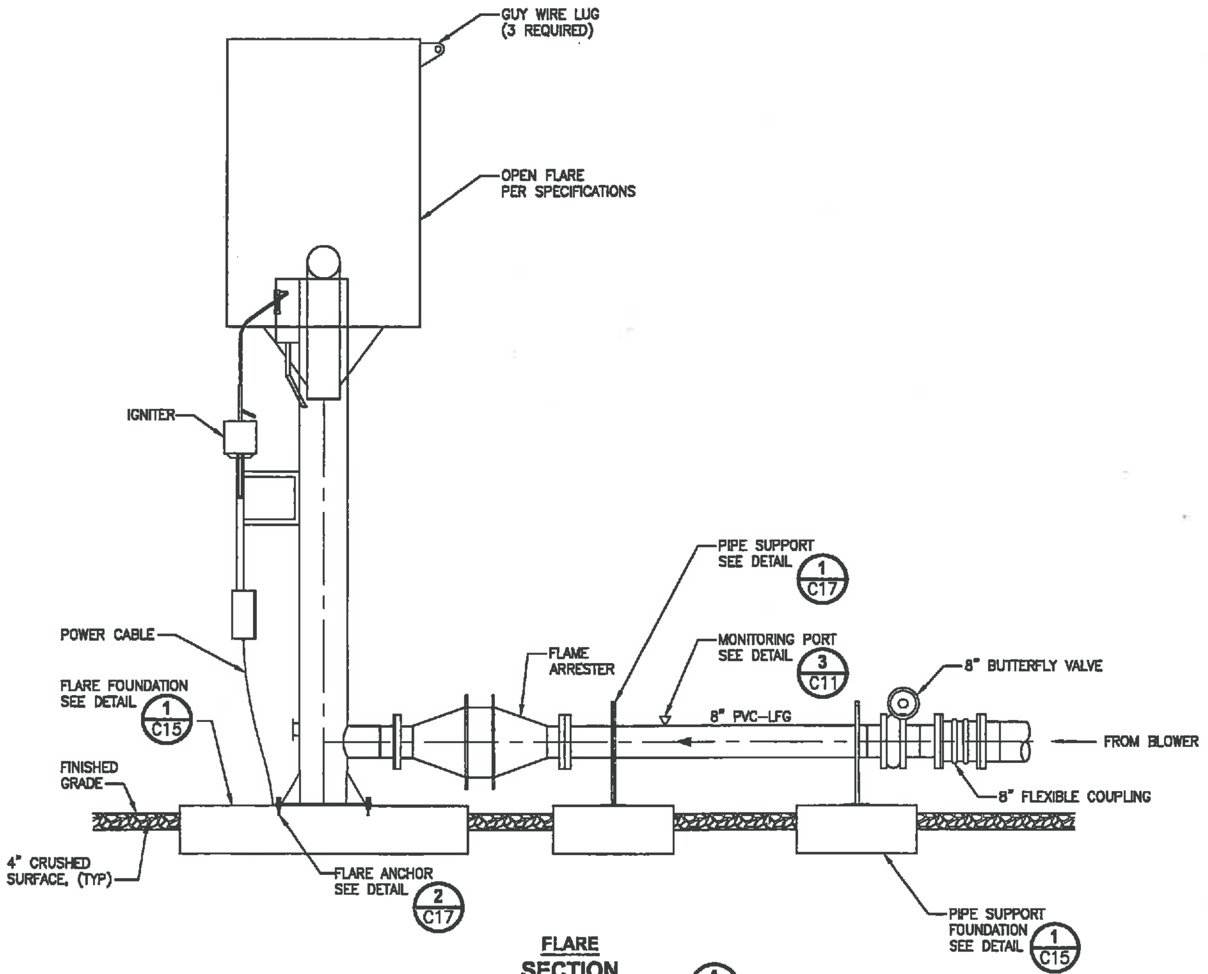
BLOWER
SECTION
NO SCALE A/C14



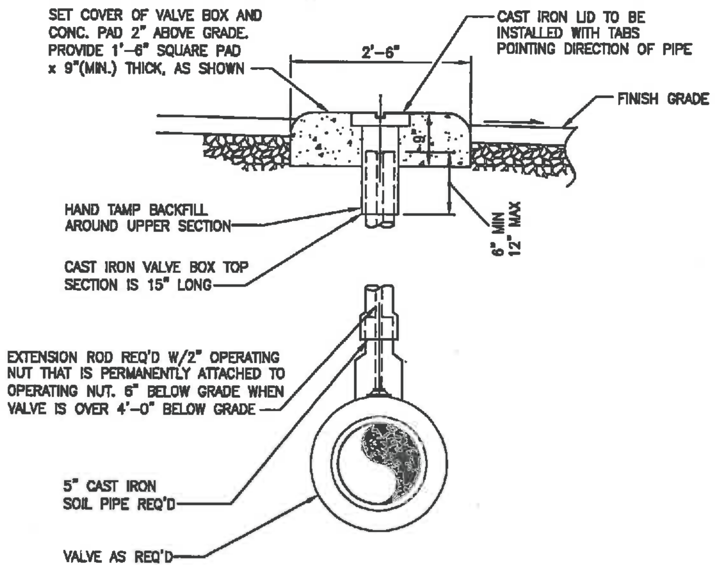
NOTE:

1 CONTRACTOR SHALL VERIFY ALL DIMENSIONS SO NEW INLET AND DISCHARGE BLOWER PIPING IS IN ALIGNMENT WITH BLOWER.

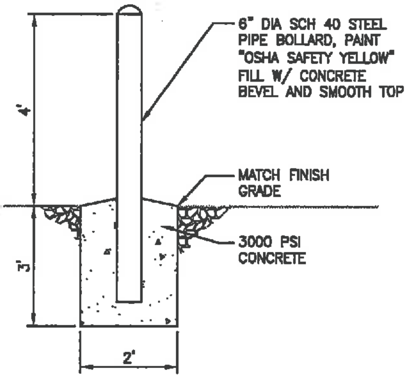
BLOWER
SECTION
NO SCALE B/C14



FLARE
SECTION
NO SCALE A/C13



BURIED VALVE BOX
DETAIL
NO SCALE 1/C15



BOLLARD
DETAIL
NO SCALE 2/C15

STEPHEN M. EMGE 34369

3/16/12

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△	REVISIONS	DATE	BY
	RECORD DRAWINGS	MAR. 2012	S.M.E.

DESIGNED S. EMGE
DRAWN S. SIRES
CADD CHECKED
CHECKED
APPROVED

ONE INCH AT FULL SCALE. IF NOT, SCALE ACCORDINGLY
FILE NAME BL3820003P01T03–C16
JOB No. 555–3820–003
DATE MARCH 2012

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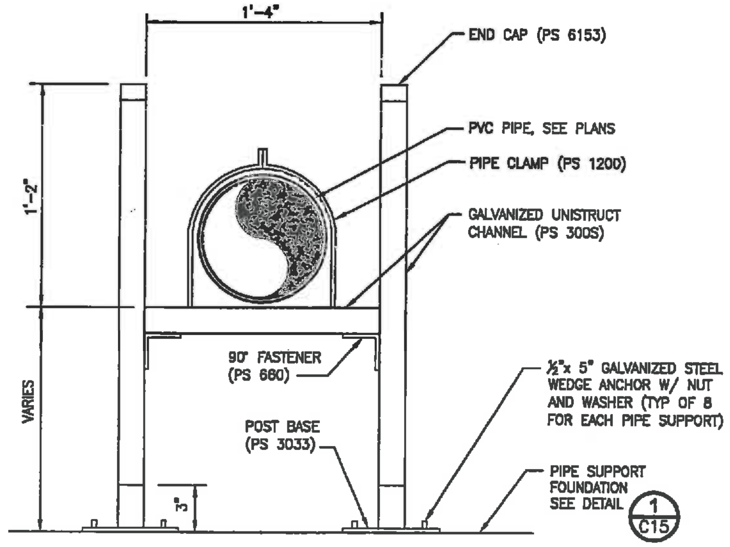
PROJECT NAME
HORN RAPIDS LANDFILL
PHASE 1 CLOSURE PROJECT
CONTRACT No. SB 11-01PW
RICHLAND, WA

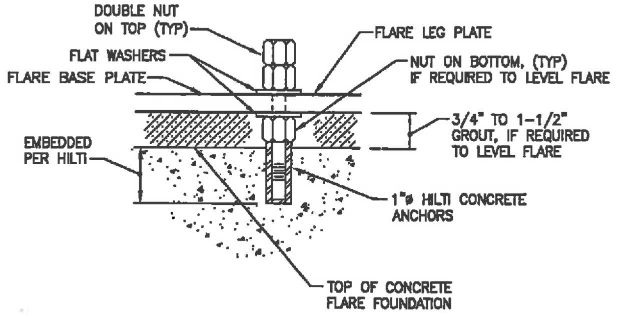
DETAILS

DRAWING NO.
16 OF 23
C16

DATE: Mar 16, 2012 – 10:23am PLOTTED BY: sireaste LAYOUT: C16
IMAGES:
XREF'S: XBL2800003P01T03–TBLK | Steve Emge sed

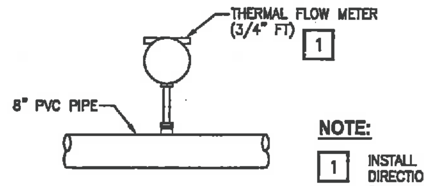


PIPE SUPPORT
DETAIL
NO SCALE
1
C13,C14,C16



NOTE:
GROUT TO BE UNDER FLARE BASE PLATE.

FLARE ANCHOR
DETAIL
NO SCALE
2
C16



NOTE:

1 INSTALL PER MANUFACTURER'S DIRECTIONS FOR SATURATED ENVIRONMENT. DISPLAY SHALL MOUNTED AT ELECTRICAL PAD PER THE ENGINEER.

MONITORING PORT
DETAIL
NO SCALE
3
C13

DATE: Mar 16, 2012 - 10:23am LAYOUT: C17
PLOTTED BY: siressta
IMAGES:
XREF'S: XBL2800003P01T03-TBLK | Steve Emge sed

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JOB No. 555-3820-003
DATE MARCH 2012

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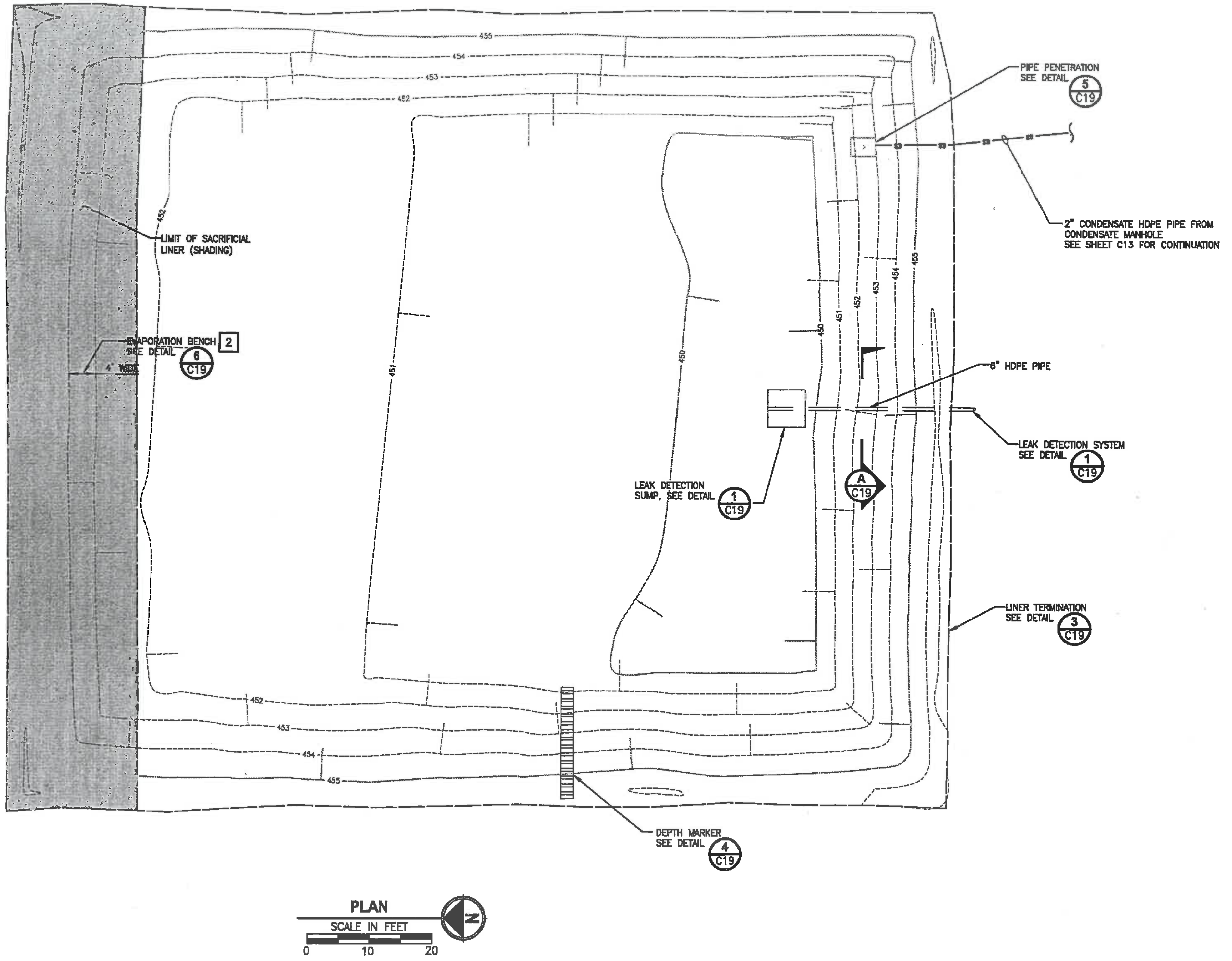
PHASE 1 CLOSURE PROJECT
CONTRACT No. SB 11-01PW
RICHLAND, WA

DETAILS

DRAWING NO.
17 OF 23
C17



PLAN

NOTES:

1. CONDENSATE POND LINER SYSTEM, SEE DETAIL 2/C19
2. BENCH IS ONLY LOCATED ON THE NORTH END OF THE POND FOR FUTURE CONNECTION.

IMAGES:
XREF'S: XBL2800003P01T03-TBLK | XBL3820003P01T02BA-OTHERS | XBL3820003P01T03-DE | Steve Emge seal

DATE: Mar 16, 2012 - 10:23am LAYOUT: C18
PLOTTED BY: siresis

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FILE NAME BL3820003P01T03-C18
JOB No. 555-3820-003
DATE MARCH 2012

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PROJECT NAME
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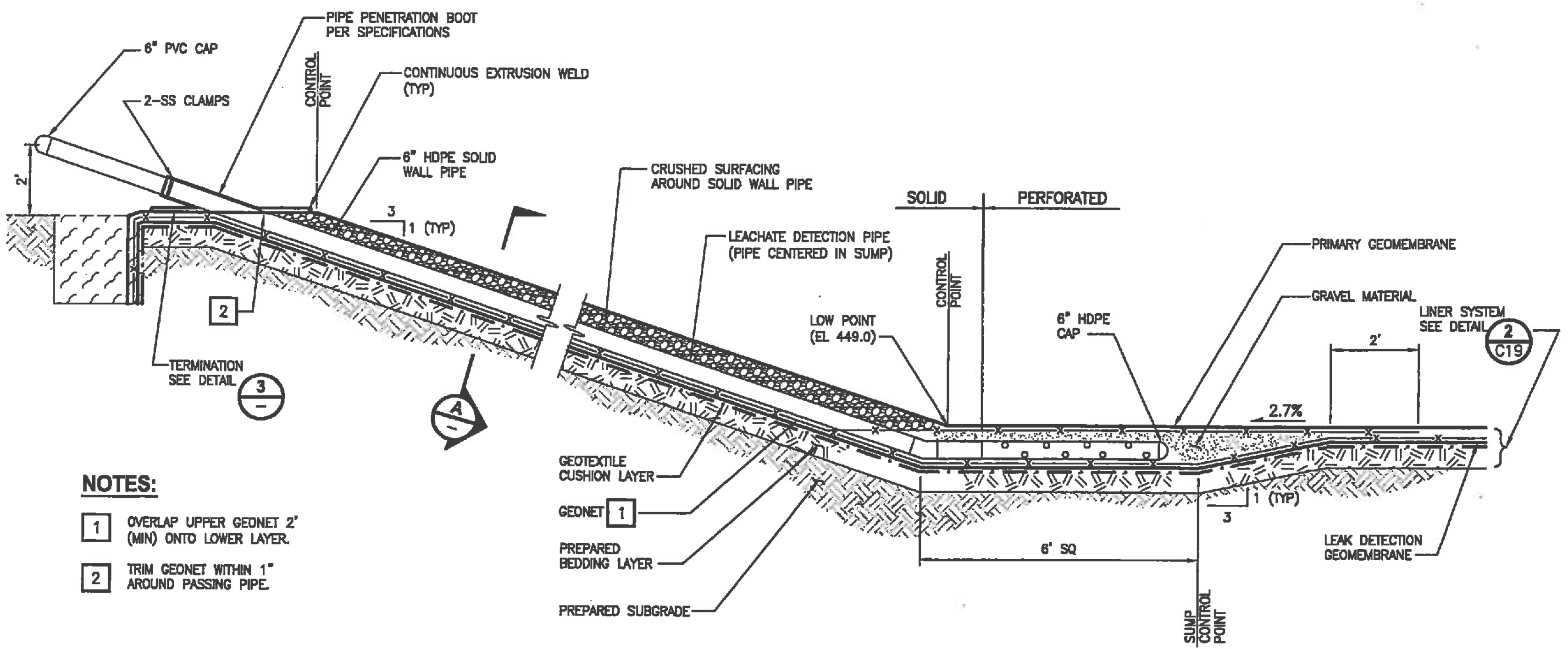
PHASE 1 CLOSURE PROJECT
CONTRACT No. SB 11-01PW
RICHLAND, WA

CONDENSATE EVAPORATION POND PLAN

DRAWING NO.
18 OF 23
C18



NOTES:

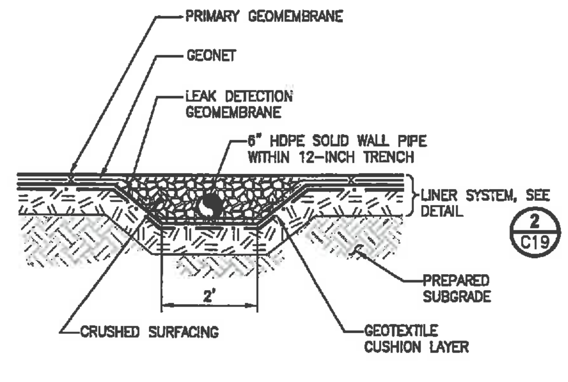
1 OVERLAP UPPER GEONET 2' (MIN) ONTO LOWER LAYER.

2 TRIM GEONET WITHIN 1" AROUND PASSING PIPE.

EVAPORATION POND LEAK DETECTION SUMP

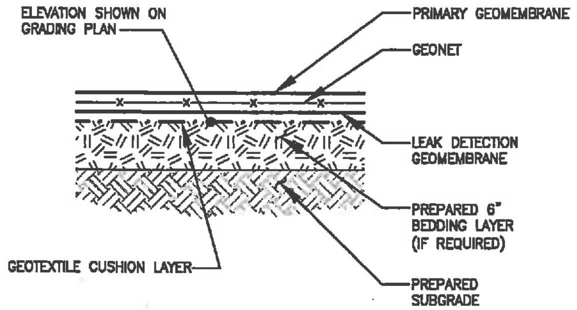
DETAIL 1 C18

NO SCALE



SECTION A C18,C19

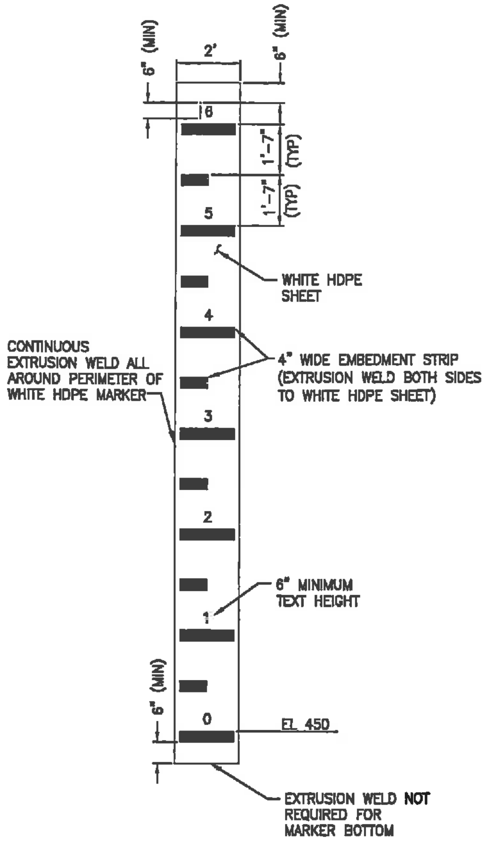
NO SCALE



EVAPORATION POND LINER SYSTEM

DETAIL 2 C18,C19

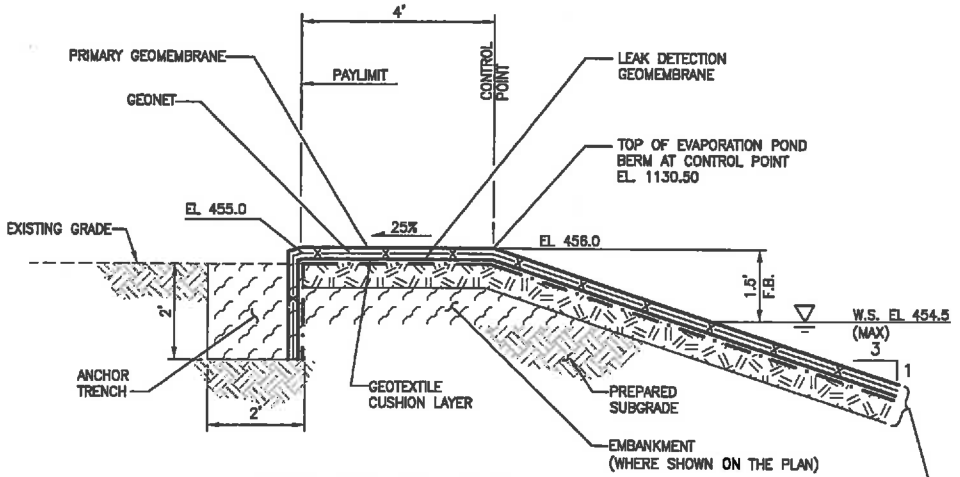
NO SCALE



DEPTH MARKER

DETAIL 4 C18

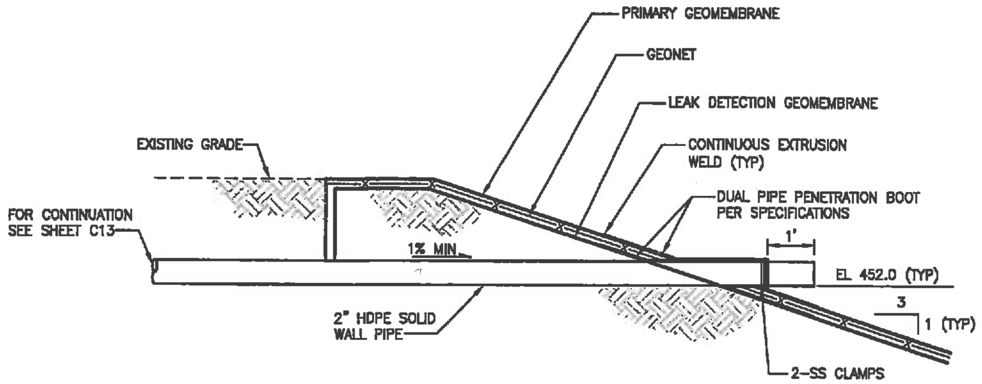
NO SCALE



EVAPORATION POND LINER TERMINATION

DETAIL 3 C18,C19

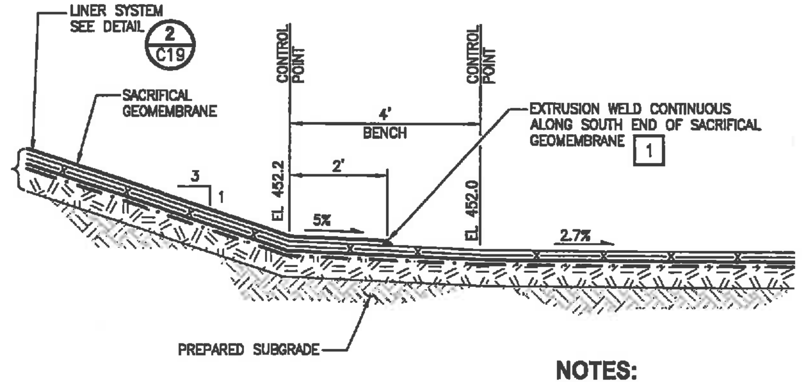
NO SCALE



TYPICAL PIPE PENETRATION

DETAIL 5 C18

NO SCALE



NOTES:

1 SEE SHEET C18 FOR LIMIT OF SACRIFICAL GEOMEMBRANE.

EVAPORATION BENCH

DETAIL 6 C18

NO SCALE

DATE: Mar 16, 2012 - 10:23am
PLOTTED BY: siresste LAYOUT: C19

IMAGES:
XREF'S: XBL2800003P01T03-TBLK | Steve Emge sed

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				DRAWN S. SIRES
				CADD CHECKED
				CHECKED
				APPROVED

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JOB No. 555-3820-003
DATE MARCH 2012

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38889
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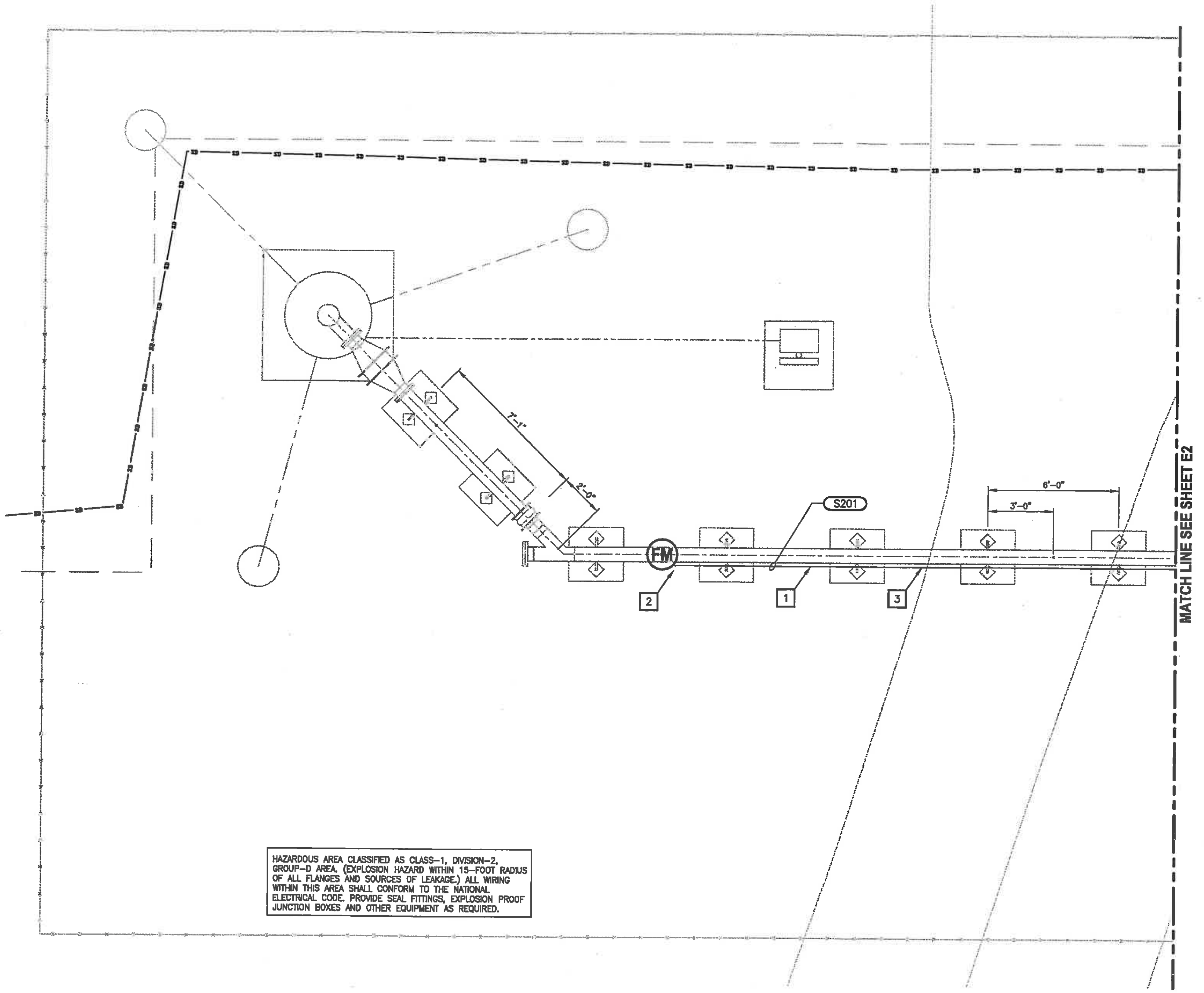
PROJECT NAME
HORN RAPIDS LANDFILL
PHASE 1 CLOSURE PROJECT
CONTRACT No. SB 11-01PW
RICHLAND, WA

DETAILS

DRAWING NO.
19 OF 23
C19



HAZARDOUS AREA CLASSIFIED AS CLASS–1, DIVISION–2, GROUP–D AREA. (EXPLOSION HAZARD WITHIN 15–FOOT RADIUS OF ALL FLANGES AND SOURCES OF LEAKAGE.) ALL WIRING WITHIN THIS AREA SHALL CONFORM TO THE NATIONAL ELECTRICAL CODE. PROVIDE SEAL FITTINGS, EXPLOSION PROOF JUNCTION BOXES AND OTHER EQUIPMENT AS REQUIRED.

PLAN
3/8" = 1'

NOTES:

1. PROVIDE CONDUIT SUPPORT SEE DETAIL E–3
2. PROVIDE FLEXIBLE WATERTIGHT METALLIC CONDUIT AND SEALING FITTING FOR FINAL CONNECTION FROM GRS
3. RUN CONDUITS ALONG PIPE SUPPORTS. PROVIDE SUPPORTS AS NECESSARY. BURY CONDUITS BETWEEN CONCRETE PAD AND PANELS.

DATE: Mar 16, 2012 – 10:23am
PLOTTED BY: sirossto LAYOUT: E1

IMAGES:
XREF'S: XBL2800003P01T03–TBLK | XBL3820003P01T02BA–OTHERS | XBL3820003P01T03–DE | RLR–PE | Steve Emge seal

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				CHECKED
				APPROVED

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FILE NAME BL3820003P01T03–E1
JOB No. 555–3820–003
DATE MARCH 2012

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3/14/12

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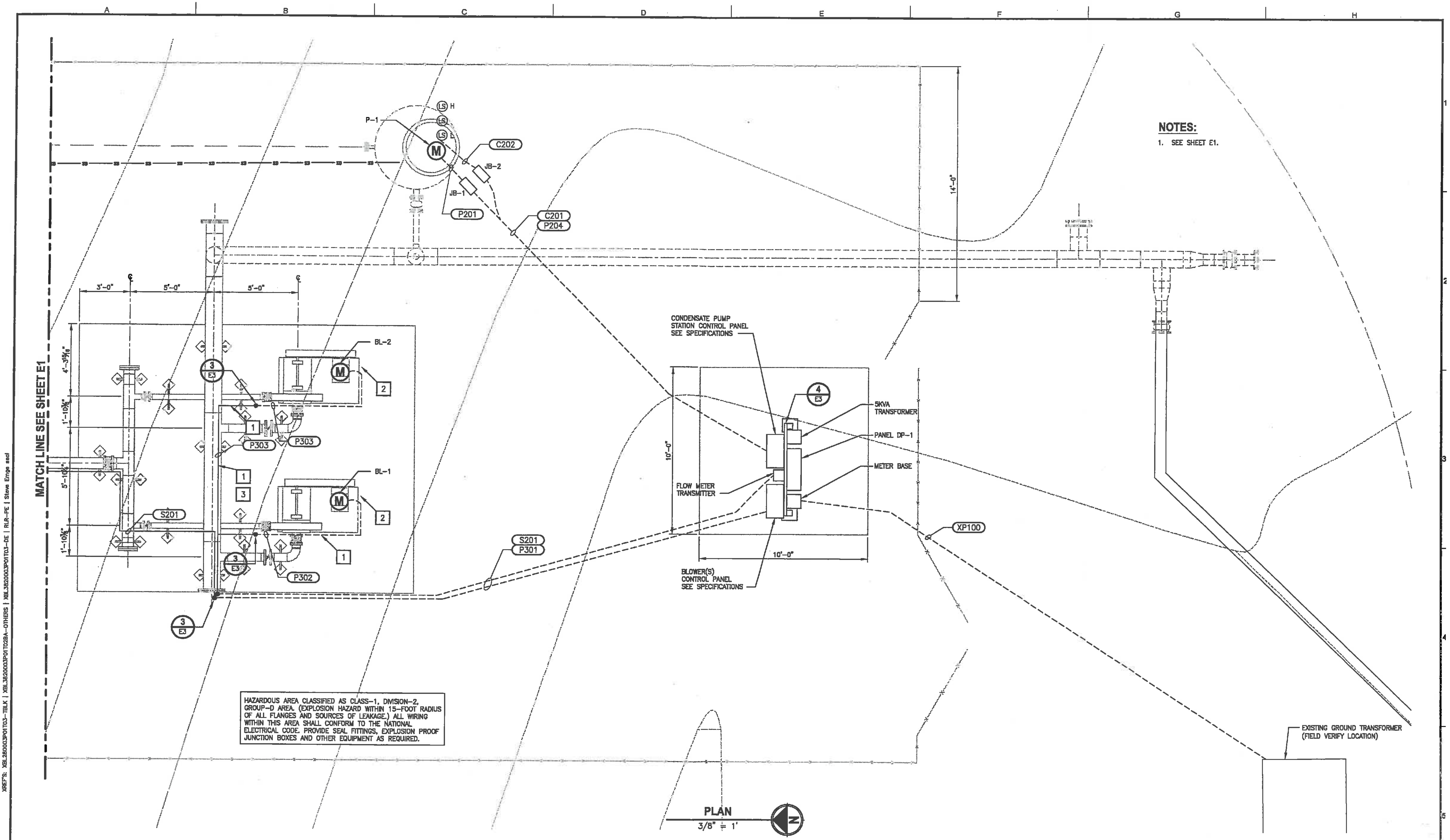
PROJECT NAME
HORN RAPIDS LANDFILL
PHASE 1 CLOSURE PROJECT
CONTRACT No. SB 11-01PW
RICHLAND, WA

FLARE FACILITY PLAN

DRAWING NO.
20 OF 23
E1



NOTES:

1. SEE SHEET E1.

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IMAGES:
XREFS: XBL2800003P01T03-TBLK | XBL3820003P01T02BA-OTHERS | XBL3820003P01T03-DE | RLR-PE | Steve Emge seal

DATE: Mar 16, 2012 - 10:24am LAYOUT: E2
PLOTTED BY: sireste

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				DRAWN S. SIRES
				CADD CHECKED
				CHECKED
				APPROVED

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FILE NAME BL3820003P01T03-E1
JOB No. 555-3820-003
DATE MARCH 2012

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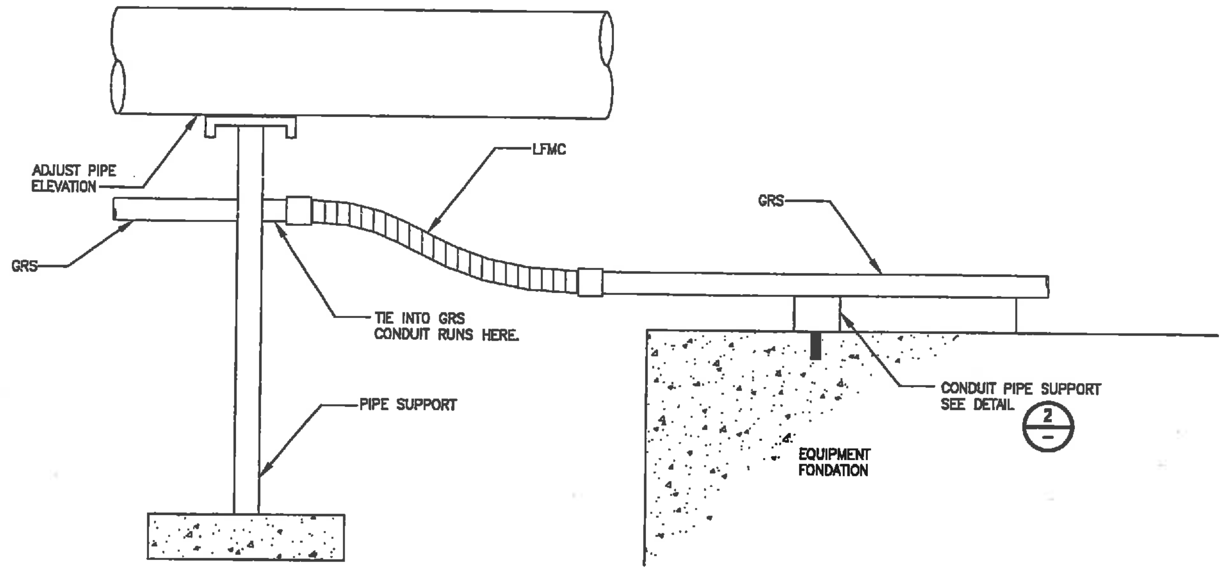
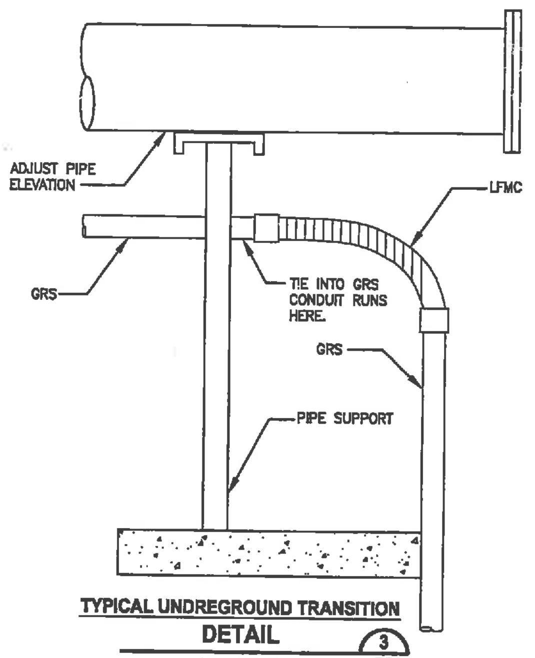
PHASE 1 CLOSURE PROJECT
CONTRACT No. SB 11-01PW
RICHLAND, WA

FLARE FACILITY PLAN

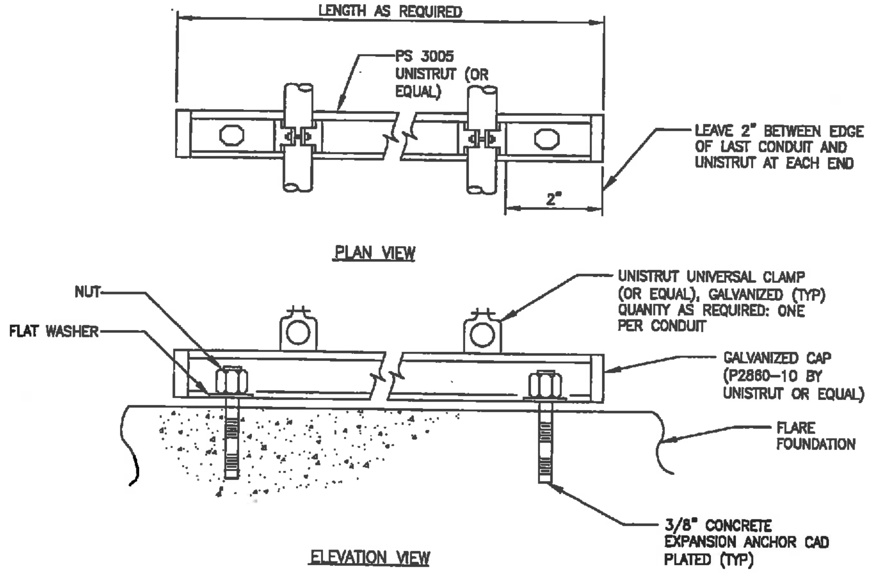
DRAWING NO.
21 OF 23
E2



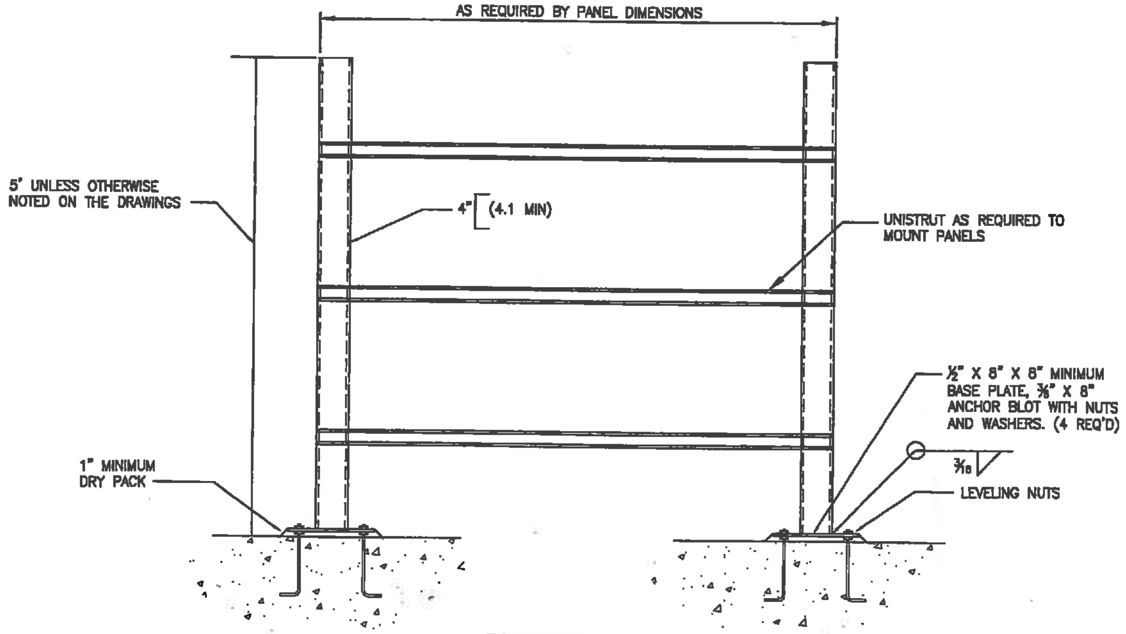
TYPICAL FOUNDATION TRANSITION
DETAIL 1
NO SCALE E1, E2



TYPICAL UNDREGROUND TRANSITION
DETAIL 3
NO SCALE E2



PROPANE PIPE & CONDUIT PIPES SUPPORT
DETAIL 2
NO SCALE –



EQUIPMENT PANEL MOUNTING
DETAIL 4
NO SCALE E2

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				DRAWN P. BRENNAN
				CADD CHECKED
				CHECKED
				APPROVED

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FILE NAME BL3820003P01T03–E3
JOB No. 555–3820–003
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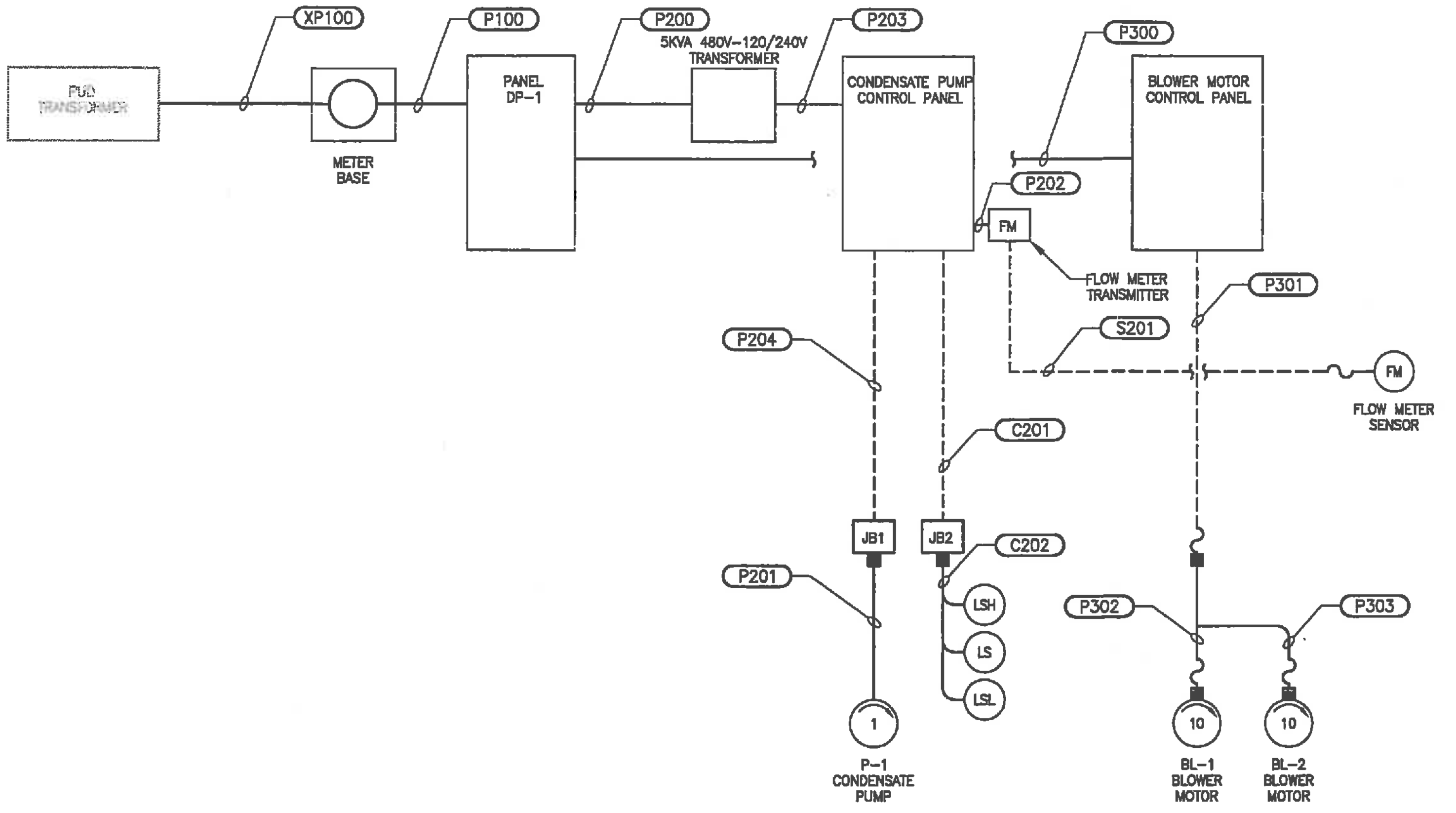
PROJECT NAME
HORN RAPIDS LANDFILL
PHASE 1 CLOSURE PROJECT
CONTRACT No. SB 11-01PW
RICHLAND, WA

ELECTRICAL DETAILS

DRAWING NO.
22 OF 23
E3

DATE: Mar 16, 2012 – 10:24am
PLOTTED BY: slrasste LAYOUT: E2
IMAGES:
XREF'S: XBL280003P01T03–TBLK | RLR–PE | Steve Emge scd



PANELBOARD SCHEDULE

NAME: DP-1

VOLTAGE RATING: 480Y/277 VOLTS, 3 PHASE, 4 WIRE
BUS RATING: 225 AMPS
MAIN BREAKER: 100 AMPS
FEED: UTILITY Via METER BASE
MOUNTING: SURFACE
SPECIAL FEATURES: 14,000 AIC BRACING
LOCATION: ELECTRICAL ROOM
FED FROM: Utility transformer

LOAD TYPE	CIRCUIT DESCRIPTION	VA	CKT	BRKR	L1 L2 L3	BRKR	CKT	VA	CIRCUIT DESCRIPTION	LOAD TYPE
M	BLOWER MOTOR	9,007	1	40 / 3	-A-	20 / 2	2	2,500	CONDENSATE PUMP CONTROL	M
M	CONTROL PANEL	9,007	3		-B-		4	2,500	PANEL VIA 5.0 KVA TRANSFORMER	M
M		9,007	5		-C-		6			
	SPARE		7	20 / 3	-A-	20 / 1	8		SPARE	
			9		-B-	20 / 2	10		SPARE	
			11		-C-		12			

LINE LOADS: 11,507 VA(L1) 11,507 VA(L2) 9,007 VA(L3)

TOTAL LOAD = 32.02 KVA = 38.5 Amps Average

LOAD CALCULATION:

		CONNECTED VA	METHOD	NEC DEMAND	CALC. VA
TOTAL LIGHTING (L) LOAD:	L	0	ALL @	125%	0
TOTAL RECEPTACLE (R) LOAD:	R	0	FIRST 10KVA @	100%	0
			REMAINDER OVER 10KVA	50%	0
TOTAL MOTOR (M) LOAD:	M	32021	ALL @	100%	32021
	LM	0	125% OF LARGEST	125%	0
TOTAL HVAC (H) LOAD:	H	0	ALL @	100%	0
TOTAL MISCELLANEOUS (X) LOAD:	X	0	ALL @	100%	0
TOTAL VA:		32021 VA			32021 VA
AVERAGE AMPS @		39 AMPS			39 AMPS

VOLTAGE PHASE TO PHASE = 480

CONDUIT AND CABLE SCHEDULE

NUMBER	CONDUIT # SIZE	WIRE FILL	FROM	TO	VIA	Devices served
XP100	2"	(4)#1	UTILITY TRANSFORMER	METER BASE		
P100	1-1/2"	(4)#1	METER BASE	DP-1		
P200	1"	(2)#12,(1)#12G	DP-1	5KVA TRANSFORMER		
P201	1"	(1) VENDOR CABLE	CONDESATE PUMP	JB-1		
P202	1"	(2) #12,(1)#12G	CONDENSATE PUMP CONTROL PANEL	TRANSMITTER		
P203	1"	(3)#10,(1)#10G	5KVA TRANSFORMER	CONDENSATE PUMP CONTROL PANEL		
P204	1"	(2)#10,#10G	CONDENSATE PUMP CONTROL PANEL P-1	JB-1	SEAL OFF	
P300	1"	(3)#8,(1)#10G	DP-1	BLOWER MOTOR CONTROL PANEL		
P301	1-1/4"	(6)#12,(2)#12G	BLOWER MOTOR CONTROL PANEL	BLOWER MOTOR CONDUIT BODY		
P302	1"	(3) #12,(1)#12G	BLOWER MOTOR CONDUIT BODY	BLOWER MOTOR BL-1	SEAL OFF	
P303	1"	(3) #12,(1)#12G	BLOWER MOTOR CONDUIT BODY	BLOWER MOTOR BL-2	SEAL OFF	
C201	1"	(6) #14,#14G	CONDENSATE PUMP CONTROL PANEL	JB-2		
C202	1-1/2"	(3) VENDOR CABLES	JB-2	LSH,LS,LSL	SEAL OFF	PROVIDE ADEQUATE SLACK IN WETWELL TO ADJUST LEVEL SWITCHES
S201	1"	VENDOR CABLES	FLOW METER TRANSMITTER	FLOW METER SENSOR	SEAL OFF	

LEGEND:

-⊖- - - -	UNDERGROUND CONDUIT
XXXX	CONDUIT NUMBER PXXX = POWER CXXX = CONTROL
∿	LFMC CONDUIT
—	EXPOSED CONDUIT
FM	FLOW METER
#	MOTOR # = HORSEPOWER
S	SWITCH
JB	JUNCTION BOX
■	SEAL OFFS

THIS DRAWING AND OR SPECIFICATION DOCUMENT HAS BEEN REVISED TO REFLECT INFORMATION PROVIDED BY THE CONSTRUCTION CONTRACTOR (AND OTHERS) DEFINING KNOWN DIFFERENCES BETWEEN THE FACILITIES SHOWN ON THE ORIGINAL CONSTRUCTION DOCUMENTS TO THOSE CONSTRUCTED. THE INFORMATION PROVIDED ON THESE RECORDS, HAS BEEN ASSUMED TO BE CORRECT AND HAS NOT BEEN VERIFIED BY THE ENGINEER, WHO IS UNDER NO OBLIGATION OR DUTY TO VERIFY SUCH ACCURACY AND/OR COMPLETENESS. SAID ENGINEER, BY PLACING HER/HIS PROFESSIONAL SEAL ON THIS DRAWING, HAS REVIEWED THE REVISION(S) TO VERIFY THAT THE CHANGES AS DEFINED BY THESE RECORDS DO NOT APPEAR TO BE ADVERSE TO THE PLANNED USE AND/OR INTENT OF THE ORIGINAL DESIGN. THERE IS NO WARRANTY HEREIN FOR THE ACCURACY OF THE CHANGES SHOWN, NOR ASSURANCE THAT ALL DIFFERENCES TO THE ORIGINAL DRAWING AND OR SPECIFICATION DOCUMENT HAVE BEEN IDENTIFIED.

△	REVISIONS	DATE	BY
	RECORD DRAWINGS	MAR. 2012	S.M.E.

DESIGNED R. REYGERS
DRAWN D. PETERSON
CADD CHECKED
CHECKED
APPROVED

ONE INCH AT FULL SCALE. IF NOT, SCALE ACCORDINGLY
FILE NAME BL3820003P01T03–E4
JOB No. 555–3820–003
DATE MARCH 2012

STEPHEN M. EMGE
/14/12

Parametrix
ENGINEERING . PLANNING . ENVIRONMENTAL SCIENCES
411 108TH AVENUE N.E., SUITE 1800
BELLEVUE, WASHINGTON 98004
T. 425.458.6200 F. 425.458.6363
www.parametrix.com

PROJECT NAME
HORN RAPIDS LANDFILL
PHASE 1 CLOSURE PROJECT
CONTRACT No. SB 11-01PW
RICHLAND, WA

ONE-LINE DIAGRAM AND CONDUIT AND CABLE SCHEDULE

DRAWING NO.
23 OF 23
E4

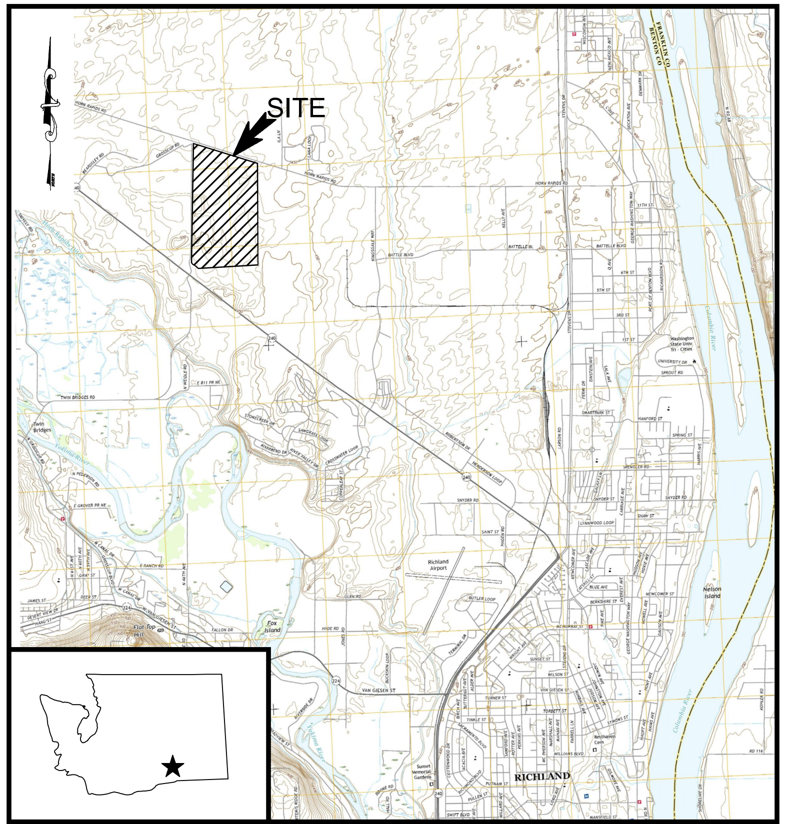
DATE: Mar 16, 2012 – 12:22pm LAYOUT: E2
PLOTTED BY: slreeste
IMAGES:
XREF'S: XBL2800003P01T03–TBLK | Steve Emge seal

A-3

Phase 2 Closure

PHASE 2 GCCS CONSTRUCTION DRAWINGS
HORN RAPIDS LANDFILL

RICHLAND, WASHINGTON
SEPTEMBER 2019



SOURCE: USGS 7.5-MINUTE TOPOGRAPHIC QUADRANGLE FOR RICHLAND, WASHINGTON (2017)

LOCUS PLAN

SCALE: 1" = 4,000'

SHEET INDEX

SHEET	TITLE
1	EXISTING CONDITIONS PLAN
2	PROPOSED GCCS LAYOUT PLAN
3	LFG HEADER PIPE PLAN AND PROFILE
4-6	TYPICAL DETAILS
7	TECHNICAL SPECIFICATIONS

DRAFT

PREPARED FOR:

WRH HORN RAPIDS, LLC
111 E. BROADWAY, SUITE 150
SALT LAKE CITY, UT 84111

PREPARED BY:

SANBORN HEAD
3350 PEORIA STREET, SUITE 150, AURORA, COLORADO 80010
(603) 229-1900 FAX (603) 229-1919

PROJ.#: 4631.00 "HORN RAPIDS LANDFILL PHASE 2 GCCS CONSTRUCTION DRAWINGS" SEPTEMBER 2019

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USER: kanderson
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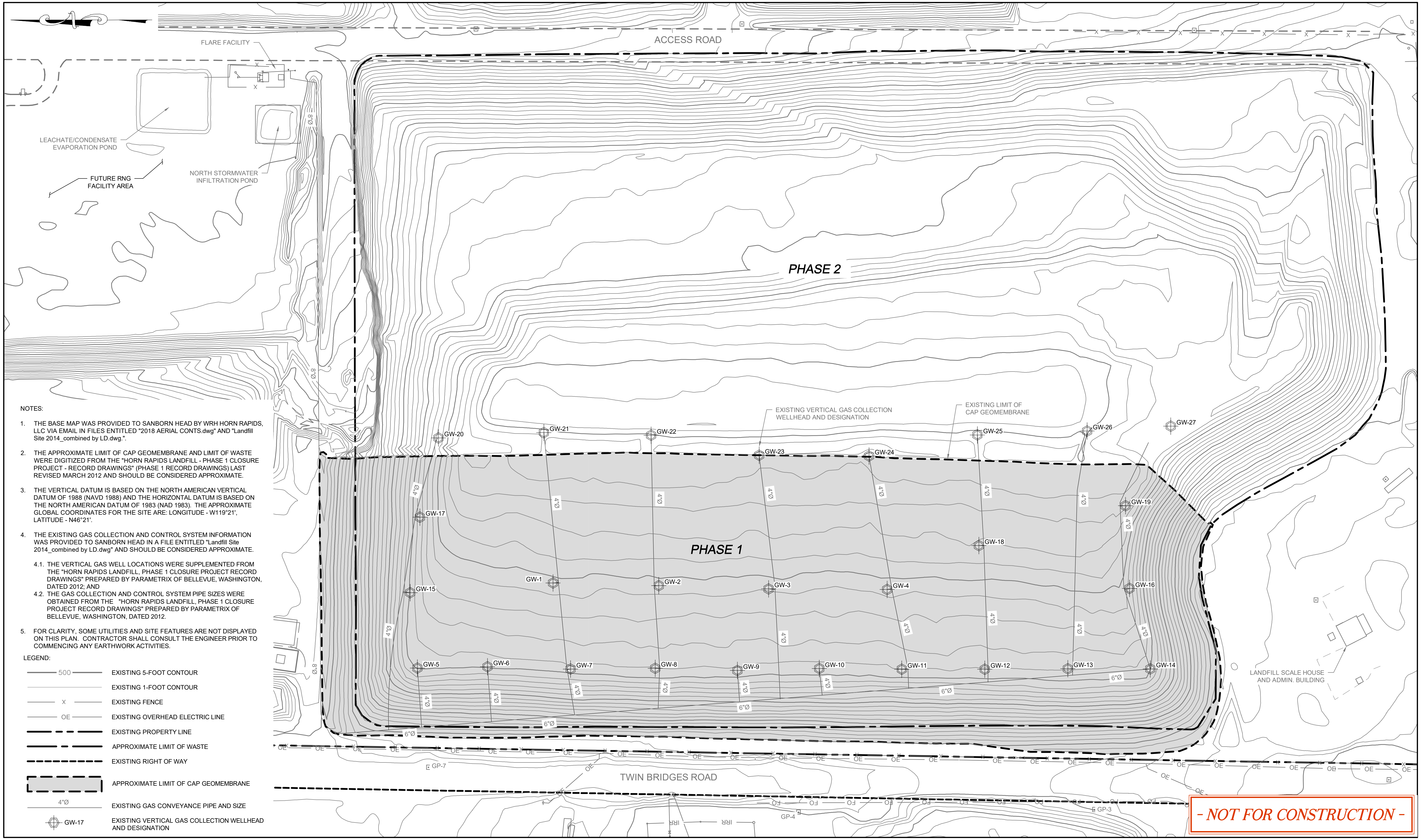


NOTES:

1. THE BASE MAP WAS PROVIDED TO SANBORN HEAD BY WRH HORN RAPIDS, LLC VIA EMAIL IN FILES ENTITLED "2018 AERIAL CONTS.dwg" AND "Landfill Site 2014_combined by LD.dwg.".

2. THE APPROXIMATE LIMIT OF CAP GEOMEMBRANE AND LIMIT OF WASTE WERE DIGITIZED FROM THE "HORN RAPIDS LANDFILL - PHASE 1 CLOSURE PROJECT - RECORD DRAWINGS" (PHASE 1 RECORD DRAWINGS) LAST REVISED MARCH 2012 AND SHOULD BE CONSIDERED APPROXIMATE.

3. THE VERTICAL DATUM IS BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 1988) AND THE HORIZONTAL DATUM IS BASED ON THE NORTH AMERICAN DATUM OF 1983 (NAD 1983). THE APPROXIMATE GLOBAL COORDINATES FOR THE SITE ARE: LONGITUDE - W119°21', LATITUDE - N46°21'.

4. THE EXISTING GAS COLLECTION AND CONTROL SYSTEM INFORMATION WAS PROVIDED TO SANBORN HEAD IN A FILE ENTITLED "Landfill Site 2014_combined by LD.dwg" AND SHOULD BE CONSIDERED APPROXIMATE.

   4.1. THE VERTICAL GAS WELL LOCATIONS WERE SUPPLEMENTED FROM THE "HORN RAPIDS LANDFILL, PHASE 1 CLOSURE PROJECT RECORD DRAWINGS" PREPARED BY PARAMETRIX OF BELLEVUE, WASHINGTON, DATED 2012; AND
   4.2. THE GAS COLLECTION AND CONTROL SYSTEM PIPE SIZES WERE OBTAINED FROM THE "HORN RAPIDS LANDFILL, PHASE 1 CLOSURE PROJECT RECORD DRAWINGS" PREPARED BY PARAMETRIX OF BELLEVUE, WASHINGTON, DATED 2012.

5. FOR CLARITY, SOME UTILITIES AND SITE FEATURES ARE NOT DISPLAYED ON THIS PLAN. CONTRACTOR SHALL CONSULT THE ENGINEER PRIOR TO COMMENCING ANY EARTHWORK ACTIVITIES.

LEGEND:

—— 500 ——	EXISTING 5-FOOT CONTOUR
————	EXISTING 1-FOOT CONTOUR
—— X ——	EXISTING FENCE
—— OE ——	EXISTING OVERHEAD ELECTRIC LINE
—— – – ——	EXISTING PROPERTY LINE
—— – ——	APPROXIMATE LIMIT OF WASTE
– – – – – –	EXISTING RIGHT OF WAY
▨	APPROXIMATE LIMIT OF CAP GEOMEMBRANE
4"Ø	EXISTING GAS CONVEYANCE PIPE AND SIZE
⌖ GW-17	EXISTING VERTICAL GAS COLLECTION WELLHEAD AND DESIGNATION

- NOT FOR CONSTRUCTION -

SANBORN HEAD

GRAPHICAL SCALE

80' 40' 0 80' 160'

DRAFT

NO.	DATE	DESCRIPTION	BY

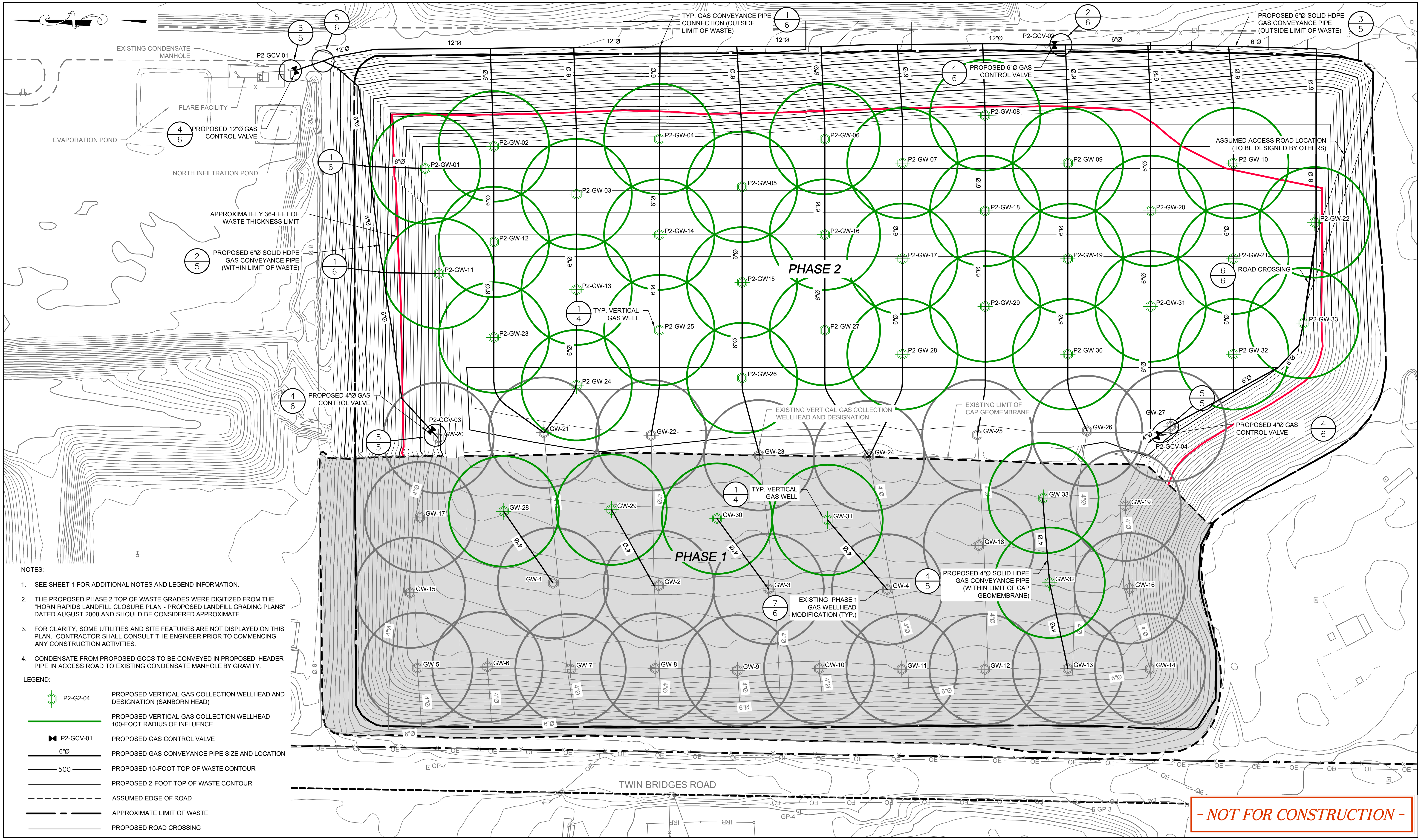
DRAWN BY: J. GRACE
DESIGNED BY: J. GRACE
REVIEWED BY: J. CHABOT
PROJECT MGR: M. KOZLOWSKI
PIC: J. CHABOT
DATE: SEPTEMBER 2019

PHASE 2 GCCS CONSTRUCTION DRAWINGS
WRH HORN RAPIDS, LLC
RICHLAND, WASHINGTON

EXISTING CONDITIONS PLAN

PROJECT NUMBER:
4631.00

SHEET NUMBER:
1 OF 7



NOTES:

1. SEE SHEET 1 FOR ADDITIONAL NOTES AND LEGEND INFORMATION.
2. THE PROPOSED PHASE 2 TOP OF WASTE GRADES WERE DIGITIZED FROM THE "HORN RAPIDS LANDFILL CLOSURE PLAN - PROPOSED LANDFILL GRADING PLANS" DATED AUGUST 2008 AND SHOULD BE CONSIDERED APPROXIMATE.
3. FOR CLARITY, SOME UTILITIES AND SITE FEATURES ARE NOT DISPLAYED ON THIS PLAN. CONTRACTOR SHALL CONSULT THE ENGINEER PRIOR TO COMMENCING ANY CONSTRUCTION ACTIVITIES.
4. CONDENSATE FROM PROPOSED GCCS TO BE CONVEYED IN PROPOSED HEADER PIPE IN ACCESS ROAD TO EXISTING CONDENSATE MANHOLE BY GRAVITY.

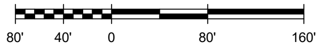
LEGEND:

⌖ P2-G2-04	PROPOSED VERTICAL GAS COLLECTION WELLHEAD AND DESIGNATION (SANBORN HEAD)
🟩	PROPOSED VERTICAL GAS COLLECTION WELLHEAD 100-FOOT RADIUS OF INFLUENCE
⋈ P2-GCV-01	PROPOSED GAS CONTROL VALVE
6"Ø	PROPOSED GAS CONVEYANCE PIPE SIZE AND LOCATION
—500—	PROPOSED 10-FOOT TOP OF WASTE CONTOUR
—	PROPOSED 2-FOOT TOP OF WASTE CONTOUR
– – – –	ASSUMED EDGE OF ROAD
— – —	APPROXIMATE LIMIT OF WASTE
═	PROPOSED ROAD CROSSING

- NOT FOR CONSTRUCTION -

SANBORN HEAD

GRAPHICAL SCALE



DRAFT

NO.	DATE	DESCRIPTION	BY

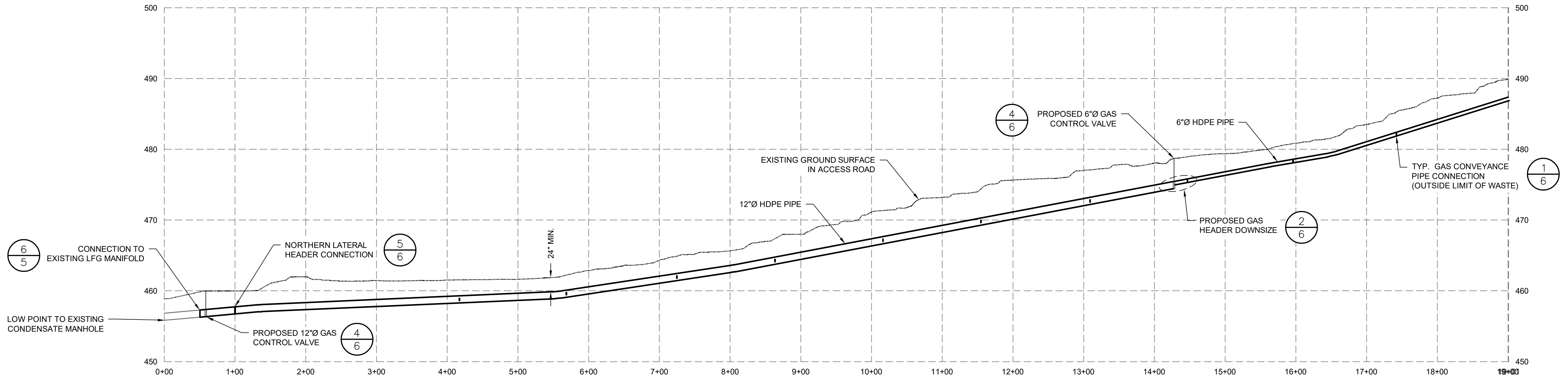
DRAWN BY: J. GRACE
DESIGNED BY: J. GRACE
REVIEWED BY: J. CHABOT
PROJECT MGR: M. KOZLOWSKI
PIC: J. CHABOT
DATE: SEPTEMBER 2019

PHASE 2 GCCS CONSTRUCTION DRAWINGS
WRH HORN RAPIDS, LLC
RICHLAND, WASHINGTON

PROPOSED GCCS LAYOUT PLAN

PROJECT NUMBER: 4631.00

SHEET NUMBER: 2 OF 7



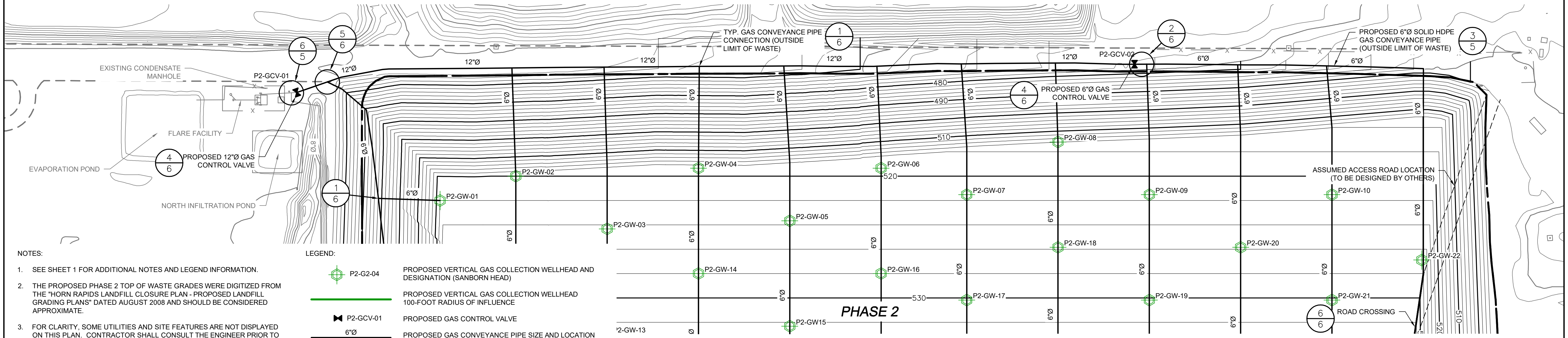
NOTE:

1. GAS CONVEYANCE PIPE TO BE INSTALLED WITH A MINIMUM 0.5% SLOPE IN AREAS OUTSIDE THE LIMIT OF WASTE.

1 HEADER PIPE PROFILE

NOT TO SCALE

VERTICAL SCALE
8' 4' 0 8' 16'
80' 40' 0 80' 160'
HORIZONTAL SCALE



NOTES:

1. SEE SHEET 1 FOR ADDITIONAL NOTES AND LEGEND INFORMATION.
2. THE PROPOSED PHASE 2 TOP OF WASTE GRADES WERE DIGITIZED FROM THE "HORN RAPIDS LANDFILL CLOSURE PLAN - PROPOSED LANDFILL GRADING PLANS" DATED AUGUST 2008 AND SHOULD BE CONSIDERED APPROXIMATE.
3. FOR CLARITY, SOME UTILITIES AND SITE FEATURES ARE NOT DISPLAYED ON THIS PLAN. CONTRACTOR SHALL CONSULT THE ENGINEER PRIOR TO COMMENCING ANY CONSTRUCTION ACTIVITIES.

LEGEND:

⊕ P2-G2-04	PROPOSED VERTICAL GAS COLLECTION WELLHEAD AND DESIGNATION (SANBORN HEAD)
━	PROPOSED VERTICAL GAS COLLECTION WELLHEAD 100-FOOT RADIUS OF INFLUENCE
⧓ P2-GCV-01	PROPOSED GAS CONTROL VALVE
6"Ø ━	PROPOSED GAS CONVEYANCE PIPE SIZE AND LOCATION
— 500 —	PROPOSED 10-FOOT TOP OF WASTE CONTOUR
—	PROPOSED 2-FOOT TOP OF WASTE CONTOUR
━ ━ ━	APPROXIMATE LIMIT OF WASTE

2 HEADER PIPE PLAN

NOT TO SCALE

GRAPHICAL SCALE
80' 40' 0 80' 160'

- NOT FOR CONSTRUCTION -

SANBORN HEAD

SCALE AS INDICATED

DRAFT

NO.	DATE	DESCRIPTION	BY

DRAWN BY: J. GRACE/K. ANDERSON
DESIGNED BY: J. GRACE/K. ANDERSON
REVIEWED BY: J. CHABOT
PROJECT MGR: M. KOZLOWSKI
PIC: J. CHABOT
DATE: SEPTEMBER 2019

PHASE 2 GCCS CONSTRUCTION DRAWINGS
WRH HORN RAPIDS, LLC
RICHLAND, WASHINGTON

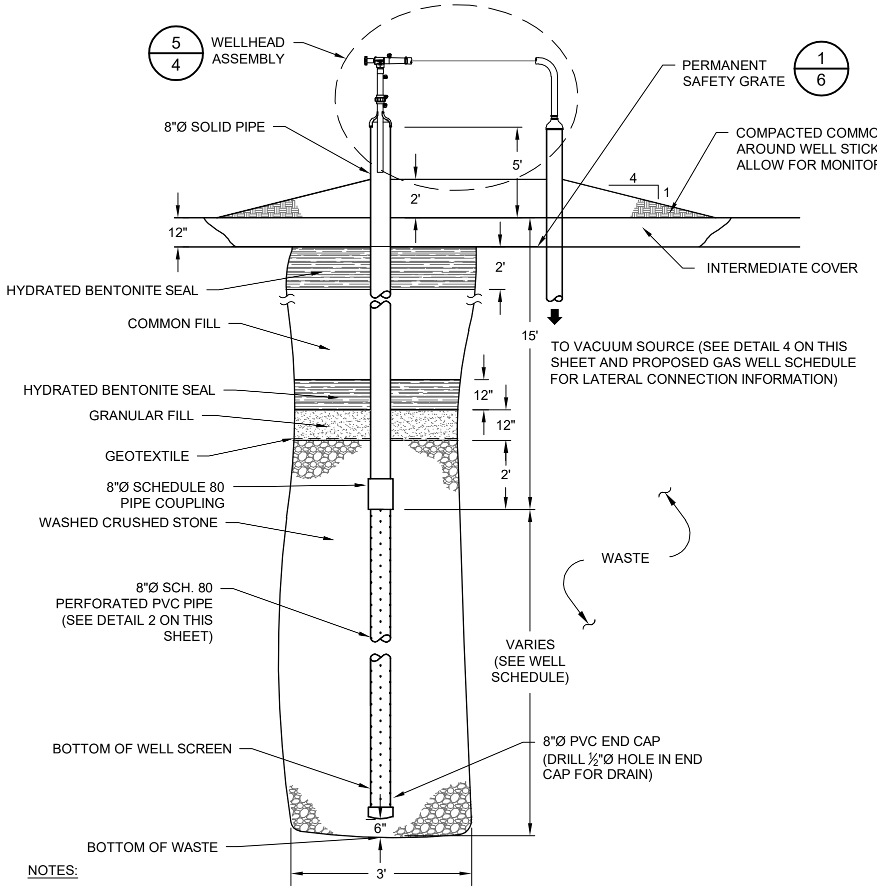
LFG HEADER PIPE PLAN AND PROFILE

PROJECT NUMBER: 4631.00

SHEET NUMBER: 3 OF 7

PROPOSED GAS WELL SCHEDULE

WELL DESIGNATION	NORTHING	EASTING	ASSUMED BOTTOM OF WASTE (FT)	TOP OF EXISTING WASTE (FT)	TOTAL WELL DEPTH (FT)	BOTTOM OF WELL SCREEN (FT)	TOP OF WELL SCREEN (FT)	SCREEN LENGTH (FT)	TOP OF CASING ELEV. (FT)	LATERAL CONNECTION TYPE
P2-GW-01	372306.1	1932982.4	467.2	522.0	54.8	467.2	507.0	39.8	527.0	B
P2-GW-02	372181.9	1933022.4	466.5	520.0	53.5	466.5	505.0	38.5	525.0	A
P2-GW-03	372032.1	1932935.9	469.0	524.3	55.3	469.0	509.3	40.3	529.3	A
P2-GW-04	371882.2	1933035.6	468.0	518.6	50.6	468.0	503.6	35.6	523.6	A
P2-GW-05	371732.4	1932949.1	471.2	523.7	52.5	471.2	508.7	37.5	528.7	A
P2-GW-06	371582.6	1933035.6	472.1	519.2	47.1	472.1	504.2	32.1	524.2	A
P2-GW-07	371442.1	1932992.0	474.0	521.5	47.5	474.0	506.5	32.5	526.5	A
P2-GW-08	371292.3	1933078.5	474.8	515.9	41.1	474.8	500.9	26.1	520.9	A
P2-GW-09	371142.4	1932992.0	478.7	521.5	42.8	478.7	506.5	27.8	526.5	A
P2-GW-10	370842.8	1932992.0	486.0	521.5	35.5	486.0	506.5	20.5	526.5	A
P2-GW-11	372281.1	1932792.2	470.9	530.0	59.1	470.9	515.0	44.1	535.0	B
P2-GW-12	372181.9	1932849.4	469.7	528.7	58.9	469.7	513.7	43.9	533.7	A
P2-GW-13	372032.1	1932762.9	472.1	533.0	60.9	472.1	518.0	45.9	538.0	A
P2-GW-14	371882.2	1932862.6	471.0	528.0	57.0	471.0	513.0	42.0	533.0	A
P2-GW-15	371732.4	1932776.1	473.1	532.3	59.2	473.1	517.3	44.2	537.3	A
P2-GW-16	371582.6	1932862.6	473.8	528.0	54.2	473.8	513.0	39.2	533.0	A
P2-GW-17	371442.1	1932819.0	475.8	530.2	54.4	475.8	515.2	39.4	535.2	A
P2-GW-18	371292.3	1932905.5	477.1	525.8	48.7	477.1	510.8	33.7	530.8	A
P2-GW-19	371142.4	1932819.0	481.6	530.2	48.6	481.6	515.2	33.6	535.2	A
P2-GW-20	370992.6	1932905.5	484.0	525.8	41.8	484.0	510.8	26.8	530.8	A
P2-GW-21	370842.8	1932819.0	487.3	530.2	42.9	487.3	515.2	27.9	535.2	A
P2-GW-22	370695.5	1932884.8	488.2	526.9	38.7	488.2	511.9	23.7	531.9	A
P2-GW-23	372181.9	1932676.4	472.6	537.3	64.7	472.6	522.3	49.7	542.3	A
P2-GW-24	372032.1	1932589.9	474.1	541.6	67.5	474.1	526.6	52.5	546.6	B
P2-GW-25	371882.2	1932689.6	473.5	536.6	63.2	473.5	521.6	48.2	541.6	B
P2-GW-26	371732.4	1932603.1	475.1	541.0	65.9	475.1	526.0	50.9	546.0	B
P2-GW-27	371582.6	1932689.6	475.5	536.6	61.1	475.5	521.6	46.1	541.6	B
P2-GW-28	371442.1	1932646.0	477.9	538.8	61.0	477.9	523.8	46.0	543.8	B
P2-GW-29	371292.3	1932732.5	479.6	534.5	54.9	479.6	519.5	39.9	539.5	B
P2-GW-30	371142.4	1932646.0	483.6	538.8	55.2	483.6	523.8	40.2	543.8	B
P2-GW-31	370992.6	1932732.5	486.0	534.5	48.5	486.0	519.5	33.5	539.5	A
P2-GW-32	370842.8	1932646.0	488.6	538.8	50.2	488.6	523.8	35.2	543.8	A
P2-GW-33	370715.8	1932702.4	489.5	536.0	46.5	489.5	521.0	31.5	541.0	A

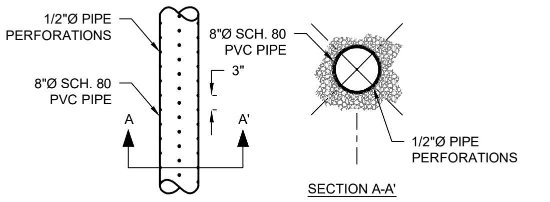


NOTES:

1. PROVIDE TEMPORARY PVC SLIP CAP ON TOP OF WELL AFFIXED TO CASING WITH 3 LAG SCREWS UNTIL WELLHEAD IS INSTALLED.
2. PIPE COUPLES SHOULD BE SOLVENT WELDED AND SECURED WITH 3 LAG SCREWS TO THE CASING PIPE.

① TYPICAL VERTICAL GAS WELL

NOT TO SCALE



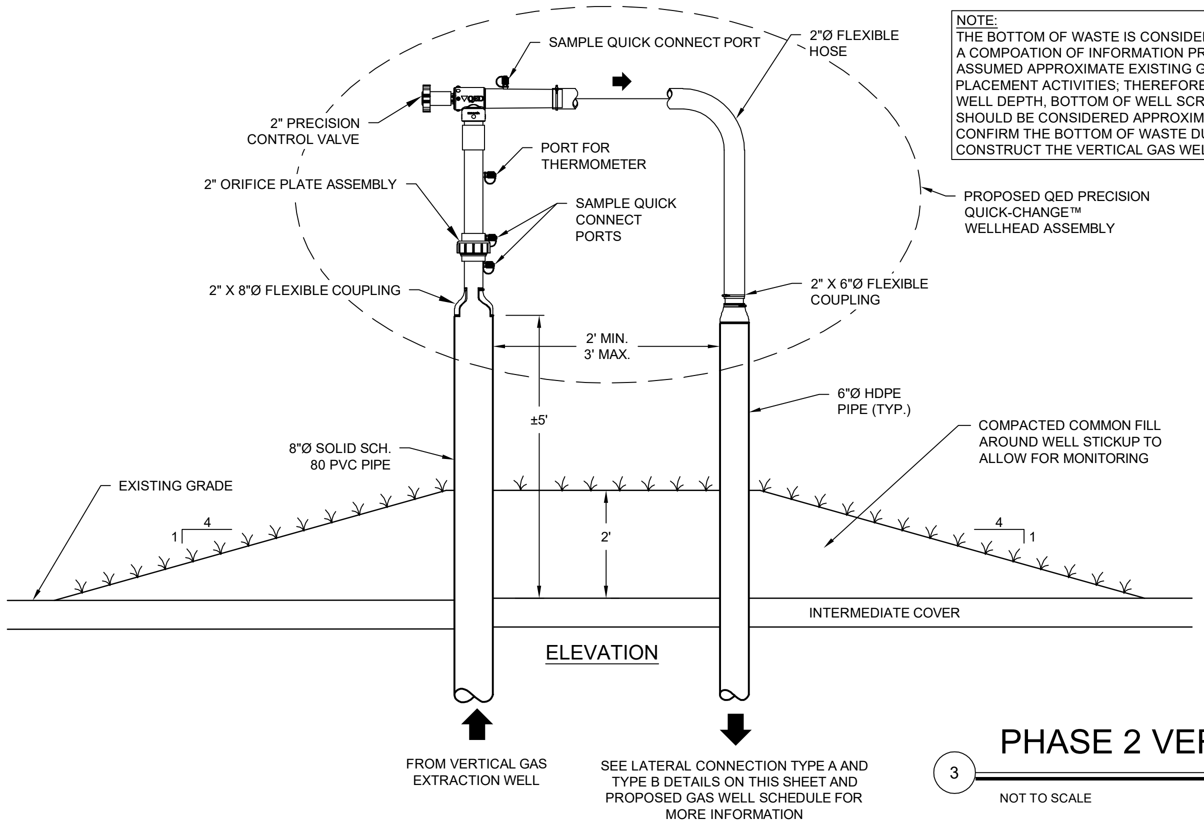
NOTE:

1. PVC PIPE SHALL BE PERFORATED WITH ½"Ø HOLES. FOUR HOLES PER ROW SPACED 90° APART, WITH ADJACENT ROWS OFFSET BY 45°. ROWS OF HOLES SHALL BE SPACED 3-INCHES APART ALONG THE LENGTH OF THE PIPE.

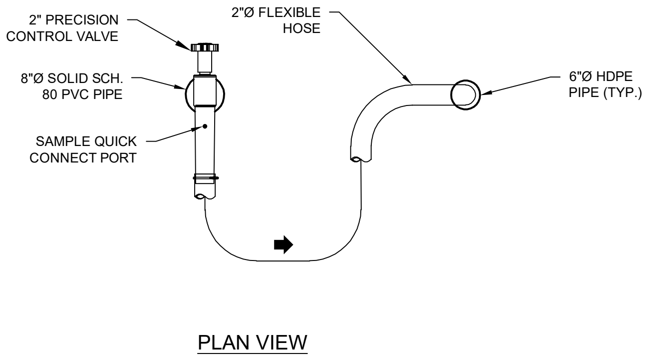
② VERTICAL WELL PERFORATED PIPE DETAIL

NOT TO SCALE

NOTE:
THE BOTTOM OF WASTE IS CONSIDERED APPROXIMATED BASED ON A COMPOATION OF INFORMATION PROVIDED TO SANBORN HEAD AND ASSUMED APPROXIMATE EXISTING GRADE PRIOR TO WASTE PLACEMENT ACTIVITIES; THEREFORE, BOTTOM OF WASTE, TOTAL WELL DEPTH, BOTTOM OF WELL SCREEN, AND SCREEN LENGTH SHOULD BE CONSIDERED APPROXIMATE. CONTRACTOR TO CONFIRM THE BOTTOM OF WASTE DURING WELL DRILLING AND CONSTRUCT THE VERTICAL GAS WELL TO BOTTOM OF WASTE.



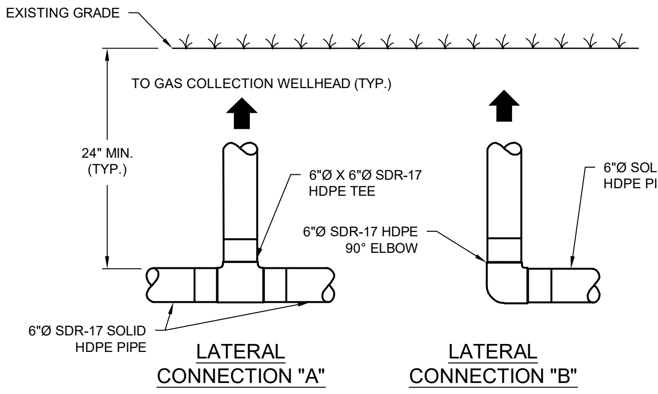
ELEVATION



PLAN VIEW

③ PHASE 2 VERTICAL GAS WELLHEAD DETAIL

NOT TO SCALE



LATERAL CONNECTION "A"

LATERAL CONNECTION "B"

④ LATERAL CONNECTION DETAILS

NOT TO SCALE

- NOT FOR CONSTRUCTION -

SANBORN | HEAD

SCALE AS INDICATED

DRAFT

NO.	DATE	DESCRIPTION	BY

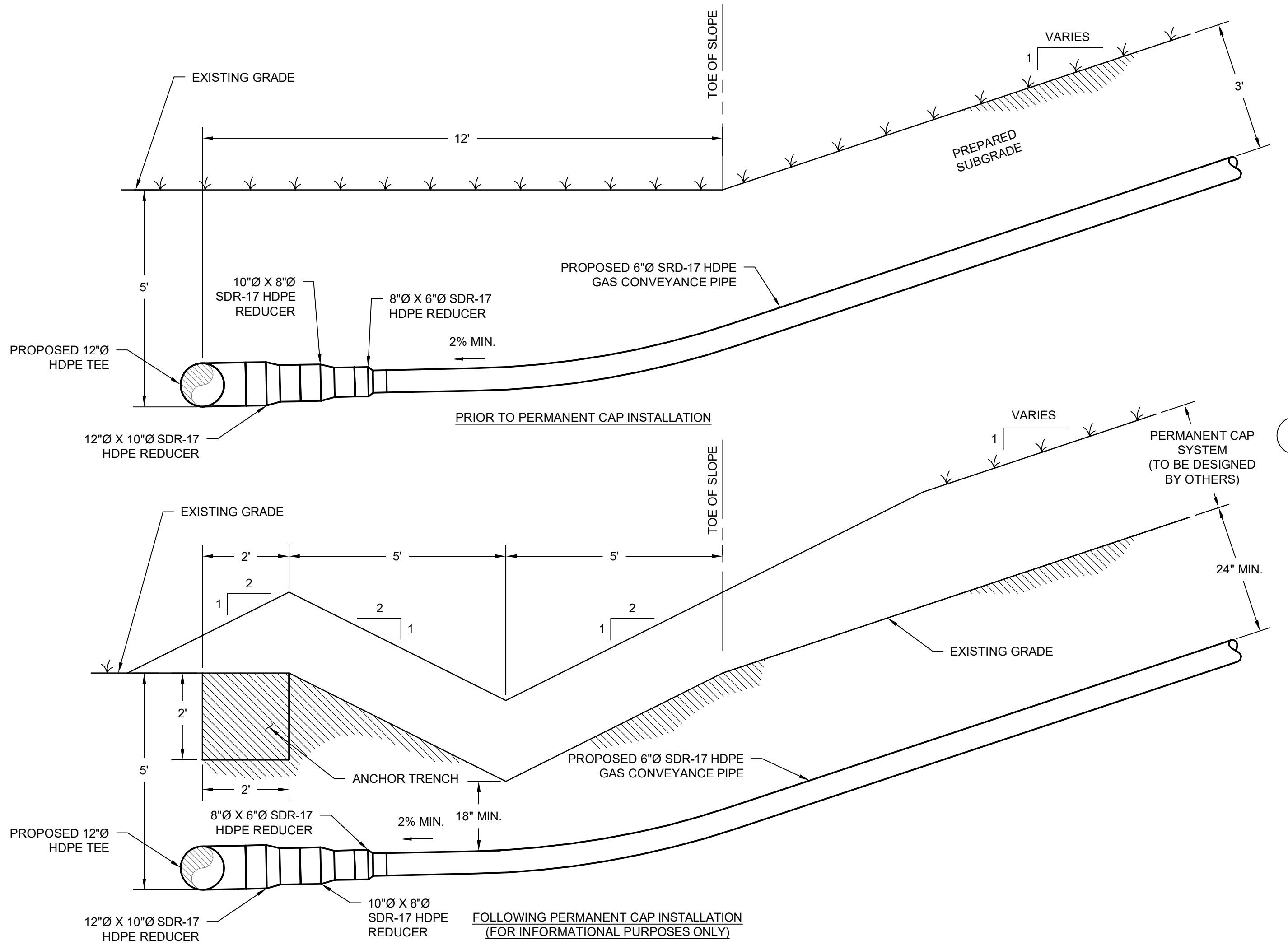
DRAWN BY: J. GRACE
DESIGNED BY: J. GRACE
REVIEWED BY: J. CHABOT
PROJECT MGR: M. KOZLOWSKI
PIC: J. CHABOT
DATE: SEPTEMBER 2019

PHASE 2 GCCS CONSTRUCTION DRAWINGS
WRH HORN RAPIDS, LLC
RICHLAND, WASHINGTON

TYPICAL DETAILS

PROJECT NUMBER:
4631.00

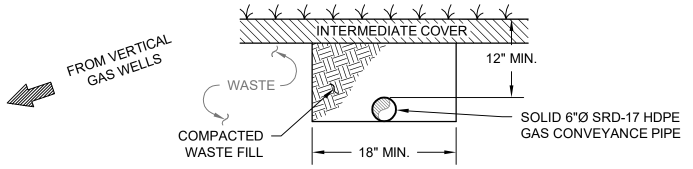
SHEET NUMBER:
4 OF 7



GAS CONVEYANCE PIPE CONNECTION TO HEADER DETAIL

1

NOT TO SCALE



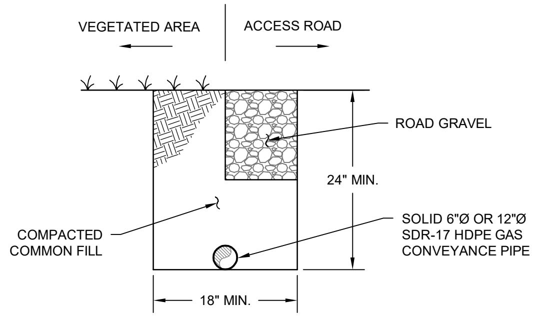
NOTE:

1. GAS CONVEYANCE PIPE TO BE INSTALLED WITH A MINIMUM 5% SLOPE IN AREAS WITHIN LIMIT OF WASTE.

GAS CONVEYANCE PIPE TRENCH SECTION (WITHIN LIMIT OF WASTE)

2

NOT TO SCALE



NOTE:

1. GAS CONVEYANCE PIPE TO BE INSTALLED WITH A MINIMUM 0.5% SLOPE IN AREAS OUTSIDE THE LIMIT OF WASTE.

GAS CONVEYANCE PIPE TRENCH SECTION (OUTSIDE LIMIT OF WASTE)

3

NOT TO SCALE

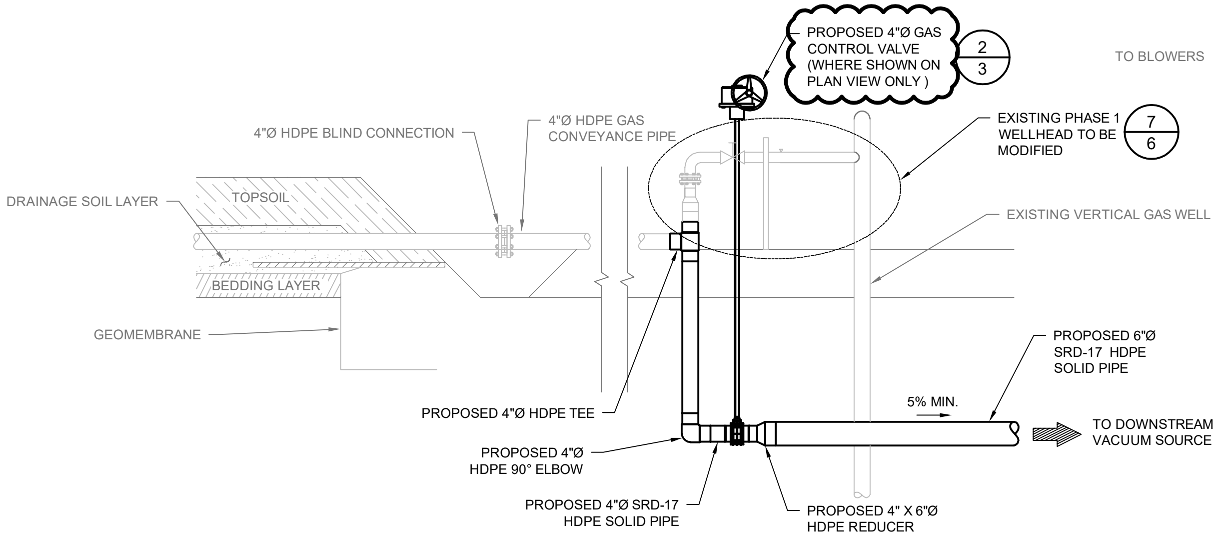
NOTE:

1. GAS CONVEYANCE PIPE TO BE INSTALLED WITH A MINIMUM 5% SLOPE IN AREAS WITHIN LIMIT OF CAP GEOMEMBRANE.

GAS CONVEYANCE PIPE TRENCH SECTION (WITHIN LIMIT OF WASTE)

4

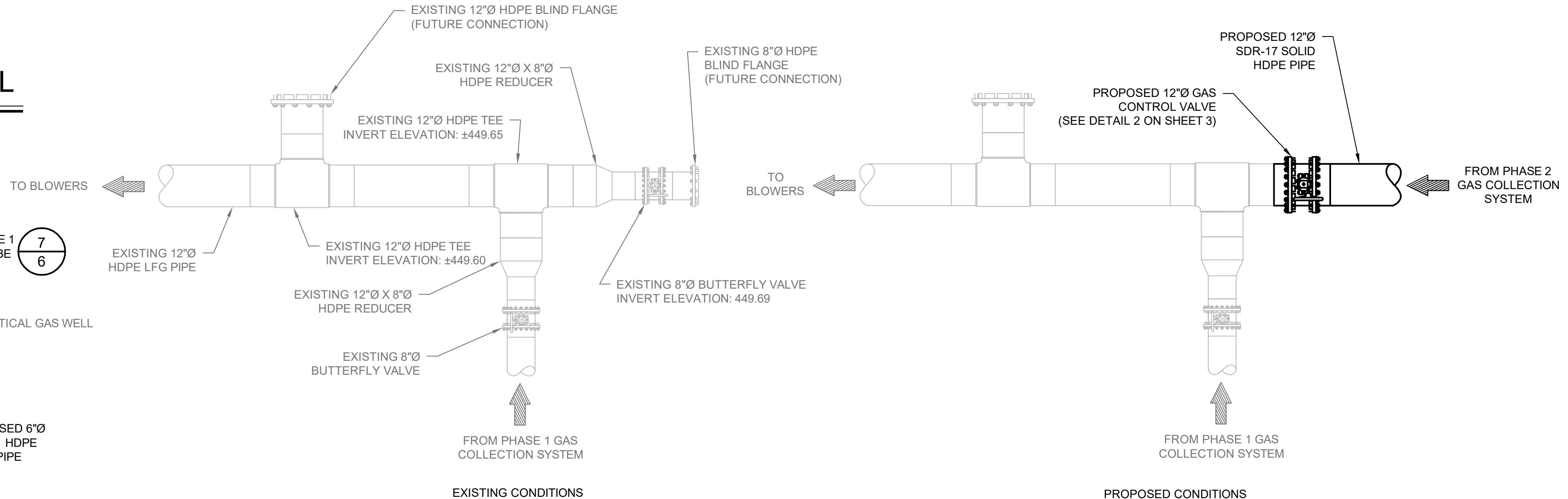
NOT TO SCALE



CONNECTION TO EXISTING LATERAL DETAIL

5

NOT TO SCALE



CONNECTION TO EXISTING LFG MANIFOLD DETAIL

6

NOT TO SCALE

- NOT FOR CONSTRUCTION -

SANBORN HEAD

SCALE AS INDICATED

DRAFT

NO.	DATE	DESCRIPTION	BY

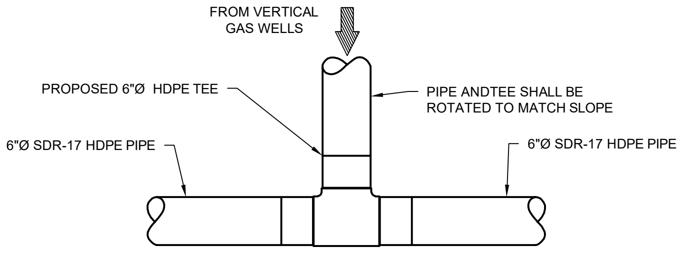
DRAWN BY: J. GRACE
DESIGNED BY: J. GRACE
REVIEWED BY: J. CHABOT
PROJECT MGR: M. KOZLOWSKI
PIC: J. CHABOT
DATE: SEPTEMBER 2019

PHASE 2 GCCS CONSTRUCTION DRAWINGS
WRH HORN RAPIDS, LLC
RICHLAND, WASHINGTON

TYPICAL DETAILS

PROJECT NUMBER:
4631.00

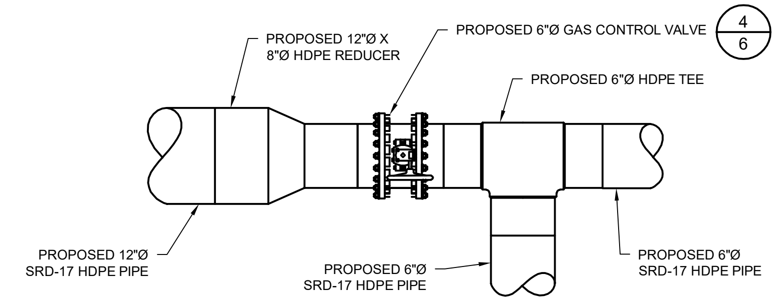
SHEET NUMBER:
5 OF 7



GAS CONVEYANCE PIPE TEE CONNECTION

1

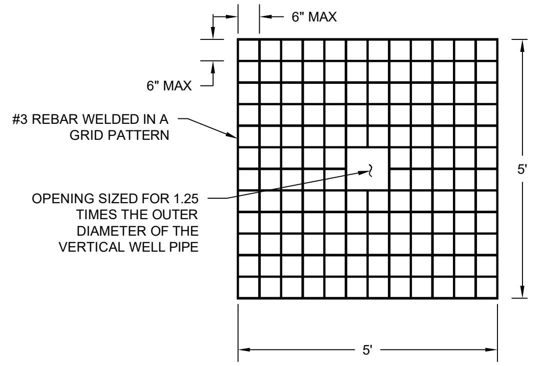
NOT TO SCALE



PROPOSED GAS HEADER DOWNSIZE DETAIL

2

NOT TO SCALE



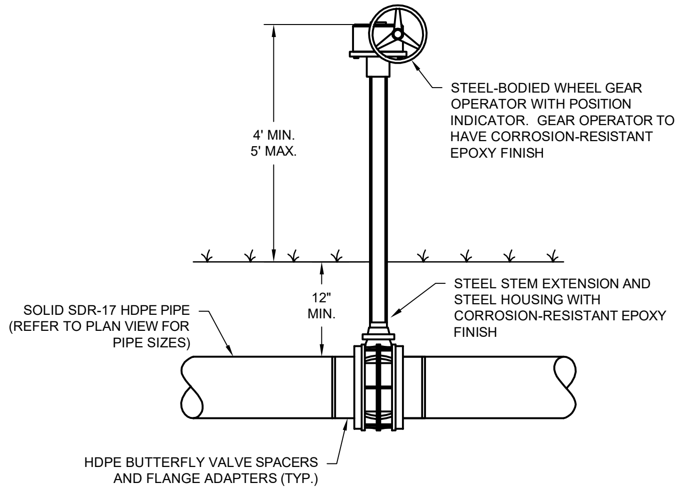
NOTE:

1. SAFETY GRATE SHALL BE ISCO INDUSTRIES WELL SAFETY GRATE OR APPROVED EQUIVALENT.
2. PERMANENT SAFETY GRATE TO BE BURIED IN INTERMEDIATE COVER AT EACH WELL LOCATION.

PERMANENT SAFETY GRATE DETAIL

3

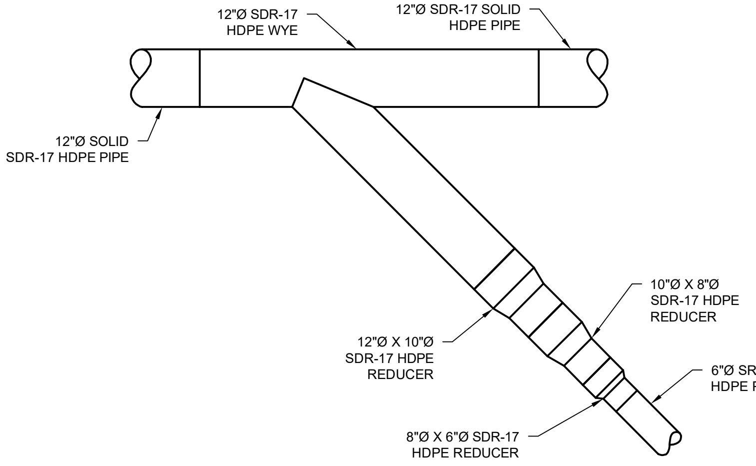
NOT TO SCALE



TYPICAL GAS CONTROL VALVE DETAIL

4

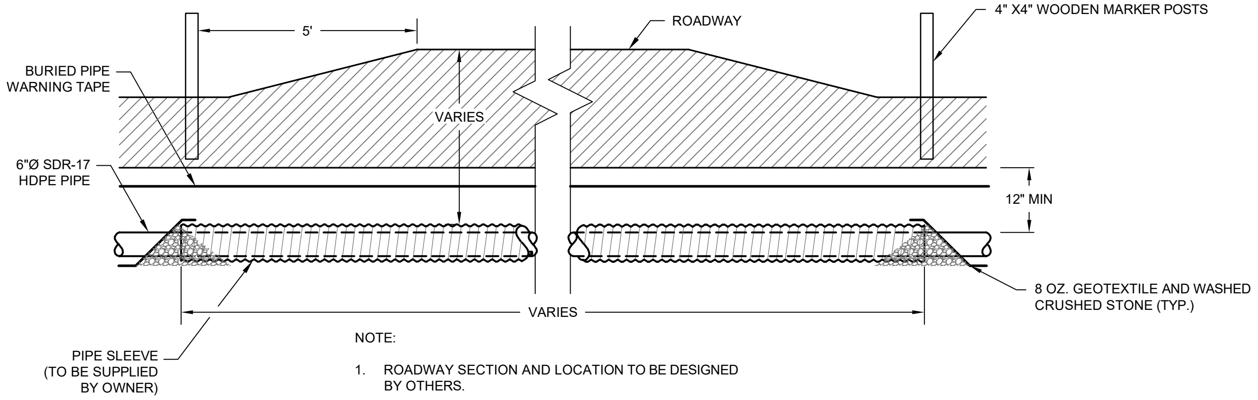
NOT TO SCALE



NORTHERN LATERAL HEADER CONNECTION DETAIL

5

NOT TO SCALE



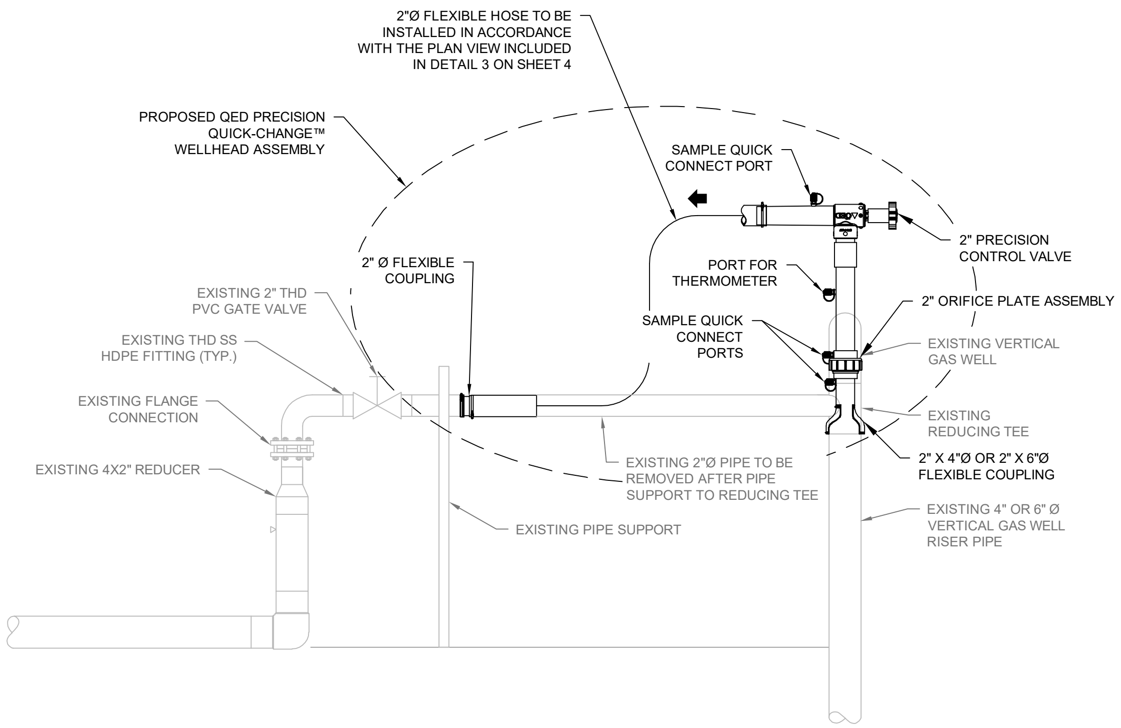
NOTE:

1. ROADWAY SECTION AND LOCATION TO BE DESIGNED BY OTHERS.

ROADWAY CROSSING

6

NOT TO SCALE



PHASE 1 WELLHEAD MODIFICATION DETAIL

7

NOT TO SCALE

- NOT FOR CONSTRUCTION -

SANBORN | HEAD

SCALE AS INDICATED

DRAFT

NO.	DATE	DESCRIPTION	BY

DRAWN BY: J. GRACE
DESIGNED BY: J. GRACE
REVIEWED BY: J. CHABOT
PROJECT MGR: M. KOZLOWSKI
PIC: J. CHABOT
DATE: SEPTEMBER 2019

PHASE 2 GCCS CONSTRUCTION DRAWINGS
WRH HORN RAPIDS, LLC
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TYPICAL DETAILS

PROJECT NUMBER: 4631.00

SHEET NUMBER: 6 OF 7

MATERIAL SPECIFICATIONS:

HIGH DENSITY POLYETHYLENE PIPE AND FITTINGS:

1. THE CONTRACTOR SHALL FURNISH AND INSTALL HDPE PIPE AND FITTINGS, AND ISOLATION VALVES AND PROVIDE TESTING FOR EACH OF THE HDPE PIPE SYSTEMS.
2. PRIOR TO PURCHASING MATERIALS, THE CONTRACTOR SHALL SUBMIT TO THE OWNER FOR REVIEW AND APPROVAL:

MANUFACTURING DATA FOR THE PIPE AND FITTINGS MATERIAL LISTING THE PHYSICAL PROPERTIES IN THE SAME UNITS AND USING THE SAME TEST IDENTIFIED IN THIS SECIFICATION.

   A. PIPE DIMENSIONS, INCLUDING AVERAGE OUTSIDE DIAMETER, AVERAGE INSIDE DIAMETER, MINIMUM AND AVERAGE WALL THICKNESS, FLARE OUTSIDE DIAMETER, PITCH, AND APPROXIMATE WEIGHT IN POUNDS PER FOOT.
   B. MANUFACTURER'S INSTRUCTIONS FOR FUSING JOINTS.
   C. PRESSURE TEST REPORT TO BE USED FOR EACH PIPING SYSTEM TESTED.

3. MATERIALS USED FOR THE MANUFACTURE OF HIGH DENSITY POLYETHYLENE PIPE AND FITTINGS SHALL MEET THE FOLLOWING PHYSICAL PROPERTY REQUIREMENTS OF PE4710.
4. THERE SHALL BE NO EVIDENCE OF SPLITTING, CRACKING, OR BREAKING WHEN THE PIPE IS TESTED.
5. THE PIPE AND FITTINGS SHALL BE HOMOGENEOUS THROUGHOUT AND FREE FROM VISIBLE CRACKS, HOLES, FOREIGN INCLUSIONS, OR OTHER INJURIOUS DEFECTS. THE PIPE SHALL BE UNIFORM AS COMMERCIALLY PRACTICAL IN COLOR, OPACITY, DENSITY, AND OTHER PHYSICAL PROPERTIES.
6. FITTINGS SUCH AS COUPLINGS, WYES, TEES, ADAPTERS, ETC. FOR USE IN LAYING PIPE SHALL HAVE STANDARD DIMENSIONS THAT CONFORM TO ASTM D3261. AT THE POINT OF FUSION, THE OUTSIDE DIAMETER AND MINIMUM WALL THICKNESS OF FITTING BUTT FUSION OUTLETS SHALL MEET THE DIAMETER AND WALL THICKNESS SPECIFICATIONS OF THE MATING SYSTEM PIPE. FITTING MARKINGS SHALL INCLUDE A PRODUCTION CODE THAT IDENTIFIES THE LOCATION AND DATE OF MANUFACTURE. UPON REQUEST, THE MANUFACTURER SHALL PROVIDE AN EXPLANATION OF THE PRODUCTION CODE.
7. PIPE FITTINGS SHALL BE MOLDED AND PRODUCED BY THE SAME MANUFACTURER AND FROM IDENTICAL MATERIALS MEETING THE REQUIREMENTS OF THIS SPECIFICAITON. SPECIAL OR CUSTOM FITTINGS MAY BE EXEMPTED FROM THIS REQUIREMENT. OWNER MAY ALLOW SUBSTITUTION FOR APPROVED MATERIAL WITH USE OF FLANGED JOINT SECTIONS. THE DRAWINGS DO NOT SHOW ALL FITTINGS THAT MAY BE REQUIRED. PROVIDE ALL FITTINGS FOR A COMPLETE INSTALLATION.
8. PIPE AND FITTINGS SHALL BE PRESSURE RATED TO MEET THE SERVICE PRESSURE REQUIREMENTS SPECIFIED. FITTINGS SHALL BE FULLY PRESSURE RATED TO AT LEAST THE SAME PRESSURE RATING AS THE JOINING PIPE.
9. EACH RANDOM LENGTH OF PIPE AND FITTING SHALL BE CLEARLY MARKED WITH THE MANUFACTURER'S NAME OR TRADEMARK, ASTM DESIGNATION, NOMINAL PIPE SIZE, CLASS AND PROFILE NUMBER, PRODUCTION CODE INCLUDING EXTRUSION DATE AND LOT OR BATCH NUMBER, AND STANDARD DIMENSION RATIO.
10. THE PIPE AND FITTING MANUFACTURER SHALL CERTIFY THAT SAMPLES OF THE PRODUCTION PIPE HAVE UNDERGONE STRESS REGRESSION TESTING, EVALUATION, AND VALIDATION IN ACCORDANCE WITH ASTM D2837 AND PPI TR-3. UNDER THESE PROCEDURES, THE MINIMUM HYDROSTATIC DESIGN SHALL BE CERTIFIED BY THE PIPE AND FITTING MANUFACTURER TO BE 1600 PSI AT 73.4 °F AND 800 PSI AT 140 °F.
11. THE MANUFACTURER SHALL FURNISH A CERTIFICATE OF CONFORMANCE TO THESE SPECIFICATIONS UPON REQUEST. WHEN PRIOR AGREEMENT IS BEING MADE IN WRITING BETWEEN CONTRACTOR AND THE MANUFACTURER, THE MANUFACTURER SHALL FURNISH OTHER CONFORMANCE CERTIFICATION IN THE FORM OF AFFIDAVIT OF CONFORMANCE, TEST RESULTS, OR COPIES OF TEST REPORTS.
12. ALL FLANGE GASKETS SHALL BE FULL-FACE VITON. ALL BACK-UP RINGS SHALL BE DUCTILE IRON WITH EPOXY POWDER COATING AND ALL FASTENING HARDWARE SHALL BE ZINC DICHROMATE PLATED. ALL THREADS SHALL BE LUBRICATED WITH NEVERSEIZE. DO NOT OVER-TORQUE BOLTS. CONTRACTOR SHALL USE A TORQUE WRENCH TO TIGHTEN ALL FLANGE FASTENERS IN SEQUENCE AND IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.

PNEUMATIC PIPE TESTING (HDPE PIPE)

1. **WARNING: COMPRESSED AIR OR ANY PRESSURIZED GAS USED AS A TEST MEDIUM MAY PRESENT SEVERE HAZARDS TO PERSONNEL IN THE VICINITY OF PIPELINES BEING TESTED. EXTRA PERSONNEL PROTECTION PRECAUTIONS SHOULD BE OBSERVED WHEN A GAS UNDER PRESSURE IS USED AS THE TEST MEDIUM. PIPE SYSTEM RUPTURE DURING PNEUMATIC PRESSURE TESTS MAY RESULT IS EXPLOSIVE, UNCONTROLLED MOVEMENT OF SYSTEM PIPE, COMPONENTS, OR PARTS OF COMPONENTS. KEEP PERSONNEL A SAFE DISTANCE AWAY FROM THE TEST SECTION DURING TESTING.**
2. THE CONTRACTOR SHALL PROVIDE ALL NECESSARY CONNECTIONS, BULKHEADS, FLANGES, BRACING, AND BLOCKING, AS WELL AS ALL REQUIRED TEST EQUIPMENT.
3. TEST PRESSURE GAUGE SHALL HAVE A MAXIMUM RANGE OF NO MORE THAN 20 PSIG, WITH MINOR GRADATIONS NO GREATER THAN 0.4 PSIG.
4. PIPE TO BE TESTED SHALL BE EXPOSED, EXCEPT BENDS AND REDUCED PRESSURE-RATED FITTINGS AND COMPONENTS, WHICH SHALL BE BURIED OR RESTRAINED. FLANGE CONNECTIONS SHALL BE VISIBLE TO CHECK FOR LEAKS.
5. TEST PRESSURE SHALL BE 10 PSIG. THE TEST PERIOD AT THE TEST PRESSURE SHALL LAST NO MORE THAN 10 MINUTES. TEST SHALL BE ACCEPTED IF THE PRESSURE DROP OVER 10 MINUTES IS LESS THAN 5 PERCENT (0.5PSIG) OF THE PRESSURE AT THE BEGINNING OF THE TEST PERIOD.
6. TEST REPORTS SHALL BE PROVIDED TO THE OWNER. AT A MINIMUM, TEST REPORTS SHALL INCLUDE THE DATE OF THE TEST, DESCRIPTION AND IDENTIFICATION OF PIPE SYSTEM TESTED, TYPE OF TEST FLUID, TEST PRESSURE, PRESSURE AT START OF TEST, PRESSURE AT COMPLETION OF TEST, TEST RESULT, TYPE AND LOCATION OF LEAKS DETECTED, CORRECTIVE ACTION TAKEN TO REPAIR LEAKS, RESULTS OF RETESTING, AND THE NAME OF THE PERSON PERFORMING THE TEST.

HYDROSTATIC PIPE TESTING (HDPE PIPE)

1. HYROSTATIC TESTS SHALL BE PERFORMED AS FOLLOWS:
   A. REMOVE OR ISOLATE VALVES, FLOW METERS, AND INSTRUMENTS THAT MAY NOT WITHSTAND THE REQUIRED TEST PRESSURE FROM WITHIN THE TEST SECTIONS. RECONNECT PIPES WITH TEMPORARY FITTINGS. VENT ISOLATED EQUIPMENT.
   B. FLUSH PIPE WITH CLEAN WATER UNTIL PIPE SECTION TO BE TESTED IS CLEAN AND FREE OF DIRT, SAND, PIPE SHAVINGS, OR OTHER FOREIGN MATERIAL.
   C. PLUG PIPE OUTLETS WITH TEST PLUGS, BLIND FLANGES OR OTHER DEVICES SUITABLE FOR THE TEST PRESSURE. BRACE SECURELY TO PREVENT BLOWOUTS. VERIFY TEST PRESSURE DOES NOT EXCEED ANY COMPONENT OF THE PIPE SYSTEM.
   D. RESTRAIN OR REMOVE EXPANSION JOINTS.
   E. PRESSURIZING EQUIPMENT SHALL INCLUDE A PRESSURE REGULATOR SET TO AVOID OVER-PRESSURIZING AND DAMAGING OTHERWISE ACCEPTABLE PIPE.
   F. THE CONTRACTOR SHALL USE A HYDROSTATIC TEST PUMP SPECIFICALLY DESIGNED FOR PERFORMING HYDROSTATIC PRESSURE TESTS ON PIPE.
   G. PIPE SHALL BE TESTED AT 1.5 TIMES THE RATED WORKING PRESSURE OF THE PIPE OR THE LOWEST RATED PRESSURE OF ANY COMPONENT OF THE SYSTEM BEING TESTED, EXCEPT COMPRESSED AIR PIPE, WHICH SHALL BE TESTED AT THE RATED WORKING PRESSURE OF THE PIPE. FOR EXAMPLE, SDR-11 PIPE IS RATED FOR 160 PSIG SERVICE. THEREFORE THE TEST PRESSURE IS 240 PSIG.
   H. APPLY TEST PRESSURE SLOWLY, AND ONCE THE TEST PRESSURE HAS BEEN REACHED ALLOW THE PRESSURE TO STABILIZE WITHOUT ADDING ADDITIONAL PRESSURE. THIS MAY TAKE SEVERAL HOURS.
   I. ONCE PRESSURE HAS STABILIZED, ADD ADDITIONAL WATER TO ACHIEVE THE TEST PRESSURE, AND BEGIN THE TEST.
   J. AFTER 1 HOUR ADDITIONAL WATER SHALL BE ADDED TO RETURN TO THE TEST PRESSURE. IF THE VOLUME OF WATER REQUIRED TO ACHIEVE THE TEST PRESSURE AFTER 1 HOUR IS LESS THAN SHOWN IN THE TABLE BELOW, THEN THE PIPE HAS PASSED THE PRESSURE TEST.
   K. THE TOTAL TEST TIME, INCLUDING THE INITIAL PRESSURIZATION, INITIAL EXPANSION, AND TIME AT TEST PRESSURE, SHALL NOT EXCEED EIGHT HOURS. IF THE TEST IS NOT COMPLETED WITHIN THAT TIME, THEN THE TEST PRESSURE SHALL BE REMOVED FOR AT LEAST EIGHT HOURS PRIOR TO PERFORMING THE TEST AGAIN.
   L. CLEAN POTABLE WATER SHALL BE USED AS THE TESTING MEDIUM TO FILL THE PIPES.

ALLOWABLE WATER LOSS UNDER PRESSURE FOR A ONE (1) HOUR TEST

NOMINAL PIPE SIZE (IN)	U.S. GALS PER 100 FT OF PIPE
1	0.06
2	0.07
3	0.10
4	0.13
6	0.30

2. TEST PRESSURES
   A. LANDFILL GAS CONVEYANCE PIPE - HYDROSTATIC TEST AT 150% OF RATED PRESSURE OR LANDFILL GAS CONVEYANCE PIPE - PNEUMATIC TEST AT 15 PSIG AIR.
   B. IN NO CASE EXCEED MAXIMUM ALLOWABLE PRESSURE FOR ANY PIPELINE COMPONENT, INCLUDING VALVES, FITTINGS, AND INSTRUMENTS.
   C. IF PRESSURE TEST IS NOT ACCEPTED, THEN CORRECT LEAKS OR DEFECTS IN THE PIPE, AND RETEST.
   D. REMOVE TEMPORARY SECTIONALIZING DEVICES AFTER TESTS ARE COMPLETE.
   E. REMOVE ALL WATER FROM COMPRESSED AIR DISTRIBUTION PIPE AFTER TEST IS COMPLETED.
3. TEST REPORTS SHALL BE PROVIDED TO THE OWNER. AT A MINIMUM, TEST REPORTS SHALL INCLUDE THE DATE OF THE TEST, DESCRIPTION AND IDENTIFICATION OF PIPE SYSTEM TESTED, TYPE OF TEST FLUID, TEST PRESSURE, PRESSURE AT START OF TEST, PRESSURE AT COMPLETION OF TEST, TEST RESULT, TYPE AND LOCATION OF LEAKS DETECTED, CORRECTIVE ACTION TAKEN TO REPAIR LEAKS, RESULTS OF RETESTING, AND THE NAME OF THE PERSON PERFORMING THE TEST.

WASHED CRUSHED STONE

2. WASHED CRUSHED STONE FOR USE IN THE VERTICAL EXTRACTION WELLS SHALL BE HARD, DURABLE, AND RESISTANT TO WEATHERING AND TO WATER ACTION, FREE FROM OVERBURDEN, SPOIL, AND ORGANIC MATERIALS. CRUSHED STONE SHALL BE WASHED AND UNIFORMLY BLENDED TO MEET THE GRADATION REQUIREMENTS SHOWN BELOW:

SIEVE SIZE:	PERCENT PASSING BY WEIGHT
2 INCH	100
1 1/2 INCH	95-100
1 INCH	35-70
3/4 INCH	0-25
1/4 INCH	0-2

BENTONITE SEAL

1. BENTONITE FOR THE WELL SEALS SHALL BE PREHYDRATED AT THE SURFACE USING A MORTAR OR GROUT MIXER. BENTONITE SHALL NOT BE MIXED AND HYDRATED BY HAND MIXING IN A BUCKET. BENTONITE SHALL BE PREPARED AS FOLLOWS:
   - PLACE 24 GALLONS OF WATER INTO THE MORTAR OR GROUT MIXER.
   - ADD 32 OUNCES OF PDS SUPER MUD OR 4 OUNCES OF HALLIBURTON QUICK MUD® D-50 VISCOSIFIER/BOREHOLE STABILIZER POLYMER TO THE WATER. MIX THOROUGHLY UNTIL OBSERVED TO BE UNIFORM IN COLOR.
   - ADD 2 BAGS OF 3/8-INCH SODIUM BENTONITE “CHIPS” (50 POUNDS OF EACH PDSCO PLUG OR BAROID HOLE PLUG® OR EQUIVALENT) TO THE WATER POLYMER MIXTURE. VIGOROUSLY MIX THE COMBINATION OF CHIPS, WATER, AND POLYMER UNTIL OBSERVED TO BE UNIFORM IN COLOR THROUGHOUT WITH VARIED TEXTURE, AS THE CHIPS WILL STILL BE CLEARLY DISCERNABLE.
   - ADD ONE 50-POUND BAG OF GRANULAR SODIUM BENTONITE (8 MESH-PDS GRANULAR SEAL OR BAROID BENSEAL® OR EQUIVALENT). MIX VIGOROUSLY UNTIL THOROUGHLY BLENDED AND UNIFORM IN COLOR AND VARIED TEXTURE, AS THE CHIPS WILL STILL BE CLEARLY DISCERNABLE. THE RESULTANT MIXTURE SHOULD BE THICK BUT FLOWABLE AND READY TO PLACE.

   EACH “BATCH” (AS DESCRIBED ABOVE) IS SUFFICIENT TO DEVELOP A 6-INCH SEAL THICKNESS WITHIN A 36-INCH BOREHOLE HOLDING AN 8-INCH SCHEDULE 80 PVC PIPE. BATCH SIZES MAY BE ADJUSTED TO SUITE THE MIXING EQUIPMENT, BUT THE RATIOS OF INGREDIENTS MUST BE MAINTAINED. REPEAT THIS PROCESS AS NEEDED TO PRODUCE THE MINIMUM WELL SEAL THICKNESS.

2. PLACE THE BENTONITE MIXTURE UNIFORMLY AROUND THE CIRCUMFERENCE OF THE WELL BORE PIPE, BY TREMIE OR FREE FALL, UNTIL SUFFICIENT MATERIAL HAS BEEN INTRODUCED TO THE HOLE TO COMPLETE THE MINIMUM WELL SEAL THICKNESS. ENSURE PLACEMENT IS UNIFORM AROUND THE WELL PIPE BY ALTERNATING BACKFILL POINTS FROM SIDE TO SIDE (TO NOT PLACE ALL BENTONITE FROM ONE SIDE).
3. CONFIRM THE THICKNESS OF THE BENTONITE SEAL BY MEASUREMENT. ADD ADDITIONAL PREHYDRATED BENTONITE AS REQUIRED UNTIL THE SEAL IS FULLY DEVELOPED. WAIT AT LEAST 20-MINUTES FOR THE BENTONITE TO HYDRATE BEFORE PLACING SOIL BACKFILL.

GRANULAR FILL:

1. GRANULAR FILL SHALL BE FREE OF ICE, SNOW, ROOTS AND OTHER ORGANIC MATTER AND SHALL CONFORM TO THE FOLLOWING PARTICLE SIZE DISTRIBUTION:

SIEVE SIZE:	PERCENT PASSING BY WEIGHT
1 INCH	100
NO. 4	80 - 100
NO. 10	60 - 95
NO. 40	10 - 50
NO. 200	0 - 20

INTERMEDIATE COVER AND COMMON FILL

1. INTERMEDIATE COVER AND COMMON FILL TO BE USED SHALL BE FRIABLE SOIL CONTAINING NO STONE GREATER THAN TWO-THIRDS (⅔) LOOSE LIFT THICKNESS WHEN PLACED IN LIFTS. THE MATERIAL SHALL BE FREE OF TRASH, ICE, SNOW, TREE STUMPS, ROOTS, AND OTHER DELETERIOUS MATERIALS WITH NO MORE THAN 70 PERCENT OF THE MATERIAL PASSING THE NO. 200 SIEVE.

GEOTEXTILE:

1. GEOTEXTILE SHALL BE A 8-oz. NONWOVEN GEOTEXTILE.

ODOR CONTROL:

1. THE CONTRACTOR SHALL IMPLEMENT ODOR CONTROL MEASURES DURING CONSTRUCTION ACTIVITIES THAT INVOLVE EXCAVATION, TRENCHING, OR DRILLING IN LANDFILLED WASTE. THE AREA OF EXPOSED WASTE AS A RESULT OF THE WORK SHALL BE LIMITED TO THE LENGTH OF TRENCH THAT MAY BE BACKFILLED BEFORE THE END OF EACH DAY. THE CONTRACTOR SHALL HAUL WASTE SPOILS TO THE WORKING FACE OF THE LANDFILL AND COVER AREAS OF EXPOSED WASTE BEFORE THE END OF EACH DAY WITH APPROVED DAILY COVER SOILS, WHICH MAY BE OBTAINED FROM ON-SITE SOURCES. BOREHOLES AND TRENCHES SHALL NOT BE LEFT OPEN OVERNIGHT.

ADDITIONAL NOTES:

1. UNLESS OTHERWISE INDICATED, THE FOLLOWING COMPONENTS SHALL BE AS DESCRIBED BELOW OR EQUIVALENT APPROVED BY THE ENGINEER.
   A. ALL HDPE GAS PIPE SHALL BE SDR 17. FITTINGS MAY BE SDR 11 OR SDR 17.
   B. VERTICAL LFG EXTRACTION WELLS SHALL BE CONSTRUCTED USING FACTORY PERFORATED 8-INCH DIAMETER SCH. 80 PVC PIPE.
   C. WELLHEADS SHALL BE 2-INCH QED PRECISION QUICK-CHANGE™ ORIFICE PLATE WELLHEADS; OR EQUIVALENT APPROVED BY THE OWNER.
   D. ALL FLANGE GASKETS SHALL BE FULL-FACE VITON. ALL BACK-UP RINGS SHALL BE DUCTILE IRON WITH EPOXY POWDER COATING AND ALL FASTENING HARDWARE SHALL BE ZINC DICHROMATE PLATED.

PRECONSTRUCTION NOTES:

1. PRIOR TO PERFORMING ANY WORK, THE CONTRACTOR SHALL ATTEND A PRECONSTRUCTION MEETING SCHEDULED BY THE OWNER.

CONSTRUCTION NOTES:

1. THIS SITE IS AN ACTIVE LANDFILL. THE CONTRACTOR SHALL COORDINATE CONSTRUCTION ACTIVITIES WITH THE OWNER AND OTHER SUBCONTRACTORS SO THAT COMMERCIAL TRAFFICE ACCESS TO THE ACTIVE LANDFILL FACE IS DISRUPTED AS LITTLE AS POSSIBLE. THIS WILL REQUIRE THAT TWO-WAY TRAFFIC BE MAINTAINED ON THE ACCESS ROAD DURING FACILITY OPERATING HOURS.
2. THE CONTRACTOR SHALL TAKE CARE WHEN EXCAVATING TO ENSURE THAT EXISTING BURIED PIPES AND GEOSYNTHETIC MATERIALS ARE NOT DAMAGED. DAMAGE CAUSED BY THE CONTRACTOR TO EXISTING UTILITIES, RISERS, STRUCTURES, ACCESS ROADS, OR OTHER ANCILLARY COMPONENTS OF THE LANDFILL SHALL BE PROMPTLY REPAIRED TO THE SATISFACTION OF THE OWNER BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE OWNER.
3. THE ALIGNMENTS SHOWN ON THESE PLANS WERE DEVELOPED BASED ON THE TOPOGRAPHY SHOWN TO PROMOTE DRAINAGE OF CONDENSATE AND REDUCE THE DEPTH OF EXCAVATION NECESSARY TO PROVIDE THE MINIMUM SLOPE REQUIRED; HOWEVER, ACTUAL GRADES AT THE TIME OF CONSTRUCTION WILL LIKELY VARY FROM THOSE SHOWN. PRIOR TO EXCAVATING TRENCHES, THE CONTRACTOR SHALL CONFIRM THE LOCATION AND DEPTHS OF EXISTING LFG PIPE CONNECTIONS, AND BASED ON THE ACTUAL GRADES AT TIME OF CONSTRUCTION DETERMINE THE DEPTH OF EXCAVATION ALONG THE PROFILE OF THE PROPOSED ALIGNMENTS FOR APPROVAL BY THE OWNER.

DESIGN CRITERIA

1. THESE DRAWINGS WERE PREPARED BASED ON THE FOLLOWING DESIGN CRITERIA:
   A. 5.0 PERCENT MINIMUM SLOPE FOR SOLID LFG COLLECTION PIPES IN THE WASTE;
   B. 100-FOOT RADIUS OF INFLUENCE USED TO SPACE LOCATIONS OF VERTICAL LFG EXTRACTION WELLS;
   C. 15 FEET OF SOLID PIPE AT THE TOP OF VERTICAL LFG EXTRACTION WELLS MEASURED BETWEEN PROPOSED GROUND SURFACE AND TOP OF SCREEN ELEVATION.
   D. 36-INCH DIAMETER BOREHOLES FOR VERTICAL LFG EXTRACTION WELLS; AND
   E. MAXIMUM VACUUM OF 35 INCHES OF WATER COLUMN APPLIED TO THE COLLECTION SYSTEM.

ABBREVIATIONS:

GCCS	GAS COLLECTION & CONTROL SYSTEM
HDPE	HIGH-DENSITY POLYETHYLENE
LFG	LANDFILL GAS
MIN	MINIMUM
PVC	POLYVINYL CHLORIDE
SCH	SCHEDULE
SDR	STANDARD DIMENSION RATIO
TYP	TYPICAL

- NOT FOR CONSTRUCTION -

SANBORN HEAD

SCALE AS INDICATED

DRAFT

NO.	DATE	DESCRIPTION	BY

DRAWN BY: J. GRACE
DESIGNED BY: J. GRACE
REVIEWED BY: J. CHABOT
PROJECT MGR: M. KOZLOWSKI
PIC: J. CHABOT
DATE: SEPTEMBER 2019

PHASE 2 GCCS CONSTRUCTION DRAWINGS
WRH HORN RAPIDS, LLC
RICHLAND, WASHINGTON

TECHNICAL SPECIFICATIONS

PROJECT NUMBER: 4631.00

SHEET NUMBER: 6 OF 7

IMAGES:

XREFS: P:\4600s\4631.00\Graphics Files\CAD\Phase II\xrefs\Prop Phase 2 GCCS.dwg
P:\4600s\4631.00\Graphics Files\CAD\Phase II\xrefs\Border.dwg
P:\4600s\4631.00\Graphics Files\CAD\Phase II\xrefs\Phase 2 Final Grades.dwg

FILE: P:\4600s\4631.00\Graphics Files\CAD\Phase II\D04-07-Details.dwg
LAYOUT: D07
USER: kanderson
PLOT DATE: 9-20-19 3:16 PM

Appendix B

Well Information

B-1

Monitoring Well Logs

MW-1: 5/87

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Application No.
Permit No.

(1) OWNER: Name City of Richland Address

(2) LOCATION OF WELL: County Benton SE 4 NE ¼ SE ¼ Sec. 18 T. 16 N., R. 28E W.M.

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☒

(4) TYPE OF WORK: Owner's number of well (if more than one) TW-1

New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 2 inches.
Drilled 139 ft. Depth of completed well 136-7 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 2" Diam. from +2 ft. to 110 ft.
Threaded ☒ 2" Diam. from 120 ft. to 125 ft.
Welded ☐ " Diam. from ft. to ft.

Perforations: Yes ☐ No ☒
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☒ No ☐
Manufacturer's Name Johnson
Type Stainless Model No.
Diam. 2" Slot size 10 from 110 ft. to 120 ft.
Diam. 2 Slot size 10 from 125' ft. to 136 ft.

Gravel packed: Yes ☒ No ☐ Size of gravel: F-16
Gravel placed from 106 ft. to 136 ft.

Surface seal: Yes ☒ No ☐ To what depth? 106 ft.
Material used in seal Bentonite Volclay - cement
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name Well Wizard
Type: Teflon Bladder H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level.... ft.
Static level 106 ft. below top of well Date 4-21-87
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☐ If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Sand Tan	0	7
Silt Sandy Tan	7	16
Sand Tan silty	16	46
Sand course Tan	46	82
Sand Tan fine silty	82	99
Gravel 3" minus sand Tan	99	139

RECEIVED
JUN - 8 1987
DEPARTMENT OF ECOLOGY
CENTRAL REGION OFFICE

Work started 4-21, 1987. Completed 5-20, 1987

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

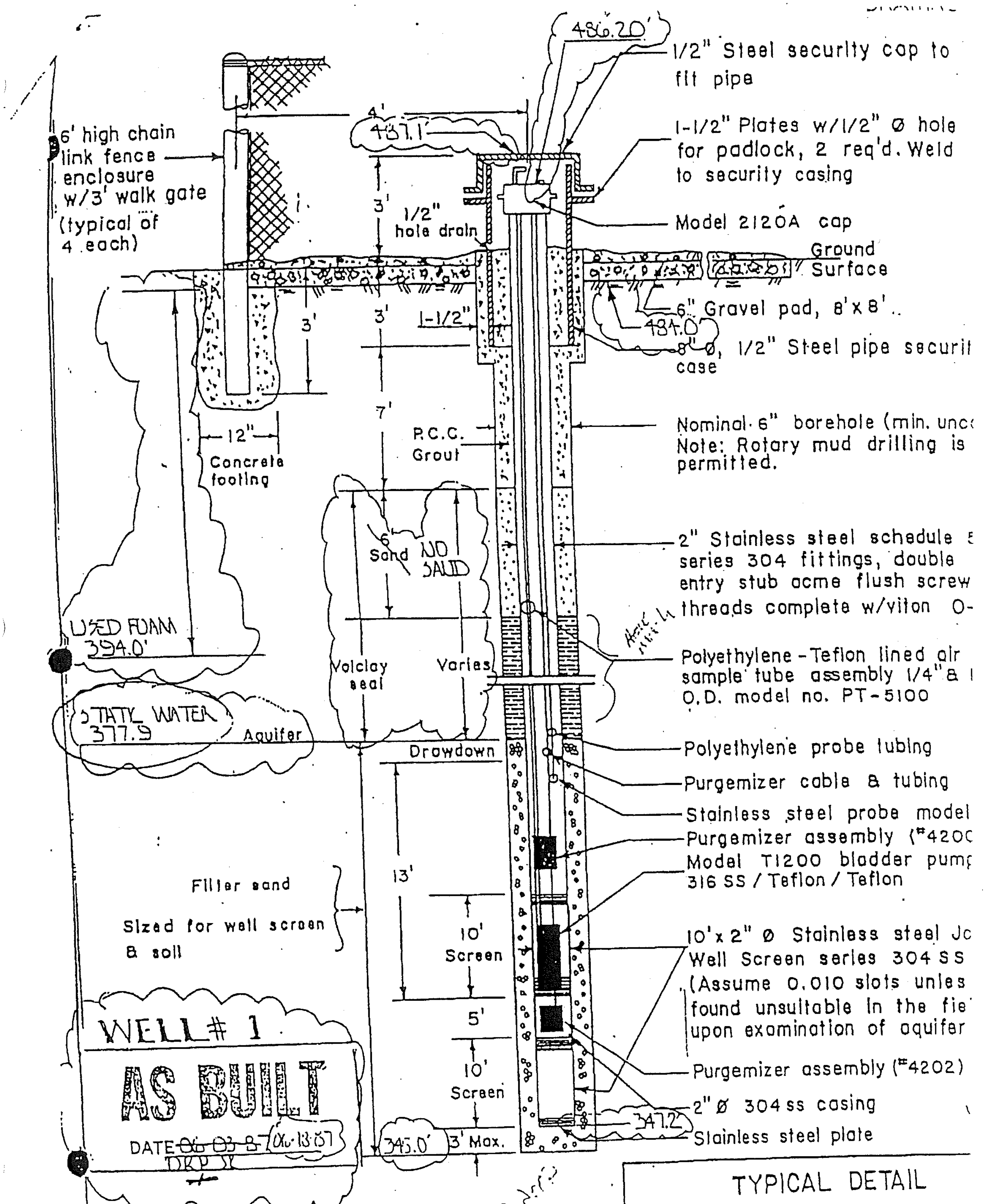
NAME Nelson Well Drilling Inc
(Person, firm, or corporation) (Type or print)

Address 10036 W Argent Drive

[Signed] James Nelson
(Well Driller)

License No. 361 Date 5-20, 1987

(USE ADDITIONAL SHEETS IF NECESSARY)



TYPICAL DETAIL

GROUND WATER MONITORING

Note: Drawing not to scale

File Original and First Copy with
Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

MW-2

WATER WELL REPORT

STATE OF WASHINGTON

Application No. /
Permit No. L

(1) OWNER: Name City of Richland Address

) LOCATION OF WELL: County Benton — NE ¼ SW ¼ Sec. 17 T. 10 N., R. 28E W.M.

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☑

(4) TYPE OF WORK: Owner's number of well (if more than one) TW 2

New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 2 inches.
Drilled 124 ft. Depth of completed well 120 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 2" Diam. from +2 ft. to 95 ft.
Threaded ☒ 2" Diam. from 105 ft. to 110 ft.
Welded ☐ " Diam. from ft. to ft.

Perforations: Yes ☐ No ☒
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☒ No ☐
Manufacturer's Name Johnson
Type Stainless Model No.
Diam. 2 Slot size 10 from 95 ft. to 105 ft.
Diam. 2 Slot size 10 from 110 ft. to 120 ft.

Gravel packed: Yes ☒ No ☐ Size of gravel: F-16
Gravel placed from 90 ft. to 120 ft.

Surface seal: Yes ☒ No ☐ To what depth? 90 ft.
Material used in seal Vol Clay + Cement
Did any strata contain unusable water? Yes ☐ No ☑
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name Well Wizard
Type: Teflon Bladder H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level.... ft.
Static level 90 ft. below top of well Date 4-15-87
Artesian pressure lbs. per square inch Date
Artesian water is controlled by
(Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☐ If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	*Water Level*	*Time*	*Water Level*	*Time*	*Water Level*

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Sand Tan	0	24
Sand Tan course	24	38
Sand Tan Trace gravel	38	68
Gravel, Sand Tan	68	124

RECEIVED
JUN - 5 1987
DEPARTMENT OF ECOLOGY
CENTRAL REGION OFFICE

Work started 4-15 1987 Completed 5-20 1987

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

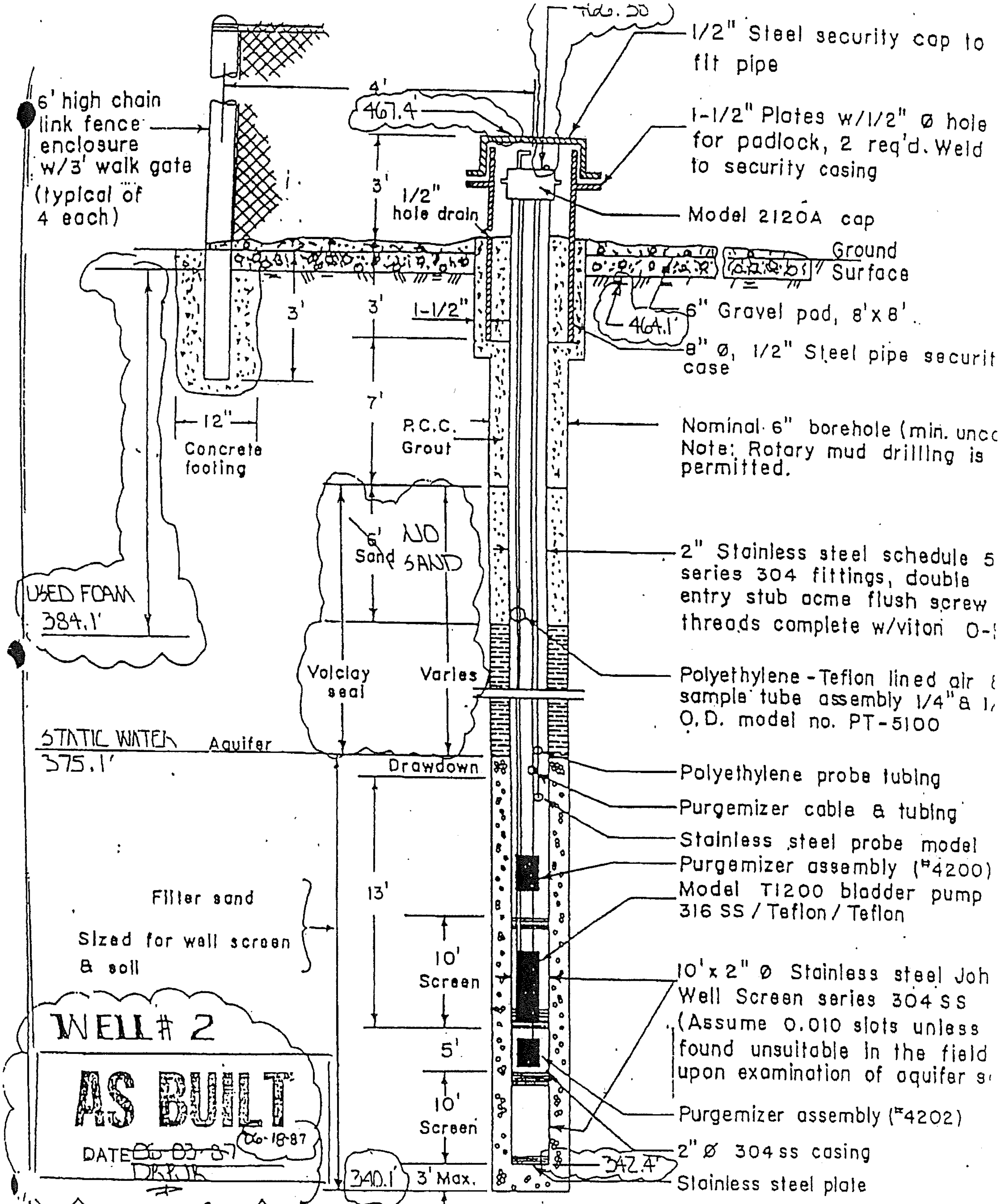
NAME Nelson Well Drilling Inc
(Person, firm, or corporation) (Type or print)

Address 10036 W. Argent Pasco

[Signed] James Nelson
(Well Driller)

License No. 361 Date 5-20 1987

(USE ADDITIONAL SHEETS IF NECESSARY)



WELL# 2

AS BUILT

DATE ~~06-03-87~~ 06-18-87

DRRJR

Note: Drawing not to scale

TYPICAL DETAIL

GROUND WATER MONITORING W

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy -- Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No
Permit No P

(1) OWNER: Name City of Richland Address

(2) LOCATION OF WELL: County Benton — SE ¼ SW ¼ Sec. 12 T. 10 N., R. 28 W.M.

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☒

(4) TYPE OF WORK: Owner's number of well (if more than one) TW 3

New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 2 inches.
Drilled 135 ft. Depth of completed well 133 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 2" Diam. from +2 ft. to 106½ ft.
Threaded ☒ 2" Diam. from 117 ft. to 123 ft.
Welded ☐ " Diam. from ft. to ft.

Perforations: Yes ☐ No ☒
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☒ No ☐
Manufacturer's Name Johnson
Type Stainless Model No.
Diam. 2 Slot size 10 from 1065 ft. to 116 ft.
Diam. 2 Slot size 10 from 123 ft. to 133 ft.

Gravel packed: Yes ☒ No ☐ Size of gravel: F-16
Gravel placed from 100 ft. to 133 ft.

Surface seal: Yes ☒ No ☐ To what depth? 100 ft.
Material used in seal Vol Clay + Cement
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name Well Wizard
Type: Teflon Bladder H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 100' 6" ft. below top of well Date 4-10
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☐ If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Sand Tan Fine	0	10
Sand Tan Course	10	57
Sand Tan Course Trace Gravel	57	68
Sand Course Tan Silty	68	92
Gravel + Sand Tan	92	133

RECEIVED
JUN - 5 1987
DEPARTMENT OF ECOLOGY
CENTRAL REGION OFFICE

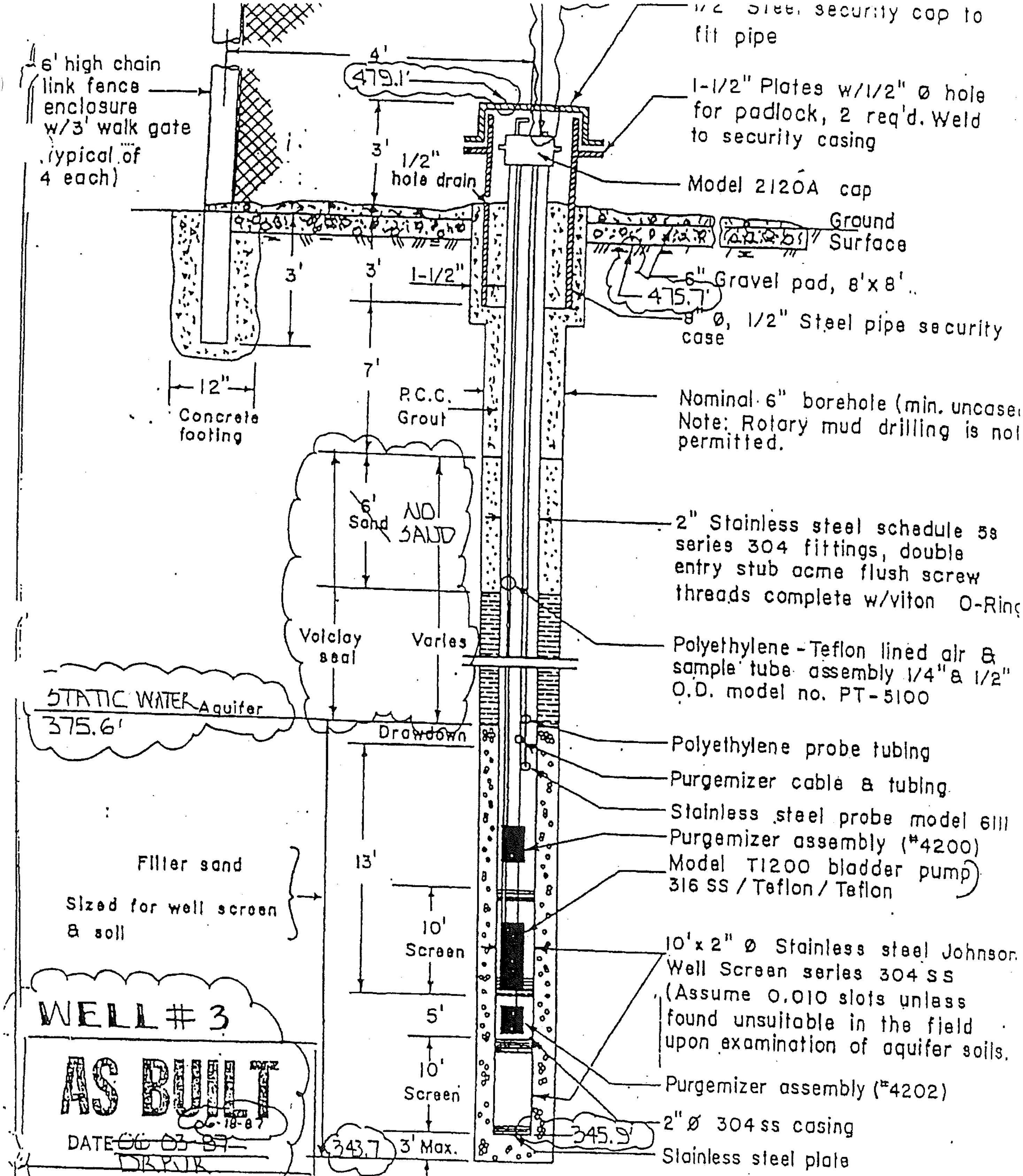
Work started 4-10 1987 Completed 5-20 1987

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME 10036 West Agent (Person, firm, or corporation) (Type or print)
Address Nelson Well Drilling INC
[Signed] Jans Nelson (Well Driller)
License No 361 Date 5-20 1987

(USE ADDITIONAL SHEETS IF NECESSARY)



Note: Drawing not to scale

TYPICAL DETAIL
GROUND WATER MONITORING WELL

File Original and First Copy with
Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

mw-4

Application No. P
Permit No.

(1) OWNER: Name City of Richland Address

(2) LOCATION OF WELL: County Benton SE ¼ SW ¼ Sec. 17 T. 10 N., R. 28 W.M. 28

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☒

(4) TYPE OF WORK: Owner's number of well (if more than one) TW 4
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 2 inches.
Drilled 118 ft. Depth of completed well 112' 3" ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 2 " Diam. from +2 ft. to 96-9 ft.
Threaded ☒ 2 " Diam. from 96-9 ft. to 102-3 ft.
Welded ☐ " Diam. from ft. to ft.

Perforations: Yes ☐ No ☒
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☒ No ☐
Manufacturer's Name Johnson
Type Stainless Model No.
Diam. 2 Slot size 10 from 86-9 ft. to 96-9 ft.
Diam. 2 Slot size 10 from 102-3 ft. to 112-3 ft.

Gravel packed: Yes ☒ No ☐ Size of gravel: F-16
Gravel placed from 81 ft. to 118 ft.

Surface seal: Yes ☒ No ☐ To what depth? 81 ft.
Material used in seal Vol Clay + Cement
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name Well Wizard
Type: Teflon Bladder H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level.... ft.
Static level 81' 5" ft. below top of well Date 4-6-87
Artesian pressure lbs. per square inch Date
Artesian water is controlled by
(Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☐ If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Sand Tan Fine	0	13
Sand Tan Course	13	46
Sand Tan Course	46	
Trace gravel		56
Sand Tan fine gravel	56	
silty		64
Silt Tan Gravel	64	76
Gravel, Sand Tan	76	118

RECEIVED
JUN - 3 1987
DEPARTMENT OF ECOLOGY
CENTRAL REGION OFFICE

Work started 4-6, 1987. Completed 5-20, 1987

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

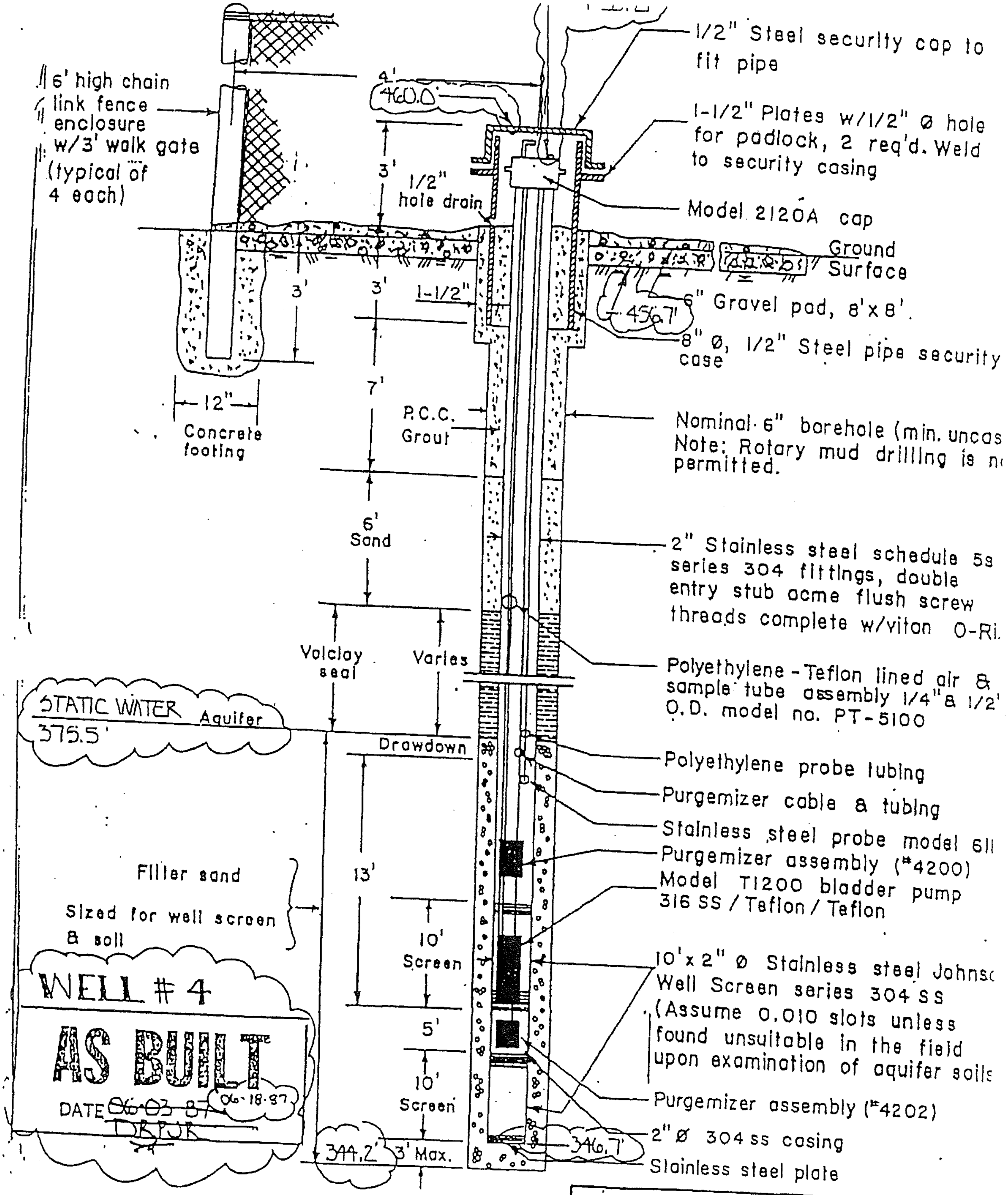
NAME Nelson Well Drilling Inc
(Person, firm, or corporation) (Type or print)

Address 40036 W Argent Pasco

[Signed] James Nelson
(Well Driller)

License No. 361 Date 5-20, 1987

(USE ADDITIONAL SHEETS IF NECESSARY)



Note: Drawing not to scale

TYPICAL DETAIL
GROUND WATER MONITORING WEL

LOG & AS-BUILT DIAGRAM

GEOLOGIC LOG

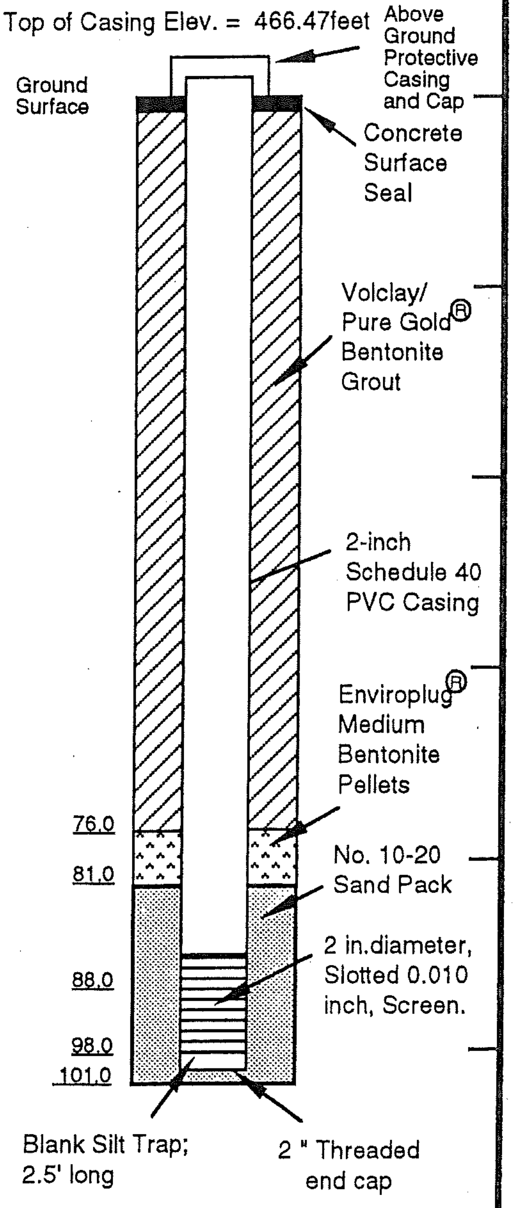
Driller: Layne Christensen
Completion Date: 05-04-98
Ground Surface Elevation = 463.21 feet

GEOLOGIC LOG	Hydrologic Unit	Samples/N-Value	Depth in Feet	Water Level
Ground Surface			0	Depth to Groundwater 83.0 feet 05-04-98
Medium dense, brown, silty SAND; dry, with occasional gravels.	5.0			
Medium dense to dense, gray-brown, poorly graded SAND, dry, medium- to fine-grained, with lenses of silty SAND.	34.0	55	20	
Dense to very dense, black-gray, poorly graded SAND; dry; coarse-grained, with occasional gravels 50 to 60 feet below ground surface.	Unsaturated Zone 72.0	45 46	40 60	
Medium dense to dense, brown, poorly graded SAND with Silt (SP-SM), moist.	81.5	21	80	▽
Medium dense to very dense, brown, poorly graded GRAVEL with sand (GP); saturated, with 1" to 3" -minus gravel, lenses of indurated silt.	Saturated Zone 101.0		100	
Bottom of Boring at 101.0'			120 140	

Well Location:
Township: 10 North
Range: 28 East
Section: 17
1/4 Section: Southwest

AS-BUILT

Top of Monument Elev. = 466.69 feet
Top of Casing Elev. = 466.47feet



Drilling Method: 8-inch Reverse Circulation

Note: Soil classification based on description of cuttings; actual transitions may be gradual.

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

June1998 V-1070-01

Richland Municipal Landfill
Richland, Washington

MONITORING WELL GW-5
(Boring B-2)

Figure 2

RESOURCE PROTECTION WELL REPORT

START CARD NO. 05020

OWNER/PROJECT: City of Richland

WELL IDENTIFICATION NO. MW-2

DRILLING METHOD: Percussion hammer

DRILLER: Charles Shory #2042

FIRM: Layne Christensen.

SIGNATURE: Chad E. Sly J.

CONSULTING FIRM: Shannon + Wilson.

REPRESENTATIVE: Matt Zyges

COUNTY: Benton . E. W. M

LOCATION: NW¼ SW¼ SEC 17 TWN 10N R 28E

STREET ADDRESS OF WELL: 3302 Grosscup Rd Richland WA

WATER LEVEL BELOW GROUND SURFACE: 81'

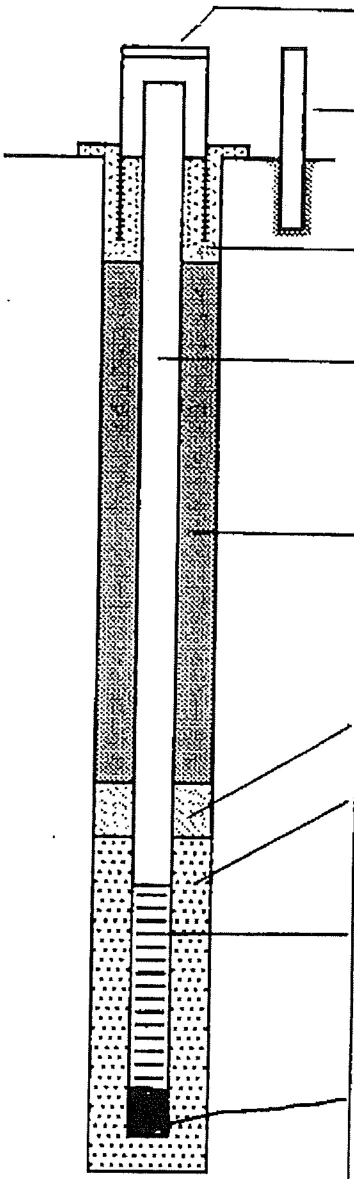
GROUND SURFACE ELEVATION: N/A

DATE(S) INSTALLED: 5-4-98

DATE(S) DEVELOPED: 5-5-98

M

AS-BUILT



TOTAL DEPTH OF BORING 100 FT.

WELL DATA

STEEL SURFACE MONUMENT

W/LOCK 3 FT. ABOVE G.L.

PROTECTIVE POSTS NO

CONCRETE SURFACE SEAL 2' TO 6" AGL

WELL CASING 87 TO 3 FT. AGL

SCHEDULE 40 PVC DIA. 2"

ANNULAR SEALANT 81 TO 2 FT.

MATERIAL Volclay Grout.

SEAL 84 TO 81 FT.

FILTER PACK 100' TO 84 FT.

MATERIAL: Silica 10-20

SCREEN INTERVAL 97 TO 87 FT.

SCHEDULE 40 PVC DIA. 2"

.010 FACTORY SLOTTED

3' sump

HOLE DIAMETER

9 IN. 0 TO 100 FT.

/ IN. / TO / FT.

FORMATION DESCRIPTION

0'-20 Course lite brown sand

20-40' Same as 0'-20'

40'-60 - Same as 20'-40

60-80' Same as 40'-60'
becoming damp.

81' stadic water

80'-90 darker course sand
water brown in color

90'-100' same as 80'-90
w/ small and med Cobbles
(good water production.)

RECEIVED
MAY 18 1998
Water Resources Program
Department of Ecology

Layne Christensen Company
1401 E. 26th Street - Tacoma, WA 98421 - (253) 572-3727 Fax (253) 572-3730

RESOURCE PROTECTION WELL REPORT

START CARD NO. 05020

OWNER/PROJECT: City of Richland

WELL IDENTIFICATION NO. MW-1

DRILLING METHOD: Percussion Hammer

DRILLER: Charles Shorey #2042

FIRM: Layne Christensen Co.

SIGNATURE: Chl C Shy Jr

CONSULTING FIRM: Shannon + Wilson

REPRESENTATIVE: Matt Zygas

COUNTY: Benton E.WM

LOCATION: NW ¼ SW ¼ SEC 17 TWN 10N R 28E

STREET ADDRESS OF WELL: 3302 Crosscup Rd Richland Wa.

WATER LEVEL BELOW GROUND SURFACE: 96'

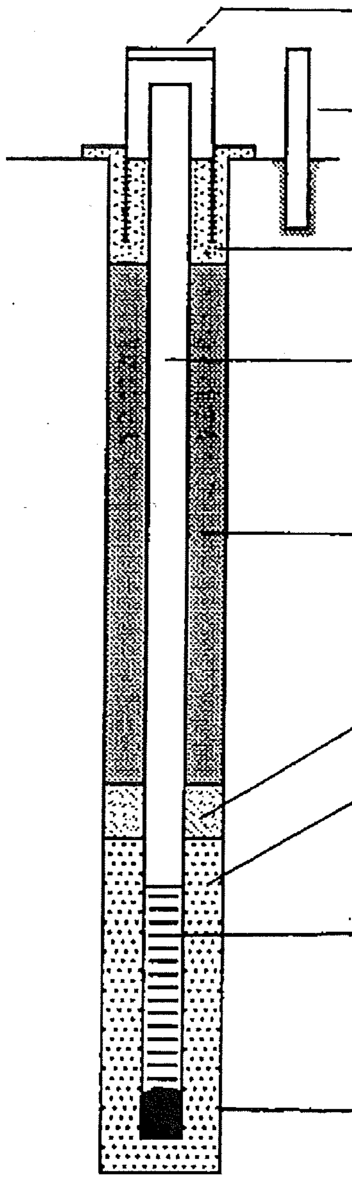
GROUND SURFACE ELEVATION: N-A

DATE(S) INSTALLED: 5-4-98

DATE(S) DEVELOPED: 5-5-98

M

AS-BUILT



TOTAL DEPTH OF BORING 115 FT.

WELL DATA

STEEL SURFACE MONUMENT W/LOCK 3' FT. ABOVE G.L.

PROTECTIVE POSTS NO

CONCRETE SURFACE SEAL 2 TO 6" AGL

WELL CASING 103 TO 3 FT. Above grade

SCHEDULE 40 PVC DIA. 2"

ANNULAR SEALANT 95 TO 2 FT.

MATERIAL Volclay grout

SEAL 99 TO 95 FT.

FILTER PACK 115 TO 99 FT.

MATERIAL: Silica 10-20

SCREEN INTERVAL 113 TO 103 FT.

SCHEDULE 40 PVC DIA. 2"

.010 FACTORY SLOTTED

3' sump

HOLE DIAMETER

9 IN. 0 TO 115 FT.

— IN. — TO — FT.

FORMATION DESCRIPTION

0' 20' Course, lite brown sand

20'-40' Same as 0'-20

40'-60' Same as 20'-40'

60'-80' Same as 40'-60 w/ small cobbles.

80'-90' Same, but becoming damp, water at 96'

90'-100' Course sand w/ small and med cobbles and silt, dark brown in color (water)

100'-115' Same as 90'-100' with water very dark brown in Color.

RECEIVED
MAY 18 1998
Water Resources Program
Department of Ecology

Layne Christensen Company
1401 E. 26th Street - Tacoma, WA 98421 - (253) 572-3727 Fax (253) 572-3730

LOG & AS-BUILT DIAGRAM

GEOLOGIC LOG

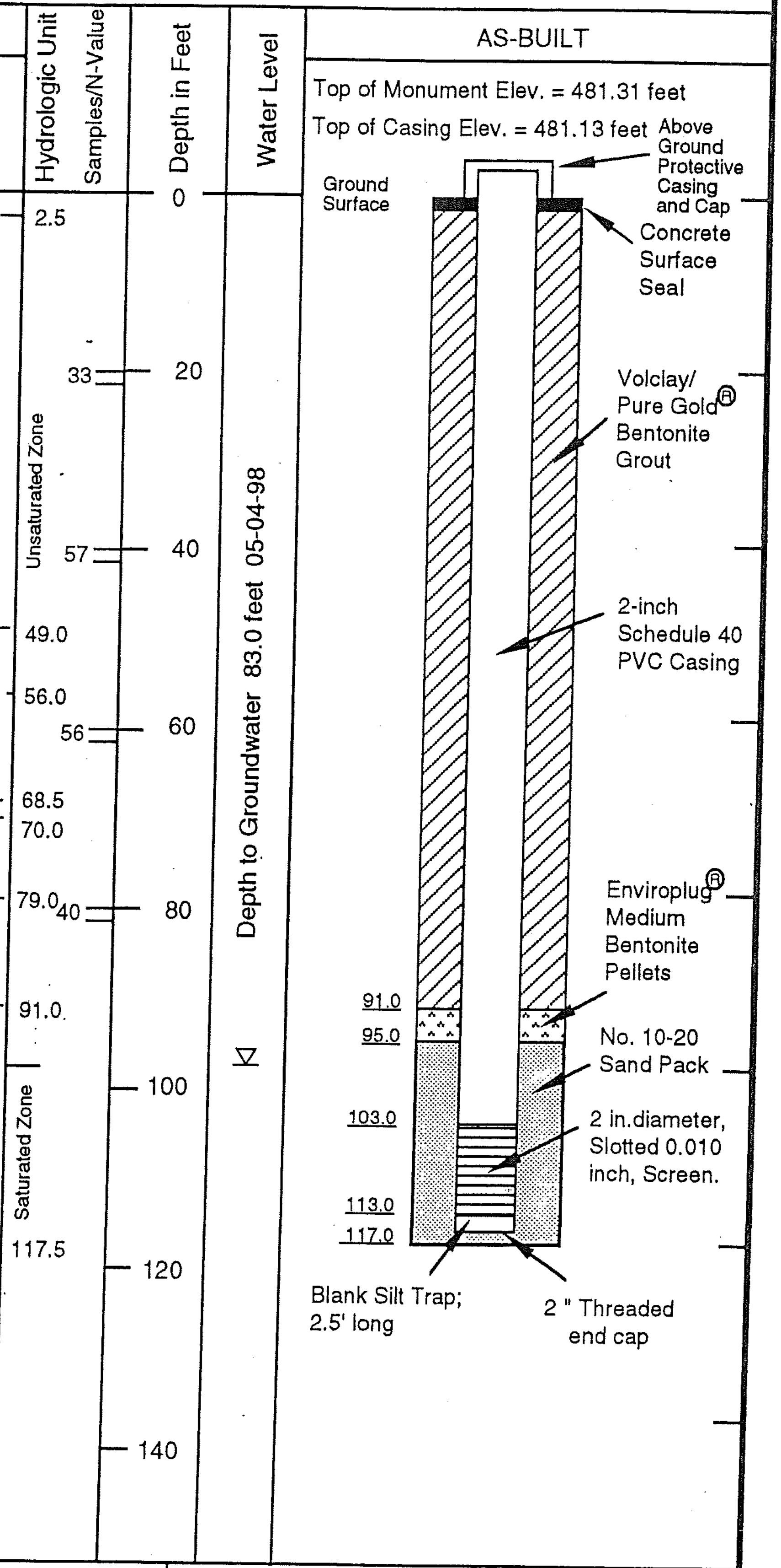
Driller: Layne Christensen
Completion Date: 05-04-98
Ground Surface Elevation = 477.77 feet

Ground Surface

Loose, brown, silty SAND; dry, fine- to very fine-grained.	2.5
Medium dense to dense, gray-brown, poorly graded SAND, moist, medium- to fine- grained, with lenses of silty SAND and coarse sand to fine gravel (3/8" minus). Dense, gray-brown, poorly graded SAND; (SP); moist.	49.0
Dense, gray-brown poorly graded SAND; moist, medium to fine-grained with lenses of fine gravel.	56.0
Dense, gray-brown, poorly graded SAND with gravel; moist, with 3/8" minus sub-angular gravel.	68.5 70.0
Dense, gray-brown, poorly graded SAND, moist, grading to fine-grained at 79.0 feet.	79.0
Dense, white-gray, poorly graded SAND; moist.	91.0
Very dense, brown, poorly graded GRAVEL with sand (GP); 1-1/2" minus rounded at 91.0 feet; becoming 3" minus at 96.0 feet, with less sand below 100.0 feet, then with silt and sand below 106.0 feet; wet to saturated.	117.5

Bottom of Boring at 117.5'

Well Location:
Township: 10 North
Range: 28 East
Section: 17
1/4 Section: Southwest



Drilling Method: 8-inch Reverse Circulation

Note: Soil classification based on description of cuttings; actual transitions may be gradual.

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

JUNE 1998 V-1070-01

Richland Municipal Landfill
Richland, Washington

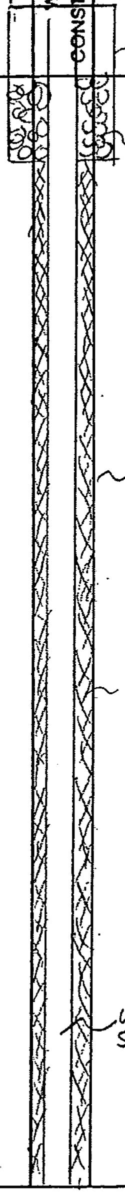
MONITORING WELL GW-6
(Boring B-1)

Figure 3

INTERNATIONAL
TECHNOLOGY
CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 810835	PROJECT NAME: RICHLAND HORN RAPIDS LANDFILL	
ORING NUMBER: MW07	COORDINATES:	DATE: 1/24/01
LEVATION:	GWL: Depth 91 Date/Time 1/24/01	DATE STARTED: 1/24/01
ENGINEER/GEOLOGIST: G. HAMILTON	Depth Date/Time	DATE COMPLETED: 1/25/01
RILLING METHODS: Air-Rotary-Tubex		PAGE 1 OF 4



DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
								8-IN DIAMETER STEEL PROTECTIVE CASING
0	N/A	N/A	N/A	0-10 POORLY GRADED FINE-GRAINED SAND, BROWN TO TAN COLOR	SP			CONCRETE 0-2ft
5				POORLY GRADED FINE-GRAINED SAND				
10				10-18 POORLY GRADED SILTY FINE TO MEDIUM-GRAINED SAND, 80% FINE TO MEDIUM SAND, 20% SILT/CLAY	SM			6-IN DIAMETER BOREHOLE
15				POORLY GRADED VERY FINE TO FINE-GRAINED SAND WITH SILT. 95% SAND 5% SILT				CEMENT/BENTONITE GROUT 2-68.8ft
20				18-21 POORLY GRADED MEDIUM-GRAINED SAND LIGHT TAN COLOR	SP			
25				21-28 MODERATELY GRADED, VERY FINE TO MEDIUM-GRAINED SAND	SW/SP			WELL CASING, 2-IN ID SCH40 PVC +2-87.5ft
30				28-35 POORLY GRADED FINE TO MEDIUM-GRAINED SAND	SP			

NOTES:

Drilling Contractor Environmental West

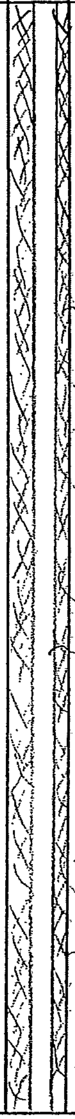
Drilling Equipment Schramm Tubex

Driller: Ron Sink
Kelly Hill, Gary Baker

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 810835
PROJECT NAME: RICHLAND HORN RAPIDS LANDFILL
ORING NUMBER: MW07
COORDINATES:
DATE: 1/24/01
LEVATION:
GWL: Depth Date/Time
DATE STARTED: 1/24/01
ENGINEER/GEOLOGIST: C. HAMILTON
Depth Date/Time
DATE COMPLETED: 1/25/01
RILLING METHODS: Air Rotary - Tubex
PAGE 2 OF 4

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
30	NA	NA	NA	POORLY GRADED FINE TO MEDIUM-GRAINED SAND	SP			
35				35-37 VERY FINE GRAINED SAND WITH PIECES of Clay	SC/ML			
				37-45 MODERATELY GRADED, MEDIUM to COARSE-GRAINED, SAND GRAINS TO 3MM, WITH PIECES of BROWN CLAY	SW			CEMENT BENTONITE GROUT 2-68.8 ft
40								
45				45-48 POORLY GRADED, MEDIUM GRAINED SAND	SP			WELL CASING, 2-IN I.D. SCH40, PVC +2 - 87.5 ft
				48-49 WELL GRADED, ~~FINE SAND & GRAV~~ FINE TO MEDIUM GRAINED SAND, WELL ROUNDED 5-10MM GRAVEL	GM			
50				49-68 WELL GRADED GRAVELLY SAND, ROUNDED GRAVEL TO 7 MM, VERY FINE TO MEDIUM-GRAINED SAND	SW			
55								6-IN DIAMETER BORE HOLE
60				MODERATELY SORTED FINE TO MEDIUM-GRAINE SAND	SP/SW			

NOTES:

Drilling Contractor

Drilling Equipment

Driller:

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 810835	PROJECT NAME: RICHLAND HORN RAPIDS LANDFILL	
BORING NUMBER: MW07	COORDINATES:	DATE: 1/24/01
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 1/24/01
ENGINEER/GEOLOGIST: G. Hamilton	Depth Date/Time	DATE COMPLETED: 1/25/01
DRILLING METHODS: Air Rotary Tubex		PAGE 3 OF 4

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
60	NA	NA	NA	MODERATELY SORTED FINE TO MEDIUM GRAINED SAND	SP/SW			CEMENT/BENTONITE GROUT 2 - 68.8 ft
65				WELL GRADED GRAVELY SAND, GRAVEL to 10 MM, COARSE TO MEDium-GRAINED SAND	SW			6-IN DIAMETER BOREHOLE
70				68-73 POORLY GRADED FINE-GRAINED SAND VERY POORLY GRADED, VERY FINE TO FINE-GRAINED SAND, MICA FLAKES TO 0.5 mm, QUARTZ AND BASALT GRAINS.	SM			WELL CASING, 2-IN ID, SHD 40 PVC +2-87.5 ft
75				73-78 POORLY GRADED FINE-GRAINED SAND, WITH OCCASIONAL GRAVEL TO 1.2 CM.	SP			BENTONITE CHIP SEAL 68.8 - 83.5 ft
80				78-83 VERY FINE-GRAINED SILTY SAND POORLY GRADED FINE SAND WITH SILT	SM			
85				83-91 POORLY GRADED COARSE GRAVEL, WELL ROUNDED WITH FINES WELL ROUNDED FINE TO COARSE-GRAINED GRAVEL WITH FINES	GM			10-20 MESH SILICA SAND 83.5-105 ft CENTRALIZER WELL SCREEN 2-IN ID, SCH 40 PVC 0.010-IN MACHINE SLOTTED 87.5-102.5 ft
90								

NOTES:

Drilling Contractor ____________________

Drilling Equipment ____________________

Driller: ____________________

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

ROJECT NUMBER: 810835	PROJECT NAME: Horn Rapids Landfill	
ORING NUMBER: MW07	COORDINATES:	DATE: 1/24/01
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 1/24/01
NGINEER/GEOLOGIST: G. HAMILTON	Depth Date/Time	DATE COMPLETED: 1/25/01
RILLING METHODS: Air Rotary - Tubex		PAGE 4 OF 4

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
90				FINE to COARSE-GRAINED GRAVEL WITH SAND WELL ROUNDED, WET	GM			▽ 91 ft SATURATED
				91-104 VERY WELL GRADED SANDY GRAVEL, GRAVEL IS WELL ROUNDED to 1CM	GW			10-20 MESH SILICA SAND 83.5 - 105 ft
95								WELL SCREEN 2-IN ID SCH 40 PVC, 0.010-IN MACHINE SLOTTED SCREEN 87.5 - 102.5
100				WELL GRADED SAND AND GRAVEL, FINE TO COARSE-GRAINED SAND, GRAVEL WELL ROUNDED TO 8MM				6-ID DIAMETER BOREHOLE
				104-105 WELL GRADED SAND AND GRAVEL WITH SILT	GM			BOTTOM SUMP, 2-IN ID, SHD 40 WELL CASING WITH END CAP 102.5 to 105 FT CENTRALIZER
105				TD = 105				

NOTES:

Drilling Contractor

Drilling Equipment

Driller:

96747

AFM 367

RESOURCE PROTECTION WELL REPORT

START CARD NO R43268

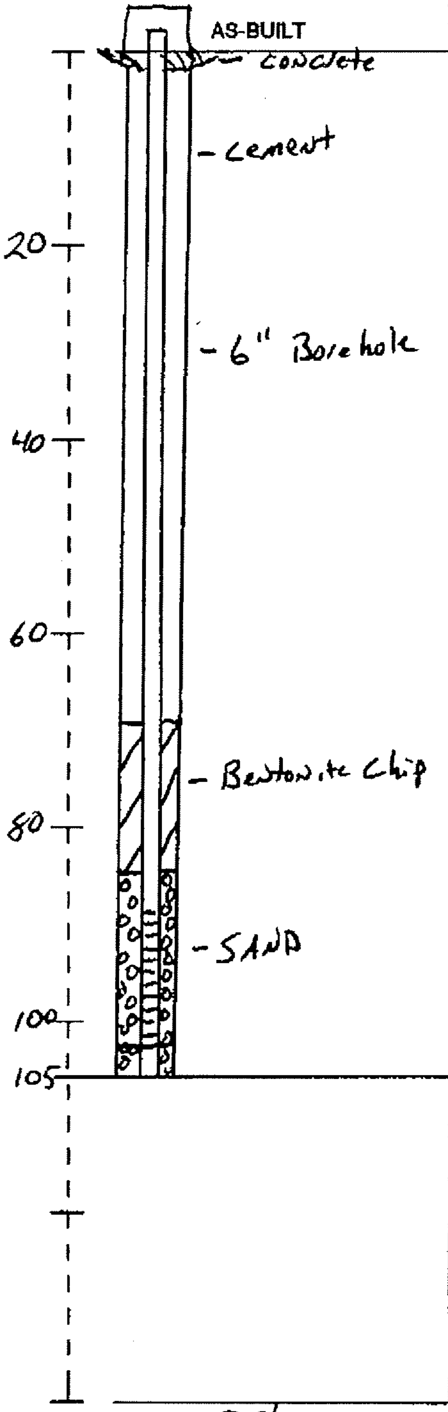
N

PROJECT NAME: Horn Rapids Landfill
WELL IDENTIFICATION NO MW-7
DRILLING METHOD Air Rotary
DRILLER Ronald Sink
FIRM Environmental West Exp
SIGNATURE Ronald Sink
CONSULTING FIRM: IT
REPRESENTATIVE: Gary Hamilton

COUNTY: Benton
LOCATION: SW1/4 SW1/4 Sec 17 Twn 10N R 28E
STREET ADDRESS OF WELL 3102 Twin Bridges Rd
Richland Wa 99353
WATER LEVEL ELEVATION: 90.8
GROUND SURFACE ELEVATION
INSTALLED 1/24/01 to 1/28/01
DEVELOPED: 1/29/01

DEPT OF ECOLOGY
Received
JAN 31 2001
CENTRAL REGION OFFICE

AS-BUILT



WELL DATA

Use of Well:
monitor
Borehole 6"
Casing: 2" Sch 40 PVC
+2' to 87.5
102.5' to 105'
Screen 2" sch 40 PVC
.010 87.5' to 102.5'
Seal: Bentonite Chip
84.5' to 70'
Cement Grout
70' to 2'
Sand. 10/20
84.5' to 105'

FORMATION DESCRIPTION

Fine Sand
17
Fine to Med. Sand
83
Sandy Gravel
105

SCALE 1" = 20'

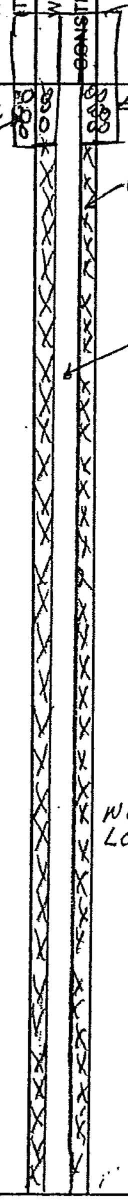
PAGE 1 OF 1

ECY 050-12 (Rev 11/89)

INTERNATIONAL
TECHNOLOGY
CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 810835
PROJECT NAME: Richland, Horn Rapids LANDfill
BORING NUMBER: MW08
COORDINATES:
DATE: 1/18/01
ELEVATION:
GWL: Depth 89.5 Date/Time 1/18/01
DATE STARTED: 1/18/01
ENGINEER/GEOLOGIST: G. Hamilton
Depth Date/Time
DATE COMPLETED: 1/18/01
DRILLING METHODS: Air Rotary -TUBEX
PAGE 1 OF 4

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 IN.)	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
								locking WELL CAP
					CONCRETE			8-in STEEL PROTECTIVE CASING
				Poorly graded very fine to fine-grained SAND				CEMENT /BENTONITE GROUT 2- 71.2 ft
5		10/13/13	18	poorly graded very fine-grained SAND with silt, medium dense	SM			
								2-IN DIA SCH 40, PVC WELL CASING 0- 84.5 FT
10		7/10/14	18	Poorly sorted very fine-grained SAND with silt, medium dense				
15		15/33/50	17	Poorly sorted very fine to fine grained SAND [illegible], very dense				
20		NS		Poorly graded very FINE to FINE-GRAINED SAND with SILT				NO SAMPLE, BIT CAM LOCKED OPEN
				23 - 40				
25	HRL S003 ▨	30/50	11	Poorly GRADED VERY FINE TO FINE GRAINED SAND, VERY DENSE	SP/SM			
30								

NOTES:

Drilling Contractor ENVIRONMENTAL WEST EXPLORATION

Drilling Equipment SCHRAMM ROTARY AIR -TUBEX

Driller: RON SINK
Kelly HILL, CASEY BAKER

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 810835	PROJECT NAME: RICHLAND HORN RAPIDS LANDFILL	
BORING NUMBER: MW08	COORDINATES:	DATE: 1/18/01
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 1/18/01
ENGINEER/GEOLOGIST: G. HAMILTON	Depth Date/Time	DATE COMPLETED: 1/18/01
DRILLING METHODS: Air Rotary Tubex		PAGE 2 OF 4

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
30				Poorly GRADED FINE-GRAINED SAND with <5% MEDIUM SAND	SP			NO SAMPLE, BIT CAM JAMMED with SAND
35		34/50	11	POORLY GRADED FINE to MEDIUM-GRAINED SAND, VERY DENSE				2-IN DIA SCH 40 PVC WELL CASING 0-84.5 FT
								CEMENT/BENTONITE GROUT 2-71.5 ft
40		4/22/50	17	40-42 FINE to MEDIUM-GRAINED SAND WITH SOME FINE to COARSE-GRAINED GRAVEL, VERY DENSE SOIL	GC			
				42-45 POORLY GRADED FINE to MEDIUM-GRAINED SAND	SW			6-IN DIA BOREHOLE
45		25/50	10	45-46 WELL GRADED FINE to COARSE-GRAINE SAND, PREDOMINATELY fINE to MEDIUM GRAINED, <5% fINE GRAVEL and Clay	GC			
				46-55				
50		10/50	11	POORLY GRADED FINE TO MEDIUM-GRAINED SAND, VERY DENSE SOIL	SP			
55				55-71.5 WELL GRADED VERY FINE to COARSE-GRAINED SAND, With some MICA GRAINS	SW			NOT SAMPLED DUE To SAND-LOCKED BIT CAM
60								

NOTES:

Drilling Contractor

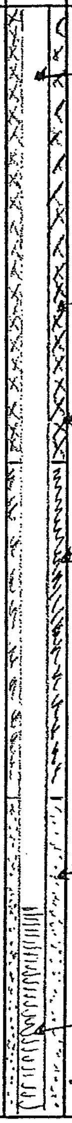
Drilling Equipment

Driller:

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 810835	PROJECT NAME: RICHLAND HORN RAPIDS LANDFILL	
BORING NUMBER: MW08	COORDINATES:	DATE: 1/18/01
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 1/18/01
ENGINEER/GEOLOGIST: G HAMILTON	Depth Date/Time	DATE COMPLETED: 1/19/01
DRILLING METHODS: Air Rotary Tubex		PAGE 3 OF 4

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
60		6/25/45	18	WELL GRADED FINE TO COARSE-GRAINED SAND, VERY DENSE SOIL	SW			2-IN SCH 40 PVC WELL CASING, 0-84.5 FT
65				WELL GRADED MEDIUM TO COARSE-GRAINED SAND, < 5% FINE GRAINED WELL ROUNDED GRAVEL				NOT SAMPLED DUE TO SAND LOCKED BIT CAM CEMENT/BENTONITE GROUT 2-72.5 ft
70		5/11/25		WELL GRADED FINE TO COARSE-GRAINED SAND WITH WELL ROUNDED GRAVEL				6-in dia Borehole
75				POORLY GRADED VERY FINE TO FINE SAND WITH FLAKES OF MICA	SM			BENTONITE SEAL (HYDRATED CHIPS) 72.5 - 81.5 ft
80		2/3/30		POORLY GRADED VERY FINE TO FINE-GRAINED SAND WITH TRACE FLAKES OF MICA, MEDIUM TO DENSE SOIL				10-20 MESH SILICA SAND 81.5 - 102 ft
85				POORLY GRADED, GRAVELLY VERY FINE TO FINE-GRAINED SAND, 80% SAND, 20% GRAVEL, DAMP	SP			2-IN DIA. SCH. 40 PVC SCREEN 0.010-IN MACHINE SLOT 84.5 - 99.5 ft
90				COBBLE AND PEPPLE GRAVEL WITH fine SAND AND SILT, COBBLES to 3 CM, SATURATED, WELL ROUNDED	GM			▽ WATER LEVEL STABILIZED AT 89.3 FT

NOTES:

Drilling Contractor ______

Drilling Equipment ______

Driller: ______

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 810835
PROJECT NAME: RICHLAND HORN RAPIDS LANDFILL
BORING NUMBER: MW08
COORDINATES:
DATE: 1/18/01
ELEVATION:
GWL: Depth 89.5 Date/Time 1/18/01
DATE STARTED: 1/18/01
ENGINEER/GEOLOGIST: G HAMILTON
Depth Date/Time
DATE COMPLETED: 1/18/01
DRILLING METHODS: Air Rotary Tubex
PAGE 4 OF 4

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
90	XXXX HRL S004	15/50	10		SP/GM			6-IN DIA BOREHOLE
95				COBBLE AND PEBBLIE GRAVEL with Fine GRAIND SAND AND SILT	GM			2-IN DIA PVC WELL SCREEN, SCH 40, 0.010-IN MACHINE SLOT, 84.5 - 99.5 ft 10-20 MESH SILICA SAND 84.5 to 99.5 FT
100		20/50	10	COBBLE AND PEBBLE GRAVEL WITH FINE GRAIND SAND AND SILT, WELL ROUNDED, to 1.5 CM DIAMETER				2.5 ft Bottom sump w/ END CAP, SCK40, 2-IN DIA. PVC
				TD= 102 FT				
105								

NOTES:

Drilling Contractor

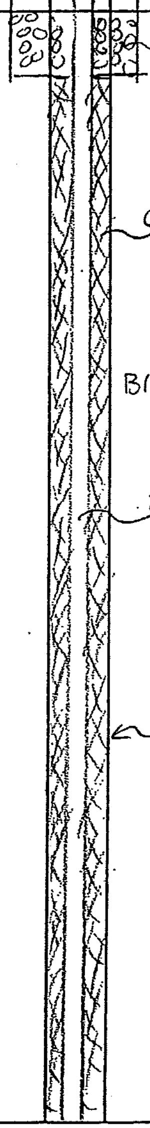
Drilling Equipment

Driller:

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 810835	PROJECT NAME: RICHLAND HORN RAPIDS LANDFILL	
BORING NUMBER: MW09	COORDINATES:	DATE: 1/16/01
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 1/16/01
ENGINEER/GEOLOGIST: G. HAMILTON	Depth Date/Time	DATE COMPLETED: 1/22/01
DRILLING METHODS: AIR ROTARY - TUBEX		PAGE 1 OF 4

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6-IN)	RECOVERY (") IN	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
				0-3 POORLY GRADED FINE GRAINED SAND	SP			8-IN ID PROTECTIVE STEEL CASING W/ locking LID CONCRETE FILL 0-2 FT
				3-33 POORLY GRADED FINE TO MEDIUM-GRAINED SAND with SILT, VERY DENSE				
5		22/18/43	18		SM			CEMENT/BENTONITE GROUT 2-83 FT
10		50	1	POORLY GRADED VERY FINE SILTY SAND W/ OCCATIONAL COBBLES				Blocked SAmple TUBE
								2-IN ID, SCH40, PVC WELLCASING 0-97.5 ft
15		50	4	POORLY GRADED VERY FINE-GRAINED SILTY, SAND, VERY DENSE SOIL, with OCCATIONAL Cobbles				
								6-IN DIAMETER BOREHOLE
20		18/50	11.5	POORLY GRADED VERY FINE-GRAINED SILTY SAND, VERY DENSE				
					SM			
25	HRL S001	30/50	11	POORLY GRADED VERY FINE-GRAINED SILTY SAND, Very DENSE SOIL	SP/SM			
30								

NOTES:

Drilling Contractor ENVIRONMENTAL WEST EXPLORATION

Drilling Equipment SCHRAMM AIR ROTARY - TUBEX

Driller: RON SINK
KELLY HILL, CASEY BAKER

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 810835	PROJECT NAME: RICHLAND HORN RAPIDS LANDFILL	
ORING NUMBER: MW09	COORDINATES:	DATE: 1/16/01
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 1/16/01
ENGINEER/GEOLOGIST: G. Hamiton	Depth Date/Time	DATE COMPLETED: 1/22/01
RILLING METHODS: Air Rotary-Tubex		PAGE 2 OF 4

D... ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
30				POORLY GRADED VERY FINE-GRAINED SILTY SAND	SM			NO SAMPLE, SAND-LOCKED REAMER BIT
				33-41 POORLY GRADED FINE TO MEDIUM GRAINED SAND	SP			
35		25/50	9					2-IN ID, SCH 40, PVC WELL CASING 0-97.5 ft
					SW			CEMENT/BENTONITE GROUT 2-83ft
40		10/40/50	10	Poorly GRADED FINE to MEDIUM-GRAINED SAND, ANGULAR GRAINS, VERY DENSE				
				41-47.5	SM			
45		25/50	6	POORLE GRADED VERY FINE-GRAINED SILTY SAND, very DENSE SOIL				6-IN DIAMETER BOREHOLE
				47.5- F.				
50		3/10/50	16	POORLY GRADED MEDIUM-GRAINED SAND with TRACE Coarse-GRAINED SAND AND Pebbles. VERY DENSE SOIL	SP			
55								
				WELL GRADED COARSE TO VERY COARSE-GRAINED SAND, with Trace MEDIUM-GRAINED SAND, AND FINE-GRAINED ROUNDED GRAVEL	SW			
				WELL GRADED VERY FINE TO COARSE-GRAINED SAND				
60								

NOTES:

Drilling Contractor ______

Drilling Equipment ______

Driller: ______

INTERNATIONAL
TECHNOLOGY
CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 810835
PROJECT NAME: Horn Rapids Landfill
BORING NUMBER: MW 09
COORDINATES:
DATE: 1/16/01
ELEVATION:
GWL: Depth Date/Time
DATE STARTED: 1/16/01
ENGINEER/GEOLOGIST: G Hamilton
Depth Date/Time
DATE COMPLETED: 1/22/01
DRILLING METHODS: Air Rotary - Tubex
PAGE 3 OF 4

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
60					SW			NO SAMPLE SAND-LOCCED REAMER BIT
				62-64 WELL GRADED GRAVELY FINE to COARSE GRAINED SAND, FINE-GRAINED GRAVEL.	GM			CEMENT/BENTONITE GROUT 2-83 ft
				64-85 POORLY GRADED SILTY VERY FINE-GRAINED SAND	SM			
65	HRL S002	20/50	10	65-68 POORLY GRADED VERY FINE TO MEDIUM-GRAINED SAND	SP			6-IN BOREHOLE
				69-71				
70		4/25/50	0	WELL GRADED COARSE TO VERY COARSE GRAINED SAND with GRAVEL.	SW			70 ft SAMPLER BREAKS off In HOLE. 70-78 Drill Through SAMPLER & PUSH SAMPLER AHEAD OF Bi/
		71-72		WELL GRADED GRAVEL WITH FINE to COARSE-GRAINED SAND	GW			
			72-87	WELL GRADED MEDIUM TO COARSE GRAIND SAND				
95					SW			
80		2/2/16	13	WELL GRADED MEDIUM TO COARSE-GRAINED SAND				
85								BENTONITE CHIPS SEAL 83-92.5 ft
				87-100 POORLY SORTED VERY FINE-GRAINED SAND and SILT	SM			2-IN ID, SCH 40 PVC WELL CASING 0-97.5 ft
90								

NOTES:

Drilling Contractor ________

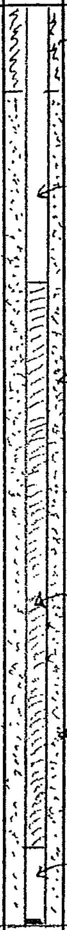
Drilling Equipment ________

Driller: ________

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 810835	PROJECT NAME: Horn Rapids Landfil	
BORING NUMBER: MW09	COORDINATES:	DATE: 1/17/01
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 1/16/01
ENGINEER/GEOLOGIST: G. HAMILTON	Depth Date/Time	DATE COMPLETED: 1/22/01
DRILLING METHODS: Air Rotary Tubex		PAGE 4 OF 4

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
90	1	18/50	9	POORLY GRADED VERY FINE-GRAINED SAND	SM			BENTONITE CHIPS SEAL 83-92.5 ft
95				POORLY SORTED VERY FINE-GRAINED SAND AND SILT, WITH TRACE clay SIZE PARTICLES	SM/SC			2-IN ID, SCH 40 PVC WELL CASING 0-97.5 ft
100				100-101 POORLY SORTED clayey VERY FINE-GRAINED SAND AND SILT,	SC			10-20 MESH SILICA SAND 93.5-115
				101-115 POORLY SORTED SILTY GRAVEL, 85-90% GRAVEL, 10-15% SILT, WET	GM			▽ WATER LEVEL 103 ft
105								WELL SCREEN, 2-IN ID, SCH 40 PVC, 0.010-IN MACHINE SLOT SCREEN 97.5-112.5
110								6-IN BOREHOLE
								Bottom sump, 2-IN ID SCH 40 PVC WELL CASING WITH END CAP
115				TD = ~~105 ft~~ 115 ft				

NOTES:

Drilling Contractor

Drilling Equipment

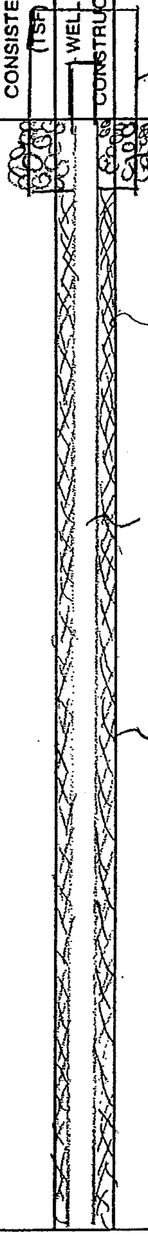
Driller:

243B-3-86

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 810835
PROJECT NAME: RICHLAND HORNRAPIDS LANDFILL
BORING NUMBER: MW10
COORDINATES:
DATE: 1/22/01
ELEVATION:
GWL: Depth 74.0 Date/Time 1/22/01
DATE STARTED: 1/22/01
ENGINEER/GEOLOGIST: B HAMILTON
Depth 72.3 Date/Time 1/24/01 0800
DATE COMPLETED: 1/22/01
DRILLING METHODS: AIR ROTARY - TUBEX
PAGE 1 OF 3

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6-IN)	RECOVERY (IN)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
0				0-15 POORLY GRADED: FINE-GRAINED SAND				8-IN I D STEEL PROTECTIVE CASING WITH LOCKING LID CONCRETE
5	HRL S005	8/30/49	18	POORLY GRADED VERY FINE-GRAINED SAND BROWN/TAN	SP			CEMENT/BENTONITE GROUT 2-57.6 ft
10		15/30/50	16	POORLY GRADED VERY FINE TO FINE-GRAINED SAND, 10% Biotite MICA				2-IN I.D, SCH40, PVC WELL CASING
15		10/30/49		15-20 POORLY GRADED FINE-TO MEDIUM-GRAINED SAND decrease in MICA CONTENT	SP			6-IN BOREHOLE
20		15/47/50	17	20-24 WELL GRADED, VERY FINE TO MEDIUM GRAINED SAND @23 ft 8-10 mm GRAVEL STRINGER, WELL Rounded Pebbles	SW			
25		15/50	11	24-26 POORLY GRADED FINE-GRAINED SAND	SM			
				26-33 WELL GRADED MEDIUM TO COARSE-GRAINED SAND	SW			
30								

NOTES:

Drilling Contractor ENVIRONMENTAL WEST EXPLORATION

Drilling Equipment RON SINK

Driller: Kelly Hill, CASEY BAKER

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 831835	PROJECT NAME: RICHLAND HORN RAPIDS LANDFILL	
ORING NUMBER: MW10	COORDINATES:	DATE: 1/22/01
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 1/22/01
ENGINEER/GEOLOGIST: G.HAMILTON	Depth Date/Time	DATE COMPLETED: 1-22-01
)RILLING METHODS:		PAGE 2 OF 3

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
30		5/43/50	15	WELL GRADED FINE- TO COARSE-GRAINED SAND	SW			
				33-43	SM			CEMENT/BENTONITE GROUT 2-57.6 ft
35		10/27/40	18	GRADED VERY FINE to MEDIUM-GRAINED SAND WITH TRACE SILT				
40				FINE-GRAINED SAND WITH SILT				NO SAMPLE, SAND LOCKED REAMER ON BIT
				43-50				2-IN COBBLE BLOCKED SAMPLER
45		30/50	11	WELL GRADED FINE to MEDIUM-GRAINED SAND with <5% Coarse SAND and FINE ROUNDED GRAVEL	SW			2-IN I.D. SCH 40, PVC WELL CASING
50		6/25/45	18	50-60 POORLY GRADED MEDIUM-GRAINED SAND	SP			
55				POORLY GRADED FINE TO MEDIUM-GRAINED SAND WITH OCCATIONAL WELL ROUNDED PEBBLES				BENTONITE CHIPS 57.6-66.5 ft
60								

NOTES:

Drilling Contractor

Drilling Equipment

Driller:

INTERNATIONAL TECHNOLOGY CORPORATION

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 810835
PROJECT NAME: RICHLAND HORN RAPIDS LANDFILL
ORING NUMBER: MW10
COORDINATES:
DATE: 1/22/01
LEVATION:
GWL: Depth 74.0 Date/Time 1/22/01
DATE STARTED: 1/22/01
ENGINEER/GEOLOGIST:
Depth 72.3 Date/Time 1/24/01 0800
DATE COMPLETED: 1/22/01
RILLING METHODS:
PAGE 3 OF 3

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
60		11/40/50	15	60-72 POORLY GRADED VERY FINE TO FINE GRAINED SAND WITH SILT	SM			BENTONITE CHIPS 57.6 - 66.5 ft
65				SILTY SAND				2-IN ID, SCH 40, PVC WELL CASING 0-69.5 ft
70		15/40/50	17	POORLY GRADED SILTY VERY FINE-GRAINED SAND, WITH OCCASIONAL 4CM COBBLE				10-20 MESH SILICA SAND 66.5-87.0 ft
				72-87 GRAVEL TO 10 MM				∇ WATER LEVEL 72.3 ft 1/24/01
75				GRAVEL, WELL ROUNDED GRAVEL TO 10MM				∇ WATER LEVEL 74.0 ft 1/22/01 WELLSCREEN, 2-IN ID, SCH 40, PVC, 0.010-IN MACHINE SLOT 69.5-84.5 ft
80	HRL-S006 ☒	13/50	10	GRAVEL, WELL ROUNDED GRAVEL TO 10MM	GP			6-IN DIAMETER BORE HOLE
85								BOTTOM SUMP, 2-IN ID WELL CASING WITH END CAP 84.5-87.0 ft
				TD = 87 ft				
90								

NOTES:

Drilling Contractor

Drilling Equipment

Driller:

RESOURCE PROTECTION WELL REPORT
(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

CURRENT
Notice of Intent No. AE09303

Construction/Decommission

☐ Construction

☒ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* ______

Type of Well

☒ Resource Protection

☐ Geotechnical Soil Boring

Property Owner Horn Rapids Landfill

Site Address 3102 Twin Bridges Rd.

City Richland County 03-Benton

Consulting Firm SCS Field Services

Unique Ecology Well ID Tag No. ______

Location 1/4 NW 1/4 SW Sec 17 Twn 10N R 28E ☒ EWM or ___ WWM

Lat/Long (s,t,r still Required) Lat Deg ____ Lat Min/Sec ____

Long Deg ____ Long Min/Sec ____

Tax Parcel No. 117083000001000

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Trainee Name (Print) Scott Krueger

Driller/Trainee Signature x Scott K

Driller/Trainee License No. 2073

If trainee, licensed driller's Signature and License No. ______

Cased or [✓ Uncased] Diameter 8 1/4" Static Level 95'

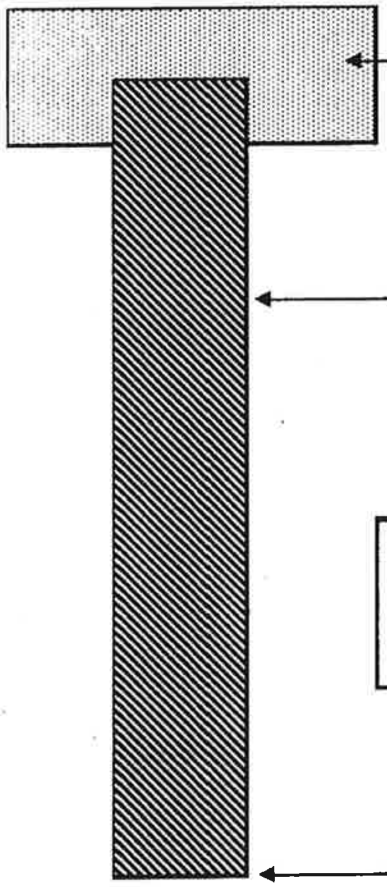
Work/Decommission Start Date 5/10/2010

Work/Decommission Completed Date 5/11/10

Construction/Design

Well Data W10-239

Formation Description



CONCRETE SURFACE SEAL 2 FT

0 - 105 FT

Chip in place

BACKFILL 103 FT

Bent chips

0 - FT

REQUIRED INFORMATION
(Must get one or both if available)

DEPT OF ECOLOGY WELL TAG #: AFM 367

CLIENT WELL ID #: MW-7

DEPTH OF BORING 105 FT

Scale 1" = ______

Page ____ of ____

ECY 050-12 (Rev 2/01)

RESOURCE PROTECTION WELL REPORT

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

CURRENT

Notice of Intent No. AE09303

Construction/Decommission

☐ Construction

☒ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* ________

Type of Well

☒ Resource Protection

☐ Geotechnical Soil Boring

Property Owner Horn Rapids Landfill

Site Address 3102 Twin Bridges Rd.

City Richland County 03-Benton

Consulting Firm SCS Field Services

Unique Ecology Well ID

Tag No. ________

Location 1/4 NW 1/4 SW Sec 17 Twn 10N R 28E EWM or ___ WWM

Lat/Long (s,t,r still Required) Lat Deg ____ Lat Min/Sec ____

Long Deg ____ Long Min/Sec ____

Tax Parcel No. 117083000001000

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

☒ Driller ☐ Trainee Name (Print) Scott Krueger

Driller/Trainee Signature x

Driller/Trainee License No. 2073

If trainee, licensed driller's Signature and License No. ________

Cased or Uncased Diameter 8 1/4"

Static Level N/A

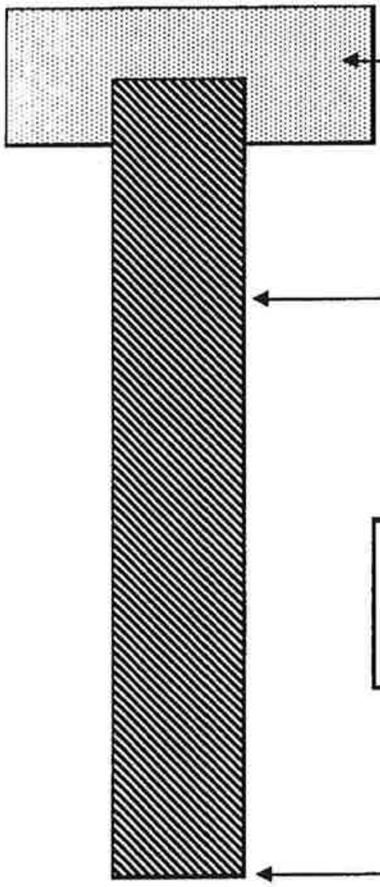
Work/Decommission Start Date 5/10/2010

Work/Decommission Completed Date 5/11/10

Construction/Design

Well Data W10-239

Formation Description



CONCRETE SURFACE SEAL 2 FT

0 - 60 FT

Drill out

BACKFILL 58 FT

Bent chips

0 - ____ FT

REQUIRED INFORMATION

(Must get one or both if available)

DEPT OF ECOLOGY WELL TAG # : ________

CLIENT WELL ID #: GP-5

DEPTH OF BORING 60 FT

Scale 1" = ________

Page ____ of ____

ECY 050-12 (Rev 2/01)

RESOURCE PROTECTION WELL REPORT
(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

CURRENT
Notice of Intent No. RE04560

MW-11

Construction/Decommission
☒ Construction
☐ Decommission *ORIGINAL INSTALLATION Notice of Intent Number*

Type of Well
☒ Resource Protection
☐ Geotechnical Soil Boring

Property Owner Horn Rapids Landfill
Site Address 3102 Twin Bridges Rd.
City Richland County 03-Benton

Consulting Firm SCS Field Services

Location 1/4 NW 1/4 SW Sec 17 Twn 10N R 28E [✓ EWM] or WWM

Unique Ecology Well ID Tag No. BCP 824

Lat/Long (s,t,r still Required) Lat Deg Lat Min/Sec
Long Deg Long Min/Sec

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

Tax Parcel No. 117083000001000

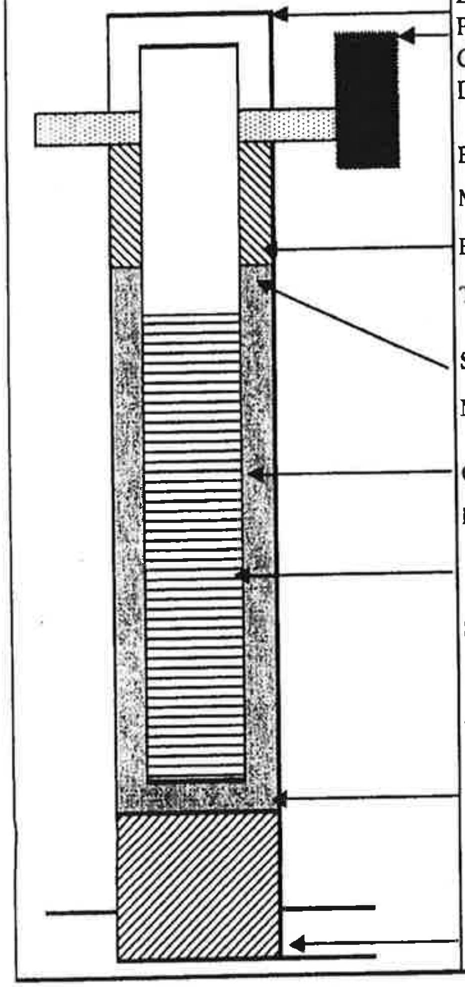
☒ Driller ☐ Engineer ☐ Trainee Name (Print) Scott Krueger
Driller/Trainee Signature Scott K
Driller/Trainee License No. 2073

Cased or [✓ Uncased] Diameter 8 1/4" Static Level 92

Work/Decommission Start Date 5/10/2010
Work/Decommission End Date 5/10/10

If trainee, licensed driller's Signature and License No.

Construction/Design Well Data W10-239 Formation Description



Locking Cap		
Protective Post		
Concrete Surface Seal Depth	5	FT
Blank Casing (dia x dep)	2 88	
Material	pvc	
Backfill	81	FT
Type	neat cement	
Seal	2 FT	
Material	100 mesh	
Gravel Pack	17	FT
Material	20/40	
Screen (dia x dep)	2 15	
Slot Size	.010	
Material	pvc	
Well Depth	103	FT
Backfill		
Material		
Total Hole Depth		FT

0 - 65 FT
med Sand

065 - 70 FT
med Sand, gravel

70 - 95 FT
med Sand

95 - 103
med Sand gravel

Scale 1" =

Page of

ECY 050-12 (Rev 2/01)

RESOURCE PROTECTION WELL REPORT

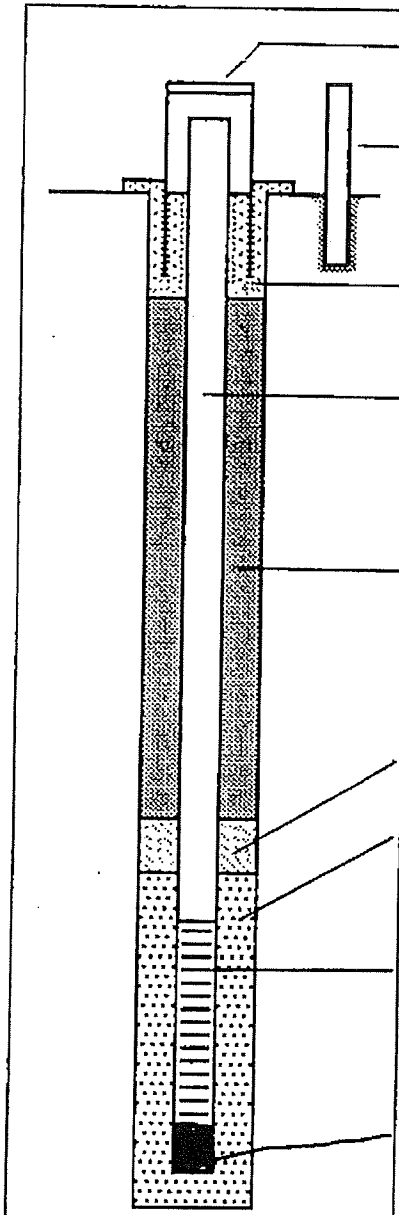
START CARD NO. 05020

OWNER/PROJECT: City of Richland
WELL IDENTIFICATION NO. MW-2
DRILLING METHOD: Percussion hammer
DRILLER: Charles Shory #2042
FIRM: Layne Christensen
SIGNATURE: Charl E. Shy Jr.
CONSULTING FIRM: Shannon + Wilson
REPRESENTATIVE: Matt Zyges

COUNTY: Benton E.WM
LOCATION: NW¼ SW¼ SEC 17 TWN 10N R 28E
STREET ADDRESS OF WELL: 3302 Grosscup Rd Richland WA
WATER LEVEL BELOW GROUND SURFACE: 81'
GROUND SURFACE ELEVATION: N/A
DATE(S) INSTALLED: 5-4-98
DATE(S) DEVELOPED: 5-5-98

M

AS-BUILT



TOTAL DEPTH OF BORING 100 FT.

WELL DATA

STEEL SURFACE MONUMENT
W / LOCK 3 FT. ABOVE G.L.
PROTECTIVE POSTS NO

CONCRETE SURFACE SEAL 2' TO 6" AGL

WELL CASING 87 TO 3 FT. AGL
SCHEDULE 40 PVC DIA. 2"

ANNULAR SEALANT 81 TO 2 FT.
MATERIAL Volclay Grout

SEAL 84 TO 81 FT.

FILTER PACK 100' TO 84 FT.
MATERIAL: Silica 10-20

SCREEN INTERVAL 97 TO 87 FT.
SCHEDULE 40 PVC DIA. 2"
.010 FACTORY SLOTTED

3' sump
HOLE DIAMETER
9 IN. 0 TO 100 FT.
/ IN. / TO / FT.

FORMATION DESCRIPTION

0'-20 Course lite brown sand

20-40' Same as 0'-20'

40'-60 - Same as 20'-40

60-80' Same as 40'-60' becoming damp.

81' stadic water

80'-90 darker course sand water brown in color

90'-100' same as 80'-90 w/ small and med cobbles (good water production.)

RECEIVED
MAY 18 1998
Water Resources Program
Department of Ecology

Layne Christensen Company
1401 E. 26th Street - Tacoma, WA 98421 - (253) 572-3727 Fax (253) 572-3730

RESOURCE PROTECTION WELL REPORT

START CARD NO. 05020

OWNER/PROJECT: City of Richland

COUNTY: Benton E.WM

WELL IDENTIFICATION NO. MW-1

2 | 1998 CATION: NW ¼ SW ¼ SEC 17 TWN 10N R 28E

DRILLING METHOD: Percussion Hammer

STREET ADDRESS OF WELL: 3302 Grosscup Rd
Richland Wa.

DRILLER: Charles Sharp #2042

FIRM: Layne Christensen Co.

WATER LEVEL BELOW GROUND SURFACE: 96'

SIGNATURE:

GROUND SURFACE ELEVATION: N-A

CONSULTING FIRM: Shannon + Wilson

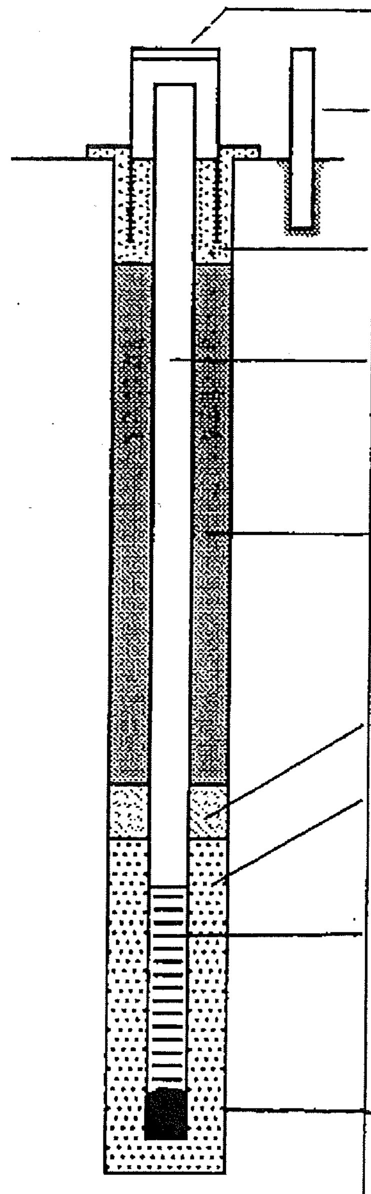
DATE(S) INSTALLED: 5-4-98

REPRESENTATIVE: Matt Zyqas

DATE(S) DEVELOPED: 5-5-98

M

AS-BUILT



TOTAL DEPTH OF BORING 115 FT.

WELL DATA

STEEL SURFACE MONUMENT W/LOCK 3' FT. ABOVE G.L.

PROTECTIVE POSTS NO

CONCRETE SURFACE SEAL 2 TO 6" AGL

WELL CASING 103 TO 3 FT. Above grade

SCHEDULE 40 PVC DIA. 2"

ANNULAR SEALANT 95 TO 2 FT.

MATERIAL Volclay grout

SEAL 99 TO 95 FT.

FILTER PACK 115 TO 99 FT.

MATERIAL: Silica 10-20

SCREEN INTERVAL 113 TO 103 FT.

SCHEDULE 40 PVC DIA. 2"

010 FACTORY SLOTTED

3' sump

HOLE DIAMETER

9 IN. 0 TO 115 FT.

— IN. — TO — FT.

FORMATION DESCRIPTION

0' 20' Course, lite brown sand

20'-40' Same as 0'-20

40'-60' Same as 20'-40'

60'-80' Same as 40'-60 w/ small cobbles.

80'-90' Same, but becoming damp, water at 96'

90'-100' Course sand w/ small and med cobbles and silt, dark brown in color (water)

100'-115' Same as 90'-100' with water very dark brown in Color.

RECEIVED
MAY 18 1998
Water Resources Program
Department of Ecology

Layne Christensen Company
1401 E. 26th Street - Tacoma, WA 98421 - (253) 572-3727 Fax (253) 572-3730

RESOURCE PROTECTION WELL REPORT

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

CURRENT

Notice of Intent No. AE09303

Construction/Decommission

☐ Construction

☒ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* ______

Type of Well

☒ Resource Protection

☐ Geotechnical Soil Boring

Property Owner Horn Rapids Landfill

Site Address 3102 Twin Bridges Rd.

City Richland

County 03-Benton

Consulting Firm SCS Field Services

Unique Ecology Well ID Tag No. ______

Location 1/4 NW 1/4 SW Sec 17 Twn 10N R 28E EWM or ______ WWM

Lat/Long (s,t,r still Required) Lat Deg ______ Lat Min/Sec ______

Long Deg ______ Long Min/Sec ______

Tax Parcel No. 117083000001000

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Trainee Name (Print) Scott Krueger

Driller/Trainee Signature x Scott K

Driller/Trainee License No. 2073

If trainee, licensed driller's Signature and License No. ______

Cased or Uncased Diameter 8 1/4"

Static Level 95'

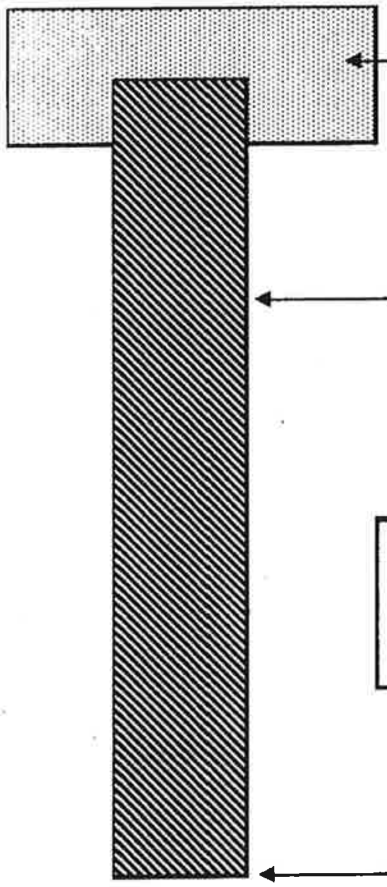
Work/Decommission Start Date 5/10/2010

Work/Decommission Completed Date 5/11/10

Construction/Design

Well Data W10-239

Formation Description



CONCRETE SURFACE SEAL 2 FT

BACKFILL 103 FT

Bent chips

DEPTH OF BORING 105 FT

0 - 105 FT

Chip in place

0 - FT

REQUIRED INFORMATION

(Must get one or both if available)

DEPT OF ECOLOGY WELL TAG #: AFM 367

CLIENT WELL ID #: MW-7

Scale 1" = ______

Page ______ of ______

ECY 050-12 (Rev 2/01)

Boring Log MW-12

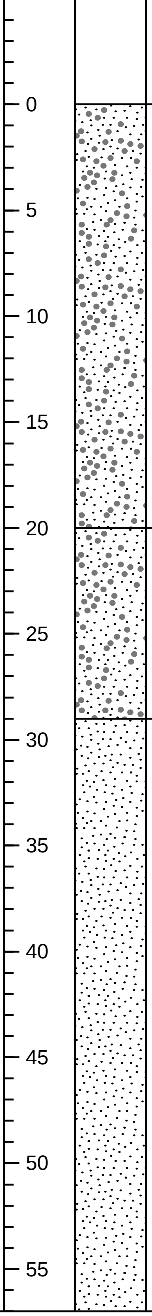
PROJECT NUMBER 553-3820-007
PROJECT Horn Rapids Assessment Monitoring
CLIENT City of Richland
LOCATION Horn Rapids Landfill, Richland, WA
COMPANY Carpenter Drilling

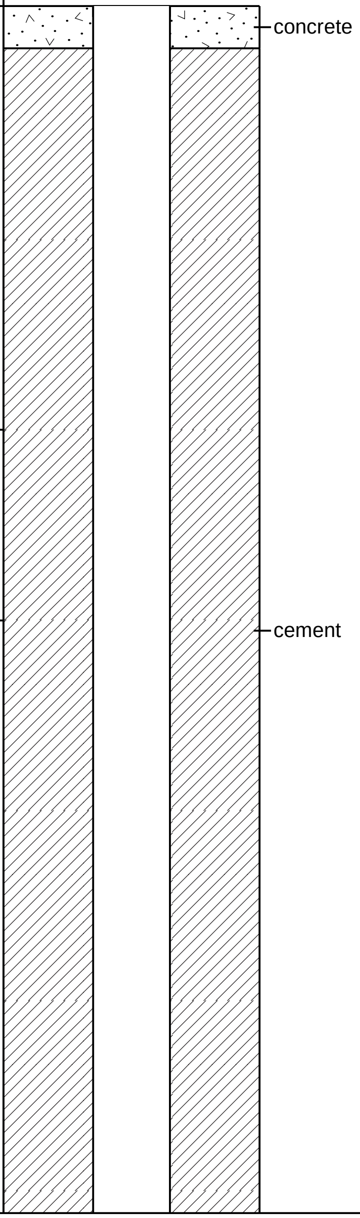
DRILLING DEPTH 10/29/18 - 11/14/18
TOTAL DEPTH 102.5 feet
DEPTH TO STATIC WATER 90.6 feet
CASING 2-inch Schedule 40 PVC
SCREEN 0.010-inch slot screen

COMMENTS Well completed 3 feet above ground surface

LOGGED BY Adam Romey LG

Water	Depth (ft)	Graphic Log	Material Description	Well Diagram
	0		Sand - fine, poorly graded, mica flakes	concrete
	5			
	10			
	15			
	20		Sand - fine to medium, poorly graded, some silt, mica flakes	
	25			
	30		Sand - fine to coarse, well graded, less fines	cement
	35			
	40			
	45			
	50			
	55			

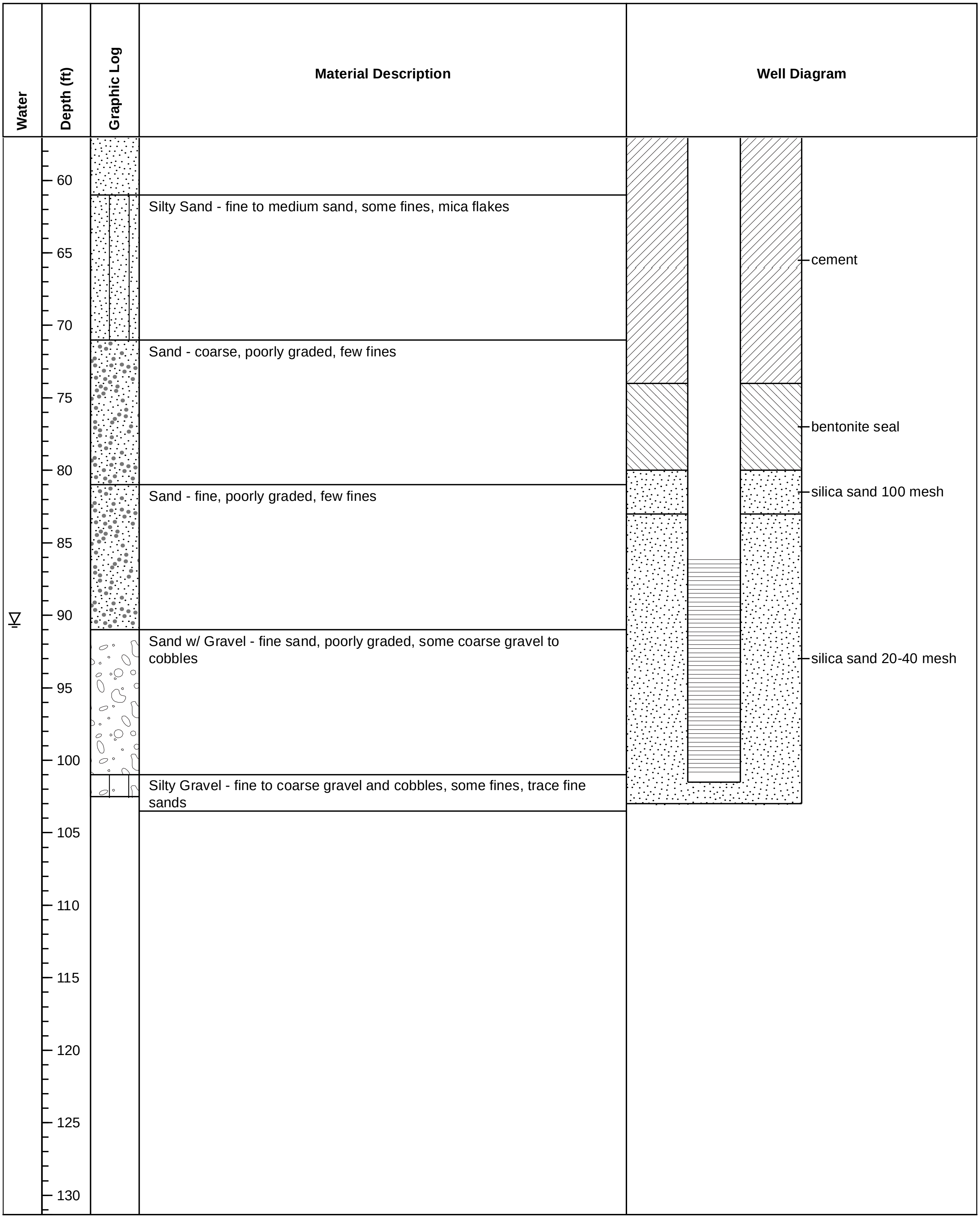




Disclaimer This bore log is intended for environmental not geotechnical purposes.

produced by ESlog.ESdat.net on 25 Jan 2019

Boring Log MW-12



Silty Sand - fine to medium sand, some fines, mica flakes

Sand - coarse, poorly graded, few fines

Sand - fine, poorly graded, few fines

Sand w/ Gravel - fine sand, poorly graded, some coarse gravel to cobbles

Silty Gravel - fine to coarse gravel and cobbles, some fines, trace fine sands

B-2

GP-12 Gas Probe Log

RESOURCE PROTECTION WELL REPORT

Notice of Intent No R53440

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

Construction/Decommission *("x" in circle)*

☒ Construction 139272

○ Decommission *Original Construction Notice of Intent Number* ____

DEPT OF ECOLOGY Received SEP 08 2003 CENTRAL REGION OFFICE

Type of Well *(x in circle)*

☒ Resource Protection N

○ Geotech Soil Boring

Property Owner City of Richland

Unique Ecology Well ID Tag No AHR 183

Consulting Firm Emcon/OWT, Inc

Driller or Trainee Name Randall E Wilder

Driller or Trainee Signature

Driller or Trainee License No ____

If trainee licensed driller's Signature and License no ____

Site Address 3102 Twin Bridges Rd

City Richland County Benton

Location SW 1/4 1/4 SW 1/4 Sec 17 Twn 10N R 28 [✓ EWM] or WWM *circle one*

Lat/Long (s t r still REQUIRED) Lat Deg ____ Lat Min/Sec ____

Long Deg ____ Long Min/Sec ____

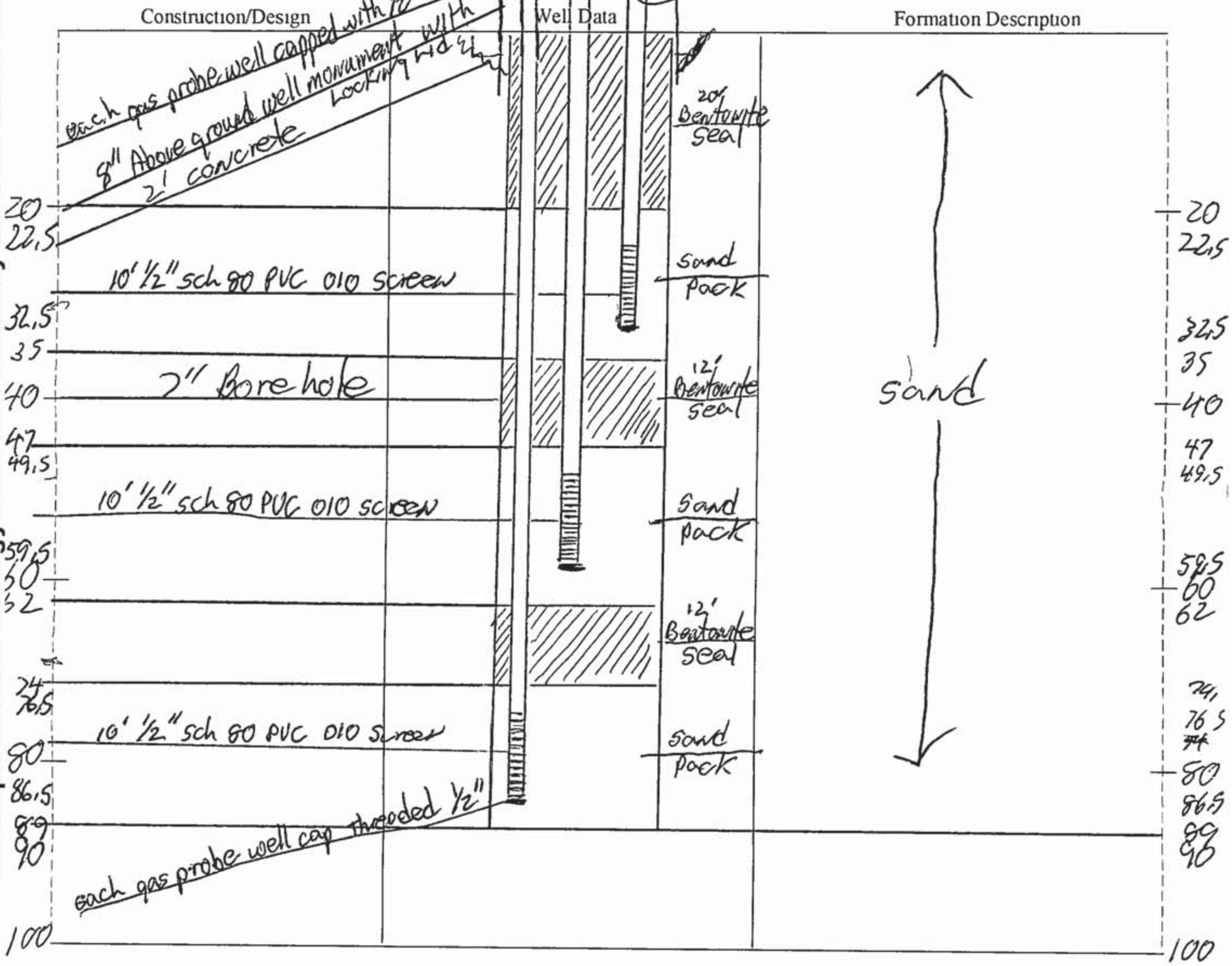
Tax Parcel No ____

Cased or Uncased Diameter ____ Static Level No water

Work/Decommission Start Date 8-10-03

Work/Decommission Completed Date 8-11-03

Construction/Design	Well Data	Formation Description


each gas probe well capped with 1/2" ball valve

8" Above ground well monument with Locking lid

2' concrete

20' Bentonite seal

10' 1/2" sch 80 PVC 010 screen

Sand pack

2" Borehole

12' Bentonite seal

10' 1/2" sch 80 PVC 010 screen

Sand pack

12' Bentonite seal

10' 1/2" sch 80 PVC 010 Screen

Sand pack

each gas probe well cap threaded 1/2"

sand

Scale 1 = ____

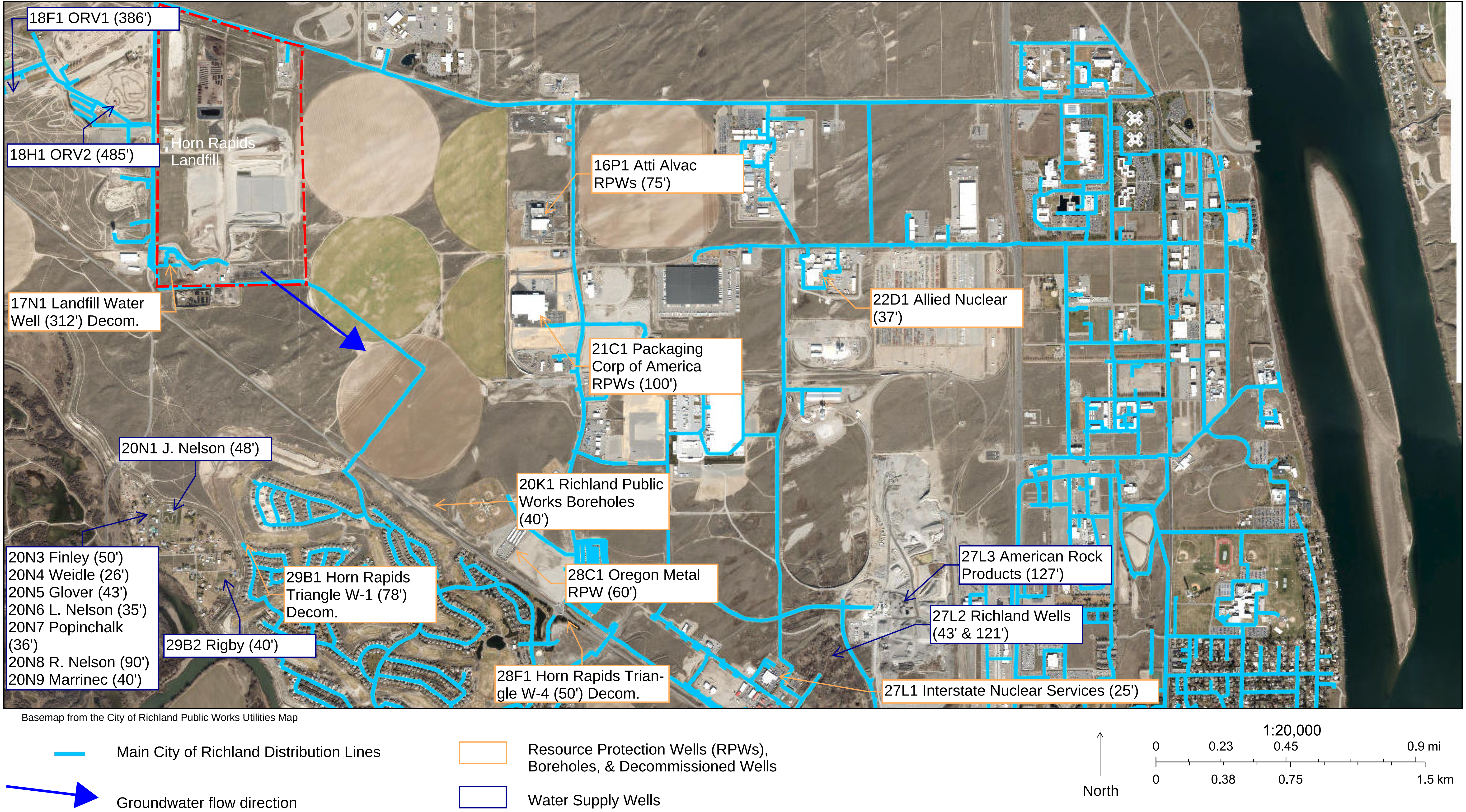
Page ____ of ____

ECY 050 12 (Rev 2/01)

B-3

Water Well Logs

Water Distribution Map & Wells Surrounding the Horn Rapids Landfill



Basemap from the City of Richland Public Works Utilities Map

APPENDIX D

Water Wells within a 2,000 ft Radius of the Horn Rapids Landfill

This table presents a summary of all well logs currently on file with the Department of Ecology. The locations of the wells are shown on the Vicinity Map, and boring logs for these wells are included. Wells are plotted by quarter quarter section, unless otherwise noted.

Summary of Wells[a] within 2,000 ft of the Horn Rapids Landfill

T/R-S#[b]	Owner[c]	Use[d]	Date Drilled	Completed Depth (ft)[e]	Geology at Completion[f]	Reported Water Level (ft)[g]
10N/28E-17 SWSW	City of Richland MW-7 (decommissioned 2010)	R	1/29/2001	102.5	S,G	91
10N/28E-17 SWSW	City of Richland MW-8	R	1/26/2001	99.5	S,G	89
10N/28E-17 SWSW	City of Richland MW-9	R	1/26/2001	112.5	G	103
10N/28E-17 SWSW	City of Richland MW-10	R	1/26/2001	84.5	S	74
10N/28E-17 SWSW	City of Richland GP-12	R	8/11/2003	89	S	NA
10N/28E-17 SWSW	Control X Corporation (Landfill supply well) decommissioned 2020	D	12/14/1977	312	B	105
10N/28E-17 NWSW	City of Richland MW-5	R	5/4/1998	98	S	96
10N/28E-17 NWSW	City of Richland MW-6	R	5/4/1998	113	G	97
10N/28E-17 NWSW	City of Richland MW-11	R	5/10/2010	102	S,G	92
10N/28E-17 NESW	City of Richland TW-2 (MW-2)	R	5/20/1987	120	S,G	90
10N/28E-17 SESW	City of Richland TW-4 (MW-4)	R	5/20/1987	112	S,G	81
10N/28E-17 SESW	City of Richland TW-3 (MW-3)	R	5/20/1987	133	S,G	100
10N/28E-18 NESE	City of Richland TW-1 (MW-1)	R	5/20/1987	136	G	106
10N/28E-18 NESW	City of Richland ORV-1	M	10/12/1982	386	B	77
10N/28E-18 SWSW	City of Richland ORV-2	I	6/12/1985	485	B	80
10N/28E-20 NENW	City of Richland MW-12	R	11/14/2018	100.5	S,G	90

[a] Table shows wells with logs on file with the Department of Ecology as of October 2020

[b] T = Township, R = Range, S - Section, # = Subsection letter (and number within subsection if applicable).

[c] Owner at time of report to Ecology

[d] I = Irrigation, D = Domestic, T = Test, M = Municipal, R = Resource Protection

[e] Depth of casing bottom, screened interval, or open interval below ground surface

[f] G = Gravel, S = Sand, B =Bedrock, Si = Silt, C = Clay, N.R.= No record

[g] Depth below ground surface; N.R. = No record

Please print, sign and return by mail to Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. 526877

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *(select one)*
☒ Construction 306569
☐ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* ______

Type of Well *(select one)*
☐ Resource Protection
☑ Geotech Soil Boring

Consulting Firm Shannon + Wilson
Unique Ecology Well ID Tag No. B-4

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Randall E Wilder
Driller/Engineer/Trainee Signature
Driller or Trainee License No. 2528

If trainee, licensed driller's Signature and License No. ______

Property Owner ATI Allvac
Site Address 3101 Kingsgate Way
City Richland County Benton
Location SE 1/4-1/4 SW 1/4 Sec 16 Twn 10N R 28 Select One ☒ EWM ☐ WWM
Lat/Long (s, t, r still REQUIRED) Lat Deg ____ Lat Min/Sec ____ Long Deg ____ Long Min/Sec ____
Tax Parcel No. 116083000001003
Cased or Uncased Diameter ______ Static Level 55
Work/Decommission [✓ Start Date] 5-6-08
Work/Decommission [✓ Completed Date] 5-6-08

Construction/Design	Well Data	Formation Description
Abandoned With Bentonite		sand
50 6" Borehole		50
		sand + Gravel
75		75

RECEIVED
JUN 10 2008
DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

File Original and First Copy with
Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. ....
Permit No. G4-23994P

(1) OWNER: Name Control X Corporation Address PO Box 1007 Richland Wash.

(2) LOCATION OF WELL: County Benton — SW ¼ SW ¼ Sec. 17 T. 10 N., R. 28E W.M.

Bearing and distance from section or subdivision corner NE

(3) PROPOSED USE: Domestic ☒ Industrial ☒ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) ....

New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 8 inches.
Drilled 312 ft. Depth of completed well 312 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 8" Diam. from +2 ft. to 248'2" ft.
Threaded ☐ ....." Diam. from ..... ft. to ..... ft.
Welded ☒ ....." Diam. from ..... ft. to ..... ft.

Perforations: Yes ☐ No ☒
Type of perforator used ....
SIZE of perforations ..... in. by ..... in.
..... perforations from ..... ft. to ..... ft.
..... perforations from ..... ft. to ..... ft.
..... perforations from ..... ft. to ..... ft.

Screens: Yes ☐ No ☒
Manufacturer's Name ....
Type ..... Model No. .....
Diam. ..... Slot size ..... from ..... ft. to ..... ft.
Diam. ..... Slot size ..... from ..... ft. to ..... ft.

Gravel packed: Yes ☐ No ☒ Size of gravel: .....
Gravel placed from ..... ft. to ..... ft.

Surface seal: Yes ☒ No ☐ To what depth? 20 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? ..... Depth of strata .....
Method of sealing strata off .....

(7) PUMP: Manufacturer's Name .....
Type: ..... H.P. .....

(8) WATER LEVELS: Land-surface elevation above mean sea level..... ft.
Static level 105 ft. below top of well Date .....
Artesian pressure ..... lbs. per square inch Date .....
Artesian water is controlled by .....
(Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? Yes ☒ No ☐ If yes, by whom? .....
Yield: ..... gal./min. with ..... ft. drawdown after ..... hrs.
" " " 192' "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level
6 AM	113	12:30PM	139		
[illegible]	210	3:30PM	192		
[illegible] AM	130				

Date of test Dec 19 - 77
~~Bailer~~ 118 test 320 gal./min. with 192 ft. drawdown after 7 hrs.
Artesian flow ..... g.p.m. Date .....
Temperature of water Cold Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Sand	0	40
Wash sand & pebbles	40	51
Damp clay & sand	51	56
Silt & sand	56	67
Fine sand	67	86
Gravel course - damp	86	142
Gravel small damp	142	154
pea gravel water	154	162
Gravel	162	171
Broken Basalt	171	182
Broken Basalt some clay	182	202
Brown clay	202	235
Blue clay	235	248
Basalt	248	270
Broken seam seep	270	273
Firm Basalt	273	305
Broken water	305	312

Water at - 86 - 142 Damp
142 - 154 Damp
154 - 162 water
270 - 273 seep
305 - 312 water

RECEIVED
FEB 14 1978
DEPARTMENT OF ECOLOGY

RECEIVED
FEB 9 1978
DEPARTMENT OF ECOLOGY
SPOKANE REGIONAL OFFICE

Work started 10/20, 19 77. Completed 12/14, 19 77

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME American Development & Drilling
(Person, firm, or corporation) (Type or print)

Address P.O. Box 14977 Spokane, Wa. 99214

[Signed] B. G. [illegible]
(Well Driller)

License No. 0322 Date 12/28, 19 77

OR

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

File Original and First Copy with
Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Application No.
Permit No. G4 25674

(1) OWNER: Name City of Richland Address 505 Swift Blvd, Richland WA

LOCATION OF WELL: County Benton NE ¼ SW ¼ Sec. 18 T. 10 N., R. 28 W.M.

Bearing and distance from section or subdivision corner 2200 N. Then 3000 W SE corner sec 18

(3) PROPOSED USE: Domestic ☐ Industrial ☐ Municipal ☒ Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) ORV-1

New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☒ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 8 inches.
Drilled 386 ft. Depth of completed well 386 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 8 " Diam. from +1½ ft. to 217 ft.
Threaded ☐ 6 " Diam. from 226 ft. to 386 ft.
Welded ☒ " Diam. from ft. to ft.

Perforations: Yes ☒ No ☐
Type of perforator used torch
SIZE of perforations 1/2 in. by 6 in.
32 perforations from 286 ft. to 294 ft.
64 perforations from 322 ft. to 354 ft.
128 perforations from 354 ft. to 386 ft.

Screens: Yes ☐ No ☒
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☒ Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☐ To what depth? 25 ft.
Material used in seal Bentonite grout
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level 475 ft.
Static level 77 ft. below top of well Date 11/12/82
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☒ No ☐ If yes, by whom? Self

Yield: gal./min. with	ft. drawdown after	hrs.
325	14.38	16

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test 11/11/82
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water 66 Was a chemical analysis made? Yes ☒ No ☐

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Sand + silt	0	12
Brown Black sand small		
amount gravel + silt	12	75
Brown sand silt +		
gravel conglomerate	75	158
Dark clay + Basalt		
gravel	158	200
Broken Black Basalt		
+ clay	200	222
Gray Basalt	222	291
Fractured basalt	291	294
Broken basalt Basalt		
gravel + Blue Clay	294	303
Blue Clay + Broken basalt	303	322
Broken Basalt some		
blue Clay	322	354
Gray Basalt	354	375
Brownish Black		
vasicular Basalt		
green claystone veins	375	379
Reddish Brown basalt		
Rotten + caving	379	386

NOV 15 1982

Work started 10/4 1982 Completed 10/12 1982

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Owego Drilling Co Inc (Person, firm, or corporation) (Type or print)

Address 6417 W. Court Pasco WA

[Signed] (Well Driller)

License No. 0036 Date 11/12 1982

(USE ADDITIONAL SHEETS IF NECESSARY) SP 12/3/82

ECY 050-1-20

WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

UNIQUE WELL I D NUMBER ABR575
X Y Z 1 2 3

WELL TAGGING FORM

Date of Field Visit 8/29/94 By Larry Wandt IEL

ADDITIONAL WELL IDENTIFIERS

ORV PARK

Department of Health System ID Number 41574 P Source Number SO01

USGS Site Identification ____________

RECORD VERIFICATION

☑ Well Report available *(please attach)*
☐ Well Report not available
☐ Verification inconclusive

WELL OWNERSHIP, IF DIFFERENT FROM WELL REPORT

Name City of Richland

Street address P.O. Box 190

City Richland State WA 99352

LOCATION OF WELL, IF DIFFERENT FROM WELL REPORT

Well Address 3400 Grosscup Road

City Richland WA County BENTON

T. 10 N. R 28 E WM Sec. 18 S.E ¼ of the N.W. ¼

Latitude ______ ° ______ ' ______ "
Longitude ______ ° ______ ' ______ "

☐ GPS (raw data)
☐ GPS (corrected)
☐ Topographic Map
☐ Survey
☐ Computer generated
☐ Other ____________

Elevation at land surface 475' [✓ feet]/meters *(circle one)*

☐ Digital Altimeter
☐ Topographic Map

Additional information, if available:

☐ Location marked on topographic map *(please attach)*

☐ Location marked on air photo *(please attach)*

Water Right # G4-28554 C Priority Date October 26, 1984

Circle one: Application Permit [✓ Certificate] Claim Exempt

WELL CHARACTERISTICS

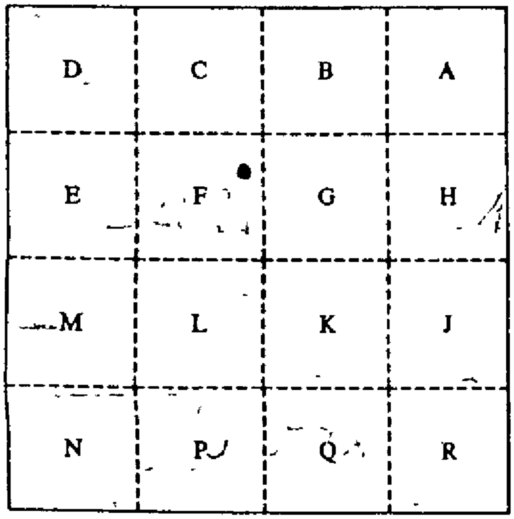
Physical Description of Well (size of casing, type of well, housing, etc.): 8" casing
Drilled well 386' wellhead located inside wellhouse.

Location of Well Identification Tag: Wellhead.

Was Supplemental Tag needed for ease of identifying well?
☒ NO ☐ YES

If yes, where was tag placed?

Scale 1:24,000 (1"=2,000')



Indicate the location of the well within the Section by drawing a dot at that point.

SECTION 18

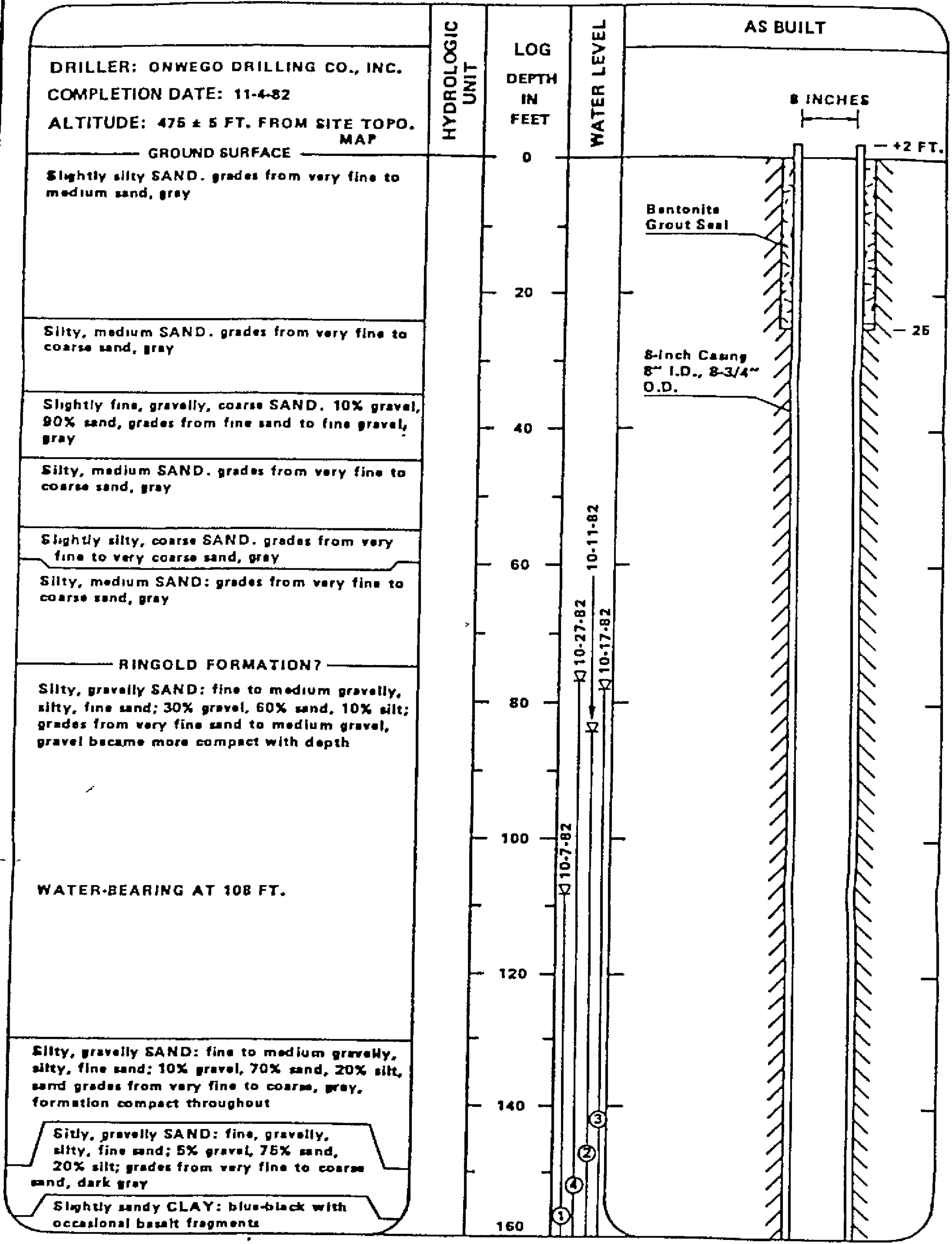
COMMENTS:

Please attach this form to the Well Report and submit it to the Department of Ecology Water Resources Program Headquarters,
Well [illegible] Program P.O. Box 47600 [illegible] WA 98504 7600
P.O Box 47600 Olympia

LOG & AS-B ILT DIAGRAM

FIGURE 1

DRILLER: ONWEGO DRILLING CO., INC.
COMPLETION DATE: 11-4-82
ALTITUDE: 475 ± 5 FT. FROM SITE TOPO. MAP



GROUND SURFACE

Slightly silty SAND. grades from very fine to medium sand, gray

Silty, medium SAND. grades from very fine to coarse sand, gray

Slightly fine, gravelly, coarse SAND. 10% gravel, 90% sand, grades from fine sand to fine gravel, gray

Silty, medium SAND. grades from very fine to coarse sand, gray

Slightly silty, coarse SAND. grades from very fine to very coarse sand, gray

Silty, medium SAND: grades from very fine to coarse sand, gray

RINGOLD FORMATION?

Silty, gravelly SAND: fine to medium gravelly, silty, fine sand; 30% gravel, 60% sand, 10% silt; grades from very fine sand to medium gravel, gravel became more compact with depth

WATER-BEARING AT 108 FT.

Silty, gravelly SAND: fine to medium gravelly, silty, fine sand; 10% gravel, 70% sand, 20% silt, sand grades from very fine to coarse, gray, formation compact throughout

Sitly, gravelly SAND: fine, gravelly, silty, fine sand; 5% gravel, 75% sand, 20% silt; grades from very fine to coarse sand, dark gray

Slightly sandy CLAY: blue-black with occasional basalt fragments

Bentonite Grout Seal

8-Inch Casing 8" I.D., 8-3/4" O.D.

SHANNON & WILSON, INC.
GROUNDWATER SECTION
SEATTLE, WASHINGTON

CITY OF RICHLAND, WASHINGTON
HORN RAPIDS TRIANGLE O.R.V. PARK

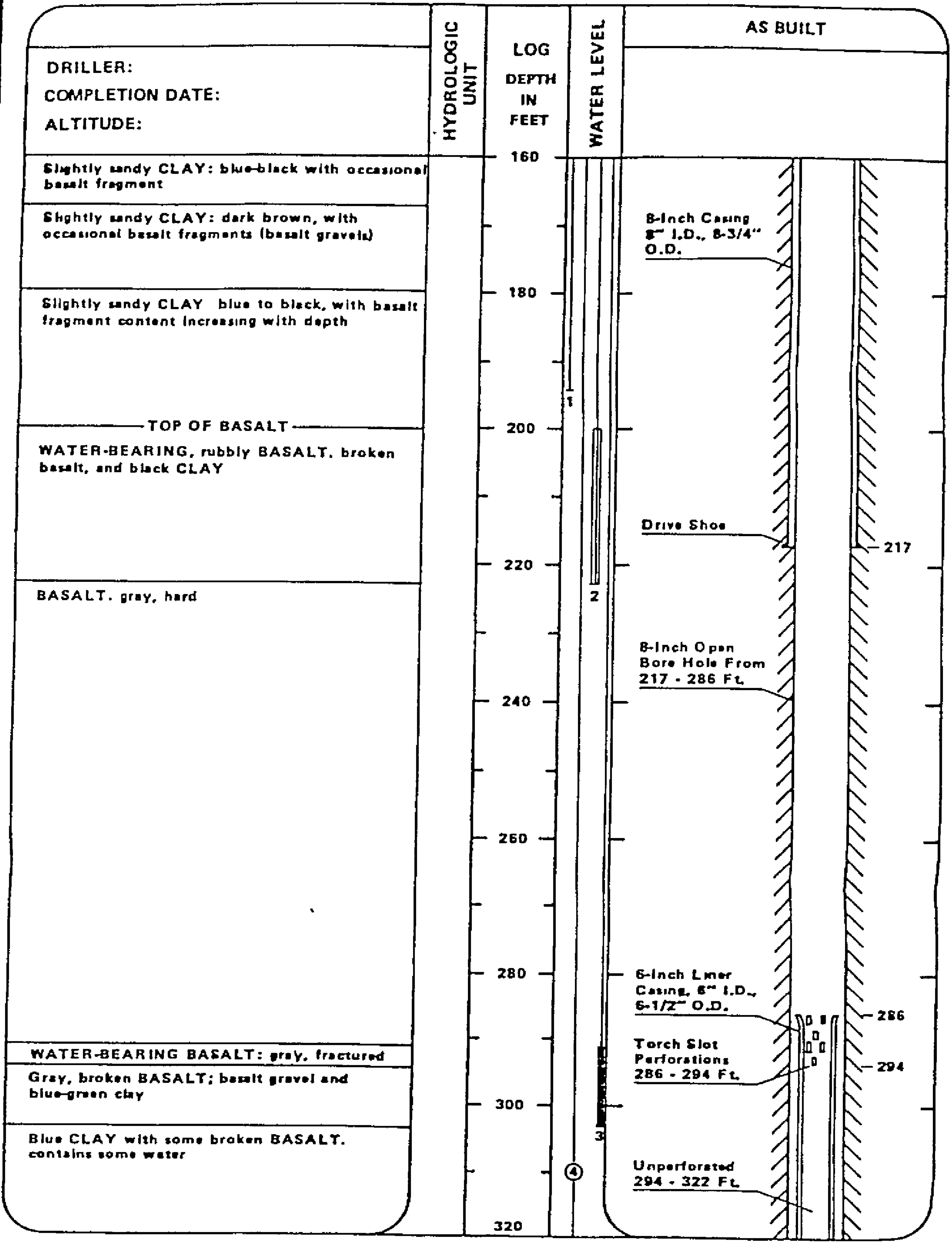
O.R.V. PARK WELL #1

W-3992-02
NOV. 1982

LOG & AS-B ILT DIAGRAM

FIGURE 1 CONT.

DRILLER:
COMPLETION DATE:
ALTITUDE:



Slightly sandy CLAY: blue-black with occasional basalt fragment

Slightly sandy CLAY: dark brown, with occasional basalt fragments (basalt gravels)

Slightly sandy CLAY blue to black, with basalt fragment content increasing with depth

TOP OF BASALT

WATER-BEARING, rubbly BASALT, broken basalt, and black CLAY

BASALT, gray, hard

WATER-BEARING BASALT: gray, fractured

Gray, broken BASALT; basalt gravel and blue-green clay

Blue CLAY with some broken BASALT, contains some water

SHANNON & WILSON, INC.
GROUNDWATER SECTION
SEATTLE, WASHINGTON

CITY OF RICHLAND, WASHINGTON
HORN RAPIDS TRIANGLE O.R.V. PARK

O.R.V. PARK WELL #1

W-3992-02
NOV. 1982

LOG & AS-BUILT DIAGRAM

FIGURE 1 CONT.

DRILLER:
COMPLETION DATE.
ALTITUDE:

WATER-BEARING, broken **BASALT** with some blue **CLAY**

BASALT, gray, hard

WATER-BEARING BASALT vesicular, brownish-black with buish-green claystone vein fillings

WATER-BEARING BASALT. very porous, reddish-brown

TOTAL DEPTH 386 FEET

NOTES

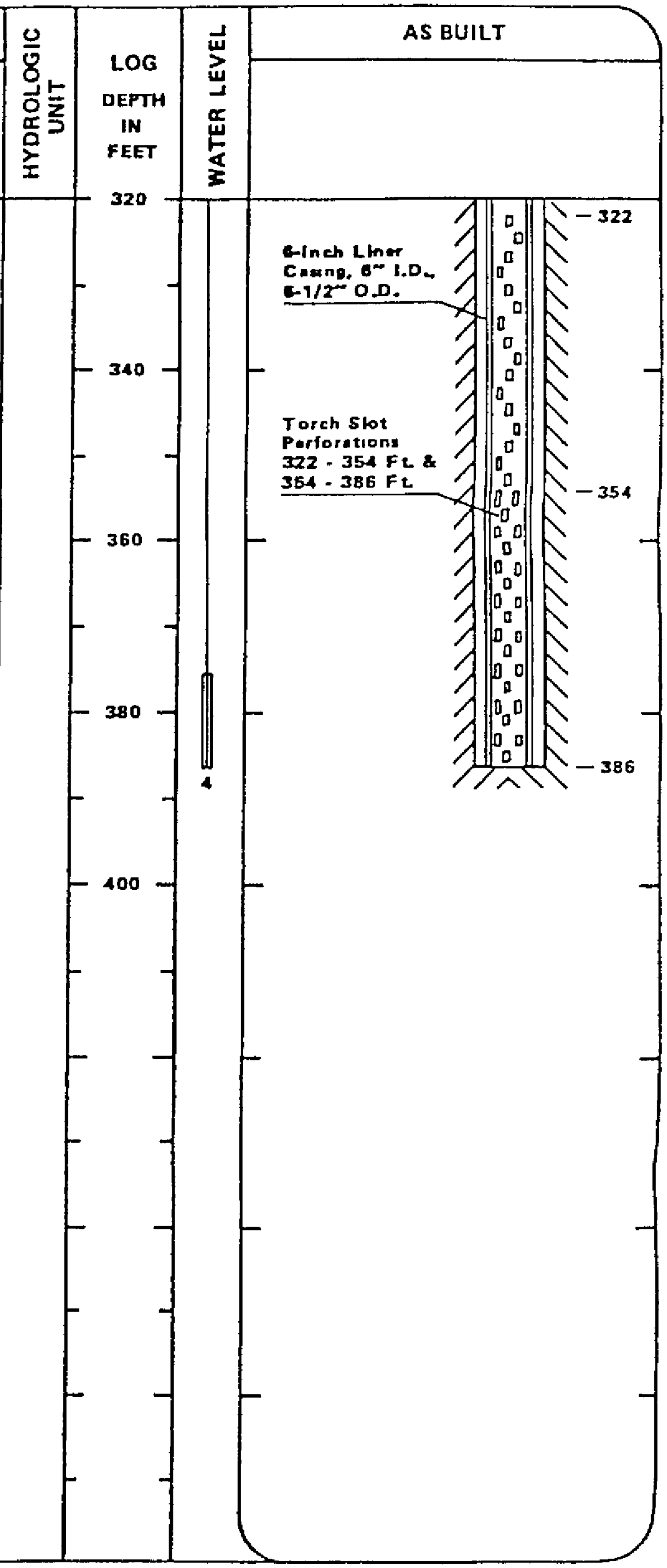
1. 6-INCH LINER—PERFORATION SUMMARY. TORCH-SLOT PERFORATION (1/2 INCH WIDE BY 6 INCHES LONG)

   32 PERFORATIONS FROM 286 - 294 FT.

   64 PERFORATIONS FROM 322 - 354 FT.

   128 PERFORATIONS FROM 354 - 386 FT.

2. WELL WAS PUMPED AT 325 GALLONS PER MINUTE FOR 16 HOURS. STATIC-WATER LEVEL WAS 77 FEET BELOW GROUND SURFACE. DRAWDOWN WAS 14-1/2 FEET WITH PUMPING WATER LEVEL AT 91-1/2 FEET.

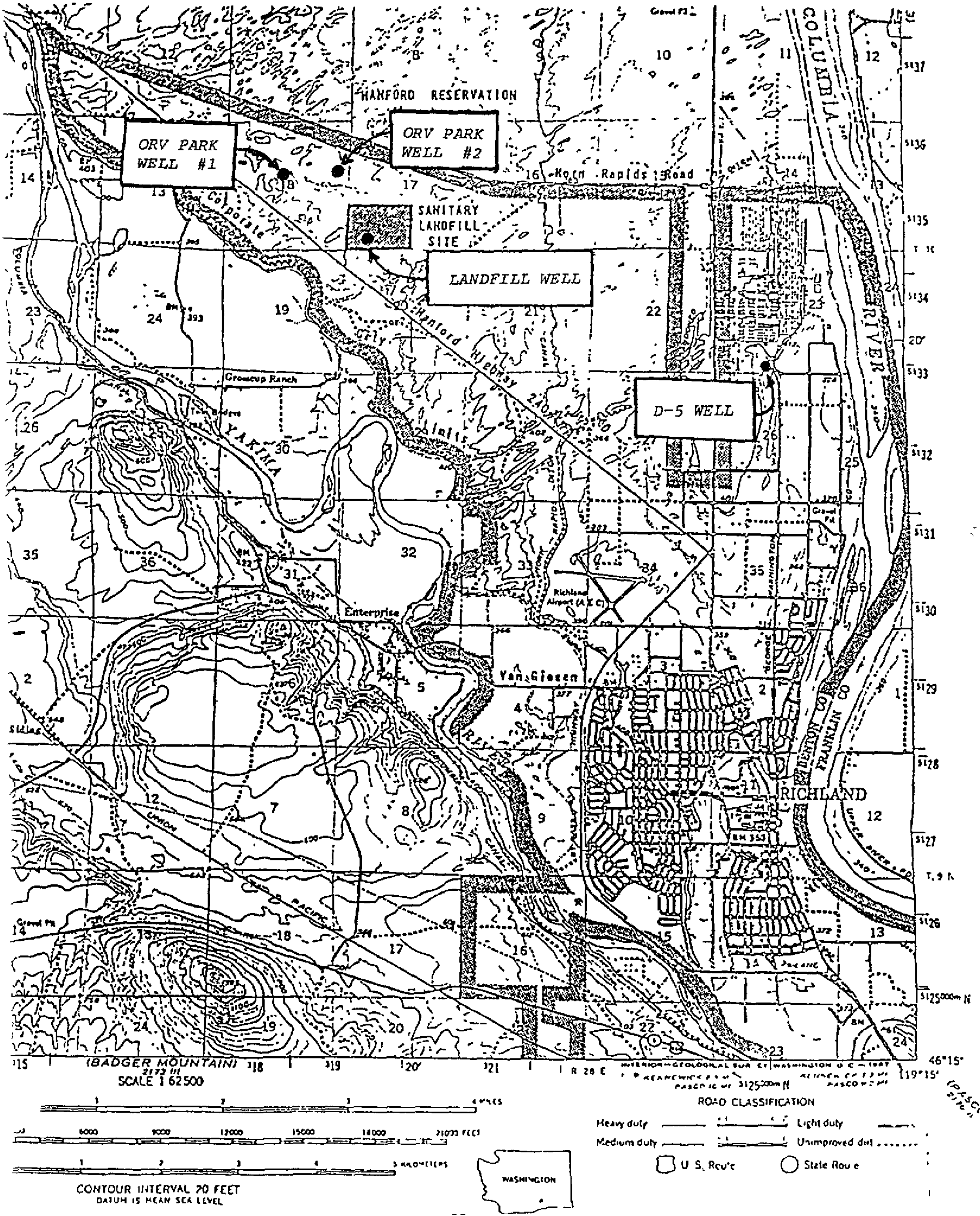


SHANNON & WILSON, INC.
GROUNDWATER SECTION
SEATTLE, WASHINGTON
(206) 632-8020

CITY OF RICHLAND, WASHINGTON
HORN RAPIDS TRIANGLE O.R.V. PARK

O.R.V. PARK WELL #1

W-3992-02
NOV. 1982


HANFORD RESERVATION
ORV PARK WELL #1
ORV PARK WELL #2
SANITARY LANDFILL SITE
LANDFILL WELL
D-5 WELL
Horn Rapids Road
Hanford Highway
Grosscup Ranch
YAKIMA
Enterprise
Van Giesen
Richland Airport
RICHLAND
COLUMBIA RIVER
BENTON CO
FRANKLIN CO
UNION PACIFIC
Sidlea
(BADGER MOUNTAIN)
SCALE 1 62500
1 MILES
FEET
KILOMETERS
CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL
ROAD CLASSIFICATION
Heavy duty
Medium duty
Light duty
Unimproved dirt
U. S. Route
State Route
WASHINGTON
46°15'
119°15'
R 28 E
T. 9 N.
5125000m N

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. ....
Permit No. G4-28642

(1) **OWNER:** Name CITY OF RICHLAND Address P.O. Box 190, Richland, WA 99352

(2) **LOCATION OF WELL:** County BENTON — SW ¼ SW ¼ Sec ~~18~~10 T. 10 N., R 28E W.M.

Bearing and distance from section or subdivision corner Horn Rapids Triangle Off Road Vehicle Park Well No. 2

(3) **PROPOSED USE:** Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☒ Test Well ☐ Other ☐

(4) **TYPE OF WORK:** Owner's number of well (if more than one) #2
New well ☒ Deepened ☐ Reconditioned ☐
Method: Dug ☐ Bored ☐ Cable ☐ Driven ☐ Rotary ☒ Jetted ☐

(5) **DIMENSIONS:** Diameter of well 10 inches.
Drilled 485 ft. Depth of completed well 485 ft.

(6) **CONSTRUCTION DETAILS:**

Casing installed: 10 " Diam. from +1 ft. to 202 ft.
Threaded ☐ 8 " Diam. from 180 ft. to 485 ft.
Welded ☒ " Diam. from ft. to ft.

Perforations: Yes ☒ No ☐
Type of perforator used torch
SIZE of perforations 1/4 in. by 12 in.
128 perforations from 380 ft. to 460 ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☐ No ☒
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☒ Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☐ To what depth? 20 ft.
Material used in seal bentonite
Did any strata contain unusable water? Yes ☒ No ☐
Type of water? clean Depth of strata 110-160
Method of sealing strata off cased out

(7) **PUMP:** Manufacturer's Name
Type: H.P.

(8) **WATER LEVELS:** Land-surface elevation above mean sea level ft.
Static level 80 ft. below top of well Date 6/12/85
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) **WELL TESTS:** Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☒ If yes, by whom?
Yield: 250+ gal./min. with ft. drawdown after hrs.
" ESTIMATED AIRLIFT " "
" " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) **WELL LOG:**

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Sand, fine	0	60
Sand & Gravel	60	90
Large gravel & boulders w/water	90	120
Basalt boulders & gravel w/water	120	160
Clay, yellow	160	200
Basalt, broken	200	202
Basalt, hard	202	290
Clay, gray	290	330
Basalt scoria w/some blue clay w/trace of water	330	345
Basalt, hard w/water	345	460
Clay, gray	460	485
NO PVC Liner Installed		
10" Drive shoe installed		
Developed for 4½ hours		

RECEIVED
JUN 25 1985
DEPARTMENT OF ECOLOGY
CENTRAL REGION OFFICE

Work started 5/23/, 19 85 Completed 6/12, 19 85

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME PONDEROSA DRILLING & DEVELOPMENT INC.
(Person, firm, or corporation) (Type or print)

Address E. 6010 Broadway, Spokane, WA 99212

[Signed] Thomas R. Richardson (Well Driller)
Thomas R. Richardson

License No. 1295 Date 6/12, 19 85

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

SW1213

RESOURCE PROTECTION WELL REPORT

Notice of Intent No. S13074

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *("x" in circle)* 19535

☒ Construction

○ Decommission *Original Construction Notice of Intent Number* ____

Type of Well *("x" in circle)*

○ Resource Protection

☒ Geotech Soil Boring

Property Owner City of Richland Public Works

Unique Ecology Well ID Tag No. B-1, 2, 3

Consulting Firm Shannon & Wilson

Driller or Trainee Name Ronald Sink

Driller or Trainee Signature Ronald Sink

Driller or Trainee License No. 2661

If trainee, licensed driller's Signature and License no. ____

Site Address Highway 240

City Richland County: Benton

Location ____1/4-1/4 NW/SE 1/4 Sec 20 Twn 10N R 28E [✓ EWM] or WWM circle one

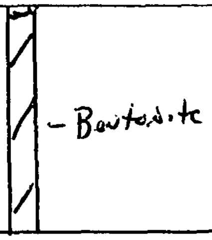
Lat/Long (s, t, r still REQUIRED) Lat Deg ____ Lat Min/Sec ____ Long Deg ____ Long Min/Sec ____

Tax Parcel No. ____

Cased or Uncased Diameter 8" Static Level N/A

Work/Decommission Start Date 12/14/05

Work/Decommission Completed Date 12/14/05

Construction/Design	Well Data	Formation Description
 - Bentonite	Drill Method: HSA Seal: Bentonite Chips 1' to 40'	silty Sand

40

40

DEPT. OF ECOLOGY
Received
MAR 16 2006
CENTRAL REGION OFFICE

Scale 1"= 40'

Page 1 of 1

ECY 050-12 (Rev 2/01)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WASHINGTON STATE DEPARTMENT OF ECOLOGY

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission *("x" in circle)*

● Construction 467844

○ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* ______

CURRENT

Notice of Intent No. WE 15396

Unique Ecology Well ID Tag No. BAE 884

Water Right Permit No. ______

Property Owner Name Jim Nelson

Well Street Address 82123 N. Weidle Rd.

City W. Richland County Benton

Location SW 1/4-1/4 SW 1/4 Sec 20 Twn 10 R 28 [✓ EWM] or WWM circle one

Lat/Long (s, t, r Still **REQUIRED**) Lat Deg ______ Lat Min/Sec ______ Long Deg ______ Long Min/Sec ______

Tax Parcel No. 200830000005001

PROPOSED USE: ☑ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other ______

TYPE OF WORK: Owner's number of well (if more than one) ______

☑ New well ☐ Reconditioned *Method:* ☐ Dug ☐ Bored ☐ Driven

☐ Deepened ☐ Cable ☑ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6" inches, drilled 60 ft.

Depth of completed well 55' ft.

CONSTRUCTION DETAILS

Casing Installed:

☑ Welded 6" Diam. from +2 ft. to 55 ft.

☐ Liner installed ______" Diam. from ______ ft. to ______ ft.

☐ Threaded ______" Diam. from ______ ft. to ______ ft.

Perforations: ☐ Yes ☑ No

Type of perforator used — —

SIZE of perfs ______ in. by ______ in. and no. of perfs ______ from ______ ft. to ______ ft.

Screens: ☐ Yes ☑ No ☐ K-Pac Location ______

Manufacturer's Name ______

Type ______ Model No. ______

Diam. ______ Slot size ______ from ______ ft. to ______ ft.

Diam. ______ Slot size ______ from ______ ft. to ______ ft.

Gravel/Filter packed: ☑ Yes ☐ No ☐ Size of gravel/sand 2"-3" Formation

Materials placed from 52 ft. to 55-60 ft.

Surface Seal: ☑ Yes ☐ No To what depth? 20 ft.

Material used in seal Bentonite

Did any strata contain unusable water? ☐ Yes ☑ No

Type of water? ______ Depth of strata ______

Method of sealing strata off ______

PUMP: Manufacturer's Name ______

Type: ______ H.P. ______

WATER LEVELS: Land-surface elevation above mean sea level 23 ft.

Static level 23 ft. below top of well Date 10-24-2012

Artesian pressure ______ lbs. per square inch Date ______

Artesian water is controlled by ______ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☐ Yes ☑ No If yes, by whom? ______

Yield ______ gal./min. with ______ ft. drawdown after ______ hrs.

Yield: ______ gal./min. with ______ ft. drawdown after ______ hrs

Yield: ______ gal./min. with ______ ft. drawdown after ______ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ______

Bailer test ______ gal./min. with ______ ft. drawdown after ______ hrs.

Airtest 25+ gal./min. with stem set at 52 ft. for 1 hrs.

Artesian flow ______ g.p.m. Date ______

Temperature of water 56° Was a chemical analysis made? ☐ Yes ☑ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Top Soil	0	3
Silty Sand	3	16
Sand & Gravel	16	23
Silty, Gravel	23	32
cemented Gravel	32	43
large Gravel & Sand	43	50
Gravel & Sand	50	60

DEPT OF ECOLOGY
Received
NOV 15 2012
CENTRAL REGION OFFICE

Start Date 10-24-2012 Completed Date 10-24-2012

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☑ Driller ☐ Engineer ☐ Trainee Name (Print) Lyle O-Amos

Driller/Engineer/Trainee Signature Lyle O. Amos

Driller or trainee License No. 1224

If TRAINEE,
Driller's Licensed No. ______
Driller's Signature ______

Drilling Company Triple A Drilling Inc

Address P.O. Box 278

City, State, Zip Burbank Wa

Contractor's Registration No. TRIPLDI937BB Date 10-24-12

Ecology is an Equal Opportunity Employer.

ECY 050-1-20 (Rev 3/05)

The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.

WATER WELL REPORT

ECOLOGY Original & 1st copy - Ecology, 2nd copy - owner, 3rd copy - driller

109947

Construction/Decommission *("x" in circle)*
○ Construction
○ Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number*

CURRENT Notice of Intent No. W131600

Unique Ecology Well ID Tag No. AGH 825

Water Right Permit No.

Property Owner Name Bill Finley N

Well Street Address Weidle Rd

City W, Richland County: Benton

Location SW 1/4- 1/4 SW 1/4 Sec 20 Twn 10 R 25 [✓ EWM] or WWM *circle one*

Lat/Long: (s,t,r still REQUIRED) Lat Deg Lat Min/Sec
Long Deg Long Min/Sec

Tax Parcel No.

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other

TYPE OF WORK: Owner's number of well (if more than one)
☒ New Well ☐ Reconditioned *Method* ☐ Dug ☐ Bored ☐ Driven
☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 10X6 inches, drilled ft
Depth of completed well 50' ft

CONSTRUCTION DETAILS
Casing Installed: ☒ Welded 6" Diam. from +1 1/2 ft. to 50 ft.
☐ Liner installed " Diam from ft to ft.
☐ Threaded " Diam. from ft. to ft

Perforations: ☐ Yes ☒ No
Type of perforator used
SIZE of perfs in. by in and no. of perfs from ft. to ft

Screens: ☐ Yes ☒ No ☐ K-Pac Location
Manufacturer's Name
Type Model No.
Diam Slot Size from ft. to ft
Diam. Slot Size from ft. to ft

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand
Materials placed from ft to ft

Surface Seal: ☒ Yes ☐ No To what depth? 20+ ft
Materials used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? Depth of strata
Method of sealing strata off

PUMP: Manufacturer's Name
Type H.P.

WATER LEVELS: Land-surface elevation above mean sea level ft
Static level 8' ft below top of well Date 1-25-02
Artesian pressure lbs per square inch Date
Artesian water is controlled by (cap,valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level.
Was a pump test made? ☐ Yes ☒ No If yes, by whom?
Yield gal./min. with ft drawdown after hrs
Yield gal./min with ft. drawdown after hrs
Yield gal./min with ft drawdown after hrs
Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)
Time Water Level Time Water Level Time Water Level
40gPM BY AIRLIFT
Date of test
Bailer test gal./min. with ft drawdown after hrs
Airtest 40 gal./min with stem set at 30 ft for 2 hrs
Artesian flow g p m Date
Temperature of water Was a chemical analysis made? ☐ Yes ☐ No

CONSTRUCTION OR DECOMMISSION PROCEDURE
Formation Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. Indicate all water encountered
(USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
SAND & CLAY	0	12
LARGE GRAVEL	12	23
SAND GRAVEL	23	30
Cemented GRAVEL	30	45
LARGE GRAVEL / WATER	45	50

DEPT. OF ECOLOGY
Received
FEB 11 2002
CENTRAL REGION OFFICE

Start Date 1-23-02 Completed Date 1-25-02

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) ROD COX
Driller/Engineer/Trainee Signature Rod W Cox
Driller or Trainee License No. 2302

If trainee, licensed driller's Signature and License no.

Drilling Company RWCOX Drilling
Address P.O. Box 5324
City, State, Zip Benton City, WASh 99320
Contractor's Registration No RWCOXDD222K Date 1-25-02

Ecology is an Equal Opportunity Employer ECY 050-1-20 (Rev 4/01)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with
Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Application No.
Permit No.

(1) OWNER: Name [illegible] Address [illegible]

(2) LOCATION OF WELL: County [illegible] SW ¼ SW ¼ Sec [illegible] T [illegible] N., R [illegible] W.M.
Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic ☒ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one)
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☒
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well .... inches.
Drilled [illegible] ft. Depth of completed well [illegible] ft.

(6) CONSTRUCTION DETAILS:

Casing installed: [illegible] " Diam. from [illegible] ft. to [illegible] ft.
Threaded ☐ .... " Diam. from .... ft. to .... ft.
Welded ☐ .... " Diam. from .... ft. to .... ft.

Perforations: Yes ☐ No ☒
Type of perforator used
SIZE of perforations .... in. by .... in.
.... perforations from .... ft. to .... ft.
.... perforations from .... ft. to .... ft.
.... perforations from .... ft. to .... ft.

Screens: Yes ☐ No ☒
Manufacturer's Name
Type .... Model No.
Diam. .... Slot size .... from .... ft. to .... ft.
Diam. .... Slot size .... from .... ft. to .... ft.

Gravel packed: Yes ☐ No ☒ Size of gravel:
Gravel placed from .... ft. to .... ft.

Surface seal: Yes ☐ No ☐ To what depth? [illegible] ft.
Material used in seal [illegible]
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? .... Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name [illegible]
Type [illegible] H.P. [illegible]

(8) WATER LEVELS: Land-surface elevation above mean sea level .... ft.
Static level [illegible] ft. below top of well Date [illegible]
Artesian pressure [illegible] lbs. per square inch Date
Artesian water is controlled by .... (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☒ No ☐ If yes, by whom? [illegible]
Yield: [illegible] gal./min. with [illegible] ft. drawdown after [illegible] hrs.
" " "
" " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	*Water Level*	*Time*	*Water Level*	*Time*	*Water Level*

Date of test
Bailer test .... gal./min. with .... ft. drawdown after .... hrs.
Artesian flow .... g.p.m. Date
Temperature of water .... Was a chemical analysis made? Yes ☐ No ☐

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
[illegible]	0	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	74	[illegible]
[illegible]	[illegible]	[illegible]

RECEIVED
NOV 5 1976
DEPARTMENT OF ECOLOGY
CENTRAL REGIONAL OFFICE

Work started [illegible], 19[illegible]. Completed [illegible], 19[illegible]

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME [illegible]
(Person, firm, or corporation) (Type or print)

Address [illegible]

[Signed]
(Well Driller)

License No. [illegible] Date ...., 19

(USE ADDITIONAL SHEETS IF NECESSARY)

S. F. No. 7356—OS—(Rev. 4-71)

File Original and First Copy with
Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. /
Permit No. /

(1) OWNER: Name Don Glover Address RT. 1 Box 347A - Richland, Wash. 9935

(2) LOCATION OF WELL: County Benton — SW ¼ SW ¼ Sec. 20 T. 10 N., R. 28 W.M.

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic ☑ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) ....
New well ☐ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☑ Driven ☐
Reconditioned ☑ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 43 ft. Depth of completed well 43 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from 0 ft. to 38 ft.
Threaded ☐ ....." Diam. from ..... ft. to ..... ft.
Welded ☑ ....." Diam. from ..... ft. to ..... ft.

Perforations: Yes ☐ No ☑
Type of perforator used.....
SIZE of perforations ..... in. by ..... in.
..... perforations from ..... ft. to ..... ft.
..... perforations from ..... ft. to ..... ft.
..... perforations from ..... ft. to ..... ft.

Screens: Yes ☑ No ☐
Manufacturer's Name Cook
Type Stainless Steel Model No. –
Diam. 6 Slot size 20 from ..... ft. to ..... ft.
Diam. ..... Slot size ..... from ..... ft. to ..... ft.

Gravel packed: Yes ☐ No ☑ Size of gravel: .....
Gravel placed from ..... ft. to ..... ft.

Surface seal: Yes ☐ No ☐ To what depth? ? ft.
Material used in seal.....
Did any strata contain unusable water? Yes ☐ No ☐
Type of water?..... Depth of strata.....
Method of sealing strata off.....

(7) PUMP: Manufacturer's Name.....
Type: ..... H.P. .....

(8) WATER LEVELS: Land-surface elevation above mean sea level..... ft.
Static level 11 ft. below top of well Date 2-1-77
Artesian pressure ..... lbs. per square inch Date .....
Artesian water is controlled by..... (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☑ If yes, by whom? .....

Yield:	gal./min. with	ft. drawdown after	hrs.
"	"	"	"
"	"	"	"

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test .....
Bailer test 30 gal./min. with 0 ft. drawdown after 1/2 hrs.
Artesian flow ..... g.p.m. Date .....
Temperature of water..... Was a chemical analysis made? Yes ☐ No ☑

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Installed Screen and pulled Casing back 5 ft, Surged well 2 hrs,		

RECEIVED
MAY 25 1977
DEPARTMENT OF ECOLOGY
CENTRAL REGIONAL OFFICE

Work started 2-1, 1977 Completed 2-1, 1977

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME B & H Drilling (Person, firm, or corporation) (Type or print)

Address Rt. 3 Box 3365 A - Kennewick Wash 993

[Signed] H. A. Buttna (Well Driller)

License No. 0046 Date 2-24, 1977

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

File Original and First Copy with
Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No.
Permit No. G3-21155

(1) OWNER: Name Lyman Nelson Address RT1 Bx 347 Richland Wn.

(2) LOCATION OF WELL: County Benton — SW ¼ SW ¼ Sec. 20 T. 10 N., R. 28E W.M. N

ring and distance from section or subdivision corner

(3) PROPOSED USE: Domestic ☒ Industrial ☐ Municipal ☐
Irrigation ☒ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one)
New well ☐ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☒ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 8 inches.
Drilled 35 ft. Depth of completed well 35 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 8 " Diam. from 0 ft. to 35 ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☒ " Diam. from ft. to ft.

Perforations: Yes ☒ No ☐
Type of perforator used Knife. Milles
SIZE of perforations 3 in. by 4 in.
perforations from ft. to ft.
120 perforations from 28 ft. to 16 ft.
perforations from ft. to ft.

Screens: Yes ☐ No ☒
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: ~~Yes~~ ☒ No ☒ Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☒ To what depth? 18 ft.
Material used in seal
Did any strata contain unusable water? Yes ☐ No ☐
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP: Manufacturer's Name
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level 300 ft.
Static level 10 ft. below top of well Date May 1973
Artesian pressure lbs. per square inch Date
Artesian water is controlled by
(Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☒ If yes, by whom?
Yield: gal./min. with ft. drawdown after hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

ate of test
iler test 100 gal./min. with 0 ft. drawdown after ½ hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Top Soil	0	2
Sand Brown	2	19
Sand - Gravel	19	33
S.W.L. 10 ft.		

RECEIVED
AUG 13 1975
DEPARTMENT OF ECOLOGY
CENTRAL REGIONAL OFFICE

RECEIVED
AUG 1975
DEPARTMENT OF ECOLOGY
CENTRAL REGIONAL OFFICE

Work started May, 1973 Completed May, 1973

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME St George Drilling Co.
(Person, firm, or corporation) (Type or print)

Address 701 So 45th. W. Richland

[Signed] Pete St George
(Well Driller)

License No. 0492 Date 8-7- 1975

(USE ADDITIONAL SHEETS IF NECESSARY)

S. F. No. 7356—OS—(Rev. 4-71) OK/LWD

3

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Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. 1C
Permit No. DOMESTIC

(1) OWNER: Name PAUL POPINCHALK Address RR # 1 BOX 345 A WEIDLE RD. RICHLAND, WN. 99352

LM
NE

(2) LOCATION OF WELL: County BENTON — SW ¼ ¼ Sec 20 T. 10 N., R. 28E W.M.

aring and distance from section or subdivision corner

PROPOSED USE: Domestic ☒ Industrial ☐ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one)
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☒ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 8 inches.
Drilled 36 ft. Depth of completed well 36 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 8 " Diam. from 0 ft. to 36 ft.
Threaded ☐ X " Diam. from XX ft. to XX ft.
Welded ☒XX X " Diam. from XX ft. to XX ft.

Perforations: Yes ☐ No ☒XX
Type of perforator used XXXXX
SIZE of perforations XXXXXXX in. by XXXXXXXX in.
XXXXXX perforations from XXXXXXXX ft. to XXXXX ft.
XXXXXXX perforations from XXX ft. to XXX ft.
XXXX perforations from XXXX ft. to XXX ft.

Screens: Yes ☐ No ☒XX
Manufacturer's Name XXXXXXX
Type Model No
Diam XXXXXX Slot size XXXXXX from XXXXXX ft. to XXXXXX ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☒XX Size of gravel XXXXXXX
Gravel placed from ft. to ft.

Surface seal: Yes ☒X No ☐ To what depth? 21 ft.
Material used in seal BENTONITE
Did any strata contain unusable water? Yes ☐ No ☒X
Type of water? Depth of strata XXX
Method of sealing strata off XXX

(7) PUMP: Manufacturer's Name XXXXXXXXXXXXXXX
Type: H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level XXXXX ft.
Static level 10 ft. below top of well Date 5/17/75
Artesian pressure XXX lbs. per square inch Date XXXX
Artesian water is controlled by XXXXXXX (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☒X If yes, by whom? XXXXXX
Yield: XXXX gal./min. with XXXX ft. drawdown after XXX hrs.
" " " "
" XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level
	XXXXXXX	XXXXXXXXXXXXXXX		XXXXXXXXXXXX	

Date of test XXXXXX
ailer test gal./min. with ft. drawdown after hrs.
Artesian flow XXXXXXX g.p.m. Date XXXXXXXXXX
Temperature of water Was a chemical analysis made? Yes ☐ No ☐

OK MAB

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Surface seal	0	21
Sand and clay	0	8
Sand and gravel, 4 inch minus rock	8	21
Hard pan	21	23
Hit water in colored pea gravel with a little sand	23	28
Pea gravel with other gravel, 2 inch minus rock.	28	36
8 inch Blue Crown Drive shoe		

RECEIVED
JUL 24 1975
DEPARTMENT OF ECOLOGY
CENTRAL REGIONAL OFFICE

Work started 5/9 1975 Completed 5/17/ 1975

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME GOLDEN AUTUMN CONST., CO., INC.
(Person, firm, or corporation) (Type or print)

Address P.O. BOX 811, PASCO, WN. 99301

[Signed] (Well Driller)

License No. 0066 Date 6/15, 1975

(USE ADDITIONAL SHEETS IF NECESSARY)

S. F. No. 7356—OS—(Rev. 4-71)
ECY-070-28

File Original with Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy 9bb15

WATER WELL REPORT

STATE OF WASHINGTON

Notice of Intent W135092
UNIQUE WELL I.D. # AFS 925
Water Right Permit No

(1) **OWNER:** Name Richard Nelson Address

(2) **LOCATION OF WELL:** County Benton County SW 1/4 SW 1/4 Sec ~~16~~ 20 T ~~28~~ 10 N.R. 28 WM
(2a) **STREET ADDRESS OF WELL:** (or nearest address) WenDel RD
TAX PARCEL NO.

(3) **PROPOSED USE:** ☒ Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☐ Other ☐ DeWater

(4) **TYPE OF WORK:** Owner's number of well (if more than one)
☒ New Well
☐ Deepened
☐ Reconditioned
☐ Decommission
Method:
☐ Dug ☐ Bored
☐ Cable ☐ Driven
☒ Rotary ☐ Jetted

(5) **DIMENSIONS:** Diameter of well 10X6 inches
Drilled 26 feet Depth of completed well 90 ft.

(6) **CONSTRUCTION DETAILS**
Casing Installed:
☒ Welded 6" " Diam. from +2 ft to 80' ft
☐ Liner installed " Diam. from ft to ft.
☐ Threaded " Diam. from ft. to ft.

Perforations: ☐ Yes ☒ No
Type of perforator used
SIZE of perforations in by in.
perforations from ft to ft

Screens: ☐ Yes ☐ No ☐ K-Pac Location
Manufacturer's Name
Type Model No
Diam. Slot Size from ft to ft.
Diam Slot Size from ft to ft

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand
Material placed from ft. to ft

Surface seal: ☒ Yes ☐ No To what depth? 26' ft.
Material used in seal BentoNite
Did any strata contain unusable water? ☐ Yes ☐ No
Type of water? Depth of strata
Method of sealing strata off

(7) **PUMP:** Manufacturer's Name
Type H.P.

(8) **WATER LEVELS:** Land-surface elevation above mean sea level ft.
Static level 12' ft below top of well Date 4 17 01
Artesian pressure lbs per square inch Date
Artesian water is controlled by
(Cap, valve, etc)

(9) **WELL TESTS:** Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☐ No If yes, by whom?
Yield gal./min with ft drawdown after hrs
Yield gal /min with ft. drawdown after hrs.
Yield gal /min with ft drawdown after hrs.
Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)
Time Water Level Time Water Level Time Water Level
60 GPM BY AIRLIFT
Date of test
Bailer test gal /min with ft drawdown after hrs
Airtest 60 gal /min with 0 ft drawdown after 1 hrs
Artesian flow g p m Date
Temperature of water Was a chemical analysis made? ☐ Yes ☐ No

ECY 050-1-20 (11/98)

(10) **WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION**
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information Indicate all water encountered.

MATERIAL	FROM	TO
SAND	0	14
gRAvel SAND	14	56
Cemented gRAvel	56	69
Blue SAND	69	78
BASalt gRAvel	78	97
WATER		

DEPT. OF ECOLOGY
Received
APR 25 2001
CENTRAL REGION OFFICE

Work Started 4 16 01 Completed 4-17-01

WELL CONSTRUCTION CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief.

Type or Print Name Rodney Cox License No 2302
(Licensed Driller/Engineer)
Trainee Name License No
Drilling Company RW COX Drilling
(Signed) License No 2302
(Licensed Driller/Engineer)
Address P.O. Box 5324 Benton City WA 99320
Contractor's Registration No RWCOXD022JC Date -01

(USE ADDITIONAL SHEETS IF NECESSARY)

400

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT N

STATE OF WASHINGTON

Start Card No. 011365
Water Right Permit No. ______

(1) **OWNER:** Name Rigby Martinec Address 1211 Sunset Richland, WA.

(2) **LOCATION OF WELL:** County Benton SW ¼ SW ¼ Sec 20 T. 10 N., R 28 W.M.

(2a) **STREET ADDDRESS OF WELL** (or nearest address) ______

(3) **PROPOSED USE:** ☒ Domestic ☐ Irrigation ☐ DeWater Industrial ☐ Test Well ☐ Municipal ☐ Other ☐

(4) **TYPE OF WORK:** Owner's number of well (if more than one) ______
Abandoned ☐ New well ☒ Deepened ☐ Reconditioned ☐
Method: Dug ☐ Cable ☐ Rotary ☒ Bored ☐ Driven ☐ Jetted ☐

(5) **DIMENSIONS:** Diameter of well 6 inches.
Drilled 40 feet. Depth of completed well 40 ft.

(6) **CONSTRUCTION DETAILS:**
Casing installed: 6 " Diam. from -1 ft. to 40 ft.
Welded ☒ ______ " Diam. from ______ ft. to ______ ft.
Liner installed ☐
Threaded ☐ ______ " Diam. from ______ ft. to ______ ft.

Perforations: Yes ☐ No ☒
Type of perforator used ______
SIZE of perforations ______ in. by ______ in.
______ perforations from ______ ft. to ______ ft.
______ perforations from ______ ft. to ______ ft.
______ perforations from ______ ft. to ______ ft.

Screens: Yes ☐ No ☒
Manufacturer's Name ______
Type ______ Model No. ______
Diam. ______ Slot size ______ from ______ ft. to ______ ft.
Diam. ______ Slot size ______ from ______ ft. to ______ ft.

Gravel packed: Yes ☐ No ☒ Size of gravel ______
Gravel placed from ______ ft. to ______ ft.

Surface seal: Yes ☒ No ☐ To what depth? 20 ft.
Material used in seal Benton
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? ______ Depth of strata ______
Method of sealing strata off ______

(7) **PUMP:** Manufacturer's Name ______
Type: ______ H.P. ______

(8) **WATER LEVELS:** Land-surface elevation above mean sea level ______ ft.
Static level 16 ft. below top of well Date ______
Artesian pressure ______ lbs. per square inch Date ______
Artesian water is controlled by ______ (Cap, valve, etc.))

(9) **WELL TESTS:** Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☒ If yes, by whom? ______
Yield: ______ gal./min. with ______ ft. drawdown after ______ hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ______
Bailer test ______ gal./min. with ______ ft. drawdown after ______ hrs.
Airtest 70 gal./min. with stem set at 35 ft. for 4 hrs.
Artesian flow ______ g.p.m. Date ______
Temperature of water ______ Was a chemical analysis made? Yes ☐ No ☒

(10) **WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION**

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Sand Brown	0	7
Sand + Gravel/Brown in colar 1½ to 3/4	7	26
Sand + Gravel/Brown in colars 1/2 to 6" Bearing Water	26	40

9 1989
DEPARTMENT OF ECOLOGY
CENTRAL REGION OFFICE

Work started 10/8/88, 19. Completed 10/8/88, 1988

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME St George Drilling (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address 701 So 45 AVE W Richland
(Signed) Ron E. St George License No 0483 (WELL DRILLER)
Contractor's Registration No. 601-048-715 Date 10/8/88, 1988

(USE ADDITIONAL SHEETS IF NECESSARY)

Please print, sign and return by mail to Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. SE68719

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *(select one)*
☑ Construction
☐ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* ____

Type of Well *(select one)*
☐ Resource Protection
☑ Geotech Soil Boring

Consulting Firm GPI

Unique Ecology Well ID Tag No. ____

Property Owner Packaging Corporation of America

Site Address 3003 Kingsgate Way

City Richland County Benton

Location NE 1/4-1/4 NW1/4 Sec 21 Twn 10N R 28 Select One ☒ EWM ☐ WWM

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☑ Driller ☐ Engineer ☐ Trainee Name (Print) Mike Corn
Driller/Engineer /Trainee Signature
Driller or Trainee License No. 2833

If trainee, licensed driller's Signature and License No. 2833

Lat/Long (s, t, r still REQUIRED) Lat Deg ____ Lat Min/Sec ____
Long Deg ____ Long Min/Sec ____

Tax Parcel No. ____

Cased or [✓ Uncased] Diameter 8.5 Static Level 38.3'

Work/Decommission Start Date 1/16/2019

Work/Decommission Completed Date 1/16/2019

Construction/Design	Well Data	Formation Description
HSA to a depth of 100' BGS.	B-5	0-28.5' Sand, tan/black. 28.5-29 Gravel/cobble. 29-39 Sand, fine, black. 39-86 Sand and gravels. 86-100 Tan silt, w/clay and gravel layers.

RECEIVED
JAN 25 2019
Dept of Ecology
Central Regional Office

68

File Original and First Copy with
Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

D

STATE OF WASHINGTON

Start Card No. 148

Water Right Permit No.

(1) **OWNER:** Name Allied Nuclear Address 2025 Battelle Blvd

(2) **LOCATION OF WELL:** County Benton N ¼ NW ¼ Sec 22 T 10 N., R 28E W.M.

(2a) **STREET ADDDRESS OF WELL** (or nearest address)

(3) **PROPOSED USE:** ☐ Domestic ☐ Irrigation ☐ DeWater Industrial ☐ Test Well ☒ Municipal ☐ Other ☐

(4) **TYPE OF WORK:** Owner's number of well (if more than one)

Abandoned ☐ New well ☒ Deepened ☐ Reconditioned ☐ Method: Dug ☐ Cable ☐ Rotary ☒ Bored ☐ Driven ☐ Jetted ☐

(5) **DIMENSIONS:** Diameter of well 6 inches.

Drilled 39 feet. Depth of completed well 37-6 ft.

(6) **CONSTRUCTION DETAILS:**

Casing installed: 6 " Diam. from +1 ft. to 32-6 ft.

Welded ☒ " Diam. from ft. to ft.

Liner installed ☐ " Diam. from ft. to ft.

Threaded ☐

Perforations: Yes ☐ No ☒

Type of perforator used

SIZE of perforations in. by in.

perforations from ft. to ft.

perforations from ft. to ft.

perforations from ft. to ft.

Screens: Yes ☒ No ☐

Manufacturer's Name Johnson

Type Stainless Steel Model No.

Diam. 5 ⅝ Slot size 12 from 37-6 ft. to 32-6 ft.

Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☒ Size of gravel

Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☐ To what depth? 19 ft.

Material used in seal Bentonite

Did any strata contain unusable water? Yes ☐ No ☒

Type of water? Depth of strata

Method of sealing strata off

(7) **PUMP:** Manufacturer's Name

Type: H.P.

(8) **WATER LEVELS:** Land-surface elevation above mean sea level ft.

Static level 17 ft. below top of well Date 5-12-88

Artesian pressure lbs. per square inch Date

Artesian water is controlled by (Cap, valve, etc.)

(9) **WELL TESTS:** Drawdown is amount water level is lowered below static level

Was a pump test made? Yes ☐ No ☐ If yes, by whom?

Yield: gal./min. with ft. drawdown after hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test

Bailer test gal./min. with ft. drawdown after hrs.

Airtest 30 gal./min. with stem set at 32 ft. for 2 hrs.

Artesian flow g.p.m. Date

Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) **WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION**

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Sand Tan	0	9
Gravel 6" minus, Sand Tan	9	17
Gravel 6" minus, Sand Tan Water Bearing	17	37'6"
Gravel very silty very slow water	37-6	39

MAY 17 1988

Work started 5-12, 19 Completed 5-12, 1988

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

ENTERED

NAME Nelson Well Drilling Inc (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address 10036 W Argent Pasco

(Signed) James Nelson (WELL DRILLER) License No. 361

Contractor's Registration No. NELSOWD198CR Date 5-12-88, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10-87) -1329

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

7650

Start Card No 33897

Water Right Permit No. B

(1) OWNER: Name Interstate Nuclear Services Address Richland, Washington

LOCATION OF WELL: County Benton NW ¼ NE ¼ Sec 28 T. 10 N., R 28 W.M.

(2a) STREET ADDDRESS OF WELL (or nearest address) Horn Rapids Bus. Park; Richland, Washington

(3) PROPOSED USE: ☐ Domestic ☐ Irrigation ☐ DeWater Industrial ☐ Test Well ☐ Municipal ☐ Other ☒

(4) TYPE OF WORK: Owner's number of well (if more than one)

Abandoned ☐ New well ☒ Deepened ☐ Reconditioned ☐

Method: Dug ☐ Cable ☐ Rotary ☐ Bored ☒ Driven ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 2 inches.

Drilled 26.5 feet. Depth of completed well 25 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 2 " Diam from 0.0 ft. to 15.0 ft.

Welded ☐ " Diam. from ft. to ft.

Liner installed ☐ " Diam. from ft. to ft.

Threaded ☒

Perforations: Yes ☐ No ☒

Type of perforator used

SIZE of perforations in. by in.

perforations from ft. to ft.

perforations from ft. to ft.

perforations from ft. to ft.

Screens: Yes ☒ No ☐

Manufacturer's Name Aardvark

Type 2"Sch. 40 pvc Model No

Diam 2" Slot size .020 from 15.0 ft. to 25.0 ft.

Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☒ Size of gravel

Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☐ To what depth? 5.0 ft.

Material used in seal Bentonite Chips

Did any strata contain unusable water? Yes ☐ No ☐

Type of water? Depth of strata

Method of sealing strata off

(7) PUMP: Manufacturer's Name

Type H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.

Static level 10 ft. below top of well Date 9-27-92

Artesian pressure lbs. per square inch Date

Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? Yes ☐ No ☒ If yes, by whom?

Yield: gal./min. with ft. drawdown after hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test

Bailer test gal./min. with ft. drawdown after hrs.

Airtest gal./min. with stem set at ft. for hrs.

Artesian flow g.p.m. Date

Temperature of water Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Medium dense, brown, fine to medium grained sand; dry to moist	0.0	15.0
Very dense gravel, black	15.0	26.5

OCT 22 [illegible]

Work started 9-25-92, 19 Completed 9-28-92, 19

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Brian J. Williams (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address 1104 Gribble #3, Richland, WA 99352

(Signed) B J W (WELL DRILLER) License No. 1847

Contractor's Registration No. Date 10-21, 1992

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10/87) -1329

1764

File Original and First Copy with
Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. ....

Permit No. ....

(1) OWNER: Name Wiser Co Inc Address 236 Hillview Dr. Richland

(2) LOCATION OF WELL: County Benton SE ¼ NW ¼ Sec 27 T. 10 N., R 28 W.M.

[illegible]ring and distance from section or subdivision corner

(3) PROPOSED USE: Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☒ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) 2

New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☒ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 10 inches.
Drilled 43 ft. Depth of completed well 43 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 10 " Diam. from +1 ft. to 43 ft.
Threaded ☐ ......" Diam. from ...... ft. to ...... ft.
Welded ☒ ......" Diam. from ...... ft. to ...... ft.

Perforations: Yes ☒ No ☐
Type of perforator used mills Knife
SIZE of perforations 3/8 in. by 2 in.
192 perforations from 17 ft. to 29 ft.
...... perforations from ...... ft. to ...... ft.
...... perforations from ...... ft. to ...... ft.

Screens: Yes ☐ No ☒
Manufacturer's Name ......
Type ...... Model No. ......
Diam. ...... Slot size ...... from ...... ft. to ...... ft.
Diam. ...... Slot size ...... from ...... ft. to ...... ft.

Gravel packed: Yes ☐ No ☒ Size of gravel: ......
Gravel placed from ...... ft. to ...... ft.

Surface seal: Yes ☒ No ☐ To what depth? 17 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? ...... Depth of strata ......
Method of sealing strata off ......

(7) PUMP: Manufacturer's Name ......
Type: ...... H.P. ......

(8) WATER LEVELS: Land-surface elevation above mean sea level ...... ft.
Static level 4 ft. below top of well Date 5/25
Artesian pressure ...... lbs. per square inch Date ......
Artesian water is controlled by ...... (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☒ If yes, by whom? ......
Yield: ...... gal./min. with ...... ft. drawdown after ...... hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

[illegible]Date of test ......
[illegible]ler test ...... gal./min. with ...... ft. drawdown after ...... hrs.
Artesian flow ...... g.p.m. Date ......
Temperature of water ...... Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG:

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.

MATERIAL	FROM	TO
Silt	0	2
Black Sand some Fine Gravel	2	10
Sand gravel cobbles	10	15
Sand gravel Large cobbles	15	20
Sand gravel	20	24
Sand gravel cobbles	24	30
Silt sand gravel	30	32
Brown silt Clay	32	43

RECEIVED
JUN - 2 1989
DEPARTMENT OF ECOLOGY
CENTRAL REGION OFFICE

Work started 5/22, 1989 Completed 5/25, 1989

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Owinego Drilling Co Inc
(Person, firm, or corporation) (Type or print)

Address Rt 14 Box 3010 Kennewick

[Signed] ......
(Well Driller)

License No. 1333 Date 5/31, 1989

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

1762

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. ....
Permit No. ....

(1) OWNER: Name Wiser Co Inc Address 236 Hillview Dr. Richland

(2) LOCATION OF WELL: County Benton SE ¼ NW ¼ Sec. 27 T. 10 N., R. 28 W.M.

ring and distance from section or subdivision corner

(3) PROPOSED USE: Domestic ☐ Industrial ☐ Municipal ☐ Irrigation ☐ Test Well ☒ Other ☒ dewatering

(4) TYPE OF WORK: Owner's number of well (if more than one) ....
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☒ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 14 inches.
Drilled 121 ft. Depth of completed well 85 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 14 " Diam. from +1 ft. to 85 ft.
Threaded ☐ ...... " Diam. from ...... ft. to ...... ft.
Welded ☒ ...... " Diam. from ...... ft. to ...... ft.

Perforations: Yes ☒ No ☐
Type of perforator used mills knife
SIZE of perforations ...... in. by ...... in.
...... perforations from ...... ft. to ...... ft.
...... perforations from ...... ft. to ...... ft.
...... perforations from ...... ft. to ...... ft.

Screens: Yes ☐ No ☒
Manufacturer's Name ......
Type ...... Model No. ......
Diam. ...... Slot size ...... from ...... ft. to ...... ft.
Diam. ...... Slot size ...... from ...... ft. to ...... ft.

Gravel packed: Yes ☐ No ☒ Size of gravel: ......
Gravel placed from ...... ft. to ...... ft.

Surface seal: Yes ☒ No ☐ To what depth? 10 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? ...... Depth of strata ......
Method of sealing strata off ......

(7) PUMP: Manufacturer's Name ......
Type: ...... H.P. ......

(8) WATER LEVELS: Land-surface elevation above mean sea level .... ft.
Static level 4 ft. below top of well Date 4/20/89
Artesian pressure ...... lbs. per square inch Date ......
Artesian water is controlled by ...... (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☒ No ☐ If yes, by whom? Onwego

Yield: gal./min. with	ft. drawdown after	hrs.
350	36	2
"	"	"

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test 4/20/89
ler test ...... gal./min. with ...... ft. drawdown after ...... hrs.
Artesian flow ...... g.p.m. Date ......
Temperature of water ...... Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG:

Formation: *Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of formation.*

MATERIAL	FROM	TO
Sand + Gravel	0	5
Cemented Sand + Gravel	5	10
Loose Sand + Gravel	10	22
Sand + Gravel Cemented Layers	22	34
Brown Silt	34	59
Blue Clay	59	79
Sand, Gravel - silt	79	83
Blue Clay with Sand + Grav	83	95
Blue Clay	95	105
Blue Clay - Sand + Gravel	105	118
Cemented Sand + Gravel (Ringold)	118	121

RECEIVED
JUN - 2 1989
DEPARTMENT OF ECOLOGY
CENTRAL REGION OFFICE

Work started 4/3, 1989 Completed 4/20, 1989

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Onwego Drilling Co Inc (Person, firm, or corporation) (Type or print)
Address Rt 14 Box 301D Kennewick Wa
[Signed] Daniel LaOtte (Well Driller)
License No. 1333 Date 4/21, 1989

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

1293

File Original and First Copy with
Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Start Card No. 011440

Water Right Permit No. ______

(1) **OWNER:** Name DEPT. OF ENERGY Address RICHLAND WA 99352

(2) **LOCATION OF WELL:** County BENTON SE ¼ ___ ¼ Sec 27 T. 10 N., R 28E W.M.

(2a) **STREET ADDDRESS OF WELL** (or nearest address) ______

(3) **PROPOSED USE:** ☐ Domestic ☐ Irrigation ☐ DeWater Industrial ☐ Test Well ☒ Municipal ☐ Other ☐

(4) **TYPE OF WORK:** Owner's number of well (if more than one) 1100-1

Abandoned ☐ New well ☒ Deepened ☐ Reconditioned ☐

Method: Dug ☐ Cable ☒ Rotary ☐ Bored ☐ Driven ☐ Jetted ☐

(5) **DIMENSIONS:** Diameter of well 4 inches.

Drilled ______ feet. Depth of completed well 65'4" ft.

(6) **CONSTRUCTION DETAILS:**

Casing installed: 10 " Diam. from +1 ft. to 20-6" ft.

Welded ☐ 8 " Diam. from +2 ft. to 66 ft.

Liner installed ☐

Threaded ☐ 4 " Diam. from +1 ft. to 65'8" ft.

Perforations: Yes ☐ No ☒

Type of perforator used ______

SIZE of perforations ______ in. by ______ in.

______ perforations from ______ ft. to ______ ft.

______ perforations from ______ ft. to ______ ft.

______ perforations from ______ ft. to ______ ft.

Screens: Yes ☒ No ☐

Manufacturer's Name JOHNSON

Type ______ Model No. ______

Diam. 4" Slot size 20 from 50 ft. to 65'8" ft.

Diam. ______ Slot size ______ from ______ ft. to ______ ft.

~~Gravel~~ Sand packed: Yes ☑ ~~No ☒~~ Size of ~~gravel~~ Sand 16-30

Gravel placed from 45' ft. to 65.8" ft.

Surface seal: Yes ☒ No ☐ To what depth? 20 ft.

Material used in seal CEMENT GROUT

Did any strata contain unusable water? Yes ☐ No ☒

Type of water? ______ Depth of strata ______

Method of sealing strata off ______

(7) **PUMP:** Manufacturer's Name ______

Type: ______ H.P. ______

(8) **WATER LEVELS:** Land-surface elevation above mean sea level ______ ft.

Static level 53'6" ft. below top of well Date 10-12-88

Artesian pressure ______ lbs. per square inch Date ______

Artesian water is controlled by ______ (Cap, valve, etc.))

(9) **WELL TESTS:** Drawdown is amount water level is lowered below static level

Was a pump test made? Yes ☒ ~~No~~ If yes, by whom? PNL

Yield: ______ gal./min. with ______ ft. drawdown after ______ hrs.

" ______ " ______ " ______ "

" ______ " ______ " ______ "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ______

Bailer test 4 gal./min. with 0 ft. drawdown after 4 hrs.

Airtest ______ gal./min. with stem set at ______ ft. for ______ hrs.

Artesian flow ______ g.p.m. Date ______

Temperature of water ______ Was a chemical analysis made? Yes ☒ No ☐

(10) **WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION**

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Gravel-Silt & Clay	0	5
Large Gravel & Silt	5	20
Gravel-Silt & Sand	10	55
" " " water	55	62
Ringold water	62	66

PULLED ALL CARBON STEEL CASING LEFT 4" STAINLESS IN GROUND

NOV 18

Work started 10-7-88, 19__ Completed 10-17, 1988

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME ROBERT CORDON (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address RATHDRUM, IDA

(Signed) Robert Lendon Cordon (WELL DRILLER) License No. 0079

Contractor's Registration No. 1224 Date 11-1, 1988

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10/87) -1329- 3

WASHINGTON STATE DEPARTMENT OF ECOLOGY

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

Construction/Decommission *("x" in circle)*
☒ Construction
○ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* ______

CURRENT Notice of Intent No. WE 27738.
Unique Ecology Well ID Tag No. B5B503.
Water Right Permit No. G4-29925P
Property Owner Name Wildlands Inc.
Well Street Address ______
City Richland WA. County ~~WA~~ Benton.
Location SE 1/4-1/4 NW 1/4 Sec 27 Twn 10N R 28E EWM or WWM circle one
Lat/Long (s, t, r Still **REQUIRED**) Lat Deg ______ Lat Min/Sec ______ Long Deg ______ Long Min/Sec -
Tax Parcel No. 127082000001021.

PROPOSED USE: ☑ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other ______

TYPE OF WORK: Owner's number of well (if more than one) ______
☑ New well ☐ Reconditioned *Method:* ☐ Dug ☐ Bored ☐ Driven
☐ Deepened ☐ Cable ☐ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 8 inches, drilled 127. ft.
Depth of completed well 127 ft.

CONSTRUCTION DETAILS
Casing Installed: ☑ Welded 8 " Diam. from +2 ft. to 116. ft.
☒ Liner installed 4½ " Diam. from -7 ft. to 127. ft.
☐ Threaded ______ " Diam. from ______ ft. to ______ ft.

Perforations: ☑ Yes ☐ No
Type of perforator used SAW CUT.
SIZE of perfs 1/8" in. by 6" in. and no. of perfs 66 from 116. ft. to 127 ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location ______
Manufacturer's Name ______
Type ______ Model No. ______
Diam. ______ Slot size ______ from ______ ft. to ______ ft.
Diam. ______ Slot size ______ from ______ ft. to ______ ft.

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand ______
Materials placed from ______ ft. to ______ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 18 ft.
Material used in seal Bentonite.
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? ______ Depth of strata ______
Method of sealing strata off ______

PUMP: Manufacturer's Name ______
Type: ______ H.P. ______

WATER LEVELS: Land-surface elevation above mean sea level ______ ft.
Static level 27 ft. below top of well Date Aug 7/17.
Artesian pressure ______ lbs. per square inch Date ______
Artesian water is controlled by ______ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☐ No If yes, by whom? ______
Yield: ______ gal./min. with ______ ft. drawdown after ______ hrs.
Yield: ______ gal./min. with ______ ft. drawdown after ______ hrs.
Yield: ______ gal./min. with ______ ft. drawdown after ______ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ______
Bailer test ______ gal./min. with ______ ft. drawdown after ______ hrs.
Airtest 40+ gal./min. with stem set at 120 ft. for 2 hrs.
Artesian flow ______ g.p.m. Date ______
Temperature of water 68 Was a chemical analysis made? ☐ Yes ☒ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Brown Sand	0	15
Gravel.	15	35.
Cemented Gravel	35.	65.
Loose Gravel ~~[illegible]~~ and	65	75.
& Sand. 5-10 Gpm water		
Cemented Gravel	75	95
Grey Sandy Clay with Gravels	95	105.
Sandy Gravel	105	110.
Clean Gravel.	110	127.
water. 40+ Gpm.		

RECEIVED
AUG 16 2017
Dept of Ecology
Central Regional Office

Start Date 6-20-17 Completed Date 8-7-17.

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Robert Dobush
Driller/Engineer/Trainee Signature
Driller or trainee License No. 2820.

If TRAINEE,
Driller's Licensed No. ______
Driller's Signature ______

Drilling Company Blue Star Ent NW.
Address 2019 Butler Loop.
City, State, Zip Richland WA. 99354
Contractor's Registration No. BLUESEN942RM Date Aug 10/17.

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13658

DEPT OF ECOLOGY
Received
JUL 15 1999
CENTRAL REGION OFFICE

RESOURCE PROTECTION WELL REPORT

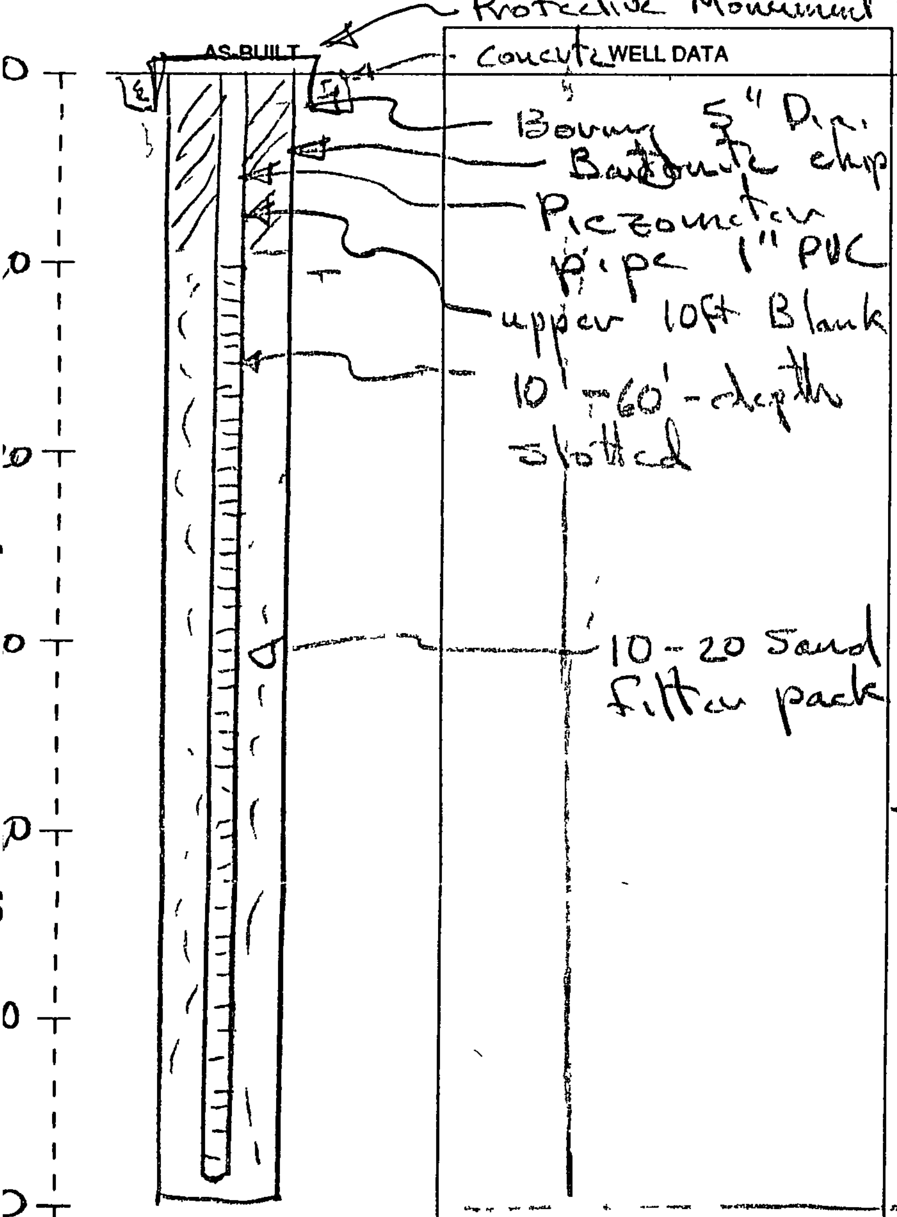
START CARD NO R 27254

PROJECT NAME Foundation Investigation
WELL IDENTIFICATION NO Tag ACF 340
DRILLING METHOD Mud Rotary
DRILLER Jim Clarke
FIRM Subterranean Inc
SIGNATURE James D Clarke
CONSULTING FIRM Dames & Moor
REPRESENTATIVE

COUNTY Benton
LOCATION NE 1/4 NW 1/4 Sec 28 Twn 10N R 28E
STREET ADDRESS OF WELL on Kingsgate Road Richland, Wash
WATER LEVEL ~~ELEVATION~~ depth - 45ft
GROUND SURFACE ELEVATION not known
INSTALLED 6/6/97
DEVELOPED 6/6/97

C

AS BUILT | WELL DATA | FORMATION DESCRIPTION



0' Sand (fine to med.) Dense

38ft

Sandy Gravel and Gravel

End of boring 60'

SCALE 1" = 10ft

PAGE 1 OF 1

ECY 050 12 (Rev 11/89)

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

Resource Protection

WATER WELL REPORT

STATE OF WASHINGTON

9067 Start Card No. 059883

UNIQUE WELL I.D. # 1

Water Right Permit No.

(1) **OWNER:** Name Columbia Triangle Ventures Address [illegible] Bellevue, WA F

(2) **LOCATION OF WELL:** County Benton - SE ¼ NW ¼ Sec. 28 T. 10 N., R. 28E W.M.

(2a) **STREET ADDDRESS OF WELL** (or nearest address) HWY 240

(3) **PROPOSED USE:** ☐ Domestic ☐ Irrigation ☐ DeWater Industrial ☐ Test Well ☒ Municipal ☐ Other ☐

(4) **TYPE OF WORK:** Owner's number of well (if more than one) MW#1

Abandoned ☐ New well ☒ Deepened ☐ Reconditioned ☐ Method: Dug ☐ Cable ☐ Rotary ☐ Bored ☒ Driven ☐ Jetted ☐

(5) **DIMENSIONS:** Diameter of well 8 inches.

Drilled 50 feet. Depth of completed well 50 ft.

(6) **CONSTRUCTION DETAILS:**

Casing installed: 2in " Diam. from +3 ft. to -50 ft.

Welded ☐ " Diam. from ft. to ft.

Liner installed ☐ " Diam. from ft. to ft.

Threaded ☒

Perforations: Yes ☐ No ☒

Type of perforator used

SIZE of perforations in. by in.

perforations from ft. to ft.

perforations from ft. to ft.

perforations from ft. to ft.

Screens: Yes ☒ No ☐

Manufacturer's Name Johnson

Type PVC Sch 40 Model No.

Diam. 2in. Slot size .020 from 50 ft. to 40 ft.

Diam. Slot size from ft. to ft.

Gravel packed: Yes ☒ No ☐ Size of gravel 8/12 sand

Gravel placed from 50 ft. to 37 ft.

Surface seal: Yes ☒ No ☐ To what depth? 37 ft.

Material used in seal Bentonite Chips

Did any strata contain unusable water? Yes ☐ No ☒

Type of water? Depth of strata

Method of sealing strata off

(7) **PUMP:** Manufacturer's Name N/A

Type: H.P.

(8) **WATER LEVELS:** Land-surface elevation above mean sea level ft.

Static level ft. below top of well Date

Artesian pressure lbs. per square inch Date

Artesian water is controlled by (Cap, valve, etc.))

(9) **WELL TESTS:** Drawdown is amount water level is lowered below static level

Was a pump test made? Yes ☐ No ☑ If yes, by whom?

Yield: gal./min. with ft. drawdown after hrs.

" " " "

" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test

Bailer test gal./min. with ft. drawdown after hrs.

Airtest gal./min. with stem set at ft. for hrs.

Artesian flow g.p.m. Date

Temperature of water Was a chemical analysis made? Yes ☐ No ☐

(10) **WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION**

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
MW#1		
Clean dry med. sand	0	37
Clean, damp med. to course sand, som gravel, saturated at 40 ft.	37	50

RECEIVED
JUN 22 1993

Work started 6-9, 1993 Completed 6-9, 1993

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Environmental West Exploration, Inc (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address PO Box 11095 Spokane, WA 99211

(Signed) Dan Claassen (WELL DRILLER) License No. 1827

Contractor's Registration No. ENVIRWE101PP Date 6/16, 1993

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10/87) -1329- 18

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

2

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

Resource Protection

WATER WELL REPORT

STATE OF WASHINGTON

84761
Start Card No. 82852

Water Right Permit No. C

(1) **OWNER:** Name Horn Rapids R Triangle Development Address Richland, Washington

(2) **LOCATION OF WELL:** County Benton NW1/4 NE ¼ NW ¼ Sec 29 T. 10 N., R 28 E W.M.

(2a) **STREET ADDDRESS OF WELL** (or nearest address) Intersection of SR 240 and Grosscup Road

(3) **PROPOSED USE:** ☐ Domestic ☐ Irrigation ☐ DeWater Industrial ☐ Test Well ☒ Municipal ☐ Other ☐

(4) **TYPE OF WORK:** Owner's number of well (if more than one) MW-1

Abandoned ☐ New well ☒ Deepened ☐ Reconditioned ☐

Method: Dug ☐ Cable ☐ Rotary ☐ Bored ☒ Driven ☐ Jetted ☐

(5) **DIMENSIONS:** Diameter of well 2 inches inches.

Drilled 79.0 feet. Depth of completed well 78.5 ft.

(6) **CONSTRUCTION DETAILS:**

Casing installed: 2 " Diam. from 0.0 ft. to 58.5 ft.

Welded ☐ " Diam. from ft. to ft.

Liner installed ☐

Threaded ☒ " Diam. from ft. to ft.

Perforations: Yes ☐ No ☒

Type of perforator used

SIZE of perforations in. by in.

perforations from ft. to ft.

perforations from ft. to ft.

perforations from ft. to ft.

Screens: Yes ☒ No ☐

Manufacturer's Name Aardvark

Type 2" Sch 40 PVC Model No.

Diam. 2" Slot size .020 from 58.5 ft. to 78.5 ft.

Diam. Slot size from ft. to ft.

Gravel packed: Yes ☒ No ☐ Size of gravel 8-12 Silica

Gravel placed from 55.0 ft. to 79.0 ft.

Surface seal: Yes ☒ No ☐ To what depth? 55.0 ft.

Material used in seal Hydrated Bentonite Chips

Did any strata contain unusable water? Yes ☐ No ☐

Type of water? Depth of strata

Method of sealing strata off

(7) **PUMP:** Manufacturer's Name

Type: H.P.

(8) **WATER LEVELS:** Land-surface elevation above mean sea level 439.8 ft.

Static level 65.6 ft. below top of well Date 3-23-93

Artesian pressure lbs. per square inch Date

Artesian water is controlled by
(Cap, valve, etc.)

(9) **WELL TESTS:** Drawdown is amount water level is lowered below static level

Was a pump test made? Yes ☐ No ☒ If yes, by whom?

Yield: gal./min. with ft. drawdown after hrs.

" " " "

" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test

Bailer test gal./min. with ft. drawdown after hrs.

Airtest gal./min. with stem set at ft. for hrs.

Artesian flow g.p.m. Date

Temperature of water Was a chemical analysis made? Yes ☒ No ☐

(10) **WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION**

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Brown, Well-Graded SAND; dry to moist, medium to very fine grained	0.0	35.0
Tan-brown, Silty SAND; dry to moist, fine to very fine grained, with non-plastic fines, slightly cemented	35.0	65.0
Brown-black, Silty SAND with Gravel; wet to satrated, with minor silt	65.0	79.0

RECEIVED
APR 1 1993
[illegible]
CENTRAL REGION OFFICE

Work started 3/15/1993, 19 Completed 3/16/1993, 19

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Brian J. Williams
(PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address 1104 Gribble #3, Richland, WA 99352

(Signed) License No. 1847
(WELL DRILLER)

Contractor's Registration No. Date 3/30/1993, 19

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10/87) -1329- See Attached Report

LOG & AS-BUILT DIAGRAM

GEOLOGIC LOG

Driller: Environmental West Explorations
Completion Date: 03-16-93
Ground Elevation: Approx. 439.8 ft.

Ground Surface

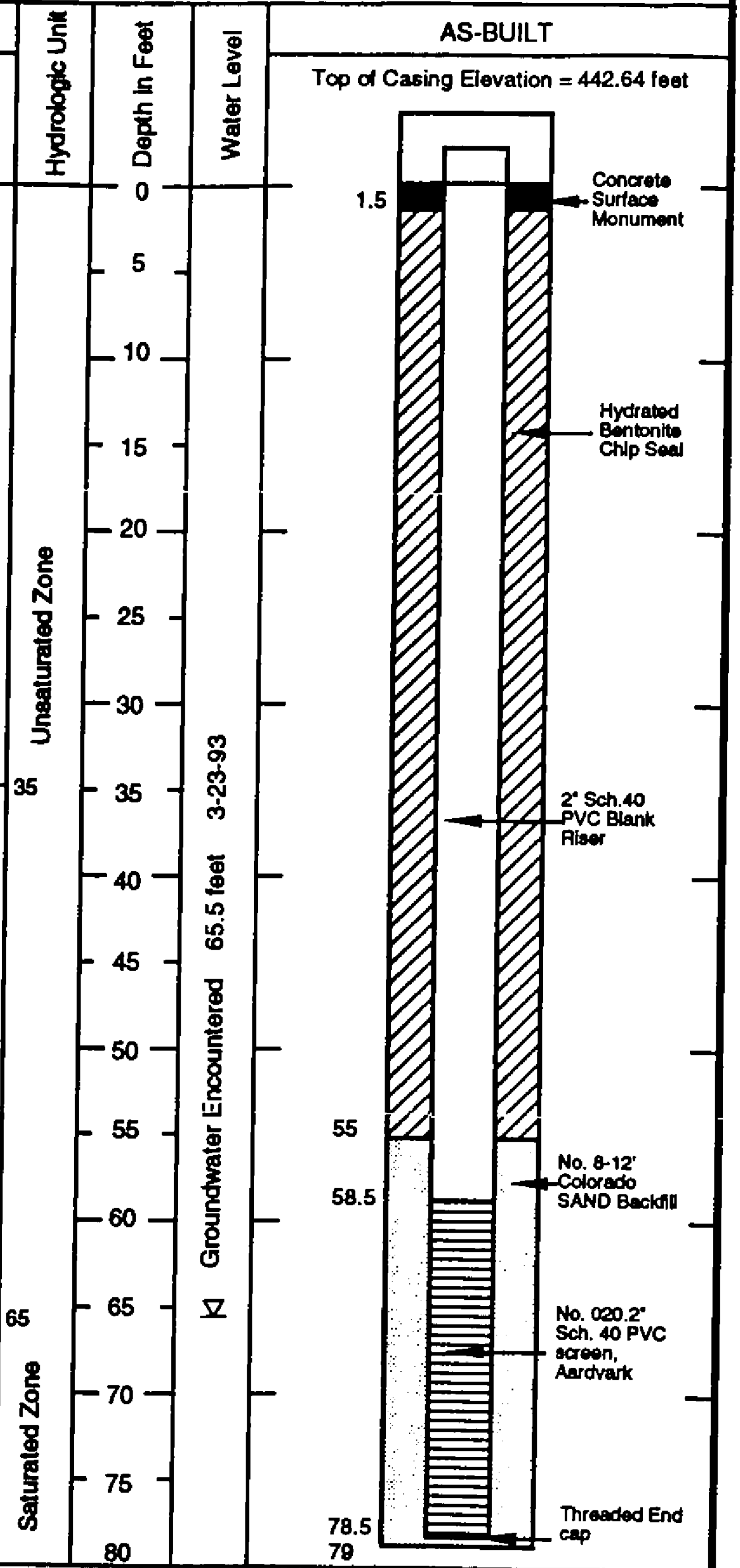
brown, Well-Graded SAND; dry to moist, medium to very fine grained.

tan-brown, Silty SAND; dry to moist, fine to very fine grained, with non-plastic fines, slightly cemented.

DRAFT
3-30-93

brown-black, Silty SAND with Gravel; wet to saturated, with minor silt.

Bottom of Well at 79.0 Feet



Drilling Method: 8" ODEX
Sampling Method: Drill Cuttings

Note: The contacts represent the approximate soil types and the actual transitions may be gradual.

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

March 1993 H-1033-02

Horn Rapids Triangle Development
Richland, Washington

MONITORING WELL MW-1

FIG. A-2

File Original and First Copy with Department of Ecology
Second Copy—Owner's Copy
Third Copy—Driller's Copy

1886

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No C11379

Water Right Permit No. ______

OWNER: Name MR RIGBY Address 1211 SUNSET, RichlAnd, WA 993

(2) LOCATION OF WELL: County BENTON NW ¼ NW ¼ Sec. 24 T. 10 N., R. 28 W.M.

D

(2a) STREET ADDDRESS OF WELL (or nearest address) WEidlE Rd,

(3) PROPOSED USE: ☒ Domestic ☐ Irrigation ☐ DeWater Industrial ☐ Test Well ☐ Municipal ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) ______

Abandoned ☐ New well ☒ Deepened ☐ Reconditioned ☐ Method: Dug ☐ Cable ☐ Rotary ☒ Bored ☐ Driven ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 40 feet. Depth of completed well 40 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from -1 ft. to 40 ft.
Welded ☐ ______ " Diam. from ______ ft. to ______ ft.
Liner installed ☐ ______ " Diam. from ______ ft. to ______ ft.
Threaded ☐

Perforations: Yes ☐ No ☒
Type of perforator used ______
SIZE of perforations ______ in. by ______ in.
______ perforations from ______ ft. to ______ ft.
______ perforations from ______ ft. to ______ ft.
______ perforations from ______ ft. to ______ ft.

Screens: Yes ☐ No ☒
Manufacturer's Name ______
Type ______ Model No. ______
Diam. ______ Slot size ______ from ______ ft. to ______ ft.
Diam. ______ Slot size ______ from ______ ft. to ______ ft.

Gravel packed: Yes ☐ No ☒ Size of gravel ______
Gravel placed from ______ ft. to ______ ft.

Surface seal: Yes ☒ No ☐ To what depth? 18 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? ______ Depth of strata ______
Method of sealing strata off ______

(7) PUMP: Manufacturer's Name ______
Type: ______ H.P. ______

(8) WATER LEVELS: Land-surface elevation above mean sea level ______ ft.
Static level 18 ft. below top of well Date ______
Artesian pressure ______ lbs. per square inch Date ______
Artesian water is controlled by ______ (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☐ No ☒ If yes, by whom? ______
Yield: ______ gal./min. with ______ ft. drawdown after ______ hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level

Date of test ______
Bailer test ______ gal./min. with ______ ft. drawdown after ______ hrs.
Airtest 85 gal./min. with stem set at 36 ft. for 2 hrs.
Artesian flow ______ g.p.m. Date ______
Temperature of water ______ Was a chemical analysis made? Yes ☐ No ☒

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information.

MATERIAL	FROM	TO
Top Soil	0	1
Sand + Gravel 3"X3/4	1	12
Sand + Gravel 1½ X 3/4 Bearing Water	12	36
3/4 X 3/8 Sand + Gravel	36	40

RECEIVED
JUN 29 1989
DEP[illegible]

Work started 6/13/89, 19. Completed 6/15, 1989

WELL CONSTRUCTOR CERTIFICATION:

I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME St. GEORGE DRillingCO (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address 701 S 45th AVE, WestRichland
(Signed) Pete E. ______ (WELL DRILLER) License No. C487
Contractor's Registration No. 601-048-715 Date 6/15, 1989

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20 (10-87) -1329

B-4

Water Right Information

Record No.	Person or Organization	Priority Date	Record Status	Imaged	Metered	Low Flow Provision	Application No.	Permit No.	Certificate No.	Record Type
G4-32891	Endicott, Almal	9/24/1999	Active	Y	N	N	...	...	...	New Application
G4-160807CL	Polster, William T	6/25/1974	Active	N	N	N	...	...	...	Claim
G4-121370CL	Barker, J B	6/21/1974	Active	N	N	N	...	...	...	Claim
G4-122204CL	Van Belle, John P	...	Active	N	N	N	...	...	...	Claim
G4-077644CL	Sebero, W H	5/31/1974	Active	N	N	N	...	...	...	Claim
G4-074053CL	Weidle, Clara L	3/21/1974	Active	N	N	N	...	...	...	Claim
G4-043376CL	Nelson, Lyman	1/1/1950	Active	N	N	N	...	...	...	Claim
G4-016037CL	Nelson,	3/2/1968	Active	N	N	N	...	...	...	Claim
G4-28642GWRIS	Richland City (Aldrich),	3/18/1985	Active	Y	N	N	...	...	G4-28642 G	Certificate
G4-27947GWRIS	Stolp John L,	5/11/1982	Active	Y	N	N	...	...	G4-27947 G	Certificate
G4-24307CWRIS	Endicott Merl R,	5/25/1976	Active	Y	N	N	...	...	G4-24307 C	Certificate
G4-23891CWRIS	Mclain Garry & Linda,	3/31/1975	Active	Y	N	N	...	...	G4-23891 C	Certificate
G4-23944CWRIS	Richland City (Aldrich),	4/22/1975	Active	Y	N	N	...	...	G4-23944 C	Certificate
CG3-21927C(A)@1	Phillips, Dianer	1/29/1990	Active	Y	N	N	...	...	...	Change Application
CG3-21927C(A)	Robert, Ray	2/5/1990	Active	Y	N	N	...	...	G3-21927C(A)	Change Application
G4-29925	Richland City (Aldrich),	2/9/1989	Active	Y	N	N	...	...	...	Permit
G3-21927(B)	Bern, Williamf	10/10/1973	Active	Y	N	N	...	...	...	Certificate
G3-+21927AMCWRIS	Rigby Marriner,	10/10/1973	Active	Y	N	N	...	...	G3+21927AMC	Certificate
G3-+21155CWRIS	Nelson Lyman,	5/16/1973	Active	Y	N	N	...	...	G3+21155 C	Certificate
G4-34910	American Rock Products Inc,	7/3/2003	Active	Y	N	N	...	...	...	New Application
CG4-28515C@1	Richland City (Aldrich),	1/31/2005	Active	Y	Y	N	...	...	G4-28515 C	Change-ROE
G4-35095	Battelle Memorial Institute,	7/21/2006	Active	Y	N	N	...	...	...	New Application
CS4-SWC08098	Richland City,	2/16/2016	Active	Y	Y	Y	16464	12229	8098	Change-ROE

Water Resources Explorer

Water Resources | Water Right Information | GIS Data | Help | Contact Us | Disclaimer | Privacy Policy

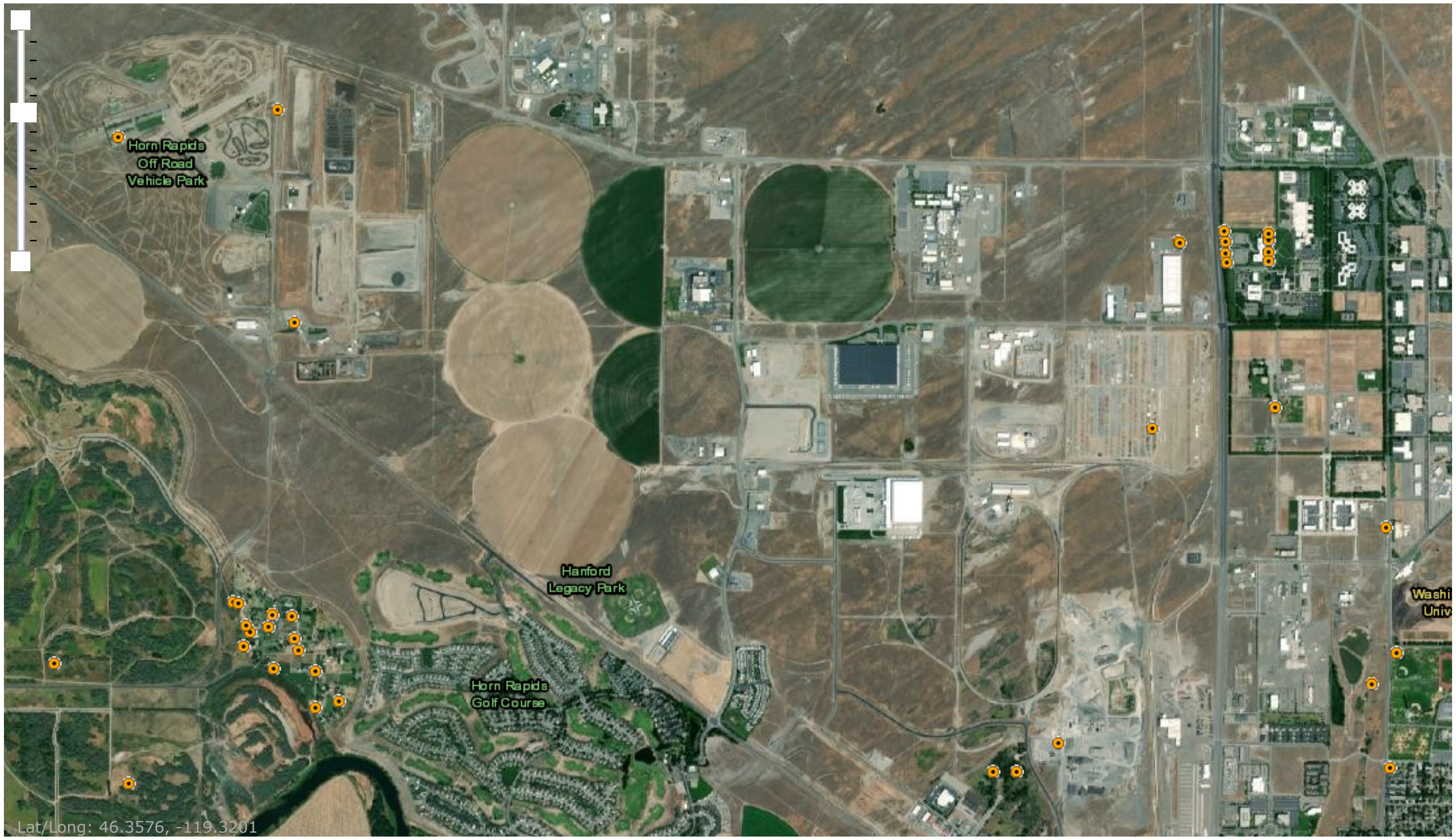
Map Navigation Menu

Search Options | Layers/Legend | Selected Record

Water Right Layers

- ☑ Water Device Points
  - ☑ ● Ground Water Collector
  - ☑ ▲ Headworks Gravity Flow
  - ☑ ■ Irrigation Dam
  - ☑ ● Monitoring Well
  - ☑ ■ Reservoir Dam
  - ☑ ▲ Surface Water Pump
  - ☑ ● Well
  - ☑ ● Other
- ☑ Unmapped Water Device Points
  - ☑ ▲ Headworks Gravity Flow
  - ☑ ■ Reservoir Dam
  - ☑ ● Well
- ☐ Water Places of Use
- ☐ Hydrographic Features
- ☐ Administrative Boundaries

Water Bank Layers



Record No.	Person or Organization	Priority Date	Record Status	Imaged	Metered	Low Flow Provision	Application No.	Permit No.	Certificate No.	Record Type
										Application
G4-29925	Richland City (Aldrich),	02/09/1989	Active	Y	N	N	...	...	...	Permit
G3-21927(B)	Bern, Williamf	10/10/1973	Active	Y	N	N	...	...	...	Certificate
G3-+21927AMCWRIS	Rigby Marriner,	10/10/1973	Active	Y	N	N	...	...	G3+21927AMC	Certificate
G3-+21155CWRIS	Nelson Lyman,	05/16/1973	Active	Y	N	N	...	...	G3+21155 C	Certificate

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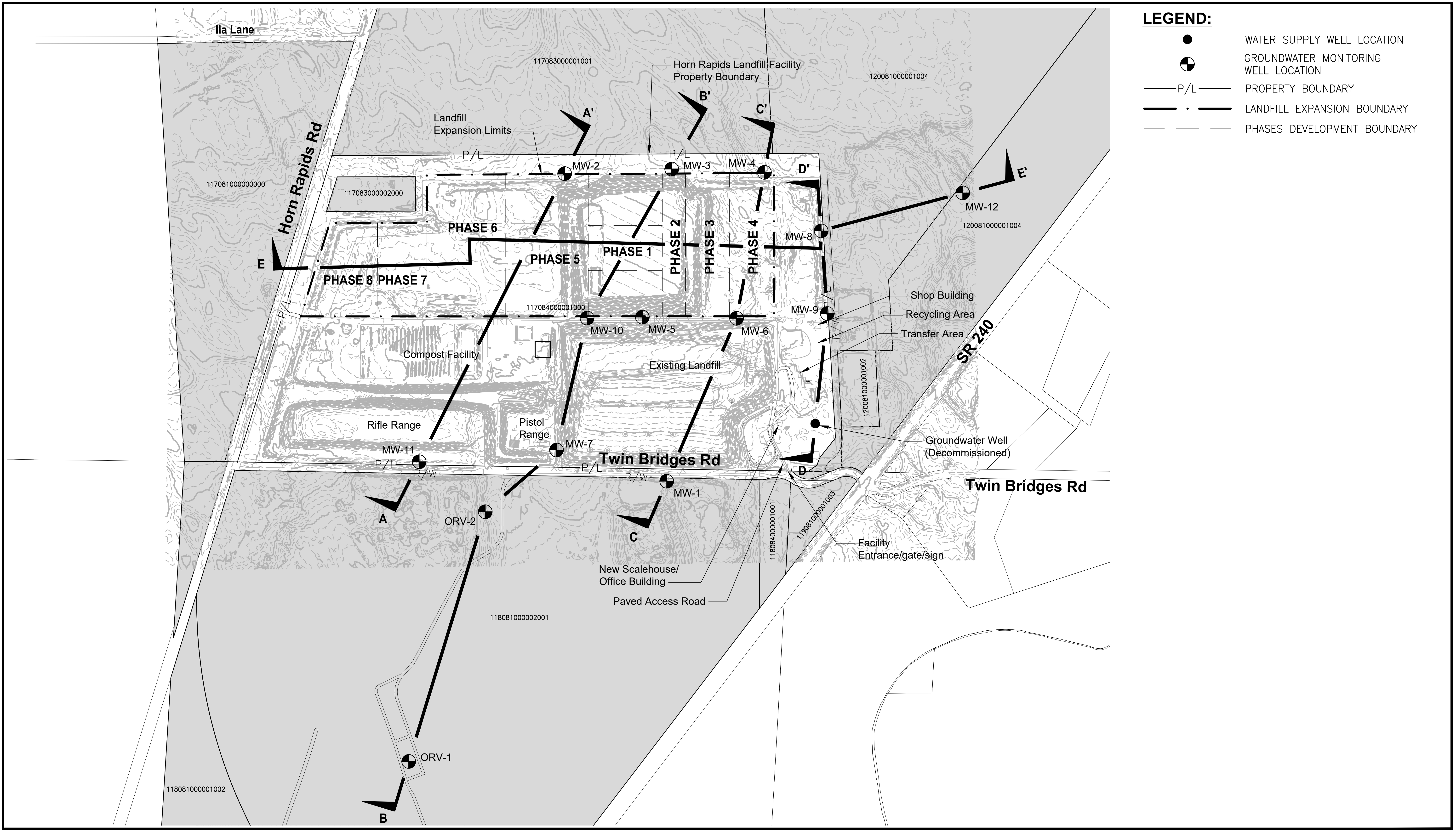
Appendix C

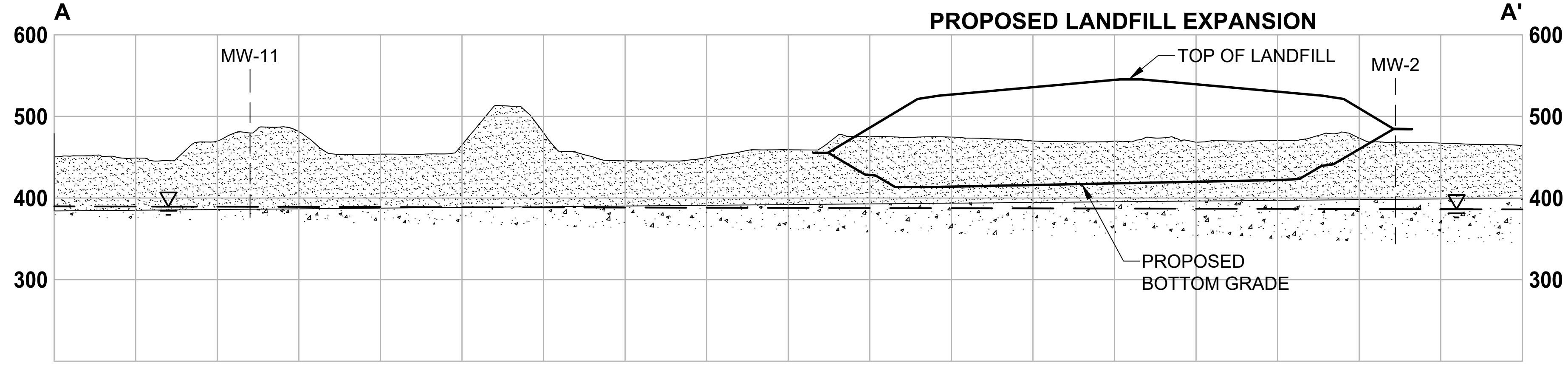
Geologic Cross Sections

FILE: BL3820006P03T01F-C1 LAYOUT: C-1 PATH: U:\PSO\Projects\Clients\3820-City of Richland\553-3820-006 HR_LFExpansion\99Svcs\CADD\Phase 3\Task 01\Figures PLOTTED BY: purgobut DATE: Friday, November 6, 2020 1:48:31 PM



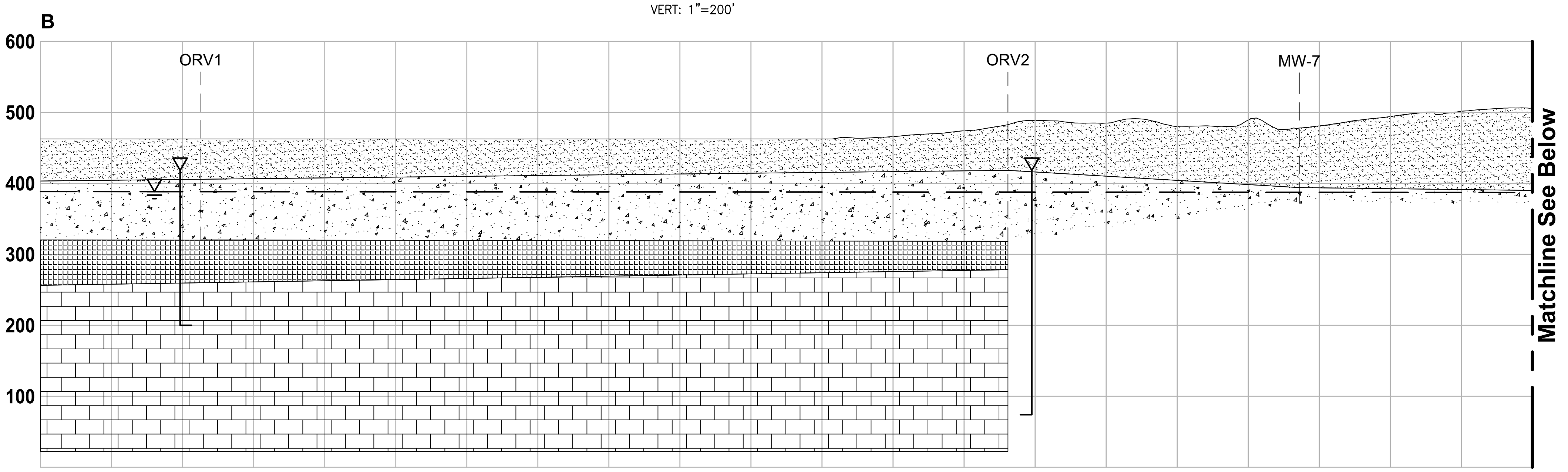
Parametrix DATE: November 6, 2020 FILE: BL3820006P03T01F-C1

Figure C-1
Geologic Cross Sections
Horn Rapids Landfill



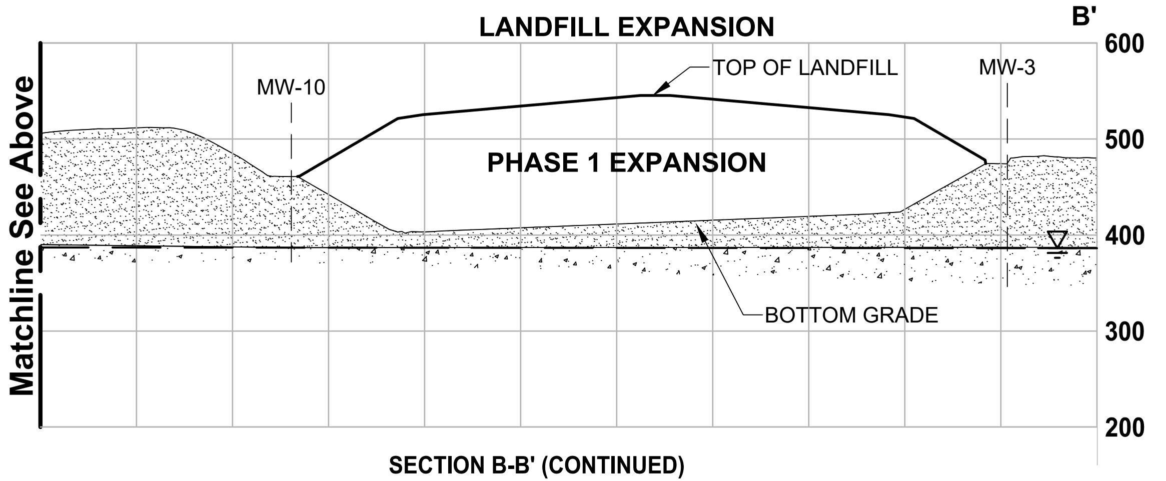
SECTION A-A'

HORIZ: 1"=400'
VERT: 1"=200'



SECTION B-B'

HORIZ: 1"=400'
VERT: 1"=200'



SECTION B-B' (CONTINUED)

HORIZ: 1"=400'
VERT: 1"=200'

Parametrix DATE: November 5, 2020 FILE: BL3820006P03T01F-C2-3

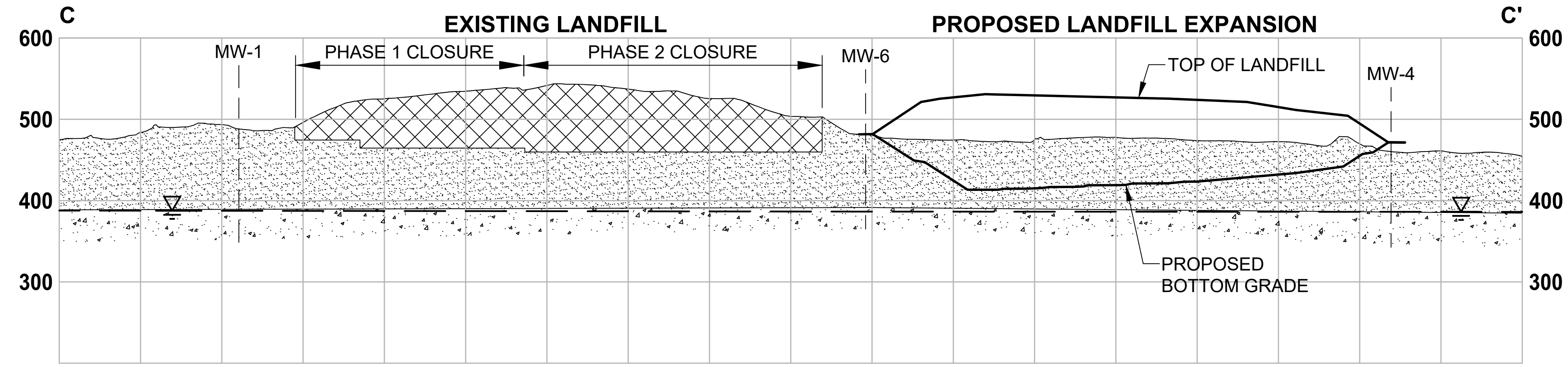
Legend:

- ▒ Sand
- ░ Sand and Gravel
- ▦ Clay
- ▤ Basalt
- ▽ Groundwater Elevation

Note:

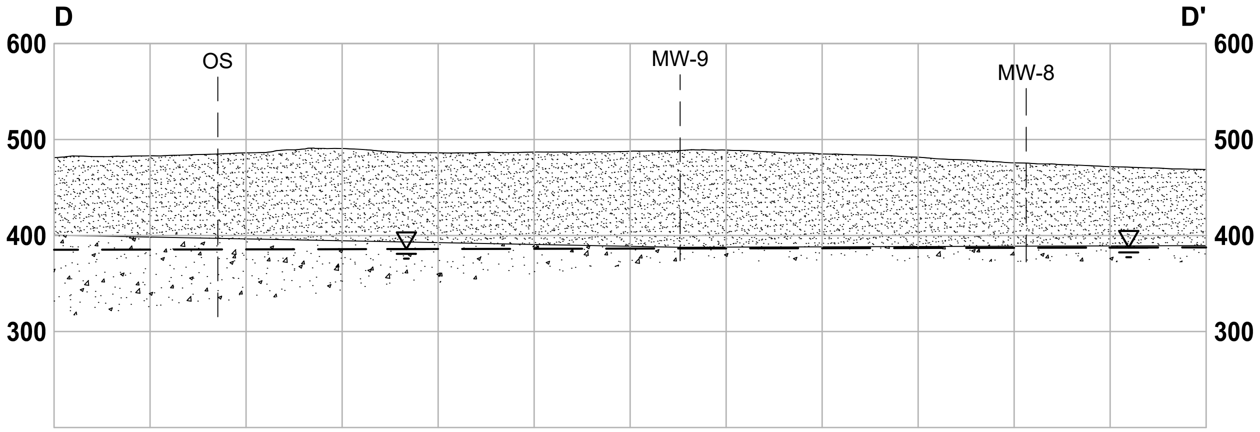
Vertical Datum: NAVD88

Figure C-2
Geologic Cross Sections
Horn Rapids Landfill



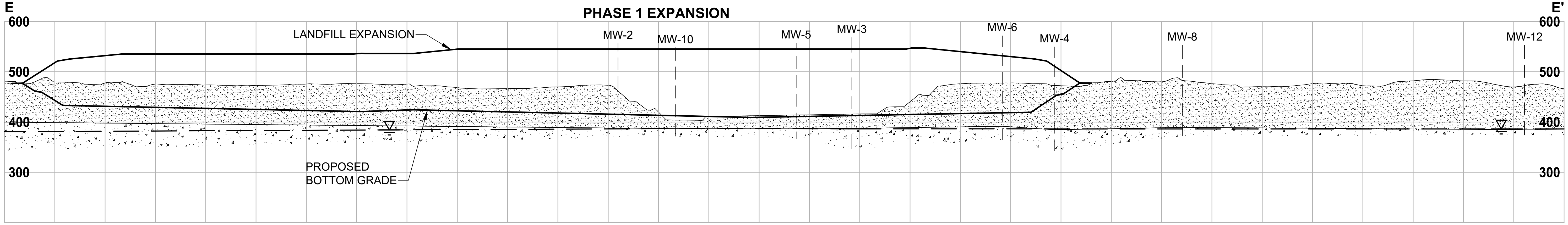
SECTION C-C'

HORIZ: 1"=400'
VERT: 1"=200'



SECTION D-D'

HORIZ: 1"=400'
VERT: 1"=200'



SECTION E-E'

HORIZ: 1"=400'
VERT: 1"=200'

FILE: BL3820006P03T01F-C2-3 LAYOUT: C-3 PATH: U:\PSO\Projects\Clients\3820-City of Richland\553-3820-006 HR_LFExpansion\99Svcs\CADD\Phase 3\Task 01\Figures PLOTTED BY: purgabut DATE: Thursday, November 5, 2020 3:14:19 PM

Parametrix DATE: November 5, 2020 FILE: BL3820006P03T01F-C2-3

Legend:

▨ Sand
▨ Sand and Gravel
▨ Refuse
▦ Clay
▤ Basalt
▽ Groundwater Elevation

Note:

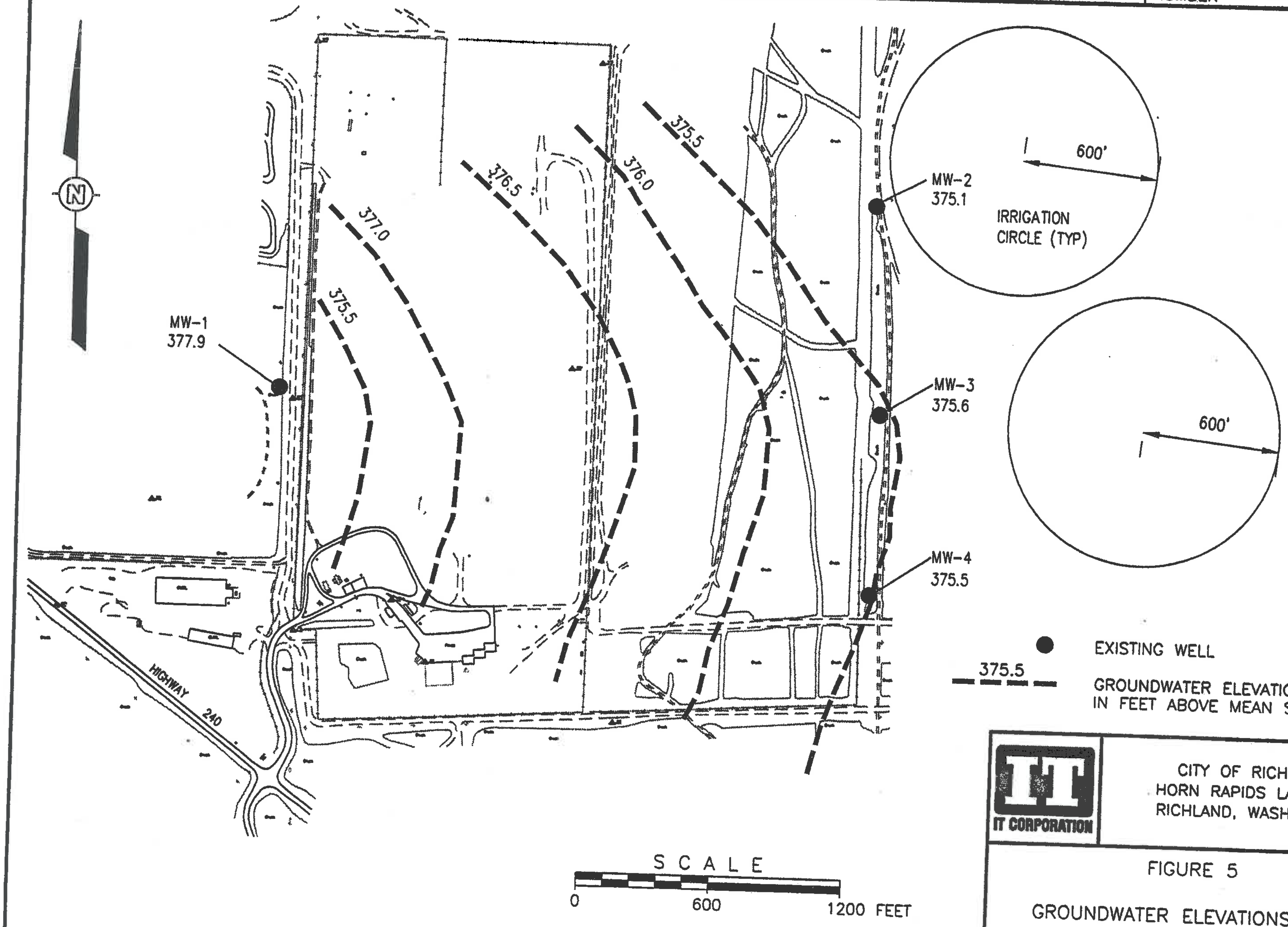
Vertical Datum: NAVD88

Figure C-3
Geologic Cross Sections
Horn Rapids Landfill

Appendix D

Potentiometric Surface Flow Maps

---	---	RICHLAND, WA	J. WILLIAMS	9/5/00	CHECKED BY	APPROVED BY	DRAWING NUMBER 810835_FIG1



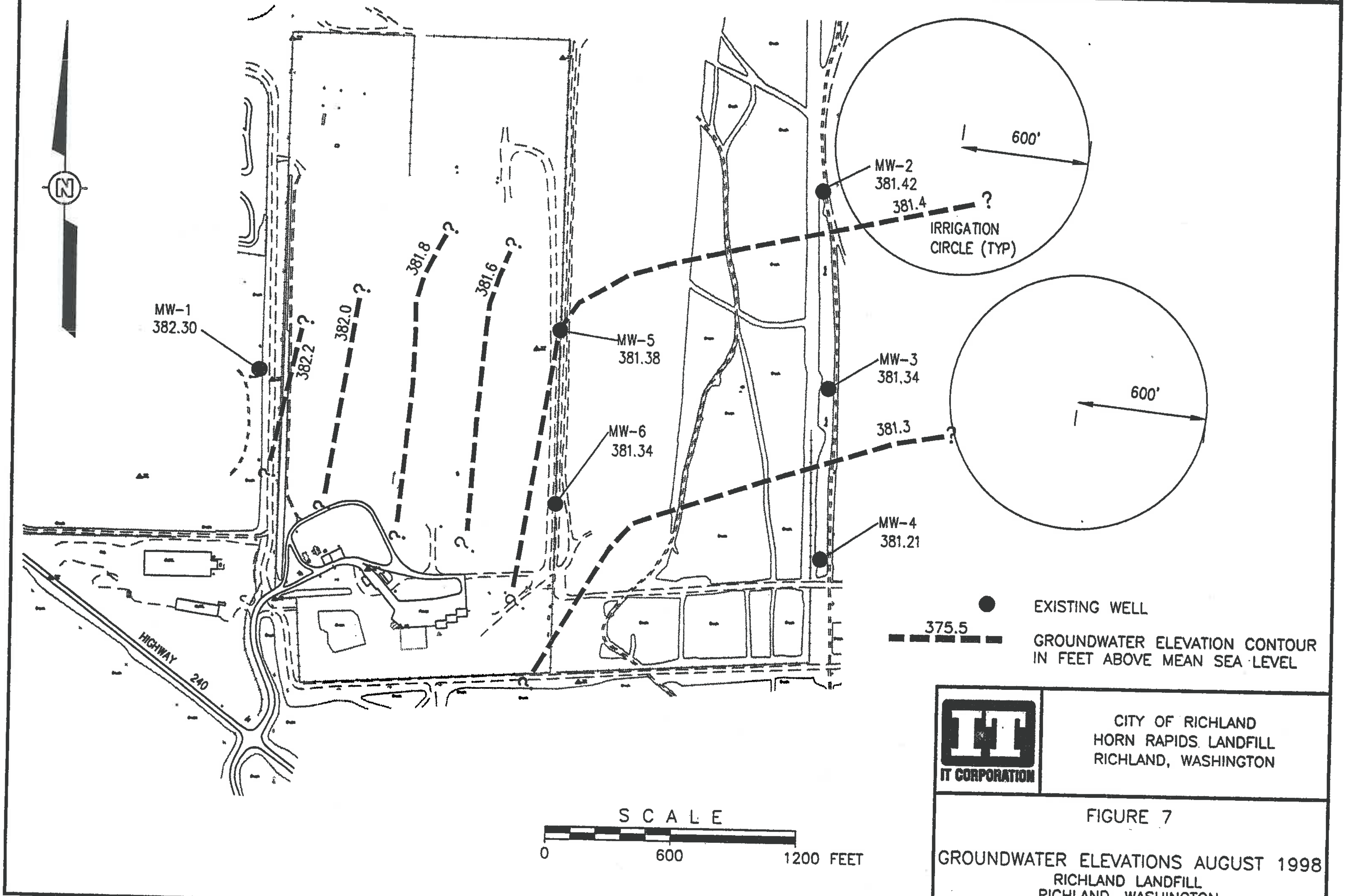
IT CORPORATION

CITY OF RICHLAND
HORN RAPIDS LANDFILL
RICHLAND, WASHINGTON

FIGURE 5

GROUNDWATER ELEVATIONS 1987
RICHLAND LANDFILL
RICHLAND, WASHINGTON

OFFICE	DRAWN BY		CHECKED BY	APPROVED BY	DRAWING NUMBER 810835_FIG3
RICHLAND, WA	J. WILLIAMS	9/5/00			



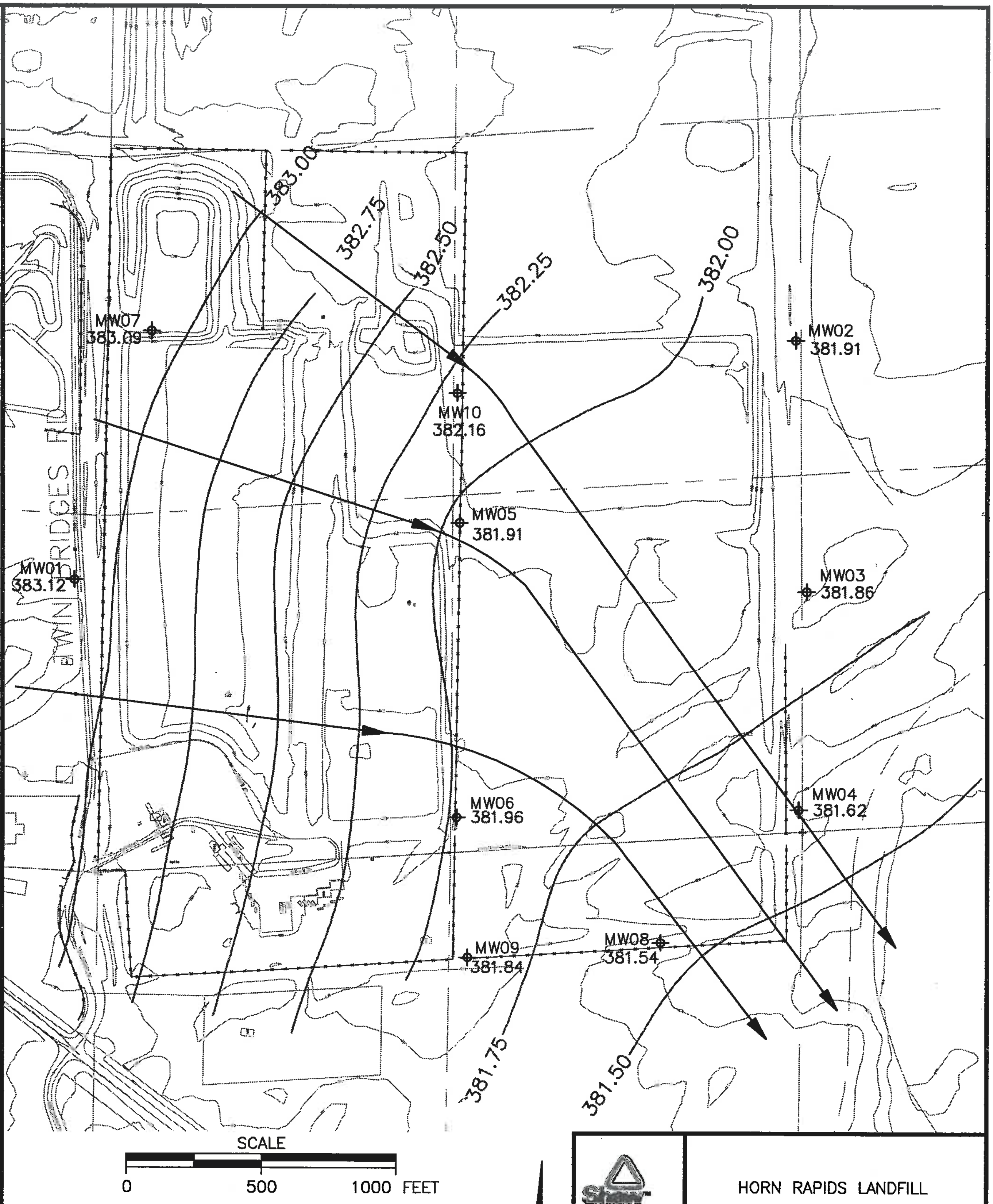
IT CORPORATION

CITY OF RICHLAND
HORN RAPIDS LANDFILL
RICHLAND, WASHINGTON

FIGURE 7

GROUNDWATER ELEVATIONS AUGUST 1998
RICHLAND LANDFILL
RICHLAND, WASHINGTON

DRAWING NUMBER	810835-A1
APPROVED BY	
CHECKED BY	
DRAWN BY	SCHAEFFER 7/17/02
OFFICE	Concord
X-REF	---
IMAGE	---



LEGEND

⌖	MONITORING WELL LOCATION
381.84	GROUNDWATER ELEVATION (FEET)
⁓	GROUNDWATER ELEVATION CONTOUR (FEET)
→	GROUNDWATER FLOW LINE

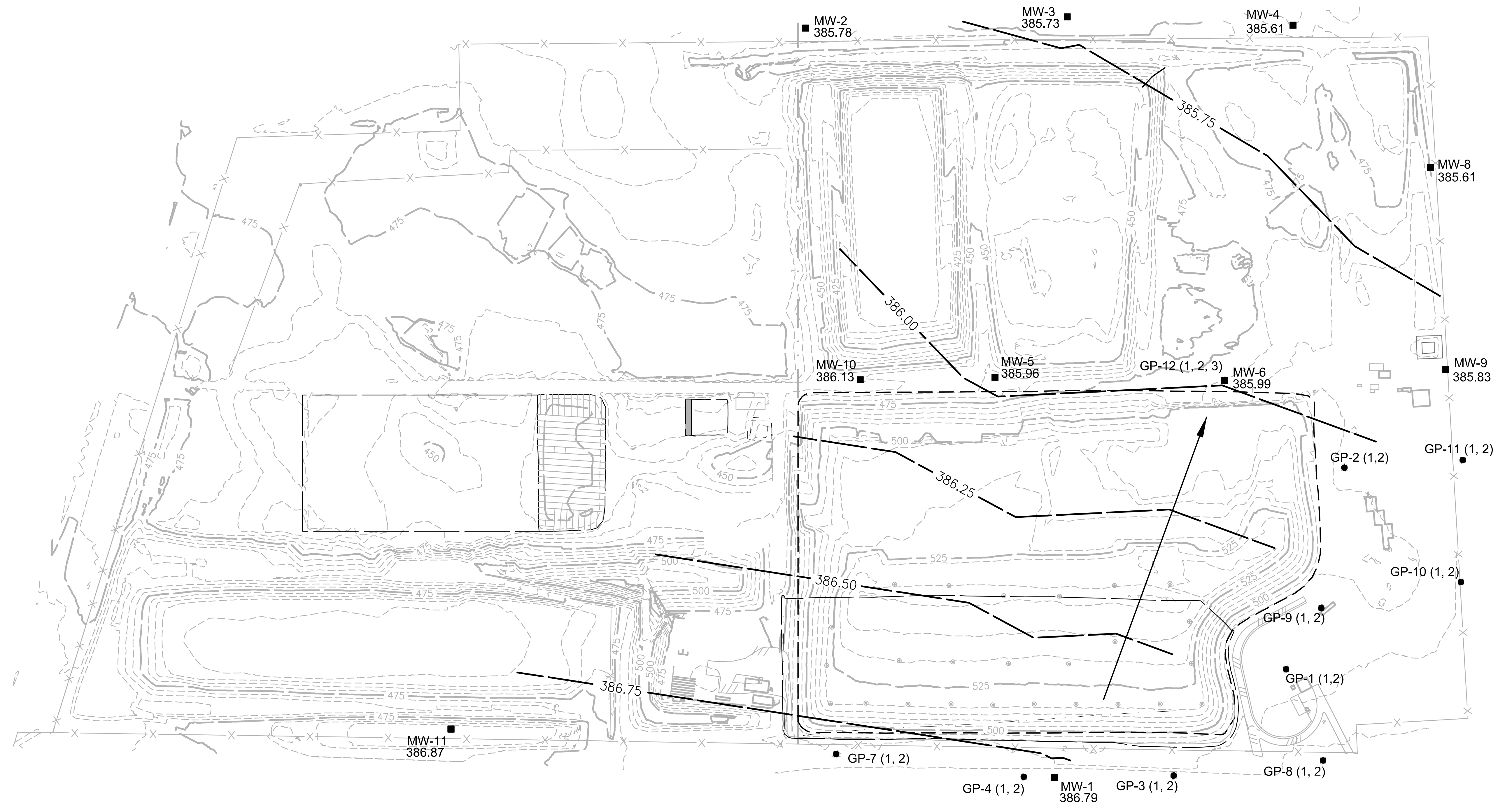
Shaw E & I, Inc.

HORN RAPIDS LANDFILL

FIGURE 9

GROUNDWATER ELEVATION MAP
MARCH 2002

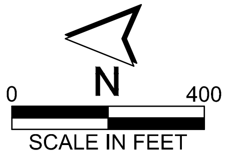
FILE: BL3820004P04T02-F2-1STQ2015 LAYOUT: Fig-2 PATH: U:\PSO\Projects\Clients\3820-City of Richland\555-3820-004 HornRapids2011EM\99Svcs\CADD\555-3820-004\Phase 04\Task 02\Figures\ PLOTTED BY: purgabut DATE: Tuesday, June 02, 2015 10:34:32 AM



Topographic Contour Interval: 10 ft

Elevation Datum: NAVD88

Parametrix DATE: Jun 02, 2015 FILE: BL3820004P04T02-F2-1stQ2015



LEGEND:

- Approximate extent of refuse
- Approximate site boundary
- Groundwater elevation contour
- Approximate groundwater flow direction

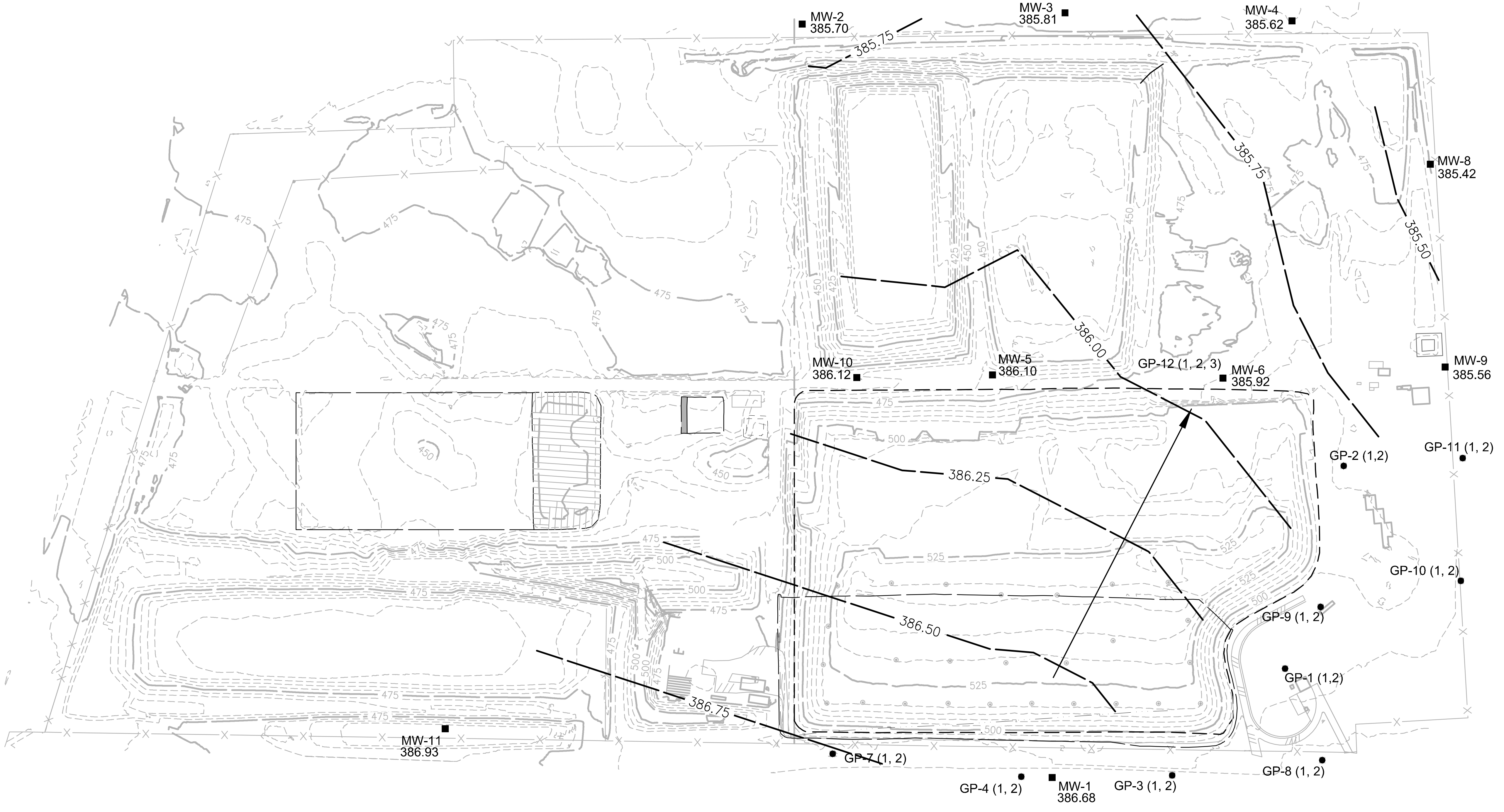
Monitoring Stations

■ Monitoring well, with groundwater elevation in ft NAVD88 measured March 30 and 31, 2015

● Gas Probe (1, 2, 3) with variable-depth screens

Figure 2
Potentiometric Surface Map
First Quarter 2015
Horn Rapids Landfill

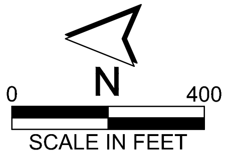
FILE: BL3820004P04T02-F2-3RDQ2015 LAYOUT: Fig-2 PATH: U:\PSO\Projects\Clients\3820-City of Richland\555-3820-004 HornRapids2011EM\99Svcs\CADD\555-3820-004\Phase 04\Task 02\Figures\ PLOTTED BY: purgobut DATE: Tuesday, October 13, 2015 1:48:56 PM



Topographic Contour Interval: 10 ft

Elevation Datum: NAVD88

Parametrix DATE: Oct 13, 2015 FILE: BL3820004P04T02-F2-3rdQ2015



LEGEND:

— · — · —	Approximate extent of refuse
—— — — ——	Approximate site boundary
—— —— ——	Groundwater elevation contour
——→	Approximate groundwater flow direction

Monitoring Stations

■	Monitoring well, with groundwater elevation in ft NAVD88 measured September 16 and 17, 2015
●	Gas Probe (1, 2, 3) with variable-depth screens

Figure 2
Potentiometric Surface Map
Third Quarter 2015
Horn Rapids Landfill

Appendix E

Information from 2001–2004 RI and 2004 Pilot Study

E-1

2001–2004 RI

Table 2-1
Field-Measured Major Gas Concentrations in Gas Probes
Horn Rapids Landfill

Gas Probe Designation	Screened Interval (feet-bgs)	Units Date	Methane (%)	Oxygen (%)	Carbon Dioxide (%)	Purge time (seconds)
GP-1(2)[1]	8.5 - 10	9-18-03	0.0	17.7	2.2	180
GP-1(1)	16.5 - 18	9-18-03	0.0	16.9	2.7	180
GP-2(2)	18.5 - 20	9-18-03	25.0	0.3	31.2	180
GP-2(1)	36.5 - 38	9-18-03	19.1	0.2	28.9	180
GP-5(3)	18.5 - 20	9-18-03	0.2	12.3	7.7	180
GP-5(2)	36.5 - 38	9-18-03	5.0	0.4	25.1	180
GP-5(1)	56.5 -58	9-18-03	6.3	0.3	26.5	360
GP-6(shallow)	11-15	9-18-03	0.0	13.0	8.2	360
GP-6(deep)	26-30	9-18-03	0.0	7.7	14.3	540
GP-9(2)	11 - 16	9-18-03	0.0	10.5	9.2	180
GP-9(1)	26 - 30	9-18-03	5.2	0.2	21.2	180
GP-12(shallow)	22.5 -35.5	9-18-03	0.3	2.4	19.2	360
GP-12(intermediate)	35.5 - 49.5	9-18-03	16.3	0.0	26.2	720
GP-12(deep)	76.5 - 89.5	9-18-03	11.9	0.0	24.8	960

Notes: % = percent of total atmospheric gases; bgs = below ground surface

[1] = the number within the parenthesis represents a distinct screen interval for multiple completion gas probes.

Table 3-1:
Depth-Discrete Methane Concentrations in MW05, MW06, and MW07 Well Casings
Horn Rapids Landfill

Measurement Depth (feet, btoc)	Methane Concentration (percent)		
	MW05	MW06	MW07
In security casing	0.0	0-2	0.0
10	1.2	3.1	16.2
20	2.3	4.0	16.6
30	2.7	5.4	16.4
40	3.0	5.5	16.4
50	3.0	4.7	15.9
60	3.1	3.9	15.3
70	3.0	3.1	14.9
80	2.9	2.7	14.7
90	----	2.3	14.5
Above groundwater surface	2.7[a]	4.4[b]	14.5[c]

Notes: *btoc = below top of casing; ; ---- = not measured. % = percent of total atmospheric gases. Methane gas concentrations measured with a LandTec GEM 500 landfill gas meter on September 18, 2003.

[a] MW05 groundwater surface at 84.39 feet btoc.

[b] MW06 groundwater surface at 98.98 feet btoc.

[c] MW07 groundwater surface at 91.45 feet btoc.

Table 3-2
Fixed Gas Concentrations in MW05, MW06 MW07, and GP-12 Gas Samples
Horn Rapids Landfill

Sample Location	Sampling Date	Fixed Gas Concentrations (%, v/v)			
		Methane	Carbon Dioxide	Oxygen + Argon	Nitrogen
GP-12 (intermediate)	9/18/2003	16.7	28.2	0.710	54.5
MW05 (~84 feet-bgs)	9/18/2003	<0.127	6.09	16.8	77.1
MW06 (~98 feet-bgs)	9/18/2003	<0.298	0.621	22.2	77.2
MW07 (~91 feet-bgs)	9/18/2003	11.9	27.9	3.99	56.2

Notes: % = percent; v/v = volume of constituent divided by total sample volume; < = less than the method reporting limit show to the right of this symbol; bgs = below ground surface)

Table 3-3
VOCs Detected in Groundwater, Landfill Gas, and Lysimeter Liquid Samples
Horn Rapids Landfill

Sample Location	Date Collected	Tetra-chloro-ethene	cis-1,2-Dichloro-ethene	Trichloro-fluoro-methane	1,1-Dichloro-ethane	Tri-chloro-ethene	Vinyl Chloride	Chloro-ethane	Methylene chloride	trans-1,2 Dichloro-ethene	Benzene	1,1-Dichloro-ethene	Trichloro-trifluoro-ethane	Carbon Disulfide	1,1,1-Trichloro-ethane	Acetone	2-Butanone (MEK)	Chloro-methane	1,2-Dichloro-propane	1,2-D.-chloro-ethane	Toluene	Total Xylenes	Ethyl-benzene	Chloro-form	1,4-Dichloro-benzene	4-Methyl-2-pent-anone	Styrene	Acrylo-nitrile
H.L. Coeffcients		0.017	0.0041	0.097	0.0056	0.01	0.027	0.011	0.0022	0.0094	0.0056	0.026	0.097	0.03	0.017	0.000039	0.00027	0.024	0.0028	0.00098	0.0066	0.0073	0.0079	0.0037	0.0019	0.00014	0.0028	0.000088
Landfill Gas (parts per billion by volume [ppbV])																												
MW05	18-Sep-03	**150**	**360**	29	**260**	**120**	**190**	**120**	**6[illegible]**	**12**	**5.5**	**34**	**7.4**	**8.7**	**9.5**	ND	ND	ND	**2.7**	**4.4**	ND	ND	ND	ND	ND	ND	ND	NT
MW06	18-Sep-03	**8.7**	**48**	**0.74**	**42**	**13**	**47**	**86**	**4.1**	**5**	**4.4**	**5.7**	ND	**44**	ND	**91**	**10**	**3.1**	ND	ND	**8.9**	**1.6**	ND	ND	ND	ND	ND	NT
MW07	18-Sep-03	**1300**	**1100**	720	**240**	**220**	**190**	**420**	**360**	**52**	**68**	**45**	**44**	ND	**110**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NT
GP012	18-Sep-03	**2700**	**810**	28	**570**	**540**	**480**	**51**	**43**	**79**	**30**	**33**	**15**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NT
Groundwater (micrograms per liter [ug/L])																												
MW05	18-May-98	**24.5**	**30.9**	**1.4**	**20.2**	**11.8**	**0.8**	ND	**15.4**	ND	**0.8**	**0.6**	NT	ND	**1.6**	ND	ND	**1.3**	**0.7**	**1.1**	ND	ND	ND	**0.5**	ND	ND	ND	ND
	30-Jun-98	**18.2**	**29.9**	**1.5**	**19.7**	**10.1**	**1.1**	ND	**19.9**	**0.5**	**1.3**	**0.5**	NT	ND	**1.5**	ND	ND	ND	**0.6**	**1**	ND	ND	ND	ND	ND	ND	ND	ND
	30-Jun-98	**19.2**	**28.5**	ND	**19.6**	**8**	ND	ND	**10.9**	ND	**0.8**	ND	NT	ND	**1.3**	ND	ND	ND	ND	**1.1**	ND	ND	ND	ND	ND	ND	ND	ND
	10-Aug-98	**22**	**34**	**1.7**	**22**	**12**	**1.3**	ND	**15**	ND	**1.8**	**0.5**	NT	ND	**1.7**	ND	ND	ND	**0.7**	**1.1**	ND	ND	ND	**0.5**	ND	ND	ND	ND
	16-Nov-98	**33.6**	**44.3**	**2.2**	ND	**15.6**	**2.1**	ND	**26.5**	ND	**2.1**	**0.7**	NT	ND	**2.3**	**11.9**	ND	ND	ND	**1.3**	ND	ND	ND	**0.6**	ND	ND	ND	ND
	26-Jan-99	**11.5**	**11**	ND	**2.9**	**0.9**	**0.6**	ND	[illegible]	ND	**2.4**	**0.6**	NT	ND	**1.1**	**10.1**	ND	ND	ND	**2.1**	ND	ND	ND	ND	ND	ND	ND	ND
	12-May-99	**36.2**	**44.4**	**2**	**28.1**	**17.5**	ND	ND	**13.8**	ND	**2.8**	**1.7**	NT	ND	**2.1**	**16.2**	NT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5-Oct-99	**30.8**	**52.6**	ND	**26.7**	**16.5**	**2.9**	ND	ND	ND	**2.7**	ND	NT	ND	**1.9**	**9.6**	NT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	21-Dec-99	**22**	ND	ND	**24**	**11**	ND	ND	ND	ND	**2**	ND	NT	ND	ND	**20**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	8-Feb-00	**23.8**	**48.2**	ND	**20.8**	**10.1**	**1.3**	ND	ND	ND	**2.1**	ND	NT	ND	**1**	**12.3**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	16-May-00	**25**	**37**	**2**	**22**	**13**	**3**	**2**	**1[illegible]**	ND	**2**	**1**	NT	ND	**1**	ND	ND	ND	ND	**2**	ND	ND	ND	ND	ND	ND	ND	ND
	30-Aug-00	**31**	**49**	ND	**25**	**13**	**4.8**	ND	**1[illegible]**	**1.4**	**1.4**	**1.7**	NT	ND	**1.6**	ND	ND	ND	ND	**2.3**	ND	ND	ND	ND	ND	ND	ND	ND
	5-Dec-00	**29**	**48**	**3.5**	**23**	**13**	**4.4**	**1.2**	**14**	ND	ND	ND	NT	ND	ND	ND	ND	ND	ND	**1.8**	ND	ND	ND	ND	ND	ND	ND	ND
	10-Apr-01	**26**	**48**	**3.7**	**22**	**13**	**4.5**	**1.6**	**12**	ND	ND	ND	NT	ND	ND	ND	ND	ND	ND	**1.2**	ND	ND	ND	ND	ND	ND	ND	ND
	25-Jul-01	**23**	**99**	**3.7**	**42**	**9**	**11**	ND	**2[illegible]**	ND	ND	ND	NT	ND	ND	ND	ND	ND	ND	ND	ND	**1.2**	ND	ND	ND	ND	ND	ND
	16-Oct-01	**22**	**45**	**4**	**20**	**8.5**	**4.9**	ND	**8.8**	ND	ND	ND	NT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	18-Dec-01	**21**	**67**	ND	**27**	**5.5**	**7.3**	ND	**12**	ND	ND	ND	NT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	20-Mar-02	**22**	**63**	ND	**30**	**5.3**	**7.6**	ND	**12**	ND	ND	ND	NT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	3-Jul-02	**24**	**59**	**3.8**	**24**	**8.9**	**7.8**	**2.6**	**8.2**	ND	ND	ND	NT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	15-Oct-02	**18**	**34**	ND	**16**	**11**	**2.7**	ND	**7.2**	ND	**1.4**	ND	NT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	17-Dec-02	**18.4**	**36.4**	**1.2**	**17.6**	**9.8**	**10**	**2.1**	**8.1**	ND	**0.7**	**1.1**	NT	ND	**0.5**	ND	ND	ND	**0.5**	**1.2**	ND	ND	ND	ND	ND	ND	ND	ND
	26-Mar-03	**24**	**35**	ND	**17**	**13**	**4.4**	ND	**3.5**	ND	**1.6**	ND	NT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11-Jun-03	**19**	**32**	ND	**14**	**10**	**5.1**	ND	**3.4**	ND	ND	ND	NT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW06	18-May-98	**36.5**	**21.6**	**0.5**	**32.4**	**13.6**	**0.6**	ND	**14.2**	**0.7**	**0.7**	**0.6**	NT	ND	**0.5**	ND	ND	**1.3**	**0.7**	**1.5**	ND	ND	ND	ND	ND	ND	ND	ND
	7-Jul-98	**32.1**	**24.6**	**0.6**	**33.6**	**13.5**	**1.2**	ND	**9.4**	**0.9**	**2.5**	ND	NT	ND	**0.5**	ND	ND	ND	**0.7**	**1.5**	ND	ND	ND	ND	ND	ND	ND	ND
	7-Jul-98	**35**	**22.2**	ND	**32.7**	**12.7**	ND	ND	**8.8**	**1.3**	**1.8**	ND	NT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10-Aug-98	**36**	**28**	**0.5**	**36**	**15**	**1.5**	ND	**7.9**	**1.1**	**3.3**	**0.5**	NT	ND	**0.5**	ND	ND	ND	**0.7**	**1.7**	ND	ND	ND	ND	ND	ND	ND	ND
	16-Nov-98	**43.5**	**35.8**	**0.5**	ND	**17.9**	**3.1**	ND	**10**	**1.4**	**4.1**	**0.8**	NT	ND	**0.6**	**25**	ND	ND	**0.8**	**2.3**	ND	ND	ND	ND	ND	ND	ND	ND
	26-Jan-99	**34**	**16.5**	ND	**6.9**	**0.9**	**0.8**	ND	ND	**0.7**	**2.5**	**0.7**	NT	ND	ND	ND	ND	ND	ND	**0.9**	**1.5**	ND	ND	ND	ND	ND	ND	ND
	12-May-99	**55.5**	**34.9**	**0.5**	**42.2**	**20.3**	**3.5**	**1**	**2.3**	**0.8**	**4.5**	ND	NT	ND	**2.1**	**22.8**	ND	ND	ND	**0.6**	ND	ND	ND	ND	ND	ND	ND	ND
	5-Oct-99	**52.7**	**48.7**	ND	**47.8**	**22.2**	**6**	ND	**6.6**	ND	**5.3**	ND	NT	ND	**0.5**	**17.4**	ND	ND	ND	**3.5**	ND	ND	ND	ND	ND	ND	ND	ND
	21-Dec-99	**45**	**1.8**	ND	**42**	**17**	ND	ND	**4.9**	ND	ND	ND	NT	ND	**0.5**	ND	ND	ND	ND	**3.5**	ND	ND	ND	ND	ND	ND	ND	ND
	8-Feb-00	**48.6**	**38.1**	ND	**41.9**	**18.9**	**4.1**	ND	**1.2**	ND	**6**	ND	NT	ND	ND	**14.9**	ND	ND	ND	**1.8**	ND	ND	ND	ND	ND	ND	ND	ND
	16-May-00	**45**	**40**	ND	**38**	**21**	**5**	**1**	**5**	ND	**5**	**1**	NT	ND	ND	ND	ND	ND	ND	**2**	ND	ND	ND	ND	ND	ND	ND	ND
	30-Aug-00	**71**	**58**	ND	**54**	**25**	**8**	ND	**5.1**	**3.8**	**6.7**	**2.2**	NT	ND	ND	ND	ND	ND	ND	**3.5**	ND	ND	ND	ND	ND	ND	ND	ND
	5-Dec-00	**66**	**59**	ND	**50**	**28**	**6.4**	ND	**4**	**2.5**	**6**	ND	NT	ND	ND	ND	ND	ND	ND	**2.7**	ND	ND	ND	ND	ND	ND	ND	ND
	10-Apr-01	**67**	**57**	ND	**46**	**28**	**6.7**	ND	**3.2**	**2.6**	**5.6**	ND	NT	**4.9**	ND	ND	ND	ND	ND	**2.3**	ND	ND	ND	ND	ND	ND	ND	ND
	25-Jul-01	**63**	**120**	ND	**87**	**22**	**13**	ND	**8.7**	ND	**7.7**	ND	NT	ND	ND	ND	ND	ND	ND	ND	ND	**5.3**	ND	ND	ND	ND	ND	ND
	16-Oct-01	**79**	**63**	ND	**45**	**27**	**8.4**	ND	**2**	**2.6**	**5.8**	ND	NT	ND	ND	ND	ND	ND	ND	**1.7**	ND	ND	ND	ND	ND	ND	ND	ND
	18-Dec-01	**61**	**89**	ND	**64**	**16**	**12**	ND	**5.4**	ND	ND	ND	NT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	20-Mar-02	**82**	**88**	ND	**61**	**16**	**11**	ND	**3.4**	**4.8**	**6.5**	ND	NT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	3-Jul-02	**77**	**99**	ND	**63**	**28**	**15**	ND	**2.6**	**4.8**	**5.7**	**1.6**	NT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	15-Oct-02	**77**	**49**	ND	**35**	**34**	**5.5**	ND	ND	**2.9**	**6.3**	**1.1**	NT	ND	ND	ND	ND	ND	ND	**1.8**	ND	ND	ND	ND	ND	ND	ND	ND
	17-Dec-02	**47.3**	**43.8**	**0.5**	**35.2**	**28.2**	**16.9**	**1.3**	**3.3**	**3.5**	**4.6**	**1.5**	NT	ND	ND	ND	ND	ND	**0.7**	**1.7**	ND	ND	ND	ND	ND	ND	ND	ND
	26-Mar-03	**78**	**50**	ND	**36**	**37**	**8.1**	ND	ND	**3.1**	**6.7**	ND	NT	ND	ND	ND	ND	ND	ND	**1.3**	ND	ND	ND	ND	ND	ND	ND	ND
	11-Jun-03	**94**	**53**	ND	**31**	**33**	**9.3**	ND	ND	**3**	**4.4**	ND	NT	ND	ND	ND	ND	ND	ND	**1.4**	ND	ND	ND	ND	ND	ND	ND	ND

Table 3-3
VOCs Detected in Groundwater, Landfill Gas, and Lysimeter Liquid Samples
Horn Rapids Landfill

Sample Location	Date Collected	Tetra-chloro-ethene	cis-1,2-Dichloro-ethene	Trichloro-fluoro-methane	1,1-Dichloro-ethane	Tri-chloro-ethene	Vinyl Chloride	Chloro-ethane	Methylene chloride	trans-1,2 Dichloro-ethene	Benzene	1,1-Dichloro-ethene	Trichloro-trifluoro-ethane	Carbon Disulfide	1,1,1-Trichloro-ethane	Acetone	2-Butanone (MEK)	Chloro-methane	1,2-Dichloro-propane	1,2-Di-chloro-ethane	Toluene	Total Xylenes	Ethyl-benzene	Chloro-form	1,4-Dichloro-benzene	4-Methyl-2-pent-anone	Styrene	Acrylo-nitrile
MW07	10-Apr-01	24	44	3.2	3.3	4.6	ND	1.4	17	ND	ND	ND	NT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	25-Jul-01	25	78	ND	11	3.7	ND	5	27	ND	ND	ND	NT	ND	ND	ND	ND	ND	ND	ND	ND	--	ND	ND	ND	ND	ND	ND
	16-Oct-01	29	51	3.9	5.3	4.1	1.8	3.4	10	ND	ND	ND	NT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	18-Dec-01	29	120	ND	ND	4.5	ND	ND	16	ND	ND	ND	NT	ND	ND	ND	ND	ND	ND	13	ND	ND	ND	ND	ND	ND	ND	ND
	20-Mar-01	35	49	ND	5	5.6	ND	ND	7.8	ND	ND	ND	NT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	3-Jul-20	41	74	5.4	7.8	6.1	3.8	4.9	10	ND	ND	ND	NT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	15-Oct-02	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	ND	ND	NT
	17-Dec-02	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	ND	ND	NT
	26-Mar-03	40	39	ND	6	9.2	1	ND	2.6	ND	ND	ND	NT	ND	1.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11-Jun-03	22	40	ND	5.4	5.2	2.2	ND	ND	ND	ND	ND	NT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lysimeter Liquid Samples (ug/L)																												
Port 1	8-Jun-94	7	ND	2	83	6	1	24	42	ND	10	ND	NT	ND	22	ND	NT	ND	ND	ND	2	9	1	2	ND	33	ND	ND
	22-Feb-95	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NT	NT	ND	NT	NT	ND	ND	ND	ND	ND	ND	ND	ND	NT	ND	NT
	19-Jul-95	ND	ND	ND	16	ND	ND	15	72	ND	ND	ND	NT	ND	ND	ND	ND	ND	ND	ND	ND	6	ND	ND	ND	7.9	ND	ND
	12-Sep-96	5	ND	ND	7	ND	ND	ND	ND	ND	ND	ND	NT	ND	ND	NT	NT	ND	ND	ND	ND	ND	ND	ND	ND	NT	ND	NT
	15-Apr-97	ND	38	ND	16	ND	21	ND	ND	ND	15	ND	NT	ND	ND	800	36000	ND	ND	ND	ND	ND	ND	ND	ND	310	ND	ND
	8-Apr-98	3	45	ND	9.9	1.8	9.3	11	4.7	ND	6.5	0.6	NT	73	ND	519	4060	3.6	ND	1.7	56	57	9.7	ND	ND	655	ND	8.7
	21-Oct-98	7.2	113.2	ND	78.5	5.3	ND	41.4	9.9	ND	11.3	ND	NT	ND	ND	152	5400	9.6	ND	ND	113	126.1	17.2	ND	ND	28.4	ND	ND
	11-Jan-00	6.4	96.3	ND	76.5	6.1	14	30.2	8.3	1.5	10.9	ND	NT	ND	ND	120	4200	7.5	ND	2.5	109	113.3	18.2	ND	2	22.3	ND	ND
	8-Nov-00	2.3	110	ND	13	1.1	25	28	5.1	ND	14	1	NT	11	ND	6.7	760	2.1	ND	2.8	140	80	22	ND	ND	31	2.1	ND
	18-Jun-01	ND	51	ND	8.2	ND	11	18	2.8	ND	5.5	ND	NT	6.2	ND	60	160	ND	ND	1.6	43	26	6.6	ND	ND	56	ND	ND
	5-Dec-01	2	110	ND	14	ND	11	30	8.8	ND	7.6	ND	NT	9.8	ND	54	79	ND	ND	3.4	77	78	16	ND	ND	580	ND	ND
	19-Aug-02	ND	44	ND	ND	ND	ND	12	2.5	ND	3.7	6.3	NT	ND	ND	ND	ND	ND	ND	ND	43	36	8	ND	ND	30	ND	ND
	31-Dec-02	2.7	59.5	ND	9.2	1.8	51.3	27.3	5.4	ND	4.5	1.8	NT	ND	ND	111	75.9	3	ND	1.6	34.5	56.5	7.4	ND	ND	189	ND	ND
Port 2	22-Feb-95	14	94	ND	110	NT	ND	24	83	ND	1.3	ND	NT	ND	ND	NT	NT	ND	ND	2.4	28	38	3.3	ND	ND	NT	ND	ND
	12-Sep-96	ND	142	ND	124	ND	ND	31	12	ND	10	ND	NT	ND	ND	NT	NT	ND	ND	ND	188	67	14	ND	ND	NT	ND	ND
	15-Apr-97	ND	31	ND	28	ND	7	ND	ND	ND	ND	ND	NT	ND	ND	ND	ND	ND	ND	ND	65	45	7	ND	ND	41	ND	ND
	11-Jan-00	1.9	52.8	ND	39.1	0.8	12.6	23.9	5.5	ND	9.9	ND	NT	ND	ND	8.2	52.3	1.8	ND	4	101	78.2	15.2	ND	2.1	ND	ND	ND
Port 3	18-May-95	9.8	ND	ND	16	7.4	ND	35	73	ND	ND	ND	NT	7.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	12-Sep-96	ND	23	ND	19	ND	ND	8	6	ND	ND	ND	NT	NT	ND	NT	NT	ND	ND	ND	43	28	6	ND	ND	NT	ND	ND
	15-Apr-97	ND	38	ND	28	ND	21	ND	ND	ND	7	ND	NT	ND	ND	230	2000	ND	ND	ND	60	32	8	ND	ND	41	ND	ND
	8-Apr-98	1.7	36	ND	15	1.4	2.3	2.2	1.5	ND	6.2	ND	NT	ND	0.8	ND	52	3.1	ND	3	49	43	6.7	ND	ND	30	ND	ND
	21-Oct-98	6.8	89.4	ND	58.8	5.2	11.9	37.6	9.4	ND	13.8	ND	NT	ND	ND	ND	99.3	8.9	ND	ND	148	102	20.1	ND	ND	47.6	ND	ND
	29-Jun-99	1.4	63.2	ND	46.7	1.6	14	27.7	4.3	ND	10.5	ND	NT	ND	ND	12	14.5	1.5	ND	3.3	118	73.3	14.8	ND	1	ND	ND	ND
	11-Jan-00	3	58	ND	43.7	2	11.8	20.5	5.3	ND	12.3	ND	NT	ND	ND	10.9	13.6	1.9	ND	2.9	109	63.5	12.9	ND	1.8	ND	ND	ND
	8-Nov-00	1.6	73	ND	14	ND	9.2	25	5.2	ND	8.6	ND	NT	ND	ND	ND	ND	1.4	ND	3.3	66	42	11	ND	ND	160	1.6	ND
	18-Jun-01	ND	62	ND	11	ND	8.1	29	5.1	ND	8.4	ND	NT	6.4	ND	ND	20	3.4	ND	3.2	56	26	7.4	ND	ND	99	ND	ND
	5-Dec-01	2	120	ND	19	ND	8.5	44	11	ND	9.4	1.2	NT	ND	ND	ND	ND	5.7	ND	ND	64	49	12	ND	ND	95	ND	ND
Port 4	8-Jun-94	14	2	3	22	5	ND	11	106	ND	ND	ND	NT	ND	7	ND	NT	ND	ND	12	95	146	6	ND	ND	68	ND	ND
	22-Feb-95	15	1.6	4.3	28	4.8	ND	17	160	ND	1.1	ND	NT	NT	ND	NT	NT	ND	ND	7.4	46	25	4.4	ND	ND	NT	ND	ND
	18-May-95	14	ND	ND	23	ND	ND	23	150	ND	ND	ND	NT	ND	ND	ND	ND	ND	ND	6.1	9.4	7.6	ND	ND	ND	ND	ND	ND
	19-Jul-95	6	ND	ND	5.4	6.3	ND	ND	7.2	ND	ND	ND	NT	ND	ND	ND	ND	ND	ND	ND	<5	<5	ND	ND	ND	ND	ND	ND
	12-Sep-96	8	ND	ND	16	ND	ND	ND	ND	ND	ND	ND	NT	NT	ND	NT	NT	ND	ND	ND	23	16	ND	ND	ND	NT	ND	ND
	15-Apr-97	<5	160	ND	140	5	13	44	10	ND	15	ND	NT	85	ND	ND	430	ND	ND	ND	240	66	21	ND	ND	860	ND	ND
	8-Apr-98	3	110	ND	70	2.3	3.9	15	4.1	ND	11	0.7	NT	24	ND	ND	104	2.3	ND	3	135	71	14	ND	1.8	103	1.4	ND
	29-Jun-99	2.7	63.2	ND	101	2.1	19.1	30.3	7.8	ND	10.3	ND	NT	ND	ND	23.2	568	1.7	ND	3.7	110	113.8	16.7	ND	1.2	ND	ND	ND
	11-Jan-00	2.7	63.2	ND	101	2.1	19.1	30.3	7.8	ND	10.3	ND	NT	ND	ND	23.2	568	1.7	ND	3.7	110	113.8	16.7	ND	1.2	ND	ND	ND
	8-Nov-00	1.1	100	ND	51	ND	8.7	31	10	ND	8.2	ND	NT	11	ND	ND	ND	1.5	ND	3	77	45	12	ND	2.1	55	1.7	ND
	18-Jun-01	1.7	110	ND	53	1	8.6	50	11	ND	6.6	ND	NT	11	ND	ND	7.9	1.5	ND	3.1	37	37	11	ND	1.5	120	ND	ND
	5-Dec-01	2.8	280	ND	110	ND	12	84	21	ND	12	2.1	NT	4.6	ND	ND	ND	4.6	ND	ND	110	72	14	ND	3.2	360	ND	ND
	19-Aug-02	1.5	100	ND	36	ND	ND	ND	7.2	ND	5.8	ND	NT	ND	ND	ND	ND	ND	ND	ND	44	29	9.7	ND	ND	160	ND	ND

Notes: ND = not detected, NT = not tested, BOLD results are detects, H.L. = Henry's Law dimensionless coeffcients.

Table 3-4
Cations and Anions in MW05, MW06, and MW07 Groundwater and Lysimeter Liquid Samples
Horn Rapids Landfill

Sample Location	Date	Alkalinity (mg/L)	Bicarb-onate (mg/L)	Calcium (mg/L)	Chloride (mg/L)	Magnesium (mg/L)	Manganese (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Sulfate (mg/L)
MW05	18-May-98	467	570	159	19.3	37.9	4.7	13.6	18.3	39.8
	30-Jun-98	469	572	149	19.3	30.3	0.09	9.88	17.9	40.6
	10-Aug-98	472	576	151	18.9	32	0.033	9.7	17.9	40.4
	16-Nov-98	238	290	155	20.2	32.3	0.021	10	18.3	39.3
	26-Jan-99	466	568	163	20.4	37	0.02	9.8	18.2	41
	12-May-99	478	583	149	19.9	33.7	0.015	9.7	17.7	41.9
	5-Oct-99	494	602	148	19.6	31.1	0.009	8.9	17.2	42.5
	21-Dec-99	480	585	44	22.5	22.9	0.018	9.8	18.8	46.2
	8-Feb-00	472	576	53	53.2	24.2	0.015	10	17.3	46
	16-May-00	477	477	168	20.8	34.6	0.0094	10.5	19.2	32.9
	30-Aug-00	710	710	150	18	35	0.012	11	19	38
	5-Dec-00	480	480	130	24	29	0.0082	9.1	18	65
	10-Apr-01	470	470	160	19	35	0.011	11	21	42
	25-Jul-01	480	480	170	20	34	0.011	9.8	18	43
	16-Oct-01	500	500	170	23	35	0.0082	6.8	18	44
	18-Dec-01	510	510	160	23	32	0.0088	9.3	17	44
	20-Mar-02	490	490	170	26	33	0.018	9	17	44
	3-Jul-02	470	470	170	23	38	0.016	11	21	42
	15-Oct-02	510	510	200	17	46	0.012	8.6	23	33
	17-Dec-02	510	510	160	23	36	0.0093	10	20	45
	26-Mar-03	480	480	150	25	33	0.0099	9.9	17	44
	11-Jun-03	670	670	170	39	36	0.015	11	20	49
MW06	18-May-98	475	579	151	12.4	37.8	1.2	16.3	25.1	32.7
	7-Jul-98	504	615	142	11.9	31.1	0.11	10.7	21.9	31.4
	10-Aug-98	514	627	149	11.9	33.1	0.101	10.5	21.4	31.6
	16-Nov-98	294	359	151	11.8	33	0.067	10.4	21.5	33.2
	26-Jan-99	538	656	164	11.7	38.6	0.057	10.6	22.4	32.9
	12-May-99	558	680	157	11.8	36.7	0.062	10.7	22.5	32.3
	5-Oct-99	566	690	159	12.3	34.2	0.062	10.1	21.1	32.8
	21-Dec-99	560	683	45	13.5	24.5	0.065	10.8	23.5	35.5
	8-Feb-00	544	663	54	14	25.8	0.069	10.8	21.4	36
	16-May-00	569	569	194	11.5	40.8	0.0396	12.1	25	38.8
	30-Aug-00	650	650	190	11	47	0.036	13	27	31
	5-Dec-00	620	620	160	11	35	0.025	11	23	34
	10-Apr-01	610	610	190	11	41	0.027	13	27	33
	25-Jul-01	610	610	200	15	41	0.023	11	24	35
	16-Oct-01	620	620	190	16	42	0.02	7.5	23	36
	18-Dec-01	630	630	180	15	39	0.021	11	24	34
	20-Mar-02	610	610	220	18	44	0.02	11	27	36
	3-Jul-02	630	630	200	16	45	0.022	13	27	35
	15-Oct-02	650	650	240	13	57	0.014	9.9	32	27
	17-Dec-02	650	650	190	17	43	0.0051	12	26	36
	26-Mar-03	630	630	170	17	39	0.012	11	23	37
	11-Jun-03	650	650	180	13	41	0.015	12	24	40

Table 3-4
Cations and Anions in MW05, MW06, and MW07
Groundwater and Lysimeter Liquid Samples
Horn Rapids Landfill

Sample Location	Date	Alkalinity (mg/L)	Bicarbonate (mg/L)	Calcium (mg/L)	Chloride (mg/L)	Magnesium (mg/L)	Manganese (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Sulfate (mg/L)
MW07	20-Mar-01	740	740	290	77	58	0.01	11	31	84
	10-Apr-01	560	560	230	59	43	0.13	11	27	74
	25-Jul-01	580	580	240	56	44	0.033	11	25	75
	16-Oct-01	750	750	280	60	55	0.034	9.5	28	82
	18-Dec-01	740	740	260	54	48	0.013	11	27	76
	3-Jul-02	710	710	290	57	57	0.011	13	31	79
	26-Mar-03	730	730	230	68	47	0.0064	11	27	81
	11-Jun-03	790	790	280	61	52	0.0091	12	29	80
Port 1	8-Jun-94	ND	1180	206	20	82	9.9	25	54	5 U
	13-Oct-94	ND	1340	282	24	87	87	19	45	5 U
	22-Feb-95	ND	450	15	21	66	0.16	16	48	15
	12-Sep-96	ND	1000	210	25	84	2.1	19	46	1
	15-Apr-97	ND	1000	210	41	77	1.2	21	46	1 U
	23-Sep-97	ND	1200	240	55	81	1	20	49	1 U
	8-Apr-98	ND	880	244	64.6	74.7	4.6	17	35.9	1.06
	21-Oct-98	ND	1050	368	391	132	11.3	23.1	46.7	0.21
	11-Jan-00	ND	853	51.8	120	43.5	1.98	21	48.7	0.4
	8-Nov-00	ND	220	76.5	68	30.3	0.849	5.07	12.8	0.8 U
	18-Jun-01	ND	300	100	87	25	2.3	4.4	12	0.25
	5-Dec-01	ND	130	48	47	15	0.66	2.8	6.3	1.6
	31-Dec-02	ND	ND	88	110	25	1.2	4.9	11	1.1
Port 2	22-Feb-95	ND	880	170	30	49	6.5	17	33	4
	18-May-95	ND	ND	190	51	56	7.6	18	34	5
	19-Jul-95	ND	710	110	21	76	0.056	16	46	5
	12-Sep-96	ND	1100	280	5.4	79	10	21	40	0.1 U
	15-Apr-97	ND	1100	260	190	90	7.8	20	58	1 U
	23-Sep-97	ND	1200	270	81	89	3.4	19	47	1
	11-Jan-00	ND	63.6	ND	1439	138	53.5	45.9	53.8	28.2
Port 3	18-May-95	ND	ND	97	22	75	1.8	22	48	25
	12-Sep-96	ND	1100	250	16	92	4.8	21	46	0.1 U
	15-Apr-97	ND	1200	270	73	91	5.9	22	50	1 U
	23-Sep-97	ND	1100	250	250	89	8.2	17	57	1 U
	8-Apr-98	ND	1020	318	282	117	10.1	22.6	61.5	0.2
	21-Oct-98	ND	1060	349	356	133	10.1	23.1	66.6	0.24
	29-Jun-99	ND	1168	290	397	130	9.8	24	63	1.2
	11-Jan-00	ND	1234	54.9	508	50.8	9.27	23.2	74.3	0.3
	8-Nov-00	ND	920	228	500	92.2	7.2	13.4	43.1	0.8 U
	18-Jun-01	ND	980	370	550	130	9.5	26	79	0.45
	5-Dec-01	ND	700	290	460	100	6.3	20	57	1

Table 3-4
Cations and Anions in MW05, MW06, and MW07 Groundwater and Lysimeter Liquid Samples
Horn Rapids Landfill

Sample Location	Date	Alkalinity (mg/L)	Bicarb-onate (mg/L)	Calcium (mg/L)	Chloride (mg/L)	Magnesium (mg/L)	Manganese (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Sulfate (mg/L)
Port 4	8-Jun-94	ND	1190	242	106	91	4.4	26	60	5 U
	13-Oct-94	ND	1380	296	119	108	1.25	22	57	5 U
	22-Feb-95	ND	1400	290	140	110	4.8	19	59	1 U
	18-May-95	ND	ND	260	150	99	4.5	17	54	1
	19-Jul-95	ND	1200	270	140	110	3	19	64	2
	12-Sep-96	ND	1100	280	130	96	4	19	57	1 U
	15-Apr-97	ND	1000	290	190	86	12	22	45	1 U
	23-Sep-97	ND	1100	280	270	90	9.3	19	44	1 U
	8-Apr-98	ND	1020	348	325	120	12.3	23	44.5	0.1 U
	29-Jun-99	ND	1239	320	441	130	11	24	60	0.5
	11-Jan-00	ND	1190	55.2	470	50.2	10.07	22.9	59.9	0.1 U
	8-Nov-00	ND	950	264	470	101	6.99	14.5	37.5	0.8 U
	18-Jun-01	ND	960	360	490	130	9.4	24	60	0.48
	5-Dec-01	ND	920	380	550	130	8.4	24	59	0.16

Note; mg/L = milligrams per liter, ND = no data, U = not detected at or above the method reporting limit.

Table 3-5
Leachate Indicator Parameters in MW05, MW06 and MW07 Groundwater and Lysimeter Liquid Samples
Horn Rapids Landfill

Location	Date	Ammonia as N (mg/L)	Conductivity (µmhos/cm$^{3)}$	Nitrate as N (mg/L)	pH (SU)	TDS (mg/L)	TOC (mg/L)
MW05	18-May-98	0.01 U	894	2.74	7.04	595	1 U
	30-Jun-98	0.5 U	851	2.72	6.8	598	5
	10-Aug-98	0.018	873	2.87	6.83	598	9.4
	16-Nov-98	0.012	967	3.02	6.72	603	24
	26-Jan-99	0.026	1015	3.19	6.97	615	4.8
	12-May-99	0.01 U	933	NT	6.89	605	1.7
	5-Oct-99	0.01	1026	3.4	6.8	634	1 U
	21-Dec-99	0.02	1033	4	6.64	621	1 U
	8-Feb-00	0.03	1102	3.4	6.65	620	5.4
	16-May-00	0.07	781	3.29	6.52	596	1.09
	30-Aug-00	0.36	741	2.9	6.41	610	1
	5-Dec-00	0.027	887	3.2	6.5	620	1.5 U
	10-Apr-01	0.048	813	3.2	6.58	610	1.5 U
	25-Jul-01	0.01 U	709	3.2	6.17	610	1.5 U
	16-Oct-01	0.03	889	3.6	6.77	600	1.3
	18-Dec-01	0.14	756	3.4	6.27	600	2.1
	20-Mar-02	0.73	761	3.4	6.44	600	4.4
	3-Jul-02	0.43	1023	3.2	6.17	590	3.4
	15-Oct-02	0.41	938	2.5	6.29	620	1.7
	17-Dec-02	0.2	1069	3.3	6.29	610	1.9
	26-Mar-03	0.33	1048	3.4	6.34	620	2.4
	11-Jun-03	0.19	867	3.7	6.03	610	2.1
MW06	18-May-98	0.01 U	885	0.21	7.18	581	1 U
	7-Jul-98	0.5 U	847	0.5 U	6.84	608	6.4
	10-Aug-98	0.028	922	0.25	6.81	602	9.8
	16-Nov-98	0.015	953	0.27	6.73	600	5
	26-Jan-99	0.042	1033	0.33	6.82	637	9.6
	12-May-99	0.01 U	1067	NT	6.89	627	3.2
	5-Oct-99	0.01 U	1098	0.4	6.86	667	1 U
	21-Dec-99	0.01 U	1127	0.4	6.73	668	1 U
	8-Feb-00	0.03	1162	0.9	6.76	650	5
	16-May-00	0.07	877	0.4	6.61	664	1.35
	30-Aug-00	0.072	907	0.1 U	6.39	700	1.4
	5-Dec-00	0.01 U	1027	0.39	6.51	710	1.5 U
	10-Apr-01	0.043	926	0.3	6.44	680	1.6
	25-Jul-01	0.023	733	0.33	6.22	700	1.5 U
	16-Oct-01	0.03 U	1029	0.6	7.14	690	1.5
	18-Dec-01	0.03 U	843	0.47	6.31	700	2
	20-Mar-02	0.03 U	881	0.6	6.5	700	1.5
	3-Jul-02	0.048	1113	0.48	6.27	690	1.8
	15-Oct-02	0.045	1033	0.4	6.16	710	1.5
	17-Dec-02	0.03 U	1203	0.52	6.15	710	1.6
	26-Mar-03	0.1	1147	0.67	6.32	700	1.7
	11-Jun-03	0.062	972	0.63	6.13	710	1.5

Table 3-5
Leachate Indicator Parameters in
MW05, MW06 and MW07 Groundwater and Lysimeter Liquid Samples
Horn Rapids Landfill

Location	Date	Ammonia as N (mg/L)	Conductivity (μmhos/cm$^{3)}$	Nitrate as N (mg/L)	pH (SU)	TDS (mg/L)	TOC (mg/L)
MW07	20-Mar-01	0.04	936	12	6.34	960	2.3
	10-Apr-01	0.046	982	12	6.5	860	3.9
	25-Jul-01	0.01 U	755	12	6.33	860	1.5 U
	16-Oct-01	0.047	974	12	6.43	960	3.3
	18-Dec-01	0.049	928	11	6.09	950	2.5
	3-Jul-02	0.048	1252	11	6.15	940	2.2
	26-Mar-03	0.056	907	14	6.24	990	1.9
	11-Jun-03	0.061	158	14	6.2	1000	1.9
Port 1	29-Apr-94	NT	-10.5*	NT	6.5	NT	NT
	8-Jun-94	0.14	-15.5*	0.01	6.8	1150	19.3
	13-Oct-94	0.05 U	-16.9*	0.02	6.7	1230	23.2
	22-Feb-95	0.04 U	-103.9*	n/a	8.2	330	14
	18-May-95	NT	NT	NT	NT	NT	NT
	19-Jul-95	NT	-35.1*	NT	7	NT	NT
	12-Sep-96	0.2 U	NT	0.1 U	6.5	1200	46
	15-Apr-97	7.9	2130	0.1 U	7.5	1200	200
	23-Sep-97	5.5	2280	0.1 U	6.3	1500	280
	8-Apr-98	NT	1155	NT	5.8	NT	NT
	21-Oct-98	2.35	2550	0.1 U	6.4	1770	140
	29-Jun-99	NT	NT	NT	NT	NT	NT
	3-May-00	NT	NT	NT	NT	NT	NT
	8-Nov-00	1.95	832	0.46	5.9	360	NT
	18-Jun-01	0.70	1100	0.16	5.9	770	NT
	5-Dec-01	2.1	429	0.13	4.9	250	NT
	19-Aug-02	NT	802	NT	5.3	NT	NT
	31-Dec-02	NT	NT	0.079	NT	NT	NT
	0/11/00	3.1	1384	0.3	6	1358	150
Port 2	29-Apr-94	NT	2.4*	NT	6.3	NT	NT
	8-Jun-94	NT	NT	NT	NT	NT	NT
	13-Oct-94	NT	NT	NT	NT	NT	NT
	22-Feb-95	0.04 U	14.2*	NT	6.1	810	43
	18-May-95	0.05	11.3*	0.05 U	6.2	1100	40
	19-Jul-95	0.04 U	NT	0.05 U		850	28
	12-Sep-96	1.8	-5.4*	0.01 U	6.3	1300	65
	15-Apr-97	1.7	2560	0.2 U	7.3	1600	38
	23-Sep-97	8.1	2200	0.1 U	6.5	1700	95
	8-Apr-98	NT	NT	NT	NT	NT	NT
	21-Oct-98	NT	NT	NT	NT	NT	NT
	29-Jun-99	NT	NT	NT	NT	NT	NT
	11-Jan-00	2.95	1535	1544	6.3	160	8.4
	3-May-00	NT	NT	NT	NT	NT	NT
	8-Nov-00	NT	NT	NT	NT	NT	NT
	18-Jun-01	NT	NT	NT	NT	NT	NT
Port 2	5-Dec-01	NT	NT	NT	NT	NT	NT
	19-Aug-02	NT	NT	NT	NT	NT	NT
	31-Dec-02	NT	NT	NT	NT	NT	NT

Table 3-5
Leachate Indicator Parameters in MW05, MW06 and MW07 Groundwater and Lysimeter Liquid Samples
Horn Rapids Landfill

Location	Date	Ammonia as N (mg/L)	Conductivity (µmhos/cm$^{3)}$	Nitrate as N (mg/L)	pH (SU)	TDS (mg/L)	TOC (mg/L)
Port 3	29-Apr-94	NT	NT	NT	NT	NT	NT
	8-Jun-94	NT	NT	NT	NT	NT	NT
	13-Oct-94	NT	NT	NT	NT	NT	NT
	22-Feb-95	NT	NT	NT	NT	NT	NT
	18-May-95	0.04 U	-1.5*	n/a	6.4	840	27
	19-Jul-95	NT	NT	NT	NT	NT	NT
	12-Sep-96	0.2	-9.6*	0.01 U	6.4	1400	1400
	15-Apr-97	4.8	2250	0.1 U	7.4	1400	86
	23-Sep-97	2.6	2610	1 U	6.4	1800	40
	8-Apr-98	6.23	2550	0.1 U	6.4	1530	1 U
	21-Oct-98	2.75	2670	0.1 U	6.2	1690	160
	29-Jun-99	1.3	1903	0.1 U	6.2	727	48
	11-Jan-00	2.8	2530	0.1 U	6.1	1836	47
	3-May-00	NT	NT	NT	NT	NT	NT
	8-Nov-00	2.1	1220	0.10 U	5.2	1800	43
	18-Jun-01	1.7	2500	0.03 U	6.3	2000	54.5
	5-Dec-01	2.8	1136	0.03 U	5.7	1400	NT
	19-Aug-02	NT	NT	NT	NT	NT	NT
	31-Dec-02	NT	NT	NT	NT	NT	NT
Port 4	29-Apr-94	NT	NT	NT		NT	NT
	8-Jun-94	0.23	NT	0.01 U	6.6	1090	36.8
	13-Oct-94	0.06	-10.3*	0.02	6.6	1370	46.5
	22-Feb-95	0.36	-4.0*	NT	6.4	1700	92
	18-May-95	0.04 U	-2.7*	NT	6.4	1700	48
	19-Jul-95	0.05	-21.7*	0.05 U	6.8	1500	34
	12-Sep-96	0.2 U	-19.2*	0.1 U	6.5	1500	250
	15-Apr-97	1.4	2500	0.2 U	7.2	1600	69
	23-Sep-97	2.2	2620	1 U	6.4	1900	61
	8-Apr-98	5.58	2620	0.1 U	6.4	1630	1 U
	21-Oct-98	NT	NT	NT	NT	NT	NT
	29-Jun-99	1.5	2370	0.1 U	6.3	1837	90
	11-Jan-00	2.3	2410	0.1 U	6	1906	100
	3-May-00	NT	NT	NT	NT	NT	NT
	8-Nov-00	1.5	1720	0.1 U	5.5	1800	68
	18-Jun-01	1.8	2700	0.03 U	6.3	2000	67.5
	5-Dec-01	1.8	1149	0.03 U	5.6	1900	NT
	19-Aug-02	NT	905	NT	5.8	NT	NT
	31-Dec-02	NT	NT	NT		NT	NT

Notes: U = parameter not detected; NT = parameter not tested; mg/L = milligrams per liter; mmhos/cm3 = micromohs per cubic centimeter; SU = standard pH units; ** Specific Conductance units of measurement rel/mv .

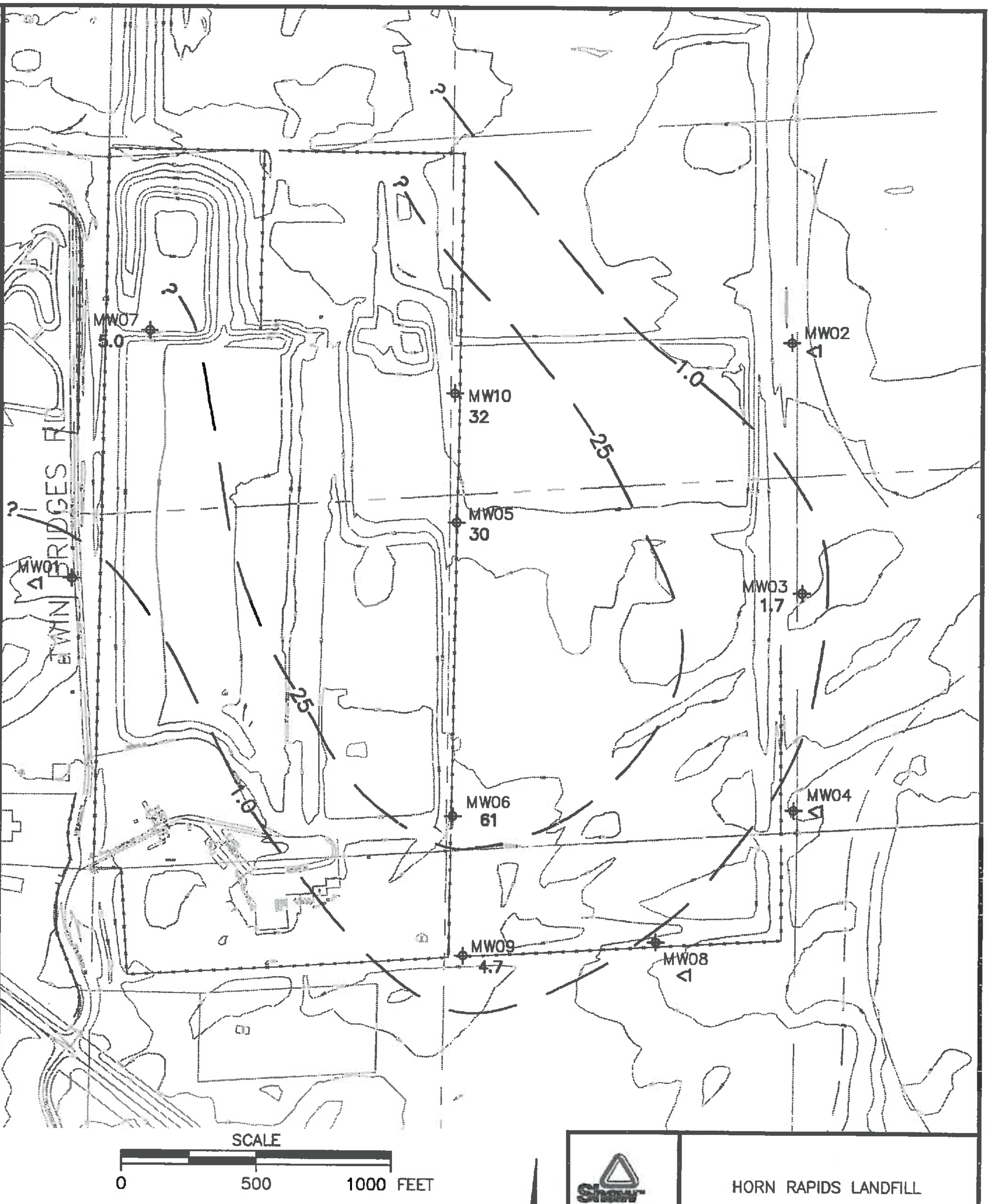
Table 4-1
Dissolved Methane and Total VOC Concentrations
Groundwater Samples
Horn Rapids Landfill

Sample Location	Date Collected	Total VOCs (µg/L)	Methane (µg/L)
MW05	10-Apr-01	132	840
	25-Jul-01	208.9	1200
	16-Oct-01	113.2	990
	18-Dec-01	139.8	1300
	20-Mar-02	139.9	910
	3-Jul-02	138.3	840
	15-Oct-02	90.3	525
	17-Dec-02	107.6	458
	26-Mar-03	98.5	NT
	11-Jun-03	83.5	353
MW06	18-Dec-01	139.8	1300
	20-Mar-02	139.9	910
	3-Jul-02	138.3	840
	15-Oct-02	90.3	525
	17-Dec-02	107.6	458
	26-Mar-03	98.5	NT
	11-Jun-03	83.5	353
	10-Apr-01	223.3	3500
	25-Jul-01	326.7	5300
	16-Oct-01	234.5	4400
	18-Dec-01	247.4	5000
	20-Mar-02	272.7	4100
	3-Jul-02	296.7	8000
	15-Oct-02	212.6	2090
	17-Dec-02	188.5	1930
	26-Mar-03	220.2	NT
	11-Jun-03	229.1	2120

Note; µg/L = micrograms per liter, ND = not detected at or above the method detection limit, NT = not tested.

Sample Location	Date Collected	Total VOCs (µg/L)	Methane (µg/L)
MW07	20-Mar-01	102.4	13
	10-Apr-01	97.5	ND
	25-Jul-01	149.7	4.5
	16-Oct-01	108.5	1.2
	18-Dec-01	182.5	4.4
	19-Dec-01	182.5	4.4
	15-Oct-02	ND	NT
	17-Dec-02	ND	NT
	26-Mar-03	98.9	NT
	11-Jun-03	74.8	ND
MW10	10-Apr-01	50.2	2.3
	25-Jul-01	95.4	81
	16-Oct-01	38.9	0.0036
	18-Dec-01	104.8	75
	20-Mar-02	80.8	110
	3-Jul-02	74.8	98
	15-Oct-02	57.2	103
	17-Dec-02	58.2	82
	26-Mar-03	46.5	NT
	11-Jun-03	39.8	13

IMAGE ---
X-REF ---
OFFICE Concord
DRAWN BY SCHAEFFER 7/17/02
CHECKED BY
APPROVED BY
DRAWING NUMBER 810835-A2



LEGEND

⌖ MONITORING WELL LOCATION

30 1,1-DCA CONCENTRATION IN µg/L

— 1,1-DCA ISOCONCENTRATION CONTOUR

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FIGURE 18

1,1-DCA ISOCONCENTRATION MAP
MARCH 2002

DRAWING NUMBER 810835-A3

APPROVED BY

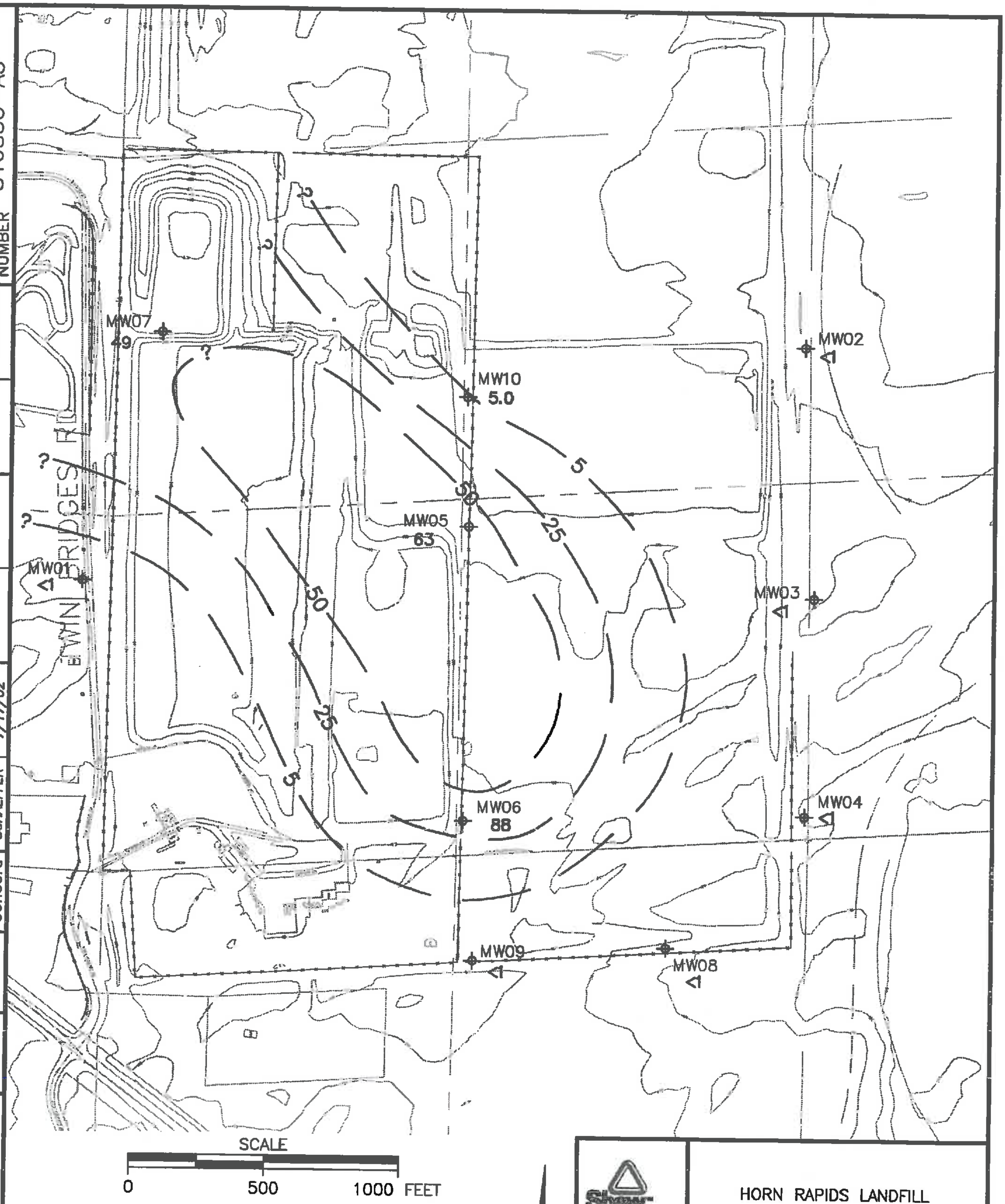
CHECKED BY

DRAWN BY SCHAEFFER 7/17/02

OFFICE Concord

X-REF --

IMAGE --



LEGEND

- ⌖ MONITORING WELL LOCATION
- 63 CIS–1,2–DCE CONCENTRATION IN μg/L
- ⁀ CIS–1,2–DCE ISOCONCENTRATION CONTOUR

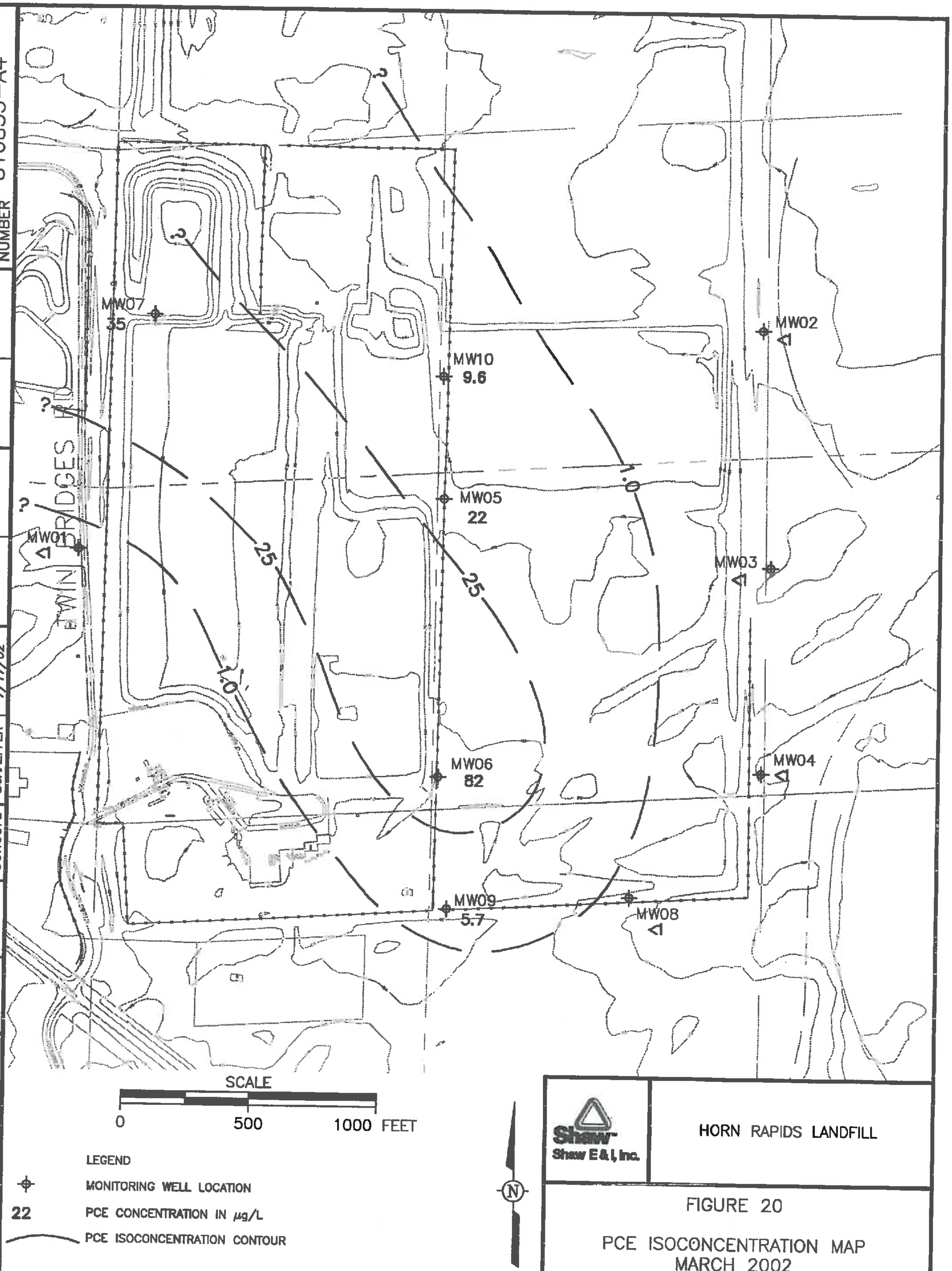
N

Shaw™
Shaw E & I, Inc.

HORN RAPIDS LANDFILL

FIGURE 19

CIS–1,2–DCE ISOCONCENTRATION MAP
MARCH 2002



DRAWING NUMBER 810835-A4

APPROVED BY

CHECKED BY

DRAWN BY SCHAEFFER 7/17/02

OFFICE Concord

X-REF --

IMAGE --

Shaw E&I, Inc.

HORN RAPIDS LANDFILL

FIGURE 20

PCE ISOCONCENTRATION MAP
MARCH 2002

DRAWING NUMBER 810835-A5

APPROVED BY

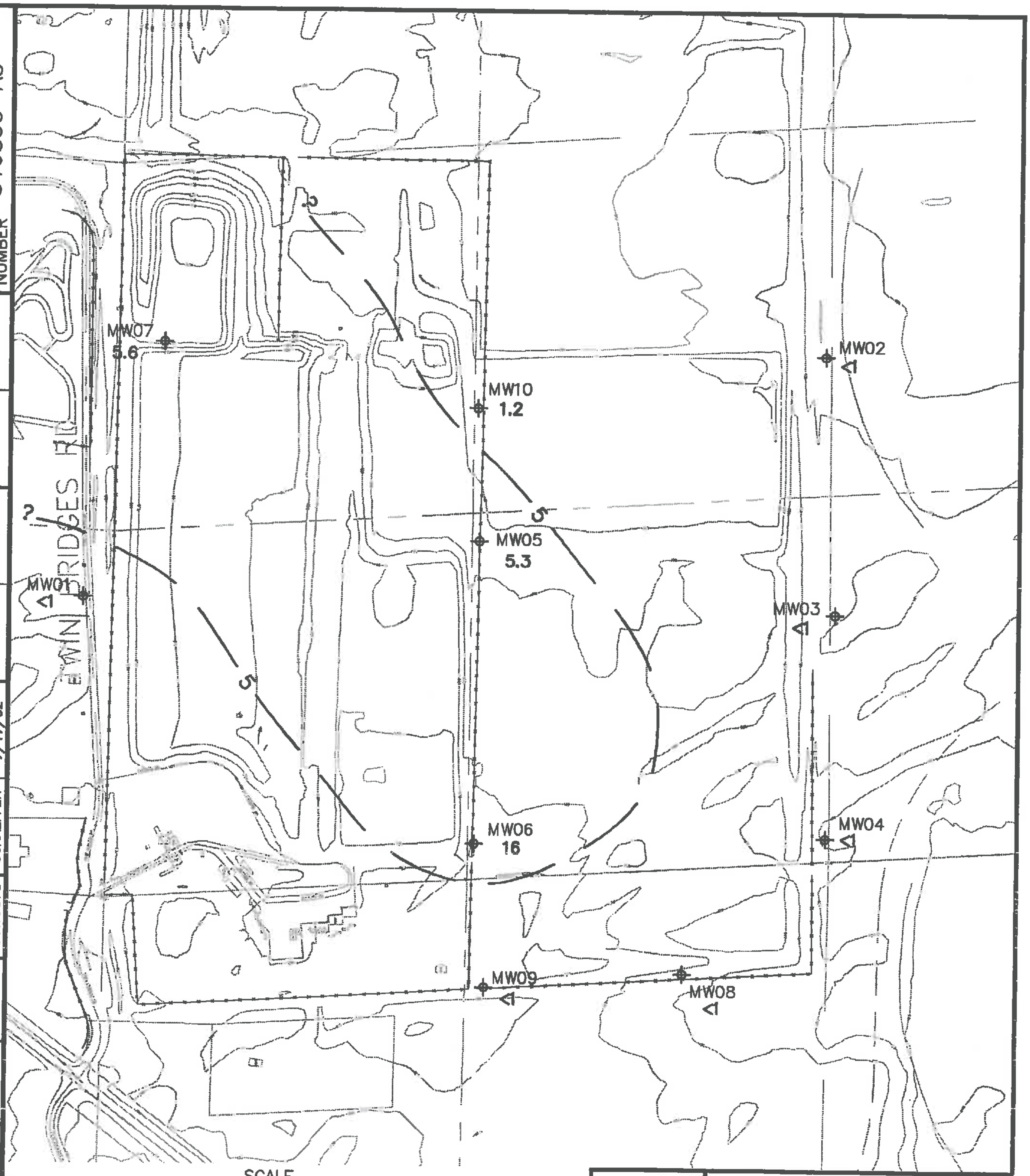
CHECKED BY

DRAWN BY SCHAEFFER 7/17/02

OFFICE Concord

X-REF ---

IMAGE ---



SCALE

0 500 1000 FEET

LEGEND

- MONITORING WELL LOCATION
- 5.3 TCE CONCENTRATION IN µg/L
- TCE ISOCONCENTRATION CONTOUR

N

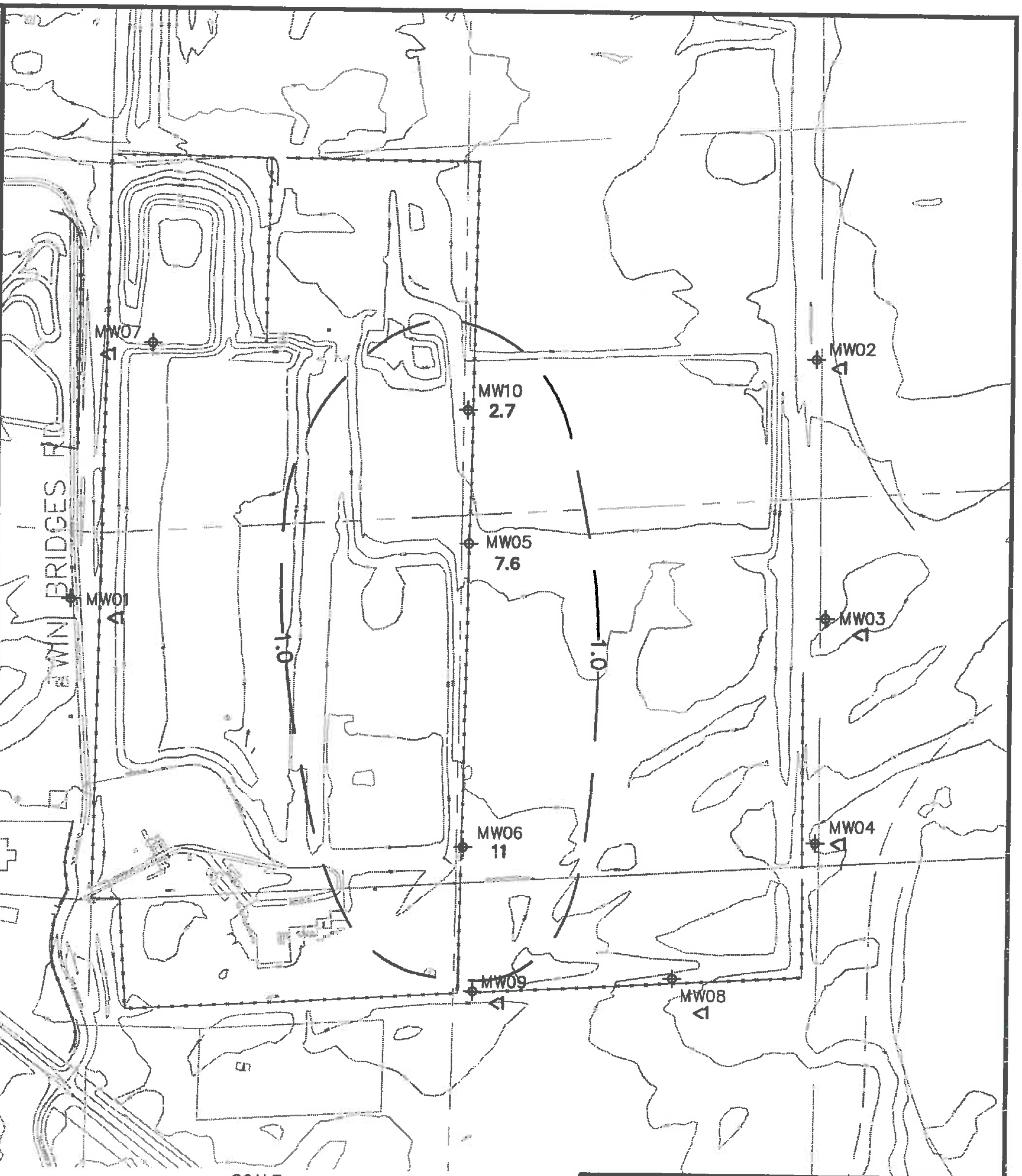
Shaw E & I, Inc.

HORN RAPIDS LANDFILL

FIGURE 21

TCE ISOCONCENTRATION MAP
MARCH 2002

DRAWING NUMBER	810835-A6
APPROVED BY	
CHECKED BY	
DRAWN BY	SCHAEFFER 7/17/02
OFFICE	Concord
X-REF	---
IMAGE	---



SCALE

0 500 1000 FEET

N

LEGEND

⌖ MONITORING WELL LOCATION

2.7 VINYL CHLORIDE CONCENTRATION IN µg/L

— VINYL CHLORIDE ISOCONCENTRATION CONTOUR

Shaw E & I, Inc.

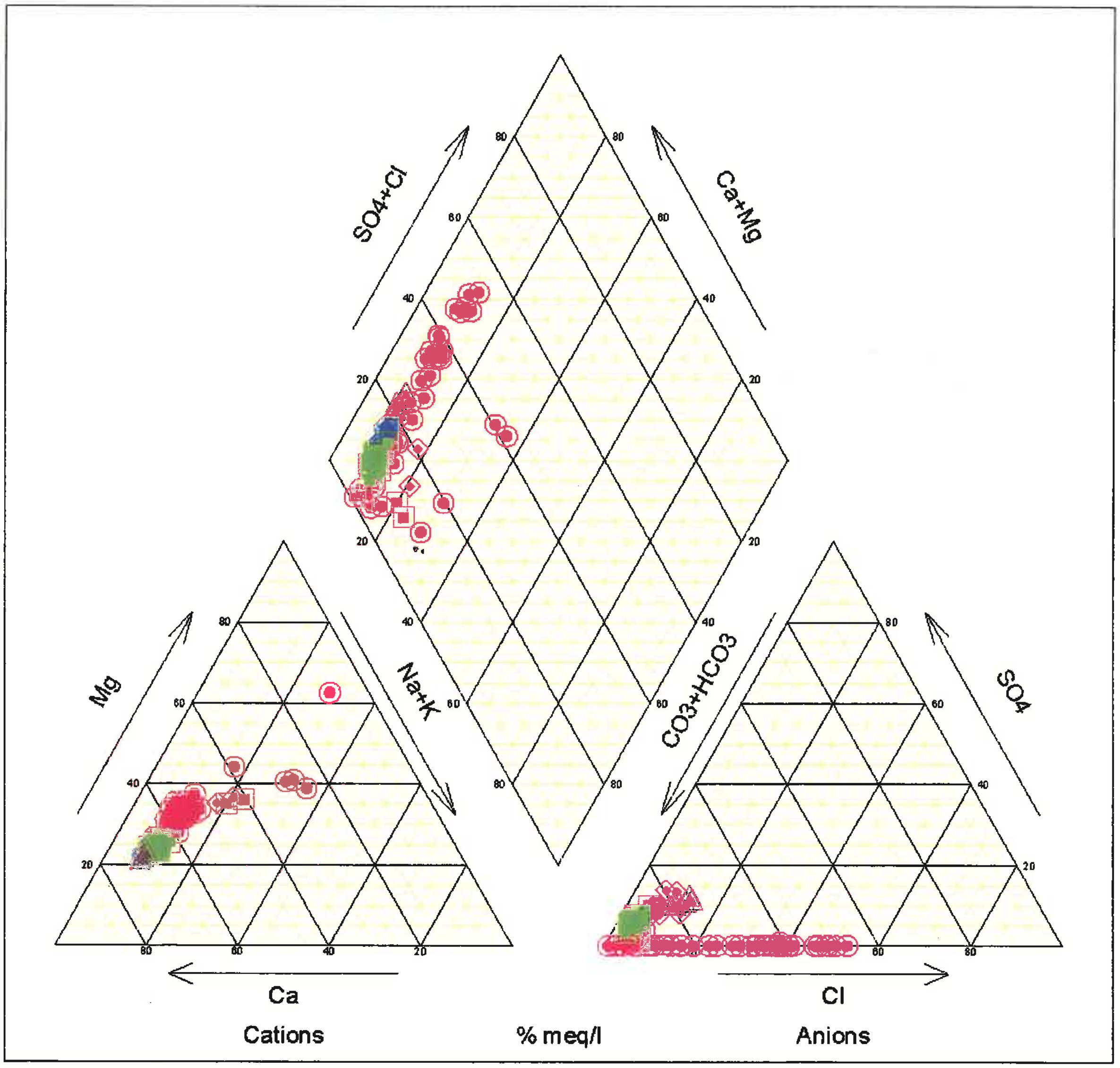
HORN RAPIDS LANDFILL

FIGURE 22

VINYL CHLORIDE ISOCONCENTRATION MAP
MARCH 2002

Figure 3-1

Piper (Trilinear) Diagram Showing Ionic Chemistry of MW05, MW06 and MW07 Groundwater Samples and Lysimeter LIquid Samples Horn Rapids Landfill



●	port 1	5/18/1994 - 6/08/1994
●	port 1	10/13/1994
●	port 1	2/22/1995 - 3/01/1995
●	port 1	8/15/1996 - 9/12/1996
●	port 1	4/15/1997
●	port 1	9/23/1997
●	port 1	4/08/1998
●	port 1	10/21/1998 - 11/16/1998
●	port 1	12/21/1999 - 1/11/2000
●	port 1	1/11/2000 - 2/08/2000
●	port 1	11/08/2000 - 12/05/2000
●	port 1	6/18/2001
●	port 1	12/05/2001 - 12/18/2001
●	port 2	2/22/1995 - 3/01/1995
●	port 2	7/19/1995 - 7/21/1995
●	port 2	8/15/1996 - 9/12/1996
●	port 2	4/15/1997
●	port 2	9/23/1997
●	port 3	8/15/1996 - 9/12/1996
●	port 3	4/15/1997
●	port 3	9/23/1997
●	port 3	4/08/1998
●	port 3	10/21/1998 - 11/16/1998
●	port 3	6/29/1999
●	port 3	12/21/1999 - 1/11/2000
●	port 3	1/11/2000 - 2/08/2000
●	port 3	11/08/2000 - 12/05/2000
●	port 3	6/18/2001
●	port 3	12/05/2001 - 12/18/2001
●	port 4	5/18/1994 - 6/08/1994
●	port 4	10/13/1994
●	port 4	2/22/1995 - 3/01/1995
●	port 4	7/19/1995 - 7/21/1995
●	port 4	8/15/1996 - 9/12/1996
●	port 4	4/15/1997
●	port 4	9/23/1997
●	port 4	4/08/1998
●	port 4	6/29/1999
●	port 4	12/21/1999 - 1/11/2000
●	port 4	1/11/2000 - 2/08/2000
●	port 4	11/08/2000 - 12/05/2000
●	port 4	6/18/2001
●	port 4	12/05/2001 - 12/18/2001
◆	MW05	5/18/1998
◆	MW05	6/30/1998 - 7/07/1998
◆	MW05	8/10/1998
◆	MW05	10/21/1998 - 11/16/1998
◆	MW05	1/26/1999
◆	MW05	5/12/1999
◆	MW05	10/05/1999
◆	MW05	12/21/1999 - 1/11/2000
◆	MW05	1/11/2000 - 2/08/2000
◆	MW05	5/16/2000
◆	MW05	8/30/2000
◆	MW05	11/08/2000 - 12/05/2000
◆	MW05	3/20/2001 - 4/10/2001
◆	MW05	7/25/2001
◆	MW05	10/16/2001
◆	MW05	12/05/2001 - 12/18/2001
◆	MW05	3/20/2002
◆	MW05	7/03/2002
◆	MW05	10/15/2002
◆	MW05	12/17/2002 - 12/31/2002
◆	MW05	3/26/2003
◆	MW05	6/11/2003
🟩	MW06	5/18/1998
🟩	MW06	6/30/1998 - 7/07/1998
🟩	MW06	8/10/1998
🟩	MW06	10/21/1998 - 11/16/1998
🟩	MW06	1/26/1999
🟩	MW06	5/12/1999
🟩	MW06	10/06/1999
🟩	MW06	12/21/1999 - 1/11/2000
🟩	MW06	1/11/2000 - 2/08/2000
🟩	MW06	5/16/2000
🟩	MW06	8/30/2000
🟩	MW06	11/08/2000 - 12/05/2000
🟩	MW06	3/20/2001 - 4/10/2001
🟩	MW06	7/26/2001
🟩	MW06	10/16/2001
🟩	MW06	12/05/2001 - 12/18/2001
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🟩	MW06	10/15/2002
🟩	MW06	12/17/2002 - 12/31/2002
🟩	MW06	3/26/2003
🟩	MW06	6/11/2003
▲	MW07	3/20/2001 - 4/10/2001
▲	MW07	7/25/2001
▲	MW07	10/16/2001
▲	MW07	12/05/2001 - 12/18/2001
▲	MW07	7/03/2002
▲	MW07	3/26/2003
▲	MW07	6/11/2003

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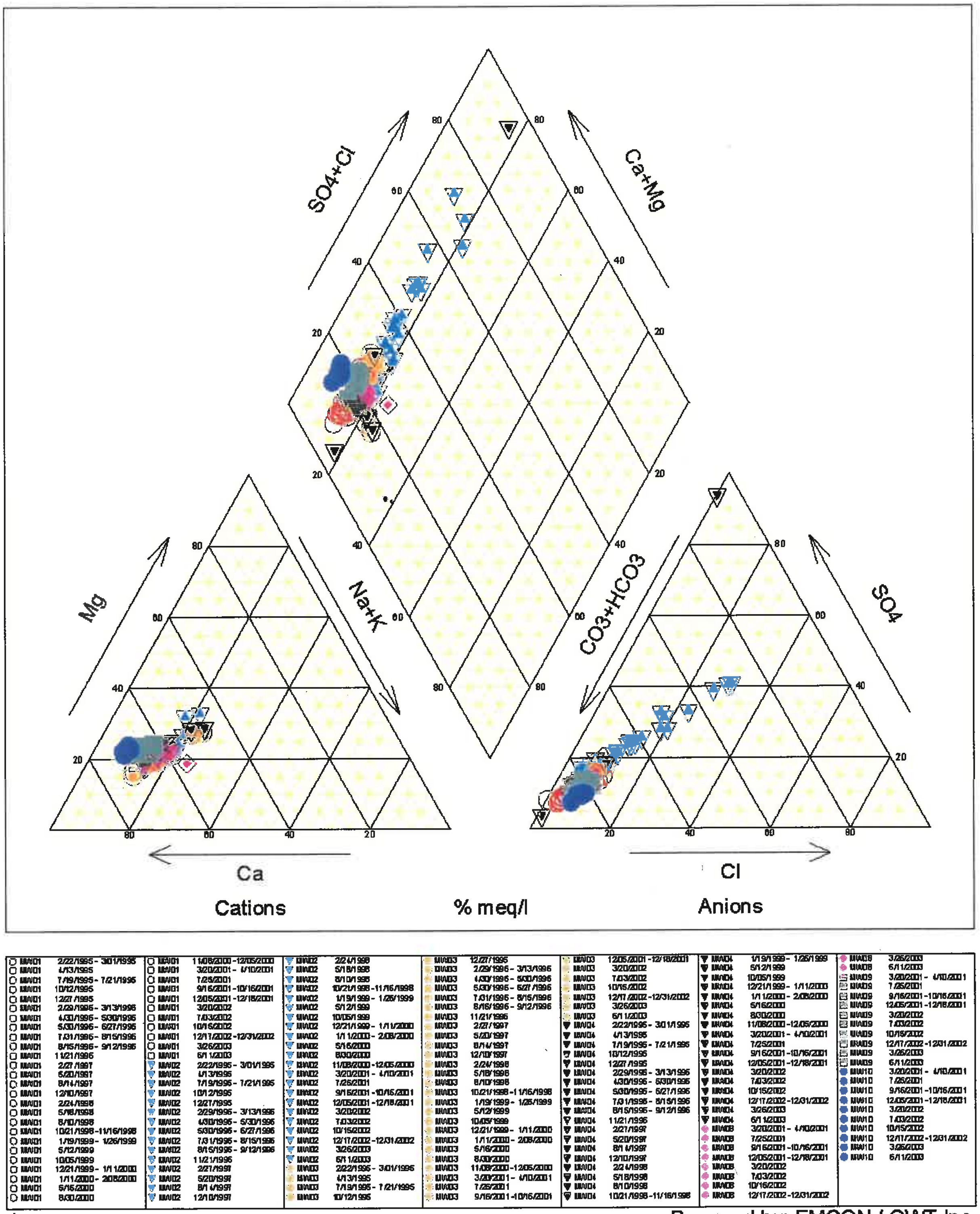
Figure 3-2
Trilinear (Piper) Diagram Showing Ionic Chemistry of MW01, MW02, MW03, MW04, MW08, MW09 and MW10 Groundwater Samples
Horn Rapids Landfill



Prepared by: EMCON / OWT, Inc.

E-2

2004 Pilot Study

Table 1
Estimates of Volatile Organic Comounds Mass Removal

Parameter	EX-1 ($\mu g/m^3$)	Duplicate ($\mu g/m^3$)	Single Gas Well[a] (lbs/day)	GCCS[b] (lbs/day)
Vinyl chloride	4300	4900	0.0101	0.0264
Acetone	3700	3300	0.0077	0.0200
2-Butanone (MEK)	13000	11000	0.0269	0.0701
cis-1,2-Dichloroethene	7000	6900	0.0145	0.0378
Benzene	1000	1000	0.0021	0.0054
Trichloroethene	1600	1600	0.0033	0.0086
4-Methyl-2-pentanone	950	850	0.0020	0.0051
Toluene	28000	28000	0.0579	0.1511
Tetrachloroethene	1100	1200	0.0025	0.0065
Ethylbenzene	7600	7800	0.0161	0.0421
m,p-Xylene	13000	13000	0.0269	0.0701
o-Xylene	3000	3100	0.0064	0.0167
Total VOCs lbs/day			**0.1763**	**0.4599**
Total VOCs lbs/year			**64.35**	**167.9**

NOTE:

$\mu g/m^3$ = micrograms per meter cubed; lbs/day = pounds per day; lbs/year = pounds per year; VOCs = volatile organic comounds; (µg/m3) is equal to 1/1000th of a part per billion in water.

[a] Assumes a flowrate of 23 standard cubic feet per minute (scfm).

[b] Assumes a flowrate of 60 scfm.

Appendix F

Push Probe Groundwater Study

Table F-1. Preliminary Chemicals of Concern, Horn Rapids Landfill

Parameter	Units	GWQS	MCL	Highest 2017 Concentration Observed at City Facility Boundary (Parametrix 2018)	Monitoring Well
Bromodichloromethane	µg/L	0.3	80	0.83	MW-8
Chloroform	µg/L	7	80	11	MW-8
1,1-Dichloroethane (1,1-DCA)	µg/L	1	NA	4.0	MW-4
Tetrachloroethene (PCE)	µg/L	0.8	5	12	MW-9
Trichloroethene (TCE)	µg/L	3	5	5.8	MW-9
Vinyl Chloride (VC)	µg/L	0.02	2	0.053	MW-9

Table F-2. Push Probe Groundwater Laboratory Duplicate Analyses, Horn Rapids Landfill

		VOCs	Natural Attenuation Parameters (methane, ethane, ethene)	
Push Probe Location	**Sample Date**	**TestAmerica**	**Energy Northwest**	**TestAmerica**
PP-1	11-15-17	x	x	
PP-2	11-07-17			
PP-3	11-09-17	x		x
PP-4	11-13-17	x		
PP-5	11-16-17			

Table F-3. Push Probe Monitoring Results, Volatile Organic Compounds, Horn Rapids Landfill

						Push Probe Samples								**Trip Blanks**					
						PP-1	**PP-1**	**PP-2**	**PP-3**	**PP-3**	**PP-4**	**PP-4**	**PP-5**	**PP-1 TB**	**PP-2 TB**	**PP-3 TB**	**PP-4 TB**	**PP-5 TB**	
Analyte	**Units**	**GWQS**		**MCL**		**Energy Northwest 11/15/2017**	**Test America 11/15/2017**	**Energy Northwest 11/7/2017**	**Energy Northwest 11/9/2017**	**Test America 11/9/2017**	**Energy Northwest 11/13/2017**	**Test America 11/13/2017**	**Energy Northwest 11/16/2017**	**Energy Northwest 11/15/2017**	**Energy Northwest 11/7/2017**	**Energy Northwest 11/9/2017**	**Energy Northwest 11/13/2017**	**Energy Northwest 11/16/2017**	**Test America 11/9/2017**
1,1,1,2-Tetrachloroethane	µg/L					<0.5	<0.20	<0.5	<0.5	<0.20	<0.5	<0.20	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.20
1,1,1-Trichloroethane	µg/L	200	*	200	*	<0.5	<0.20	<0.5	<0.5	<0.20	<0.5	<0.20	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.20
1,1,2,2-Tetrachloroethane	µg/L					<0.5	<0.20	<0.5	<0.5	<0.20	<0.5	<0.20	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.20
1,1,2-Trichloroethane	µg/L			5	*	<0.5	<0.20	<0.5	<0.5	<0.20	<0.5	<0.20	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.20
1,1-Dichloroethane	µg/L	1	***			**4.8**	**5.3**	**1.1**	0.74	0.85	<0.5	0.35	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.20
1,1-Dichloroethene	µg/L			7	*	<0.5	<0.10	<0.5	<0.5	<0.10	<0.5	<0.10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.10
1,1-Dichloropropene	µg/L					<0.5	NA	<0.5	<0.5	NA	<0.5	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NA
1,2,3-Trichlorobenzene	µg/L					<0.5	NA	<0.5	<0.5	NA	<0.5	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NA
1,2,3-Trichloropropane	µg/L					<0.5	<0.20	<0.5	<0.5	<0.20	<0.5	<0.20	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.20
1,2,4-Trichlorobenzene	µg/L					<0.5	NA	<0.5	<0.5	NA	<0.5	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NA
1,2,4-Trimethylbenzene	µg/L					<0.5	NA	<0.5	<0.5	NA	<0.5	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NA
1,2-Dibromo-3-Chloropropane	µg/L			0.2	*	<0.5	<2.0	<0.5	<0.5	<2.0	<0.5	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0
1,2-Dibromoethane	µg/L	0.001	***	0.05	*	<0.5	<0.10	<0.5	<0.5	<0.10	<0.5	<0.10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.10
1,2-Dichlorobenzene	µg/L			600	*	<0.5	<0.30	<0.5	<0.5	<0.30	<0.5	<0.30	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.30
1,2-Dichloroethane	µg/L	0.5	***	5	*	<0.5	<0.20	<0.5	<0.5	<0.20	<0.5	<0.20	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.20
1,2-Dichloropropane	µg/L	0.6	***	5	*	<0.5	0.20	<0.5	<0.5	<0.20	<0.5	<0.20	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.20
1,3,5-Trimethylbenzene	µg/L					<0.5	NA	<0.5	<0.5	NA	<0.5	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NA
1,3-Dichlorobenzene	µg/L					<0.5	NA	<0.5	<0.5	NA	<0.5	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NA
1,3-Dichloropropane	µg/L					<0.5	NA	<0.5	<0.5	NA	<0.5	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NA
1,4-Dichlorobenzene	µg/L	4	***	75	*	<0.5	<0.30	<0.5	<0.5	<0.30	<0.5	<0.30	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.30
2,2-Dichloropropane	µg/L					<0.5	NA	<0.5	<0.5	NA	<0.5	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NA
2-Butanone (MEK)	µg/L					<4	<15	6.9	<4	<15	7.8	<15	<4	<4	<4	<4	<4	<4	<15
2-Chlorotoluene	µg/L					<0.5	NA	<0.5	<0.5	NA	<0.5	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NA
2-Hexanone	µg/L					<4	<2.0	<4	<4	<2.0	<4	<2.0	<4	<4	<4	<4	<4	<4	<2.0
4-Chlorotoluene	µg/L					<0.5	NA	<0.5	<0.5	NA	<0.5	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NA
4-Methyl-2-pentanone (MIBK)	µg/L					<4	<5.0	<4	<4	<5.0	<4	<5.0	<4	<4	<4	<4	<4	<4	<5.0
Acetone	µg/L					4.5	5.0	46	8.8 J	<2.0 J	39	32	11	<4	<4	<4	<4	<4	<2.0
Acetonitrile	µg/L					<20	NA	<20	<20	NA	<20	NA	<20	<20	<20	<20	<20	<20	NA
Acrolein	µg/L					<10	NA	<10	<10	NA	<10	NA	<10	<10	<10	<10	<10	<10	NA
Acrylonitrile	µg/L	0.07	***			<0.5	<5.0	<0.5	<0.5	<5.0	<0.5	<5.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<5.0
Allyl chloride	µg/L					<0.5	NA	<0.5	<0.5	NA	<0.5	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NA
Benzene	µg/L	1	***	5	*	<0.5	<0.20	0.53	<0.5	0.25	<0.5	<0.20	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.20
Bromobenzene	µg/L					<0.5	NA	<0.5	<0.5	NA	<0.5	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NA
Bromochloromethane	µg/L					<0.5	<0.20	<0.5	<0.5	<0.20	<0.5	<0.20	<0.3	<0.5	<0.5	<0.5	<0.5	<0.3	<0.20
Bromodichloromethane	µg/L	0.3	***	80	* THM	<0.3	<0.20	<0.3	<0.3	<0.20	<0.3	<0.20	<0.5	<0.3	<0.3	<0.3	<0.3	<0.5	<0.20
Bromoform	µg/L	5	***	80	* THM	<0.5	<0.50	<0.5	<0.5	<0.50	<0.5	<0.50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.50

Table F-3. Push Probe Monitoring Results, Volatile Organic Compounds, Horn Rapids Landfill (continued)

						Push Probe Samples								Trip Blanks					
						PP-1	**PP-1**	**PP-2**	**PP-3**	**PP-3**	**PP-4**	**PP-4**	**PP-5**	**PP-1 TB**	**PP-2 TB**	**PP-3 TB**	**PP-4 TB**	**PP-5 TB**	
						Energy Northwest	**Test America**	**Energy Northwest**	**Energy Northwest**	**Test America**	**Energy Northwest**	**Test America**	**Energy Northwest**	**Energy Northwest**	**Energy Northwest**	**Energy Northwest**	**Energy Northwest**	**Energy Northwest**	**Test America**
Analyte	**Units**	**GWQS**		**MCL**		**11/15/2017**	**11/15/2017**	**11/7/2017**	**11/9/2017**	**11/9/2017**	**11/13/2017**	**11/13/2017**	**11/16/2017**	**11/15/2017**	**11/7/2017**	**11/9/2017**	**11/13/2017**	**11/16/2017**	**11/9/2017**
Bromomethane	µg/L					<0.5	<1.0	<0.5	<0.5	<1.0	<0.5	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1.0
Carbon Disulfide	µg/L					<0.5	0.20	<0.5	<0.5	0.53	<0.5	<0.20	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.20
Carbon Tetrachloride	µg/L	0.3	***	5	*	<0.3	<0.20	<0.3	<0.3	<0.20	<0.3	<0.20	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.20
Chlorobenzene	µg/L			100	*	<0.5	<0.20	<0.5	<0.5	<0.20	<0.5	<0.20	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.20
Chloroethane	µg/L					<0.5	<0.50	<0.5	<0.5	<0.50	<0.5	<0.50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.50
Chloroform	µg/L	7	***	80	* THM	<0.5	<0.20	<0.5	<0.5	0.41	<0.5	<0.20	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.20
Chloromethane	µg/L					<0.5	<0.30	<0.5	<0.5	<0.30	<0.5	<0.30	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.30
Chloroprene	µg/L					<1	NA	<1	<1	NA	<1	NA	<1	<1	<1	<1	<1	<1	NA
cis-1,2-Dichloroethene	µg/L			70	*	28	26	<0.5	0.67	0.7	<0.5	<0.20	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.20
cis-1,3-Dichloropropene	µg/L					<0.5	<0.50	<0.5	<0.5	<0.50	<0.5	<0.50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.50
Dibromochloromethane	µg/L			80	* THM	<0.5	<0.20	<0.5	<0.5	<0.20	<0.5	<0.20	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.20
Dibromomethane	µg/L					<0.5	<0.20	<0.5	<0.5	<0.20	<0.5	<0.20	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.20
Dichlorodifluoromethane	µg/L					<0.5	NA	0.88	0.68	NA	0.53	NA	1.0	<0.5	<0.5	<0.5	<0.5	<0.5	NA
Ethyl methacrylate	µg/L					<0.5	NA	<0.5	<0.5	NA	<0.5	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NA
Ethylbenzene	µg/L			700	*	<0.5	<0.20	<0.5	<0.5	<0.20	<0.5	<0.20	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.20
Hexachlorobutadiene	µg/L					<0.5	NA	<0.5	<0.5	NA	<0.5	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NA
Iodomethane	µg/L					<4	<0.50	<4	<4	<0.50	<4	<0.50	<4	<4	<4	<4	<4	<4	<0.50
Isobutyl alcohol	µg/L					<20	NA	<20	<20	NA	<20	NA	<20	<20	<20	<20	<20	<20	NA
Isopropylbenzene	µg/L					<0.5	NA	<0.5	<0.5	NA	<0.5	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NA
m,p-Xylene	µg/L					<0.5	<0.50	<0.5	<0.5	<0.50	<0.5	<0.50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.50
Methacrylonitrile	µg/L					<2	NA	<2	<2	NA	<2	NA	<2	<2	<2	<2	<2	<2	NA
Methyl methacrylate	µg/L					<0.5	NA	<0.5	<0.5	NA	<0.5	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NA
Methylene Chloride	µg/L	5	***	5	*	<0.5	<0.50	<0.5	<0.5	<0.50	<0.5	<0.50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.50
Methyl-t-butyl ether	µg/L					<0.5	NA	<0.5	<0.5	NA	<0.5	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NA
Naphthalene	µg/L					<0.5	NA	0.70	<0.5	NA	<0.5	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NA
n-Butylbenzene	µg/L					<0.5	NA	<0.5	<0.5	NA	<0.5	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NA
n-Propylbenzene	µg/L					<0.5	NA	<0.5	<0.5	NA	<0.5	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NA
o-Xylene	µg/L					<0.5	<0.50	<0.5	<0.5	<0.50	<0.5	<0.50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.50
p-isopropyltoluene	µg/L					<0.5	NA	<0.5	<0.5	NA	<0.5	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NA
Propionitrile	µg/L					<2	NA	<2	<2	NA	<2	NA	<2	<2	<2	<2	<2	<2	NA
sec-Butylbenzene	µg/L					<0.5	NA	<0.5	<0.5	NA	<0.5	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NA
Styrene	µg/L			100	*	<0.5	<0.50	<0.5	<0.5	<0.50	<0.5	<0.50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.50
tert-Butylbenzene	µg/L					<0.5	NA	<0.5	<0.5	NA	<0.5	NA	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NA
Tetrachloroethene	µg/L	0.8	***	5	*	**4.1 J**	**6.2 J**	<0.5	<0.5	<0.50	<0.5	<0.50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.50
Toluene	µg/L			1000	*	<0.5	<0.20	<0.5	<0.5	0.22	<0.5	<0.20	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.20
trans-1,2-Dichloroethene	µg/L			100	*	0.95	0.86	<0.5	<0.5	<0.20	<0.5	<0.20	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.20

Table F-3. Push Probe Monitoring Results, Volatile Organic Compounds, Horn Rapids Landfill (continued)

						Push Probe Samples								**Trip Blanks**					
						PP-1	**PP-1**	**PP-2**	**PP-3**	**PP-3**	**PP-4**	**PP-4**	**PP-5**	**PP-1 TB**	**PP-2 TB**	**PP-3 TB**	**PP-4 TB**	**PP-5 TB**	
Analyte	**Units**	**GWQS**		**MCL**		**Energy Northwest 11/15/2017**	**Test America 11/15/2017**	**Energy Northwest 11/7/2017**	**Energy Northwest 11/9/2017**	**Test America 11/9/2017**	**Energy Northwest 11/13/2017**	**Test America 11/13/2017**	**Energy Northwest 11/16/2017**	**Energy Northwest 11/15/2017**	**Energy Northwest 11/7/2017**	**Energy Northwest 11/9/2017**	**Energy Northwest 11/13/2017**	**Energy Northwest 11/16/2017**	**Test America 11/9/2017**
trans-1,3-Dichloropropene	µg/L					<0.5	<0.20	<0.5	<0.5	<0.20	<0.5	<0.20	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.20
trans-1,4-Dichloro-2-butene	µg/L					<0.5	<2.0	<0.5	<0.5	<2.0	<0.5	<2.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.0
Trichloroethene	µg/L	3	***	5	*	**4.9**	**5.0**	<0.5	<0.5	<0.20	<0.5	<0.20	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.20
Trichlorofluoromethane	µg/L					<0.5	<0.50	<0.5	<0.5	<0.50	<0.5	<0.50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.50
Vinyl Acetate	µg/L					<2	<1.0	<2	<2	<1.0	<2	<1.0	<2	<2	<2	<2	<2	<2	<1.0
Vinyl Chloride	µg/L	0.02	***	2	*	<0.5	<0.020	<0.5	<0.5	<0.020	<0.5	<0.020	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.020
1,2-Dibromo-3-chloropropane	µg/L					<0.05	NA	<0.05	<0.05	NA	<0.05	NA	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NA
1,2-Dibromoethane	µg/L	0.001	***	0.05	*	<0.001	NA	<0.001	<0.001	NA	<0.001	NA	<0.001	<0.001	**0.0033**	**0.0020**	**0.0017**	<0.001	NA
Acrylonitrile	µg/L	0.07	***			<0.02	NA	0.0207	0.0438	NA	<0.02	NA	**0.0705**	<0.02	<0.02	<0.02	<0.02	<0.02	NA
Vinyl chloride	µg/L	0.02	***	2	*	**0.3481 J**	NA	0.0052	0.0087	NA	<0.005	NA	<0.02	<0.02	<0.005	<0.005	<0.005	<0.02	NA
Total Xylenes	µg/L			10000	* XYL	NA	<0.50	NA	NA	<0.50	NA	<0.50	NA	NA	NA	NA	NA	NA	<0.50

Notes: GWQS = Water Quality Standards for Ground Waters of the State of Washington (WAC 173-200)
MCL = Maximum Contaminant Level, State Drinking Water Regulations (WAC 246-290)
* = Primary
*** = Carcinogen
*THM = Primary MCL for the sum of all trihalomethanes
*XYL = Primary MCL for the sum of all xylenes
Bold = Does not meet GWQS or MCL
NA = Not analyzed
J = Estimated concentration (See data validation memorandum)

Table F-4. Push Probe Monitoring Results, Natural Attenuation Parameters, Horn Rapids Landfill

		PP-1	**PP-1**	**PP-2**	**PP-3**	**PP-3 Dup**	**PP-4**	**PP-5**	**Trip Blank**
		ALS Environmental	**Test America**	**ALS Environmental**	**ALS Environmental**	**ALS Environmental**	**ALS Environmental**	**ALS Environmental**	**Test America**
Analyte	**Units**	**11/15/2017**	**11/15/2017**	**11/7/17**	**11/9/17**	**11/9/17**	**11/13/2017**	**11/16/2017**	**11/9/2017**
Methane	µg/L	2.6 J	7.5 J	8.1	19	23	4.0	13	<1.2
Ethane	µg/L	0.68	<10	2.2	6.1	7.3	1.3	3.4	<10
Ethene	µg/L	<1.0	<10	2.6	4.9	5.7	1.2	3.0	<10

Notes:

J = Estimated concentration (see Data validation memorandum)

Table F-5. Push Probe Monitoring Results, Field Data, Horn Rapids Landfill

				PP-1	**PP-2**	**PP-3**	**PP-4**	**PP-5**
Analyte	**Units**	**GWQS**	**MCL**	**11/15/2017**	**11/7/2017**	**11/9/2017**	**11/13/2017**	**11/16/2017**
Conductivity	µmhos/cm		700 **	**1092**	551	370	500	492
pH	units	6.5-8.5		7.02	7.58	**8.63**	8.26	8.41
Temperature	C°			11.58	10.70	10.68	9.13	10.10
Redox	mv			-59.6	-186.9	-185.9	-46.4	-199.3
Dissolved Oxygen	mg/L			2.37	1.45	0.94	3.11	0.39

Notes:

GWQS = Water Quality Standards for Ground Waters of the State of Washington (WAC 173-200)
MCL = Maximum Contaminant Level, State Drinking Water Regulations (WAC 246-290)
** = Secondary
Bold = Does not meet GWQS or MCL

Table F-6. Push Probe Construction and Groundwater Level Information, Horn Rapids Landfill

Push Probe	Northing	Easting	Installation Date	Ground Surface Elevation (ft NAVD88)	Total Depth (ft bgs)	Depth of Screened Interval (ft bgs)	Final Depth to Groundwater (ft bgs)	Final Groundwater Elevation (ft NAVD88)
PP-1	370136.48	1932732.48	11/15/17	485.83	116	103-113	98.84	386.99
PP-2	369722.92	1933633.14	11/07/17	486.54	111	100.4-110.4	101.68	384.86
PP-3	369779.73	1934183.53	11/09/17	474.80	108	90.5-100.5	90.60	384.20
PP-4	369636.95	1933012.80	11/13/17	481.26	105.4	95-105	95.72	385.54
PP-5	370047.88	1934744.04	11/16/17	453.60	89.3	79-89	67.80	385.80

Table F-7. Groundwater Monitoring Well and Push Probe Results for Selected VOCs used in Isoconcentration Maps, Horn Rapids Landfill, 2017

				Groundwater Samples										Push Probe Samples				
				MW-1	**MW-2**	**MW-3**	**MW-4**	**MW-5**	**MW-6**	**MW-8**	**MW-9**	**MW-10**	**MW-11**	**PP-1**	**PP-2**	**PP-3**	**PP-4**	**PP-5**
	Units	**GWQS**	**MCL**	**11/14/2017**	**11/15/2017**	**11/15/2017**	**11/15/2017**	**11/15/2017**	**11/15/2017**	**11/14/2017**	**11/14/2017**	**11/14/2017**	**11/14/2017**	**11/15/2017**	**11/7/2017**	**11/9/2017**	**11/13/2017**	**11/16/2017**
1,1-Dichloroethane	µg/L	1 ***		<0.20	<0.20	0.48	**4.0**	**7.7**	**4.5**	<0.20	**3.9**	**9.4**	<0.20	**4.8**	**1.1**	0.74	<0.5	<0.5
cis-1,2-Dichloroethene	µg/L		70 *	<0.20	<0.20	0.43	2.7	30	55	<0.20	13	17	<0.20	28	<0.5	0.67	<0.5	<0.5
Tetrachloroethene	µg/L	0.8 ***	5 *	0.73	<0.50	<0.50	<0.50	**11**	**24**	<0.50	**9.6**	**5.8**	<0.50	**4.1**	<0.5	<0.5	<0.5	<0.5
Trichloroethene	µg/L	3 ***	5 *	<0.20	<0.20	<0.20	<0.20	**5.1**	**13**	<0.20	**4.8**	**3.1**	<0.20	**4.9**	<0.5	<0.5	<0.5	<0.5
Vinyl Chloride	µg/L	0.02 ***	2 *	<0.020	<0.020	<0.020	<0.020	**4.5**	**3.3**	<0.020	<0.020	**1.0**	<0.020	**0.3481**	0.0052	0.0087	<0.005	<0.02

Notes:

GWQS = Water Quality Standards for Ground Waters of the State of Washington (WAC 173-200)
MCL = Maximum Contaminant Level, State Drinking Water Regulations (WAC 246-290)
* = Primary
*** = Carcinogen
Bold = Does not meet GWQS or MCL

Table F-8. November 2017 Concentrations of COCs (µg/L) with Distance from the Landfill along Groundwater Flow Paths, Horn Rapids Landfill

Flow Path	Monitoring Well or Probe	Approximate Distance from Landfill (ft)	1-1 DCA (GWQS 1.0)	TCE (GWQS 3.0)	PCE (GWQS 0.8)	VC (GWQS 0.02)
1	PP-1*	450	4.8	4.9	4.1	0.35[1]
	PP-4	950	<0.5	<0.5	<0.5	<0.005
2	MW-9*	500	3.9	4.8	9.6	<0.02
	PP-2	950	1.1	<0.5	<0.5	0.005
3	MW-6*	50	4.5	13	24	3.3
	MW-8*	900	<0.2	<0.2	<0.5	<0.02
	PP-3	1250	0.74	<0.5	<0.5	0.009
4	MW-10*	50	9.4	3.1	5.8	1.0
	MW-5*	50	7.7	5.1	11	4.5
	MW-4*	1250	4.0	<0.2	<0.5	<0.02
	PP-5	1600	<0.5	<0.5	<0.5	<0.02

* Within City Facility

[1] Estimated concentration; result for duplicate samples was less than 0.02 µg/L

Shading indicates concentration exceeds GWQS

Appendix G

Groundwater Quality Data

G-1

Groundwater Quality Summary Tables

Table G-1. Groundwater Quality Monitoring Results, First Quarter 2014, Horn Rapids Landfill

	Analyte		Units	GWQS	MCL	UTL	MW-1 3/26/2014	MW-2 3/26/2014	MW-3 3/26/2014	MW-4 3/26/2014	MW-21 (MW-4 Dup) 3/26/2014	MW-5 3/26/2014	MW-6 3/26/2014	MW-8 3/26/2014	MW-9 3/26/2014	MW-10 3/26/2014	MW-11 3/26/2014	W-1 3/25/2014	Trip Blank 3/26/2014
FIELD DATA	Conductivity		μmhos/cm		700 **	1048	**933.0**	**1051**	585.0	430.0	NA	**1134**	**1066**	506	**855.0**	**1310**	**1295**	548.0	NA
	pH		units	6.5-8.5		6.65-7.67	7.18	7.56	7.79	7.74	NA	6.66	6.58	7.78	7.03	6.58	7.29	7.46	NA
	Temperature		C°			31.5	20.65	20.83	21.97	19.55	NA	22.15	21.96	20.55	18.84	18.14	20.28	20.64	NA
	Redox		mv				100	127	135	140	NA	-56	1	81	46	73	171	220	NA
	Dissolved Oxygen		mg/L				5.36	7.24	7.14	4.29	NA	0.76	0.83	8.72	3.03	0.83	8.31	5.54	NA
WATER QUALITY PARAMETERS	Nitrate-Nitrogen		mg/L as N	10 *	10 *	14.1	8.6	**44**	6.0	2.2	2.2	3.2	2.0	5.8	3.3	4.1	**31 H**	3.7	NA
	Calcium	Dissolved	mg/L			163	120	130	79	58	59	170	150	60	120	200	180	63	NA
		Total	mg/L				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sodium	Dissolved	mg/L			29	22	19	16	12	12	19	21	17	21	21	17	26	NA
		Total	mg/L				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Bicarbonate Alkalinity		mg/L as CaCO3			432	360	130	180	190	190	520	530	110	370	630	190	190	NA
	Chloride		mg/L	250 **	250 **	46	27	56	30	10	10	44	19	52	26	30	110	18	NA
	Magnesium	Dissolved	mg/L			32	23	27	15	12	13	37	36	12	26	41	37	14	NA
		Total	mg/L				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Potassium	Dissolved	mg/L			9.7	8.1	8.1	7.4	5.8	5.9	11	11	6.5	8.7	12	11	5.6	NA
		Total	mg/L				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Sulfate		mg/L	250 **	250 **	68	49	120	54	21	21	52	45	44	51	65	160	36	NA
	Total Alkalinity		mg/L as CaCO3			431	360	130	180	190	190	520	530	110	370	630	190	190	NA
	Iron	Dissolved	mg/L	0.3 **	0.3 **	1.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	NA
		Total	mg/L	0.3 **	0.3 **		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Manganese	Dissolved	mg/L	0.05 **	0.05 **	0.15	<0.020	<0.020	<0.020	<0.020	<0.020	0.029	0.024	<0.020	<0.020	<0.020	<0.020	<0.020	NA
		Total	mg/L	0.05 **	0.05 **		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Ammonia-Nitrogen		mg/L as N			0.14	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	NA
	Total Organic Carbon		mg/L			6.8	1.8	1.9	<1.0	<1.0	<1.0	4.0	2.1	<1.0	1.8	3.0	1.6	<1.0	NA
	Total Dissolved Solids		mg/L	500 **	500 **	691	**570**	**720**	360	290	280	**720**	**680**	330	**530**	**830**	**900**	330	NA
METALS	Antimony	Dissolved	mg/L		6 *	0.0029	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	NA
		Total	mg/L		6 *		<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	NA
	Arsenic	Dissolved	mg/L	0.00005 ***	0.01 *	0.0085	**0.0042**	**0.003**	**0.0073**	**0.0045**	**0.0044**	**0.0022**	**0.0017**	**0.011**	**0.0022**	**0.0017**	**0.0047**	**0.0058**	NA
		Total	mg/L	0.00005 ***	0.01 *		**0.0045**	**0.0032**	**0.0076**	**0.0048**	**0.0047**	**0.0024**	**0.0020**	**0.012**	**0.0023**	**0.0018**	**0.0052**	**0.0062**	NA
	Barium	Dissolved	mg/L	1 *	2 *	0.081	0.059	0.071	0.034	0.034	0.035	0.110	0.095	0.044	0.070	0.110	0.097	0.059	NA
		Total	mg/L	1 *	2 *		0.065	0.075	0.036	0.037	0.037	0.120	0.100	0.048	0.074	0.120	0.100	0.062	NA
	Beryllium	Dissolved	mg/L		0.004 *	0.001	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	NA
		Total	mg/L		0.004 *		<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	NA
	Cadmium	Dissolved	mg/L	0.01 *	0.005 *	0.001	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	NA
		Total	mg/L	0.01 *	0.005 *		<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	NA
	Chromium	Dissolved	mg/L	0.05 *	0.1 *	0.061	0.0029	0.0018	0.0041	0.0014	0.0014	0.00083	<0.0004	0.0034	0.0015	0.00094	0.0036	0.0016	NA
		Total	mg/L	0.05 *	0.1 *		0.0059	0.012	0.0087	0.0020	0.0018	0.0013	0.00073	0.0082	0.0022	0.0018	0.0080	0.010	NA
	Cobalt	Dissolved	mg/L			0.013	0.011	<0.0004	0.0015	0.0018	0.0018	<0.0004	0.00076	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	NA
		Total	mg/L				0.016	0.0009	0.0043	0.0036	0.0031	<0.0004	0.0016	0.00051	<0.0004	<0.0004	<0.0004	<0.0004	NA
	Copper	Dissolved	mg/L	1 **		0.05	0.0014	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	0.0016	0.0014	<0.001	<0.001	<0.001	NA
		Total	mg/L	1 **			0.0014	0.0011	0.0015	<0.001	<0.001	0.0051	<0.001	0.0024	0.0015	<0.001	0.001	<0.001	NA
	Lead	Dissolved	mg/L	0.05 *		0.0018	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	NA
		Total	mg/L	0.05 *			0.00086	<0.0004	0.00042	<0.0004	<0.0004	0.00069	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	NA
	Nickel	Dissolved	mg/L		0.1 *	0.034	<0.003	**0.150**	<0.003	<0.003	<0.003	<0.003	<0.003	0.0048	<0.003	<0.003	<0.003	<0.003	NA
		Total	mg/L		0.1 *		<0.003	**0.200**	0.0046	<0.003	<0.003	<0.003	<0.003	0.0056	<0.003	<0.003	0.0036	0.0079	NA
	Selenium	Dissolved	mg/L	0.01 *	0.05 *	0.024	0.0017	0.002	0.0017	<0.001	<0.001	<0.001	<0.001	0.0018	<0.001	<0.001	0.0073	<0.001	NA
		Total	mg/L	0.01 *	0.05 *		0.0018	0.0024	0.0015	<0.001	<0.001	<0.001	<0.001	0.0018	<0.001	<0.001	0.008	<0.001	NA
	Silver	Dissolved	mg/L	0.05 *	0.1 **	0.03	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	NA
		Total	mg/L	0.05 *	0.1 **		<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	NA
	Thallium	Dissolved	mg/L		0.002 *	0.00006	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	NA
		Total	mg/L		0.002 *		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	NA
	Vanadium	Dissolved	mg/L			0.019	0.0089	0.0077	0.013	0.011	0.012	0.0069	0.0062	0.016	0.0072	0.0067	0.0094	0.011	NA
		Total	mg/L				0.0098	0.0082	0.014	0.013	0.012	0.0076	0.0072	0.018	0.0075	0.0073	0.011	0.013	NA
	Zinc	Dissolved	mg/L	5 **	5 **	0.06	0.005	<0.004	<0.004	<0.004	<0.004	0.018	<0.004	<0.004	0.0069	0.01	<0.004	<0.004	NA
		Total	mg/L	5 **	5 **		0.0053	<0.004	0.0048	<0.004	<0.004	0.030	<0.004	<0.004	0.0064	0.0082	<0.004	<0.004	NA

Table G-1. Groundwater Quality Monitoring Results, First Quarter 2014, Horn Rapids Landfill

	Analyte	Units	GWQS	MCL	UTL	MW-1 3/26/2014	MW-2 3/26/2014	MW-3 3/26/2014	MW-4 3/26/2014	MW-21 (MW-4 Dup) 3/26/2014	MW-5 3/26/2014	MW-6 3/26/2014	MW-8 3/26/2014	MW-9 3/26/2014	MW-10 3/26/2014	MW-11 3/26/2014	W-1 3/25/2014	Trip Blank 3/26/2014
VOLATILE ORGANIC COMPOUNDS	1,1,1,2-Tetrachloroethane	µg/L			1	<0.92	<0.92	<0.92	<0.92	<0.92	<0.92	<0.92	<0.92	<0.92	<0.92	<0.92	<0.92	<0.92
	1,1,1-Trichloroethane	µg/L	200 *	200 *	1	<0.73	<0.73	<0.73	<0.73	<0.73	<0.73	<0.73	<0.73	<0.73	<0.73	<0.73	<0.73	<0.73
	1,1,2,2-Tetrachloroethane	µg/L			1	<0.84	<0.84	<0.84	<0.84	<0.84	<0.84	<0.84	<0.84	<0.84	<0.84	<0.84	<0.84	<0.84
	1,1,2-Trichloroethane	µg/L		5 *	1	<0.57	<0.57	<0.57	<0.57	<0.57	<0.57	<0.57	<0.57	<0.57	<0.57	<0.57	<0.57	<0.57
	1,1-Dichloroethane	µg/L	1 ***		0.7	<1.6	<1.6	**2.4 J**	**2.6 J**	**3.0 J**	**8.0 J**	**6.9 J**	<1.6	**3.6 J**	**10**	<1.6	<1.6	<1.6
	1,1-Dichloroethene	µg/L		7 *	1	<0.91	<0.91	<0.91	<0.91	<0.91	<0.91	<0.91	<0.91	<0.91	<0.91	<0.91	<0.91	<0.91
	1,2,3-Trichloropropane	µg/L			1	<0.76	<0.76	<0.76	<0.76	<0.76	<0.76	<0.76	<0.76	<0.76	<0.76	<0.76	<0.76	<0.76
	1,2-Dibromo-3-chloropropane	µg/L		0.2 *	2	<0.77	<0.77	<0.77	<0.77	<0.77	<0.77	<0.77	<0.77	<0.77	<0.77	<0.77	<0.77	<0.77
	1,2-Dibromoethane	µg/L	0.001 ***	0.05 *	1	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31
	1,2-Dichlorobenzene	µg/L		600 *	1.17	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9	<1.9
	1,2-Dichloroethane	µg/L	0.5 ***	5 *	1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1
	1,2-Dichloropropane	µg/L	0.6 ***	5 *	1	<0.92	<0.92	<0.92	<0.92	<0.92	<0.92	<0.92	<0.92	<0.92	<0.92	<0.92	<0.92	<0.92
	1,4-Dichlorobenzene	µg/L	4 ***	75 *	1.11	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	2-Butanone	µg/L			35.7	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0
	2-Hexanone	µg/L			21.4	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5	<3.5
	4-Methyl-2-pentanone	µg/L			5	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0
	Acetone	µg/L			780	<3.2	<3.2	<3.2	<3.2	<3.2	<3.2	<3.2	<3.2	<3.2	<3.2	<3.2	<3.2	<3.2
	Acrylonitrile	µg/L	0.07 ***		3	<9.2	<9.2	<9.2	<9.2	<9.2	<9.2	<9.2	<9.2	<9.2	<9.2	<9.2	<9.2	<9.2
	Benzene	µg/L	1 ***	5 *	1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1
	Bromochloromethane	µg/L			0.5	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1
	Bromodichloromethane	µg/L	0.3 ***	100 * THM	1	<0.90	<0.90	<0.90	<0.90	<0.90	<0.90	<0.90	<0.90	<0.90	<0.90	<0.90	<0.90	<0.90
	Bromoform	µg/L	5 ***	100 * THM	1	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6
	Bromomethane	µg/L			4.2	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3
	Carbon disulfide	µg/L			1.3	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2
	Carbon tetrachloride	µg/L	0.3 ***	5 *	1	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3
	Chlorobenzene	µg/L		100 *	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Chloroethane	µg/L			1	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3
	Chloroform	µg/L	7 ***	100 * THM	3	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	**9.0**	<1.2	<1.2	<1.2	<1.2	<1.2
	Chloromethane	µg/L			2.7	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
	cis-1,2-Dichloroethene	µg/L		70 *	6	<1.1	<1.1	1.1 J	1.8 J	2.0 J	38	50	<1.1	8.8	14	<1.1	<1.1	<1.1
	cis-1,3-Dichloropropene	µg/L			1	<0.62	<0.62	<0.62	<0.62	<0.62	<0.62	<0.62	<0.62	<0.62	<0.62	<0.62	<0.62	<0.62
	Dibromochloromethane	µg/L		100 * THM	1	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5
	Dibromomethane	µg/L			1	<0.92	<0.92	<0.92	<0.92	<0.92	<0.92	<0.92	<0.92	<0.92	<0.92	<0.92	<0.92	<0.92
	Ethylbenzene	µg/L		700 *	1	<0.89	<0.89	<0.89	<0.89	<0.89	<0.89	<0.89	<0.89	<0.89	<0.89	<0.89	<0.89	<0.89
	Iodomethane	µg/L			3	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2
	Methylene chloride	µg/L	5 ***	5 *	5.4	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	**6.6**	<1.6	<1.6	<1.6
	m,p-Xylene	µg/L				<0.82	<0.82	<0.82	<0.82	<0.82	<0.82	<0.82	<0.82	<0.82	<0.82	<0.82	<0.82	<0.82
	o-Xylene	µg/L				<0.98	<0.98	<0.98	<0.98	<0.98	<0.98	<0.98	<0.98	<0.98	<0.98	<0.98	<0.98	<0.98
	Styrene	µg/L		100 *	1	<0.74	<0.74	<0.74	<0.74	<0.74	<0.74	<0.74	<0.74	<0.74	<0.74	<0.74	<0.74	<0.74
	Tetrachloroethene	µg/L	0.8 ***	5 *	7.5	**4.1 J**	<1.7	<1.7	<1.7	<1.7	**11**	**27**	<1.7	**6.7**	**4.6 J**	<1.7	<1.7	<1.7
	Toluene	µg/L		1000 *	1	<0.89	<0.89	<0.89	<0.89	<0.89	<0.89	<0.89	<0.89	<0.89	<0.89	<0.89	<0.89	<0.89
	trans-1,2-Dichloroethene	µg/L		100 *	1	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3	1.8 J	<1.3	<1.3	<1.3	<1.3	<1.3	<1.3
	trans-1,3-Dichloropropene	µg/L			1	<0.55	<0.55	<0.55	<0.55	<0.55	<0.55	<0.55	<0.55	<0.55	<0.55	<0.55	<0.55	<0.55
	trans-1,4-Dichloro-2-butene	µg/L			2	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
	Trichloroethene	µg/L	3 ***	5 *	0.53	<1.2	<1.2	<1.2	<1.2	<1.2	**6.4**	**16**	<1.2	**4.1 J**	**3.2 J**	<1.2	<1.2	<1.2
	Trichlorofluoromethane	µg/L			0.6	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
	Vinyl Acetate	µg/L			5	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Vinyl chloride	µg/L	0.02 ***	2 *	1	<0.77	<0.77	<0.77	<0.77	<0.77	**5.9**	**2.3**	<0.77	<0.77	**1.3 J**	<0.77	<0.77	<0.77
	Total Xylenes	µg/L		10000 * XYL	2	<0.82	<0.82	<0.82	<0.82	<0.82	<0.82	<0.82	<0.82	<0.82	<0.82	<0.82	<0.82	<0.82
NATURAL ATTENUATION PARAMETERS	Methane	µg/L				<1.2	<1.2	<1.2	<1.2	<1.2	1800	3900	<1.2	<1.2	1300	<1.2	<1.2	<1.2
	Ethane	µg/L				<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	Ethene	µg/L				<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

Table G-1. Groundwater Quality Monitoring Results, First Quarter 2014, Horn Rapids Landfill

Analyte	Units	GWQS	MCL	UTL	MW-1 3/26/2014	MW-2 3/26/2014	MW-3 3/26/2014	MW-4 3/26/2014	MW-21 (MW-4 Dup) 3/26/2014	MW-5 3/26/2014	MW-6 3/26/2014	MW-8 3/26/2014	MW-9 3/26/2014	MW-10 3/26/2014	MW-11 3/26/2014	W-1 3/25/2014	Trip Blank 3/26/2014

Notes:

GWQS = Water Quality Standards for Ground Waters of the State of Washington (WAC 173-200)
MCL = Maximum Contaminant Level, State Drinking Water Regulations (WAC 246-290)
UTL = Upper tolerance limit calculated using baseline data from upgradient well MW-1
* = Primary
** = Secondary
*** = Carcinogen
*THM = Primary MCL for the sum of all trihalomethanes
*XYL = Primary MCL for the sum of all xylenes
J = Estimated value; see lab report for details
H = Estimated value; analyzed beyond specified holding time
Bold = Does not meet GWQS or MCL
▨ = Exceeds Upper Tolerance Limit (UTL)
NA = Not analyzed

Table G-2. Groundwater Quality Data, Fourth Quarter 2018 through Second Quarter 2020, Horn Rapids Landfill

	Analyte	Units	GWQS	MCL	MW-1 11/28/2018	MW-1 3/20/2019	MW-1 6/12/2019	MW-1 9/4/2019	MW-1 12/16/2019	MW-1 3/24/2020	MW-1 6/17/2020	MW-2 11/28/2018	MW-2 3/21/2019	MW-2 6/12/2019	MW-2 9/4/2019	MW-21 (MW-2 9/4/2019	MW-2 12/17/2019	MW-2 3/24/2020	MW-2 6/17/2020
FIELD DATA	Conductivity	µmhos/cm		700 **	**890**	**953**	**784**	**742**	**888**	**942**	**938**	570.0	533.9	553	518.7	NA	583	590	579
	pH	units	6.5-8.5		7.12	7.17	7.05	7.23	7.26	7.16	7.15	7.56	7.70	7.46	7.69	NA	7.81	7.65	7.59
	Temperature	C°			20.5	20.0	22.1	21.8	20.8	20.7	21.6	19.1	20.4	21.0	21.0	NA	19.9	20.0	21.3
	Redox	mv			85.2	89.3	-10	14.0	100.4	177.6	199.4	104.4	41.6	-112.4	24.2	NA	146.7	275.6	207.3
	Dissolved Oxygen	mg/L			4.56	5.23	5.60	5.36	4.38	5.72	4.89	6.72	9.55	6.88	6.10	NA	6.01	7.93	7.03
WATER QUALITY PARAMETERS	Nitrate-Nitrogen	mg/L as N	10 *	10 *	2.9	9.8	7.5	6.8	8.6	**12**	1.7	**13**	**12**	**13**	**11**	**11**	**14**	**20**	**15**
	Calcium, Dissolved	mg/L			120	130	110	84	100	130	130	74	70	70	65	63	66	75	80
	Sodium, Dissolved	mg/L			23	24	20	17	21	23	24	15	14	12	12	12	14	14	16
	Bicarbonate Alkalinity	mg/L as CaCO3			310	350	270	210	310	310	330	110	110	120	120 H	110	110	120	110
	Chloride	mg/L	250 **	250 **	26	20	26	22	27	32	30	31	30	22	20	20	32	32	33
	Magnesium, Dissolved	mg/L			24	27	22	17	20	26	27	16	15	15	14	14	13	16	18
	Potassium, Dissolved	mg/L			8.8	9.0	7.4	6.5	7.5	8.4	8.2	6.7	6.3	5.6	5.7	5.5	6.0	6.3	6.5
	Sulfate	mg/L	250 **	250 **	53	39	52	49	55	59	57	73	68	58	55	55	73	77	74
	Total Alkalinity	mg/L as CaCO3			310	350	270	210	310	310	330	110	110	120	120 H	110	110	120	110
	Iron, Dissolved	mg/L	0.30 **	0.30 **	<0.50	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.50	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Manganese, Dissolved	mg/L	0.05 **	0.05 **	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Ammonia-Nitrogen	mg/L as N			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Total Organic Carbon	mg/L			1.5	1.4	1.1	<1.0	1.2	19	1.5	1.1	0.59	<1.0	<1.0	<1.0	<1.0	7.0	<1.5
	Total Dissolved Solids	mg/L	500 **	500 **	440	**570**	470	410	450	**560**	**510**	350	360	340	320	310	300	330	350
	Total Suspended Solids	mg/L			<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.8	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
METALS	Antimony, Total	mg/L		6 *	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00080	<0.00080	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00080	<0.00080
	Arsenic, Total	mg/L	0.00005 ***	0.01 *	**0.0038**	**0.0042**	**0.0056**	**0.0043**	**0.0038**	**0.0040**	**0.0039**	**0.0041**	**0.0049**	**0.0053**	**0.0041**	**0.0042**	**0.0042**	**0.0041**	**0.0039**
	Barium, Total	mg/L	1 *	2 *	0.056	0.066	0.052	0.041	0.051	0.063	0.060	0.036	0.034	0.036	0.033	0.035	0.034	0.039	0.038
	Beryllium, Total	mg/L		0.004 *	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00040	<0.00040	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00040	<0.00040
	Cadmium, Total	mg/L	0.01 *	0.005 *	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00080	<0.00080	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00080	<0.00080
	Chromium, Total	mg/L	0.05 *	0.1 *	0.0031	0.0035	0.0027	0.0039	0.0038	0.0031	0.0040	**0.51**	**0.210**	**0.086**	0.017	0.015	**0.150**	**0.13**	**0.063**
	Cobalt, Total	mg/L			0.027	0.032	0.022	0.013	0.018	0.012	0.011	0.00085	0.00042	0.00044	<0.0004	<0.0004	<0.0004	<0.00040	0.00050
	Copper, Total	mg/L	1 **		<0.002	<0.002	<0.002	<0.002	<0.002	<0.0020	0.0064	0.015	0.0064	0.0022	<0.002	<0.002	0.0068	0.0054	0.0048
	Lead, Total	mg/L	0.05 *		<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.00080	<0.00080	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	0.00092	<0.00080
	Nickel, Total	mg/L		0.1 *	<0.003	<0.003	<0.003	<0.003	<0.003	<0.0030	<0.0030	0.024	0.014	0.0042	0.0036	<0.003	0.010	0.011	0.012
	Selenium, Total	mg/L	0.01 *	0.05 *	<0.008	<0.008	<0.008	<0.008	<0.008	<0.0080	<0.0080	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.0080	<0.0080
	Silver, Total	mg/L	0.05 *	0.1 **	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00040	<0.00040	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00040	<0.00040
	Thallium, Total	mg/L		0.002 *	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010
	Vanadium, Total	mg/L			0.0086	0.0095	0.012	0.011	0.0091	0.0091	0.0093	0.013	0.015	0.015	0.012	0.012	0.014	0.012	0.012
	Zinc, Total	mg/L	5 **	5 **	<0.007	<0.007	<0.007	<0.007	<0.007	<0.0070	<0.0070	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.0070	<0.0070
VOLATILE ORGANIC COMPOUNDS	1,1,1,2-Tetrachloroethane	µg/L			<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
	1,1,1-Trichloroethane	µg/L	200 *	200 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,1,2,2-Tetrachloroethane	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,1,2-Trichloroethane	µg/L		5 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,1-Dichloroethane	µg/L	1 ***		<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.30	0.39	0.35	<0.20	<0.20	<0.20
	1,1-Dichloroethene	µg/L		7 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,2,3-Trichloropropane	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,2-Dibromo-3-Chloropropane	µg/L		0.2 *	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	1,2-Dibromoethane	µg/L	0.001 ***	0.05 *	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	1,2-Dichlorobenzene	µg/L		600 *	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
	1,2-Dichloroethane	µg/L	0.5 ***	5 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,2-Dichloropropane	µg/L	0.6 ***	5 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,4-Dichlorobenzene	µg/L	4 ***	75 *	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
	2-Butanone	µg/L			<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	2-Hexanone	µg/L			<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	4-Methyl-2-pentanone	µg/L			<5.0	<5.0	<5.0	<5.0	<5.0	<10	<10	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<10
	Acetone	µg/L			<6.0	<6.0	<6.0	<6.0	<6.0	<10	<10	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<10	<10
	Acrylonitrile	µg/L	0.07 ***		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	Benzene	µg/L	1 ***	5 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Bromochloromethane	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Bromodichloromethane	µg/L	0.3 ***	80 * THM	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20

Table G-2. Groundwater Quality Data, Fourth Quarter 2018 through Second Quarter 2020, Horn Rapids Landfill

	Analyte	Units	GWQS	MCL	MW-3 11/28/2018	MW-3 3/21/2019	MW-3 6/13/2019	MW-3 12/17/2019	MW-21 (MW-3 12/17/2019	MW-3 3/24/2020	MW-3 6/17/2020	MW-4 11/28/2018	MW-4 3/20/2019	MW-4 6/13/2019	MW-4 9/5/2019	MW-4 12/16/2019	MW-4 3/24/2020	MW-21 (MW-4 3/24/2020	MW-4 6/17/2020
FIELD DATA	Conductivity	µmhos/cm		700 **	297.1	288.8	303.1	287.2	NA	331.5	369.1	498.1	517.0	579	567	567	579.0	NA	590
	pH	units	6.5-8.5		7.76	7.91	7.47	7.95	NA	7.83	7.71	7.64	7.69	7.38	7.58	7.64	7.60	NA	7.54
	Temperature	C°			18.5	18.7	22.1	18.1	NA	20.3	22.5	19.4	20.1	21.6	20.7	19.1	20.6	NA	21.5
	Redox	mv			112.1	45.2	-45.9	139.1	NA	248.8	216.4	131.6	100.0	-98.2	43.0	156.0	238.2	NA	180.2
	Dissolved Oxygen	mg/L			7.68	9.13	8.64	8.31	NA	8.69	8.63	3.37	3.79	3.79	3.37	3.79	3.82	NA	3.74
WATER QUALITY PARAMETERS	Nitrate-Nitrogen	mg/L as N	10 *	10 *	0.93	0.84	0.69	2.5	2.4	4.6	5.3	2.6	3.2	2.9	2.9	3.8 H	4.7	4.9	1.4
	Calcium, Dissolved	mg/L			37	38	34	32	36	39	47	74	76	76	77	70	81	83	87
	Sodium, Dissolved	mg/L			12	12	10	11	12	12	14	15	16	14	14	14	14	15	16
	Bicarbonate Alkalinity	mg/L as CaCO3			110	100	100	88	83	96	89	210	210	220	230	220	240	230	240
	Chloride	mg/L	250 **	250 **	8.5	8.7	7.6	9.1	9.2	14	20	11	12	12	13	13	14	14	14
	Magnesium, Dissolved	mg/L			7.2	7.3	6.6	5.6	7.1	7.6	9.4	16	16	17	17	14	17	18	19
	Potassium, Dissolved	mg/L			5.7	5.6	4.6	5.1	5.2	5.4	5.8	7.0	7.0	6.1	6.4	6.4	6.8	7.0	7.1
	Sulfate	mg/L	250 **	250 **	23	23	20	22	22	29	35	25	28	27	28	28	29	31	30
	Total Alkalinity	mg/L as CaCO3			110	100	100	88	83	96	89	210	210	220	230	220	240	230	240
	Iron, Dissolved	mg/L	0.30 **	0.30 **	<0.50	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.50	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Manganese, Dissolved	mg/L	0.05 **	0.05 **	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Ammonia-Nitrogen	mg/L as N			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Total Organic Carbon	mg/L			<1.0	0.45	<1.0	<1.0	<1.0	5.4	<1.5	<1.0	0.34	<1.0	<1.0	<1.0	14	16	<1.5
	Total Dissolved Solids	mg/L	500 **	500 **	140	120	170	120 B	170 H	330	200	290	130	340	340	320	300	340	310
	Total Suspended Solids	mg/L			<2.0	<2.0	<2.0	7.2 J	<2.0 J	2.4	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
METALS	Antimony, Total	mg/L		6 *	<0.0004	<0.0004	<0.0004	<0.0004	0.00043	<0.00080	<0.00080	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00080	<0.00080	<0.00080
	Arsenic, Total	mg/L	0.00005 ***	0.01 *	**0.0083**	**0.0091**	**0.010**	**0.0093**	**0.0092**	**0.0090**	**0.0085**	**0.004**	**0.0043**	**0.0052**	**0.0042**	**0.0039**	**0.0042**	**0.0043**	**0.0041**
	Barium, Total	mg/L	1 *	2 *	0.015	0.016	0.015	0.016	0.014	0.018	0.020	0.037	0.041	0.042	0.045	0.040	0.047	0.046	0.047
	Beryllium, Total	mg/L		0.004 *	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00040	<0.00040	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00040	<0.00040	<0.00040
	Cadmium, Total	mg/L	0.01 *	0.005 *	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00080	<0.00080	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00080	<0.00080	<0.00080
	Chromium, Total	mg/L	0.05 *	0.1 *	0.021	0.028	0.011	0.048 J	0.014 J	0.028	0.011	0.0016	0.0018	0.0018	0.0031	0.0023	0.0022	0.0021	0.0023
	Cobalt, Total	mg/L			<0.0004	<0.0004	<0.0004	0.00065	0.00078	0.00040	0.00047	0.0048	0.0056	0.0075	0.0088	0.0078	0.0072	0.0071	0.0060
	Copper, Total	mg/L	1 **		0.012	<0.002	<0.002	0.0033	<0.002	<0.0020	<0.0020	<0.002	<0.002	<0.002	<0.002	<0.002	<0.0020	<0.0020	<0.0020
	Lead, Total	mg/L	0.05 *		<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.00080	<0.00080	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.00080	<0.00080	<0.00080
	Nickel, Total	mg/L		0.1 *	0.011	0.0055	<0.003	0.0097 J	0.0056 J	0.0041	0.0033	<0.003	<0.003	<0.003	<0.003	<0.003	<0.0030	<0.0030	<0.0030
	Selenium, Total	mg/L	0.01 *	0.05 *	<0.008	<0.008	<0.008	<0.008	<0.008	<0.0080	<0.0080	<0.008	<0.008	<0.008	<0.008	<0.008	<0.0080	<0.0080	<0.0080
	Silver, Total	mg/L	0.05 *	0.1 **	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00040	<0.00040	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00040	<0.00040	<0.00040
	Thallium, Total	mg/L		0.002 *	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010
	Vanadium, Total	mg/L			0.014	0.016	0.019	0.017	0.016	0.016	0.017	0.011	0.011	0.013	0.012	0.011	0.011	0.011	0.012
	Zinc, Total	mg/L	5 **	5 **	<0.007	<0.007	<0.007	<0.007	<0.007	<0.0070	<0.0070	<0.007	<0.007	<0.007	<0.007	<0.007	<0.0070	<0.0070	<0.0070
VOLATILE ORGANIC COMPOUNDS	1,1,1,2-Tetrachloroethane	µg/L			<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
	1,1,1-Trichloroethane	µg/L	200 *	200 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,1,2,2-Tetrachloroethane	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,1,2-Trichloroethane	µg/L		5 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,1-Dichloroethane	µg/L	1 ***		<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	**4.2**	**4.4**	**4.4**	**4.2**	**4.7**	**5.2**	**5.4**	**5.7**
	1,1-Dichloroethene	µg/L		7 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,2,3-Trichloropropane	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,2-Dibromo-3-Chloropropane	µg/L		0.2 *	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	1,2-Dibromoethane	µg/L	0.001 ***	0.05 *	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	1,2-Dichlorobenzene	µg/L		600 *	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
	1,2-Dichloroethane	µg/L	0.5 ***	5 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,2-Dichloropropane	µg/L	0.6 ***	5 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,4-Dichlorobenzene	µg/L	4 ***	75 *	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
	2-Butanone	µg/L			<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	2-Hexanone	µg/L			<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	4-Methyl-2-pentanone	µg/L			<5.0	<5.0	<5.0	<5.0	<5.0	<10	<10	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<10	<10
	Acetone	µg/L			<6.0	<6.0	<6.0	<6.0	<6.0	<10	<10	<6.0	<6.0	<6.0	<6.0	<6.0	<10	<10	<10
	Acrylonitrile	µg/L	0.07 ***		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	Benzene	µg/L	1 ***	5 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Bromochloromethane	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Bromodichloromethane	µg/L	0.3 ***	80 * THM	0.25	0.26	0.25	0.25	0.24	0.27	0.21	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20

Table G-2. Groundwater Quality Data, Fourth Quarter 2018 through Second Quarter 2020, Horn Rapids Landfill

	Analyte	Units	GWQS	MCL	MW-5 11/27/2018	MW-5 3/21/2019	MW-5 6/12/2019	MW-5 9/4/2019	MW-5 12/17/2019	MW-5 3/25/2020	MW-5 6/18/2020	MW-21 (MW-5 6/18/2020	MW-6 11/28/2018	MW-6 3/21/2019	MW-6 6/13/2019	MW-21 (MW-6 6/13/2019	MW-6 9/5/2019	MW-6 12/17/2019	MW-6 3/25/2020	MW-6 6/18/2020
FIELD DATA	Conductivity	µmhos/cm		700 **	**1193**	**1160**	**1245**	**1526**	**1990**	**1854**	**1762**	NA	**1083**	**1066**	**1093**	NA	**1113**	**1095**	**1049**	**1069**
	pH	units	6.5-8.5		6.70	6.79	6.61	6.66	6.71	6.70	6.71	NA	6.62	6.68	6.59	NA	6.64	6.73	6.70	6.66
	Temperature	C°			21.4	23.5	25.5	24.9	23.0	23.3	23.9	NA	27.5	26.5	27.2	NA	27.6	24.5	25.7	28.5
	Redox	mv			81.1	-15.2	-106.1	-2.2	-84.2	-19.9	-60.4	NA	-28.9	-48.3	-230.2	NA	13.9	-53.5	47.0	-57.0
	Dissolved Oxygen	mg/L			0.95	0.52	2.01	1.76	0.22	0.58	0.71	NA	0.64	0.66	0.60	NA	0.60	0.37	0.65	0.65
WATER QUALITY PARAMETERS	Nitrate-Nitrogen	mg/L as N	10 *	10 *	0.44	2.7	**17**	<0.20	**12**	0.49	3.6	3.8	0.23	2.5	2.7	2.7	<0.20	0.23	0.48	2.8
	Calcium, Dissolved	mg/L			190	180	200	220	300	290	260	260	170	160	160	160	160	140	160	170
	Sodium, Dissolved	mg/L			22	21	26	33	36	43	41	40	23	23	20	21	21	21	22	23
	Bicarbonate Alkalinity	mg/L as CaCO3			500	500	460	540	680	720	650	650	500	490	490	480	500	510	510	480
	Chloride	mg/L	250 **	250 **	44	44	33	37	88	84	74	74	19	20	19	19	20	20	22	22
	Magnesium, Dissolved	mg/L			43	40	47	52	67	69	66	64	41	39	38	38	38	34	39	42
	Potassium, Dissolved	mg/L			12	11	11	12	15	15	14	14	12	12	10	11	11	11	11	12
	Sulfate	mg/L	250 **	250 **	82	74	120	150	**260**	140	190	190	49	53	48	48	<1.2 R	50	53	53
	Total Alkalinity	mg/L as CaCO3			500	500	460	540	680	720	650	650	500	490	490	480	500	510	510	480
	Iron, Dissolved	mg/L	0.30 **	0.30 **	<0.50	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.50	<0.50	<0.20	<1	<0.20	<0.20	<0.20	<0.20
	Manganese, Dissolved	mg/L	0.05 **	0.05 **	0.046	**0.052**	**0.056**	**0.082**	**0.13**	**0.21**	**0.17**	**0.16**	0.038	0.037	0.025	0.026	<0.020	0.037	0.034	0.043
	Ammonia-Nitrogen	mg/L as N			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Total Organic Carbon	mg/L			3.1	2.6	3.7	2.5	5.1	60	4.9	5.3	2.0	1.3	1.1	1.1	<1.0	1.1	42	3.0
	Total Dissolved Solids	mg/L	500 **	500 **	**740**	**670**	**800**	**980**	**1300**	**1300**	**1100 J**	**680 J**	**650**	**550**	**650**	**620**	**650**	**590**	**700**	**590**
	Total Suspended Solids	mg/L			<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	3.0	<2.0	<2.0	3.4	<2.0	<2.0	<2.0
METALS	Antimony, Total	mg/L		6 *	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00080	<0.00080	<0.00080	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00080	<0.00080
	Arsenic, Total	mg/L	0.00005 ***	0.01 *	**0.0021**	**0.0021**	**0.004**	**0.0024**	**0.0023**	**0.0022**	**0.0022**	**0.0022**	**0.0015**	**0.0018**	**0.003**	**0.0032**	**0.0016**	**0.0015**	**0.0015**	**0.0017**
	Barium, Total	mg/L	1 *	2 *	0.11	0.110	0.110	0.130	0.160	0.15	0.13	0.13	0.097	0.098	0.095	0.093	0.100	0.084	0.091	0.10
	Beryllium, Total	mg/L		0.004 *	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00040	<0.00040	<0.00040	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00040	<0.00040
	Cadmium, Total	mg/L	0.01 *	0.005 *	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00080	<0.00080	<0.00080	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00080	<0.00080
	Chromium, Total	mg/L	0.05 *	0.1 *	0.0027	0.0011	0.0036	0.0028	0.0011	0.0013	0.0013	0.0011	0.00093	0.00051	0.00062	0.00061	0.0024	0.00093	0.0011	0.0086
	Cobalt, Total	mg/L			<0.0004	<0.0004	<0.0004	0.00044	0.00042	0.00097	0.00070	0.00070	<0.0004	<0.0004	<0.0004	<0.0004	0.0014	<0.0004	0.00042	0.013
	Copper, Total	mg/L	1 **		0.0054	0.0053	0.0038	0.003	0.002	<0.0020	0.0023 J	0.0044 J	<0.002	0.0026	<0.002	<0.002	0.0021	<0.002	0.0029	0.0022
	Lead, Total	mg/L	0.05 *		<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.00080	<0.00080	<0.00080	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.00080	<0.00080
	Nickel, Total	mg/L		0.1 *	0.0041	<0.003	0.0036	0.0035	<0.003	0.0036	0.0040	0.0039	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.0030	0.0080
	Selenium, Total	mg/L	0.01 *	0.05 *	<0.008	<0.008	<0.008	<0.008	<0.008	<0.0080	<0.0080	<0.0080	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.0080	<0.0080
	Silver, Total	mg/L	0.05 *	0.1 **	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00040	<0.00040	<0.00040	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00040	0.00055
	Thallium, Total	mg/L		0.002 *	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.0010	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010
	Vanadium, Total	mg/L			0.0083	0.0078	0.0095	0.0081	0.0075	0.0068	0.0073	0.0071	0.0062	0.0068	0.0082	0.0082	0.0071	0.0061	0.0062	0.0068
	Zinc, Total	mg/L	5 **	5 **	0.036	0.029	0.022	0.016	0.025	0.015	0.022	0.022	0.011	0.0093	0.0076	<0.007	0.0097	0.0072	0.011	0.012
VOLATILE ORGANIC COMPOUNDS	1,1,1,2-Tetrachloroethane	µg/L			<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
	1,1,1-Trichloroethane	µg/L	200 *	200 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,1,2,2-Tetrachloroethane	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,1,2-Trichloroethane	µg/L		5 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,1-Dichloroethane	µg/L	1 ***		**6.4**	**6.2**	**2.0**	0.90	**2.5**	**3.6**	**4.4**	**4.7**	**3.6**	**3.4**	**3.1**	**3.1**	**2.7**	**3.1**	**2.9**	**3.1**
	1,1-Dichloroethene	µg/L		7 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,2,3-Trichloropropane	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,2-Dibromo-3-Chloropropane	µg/L		0.2 *	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	1,2-Dibromoethane	µg/L	0.001 ***	0.05 *	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	1,2-Dichlorobenzene	µg/L		600 *	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
	1,2-Dichloroethane	µg/L	0.5 ***	5 *	**0.69**	**0.62**	<0.20	<0.20	0.33	0.43	**0.61**	**0.60**	0.41	0.37	0.37	0.37	0.38	0.38	0.30	0.39
	1,2-Dichloropropane	µg/L	0.6 ***	5 *	0.37	0.37	<0.20	<0.20	0.21	0.27	0.34	0.31	0.33	0.32	0.34	0.35	0.35	0.28	0.29	0.28
	1,4-Dichlorobenzene	µg/L	4 ***	75 *	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
	2-Butanone	µg/L			<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	2-Hexanone	µg/L			<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	4-Methyl-2-pentanone	µg/L			<5.0	<5.0	<5.0	<5.0	<5.0	<10	<10	<10	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<10
	Acetone	µg/L			<6.0	<6.0	<6.0	<6.0	<6.0	<10	120 J	<10 J	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<10	<10
	Acrylonitrile	µg/L	0.07 ***		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	Benzene	µg/L	1 ***	5 *	0.25	0.25	<0.20	<0.20	0.27	0.33	0.33	0.33	0.42	0.39	0.39	0.39	0.38	0.38	0.33	0.34
	Bromochloromethane	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Bromodichloromethane	µg/L	0.3 ***	80 * THM	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20

Table G-2. Groundwater Quality Data, Fourth Quarter 2018 through Second Quarter 2020, Horn Rapids Landfill

	Analyte	Units	GWQS	MCL	MW-8 11/27/2018	MW-8 3/20/2019	MW-8 6/12/2019	MW-8 9/4/2019	MW-8 12/16/2019	MW-8 3/25/2020	MW-8 6/17/2020	MW-9 11/27/2018	MW-9 3/20/2019	MW-9 6/12/2019	MW-9 9/4/2019	MW-9 12/16/2019	MW-9 3/24/2020	MW-9 6/18/2020
FIELD DATA	Conductivity	µmhos/cm		700 **	466.6	597	382.2	358.1	**837**	**973**	**1131**	**913**	**964**	**976**	**917**	**1066**	**1047**	**1198**
	pH	units	6.5-8.5		7.73	7.81	7.63	7.76	7.77	7.79	7.60	6.92	6.98	6.82	6.96	7.09	6.92	7.01
	Temperature	C°			18.5	21.9	23.7	23.9	22.1	18.5	24.2	18.9	19.4	22.7	23.0	19.6	19.0	24.4
	Redox	mv			201.5	162.5	-83.0	141.0	151.6	268.1	237.1	101.2	141.3	-150.5	96.7	100.9	127.3	130.8
	Dissolved Oxygen	mg/L			7.12	8.32	7.14	5.99	7.34	8.42	9.14	3.03	4.10	3.10	3.01	3.17	3.86	3.68
WATER QUALITY PARAMETERS	Nitrate-Nitrogen	mg/L as N	10 *	10 *	5.8	9.9	3.0	2.6 H	**18 H**	**31**	**24**	1.1	4.8	4.3	<0.20 H	5.7 H	6.5	5.2
	Calcium, Dissolved	mg/L			57	74	43	42	90	120	150	130	150	130	130	150	150	170
	Sodium, Dissolved	mg/L			18	21	14	14	23	28	34	23	26	21	22	28	28	33
	Bicarbonate Alkalinity	mg/L as CaCO3			120	120	110	110	120	130	130	350	360	340	310	390	390	400
	Chloride	mg/L	250 **	250 **	37	61	20	16	99	140	160	39	48	50	37	56	61	66
	Magnesium, Dissolved	mg/L			12	15	8.8	8.5	17	25	31	29	33	30	28	35	34	39
	Potassium, Dissolved	mg/L			6.7	7.5	5.0	5.3	7.9	9.3	10	9.1	9.9	8.2	8.3	9.4	9.4	9.9
	Sulfate	mg/L	250 **	250 **	35	48	27	27	61	74	81	63	73	69	72	76	79	83
	Total Alkalinity	mg/L as CaCO3			120	120	110	110	120	130	130	350	360	340	310	390	390	400
	Iron, Dissolved	mg/L	0.30 **	0.30 **	<0.50	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.50	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20
	Manganese, Dissolved	mg/L	0.05 **	0.05 **	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
	Ammonia-Nitrogen	mg/L as N			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Total Organic Carbon	mg/L			<1.0	0.84	<1.0	<1.0	2.5	9.4	1.8	1.4	1.3	1.0	<1.0	<1.0	27	2.0
	Total Dissolved Solids	mg/L	500 **	500 **	260	370	220	220	470	**660**	**790**	**560**	**540**	**560**	**530**	**660**	**660**	**650**
	Total Suspended Solids	mg/L			<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
METALS	Antimony, Total	mg/L		6 *	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00080	<0.00080	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00080	<0.00080
	Arsenic, Total	mg/L	0.00005 ***	0.01 *	**0.0097**	**0.0092**	**0.010**	**0.0085**	**0.0077**	**0.0080**	**0.0075**	**0.0016**	**0.0022**	**0.0031**	**0.0017**	**0.0019**	**0.0019**	**0.0019**
	Barium, Total	mg/L	1 *	2 *	0.032	0.045	0.026	0.026	0.053	0.083	0.11	0.064	0.081	0.074	0.071	0.077	0.090	0.097
	Beryllium, Total	mg/L		0.004 *	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00040	<0.00040	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00040	<0.00040
	Cadmium, Total	mg/L	0.01 *	0.005 *	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00080	<0.00080	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00080	<0.00080
	Chromium, Total	mg/L	0.05 *	0.1 *	0.0057	0.0038	0.0091	0.0082	0.020	0.0077	0.011	0.0023	0.0032	0.0021	0.0026	0.0099	0.0051	0.0032
	Cobalt, Total	mg/L			<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00040	<0.00040	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00040	<0.00040
	Copper, Total	mg/L	1 **		<0.002	<0.002	<0.002	<0.002	0.0032	<0.0020	<0.0020	<0.002	<0.002	<0.002	<0.002	<0.002	<0.0020	0.0026
	Lead, Total	mg/L	0.05 *		<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.00080	<0.00080	<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.00080	<0.00080
	Nickel, Total	mg/L		0.1 *	0.004	<0.003	0.0059	0.0051	0.0075	0.0049	0.0060	<0.003	<0.003	<0.003	0.005	0.0062	0.0035	<0.0030
	Selenium, Total	mg/L	0.01 *	0.05 *	<0.008	<0.008	<0.008	<0.008	<0.008	<0.0080	<0.0080	<0.008	<0.008	<0.008	<0.008	<0.008	<0.0080	<0.0080
	Silver, Total	mg/L	0.05 *	0.1 **	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00040	<0.00040	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00040	<0.00040
	Thallium, Total	mg/L		0.002 *	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010
	Vanadium, Total	mg/L			0.016	0.016	0.017	0.017	0.014	0.014	0.015	0.0065	0.0074	0.0084	0.0076	0.0074	0.0073	0.0075
	Zinc, Total	mg/L	5 **	5 **	<0.007	<0.007	<0.007	<0.007	<0.007	<0.0070	<0.0070	<0.007	<0.007	<0.007	<0.007	<0.007	<0.0070	<0.0070
VOLATILE ORGANIC COMPOUNDS	1,1,1,2-Tetrachloroethane	µg/L			<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
	1,1,1-Trichloroethane	µg/L	200 *	200 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,1,2,2-Tetrachloroethane	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,1,2-Trichloroethane	µg/L		5 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,1-Dichloroethane	µg/L	1 ***		<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	**3.1**	**2.7**	**2.8**	**2.5**	**1.9**	**2.0**	**1.8**
	1,1-Dichloroethene	µg/L		7 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,2,3-Trichloropropane	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,2-Dibromo-3-Chloropropane	µg/L		0.2 *	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	1,2-Dibromoethane	µg/L	0.001 ***	0.05 *	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	1,2-Dichlorobenzene	µg/L		600 *	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
	1,2-Dichloroethane	µg/L	0.5 ***	5 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,2-Dichloropropane	µg/L	0.6 ***	5 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,4-Dichlorobenzene	µg/L	4 ***	75 *	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
	2-Butanone	µg/L			<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	2-Hexanone	µg/L			<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	4-Methyl-2-pentanone	µg/L			<5.0	<5.0	<5.0	<5.0	<5.0	<10	<10	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<10
	Acetone	µg/L			<6.0	<6.0	<6.0	<6.0	<6.0	<10	<10	<6.0	<6.0	<6.0	<6.0	<6.0	<10	<10
	Acrylonitrile	µg/L	0.07 ***		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	Benzene	µg/L	1 ***	5 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Bromochloromethane	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Bromodichloromethane	µg/L	0.3 ***	80 * THM	**0.78**	**0.59**	**0.87**	**1.0**	**0.43**	**0.38**	0.27	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20

Table G-2. Groundwater Quality Data, Fourth Quarter 2018 through Second Quarter 2020, Horn Rapids Landfill

	Analyte	Units	GWQS	MCL	MW-10 11/27/2018	MW-10 3/20/2019	MW-10 6/13/2019	MW-10 9/4/2019	MW-10 12/16/2019	MW-10 3/25/2020	MW-10 6/17/2020	MW-11 11/27/2018	MW-11 3/20/2019	MW-11 6/12/2019	MW-11 9/4/2019	MW-11 12/16/2019	MW-11 3/25/2020	MW-11 6/17/2020
FIELD DATA	Conductivity	µmhos/cm		700 **	**1334**	**1336**	**1499**	**1502**	**1609**	**1557**	**1612**	**1699**	**1682**	**1658**	**1392**	**1828**	**1710**	**1760**
	pH	units	6.5-8.5		6.61	6.69	6.65	6.62	6.73	6.70	6.61	7.39	7.44	7.34	7.47	7.45	7.47	7.36
	Temperature	C°			23.9	24.2	23.5	23.7	24.7	25.0	25.7	15.8	19.4	23.6	23.0	20.5	20.6	23.8
	Redox	mv			95.3	65.2	-212.8	-73.3	51.3	108.3	17.2	161.2	162.7	-99.2	90.3	130.1	256.0	200.9
	Dissolved Oxygen	mg/L			0.26	0.23	0.40	0.27	0.45	0.29	5.01	7.53	8.57	8.05	6.88	7.88	8.63	8.84
WATER QUALITY PARAMETERS	Nitrate-Nitrogen	mg/L as N	10 *	10 *	0.26	3.0	1.7	4.3	<0.20	<0.2	0.77	**30**	**29**	**30**	**34 H**	**35 H**	**44**	**33**
	Calcium, Dissolved	mg/L			210	230	240	190	270	260	280	260	270	250	240	280	270	270
	Sodium, Dissolved	mg/L			24	27	23	18	27	26	29	21	22	20	24	21	20	22
	Bicarbonate Alkalinity	mg/L as CaCO3			620	620	690	690	760	740	730	170	170	180	200	160	180	170
	Chloride	mg/L	250 **	250 **	31	34	38	50	38	42	42	200	220	190	130	230	240	210
	Magnesium, Dissolved	mg/L			45	49	50	36	58	55	61	52	54	49	51	56	53	56
	Potassium, Dissolved	mg/L			13	14	12	9.6	14	13	14	12	13	11	12	12	12	12
	Sulfate	mg/L	250 **	250 **	73	75	81	65	91	91	93	**320**	**330**	**290**	190	**330**	**330**	**300**
	Total Alkalinity	mg/L as CaCO3			620	620	690	690	760	740	730	170	170	180	200	160	180	170
	Iron, Dissolved	mg/L	0.30 **	0.30 **	<0.50	<0.50	<0.20	<0.20	0.26	<0.20	**0.33**	<0.50	<0.50	<0.20	**0.55**	<0.20	<0.20	<0.20
	Manganese, Dissolved	mg/L	0.05 **	0.05 **	0.035	0.036	0.039	<0.020	**0.17**	**0.12**	**0.14**	<0.020	<0.020	<0.020	**0.29**	<0.020	<0.020	<0.020
	Ammonia-Nitrogen	mg/L as N			<0.50	<2	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Total Organic Carbon	mg/L			3.5	3.3	4.8	1.6	4.4	78	5.2	4.3	2.7	3.4	10	4.9	14	4.0
	Total Dissolved Solids	mg/L	500 **	500 **	**820**	**790**	**910**	450	**970 H**	**1100**	**940**	**1100**	**2300**	**1100**	**940**	**1300 H**	**1200**	**1300**
	Total Suspended Solids	mg/L			<2.0	<2.0	<2.0	<2.0	3.8	3.0	3.6	<2.0	<2.0	<2.0	3.8	<2.0	1.0	<2.0
METALS	Antimony, Total	mg/L		6 *	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00080	<0.00080	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00080	<0.00080
	Arsenic, Total	mg/L	0.00005 ***	0.01 *	**0.0013**	**0.0019**	**0.0039**	**0.0056**	**0.0026**	**0.0021**	**0.0020**	**0.0042**	**0.005**	**0.0068**	**0.012**	**0.0042**	**0.0046**	**0.0045**
	Barium, Total	mg/L	1 *	2 *	0.11	0.130	0.130	0.079	0.150	0.16	0.16	0.091	0.110	0.094	0.150	0.090	0.11	0.099
	Beryllium, Total	mg/L		0.004 *	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00040	<0.00040	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00040	<0.00040
	Cadmium, Total	mg/L	0.01 *	0.005 *	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00080	<0.00080	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00080	<0.00080
	Chromium, Total	mg/L	0.05 *	0.1 *	0.00072	0.001	0.0036	0.0036	0.0028	0.0027	0.0060	0.0095	0.004	0.004	0.0042	0.0037	0.0047	0.0037
	Cobalt, Total	mg/L			<0.0004	<0.0004	<0.0004	0.0005	0.00085	0.00062	0.00078	0.00057	<0.0004	0.00043	0.00047	0.00053	0.0014	0.0010
	Copper, Total	mg/L	1 **		0.002	0.002	<0.002	<0.002	0.0024	0.0029	<0.0020	0.005	0.0043	0.0035	0.0041	0.0022	0.0027	<0.0020
	Lead, Total	mg/L	0.05 *		<0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.00080	<0.00080	<0.0008	<0.0008	<0.0008	<0.0008	0.00097	<0.00080	<0.00080
	Nickel, Total	mg/L		0.1 *	<0.003	<0.003	<0.003	<0.003	0.0044	0.0035	0.0052	<0.003	<0.003	<0.003	0.0032	<0.003	<0.0030	0.0035
	Selenium, Total	mg/L	0.01 *	0.05 *	<0.008	<0.008	<0.008	<0.008	<0.008	<0.0080	<0.0080	<0.008	<0.008	<0.008	<0.008	<0.008	<0.0080	<0.0080
	Silver, Total	mg/L	0.05 *	0.1 **	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00040	<0.00040	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00040	<0.00040
	Thallium, Total	mg/L		0.002 *	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010
	Vanadium, Total	mg/L			0.0064	0.0079	0.0091	0.012	0.0078	0.0073	0.0074	0.009	0.011	0.012	0.008	0.0095	0.010	0.011
	Zinc, Total	mg/L	5 **	5 **	0.011	0.0096	0.0083	<0.007	0.0085	0.012	0.0090	<0.007	<0.007	<0.007	0.0088	0.0076	<0.0070	<0.0070
VOLATILE ORGANIC COMPOUNDS	1,1,1,2-Tetrachloroethane	µg/L			<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
	1,1,1-Trichloroethane	µg/L	200 *	200 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,1,2,2-Tetrachloroethane	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,1,2-Trichloroethane	µg/L		5 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,1-Dichloroethane	µg/L	1 ***		**8.0**	**7.9**	**7.5**	**7.6**	**4.8**	**5.4**	**6.1**	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,1-Dichloroethene	µg/L		7 *	0.23	<0.20	0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,2,3-Trichloropropane	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,2-Dibromo-3-Chloropropane	µg/L		0.2 *	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	1,2-Dibromoethane	µg/L	0.001 ***	0.05 *	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	1,2-Dichlorobenzene	µg/L		600 *	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
	1,2-Dichloroethane	µg/L	0.5 ***	5 *	**0.54**	0.42	0.37	0.36	0.31	0.31	0.43	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,2-Dichloropropane	µg/L	0.6 ***	5 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,4-Dichlorobenzene	µg/L	4 ***	75 *	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
	2-Butanone	µg/L			<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	2-Hexanone	µg/L			<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	4-Methyl-2-pentanone	µg/L			<5.0	<5.0	<5.0	<5.0	<5.0	<10	<10	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<10
	Acetone	µg/L			6.9	<6.0	<6.0	80	<6.0	<10	140	<6.0	<6.0	<6.0	<6.0	<6.0	<10	<10
	Acrylonitrile	µg/L	0.07 ***		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	Benzene	µg/L	1 ***	5 *	0.27	0.27	0.21	<0.20	0.21	<0.20	0.23	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Bromochloromethane	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Bromodichloromethane	µg/L	0.3 ***	80 * THM	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20

Table G-2. Groundwater Quality Data, Fourth Quarter 2018 through Second Quarter 2020, Horn Rapids Landfill

	Analyte	Units	GWQS	MCL	MW-12 11/28/2018	MW-21 (MW-12 11/28/2018	MW-12 3/21/2019	MW-21 (MW-12 3/21/2019	MW-12 6/12/2019	MW-12 9/5/2019	MW-12 12/17/2019	MW-12 3/24/2020	MW-12 6/17/2020	Trip Blank 11/27/2018	Trip Blank 3/21/2019	Trip Blank 6/12/2019	Trip Blank 9/4/2019	Trip Blank 12/16/2019	Trip Blank 3/24/2020	Trip Blank 6/17/2020
FIELD DATA	Conductivity	µmhos/cm		700 **	355.4	NA	412.4	NA	445.1	444.2	437.1	432.8	432.1	NA	NA	NA	NA	NA	NA	NA
	pH	units	6.5-8.5		7.97	NA	7.88	NA	7.43	7.72	7.82	7.55	7.87	NA	NA	NA	NA	NA	NA	NA
	Temperature	C°			22.4	NA	22.7	NA	23.2	23.0	21.0	16.8	23.0	NA	NA	NA	NA	NA	NA	NA
	Redox	mv			-202.6	NA	46.8	NA	21.3	99.2	160.3	214.8	249.5	NA	NA	NA	NA	NA	NA	NA
	Dissolved Oxygen	mg/L			0.29	NA	2.47	NA	5.21	8.91	4.48	8.12	7.50	NA	NA	NA	NA	NA	NA	NA
WATER QUALITY PARAMETERS	Nitrate-Nitrogen	mg/L as N	10 *	10 *	0.23	0.23	2.0	2.1	2.7	3.0	3.7	4.9	4.0	NA	NA	NA	NA	NA	NA	NA
	Calcium, Dissolved	mg/L			35	34	48	49	50	49	51	49	53	NA	NA	NA	NA	NA	NA	NA
	Sodium, Dissolved	mg/L			32	31	24	24	21	21	21	21	22	NA	NA	NA	NA	NA	NA	NA
	Bicarbonate Alkalinity	mg/L as CaCO3			110	110	150	160	140	150	140	140	140	NA	NA	NA	NA	NA	NA	NA
	Chloride	mg/L	250 **	250 **	17	18	14	14	14	14	14	15	14	NA	NA	NA	NA	NA	NA	NA
	Magnesium, Dissolved	mg/L			6.9	6.7	9.9	10	11	10	11	10	11	NA	NA	NA	NA	NA	NA	NA
	Potassium, Dissolved	mg/L			8.2	7.8	8.5	8.8	7.5	7.5	7.7	7.6	7.9	NA	NA	NA	NA	NA	NA	NA
	Sulfate	mg/L	250 **	250 **	32	33	36	36	35	36	35	37	36	NA	NA	NA	NA	NA	NA	NA
	Total Alkalinity	mg/L as CaCO3			110	110	150	160	140	150	140	140	140	NA	NA	NA	NA	NA	NA	NA
	Iron, Dissolved	mg/L	0.30 **	0.30 **	<0.50	<0.50	<0.50	<0.50	<0.20	<0.20	<0.20	<0.20	<0.20	NA	NA	NA	NA	NA	NA	NA
	Manganese, Dissolved	mg/L	0.05 **	0.05 **	**0.30**	**0.29**	**0.25**	**0.26**	**0.054**	<0.020	<0.020	<0.020	<0.020	NA	NA	NA	NA	NA	NA	NA
	Ammonia-Nitrogen	mg/L as N			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	NA	NA	NA	NA	NA	NA	NA
	Total Organic Carbon	mg/L			2.7	2.5	0.62	0.64	<1.0	<1.0	<1.0	7.6	<1.5	NA	NA	NA	NA	NA	NA	NA
	Total Dissolved Solids	mg/L	500 **	500 **	180	140	180	190	230	280	250 H	300	230	NA	NA	NA	NA	NA	NA	NA
	Total Suspended Solids	mg/L			34	40	41	37	8.4	11	7.2	44	<2.0	NA	NA	NA	NA	NA	NA	NA
METALS	Antimony, Total	mg/L		6 *	0.0015	0.0014	0.00051	0.00042	0.00045	<0.0004	<0.0004	<0.00080	<0.00080	NA	NA	NA	NA	NA	NA	NA
	Arsenic, Total	mg/L	0.00005 ***	0.01 *	**0.0027**	**0.0026**	**0.0045**	**0.0041**	**0.0051**	**0.0049**	**0.0046**	**0.0068**	**0.0077**	NA	NA	NA	NA	NA	NA	NA
	Barium, Total	mg/L	1 *	2 *	0.039	0.038	0.077	0.068	0.059	0.059	0.049	0.068	0.058	NA	NA	NA	NA	NA	NA	NA
	Beryllium, Total	mg/L		0.004 *	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00040	<0.00040	NA	NA	NA	NA	NA	NA	NA
	Cadmium, Total	mg/L	0.01 *	0.005 *	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00080	<0.00080	NA	NA	NA	NA	NA	NA	NA
	Chromium, Total	mg/L	0.05 *	0.1 *	0.0078	0.0099	0.021	0.008	0.0057	0.0086	0.0041	0.024	0.011	NA	NA	NA	NA	NA	NA	NA
	Cobalt, Total	mg/L			0.0011	0.001	0.0015	0.00083	<0.0004	<0.0004	<0.0004	0.0011	<0.00040	NA	NA	NA	NA	NA	NA	NA
	Copper, Total	mg/L	1 **		0.0022	0.002	0.0052	0.0022	0.013	0.015	0.011	0.014	0.0035	NA	NA	NA	NA	NA	NA	NA
	Lead, Total	mg/L	0.05 *		<0.0008	<0.0008	0.0008	<0.0008	<0.0008	<0.0008	<0.0008	<0.00080	<0.00080	NA	NA	NA	NA	NA	NA	NA
	Nickel, Total	mg/L		0.1 *	0.0062	0.0071	0.014	0.0057	0.0035	0.0038	<0.003	0.015	0.0052	NA	NA	NA	NA	NA	NA	NA
	Selenium, Total	mg/L	0.01 *	0.05 *	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.0080	<0.0080	NA	NA	NA	NA	NA	NA	NA
	Silver, Total	mg/L	0.05 *	0.1 **	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.00040	<0.00040	NA	NA	NA	NA	NA	NA	NA
	Thallium, Total	mg/L		0.002 *	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0010	<0.0010	NA	NA	NA	NA	NA	NA	NA
	Vanadium, Total	mg/L			<0.004	<0.004	0.010	0.008	0.010	0.011	0.010	0.014	0.016	NA	NA	NA	NA	NA	NA	NA
	Zinc, Total	mg/L	5 **	5 **	<0.007	<0.007	0.015	0.010	<0.007	<0.007	<0.007	0.0091	<0.0070	NA	NA	NA	NA	NA	NA	NA
VOLATILE ORGANIC COMPOUNDS	1,1,1,2-Tetrachloroethane	µg/L			<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
	1,1,1-Trichloroethane	µg/L	200 *	200 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,1,2,2-Tetrachloroethane	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,1,2-Trichloroethane	µg/L		5 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,1-Dichloroethane	µg/L	1 ***		0.65	0.65	0.55	0.52	0.47	0.46	0.44	0.50	0.50	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,1-Dichloroethene	µg/L		7 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,2,3-Trichloropropane	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,2-Dibromo-3-Chloropropane	µg/L		0.2 *	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	1,2-Dibromoethane	µg/L	0.001 ***	0.05 *	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	1,2-Dichlorobenzene	µg/L		600 *	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
	1,2-Dichloroethane	µg/L	0.5 ***	5 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,2-Dichloropropane	µg/L	0.6 ***	5 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	1,4-Dichlorobenzene	µg/L	4 ***	75 *	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
	2-Butanone	µg/L			<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	2-Hexanone	µg/L			<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
	4-Methyl-2-pentanone	µg/L			<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<10	<5.0	<5.0	<5.0	<5.0	<5.0	<10	<10
	Acetone	µg/L			6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<10	<10	<6.0	6.4	<6.0	<6.0	<6.0	<10	<10
	Acrylonitrile	µg/L	0.07 ***		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	Benzene	µg/L	1 ***	5 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Bromochloromethane	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Bromodichloromethane	µg/L	0.3 ***	80 * THM	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20

Table G-2. Groundwater Quality Data, Fourth Quarter 2018 through Second Quarter 2020, Horn Rapids Landfill

	Analyte	Units	GWQS	MCL	MW-1 11/28/2018	MW-1 3/20/2019	MW-1 6/12/2019	MW-1 9/4/2019	MW-1 12/16/2019	MW-1 3/24/2020	MW-1 6/17/2020	MW-2 11/28/2018	MW-2 3/21/2019	MW-2 6/12/2019	MW-2 9/4/2019	MW-21 (MW-2 9/4/2019	MW-2 12/17/2019	MW-2 3/24/2020	MW-2 6/17/2020
VOLATILE ORGANIC COMPOUNDS (Cont.)	Bromoform	µg/L	5 ***	80 * THM	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Bromomethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Carbon Disulfide	µg/L			<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
	Carbon Tetrachloride	µg/L	0.3 ***	5 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Chlorobenzene	µg/L		100 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Chloroethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Chloroform	µg/L	7 ***	80 * THM	<0.20	<0.20	<0.20	0.26	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Chloromethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	cis-1,2-Dichloroethene	µg/L		70 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	cis-1,3-Dichloropropene	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Dibromochloromethane	µg/L		80 * THM	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Dibromomethane	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Ethylbenzene	µg/L		700 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Iodomethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	m,p-Xylene	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Methylene Chloride	µg/L	5 ***	5 *	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	o-Xylene	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Styrene	µg/L		100 *	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<1.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<1.0
	Tetrachloroethene	µg/L	0.8 ***	5 *	**3.8**	**4.0**	**2.6**	**1.9**	**3.7**	**5.3**	**4.7**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Toluene	µg/L		1000 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Total Xylenes	µg/L		10000 * XYL	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	trans-1,2-Dichloroethene	µg/L		100 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	trans-1,3-Dichloropropene	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	trans-1,4-Dichloro-2-butene	µg/L			<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Trichloroethene	µg/L	3 ***	5 *	0.22	0.26	<0.20	<0.20	0.22	0.31	0.33	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Trichlorofluoromethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Vinyl Acetate	µg/L			<1.0	<1.0	<1.0	<1.5	<1.5	<2.0	<2.0	<1.0	<1.0	<1.0	<1.5	<1.5	<1.5	<2.0	<2.0
	Vinyl Chloride	µg/L	0.02 ***	2 *	<0.020	<0.020	<0.02	<0.02	<0.02	<0.020	<0.020	<0.020	<0.020	<0.02	<0.02	<0.02	<0.02	<0.020	<0.020
NATURAL ATTENUATION	Methane	µg/L			<1.2	<0.58	<0.58	<0.58	<12	<0.58	<0.58	<1.2	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58
	Ethane	µg/L			<10	<1.1	<1.1	<1.1	<22	<1.1	<1.1	<10	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1
	Ethene	µg/L			<10	<1.0	<1.0	<1.0	<20	<1.0	<1.0	<10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Table G-2. Groundwater Quality Data, Fourth Quarter 2018 through Second Quarter 2020, Horn Rapids Landfill

	Analyte	Units	GWQS	MCL	MW-3 11/28/2018	MW-3 3/21/2019	MW-3 6/13/2019	MW-3 12/17/2019	MW-21 (MW-3 12/17/2019	MW-3 3/24/2020	MW-3 6/17/2020	MW-4 11/28/2018	MW-4 3/20/2019	MW-4 6/13/2019	MW-4 9/5/2019	MW-4 12/16/2019	MW-4 3/24/2020	MW-21 (MW-4 3/24/2020	MW-4 6/17/2020
VOLATILE ORGANIC COMPOUNDS (Cont.)	Bromoform	µg/L	5 ***	80 * THM	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Bromomethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Carbon Disulfide	µg/L			<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
	Carbon Tetrachloride	µg/L	0.3 ***	5 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Chlorobenzene	µg/L		100 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Chloroethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Chloroform	µg/L	7 ***	80 * THM	5.3	4.9	5.1	6.4	6.4	6.7	6.2	0.32	0.29	0.28	0.28	0.27	0.33	0.34	0.33
	Chloromethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	cis-1,2-Dichloroethene	µg/L		70 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	2.9	2.8	3.2	3.1	3.3	3.7	3.7	4.4
	cis-1,3-Dichloropropene	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Dibromochloromethane	µg/L		80 * THM	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Dibromomethane	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Ethylbenzene	µg/L		700 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Iodomethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	m,p-Xylene	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Methylene Chloride	µg/L	5 ***	5 *	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	o-Xylene	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Styrene	µg/L		100 *	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<1.0	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<1.0	<1.0
	Tetrachloroethene	µg/L	0.8 ***	5 *	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Toluene	µg/L		1000 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Total Xylenes	µg/L		10000 * XYL	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	trans-1,2-Dichloroethene	µg/L		100 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	trans-1,3-Dichloropropene	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	trans-1,4-Dichloro-2-butene	µg/L			<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Trichloroethene	µg/L	3 ***	5 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	0.20	0.24	0.21	0.24	0.26	0.31
	Trichlorofluoromethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.98	0.95	0.89	0.96	1.1	1.1	1.4	1.5
	Vinyl Acetate	µg/L			<1.0	<1.0	<1.0	<1.5	<1.5	<2.0	<2.0	<1.0	<1.0	<1.0	<1.5	<1.5	<2.0	<2.0	<2.0
	Vinyl Chloride	µg/L	0.02 ***	2 *	<0.020	<0.020	<0.02	<0.02	<0.02	<0.020	<0.020	<0.020	<0.020	**0.027**	0.020	**0.028**	**0.037**	**0.050**	**0.048**
NATURAL ATTENUATION	Methane	µg/L			<1.2	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58	<1.2	<0.58	450 R	<0.58	<0.58	<0.58	<0.58	<0.58
	Ethane	µg/L			<10	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<10	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1
	Ethene	µg/L			<10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Table G-2. Groundwater Quality Data, Fourth Quarter 2018 through Second Quarter 2020, Horn Rapids Landfill

	Analyte	Units	GWQS	MCL	MW-5 11/27/2018	MW-5 3/21/2019	MW-5 6/12/2019	MW-5 9/4/2019	MW-5 12/17/2019	MW-5 3/25/2020	MW-5 6/18/2020	MW-21 (MW-5 6/18/2020	MW-6 11/28/2018	MW-6 3/21/2019	MW-6 6/13/2019	MW-21 (MW-6 6/13/2019	MW-6 9/5/2019	MW-6 12/17/2019	MW-6 3/25/2020	MW-6 6/18/2020
VOLATILE ORGANIC COMPOUNDS (Cont.)	Bromoform	µg/L	5 ***	80 * THM	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Bromomethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Carbon Disulfide	µg/L			<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
	Carbon Tetrachloride	µg/L	0.3 ***	5 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Chlorobenzene	µg/L		100 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Chloroethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Chloroform	µg/L	7 ***	80 * THM	<0.20	<0.20	0.53	1.5	0.82	0.41	0.26	0.28	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Chloromethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	cis-1,2-Dichloroethene	µg/L		70 *	31	29	9.4	4.4	16	25	27	28	50	48	46	48	58	56	49	46
	cis-1,3-Dichloropropene	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Dibromochloromethane	µg/L		80 * THM	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Dibromomethane	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Ethylbenzene	µg/L		700 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Iodomethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	m,p-Xylene	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Methylene Chloride	µg/L	5 ***	5 *	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	o-Xylene	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Styrene	µg/L		100 *	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<1.0	<1.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<1.0
	Tetrachloroethene	µg/L	0.8 ***	5 *	**13**	**12**	**6.1**	**4.3**	**8.1**	**10**	**11**	**11**	**21**	**20**	**28**	**28**	**21**	**29**	**20**	**18**
	Toluene	µg/L		1000 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Total Xylenes	µg/L		10000 * XYL	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	trans-1,2-Dichloroethene	µg/L		100 *	0.61	0.48	<0.20	<0.20	0.22	0.38	0.45	0.49	1.7	1.3	1.6	1.6	1.3	1.4	1.2	1.3
	trans-1,3-Dichloropropene	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	trans-1,4-Dichloro-2-butene	µg/L			<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Trichloroethene	µg/L	3 ***	5 *	**5.3**	**5.5**	2.2	1.2	2.7	**3.8**	**5.0**	**5.1**	**11**	**11**	**14**	**13**	**12**	**13**	**11**	**11**
	Trichlorofluoromethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Vinyl Acetate	µg/L			<1.0	<1.0	<1.0	<1.5	<1.5	<2.0	<2.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.5	<1.5	<2.0	<2.0
	Vinyl Chloride	µg/L	0.02 ***	2 *	**3.4**	**2.6**	**0.23**	<0.02	**0.48**	**1.1**	**1.9**	**1.9**	**2.9**	**2.2**	**2.8**	**2.6**	**2.3**	**2.9**	**2.2**	**2.4**
NATURAL ATTENUATION	Methane	µg/L			1600	2200	4700 R	450	1900	2300	2300	2100	4300	4300	<0.58 R	4300 J	2300 H	5200	3300	3500
	Ethane	µg/L			<10	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<10	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1
	Ethene	µg/L			<10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Table G-2. Groundwater Quality Data, Fourth Quarter 2018 through Second Quarter 2020, Horn Rapids Landfill

	Analyte	Units	GWQS	MCL	MW-8 11/27/2018	MW-8 3/20/2019	MW-8 6/12/2019	MW-8 9/4/2019	MW-8 12/16/2019	MW-8 3/25/2020	MW-8 6/17/2020	MW-9 11/27/2018	MW-9 3/20/2019	MW-9 6/12/2019	MW-9 9/4/2019	MW-9 12/16/2019	MW-9 3/24/2020	MW-9 6/18/2020
VOLATILE ORGANIC COMPOUNDS (Cont.)	Bromoform	µg/L	5 ***	80 * THM	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Bromomethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Carbon Disulfide	µg/L			<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
	Carbon Tetrachloride	µg/L	0.3 ***	5 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Chlorobenzene	µg/L		100 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Chloroethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Chloroform	µg/L	7 ***	80 * THM	**12**	**9.2**	**14**	**15**	**7.7**	5.9	4.9	0.30	0.25	0.26	0.29	0.20	0.22	<0.20
	Chloromethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	cis-1,2-Dichloroethene	µg/L		70 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	14	10	14	14	8.5	9.0	8.9
	cis-1,3-Dichloropropene	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Dibromochloromethane	µg/L		80 * THM	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Dibromomethane	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Ethylbenzene	µg/L		700 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Iodomethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	m,p-Xylene	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Methylene Chloride	µg/L	5 ***	5 *	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	o-Xylene	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Styrene	µg/L		100 *	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<1.0	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<1.0
	Tetrachloroethene	µg/L	0.8 ***	5 *	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	**11**	**10**	**11**	**9.9**	**10**	**11**	**11**
	Toluene	µg/L		1000 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Total Xylenes	µg/L		10000 * XYL	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	trans-1,2-Dichloroethene	µg/L		100 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.45	0.33	0.44	0.33	0.25	0.32	0.30
	trans-1,3-Dichloropropene	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	trans-1,4-Dichloro-2-butene	µg/L			<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Trichloroethene	µg/L	3 ***	5 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	**5.0**	**4.6**	**5.5**	**5.4**	**3.3**	**3.9**	**4.0**
	Trichlorofluoromethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Vinyl Acetate	µg/L			<1.0	<1.0	<1.0	<1.5	<1.5	<2.0	<2.0	<1.0	<1.0	<1.0	<1.5	<1.5	<2.0	<2.0
	Vinyl Chloride	µg/L	0.02 ***	2 *	<0.020	<0.020	<0.02	<0.02	<0.02	<0.020	<0.020	<0.020	<0.020	**0.027**	<0.02	<0.02	<0.020	**0.025**
NATURAL ATTENUATION	Methane	µg/L			<1.2	<0.58	2.3	<0.58	<0.58	<0.58	<0.58	1.9	2.5	2.2	1.6	1.4	1.5	5.1
	Ethane	µg/L			<10	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<10	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1
	Ethene	µg/L			<10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Table G-2. Groundwater Quality Data, Fourth Quarter 2018 through Second Quarter 2020, Horn Rapids Landfill

	Analyte	Units	GWQS	MCL	MW-10 11/27/2018	MW-10 3/20/2019	MW-10 6/13/2019	MW-10 9/4/2019	MW-10 12/16/2019	MW-10 3/25/2020	MW-10 6/17/2020	MW-11 11/27/2018	MW-11 3/20/2019	MW-11 6/12/2019	MW-11 9/4/2019	MW-11 12/16/2019	MW-11 3/25/2020	MW-11 6/17/2020
VOLATILE ORGANIC COMPOUNDS (Cont.)	Bromoform	µg/L	5 ***	80 * THM	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Bromomethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Carbon Disulfide	µg/L			<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
	Carbon Tetrachloride	µg/L	0.3 ***	5 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Chlorobenzene	µg/L		100 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Chloroethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Chloroform	µg/L	7 ***	80 * THM	0.64	0.80	0.91	0.93	0.55	0.55	0.64	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Chloromethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	cis-1,2-Dichloroethene	µg/L		70 *	18	14	12	12	9.3	11	12	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	cis-1,3-Dichloropropene	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Dibromochloromethane	µg/L		80 * THM	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Dibromomethane	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Ethylbenzene	µg/L		700 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Iodomethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	m,p-Xylene	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Methylene Chloride	µg/L	5 ***	5 *	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	o-Xylene	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Styrene	µg/L		100 *	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<1.0	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<1.0
	Tetrachloroethene	µg/L	0.8 ***	5 *	**6.9**	**5.9**	**5.9**	**6.5**	**6.9**	**6.7**	**6.8**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Toluene	µg/L		1000 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Total Xylenes	µg/L		10000 * XYL	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	trans-1,2-Dichloroethene	µg/L		100 *	0.27	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	trans-1,3-Dichloropropene	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	trans-1,4-Dichloro-2-butene	µg/L			<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Trichloroethene	µg/L	3 ***	5 *	**3.4**	**3.2**	3.0	3.0	2.8	3.0	**3.6**	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Trichlorofluoromethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Vinyl Acetate	µg/L			<1.0	<1.0	<1.0	<1.5	<1.5	<2.0	<2.0	<1.0	<1.0	<1.0	<1.5	<1.5	<2.0	<2.0
	Vinyl Chloride	µg/L	0.02 ***	2 *	**0.49**	**0.42**	**0.40**	<0.02	**0.36**	**0.46**	**0.52**	<0.020	<0.020	<0.02	<0.02	<0.02	<0.020	<0.020
NATURAL ATTENUATION	Methane	µg/L			2300	1600	1100	1400 H	1300	1300	1500	<1.2	<0.58	<0.58	<0.58	<0.58	<0.58	<0.58
	Ethane	µg/L			<10	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<10	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1
	Ethene	µg/L			<10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Table G-2. Groundwater Quality Data, Fourth Quarter 2018 through Second Quarter 2020, Horn Rapids Landfill

	Analyte	Units	GWQS	MCL	MW-12 11/28/2018	MW-21 (MW-12 11/28/2018	MW-12 3/21/2019	MW-21 (MW-12 3/21/2019	MW-12 6/12/2019	MW-12 9/5/2019	MW-12 12/17/2019	MW-12 3/24/2020	MW-12 6/17/2020	Trip Blank 11/27/2018	Trip Blank 3/21/2019	Trip Blank 6/12/2019	Trip Blank 9/4/2019	Trip Blank 12/16/2019	Trip Blank 3/24/2020	Trip Blank 6/17/2020
VOLATILE ORGANIC COMPOUNDS (Cont.)	Bromoform	µg/L	5 ***	80 * THM	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Bromomethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Carbon Disulfide	µg/L			6.5	5.8	1.2	0.66	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
	Carbon Tetrachloride	µg/L	0.3 ***	5 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Chlorobenzene	µg/L		100 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Chloroethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Chloroform	µg/L	7 ***	80 * THM	**8.1**	**8.1**	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Chloromethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	cis-1,2-Dichloroethene	µg/L		70 *	0.34	0.36	0.28	0.31	0.27	0.29	0.21	0.29	0.31	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	cis-1,3-Dichloropropene	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Dibromochloromethane	µg/L		80 * THM	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Dibromomethane	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Ethylbenzene	µg/L		700 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Iodomethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	m,p-Xylene	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Methylene Chloride	µg/L	5 ***	5 *	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
	o-Xylene	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Styrene	µg/L		100 *	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<1.0	<0.50	<0.50	<0.50	<0.50	<0.50	<1.0	<1.0
	Tetrachloroethene	µg/L	0.8 ***	5 *	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Toluene	µg/L		1000 *	0.88	0.87	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Total Xylenes	µg/L		10000 * XYL	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	trans-1,2-Dichloroethene	µg/L		100 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	trans-1,3-Dichloropropene	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	trans-1,4-Dichloro-2-butene	µg/L			<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
	Trichloroethene	µg/L	3 ***	5 *	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	Trichlorofluoromethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Vinyl Acetate	µg/L			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.5	<2.0	<2.0	<1.0	<1.0	<1.0	<1.5	<1.5	<2.0	<2.0
	Vinyl Chloride	µg/L	0.02 ***	2 *	<0.020	<0.020	<0.020	<0.020	<0.02	<0.02	<0.02	<0.020	<0.020	<0.020	<0.020	<0.02	<0.02	<0.02	<0.020	<0.020
NATURAL ATTENUATION	Methane	µg/L			7.1	7.9	11	15	3.2	<0.58	<0.58	<0.58	<0.58	<1.2	<0.58	<0.58	<0.58	NA	<0.58	<0.58
	Ethane	µg/L			<10	<10	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<1.1	<10	<1.1	<1.1	<1.1	NA	<1.1	<1.1
	Ethene	µg/L			<10	<10	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<10	<1.0	<1.0	<1.0	NA	<1.0	<1.0

Notes:

GWQS = Water Quality Standards for Ground Waters of the State of Washington (WAC 173-200)
MCL = Maximum Contaminant Level, State Drinking Water Regulations (WAC 246-290)
* = Primary
** = Secondary
*** = Carcinogen
*THM = Primary MCL for the sum of all trihalomethanes
*XYL = Primary MCL for the sum of all xylenes
J = Estimated value
R = Rejected value
H = Estimated value; analyzed beyond specified holding time
B = Detected in reagent blank or trip blank
Bold = Does not meet GWQS or MCL
NA = Not analyzed

Table G-3. Historical Groundwater Quality Results, WAC 173-351 Appendix III Parameters, Horn Rapids Landfill

Analyte		Units	GWQS	MCL	MW-6 6/26/2014	MW-9 6/26/2014	MW-5 6/25/2015	MW-8 6/24/2015	MW-4 6/27/2016	MW-10 6/27/2016	MW-6 5/24/2017	MW-6 8/29/2017	MW-10 6/19/2018	MW-5 6/12/2019	MW-9 6/18/2020
VOLATILE ORGANIC COMPOUNDS	1,1,1,2-Tetrachloroethane	µg/L			NA	NA	NA	NA	NA	NA	NA	NA	<1.0	<1.0	<1.0
	1,1,1-Trichloroethane	µg/L	200 *	200 *	NA	NA	NA	NA	NA	NA	NA	NA	<1.0	<1.0	<1.0
	1,1,2,2-Tetrachloroethane	µg/L			NA	NA	NA	NA	NA	NA	NA	NA	<1.0	<1.0	<1.0
	1,1,2-Trichloroethane	µg/L		5 *	NA	NA	NA	NA	NA	NA	NA	NA	<1.0	<1.0	<1.0
	1,1-Dichloroethane	µg/L	1 ***		NA	NA	NA	NA	NA	NA	NA	NA	**8.5**	**2.1**	**1.5**
	1,1-Dichloroethene	µg/L		7 *	NA	NA	NA	NA	NA	NA	NA	NA	<1.0	<1.0	<1.0
	1,1-Dichloropropene	µg/L			NA	NA	<1.0	<1.0	<1.0	<1.0	NA	NA	<1.0	<1.0	<1.0
	1,2,3-Trichloropropane	µg/L			NA	NA	NA	NA	NA	NA	NA	NA	<2.5	<2.5	<2.5
	1,2-Dibromo-3-Chloropropane	µg/L		0.2 *	NA	NA	NA	NA	NA	NA	NA	NA	<5.0	<5.0	<5.0
	Ethylene dibromide	µg/L	0.001 ***	0.05 *	NA	NA	NA	NA	NA	NA	NA	NA	<1.0	<1.0	<1.0
	1,2-Dichlorobenzene	µg/L		600 *	NA	NA	NA	NA	NA	NA	NA	NA	<1.0	<1.0	<1.0
	1,2-Dichloroethane	µg/L	0.5 ***	5 *	NA	NA	NA	NA	NA	NA	NA	NA	<1.0	<1.0	<1.0
	1,2-Dichloropropane	µg/L	0.6 ***	5 *	NA	NA	NA	NA	NA	NA	NA	NA	<1.0	<1.0	<1.0
	1,3-Dichlorobenzene	µg/L			NA	NA	<1.0	<1.0	<1.0	<1.0	NA	NA	<1.0	<1.0	<1.0
	1,3-Dichloropropane	µg/L			NA	NA	<1.0	<1.0	<1.0	<1.0	NA	NA	<1.0	<1.0	<1.0
	1,4-Dichlorobenzene	µg/L	4 ***	75 *	NA	NA	NA	NA	NA	NA	NA	NA	<1.0	<1.0	<1.0
	2,2-Dichloropropane	µg/L			NA	NA	<1.0	<1.0	<1.0	<1.0	NA	NA	<1.0	<1.0	<1.0
	Methyl ethyl ketone	µg/L			NA	NA	NA	NA	NA	NA	NA	NA	<6.0	<6.0	<6.0
	2-Hexanone	µg/L			NA	NA	NA	NA	NA	NA	NA	NA	<5.0	<5.0	<5.0
	4-Methyl-2-pentanone	µg/L			NA	NA	NA	NA	NA	NA	NA	NA	<5.0	<5.0	<5.0
	Acetone	µg/L			NA	NA	NA	NA	NA	NA	NA	NA	<10	<10	<10
	Acetonitrile	µg/L			NA	NA	<30	<30	<30	<30	NA	NA	<30	<30	<30
	Acrolein	µg/L			NA	NA	<20	<20	<20	<20	NA	NA	<20	<20	<20
	Acrylonitrile	µg/L	0.07 ***		NA	NA	NA	NA	NA	NA	NA	NA	<20	<20	<20
	Allyl Chloride	µg/L			NA	NA	<2.0	<2.0	<2.0	<2.0	NA	NA	<2.0	<2.0	<2.0
	Benzene	µg/L	1 ***	5 *	NA	NA	NA	NA	NA	NA	NA	NA	<1.0	<1.0	<1.0
	Bromoform	µg/L	5 ***	80 * THM	NA	NA	NA	NA	NA	NA	NA	NA	<1.0	<1.0	<1.0
	Bromomethane	µg/L			NA	NA	NA	NA	NA	NA	NA	NA	<2.0	<2.0	<2.0
	Carbon Disulfide	µg/L			NA	NA	NA	NA	NA	NA	NA	NA	<2.0	<2.0	<2.0
	Carbon Tetrachloride	µg/L	0.3 ***	5 *	NA	NA	NA	NA	NA	NA	NA	NA	<1.0	<1.0	<1.0
	Chlorobenzene	µg/L		100 *	NA	NA	NA	NA	NA	NA	NA	NA	<1.0	<1.0	<1.0
	Bromochloromethane	µg/L			NA	NA	NA	NA	NA	NA	NA	NA	<1.0	<1.0	<1.0
	Chlorodibromomethane	µg/L		80 * THM	NA	NA	NA	NA	NA	NA	NA	NA	<1.0	<1.0	<1.0
	Chloroethane	µg/L			NA	NA	NA	NA	NA	NA	NA	NA	<2.0	<2.0	<2.0
	Chloroform	µg/L	7 ***	80 * THM	NA	NA	NA	NA	NA	NA	NA	NA	<1.0	<1.0	<1.0
	Chloromethane	µg/L			NA	NA	NA	NA	NA	NA	NA	NA	<2.0	<2.0	<2.0
	Chloroprene	µg/L			NA	NA	<1.0	<1.0	<1.0	<1.0	NA	NA	<1.0	<1.0	<1.0
	Cis-1,2-Dichloroethene	µg/L		70 *	NA	NA	NA	NA	NA	NA	NA	NA	17	9.5	8.0
	Cis-1,3-Dichloropropene	µg/L			NA	NA	NA	NA	NA	NA	NA	NA	<1.0	<1.0	<1.0
	Dibromomethane	µg/L			NA	NA	NA	NA	NA	NA	NA	NA	<1.0	<1.0	<1.0
	Dichlorobromomethane	µg/L	0.3 ***	80 * THM	NA	NA	NA	NA	NA	NA	NA	NA	<1.0	<1.0	<1.0
	Dichlorodifluoromethane	µg/L			NA	NA	<2.0	<2.0	4.2	2.5	NA	NA	2.8	<2.0	<2.0
	Ethylmethacrylate	µg/L			NA	NA	<3.0	<3.0	<3.0	<3.0	NA	NA	<3.0	<3.0	<3.0
	Ethylbenzene	µg/L		700 *	NA	NA	NA	NA	NA	NA	NA	NA	<1.0	<1.0	<1.0
	Methyl Iodide	µg/L			NA	NA	NA	NA	NA	NA	NA	NA	<1.0	<1.0	<1.0
	Isobutyl Alcohol	µg/L			NA	NA	<110	<110	<110	<110	NA	NA	<110	<110	<110
	Methacrylonitrile	µg/L			NA	NA	<10	<10	<10	<10	NA	NA	<10	<10	<10
	Methyl Methacrylate	µg/L			NA	NA	<4.0	<4.0	<4.0	<4.0	NA	NA	<4.0	<4.0	<4.0
	Methylene Chloride	µg/L	5 ***	5 *	NA	NA	NA	NA	NA	NA	NA	NA	<2.0	<2.0	<2.0
	Propionitrile	µg/L			NA	NA	<20	<20	<20	<20	NA	NA	<20	<20	<20
	Styrene	µg/L		100 *	NA	NA	NA	NA	NA	NA	NA	NA	<1.0	<1.0	<1.0
	Tetrachloroethene	µg/L	0.8 ***	5 *	NA	NA	NA	NA	NA	NA	NA	NA	6.2	5.8	**11**
	Toluene	µg/L		1000 *	NA	NA	NA	NA	NA	NA	NA	NA	<1.0	<1.0	<1.0
	Trans-1,2-Dichloroethene	µg/L		100 *	NA	NA	NA	NA	NA	NA	NA	NA	<1.0	<1.0	<1.0

Table G-3. Historical Groundwater Quality Results, WAC 173-351 Appendix III Parameters, Horn Rapids Landfill

	Analyte	Units	GWQS	MCL	MW-6 6/26/2014	MW-9 6/26/2014	MW-5 6/25/2015	MW-8 6/24/2015	MW-4 6/27/2016	MW-10 6/27/2016	MW-6 5/24/2017	MW-6 8/29/2017	MW-10 6/19/2018	MW-5 6/12/2019	MW-9 6/18/2020
VOLATILE ORGANIC COMPOUNDS (cont.)	Trans-1,3-Dichloropropene	µg/L			NA	NA	NA	NA	NA	NA	NA	NA	<3.0	<3.0	<3.0
	Trans-1,4-Dichloro-2-butene	µg/L			NA	NA	NA	NA	NA	NA	NA	NA	<3.0	<3.0	<3.0
	Trichloroethene	µg/L	3 ***	5 *	NA	NA	NA	NA	NA	NA	NA	NA	**3.4**	2.5	**3.3**
	Trichlorofluoromethane	µg/L			NA	NA	NA	NA	NA	NA	NA	NA	<2.0	<2.0	<2.0
	Vinyl Acetate	µg/L			NA	NA	NA	NA	NA	NA	NA	NA	<3.0	<3.0	<3.0
	Vinyl Chloride	µg/L	0.02 ***	2 *	NA	NA	NA	NA	NA	NA	NA	NA	<1.0	<1.0	<1.0
	Total Xylenes	µg/L		10000 * XYL	NA	NA	NA	NA	NA	NA	NA	NA	<2.0	<2.0	<2.0
SEMIVOLATILE ORGANIC COMPOUNDS	1,2,4,5-Tetrachlorobenzene	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	1,2,4-Trichlorobenzene	µg/L			<3.8	<3.8	<4.0	<4.1	<3.9	<3.8	NA	<3.8	<3.8	<3.8	<3.8
	1,2-Dichlorobenzene	µg/L		60 *	<3.8	<3.8	<4.0	<4.1	<3.9	<3.8	NA	<3.8	<3.8	<3.8	<3.8
	1,3,5-Trinitrobenzene	µg/L			<47	<48	<50	<51	<48	<48	NA	<48	<47	<48	<48
	1,3-Dichlorobenzene	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	1,3-Dinitrobenzene	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	1,4-Dichlorobenzene	µg/L	4 ***	75 *	<3.8	<3.8	<4.0	<4.1	<3.9	<3.8	NA	<3.8	<3.8	<3.8	<3.8
	1-Naphthylamine	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	2,2'-oxybis[1-chloropropane]	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	2,3,4,6-Tetrachlorophenol	µg/L			<47	<48	<50	<51	<48	<48	NA	<48	<47	<48	<48
	2,4,5-Trichlorophenol	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	2,4,6-Trichlorophenol	µg/L	4 ***		<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	2,4-Dichlorophenol	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	2,4-Dimethylphenol	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	2,4-Dinitrophenol	µg/L			<28	<29	<30	<31	<29	<29	NA	<29	<28	<29	<29
	2,4-Dinitrotoluene	µg/L	0.1 ***		<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	2,6-Dichlorophenol	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	2,6-Dinitrotoluene	µg/L	0.1 ***		<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	2-Acetylaminofluorene	µg/L			<95	<95	<100	<100	<97	<96	NA	<95	<95	<96	<95
	2-Chloronaphthalene	µg/L			<3.8	<3.8	<4.0	<4.1	<3.9	<3.8	NA	<3.8	<3.8	<3.8	<3.8
	2-Chlorophenol	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	2-Methylnaphthalene	µg/L			<3.8	<3.8	<4.0	<4.1	<3.9	<3.8	NA	<3.8	<3.8	<3.8	<3.8
	2-Methylphenol	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	2-Nitroaniline	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	2-Nitrophenol	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	2-Toluidine	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	3 & 4 Methylphenol	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	3,3'-Dichlorobenzidine	µg/L			<47	<48	<50	<51	<48	<48	NA	<48	<47	<48	<48
	3-Methylcholanthrene	µg/L			<19	<19	<20	<20	<19	<19	NA	<19	<19	<19	<19
	4,6-Dinitro-2-Methylphenol	µg/L			<47	<48	<50	<51	<48	<48	NA	<48	<47	<48	<48
	4-Aminobiphenyl	µg/L			<47	<48	<50	<51	<48	<48	NA	<48	<47	<48	<48
	4-Bromophenyl phenyl ether	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	4-Chloro-3-Methylphenol	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	4-Chloroaniline	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	4-Chlorophenyl-Phenylether	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	4-Nitroaniline	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	4-Nitrophenol	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	7,12-Dimethylbenz(a)anthracene	µg/L			<19	<19	<20	<20	<19	<19	NA	<19	<19	<19	<19
	a,a-Dimethylphenethylamine	µg/L			<47	<48	<50	<51	<48	<48	NA	<48	<47	<48	<48
	Acenaphthene	µg/L			<3.8	<3.8	<4.0	<4.1	<3.9	<3.8	NA	<3.8	<3.8	<3.8	<3.8
	Acenaphthylene	µg/L			<3.8	<3.8	<4.0	<4.1	<3.9	<3.8	NA	<3.8	<3.8	<3.8	<3.8
	Anthracene	µg/L			<3.8	<3.8	<4.0	<4.1	<3.9	<3.8	NA	<3.8	<3.8	<3.8	<3.8
	Benzidine, 3,3-Dimethyl-	µg/L	0.007 ***		<19	<19	<20	<20	<19	<19	NA	<19	<19	<19	<19
	Benzo[a]anthracene	µg/L			<3.8	<3.8	<4.0	<4.1	<3.9	<3.8	NA	<3.8	<3.8	<3.8	<3.8
	Benzo[a]pyrene	µg/L	0.008 ***	0.2 *	<3.8	<3.8	<4.0	<4.1	<3.9	<3.8	NA	<3.8	<3.8	<3.8	<3.8
	Benzo[b]fluoranthene	µg/L			<3.8	<3.8	<4.0	<4.1	<3.9	<3.8	NA	<3.8	<3.8	<3.8	<3.8
	Benzo[g,h,i]perylene	µg/L			<3.8	<3.8	<4.0	<4.1	<3.9	<3.8	NA	<3.8	<3.8	<3.8	<3.8

Table G-3. Historical Groundwater Quality Results, WAC 173-351 Appendix III Parameters, Horn Rapids Landfill

	Analyte	Units	GWQS	MCL	MW-6 6/26/2014	MW-9 6/26/2014	MW-5 6/25/2015	MW-8 6/24/2015	MW-4 6/27/2016	MW-10 6/27/2016	MW-6 5/24/2017	MW-6 8/29/2017	MW-10 6/19/2018	MW-5 6/12/2019	MW-9 6/18/2020
SEMIVOLATILE ORGANIC COMPOUNDS (Cont.)	Benzo[k]fluoranthene	µg/L			<3.8	<3.8	<4.0	<4.1	<3.9	<3.8	NA	<3.8	<3.8	<3.8	<3.8
	Benzyl Alcohol	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	Bis(2-Chloroethoxy)Methane	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	Bis(2-Chloroethyl)Ether	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	Bis(2-Ethylhexyl) Phthalate	µg/L	6 ***		<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	Butyl benzyl phthalate	µg/L			<3.8	<3.8	<4.0	<4.1	<3.9	<3.8	NA	<3.8	<3.8	<3.8	<3.8
	Chlorobenzilate	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	Chrysene	µg/L			<3.8	<3.8	<4.0	<4.1	<3.9	<3.8	NA	<3.8	<3.8	<3.8	<3.8
	Di-allate (Avadex)	µg/L	1 ***		<5.3	<5.3	<5.6	<5.7	<5.4	<5.4	NA	<5.3	<5.3	<5.4	<5.3
	Dibenzo(a,h)anthracene	µg/L			<3.8	<3.8	<4.0	<4.1	<3.9	<3.8	NA	<3.8	<3.8	<3.8	<3.8
	Dibenzofuran	µg/L			<3.8	<3.8	<4.0	<4.1	<3.9	<3.8	NA	<3.8	<3.8	<3.8	<3.8
	Di-n-butyl phthalate	µg/L			<3.8	<3.8	<4.0	<4.1	<3.9	<3.8	NA	<3.8	<3.8	<3.8	<3.8
	Diethyl phthalate	µg/L			<3.8	<3.8	<4.0	<4.1	<3.9	<3.8	NA	<3.8	<3.8	<3.8	<3.8
	Dimethoate	µg/L			<19	<19	<20	<20	<19	<19	NA	<19	<19	<19	<19
	Dimethyl phthalate	µg/L			<3.8	<3.8	<4.0	<4.1	<3.9	<3.8	NA	<3.8	<3.8	<3.8	<3.8
	Di-N-Octyl Phthalate	µg/L			<3.8	<3.8	<4.0	<4.1	<3.9	<3.8	NA	<3.8	<3.8	<3.8	<3.8
	Diphenylamine	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	Disulfoton (Di-Syston)	µg/L			<47	<48	<50	<51	<48	<48	NA	<48	<47	<48	<48
	Acetophenone	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	Ethyl Methanesulfonate	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	Famphur	µg/L			<95	<95	<100	<100	<97	<96	NA	<95	<95	<96	<95
	Fluoranthene	µg/L			<3.8	<3.8	<4.0	<4.1	<3.9	<3.8	NA	<3.8	<3.8	<3.8	<3.8
	Fluorene	µg/L			<3.8	<3.8	<4.0	<4.1	<3.9	<3.8	NA	<3.8	<3.8	<3.8	<3.8
	Hexachlorobenzene	µg/L	0.05 ***	1 *	<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	Hexachlorobutadiene	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	Hexachlorocyclopentadiene	µg/L		50 *	<47	<48	<50	<51	<48	<48	NA	<48	<47	<48	<48
	Hexachloroethane	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	Hexachloropropene	µg/L			<95	<95	<100	<100	<97	<96	NA	<95	<95	<96	<95
	Indeno(1,2,3-cd)pyrene	µg/L			<3.8	<3.8	<4.0	<4.1	<3.9	<3.8	NA	<3.8	<3.8	<3.8	<3.8
	Isophorone	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	Isosafrole	µg/L			<3.3	<3.3	<3.5	<3.6	<3.4	<3.3	NA	<3.3	<3.3	<3.4	<3.3
	Methapyrilene	µg/L			<47	<48	<50	<51	<48	<48	NA	<48	<47	<48	<48
	Methyl Methanesulfonate	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	Methyl Parathion	µg/L			<47	<48	<50	<51	<48	<48	NA	<48	<47	<48	<48
	m-Nitroaniline	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	Naphthalene	µg/L			<3.8	<3.8	<4.0	<4.1	<3.9	<3.8	NA	<3.8	<3.8	<3.8	<3.8
	Naphthoquinone, 1,4-	µg/L			<47	<48	<50	<51	<48	<48	NA	<48	<47	<48	<48
	Naphthylamine, 2-	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	Nitrobenzene	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	N-Nitrosodiethylamine	µg/L	0.0005 ***		<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	N-Nitrosodimethylamine	µg/L	0.002 ***		<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	N-Nitrosodi-N-Butylamine	µg/L	0.02 ***		<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	N-Nitrosodi-n-propylamine	µg/L	0.01 ***		<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	n-Nitrosodiphenylamine(as diphenylamine)	µg/L	17 ***		<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	N-Nitrosomethylethylamine	µg/L	0.004 ***		<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	N-Nitrosopiperidine	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	N-Nitrosopyrrolidine	µg/L	0.04 ***		<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	O,O,O-Triethyl phosphorothioate	µg/L			<47	<48	<50	<51	<48	<48	NA	<48	<47	<48	<48
	Ethyl Parathion	µg/L			<47	<48	<50	<51	<48	<48	NA	<48	<47	<48	<48
	p-Dimethylamino azobenzene	µg/L			<19	<19	<20	<20	<19	<19	NA	<19	<19	<19	<19
	Pentachlorobenzene	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	Pentachloronitrobenzene	µg/L			<47	<48	<50	<51	<48	<48	NA	<48	<47	<48	<48
	Pentachlorophenol	µg/L		1 *	<47	<48	<50	<51	<48	<48	NA	<48	<47	<48	<48
	Phenacetin	µg/L			<19	<19	<20	<20	<19	<19	NA	<19	<19	<19	<19

Table G-3. Historical Groundwater Quality Results, WAC 173-351 Appendix III Parameters, Horn Rapids Landfill

	Analyte	Units	GWQS	MCL	MW-6 6/26/2014	MW-9 6/26/2014	MW-5 6/25/2015	MW-8 6/24/2015	MW-4 6/27/2016	MW-10 6/27/2016	MW-6 5/24/2017	MW-6 8/29/2017	MW-10 6/19/2018	MW-5 6/12/2019	MW-9 6/18/2020
SEMIVOLATILE ORGANIC COMPOUNDS (Cont.)	Phenanthrene	µg/L			<3.8	<3.8	<4.0	<4.1	<3.9	<3.8	NA	<3.8	<3.8	<3.8	<3.8
	Phenol	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	Phorate	µg/L			<47	<48	<50	<51	<48	<48	NA	<48	<47	<48	<48
	p-Phenylene diamine	µg/L			<95	<95	<100	<100	<97	<96	NA	<95	<95	<96	<95
	Pronamide (Kerb)	µg/L			<19	<19	<20	<20	<19	<19	NA	<19	<19	<19	<19
	Pyrene	µg/L			<9.5	<9.5	<10	<10	<9.7	<9.6	NA	<9.5	<9.5	<9.6	<9.5
	Safrole	µg/L			<19	<19	<20	<20	<19	<19	NA	<19	<19	<19	<19
	Thionazin	µg/L			<47	<48	<50	<51	<48	<48	NA	<48	<47	<48	<48
	Toluidine, 5-Nitro-O-	µg/L			<19	<19	<20	<20	<19	<19	NA	<19	<19	<19	<19
ORGANOCHLORINE PESTICIDES	4,4'-DDD	µg/L	0.3 ***		<0.048	<0.048	<0.049	<0.051	<0.048	<0.047	<0.048	NA	<0.048	<0.048 H	<0.048
	4,4'-DDE	µg/L	0.3 ***		<0.048	<0.048	<0.049	<0.051	<0.048	<0.047	<0.048	NA	<0.048	<0.048 H	<0.048
	4,4'-DDT	µg/L	0.3 ***		<0.048	<0.048	<0.049	<0.051	<0.048	<0.047	<0.048	NA	<0.048	<0.048 H	<0.048
	Aldrin	µg/L	0.005 ***		<0.048	<0.048	<0.049	<0.051	<0.048	<0.047	<0.048	NA	<0.048	<0.048 H	<0.048
	alpha-BHC	µg/L			<0.048	<0.048	<0.049	<0.051	<0.048	<0.047	<0.048	NA	<0.048	<0.048 H	<0.048
	beta-BHC	µg/L			<0.048	<0.048	<0.049	<0.051	<0.048	<0.047	<0.048	NA	<0.048	<0.048 H	<0.048
	delta-BHC	µg/L			<0.048	<0.048	<0.049	<0.051	<0.048	<0.047	<0.048	NA	<0.048	<0.048 H	<0.048
	Dieldrin	µg/L	0.005 ***		<0.048	<0.048	<0.049	<0.051	<0.048	<0.047	<0.048	NA	<0.048	<0.048 H	<0.048
	Endosulfan I	µg/L			<0.048	<0.048	<0.049	<0.051	<0.048	<0.047	<0.048	NA	<0.048	<0.048 H	<0.048
	Endosulfan II	µg/L			<0.048	<0.048	<0.049	<0.051	<0.048	<0.047	<0.048	NA	<0.048	<0.048 H	<0.048
	Endosulfan Sulfate	µg/L			<0.048	<0.048	<0.049	<0.051	<0.048	<0.047	<0.048	NA	<0.048	<0.048 H	<0.048
	Endrin	µg/L	0.2 *	2 *	<0.048	<0.048	<0.049	<0.051	<0.048	<0.047	<0.048	NA	<0.048	<0.048 H	<0.048
	Endrin Aldehyde	µg/L			<0.048	<0.048	<0.049	<0.051	<0.048	<0.047	<0.048	NA	<0.048	<0.048 H	<0.048
	Lindane	µg/L	0.06 ***	0.2 *	<0.048	<0.048	<0.049	<0.051	<0.048	<0.047	<0.048	NA	<0.048	<0.048 H	<0.048
	Heptachlor	µg/L	0.02 ***	0.4 *	<0.048	<0.048	<0.049	<0.051	<0.048	<0.047	<0.048	NA	<0.048	<0.048 H	<0.048
	Heptachlor Epoxide	µg/L	0.009 ***	0.2 *	<0.048	<0.048	<0.049	<0.051	<0.048	<0.047	<0.048	NA	<0.048	<0.048 H	<0.048
	Isodrin	µg/L			<0.095	<0.095	<0.099	<0.10	<0.096	<0.095	<0.095	NA	<0.095	<0.095 H	<0.095
	Kepone	µg/L			<0.95	<0.95	<0.99	<1.0	<0.96	<0.95	<0.95	NA	<0.95	<0.95 H	<0.95
	Methoxychlor	µg/L	100 *	40 *	<0.095	<0.095	<0.099	<0.10	<0.096	<0.095	<0.095	NA	<0.095	<0.095 H	<0.095
	Chlordane, technical	µg/L	0.06 ***	2 *	<0.48	<0.48	<0.49	<0.51	<0.48	<0.47	<0.48	NA	<0.48	<0.48 H	<0.48
	Toxaphene	µg/L	0.08 ***	3 *	<1.9	<1.9	<2.0	<2.0	<1.9	<1.9	<1.9	NA	<1.9	<1.9 H	<1.9
POLYCHLORINATED BIPHENYLS	PCB-aroclor 1016	µg/L	0.01 ***	0.5 *	<0.95	<0.95	<0.99	<1.0	<0.96	<0.95	<0.95	NA	<0.95	<0.95	<0.95
	PCB-aroclor 1221	µg/L	0.01 ***	0.5 *	<0.95	<0.95	<0.99	<1.0	<0.96	<0.95	<0.95	NA	<0.95	<0.95	<0.95
	PCB-aroclor 1232	µg/L	0.01 ***	0.5 *	<0.95	<0.95	<0.99	<1.0	<0.96	<0.95	<0.95	NA	<0.95	<0.95	<0.95
	PCB-aroclor 1242	µg/L	0.01 ***	0.5 *	<0.95	<0.95	<0.99	<1.0	<0.96	<0.95	<0.95	NA	<0.95	<0.95	<0.95
	PCB-aroclor 1248	µg/L	0.01 ***	0.5 *	<0.95	<0.95	<0.99	<1.0	<0.96	<0.95	<0.95	NA	<0.95	<0.95	<0.95
	PCB-aroclor 1254	µg/L	0.01 ***	0.5 *	<0.95	<0.95	<0.99	<1.0	<0.96	<0.95	<0.95	NA	<0.95	<0.95	<0.95
	PCB-aroclor 1260	µg/L	0.01 ***	0.5 *	<0.95	<0.95	<0.99	<1.0	<0.96	<0.95	<0.95	NA	<0.95	<0.95	<0.95
	PCB-aroclor 1262	µg/L	0.01 ***	0.5 *	<0.95	<0.95	<0.99	<1.0	<0.96	<0.95	<0.95	NA	<0.95	<0.95	<0.95
	PCB-aroclor 1268	µg/L	0.01 ***	0.5 *	<0.95	<0.95	<0.99	<1.0	<0.96	<0.95	<0.95	NA	<0.95	<0.95	<0.95
	PCB, Sum of Aroclors	µg/L	0.01 ***	0.5 *	<0.95	<0.95	<0.99	<1.0		NA	<0.95	NA	<0.95	<0.95	<0.95
HERBICIDES	2,4-D	µg/L	100 *	70 *	<3.8	<3.8	<4.0	<4.0	<3.8	<3.8	<3.8	NA	<3.8	<3.8	<3.8
	Dinoseb	µg/L		7 *	<0.95	<0.95	<1.0	<1.0	<0.96	<0.95	<0.95	NA	<0.95	<0.96	<0.95
	2,4,5-T	µg/L			<0.95	<0.95	<1.0	<1.0	<0.96	<0.95	<0.95	NA	<0.95	<0.96	<0.95
	Silvex	µg/L	10 *	50 *	<0.95	<0.95	<1.0	<1.0	<0.96	<0.95	<0.95	NA	<0.95	<0.96	<0.95
	Mercury	µg/L	0.002 *	0.002 *	<0.20	<0.20	<0.00020	<0.00020	<0.20	<0.20	<0.2	NA	<0.20	<0.20	<0.20
	Cyanide	mg/L		0.2 *	<0.01	0.011	<0.060 H	<0.060 H	<0.010	<0.010	<0.060	NA	<0.010	<0.01	<0.040
	Sulfide	mg/L			<4.0	<4.0	<4.0	<4.0	<4.0 H	<4.0 H	<4.0	NA	<4.0	<4	<4.0
	2,3,7,8-TCDD	pg/L		0.6	NA	NA	<10	<10	<9.5	<9.5	<9.7	NA	<9.5	<9.5	<9.5
	2,3,7,8-TCDF	pg/L			NA	NA	NA	NA	<9.5	<9.5	<9.7	NA	NA	NA	NA

Table G-3. Historical Groundwater Quality Results, WAC 173-351 Appendix III Parameters, Horn Rapids Landfill

				MW-6	MW-9	MW-5	MW-8	MW-4	MW-10	MW-6	MW-6	MW-10	MW-5	MW-9
Analyte	**Units**	**GWQS**	**MCL**	**6/26/2014**	**6/26/2014**	**6/25/2015**	**6/24/2015**	**6/27/2016**	**6/27/2016**	**5/24/2017**	**8/29/2017**	**6/19/2018**	**6/12/2019**	**6/18/2020**

Notes: = Chapter 173-351 WAC
= Water Quality Standards for Ground Waters of the State of Washington (WAC 173-200)
= Maximum Contaminant Level, State Drinking Water Regulations (WAC 246-290)
= Primary
= Secondary
= Carcinogen
= Primary MCL for the sum of all trihalomethanes
= Primary MCL for the sum of all xylenes
= Does not meet GWQS or MCL
= Estimated value; analyzed beyond specified holding time
= Sample was prepared or analyzed beyond the specified holding time

G-2

Time Series Plots

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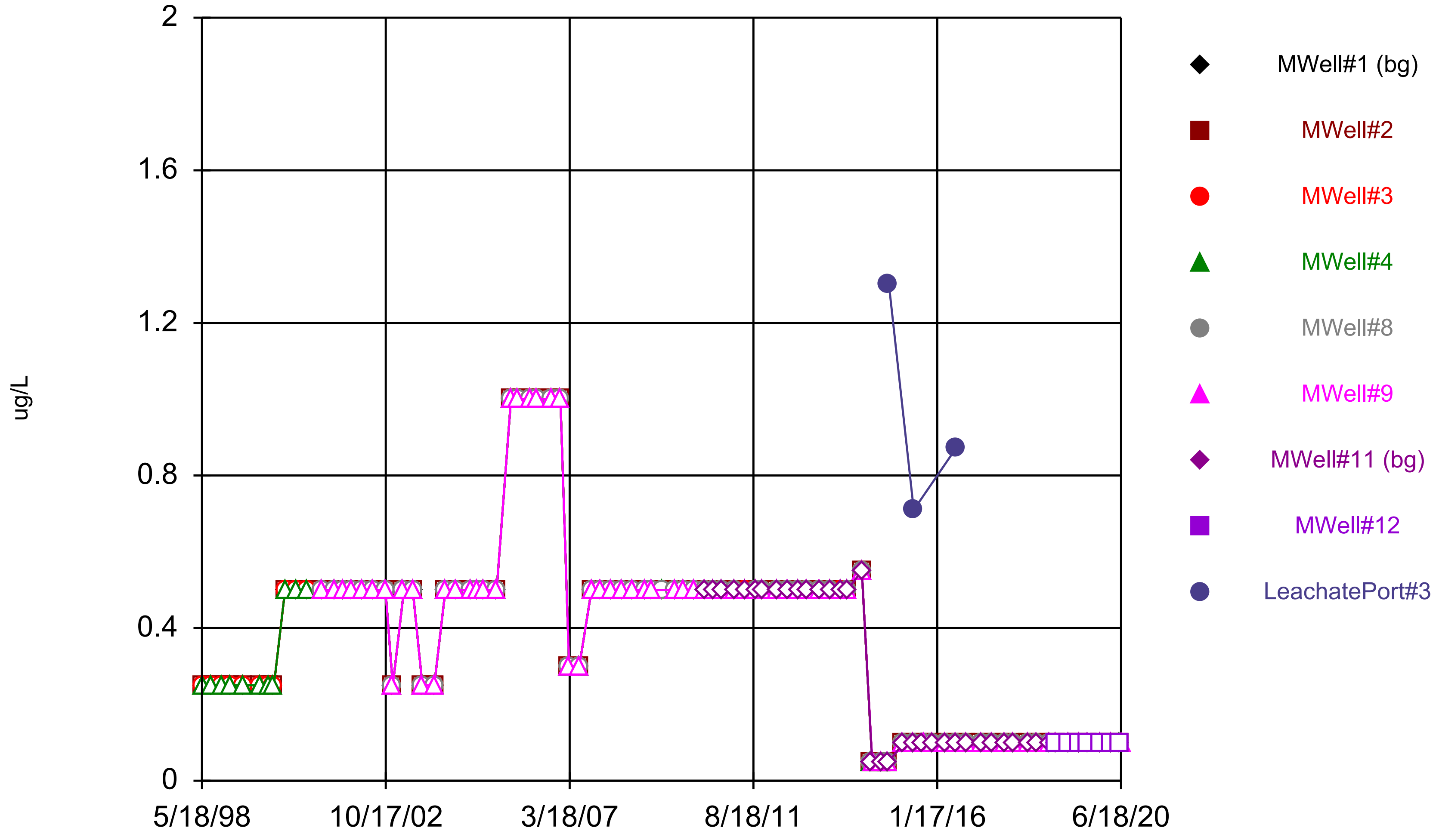
Hollow symbols indicate censored values.

Time Series



Constituent: 1,2-Dichloroethane Analysis Run 10/16/2020 10:11 AM View: HRLF_TSP Set1

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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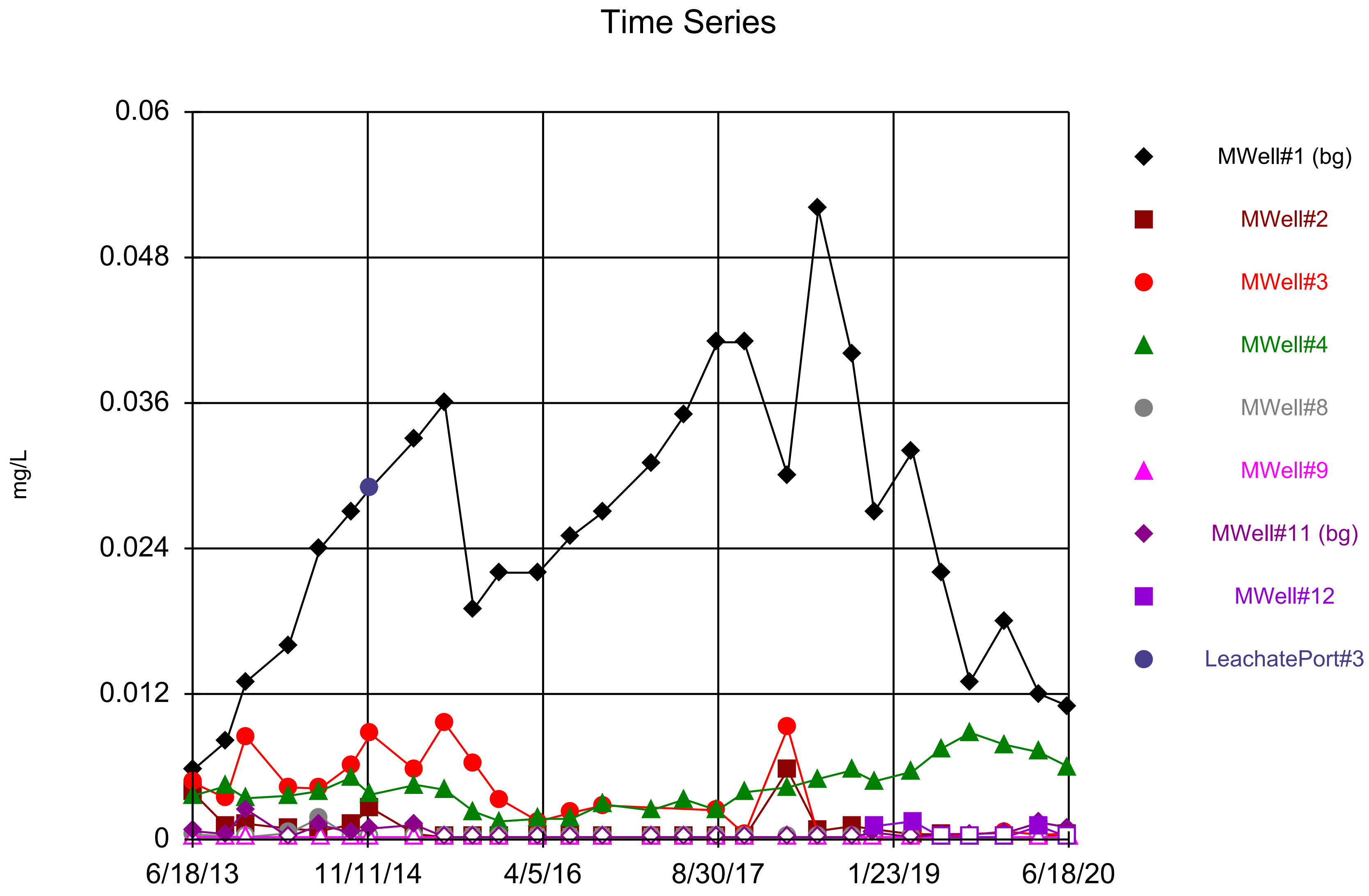
Hollow symbols indicate censored values.



Constituent: Cobalt, Total   Analysis Run 10/13/2020 3:35 PM   View: HRLF_TSP Set1

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

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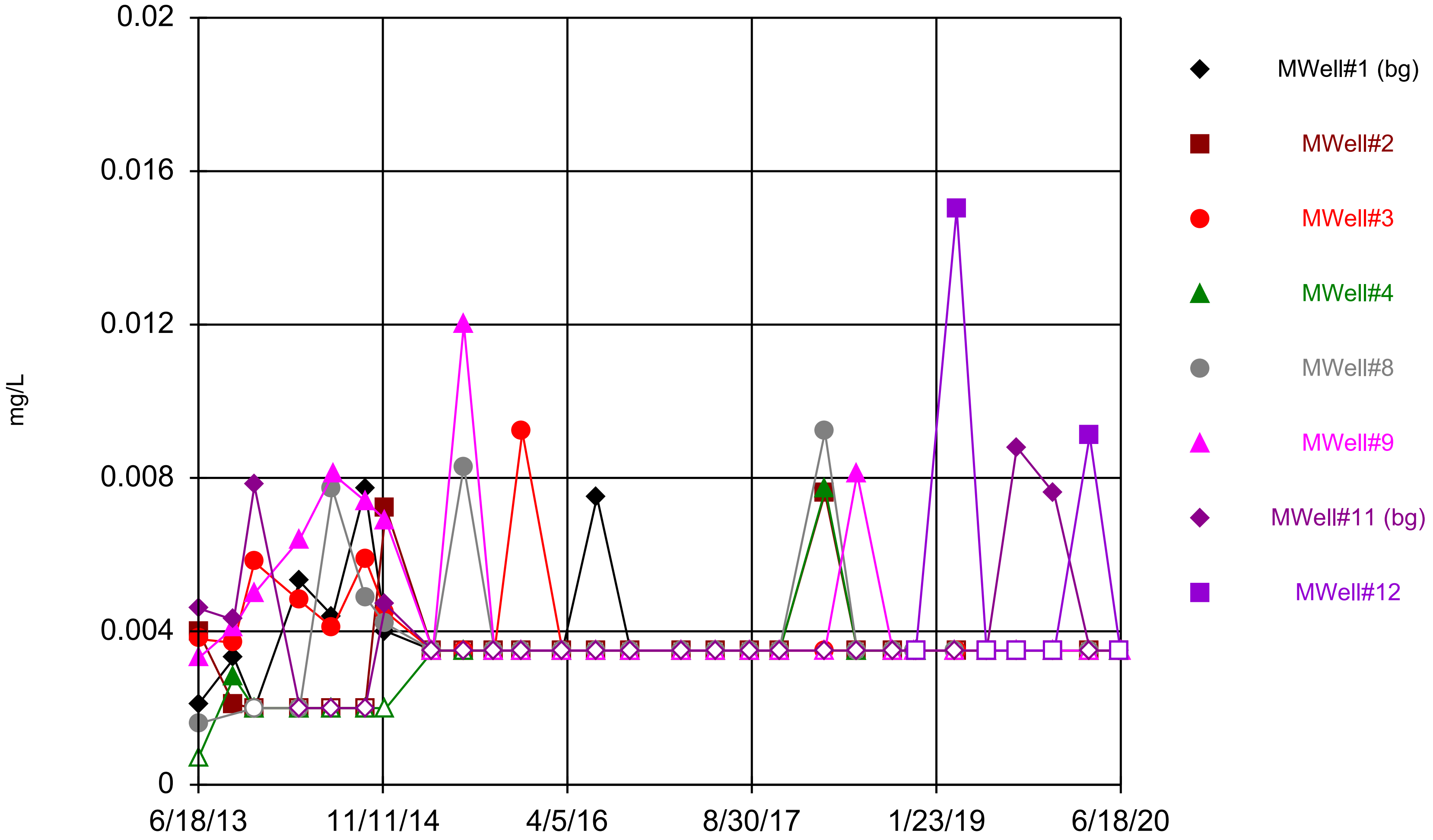
Hollow symbols indicate censored values.

Time Series



Constituent: Zinc, Total   Analysis Run 10/23/2020 12:10 PM   View: HRLF_TSP Set1

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

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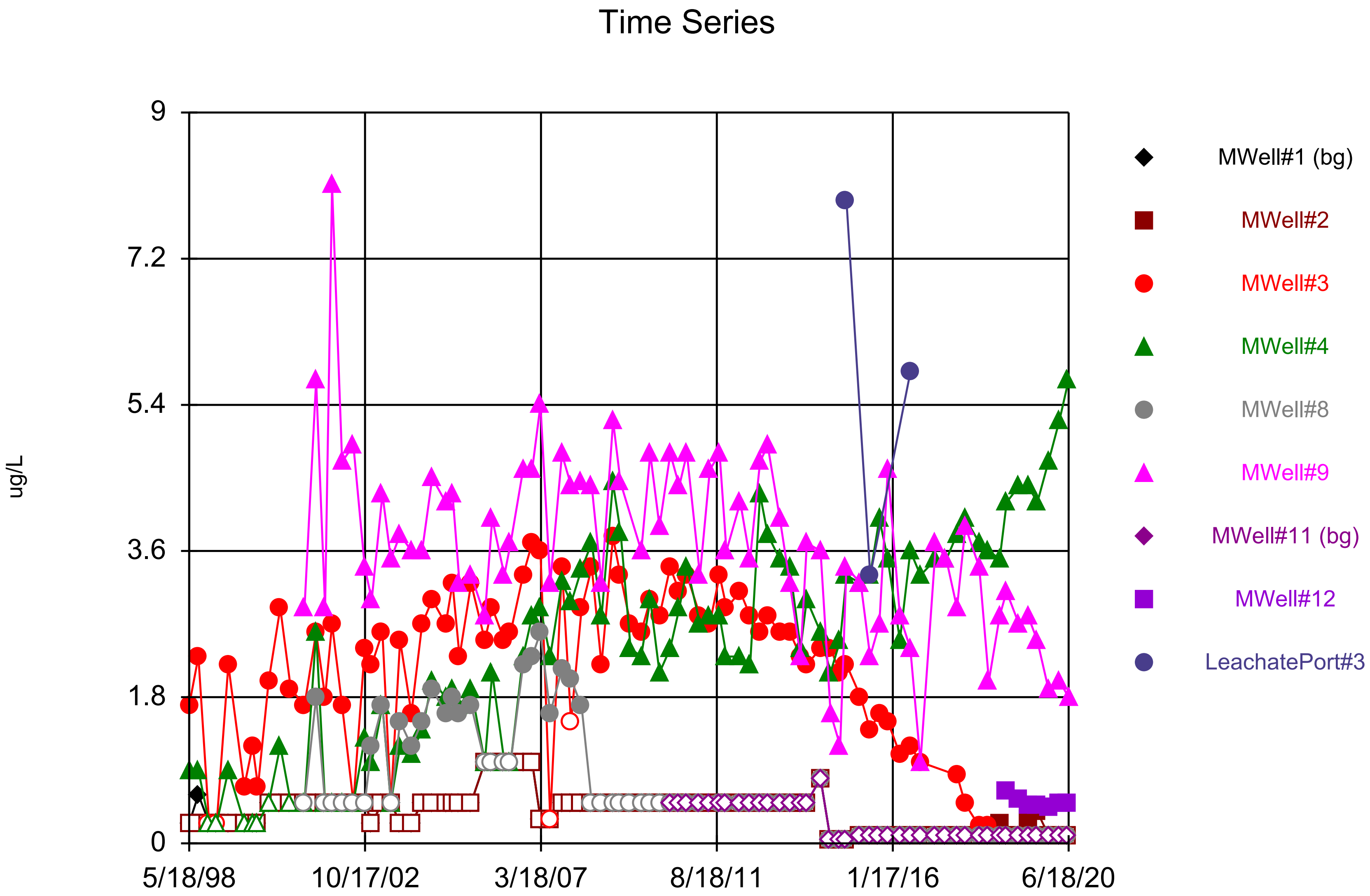

Constituent: 1,1-Dichloroethane   Analysis Run 8/12/2020 2:42 PM   View: HRLF_TSP Set1

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

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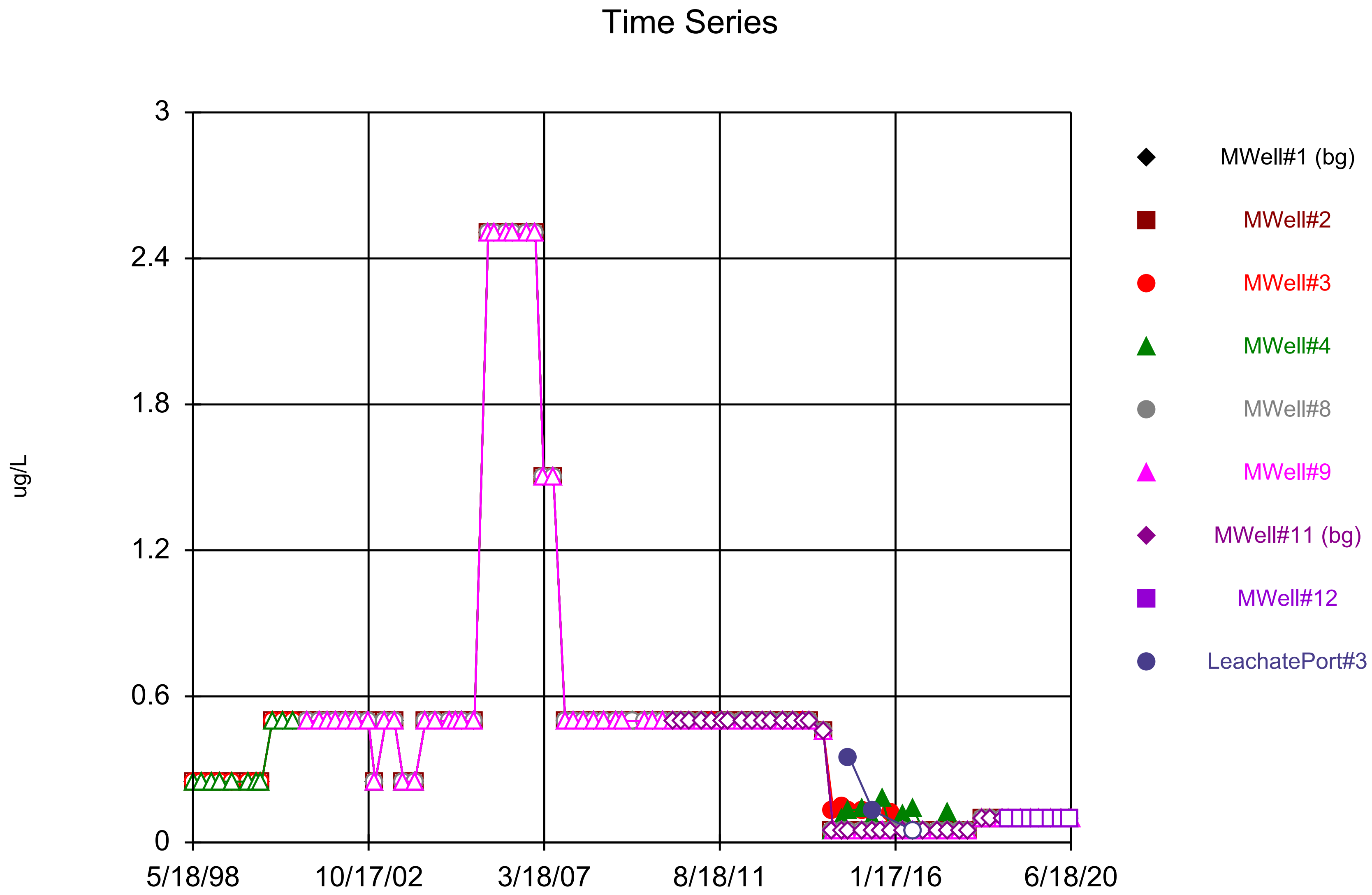
Hollow symbols indicate censored values.



Constituent: 1,1-Dichloroethene   Analysis Run 8/12/2020 2:42 PM   View: HRLF_TSP Set1

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

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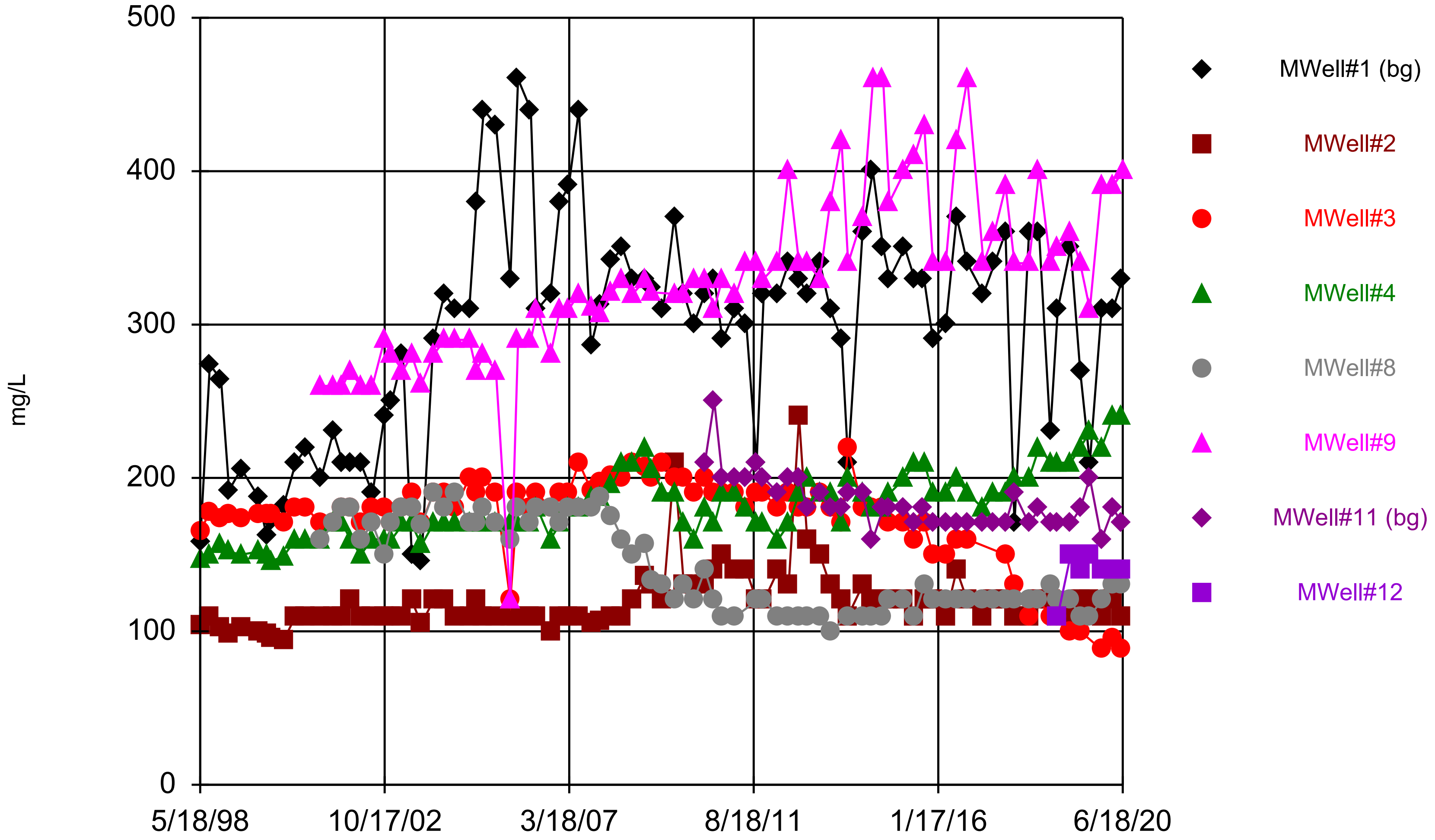
Time Series



Constituent: Alkalinity Analysis Run 8/12/2020 2:42 PM View: HRLF_TSP Set1

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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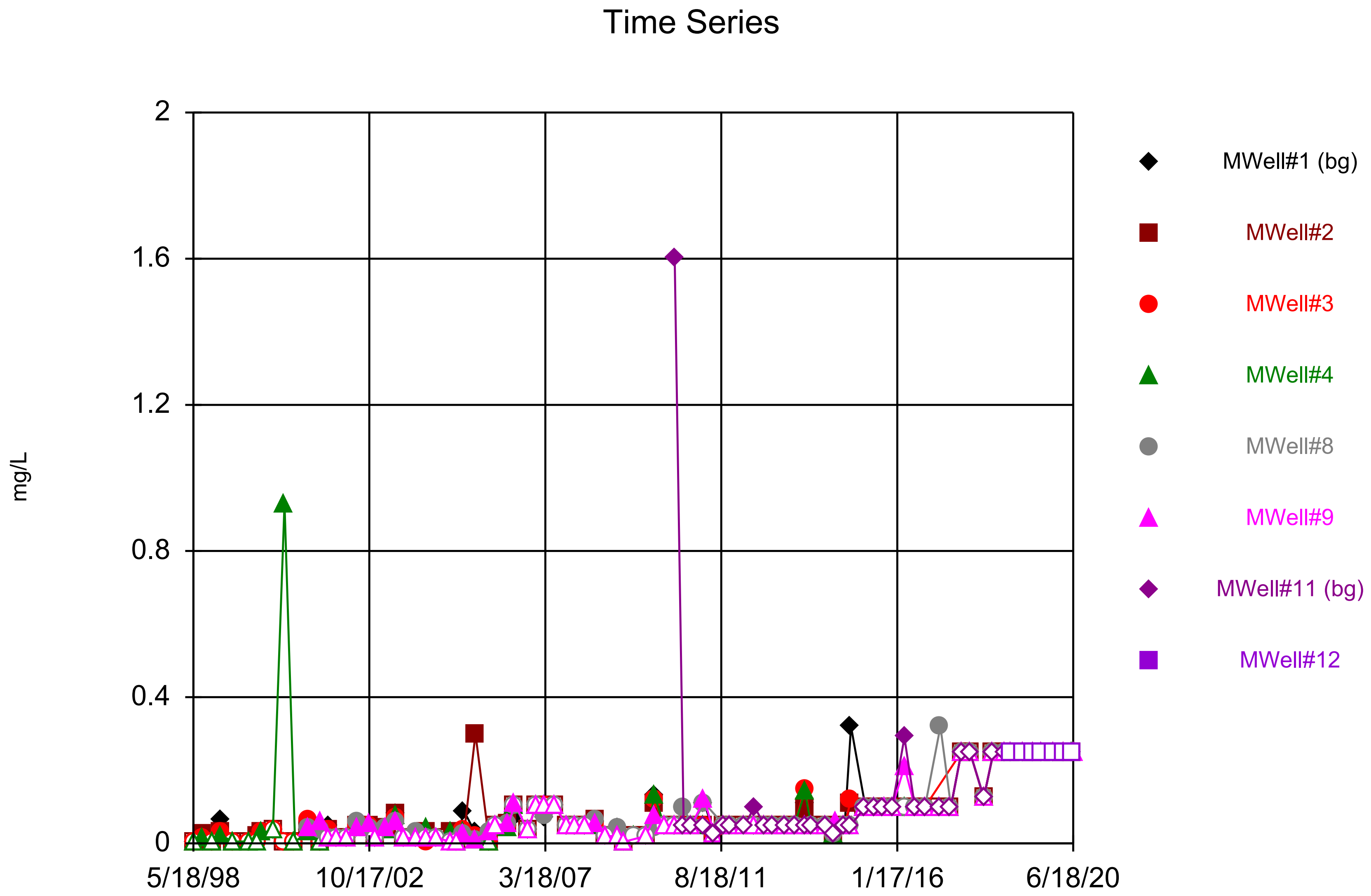
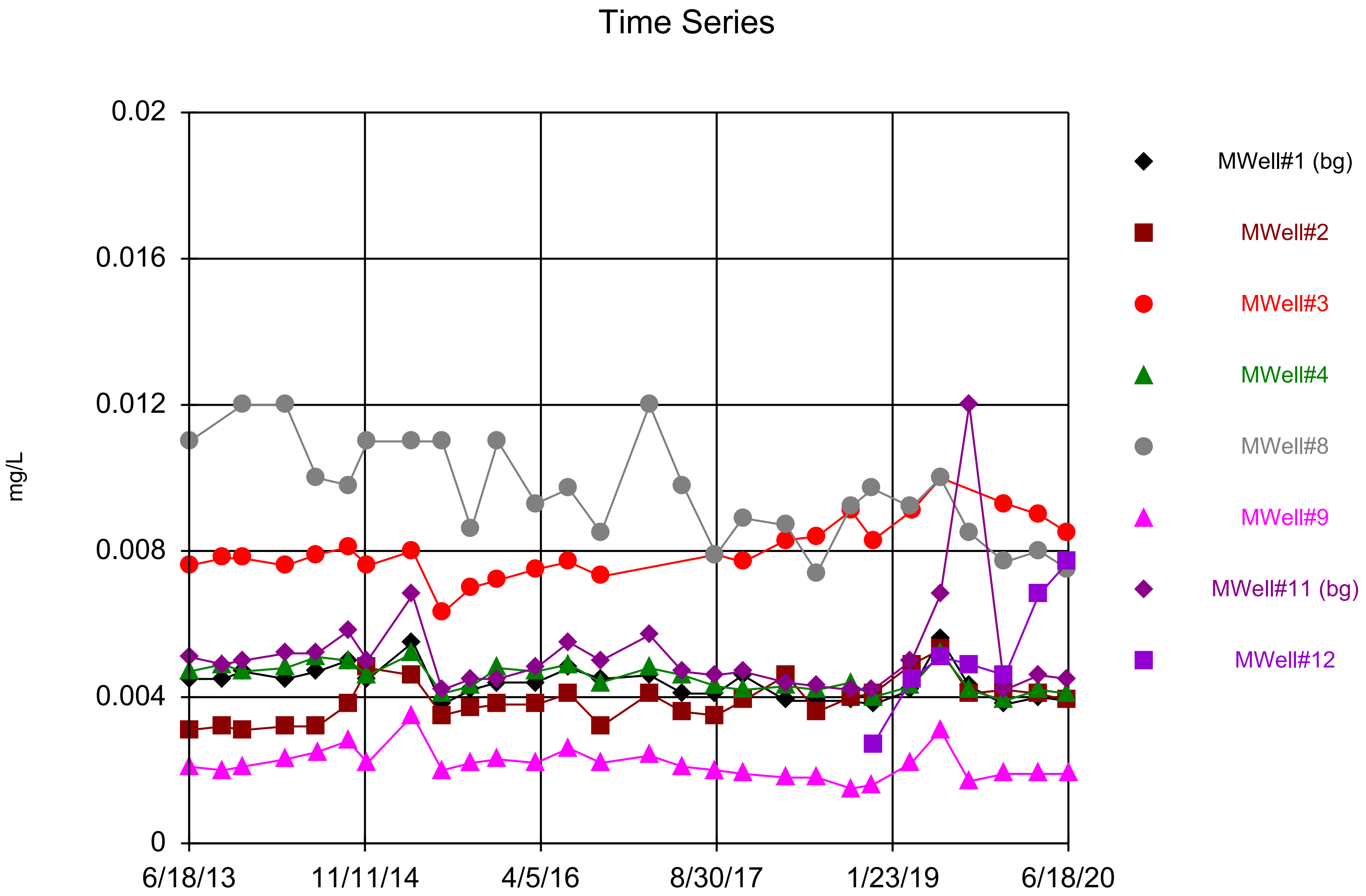
Hollow symbols indicate censored values.



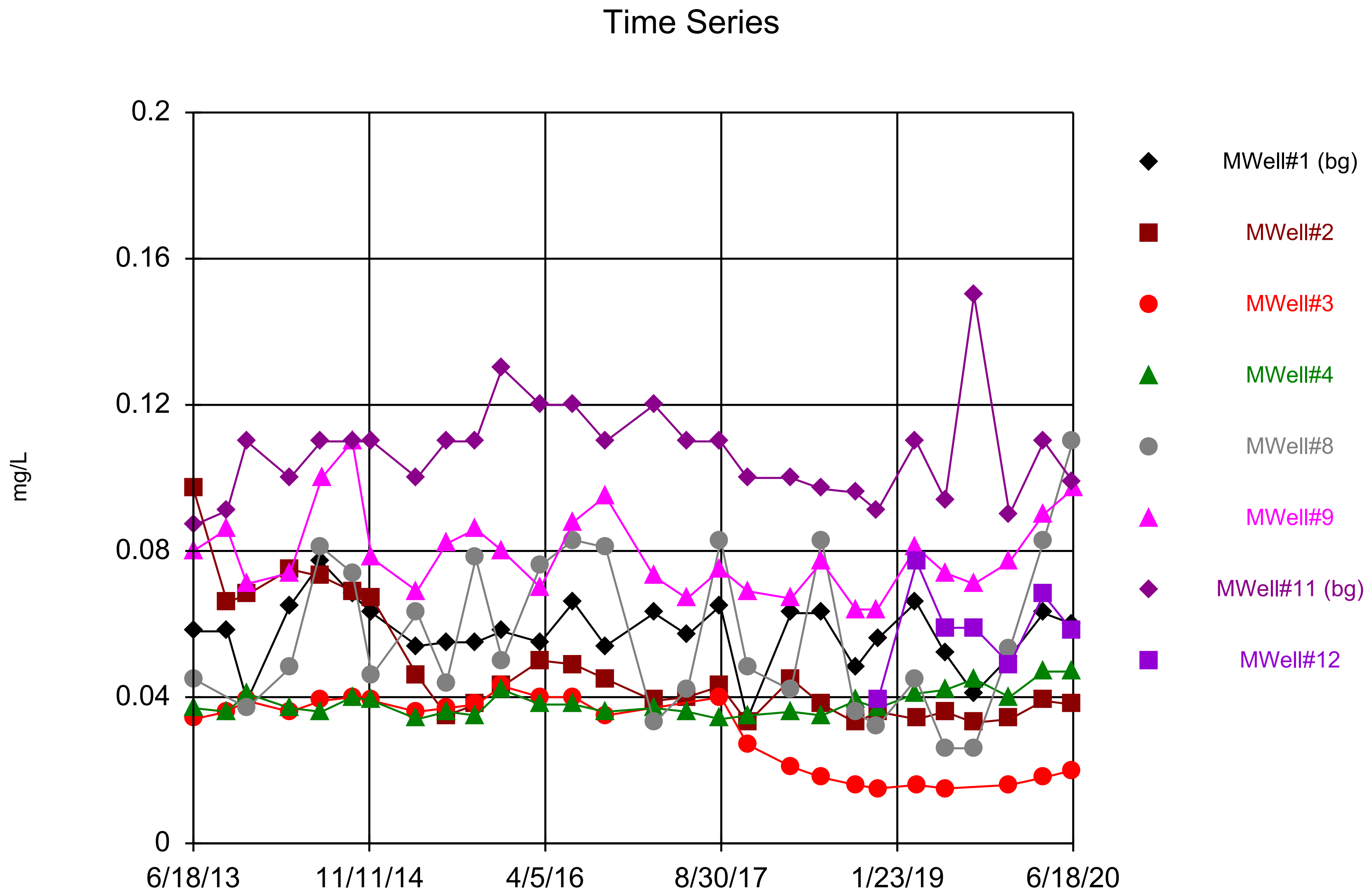
Constituent: Ammonia Nitrogen Analysis Run 8/12/2020 2:42 PM View: HRLF_TSP Set1

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata



Constituent: Arsenic, Total Analysis Run 8/12/2020 2:43 PM View: HRLF_TSP Set1

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata



Constituent: Barium, Total Analysis Run 8/12/2020 2:43 PM View: HRLF_TSP Set1

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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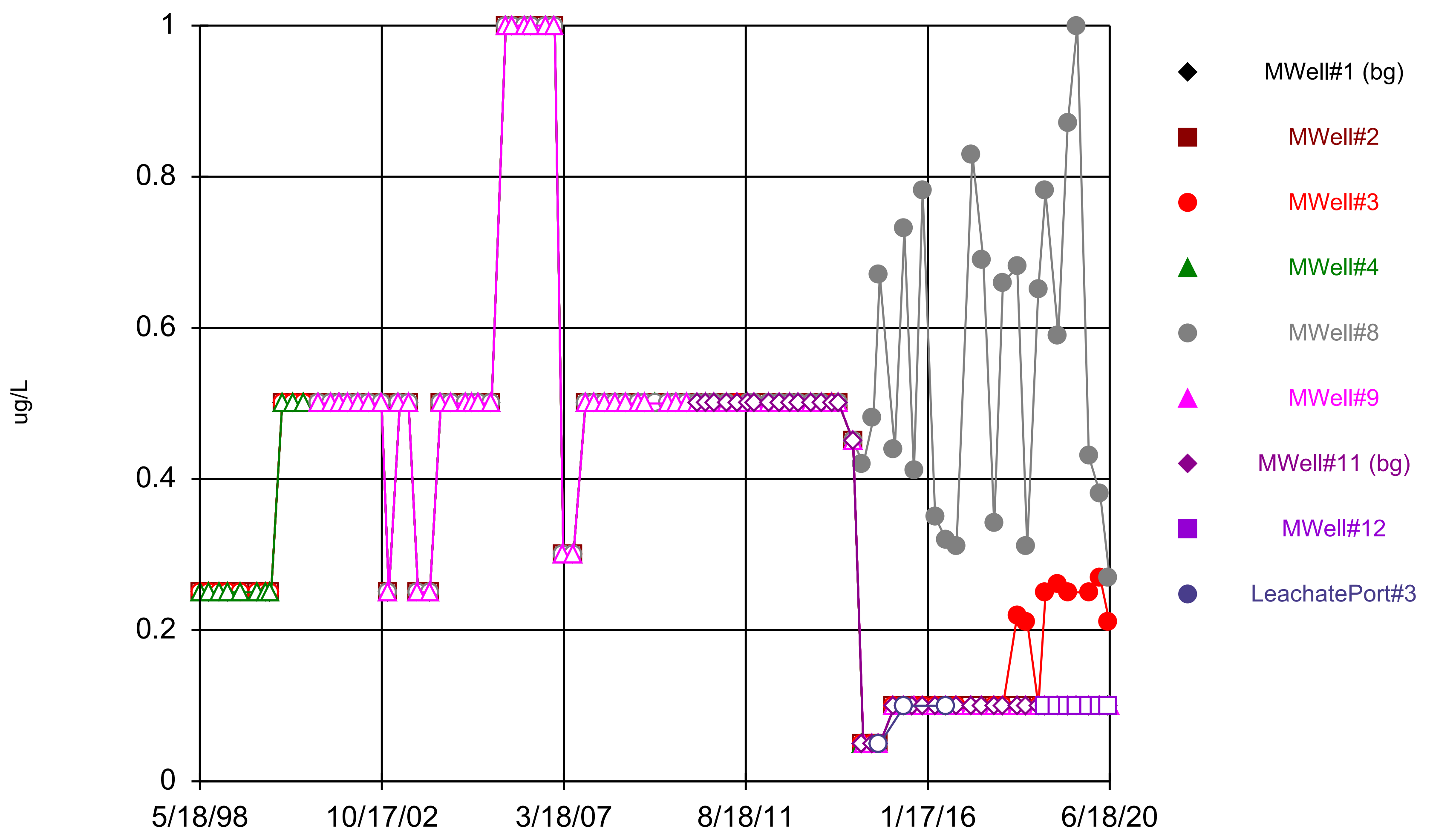
Hollow symbols indicate censored values.

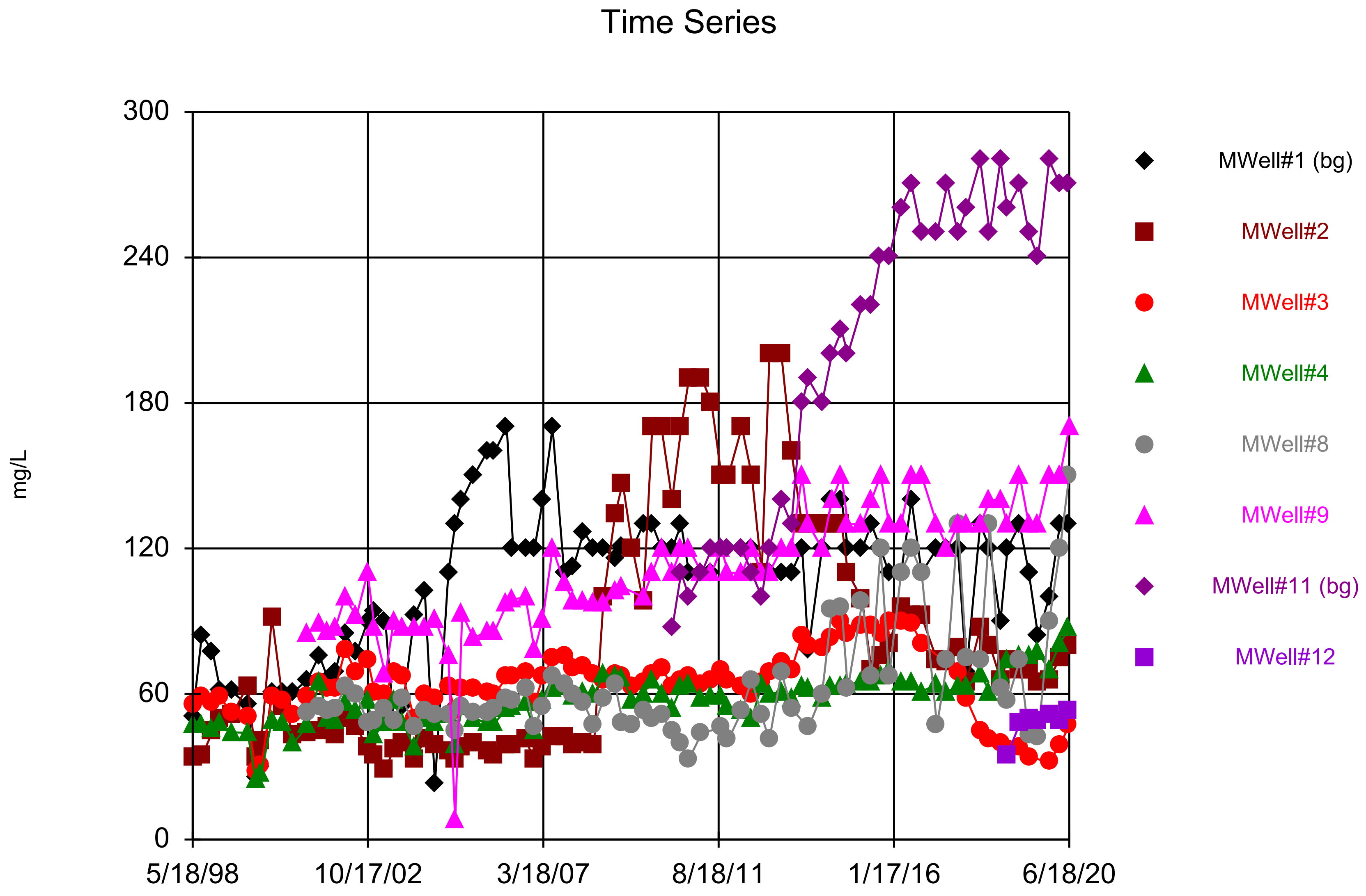
Time Series



Constituent: Bromodichloromethane Analysis Run 8/12/2020 2:43 PM View: HRLF_TSP Set1

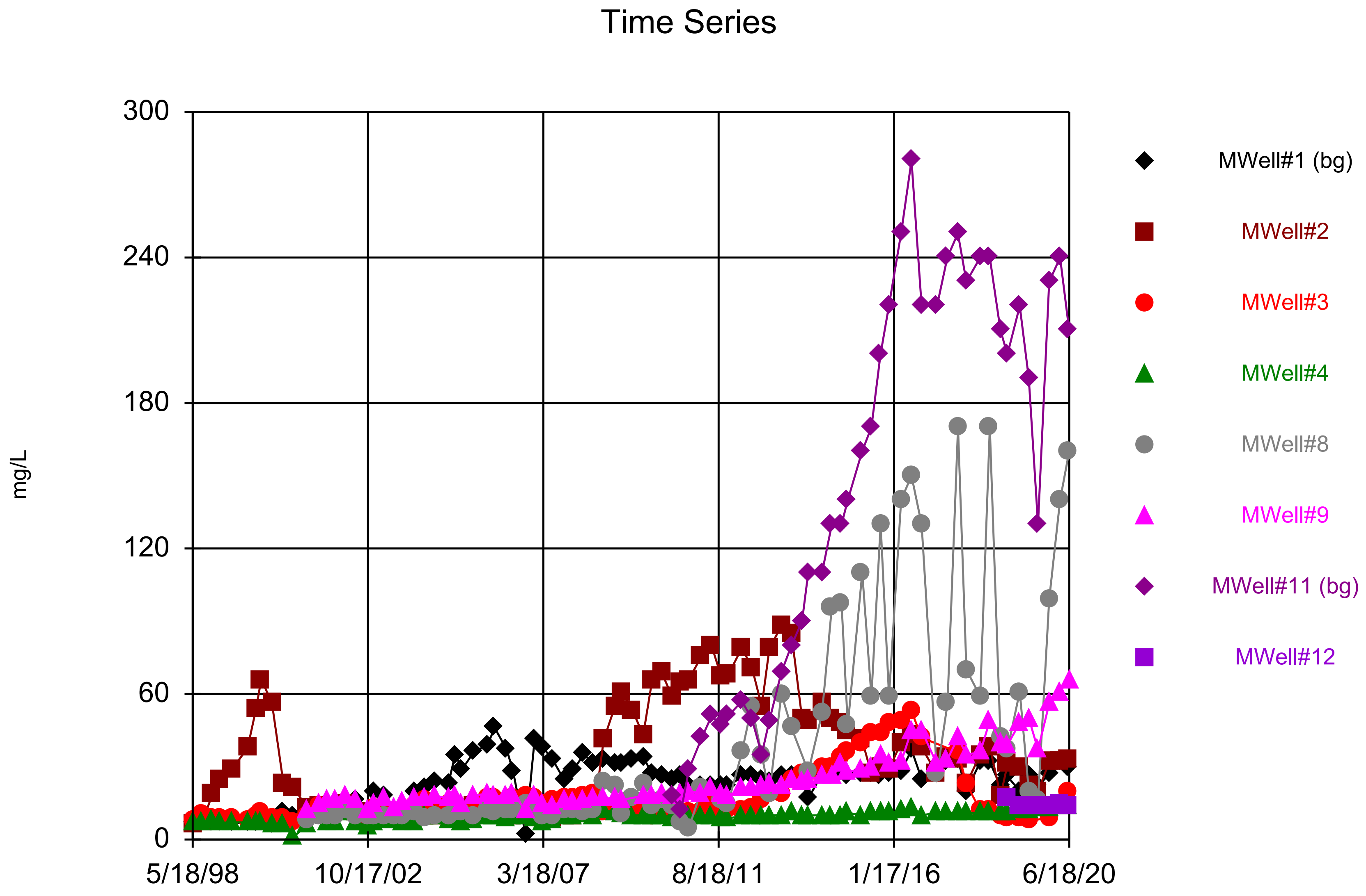
Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Sanitas™ v.9.6.26 Software licensed to Parametrix. UG



Constituent: Calcium, Dissolved   Analysis Run 8/12/2020 2:43 PM   View: HRLF_TSP Set1

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata



Constituent: Chloride   Analysis Run 8/12/2020 2:43 PM   View: HRLF_TSP Set1

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

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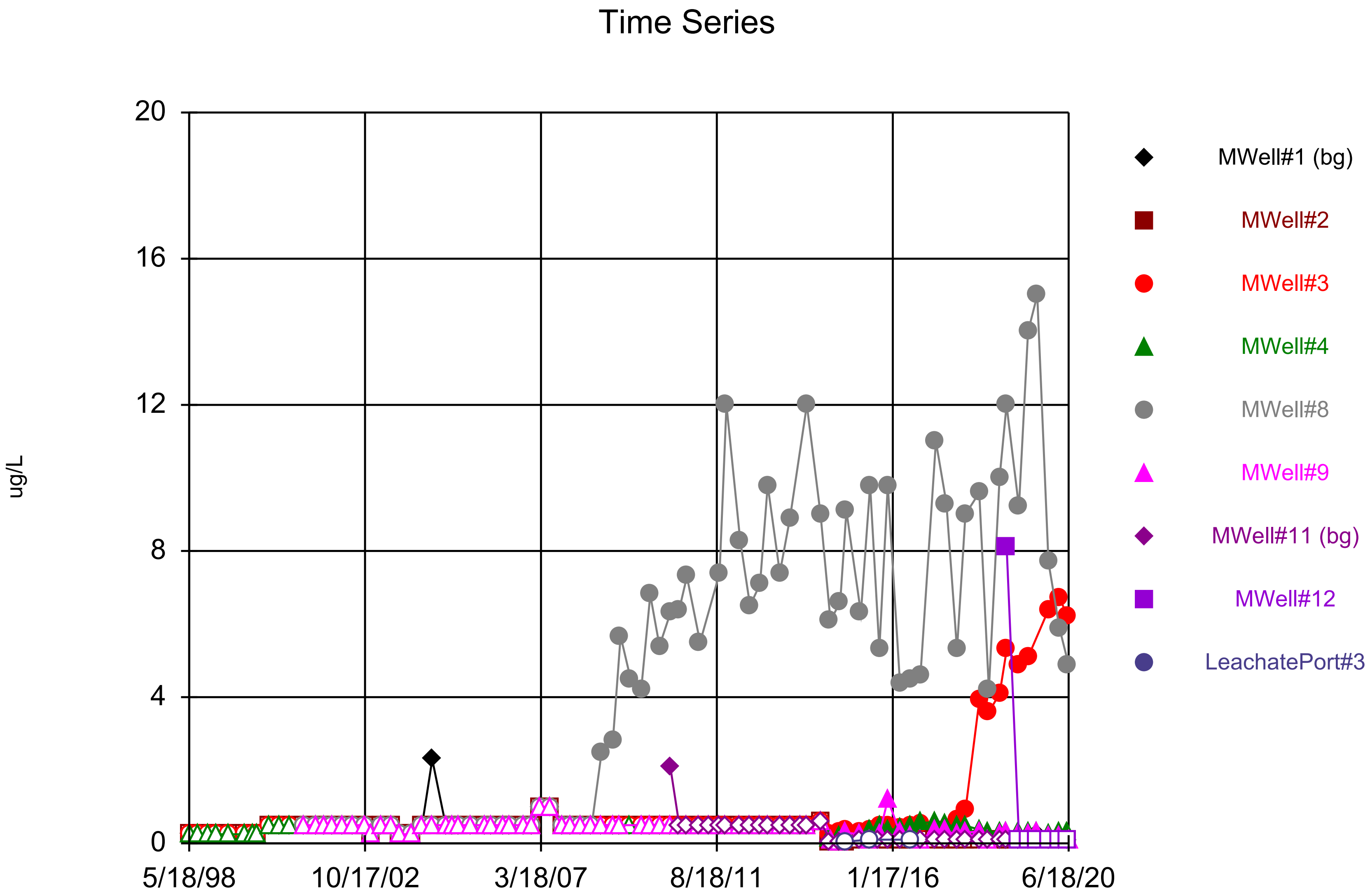
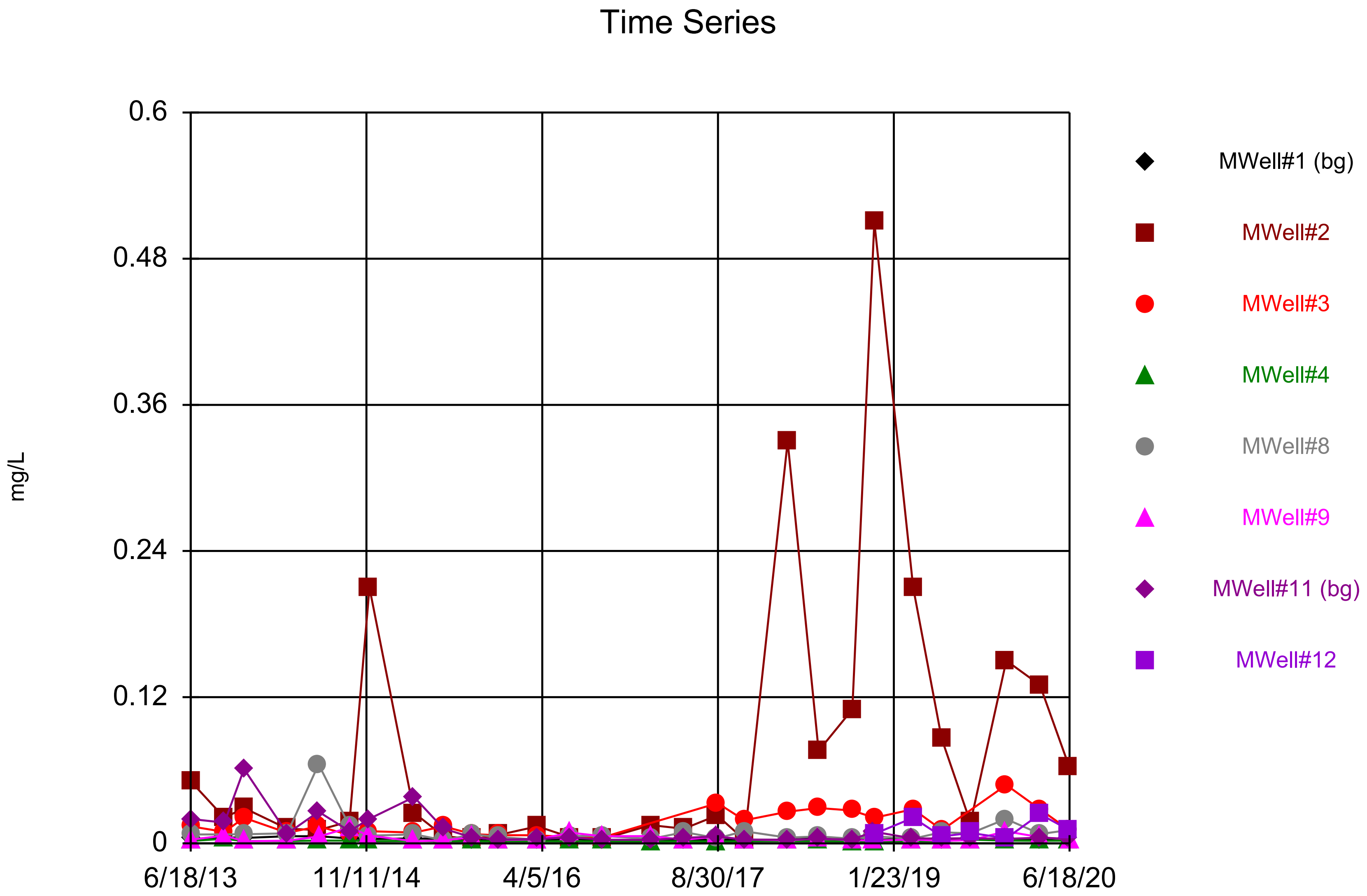
Hollow symbols indicate censored values.



Constituent: Chloroform Analysis Run 8/12/2020 2:43 PM View: HRLF_TSP Set1

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata



Constituent: Chromium, Total Analysis Run 8/12/2020 2:43 PM View: HRLF_TSP Set1

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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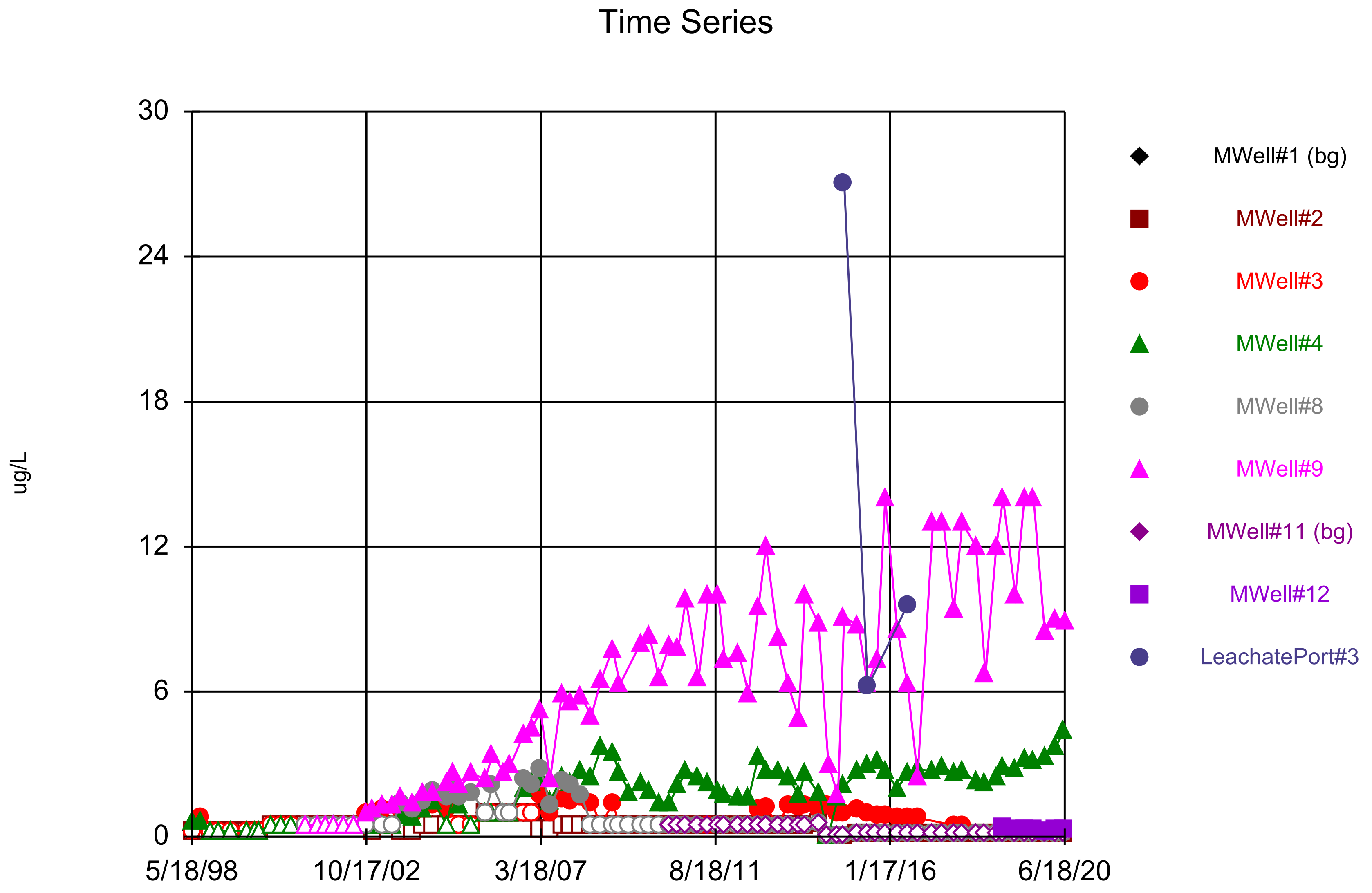
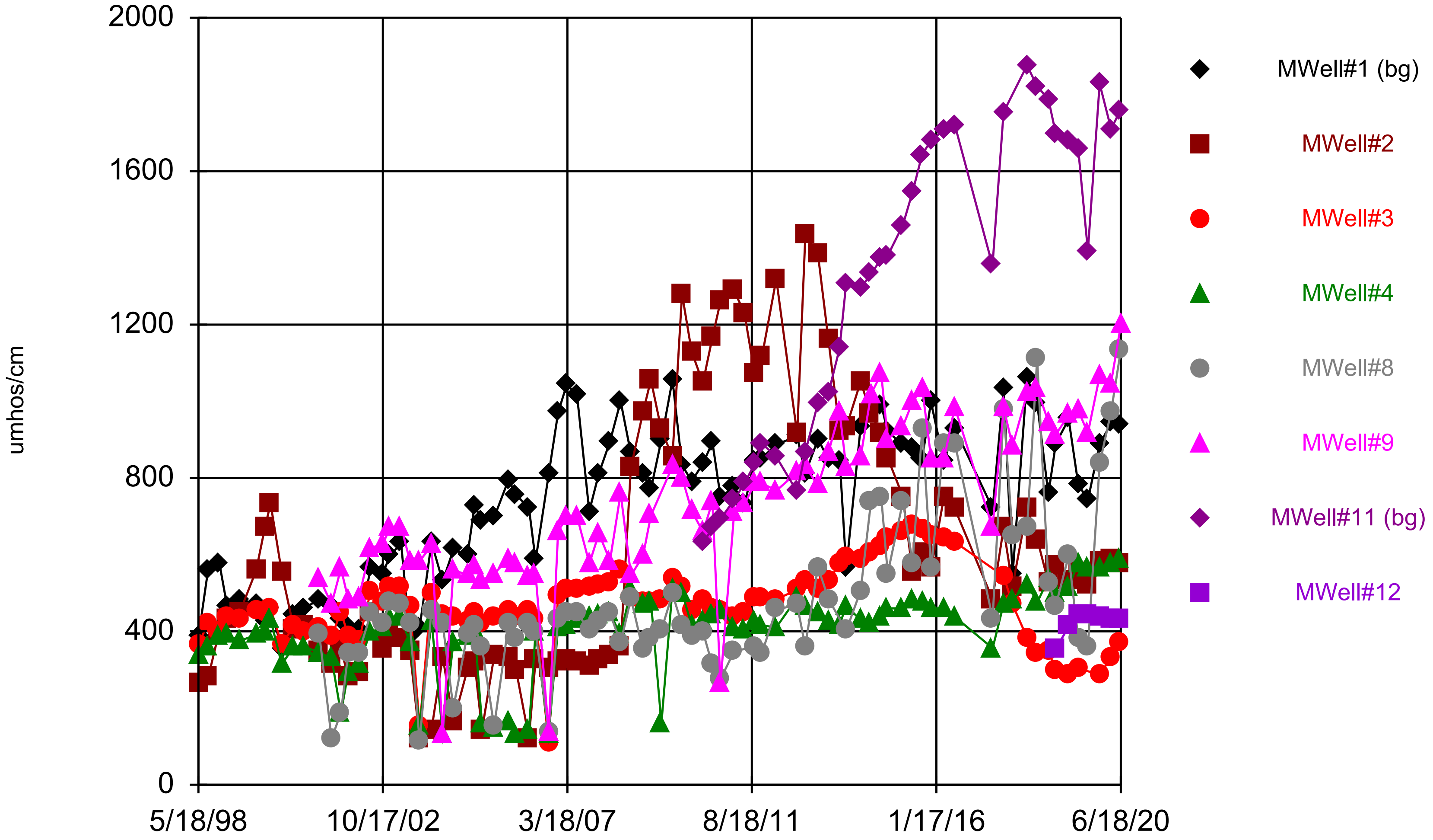
Hollow symbols indicate censored values.



Constituent: cis-1,2-Dichloroethene Analysis Run 8/12/2020 2:43 PM View: HRLF_TSP Set1
Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

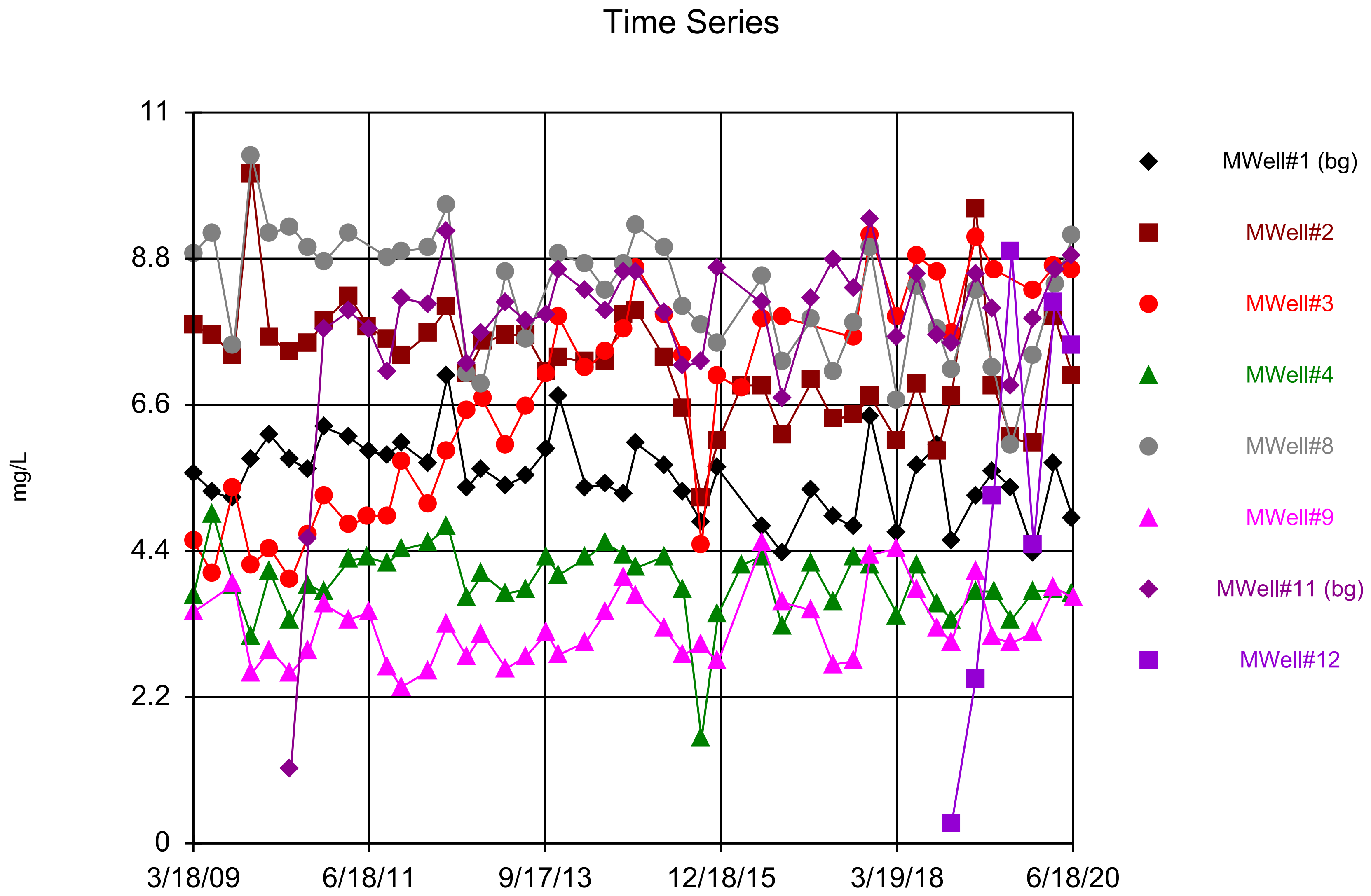
Time Series



Constituent: Conductivity Analysis Run 8/12/2020 2:43 PM View: HRLF_TSP Set1

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Sanitas™ v.9.6.26 Software licensed to Parametrix. UG



Constituent: Dissolved Oxygen Analysis Run 8/12/2020 2:43 PM View: HRLF_TSP Set1

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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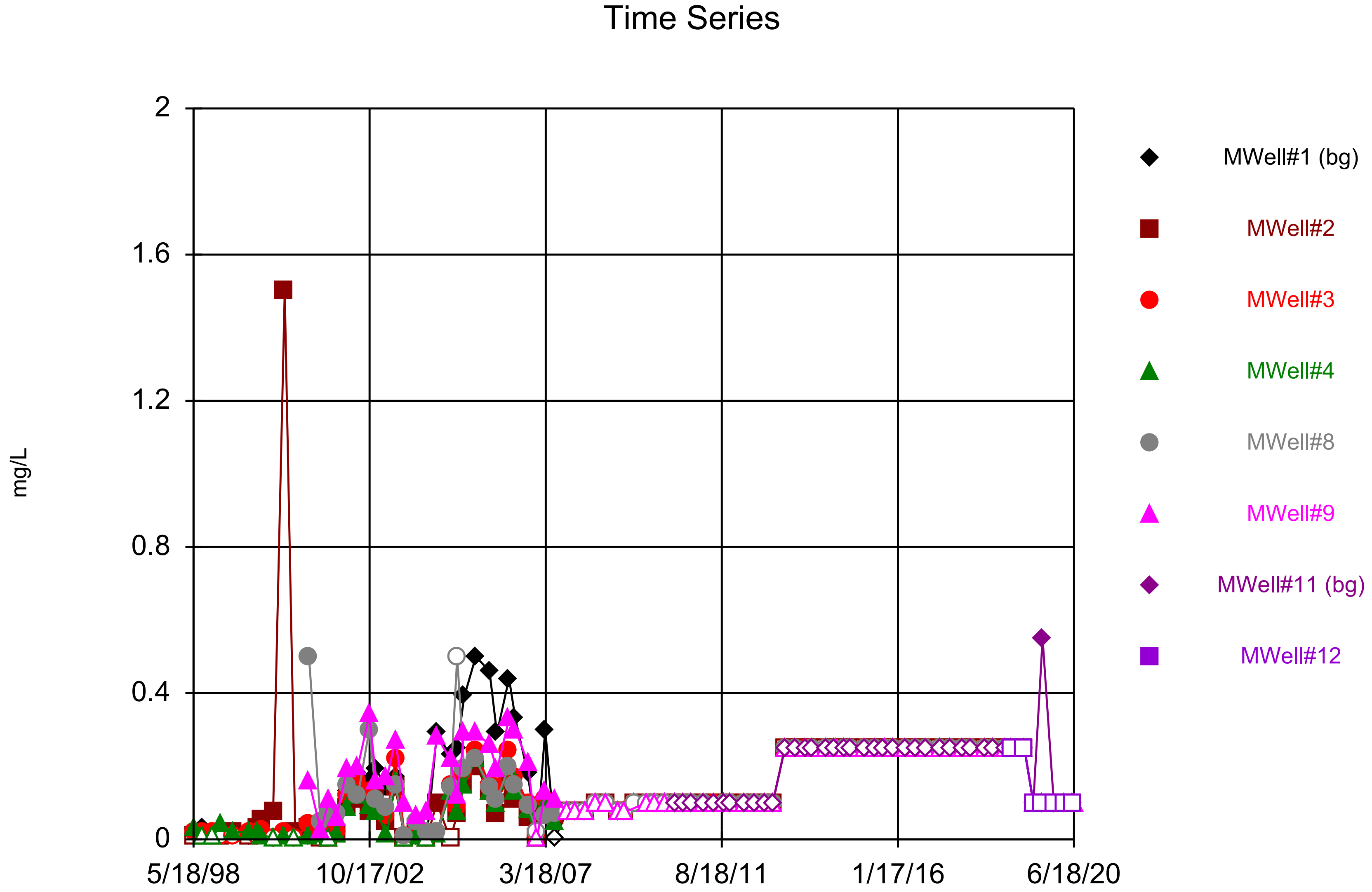
Hollow symbols indicate censored values.



Constituent: Iron, Dissolved Analysis Run 8/12/2020 2:44 PM View: HRLF_TSP Set1

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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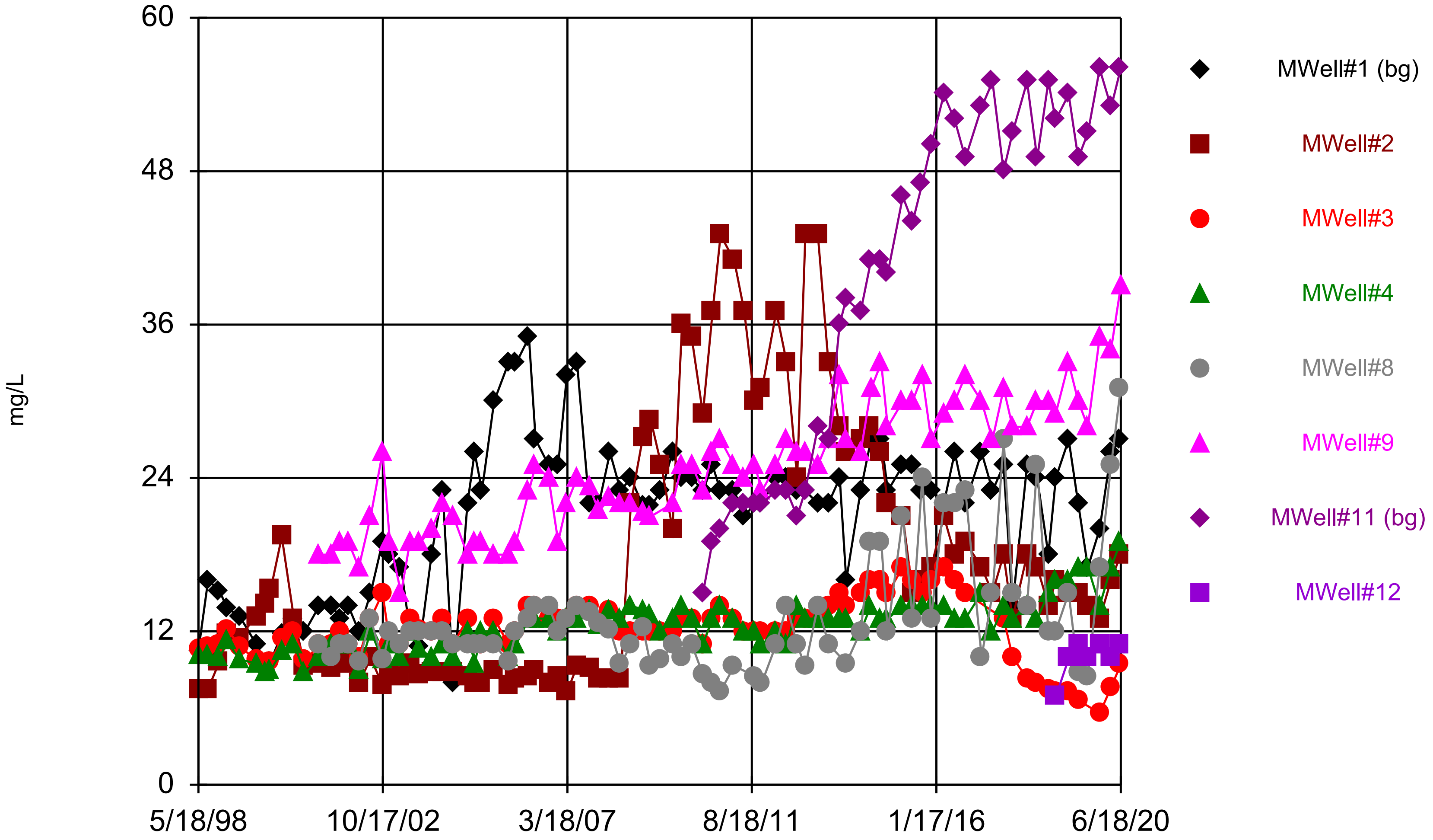
Time Series



Constituent: Magnesium, Dissolved   Analysis Run 8/12/2020 2:44 PM   View: HRLF_TSP Set1

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

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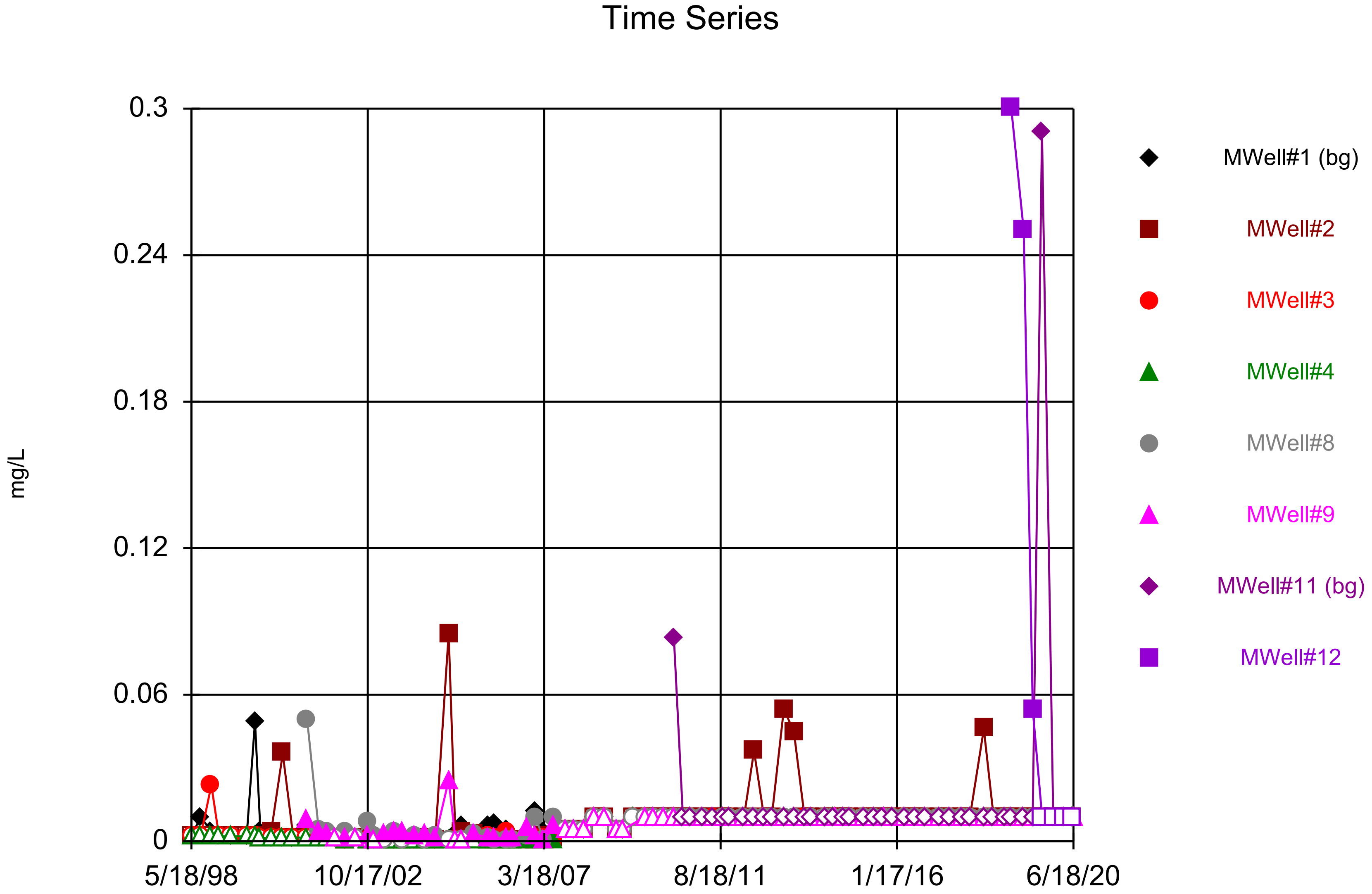
Hollow symbols indicate censored values.



Constituent: Manganese, Dissolved   Analysis Run 8/12/2020 2:44 PM   View: HRLF_TSP Set1

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

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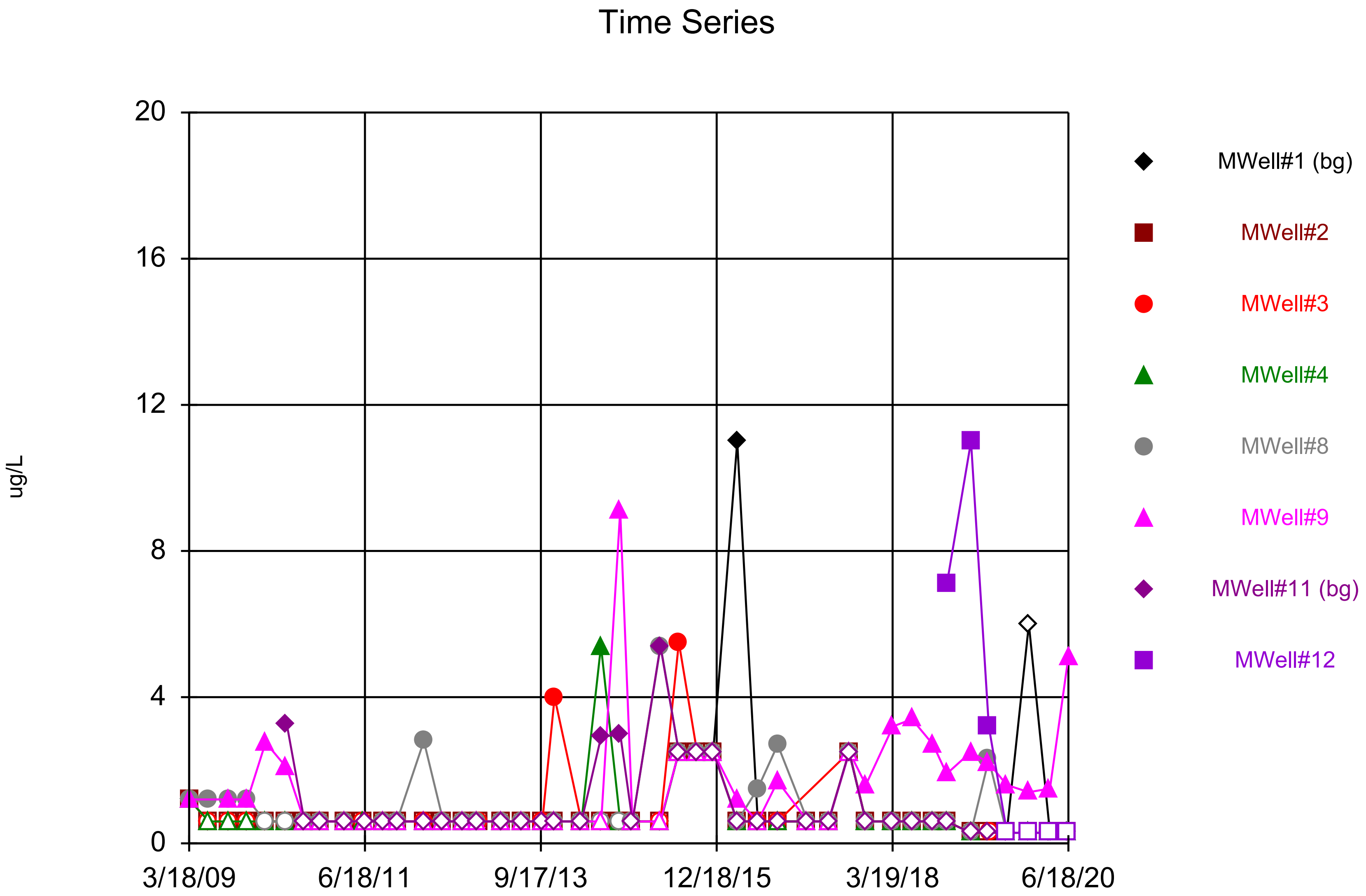
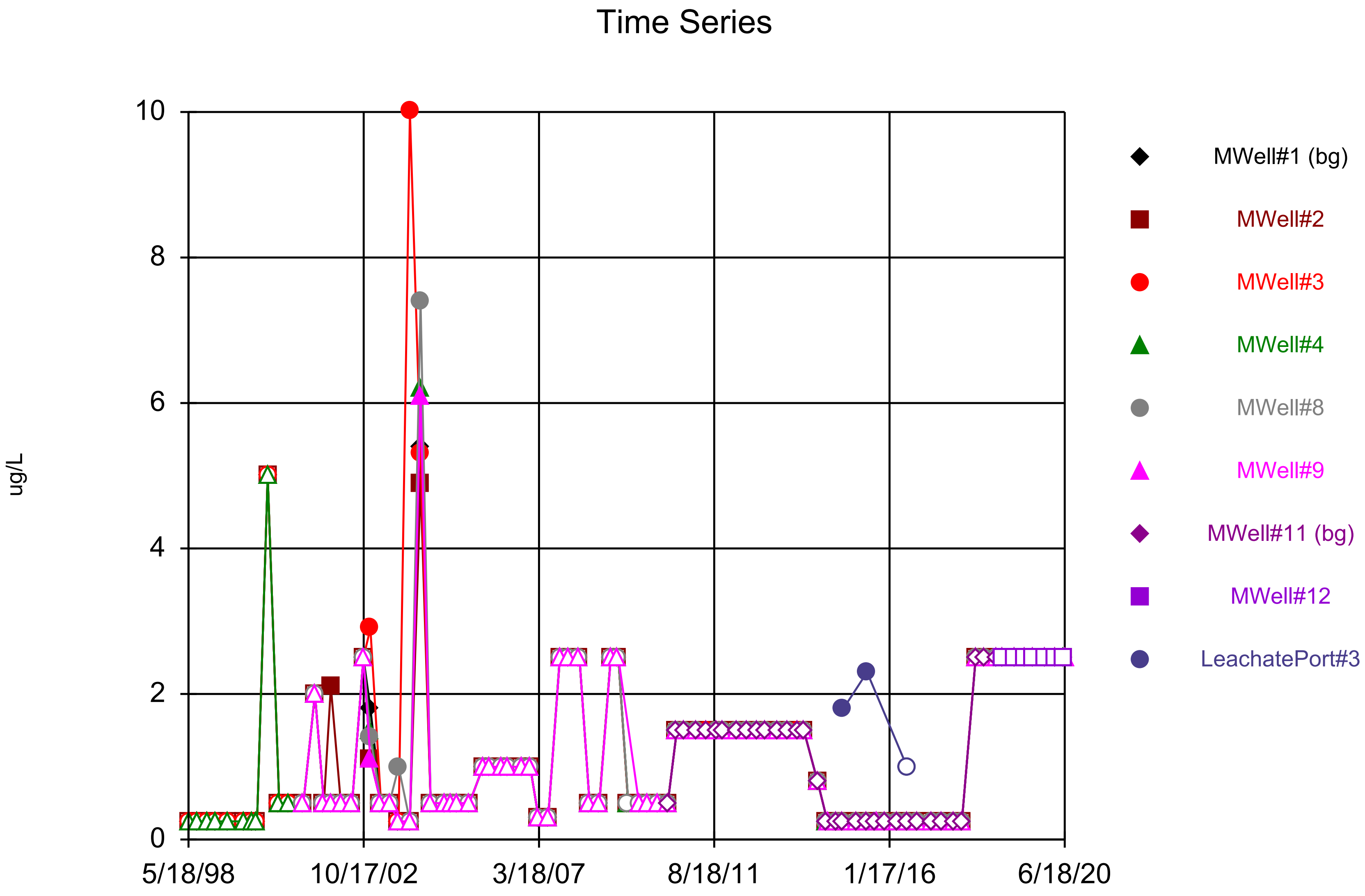
Hollow symbols indicate censored values.



Constituent: Methane Analysis Run 8/12/2020 2:44 PM View: HRLF_TSP Set1

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Sanitas™ v.9.6.26 Software licensed to Parametrix. UG
Hollow symbols indicate censored values.



Constituent: Methylene Chloride Analysis Run 8/12/2020 2:44 PM View: HRLF_TSP Set1

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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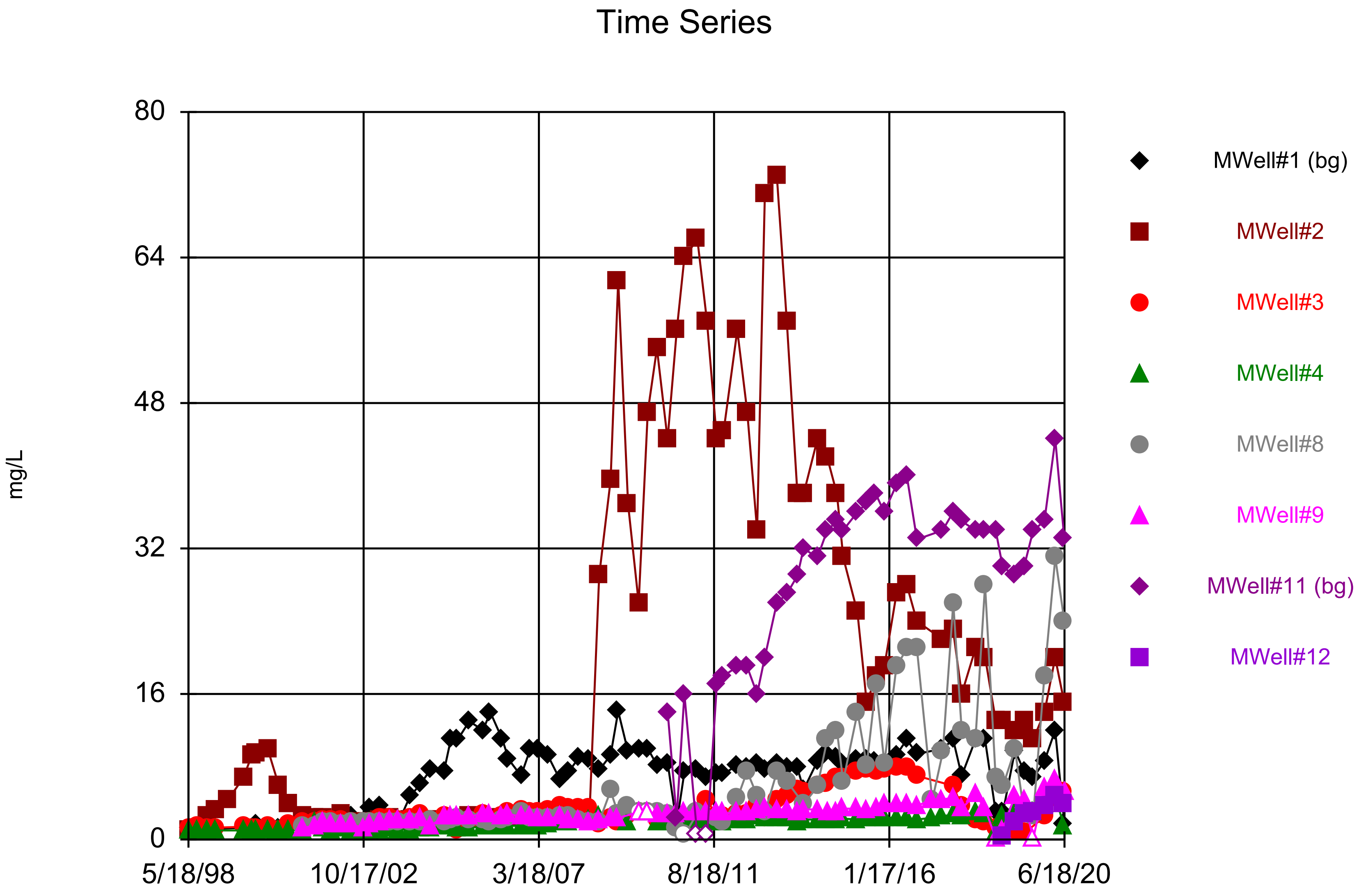
Hollow symbols indicate censored values.



Constituent: Nitrate Nitrogen Analysis Run 8/12/2020 2:44 PM View: HRLF_TSP Set1

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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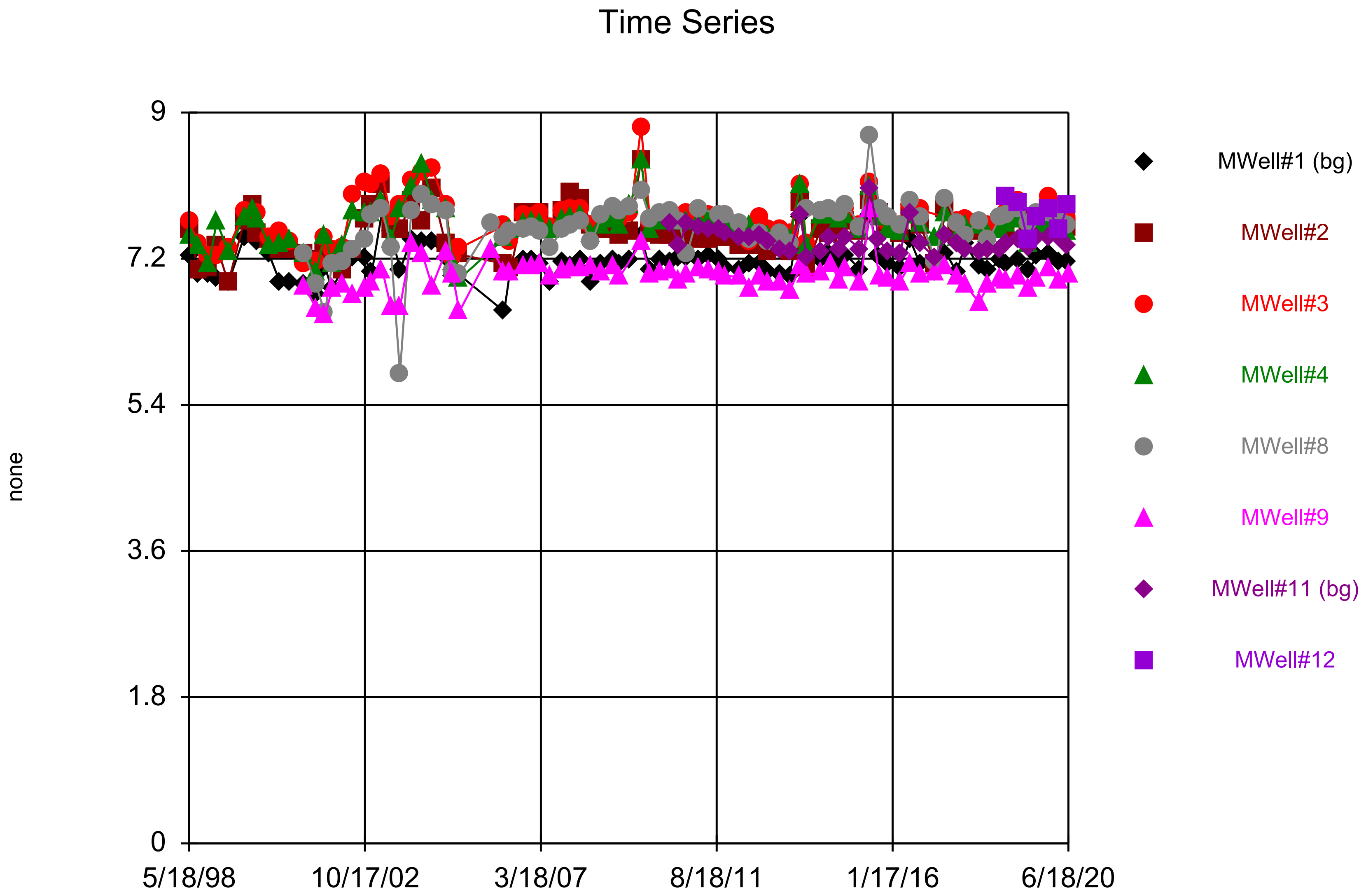
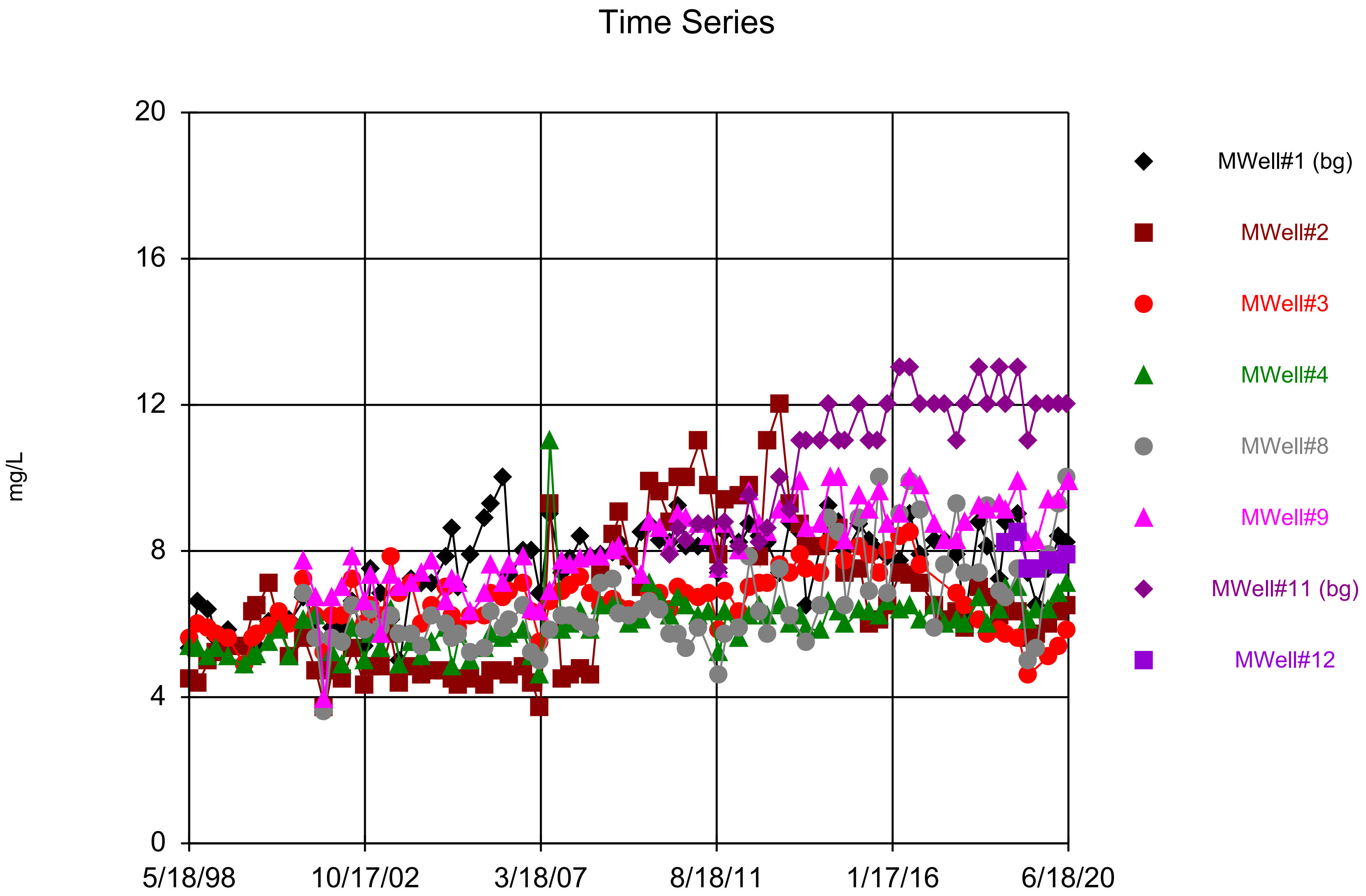


Constituent: pH Analysis Run 8/12/2020 2:44 PM View: HRLF_TSP Set1

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Sanitas™ v.9.6.26 Software licensed to Parametrix. UG



Constituent: Potassium, Dissolved Analysis Run 8/12/2020 2:44 PM View: HRLF_TSP Set1

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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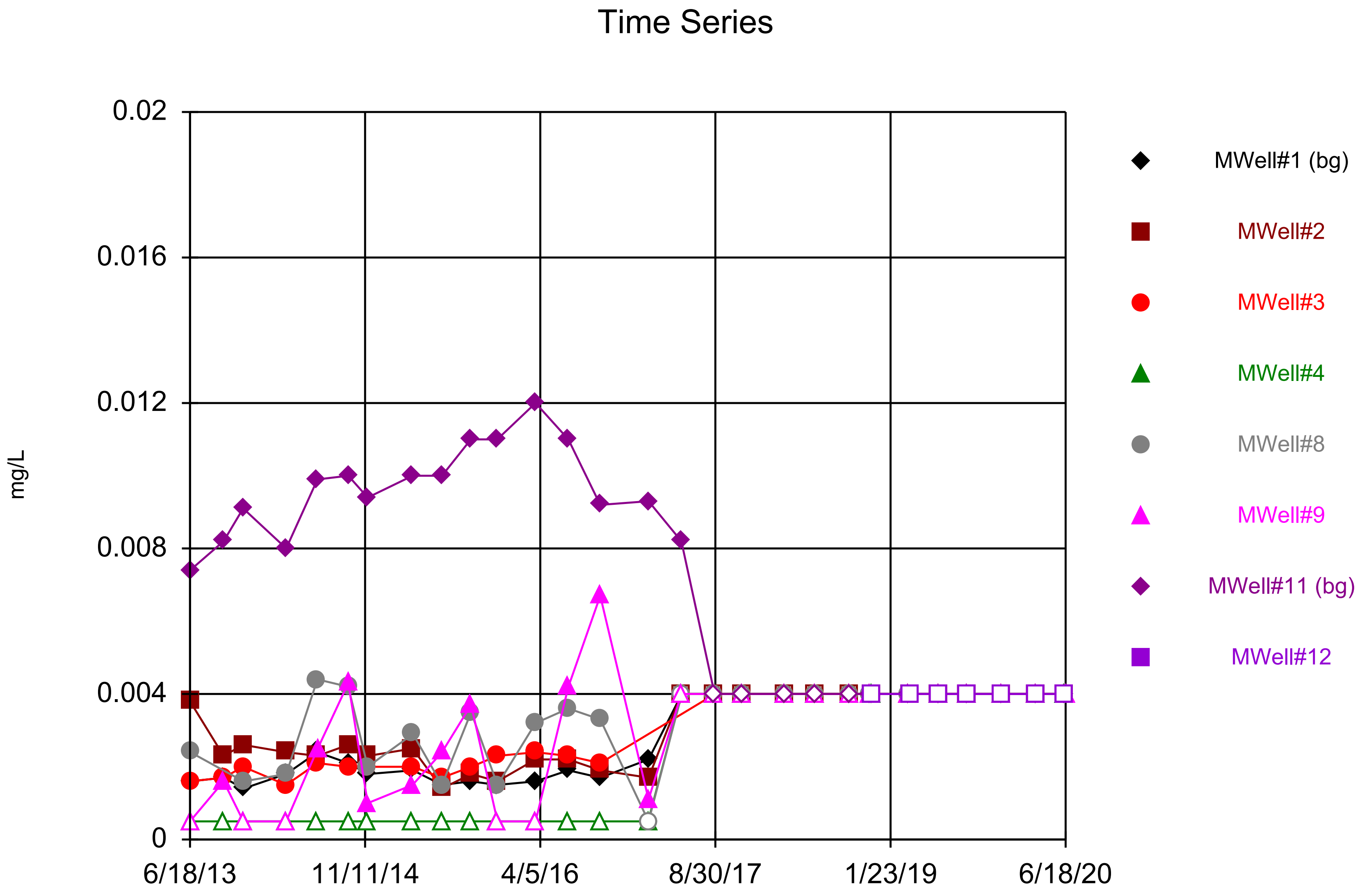
Hollow symbols indicate censored values.



Constituent: Selenium, Total   Analysis Run 8/12/2020 2:45 PM   View: HRLF_TSP Set1

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

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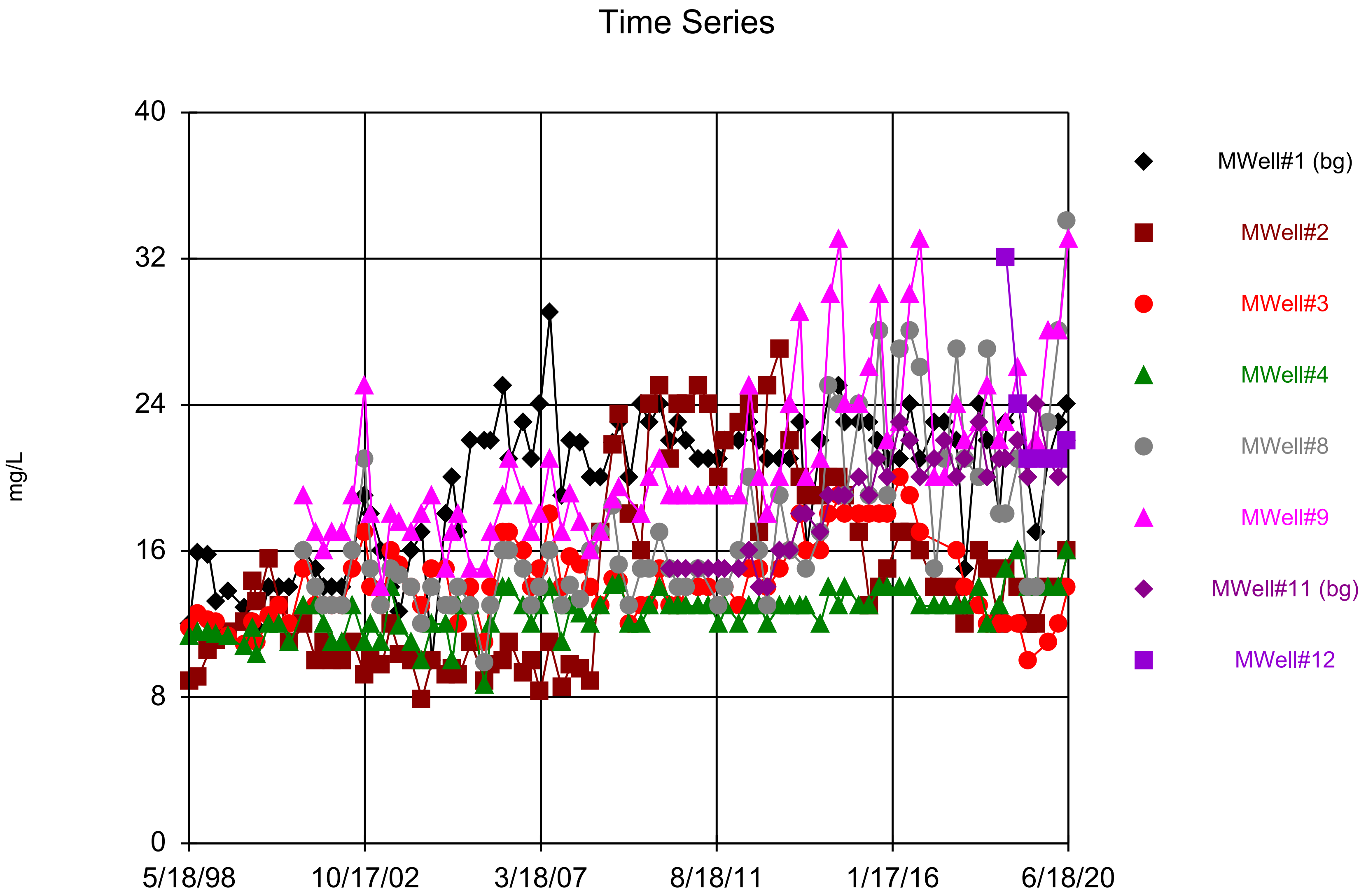
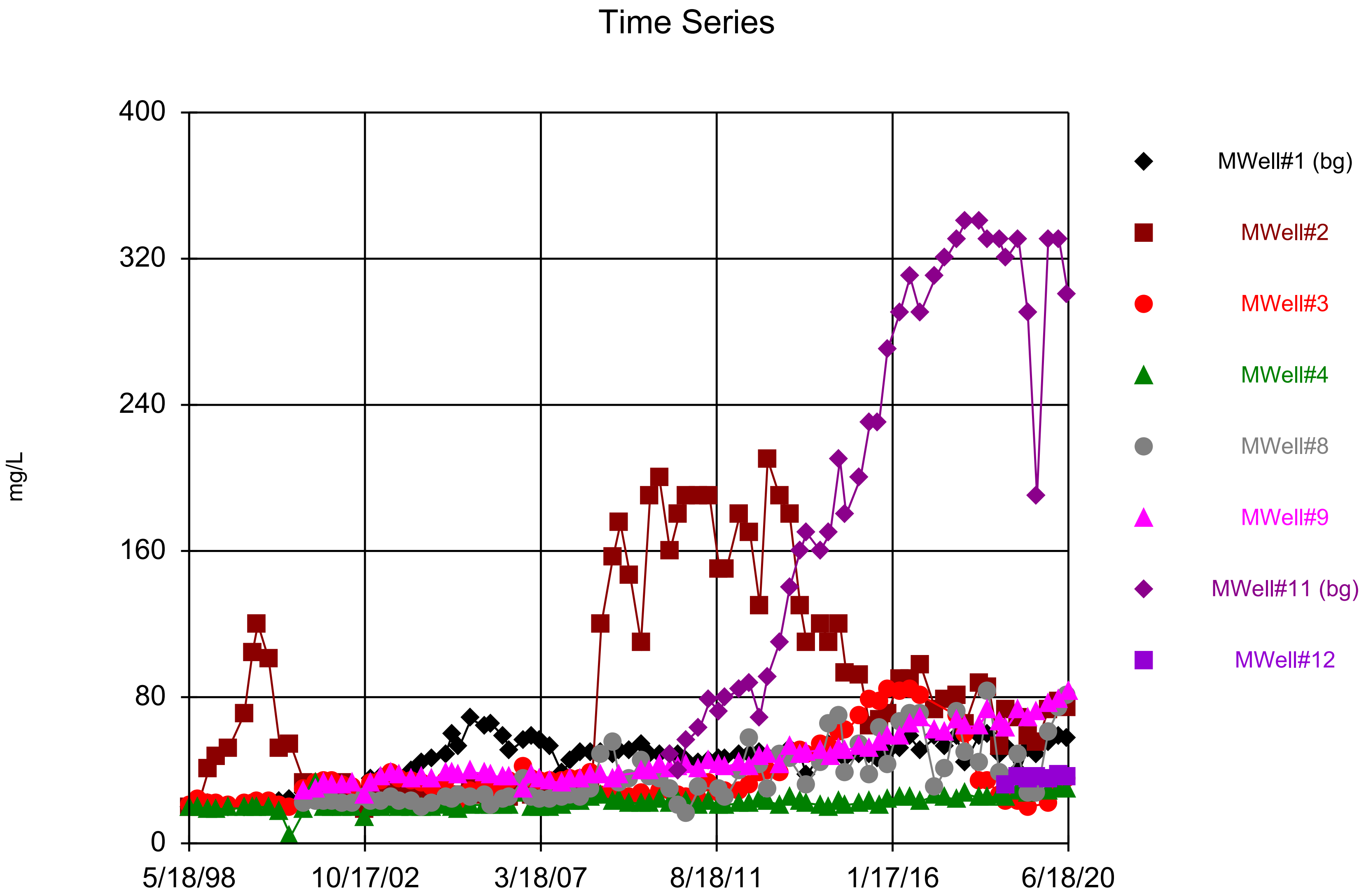


Constituent: Sodium, Dissolved Analysis Run 8/12/2020 2:45 PM View: HRLF_TSP Set1
Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Sanitas™ v.9.6.26 Software licensed to Parametrix. UG



Constituent: Sulfate Analysis Run 8/12/2020 2:45 PM View: HRLF_TSP Set1

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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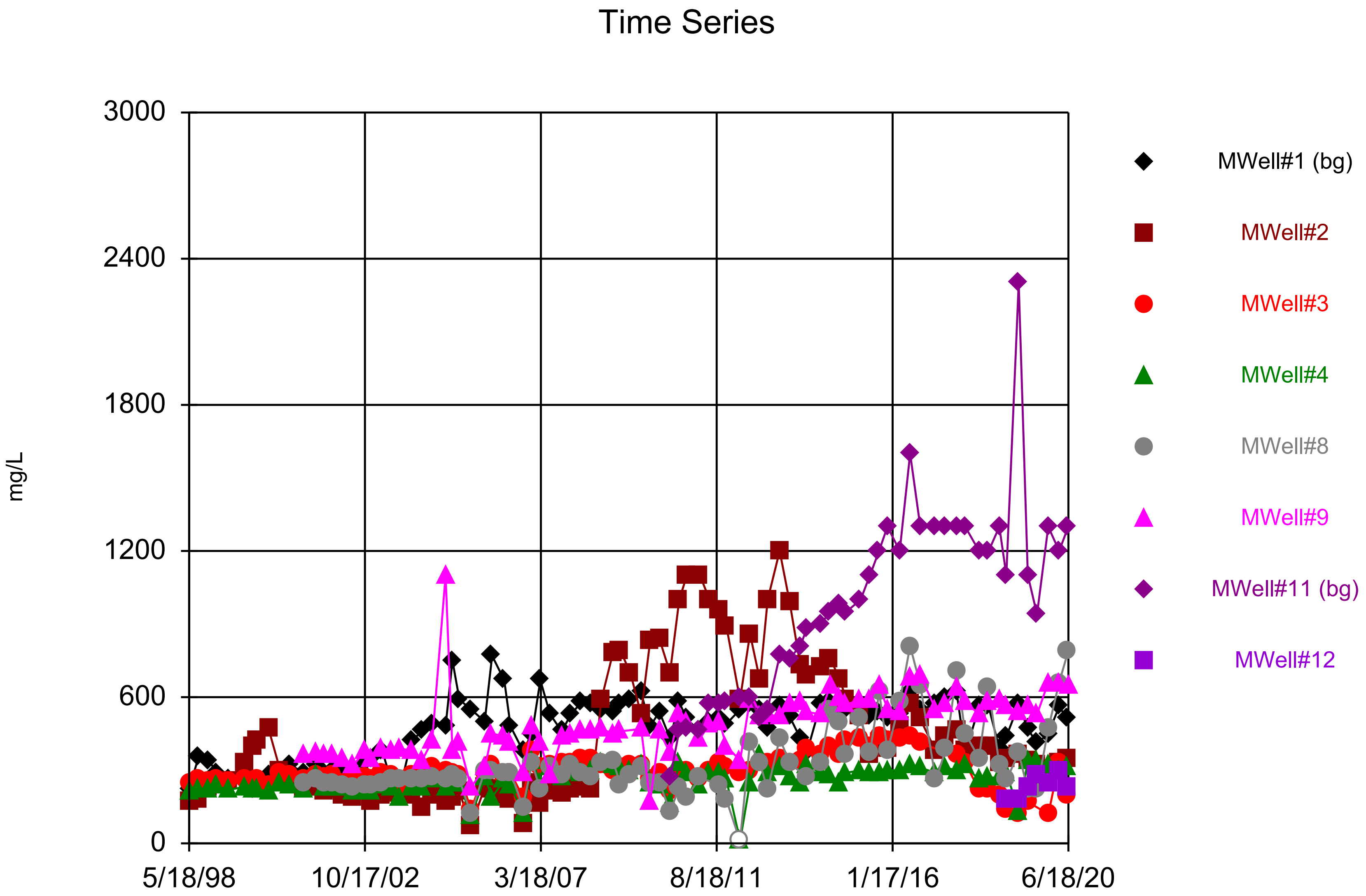
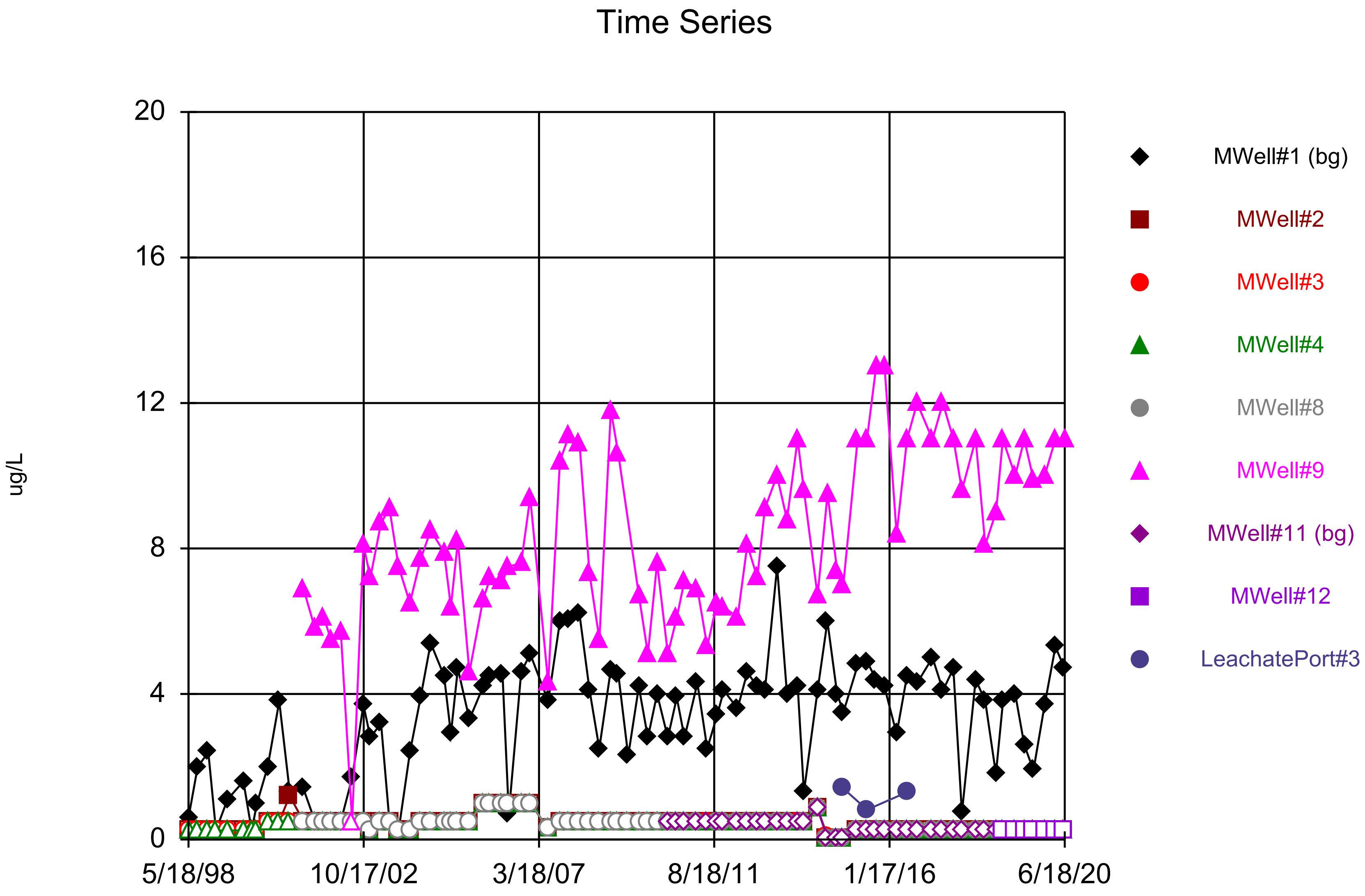
Hollow symbols indicate censored values.



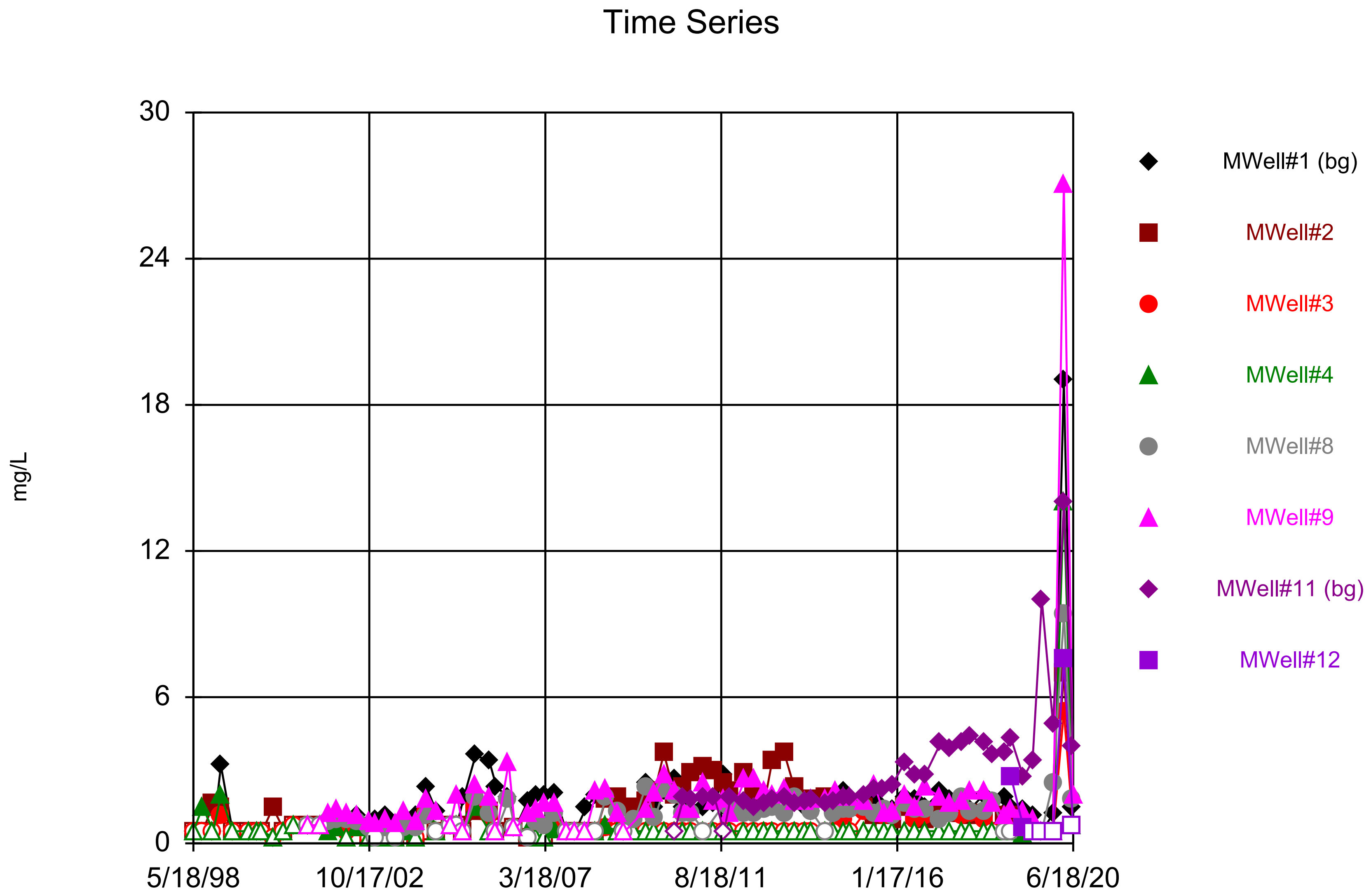
Constituent: TDS Analysis Run 8/12/2020 2:45 PM View: HRLF_TSP Set1
Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Sanitas™ v.9.6.26 Software licensed to Parametrix. UG
Hollow symbols indicate censored values.



Constituent: Tetrachloroethene Analysis Run 8/12/2020 2:45 PM View: HRLF_TSP Set1
Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

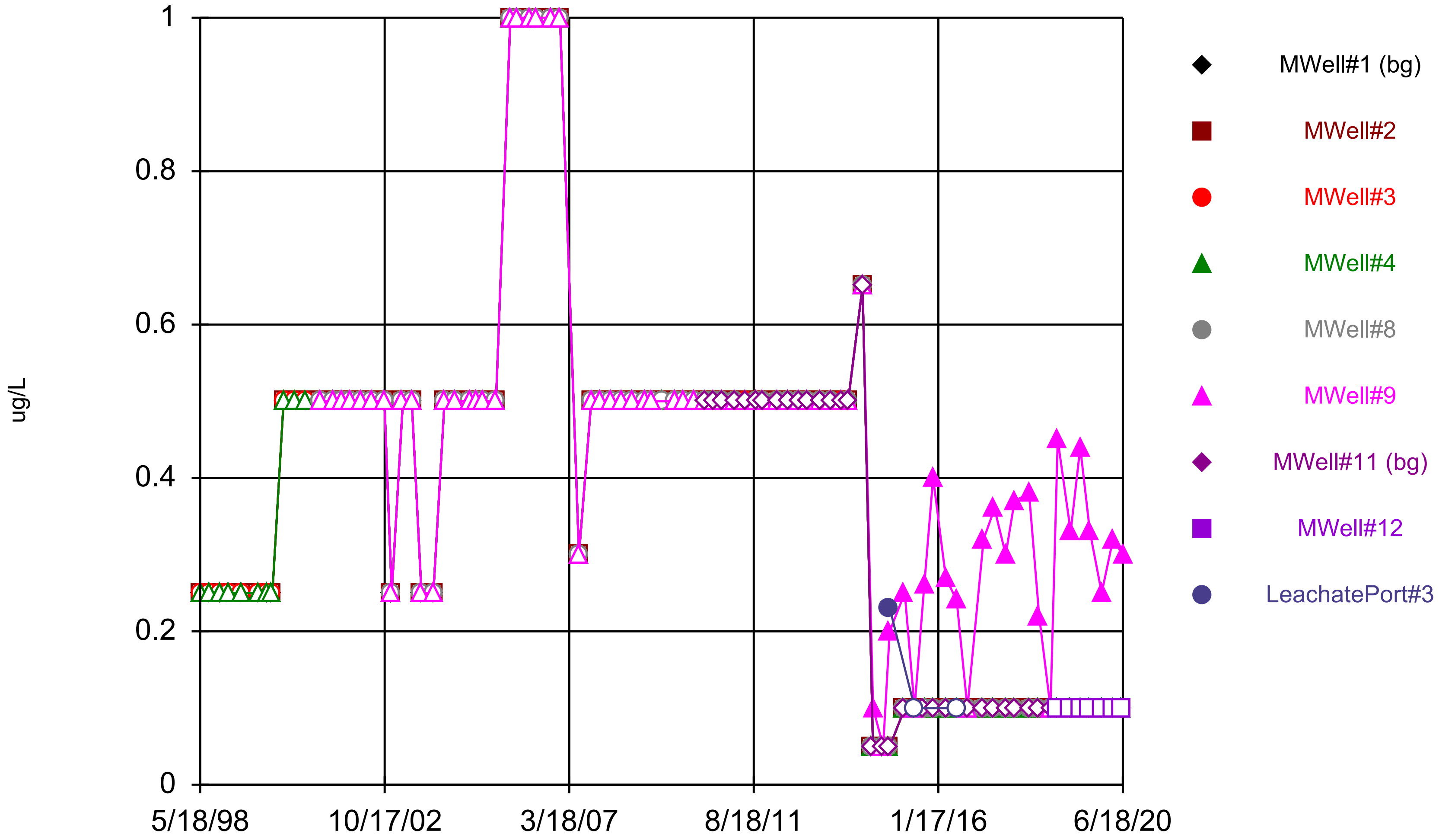
Sanitas™ v.9.6.26 Software licensed to Parametrix. UG
Hollow symbols indicate censored values.



Constituent: TOC Analysis Run 8/12/2020 2:45 PM View: HRLF_TSP Set1
Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Sanitas™ v.9.6.26 Software licensed to Parametrix. UG
Hollow symbols indicate censored values.

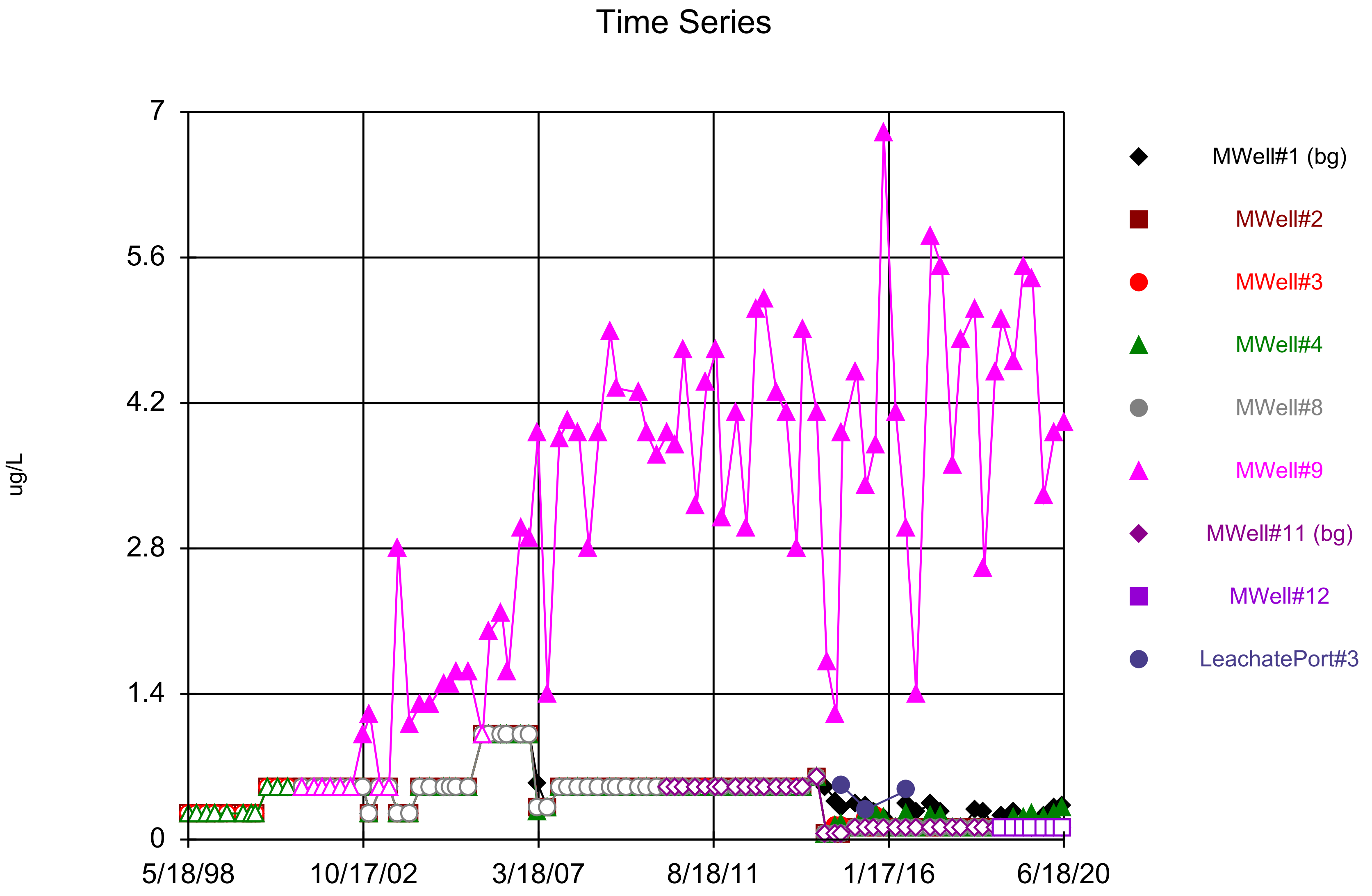
Time Series



Constituent: trans-1,2-Dichloroethene   Analysis Run 8/12/2020 2:45 PM   View: HRLF_TSP Set1

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

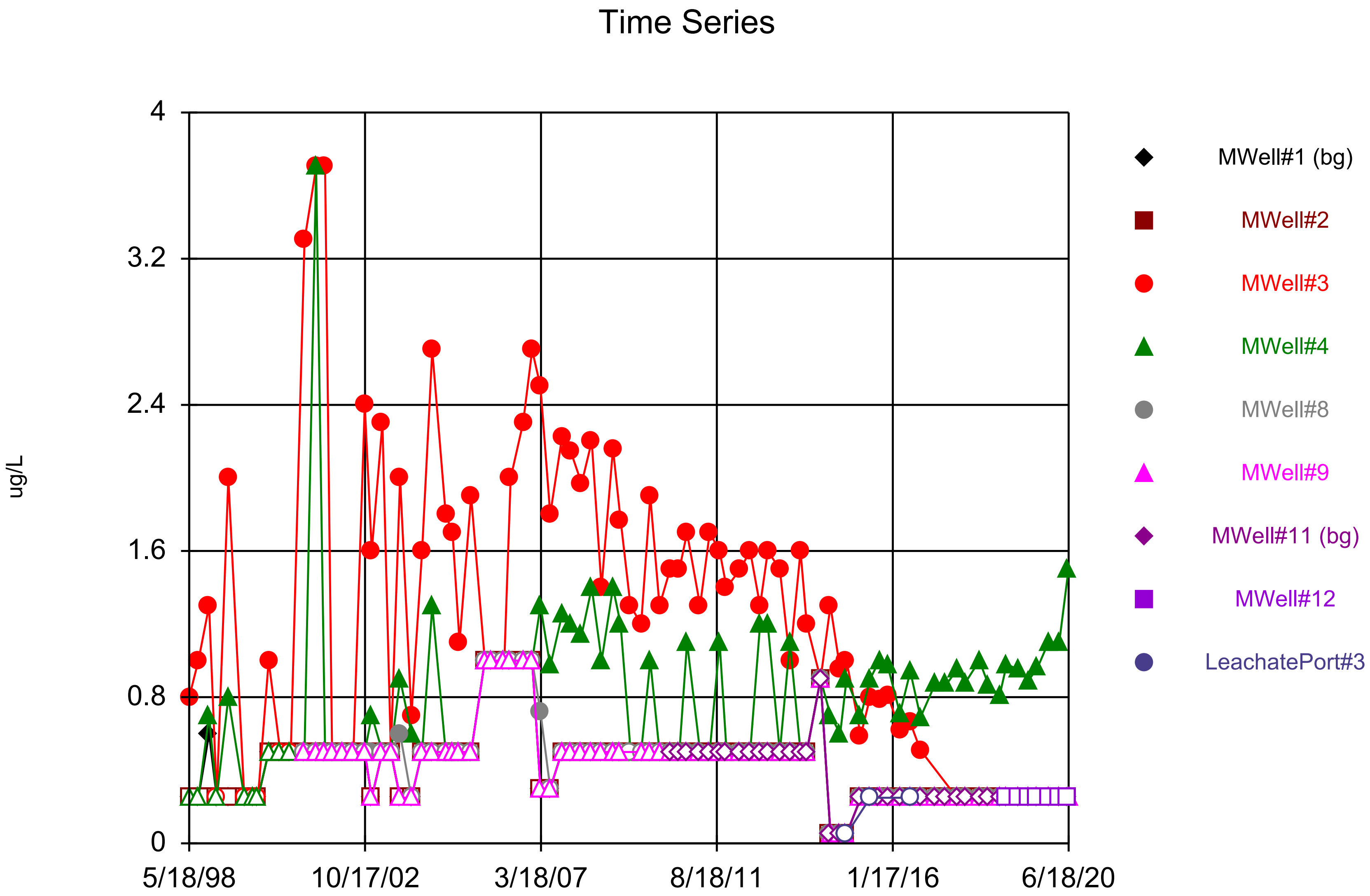
Sanitas™ v.9.6.26 Software licensed to Parametrix. UG
Hollow symbols indicate censored values.



Constituent: Trichloroethene Analysis Run 8/12/2020 2:45 PM View: HRLF_TSP Set1

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Sanitas™ v.9.6.26 Software licensed to Parametrix. UG
Hollow symbols indicate censored values.



Constituent: Trichlorofluoromethane Analysis Run 8/12/2020 2:46 PM View: HRLF_TSP Set1

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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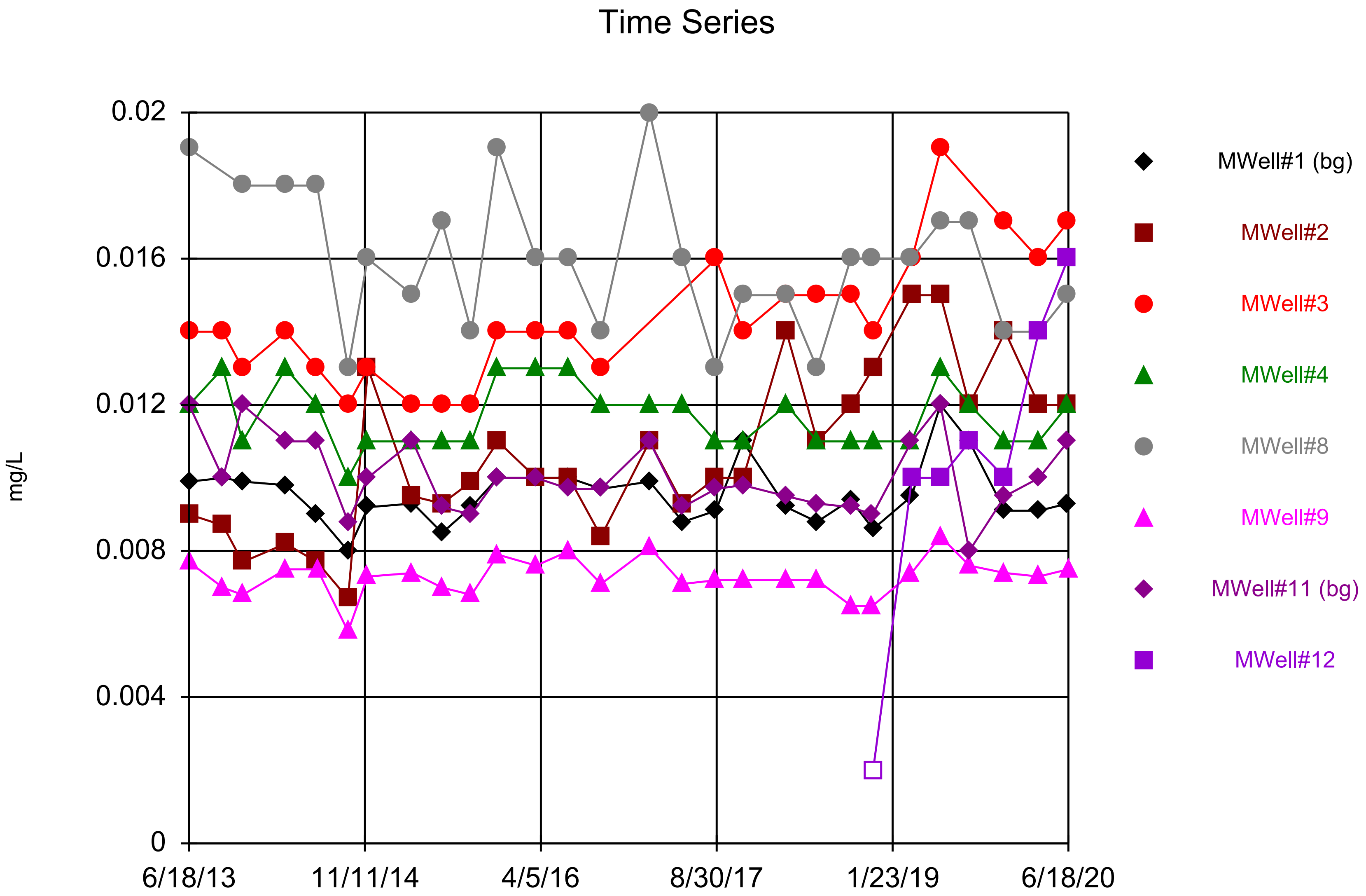
Hollow symbols indicate censored values.



Constituent: Vanadium, Total Analysis Run 8/12/2020 2:46 PM View: HRLF_TSP Set1
Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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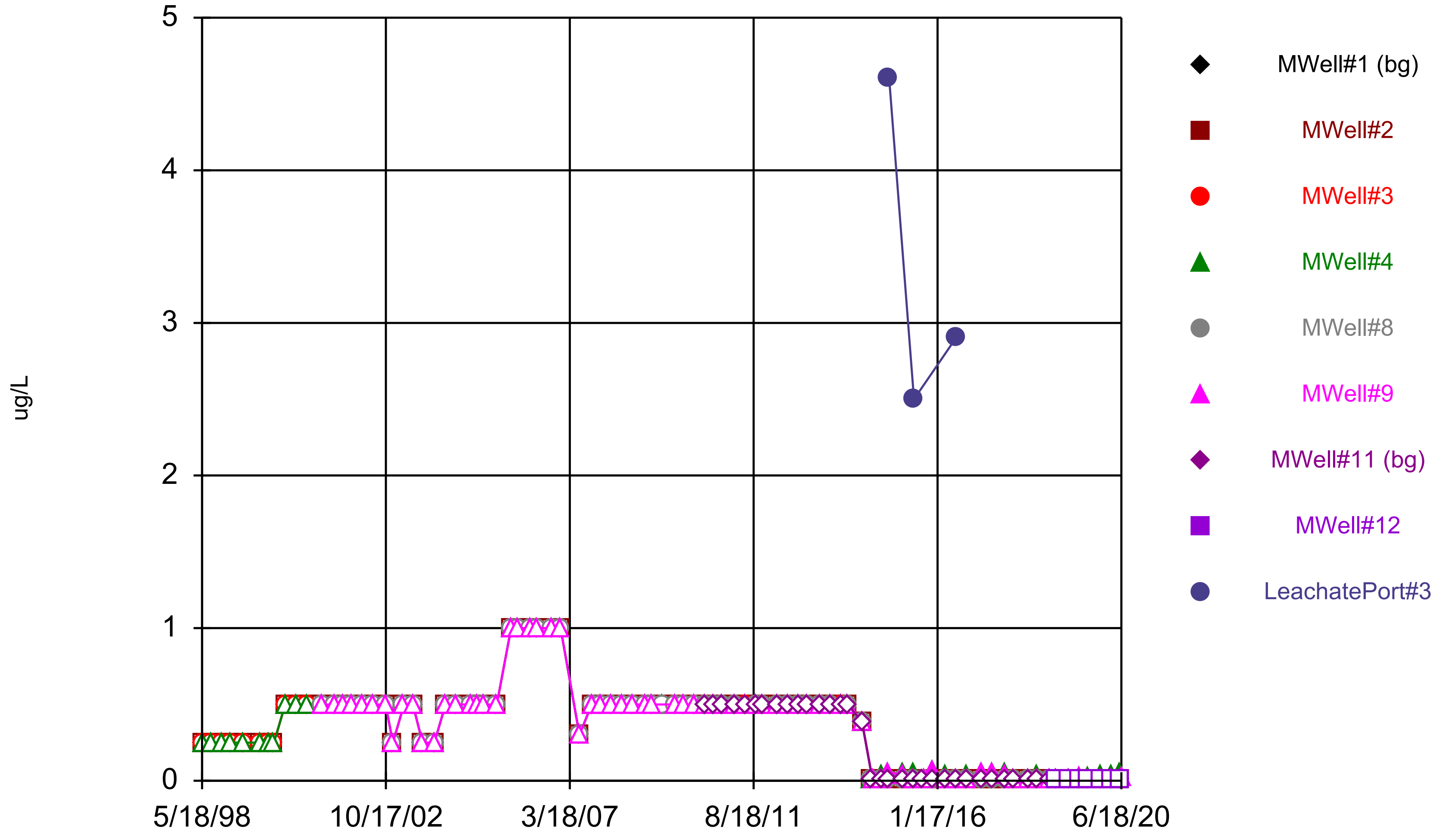
Hollow symbols indicate censored values.

Time Series



Constituent: Vinyl Chloride Analysis Run 8/12/2020 2:46 PM View: HRLF_TSP Set1

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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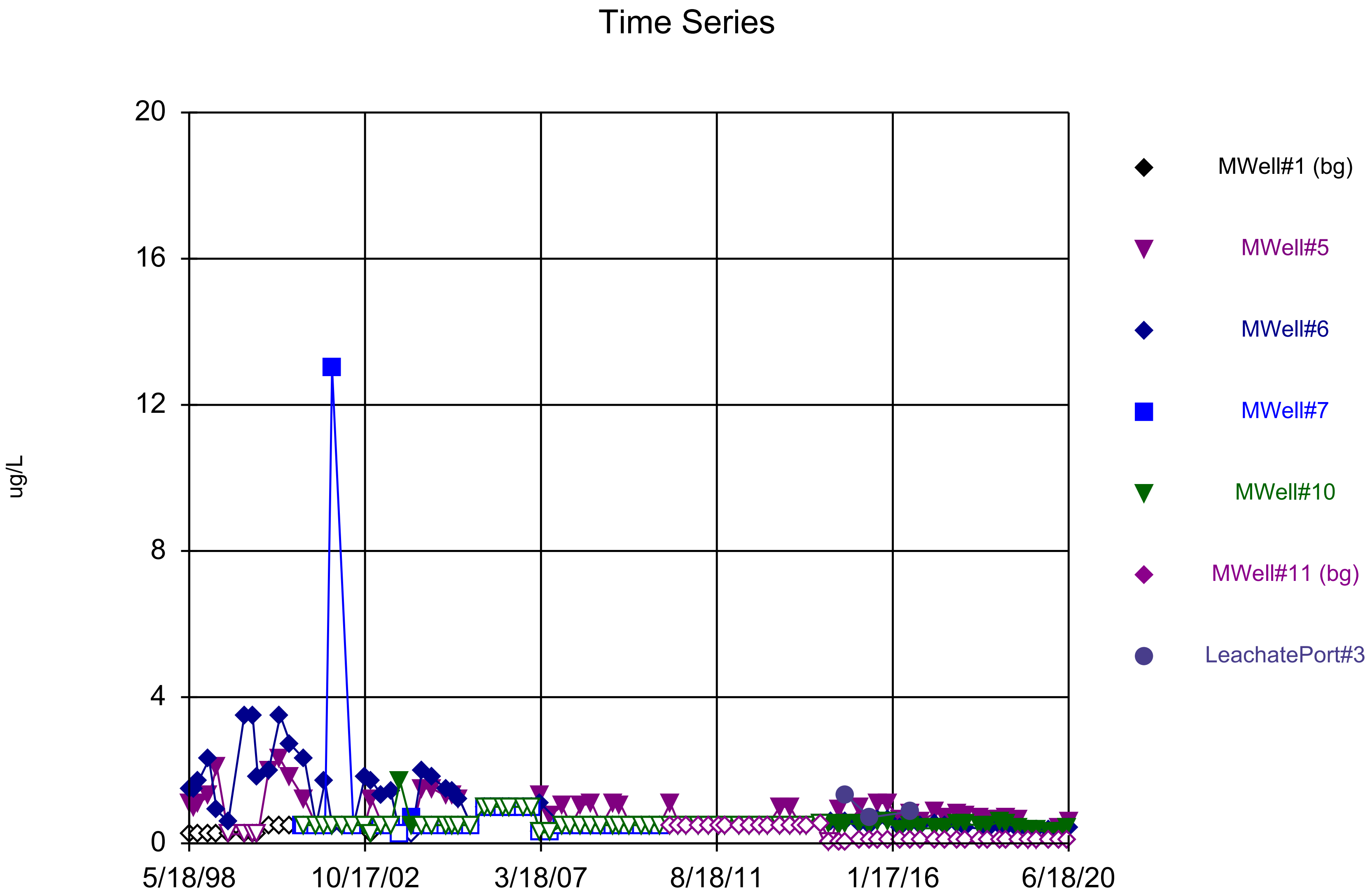
Hollow symbols indicate censored values.



Constituent: 1,2-Dichloroethane Analysis Run 10/16/2020 10:16 AM View: HRLF_TSP Set2

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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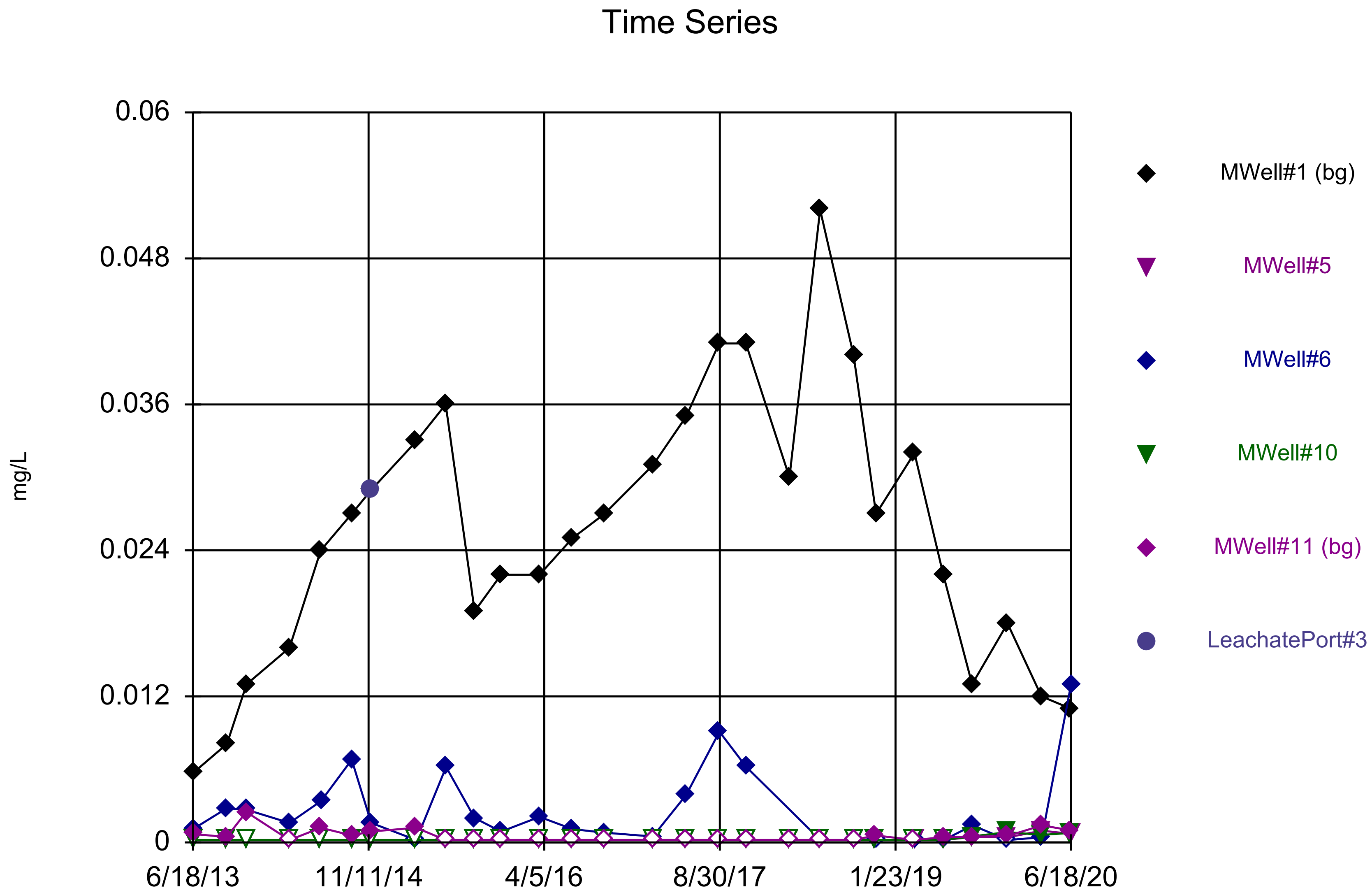
Hollow symbols indicate censored values.



Constituent: Cobalt, Total   Analysis Run 10/13/2020 3:37 PM   View: HRLF_TSP Set2

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

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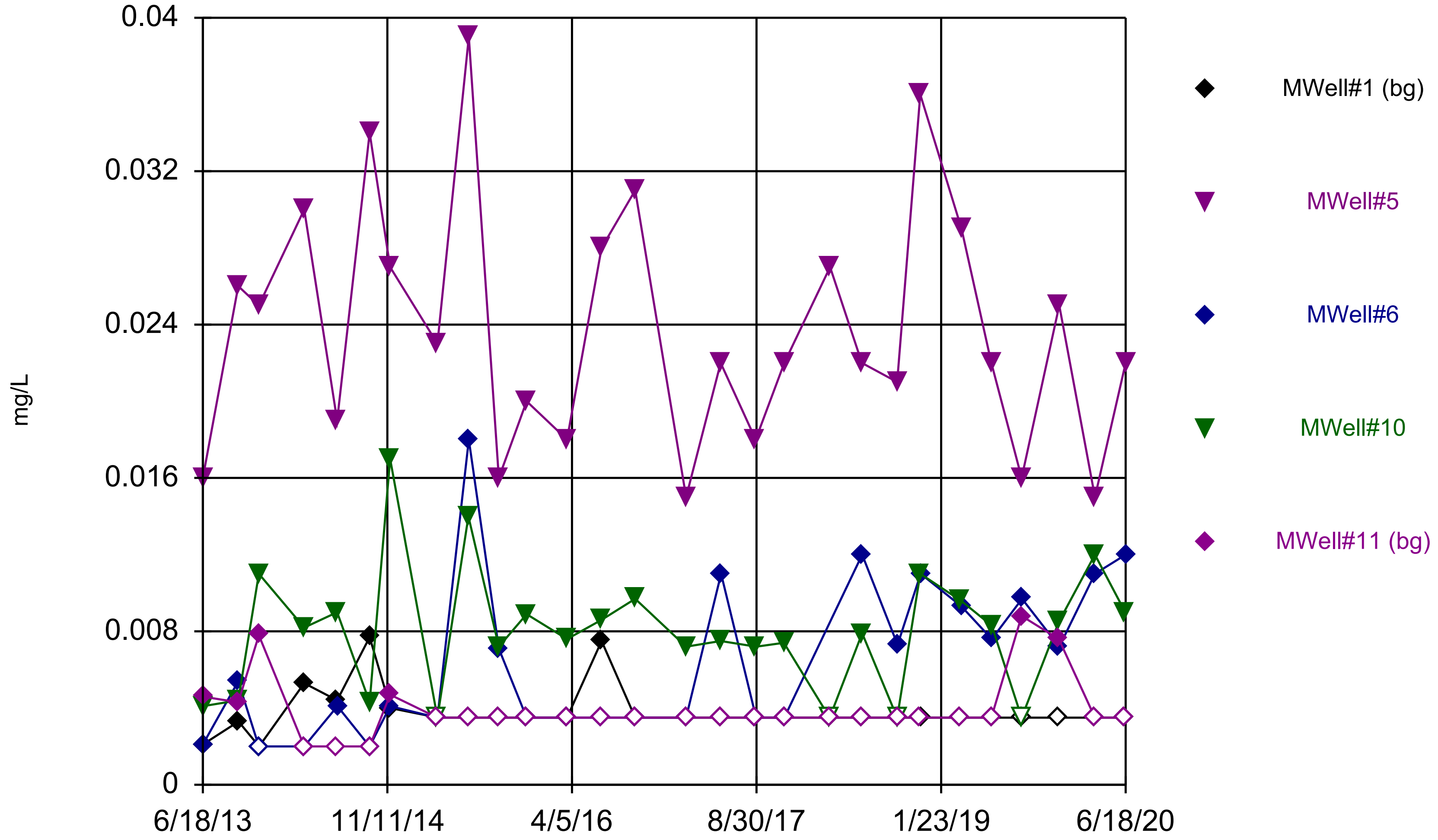
Hollow symbols indicate censored values.

Time Series



Constituent: Zinc, Total   Analysis Run 10/23/2020 12:13 PM   View: HRLF_TSP Set2

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

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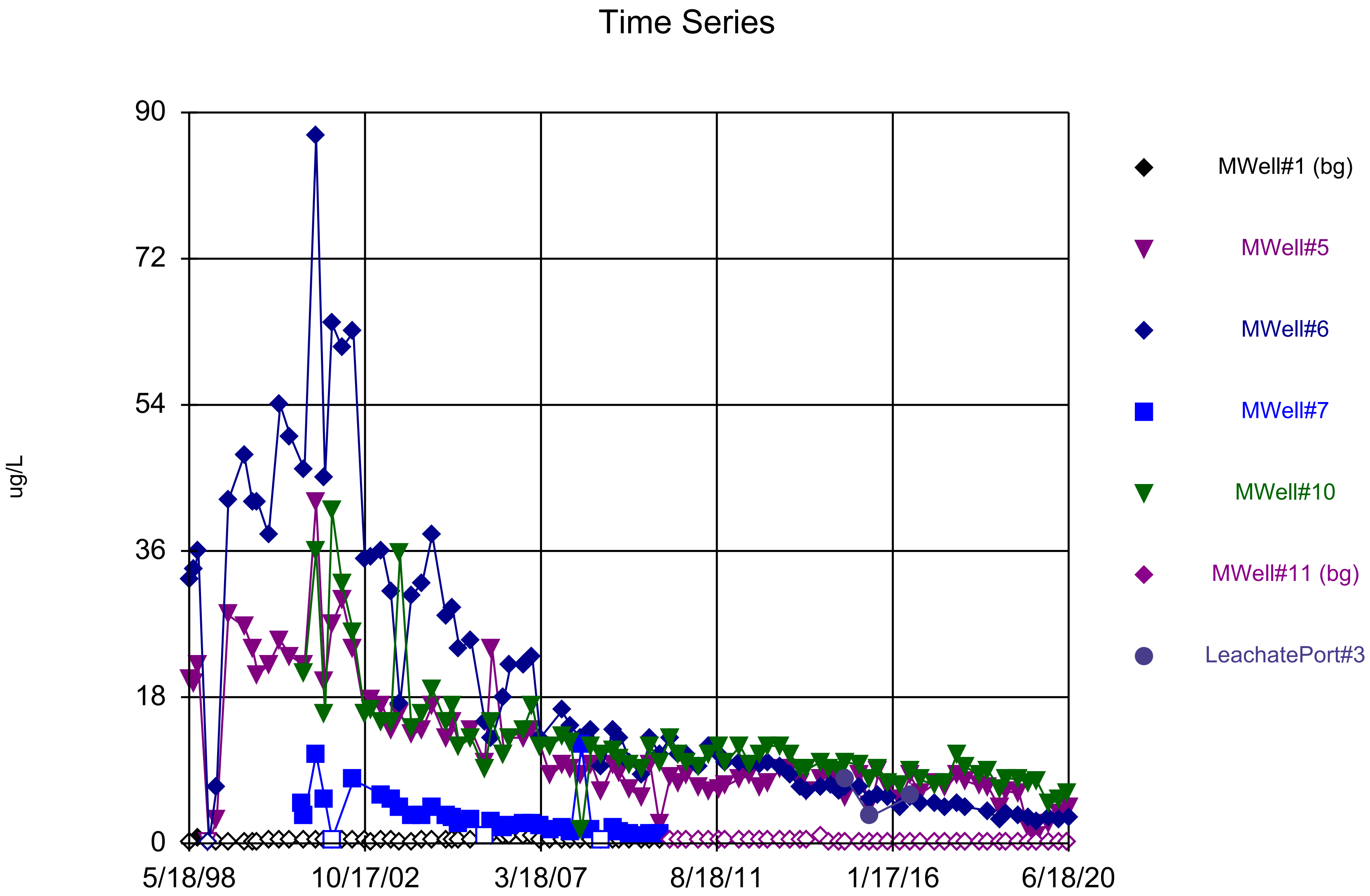
Hollow symbols indicate censored values.



Constituent: 1,1-Dichloroethane Analysis Run 8/12/2020 2:48 PM View: HRLF_TSP Set2

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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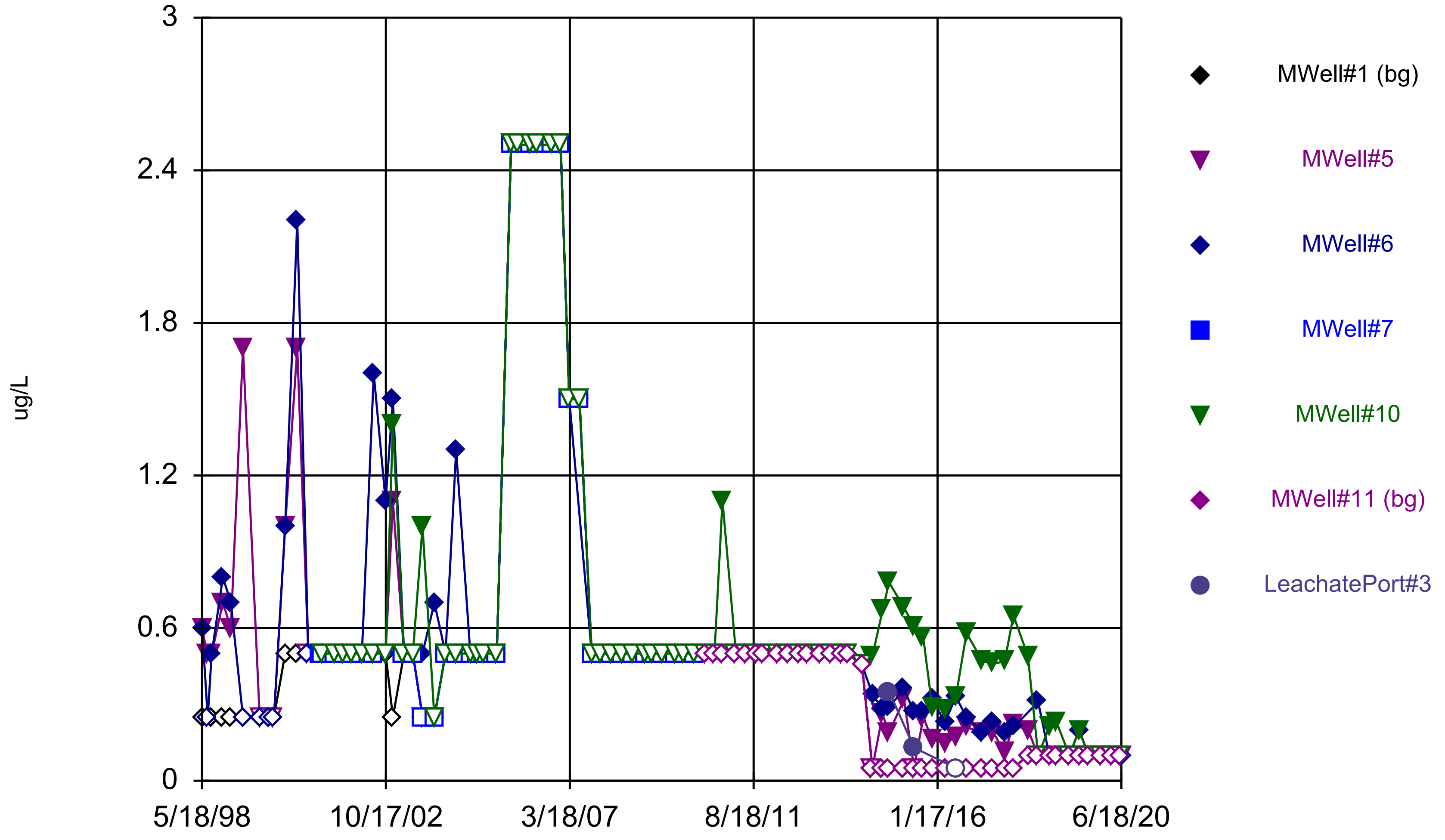
Hollow symbols indicate censored values.

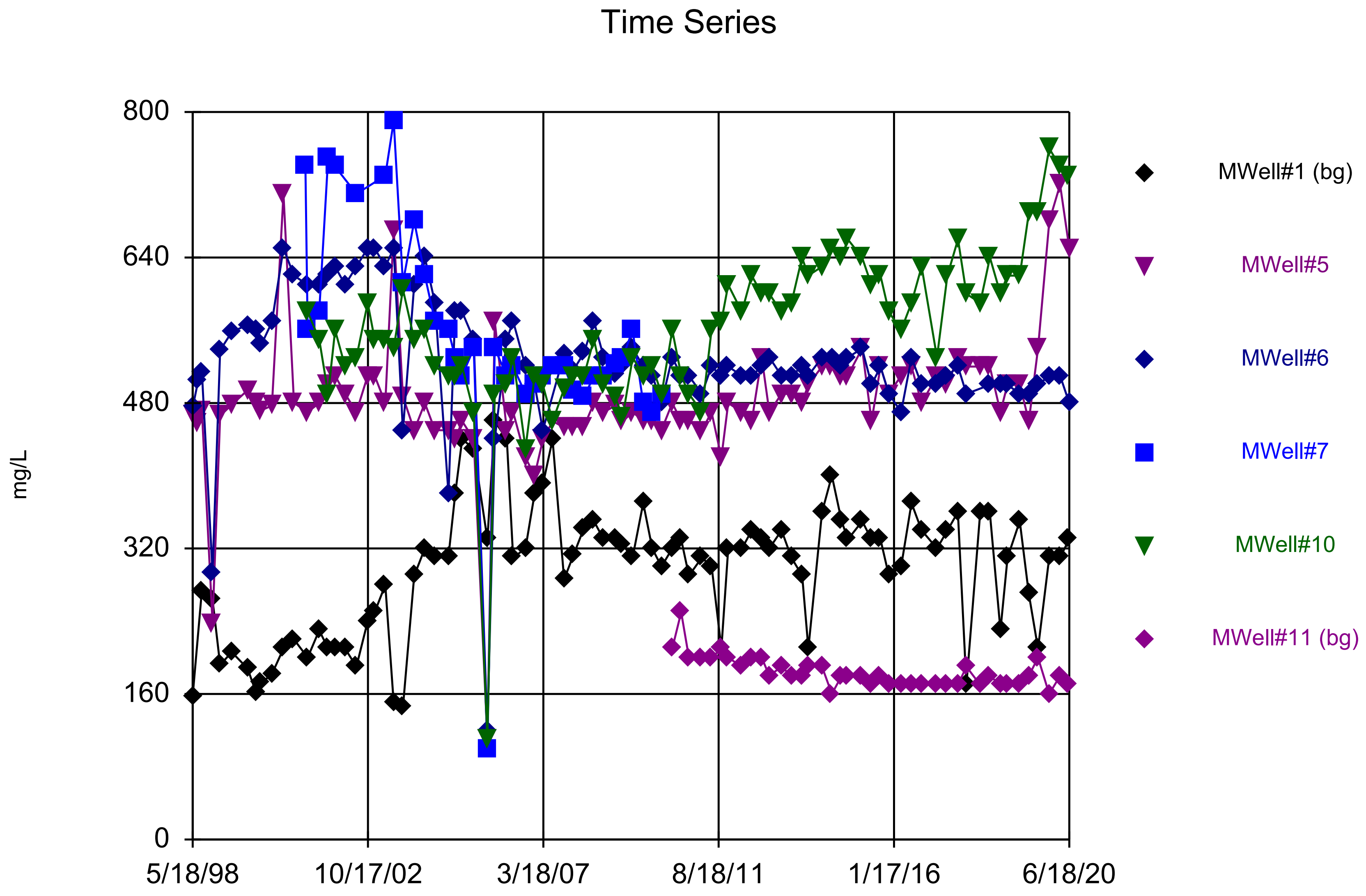
Time Series



Constituent: 1,1-Dichloroethene Analysis Run 8/12/2020 2:48 PM View: HRLF_TSP Set2

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

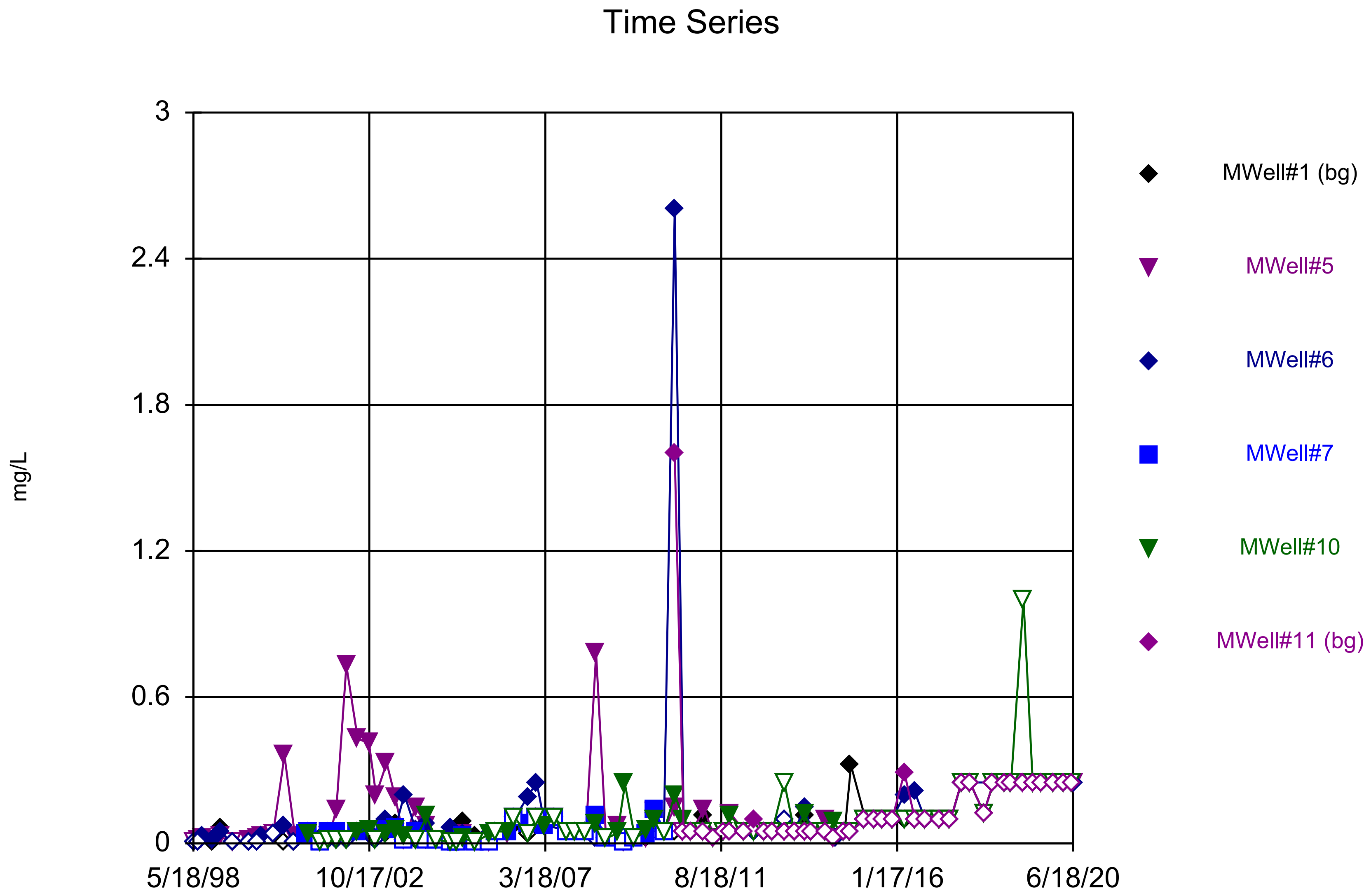
Sanitas™ v.9.6.26 Software licensed to Parametrix. UG



Constituent: Alkalinity   Analysis Run 8/12/2020 2:48 PM   View: HRLF_TSP Set2

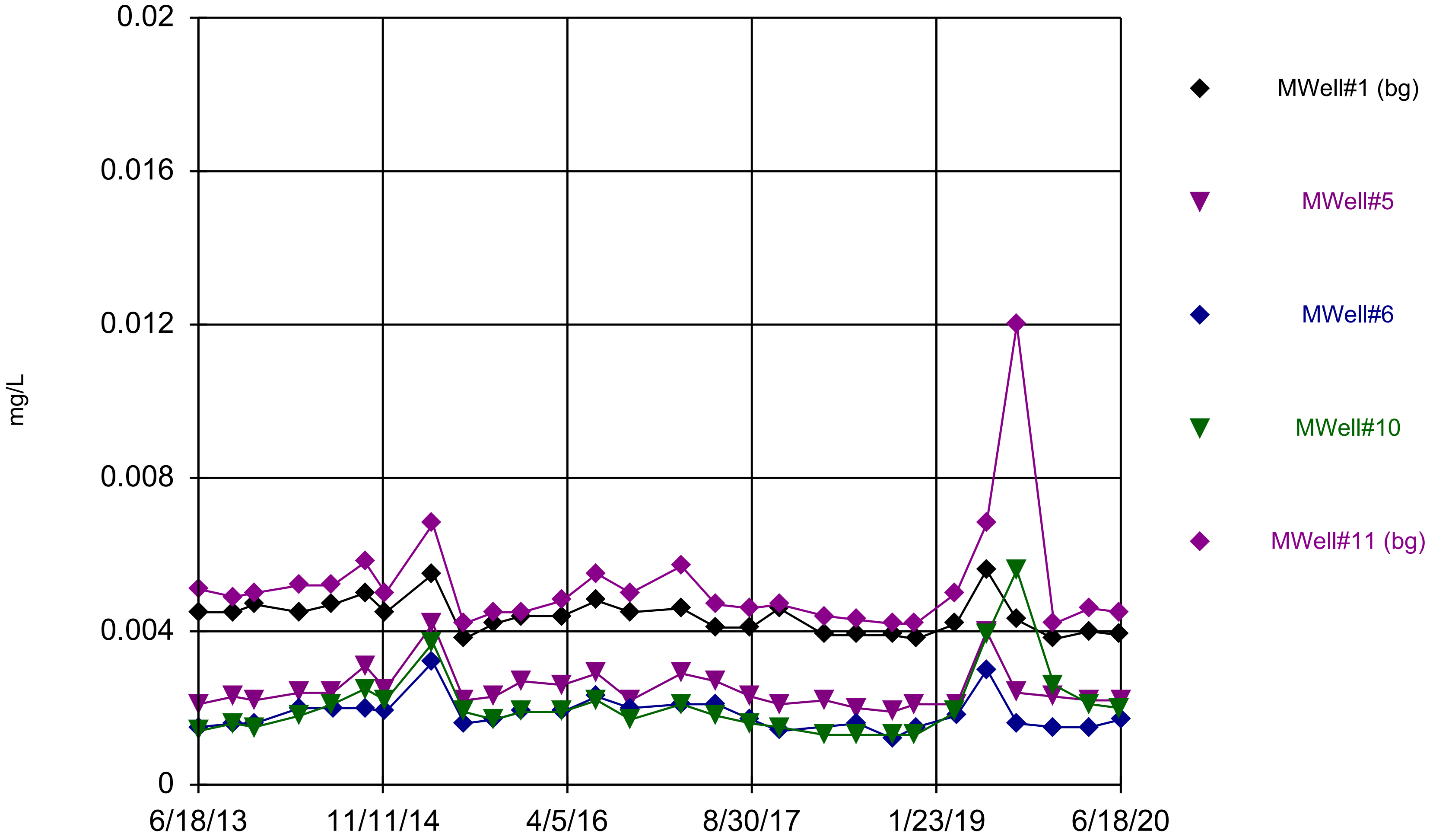
Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

Sanitas™ v.9.6.26 Software licensed to Parametrix. UG
Hollow symbols indicate censored values.



Constituent: Ammonia Nitrogen Analysis Run 8/12/2020 2:49 PM View: HRLF_TSP Set2
Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Time Series



Constituent: Arsenic, Total   Analysis Run 8/12/2020 2:49 PM   View: HRLF_TSP Set2

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

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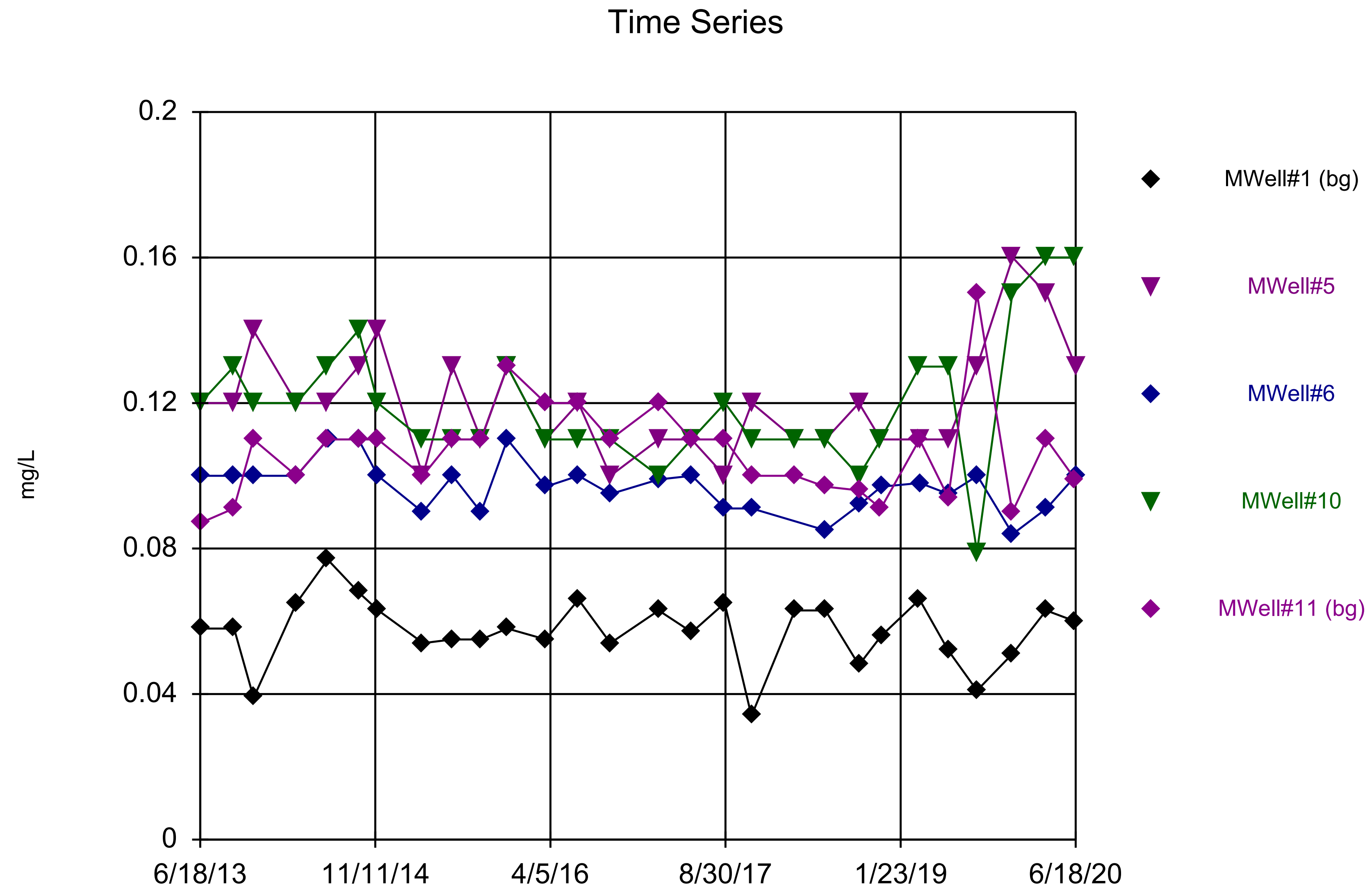
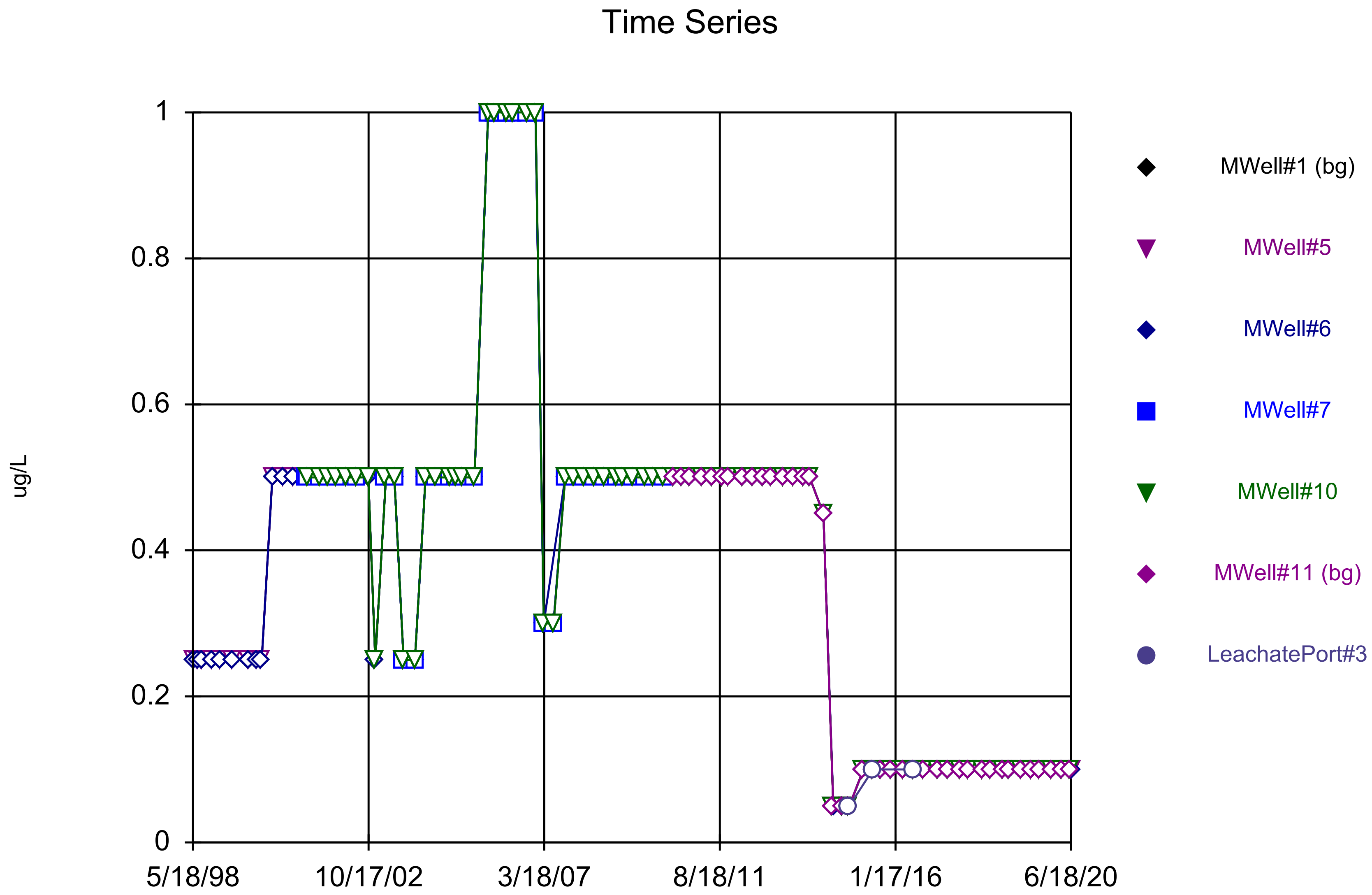


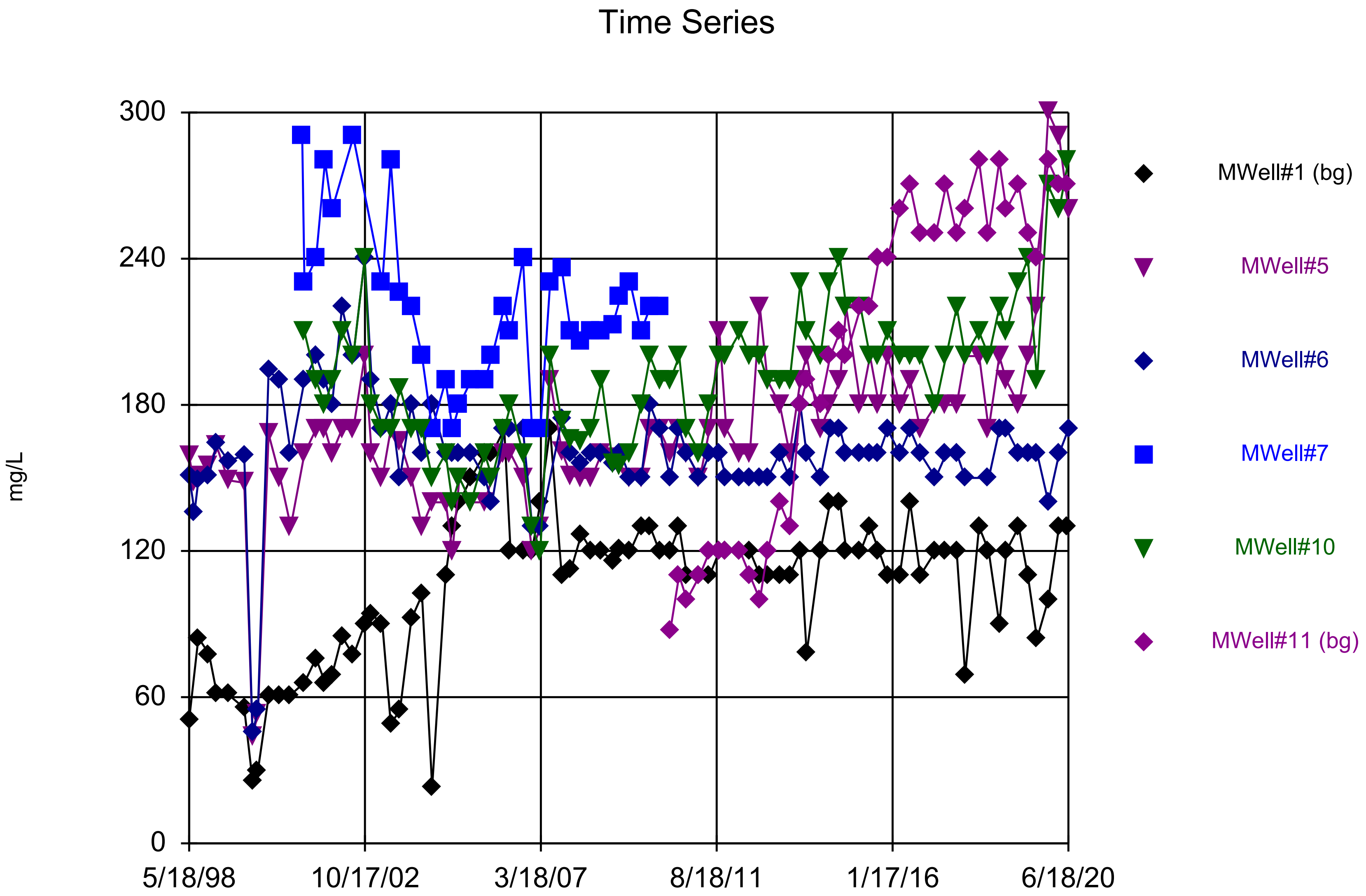
Constituent: Barium, Total Analysis Run 8/12/2020 2:49 PM View: HRLF_TSP Set2

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Sanitas™ v.9.6.26 Software licensed to Parametrix. UG
Hollow symbols indicate censored values.



Constituent: Bromodichloromethane Analysis Run 8/12/2020 2:49 PM View: HRLF_TSP Set2
Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata



Constituent: Calcium, Dissolved Analysis Run 8/12/2020 2:49 PM View: HRLF_TSP Set2
Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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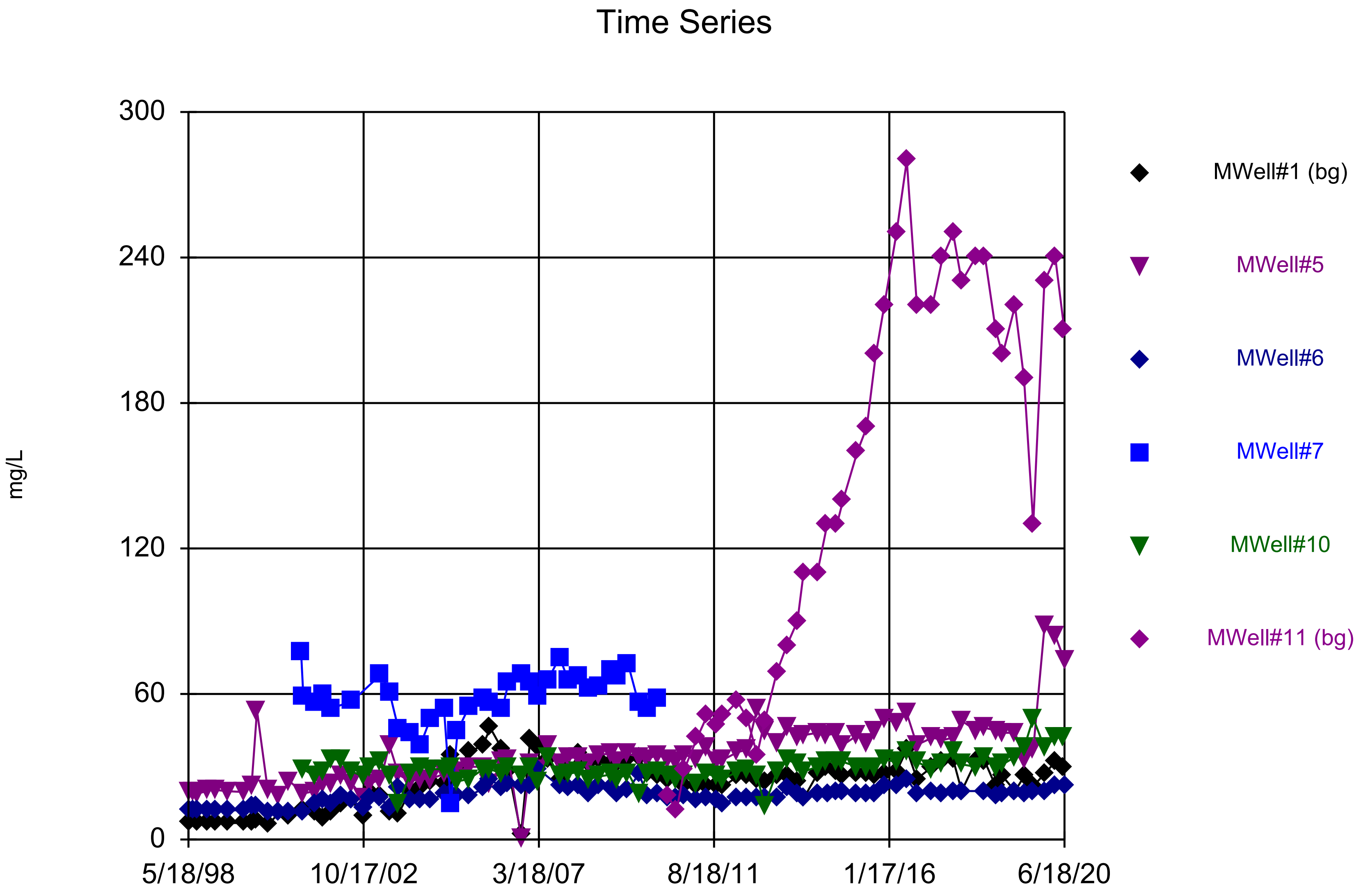


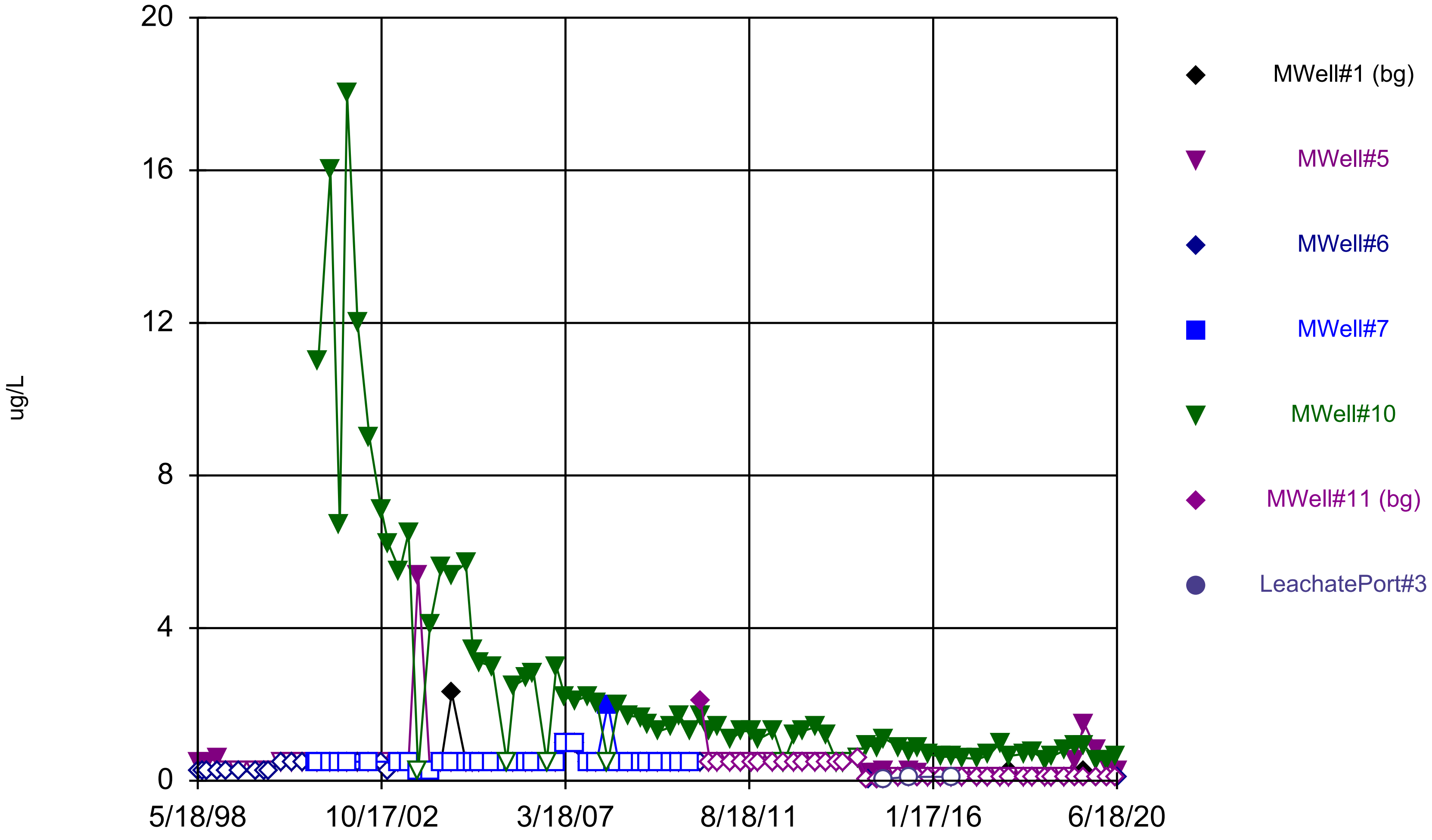
Constituent: Chloride Analysis Run 8/12/2020 2:49 PM View: HRLF_TSP Set2

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Sanitas™ v.9.6.26 Software licensed to Parametrix. UG

Hollow symbols indicate censored values.

Time Series



Constituent: Chloroform Analysis Run 8/12/2020 2:49 PM View: HRLF_TSP Set2

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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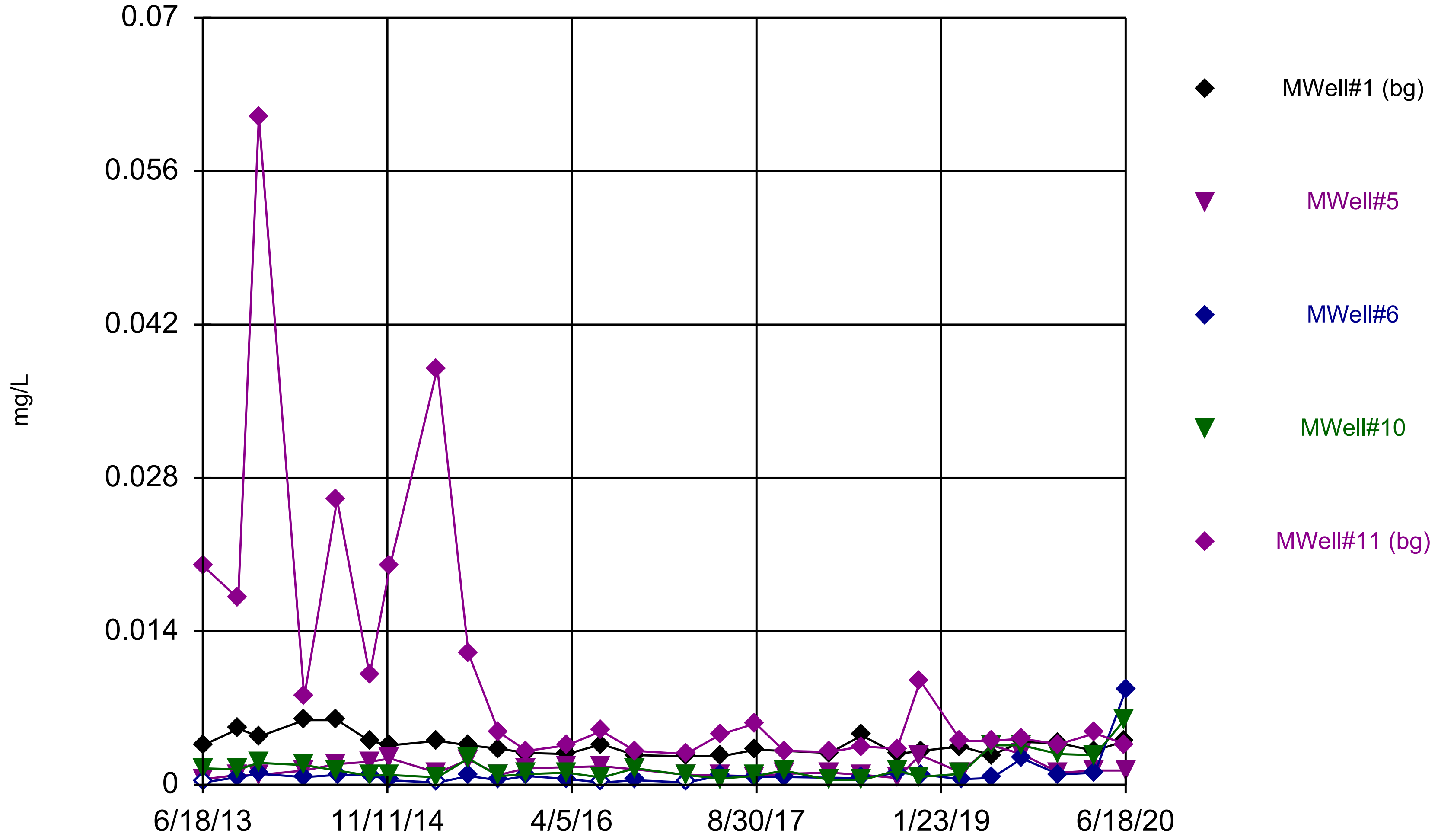
Hollow symbols indicate censored values.

Time Series



Constituent: Chromium, Total Analysis Run 8/12/2020 2:49 PM View: HRLF_TSP Set2
Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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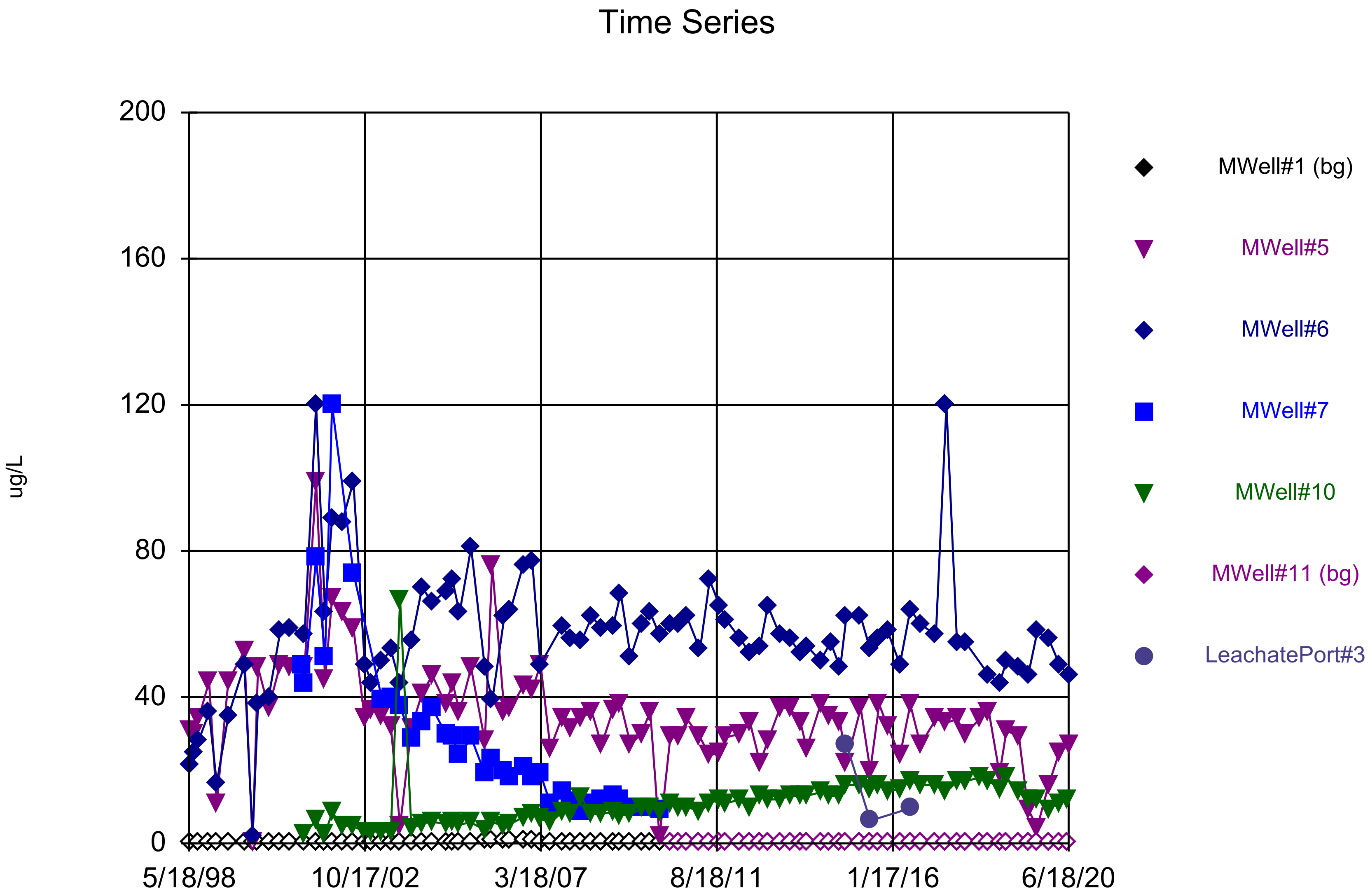
Hollow symbols indicate censored values.



Constituent: cis-1,2-Dichloroethene Analysis Run 8/12/2020 2:49 PM View: HRLF_TSP Set2
Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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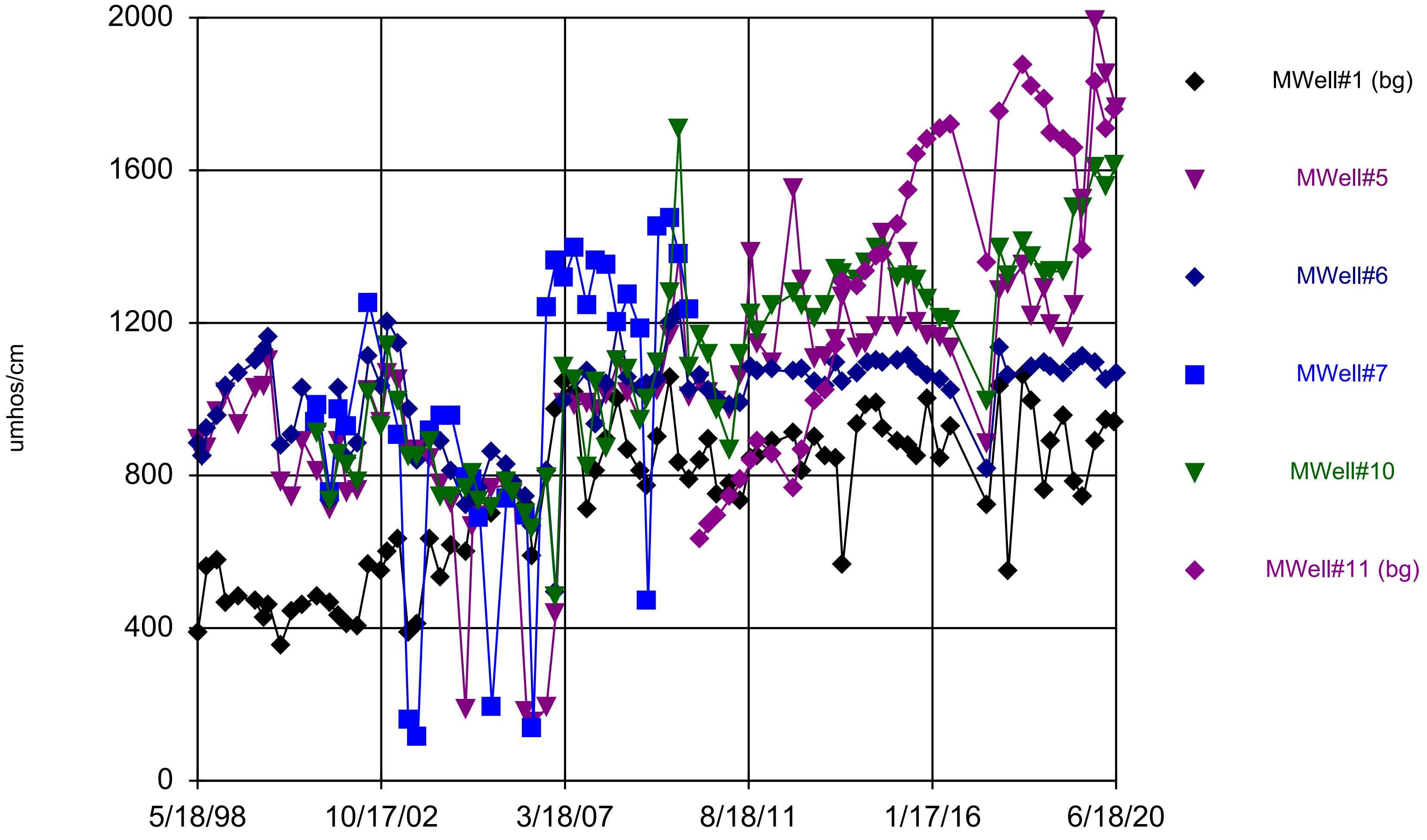
Time Series



Constituent: Conductivity Analysis Run 8/12/2020 2:49 PM View: HRLF_TSP Set2

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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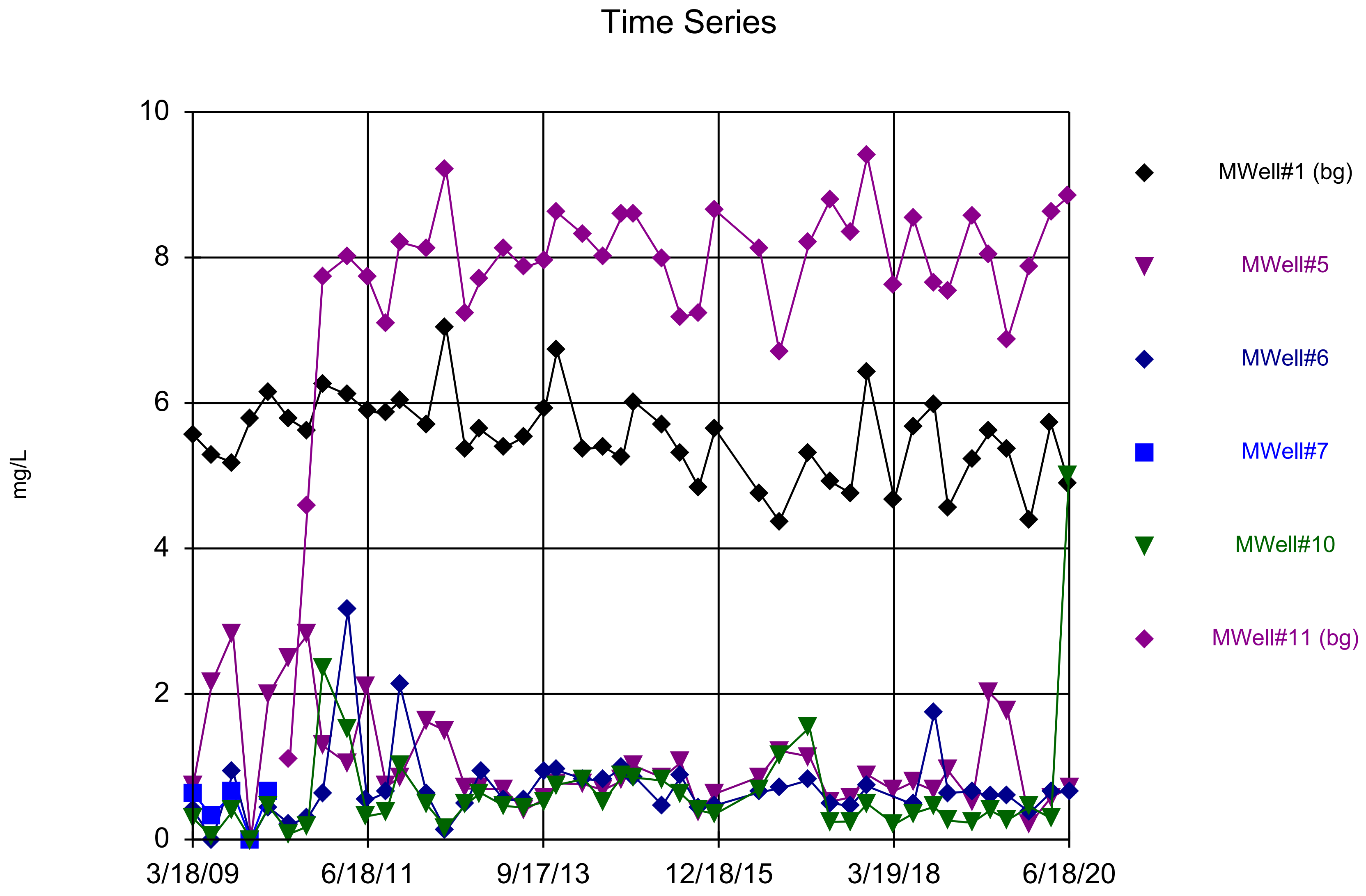

Constituent: Dissolved Oxygen Analysis Run 8/12/2020 2:49 PM View: HRLF_TSP Set2

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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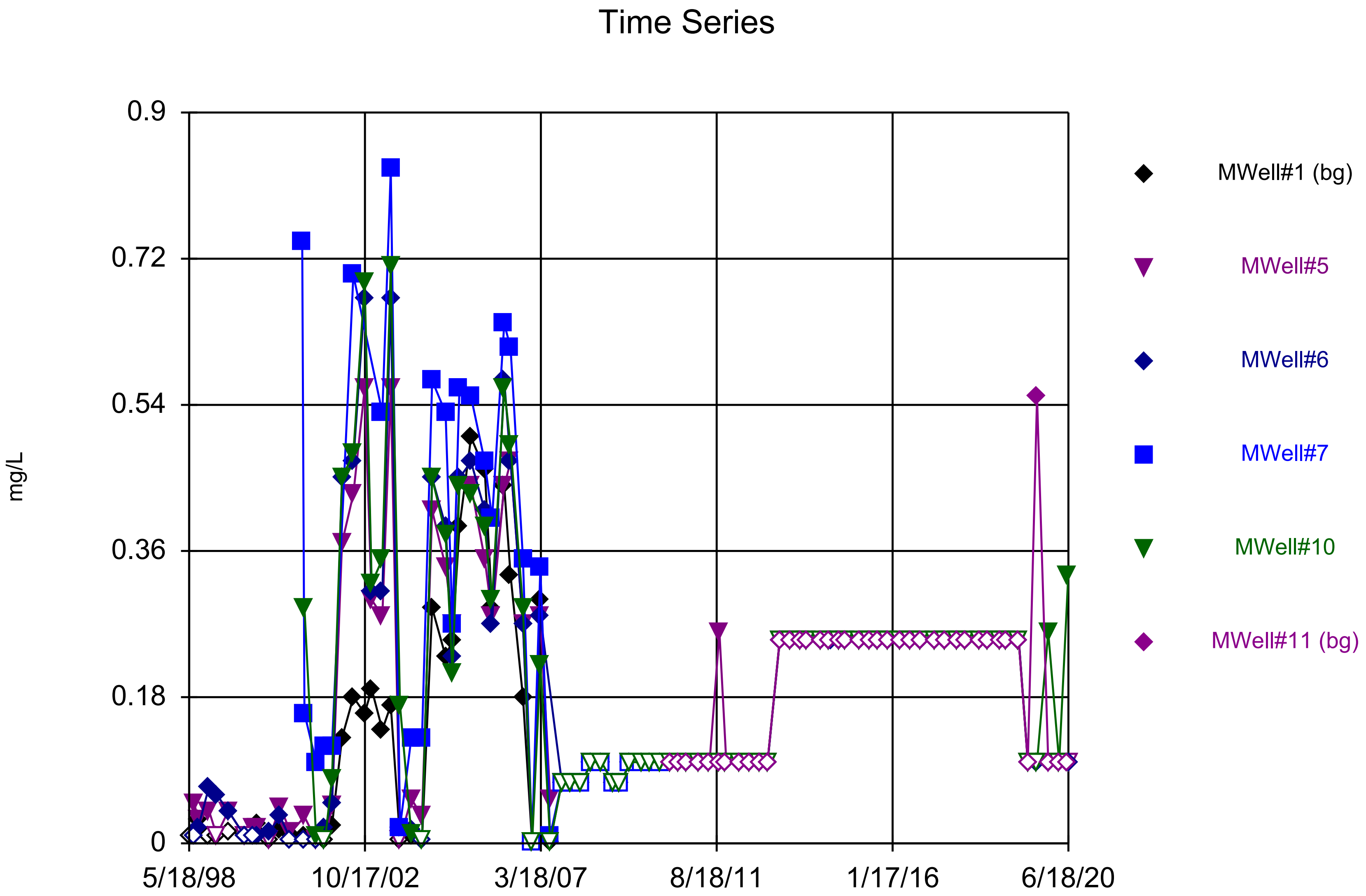
Hollow symbols indicate censored values.



Constituent: Iron, Dissolved Analysis Run 8/12/2020 2:49 PM View: HRLF_TSP Set2
Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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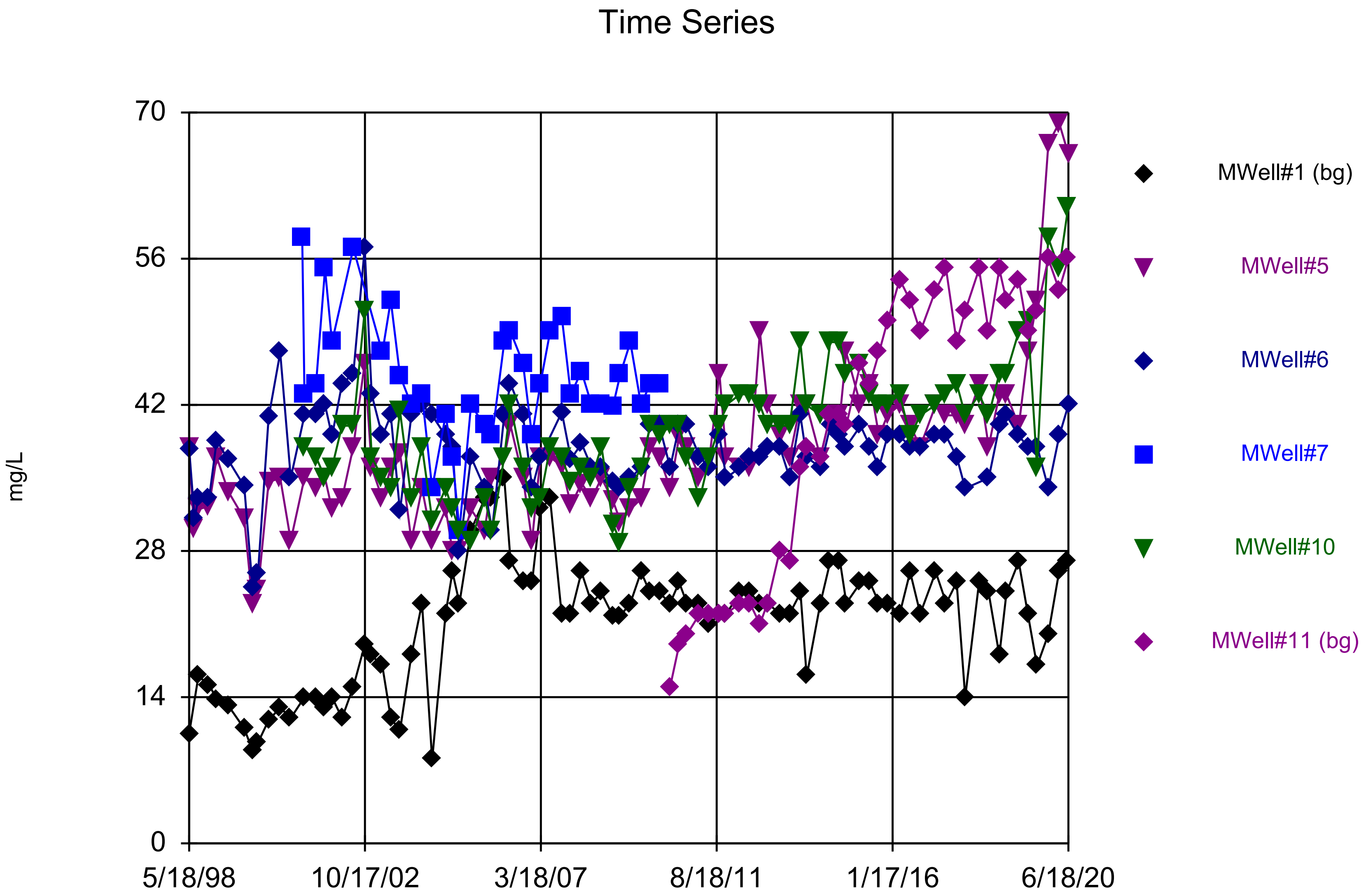

Constituent: Magnesium, Dissolved Analysis Run 8/12/2020 2:49 PM View: HRLF_TSP Set2

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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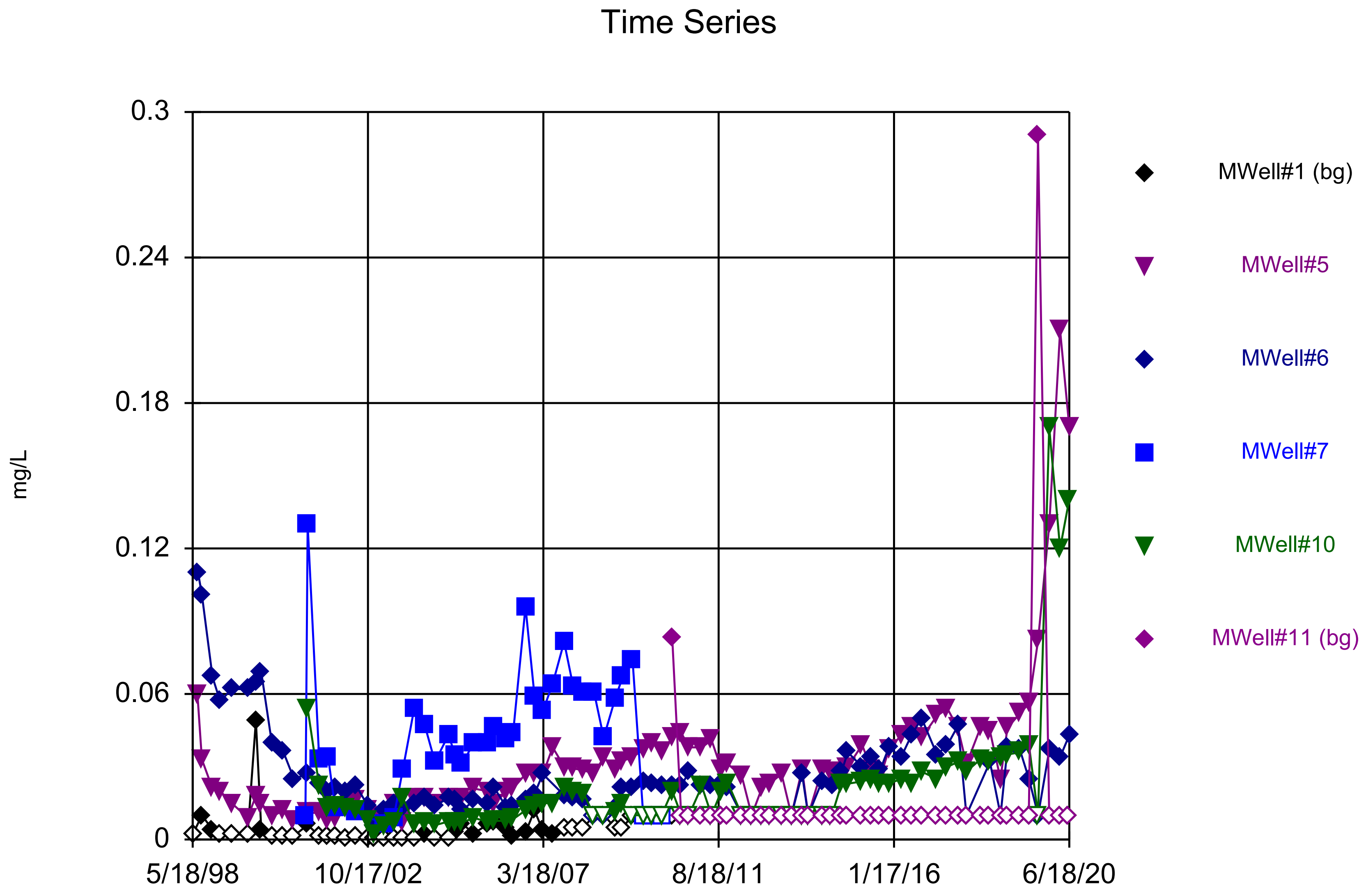
Hollow symbols indicate censored values.



Constituent: Manganese, Dissolved   Analysis Run 8/12/2020 2:50 PM   View: HRLF_TSP Set2

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

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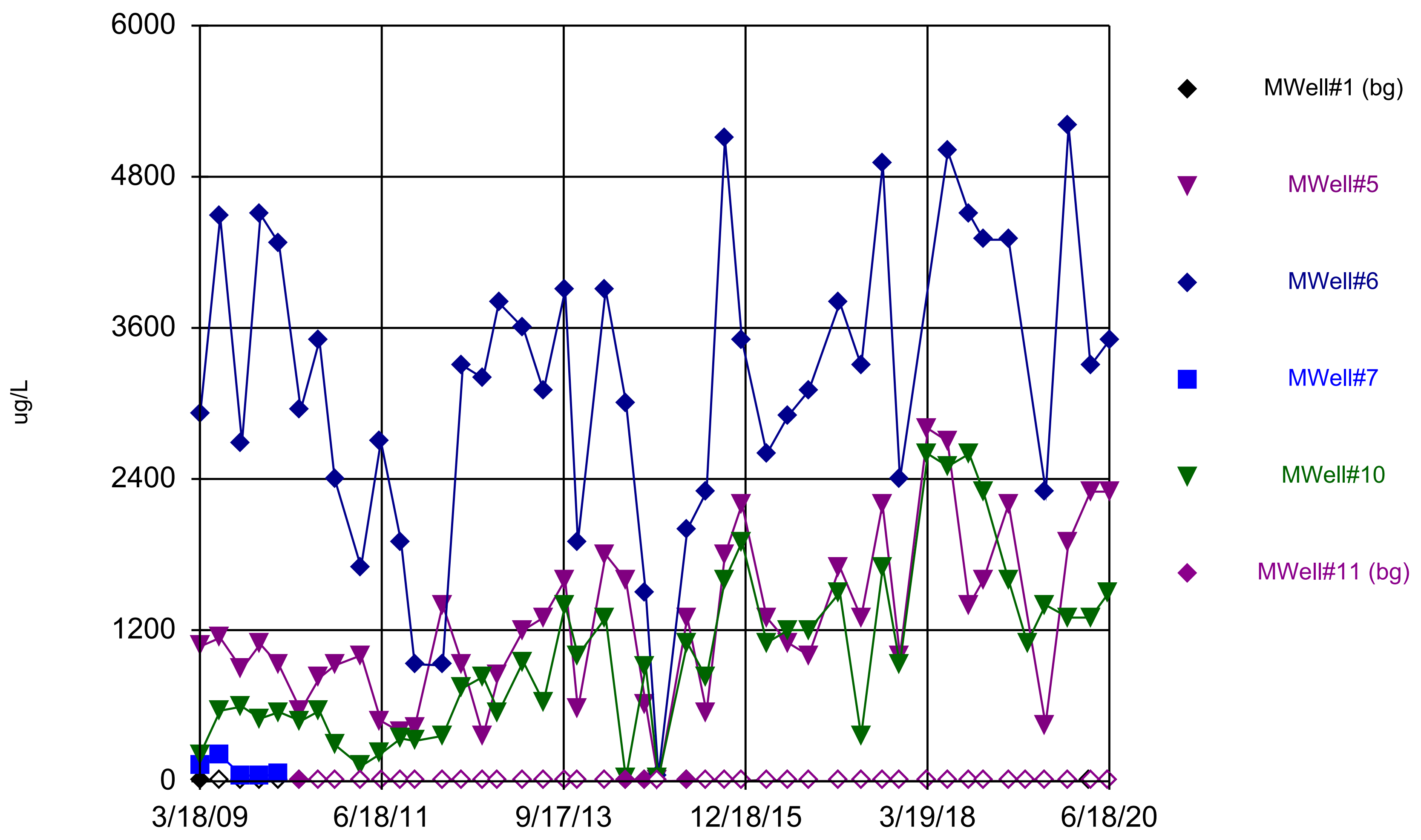
Hollow symbols indicate censored values.

Time Series



Constituent: Methane Analysis Run 8/12/2020 2:50 PM View: HRLF_TSP Set2
Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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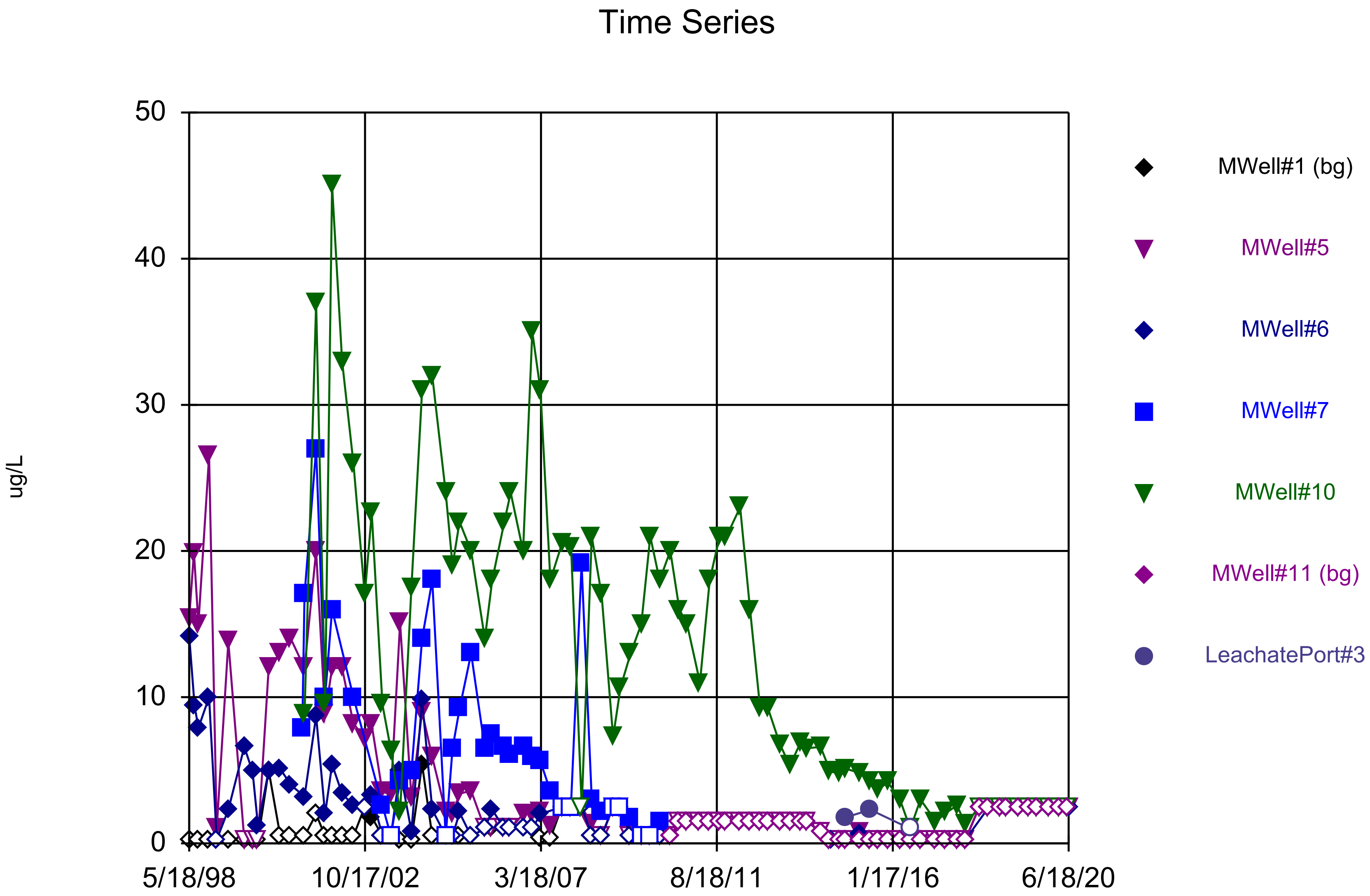
Hollow symbols indicate censored values.



Constituent: Methylene Chloride Analysis Run 8/12/2020 2:50 PM View: HRLF_TSP Set2
Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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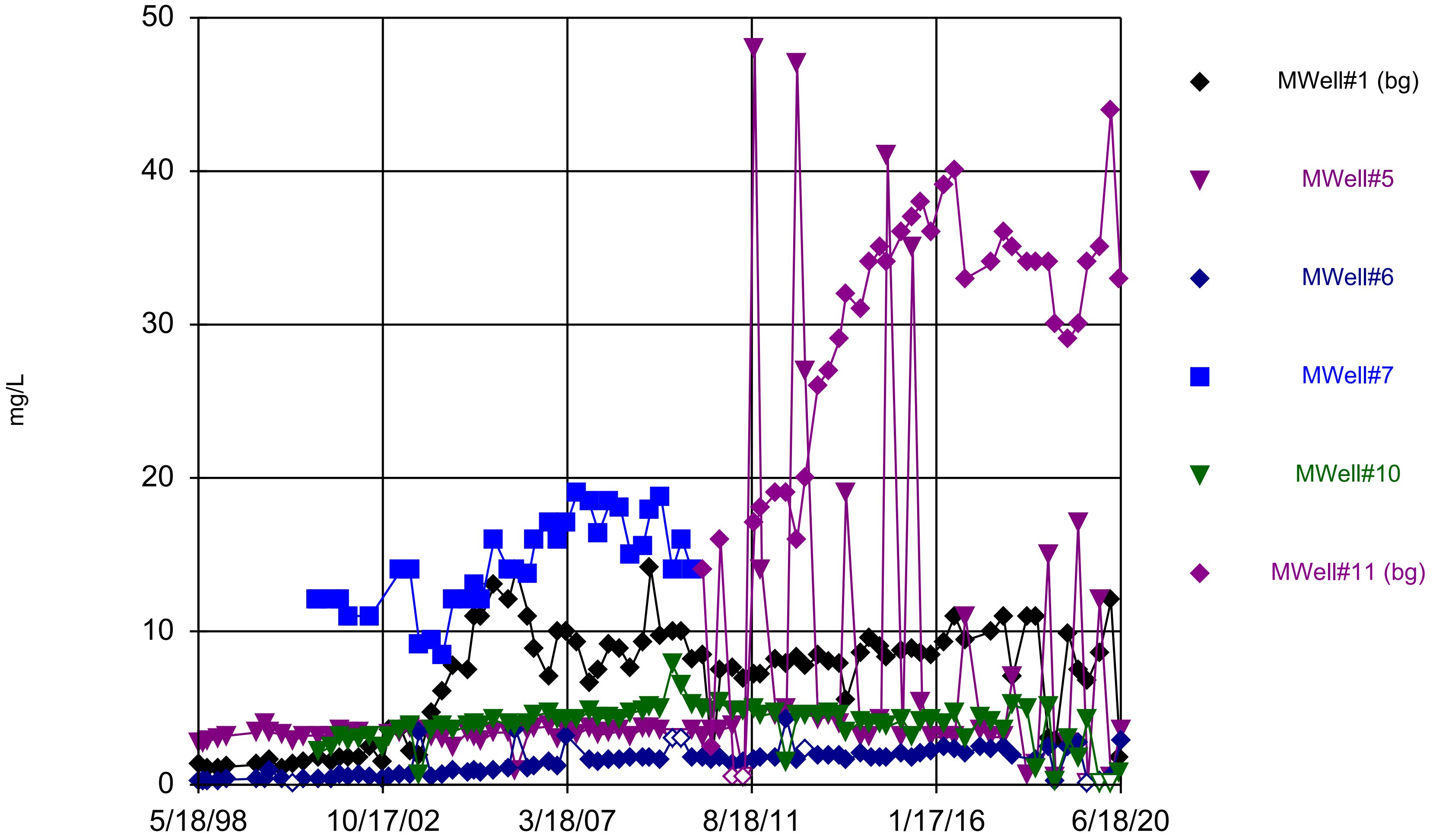
Hollow symbols indicate censored values.

Time Series



Constituent: Nitrate Nitrogen Analysis Run 8/12/2020 2:50 PM View: HRLF_TSP Set2
Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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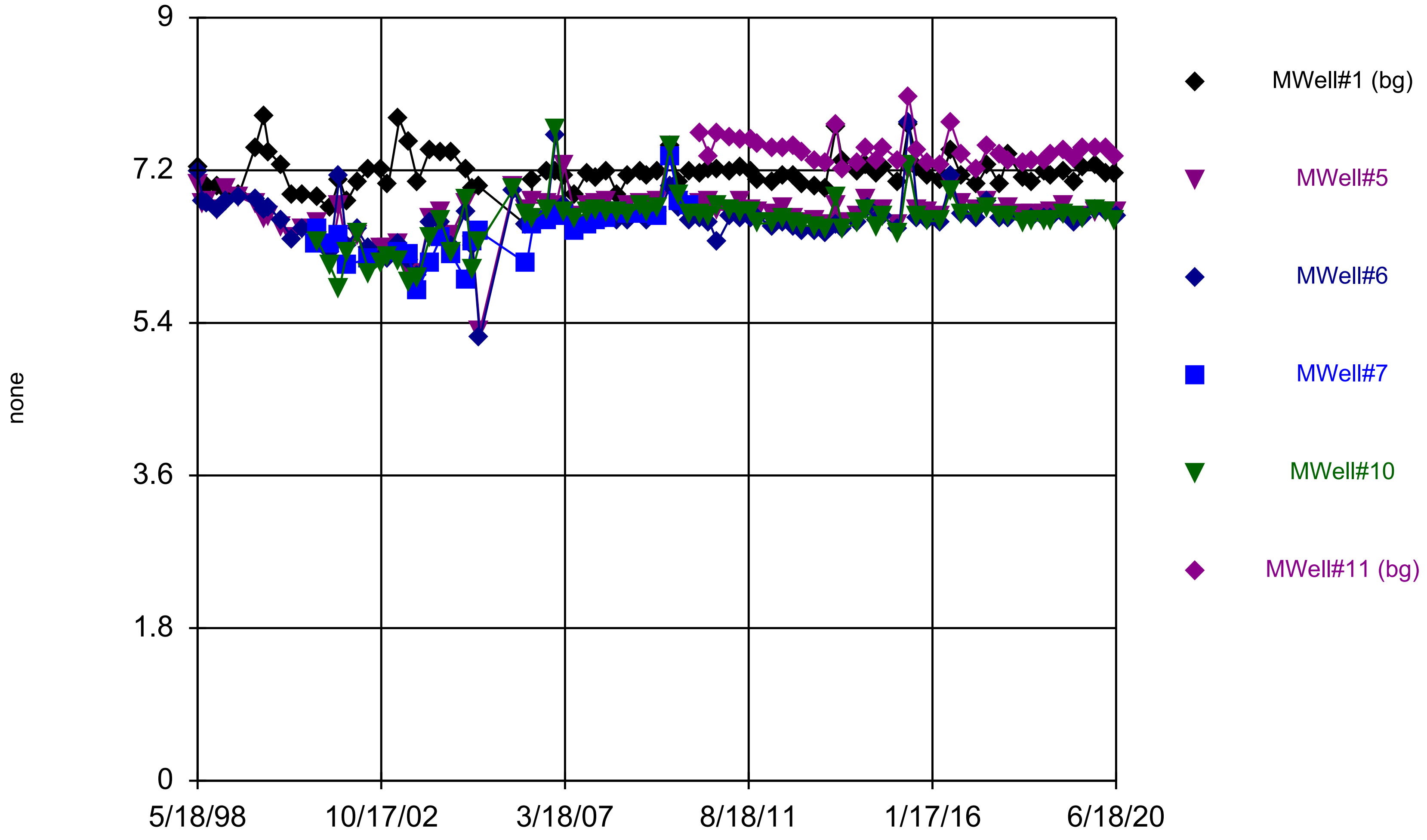
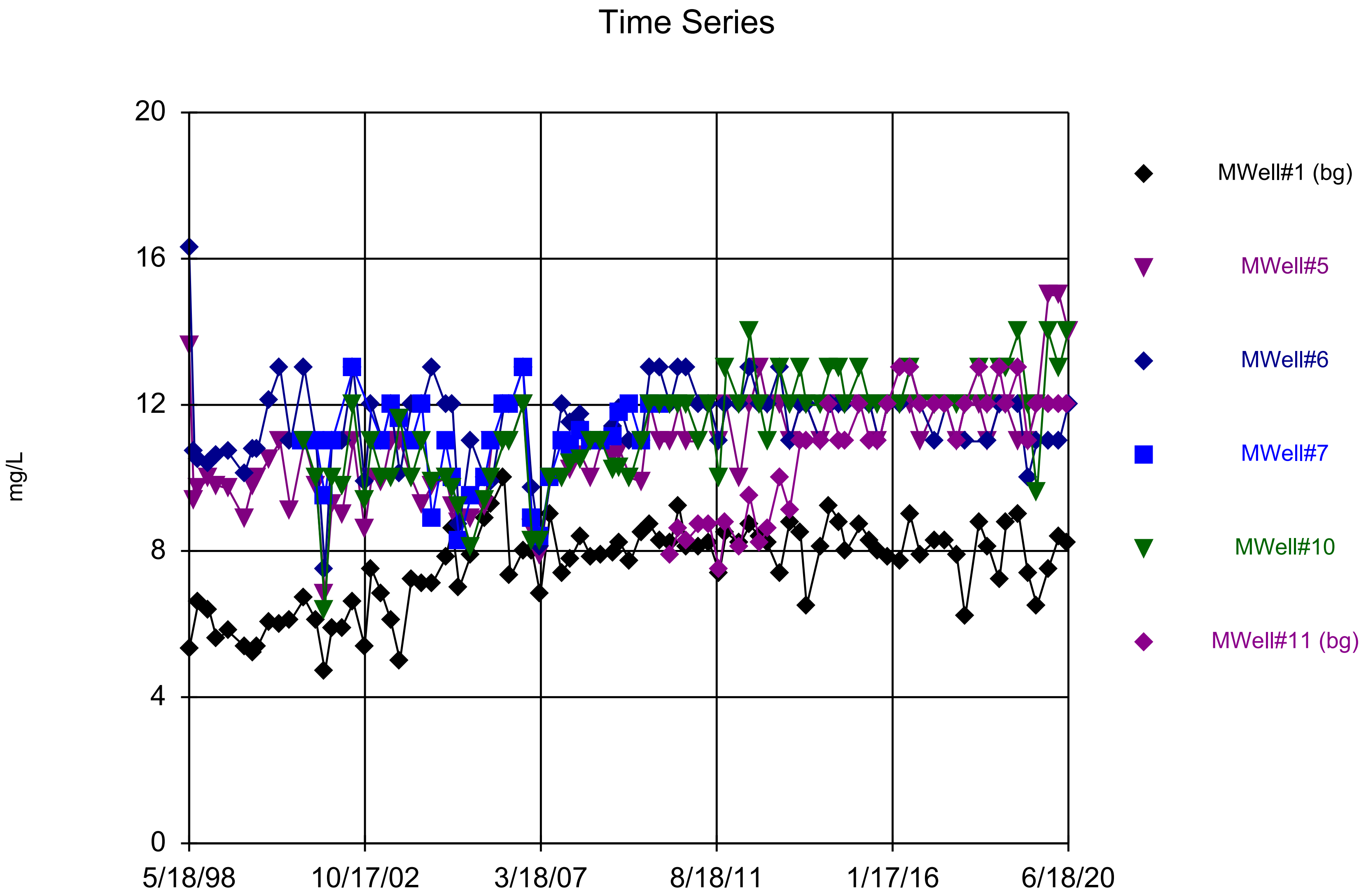
Time Series



Constituent: pH Analysis Run 8/12/2020 2:50 PM View: HRLF_TSP Set2

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata



Constituent: Potassium, Dissolved Analysis Run 8/12/2020 2:50 PM View: HRLF_TSP Set2

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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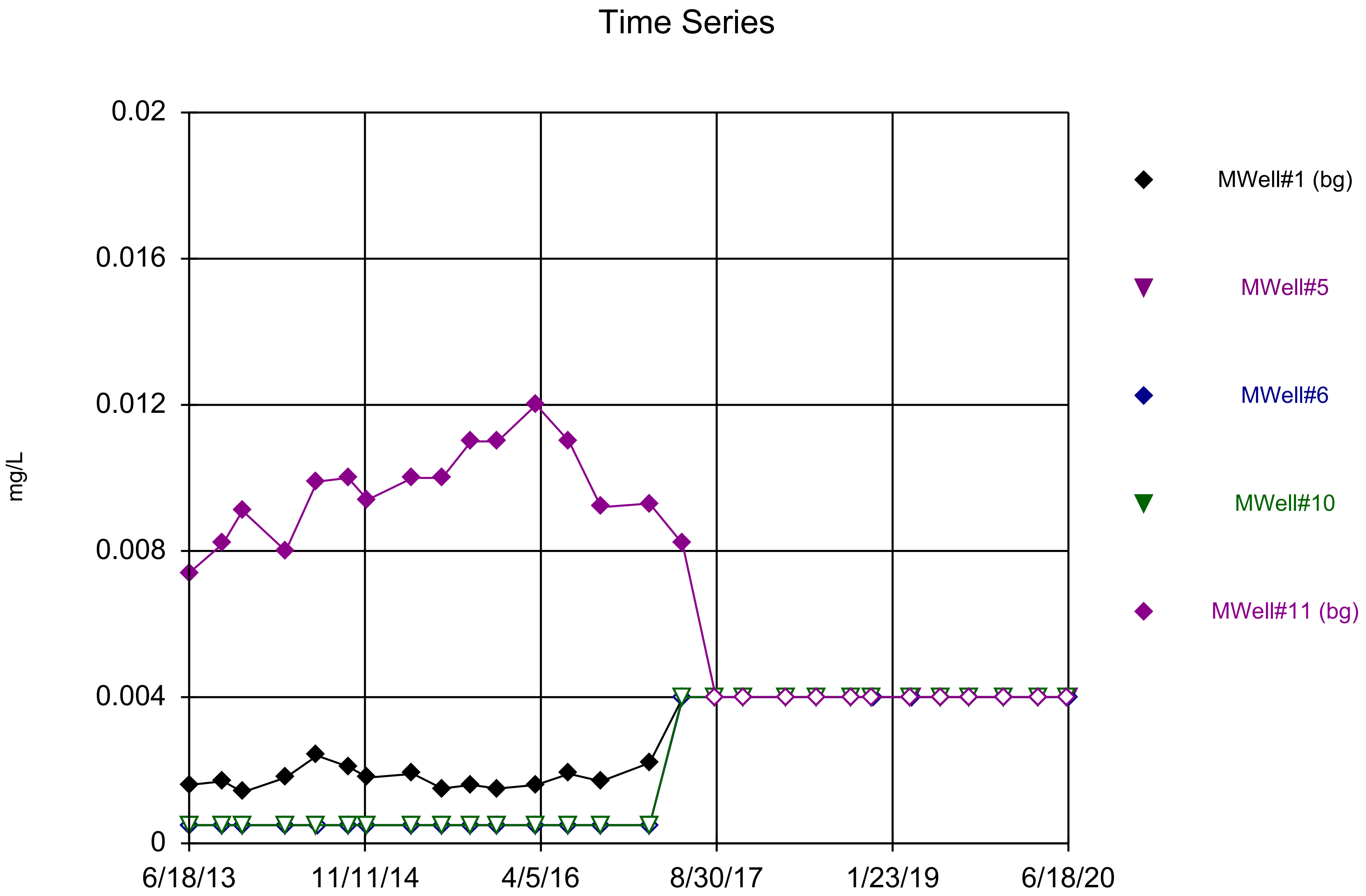
Hollow symbols indicate censored values.



Constituent: Selenium, Total Analysis Run 8/12/2020 2:50 PM View: HRLF_TSP Set2
Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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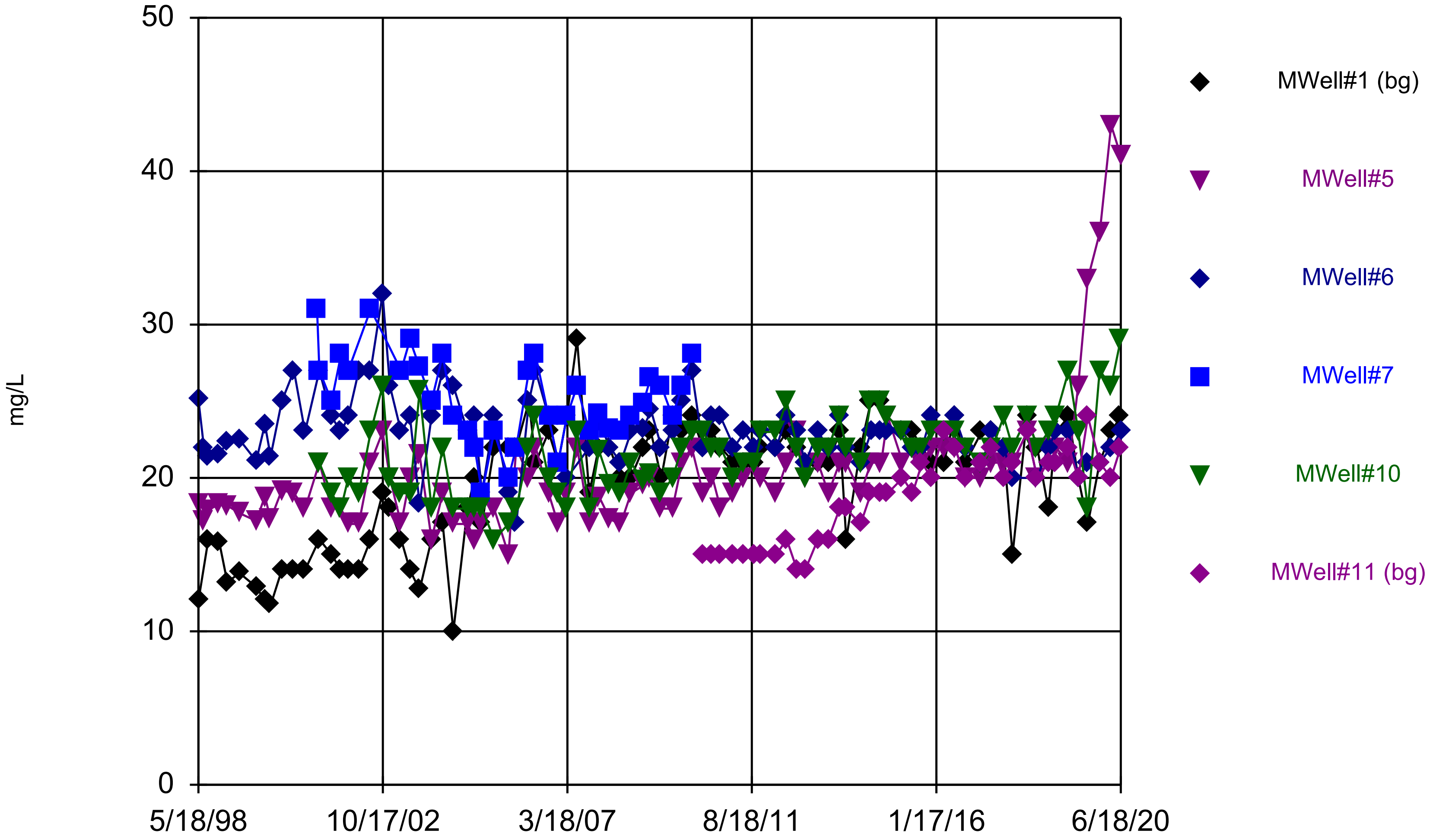
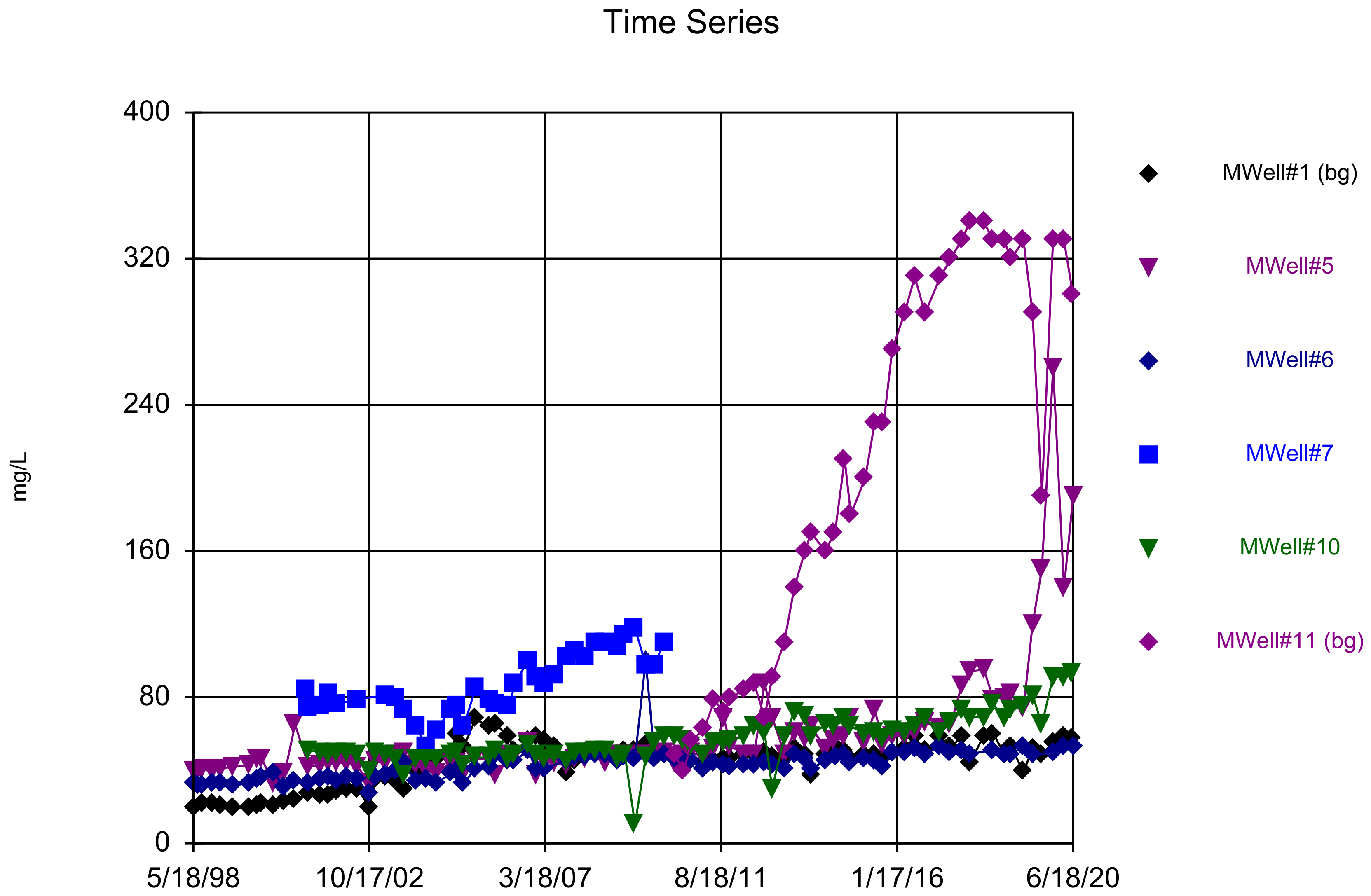
Time Series



Constituent: Sodium, Dissolved   Analysis Run 8/12/2020 2:50 PM   View: HRLF_TSP Set2

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata



Constituent: Sulfate Analysis Run 8/12/2020 2:50 PM View: HRLF_TSP Set2

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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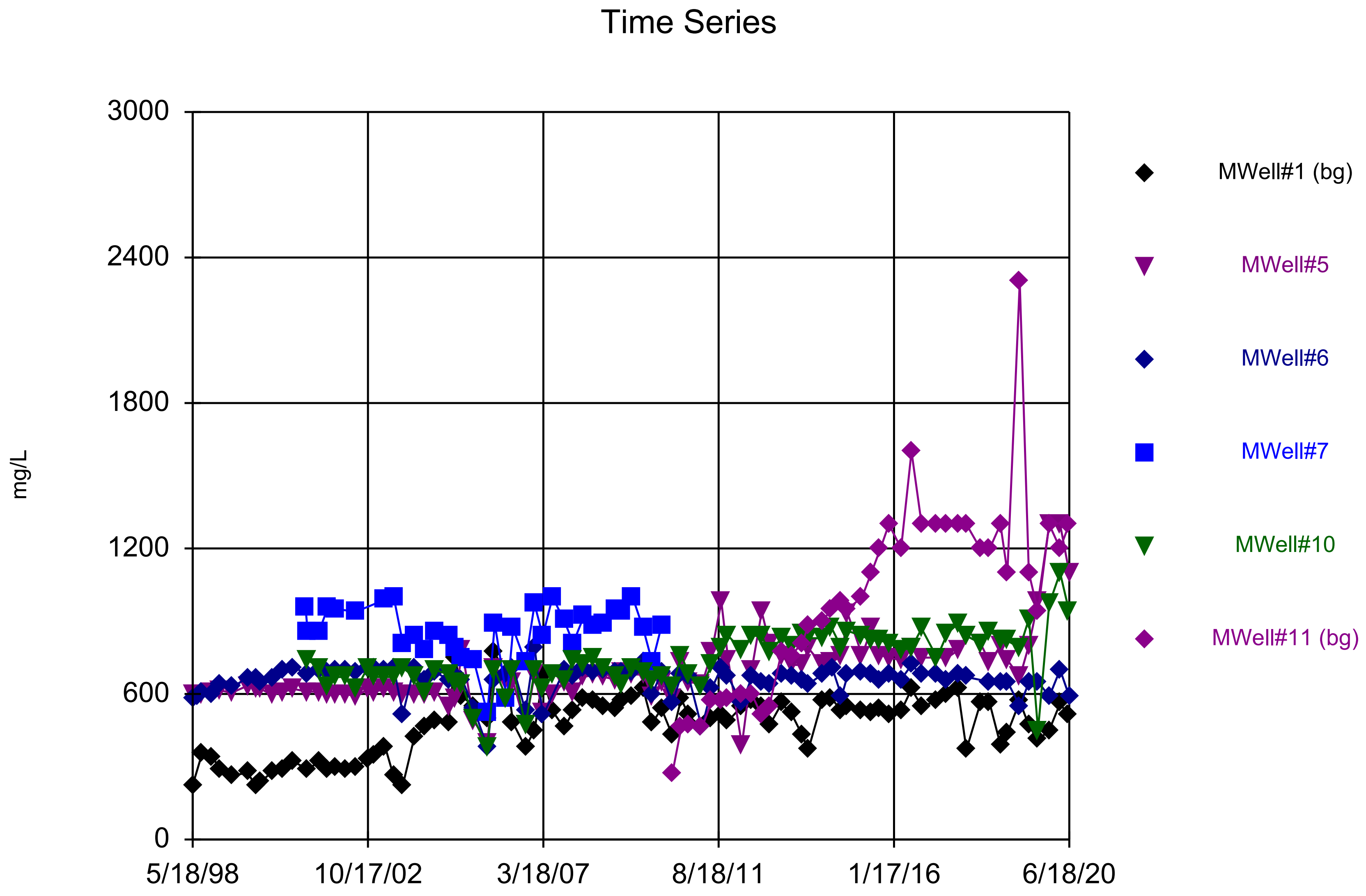

Constituent: TDS Analysis Run 8/12/2020 2:50 PM View: HRLF_TSP Set2

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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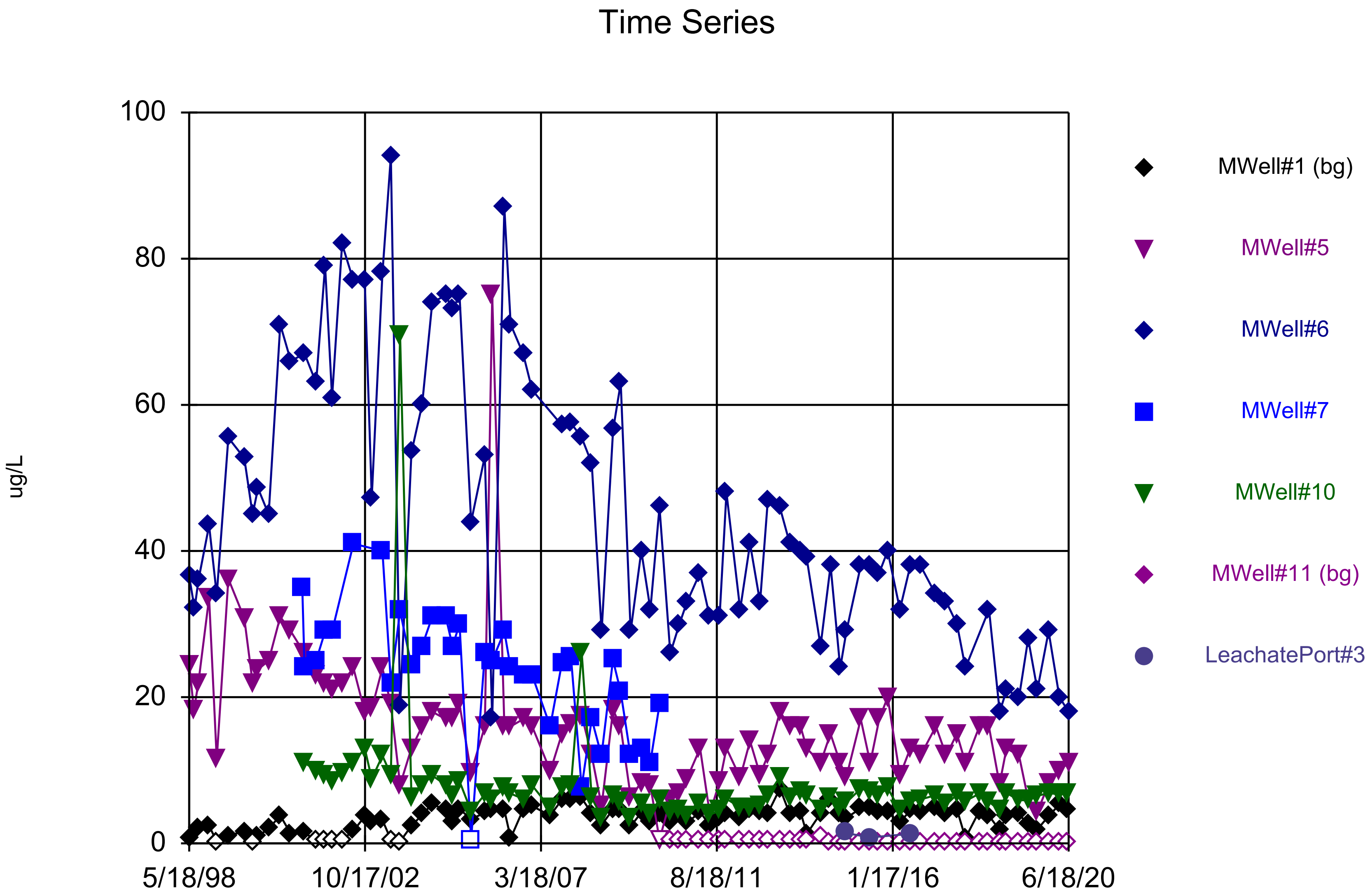
Hollow symbols indicate censored values.



Constituent: Tetrachloroethene   Analysis Run 8/12/2020 2:50 PM   View: HRLF_TSP Set2
Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

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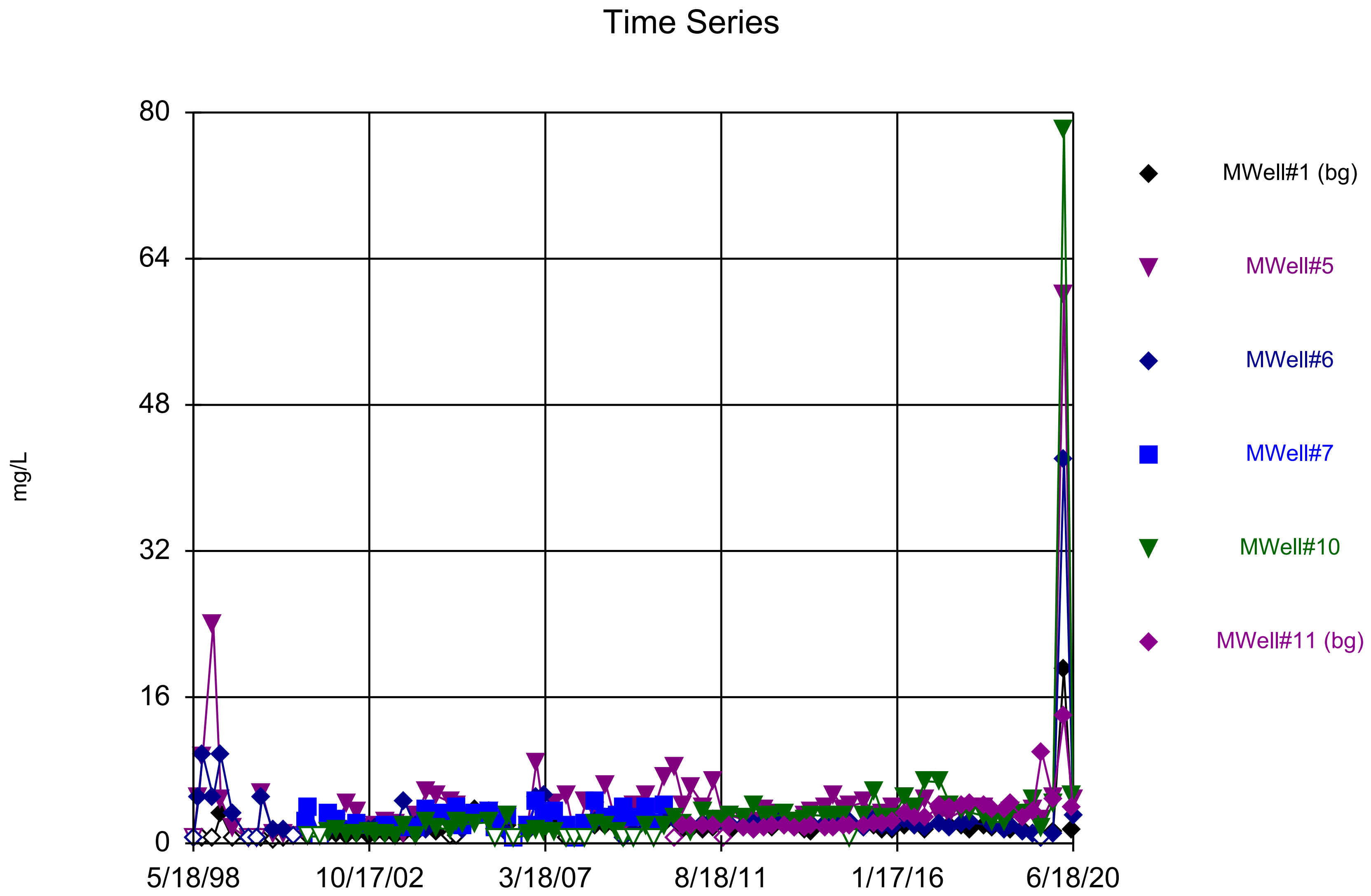
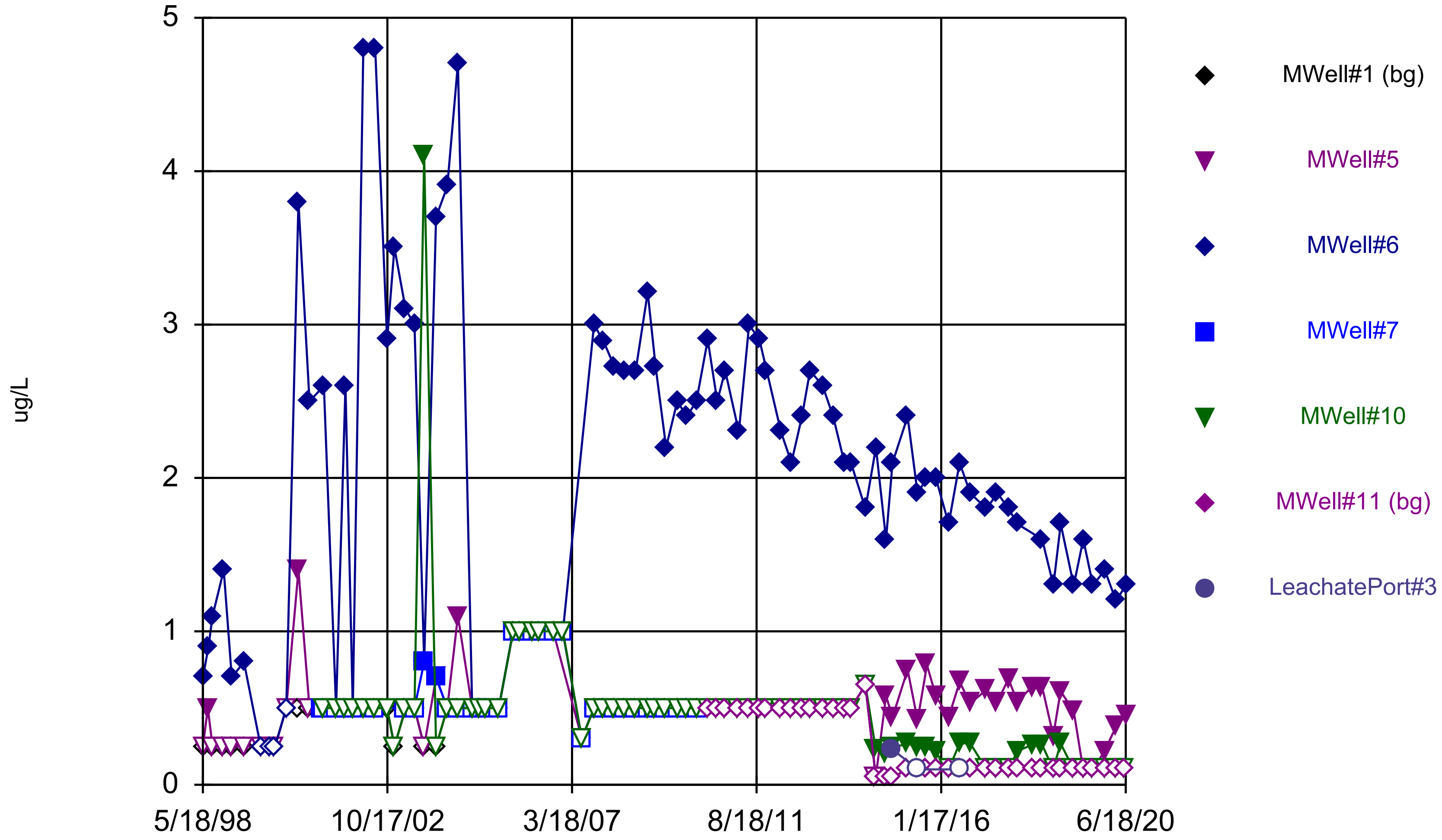
Hollow symbols indicate censored values.



Constituent: TOC   Analysis Run 8/12/2020 2:51 PM   View: HRLF_TSP Set2
Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

Sanitas™ v.9.6.26 Software licensed to Parametrix. UG
Hollow symbols indicate censored values.

Time Series



Constituent: trans-1,2-Dichloroethene Analysis Run 8/12/2020 2:51 PM View: HRLF_TSP Set2

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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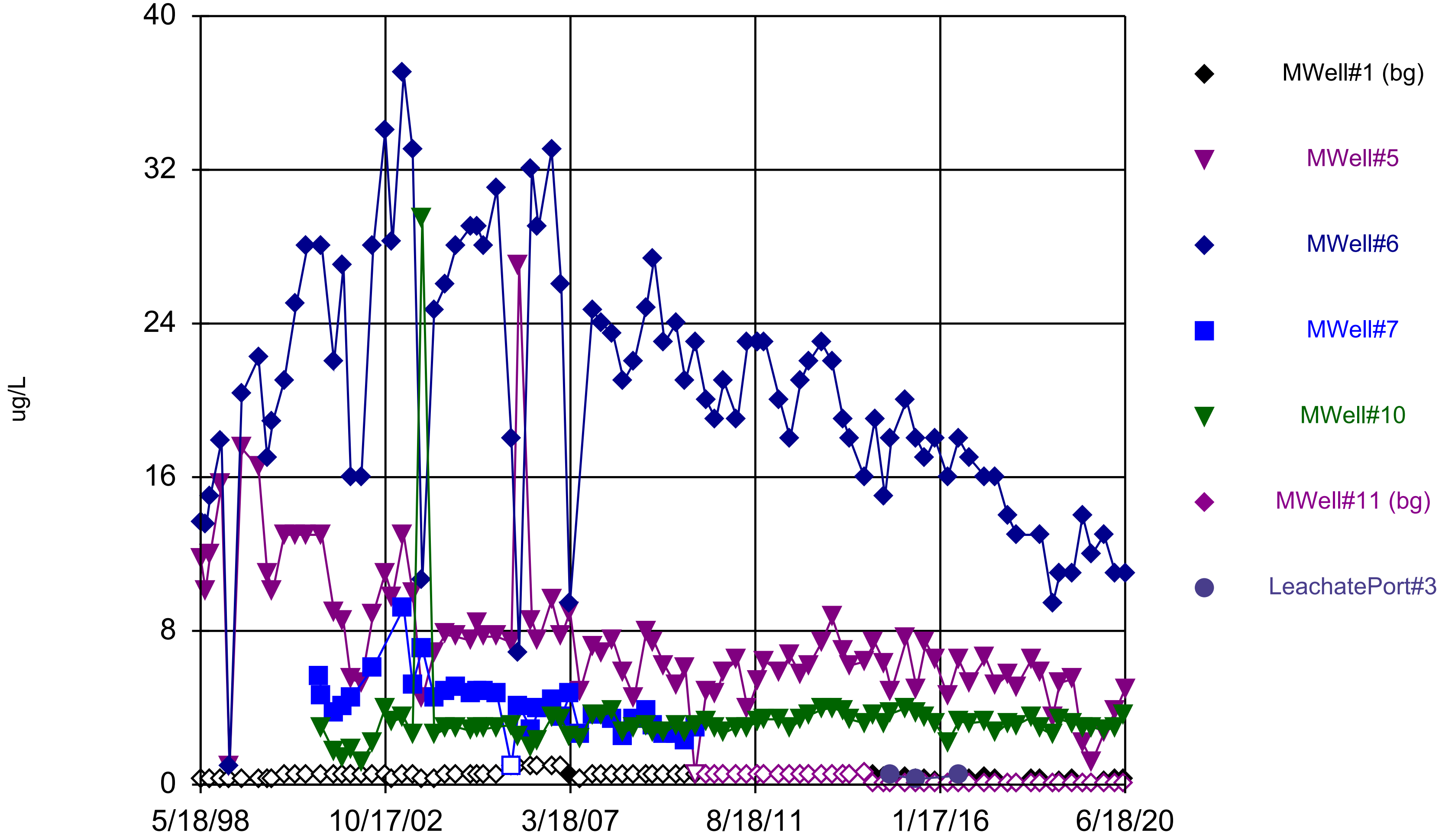
Hollow symbols indicate censored values.

Time Series



Constituent: Trichloroethene   Analysis Run 8/12/2020 2:51 PM   View: HRLF_TSP Set2

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

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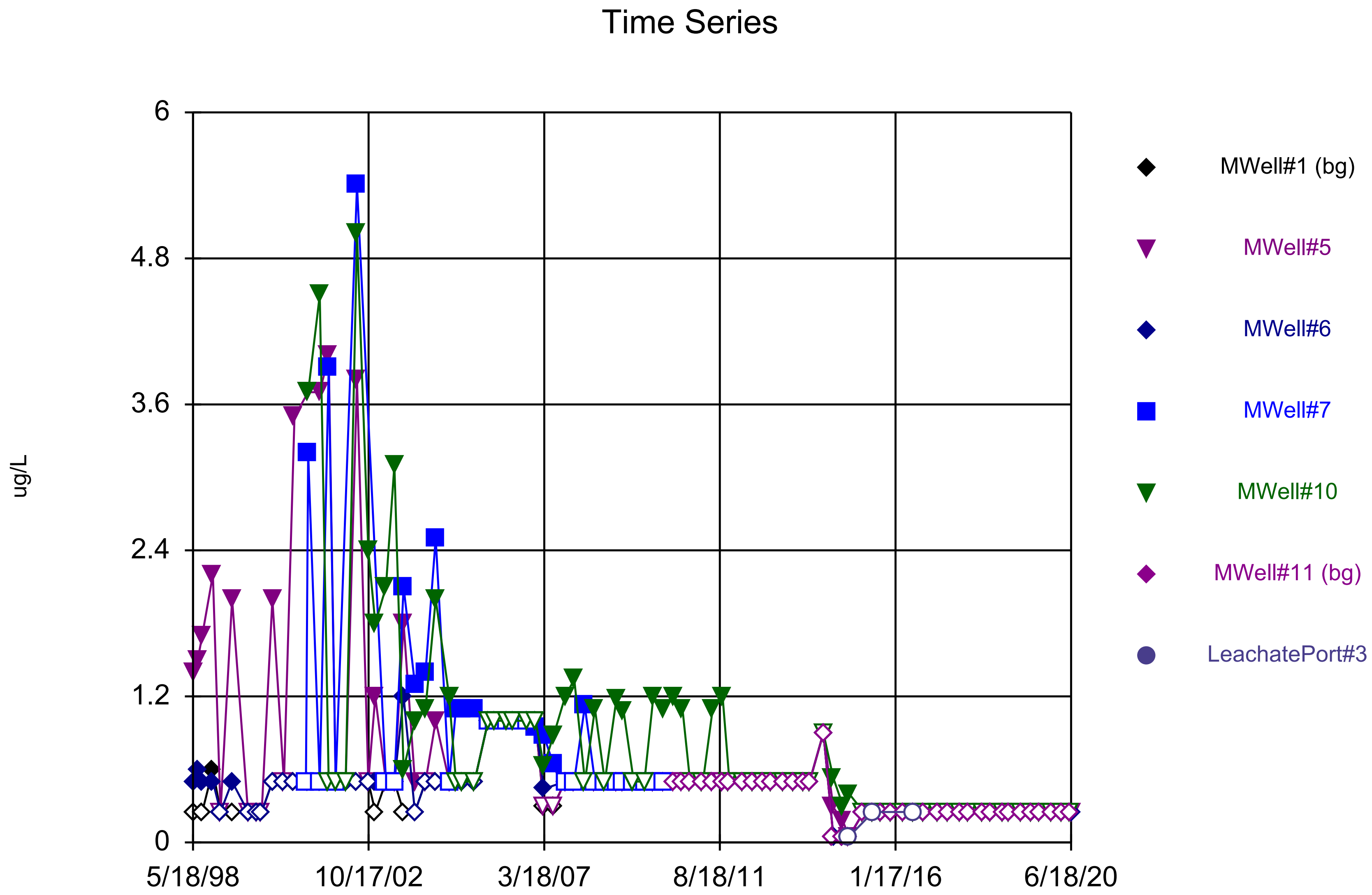
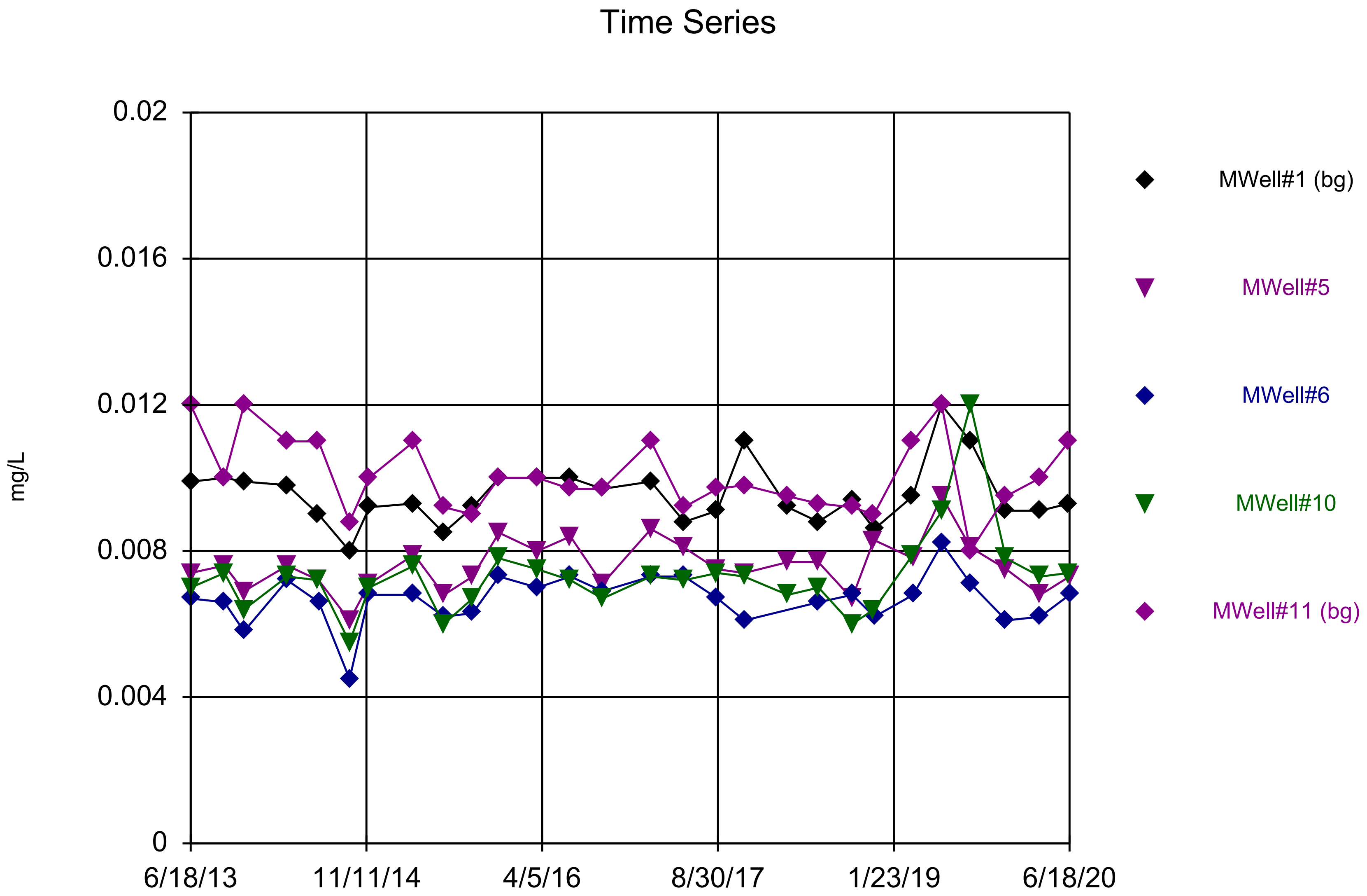
Hollow symbols indicate censored values.



Constituent: Trichlorofluoromethane   Analysis Run 8/12/2020 2:51 PM   View: HRLF_TSP Set2

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata



Constituent: Vanadium, Total Analysis Run 8/12/2020 2:51 PM View: HRLF_TSP Set2

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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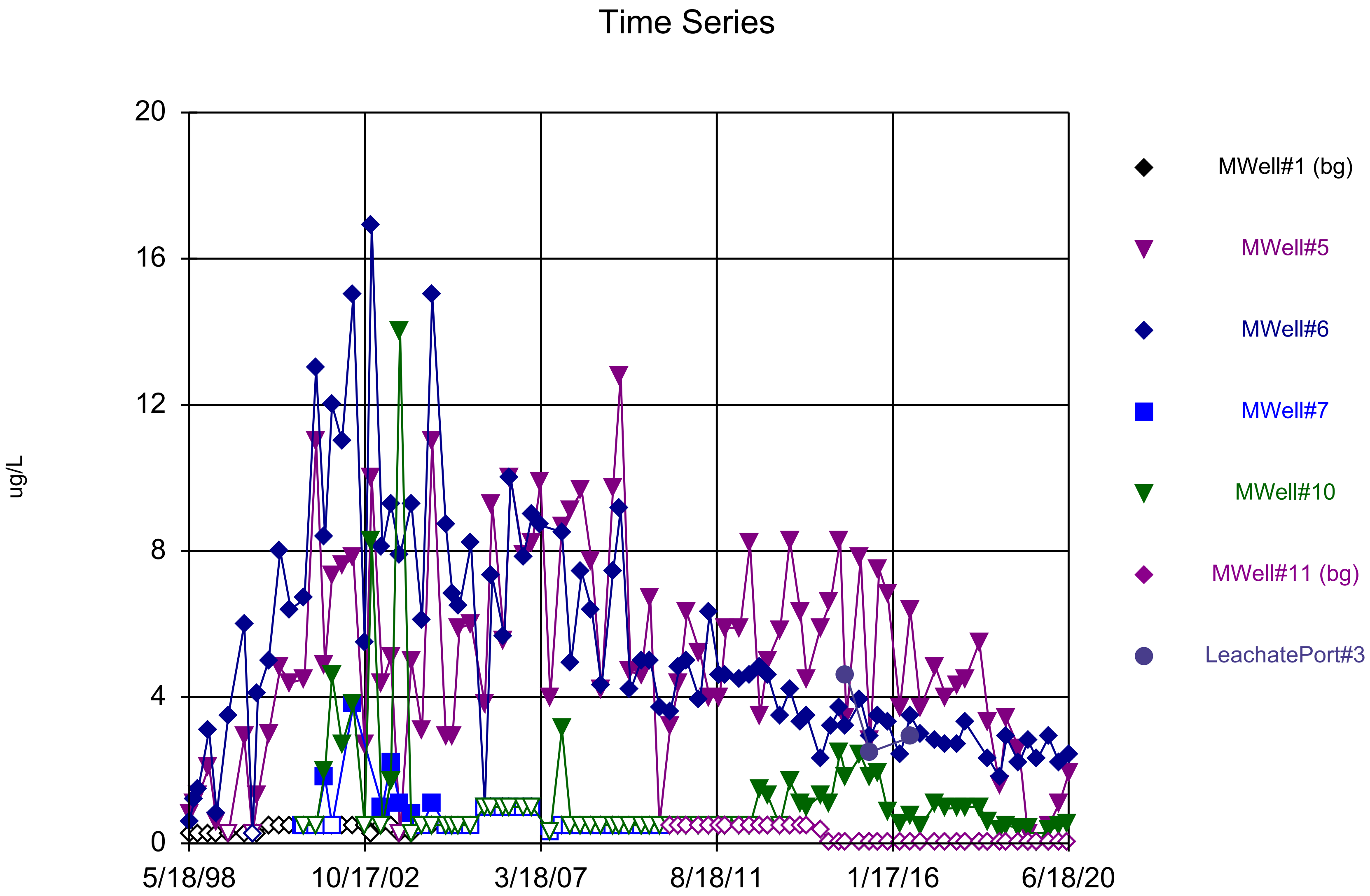
Hollow symbols indicate censored values.



Constituent: Vinyl Chloride   Analysis Run 8/12/2020 2:51 PM   View: HRLF_TSP Set2

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

G-3

Trend Analyses

Horn Rapids Landfill Trends for Volatile Organic Compounds, Third Quarter 2010 through Second Quarter 2020

Constituent Name	Well	Slope	Calculated Statistic	Critical Value	Trend	N	% Non-detects	Normality	Transformation	Alpha	Method
1,1-Dichloroethane (ug/L)	MWell#3	-0.3801	-557	-171	Yes	36	19.44	n/a	n/a	0.02	NP
1,1-Dichloroethane (ug/L)	MWell#4	0.1999	399	194	Yes	39	0	n/a	n/a	0.02	NP
1,1-Dichloroethane (ug/L)	MWell#5	-0.3136	-267	-194	Yes	39	0	n/a	n/a	0.02	NP
1,1-Dichloroethane (ug/L)	MWell#6	-0.8992	-604	-186	Yes	38	0	n/a	n/a	0.02	NP
1,1-Dichloroethane (ug/L)	MWell#9	-0.2184	-334	-194	Yes	39	0	n/a	n/a	0.02	NP
1,1-Dichloroethane (ug/L)	MWell#10	-0.4949	-450	-194	Yes	39	0	n/a	n/a	0.02	NP
1,2-Dichloroethane (ug/L)	MWell#6	-0.00996	-231	-186	Yes	38	39.47	n/a	n/a	0.02	NP
1,2-Dichloropropane (ug/L)	MWell#5	-0.01996	-371	-194	Yes	39	41.03	n/a	n/a	0.02	NP
1,2-Dichloropropane (ug/L)	MWell#6	-0.0211	-436	-186	Yes	38	36.84	n/a	n/a	0.02	NP
Benzene (ug/L)	MWell#5	-0.03259	-390	-194	Yes	39	48.72	n/a	n/a	0.02	NP
Benzene (ug/L)	MWell#6	-0.01283	-268	-186	Yes	38	39.47	n/a	n/a	0.02	NP
Benzene (ug/L)	MWell#10	-0.134	-550	-194	Yes	39	12.82	n/a	n/a	0.02	NP
Chloroform (ug/L)	MWell#3	0.1197	250	171	Yes	36	41.67	n/a	n/a	0.02	NP
Chloroform (ug/L)	MWell#4	-0.01997	-253	-194	Yes	39	38.46	n/a	n/a	0.02	NP
Chloroform (ug/L)	MWell#10	-0.06518	-285	-194	Yes	39	10.26	n/a	n/a	0.02	NP
cis-1,2-Dichloroethene (ug/L)	MWell#3	-0.05682	-237	-171	Yes	36	50	n/a	n/a	0.02	NP
cis-1,2-Dichloroethene (ug/L)	MWell#4	0.1156	296	194	Yes	39	2.564	n/a	n/a	0.02	NP
cis-1,2-Dichloroethene (ug/L)	MWell#6	-1.034	-214	-186	Yes	38	0	n/a	n/a	0.02	NP
cis-1,2-Dichloroethene (ug/L)	MWell#10	0.6611	289	194	Yes	39	0	n/a	n/a	0.02	NP
Methylene Chloride (ug/L)	MWell#10	-1.201	-540	-194	Yes	39	28.21	n/a	n/a	0.02	NP
Tetrachloroethene (ug/L)	MWell#6	-1.696	-293	-186	Yes	38	0	n/a	n/a	0.02	NP
Tetrachloroethene (ug/L)	MWell#9	0.4549	328	194	Yes	39	0	n/a	n/a	0.02	NP
Tetrachloroethene (ug/L)	MWell#10	0.1589	221	194	Yes	39	0	n/a	n/a	0.02	NP
trans-1,2-Dichloroethene (ug/L)	MWell#6	-0.1447	-515	-186	Yes	38	0	n/a	n/a	0.02	NP
trans-1,2-Dichloroethene (ug/L)	MWell#9	-0.02108	-250	-194	Yes	39	48.72	n/a	n/a	0.02	NP

Horn Rapids Landfill Trends for Volatile Organic Compounds, Third Quarter 2010 through Second Quarter 2020

Constituent Name	Well	Slope	Calculated Statistic	Critical Value	Trend	N	% Non-detects	Normality	Transformation	Alpha	Method
Trichloroethene (ug/L)	MWell#5	-0.1955	-196	-194	Yes	39	0	n/a	n/a	0.02	NP
Trichloroethene (ug/L)	MWell#6	-1.193	-490	-186	Yes	38	0	n/a	n/a	0.02	NP
Trichlorofluoromethane (ug/L)	MWell#3	-0.1698	-477	-171	Yes	36	33.33	n/a	n/a	0.02	NP
Trichlorofluoromethane (ug/L)	MWell#4	0.04943	237	194	Yes	39	25.64	n/a	n/a	0.02	NP
Vinyl Chloride (ug/L)	MWell#5	-0.4439	-294	-194	Yes	39	2.564	n/a	n/a	0.02	NP
Vinyl Chloride (ug/L)	MWell#6	-0.2722	-469	-186	Yes	38	0	n/a	n/a	0.02	NP

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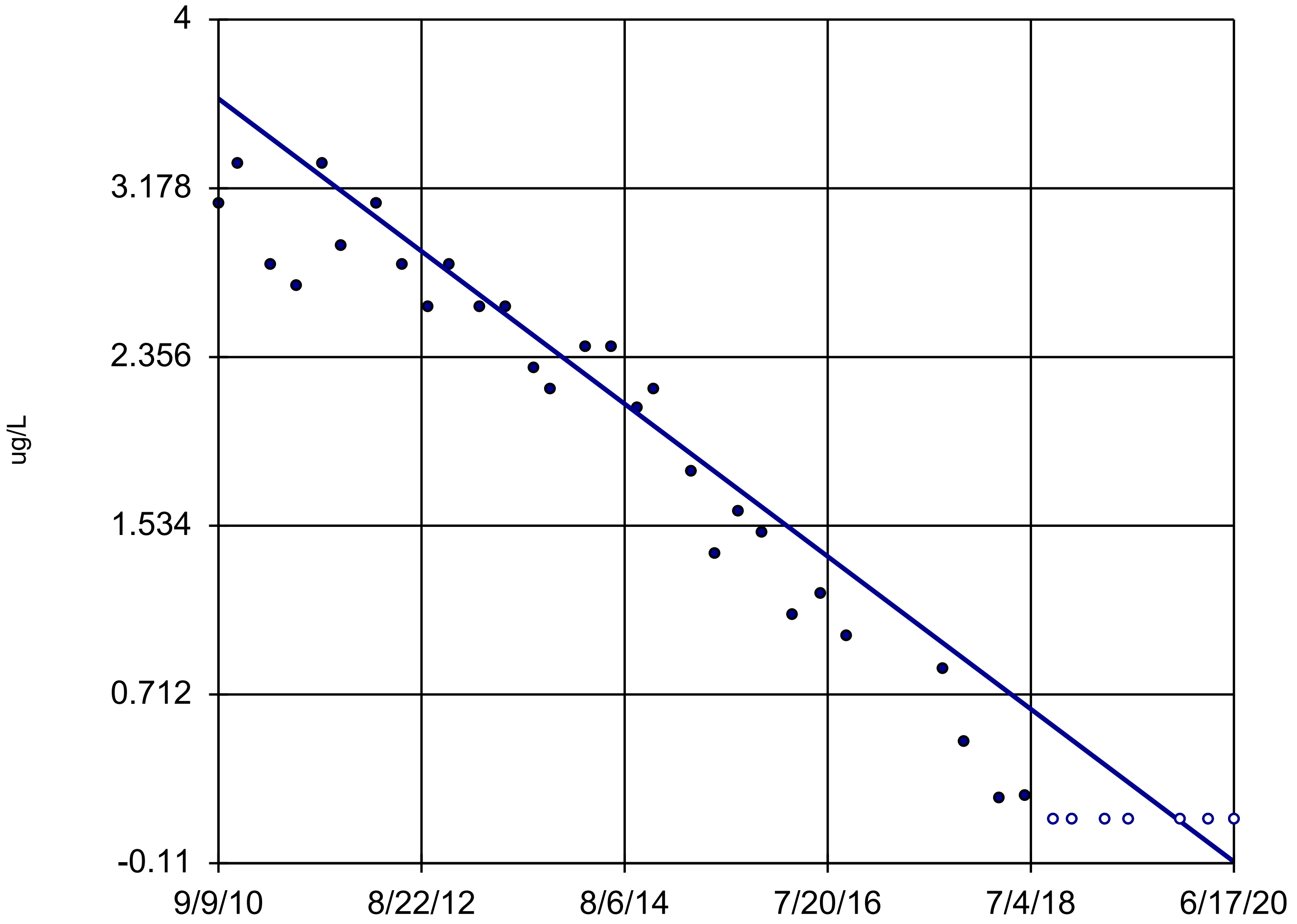
Hollow symbols indicate censored values.

Sen's Slope Estimator

MWell#3



n = 36

Slope = -0.3801
units per year.

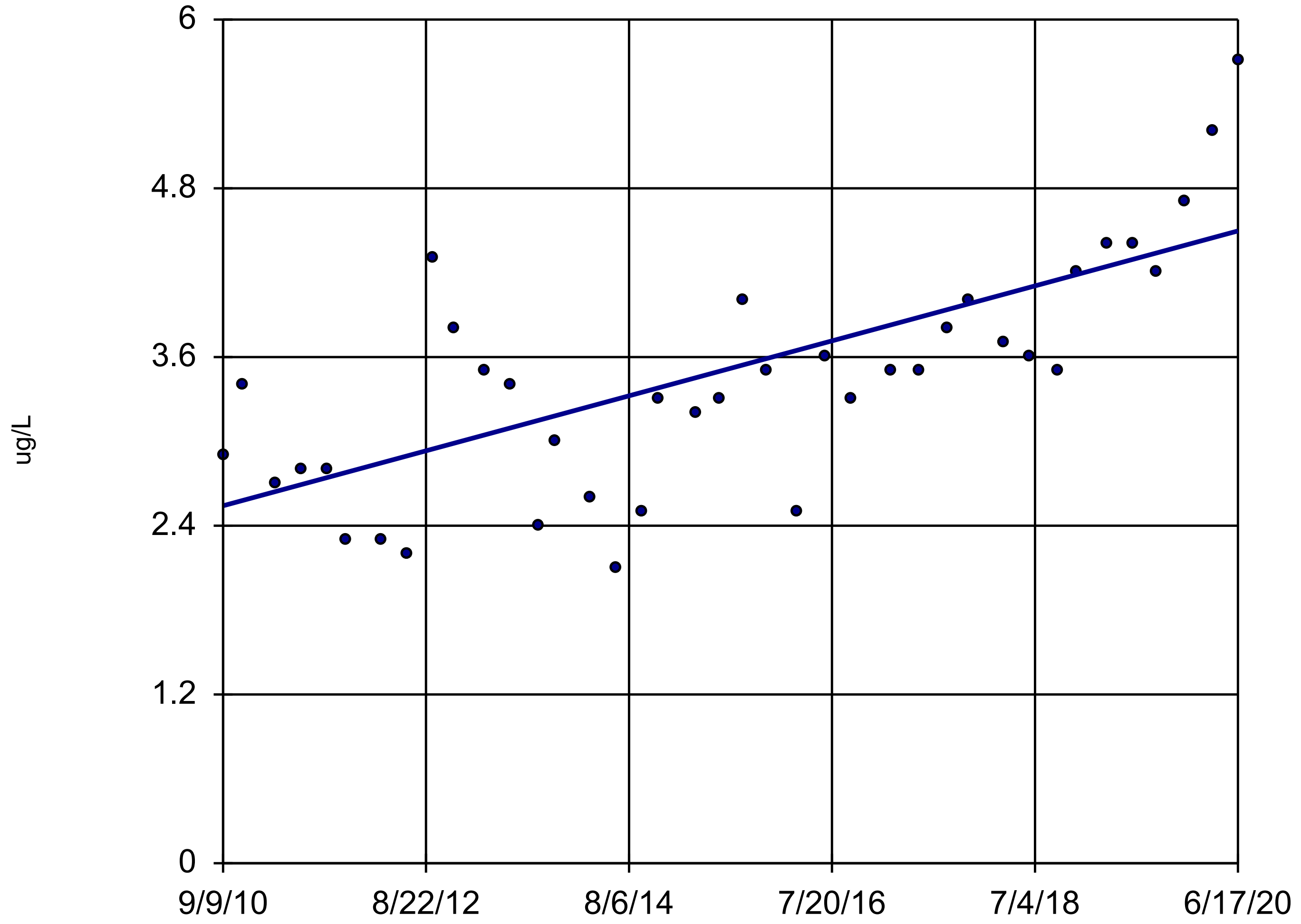
Mann-Kendall
statistic = -557
critical = -171

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: 1,1-Dichloroethane Analysis Run 8/12/2020 9:43 PM View: HRLF_SensSlope 10-year
Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Sen's Slope Estimator

MWell#4



n = 39

Slope = 0.1999
units per year.

Mann-Kendall
statistic = 399
critical = 194

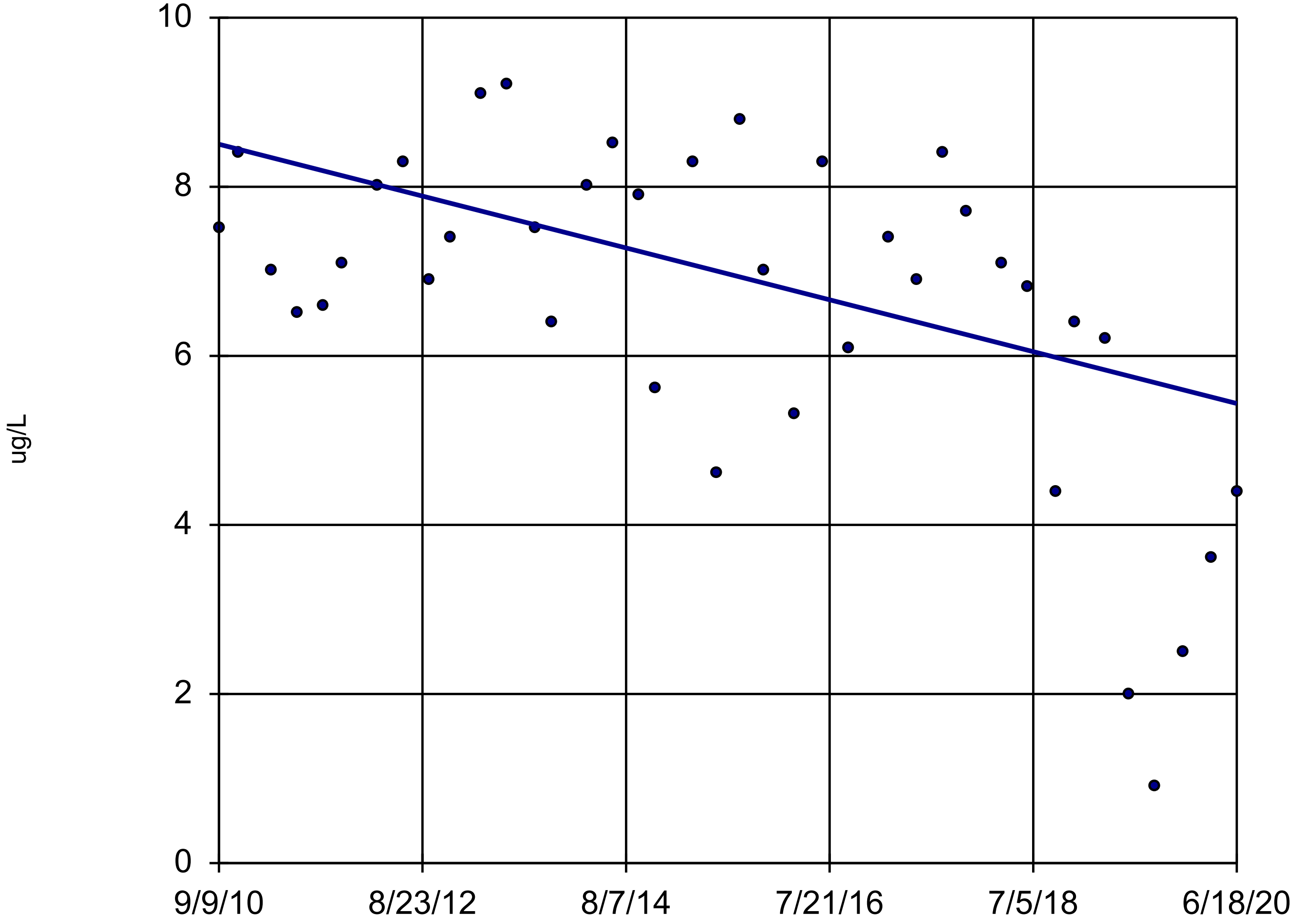
Increasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: 1,1-Dichloroethane   Analysis Run 8/12/2020 9:43 PM   View: HRLF_SensSlope 10-year

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

Sen's Slope Estimator

MWell#5



n = 39

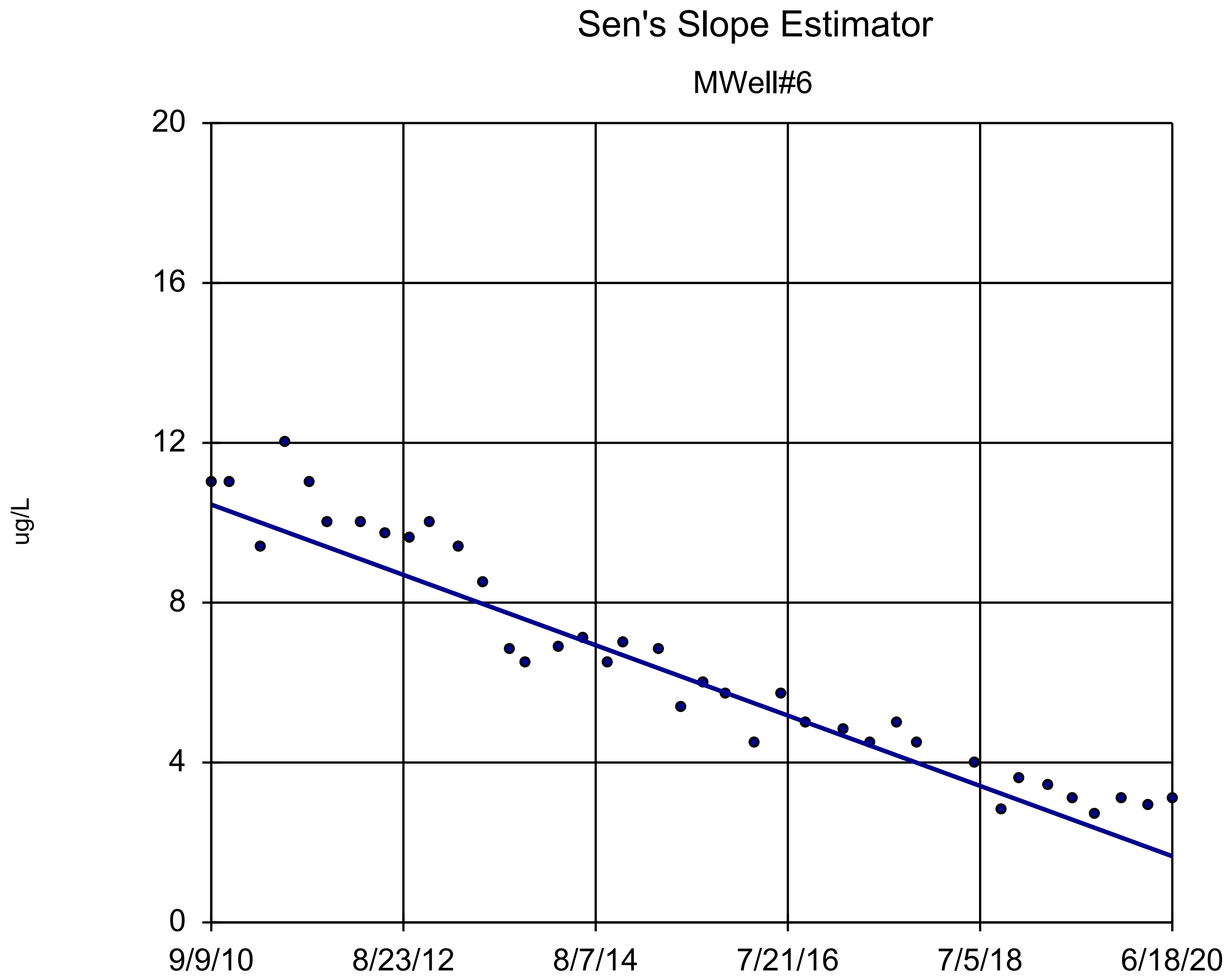
Slope = -0.3136
units per year.

Mann-Kendall
statistic = -267
critical = -194

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: 1,1-Dichloroethane Analysis Run 8/12/2020 9:43 PM View: HRLF_SensSlope 10-year

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata



n = 38

Slope = -0.8992
units per year.

Mann-Kendall
statistic = -604
critical = -186

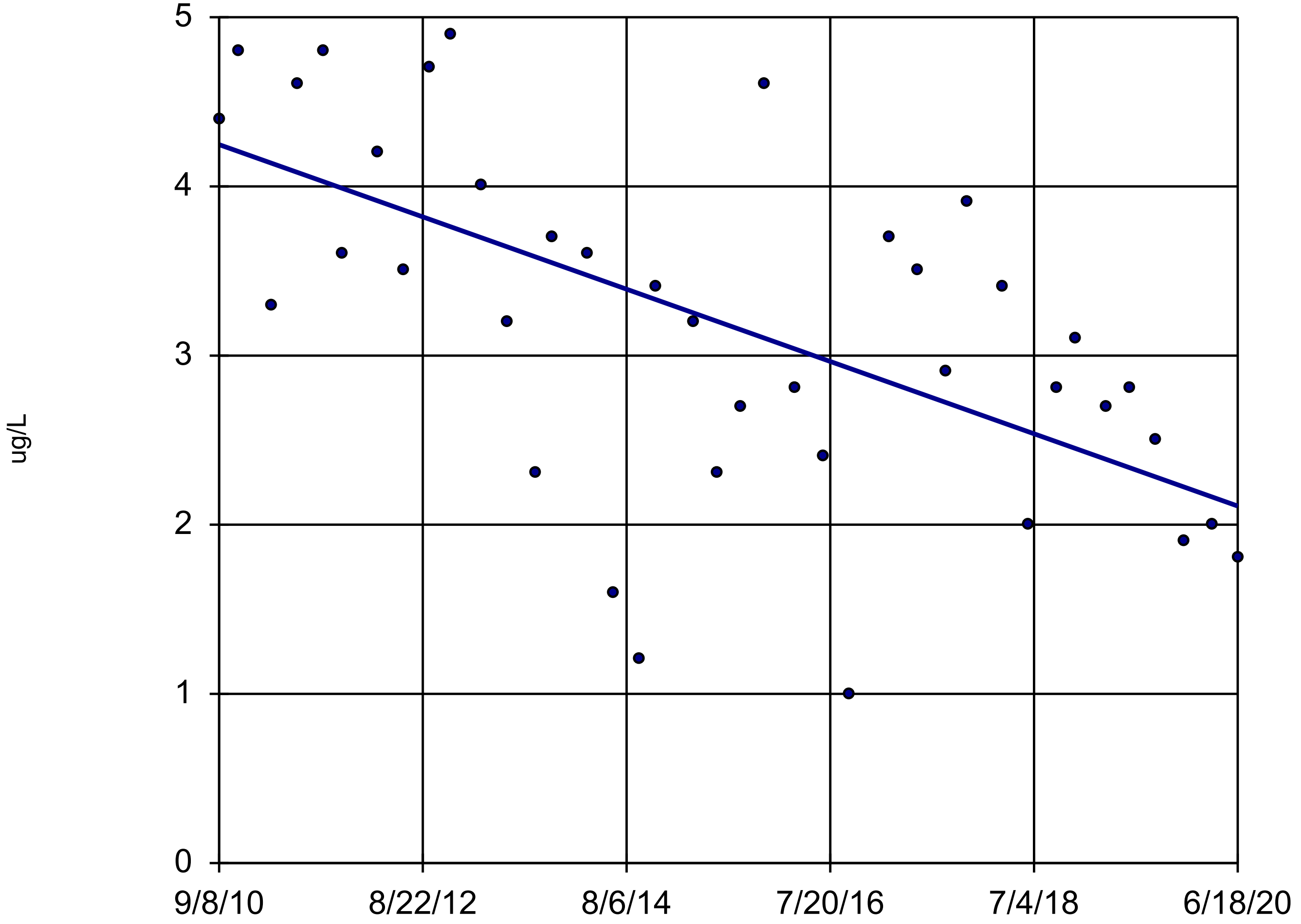
Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: 1,1-Dichloroethane   Analysis Run 8/12/2020 9:43 PM   View: HRLF_SensSlope 10-year

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

Sen's Slope Estimator

MWell#9



n = 39

Slope = -0.2184
units per year.

Mann-Kendall
statistic = -334
critical = -194

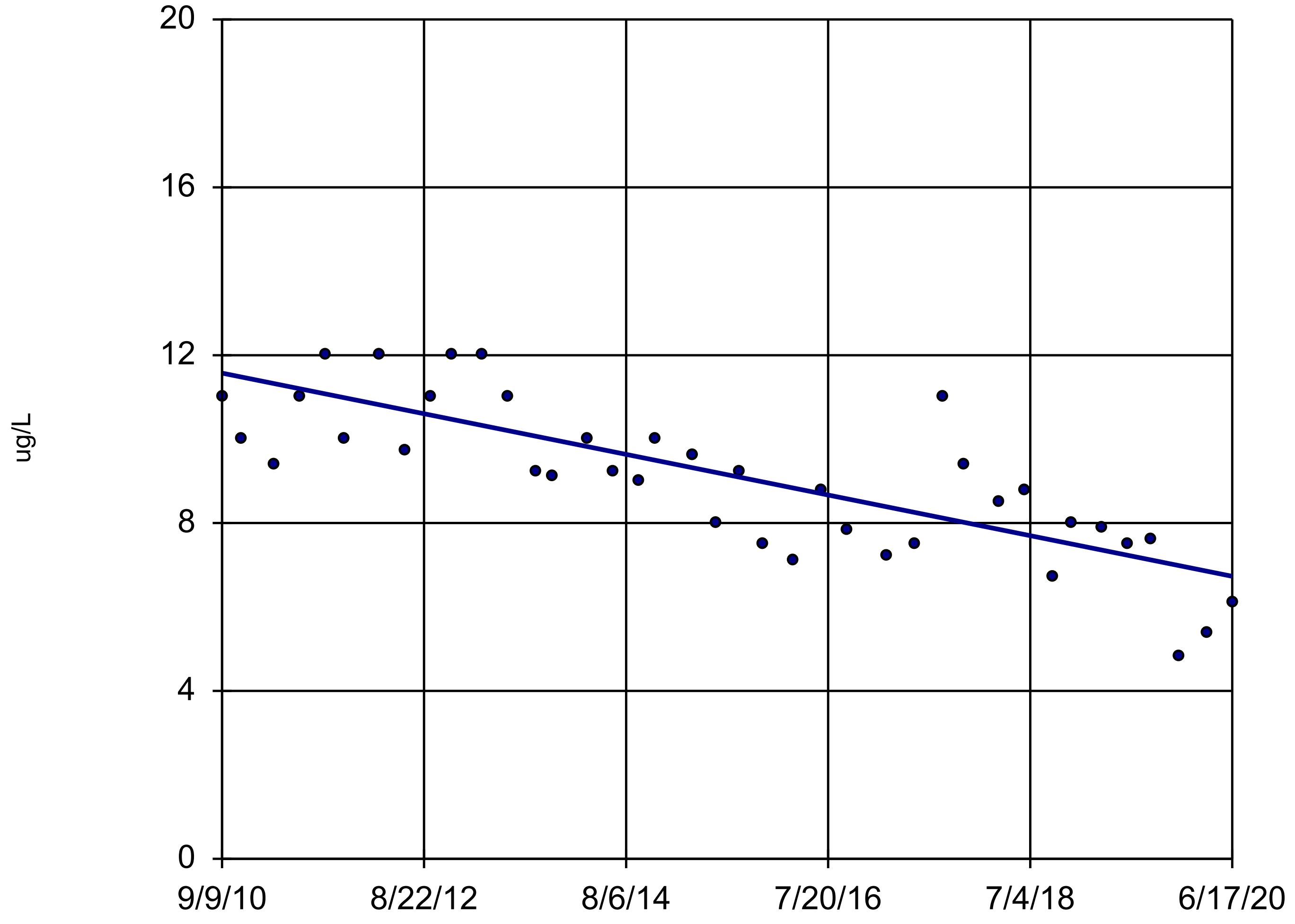
Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: 1,1-Dichloroethane Analysis Run 8/12/2020 9:43 PM View: HRLF_SensSlope 10-year

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Sen's Slope Estimator

MWell#10



n = 39

Slope = -0.4949
units per year.

Mann-Kendall
statistic = -450
critical = -194

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: 1,1-Dichloroethane Analysis Run 8/12/2020 9:43 PM View: HRLF_SensSlope 10-year
Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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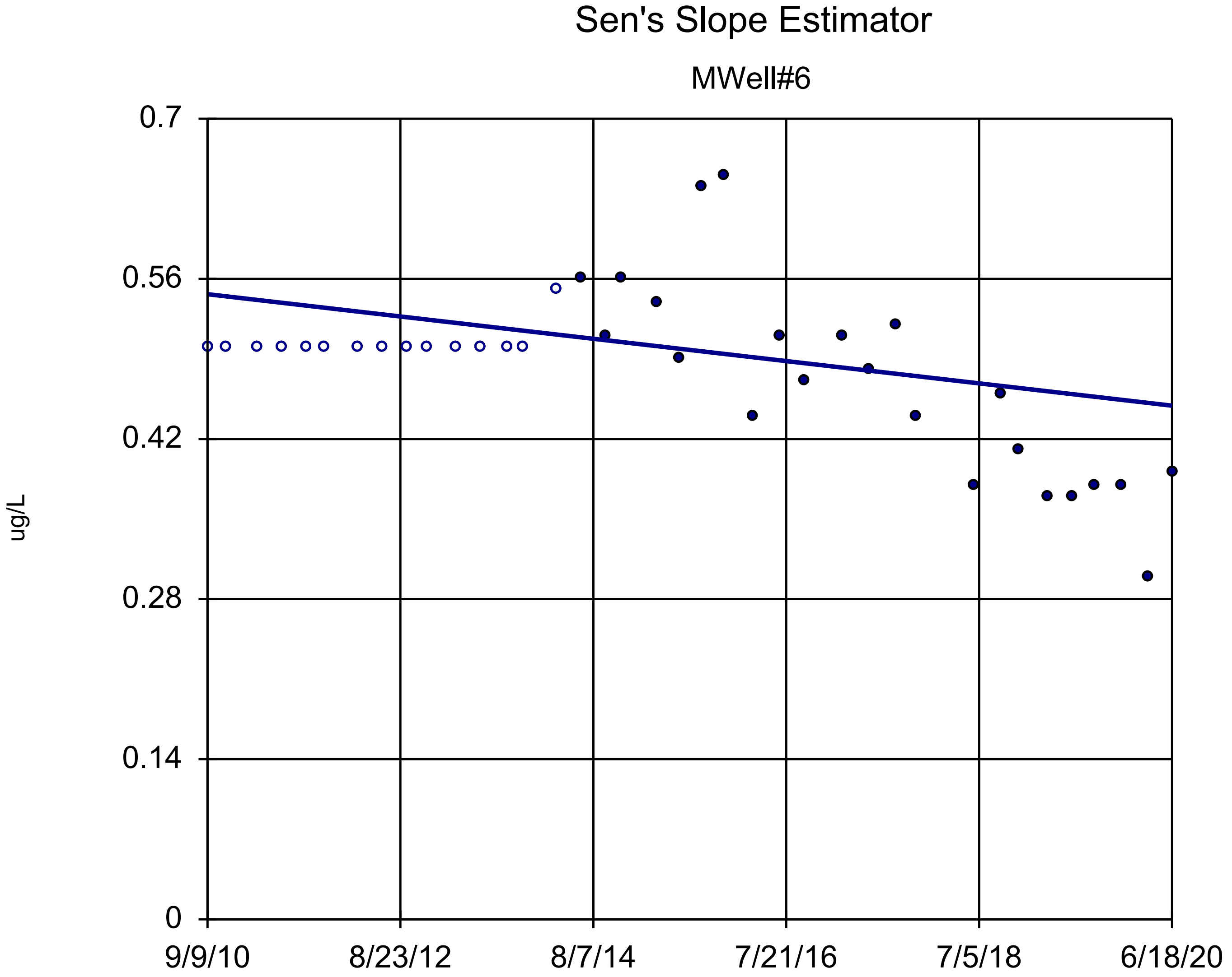
Hollow symbols indicate censored values.



n = 38

Slope = -0.009955
units per year.

Mann-Kendall
statistic = -231
critical = -186

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: 1,2-Dichloroethane   Analysis Run 8/12/2020 9:43 PM   View: HRLF_SensSlope 10-year

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

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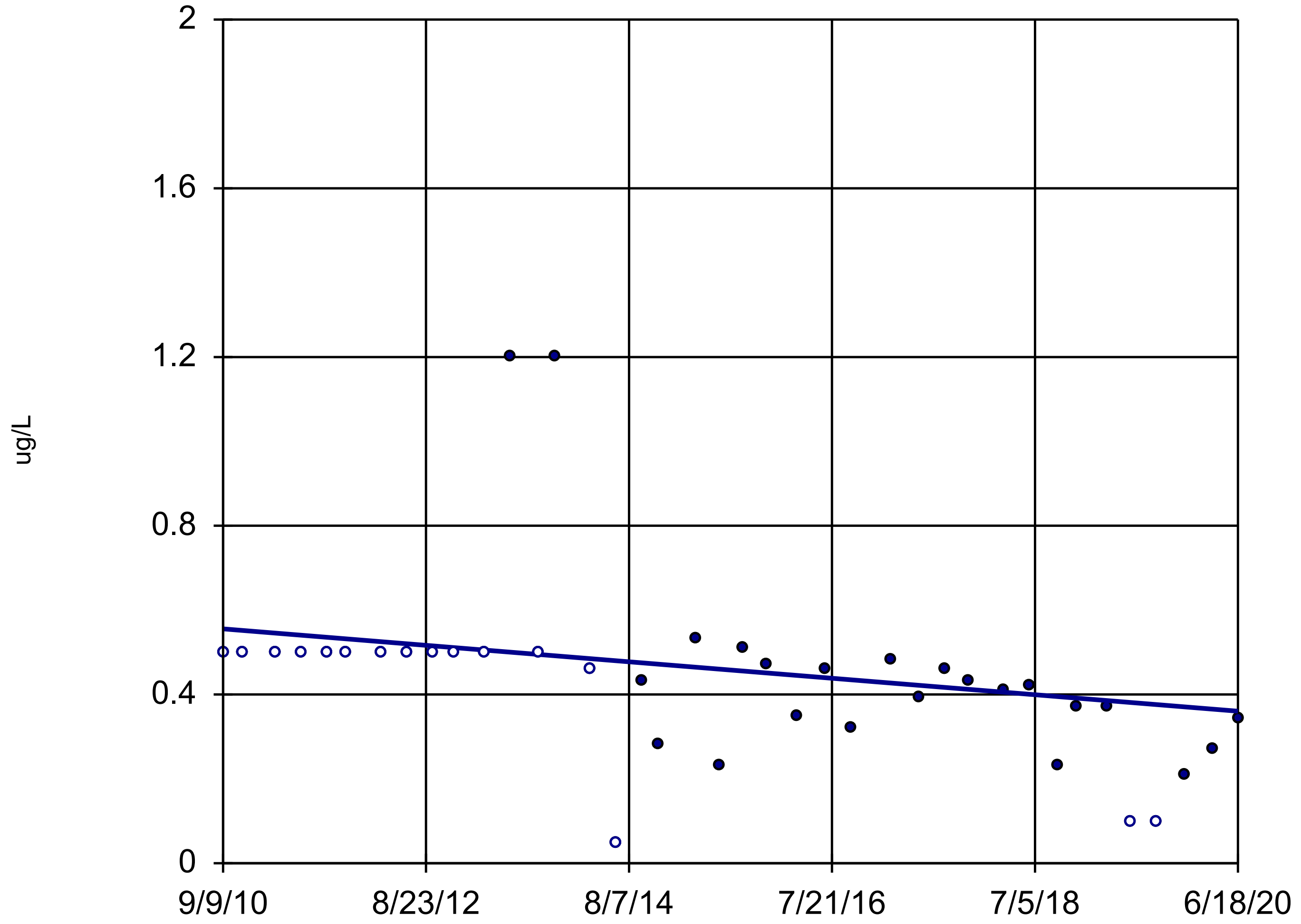
Hollow symbols indicate censored values.

Sen's Slope Estimator

MWell#5



n = 39

Slope = -0.01996
units per year.

Mann-Kendall
statistic = -371
critical = -194

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: 1,2-Dichloropropane Analysis Run 8/12/2020 9:43 PM View: HRLF_SensSlope 10-year

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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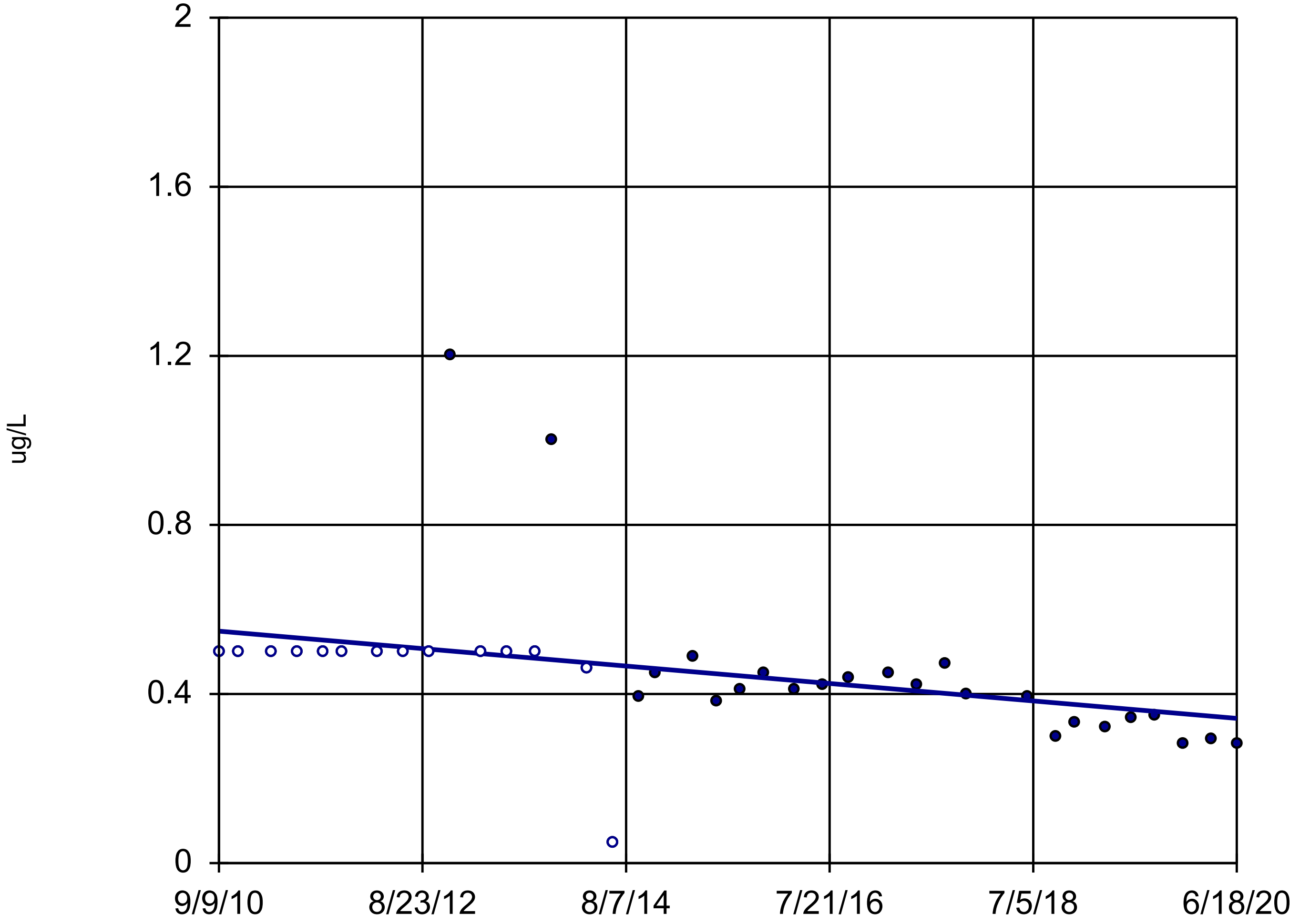
Hollow symbols indicate censored values.

Sen's Slope Estimator

MWell#6



n = 38

Slope = -0.0211
units per year.

Mann-Kendall
statistic = -436
critical = -186

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

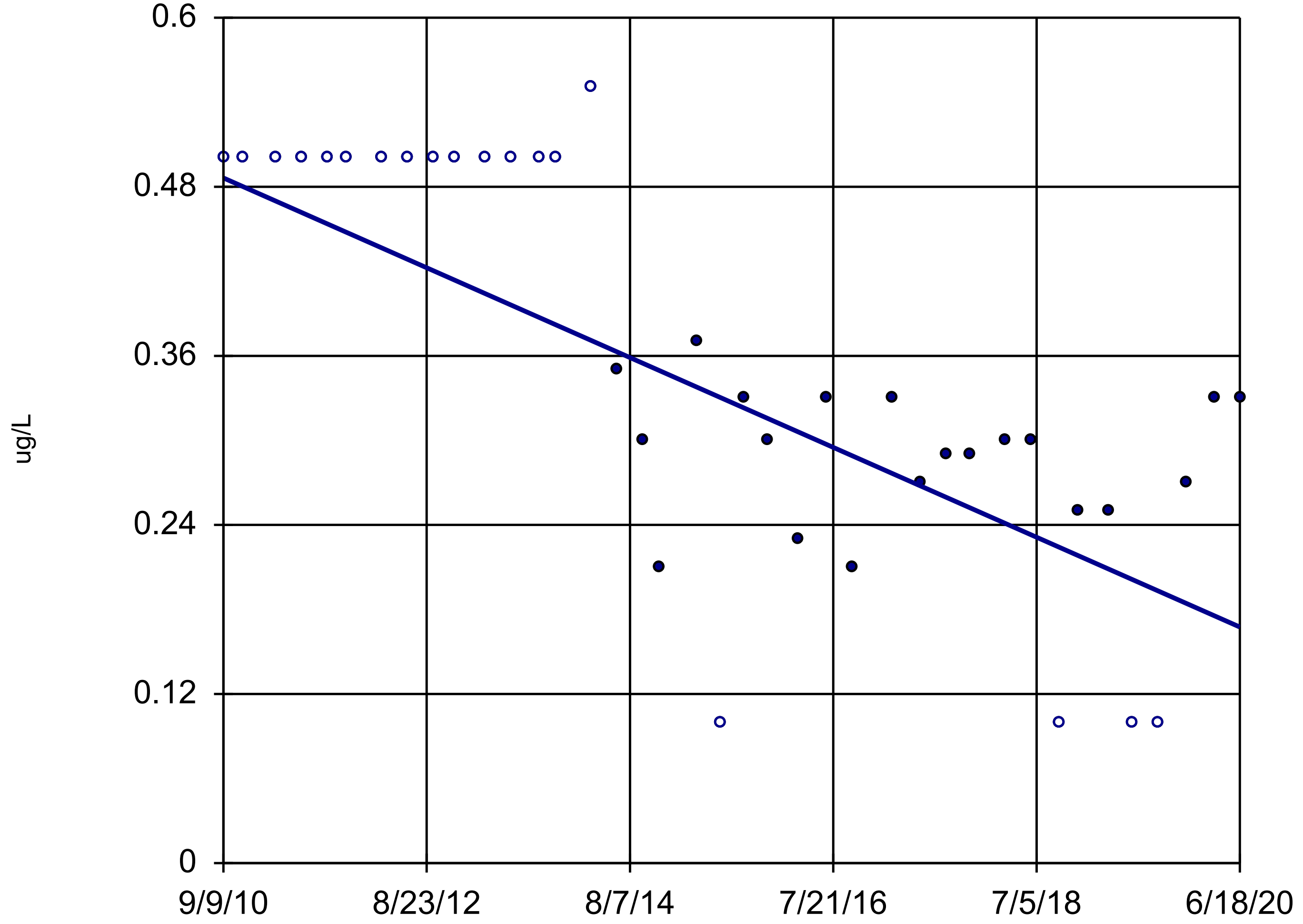
Constituent: 1,2-Dichloropropane Analysis Run 8/12/2020 9:43 PM View: HRLF_SensSlope 10-year

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Sanitas™ v.9.6.26 Software licensed to Parametrix. UG
Hollow symbols indicate censored values.

Sen's Slope Estimator

MWell#5



n = 39

Slope = -0.03259
units per year.

Mann-Kendall
statistic = -390
critical = -194

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: Benzene   Analysis Run 8/12/2020 9:43 PM   View: HRLF_SensSlope 10-year

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

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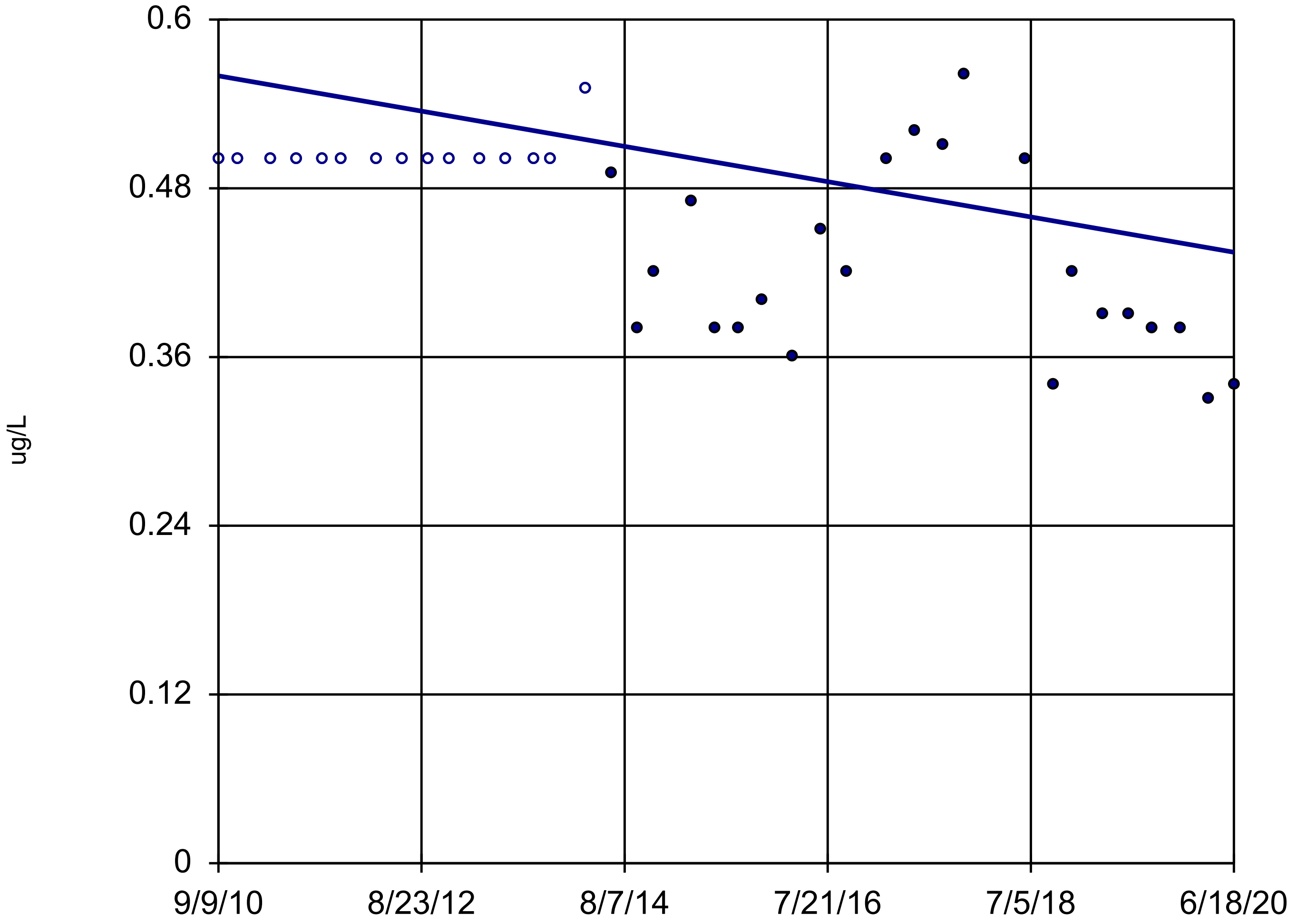
Hollow symbols indicate censored values.

Sen's Slope Estimator

MWell#6



n = 38

Slope = -0.01283 units per year.

Mann-Kendall statistic = -268 critical = -186

Decreasing trend significant at 98% confidence level (α = 0.01 per tail).

Constituent: Benzene   Analysis Run 8/12/2020 9:43 PM   View: HRLF_SensSlope 10-year

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

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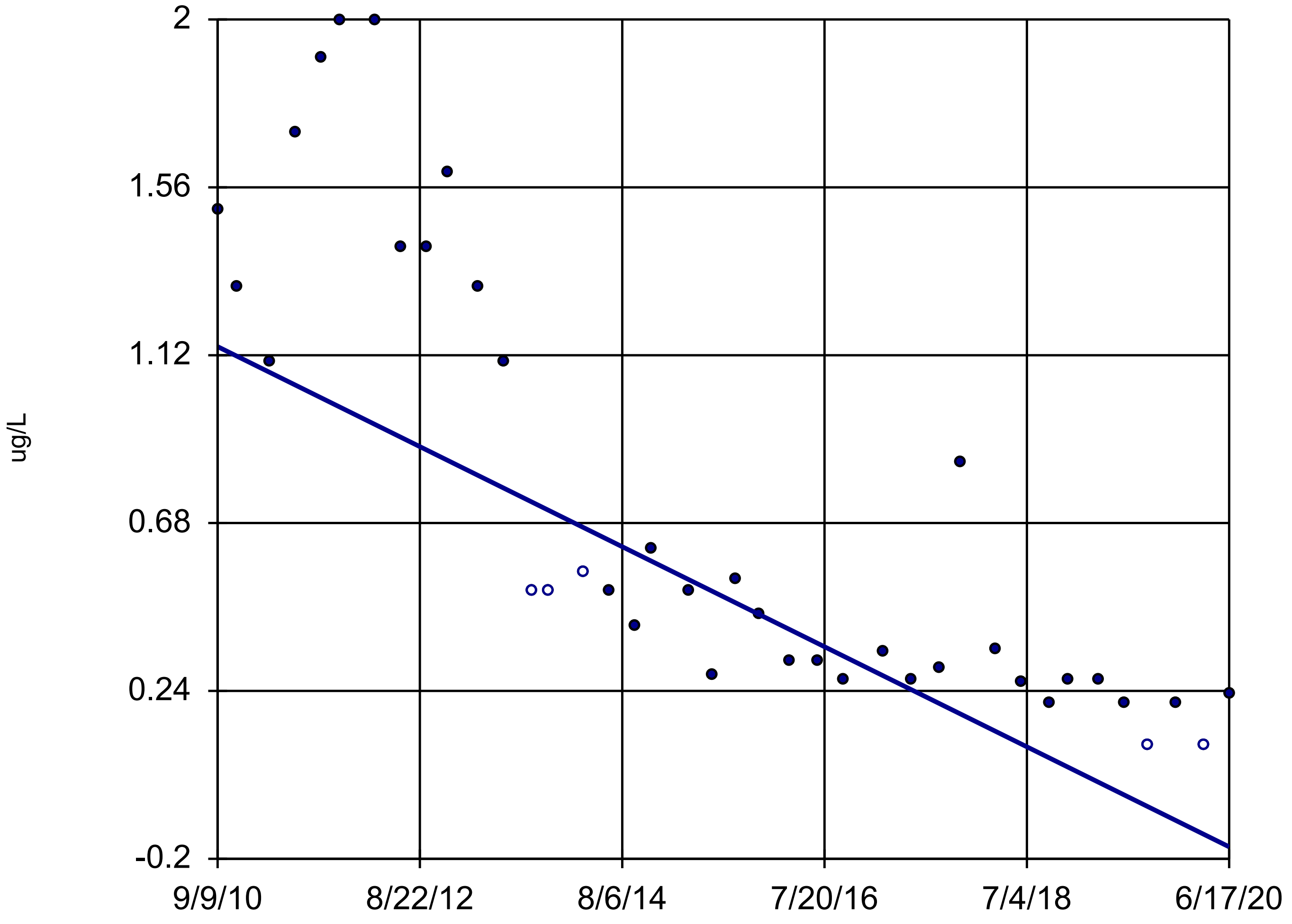
Hollow symbols indicate censored values.

Sen's Slope Estimator

MWell#10



n = 39

Slope = -0.134
units per year.

Mann-Kendall
statistic = -550
critical = -194

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: Benzene   Analysis Run 8/12/2020 9:43 PM   View: HRLF_SensSlope 10-year

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

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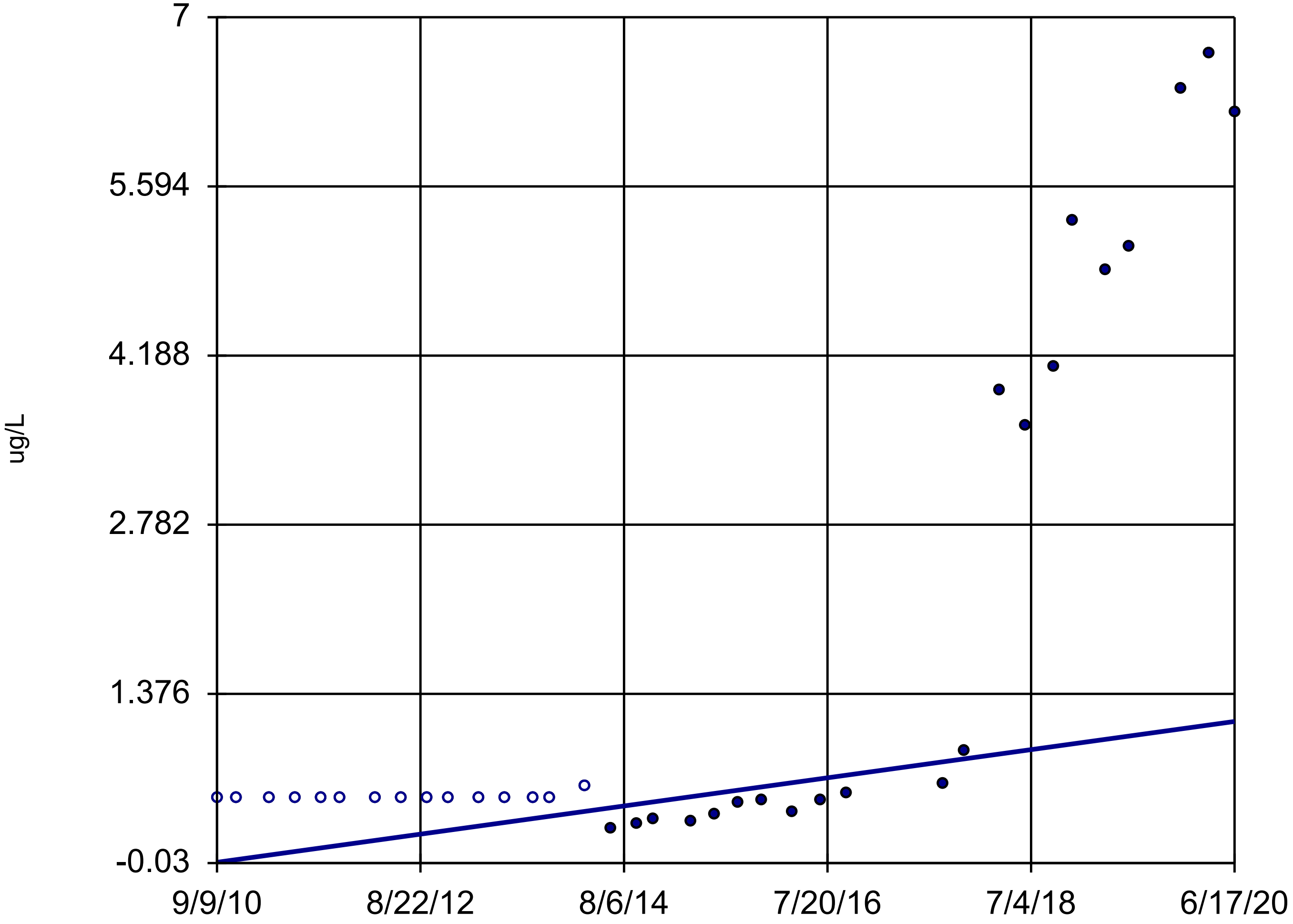
Hollow symbols indicate censored values.

Sen's Slope Estimator

MWell#3



n = 36

Slope = 0.1197
units per year.

Mann-Kendall
statistic = 250
critical = 171

Increasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

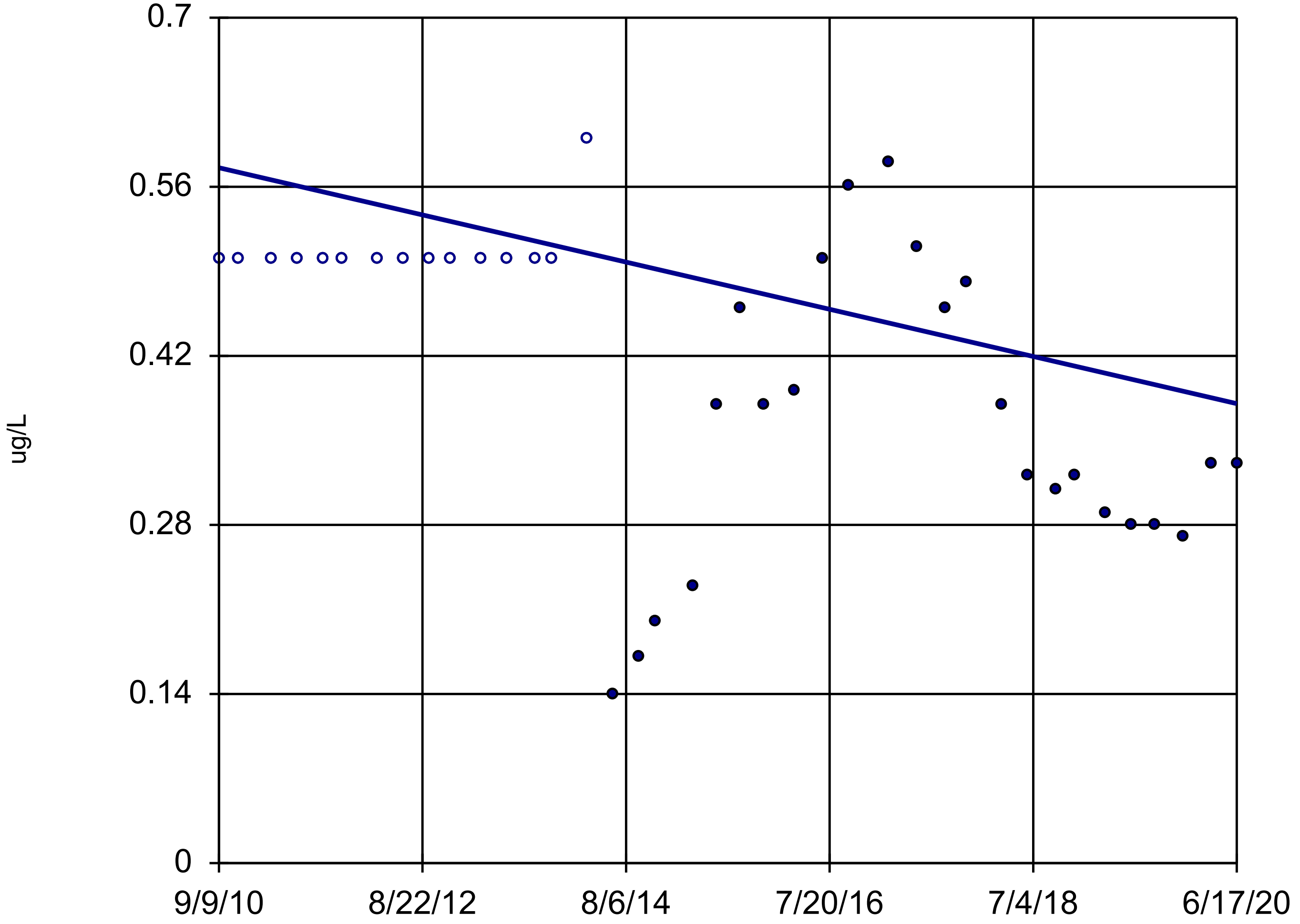
Constituent: Chloroform   Analysis Run 8/12/2020 9:43 PM   View: HRLF_SensSlope 10-year

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

Sanitas™ v.9.6.26 Software licensed to Parametrix. UG
Hollow symbols indicate censored values.

Sen's Slope Estimator

MWell#4



n = 39

Slope = -0.01997
units per year.

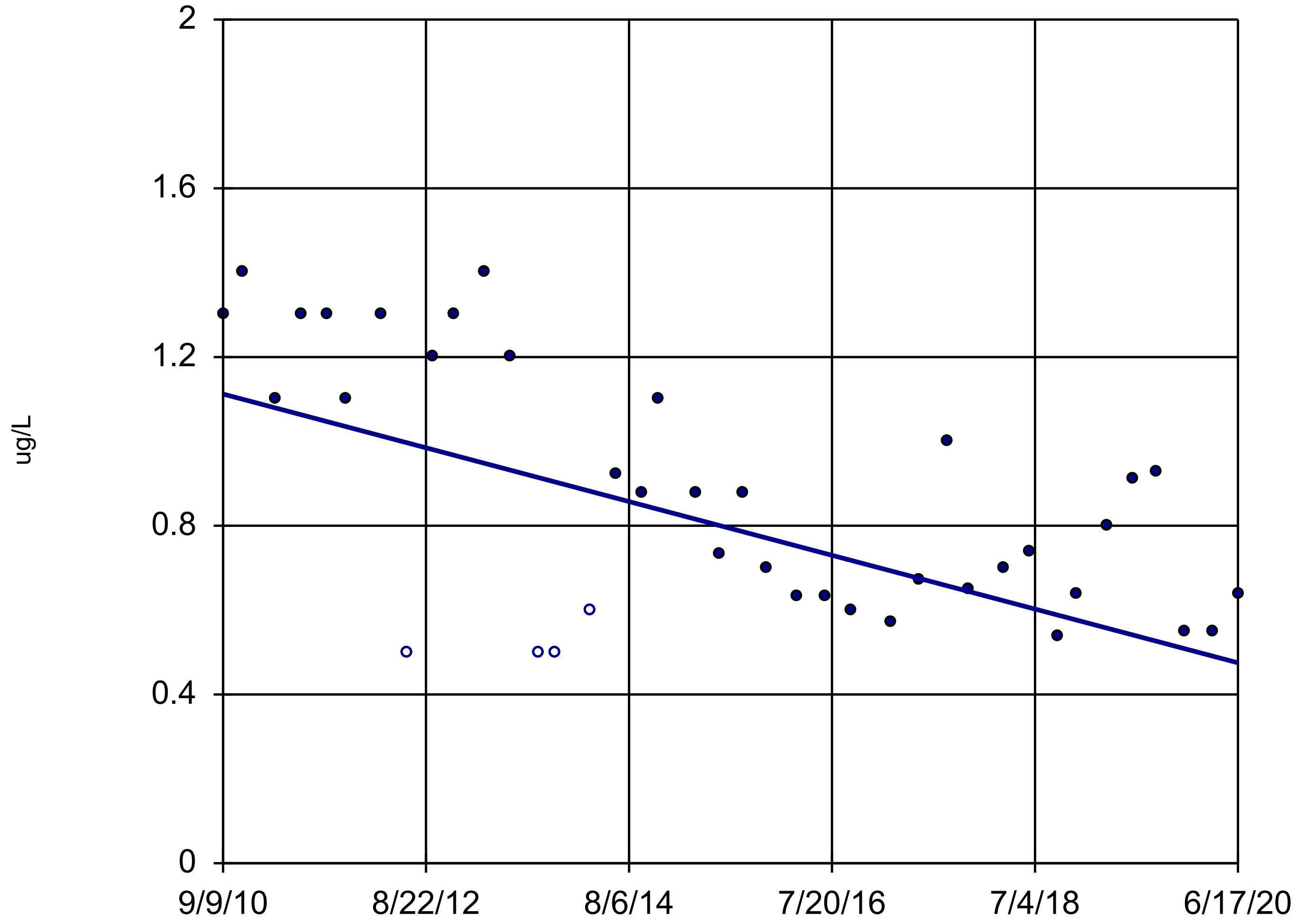
Mann-Kendall
statistic = -253
critical = -194

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: Chloroform Analysis Run 8/12/2020 9:43 PM View: HRLF_SensSlope 10-year
Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Sanitas™ v.9.6.26 Software licensed to Parametrix. UG
Hollow symbols indicate censored values.

Sen's Slope Estimator



n = 39

Slope = -0.06518
units per year.

Mann-Kendall
statistic = -285
critical = -194

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: Chloroform Analysis Run 8/12/2020 9:43 PM View: HRLF_SensSlope 10-year
Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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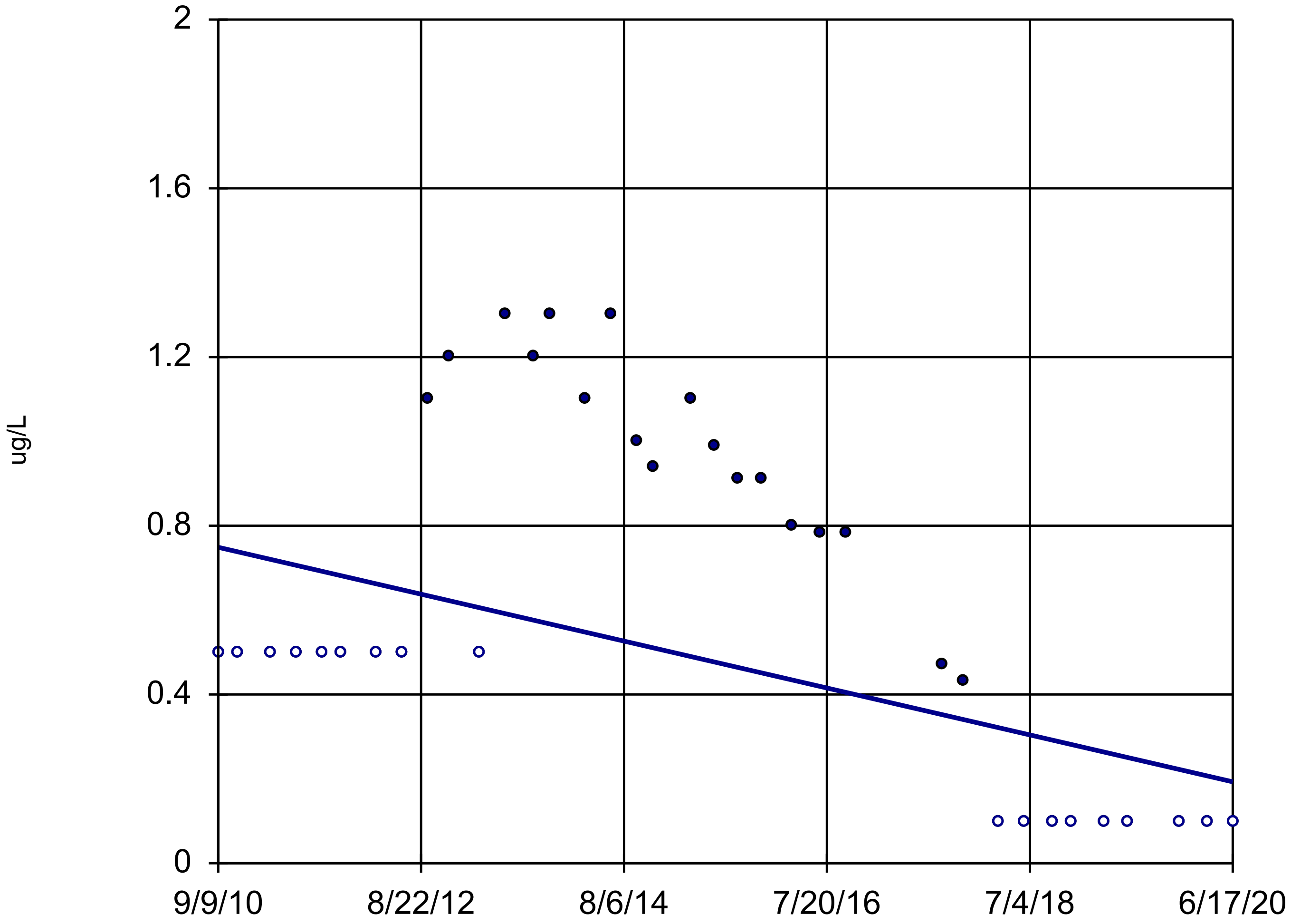
Hollow symbols indicate censored values.

Sen's Slope Estimator

MWell#3



n = 36

Slope = -0.05682
units per year.

Mann-Kendall
statistic = -237
critical = -171

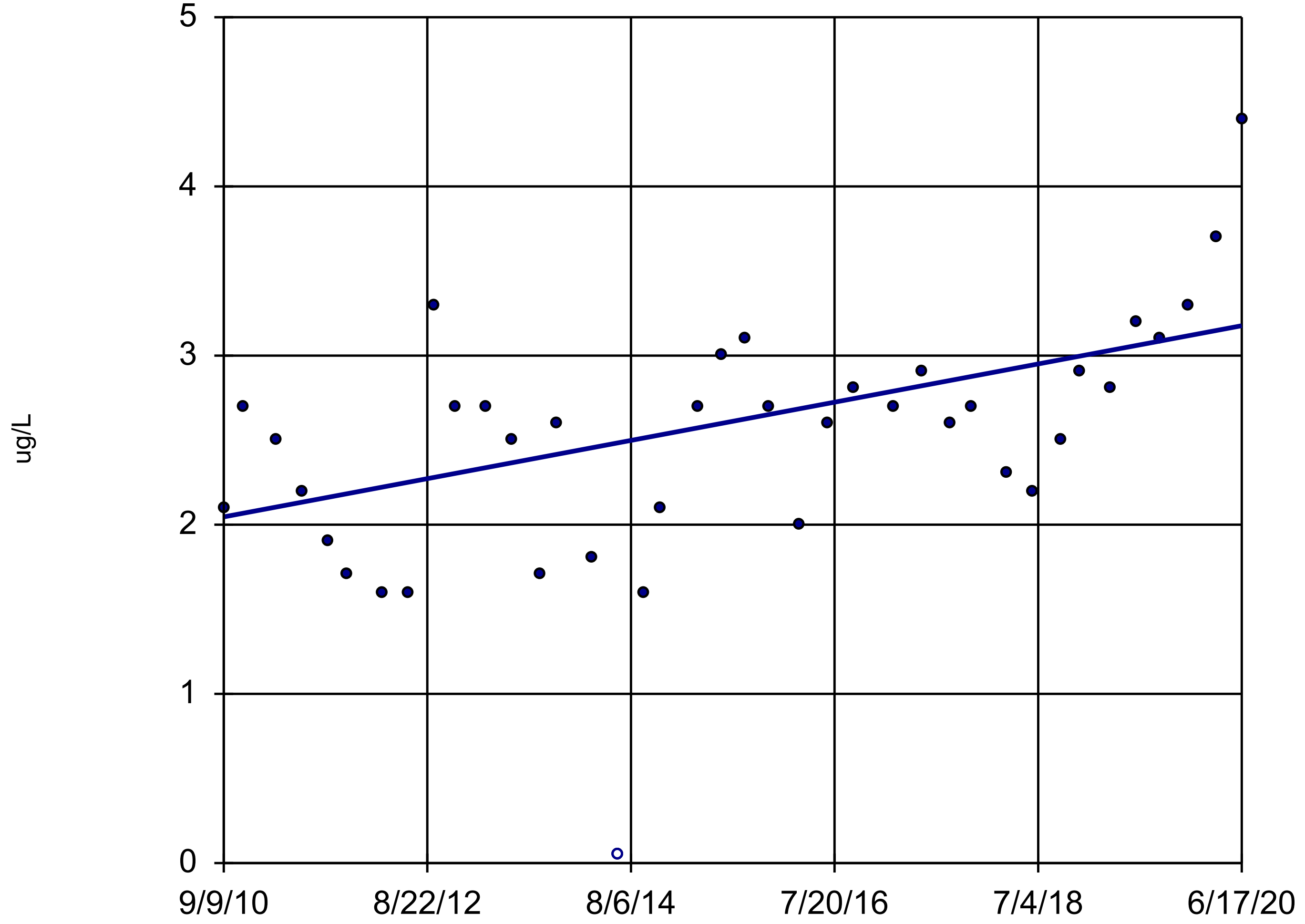
Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: cis-1,2-Dichloroethene   Analysis Run 8/12/2020 9:43 PM   View: HRLF_SensSlope 10-year
Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

Sanitas™ v.9.6.26 Software licensed to Parametrix. UG
Hollow symbols indicate censored values.

Sen's Slope Estimator

MWell#4



n = 39

Slope = 0.1156
units per year.

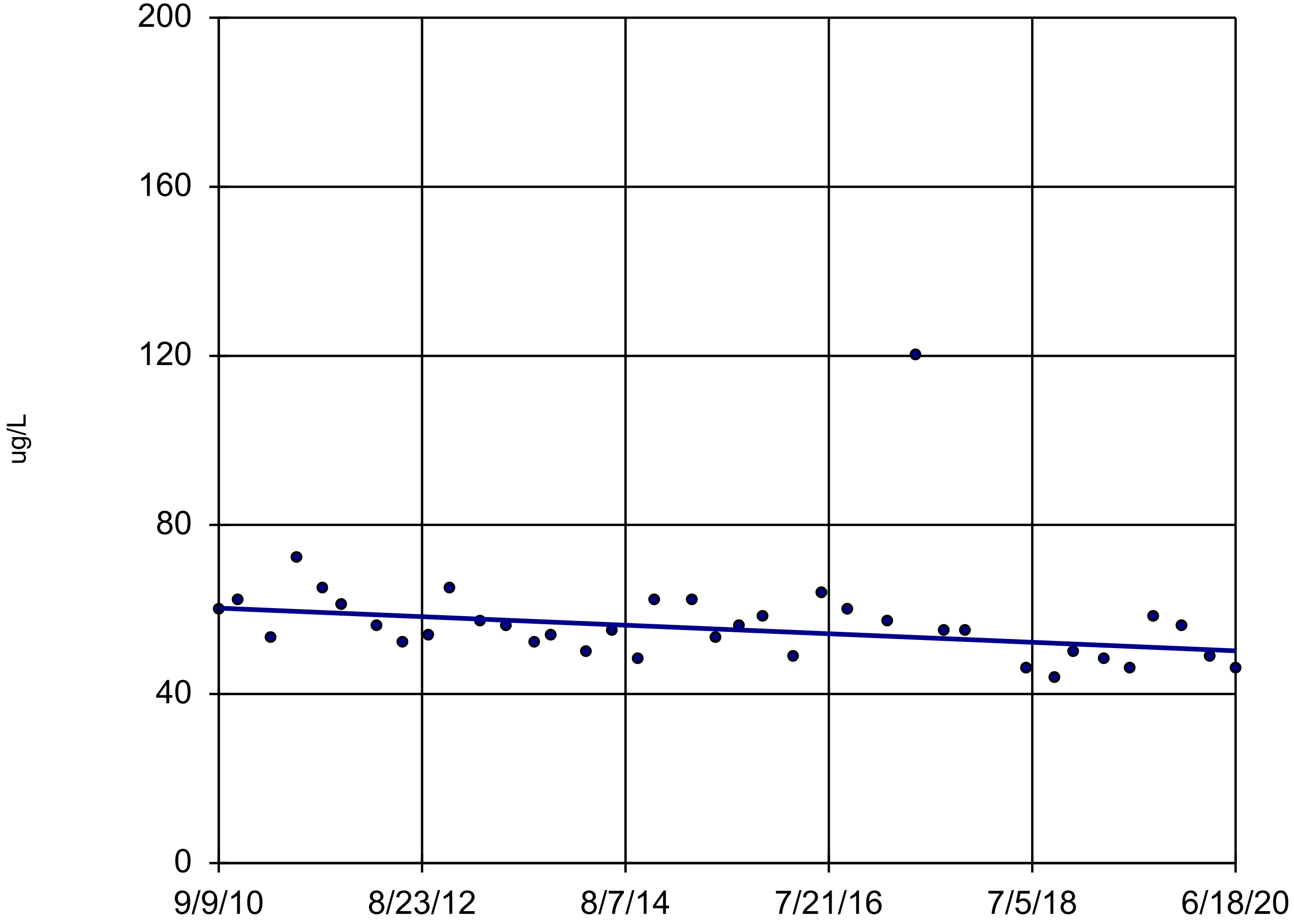
Mann-Kendall
statistic = 296
critical = 194

Increasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: cis-1,2-Dichloroethene Analysis Run 8/12/2020 9:43 PM View: HRLF_SensSlope 10-year
Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Sen's Slope Estimator

MWell#6



n = 38

Slope = -1.034
units per year.

Mann-Kendall
statistic = -214
critical = -186

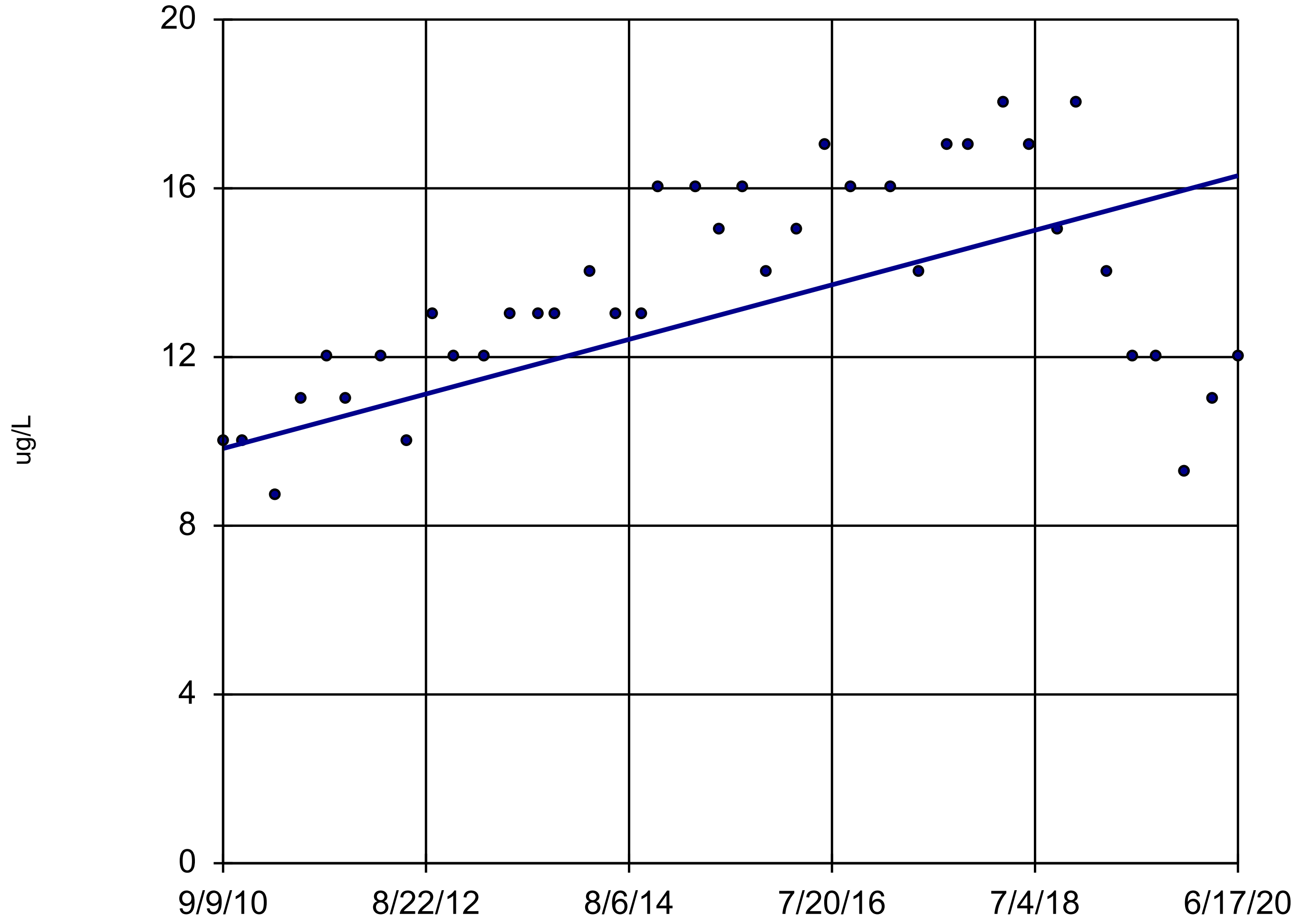
Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: cis-1,2-Dichloroethene Analysis Run 8/12/2020 9:43 PM View: HRLF_SensSlope 10-year

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Sen's Slope Estimator

MWell#10



n = 39

Slope = 0.6611
units per year.

Mann-Kendall
statistic = 289
critical = 194

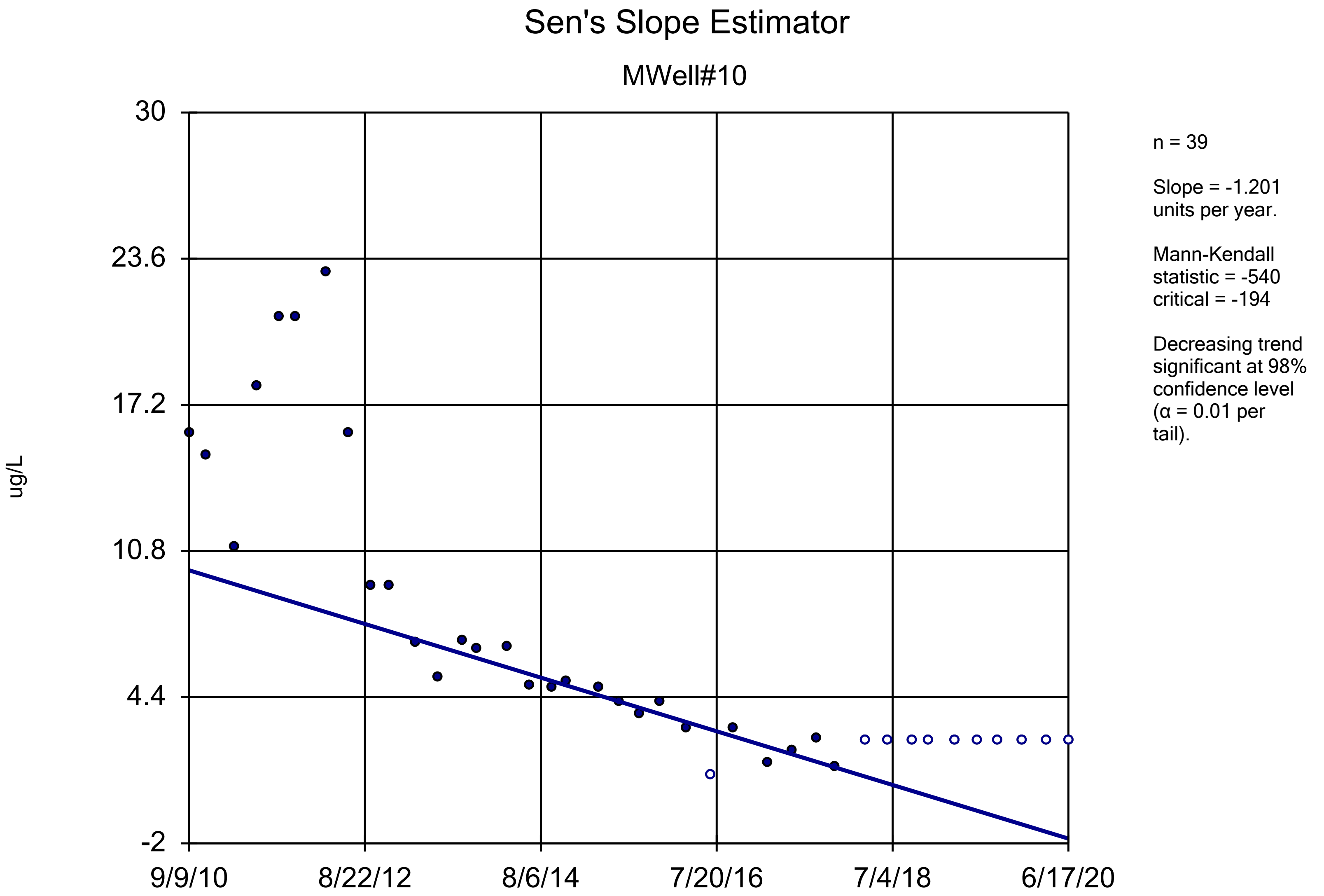
Increasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: cis-1,2-Dichloroethene   Analysis Run 8/12/2020 9:43 PM   View: HRLF_SensSlope 10-year

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

Sanitas™ v.9.6.26 Software licensed to Parametrix. UG

Hollow symbols indicate censored values.



n = 39

Slope = -1.201
units per year.

Mann-Kendall
statistic = -540
critical = -194

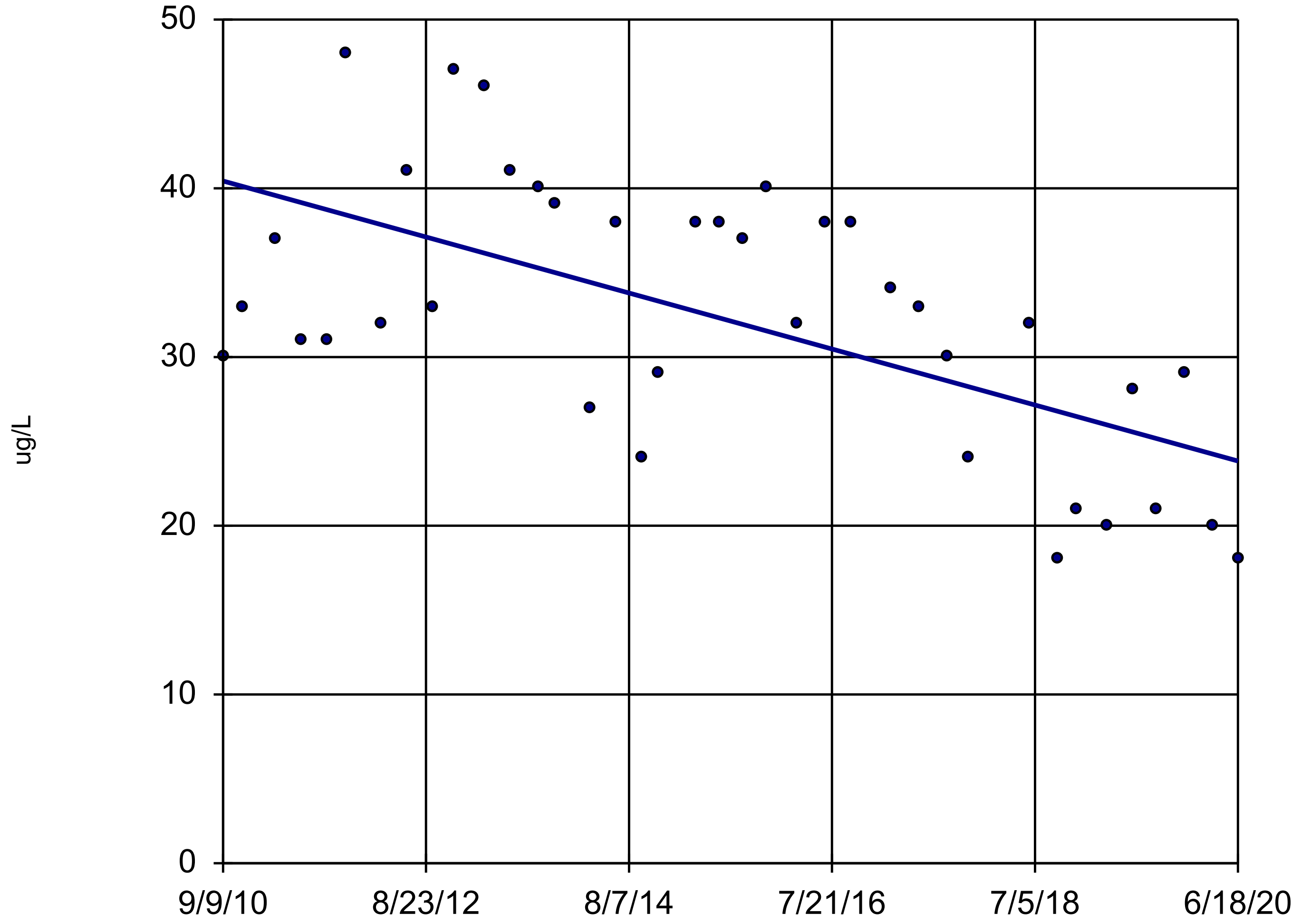
Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: Methylene Chloride Analysis Run 8/12/2020 9:43 PM View: HRLF_SensSlope 10-year

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Sen's Slope Estimator

MWell#6



n = 38

Slope = -1.696
units per year.

Mann-Kendall
statistic = -293
critical = -186

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: Tetrachloroethene Analysis Run 8/12/2020 9:44 PM View: HRLF_SensSlope 10-year

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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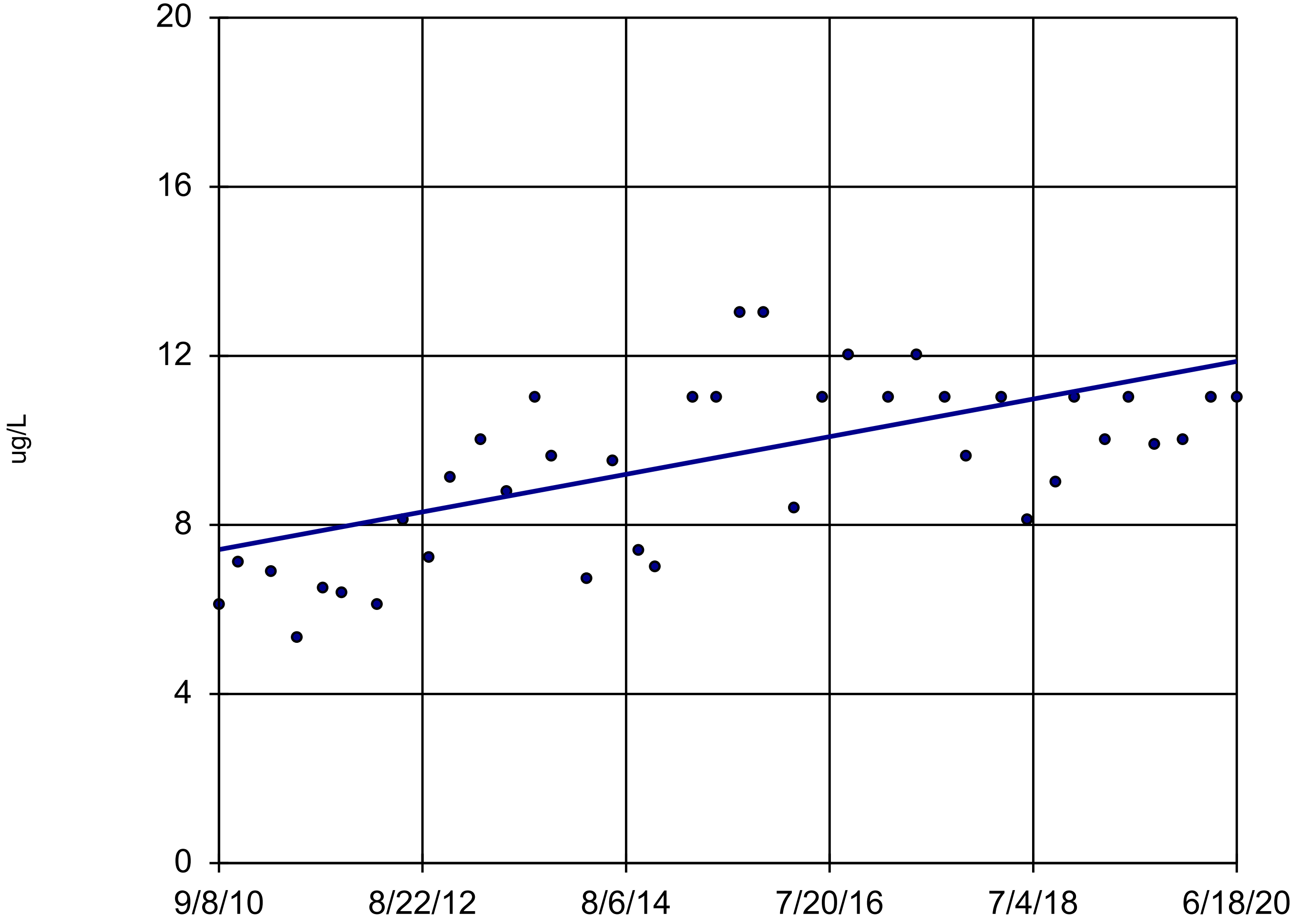
Sen's Slope Estimator

MWell#9



n = 39

Slope = 0.4549
units per year.

Mann-Kendall
statistic = 328
critical = 194

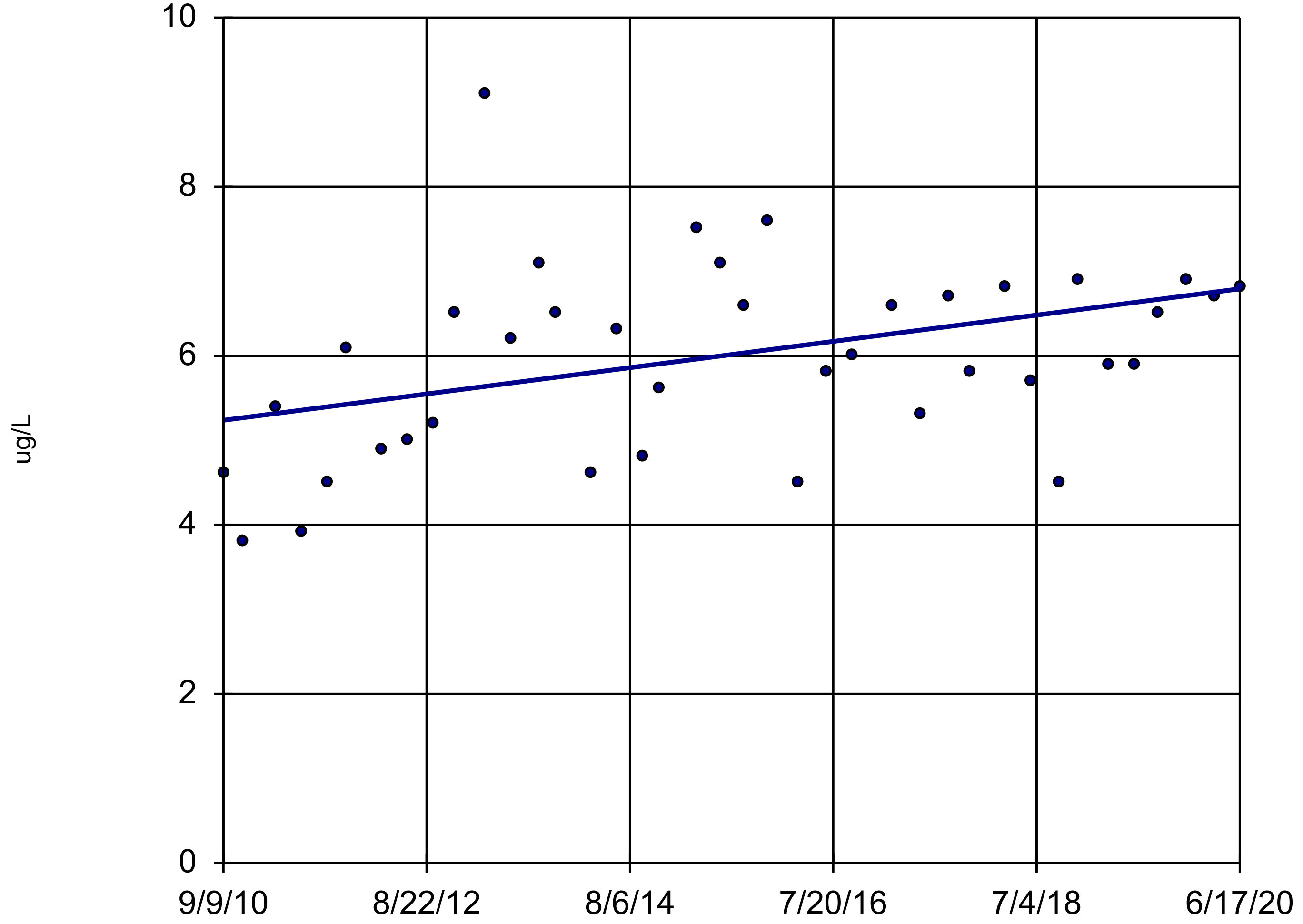
Increasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: Tetrachloroethene Analysis Run 8/12/2020 9:44 PM View: HRLF_SensSlope 10-year

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Sen's Slope Estimator

MWell#10



n = 39

Slope = 0.1589
units per year.

Mann-Kendall
statistic = 221
critical = 194

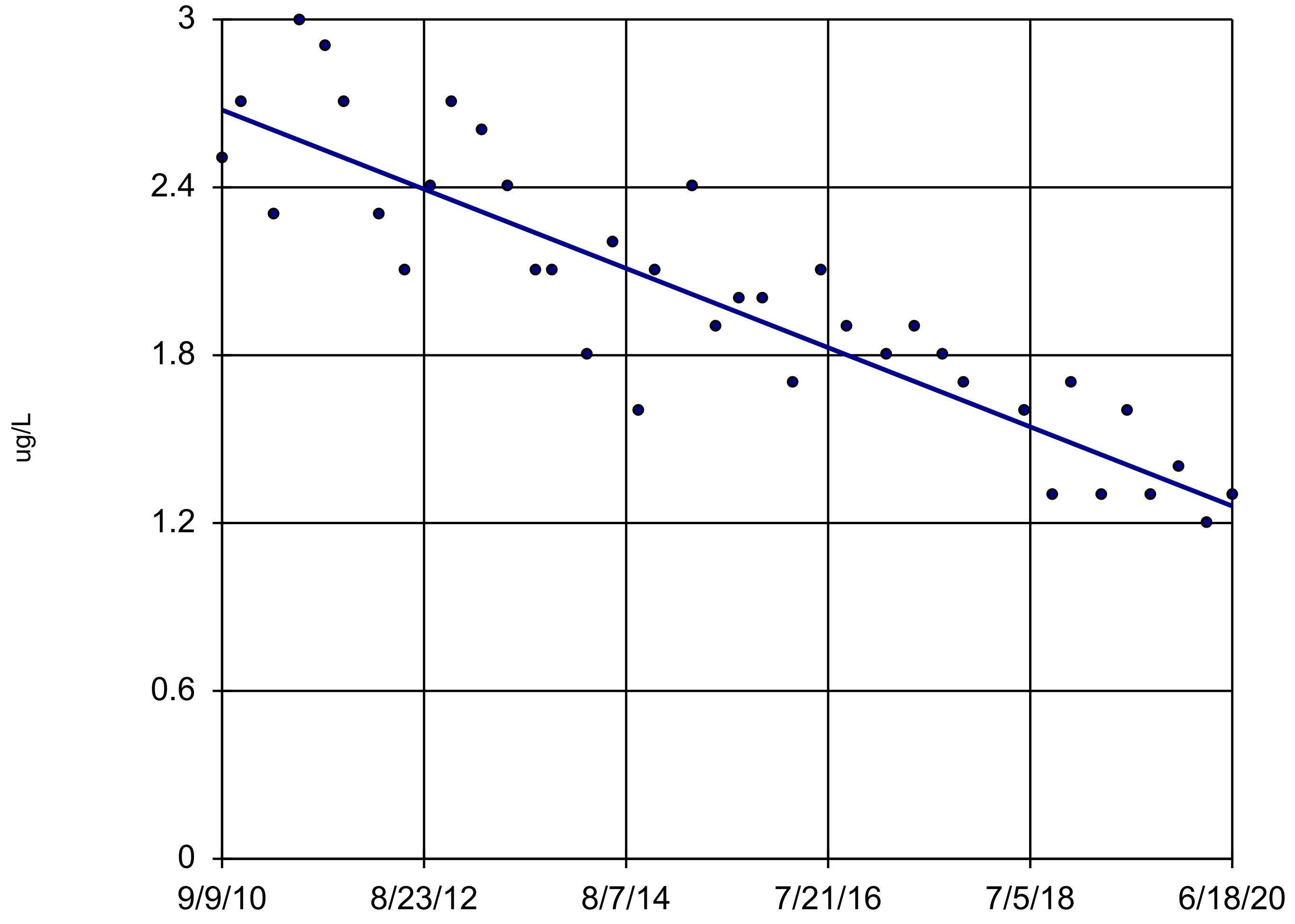
Increasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: Tetrachloroethene Analysis Run 8/12/2020 9:44 PM View: HRLF_SensSlope 10-year

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Sen's Slope Estimator

MWell#6



n = 38

Slope = -0.1447
units per year.

Mann-Kendall
statistic = -515
critical = -186

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: trans-1,2-Dichloroethene Analysis Run 8/12/2020 9:44 PM View: HRLF_SensSlope 10-year

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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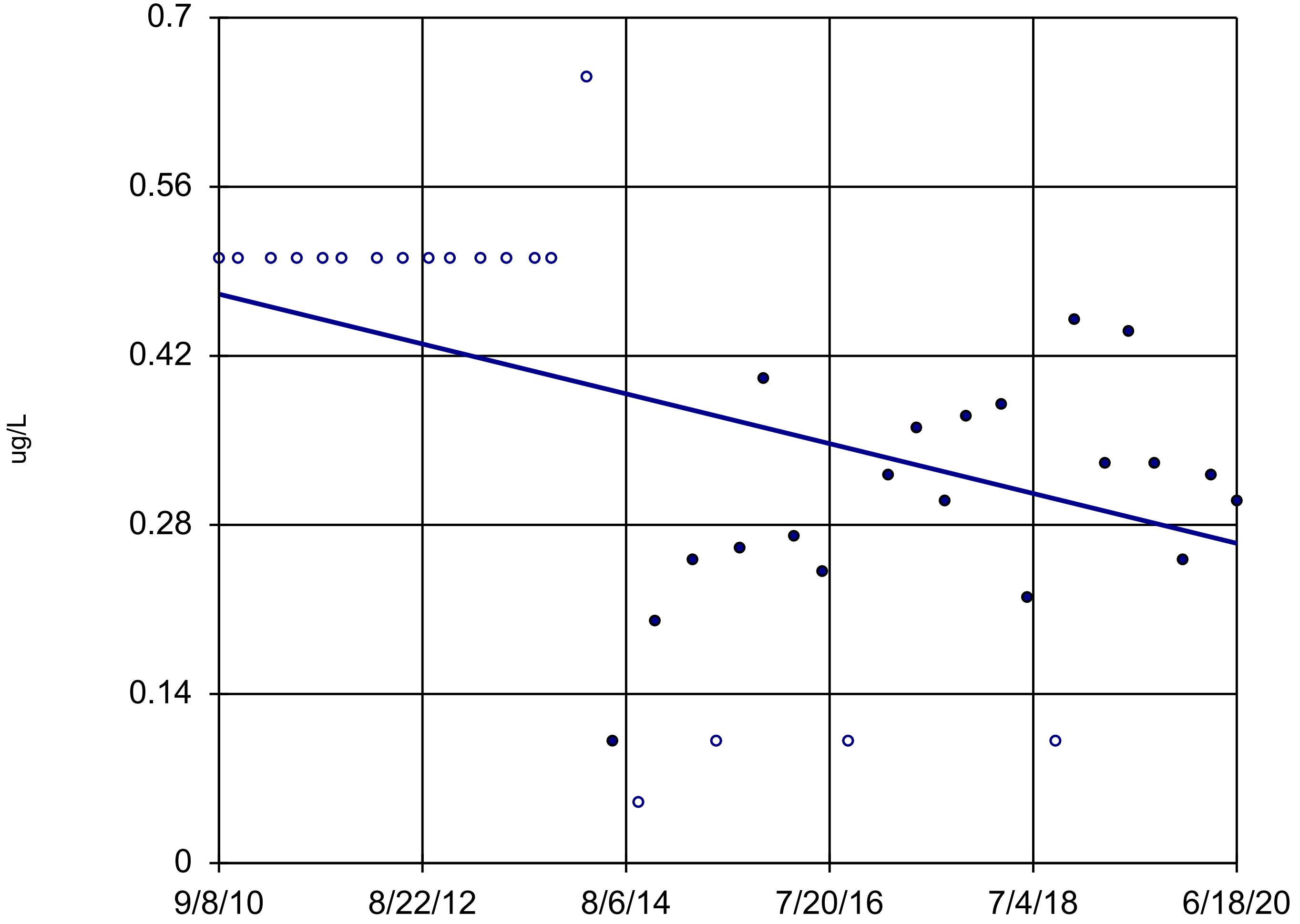
Hollow symbols indicate censored values.

Sen's Slope Estimator

MWell#9



n = 39

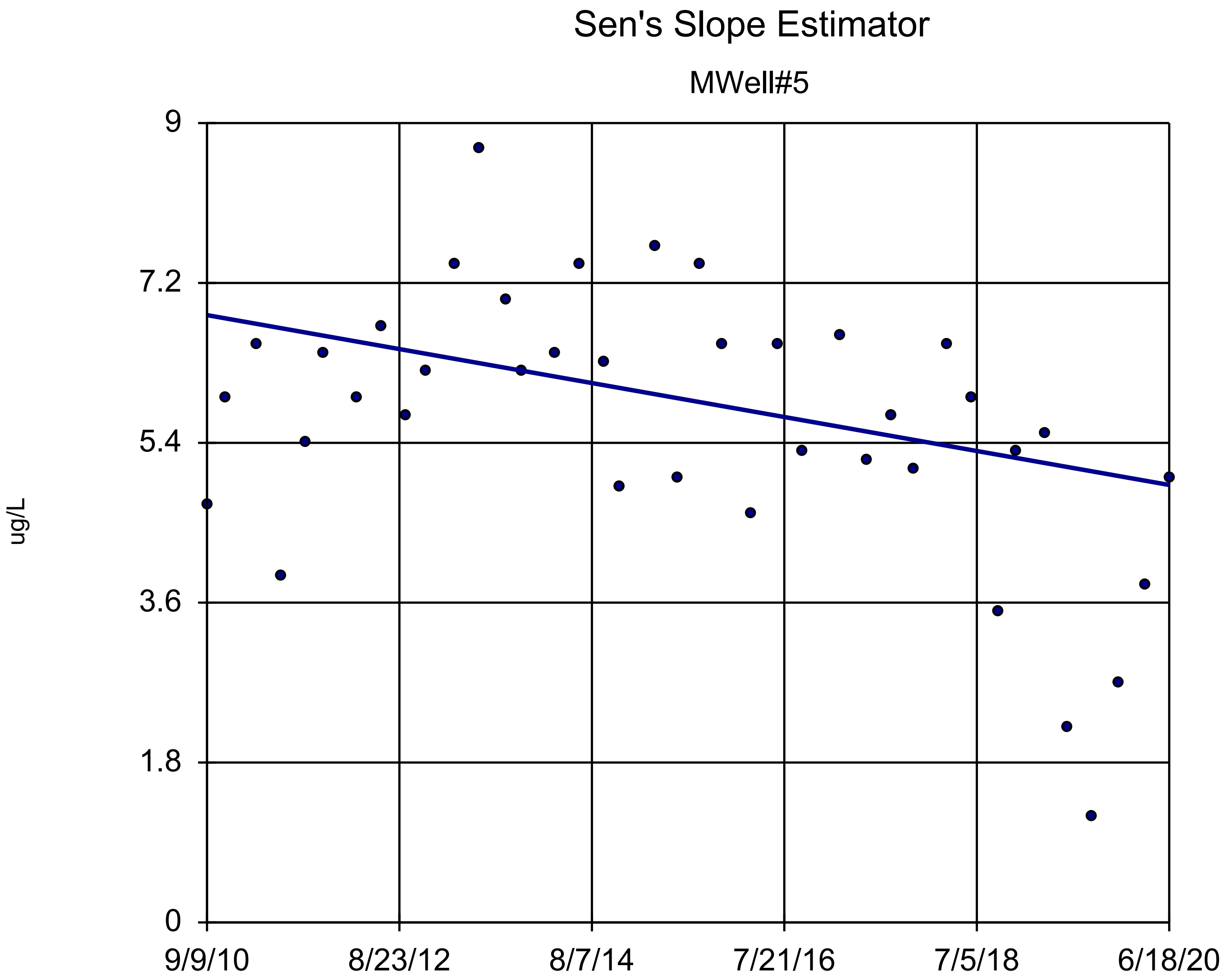
Slope = -0.02108
units per year.

Mann-Kendall
statistic = -250
critical = -194

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: trans-1,2-Dichloroethene   Analysis Run 8/12/2020 9:44 PM   View: HRLF_SensSlope 10-year

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata



n = 39

Slope = -0.1955
units per year.

Mann-Kendall
statistic = -196
critical = -194

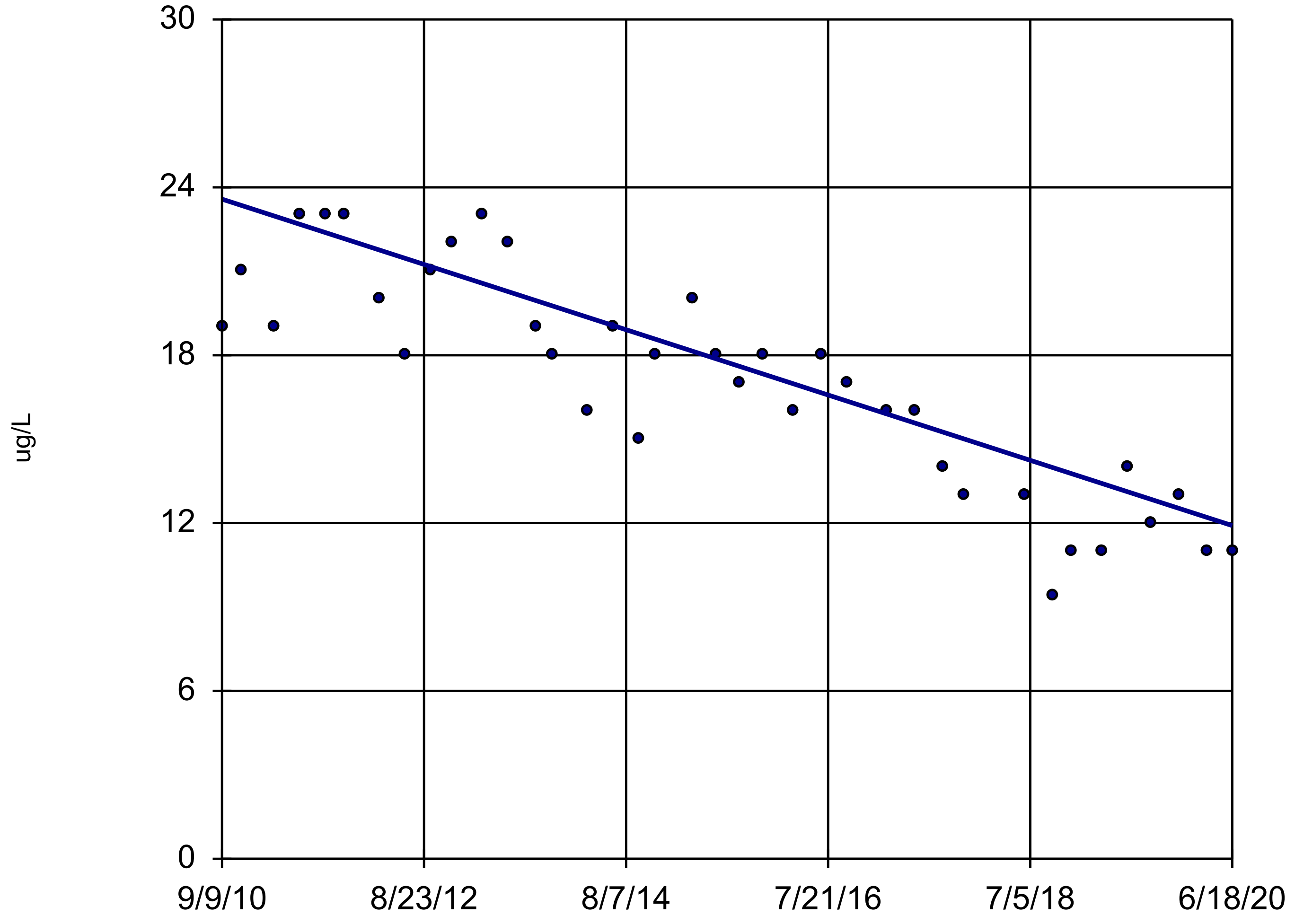
Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: Trichloroethene Analysis Run 8/12/2020 9:44 PM View: HRLF_SensSlope 10-year

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Sen's Slope Estimator

MWell#6



n = 38

Slope = -1.193
units per year.

Mann-Kendall
statistic = -490
critical = -186

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: Trichloroethene   Analysis Run 8/12/2020 9:44 PM   View: HRLF_SensSlope 10-year

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

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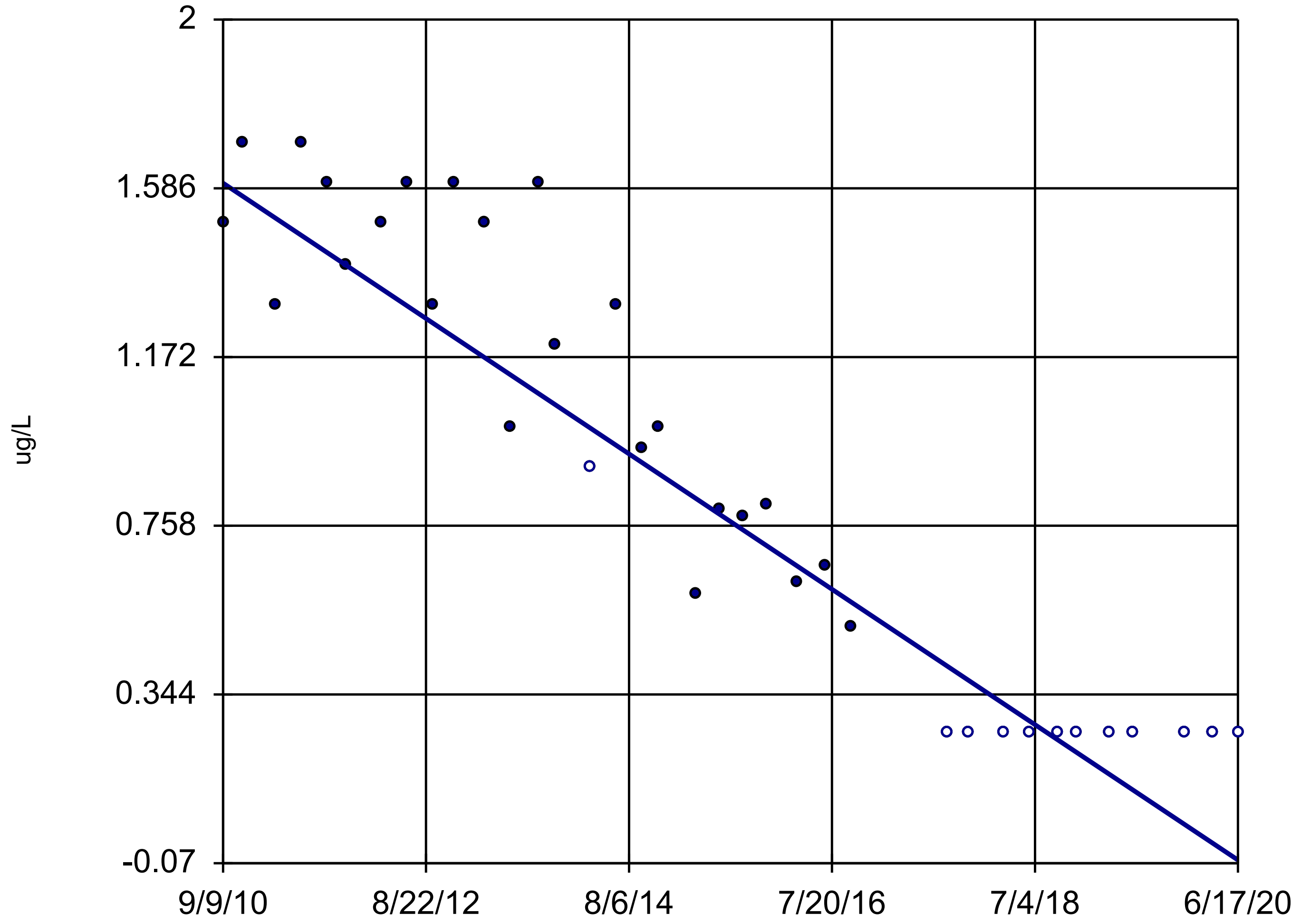
Hollow symbols indicate censored values.

Sen's Slope Estimator

MWell#3



n = 36

Slope = -0.1698
units per year.

Mann-Kendall
statistic = -477
critical = -171

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: Trichlorofluoromethane   Analysis Run 8/12/2020 9:44 PM   View: HRLF_SensSlope 10-year

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

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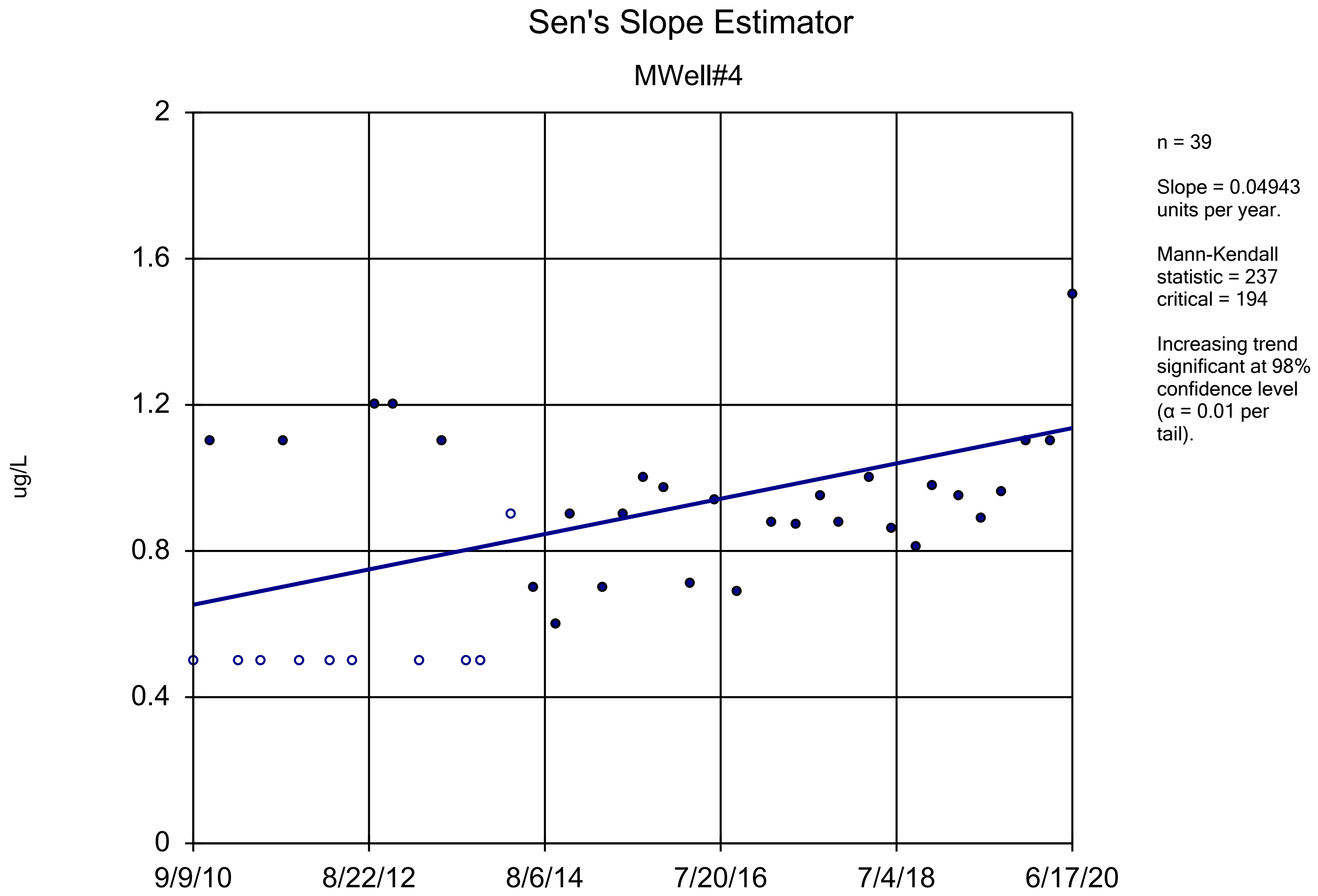
Hollow symbols indicate censored values.



Constituent: Trichlorofluoromethane   Analysis Run 8/12/2020 9:44 PM   View: HRLF_SensSlope 10-year

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

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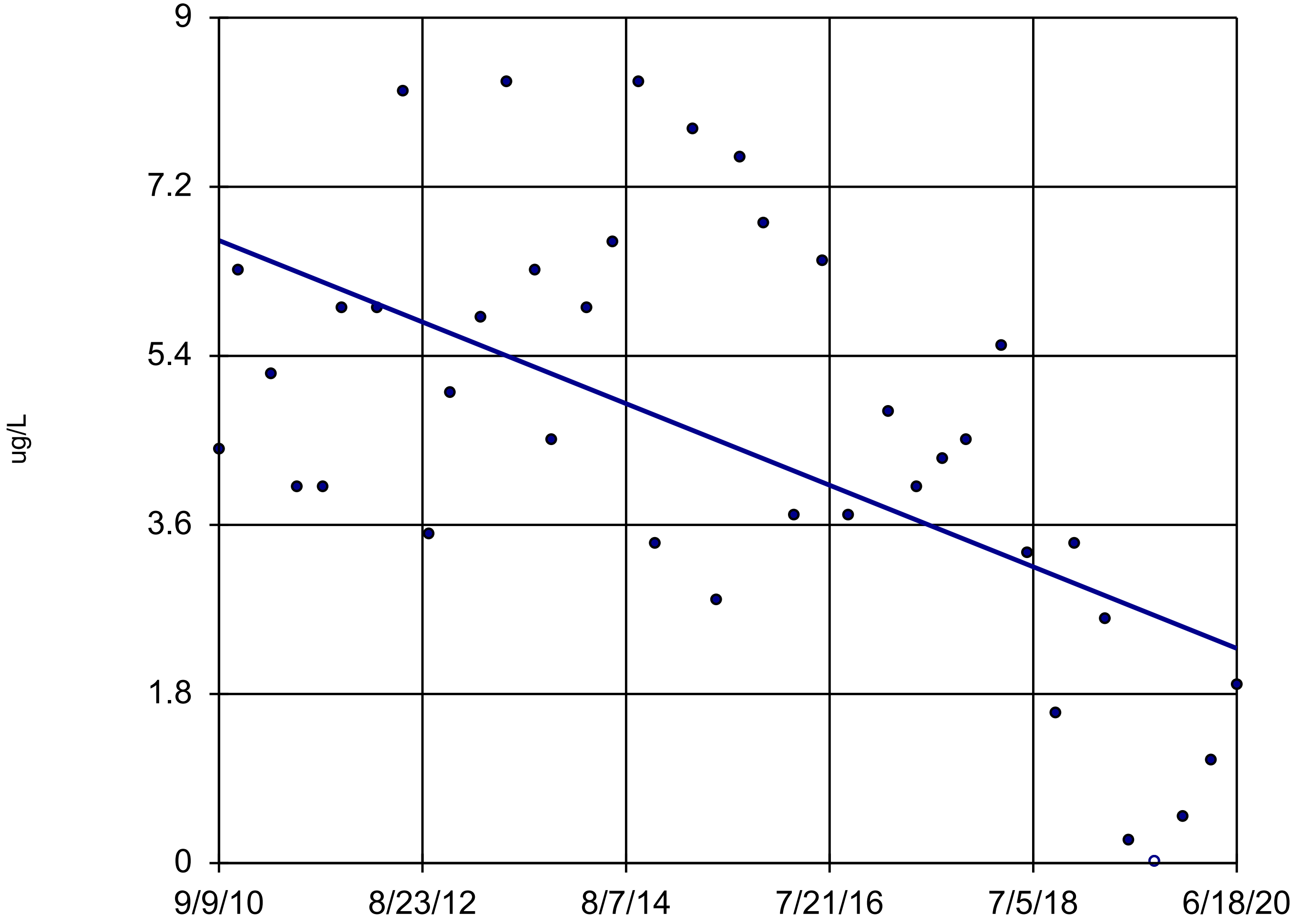
Hollow symbols indicate censored values.

Sen's Slope Estimator

MWell#5



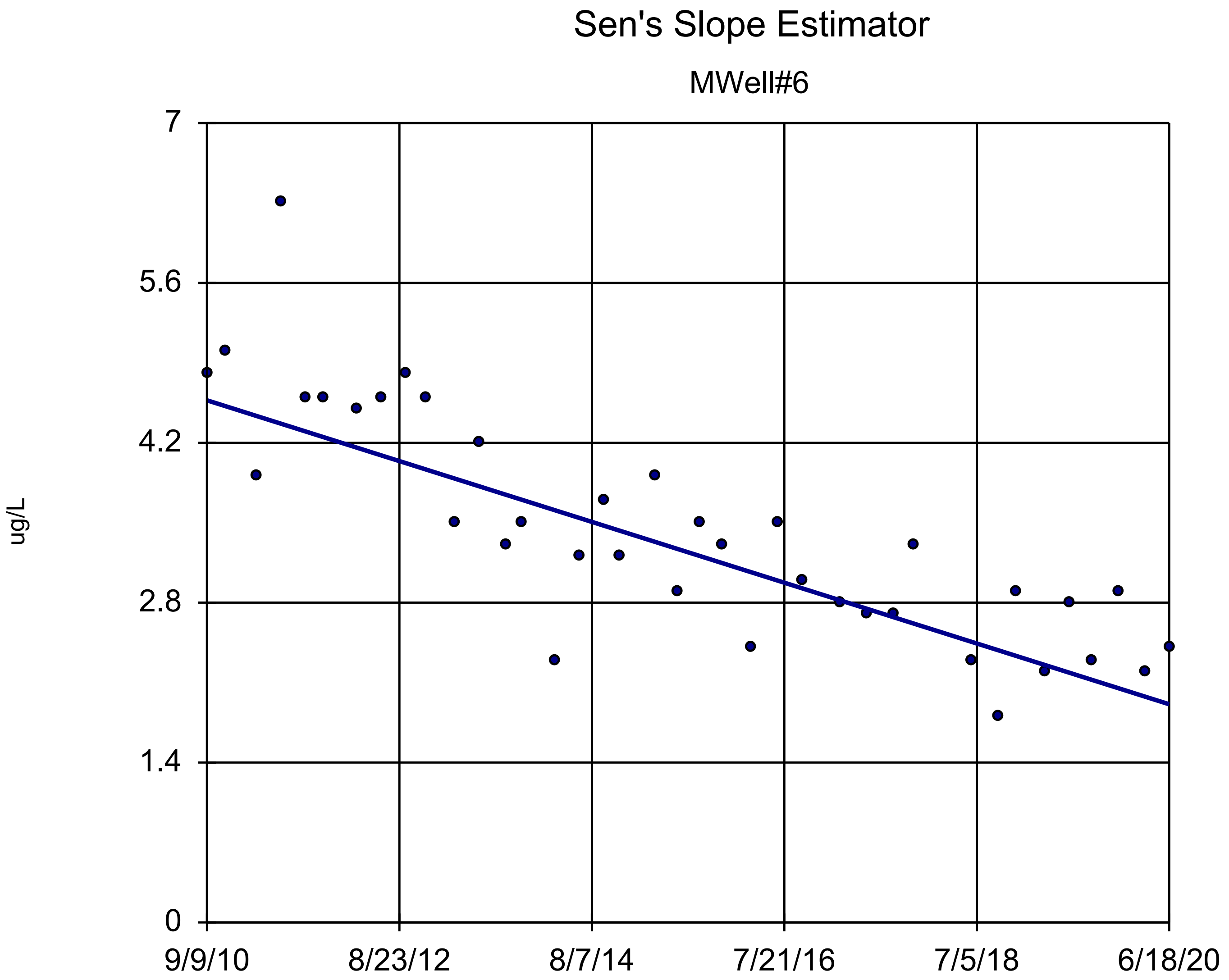
n = 39

Slope = -0.4439
units per year.

Mann-Kendall
statistic = -294
critical = -194

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: Vinyl Chloride   Analysis Run 8/12/2020 9:44 PM   View: HRLF_SensSlope 10-year
Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata



n = 38

Slope = -0.2722
units per year.

Mann-Kendall
statistic = -469
critical = -186

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: Vinyl Chloride Analysis Run 8/12/2020 9:44 PM View: HRLF_SensSlope 10-year
Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Horn Rapids Landfill Trends for Volatile Organic Compounds, Third Quarter 2015 through Second Quarter 2020

Constituent Name	Well	Slope	Calculated Statistic	Critical Value	Trend	N	% Non-detects	Normality	Transformation	Alpha	Method
1,1-Dichloroethane (ug/L)	MWell#3	-0.3232	-95	-53	Yes	16	43.75	n/a	n/a	0.02	NP
1,1-Dichloroethane (ug/L)	MWell#4	0.3911	107	68	Yes	19	0	n/a	n/a	0.02	NP
1,1-Dichloroethane (ug/L)	MWell#5	-1.024	-90	-68	Yes	19	0	n/a	n/a	0.02	NP
1,1-Dichloroethane (ug/L)	MWell#6	-0.6706	-113	-63	Yes	18	0	n/a	n/a	0.02	NP
1,1-Dichloroethene (ug/L)	MWell#5	-0.01864	-86	-68	Yes	19	47.37	n/a	n/a	0.02	NP
1,1-Dichloroethene (ug/L)	MWell#6	-0.04244	-90	-63	Yes	18	38.89	n/a	n/a	0.02	NP
1,1-Dichloroethene (ug/L)	MWell#10	-0.07457	-85	-68	Yes	19	31.58	n/a	n/a	0.02	NP
1,2-Dichloroethane (ug/L)	MWell#5	-0.1314	-105	-68	Yes	19	10.53	n/a	n/a	0.02	NP
1,2-Dichloroethane (ug/L)	MWell#6	-0.0487	-95	-63	Yes	18	0	n/a	n/a	0.02	NP
1,2-Dichloropropane (ug/L)	MWell#5	-0.04525	-92	-68	Yes	19	10.53	n/a	n/a	0.02	NP
1,2-Dichloropropane (ug/L)	MWell#6	-0.03471	-91	-63	Yes	18	0	n/a	n/a	0.02	NP
Benzene (ug/L)	MWell#10	-0.05154	-102	-68	Yes	19	10.53	n/a	n/a	0.02	NP
Bromodichloromethane (ug/L)	MWell#3	0.03843	66	53	Yes	16	50	n/a	n/a	0.02	NP
Chloroform (ug/L)	MWell#3	1.463	105	53	Yes	16	0	n/a	n/a	0.02	NP
Chloroform (ug/L)	MWell#4	-0.04471	-90	-68	Yes	19	0	n/a	n/a	0.02	NP
cis-1,2-Dichloroethene (ug/L)	MWell#4	0.1962	70	68	Yes	19	0	n/a	n/a	0.02	NP
cis-1,2-Dichloroethene (ug/L)	MWell#5	-2.816	-70	-68	Yes	19	0	n/a	n/a	0.02	NP
Tetrachloroethene (ug/L)	MWell#5	-1.572	-72	-68	Yes	19	0	n/a	n/a	0.02	NP
Tetrachloroethene (ug/L)	MWell#6	-4.007	-100	-63	Yes	18	0	n/a	n/a	0.02	NP
trans-1,2-Dichloroethene (ug/L)	MWell#5	-0.06934	-72	-68	Yes	19	10.53	n/a	n/a	0.02	NP
trans-1,2-Dichloroethene (ug/L)	MWell#6	-0.1594	-108	-63	Yes	18	0	n/a	n/a	0.02	NP
Trichloroethene (ug/L)	MWell#5	-0.6503	-81	-68	Yes	19	0	n/a	n/a	0.02	NP
Trichloroethene (ug/L)	MWell#6	-1.534	-98	-63	Yes	18	0	n/a	n/a	0.02	NP
Vinyl Chloride (ug/L)	MWell#5	-1.258	-108	-68	Yes	19	5.263	n/a	n/a	0.02	NP
Vinyl Chloride (ug/L)	MWell#10	-0.1506	-79	-68	Yes	19	5.263	n/a	n/a	0.02	NP

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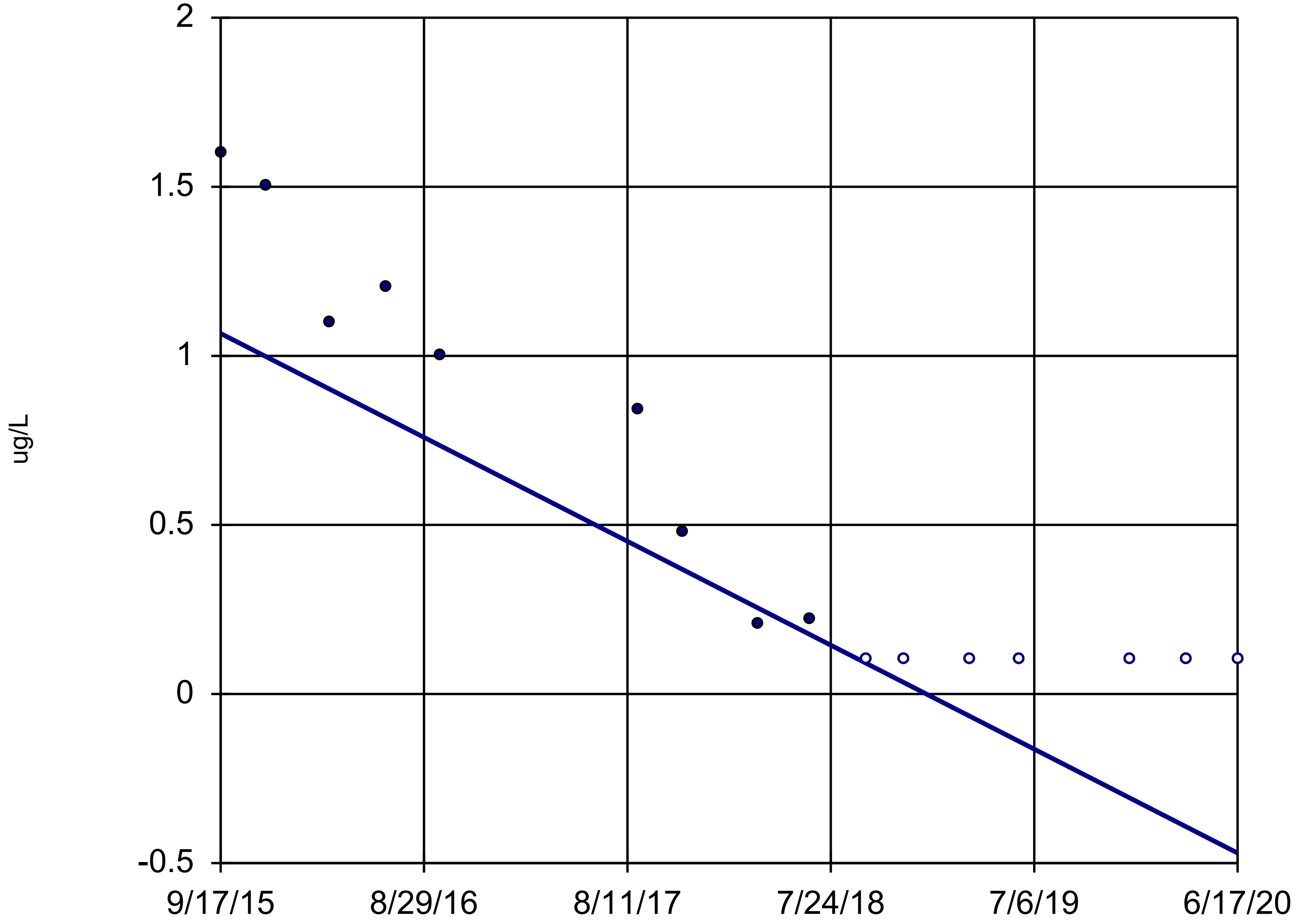
Hollow symbols indicate censored values.

Sen's Slope Estimator

MWell#3



n = 16

Slope = -0.3232
units per year.

Mann-Kendall
statistic = -95
critical = -53

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: 1,1-Dichloroethane   Analysis Run 8/13/2020 3:14 PM   View: HRLF_SensSlope 5-year

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

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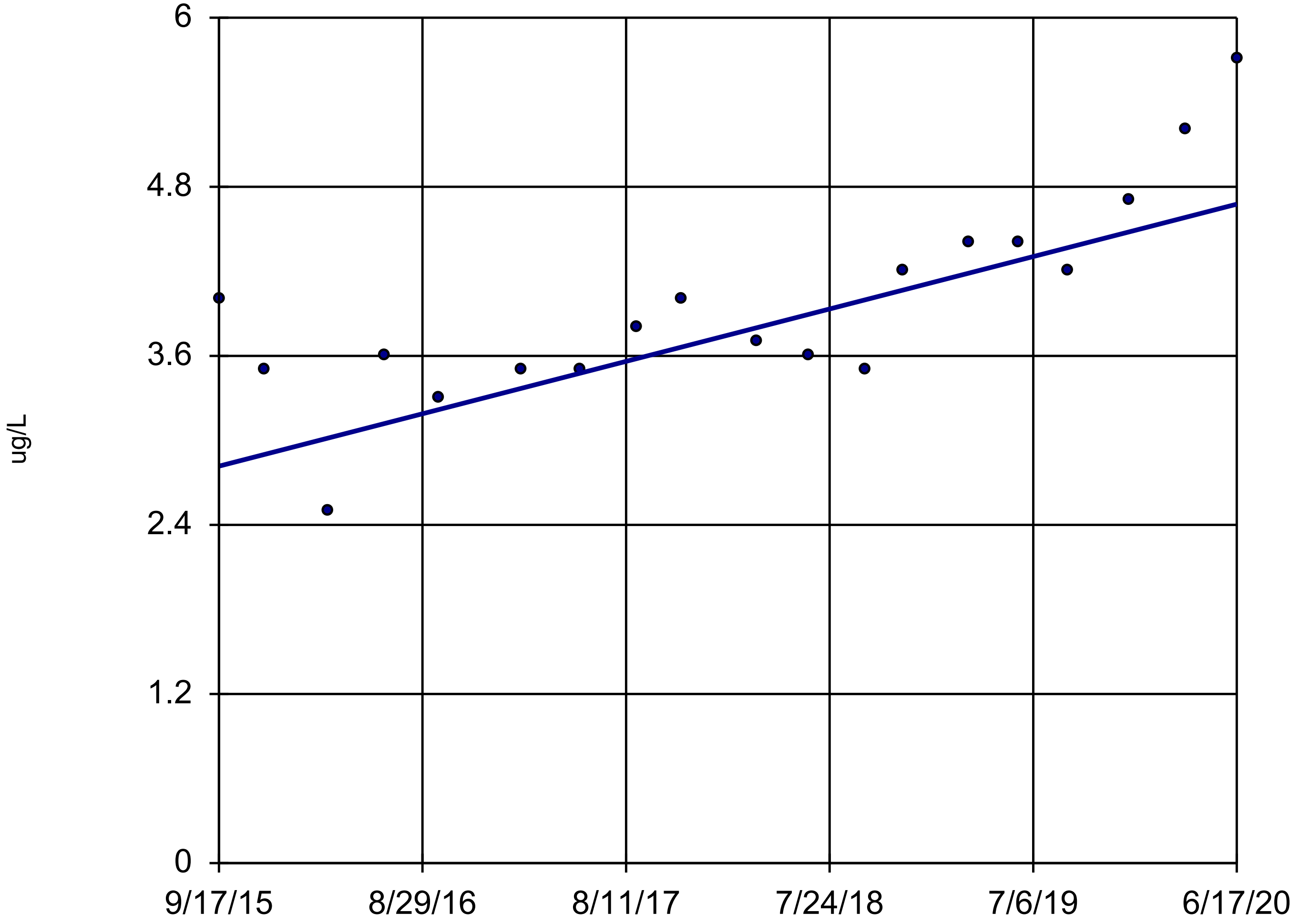
Sen's Slope Estimator

MWell#4



n = 19

Slope = 0.3911
units per year.

Mann-Kendall
statistic = 107
critical = 68

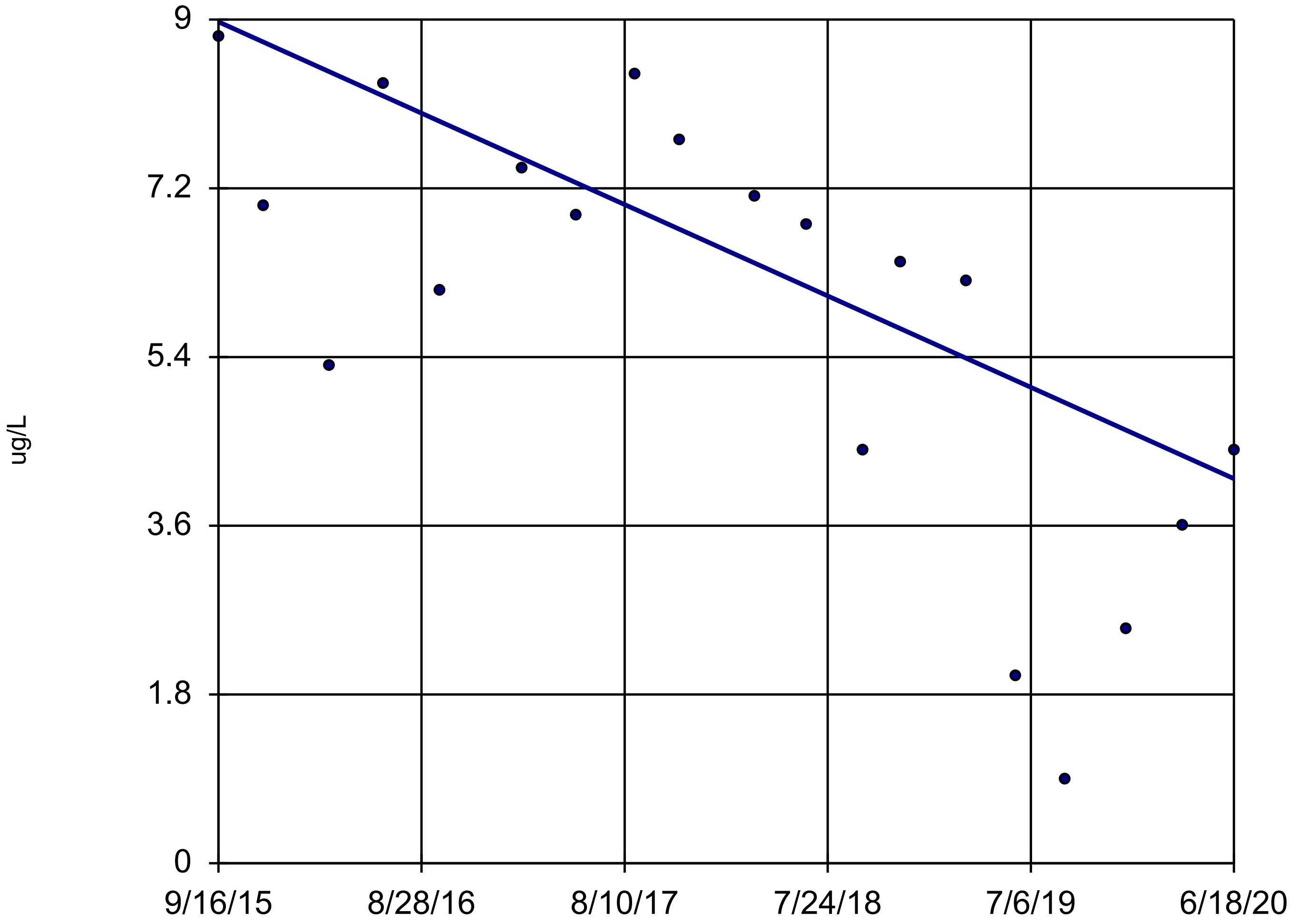
Increasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: 1,1-Dichloroethane   Analysis Run 8/13/2020 3:14 PM   View: HRLF_SensSlope 5-year

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

Sen's Slope Estimator

MWell#5



n = 19

Slope = -1.024
units per year.

Mann-Kendall
statistic = -90
critical = -68

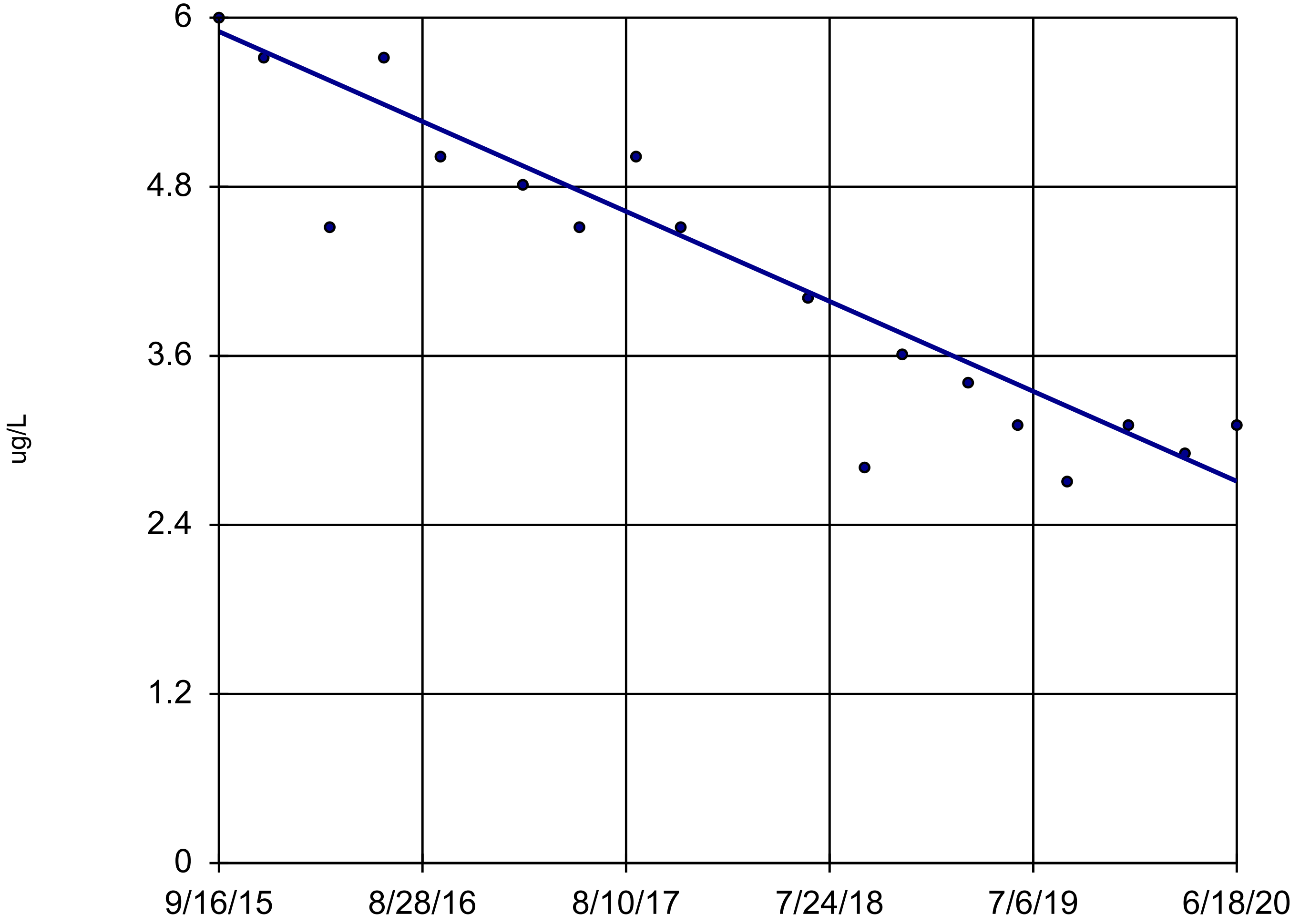
Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: 1,1-Dichloroethane Analysis Run 8/13/2020 3:14 PM View: HRLF_SensSlope 5-year

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Sen's Slope Estimator

MWell#6



n = 18

Slope = -0.6706
units per year.

Mann-Kendall
statistic = -113
critical = -63

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: 1,1-Dichloroethane Analysis Run 8/13/2020 3:14 PM View: HRLF_SensSlope 5-year

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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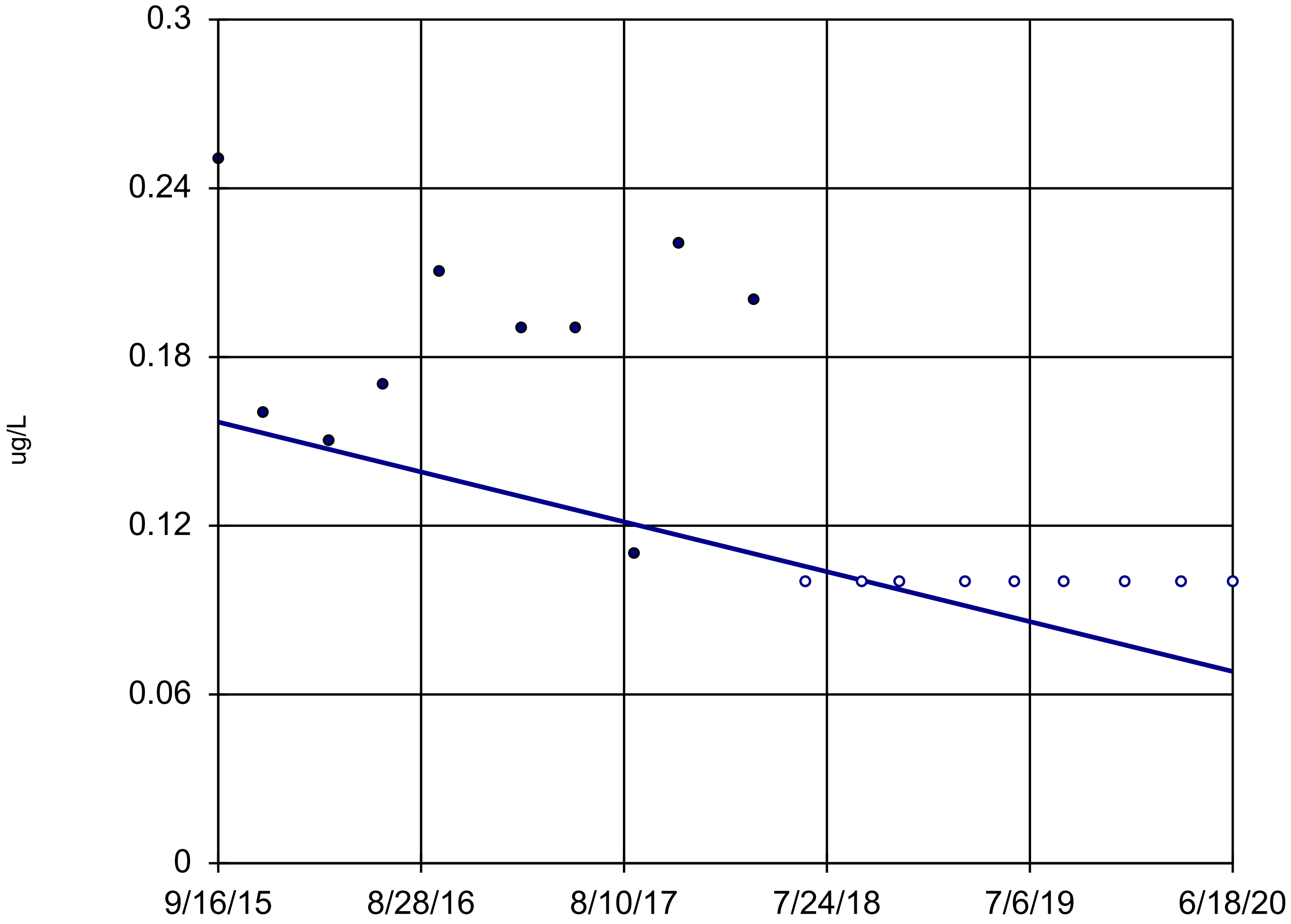
Hollow symbols indicate censored values.

Sen's Slope Estimator

MWell#5



n = 19

Slope = -0.01864
units per year.

Mann-Kendall
statistic = -86
critical = -68

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: 1,1-Dichloroethene Analysis Run 8/13/2020 3:14 PM View: HRLF_SensSlope 5-year

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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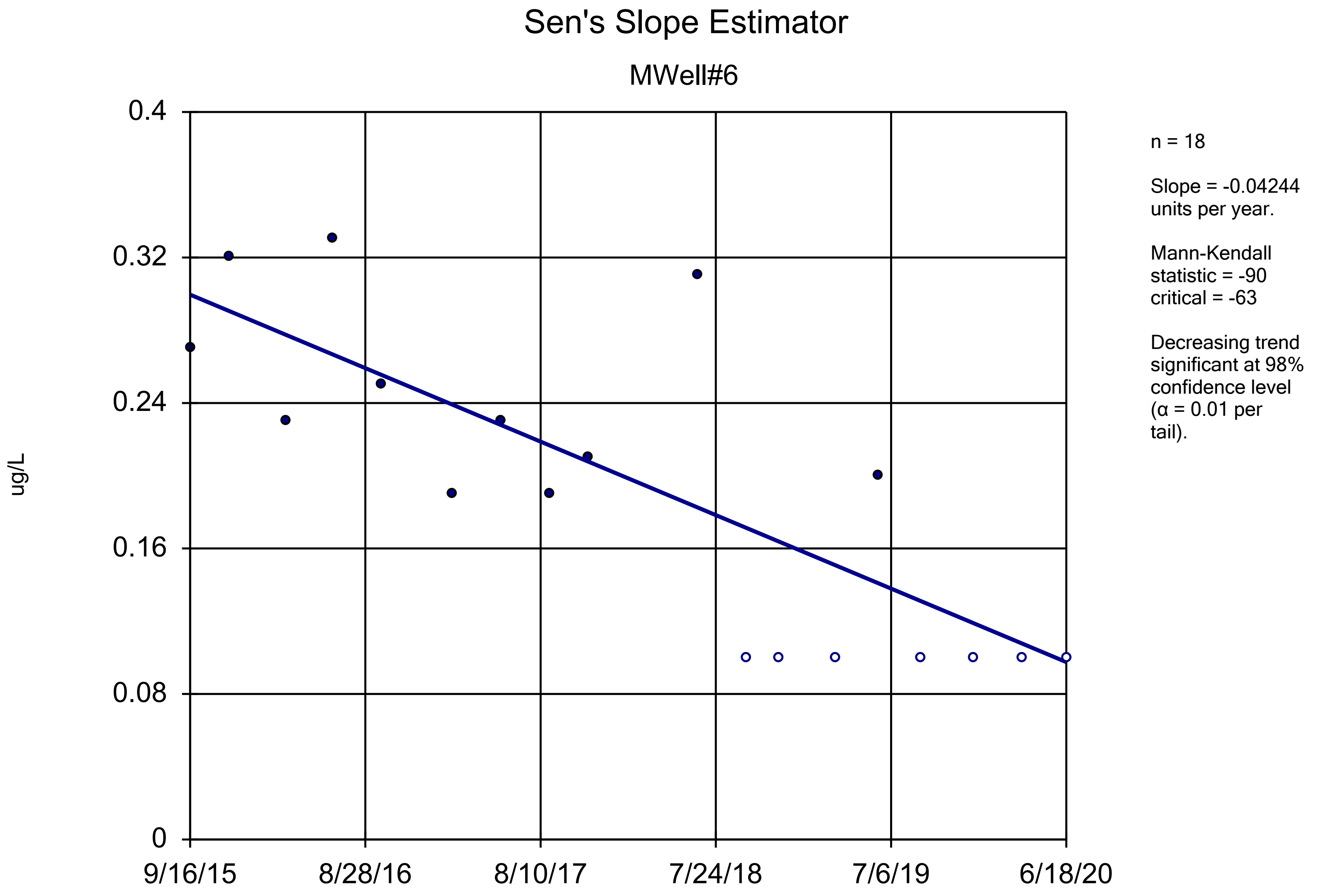
Hollow symbols indicate censored values.



n = 18

Slope = -0.04244
units per year.

Mann-Kendall
statistic = -90
critical = -63

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: 1,1-Dichloroethene Analysis Run 8/13/2020 3:14 PM View: HRLF_SensSlope 5-year
Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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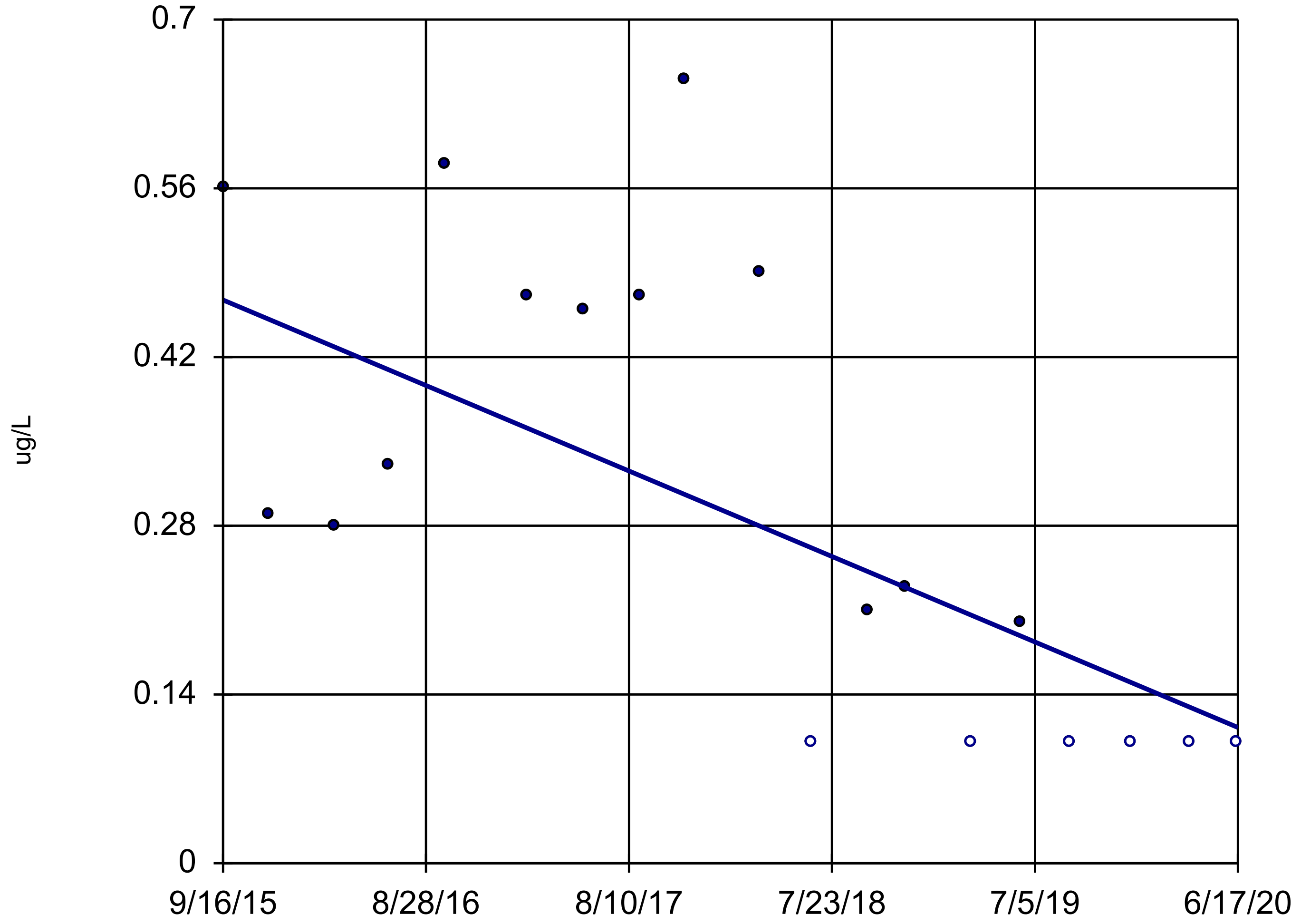
Hollow symbols indicate censored values.

Sen's Slope Estimator



n = 19

Slope = -0.07457
units per year.

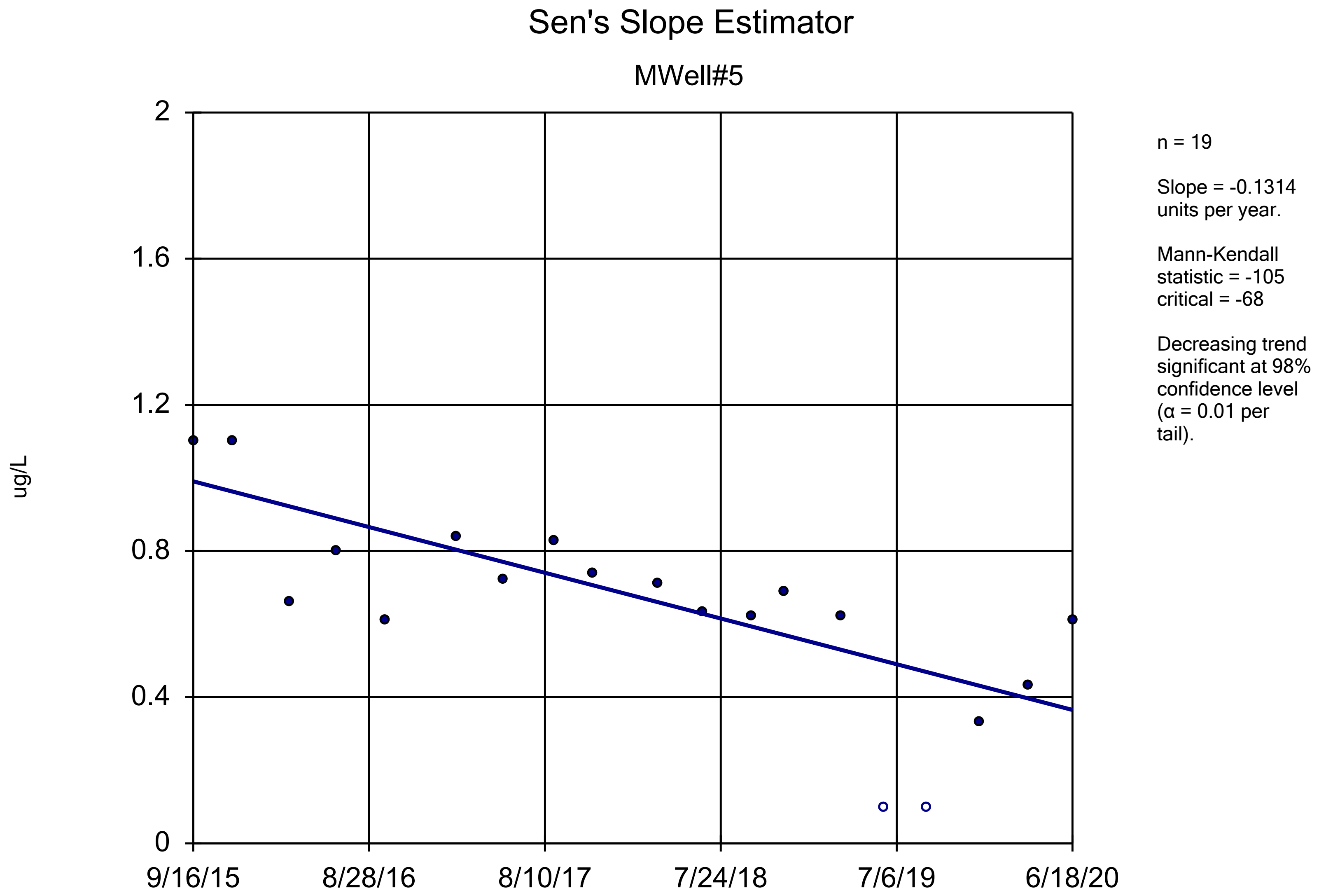
Mann-Kendall
statistic = -85
critical = -68

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: 1,1-Dichloroethene Analysis Run 8/13/2020 3:14 PM View: HRLF_SensSlope 5-year

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Sanitas™ v.9.6.26 Software licensed to Parametrix. UG
Hollow symbols indicate censored values.



Constituent: 1,2-Dichloroethane   Analysis Run 8/13/2020 3:14 PM   View: HRLF_SensSlope 5-year

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

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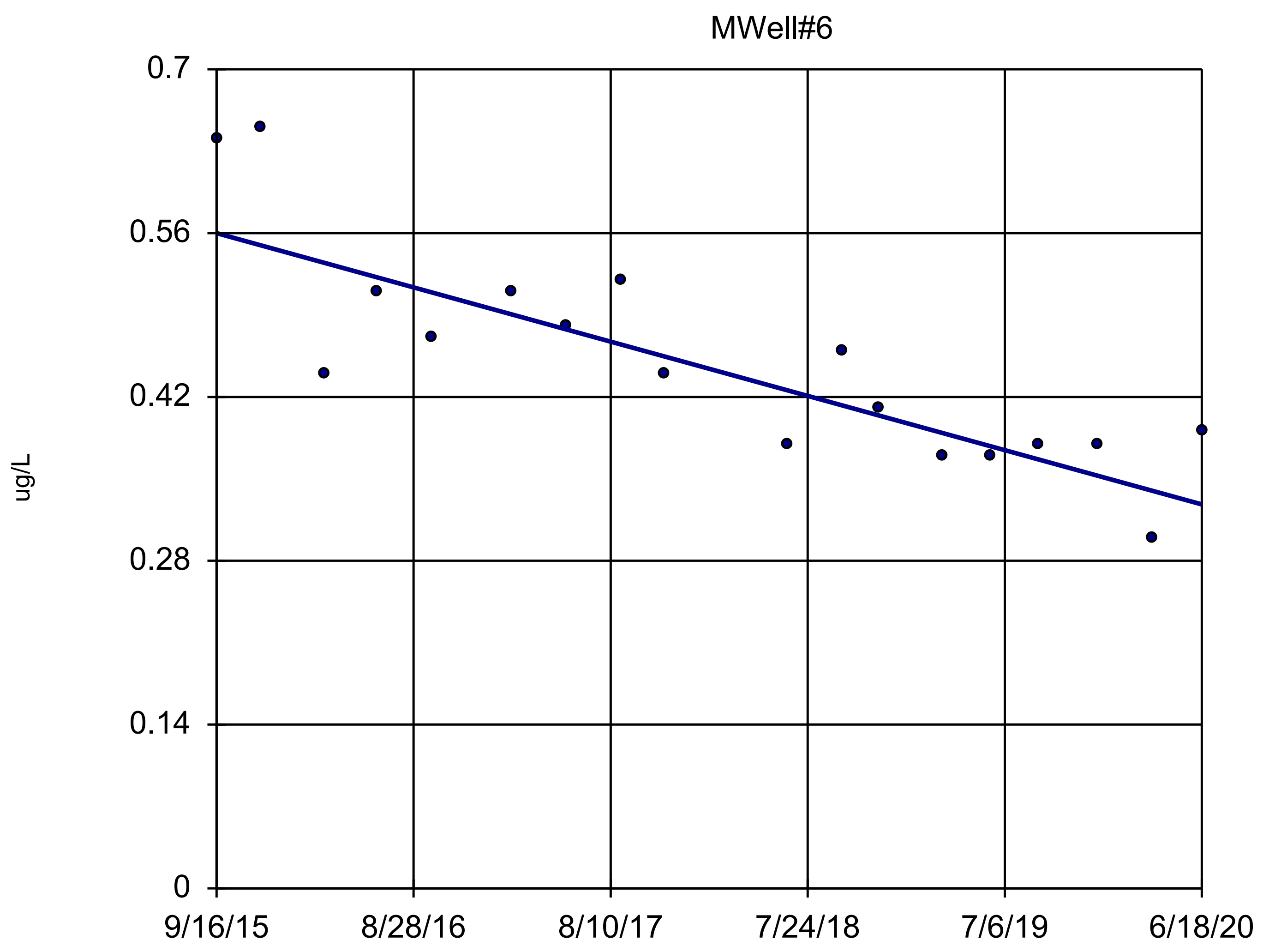
Sen's Slope Estimator



n = 18

Slope = -0.0487 units per year.

Mann-Kendall statistic = -95 critical = -63

Decreasing trend significant at 98% confidence level (α = 0.01 per tail).

Constituent: 1,2-Dichloroethane Analysis Run 8/13/2020 3:14 PM View: HRLF_SensSlope 5-year

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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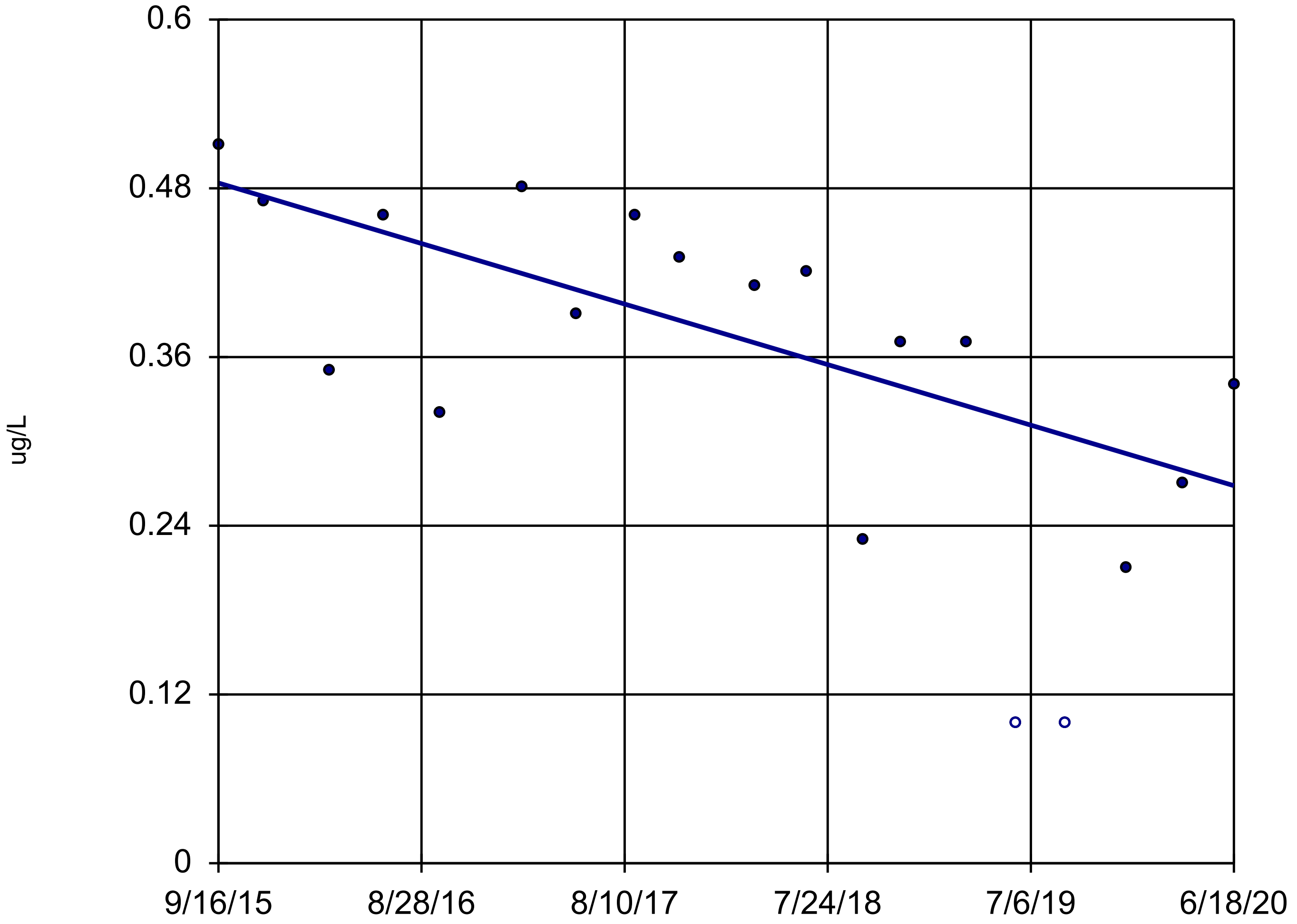
Hollow symbols indicate censored values.

Sen's Slope Estimator

MWell#5



n = 19

Slope = -0.04525
units per year.

Mann-Kendall
statistic = -92
critical = -68

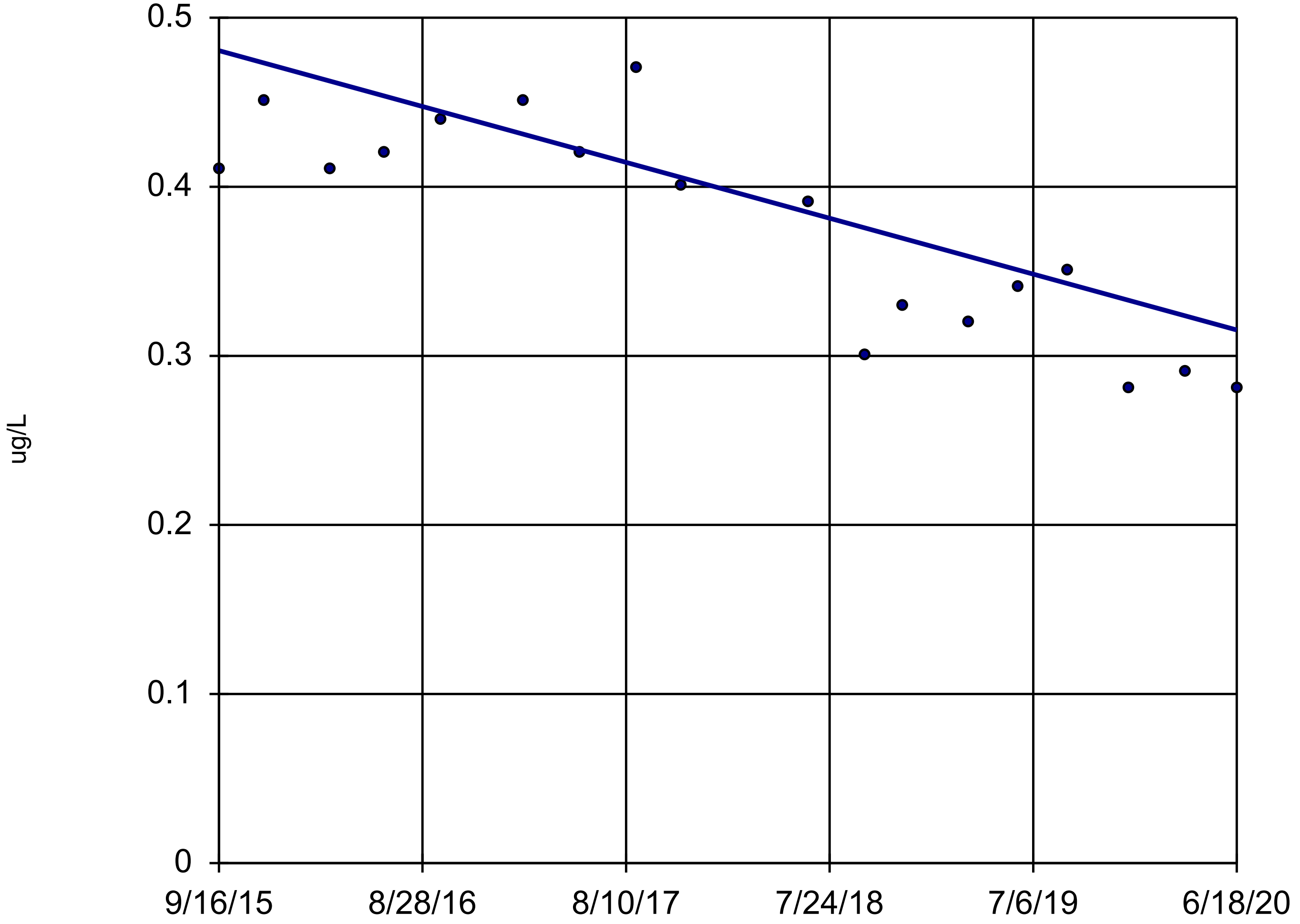
Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: 1,2-Dichloropropane Analysis Run 8/13/2020 3:14 PM View: HRLF_SensSlope 5-year

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Sen's Slope Estimator

MWell#6



n = 18

Slope = -0.03471
units per year.

Mann-Kendall
statistic = -91
critical = -63

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: 1,2-Dichloropropane Analysis Run 8/13/2020 3:14 PM View: HRLF_SensSlope 5-year

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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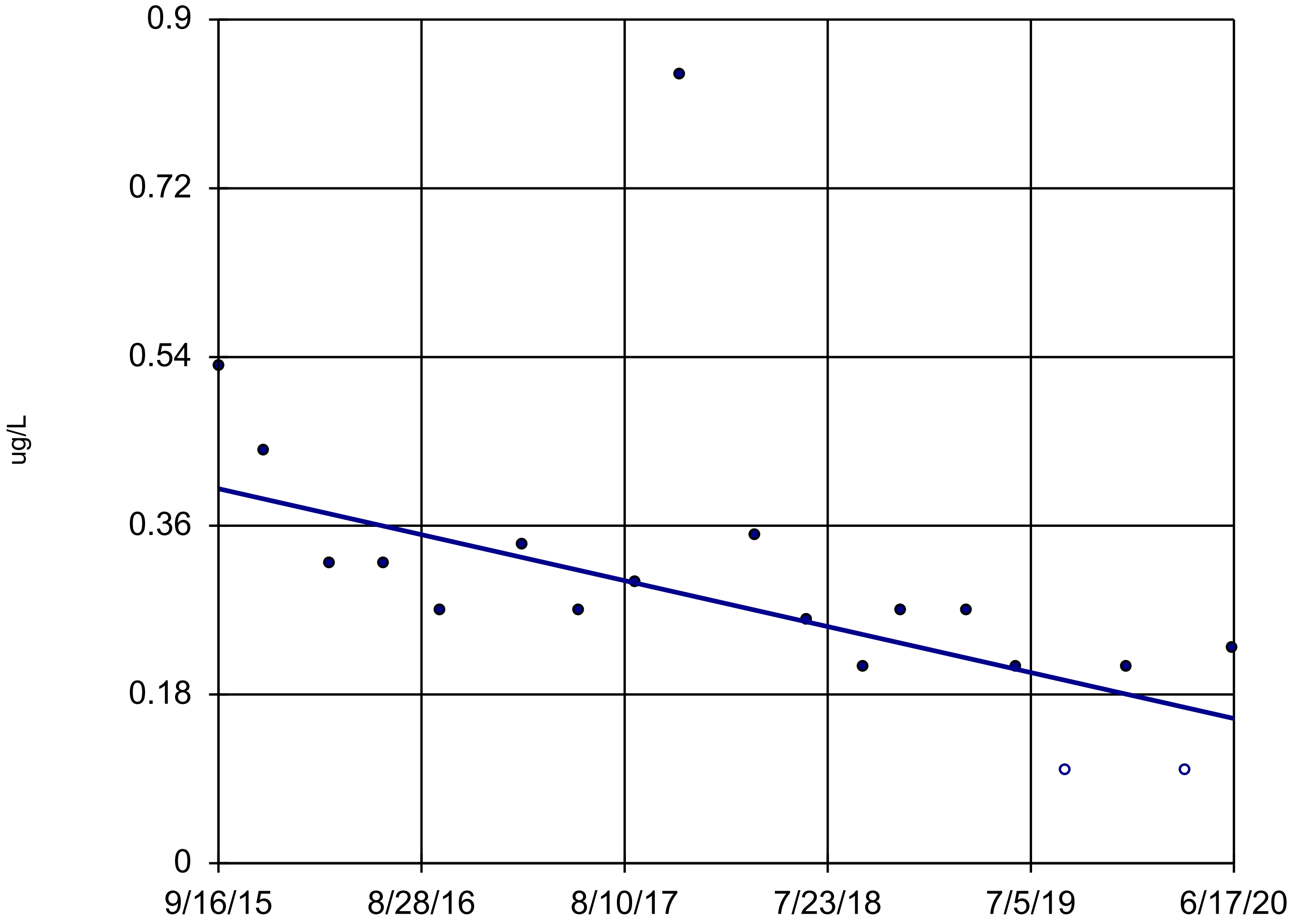
Hollow symbols indicate censored values.

Sen's Slope Estimator

MWell#10



n = 19

Slope = -0.05154
units per year.

Mann-Kendall
statistic = -102
critical = -68

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: Benzene Analysis Run 8/13/2020 3:14 PM View: HRLF_SensSlope 5-year

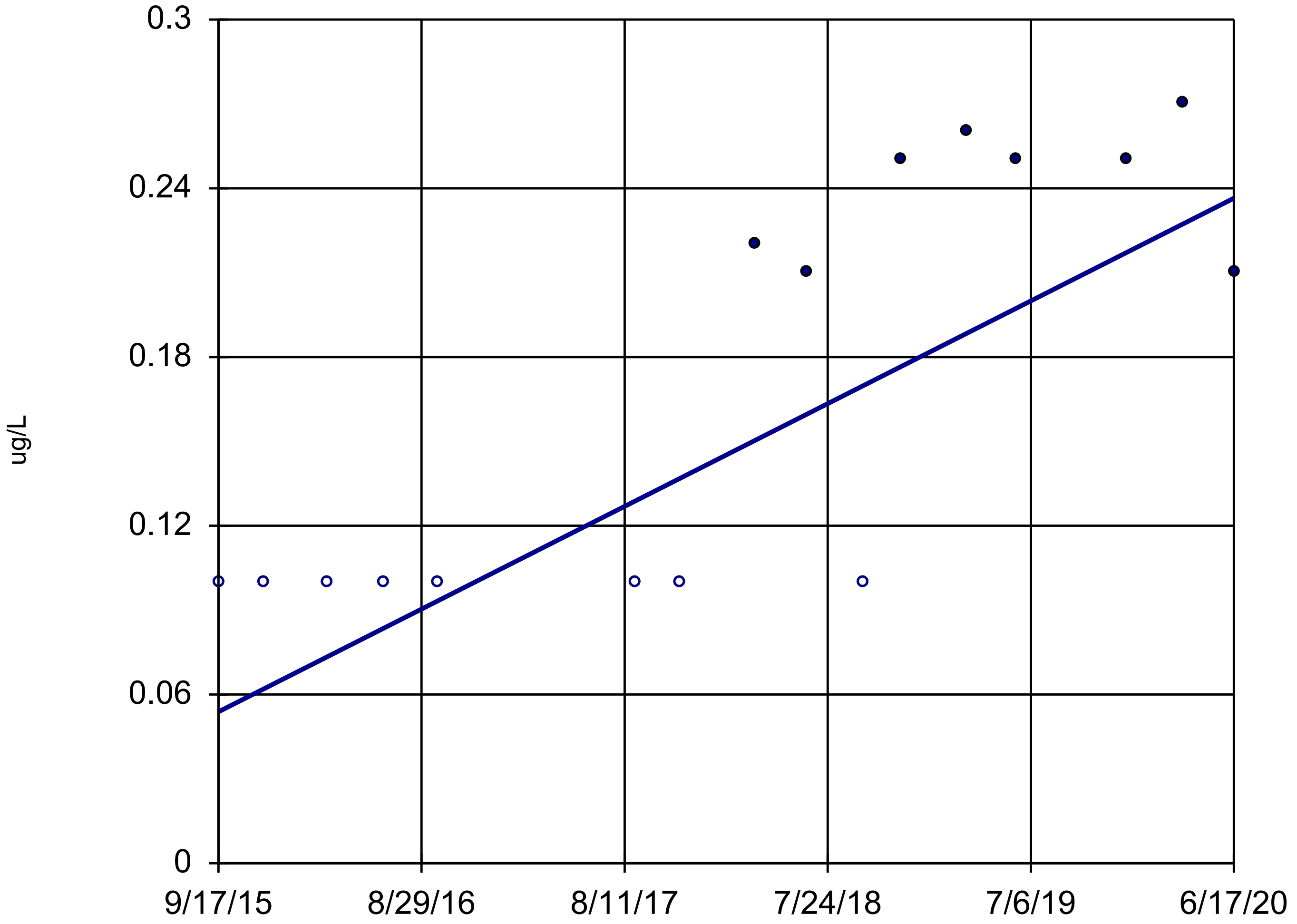
Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Sanitas™ v.9.6.26 Software licensed to Parametrix. UG

Hollow symbols indicate censored values.

Sen's Slope Estimator

MWell#3



n = 16

Slope = 0.03843
units per year.

Mann-Kendall
statistic = 66
critical = 53

Increasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: Bromodichloromethane Analysis Run 8/13/2020 3:14 PM View: HRLF_SensSlope 5-year

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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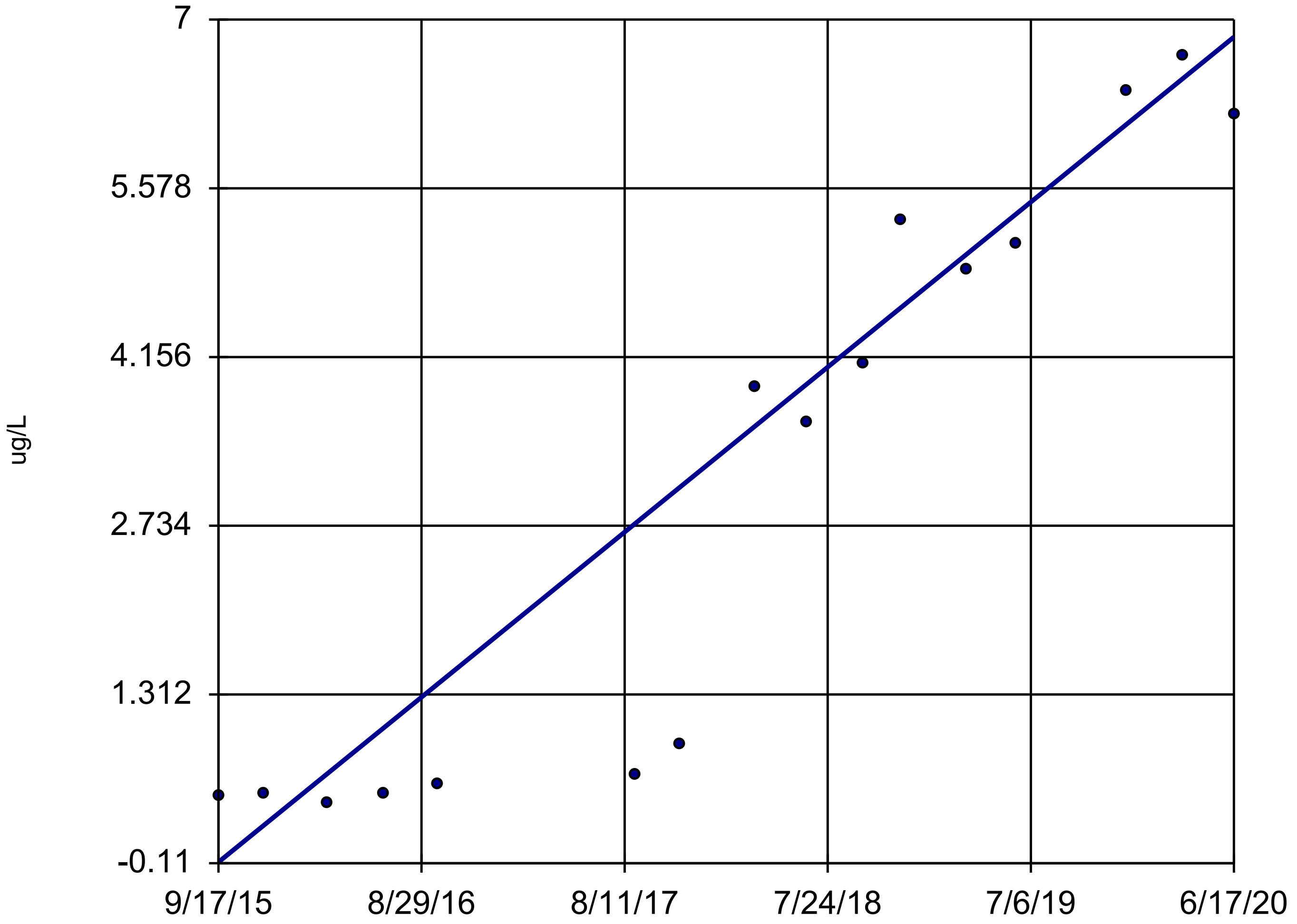
Sen's Slope Estimator

MWell#3



n = 16

Slope = 1.463
units per year.

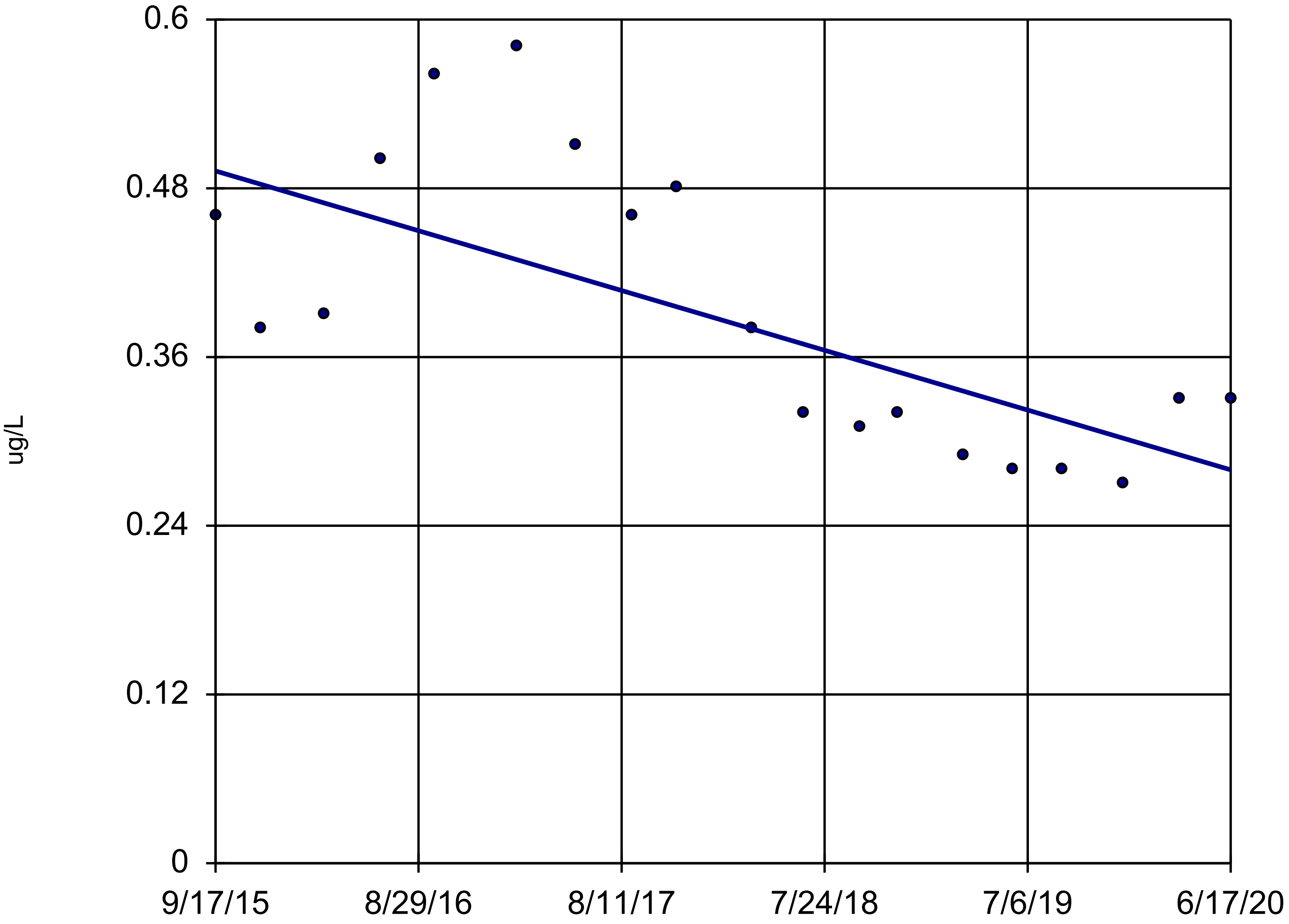
Mann-Kendall
statistic = 105
critical = 53

Increasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: Chloroform Analysis Run 8/13/2020 3:14 PM View: HRLF_SensSlope 5-year

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Sen's Slope Estimator



n = 19

Slope = -0.04471
units per year.

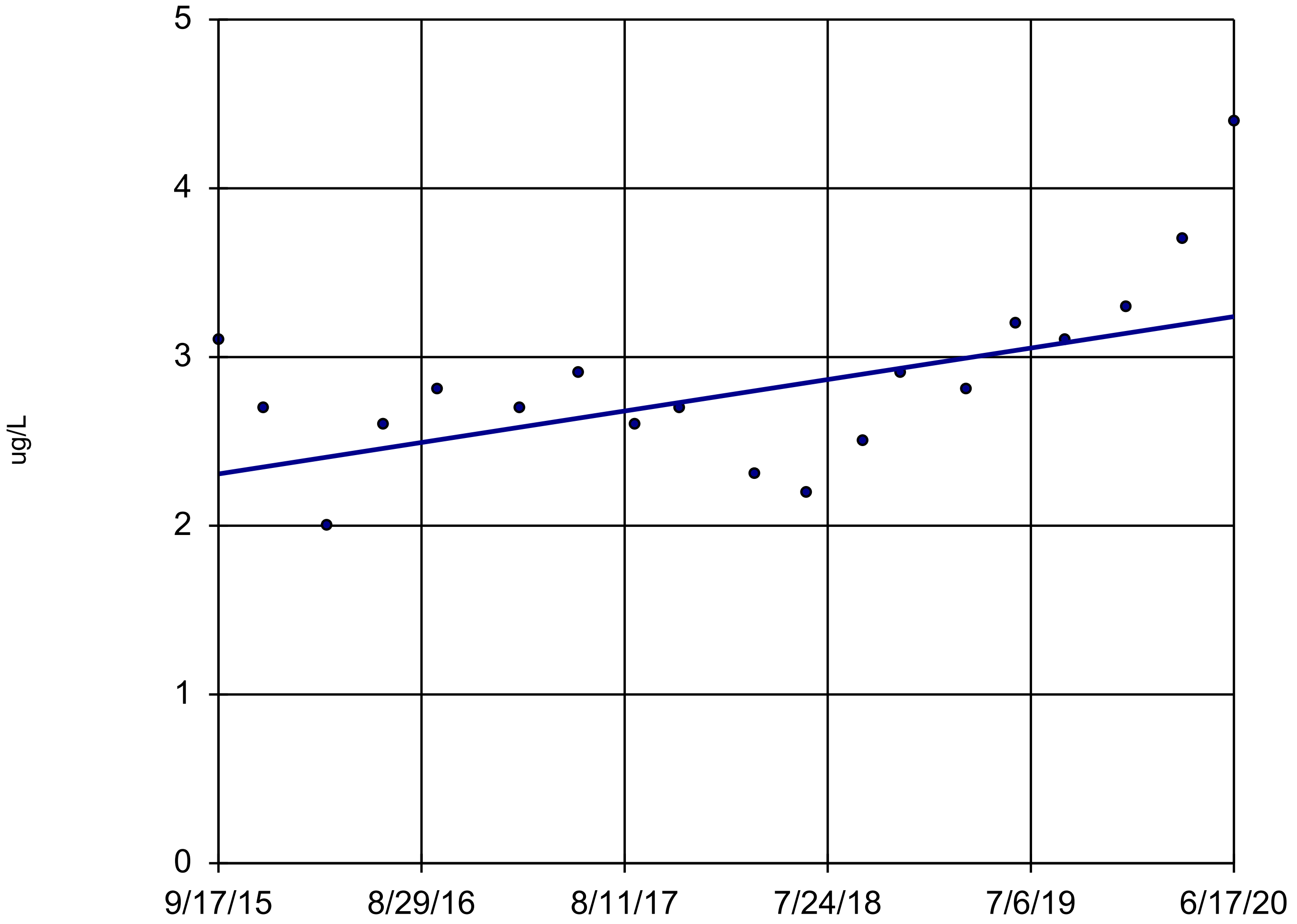
Mann-Kendall
statistic = -90
critical = -68

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: Chloroform Analysis Run 8/13/2020 3:14 PM View: HRLF_SensSlope 5-year
Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Sen's Slope Estimator

MWell#4



n = 19

Slope = 0.1962
units per year.

Mann-Kendall
statistic = 70
critical = 68

Increasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: cis-1,2-Dichloroethene   Analysis Run 8/13/2020 3:14 PM   View: HRLF_SensSlope 5-year

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

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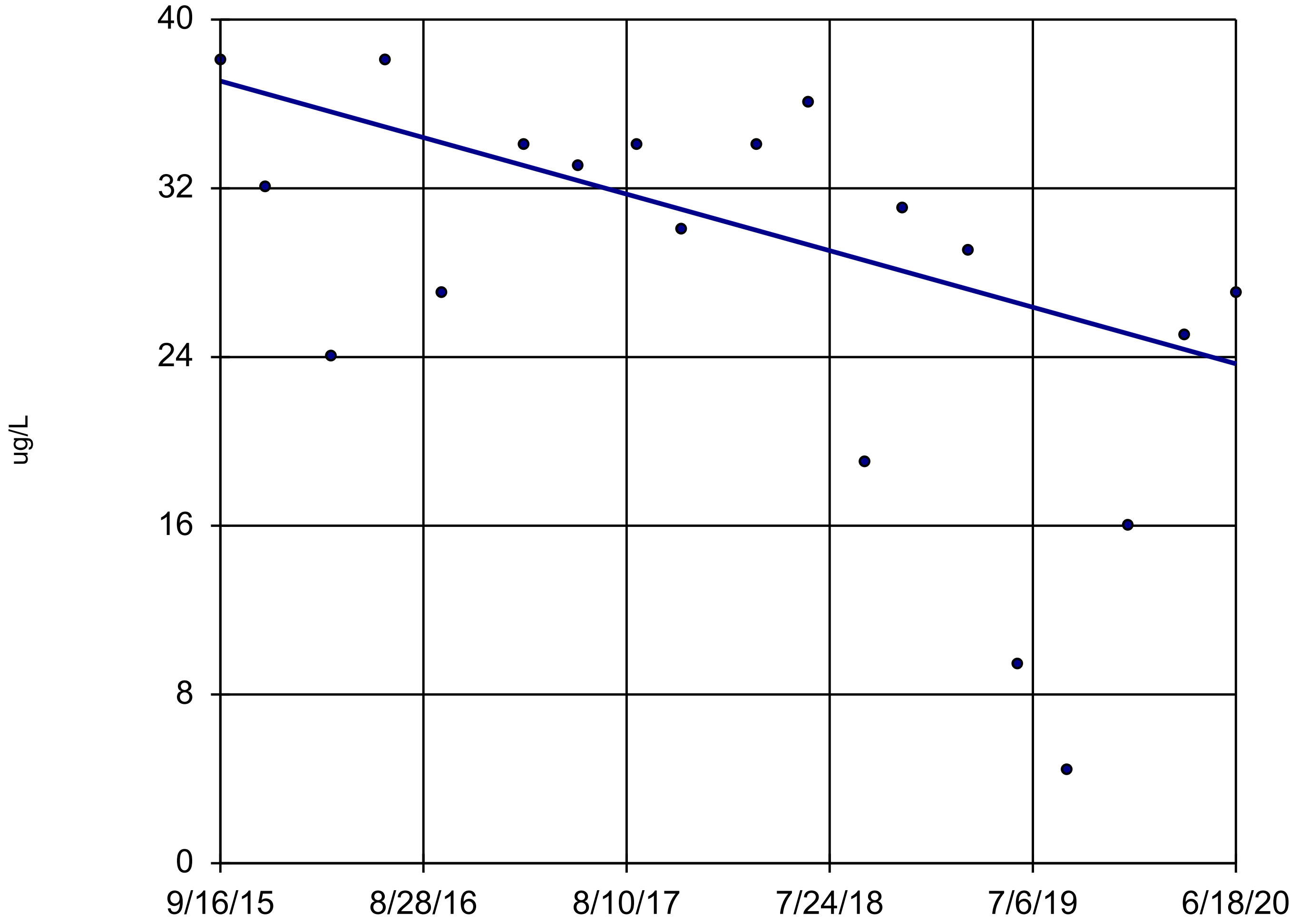
Sen's Slope Estimator

MWell#5



n = 19

Slope = -2.816
units per year.

Mann-Kendall
statistic = -70
critical = -68

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: cis-1,2-Dichloroethene Analysis Run 8/13/2020 3:14 PM View: HRLF_SensSlope 5-year

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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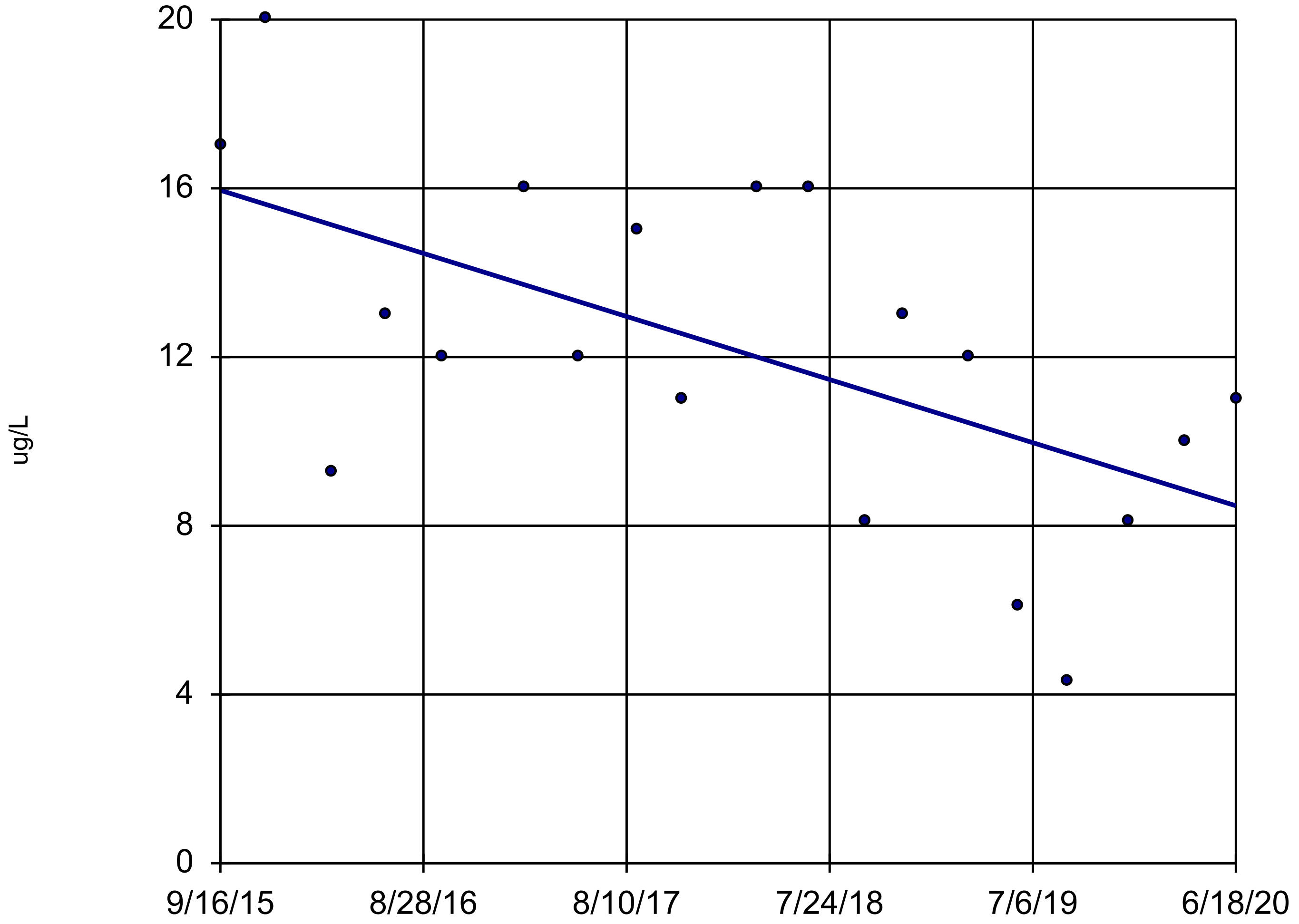
Sen's Slope Estimator

MWell#5



n = 19

Slope = -1.572
units per year.

Mann-Kendall
statistic = -72
critical = -68

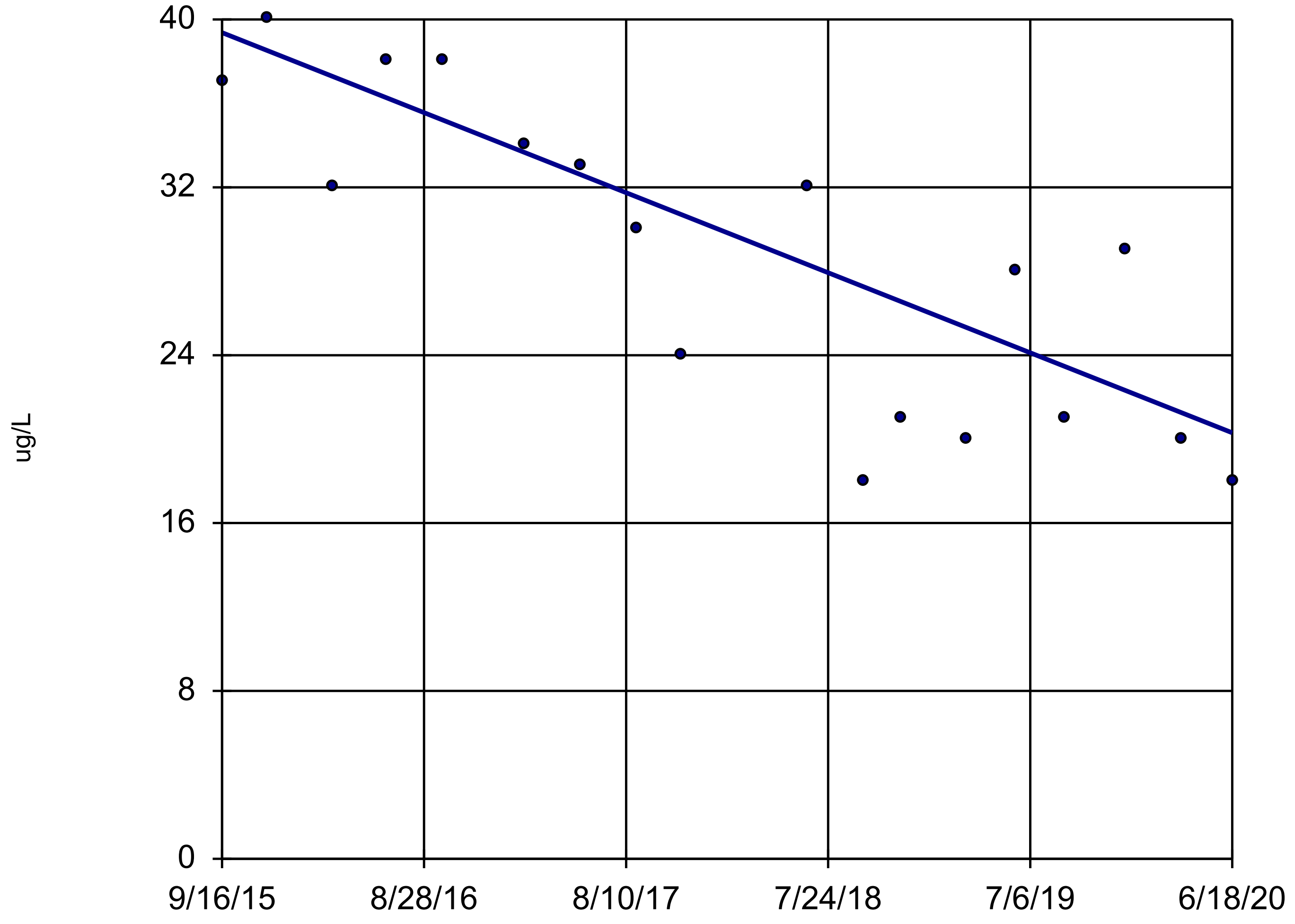
Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: Tetrachloroethene Analysis Run 8/13/2020 3:14 PM View: HRLF_SensSlope 5-year

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Sen's Slope Estimator

MWell#6



n = 18

Slope = -4.007
units per year.

Mann-Kendall
statistic = -100
critical = -63

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: Tetrachloroethene Analysis Run 8/13/2020 3:14 PM View: HRLF_SensSlope 5-year

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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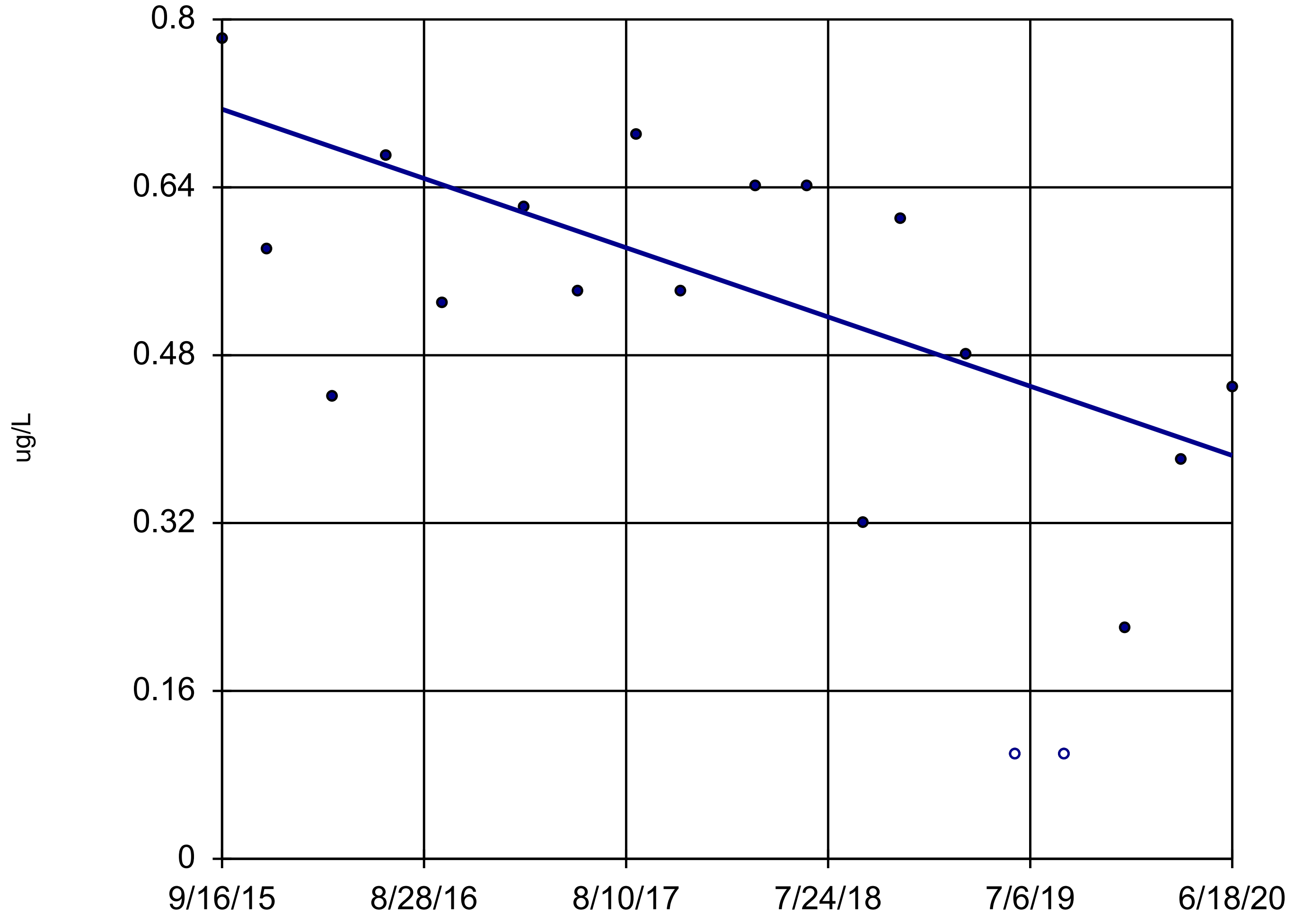
Hollow symbols indicate censored values.

Sen's Slope Estimator

MWell#5



n = 19

Slope = -0.06934
units per year.

Mann-Kendall
statistic = -72
critical = -68

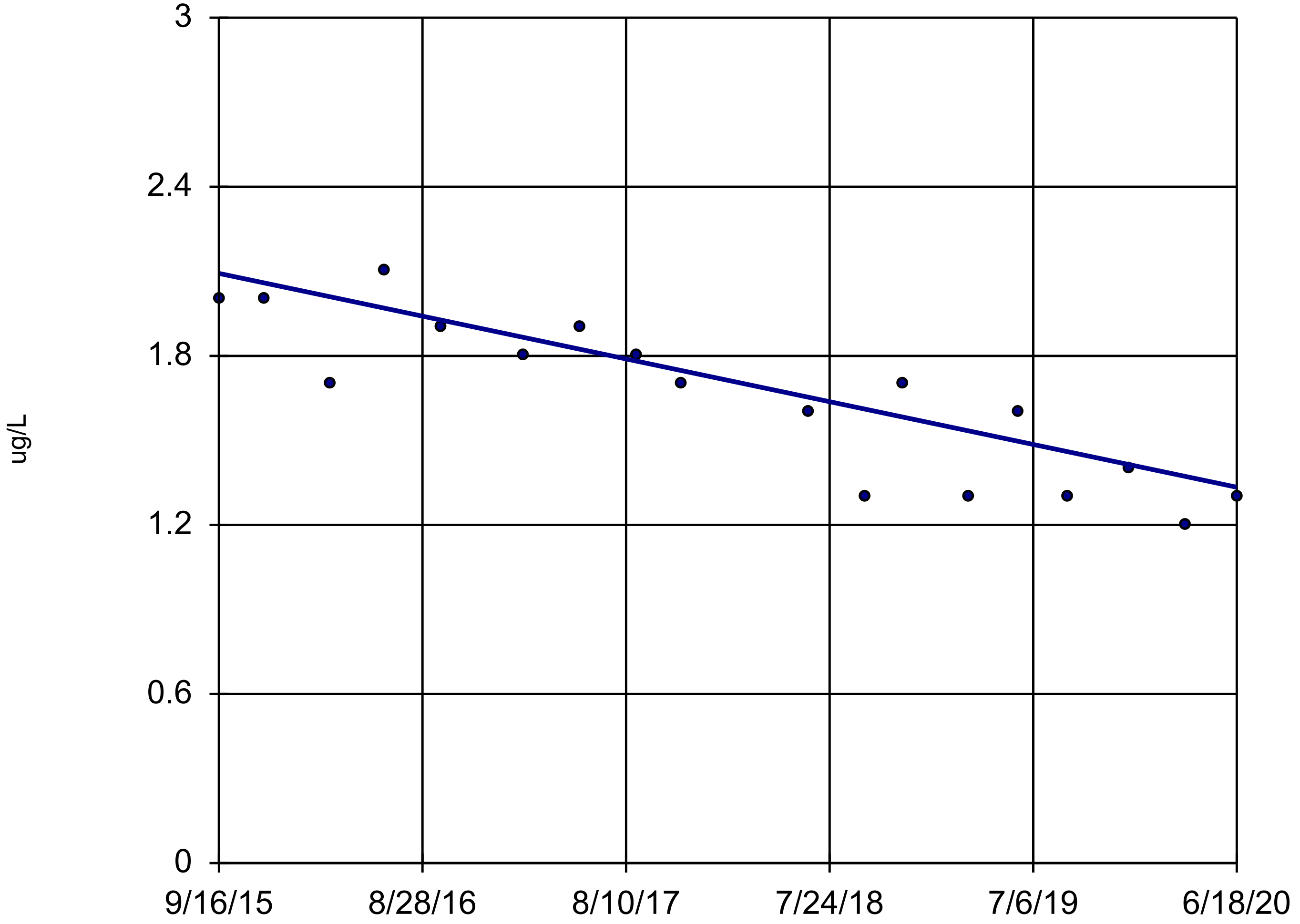
Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: trans-1,2-Dichloroethene   Analysis Run 8/13/2020 3:14 PM   View: HRLF_SensSlope 5-year

Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

Sen's Slope Estimator

MWell#6



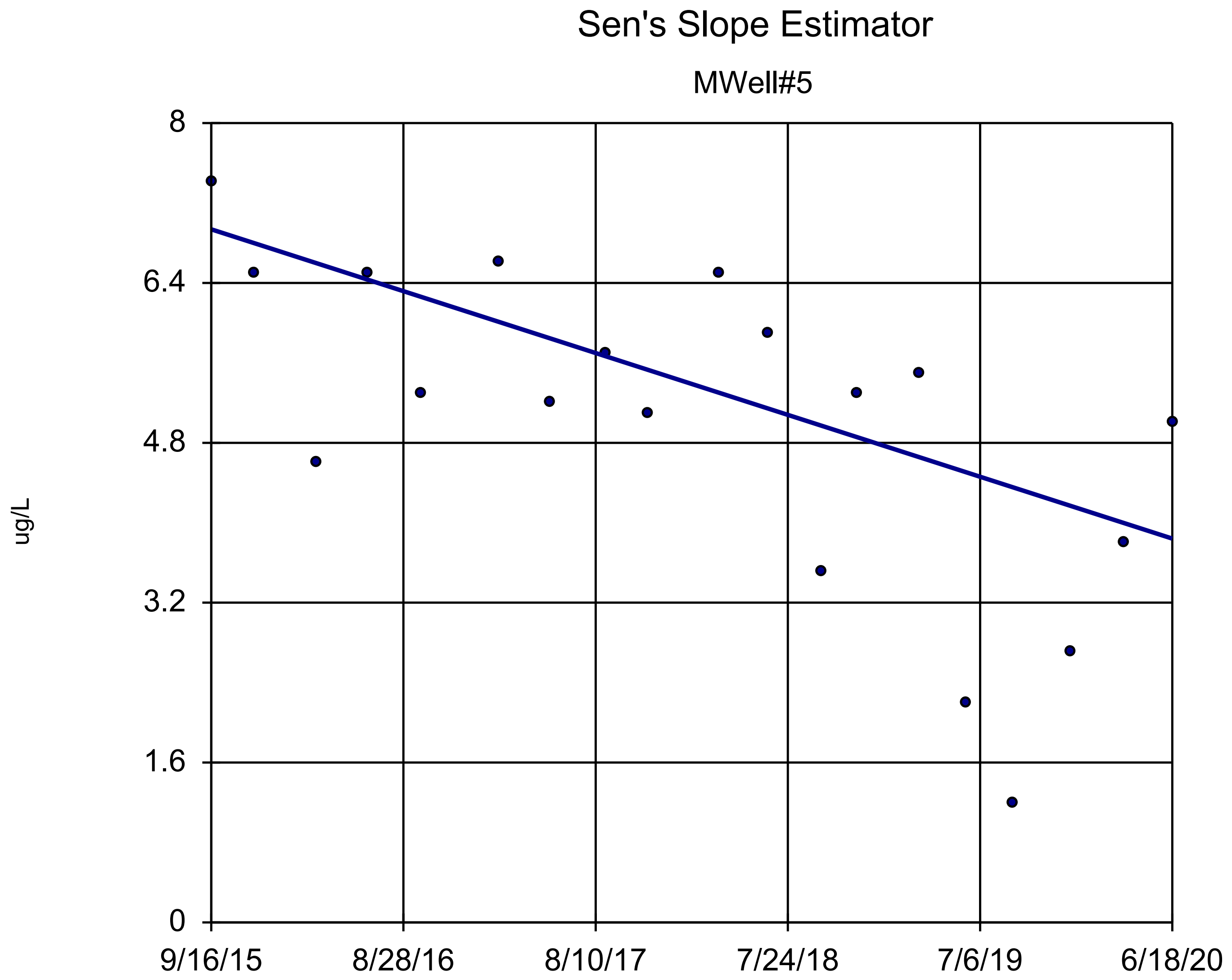
n = 18

Slope = -0.1594
units per year.

Mann-Kendall
statistic = -108
critical = -63

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: trans-1,2-Dichloroethene   Analysis Run 8/13/2020 3:14 PM   View: HRLF_SensSlope 5-year
Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata



n = 19

Slope = -0.6503
units per year.

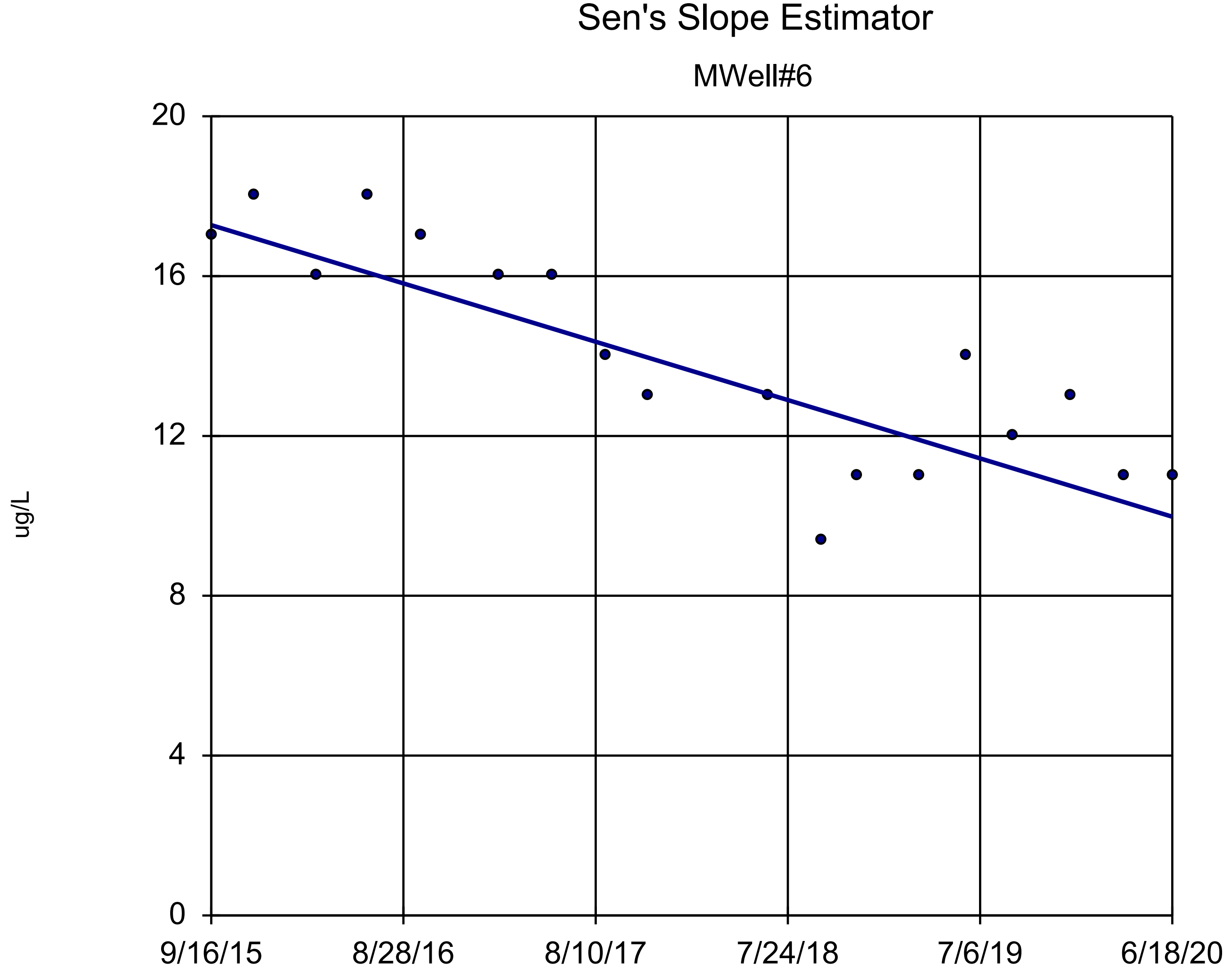
Mann-Kendall
statistic = -81
critical = -68

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: Trichloroethene Analysis Run 8/13/2020 3:14 PM View: HRLF_SensSlope 5-year

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

Sen's Slope Estimator



n = 18

Slope = -1.534
units per year.

Mann-Kendall
statistic = -98
critical = -63

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: Trichloroethene Analysis Run 8/13/2020 3:14 PM View: HRLF_SensSlope 5-year

Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

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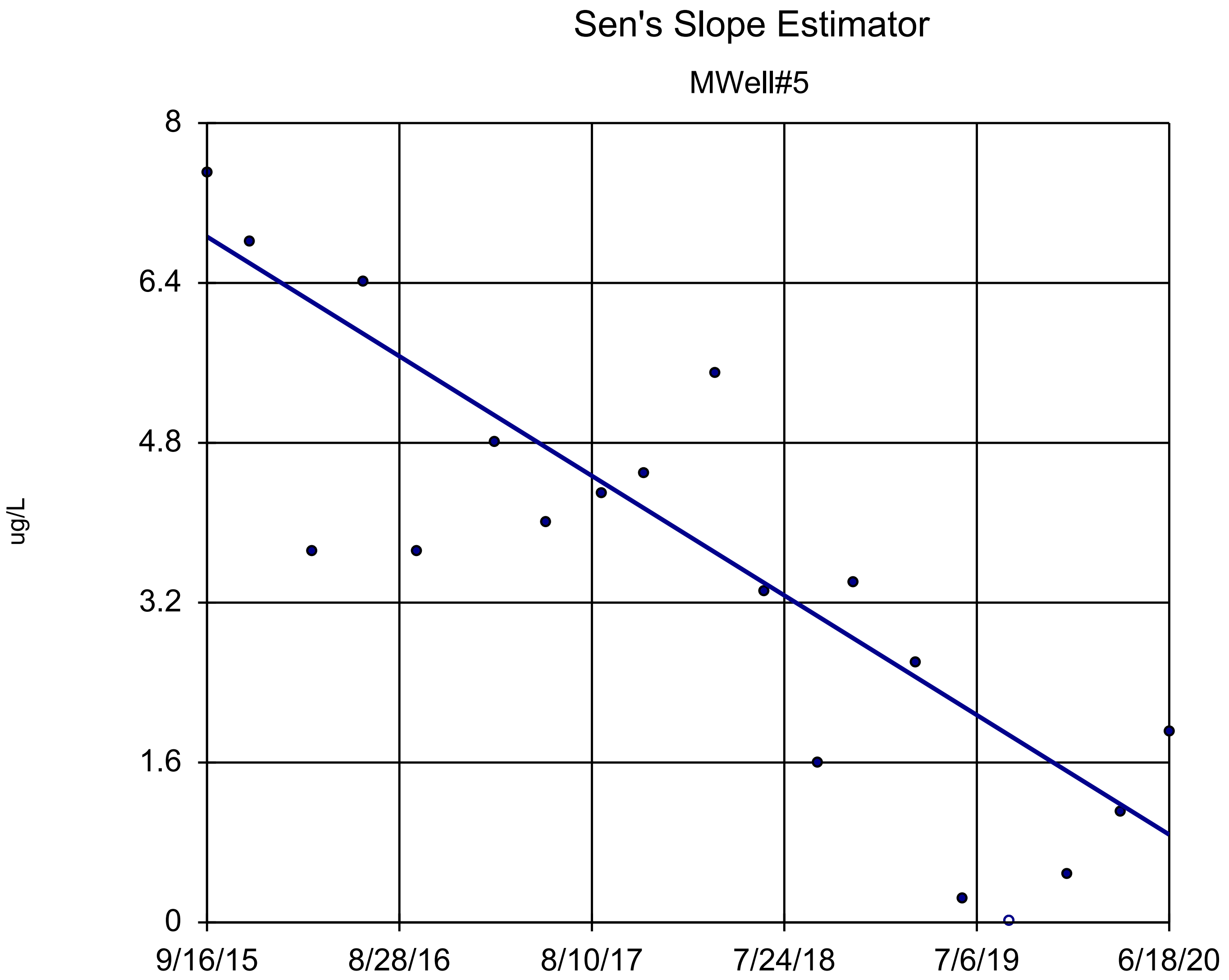
Hollow symbols indicate censored values.



n = 19

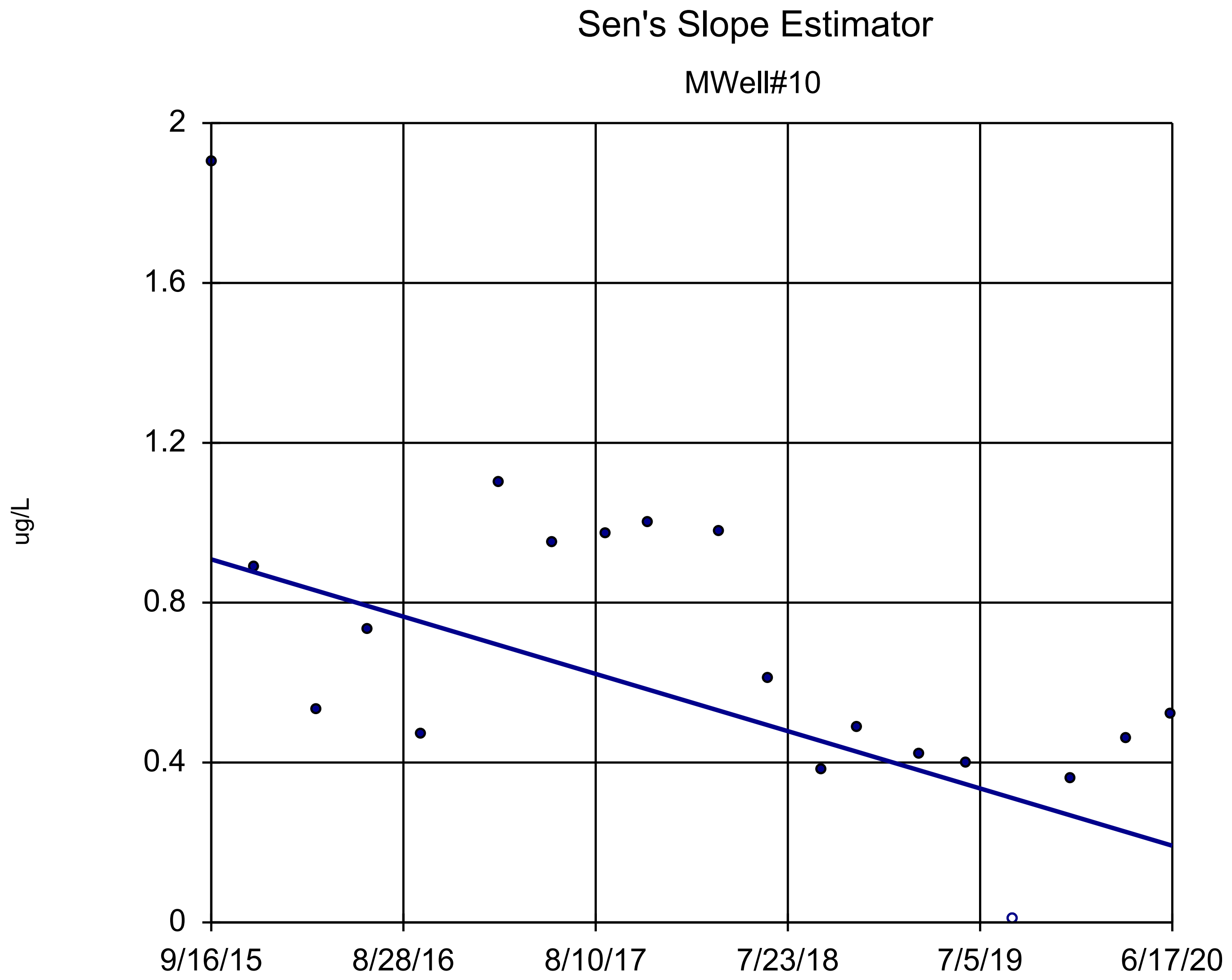
Slope = -1.258
units per year.

Mann-Kendall
statistic = -108
critical = -68

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: Vinyl Chloride   Analysis Run 8/13/2020 3:14 PM   View: HRLF_SensSlope 5-year
Horn Rapids Landfill   Client: City of Richland   Data: HRLF_alldata

Sanitas™ v.9.6.26 Software licensed to Parametrix. UG
Hollow symbols indicate censored values.



n = 19

Slope = -0.1506
units per year.

Mann-Kendall
statistic = -79
critical = -68

Decreasing trend
significant at 98%
confidence level
(α = 0.01 per
tail).

Constituent: Vinyl Chloride Analysis Run 8/13/2020 3:14 PM View: HRLF_SensSlope 5-year
Horn Rapids Landfill Client: City of Richland Data: HRLF_alldata

G-4

Upgradient Well Descriptive Statistics

HORN RAPIDS LANDFILL - SECOND QUARTER 2020
Summary of Descriptive Statistics

Constituent Name	Well	N	Mean[1]	Variance	Standard Deviation	Standard Error	Coeffient of Variation	Median	% Non-Detects
1,1,1,2-Tetrachloroethane (ug/L)	MWell#1 (bg)[2]	113	0.5027	0.27164944	0.5212	0.04903	1.036801273	0.5	100
1,1,1,2-Tetrachloroethane (ug/L)	MWell#11 (bg)	40	0.2678	0.03682561	0.1919	0.03035	0.716579537	0.15	100
1,1,1-Trichloroethane (ug/L)	MWell#1 (bg)	113	0.4953	0.275625	0.525	0.04939	1.059963658	0.5	100
1,1,1-Trichloroethane (ug/L)	MWell#11 (bg)	40	0.2529	0.03956121	0.1989	0.03145	0.786476868	0.1	100
1,1,2,2-Tetrachloroethane (ug/L)	MWell#1 (bg)	113	0.498	0.27499536	0.5244	0.04933	1.053012048	0.5	100
1,1,2,2-Tetrachloroethane (ug/L)	MWell#11 (bg)	40	0.2543	0.03996001	0.1999	0.0316	0.786079434	0.1	100
1,1,2-Trichloroethane (ug/L)	MWell#1 (bg)	113	0.5012	0.27762361	0.5269	0.04957	1.051276935	0.5	100
1,1,2-Trichloroethane (ug/L)	MWell#11 (bg)	40	0.2509	0.03924361	0.1981	0.03133	0.789557593	0.1	100
1,1-Dichloroethane (ug/L)	MWell#1 (bg)	113	0.5195	0.27384289	0.5233	0.04923	1.007314726	0.5	95.58
1,1-Dichloroethane (ug/L)	MWell#11 (bg)	40	0.2638	0.04678569	0.2163	0.0342	0.819939348	0.1	100
1,1-Dichloroethene (ug/L)	MWell#1 (bg)	113	0.6142	0.62964225	0.7935	0.07465	1.291924455	0.5	100
1,1-Dichloroethene (ug/L)	MWell#11 (bg)	40	0.2414	0.04515625	0.2125	0.0336	0.88028169	0.1	100
1,2,3-Trichloropropane (ug/L)	MWell#1 (bg)	113	0.5388	0.45319824	0.6732	0.06333	1.249443207	0.5	100
1,2,3-Trichloropropane (ug/L)	MWell#11 (bg)	40	0.257	0.03825936	0.1956	0.03093	0.761089494	0.1	100
1,2-Dibromo-3-chloropropane (ug/L)	MWell#1 (bg)	111	1.498	1.7161	1.31	0.1243	0.874499332	1	100
1,2-Dibromo-3-chloropropane (ug/L)	MWell#11 (bg)	40	0.9246	0.05308416	0.2304	0.03644	0.249188838	1	100
1,2-Dibromoethane (ug/L)	MWell#1 (bg)	112	0.5264	0.46826649	0.6843	0.06466	1.299962006	0.5	100
1,2-Dibromoethane (ug/L)	MWell#11 (bg)	40	0.2214	0.04804864	0.2192	0.03466	0.990063234	0.05	100
1,2-Dichlorobenzene (ug/L)	MWell#1 (bg)	112	0.6064	0.62678889	0.7917	0.07481	1.305573879	0.5	99.11
1,2-Dichlorobenzene (ug/L)	MWell#11 (bg)	40	0.2975	0.04141225	0.2035	0.03217	0.684033613	0.15	100
1,2-Dichloroethane (ug/L)	MWell#1 (bg)	112	0.517	0.286225	0.535	0.05055	1.034816248	0.5	100
1,2-Dichloroethane (ug/L)	MWell#11 (bg)	40	0.2575	0.04149369	0.2037	0.0322	0.791067961	0.1	100
1,2-Dichloropropane (ug/L)	MWell#1 (bg)	109	0.5441	0.30636225	0.5535	0.05302	1.017276236	0.5	100
1,2-Dichloropropane (ug/L)	MWell#11 (bg)	40	0.2553	0.04032064	0.2008	0.03175	0.786525656	0.1	100
1,4-Dichlorobenzene (ug/L)	MWell#1 (bg)	112	0.6063	0.62663056	0.7916	0.0748	1.305624278	0.5	99.11
1,4-Dichlorobenzene (ug/L)	MWell#11 (bg)	40	0.2988	0.04313929	0.2077	0.03284	0.695113788	0.15	100
2-Butanone (ug/L)	MWell#1 (bg)	107	4.981	26.030404	5.102	0.4932	1.024292311	5	98.13
2-Butanone (ug/L)	MWell#11 (bg)	40	5.313	3.125824	1.768	0.2795	0.332768681	5	100
2-Hexanone (ug/L)	MWell#1 (bg)	107	2.653	7.011904	2.648	0.256	0.998115341	2.5	99.07
2-Hexanone (ug/L)	MWell#11 (bg)	40	1.669	0.50438404	0.7102	0.1123	0.425524266	1.5	100
4-Methyl-2-pentanone (ug/L)	MWell#1 (bg)	106	2.463	2.184484	1.478	0.1435	0.600081202	2.5	100
4-Methyl-2-pentanone (ug/L)	MWell#11 (bg)	40	2.444	0.71318025	0.8445	0.1335	0.345540098	2.5	100

[1] All statistics based on Non-Detects = 1/2 MDL [2] (bg) indicates a background well.

HORN RAPIDS LANDFILL - SECOND QUARTER 2020

Summary of Descriptive Statistics

Constituent Name	Well	N	Mean[1]	Variance	Standard Deviation	Standard Error	Coeffient of Variation	Median	% Non-Detects
Acetone (ug/L)	MWell#1 (bg)	109	12.09	5559.1936	74.56	7.141	6.167080232	3	94.5
Acetone (ug/L)	MWell#11 (bg)	40	3.053	3.129361	1.769	0.2798	0.579430069	3	100
Acrylonitrile (ug/L)	MWell#1 (bg)	107	2.66	5.419584	2.328	0.2251	0.87518797	2.5	100
Acrylonitrile (ug/L)	MWell#11 (bg)	40	3.065	1.5625	1.25	0.1976	0.407830343	2.5	100
Alkalinity (mg/L)	MWell#1 (bg)	103	285.7	5715.36	75.6	7.449	0.264613231	310	0
Alkalinity (mg/L)	MWell#11 (bg)	40	183.8	295.84	17.2	2.72	0.093579978	180	0
Ammonia Nitrogen (mg/L)	MWell#1 (bg)	112	0.07158	0.005350923	0.07315	0.006912	1.021933501	0.05	77.68
Ammonia Nitrogen (mg/L)	MWell#11 (bg)	40	0.1616	0.06235009	0.2497	0.03948	1.545173267	0.1	92.5
Antimony, Dissolved (mg/L)	MWell#1 (bg)	84	0.008953	0.000357966	0.01892	0.002064	2.113258126	0.0005	95.24
Antimony, Dissolved (mg/L)	MWell#11 (bg)	21	0.0002	0	0	0	0	0.0002	100
Antimony, Total (mg/L)	MWell#1 (bg)	28	0.0002143	2.751E-09	0.00005245	0.000009913	0.24475035	0.0002	100
Antimony, Total (mg/L)	MWell#11 (bg)	28	0.0002143	2.751E-09	0.00005245	0.000009913	0.24475035	0.0002	100
Arsenic, Dissolved (mg/L)	MWell#1 (bg)	85	0.00717	3.72344E-05	0.006102	0.0006619	0.851046025	0.005	15.29
Arsenic, Dissolved (mg/L)	MWell#11 (bg)	21	0.004729	7.58118E-07	0.0008707	0.00019	0.184119264	0.0049	0
Arsenic, Total (mg/L)	MWell#1 (bg)	28	0.004382	2.21558E-07	0.0004707	0.00008895	0.107416705	0.0044	0
Arsenic, Total (mg/L)	MWell#11 (bg)	28	0.005193	2.244E-06	0.001498	0.0002832	0.288465242	0.00485	0
Barium, Dissolved (mg/L)	MWell#1 (bg)	85	0.04488	0.00032364	0.01799	0.001951	0.400846702	0.05	9.412
Barium, Dissolved (mg/L)	MWell#11 (bg)	21	0.08352	0.000259854	0.01612	0.003518	0.193007663	0.08	0
Barium, Total (mg/L)	MWell#1 (bg)	28	0.05739	8.44745E-05	0.009191	0.001737	0.160149852	0.058	0
Barium, Total (mg/L)	MWell#11 (bg)	28	0.107	0.000179024	0.01338	0.002529	0.125046729	0.11	0
Benzene (ug/L)	MWell#1 (bg)	113	0.5146	0.28430224	0.5332	0.05016	1.036144578	0.5	100
Benzene (ug/L)	MWell#11 (bg)	40	0.2575	0.04149369	0.2037	0.0322	0.791067961	0.1	100
Beryllium, Dissolved (mg/L)	MWell#1 (bg)	85	0.0006315	3.92878E-07	0.0006268	0.00006799	0.992557403	0.0005	100
Beryllium, Dissolved (mg/L)	MWell#11 (bg)	21	0.0002	0	0	0	0	0.0002	100
Beryllium, Total (mg/L)	MWell#1 (bg)	28	0.0002	0	0	0	0	0.0002	100
Beryllium, Total (mg/L)	MWell#11 (bg)	28	0.0002	0	0	0	0	0.0002	100
Bicarbonate (mg/L)	MWell#1 (bg)	103	296.1	4794.1776	69.24	6.822	0.233839919	310	0
Bicarbonate (mg/L)	MWell#11 (bg)	40	183.8	295.84	17.2	2.72	0.093579978	180	0
Bromochloromethane (ug/L)	MWell#1 (bg)	112	0.5013	0.27688644	0.5262	0.04972	1.049670856	0.5	99.11
Bromochloromethane (ug/L)	MWell#11 (bg)	40	0.2575	0.04149369	0.2037	0.0322	0.791067961	0.1	100
Bromodichloromethane (ug/L)	MWell#1 (bg)	113	0.4982	0.27499536	0.5244	0.04933	1.052589322	0.5	100
Bromodichloromethane (ug/L)	MWell#11 (bg)	40	0.255	0.04024036	0.2006	0.03171	0.786666667	0.1	100

[1] All statistics based on Non-Detects = 1/2 MDL   [2] (bg) indicates a background well.

HORN RAPIDS LANDFILL - SECOND QUARTER 2020
Summary of Descriptive Statistics

Constituent Name	Well	N	Mean[1]	Variance	Standard Deviation	Standard Error	Coeffient of Variation	Median	% Non-Detects
Bromoform (ug/L)	MWell#1 (bg)	113	0.5292	0.25664356	0.5066	0.04766	0.957294029	0.5	100
Bromoform (ug/L)	MWell#11 (bg)	40	0.3425	0.02608225	0.1615	0.02554	0.471532847	0.25	100
Bromomethane (ug/L)	MWell#1 (bg)	111	1.138	1.610361	1.269	0.1204	1.115114236	0.5	99.1
Bromomethane (ug/L)	MWell#11 (bg)	40	1.157	1.127844	1.062	0.1679	0.917891098	0.5	100
Cadmium, Dissolved (mg/L)	MWell#1 (bg)	85	0.001073	1.49084E-06	0.001221	0.0001324	1.137931034	0.0005	98.82
Cadmium, Dissolved (mg/L)	MWell#11 (bg)	21	0.0002	0	0	0	0	0.0002	100
Cadmium, Total (mg/L)	MWell#1 (bg)	28	0.0002143	2.751E-09	0.00005245	0.000009913	0.24475035	0.0002	100
Cadmium, Total (mg/L)	MWell#11 (bg)	28	0.0002143	2.751E-09	0.00005245	0.000009913	0.24475035	0.0002	100
Calcium, Dissolved (mg/L)	MWell#1 (bg)	102	100.2	1080.4369	32.87	3.255	0.328043912	110	0
Calcium, Dissolved (mg/L)	MWell#11 (bg)	40	200.7	4389.0625	66.25	10.47	0.330094669	220	0
Calcium, Total (mg/L)	MWell#1 (bg)	8	118.3	430.1476	20.74	7.333	0.175316991	120	0
Calcium, Total (mg/L)	MWell#11 (bg)	8	182.5	1164.1744	34.12	12.06	0.186958904	200	0
Carbon Disulfide (ug/L)	MWell#1 (bg)	107	2.196	47.416996	6.886	0.6657	3.135701275	0.5	99.07
Carbon Disulfide (ug/L)	MWell#11 (bg)	40	0.2713	0.03869089	0.1967	0.03111	0.725027645	0.15	100
Carbon Tetrachloride (ug/L)	MWell#1 (bg)	112	0.5246	0.29116816	0.5396	0.05098	1.028593214	0.5	100
Carbon Tetrachloride (ug/L)	MWell#11 (bg)	40	0.26	0.04322241	0.2079	0.03288	0.799615385	0.1	100
Carbonate (mg/L)	MWell#1 (bg)	50	2.65	0.35964009	0.5997	0.08482	0.226301887	2.5	100
Carbonate (mg/L)	MWell#11 (bg)	39	2.5	0	0	0	0	2.5	100
Chloride (mg/L)	MWell#1 (bg)	114	19.75	118.3744	10.88	1.019	0.550886076	22	0
Chloride (mg/L)	MWell#11 (bg)	40	146.3	6923.9041	83.21	13.16	0.568762816	150	0
Chlorobenzene (ug/L)	MWell#1 (bg)	113	0.4987	0.27499536	0.5244	0.04933	1.051533988	0.5	100
Chlorobenzene (ug/L)	MWell#11 (bg)	40	0.2563	0.040804	0.202	0.03193	0.7881389	0.1	100
Chloroethane (ug/L)	MWell#1 (bg)	113	1.008	1.547536	1.244	0.1171	1.234126984	0.5	100
Chloroethane (ug/L)	MWell#11 (bg)	40	1.094	1.221025	1.105	0.1747	1.010054845	0.25	100
Chloroform (ug/L)	MWell#1 (bg)	113	0.5271	0.346921	0.589	0.05541	1.117435022	0.5	95.58
Chloroform (ug/L)	MWell#11 (bg)	40	0.2988	0.12609601	0.3551	0.05614	1.188420348	0.1	97.5
Chloromethane (ug/L)	MWell#1 (bg)	111	1.111	1.692601	1.301	0.1235	1.171017102	0.5	99.1
Chloromethane (ug/L)	MWell#11 (bg)	40	1.064	1.279161	1.131	0.1789	1.062969925	0.25	100
Chromium, Dissolved (mg/L)	MWell#1 (bg)	85	0.004736	4.72794E-05	0.006876	0.0007458	1.451858108	0.0029	30.59
Chromium, Dissolved (mg/L)	MWell#11 (bg)	21	0.004514	2.2801E-06	0.00151	0.0003295	0.334514843	0.0042	0
Chromium, Total (mg/L)	MWell#1 (bg)	28	0.003618	8.06763E-07	0.0008982	0.0001697	0.248258706	0.00355	0
Chromium, Total (mg/L)	MWell#11 (bg)	28	0.0104	0.00016952	0.01302	0.002461	1.251923077	0.00465	0

[1] All statistics based on Non-Detects = 1/2 MDL [2] (bg) indicates a background well.

HORN RAPIDS LANDFILL - SECOND QUARTER 2020
Summary of Descriptive Statistics

Constituent Name	Well	N	Mean[1]	Variance	Standard Deviation	Standard Error	Coeffient of Variation	Median	% Non-Detects
cis-1,2-Dichloroethene (ug/L)	MWell#1 (bg)	113	0.5478	0.54272689	0.7367	0.06931	1.344833881	0.5	99.12
cis-1,2-Dichloroethene (ug/L)	MWell#11 (bg)	40	0.2575	0.04149369	0.2037	0.0322	0.791067961	0.1	100
cis-1,3-Dichloropropene (ug/L)	MWell#1 (bg)	111	0.4938	0.23415921	0.4839	0.04593	0.979951397	0.5	100
cis-1,3-Dichloropropene (ug/L)	MWell#11 (bg)	40	0.2928	0.03111696	0.1764	0.02788	0.602459016	0.25	100
Cobalt, Dissolved (mg/L)	MWell#1 (bg)	85	0.006439	5.32754E-05	0.007299	0.0007917	1.133561112	0.005	55.29
Cobalt, Dissolved (mg/L)	MWell#11 (bg)	21	0.0002833	2.11121E-08	0.0001453	0.00003172	0.512883869	0.0002	71.43
Cobalt, Total (mg/L)	MWell#1 (bg)	28	0.02542	0.00012544	0.0112	0.002117	0.440597954	0.026	0
Cobalt, Total (mg/L)	MWell#11 (bg)	28	0.0005325	2.80582E-07	0.0005297	0.0001001	0.994741784	0.0002	53.57
Conductivity (umhos/cm)	MWell#1 (bg)	99	697.9	46268.01	215.1	21.62	0.308210345	730	0
Conductivity (umhos/cm)	MWell#11 (bg)	36	1324	167854.09	409.7	68.29	0.309441088	1376	0
Copper, Dissolved (mg/L)	MWell#1 (bg)	85	0.003993	4.10368E-05	0.006406	0.0006948	1.604307538	0.0014	68.24
Copper, Dissolved (mg/L)	MWell#11 (bg)	21	0.003633	1.18405E-05	0.003441	0.000751	0.947151115	0.0024	14.29
Copper, Total (mg/L)	MWell#1 (bg)	28	0.001293	1.04858E-06	0.001024	0.0001935	0.79195669	0.001	71.43
Copper, Total (mg/L)	MWell#11 (bg)	28	0.002582	4.30148E-06	0.002074	0.0003919	0.803253292	0.0021	42.86
Dibromochloromethane (ug/L)	MWell#1 (bg)	112	0.5009	0.27804529	0.5273	0.04982	1.052705131	0.5	100
Dibromochloromethane (ug/L)	MWell#11 (bg)	40	0.2625	0.04549689	0.2133	0.03372	0.812571429	0.1	100
Dibromomethane (ug/L)	MWell#1 (bg)	109	0.5212	0.29278921	0.5411	0.05183	1.03818112	0.5	100
Dibromomethane (ug/L)	MWell#11 (bg)	40	0.2553	0.04032064	0.2008	0.03175	0.786525656	0.1	100
Dissolved Oxygen (mg/L)	MWell#1 (bg)	44	5.52	0.33593616	0.5796	0.08738	0.105	5.585	0
Dissolved Oxygen (mg/L)	MWell#11 (bg)	39	7.784	1.874161	1.369	0.2193	0.175873587	8.02	0
Ethane (ug/L)	MWell#1 (bg)	45	4.417	3.286969	1.813	0.2703	0.410459588	5	100
Ethane (ug/L)	MWell#11 (bg)	40	4.083	2.825761	1.681	0.2657	0.411707078	5	100
Ethene (ug/L)	MWell#1 (bg)	45	4.389	3.055504	1.748	0.2606	0.398268398	5	100
Ethene (ug/L)	MWell#11 (bg)	40	4.075	2.879809	1.697	0.2683	0.416441718	5	100
Ethylbenzene (ug/L)	MWell#1 (bg)	112	0.5	0.27709696	0.5264	0.04974	1.0528	0.5	100
Ethylbenzene (ug/L)	MWell#11 (bg)	40	0.2549	0.04020025	0.2005	0.03169	0.786582974	0.1	100
Iodomethane (ug/L)	MWell#1 (bg)	105	1.56	1.630729	1.277	0.1246	0.818589744	1.5	100
Iodomethane (ug/L)	MWell#11 (bg)	40	1.103	1.205604	1.098	0.1736	0.995466908	0.25	100
Iron, Dissolved (mg/L)	MWell#1 (bg)	114	0.1446	0.02205225	0.1485	0.01391	1.026970954	0.1	71.93
Iron, Dissolved (mg/L)	MWell#11 (bg)	40	0.2013	0.008524829	0.09233	0.0146	0.458668654	0.25	97.5
Iron, Total (mg/L)	MWell#1 (bg)	8	0.25	0	0	0	0	0.25	100
Iron, Total (mg/L)	MWell#11 (bg)	8	0.3813	0.13778944	0.3712	0.1313	0.973511671	0.25	87.5

[1] All statistics based on Non-Detects = 1/2 MDL [2] (bg) indicates a background well.

HORN RAPIDS LANDFILL - SECOND QUARTER 2020

Summary of Descriptive Statistics

Constituent Name	Well	N	Mean[1]	Variance	Standard Deviation	Standard Error	Coeffient of Variation	Median	% Non-Detects
Lead, Dissolved (mg/L)	MWell#1 (bg)	84	0.003381	5.8967E-05	0.007679	0.0008378	2.271221532	0.0005	90.48
Lead, Dissolved (mg/L)	MWell#11 (bg)	21	0.0002	0	0	0	0	0.0002	100
Lead, Total (mg/L)	MWell#1 (bg)	28	0.0003239	2.11121E-08	0.0001453	0.00002745	0.448595245	0.0004	92.86
Lead, Total (mg/L)	MWell#11 (bg)	28	0.0003261	2.80563E-08	0.0001675	0.00003165	0.513646121	0.0003	92.86
Magnesium, Dissolved (mg/L)	MWell#1 (bg)	102	20.11	39.715204	6.302	0.6239	0.31337643	22	0
Magnesium, Dissolved (mg/L)	MWell#11 (bg)	40	39.98	186.8689	13.67	2.162	0.34192096	45	0
Magnesium, Total (mg/L)	MWell#1 (bg)	8	24	16	4	1.414	0.166666667	24	0
Magnesium, Total (mg/L)	MWell#11 (bg)	8	37.5	47.997184	6.928	2.449	0.184746667	40.5	0
Manganese, Dissolved (mg/L)	MWell#1 (bg)	114	0.01082	0.000355323	0.01885	0.001766	1.742144177	0.01	78.07
Manganese, Dissolved (mg/L)	MWell#11 (bg)	40	0.01882	0.002066612	0.04546	0.007189	2.415515409	0.01	95
Manganese, Total (mg/L)	MWell#1 (bg)	8	0.01	0	0	0	0	0.01	100
Manganese, Total (mg/L)	MWell#11 (bg)	8	0.01262	5.51306E-05	0.007425	0.002625	0.588351823	0.01	87.5
Methane (ug/L)	MWell#1 (bg)	45	1.099	3.214849	1.793	0.2672	1.631483167	0.6	95.56
Methane (ug/L)	MWell#11 (bg)	40	1.048	1.236544	1.112	0.1759	1.061068702	0.6	90
Methylene Chloride (ug/L)	MWell#1 (bg)	113	1.238	1.256641	1.121	0.1054	0.90549273	0.5	98.23
Methylene Chloride (ug/L)	MWell#11 (bg)	40	1.27	0.80120401	0.8951	0.1415	0.70480315	1.5	100
Nickel, Dissolved (mg/L)	MWell#1 (bg)	85	0.006874	0.000119246	0.01092	0.001184	1.588594705	0.0018	69.41
Nickel, Dissolved (mg/L)	MWell#11 (bg)	21	0.005238	6.38068E-06	0.002526	0.0005513	0.482245132	0.0052	14.29
Nickel, Total (mg/L)	MWell#1 (bg)	28	0.001564	1.15736E-07	0.0003402	0.00006429	0.217519182	0.0015	96.43
Nickel, Total (mg/L)	MWell#11 (bg)	28	0.005204	5.27366E-05	0.007262	0.001372	1.395465027	0.0015	60.71
Nitrate Nitrogen (mg/L)	MWell#1 (bg)	112	5.603	15.405625	3.925	0.3708	0.70051758	6.85	0
Nitrate Nitrogen (mg/L)	MWell#11 (bg)	39	27.98	118.1569	10.87	1.74	0.38849178	33	5.128
pH (none)	MWell#1 (bg)	103	7.24	0.06996025	0.2645	0.02606	0.036533149	7.18	0
pH (none)	MWell#11 (bg)	40	7.437	0.027889	0.167	0.02641	0.022455291	7.425	0
Potassium, Dissolved (mg/L)	MWell#1 (bg)	102	7.327	1.640961	1.281	0.1268	0.17483281	7.7	0
Potassium, Dissolved (mg/L)	MWell#11 (bg)	40	10.8	2.835856	1.684	0.2663	0.155925926	11	0
Potassium, Total (mg/L)	MWell#1 (bg)	8	8.713	1.800964	1.342	0.4745	0.154022725	8.55	0
Potassium, Total (mg/L)	MWell#11 (bg)	8	10.56	1.7424	1.32	0.4667	0.125	11	0
Redox (mv)	MWell#1 (bg)	45	120.7	7218.2016	84.96	12.67	0.703893952	110	0
Redox (mv)	MWell#11 (bg)	40	133.1	10650.24	103.2	16.32	0.775356875	125.6	0
Selenium, Dissolved (mg/L)	MWell#1 (bg)	85	0.007247	0.000205062	0.01432	0.001554	1.975990065	0.002	31.76
Selenium, Dissolved (mg/L)	MWell#11 (bg)	21	0.005469	1.2996E-05	0.003605	0.0007867	0.659169867	0.0048	4.762

[1] All statistics based on Non-Detects = 1/2 MDL [2] (bg) indicates a background well.

HORN RAPIDS LANDFILL - SECOND QUARTER 2020
Summary of Descriptive Statistics

Constituent Name	Well	N	Mean[1]	Variance	Standard Deviation	Standard Error	Coeffient of Variation	Median	% Non-Detects
Selenium, Total (mg/L)	MWell#1 (bg)	28	0.002811	1.31103E-06	0.001145	0.0002165	0.407328353	0.0023	46.43
Selenium, Total (mg/L)	MWell#11 (bg)	28	0.007204	8.87444E-06	0.002979	0.000563	0.413520267	0.0081	42.86
Silver, Dissolved (mg/L)	MWell#1 (bg)	85	0.003239	4.45556E-05	0.006675	0.000724	2.060821241	0.0005	97.65
Silver, Dissolved (mg/L)	MWell#11 (bg)	21	0.0002	0	0	0	0	0.0002	100
Silver, Total (mg/L)	MWell#1 (bg)	28	0.0002	0	0	0	0	0.0002	100
Silver, Total (mg/L)	MWell#11 (bg)	28	0.0002	0	0	0	0	0.0002	100
Sodium, Dissolved (mg/L)	MWell#1 (bg)	102	18.93	18.369796	4.286	0.4244	0.226413101	20.5	0
Sodium, Dissolved (mg/L)	MWell#11 (bg)	40	18.73	8.514724	2.918	0.4613	0.155792846	19.5	0
Sodium, Total (mg/L)	MWell#1 (bg)	8	22.38	9.696996	3.114	1.101	0.139142091	23	0
Sodium, Total (mg/L)	MWell#11 (bg)	8	18.5	1.999396	1.414	0.5	0.076432432	19	0
Styrene (ug/L)	MWell#1 (bg)	112	0.5319	0.25664356	0.5066	0.04787	0.952434668	0.5	100
Styrene (ug/L)	MWell#11 (bg)	40	0.3443	0.02157961	0.1469	0.02323	0.426662794	0.25	100
Sulfate (mg/L)	MWell#1 (bg)	114	39.31	215.7961	14.69	1.376	0.37369626	45	0
Sulfate (mg/L)	MWell#11 (bg)	40	207	11257.21	106.1	16.78	0.512560386	205	0
TDS (mg/L)	MWell#1 (bg)	103	445.7	17161	131	12.91	0.293919677	470	0
TDS (mg/L)	MWell#11 (bg)	40	987	153037.44	391.2	61.86	0.396352584	990	0
Temperature (C)	MWell#1 (bg)	114	20.17	5.963364	2.442	0.2287	0.121070897	20.3	0
Temperature (C)	MWell#11 (bg)	40	20.62	5.166529	2.273	0.3593	0.110232784	20.58	0
Tetrachloroethene (ug/L)	MWell#1 (bg)	112	2.853	2.999824	1.732	0.1636	0.607080266	2.8	20.54
Tetrachloroethene (ug/L)	MWell#11 (bg)	40	0.3438	0.02732409	0.1653	0.02614	0.480802792	0.25	100
Thallium, Dissolved (mg/L)	MWell#1 (bg)	85	0.003379	5.45087E-05	0.007383	0.0008008	2.184965966	0.0005	98.82
Thallium, Dissolved (mg/L)	MWell#11 (bg)	21	0.000481	1.61926E-09	0.00004024	0.000008781	0.083659044	0.0005	100
Thallium, Total (mg/L)	MWell#1 (bg)	28	0.0005	0	0	0	0	0.0005	100
Thallium, Total (mg/L)	MWell#11 (bg)	28	0.0005	0	0	0	0	0.0005	100
TOC (mg/L)	MWell#1 (bg)	113	1.462	3.556996	1.886	0.1774	1.29001368	1.3	30.97
TOC (mg/L)	MWell#11 (bg)	40	3	5.769604	2.402	0.3799	0.800666667	2.1	5
Toluene (ug/L)	MWell#1 (bg)	113	0.5048	0.28451556	0.5334	0.05017	1.056656101	0.5	99.12
Toluene (ug/L)	MWell#11 (bg)	40	0.2549	0.04020025	0.2005	0.03169	0.786582974	0.1	100
Total Suspended Solids (mg/L)	MWell#1 (bg)	23	1.133	0.12510369	0.3537	0.07376	0.312180053	1	100
Total Suspended Solids (mg/L)	MWell#11 (bg)	23	3.067	31.753225	5.635	1.175	1.837300293	1	73.91
trans-1,2-Dichloroethene (ug/L)	MWell#1 (bg)	112	0.5018	0.27730756	0.5266	0.04976	1.049422081	0.5	100
trans-1,2-Dichloroethene (ug/L)	MWell#11 (bg)	40	0.26	0.04322241	0.2079	0.03288	0.799615385	0.1	100

[1] All statistics based on Non-Detects = 1/2 MDL [2] (bg) indicates a background well.

HORN RAPIDS LANDFILL - SECOND QUARTER 2020
Summary of Descriptive Statistics

Constituent Name	Well	N	Mean[1]	Variance	Standard Deviation	Standard Error	Coeffient of Variation	Median	% Non-Detects
trans-1,3-Dichloropropene (ug/L)	MWell#1 (bg)	111	0.4786	0.24364096	0.4936	0.04685	1.031341412	0.5	100
trans-1,3-Dichloropropene (ug/L)	MWell#11 (bg)	40	0.2506	0.03924361	0.1981	0.03132	0.790502793	0.1	100
trans-1,4-Dichloro-2-butene (ug/L)	MWell#1 (bg)	102	1.493	1.205604	1.098	0.1087	0.735432016	1	100
trans-1,4-Dichloro-2-butene (ug/L)	MWell#11 (bg)	40	1.697	1.014049	1.007	0.1592	0.593400118	1	100
Trichloroethene (ug/L)	MWell#1 (bg)	113	0.5327	0.25431849	0.5043	0.04744	0.94668669	0.5	83.19
Trichloroethene (ug/L)	MWell#11 (bg)	40	0.2588	0.04231249	0.2057	0.03252	0.794822257	0.1	100
Trichlorofluoromethane (ug/L)	MWell#1 (bg)	113	0.6513	0.958441	0.979	0.0921	1.503147551	0.5	96.46
Trichlorofluoromethane (ug/L)	MWell#11 (bg)	40	0.345	0.02869636	0.1694	0.02678	0.491014493	0.25	100
Vanadium, Dissolved (mg/L)	MWell#1 (bg)	85	0.01154	4.56976E-05	0.00676	0.0007332	0.585788562	0.0107	16.47
Vanadium, Dissolved (mg/L)	MWell#11 (bg)	21	0.0098	2.41181E-06	0.001553	0.000339	0.158469388	0.0098	0
Vanadium, Total (mg/L)	MWell#1 (bg)	28	0.009546	6.82606E-07	0.0008262	0.0001561	0.08654934	0.00935	0
Vanadium, Total (mg/L)	MWell#11 (bg)	28	0.01006	1.05884E-06	0.001029	0.0001944	0.102286282	0.0099	0
Vinyl Acetate (ug/L)	MWell#1 (bg)	107	2.274	8.661249	2.943	0.2846	1.294195251	1	100
Vinyl Acetate (ug/L)	MWell#11 (bg)	40	1.281	0.93973636	0.9694	0.1533	0.756752537	0.625	100
Vinyl Chloride (ug/L)	MWell#1 (bg)	112	0.6118	1.159929	1.077	0.1018	1.760379209	0.5	100
Vinyl Chloride (ug/L)	MWell#11 (bg)	40	0.2031	0.05769604	0.2402	0.03798	1.182668636	0.01	100
Xylenes (ug/L)	MWell#1 (bg)	74	0.7515	0.20602521	0.4539	0.05276	0.603992016	1	100
Xylenes (ug/L)	MWell#11 (bg)	40	0.5702	0.21743569	0.4663	0.07373	0.817783234	0.25	100
Zinc, Dissolved (mg/L)	MWell#1 (bg)	96	0.007066	7.98878E-05	0.008938	0.0009123	1.264930654	0.00405	53.13
Zinc, Dissolved (mg/L)	MWell#11 (bg)	21	0.006033	4.29811E-05	0.006556	0.001431	1.086689872	0.0035	28.57
Zinc, Total (mg/L)	MWell#1 (bg)	32	0.005197	2.51302E-05	0.005013	0.0008862	0.964594959	0.0035	75
Zinc, Total (mg/L)	MWell#11 (bg)	28	0.003939	2.51857E-06	0.001587	0.0003	0.402894136	0.0035	78.57

[1] All statistics based on Non-Detects = 1/2 MDL [2] (bg) indicates a background well.

G-5

Geochemical Data

Cation/Anion Balance Calculations (Dissolved Metals), Horn Rapids Landfill, Third Quarter 2019

	Conversion Factor[1] (mg/L to meq/L)	MW-1			MW-2			MW-4			MW-5			MW-6			MW-8		
		Value (mg/L)	**Value (meq/L)**	**Percent of Total (meq/L)**	**Value (mg/L)**	**Value (meq/L)**	**Percent of Total (meq/L)**	**Value (mg/L)**	**Value (meq/L)**	**Percent of Total (meq/L)**	**Value (mg/L)**	**Value (meq/L)**	**Percent of Total (meq/L)**	**Value (mg/L)**	**Value (meq/L)**	**Percent of Total (meq/L)**	**Value (mg/L)**	**Value (meq/L)**	**Percent of Total (meq/L)**
CATIONS																			
Na	0.0435	17	0.74	11.38	12	0.52	10.30	14	0.61	10.12	33	1.44	8.44	21	0.91	7.42	14	0.61	17.19
Ca	0.0499	84	4.19	64.48	65	3.24	64.01	77	3.84	63.85	220	10.98	64.55	160	7.98	64.86	42	2.10	59.14
Mg	0.08229	17	1.40	21.52	14	1.15	22.74	17	1.40	23.25	52	4.28	25.16	38	3.13	25.40	8.5	0.70	19.74
Fe(+2)	0.03581	0.1	0.00	0.06	0.1	0.00	0.07	0.1	0.00	0.06	0.1	0.00	0.02	0.1	0.00	0.03	0.1	0.00	0.10
K	0.02558	6.5	0.17	2.56	5.7	0.15	2.88	6.4	0.16	2.72	12	0.31	1.80	11	0.28	2.29	5.3	0.14	3.83
Mn	0.0364	0.010	0.00	0.01	0.010	0.00	0.01	0.010	0.00	0.01	0.082	0.003	0.02	0.01	0.00	0.00	0.010	0.00	0.01
		TOTAL	6.50	100.00	TOTAL	5.07	100.00	TOTAL	6.02	100.00	TOTAL	17.01	100.00	TOTAL	12.31	100.00	TOTAL	3.54	100.00
ANIONS																			
HCO_3[2]	0.02	210	4.20	70.58	120	2.40	55.99	230	4.60	82.19	540	10.80	72.15	500	10.00	94.64	110	2.20	67.58
SO_4	0.02082	49	1.02	17.14	55	1.15	26.71	28	0.58	10.42	150	3.12	20.86	0	0.00	0.00	27	0.56	17.27
Cl	0.02821	22	0.62	10.43	20	0.56	13.16	13	0.37	6.55	37	1.04	6.97	20	0.56	5.34	16	0.45	13.86
CO_3[2]	0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
NO_3	0.01613	6.8	0.11	1.84	11	0.18	4.14	2.9	0.05	0.84	0.1	0.00	0.01	0.1	0.00	0.02	2.6	0.04	1.29
		TOTAL	5.95	100.00	TOTAL	4.29	100.00	TOTAL	5.60	100.00	TOTAL	14.97	100.00	TOTAL	10.57	100.00	TOTAL	3.26	100.00
(meq/L cations-anions)/(meq/L cations+anions)*100				4.42			8.34			3.63			6.37			7.62			4.24

Cation/Anion Balance Calculations (Dissolved Metals), Horn Rapids Landfill, Third Quarter 2019

	Conversion Factor[1] (mg/L to meq/L)	**MW-9**			**MW-10**			**MW-11**			**MW-12**		
		Value (mg/L)	**Value (meq/L)**	**Percent of Total (meq/L)**	**Value (mg/L)**	**Value (meq/L)**	**Percent of Total (meq/L)**	**Value (mg/L)**	**Value (meq/L)**	**Percent of Total (meq/L)**	**Value (mg/L)**	**Value (meq/L)**	**Percent of Total (meq/L)**
CATIONS													
Na	0.0435	22	0.96	9.60	18	0.78	5.81	24	1.04	5.95	21	0.91	20.87
Ca	0.0499	130	6.49	65.10	190	9.48	70.35	240	11.98	68.22	49	2.45	55.86
Mg	0.08229	28	2.30	23.12	36	2.96	21.98	51	4.20	23.91	10	0.82	18.80
Fe(+2)	0.03581	0.1	0.00	0.04	0.1	0.00	0.03	0.55	0.02	0.11	0.1	0.00	0.08
K	0.02558	8.3	0.21	2.13	9.6	0.25	1.82	12	0.31	1.75	7.5	0.19	4.38
Mn	0.0364	0.010	0.00	0.00	0.01	0.00	0.00	0.290	0.01	0.06	0.010	0.00	0.01
		TOTAL	9.96	100.00	TOTAL	13.48	100.00	TOTAL	17.55	100.00	TOTAL	4.38	100.00
ANIONS													
HCO_3[2]	0.02	310	6.20	70.90	690	13.80	82.97	200	4.00	32.86	150	3.00	71.55
SO_4	0.02082	72	1.50	17.14	65	1.35	8.14	190	3.96	32.50	36	0.75	17.88
Cl	0.02821	37	1.04	11.94	50	1.41	8.48	130	3.67	30.13	14	0.39	9.42
CO_3[2]	0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
NO_3	0.01613	0.1	0.00	0.02	4.3	0.07	0.42	34	0.55	4.51	3	0.05	1.15
		TOTAL	8.74	100.00	TOTAL	16.63	100.00	TOTAL	12.17	100.00	TOTAL	4.19	100.00
(meq/L cations-anions)/(meq/L cations+anions)*100				6.52			-10.49			18.11			2.15

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[1] Reference: Hem 1985.

[2] HCO_3 and CO_3 reported as $CaCO_3$, conversion factor adjusted accordingly.

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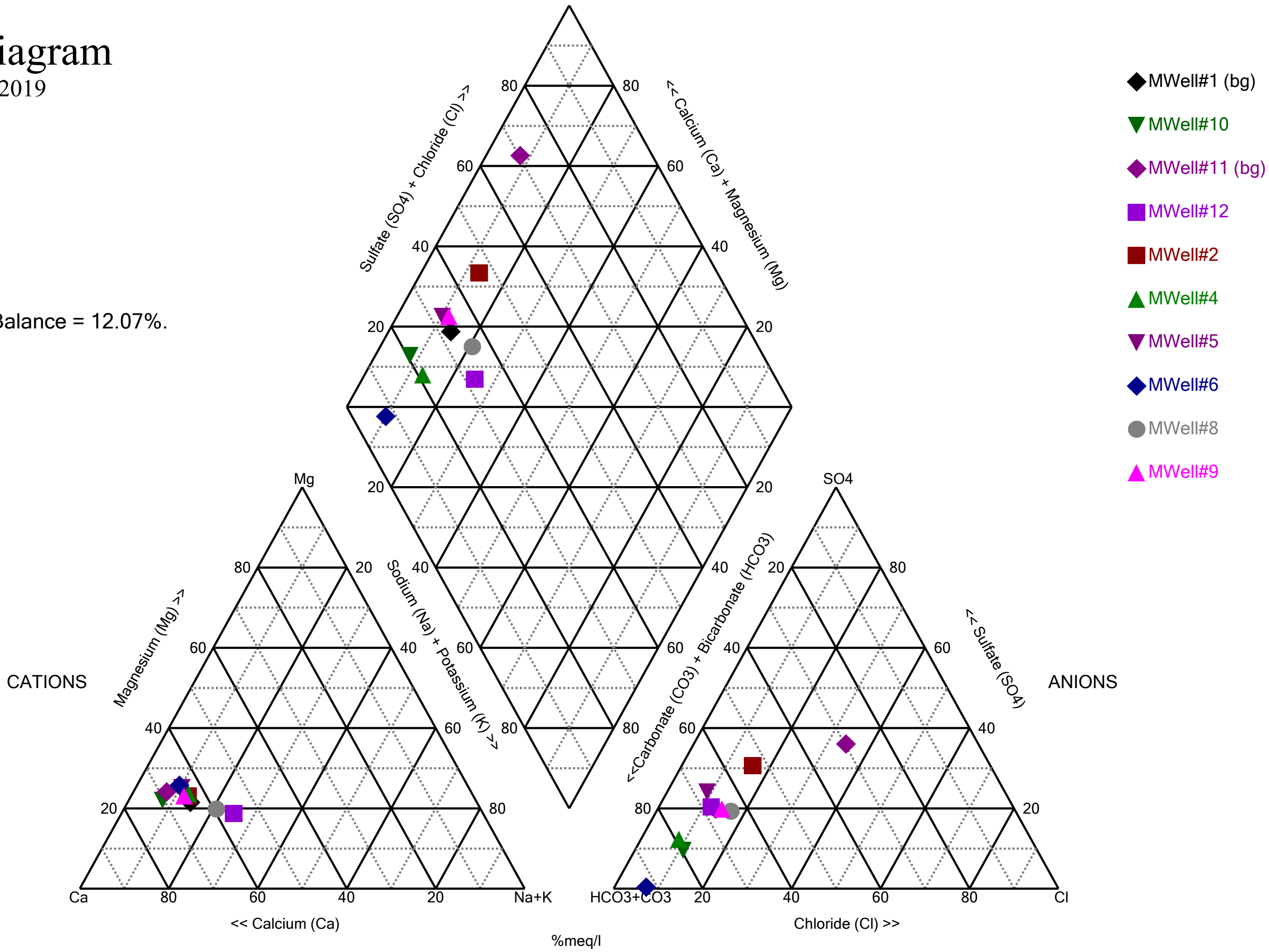
Piper Diagram

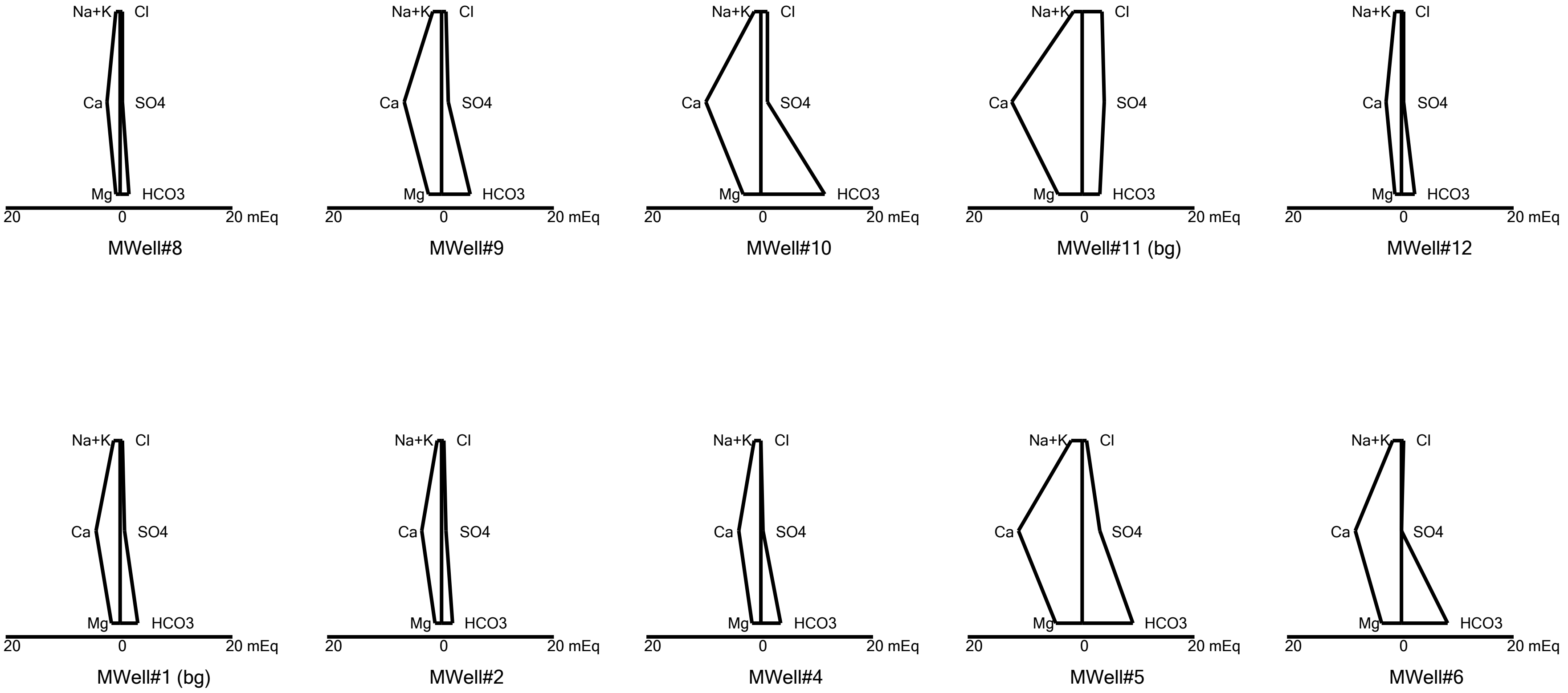
9/4/2019, 9/5/2019

Cation-Anion Balance = 12.07%.



Analysis Run 3/3/2020 4:45 PM

Horn Rapids Landfill Client: City of Richland Data: 3Q_19_PIPER



MWell#8

MWell#9

MWell#10

MWell#11 (bg)

MWell#12

MWell#1 (bg)

MWell#2

MWell#4

MWell#5

MWell#6

Stiff Diagram - 9/4/2019, 9/5/2019   Analysis Run 3/3/2020 4:48 PM

Horn Rapids Landfill   Client: City of Richland   Data: 3Q_19_PIPER

Cation/Anion Balance Calculations (Dissolved Metals), Horn Rapids Landfill, Fourth Quarter 2019

	Conversion Factor[1] (mg/L to meq/L)	**MW-1**			**MW-2**			**MW-3**			**MW-4**			**MW-5**			**MW-6**		
		Value (mg/L)	**Value (meq/L)**	**Percent of Total (meq/L)**	**Value (mg/L)**	**Value (meq/L)**	**Percent of Total (meq/L)**	**Value (mg/L)**	**Value (meq/L)**	**Percent of Total (meq/L)**	**Value (mg/L)**	**Value (meq/L)**	**Percent of Total (meq/L)**	**Value (mg/L)**	**Value (meq/L)**	**Percent of Total (meq/L)**	**Value (mg/L)**	**Value (meq/L)**	**Percent of Total (meq/L)**
CATIONS																			
Na	0.0435	21	0.91	11.79	14	0.61	11.87	11	0.48	17.92	14	0.61	11.23	36	1.57	6.98	21	0.91	8.32
Ca	0.0499	100	4.99	64.43	66	3.29	64.20	32	1.60	59.79	70	3.49	64.43	300	14.97	66.71	140	6.99	63.60
Mg	0.08229	20	1.65	21.25	13	1.07	20.85	5.6	0.46	17.26	14	1.15	21.25	67	5.51	24.57	34	2.80	25.47
Fe(+2)	0.03581	0.1	0.00	0.05	0.1	0.00	0.07	0.1	0.00	0.13	0.1	0.00	0.07	0.1	0.00	0.02	0.1	0.00	0.03
K	0.02558	7.5	0.19	2.48	6	0.15	2.99	5.1	0.13	4.89	6.4	0.16	3.02	15	0.38	1.71	11	0.28	2.56
Mn	0.0364	0.01	0.00	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.13	0.00	0.02	0.037	0.00	0.01
		TOTAL	7.75	100.00	TOTAL	5.13	100.00	TOTAL	2.67	100.00	TOTAL	5.42	100.00	TOTAL	22.44	100.00	TOTAL	10.98	100.00
ANIONS																			
HCO_3[2]	0.02	310	6.20	75.19	110	2.20	45.38	88	1.76	69.98	220	4.40	81.32	680	13.60	62.70	510	10.20	86.38
SO_4	0.02082	55	1.15	13.89	73	1.52	31.35	22	0.46	18.21	28	0.58	10.77	260	5.41	24.96	50	1.04	8.82
Cl	0.02821	27	0.76	9.24	32	0.90	18.62	9.1	0.26	10.21	13	0.37	6.78	88	2.48	11.45	20	0.56	4.78
CO_3[2]	0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
NO_3	0.01613	8.6	0.14	1.68	14	0.23	4.66	2.5	0.04	1.60	3.8	0.06	1.13	12	0.19	0.89	0.23	0.00	0.03
		TOTAL	8.25	100.00	TOTAL	4.85	100.00	TOTAL	2.52	100.00	TOTAL	5.41	100.00	TOTAL	21.69	100.00	TOTAL	11.81	100.00
(meq/L cations-anions)/(meq/L cations+anions)*100				-3.13			2.82			3.00			0.10			1.70			-3.62

Cation/Anion Balance Calculations (Dissolved Metals), Horn Rapids Landfill, Fourth Quarter 2019

	Conversion Factor[1] (mg/L to meq/L)	**MW-8**			**MW-9**			**MW-10**			**MW-11**			**MW-12**		
		Value (mg/L)	**Value (meq/L)**	**Percent of Total (meq/L)**	**Value (mg/L)**	**Value (meq/L)**	**Percent of Total (meq/L)**	**Value (mg/L)**	**Value (meq/L)**	**Percent of Total (meq/L)**	**Value (mg/L)**	**Value (meq/L)**	**Percent of Total (meq/L)**	**Value (mg/L)**	**Value (meq/L)**	**Percent of Total (meq/L)**
CATIONS																
Na	0.0435	23	1.00	14.10	28	1.22	10.30	27	1.17	5.93	21	0.91	4.61	21	0.91	20.01
Ca	0.0499	90	4.49	63.29	150	7.49	63.28	270	13.47	68.07	280	13.97	70.55	51	2.54	55.75
Mg	0.08229	17	1.40	19.71	35	2.88	24.35	58	4.77	24.11	56	4.61	23.27	11	0.91	19.83
Fe(+2)	0.03581	0.1	0.00	0.05	0.1	0.00	0.03	0.26	0.01	0.05	0.1	0.00	0.02	0.1	0.00	0.08
K	0.02558	7.9	0.20	2.85	9.4	0.24	2.03	14	0.36	1.81	12	0.31	1.55	7.7	0.20	4.32
Mn	0.0364	0.01	0.00	0.01	0.01	0.00	0.00	0.17	0.01	0.03	0.01	0.00	0.00	0.01	0.00	0.01
		TOTAL	7.10	100.00	TOTAL	11.83	100.00	TOTAL	19.79	100.00	TOTAL	19.80	100.00	TOTAL	4.56	100.00
ANIONS																
HCO_3[2]	0.02	120	2.40	35.54	390	7.80	70.56	760	15.20	83.66	160	3.20	18.69	140	2.80	70.29
SO_4	0.02082	61	1.27	18.81	76	1.58	14.31	91	1.89	10.43	330	6.87	40.12	35	0.73	18.29
Cl	0.02821	99	2.79	41.36	56	1.58	14.29	38	1.07	5.90	230	6.49	37.89	14	0.39	9.91
CO_3[2]	0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
NO_3	0.01613	18	0.29	4.30	5.7	0.09	0.83	0.1	0.00	0.01	35	0.56	3.30	3.7	0.06	1.50
		TOTAL	6.75	100.00	TOTAL	11.05	100.00	TOTAL	18.17	100.00	TOTAL	17.12	100.00	TOTAL	3.98	100.00
(meq/L cations-anions)/(meq/L cations+anions)*100				2.48			3.38			4.28			7.26			6.80

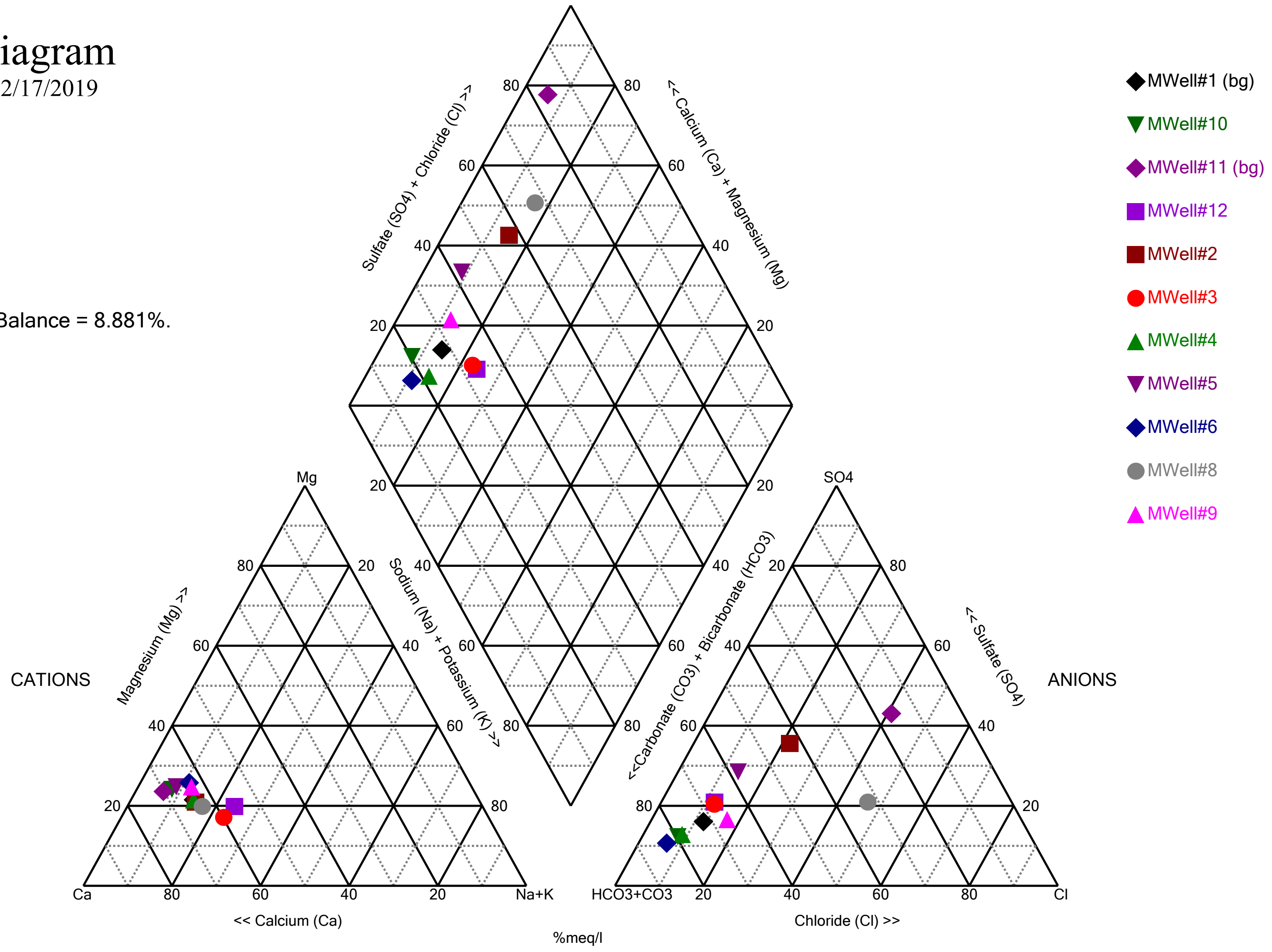
[1] Reference: Hem 1985.

[2] HCO_3 and CO_3 reported as $CaCO_3$, conversion factor adjusted accordingly.

Piper Diagram

12/16/2019, 12/17/2019

Cation-Anion Balance = 8.881%.



Analysis Run 2/14/2020 4:21 PM

Horn Rapids Landfill Client: City of Richland Data: 4Q_19_PIPER

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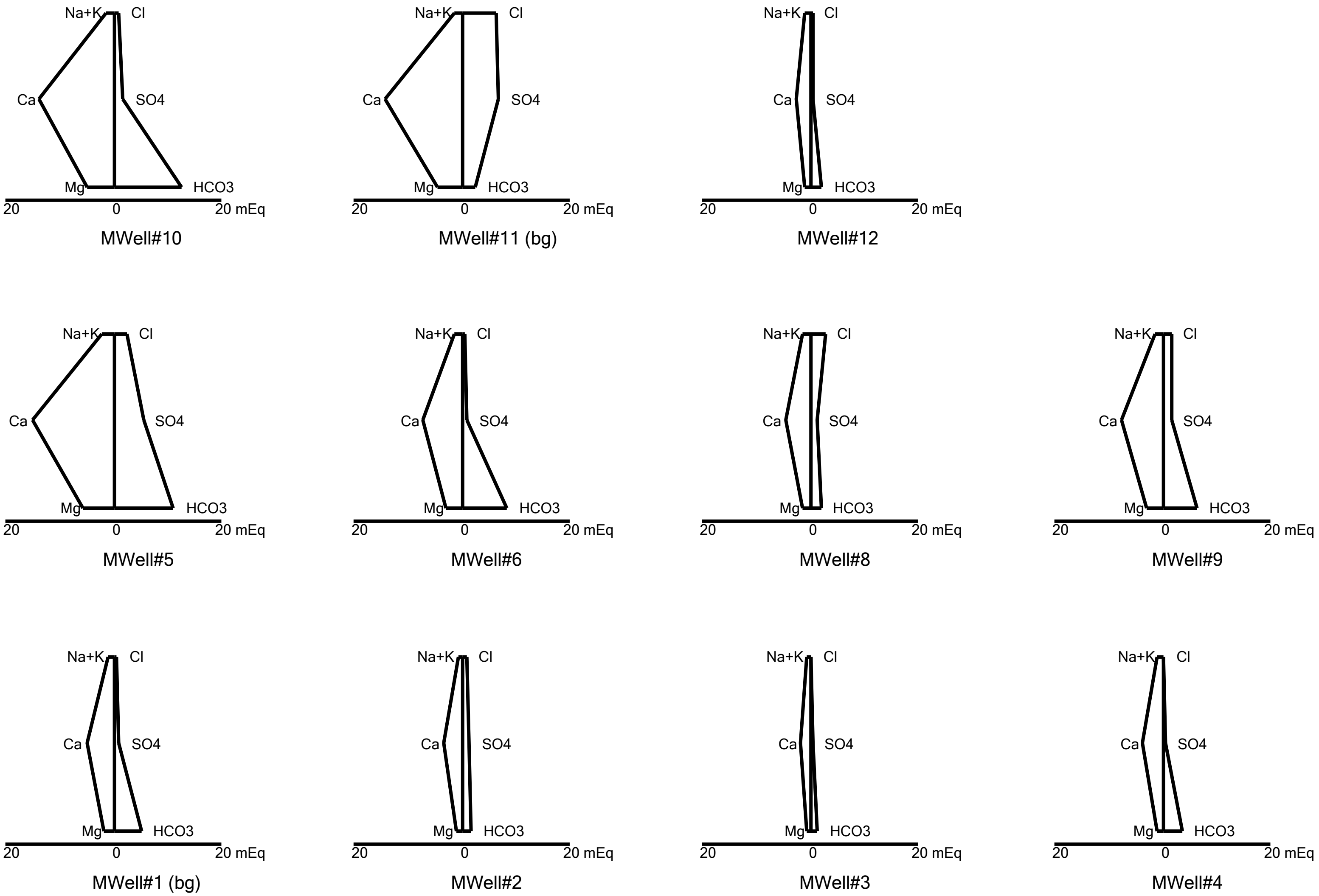

MWell#10 MWell#11 (bg) MWell#12

MWell#5 MWell#6 MWell#8 MWell#9

MWell#1 (bg) MWell#2 MWell#3 MWell#4

Stiff Diagram - 12/16/2019, 12/17/2019 Analysis Run 2/14/2020 4:25 PM

Horn Rapids Landfill Client: City of Richland Data: 4Q_19_PIPER

Cation/Anion Balance Calculations (Dissolved Metals), Horn Rapids Landfill, First Quarter 2020

	Conversion Factor[1] **(mg/L to meq/L)**	**Well #1**			**Well #2**			**Well #3**			**Well #4**			**Well #5**			**Well #6**		
		Value (mg/L)	**Value (meq/L)**	**Percent of Total (meq/L)**	**Value (mg/L)**	**Value (meq/L)**	**Percent of Total (meq/L)**	**Value (mg/L)**	**Value (meq/L)**	**Percent of Total (meq/L)**	**Value (mg/L)**	**Value (meq/L)**	**Percent of Total (meq/L)**	**Value (mg/L)**	**Value (meq/L)**	**Percent of Total (meq/L)**	**Value (mg/L)**	**Value (meq/L)**	**Percent of Total (meq/L)**
CATIONS																			
Na	0.0435	23	1.00	10.16	14	0.61	10.44	12	0.52	16.13	14	0.61	9.78	43	1.87	8.35	22	0.96	7.70
Ca	0.0499	130	6.49	65.89	75	3.74	64.16	39	1.95	60.15	81	4.04	64.90	290	14.47	64.56	160	7.98	64.20
Mg	0.08229	26	2.14	21.73	16	1.32	22.57	7.6	0.63	19.33	17	1.40	22.46	69	5.68	25.33	39	3.21	25.81
Fe(+2)	0.03581	0.1	0.00	0.04	0.1	0.00	0.06	0.1	0.00	0.11	0.1	0.00	0.06	0.1	0.00	0.02	0.1	0.00	0.03
K	0.02558	8.4	0.21	2.18	6.3	0.16	2.76	5.4	0.14	4.27	6.8	0.17	2.79	15	0.38	1.71	11	0.28	2.26
Mn	0.0364	0.01	0.00	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.21	0.01	0.03	0.034	0.00	0.01
		TOTAL	9.85	100.00	TOTAL	5.83	100.00	TOTAL	3.24	100.00	TOTAL	6.23	100.00	TOTAL	22.41	100.00	TOTAL	12.44	100.00
ANIONS																			
HCO_3[2]	0.02	310	6.20	72.73	120	2.40	45.90	96	1.92	64.15	240	4.80	81.71	720	14.40	73.12	510	10.20	85.49
SO_4	0.02082	59	1.23	14.41	77	1.60	30.66	29	0.60	20.17	29	0.60	10.28	140	2.91	14.80	53	1.10	9.25
Cl	0.02821	32	0.90	10.59	32	0.90	17.27	14	0.39	13.20	14	0.39	6.72	84	2.37	12.03	22	0.62	5.20
CO_3[2]	0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
NO_3	0.01613	12	0.19	2.27	20	0.32	6.17	4.6	0.07	2.48	4.7	0.08	1.29	0.49	0.01	0.04	0.48	0.01	0.06
		TOTAL	8.52	100.00	TOTAL	5.23	100.00	TOTAL	2.99	100.00	TOTAL	5.87	100.00	TOTAL	19.69	100.00	TOTAL	11.93	100.00
(meq/L cations-anions)/(meq/L cations+anions)*100				7.19			5.47			3.90			2.92			6.46			2.07

Cation/Anion Balance Calculations (Dissolved Metals), Horn Rapids Landfill, First Quarter 2020

	Conversion Factor[1] (mg/L to meq/L)	Well #8			Well #9			Well #10			Well #11			MW-12		
		Value (mg/L)	Value (meq/L)	Percent of Total (meq/L)	Value (mg/L)	Value (meq/L)	Percent of Total (meq/L)	Value (mg/L)	Value (meq/L)	Percent of Total (meq/L)	Value (mg/L)	Value (meq/L)	Percent of Total (meq/L)	Value (mg/L)	Value (meq/L)	Percent of Total (meq/L)
CATIONS																
Na	0.0435	28	1.22	12.81	28	1.22	10.37	26	1.13	5.96	20	0.87	4.58	21	0.91	20.86
Ca	0.0499	120	5.99	63.00	150	7.49	63.73	260	12.97	68.39	270	13.47	70.85	49	2.45	55.83
Mg	0.08229	25	2.06	21.64	34	2.80	23.82	55	4.53	23.86	53	4.36	22.94	10	0.82	18.79
Fe(+2)	0.03581	0.1	0.00	0.04	0.1	0.00	0.03	0.1	0.00	0.02	0.1	0.00	0.02	0.1	0.00	0.08
K	0.02558	9.3	0.24	2.50	9.4	0.24	2.05	13	0.33	1.75	12	0.31	1.61	7.6	0.19	4.44
Mn	0.0364	0.01	0.00	0.00	0.01	0.00	0.00	0.12	0.00	0.02	0.01	0.00	0.00	0.01	0.00	0.01
		TOTAL	9.51	100.00	TOTAL	11.75	100.00	TOTAL	18.97	100.00	TOTAL	19.02	100.00	TOTAL	4.38	100.00
ANIONS																
HCO_3[2]	0.02	130	2.60	30.27	390	7.80	69.21	740	14.80	82.77	180	3.60	20.05	140	2.80	68.75
SO_4	0.02082	74	1.54	17.94	79	1.64	14.59	91	1.89	10.60	330	6.87	38.27	37	0.77	18.92
Cl	0.02821	140	3.95	45.98	61	1.72	15.27	42	1.18	6.63	240	6.77	37.72	15	0.42	10.39
CO_3[2]	0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
NO_3	0.01613	31	0.50	5.82	6.5	0.10	0.93	0.1	0.00	0.01	44	0.71	3.95	4.9	0.08	1.94
		TOTAL	8.59	100.00	TOTAL	11.27	100.00	TOTAL	17.88	100.00	TOTAL	17.95	100.00	TOTAL	4.07	100.00
(meq/L cations-anions)/(meq/L cations+anions)*100				5.06			2.06			2.96			2.88			3.64

[1] Reference: Hem 1985.

[2] HCO_3 and CO_3 reported as $CaCO_3$, conversion factor adjusted accordingly.

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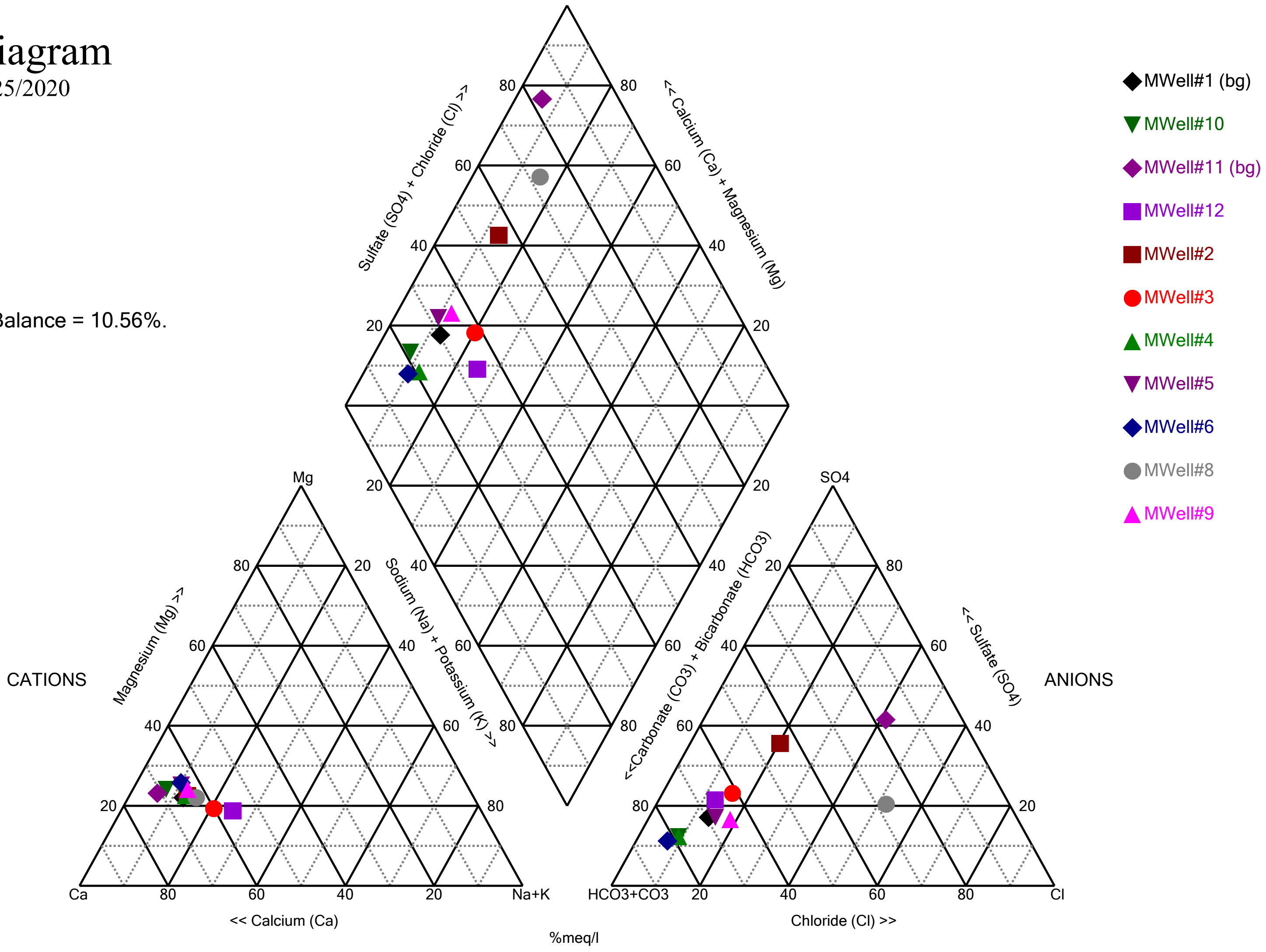
Piper Diagram

3/24/2020, 3/25/2020

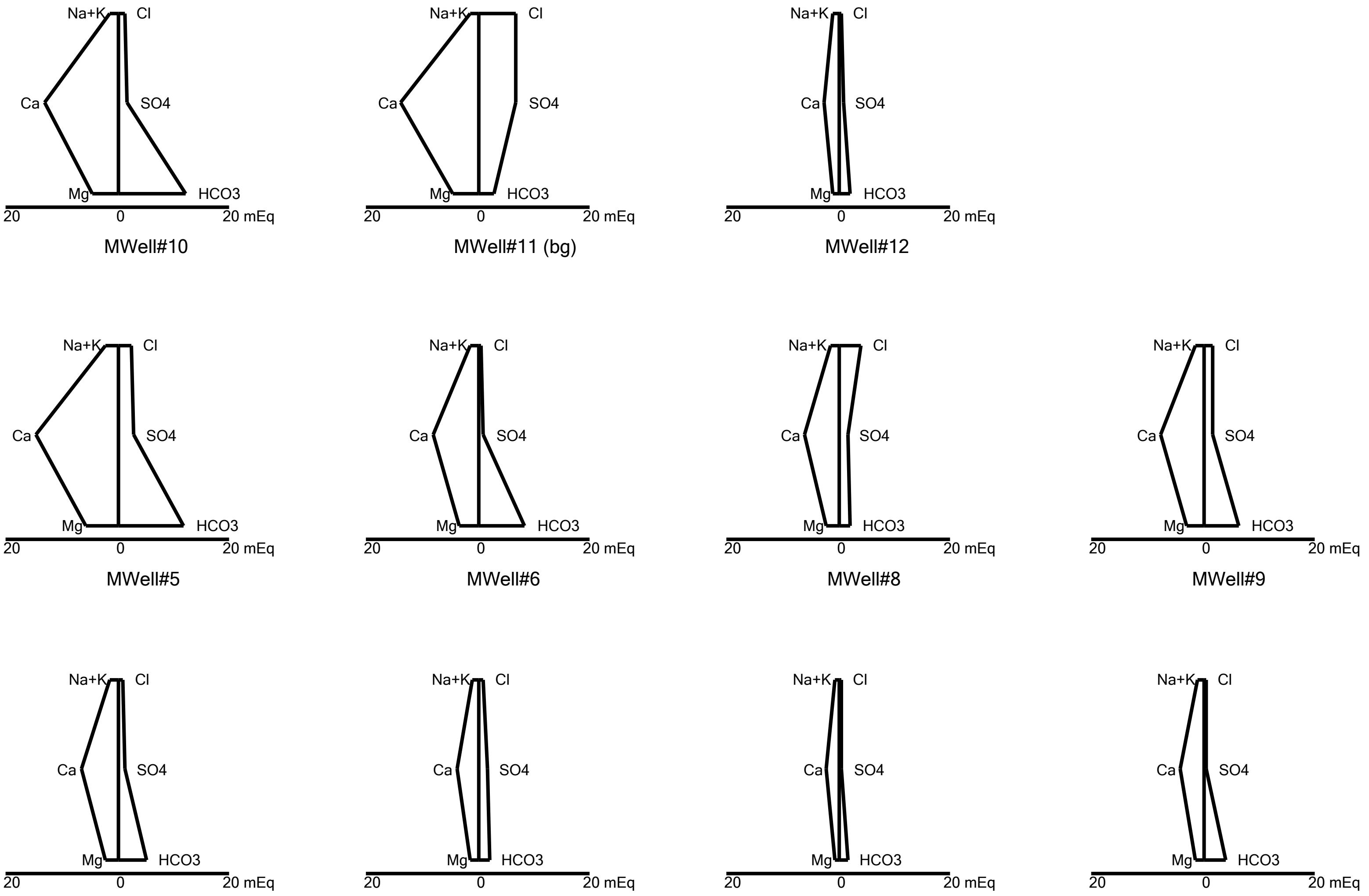
Cation-Anion Balance = 10.56%.



Analysis Run 5/14/2020 4:47 PM

Horn Rapids Landfill   Client: City of Richland   Data: 1Q_20_PIPER

Sanitas™ v.9.6.25 Software licensed to Parametrix. UG



MWell#10 MWell#11 (bg) MWell#12

MWell#5 MWell#6 MWell#8 MWell#9

MWell#1 (bg) MWell#2 MWell#3 MWell#4

Stiff Diagram - 3/24/2020, 3/25/2020 Analysis Run 5/14/2020 4:49 PM

Horn Rapids Landfill Client: City of Richland Data: 1Q_20_PIPER

Cation/Anion Balance Calculations, Horn Rapids Landfill, Second Quarter 2020

	Conversion Factor[1] (mg/L to meq/L)	Well #1			Well #2			Well #3			Well #4			Well #5			Well #6		
		Value (mg/L)	Value (meq/L)	Percent of Total (meq/L)	Value (mg/L)	Value (meq/L)	Percent of Total (meq/L)	Value (mg/L)	Value (meq/L)	Percent of Total (meq/L)	Value (mg/L)	Value (meq/L)	Percent of Total (meq/L)	Value (mg/L)	Value (meq/L)	Percent of Total (meq/L)	Value (mg/L)	Value (meq/L)	Percent of Total (meq/L)
CATIONS																			
Na	0.0435	24	1.04	10.48	16	0.70	10.98	14	0.61	15.70	16	0.70	10.26	41	1.78	8.68	23	1.00	7.55
Ca	0.0499	130	6.49	65.09	80	3.99	62.97	47	2.35	60.44	87	4.34	63.97	260	12.97	63.11	170	8.48	64.01
Mg	0.08229	27	2.22	22.29	18	1.48	23.37	9.4	0.77	19.94	19	1.56	23.04	66	5.43	26.42	42	3.46	26.08
Fe(+2)	0.03581	0.1	0.00	0.04	0.1	0.00	0.06	0.1	0.00	0.09	0.1	0.00	0.05	0.1	0.00	0.02	0.1	0.00	0.03
K	0.02558	8.2	0.21	2.10	6.5	0.17	2.62	5.8	0.15	3.82	7.1	0.18	2.68	14	0.36	1.74	12	0.31	2.32
Mn	0.0364	0.01	0.00	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.17	0.01	0.03	0.043	0.00	0.01
		TOTAL	9.97	100.00	TOTAL	6.34	100.00	TOTAL	3.88	100.00	TOTAL	6.79	100.00	TOTAL	20.56	100.00	TOTAL	13.25	100.00
ANIONS																			
HCO_3[2]	0.02	330	6.60	76.21	110	2.20	44.77	89	1.78	56.36	240	4.80	82.16	650	13.00	68.06	480	9.60	84.44
SO_4	0.02082	57	1.19	13.70	74	1.54	31.36	35	0.73	23.07	30	0.62	10.69	190	3.96	20.71	53	1.10	9.71
Cl	0.02821	30	0.85	9.77	33	0.93	18.95	20	0.56	17.86	14	0.39	6.76	74	2.09	10.93	22	0.62	5.46
CO_3[2]	0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
NO_3	0.01613	1.7	0.03	0.32	15	0.24	4.92	5.3	0.09	2.71	1.4	0.02	0.39	3.6	0.06	0.30	2.8	0.05	0.40
		TOTAL	8.66	100.00	TOTAL	4.91	100.00	TOTAL	3.16	100.00	TOTAL	5.84	100.00	TOTAL	19.10	100.00	TOTAL	11.37	100.00
(meq/L cations-anions)/(meq/L cations+anions)*100				7.01			12.67			10.25			7.48			3.67			7.65

Cation/Anion Balance Calculations, Horn Rapids Landfill, Second Quarter 2020

	Conversion Factor[1] (mg/L to meq/L)	**Well #8**			**Well #9**			**Well #10**			**Well #11**			**MW-12**		
		Value (mg/L)	**Value (meq/L)**	**Percent of Total (meq/L)**	**Value (mg/L)**	**Value (meq/L)**	**Percent of Total (meq/L)**	**Value (mg/L)**	**Value (meq/L)**	**Percent of Total (meq/L)**	**Value (mg/L)**	**Value (meq/L)**	**Percent of Total (meq/L)**	**Value (mg/L)**	**Value (meq/L)**	**Percent of Total (meq/L)**
CATIONS																
Na	0.0435	34	1.48	12.56	33	1.44	10.72	29	1.26	6.12	22	0.96	4.95	22	0.96	20.31
Ca	0.0499	150	7.49	63.57	170	8.48	63.38	280	13.97	67.73	270	13.47	69.63	53	2.64	56.12
Mg	0.08229	31	2.55	21.66	39	3.21	23.98	61	5.02	24.33	56	4.61	23.82	11	0.91	19.21
Fe(+2)	0.03581	0.1	0.00	0.03	0.1	0.00	0.03	0.33	0.01	0.06	0.1	0.00	0.02	0.1	0.00	0.08
K	0.02558	10	0.26	2.17	9.9	0.25	1.89	14	0.36	1.74	12	0.31	1.59	7.9	0.20	4.29
Mn	0.0364	0.01	0.00	0.00	0.01	0.00	0.00	0.14	0.01	0.02	0.01	0.00	0.00	0.01	0.00	0.01
		TOTAL	11.77	100.00	TOTAL	13.38	100.00	TOTAL	20.63	100.00	TOTAL	19.35	100.00	TOTAL	4.71	100.00
ANIONS																
HCO_3[2]	0.02	130	2.60	28.30	400	8.00	68.53	730	14.60	82.33	170	3.40	21.11	140	2.80	69.84
SO_4	0.02082	81	1.69	18.36	83	1.73	14.80	93	1.94	10.92	300	6.25	38.79	36	0.75	18.70
Cl	0.02821	160	4.51	49.13	66	1.86	15.95	42	1.18	6.68	210	5.92	36.79	14	0.39	9.85
CO_3[2]	0.02	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00
NO_3	0.01613	24	0.39	4.21	5.2	0.08	0.72	0.77	0.01	0.07	33	0.53	3.31	4	0.06	1.61
		TOTAL	9.19	100.00	TOTAL	11.67	100.00	TOTAL	17.73	100.00	TOTAL	16.10	100.00	TOTAL	4.01	100.00
(meq/L cations-anions)/(meq/L cations+anions)*100				12.34			6.83			7.55			9.16			8.07

[1] Reference: Hem 1985.

[2] HCO_3 and CO_3 reported as $CaCO_3$, conversion factor adjusted accordingly.

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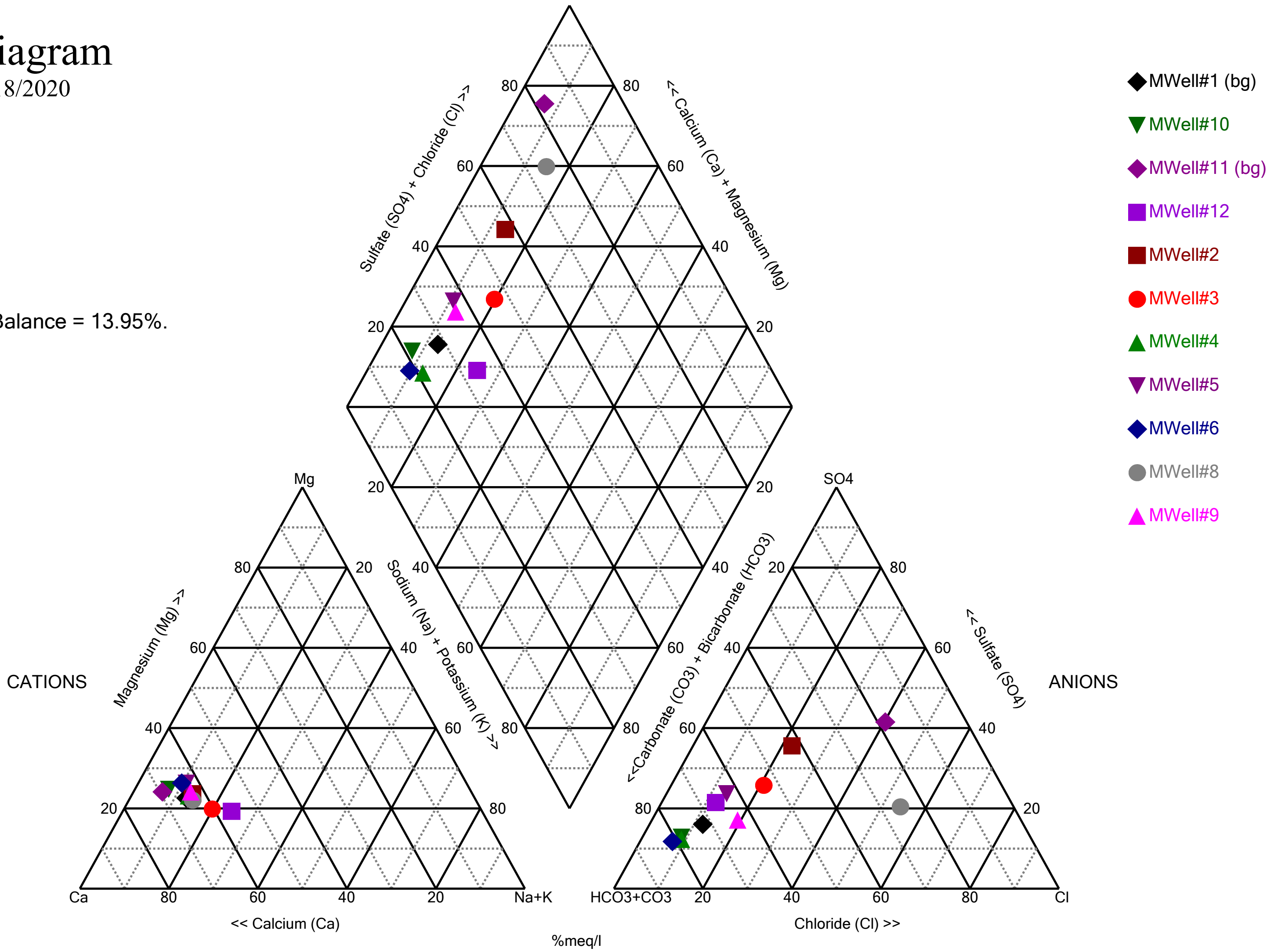
Piper Diagram

6/17/2020, 6/18/2020

Cation-Anion Balance = 13.95%.



Analysis Run 8/14/2020 5:57 AM

Horn Rapids Landfill   Client: City of Richland   Data: 2Q_20_PIPER

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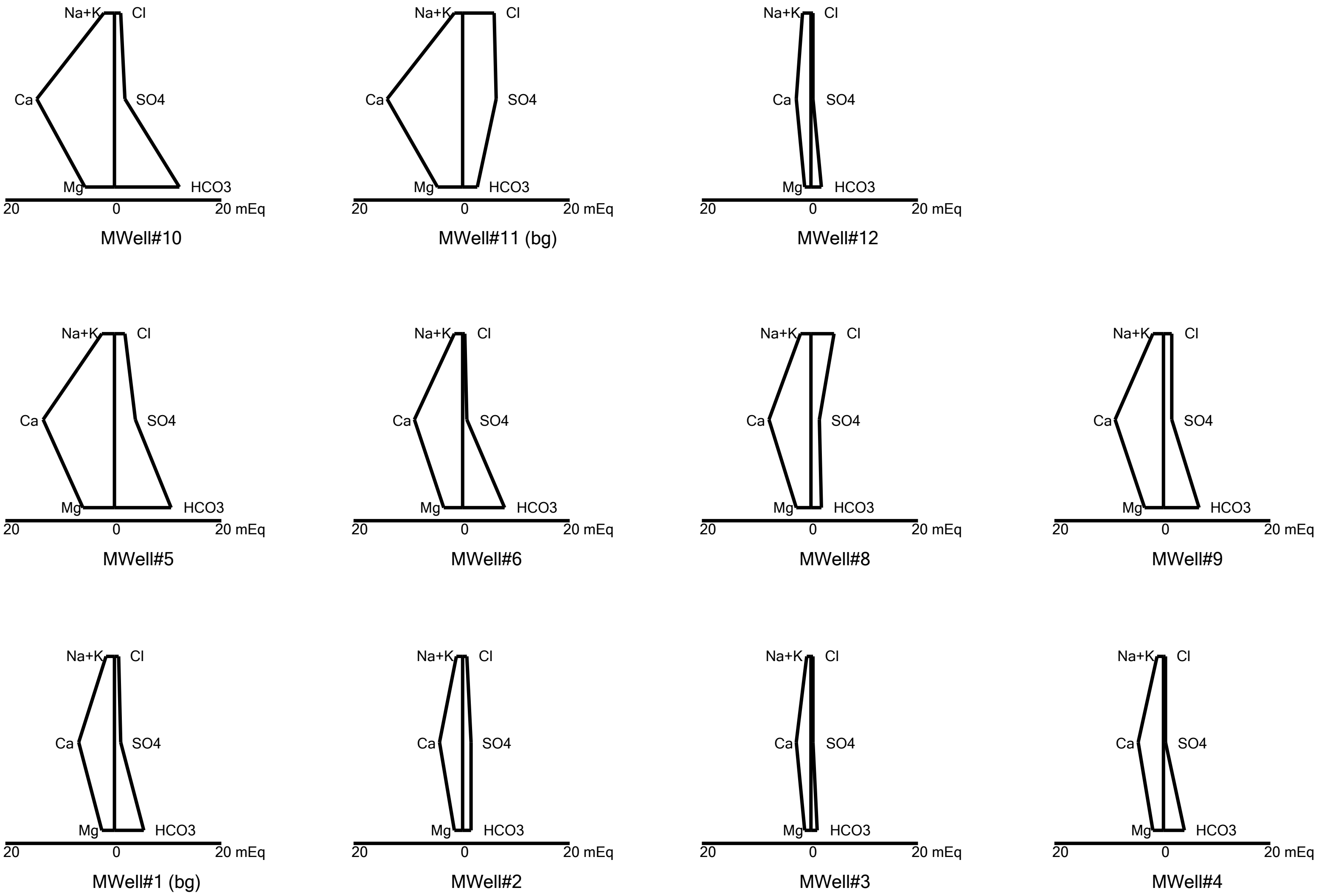


MWell#10 MWell#11 (bg) MWell#12

MWell#5 MWell#6 MWell#8 MWell#9

MWell#1 (bg) MWell#2 MWell#3 MWell#4

Stiff Diagram - 6/17/2020, 6/18/2020 Analysis Run 8/14/2020 5:58 AM

Horn Rapids Landfill Client: City of Richland Data: 2Q_20_PIPER

Appendix H

Leachate Data

H-1

Lysimeter Construction

Don D.

CITY OF
RICHLAND
505 Swift Blvd. • Box 190 • Richland, Washington 99352 • (509) 943-9161 • FAX (509) 943-5666

WATER AND WASTE UTILITIES DEPARTMENT

December 4, 1995

RECEIVED
DEC 4 1995
WATER DIVISION
SOLID WASTE DIVISION

MICHAEL PELOQUIN
Environmental Health Specialist
Solid Waste Program
800 West Canal Drive
Kennewick, WA 99336

SUBJECT: VADOSE ZONE MONITORING

Dear Mr. Peloquin:

The city is requesting that present quarterly vadose zone monitoring be done on a semiannual basis. As mentioned in our November 14, 1995 meeting we identified that purged sample amounts in some ports are too small for analysis. As a result, the only analysis performed is on a few purged lysimeters for every sample period. Given that one (1) gallon of leachate occupies approximately one and one half (1.5) feet of pipe, it is unlikely that any leachate will be lost if sampled semiannually. For example, the 561 foot four inch pipe, connecting lysimeter one and port one, can hold 374 gallons of leachate before displacing leachate held in lysimeter one (pipe two 279 gallons, pipe three 226 gallons and pipe four 97 gallons). (Refer to attached map for pipe length.) The following table identifies total amount of leachate purged form each port and pipe holding capacity. Less than one (<1) gallon indicates that there is not enough leachate to collect a complete sample.

VADOSE ZONE MONITORING
PURGE VOLUMES IN GALLONS

YEAR	1994				1995			TOTAL GALLONS PURGED	PIPE HOLDING CAPACITY
QUARTER	1	2	3	4	1	2	3		
Port one	16	13	2.5	5	3.5	<1	2	41	374
Port Two	26	3	0	0	1.5	<1	<1	32.5	279
Port Three	13	0	0	0	0	2	<1	16	226
Port Four	16	<1	<1	4	9	8	5	44	97

This table illustrates that total leachate collected for individual lysimeters would not cause lysimeters to overflow. Therefore, in an attempt to increase lysimeter volumes for sampling and save on laboratory costs the city would like to sample semiannually.

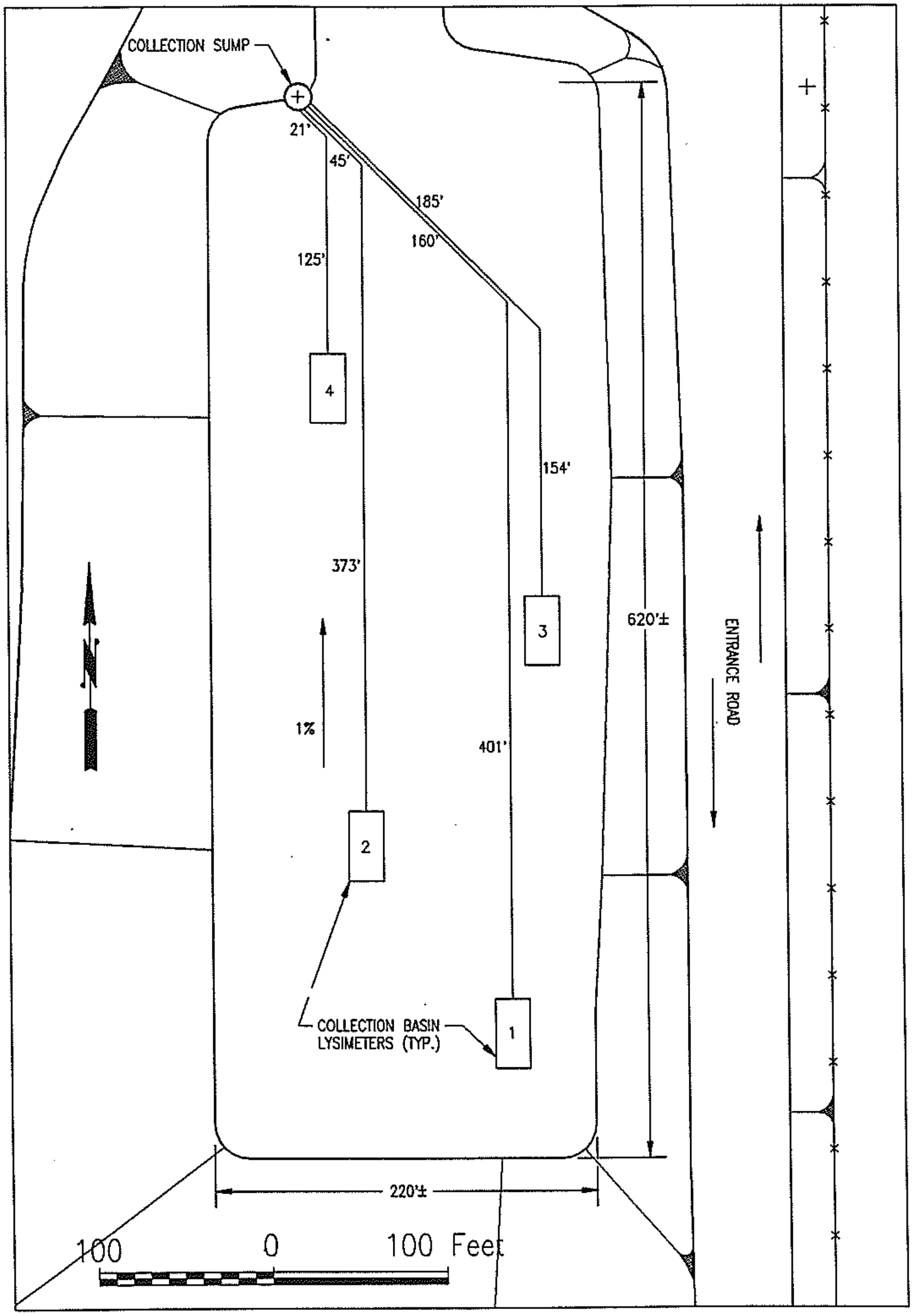
Another factor for requesting semiannual sampling is that city is waiting for the arrival of a safety hoist to be used by staff when sampling in the confined space. It is anticipated that this equipment will be receive in February of 1996. However, this does not mean that the city cannot access the sampling vault if required by BFHD before arrival of equipment.

Also enclosed is the time line you requested on additional landfill activities. If you have any question I can be reached at 943-7463.

Sincerely,

Rog G. Wright
ROGER G. WRIGHT, P.E.
Division Manager
Utilities and Environmental Engineering Division

cc: Matthew Zybas


COLLECTION SUMP
21'
45'
185'
160'
125'
4
154'
373'
3
620'±
ENTRANCE ROAD
1%
401'
2
COLLECTION BASIN
LYSIMETERS (TYP.)
1
220'±
100
0
100 Feet

CITY OF RICHLAND
505 Swift Blvd. • Box 190 • Richland, Washington 99352 • (509) 943-9161 • FAX (509) 943-5666

WATER AND WASTE UTILITIES DEPARTMENT

December 20, 1991

Mr. Ray Collins, R.S.
Solid Waste Program
Environmental Health Section
BENTON-FRANKLIN HEALTH DISTRICT
800 W. Canal Drive
Kennewick, WA 99336

SUBJECT: RICHLAND SANITARY LANDFILL - PERMIT NO. BFHD 91-691 VADOSE ZONE MONITORING VARIANCE

Ray

Dear ~~Mr. Collins~~:

According to the Richland Sanitary Landfill Permit, Special Conditions, Item 4. B., the City of Richland is required to install a Vadose Zone Moisture Monitoring system by November 4, 1991. According to Chapter 173-304 of the Washington Administrative Code, Minimum Functional Standards for Solid Waste Handling, the Vadose Zone Monitoring system is to be installed in any new active area prior to receiving solid waste.

The new active area at the Richland Landfill has not yet been completely constructed. Excavation of the new cell is underway and is expected to be completed in late 1992. Currently refuse is being disposed of over existing compacted waste. Following completion of the excavation, the Vadose Zone Monitoring System (lysimeters), will be installed prior to the area receiving solid waste.

Enclosed please find a request for variance of the required installation schedule. We request that the time schedule be revised to March of 1993 for completion of the Vadose Zone Monitoring System. We plan to complete the excavation and lysimeter construction as soon as possible, but, at least by March of 1993.

Please review the attached information at your earliest convenience. If we can provide additional information please give us a call. We appreciate your cooperation in this matter.

Sincerely,

Stan

STANLEY R. ARLT, P.E., Director
Water and Waste Utilities Department

SRA/rgw

cc: Mike Gillum
Don Dawson
Roger Wright

RICHLAND SANITARY LANDFILL
VADOSE ZONE MONITORING SYSTEM
VARIANCE REQUEST

Introduction

The City of Richland landfill has been in operation since 1976. The landfill is located on a 115-acre site approximately 8 miles northeast of Richland on Highway 240 at the intersection of Grosscup Road and Highway 240. A location map is included in the appendix. The landfill is permitted by the Benton-Franklin District Health Department, Permit No. BFHD: 91-691, as a solid waste disposal site. The landfill operation includes collection and disposal of municipal solid waste mainly from just the City of Richland service area.

The Richland Sanitary Landfill is regulated by the Minimum Functional Standards for Solid Waste Handling (MFS), Chap 173-304 of the Washington Administrative Code (WAC). WAC 173-304-450 (3) (c) (iv) Arid Design, states that landfill locations having less than twelve inches of precipitation annually may install a vadose zone moisture monitoring system in lieu of a lined facility. In February of 1989 the Department of Ecology issued Technical Information Memorandum (TIM) No. 89-1, titled Vadose Zone Monitoring. This TIM clarified the acceptable method for monitoring the vadose zone and described the use of collection basin lysimeters as the acceptable method.

According to the present Richland Sanitary Landfill permit, Special Conditions, Item 4. B., the Landfill is required to install a vadose zone moisture monitoring system in any future active area prior to receiving solid waste. The permit states that the monitoring system shall be installed by November 4, 1991. The permit also states that if the installation of the lysimeters is to be delayed beyond November 4, 1991 then a variance request will need to be submitted and reviewed.

The purpose of this variance is to request that the time for construction of the lysimeters be extended to March of 1993 for completion.

Vadose Zone Monitoring Requirements

In accordance with WAC 173-304-450 landfill locations having less than twelve inches of annual precipitation can substitute a vadose zone moisture monitoring system for a complete landfill liner. In addition, the location must not have waste material within ten feet of the seasonal high groundwater level of the uppermost aquifer. Should any evidence of leachate or waste constituents be detected in the vadose zone that violates or could be expected to violate the performance standard of WAC 173-304-460 the owner must take corrective action.

The Department of Ecology TIM No. 89-1 states that the acceptable method for monitoring the vadose zone is the use of lysimeters due to the ability to measuring both leachate volume as well as quality. The TIM details design of the vadose zone moisture monitoring system utilizing lysimeter basins constructed of 20' by 40' membrane liners sloped toward a perforated collection pipe. The collection pipe is routed to a sump located outside of the refuse area.

Vadose Zone Monitoring System

The Richland Landfill Development and Closure/Post-Closure Plan submitted in 1990 identifies the proposed method for Leachate Control and Vadose Zone Monitoring at the Richland Landfill. The location meets the Arid Design requirements since the average annual precipitation is less than twelve inches and the distance between the waste and the highest seasonal groundwater level is in excess than 10 feet. The average annual rainfall in the area surrounding the landfill is 6.3 inches, according to the Climatological Summary for the Hanford Area, (Stone, W.A., J.M. Thorp, O.P. Gifford, D.J. Hoitink, 1983, Pacific Northwest Laboratory, Richland, Washington, PNL-4622). During a geotechnical evaluation of the area the groundwater was determined to be at about elevation 378 feet above MSL directly underneath the landfill. A copy of the potentiometric map of the landfill prepared during the geotechnical investigation is included in the appendix. The deepest excavation for disposal of waste planned for the facility is 420 feet above MSL for a separation distance of between 40 and 50 feet.

Section III of the Closure/Post Closure Plan, page 7, Item 4., Leachate Control states that the lysimeters shall be constructed on a frequency of one lysimeter per one acre. This is a more frequent placement than the one lysimeter per 2 1/2 acres as recommended in the TIM so as to obtain more frequent and broad based data on this location. Drawings indicating the proposed placement and construction of the lysimeters are included in the appendix.

Current Operating Plan

Past operation of the Richland Landfill was performed without proper future planning. As a result a large area of landfill has received a small amount of refuse, estimated at 10 to 15 feet of depth. The current operation utilizes the remaining available space located over the past disposal area bringing the finished refuse depth to approximately 20 feet above the original ground level. Therefore, all current refuse is being deposited over existing garbage.

Within the existing "active" area (57 1/2 acres) consisting of the west half of the permitted 115 acres of landfill, all but approximately four acres has received waste. This four acre area, located in the northeast corner of the west half of the landfill, is the next scheduled area to begin receiving waste. This area is currently being excavated in preparation for the lysimeter basins and for receiving waste.

New-Active Area Construction

The new active area will consist of a cell approximately 250 feet wide and in excess of 600 feet long. The bottom of the excavation will be at about elevation 420 feet above MSL or approximately 30 feet below original ground level. The planned finished refuse elevation will be 470 feet above MSL or about 20 feet above the original ground level. The existing bottom elevation is approximately 435 feet above MSL. There is an estimated 100,000 cubic yards of soil remaining to be removed from the new cell.

Schedule

Currently one 20 cubic yard scraper is operating in the new excavation. The equipment averages approximately 400 to 500 loads per month. At this rate completion of the excavation would take until late 1992. Installation of the lysimeter basins is expected to take four to six weeks with the new cell being ready to receive waste by March of 1993.

Summary

The current operation at the Richland Sanitary Landfill is in compliance with Chapter 173-304 of the WAC, Minimum Function Standards, as no new areas have received waste prior to construction of the Vadose Zone Monitoring System. This variance is requested to extend the date required by Benton-Franklin Health District Solid Waste Permit Number BFHD:91-691.

RICHLAND SANITARY LANDFILL
VADOSE ZONE MONITORING SYSTEM
VARIANCE REQUEST

APPENDIX

- Location Map
- Potentiometric Map
- New Active Area
  March 1993 Completion
- Cross Section
  Collection Basin Lysimeter
- Cross Section
  Collection Sump

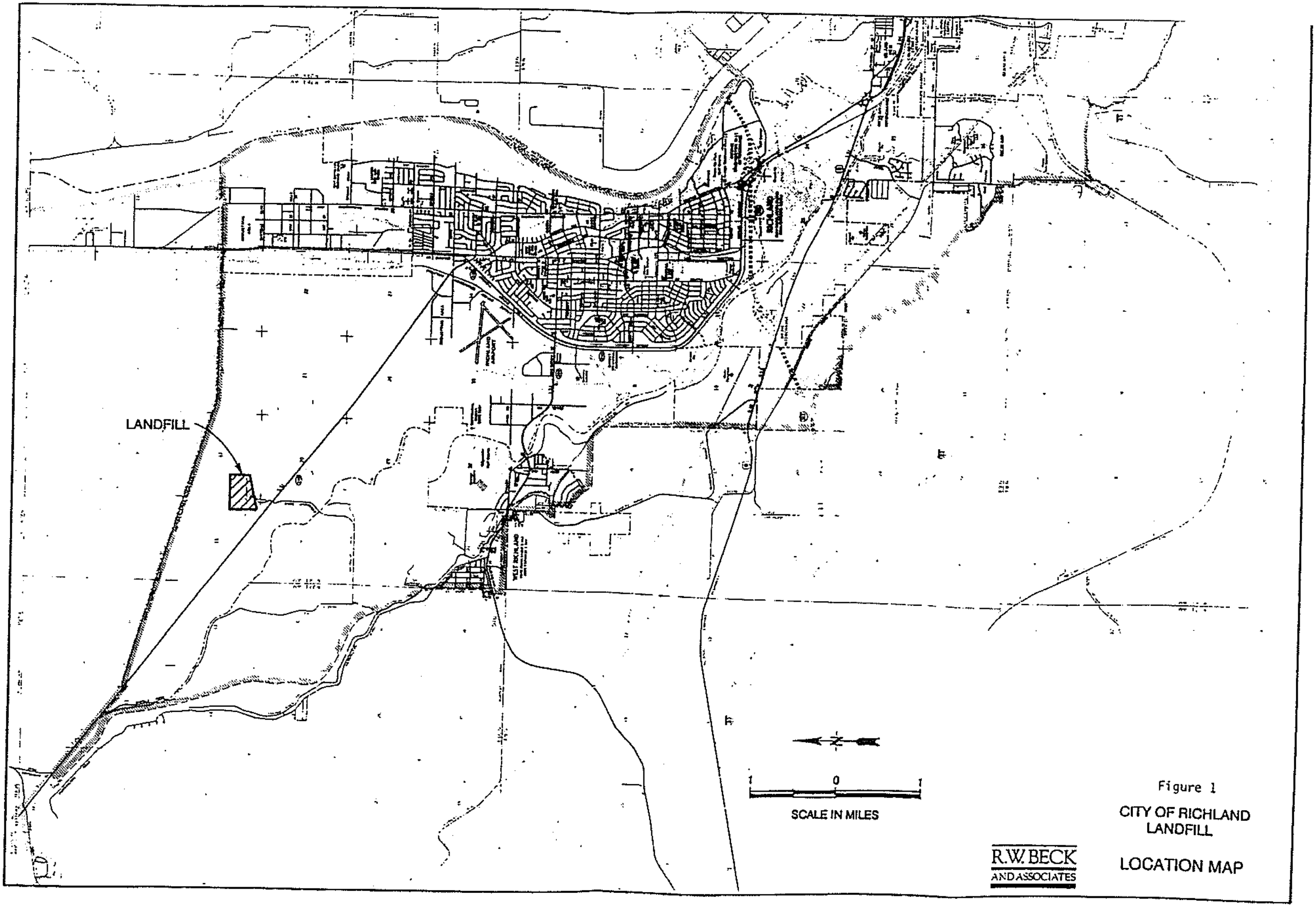
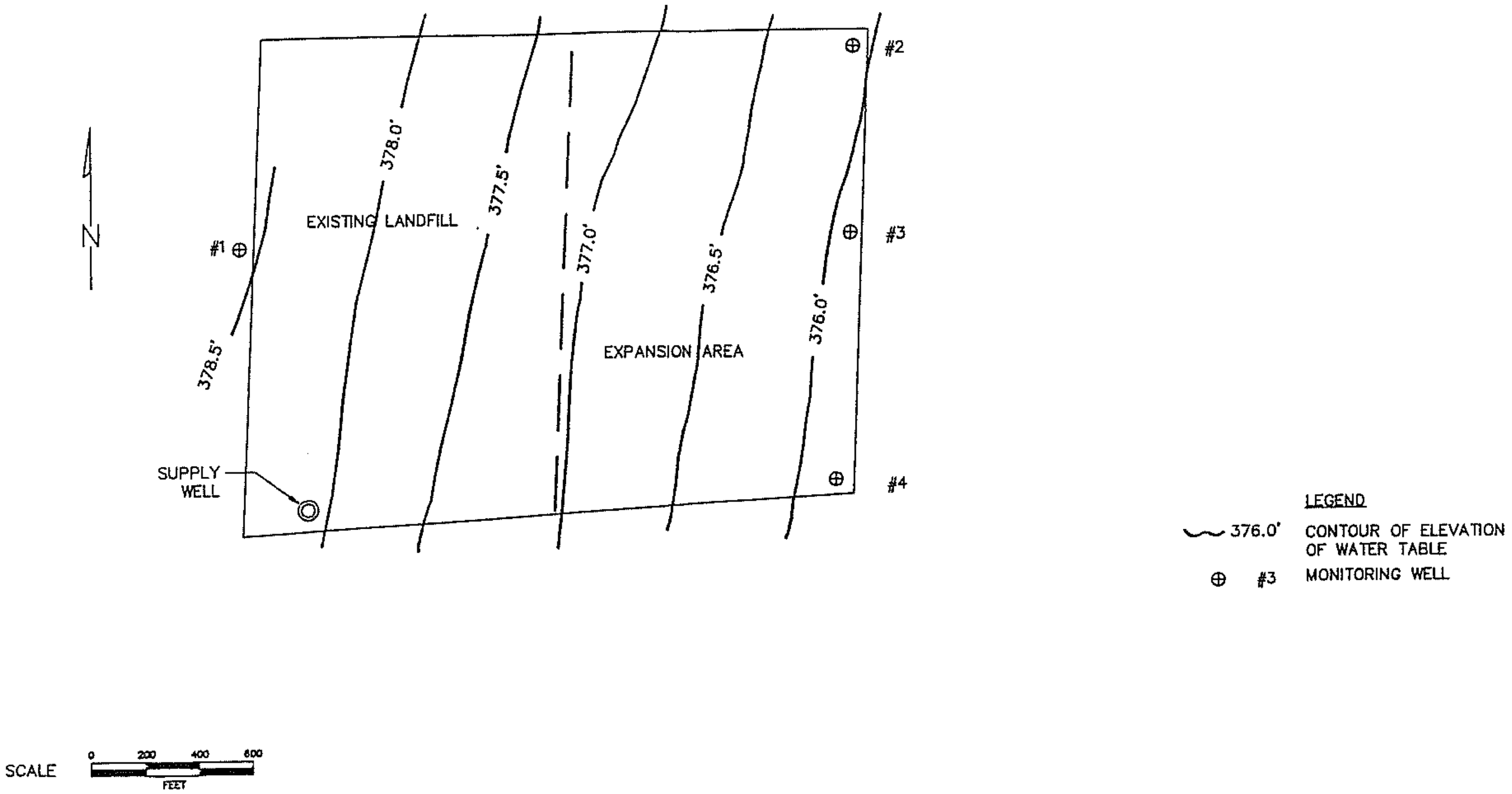


Figure 1

CITY OF RICHLAND
LANDFILL

LOCATION MAP

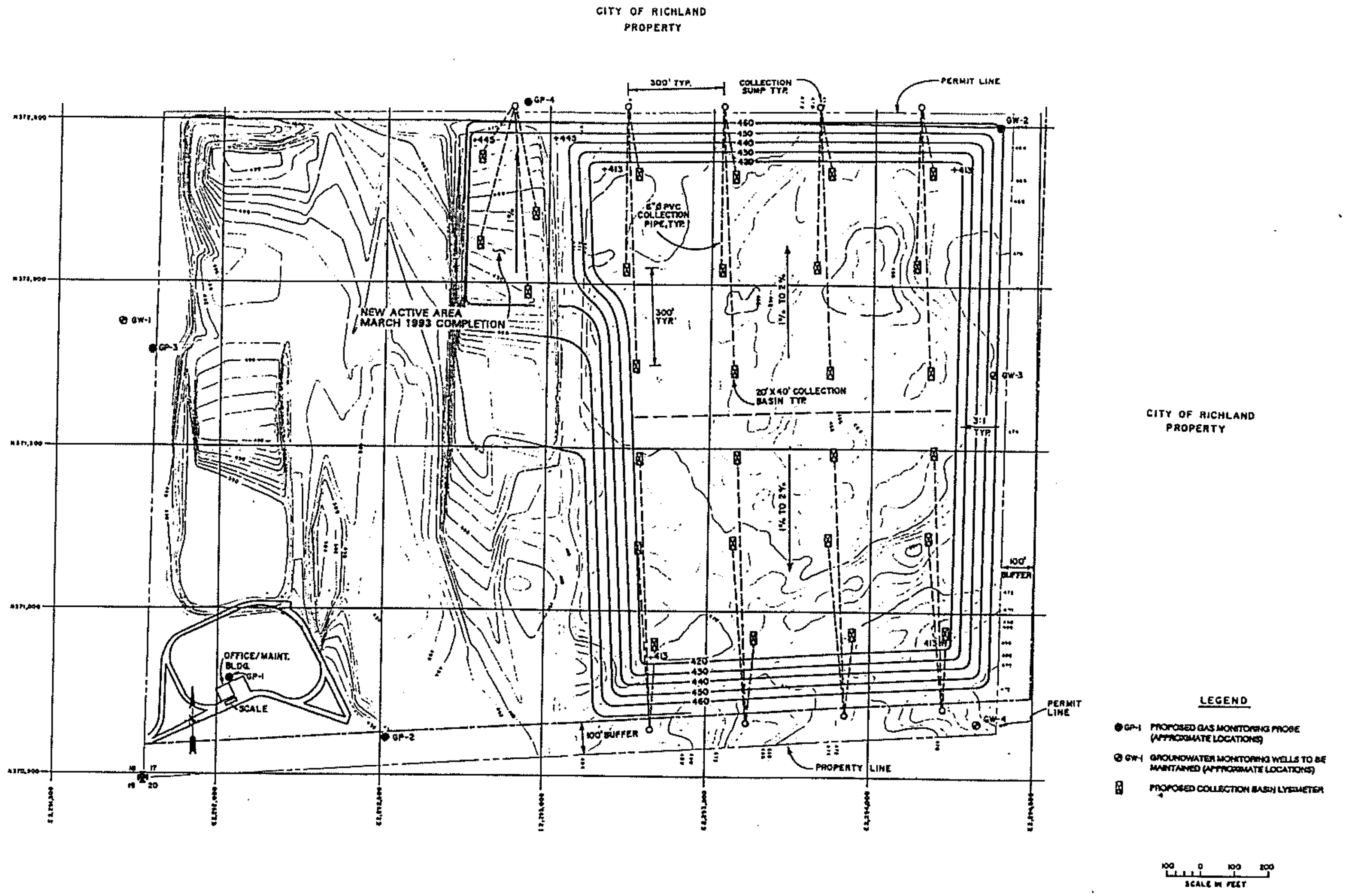
POTENTIOMETRIC MAP
RICHLAND LANDFILL



DATE 2/7/90

FIGURE 3

HONG WEST & ASSOCIATES



REV.	DATE	BY	CK'D	APPROVALS		DESCRIPTION
A	3/27/90	JRW	KRH			CLIENT REVIEW

DRAWING REVISION RECORD

DES. JJS	CIVIL REV.	ELEC. REV.
DWN. JRW	MECH. REV.	STRUC. REV.
CK'D. KRH	APPD.	DATE

R.W. BECK AND ASSOCIATES

CITY OF RICHLAND, WASHINGTON
LANDFILL
EXCAVATION PLAN

W/O WV-1309-AA1-AC
DWG. NO. C-1

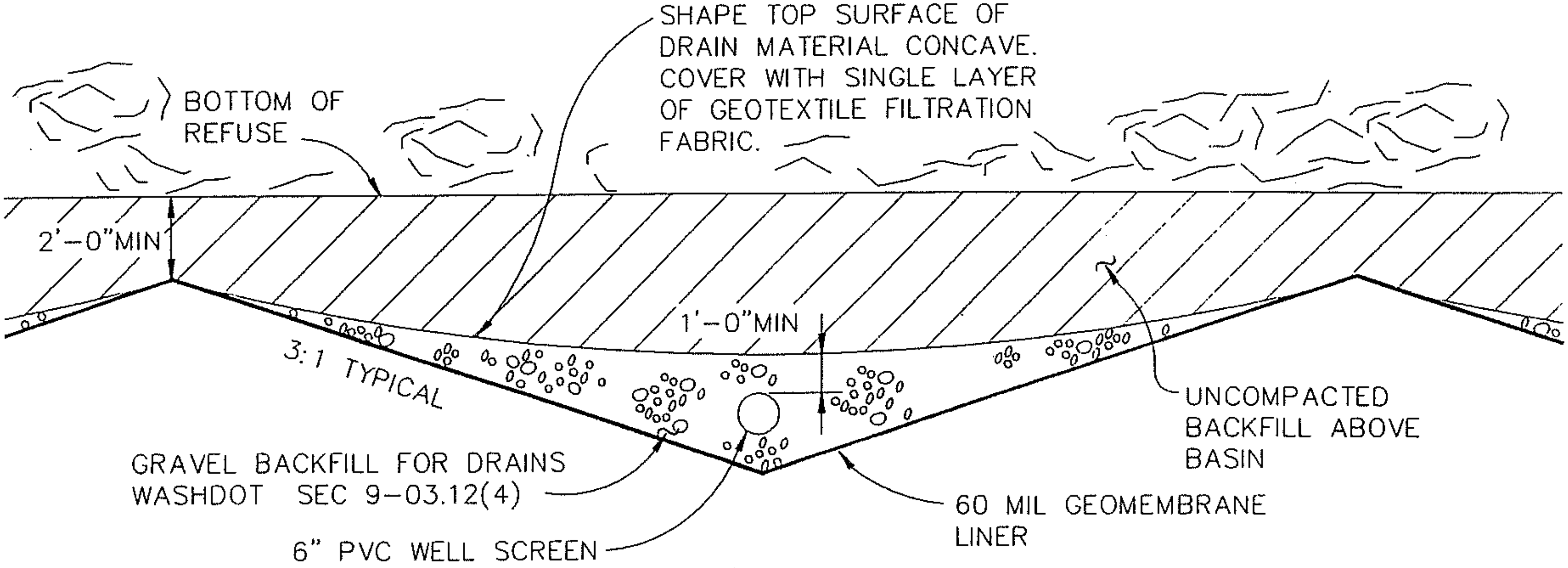


Figure III-3
Richland Landfill Closure

Cross-Section
Collection Basin Lysimeter

R.W. BECK
AND ASSOCIATES

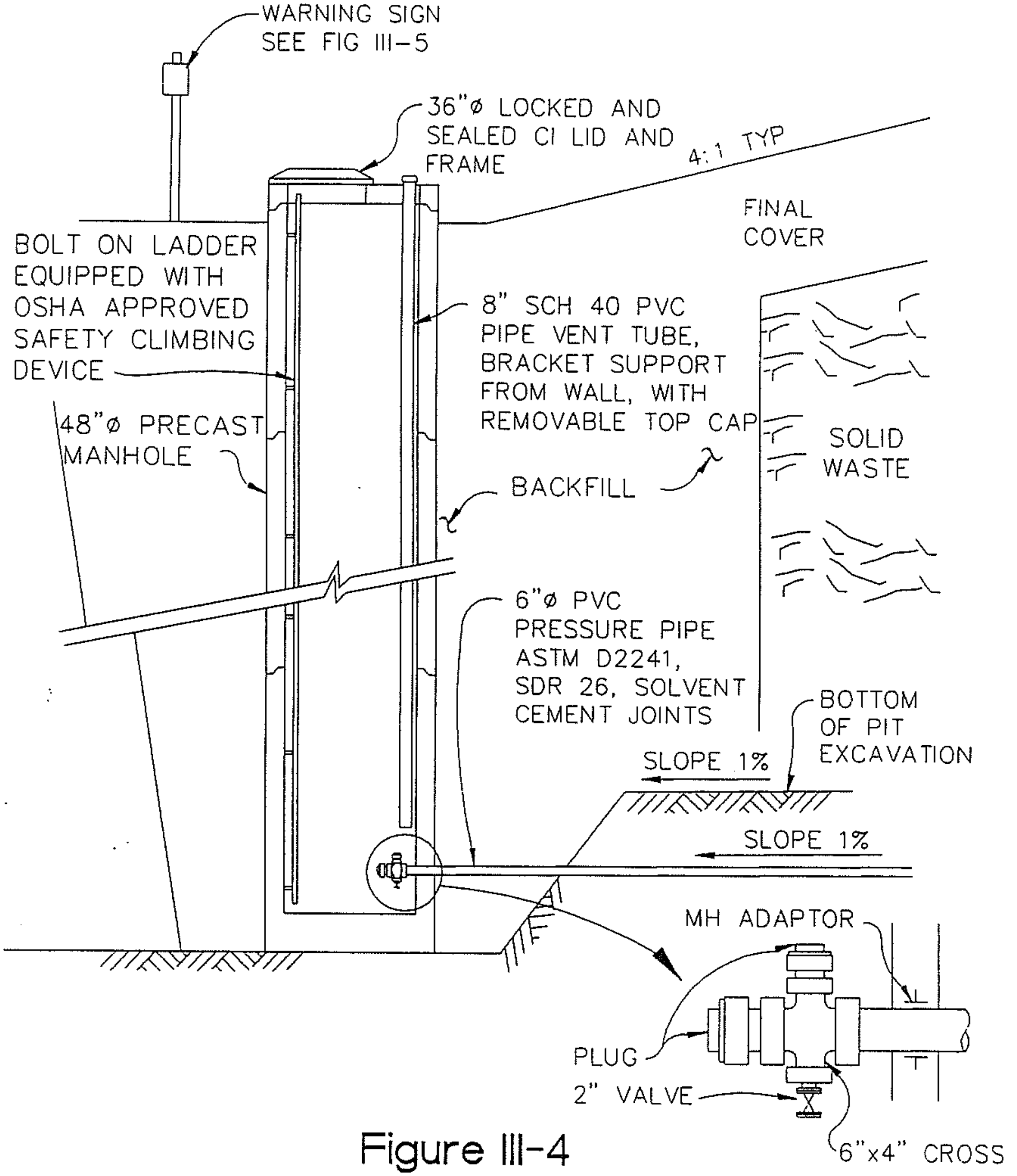


Figure III-4
Richland Landfill Closure

Cross-Section
Collection Sump

R.W. BECK
AND ASSOCIATES

H-2

Leachate Quality Data

Table H-1. Historical Leachate Quality Results,Horn Rapids Landfill

	Analyte	Units	GWQS	MCL	(LEACHATE) PORT-3 11/19/2014	Port 3 6/25/2015	Port 3 6/27/2016	Trip Blank 11/19/2014	Trip Blank 6/24/2015	Trip Blank 6/27/2016
WATER QUALITY PARAMETERS	Nitrate-Nitrogen	mg/L as N	10 *	10 *	<0.90	NA	NA	NA	NA	NA
	Calcium, Total	mg/L			300	NA	NA	NA	NA	NA
	Sodium, Total	mg/L			53	NA	NA	NA	NA	NA
	Bicarbonate Alkalinity	mg/L as CaCO3			830	NA	NA	NA	NA	NA
	Chloride	mg/L	250 **	250 **	**520**	NA	NA	NA	NA	NA
	Magnesium, Total	mg/L			140	NA	NA	NA	NA	NA
	Potassium, Total	mg/L			67	NA	NA	NA	NA	NA
	Sulfate	mg/L	250 **	250 **	<1.2	NA	NA	NA	NA	NA
	Total Alkalinity	mg/L as CaCO3			830	NA	NA	NA	NA	NA
	Iron, Total	mg/L	0.3 **	0.3 **	**26**	NA	NA	NA	NA	NA
	Manganese, Total	mg/L	0.05 **	0.05 **	**8.5**	NA	NA	NA	NA	NA
	Ammonia-Nitrogen	mg/L as N			1.9	NA	NA	NA	NA	NA
	Total Organic Carbon	mg/L			98	NA	NA	NA	NA	NA
	Total Dissolved Solids	mg/L	500 **	500 **	**1700**	NA	NA	NA	NA	NA
	Total Suspended Solids	mg/L			190	NA	NA	NA	NA	NA
METALS	Antimony, Total	mg/L		6 *	<0.0004	NA	NA	NA	NA	NA
	Arsenic, Total	mg/L	0.00005 ***	0.01 *	**0.0150**	NA	NA	NA	NA	NA
	Barium, Total	mg/L	1 *	2 *	0.690	NA	NA	NA	NA	NA
	Beryllium, Total	mg/L		0.004 *	<0.0004	NA	NA	NA	NA	NA
	Cadmium, Total	mg/L	0.01 *	0.005 *	<0.0004	NA	NA	NA	NA	NA
	Chromium, Total	mg/L	0.05 *	0.1 *	0.00077	NA	NA	NA	NA	NA
	Cobalt, Total	mg/L			0.029	NA	NA	NA	NA	NA
	Copper, Total	mg/L	1 **		0.016	NA	NA	NA	NA	NA
	Lead, Total	mg/L	0.05 *		0.0035	NA	NA	NA	NA	NA
	Nickel, Total	mg/L		0.1 *	0.039	NA	NA	NA	NA	NA
	Selenium, Total	mg/L	0.01 *	0.05 *	<0.001	NA	NA	NA	NA	NA
	Silver, Total	mg/L	0.05 *	0.1 **	<0.0004	NA	NA	NA	NA	NA
	Thallium, Total	mg/L		0.002 *	<0.001	NA	NA	NA	NA	NA
	Vanadium, Total	mg/L			0.0021	NA	NA	NA	NA	NA
	Zinc, Total	mg/L	5 **	5 **	0.92	NA	NA	NA	NA	NA
VOLATILE ORGANIC COMPOUNDS	Chloromethane	µg/L			0.41	<0.30	<0.30	<0.10	<0.30	<0.30
	Vinyl Chloride	µg/L	0.02 ***	2 *	**4.6**	**2.5**	**2.9**	<0.020	<0.020	<0.020
	Bromomethane	µg/L			<0.10	<1.0	<1.0	<0.10	<1.0	<1.0
	Chloroethane	µg/L			4.8	1.9	4.3	<0.25	<0.50	<0.50
	Trichlorofluoromethane	µg/L			<0.10	<0.50	<0.50	<0.10	<0.50	<0.50
	1,1-Dichloroethene	µg/L		7 *	0.35	0.13	<0.10	<0.10	<0.10	<0.10
	Iodomethane	µg/L			<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Carbon Disulfide	µg/L			0.47	5.7	18	<0.10	<0.20	<0.20
	Acetone	µg/L			60	47	<2.0	<2.0	<2.0	<2.0
	Methylene Chloride	µg/L	5 ***	5 *	1.8	2.3	2.7 J	<0.50	1.4	2.0 B
	Acrylonitrile	µg/L	0.07 ***		<2.0	12	**20**	<2.0	<5.0	<5.0
	Vinyl Acetate	µg/L			<0.50	<1.0	<1.0	<0.50	<1.0	<1.0
	trans-1,2-Dichloroethene	µg/L		100 *	0.23	<0.20	<0.20	<0.10	<0.20	<0.20
	1,1-Dichloroethane	µg/L	1 ***		**7.9**	**3.3**	**5.8**	<0.10	<0.20	<0.20
	cis-1,2-Dichloroethene	µg/L		70 *	27	6.2	9.6	<0.10	<0.20	<0.20
	2-Butanone	µg/L			<2.0	<15	<15	<2.0	<15	<15
	Bromochloromethane	µg/L			<0.10	<0.20	<0.20	<0.10	<0.20	<0.20
	Chloroform	µg/L	7 ***	80 * THM	<0.10	<0.20	<0.20	<0.10	<0.20	<0.20
	1,1,1-Trichloroethane	µg/L	200 *	200 *	<0.10	<0.20	<0.20	<0.10	<0.20	<0.20
	Carbon Tetrachloride	µg/L	0.3 ***	5 *	<0.10	<0.20	<0.20	<0.10	<0.20	<0.20
	Benzene	µg/L	1 ***	5 *	**4.8**	1.0	**1.8**	<0.10	<0.20	<0.20
	1,2-Dichloroethane	µg/L	0.5 ***	5 *	**1.3**	**0.71**	**0.87**	<0.10	<0.20	<0.20
	Trichloroethene	µg/L	3 ***	5 *	0.51	0.29	0.47	<0.10	<0.20	<0.20
	1,2-Dichloropropane	µg/L	0.6 ***	5 *	0.36	<0.20	<0.20	<0.10	<0.20	<0.20
	Dibromomethane	µg/L			<0.10	<0.20	<0.20	<0.10	<0.20	<0.20
	Bromodichloromethane	µg/L	0.3 ***	80 * THM	<0.10	<0.20	<0.20	<0.10	<0.20	<0.20
	cis-1,3-Dichloropropene	µg/L			<0.10	<0.50	<0.50	<0.10	<0.50	<0.50
	4-Methyl-2-pentanone	µg/L			160	5400	3100 E	<0.50	<5.0	<5.0
	Toluene	µg/L		1000 *	5.7	3.8	6.1	<0.10	<0.20	<0.20
	trans-1,3-Dichloropropene	µg/L			<0.10	<0.20	<0.20	<0.10	<0.20	<0.20
	1,1,2-Trichloroethane	µg/L		5 *	<0.10	<0.20	<0.20	<0.10	<0.20	<0.20
	Tetrachloroethene	µg/L	0.8 ***	5 *	**1.4**	**0.82**	**1.3**	<0.10	<0.50	<0.50
	2-Hexanone	µg/L			1.5	<2.0	<2.0	<1.0	<2.0	<2.0
	Dibromochloromethane	µg/L		80 * THM	<0.10	<0.20	<0.20	<0.10	<0.20	<0.20
	1,2-Dibromoethane	µg/L	0.001 ***	0.05 *	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
	Chlorobenzene	µg/L		100 *	<0.10	<0.20	<0.20	<0.10	<0.20	<0.20
	1,1,1,2-Tetrachloroethane	µg/L			<0.10	<0.20	<0.20	<0.10	<0.20	<0.20
	Ethylbenzene	µg/L		700 *	1.5	2.6	4.2	<0.10	<0.20	<0.20
	Styrene	µg/L		100 *	0.52	<0.50	<0.50	<0.10	<0.50	<0.50
	Bromoform	µg/L	5 ***	80 * THM	<0.10	<0.50	<0.50	<0.10	<0.50	<0.50
	1,1,2,2-Tetrachloroethane	µg/L			<0.10	<0.20	<0.20	<0.10	<0.20	<0.20
	1,2,3-Trichloropropane	µg/L			<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
	trans-1,4-Dichloro-2-butene	µg/L			<1.0	<2.0	<2.0	<1.0	<2.0	<2.0
	1,4-Dichlorobenzene	µg/L	4 ***	75 *	<0.20	<0.30	<0.30	<0.20	<0.30	<0.30
	1,2-Dichlorobenzene	µg/L		600 *	<0.20	<0.30	<0.30	<0.20	<0.30	<0.30
	1,2-Dibromo-3-Chloropropane	µg/L		0.2 *	<0.40	<2.0	<2.0	<0.40	<2.0	<2.0
	Total Xylenes	µg/L		10000 * XYL	19	31	54	<0.10	<0.50	<0.50

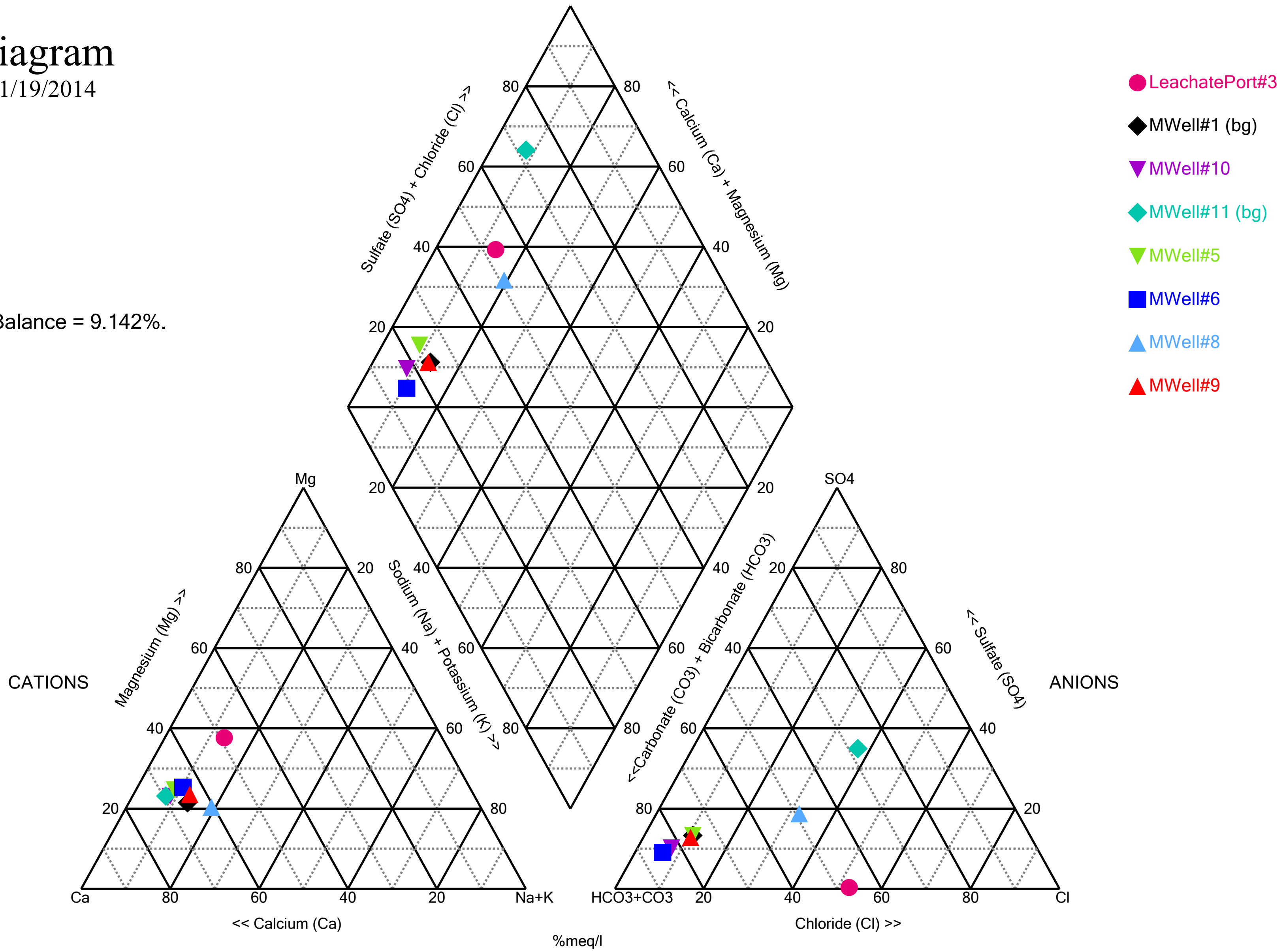
Notes:

[1] = Chapter 173-351 WAC
GWQS = Water Quality Standards for Ground Waters of the State of Washington (WAC 173-200)
MCL = Maximum Contaminant Level, State Drinking Water Regulations (WAC 246-290)
UTL = Upper tolerance limit calculated using baseline data from upgradient well MW-1
* = Primary
** = Secondary
*** = Carcinogen
*THM = Primary MCL for the sum of all trihalomethanes
*XYL = Primary MCL for the sum of all xylenes
J = Estimated value; see lab report for details
E = Result exceeded calibration range
B = Detected in reagent blank or trip blank
Bold = Does not meet GWQS or MCL
NA = Not analyzed

Piper Diagram

11/20/2014, 11/19/2014

Cation-Anion Balance = 9.142%.



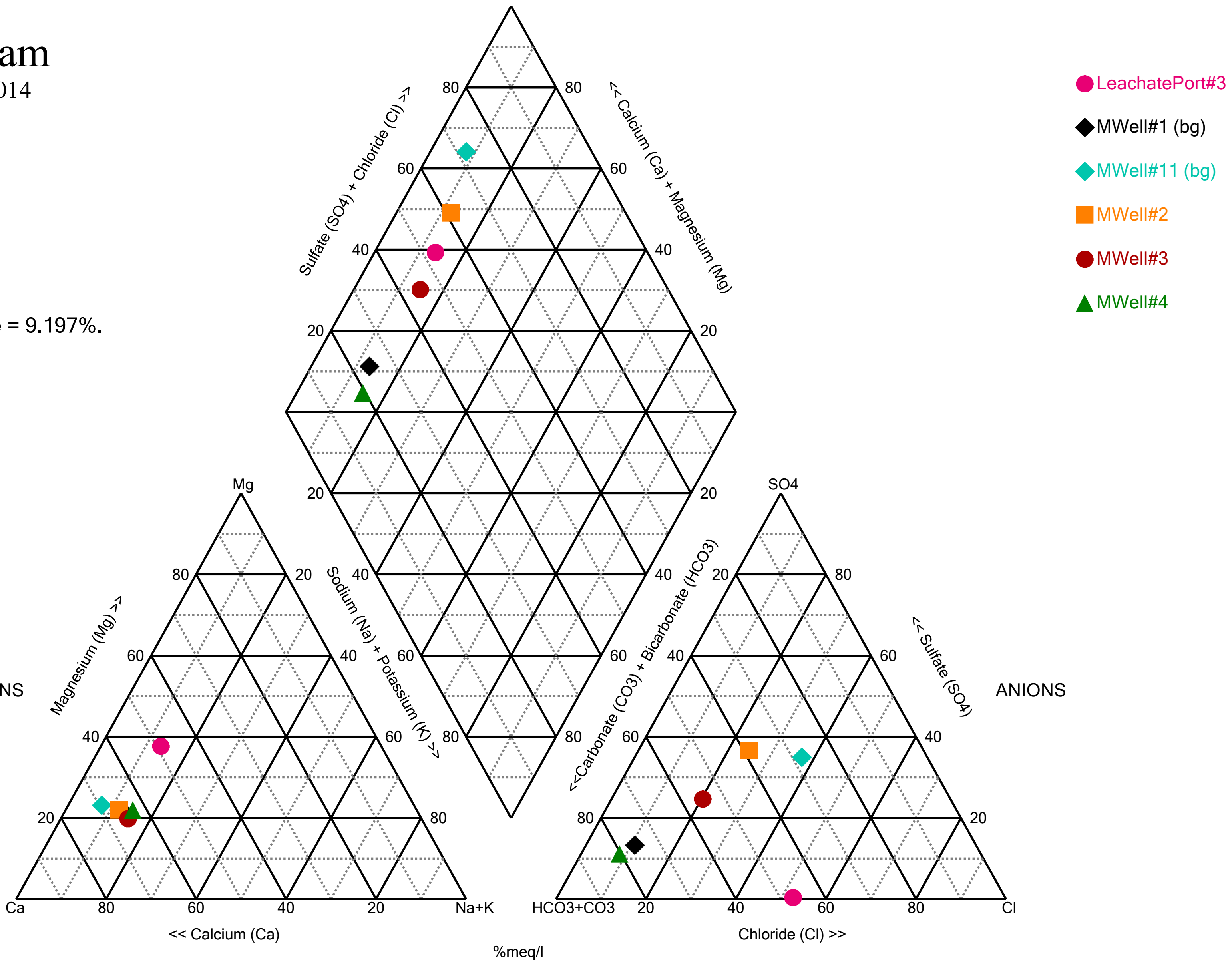
Analysis Run 2/19/2015 4:36 PM

Facility: Horn Rapids LF   Client: City of Richland   Data File: 4Q_14_PIPER2

Piper Diagram

11/20/2014, 11/19/2014

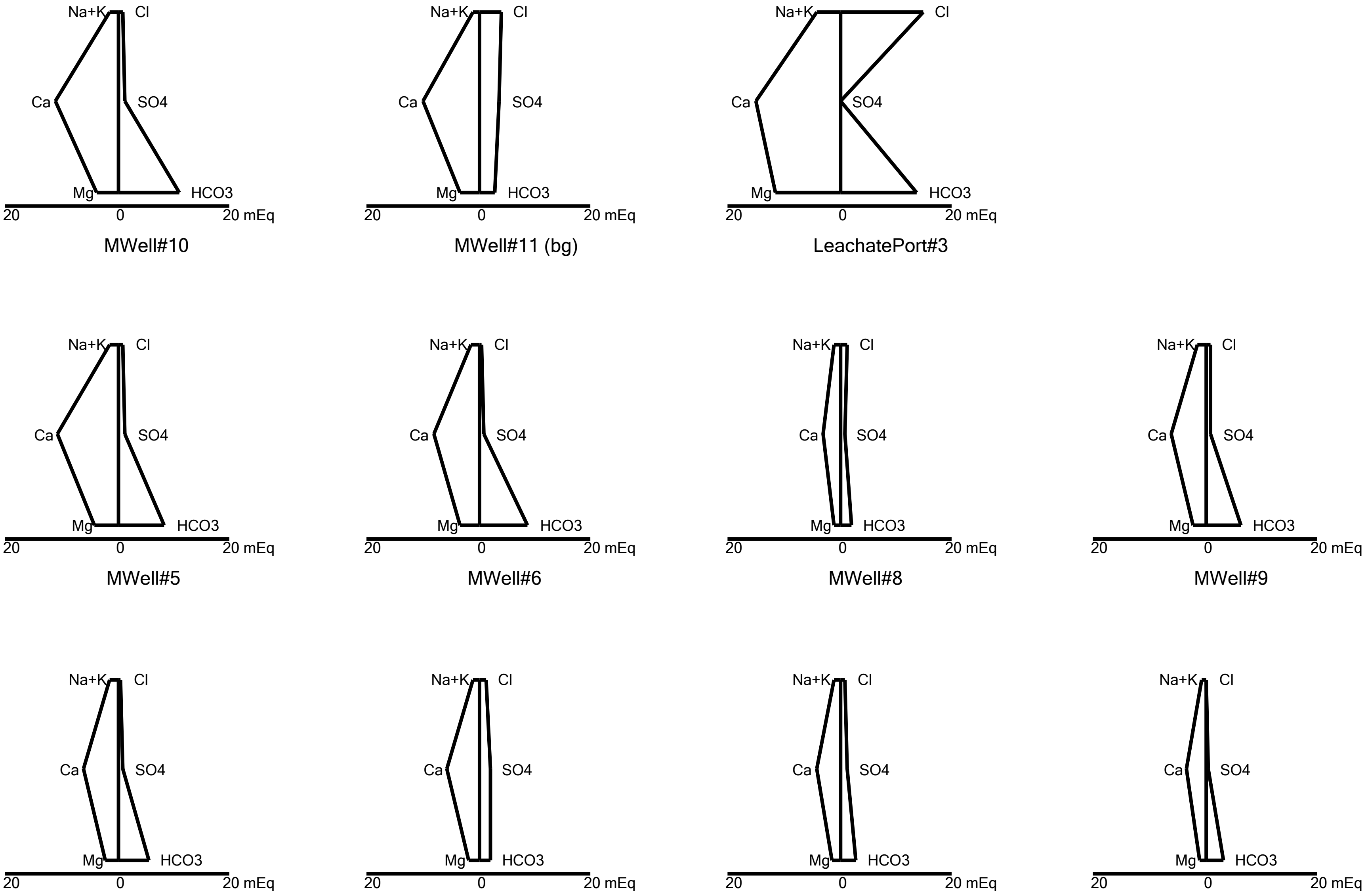
Cation-Anion Balance = 9.197%.



Analysis Run 2/19/2015 4:35 PM

Facility: Horn Rapids LF Client: City of Richland Data File: 4Q_14_PIPER2

Sanitas™ v.9.4.38 For the statistical analyses of groundwater by Parametrix, Inc. EPA



MWell#10 MWell#11 (bg) LeachatePort#3

MWell#5 MWell#6 MWell#8 MWell#9

MWell#1 (bg) MWell#2 MWell#3 MWell#4

Stiff Diagram - 11/20/2014, 11/19/2014 Analysis Run 2/19/2015 4:33 PM

Facility: Horn Rapids LF Client: City of Richland Data File: 4Q_14_PIPER2

Comparison of Upgradient Horn Rapids Groundwater to Historical Horn Rapids Landfill Leachate

		UTL MW-1	Port 1	Port 2	Port 3	Port 4	Port Average	Ratio Average Port to MW-1
Sulfate	mg/L	68	0.75	28.2	0.5375	0.2725	7	0.1
pH	mg/L	6.65	5.6	6.3	5.825	5.85	6	0.9
Calcium, Total	mg/L	164	72.86	NA	235.725	264.8	191	1.2
Bicarbonate as CaCO3	mg/L	434	375.75	63.6	958.5	1005	601	1.4
Total Dissolved Solids	mg/L	780	684.5	160	1759	1901.5	1126	1.4
conductivity	mg/L	1048	909.4	1535	1846.5	1994.75	1571	1.5
Sodium, Total	mg/L	29	18.16	53.8	63.35	54.1	47	1.6
Potassium, Total	mg/L	9.7	7.634	45.9	20.65	21.35	24	2.5
Magnesium, Total	mg/L	35	27.76	138	93.25	102.8	90	2.6
Total Organic Carbon	mg/L	6.8	150	8.4	48.166667	78.5	71	10.5
Chloride	mg/L	46	86.4	1439	504.5	495	631	13.7
Ammonia as Nitrogen Total	mg/L	0.14	1.9625	2.95	2.35	1.85	2	16.3
nitrate	mg/L	14.1	0.2258	1544	0.0325	0.0325	386	27.4
Manganese, Total	mg/L	0.15	1.3978	53.5	8.0675	8.715	18	119.5

NA = Not available

Includes data collected between 2000 and 2002

Horn Rapids Leachate Quality

	Port 1	Port 2	Port 3	Port 4	Average
Bicarbonate	375.75	63.6	958.5	1005	601
Calcium	72.86		235.725	264.8	191
Chloride	86.4	1439	504.5	495	631
Magnesium	27.76	138	93.25	102.8	90
Manganese	1.3978	53.5	8.0675	8.715	18
Potassium	7.634	45.9	20.65	21.35	24
Sodium	18.16	53.8	63.35	54.1	47
Sulfate	0.75	28.2	0.5375	0.2725	7
Ammonia	1.9625	2.95	2.35	1.85	2
Conductivity	909.4	1535	1846.5	1994.75	1571
Nitrate	0.2258	1544	0.0325	0.0325	386
pH	5.6	6.3	5.825	5.85	6
TDS	684.5	160	1759	1901.5	1126
TOC	150	8.4	48.166667	78.5	71

Horn Rapids Leachate Quality

	Port 1					
	1/11/2000	11/8/2000	6/18/2001	12/5/2001	12/31/2002	Average
Bicarbonate	853	220	300	130		375.75
Calcium	51.8	76.5	100	48	88	72.86
Chloride	120	68	87	47	110	86.4
Magnesium	43.5	30.3	25	15	25	27.76
Manganese	1.98	0.849	2.3	0.66	1.2	1.3978
Potassium	21	5.07	4.4	2.8	4.9	7.634
Sodium	48.7	12.8	12	6.3	11	18.16
Sulfate	0.4	0.4	0.25	1.6	1.1	0.75
Ammonia	1.95	0.7	2.1	3.1		1.9625
Conductivity	832	1100	429	802	1384	909.4
Nitrate	0.46	0.16	0.13	0.079	0.3	0.2258
pH	5.9	5.9	4.9	5.3	6	5.6
TDS	360	770	250	1358		684.5
TOC	150					150

Horn Rapids Leachate Quality

	Port 2	
	1/11/2000	Average
Bicarbonate	63.6	63.6
Calcium		
Chloride	1439	1439
Magnesium	138	138
Manganese	53.5	53.5
Potassium	45.9	45.9
Sodium	53.8	53.8
Sulfate	28.2	28.2
Ammonia	2.95	2.95
Conductivity	1535	1535
Nitrate	1544	1544
pH	6.3	6.3
TDS	160	160
TOC	8.4	8.4

Horn Rapids Leachate Quality

	Port 3				
	1/11/2000	11/8/2000	6/18/2001	12/5/2001	Average
Bicarbonate	1234	920	980	700	958.5
Calcium	54.9	228	370	290	235.725
Chloride	508	500	550	460	504.5
Magnesium	50.8	92.2	130	100	93.25
Manganese	9.27	7.2	9.5	6.3	8.0675
Potassium	23.2	13.4	26	20	20.65
Sodium	74.3	43.1	79	57	63.35
Sulfate	0.3	0.4	0.45	1	0.5375
Ammonia	2.8	2.1	1.7	2.8	2.35
Conductivity	2530	1220	2500	1136	1846.5
Nitrate	0.05	0.05	0.015	0.015	0.0325
pH	6.1	5.2	6.3	5.7	5.825
TDS	1836	1800	2000	1400	1759
TOC	47	43	54.5		48.166667

Horn Rapids Leachate Quality

	Port 4				
	1/11/2000	**11/8/2000**	**6/18/2001**	**12/5/2001**	**Average**
Bicarbonate	1190	950	960	920	1005
Calcium	55.2	264	360	380	264.8
Chloride	470	470	490	550	495
Magnesium	50.2	101	130	130	102.8
Manganese	10.07	6.99	9.4	8.4	8.715
Potassium	22.9	14.5	24	24	21.35
Sodium	59.9	37.5	60	59	54.1
Sulfate	0.05	0.4	0.48	0.16	0.2725
Ammonia	2.3	1.5	1.8	1.8	1.85
Conductivity	2410	1720	2700	1149	1994.75
Nitrate	0.05	0.05	0.015	0.015	0.0325
pH	6	5.5	6.3	5.6	5.85
TDS	1906	1800	2000	1900	1901.5
TOC	100	68	67.5		78.5

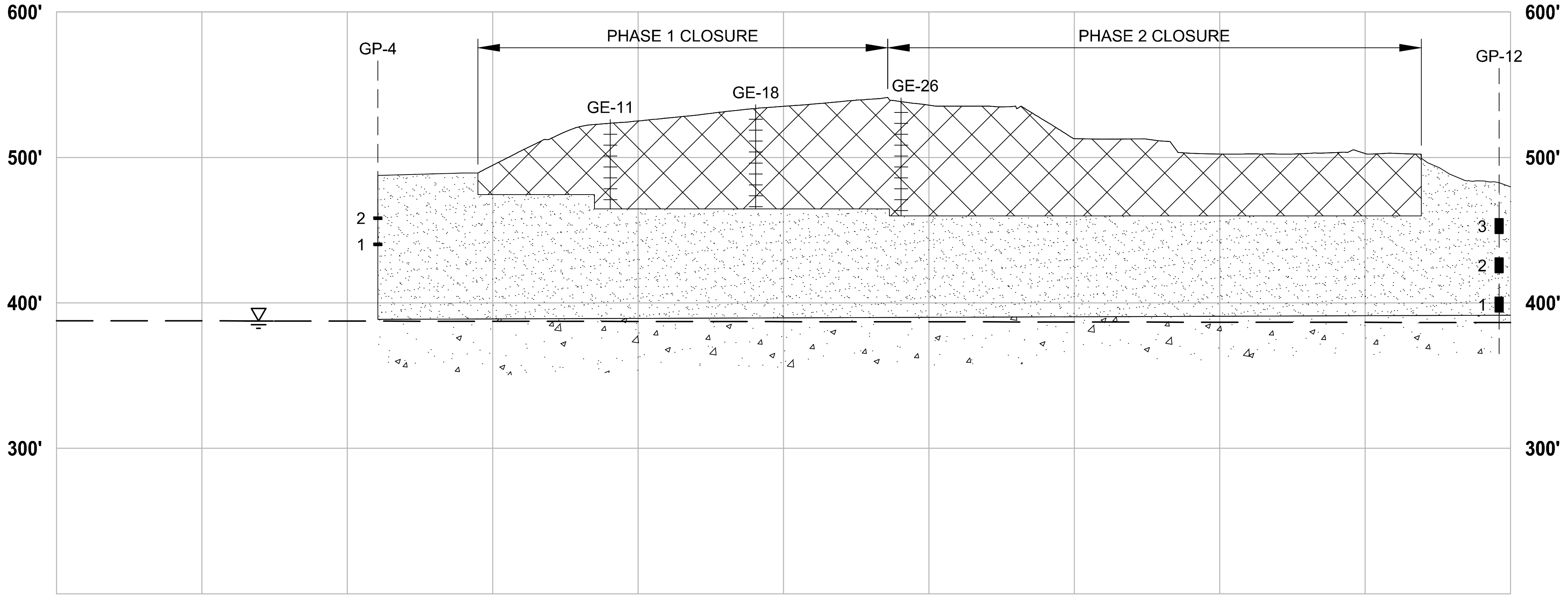
Appendix I

Landfill Gas Data

I-1

Landfill Gas Cross Sections

FILE: BL3820004P04T03F1 LAYOUT: FB-2 PATH: U:\PSO\Projects\Clients\3820-City of Richland\555-3820-004 HornRapids2011EM\99Svcs\CADD\555-3820-004\Phase 04\Task 03\Figures PLOTTED BY: purgabut DATE: Thursday, April 14, 2016 3:18:06 PM



SECTION A

HORIZ: 1"=200'
VERT: 1"=100'

Note:

Vertical Datum: NAVD88

Parametrix DATE: April 14, 2016 FILE: BL3820004P04T03F1

Legend:

▨	Sand	▦	Clay	▽	Groundwater Elevation
▨	Sand and Gravel	▤	Basalt	GE-11	Gas Extraction Well

GP-12
3 ▮ Gas Probe, Showing Screened Intervals

Geologic Cross Section
Showing Gas Probes
Horn Rapids Landfill

I-2

Landfill Gas Quality Data

Summary of Methane Data in Gas Probes, Horn Rapids Landfill

Probe	Port	Ground Surface Elev	Top of Screen	Bottom of Screen	1/26/2006	10/7/2006	12/29/2006	3/15/2007	6/13/2007	9/27/2007	12/19/2007	3/26/2008	6/28/2008
GP-1	1	485.3	18.5	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2	485.3	8.5	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GP-2	1	489.1	36.5	38.0	37.1	14.6	30.5	16.2	31.7	2.8	1.9	41.9	32.1
	2	489.1	18.5	20.0	41.2	42.7	40.5	0.0	21.2	4.7	46.5	44.7	44.4
GP-3	1	477.1	36.5	38.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2	477.1	18.5	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GP-4	1	477.5	36.5	38.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2	477.5	18.5	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GP-5	1	479.4	56.5	58.0	6.4	10.1	12.3	0	2.0	0.8	13.9	12.7	0
	2	479.4	36.5	38.0	4.4	7.0	25.0	3.9	6.8	1.0	13.7	12.4	10.7
	3	479.4	18.5	20.0	0.1	0.0	10.4	0	0.0	0.5	4.1	1.2	0
GP-6	1	479.4	36.5	38.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2	479.4	18.5	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GP-7	1	479.4	24.0	28.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2	479.4	11.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GP-8	1	478.8	26.0	30.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2	478.8	11.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GP-9	1	489.3	26.0	30.0	6.3	0.1	7.8	0.0	0.0	1.2	2.2	17.0	9.0
	2	489.3	11.0	16.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
GP-10	1	484.5	11.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2	484.5	26.0	30.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GP-11	1	486.0	36.0	39.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2	486.0	14.0	17.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GP-12	1	480.3	22.5	32.5	8.6	11.3	0.0	9.7	16.3	1.4	29.0	26.2	16.9
	2	480.3	49.5	59.5	28.7	35.3	7.2	21.2	26.4	4.6	35.3	30.9	30.0
	3	480.3	76.5	86.5	21.3	22.9	0.0	10.4	14.1	1.4	21.2	22.0	22.0

Summary of Methane Data in Gas Probes, Horn Rapids Landfill

Probe	Port	Ground Surface Elev	Top of Screen	Bottom of Screen	9/26/2008	1/8/2009	3/19/2009	6/17/2009	9/24/2009	12/17/2009	3/11/2010	6/16/2010	9/8/2010	11/18/2010
GP-1	1	485.3	18.5	20.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0
	2	485.3	8.5	10.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0
GP-2	1	489.1	36.5	38.0	0.2	34.2	41.4	35.6	36.8	0.1	36.8	27.8	33.6	0.0
	2	489.1	18.5	20.0	0.2	45.2	42.0	1.0	40.8	0.1	40.9	38.3	33.8	0.0
GP-3	1	477.1	36.5	38.0	0.0	0.0	0.0	0.2	0.0	0.1	0.0	0.0	0.0	0.0
	2	477.1	18.5	20.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0
GP-4	1	477.5	36.5	38.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0
	2	477.5	18.5	20.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0
GP-5	1	479.4	56.5	58.0	1.0	15.2	13.7	1.8	0.4	8.7	14.7	NA	NA	NA
	2	479.4	36.5	38.0	11.2	9.7	12.6	13.9	0.2	10.9	13.0	NA	NA	NA
	3	479.4	18.5	20.0	0.3	0.0	2.6	0.5	3.1	8.9	2.0	NA	NA	NA
GP-6	1	479.4	36.5	38.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	NA	NA	NA
	2	479.4	18.5	20.0	0.0	0.0	0.0	0.1	0.0	0.2	0.0	NA	NA	NA
GP-7	1	479.4	24.0	28.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0
	2	479.4	11.0	15.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0
GP-8	1	478.8	26.0	30.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0
	2	478.8	11.0	15.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0
GP-9	1	489.3	26.0	30.0	0.0	16.4	16.4	17.7	18.1	0.1	2.6	0.0	11.3	0.0
	2	489.3	11.0	16.0	0.0	0.5	0.2	0.4	0.7	0.1	0.1	0.0	0.4	0.0
GP-10	1	484.5	11.0	15.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0
	2	484.5	26.0	30.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
GP-11	1	486.0	36.0	39.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
	2	486.0	14.0	17.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0
GP-12	1	480.3	22.5	32.5	21.8	20.4	23.4	21.6	23.5	0.0	18.8	15.5	19.5	26.6
	2	480.3	49.5	59.5	24.7	34.1	32.9	28.8	15.8	2.1	28.0	24.5	24.9	31.5
	3	480.3	76.5	86.5	16.3	27.3	23.5	18.6	19.5	0.1	21.5	19.6	18.0	21.4

Summary of Methane Data in Gas Probes, Horn Rapids Landfill

Probe	Port	Ground Surface Elev	Top of Screen	Bottom of Screen	3/16/2011	6/21/2011	9/15/2011	12/16/2011	3/22/2012	6/20/2012	9/19/2012	10/16/2012	3/13/13	6/1/13
GP-1	1	485.3	18.5	20.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
	2	485.3	8.5	10.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
GP-2	1	489.1	36.5	38.0	0.2	35	0	0	3.0	0.0	0.0	0.0	0.0	0.0
	2	489.1	18.5	20.0	0.0	40	0	0	2.9	0.0	0.0	0.0	0.0	0.0
GP-3	1	477.1	36.5	38.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
	2	477.1	18.5	20.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
GP-4	1	477.5	36.5	38.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
	2	477.5	18.5	20.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
GP-5	1	479.4	56.5	58.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2	479.4	36.5	38.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	3	479.4	18.5	20.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
GP-6	1	479.4	36.5	38.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2	479.4	18.5	20.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
GP-7	1	479.4	24.0	28.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
	2	479.4	11.0	15.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
GP-8	1	478.8	26.0	30.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
	2	478.8	11.0	15.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
GP-9	1	489.3	26.0	30.0	0.0	0	0	2	0.0	0.0	0.0	0.0	0.0	0.0
	2	489.3	11.0	16.0	0.5	16	3	0	0.0	0.0	0.0	0.0	0.0	0.0
GP-10	1	484.5	11.0	15.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
	2	484.5	26.0	30.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
GP-11	1	486.0	36.0	39.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
	2	486.0	14.0	17.0	0.0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
GP-12	1	480.3	22.5	32.5	15.0	11	16	10	7.0	8.0	8.0	8.0	5.0	4.0
	2	480.3	49.5	59.5	19.5	20	23	26	17.0	20.0	18.0	18.0	12.0	10.0
	3	480.3	76.5	86.5	17.2	16	17	17	16.0	17.0	20.0	15.0	14.0	11.0

Summary of Methane Data in Gas Probes, Horn Rapids Landfill

Probe	Port	Ground Surface Elev	Top of Screen	Bottom of Screen	9/20/13	1/8/14	3/13/14	6/18/14	9/29/14	12/12/14	3/19/2015	7/14/2015	10/7/2015	1/7/2016
GP-1	1	485.3	18.5	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	2	485.3	8.5	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
GP-2	1	489.1	36.5	38.0	0.0	0.0	0.0	18.0	0.0	0.0	19.0	4.0	4.0	0
	2	489.1	18.5	20.0	0.0	0.0	0.0	2.0	0.0	0.0	28.0	0.0	2.7	0
GP-3	1	477.1	36.5	38.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	2	477.1	18.5	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
GP-4	1	477.5	36.5	38.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	2	477.5	18.5	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
GP-5	1	479.4	56.5	58.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2	479.4	36.5	38.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	3	479.4	18.5	20.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
GP-6	1	479.4	36.5	38.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2	479.4	18.5	20.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
GP-7	1	479.4	24.0	28.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	2	479.4	11.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
GP-8	1	478.8	26.0	30.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	2	478.8	11.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
GP-9	1	489.3	26.0	30.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0
	2	489.3	11.0	16.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0
GP-10	1	484.5	11.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	2	484.5	26.0	30.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
GP-11	1	486.0	36.0	39.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	2	486.0	14.0	17.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
GP-12	1	480.3	22.5	32.5	0.0	0.0	5.0	1.0	0.0	0.0	5.0	0.0	0.0	0
	2	480.3	49.5	59.5	0.0	4.0	12.0	2.0	0.0	0.0	0.0	0.0	0.8	1
	3	480.3	76.5	86.5	0.0	5.0	14.0	0.0	1.0	0.0	1.0	0.0	0.0	1

HORN RAPIDS LANDFILL
PERIMETER GAS PROBES

MONITORED DATA

DATE: 3/25/16

PROBE	PRESSURE INCHES W.C.	CH4 (% VOL)	O2 (% VOL)	CO2 (% VOL)
GP-1-1	-0.37	0	21	0.8
GP-1-2	-0.31	0	21	0.6
GP-2-1	-0.41	10	0.5	22
GP-2-2	-0.47	0	21	0
GP-3-1	-0.47	0	21	0
GP-3-2	-0.41	0	21	0
GP-4-1	-0.44	0	21	0
GP-4-2	-0.43	0	21	0
GP-7-1	-0.30	0	21	0
GP-7-2	-0.31	0	21	0
GP-8-1	-0.43	0	21	0
GP-8-2	-0.42	0	20	0.5
GP-9-1	-0.60	0	21	0
GP-9-2	-0.37	0	18	3.5
GP-10-1	-0.53	0	21	0.6
GP-10-2	-0.37	0	21	0.9
GP-11-1	-0.47	0	21	0
GP-11-2	-0.43	0	21	0
GP-12-1	-0.22	0	16	6.2
GP-12-2	-0.27	0	20	0.9
GP-12-3	-0.24	1	10	11
Transfer Building		0	21	
Toe Drains 1-3		0	21	
Maintain Shop		0	21	
Scale House		0	21	
Oil Shed		0	21	
Compressor Shed		0	21	
Storage Buiilding		0	21	
Fuel Station		0	21	

COMMENTS:

Weather: 45 to 60° F, partly cloudy and calm

Barometer: 29.65 in. of mercury steady

MONITORED DATA

DATE: 6/29/16

PROBE	PRESSURE INCHES W.C.	CH4 (% VOL)	O2 (% VOL)	CO2 (% VOL)
GP-1-1	0.43	0	17	1.8
GP-1-2	0.49	0	18	1.4
GP-2-1	0.70	22	0	29
GP-2-2	1.04	28	0	31
GP-3-1	-0.08	0	20	0
GP-3-2	-0.04	0	20	0
GP-4-1	-0.16	0	20	1
GP-4-2	-0.12	0	20	1
GP-7-1	0.10	0	21	0
GP-7-2	-0.09	0	20	1
GP-8-1	0.09	0	19	1
GP-8-2	0.09	0	19	1
GP-9-1	0.92	0	3	15
GP-9-2	0.50	0	14	4
GP-10-1	0.08	0	17	3
GP-10-2	0.11	0	19	1
GP-11-1	0.12	0	19	1
GP-11-2	0.13	0	18	2
GP-12-1	0.51	2	0	24
GP-12-2	0.86	4	0	23
GP-12-3	0.41	2	8	12
Scalehouse		0	20	0
Transfer Building		0	20	0
Maintain Shop		0	21	0
Oil Shed		0	21	0
Compressor Shed		0	21	0
Storage Building		0	21	0

COMMENTS:

Weather: 90° F, clear and sw wind 5 mph

Barometer: 30.00 in. of mercury steady

HORN RAPIDS LANDFILL
PERIMETER GAS PROBES

MONITORED DATA

DATE: 9/30/16

PROBE	PRESSURE INCHES W.C.	CH4 (% VOL)	O2 (% VOL)	CO2 (% VOL)
GP-1-1	0.46	0	18	2
GP-1-2	0.52	0	20	1.6
GP-2-1	0.56	18	0.4	27
GP-2-2	0.73	26	18	28
GP-3-1	-0.06	0	20	2
GP-3-2	-0.08	0	20	0.1
GP-4-1	-0.07	0	20	0.6
GP-4-2	-0.02	0	20	0.8
GP-7-1	0.04	0	20	0.8
GP-7-2	0.08	0	20	0.5
GP-8-1	0.00	0	21	0.5
GP-8-2	0.08	0	21	0.5
GP-9-1	0.91	0	3	14
GP-9-2	0.54	0	15	4
GP-10-1	0.11	0	18	3
GP-10-2	-0.02	0	20	1
GP-11-1	-0.06	0	20	1
GP-11-2	-0.06	0	19	2
GP-12-1	0.34	4	0	24
GP-12-2	0.58	6	0	23
GP-12-3	0.66	2	10	11
Scalehouse		0	20	0
Transfer Building		0	21	0
Maintain Shop		0	21	0
Oil Shed		0	21	0
Compressor Shed		0	21	0
Storage Building		0	21	0
Trailer		0	21	0

COMMENTS:

Weather: 62° F, clear and calm

Barometer: 29.97 in. of mercury falling

MONITORED DATA

DATE: 12/30/16

PROBE	PRESSURE INCHES W.C.	CH4 (% VOL)	O2 (% VOL)	CO2 (% VOL)
GP-1-1	-0.15	0	21	0
GP-1-2	-0.20	0	21	0
GP-2-1	0.20	14	1	24
GP-2-2	-0.39	20	6	22
GP-3-1	-0.15	0	21	0
GP-3-2	-0.23	0	21	0
GP-4-1	-0.21	0	20	1
GP-4-2	-0.16	0	21	0
GP-7-1	-0.07	0	21	0
GP-7-2	-0.02	0	21	0
GP-8-1	-0.03	0	21	0
GP-8-2	-0.10	0	21	0
GP-9-1	-0.48	0	21	0
GP-9-2	-0.30	0	19	3
GP-10-1	-0.16	0	18	3
GP-10-2	-0.12	0	20	1
GP-11-1	-0.19	0	21	0
GP-11-2	-0.18	0	21	0
GP-12-1	-0.24	1	5	19
GP-12-2	-0.34	0	21	0
GP-12-3	-0.28	0	21	0
Scalehouse		0	21	0
Transfer Building		0	21	0
Maintain Shop		0	21	0
Oil Shed		0	21	0
Compressor Shed		0	21	0
Storage Building		0	21	0
Trailer		0	21	0

COMMENTS:

Weather: 45° F, clear

Barometer: 29.65 in. of mercury steady

HORN RAPIDS LANDFILL
PERIMETER GAS PROBES

MONITORED DATA

PROBE	PRESSURE INCHES W.C.	CH4 (% VOL)	O2 (% VOL)	CO2 (% VOL)
DATE: 3/27/17				
GP-1-1	-0.21	0.0	20	1
GP-1-2	-0.18	0.0	21	0
GP-2-1	-0.41	13.5	0	21
GP-2-2	-0.60	27.0	1	29
GP-3-1	-0.95	0.0	20	0
GP-3-2	-0.73	0.0	20	0
GP-4-1	-0.80	0.0	21	0
GP-4-2	-0.74	0.0	20	1
GP-7-1	-0.42	0.0	21	0
GP-7-2	-0.22	0.0	21	0
GP-8-1	-0.39	0.0	21	0
GP-8-2	-0.37	0.0	20	0
GP-9-1	-0.92	0.0	21	0
GP-9-2	-0.35	0.0	18	3
GP-10-1	-0.63	0.0	18	3
GP-10-2	-0.24	0.0	20	1
GP-11-1	-0.33	0.0	20	1
GP-11-2	-0.26	0.0	20	1
GP-12-1	-0.22	1.6	0	23
GP-12-2	-0.39	0.0	21	0
GP-12-3	-0.40	2.8	6.8	16
Transfer Building		0	21	0
Toe Drains 1-3		0	21	0
Maintain Shop		0	21	0
Scale House		0	21	0
Oil Shed		0	21	0
Compressor Shed		0	21	0
Storage Buiilding		0	21	0
Fuel Station		0	21	0

COMMENTS:

Weather: 50° F, mostly sunny and calm

Barometer: 29.68 in. of mercury steady

MONITORED DATA

PROBE	PRESSURE INCHES W.C.	CH4 (% VOL)	O2 (% VOL)	CO2 (% VOL)
DATE: 7/10/17				
GP-1-1	0.12	0.0	20	1
GP-1-2	0.12	0.0	21	0
GP-2-1	0.14	10.5	0	22
GP-2-2	0.16	27.7	0	29
GP-3-1	-0.38	0.0	20	0
GP-3-2	-0.27	0.0	20	0
GP-4-1	0.49	0.0	20	0
GP-4-2	0.46	0.0	19	1
GP-7-1	0.28	0.0	20	0
GP-7-2	0.25	0.0	20	0
GP-8-1	0.04	0.0	20	0
GP-8-2	0.01	0.0	20	0
GP-9-1	-0.16	0.0	21	0
GP-9-2	0.11	0.0	18	3
GP-10-1	-0.15	0.0	19	1
GP-10-2	0.10	0.0	19	1
GP-11-1	0.01	0.0	19	1
GP-11-2	0.08	0.0	20	0
GP-12-1	0.35	9.8	0	25
GP-12-2	0.34	0.0	18	1
GP-12-3	0.27	0.6	14	5
Transfer Building		0	21	0
Toe Drains 1-3		0	21	0
Maintain Shop		0	21	0
Scale House		0	21	0
Oil Shed		0	21	0
Compressor Shed		0	21	0
Storage Buiilding		0	21	0
Fuel Station		0	21	0

COMMENTS:

Weather: 96° F, clear and sw wind 4 mph

Barometer: 30.00 in. of mercury steady

HORN RAPIDS LANDFILL
PERIMETER GAS PROBES

MONITORED DATA

PROBE	PRESSURE INCHES W.C.	CH4 (% VOL)	O2 (% VOL)	CO2 (% VOL)
DATE: 9/15/17				
GP-1-1	0.28	0.0	19	1
GP-1-2	0.52	0.0	19	1
GP-2-1	0.40	11.9	0	25
GP-2-2	0.49	26.1	0	29
GP-3-1	0.18	0.0	20	0
GP-3-2	0.17	0.0	20	0
GP-4-1	0.05	0.0	20	0
GP-4-2	0.13	0.0	20	1
GP-7-1	0.03	0.0	21	0
GP-7-2	0.23	0.0	20	0
GP-8-1	0.34	0.0	20	0
GP-8-2	0.37	0.0	20	0
GP-9-1	0.38	0.0	12	7
GP-9-2	0.31	0.0	19	1
GP-10-1	0.39	0.0	20	0
GP-10-2	0.32	0.0	18	2
GP-11-1	0.35	0.0	19	0
GP-11-2	0.35	0.0	19	1
GP-12-1	0.41	12.7	0	27
GP-12-2	0.49	7.0	0	23
GP-12-3	0.41	12.7	0	27
Transfer Building				
Toe Drains 1-3		0	21	0
Maintain Shop		0	21	0
Scale House		0	21	0
Oil Shed		0	21	0
Compressor Shed		0	21	0
Storage Buiilding		0	21	0
Fuel Station		0	21	0

COMMENTS:

Weather: 80° F, partly cloudy and calm

Barometer: 29.54 in. of mercury falling

MONITORED DATA

PROBE	PRESSURE INCHES W.C.	CH4 (% VOL)	O2 (% VOL)	CO2 (% VOL)
DATE: 1/2/18				
GP-1-1	-0.14	0.0	20	2
GP-1-2	-0.35	0.0	20	2
GP-2-1	-0.18	16.7	0	28
GP-2-2	-0.24	22.3	0	30
GP-3-1	0.42	0.0	21	0
GP-3-2	0.23	0.0	20	2
GP-4-1	0.24	0.0	21	0
GP-4-2	0.00	0.0	20	1
GP-7-1	0.11	0.0	20	1
GP-7-2	0.01	0.0	21	0
GP-8-1	0.28	0.0	20	1
GP-8-2	0.04	0.0	20	1
GP-9-1	-0.10	0.0	6	13
GP-9-2	-0.16	0.0	19	3
GP-10-1	0.14	0.0	19	3
GP-10-2	-0.05	0.0	20	2
GP-11-1	-0.08	0.0	20	1
GP-11-2	-0.14	0.0	20	2
GP-12-1	-0.11	2.4	4	20
GP-12-2	-0.01	6.2	0	25
GP-12-3	0.05	0.2	20	2
Transfer Building				
Toe Drains 1-3		0	21	0
Maintain Shop		0	21	0
Scale House		0	21	0
Oil Shed		0	21	0
Compressor Shed		0	21	0
Storage Buiilding		0	21	0
Fuel Station		0	21	0

COMMENTS:

Weather: 34° F, overcast

Barometer: 30.24 in. of mercury steady

HORN RAPIDS LANDFILL
PERIMETER GAS PROBES

	MONITORED DATA			
PROBE	PRESSURE INCHES W.C.	CH4 (% VOL)	O2 (% VOL)	CO2 (% VOL)
DATE: 3/30/18				
GP-1-1	0.03	0.0	20	1.2
GP-1-2	0.15	0.0	20	1
GP-2-1	0.39	13.6	0.3	25
GP-2-2	0.61	22.3	0.2	29
GP-3-1	0.27	0.0	21	0
GP-3-2	0.20	0.0	20	1.3
GP-4-1	0.16	0.0	21	0
GP-4-2	0.15	0.0	21	0.3
GP-7-1	0.12	0.0	21	0
GP-7-2	0.07	0.0	21	0
GP-8-1	0.25	0.0	21	0
GP-8-2	0.27	0.0	21	0
GP-9-1	0.51	0.0	11	7.7
GP-9-2	0.24	0.0	20	1.4
GP-10-1	0.44	0.0	21	3
GP-10-2	0.27	0.0	20	1.1
GP-11-1	0.33	0.0	20	0.7
GP-11-2	0.31	0.0	19	1.9
GP-12-1	0.24	2.2	2.8	19.9
GP-12-2	0.48	4.3	0	23.1
GP-12-3	0.49	0.2	19.2	2.5
Transfer Building		0	21	0
Toe Drains 1-3		0	21	0
Maintain Shop		0	21	0
Scale House		0	21	0
Oil Shed		0	21	0
Compressor Shed		0	21	0
Storage Buiilding		0	21	0
Fuel Station		0	21	0

COMMENTS:

Weather: 35° F, partly cloudy and calm

Barometer: 29.88 in. of mercury falling

	MONITORED DATA			
PROBE	PRESSURE INCHES W.C.	CH4 (% VOL)	O2 (% VOL)	CO2 (% VOL)
DATE: 5/24/18				
GP-1-1	0.24	0.0	19	1
GP-1-2	0.19	0.0	19	0.3
GP-2-1	0.11	10.5	19	0
GP-2-2	0.01	27.7	19	0
GP-3-1	-0.40	0.0	19	0
GP-3-2	-0.30	0.0	19	0
GP-4-1	-0.34	0.0	20	0
GP-4-2	-0.33	0.0	20	1
GP-7-1	-0.25	0.0	21	0
GP-7-2	-0.05	0.0	20	0
GP-8-1	0.04	0.0	19	0
GP-8-2	0.13	0.0	19	1
GP-9-1	-0.41	0.0	19	0
GP-9-2	0.00	0.0	18	2
GP-10-1	-0.21	0.0	17	3
GP-10-2	0.11	0.0	18	1
GP-11-1	-0.02	0.0	19	1
GP-11-2	0.05	0.0	19	0
GP-12-1	0.17	3.9	2	21
GP-12-2	0.10	0.0	19	1
GP-12-3	0.17	0.5	14	4.9
Transfer Building		0	21	0
Toe Drains 1-3		0	21	0
Maintain Shop		0	21	0
Scale House		0	21	0
Oil Shed		0	21	0
Compressor Shed		0	21	0
Storage Buiilding		0	21	0
Fuel Station		0	21	0

COMMENTS:

Weather: 82° F, clear and calm

Barometer: 30.00 in. of mercury steady

HORN RAPIDS LANDFILL
PERIMETER GAS PROBES

MONITORED DATA

DATE: 9/20/18

PROBE	PRESSURE INCHES W.C.	CH4 (% VOL)	O2 (% VOL)	CO2 (% VOL)
GP-1-1	0.19	0.0	19	1
GP-1-2	0.19	0.0	20	1
GP-2-1	0.21	3.7	19	1
GP-2-2	0.19	0.0	21	0
GP-3-1	-0.22	0.0	19	0
GP-3-2	-0.17	0.0	20	0
GP-4-1	-0.47	0.0	20	0
GP-4-2	-0.35	0.0	20	0
GP-7-1	-0.23	0.0	21	0
GP-7-2	-0.08	0.0	20	0
GP-8-1	-0.09	0.0	20	0
GP-8-2	-0.06	0.0	20	1
GP-9-1	0.03	0.0	20	8
GP-9-2	0.17	0.0	19	1
GP-10-1	-0.18	0.0	19	2
GP-10-2	0.04	0.0	19	1
GP-11-1	0.10	0.0	20	1
GP-11-2	0.12	0.0	20	0
GP-12-1	0.27	3.9	4	17
GP-12-2	0.17	0.0	18	1
GP-12-3	0.17	0.0	18	1
Transfer Building				
Toe Drains 1-3		0	21	0
Maintain Shop		0	21	0
Scale House		0	21	0
Oil Shed		0	21	0
Compressor Shed		0	21	0
Storage Buiilding		0	21	0
Fuel Station		0	21	0

COMMENTS:

Weather: 70° F, clear and calm

Barometer: 30.00 in. of mercury steady

MONITORED DATA

DATE: 12/19/18

PROBE	PRESSURE INCHES W.C.	CH4 (% VOL)	O2 (% VOL)	CO2 (% VOL)
GP-1-1	-0.03	0.0	20	0
GP-1-2	-0.12	0.0	20	0
GP-2-1	-0.48	0.0	20	0
GP-2-2	-0.78	0.0	20	0
GP-3-1	-1.03	0.0	20	0
GP-3-2	-0.08	0.0	20	0
GP-4-1	-0.89	0.0	20	0
GP-4-2	-0.81	0.0	20	0
GP-7-1	-0.54	0.0	20	0
GP-7-2	-0.39	0.0	20	0
GP-8-1	-0.44	0.0	20	0
GP-8-2	-0.47	0.0	20	0
GP-9-1	-1.06	0.0	20	0
GP-9-2	-0.42	0.0	20	0
GP-10-1	-0.81	0.0	20	0
GP-10-2	-0.58	0.0	20	1
GP-11-1	-0.73	0.0	20	0
GP-11-2	-0.65	0.0	20	0
GP-12-1	-0.32	2.5	6	17
GP-12-2	-0.43	0.0	21	0
GP-12-3	-0.39	0.0	21	0
Transfer Building				
Toe Drains 1-3		0	21	0
Maintain Shop		0	21	0
Scale House		0	21	0
Oil Shed		0	21	0
Compressor Shed		0	21	0
Storage Buiilding		0	21	0
Fuel Station		0	21	0

COMMENTS:

Weather: 46° F, partly cloudy

Barometer: 30.00 in. of mercury steady

HORN RAPIDS LANDFILL
PERIMETER GAS PROBES

MONITORED DATA

DATE: 3/29/19

PROBE	PRESSURE INCHES W.C.	CH4 (% VOL)	O2 (% VOL)	CO2 (% VOL)
GP-1-1	-0.29	0.0	20	0
GP-1-2	-0.33	0.0	20	0
GP-2-1	-0.56	0.0	20	0
GP-2-2	-0.74	0.0	21	0
GP-3-1	-0.91	0.0	20	0
GP-3-2	-0.75	0.0	20	0
GP-4-1	-0.81	0.0	20	0
GP-4-2	-0.70	0.0	20	0
GP-7-1	-0.58	0.0	20	0
GP-7-2	-0.38	0.0	20	0
GP-8-1	-0.47	0.0	20	0
GP-8-2	-0.41	0.0	20	0
GP-9-1	-1.05	0.0	21	0
GP-9-2	-0.55	0.0	21	0
GP-10-1	-0.62	0.0	20	0
GP-10-2	-0.39	0.0	19	1
GP-11-1	-0.49	0.0	20	1
GP-11-2	-0.46	0.0	20	0
GP-12-1	-0.36	2.5	2	20
GP-12-2	-0.68	0.0	21	0
GP-12-3	-0.60	0.0	21	0
Transfer Building		0	21	0
Toe Drains 1-3		0	21	0
Maintain Shop		0	21	0
Scale House		0	21	0
Oil Shed		0	21	0
Compressor Shed		0	21	0
Storage Buiilding		0	21	0
Fuel Station		0	21	0

COMMENTS:

Weather: 45° F, partly cloudy and calm

Barometer: 29.66 in. of mercury rising

MONITORED DATA

DATE: 6/20/19

PROBE	PRESSURE INCHES W.C.	CH4 (% VOL)	O2 (% VOL)	CO2 (% VOL)
GP-1-1	-0.18	0.0	20	1
GP-1-2	-0.13	0.0	21	0.6
GP-2-1	-0.18	6.9	1	18
GP-2-2	-0.26	0.0	21	0
GP-3-1	0.24	0.0	20	0
GP-3-2	0.29	0.0	20	1
GP-4-1	0.10	0.0	20	0
GP-4-2	0.15	0.0	20	1
GP-7-1	0.00	0.0	21	0
GP-7-2	-0.04	0.0	21	0
GP-8-1	0.23	0.0	20	0
GP-8-2	0.20	0.0	20	1
GP-9-1	-0.36	0.0	21	0
GP-9-2	-0.11	0.0	20	1
GP-10-1	0.50	0.0	17	3
GP-10-2	0.26	0.0	19	1
GP-11-1	0.33	0.0	20	0
GP-11-2	0.30	0.0	19	1
GP-12-1	-0.01	12.3	1	25
GP-12-2	-0.06	0.0	20	1
GP-12-3	-0.10	0.2	16	5
Transfer Building		0	21	0
Toe Drains 1-3		0	21	0
Maintain Shop		0	21	0
Scale House		0	21	0
Oil Shed		0	21	0
Compressor Shed		0	21	0
Storage Buiilding		0	21	0
Fuel Station		0	21	0

COMMENTS:

Weather: 77° F, clear and calm

Barometer: 29.52 in. of mercury falling

HORN RAPIDS LANDFILL
PERIMETER GAS PROBES

MONITORED DATA

DATE: 9/25/19

PROBE	PRESSURE INCHES W.C.	CH4 (% VOL)	O2 (% VOL)	CO2 (% VOL)
GP-1-1	-0.46	0.0	19	1
GP-1-2	-0.58	0.0	20	1
GP-2-1	-0.52	8.9	0	21
GP-2-2	-0.83	0.0	21	0
GP-3-1	-0.54	0.0	20	0
GP-3-2	-0.54	0.0	20	1
GP-4-1	-0.44	0.0	20	0
GP-4-2	-0.44	0.0	20	1
GP-7-1	-0.21	0.0	21	0
GP-7-2	-0.09	0.0	21	0
GP-8-1	-0.58	0.0	20	0
GP-8-2	-0.48	0.0	20	0
GP-9-1	-0.76	0.0	15	4
GP-9-2	-0.48	0.0	20	0
GP-10-1	-0.79	0.0	20	0
GP-10-2	-0.49	0.0	19	1
GP-11-1	-0.65	0.0	20	0
GP-11-2	-0.59	0.0	18	1
GP-12-1	-0.53	16.8	0	27
GP-12-2	-0.74	4.8	0	21
GP-12-3	-0.70	0.0	20	1
Transfer Building				
Toe Drains 1-3		0	21	0
Maintain Shop		0	21	0
Scale House		0	21	0
Oil Shed		0	21	0
Compressor Shed		0	21	0
Storage Buiilding		0	21	0
Fuel Station		0	21	0

COMMENTS:

Weather: 69 to 75° F, clear and calm

Barometer: 29.35 in. of mercury steady

MONITORED DATA

DATE: 12/30/19

PROBE	PRESSURE INCHES W.C.	CH4 (% VOL)	O2 (% VOL)	CO2 (% VOL)
GP-1-1	0.00	0.0	21	1
GP-1-2	0.00	0.0	21	1
GP-2-1	0.00	16.6	0	25
GP-2-2	0.00	20.2	1	26
GP-3-1	0.00	0.0	21	1
GP-3-2	0.00	0.0	21	1
GP-4-1	0.00	0.2	21	1
GP-4-2	0.00	0.2	21	1
GP-7-1	0.00	0.0	21	0
GP-7-2	0.00	0.0	21	0
GP-8-1	0.00	0.0	20	1
GP-8-2	0.00	0.0	21	0
GP-9-1	0.00	0.0	14	6
GP-9-2	0.00	0.0	21	1
GP-10-1	0.00	0.0	21	0
GP-10-2	0.00	0.0	20	1
GP-11-1	0.00	0.0	21	0
GP-11-2	0.00	0.0	20	1
GP-12-1	0.00	9.2	1	25
GP-12-2	0.00	6.5	1	22
GP-12-3	0.00	0.3	21	1
Transfer Building				
Toe Drains 1-3		0	21	0
Maintain Shop		0	21	0
Scale House		0	21	0
Oil Shed		0	21	0
Compressor Shed		0	21	0
Storage Buiilding		0	21	0
Fuel Station		0	21	0

COMMENTS:

Weather: 35° F, overcast

Barometer: 29.75 in. of mercury steady

Landfill Gas Monitoring Results, Second Quarter 2020, Horn Rapids Landfill

Probe	Port	Date	PRESSURE INCHES W.C.	CH4	O2	CO2
				percent by volume		
GP-1	**1**	6/18/2020	-0.18	0.0	20	1
	2	6/18/2020	-0.19	0.0	21	0
GP-2	**1**	6/18/2020	-0.21	16.9	1	25
	2	6/18/2020	-0.35	17.2	2	23
GP-3	**1**	6/18/2020	-0.45	0.0	20	1
	2	6/18/2020	-0.42	0.0	20	1
GP-4	**1**	6/18/2020	-0.35	0.0	20	1
	2	6/18/2020	-0.48	0.0	20	1
GP-7	**1**	6/18/2020	-0.42	0.0	21	0
	2	6/18/2020	-0.40	0.0	21	0
GP-8	**1**	6/18/2020	-0.45	0.0	20	1
	2	6/18/2020	-0.45	0.0	20	1
GP-9	**1**	6/18/2020	-0.41	0.0	21	0
	2	6/18/2020	-0.22	0.0	20	1
GP-10	**1**	6/18/2020	-0.37	0.0	18	3
	2	6/18/2020	-0.32	0.0	20	1
GP-11	**1**	6/18/2020	-0.27	0.0	20	0
	2	6/18/2020	-0.27	0.0	20	1
GP-12	**1**	6/18/2020	-0.25	4.0	10	13
	2	6/18/2020	-0.24	0.0	20	2
	3	6/18/2020	-0.20	0.0	19	2
Transfer Building		6/18/2020		0	21	0
Toe Drains 1-3		6/18/2020		0	21	0
Maintain Shop		6/18/2020		0	21	0
Scale House		6/18/2020		0	21	0
Oil Shed		6/18/2020		0	21	0
Compressor Shed		6/18/2020		0	21	0
Storage Buiilding		6/18/2020		0	21	0
Fuel Station		6/18/2020		0	21	0

Appendix J

Indicator Hazardous Substances

J-1

Evaluation of Indicator Hazardous Substances

Table J-1. Frequency of Detection of Parameters in Downgradient Wells, September 2011 through June 2020, Horn Rapids Landfill

Constituent Name	N	Maximum Concentration	Frequency of Detection %
Alkalinity (mg/L)	247	760	100
Bicarbonate (mg/L)	247	760	100
Calcium, Dissolved (mg/L)	247	300	100
Chloride (mg/L)	247	170	100
Conductivity (umhos/cm)	227	1990	100
Magnesium, Dissolved (mg/L)	247	69	100
pH (none)	247	8.72	100
Potassium, Dissolved (mg/L)	247	15	100
Sodium, Dissolved (mg/L)	247	43	100
Sulfate (mg/L)	246	260	100
Arsenic, Total (mg/L)	198	0.012	100
Barium, Total (mg/L)	198	0.16	100
Vanadium, Total (mg/L)	198	0.02	99.5
TDS (mg/L)	247	1300	99.2
Chromium, Total (mg/L)	198	0.065	98.0
Nitrate Nitrogen (mg/L)	247	48	96.8
1,1-Dichloroethane (µg/L)	247	12	83.4
cis-1,2-Dichloroethene (µg/L)	247	120	80.2
TOC (mg/L)	247	78	73.7
Trichloroethene (µg/L)	247	23	63.6
Chloroform (µg/L)	247	15	56.7
Tetrachloroethene (µg/L)	247	48	56.7
Vinyl Chloride (µg/L)	247	8.3	49.0
Zinc, Total (mg/L)	198	0.039	48.0
Cobalt, Total (mg/L)	198	0.013	41.4
Copper, Total (mg/L)	198	0.038	40.9
Nickel, Total (mg/L)	198	0.04	37.9
trans-1,2-Dichloroethene (µg/L)	247	2.9	35.6
Manganese, Dissolved (mg/L)	247	0.3	33.6
Manganese, Total (mg/L)	55	0.04	32.7
Benzene (µg/L)	247	2	29.6
1,2-Dichloroethane (µg/L)	247	1.1	28.3
1,1-Dichloroethene (µg/L)	247	0.78	24.3
1,2-Dichloropropane (µg/L)	247	1.2	22.7
Trichlorofluoromethane (µg/L)	247	1.6	21.9
Selenium, Total (mg/L)	198	0.0067	18.7
Bromodichloromethane (µg/L)	247	1	13.0
Total Suspended Solids (mg/L)	164	44	11.0
Methylene Chloride (µg/L)	247	23	10.5
Lead, Total (mg/L)	198	0.0018	9.1
Acetone (µg/L)	247	140	6.9
Ammonia Nitrogen (mg/L)	247	1	5.7

Table J-1. Frequency of Detection of Parameters in Downgradient Wells, September 2011 through June 2020, Horn Rapids Landfill

Constituent Name	N	Maximum Concentration	Frequency of Detection %
Iron, Total (mg/L)	55	1.2	5.5
Chloroethane (µg/L)	247	2.5	4.1
Antimony, Total (mg/L)	198	0.0015	2.5
1,1,1-Trichloroethane (µg/L)	247	0.5	1.2
Iron, Dissolved (mg/L)	247	0.33	1.2
Carbon Disulfide (µg/L)	247	6.5	0.8
Cadmium, Total (mg/L)	198	0.00058	0.5
Silver, Total (mg/L)	198	0.00055	0.5
Chloromethane (µg/L)	247	2.5	0.4
Toluene (µg/L)	247	0.88	0.4
1,1,1,2-Tetrachloroethane (µg/L)	247	0.5	0
1,1,2,2-Tetrachloroethane (µg/L)	247	0.5	0
1,1,2-Trichloroethane (µg/L)	247	0.5	0
1,2,3-Trichloropropane (µg/L)	247	0.5	0
1,2-Dibromo-3-chloropropane (µg/L)	247	1	0
1,2-Dibromoethane (µg/L)	247	0.5	0
1,2-Dichlorobenzene (µg/L)	247	0.95	0
1,4-Dichlorobenzene (µg/L)	247	1	0
2-Butanone (µg/L)	247	7.5	0
2-Hexanone (µg/L)	247	2.5	0
4-Methyl-2-pentanone (µg/L)	247	5	0
Acrylonitrile (µg/L)	247	5	0
Bromochloromethane (µg/L)	247	0.55	0
Bromoform (µg/L)	247	0.8	0
Bromomethane (µg/L)	247	2.5	0
Carbon Tetrachloride (µg/L)	247	0.65	0
Chlorobenzene (µg/L)	247	0.5	0
cis-1,3-Dichloropropene (µg/L)	247	0.5	0
Dibromochloromethane (µg/L)	247	0.75	0
Dibromomethane (µg/L)	247	0.5	0
Ethylbenzene (µg/L)	247	0.5	0
Iodomethane (µg/L)	247	2.5	0
Styrene (µg/L)	247	0.5	0
trans-1,3-Dichloropropene (µg/L)	247	0.5	0
trans-1,4-Dichloro-2-butene (µg/L)	247	3	0
Vinyl Acetate (µg/L)	247	2.5	0
Xylenes (µg/L)	247	1.5	0
Beryllium, Total (mg/L)	198	0.0002	0
Thallium, Total (mg/L)	198	0.0005	0

N = number of observations

MTCA = Model Toxics Control Act Chapter 173-340 WAC

Table J-2. Identification of Initial Indicator Hazardous Substances in Downgradient Wells, Horn Rapids Landfill

						MTCA Method B SFV					
Constituent Name	**N**	**Maximum**	**Maximum Concentration (µg/L)**	**% Non-Detects**	**Frequency of Detection %**	**Groundwater Noncancer (µg/L)**	**Groundwater Cancer (µg/L)**	**Maximum Concentration >Minimum MTCA Method B SFV?**	**Second Highest Concentration (µg/L)**	**Maximum at least 2x or at least 2 Concentrations >Minimum MTCA Method B SFV ?**	**Recommended Initial IHS?**
VOCs											
1,1-Dichloroethane (µg/L)	247	12	12	16.6	83.4	1600	7.7	yes	11	yes	yes
1,1-Dichloroethene (µg/L)	247	0.78	0.78	75.71	24.29	400		no		no	no
1,2-Dichloroethane (µg/L)	247	1.1	1.1	71.66	28.34	48	0.48	yes		yes	yes
1,2-Dichloropropane (µg/L)	247	1.2	1.2	77.33	22.67	320	1.2	no		no	no
Acetone (µg/L)	247	140	140	93.12	6.88	7200		no		no	no
Benzene (µg/L)	247	2	2	70.45	29.55	32	0.8	yes		yes	yes
Bromodichloromethane (µg/L)	247	1	1	87.04	12.96	160	0.71	yes	0.87	yes	yes
Chloroform (µg/L)	247	15	15	43.32	56.68	80	1.4	yes		yes	yes
cis-1,2-Dichloroethene (µg/L)	247	120	120	19.84	80.16	16		yes		yes	yes
Methylene Chloride (µg/L)	247	23	23	89.47	10.53	48	5.8	yes		yes	yes
Tetrachloroethene (µg/L)	247	48	48	43.32	56.68	48	21	yes		yes	yes
trans-1,2-Dichloroethene (µg/L)	247	2.9	2.9	64.37	35.63	160		no		no	no
Trichloroethene (µg/L)	247	23	23	36.44	63.56	4	0.54	yes		yes	yes
Trichlorofluoromethane (µg/L)	247	1.6	1.6	78.14	21.86	2400		no		no	no
Vinyl Chloride (µg/L)	247	8.3	8.3	51.01	48.99	24	0.029	yes		yes	yes
Nutrients											
Nitrate Nitrogen (mg/L)	247	48	48000	3.239	96.761	26000		yes		yes	yes
Metals											
Arsenic, Total (mg/L)	198	0.012	12	0	100	4.8	0.058	yes		yes	yes
Barium, Total (mg/L)	198	0.16	160	0	100	3200		no		no	no
Chromium, Total (mg/L)	198	0.065	65	2.02	97.98	48		yes	48	yes	no
Cobalt, Total (mg/L)	198	0.013	13	58.59	41.41	4.8		yes		yes	yes
Copper, Total (mg/L)	198	0.038	38	59.09	40.91	640		no		no	no
Iron, Total (mg/L)	55	1.2	1200	94.55	5.45	11000		no		no	no
Manganese, Dissolved (mg/L)	247	0.3	300	66.4	33.6	750		no		no	no
Nickel, Total (mg/L)	198	0.04	40	62.12	37.88	320		no		no	no
Selenium, Total (mg/L)	198	0.0067	6.7	81.31	18.69	80		no		no	no
Vanadium, Total (mg/L)	198	0.02	20	0.5051	99.4949	80		no		no	no
Zinc, Total (mg/L)	198	0.039	39	52.02	47.98	4800		no		no	no

N = number of observations

MTCA = Model Toxics Control Act Chapter 173-340 WAC

SFV = Standard Formula Value, from Ecology's Cleanup Level and Risk Calculation database (updated January 2020)

Table J-3. Identification of Final Indicator Hazardous Substances in Downgradient Wells, Horn Rapids Landfill

				MTCA Method B SFV						
Constituent Name	**N**	**Maximum Concentration (µg/L)**	**Frequency of Detection %**	**Groundwater Noncancer (µg/L)**	**Groundwater Cancer (µg/L)**	**Aqueous Solubility mg/L**	**Henry's Law Constant (@ 13 degrees C) unitless**	**Koc Soil Organic Carbon-Water Partition Coefficient (L/kg)**	**Recommended IHS?**	**Site-Specific Observations**
VOCs										
1,1-Dichloroethane (µg/L)	247	12	83.4	1600	7.7	5060	0.141	53	yes	Concentrations above SFV in MW-5 and MW-6; downward trends in MW-3, MW-5, MW-6, MW-9, MW-10; upward trend in MW-4
1,2-Dichloroethane (µg/L)	247	1.1	28.34	48	0.48	8520	0.0228	38	no	Downward trends in MW-5 and MW-6; all values below criteria past few years
Benzene (µg/L)	247	2	29.55	32	0.8	1750	0.133	62	no	All concentrations below SFV since 2013; downward trends in MW-5 and MW-6
Bromodichloromethane (µg/L)	247	1	12.96	160	0.71	6740	0.0369	55	yes	Six concentrations above SFV in MW-8; upward trend in MW-3
Chloroform (µg/L)	247	15	56.68	80	1.4	7920	0.0915	53	yes	Concentrations above SFV in MW-3 and MW-8; downward trends in MW-4 and MW-10; upward trend in MW-3
cis-1,2-Dichloroethene (µg/L)	247	120	80.16	16		3500	0.1	35.5	yes	Concentrations above SFV in MW-5 and MW-6; downward trend in MW-5
Methylene Chloride (µg/L)	247	23	10.53	48	5.8	13000	0.0567	10	no	All concentrations below SFV since 2014; downward trend in MW-10
Tetrachloroethene (µg/L)	247	48	56.68	48	21	200	0.398	265	yes	Concentrations above SFV in MW-6; downward trend in MW-6; upward trends in MW-9 and MW-10
Trichloroethene (µg/L)	247	23	63.56	4	0.54	1100	0.239	94	yes	Concentrations above SFV in MW-5, MW-6, MW-9, and MW-10 (and PP-1); downward trends in MW-5 and MW-6
Vinyl Chloride (µg/L)	247	8.3	48.99	24	0.029	2760	0.807	18.6	yes	Concentrations consistently above SFV in MW-5, MW-6, and MW-10; sporadically above SFV in MW-4 (and PP-1); downward trends in MW-5, MW-6, and MW-10
Nutrients										
Nitrate Nitrogen (mg/L)	247	48000	96.761	26000					no	Concentrations above SFV in upgradient well MW-11 and downgradient wells MW-2 and MW-8; all downgradient concentrations below calculated background concentration of 43,820 µg/L
Metals										
Arsenic, Total (mg/L)	198	12	100	4.8	0.058				yes	Concentrations above SFV in all upgradient and downgradient wells; some downgradient concentrations equal to the background concentration of 12 µg/L
Cobalt, Total (mg/L)	198	13	41.41	4.8					no	All concentrations below calculated background concentration of 26 µg/L

N = number of observations

MTCA = Model Toxics Control Act Chapter 173-340 WAC

SFV = Standard Formula Value

Groundwater Criteria and Chemical Properties from Ecology's Cleanup Level and Risk Calculation database (updated January 2020)

J-2

Data Summary Tables by Well

HORN RAPIDS LANDFILL
MW-1
September 2011 to June 2020
Summary of Descriptive Statistics

Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
1,1,1,2-Tetrachloroethane (ug/L)	MWell#1 (bg)	35	0.2346	0.1822	0.03079	0.15	0.1	0.5	0.05	0.5	100
1,1,1-Trichloroethane (ug/L)	MWell#1 (bg)	35	0.2176	0.1874	0.03167	0.1	0.1	0.5	0.05	0.5	100
1,1,2,2-Tetrachloroethane (ug/L)	MWell#1 (bg)	35	0.2191	0.1889	0.03193	0.1	0.1	0.5	0.05	0.5	100
1,1,2-Trichloroethane (ug/L)	MWell#1 (bg)	35	0.2153	0.186	0.03144	0.1	0.1	0.5	0.05	0.5	100
1,1-Dichloroethane (ug/L)	MWell#1 (bg)	35	0.23	0.2105	0.03557	0.1	0.1	0.5	0.05	0.8	100
1,1-Dichloroethene (ug/L)	MWell#1 (bg)	35	0.2044	0.2014	0.03405	0.1	0.05	0.5	0.05	0.5	100
1,2,3-Trichloropropane (ug/L)	MWell#1 (bg)	35	0.2223	0.1843	0.03115	0.1	0.1	0.5	0.1	0.5	100
1,2-Dibromo-3-chloropropane (ug/L)	MWell#1 (bg)	35	0.9139	0.2449	0.04139	1	1	1	0.2	1	100
1,2-Dibromoethane (ug/L)	MWell#1 (bg)	35	0.1816	0.2051	0.03467	0.05	0.05	0.5	0.05	0.5	100
1,2-Dichlorobenzene (ug/L)	MWell#1 (bg)	35	0.2686	0.2015	0.03406	0.15	0.15	0.5	0.1	0.95	100
1,2-Dichloroethane (ug/L)	MWell#1 (bg)	35	0.2229	0.1942	0.03282	0.1	0.1	0.5	0.05	0.55	100
1,2-Dichloropropane (ug/L)	MWell#1 (bg)	35	0.2203	0.1903	0.03216	0.1	0.1	0.5	0.05	0.5	100
1,4-Dichlorobenzene (ug/L)	MWell#1 (bg)	35	0.27	0.2066	0.03492	0.15	0.15	0.5	0.1	1	100
2-Butanone (ug/L)	MWell#1 (bg)	35	5.357	1.889	0.3193	5	5	7.5	1	7.5	100
2-Hexanone (ug/L)	MWell#1 (bg)	35	1.55	0.6801	0.115	1.5	1	2.5	0.5	2.5	100
4-Methyl-2-pentanone (ug/L)	MWell#1 (bg)	35	2.436	0.9041	0.1528	2.5	2.5	2.5	0.25	5	100
Acetone (ug/L)	MWell#1 (bg)	35	2.894	1.729	0.2923	3	1	5	1	5	97.14
Acrylonitrile (ug/L)	MWell#1 (bg)	35	3.146	1.318	0.2228	2.5	2.5	5	1	5	100
Alkalinity (mg/L)	MWell#1 (bg)	35	313.4	51.62	8.725	330	300	350	170	400	0
Ammonia Nitrogen (mg/L)	MWell#1 (bg)	35	0.1366	0.09122	0.01542	0.1	0.05	0.25	0.025	0.32	94.29
Antimony, Dissolved (mg/L)	MWell#1 (bg)	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Antimony, Total (mg/L)	MWell#1 (bg)	28	0.0002143	0.00005245	0.000009913	0.0002	0.0002	0.0002	0.0002	0.0004	100
Arsenic, Dissolved (mg/L)	MWell#1 (bg)	16	0.004494	0.0004654	0.0001164	0.0045	0.00425	0.0046	0.0037	0.0057	0
Arsenic, Total (mg/L)	MWell#1 (bg)	28	0.004382	0.0004707	0.00008895	0.0044	0.00395	0.0046	0.0038	0.0056	0
Barium, Dissolved (mg/L)	MWell#1 (bg)	16	0.05869	0.007153	0.001788	0.059	0.0555	0.062	0.039	0.071	0
Barium, Total (mg/L)	MWell#1 (bg)	28	0.05739	0.009191	0.001737	0.058	0.054	0.063	0.034	0.077	0
Benzene (ug/L)	MWell#1 (bg)	35	0.2229	0.1942	0.03282	0.1	0.1	0.5	0.05	0.55	100
Beryllium, Dissolved (mg/L)	MWell#1 (bg)	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Beryllium, Total (mg/L)	MWell#1 (bg)	28	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Bicarbonate (mg/L)	MWell#1 (bg)	35	313.4	51.62	8.725	330	300	350	170	400	0

HORN RAPIDS LANDFILL
MW-1
September 2011 to June 2020
Summary of Descriptive Statistics

Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
Bromochloromethane (ug/L)	MWell#1 (bg)	35	0.2229	0.1942	0.03282	0.1	0.1	0.5	0.05	0.55	100
Bromodichloromethane (ug/L)	MWell#1 (bg)	35	0.22	0.1899	0.0321	0.1	0.1	0.5	0.05	0.5	100
Bromoform (ug/L)	MWell#1 (bg)	35	0.32	0.1605	0.02713	0.25	0.25	0.5	0.05	0.8	100
Bromomethane (ug/L)	MWell#1 (bg)	35	0.9657	0.995	0.1682	0.5	0.25	2.5	0.05	2.5	100
Cadmium, Dissolved (mg/L)	MWell#1 (bg)	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Cadmium, Total (mg/L)	MWell#1 (bg)	28	0.0002143	0.00005245	0.000009913	0.0002	0.0002	0.0002	0.0002	0.0004	100
Calcium, Dissolved (mg/L)	MWell#1 (bg)	35	115.7	16.11	2.723	120	110	120	69	140	0
Calcium, Total (mg/L)	MWell#1 (bg)	8	118.3	20.74	7.333	120	115	125	76	150	0
Carbon Disulfide (ug/L)	MWell#1 (bg)	35	0.2386	0.1887	0.03189	0.15	0.1	0.5	0.05	0.6	100
Carbon Tetrachloride (ug/L)	MWell#1 (bg)	35	0.2257	0.1998	0.03377	0.1	0.1	0.5	0.05	0.65	100
Carbonate (mg/L)	MWell#1 (bg)	34	2.5	0	0	2.5	2.5	2.5	2.5	2.5	100
Chloride (mg/L)	MWell#1 (bg)	35	26.57	4.168	0.7045	26	24	30	17	37	0
Chlorobenzene (ug/L)	MWell#1 (bg)	35	0.2214	0.1919	0.03243	0.1	0.1	0.5	0.05	0.5	100
Chloroethane (ug/L)	MWell#1 (bg)	35	0.8936	1.034	0.1747	0.25	0.25	2.5	0.125	2.5	100
Chloroform (ug/L)	MWell#1 (bg)	35	0.236	0.1927	0.03258	0.1	0.1	0.5	0.05	0.6	91.43
Chloromethane (ug/L)	MWell#1 (bg)	35	0.8586	1.059	0.179	0.25	0.15	2.5	0.05	2.5	100
Chromium, Dissolved (mg/L)	MWell#1 (bg)	16	0.002838	0.0005451	0.0001363	0.0029	0.00235	0.0033	0.0021	0.0037	0
Chromium, Total (mg/L)	MWell#1 (bg)	28	0.003618	0.0008982	0.0001697	0.00355	0.0029	0.004	0.0026	0.0059	0
cis-1,2-Dichloroethene (ug/L)	MWell#1 (bg)	35	0.2229	0.1942	0.03282	0.1	0.1	0.5	0.05	0.55	100
cis-1,3-Dichloropropene (ug/L)	MWell#1 (bg)	35	0.2631	0.1687	0.02851	0.25	0.1	0.5	0.05	0.5	100
Cobalt, Dissolved (mg/L)	MWell#1 (bg)	16	0.01244	0.006854	0.001713	0.01015	0.00705	0.016	0.0057	0.028	0
Cobalt, Total (mg/L)	MWell#1 (bg)	28	0.02542	0.0112	0.002117	0.026	0.017	0.0325	0.0057	0.052	0
Conductivity (umhos/cm)	MWell#1 (bg)	32	872.7	115.9	20.49	887.5	844	940	546.1	1061	0
Copper, Dissolved (mg/L)	MWell#1 (bg)	16	0.001531	0.0006063	0.0001516	0.0014	0.0011	0.00205	0.0005	0.0027	12.5
Copper, Total (mg/L)	MWell#1 (bg)	28	0.001293	0.001024	0.0001935	0.001	0.001	0.0011	0.001	0.0064	71.43
Dibromochloromethane (ug/L)	MWell#1 (bg)	35	0.2286	0.2066	0.03492	0.1	0.1	0.5	0.05	0.75	100
Dibromomethane (ug/L)	MWell#1 (bg)	35	0.2203	0.1903	0.03216	0.1	0.1	0.5	0.05	0.5	100
Dissolved Oxygen (mg/L)	MWell#1 (bg)	34	5.449	0.6164	0.1057	5.395	4.905	5.785	4.37	7.04	0
Ethane (ug/L)	MWell#1 (bg)	35	4.25	2.032	0.3434	5	2.5	5	0.55	11	100
Ethene (ug/L)	MWell#1 (bg)	35	4.214	1.953	0.3301	5	2.5	5	0.5	10	100

HORN RAPIDS LANDFILL
MW-1
September 2011 to June 2020
Summary of Descriptive Statistics

Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
Ethylbenzene (ug/L)	MWell#1 (bg)	35	0.2199	0.1897	0.03207	0.1	0.1	0.5	0.05	0.5	100
Iodomethane (ug/L)	MWell#1 (bg)	35	0.9029	1.027	0.1735	0.25	0.25	2.5	0.25	2.5	100
Iron, Dissolved (mg/L)	MWell#1 (bg)	35	0.2029	0.07065	0.01194	0.25	0.1	0.25	0.1	0.25	100
Iron, Total (mg/L)	MWell#1 (bg)	8	0.25	0	0	0.25	0.25	0.25	0.25	0.25	100
Lead, Dissolved (mg/L)	MWell#1 (bg)	16	0.0003962	0.0004152	0.0001038	0.0002	0.0002	0.000485	0.0002	0.0018	68.75
Lead, Total (mg/L)	MWell#1 (bg)	28	0.0003239	0.0001453	0.00002745	0.0004	0.0002	0.0004	0.0002	0.00086	92.86
Magnesium, Dissolved (mg/L)	MWell#1 (bg)	35	23.03	3.063	0.5177	23	22	25	14	27	0
Magnesium, Total (mg/L)	MWell#1 (bg)	8	24	4	1.414	24	23	26	16	30	0
Manganese, Dissolved (mg/L)	MWell#1 (bg)	35	0.01	0	0	0.01	0.01	0.01	0.01	0.01	100
Manganese, Total (mg/L)	MWell#1 (bg)	8	0.01	0	0	0.01	0.01	0.01	0.01	0.01	100
Methane (ug/L)	MWell#1 (bg)	35	1.224	2.019	0.3413	0.6	0.6	0.6	0.29	11	97.14
Methylene Chloride (ug/L)	MWell#1 (bg)	35	1.266	0.9463	0.1599	1.5	0.25	2.5	0.25	2.5	100
Nickel, Dissolved (mg/L)	MWell#1 (bg)	16	0.0015	0	0	0.0015	0.0015	0.0015	0.0015	0.0015	100
Nickel, Total (mg/L)	MWell#1 (bg)	28	0.001564	0.0003402	0.00006429	0.0015	0.0015	0.0015	0.0015	0.0033	96.43
Nitrate Nitrogen (mg/L)	MWell#1 (bg)	34	8.182	2.263	0.3881	8.4	7.35	9.45	1.7	12	0
pH (none)	MWell#1 (bg)	35	7.184	0.1697	0.02869	7.15	7.06	7.24	6.99	7.74	0
Potassium, Dissolved (mg/L)	MWell#1 (bg)	35	8.077	0.7248	0.1225	8.2	7.7	8.7	6.2	9.2	0
Potassium, Total (mg/L)	MWell#1 (bg)	8	8.713	1.342	0.4745	8.55	8.15	9.45	6.4	11	0
Redox (mv)	MWell#1 (bg)	35	116.8	90.08	15.23	100.4	55.4	168	-54.2	378.5	0
Selenium, Dissolved (mg/L)	MWell#1 (bg)	16	0.001831	0.0002915	0.00007287	0.00185	0.0017	0.0021	0.0013	0.0023	0
Selenium, Total (mg/L)	MWell#1 (bg)	28	0.002811	0.001145	0.0002165	0.0023	0.0017	0.004	0.0014	0.004	46.43
Silver, Dissolved (mg/L)	MWell#1 (bg)	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Silver, Total (mg/L)	MWell#1 (bg)	28	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Sodium, Dissolved (mg/L)	MWell#1 (bg)	35	21.74	2.292	0.3875	22	21	23	15	25	0
Sodium, Total (mg/L)	MWell#1 (bg)	8	22.38	3.114	1.101	23	21.5	23.5	16	27	0
Styrene (ug/L)	MWell#1 (bg)	35	0.322	0.1438	0.0243	0.25	0.25	0.5	0.05	0.5	100
Sulfate (mg/L)	MWell#1 (bg)	35	50.57	5.387	0.9105	50	47	54	37	60	0
TDS (mg/L)	MWell#1 (bg)	35	518	66.46	11.23	530	470	560	370	620	0
Temperature (C)	MWell#1 (bg)	35	20.51	1.16	0.1961	20.65	19.86	21.12	16.2	22.4	0
Tetrachloroethene (ug/L)	MWell#1 (bg)	35	3.975	1.259	0.2128	4.1	3.6	4.6	0.73	7.5	0

HORN RAPIDS LANDFILL
MW-1
September 2011 to June 2020
Summary of Descriptive Statistics

Constituent Name	Well	N	Mean^1	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
Thallium, Dissolved (mg/L)	MWell#1 (bg)	16	0.0005	0	0	0.0005	0.0005	0.0005	0.0005	0.0005	100
Thallium, Total (mg/L)	MWell#1 (bg)	28	0.0005	0	0	0.0005	0.0005	0.0005	0.0005	0.0005	100
TOC (mg/L)	MWell#1 (bg)	35	2.14	2.957	0.4998	1.7	1.5	1.9	0.5	19	2.857
Toluene (ug/L)	MWell#1 (bg)	35	0.2199	0.1897	0.03207	0.1	0.1	0.5	0.05	0.5	100
Total Suspended Solids (mg/L)	MWell#1 (bg)	23	1.133	0.3537	0.07376	1	1	1	1	2.5	100
trans-1,2-Dichloroethene (ug/L)	MWell#1 (bg)	35	0.2257	0.1998	0.03377	0.1	0.1	0.5	0.05	0.65	100
trans-1,3-Dichloropropene (ug/L)	MWell#1 (bg)	35	0.215	0.1859	0.03143	0.1	0.1	0.5	0.05	0.5	100
trans-1,4-Dichloro-2-butene (ug/L)	MWell#1 (bg)	35	1.526	0.9562	0.1616	1	1	3	0.5	3	100
Trichloroethene (ug/L)	MWell#1 (bg)	35	0.332	0.1504	0.02542	0.32	0.22	0.5	0.1	0.6	48.57
Trichlorofluoromethane (ug/L)	MWell#1 (bg)	35	0.3229	0.1699	0.02872	0.25	0.25	0.5	0.05	0.9	100
Vanadium, Dissolved (mg/L)	MWell#1 (bg)	16	0.009456	0.0007465	0.0001866	0.0096	0.00885	0.00995	0.0079	0.011	0
Vanadium, Total (mg/L)	MWell#1 (bg)	28	0.009546	0.0008262	0.0001561	0.00935	0.0091	0.00995	0.008	0.012	0
Vinyl Acetate (ug/L)	MWell#1 (bg)	35	1.107	0.9101	0.1538	0.5	0.5	2.5	0.25	2.5	100
Vinyl Chloride (ug/L)	MWell#1 (bg)	35	0.1607	0.2267	0.03831	0.01	0.01	0.5	0.01	0.5	100
Xylenes (ug/L)	MWell#1 (bg)	35	0.5089	0.4673	0.07899	0.25	0.25	1	0.05	1.5	100
Zinc, Dissolved (mg/L)	MWell#1 (bg)	16	0.003838	0.001903	0.0004756	0.0035	0.00205	0.0053	0.0007	0.0082	37.5
Zinc, Total (mg/L)	MWell#1 (bg)	28	0.003796	0.001213	0.0002292	0.0035	0.0035	0.0035	0.002	0.0077	75

HORN RAPIDS LANDFILL
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Summary of Descriptive Statistics

Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
1,1,1,2-Tetrachloroethane (ug/L)	MWell#2	35	0.2346	0.1822	0.03079	0.15	0.1	0.5	0.05	0.5	100
1,1,1-Trichloroethane (ug/L)	MWell#2	35	0.2176	0.1874	0.03167	0.1	0.1	0.5	0.05	0.5	100
1,1,2,2-Tetrachloroethane (ug/L)	MWell#2	35	0.2191	0.1889	0.03193	0.1	0.1	0.5	0.05	0.5	100
1,1,2-Trichloroethane (ug/L)	MWell#2	35	0.2153	0.186	0.03144	0.1	0.1	0.5	0.05	0.5	100
1,1-Dichloroethane (ug/L)	MWell#2	35	0.248	0.2083	0.0352	0.1	0.1	0.5	0.05	0.8	91.43
1,1-Dichloroethene (ug/L)	MWell#2	35	0.2044	0.2014	0.03405	0.1	0.05	0.5	0.05	0.5	100
1,2,3-Trichloropropane (ug/L)	MWell#2	35	0.2223	0.1843	0.03115	0.1	0.1	0.5	0.1	0.5	100
1,2-Dibromo-3-chloropropane (ug/L)	MWell#2	35	0.9139	0.2449	0.04139	1	1	1	0.2	1	100
1,2-Dibromoethane (ug/L)	MWell#2	35	0.1816	0.2051	0.03467	0.05	0.05	0.5	0.05	0.5	100
1,2-Dichlorobenzene (ug/L)	MWell#2	35	0.2686	0.2015	0.03406	0.15	0.15	0.5	0.1	0.95	100
1,2-Dichloroethane (ug/L)	MWell#2	35	0.2229	0.1942	0.03282	0.1	0.1	0.5	0.05	0.55	100
1,2-Dichloropropane (ug/L)	MWell#2	35	0.2203	0.1903	0.03216	0.1	0.1	0.5	0.05	0.5	100
1,4-Dichlorobenzene (ug/L)	MWell#2	35	0.27	0.2066	0.03492	0.15	0.15	0.5	0.1	1	100
2-Butanone (ug/L)	MWell#2	35	5.357	1.889	0.3193	5	5	7.5	1	7.5	100
2-Hexanone (ug/L)	MWell#2	35	1.55	0.6801	0.115	1.5	1	2.5	0.5	2.5	100
4-Methyl-2-pentanone (ug/L)	MWell#2	35	2.436	0.9041	0.1528	2.5	2.5	2.5	0.25	5	100
Acetone (ug/L)	MWell#2	35	2.846	1.758	0.2972	3	1	5	1	5	100
Acrylonitrile (ug/L)	MWell#2	35	3.146	1.318	0.2228	2.5	2.5	5	1	5	100
Alkalinity (mg/L)	MWell#2	35	124.6	23.18	3.918	120	110	120	110	240	0
Ammonia Nitrogen (mg/L)	MWell#2	35	0.1303	0.08562	0.01447	0.1	0.05	0.25	0.025	0.25	94.29
Antimony, Dissolved (mg/L)	MWell#2	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Antimony, Total (mg/L)	MWell#2	28	0.0002143	0.00005245	0.000009913	0.0002	0.0002	0.0002	0.0002	0.0004	100
Arsenic, Dissolved (mg/L)	MWell#2	16	0.003181	0.0005063	0.0001266	0.0032	0.00285	0.0033	0.0025	0.0046	0
Arsenic, Total (mg/L)	MWell#2	28	0.003893	0.0005728	0.0001082	0.00385	0.0035	0.0041	0.0031	0.0053	0
Barium, Dissolved (mg/L)	MWell#2	16	0.07619	0.0227	0.005676	0.0715	0.0655	0.093	0.034	0.12	0
Barium, Total (mg/L)	MWell#2	28	0.04793	0.01656	0.00313	0.0415	0.036	0.058	0.033	0.097	0
Benzene (ug/L)	MWell#2	35	0.2229	0.1942	0.03282	0.1	0.1	0.5	0.05	0.55	100
Beryllium, Dissolved (mg/L)	MWell#2	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Beryllium, Total (mg/L)	MWell#2	28	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100

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Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
Bicarbonate (mg/L)	MWell#2	35	124.6	23.18	3.918	120	110	120	110	240	0
Bromochloromethane (ug/L)	MWell#2	35	0.2229	0.1942	0.03282	0.1	0.1	0.5	0.05	0.55	100
Bromodichloromethane (ug/L)	MWell#2	35	0.22	0.1899	0.0321	0.1	0.1	0.5	0.05	0.5	100
Bromoform (ug/L)	MWell#2	35	0.32	0.1605	0.02713	0.25	0.25	0.5	0.05	0.8	100
Bromomethane (ug/L)	MWell#2	35	0.9657	0.995	0.1682	0.5	0.25	2.5	0.05	2.5	100
Cadmium, Dissolved (mg/L)	MWell#2	16	0.00027	0.000152	0.00003799	0.0002	0.0002	0.0002	0.0002	0.00064	81.25
Cadmium, Total (mg/L)	MWell#2	28	0.000235	0.000119	0.00002248	0.0002	0.0002	0.0002	0.0002	0.00078	96.43
Calcium, Dissolved (mg/L)	MWell#2	35	105.1	39.27	6.638	92	74	130	65	200	0
Calcium, Total (mg/L)	MWell#2	8	113.3	30.17	10.66	120	87.5	130	71	160	0
Carbon Disulfide (ug/L)	MWell#2	35	0.2386	0.1887	0.03189	0.15	0.1	0.5	0.05	0.6	100
Carbon Tetrachloride (ug/L)	MWell#2	35	0.2257	0.1998	0.03377	0.1	0.1	0.5	0.05	0.65	100
Carbonate (mg/L)	MWell#2	34	2.5	0	0	2.5	2.5	2.5	2.5	2.5	100
Chloride (mg/L)	MWell#2	35	44.17	19.27	3.258	38	30	55	18	88	0
Chlorobenzene (ug/L)	MWell#2	35	0.2214	0.1919	0.03243	0.1	0.1	0.5	0.05	0.5	100
Chloroethane (ug/L)	MWell#2	35	0.8936	1.034	0.1747	0.25	0.25	2.5	0.125	2.5	100
Chloroform (ug/L)	MWell#2	35	0.2243	0.1968	0.03327	0.1	0.1	0.5	0.05	0.6	100
Chloromethane (ug/L)	MWell#2	35	0.8586	1.059	0.179	0.25	0.15	2.5	0.05	2.5	100
Chromium, Dissolved (mg/L)	MWell#2	16	0.003788	0.002348	0.0005871	0.0028	0.0021	0.005	0.0018	0.0088	0
Chromium, Total (mg/L)	MWell#2	28	0.07682	0.1166	0.02204	0.022	0.0115	0.098	0.0029	0.51	0
cis-1,2-Dichloroethene (ug/L)	MWell#2	35	0.2229	0.1942	0.03282	0.1	0.1	0.5	0.05	0.55	100
cis-1,3-Dichloropropene (ug/L)	MWell#2	35	0.2631	0.1687	0.02851	0.25	0.1	0.5	0.05	0.5	100
Cobalt, Dissolved (mg/L)	MWell#2	16	0.001354	0.001805	0.0004514	0.000575	0.0002	0.0014	0.0002	0.0056	43.75
Cobalt, Total (mg/L)	MWell#2	28	0.0008739	0.001255	0.0002371	0.00043	0.0002	0.001	0.0002	0.0057	46.43
Conductivity (umhos/cm)	MWell#2	32	795.8	274.7	48.57	721	566.5	949.5	484	1433	0
Copper, Dissolved (mg/L)	MWell#2	16	0.001856	0.001848	0.0004619	0.001	0.0005	0.00255	0.0005	0.0061	56.25
Copper, Total (mg/L)	MWell#2	28	0.003575	0.004604	0.0008701	0.00135	0.001	0.0048	0.0005	0.02	46.43
Dibromochloromethane (ug/L)	MWell#2	35	0.2286	0.2066	0.03492	0.1	0.1	0.5	0.05	0.75	100
Dibromomethane (ug/L)	MWell#2	35	0.2203	0.1903	0.03216	0.1	0.1	0.5	0.05	0.5	100
Dissolved Oxygen (mg/L)	MWell#2	35	7.029	0.8184	0.1383	7.03	6.44	7.57	5.18	9.55	0

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Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
Ethane (ug/L)	MWell#2	35	3.951	1.76	0.2975	5	2.5	5	0.55	5	100
Ethene (ug/L)	MWell#2	35	3.943	1.777	0.3004	5	2.5	5	0.5	5	100
Ethylbenzene (ug/L)	MWell#2	35	0.2199	0.1897	0.03207	0.1	0.1	0.5	0.05	0.5	100
Iodomethane (ug/L)	MWell#2	35	0.9029	1.027	0.1735	0.25	0.25	2.5	0.25	2.5	100
Iron, Dissolved (mg/L)	MWell#2	35	0.2029	0.07065	0.01194	0.25	0.1	0.25	0.1	0.25	100
Iron, Total (mg/L)	MWell#2	8	0.4688	0.6187	0.2188	0.25	0.25	0.25	0.25	2	87.5
Lead, Dissolved (mg/L)	MWell#2	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Lead, Total (mg/L)	MWell#2	28	0.0003614	0.0002873	0.0000543	0.0003	0.0002	0.0004	0.0002	0.0016	92.86
Magnesium, Dissolved (mg/L)	MWell#2	35	22.2	8.348	1.411	18	16	28	13	43	0
Magnesium, Total (mg/L)	MWell#2	8	23.25	6.431	2.274	24	18.5	27	14	33	0
Manganese, Dissolved (mg/L)	MWell#2	35	0.01406	0.01164	0.001968	0.01	0.01	0.01	0.01	0.054	88.57
Manganese, Total (mg/L)	MWell#2	8	0.02062	0.02226	0.007872	0.01	0.01	0.0215	0.01	0.072	75
Methane (ug/L)	MWell#2	35	0.764	0.6434	0.1088	0.6	0.6	0.6	0.29	2.5	100
Methylene Chloride (ug/L)	MWell#2	35	1.266	0.9463	0.1599	1.5	0.25	2.5	0.25	2.5	100
Nickel, Dissolved (mg/L)	MWell#2	16	0.1303	0.1213	0.03033	0.12	0.018	0.16	0.0015	0.39	12.5
Nickel, Total (mg/L)	MWell#2	28	0.04558	0.07223	0.01365	0.0105	0.00455	0.027	0.0015	0.24	17.86
Nitrate Nitrogen (mg/L)	MWell#2	34	30.21	16.86	2.891	24.5	15.5	43	11	73	0
pH (none)	MWell#2	35	7.547	0.1904	0.03218	7.56	7.46	7.65	7.09	7.9	0
Potassium, Dissolved (mg/L)	MWell#2	35	7.486	1.556	0.263	7.1	6.3	8.6	5.6	12	0
Potassium, Total (mg/L)	MWell#2	8	8.038	0.9531	0.337	8.25	7.6	8.65	6.1	9.2	0
Redox (mv)	MWell#2	35	110.8	118.8	20.08	108.8	41.6	178	-150.1	359.4	0
Selenium, Dissolved (mg/L)	MWell#2	16	0.002938	0.0008074	0.0002018	0.0027	0.0023	0.0036	0.0014	0.0041	0
Selenium, Total (mg/L)	MWell#2	28	0.003057	0.000983	0.0001858	0.0032	0.00225	0.004	0.0014	0.004	46.43
Silver, Dissolved (mg/L)	MWell#2	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Silver, Total (mg/L)	MWell#2	28	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Sodium, Dissolved (mg/L)	MWell#2	35	17.14	3.986	0.6738	16	14	20	12	27	0
Sodium, Total (mg/L)	MWell#2	8	18.25	2.55	0.9014	18.5	16.5	20	14	22	0
Styrene (ug/L)	MWell#2	35	0.322	0.1438	0.0243	0.25	0.25	0.5	0.05	0.5	100
Sulfate (mg/L)	MWell#2	35	103.3	42.61	7.203	90	73	130	53	210	0

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Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
TDS (mg/L)	MWell#2	35	562.9	238.5	40.32	480	360	720	300	1200	0
Temperature (C)	MWell#2	35	20.57	1.101	0.1862	20.83	20.16	21.22	16.6	22.2	0
Tetrachloroethene (ug/L)	MWell#2	35	0.3214	0.1651	0.0279	0.25	0.25	0.5	0.05	0.85	100
Thallium, Dissolved (mg/L)	MWell#2	16	0.0005	0	0	0.0005	0.0005	0.0005	0.0005	0.0005	100
Thallium, Total (mg/L)	MWell#2	28	0.0005	0	0	0.0005	0.0005	0.0005	0.0005	0.0005	100
TOC (mg/L)	MWell#2	35	1.635	1.222	0.2066	1.2	1	1.9	0.5	7	17.14
Toluene (ug/L)	MWell#2	35	0.2199	0.1897	0.03207	0.1	0.1	0.5	0.05	0.5	100
Total Suspended Solids (mg/L)	MWell#2	23	2.352	5.823	1.214	1	1	1	1	29	91.3
trans-1,2-Dichloroethene (ug/L)	MWell#2	35	0.2257	0.1998	0.03377	0.1	0.1	0.5	0.05	0.65	100
trans-1,3-Dichloropropene (ug/L)	MWell#2	35	0.215	0.1859	0.03143	0.1	0.1	0.5	0.05	0.5	100
trans-1,4-Dichloro-2-butene (ug/L)	MWell#2	35	1.526	0.9562	0.1616	1	1	3	0.5	3	100
Trichloroethene (ug/L)	MWell#2	35	0.2243	0.1968	0.03327	0.1	0.1	0.5	0.05	0.6	100
Trichlorofluoromethane (ug/L)	MWell#2	35	0.3229	0.1699	0.02872	0.25	0.25	0.5	0.05	0.9	100
Vanadium, Dissolved (mg/L)	MWell#2	16	0.007694	0.0007827	0.0001957	0.0077	0.0074	0.00805	0.0055	0.009	0
Vanadium, Total (mg/L)	MWell#2	28	0.01069	0.002251	0.0004253	0.01	0.00915	0.012	0.0067	0.015	0
Vinyl Acetate (ug/L)	MWell#2	35	1.107	0.9101	0.1538	0.5	0.5	2.5	0.25	2.5	100
Vinyl Chloride (ug/L)	MWell#2	35	0.1607	0.2267	0.03831	0.01	0.01	0.5	0.01	0.5	100
Xylenes (ug/L)	MWell#2	35	0.5089	0.4673	0.07899	0.25	0.25	1	0.05	1.5	100
Zinc, Dissolved (mg/L)	MWell#2	16	0.004088	0.002148	0.000537	0.0034	0.002	0.00625	0.0017	0.0083	37.5
Zinc, Total (mg/L)	MWell#2	28	0.003532	0.001242	0.0002348	0.0035	0.0035	0.0035	0.002	0.0076	85.71

HORN RAPIDS LANDFILL
MW-3
September 2011 to June 2020
Summary of Descriptive Statistics

Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
1,1,1,2-Tetrachloroethane (ug/L)	MWell#3	32	0.2456	0.1867	0.03301	0.15	0.1	0.5	0.05	0.5	100
1,1,1-Trichloroethane (ug/L)	MWell#3	32	0.2327	0.1892	0.03345	0.1	0.1	0.5	0.05	0.5	93.75
1,1,2,2-Tetrachloroethane (ug/L)	MWell#3	32	0.2303	0.194	0.03429	0.1	0.1	0.5	0.05	0.5	100
1,1,2-Trichloroethane (ug/L)	MWell#3	32	0.2261	0.1912	0.03379	0.1	0.1	0.5	0.05	0.5	100
1,1-Dichloroethane (ug/L)	MWell#3	32	1.511	1.099	0.1944	1.55	0.215	2.5	0.1	3.3	21.88
1,1-Dichloroethene (ug/L)	MWell#3	32	0.2302	0.1973	0.03488	0.11	0.1	0.5	0.05	0.5	84.38
1,2,3-Trichloropropane (ug/L)	MWell#3	32	0.2338	0.1889	0.03339	0.1	0.1	0.5	0.1	0.5	100
1,2-Dibromo-3-chloropropane (ug/L)	MWell#3	32	0.9058	0.2549	0.04506	1	1	1	0.2	1	100
1,2-Dibromoethane (ug/L)	MWell#3	32	0.1939	0.2105	0.03721	0.05	0.05	0.5	0.05	0.5	100
1,2-Dichlorobenzene (ug/L)	MWell#3	32	0.2797	0.2075	0.03668	0.15	0.15	0.5	0.1	0.95	100
1,2-Dichloroethane (ug/L)	MWell#3	32	0.2344	0.1994	0.03524	0.1	0.1	0.5	0.05	0.55	100
1,2-Dichloropropane (ug/L)	MWell#3	32	0.2316	0.1954	0.03454	0.1	0.1	0.5	0.05	0.5	100
1,4-Dichlorobenzene (ug/L)	MWell#3	32	0.2813	0.2128	0.03762	0.15	0.15	0.5	0.1	1	100
2-Butanone (ug/L)	MWell#3	32	5.234	1.896	0.3352	5	5	7.5	1	7.5	100
2-Hexanone (ug/L)	MWell#3	32	1.586	0.6974	0.1233	1.5	1	2.5	0.5	2.5	100
4-Methyl-2-pentanone (ug/L)	MWell#3	32	2.43	0.9466	0.1673	2.5	2.5	2.5	0.25	5	100
Acetone (ug/L)	MWell#3	32	2.988	1.75	0.3094	3	1	5	1	5	96.88
Acrylonitrile (ug/L)	MWell#3	32	3.128	1.329	0.235	2.5	2.5	5	1	5	100
Alkalinity (mg/L)	MWell#3	32	153.2	36.26	6.409	165	115	180	88	220	0
Ammonia Nitrogen (mg/L)	MWell#3	32	0.1303	0.08656	0.0153	0.1	0.05	0.25	0.025	0.25	93.75
Antimony, Dissolved (mg/L)	MWell#3	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Antimony, Total (mg/L)	MWell#3	25	0.000216	0.00005538	0.00001108	0.0002	0.0002	0.0002	0.0002	0.0004	100
Arsenic, Dissolved (mg/L)	MWell#3	16	0.007375	0.0007987	0.0001997	0.0077	0.0069	0.0079	0.0055	0.0084	0
Arsenic, Total (mg/L)	MWell#3	25	0.00804	0.0008088	0.0001618	0.0079	0.0076	0.00845	0.0063	0.01	0
Barium, Dissolved (mg/L)	MWell#3	16	0.03413	0.003538	0.0008845	0.034	0.0315	0.037	0.028	0.04	0
Barium, Total (mg/L)	MWell#3	25	0.03016	0.01039	0.002077	0.036	0.018	0.039	0.015	0.043	0
Benzene (ug/L)	MWell#3	32	0.2344	0.1994	0.03524	0.1	0.1	0.5	0.05	0.55	100
Beryllium, Dissolved (mg/L)	MWell#3	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Beryllium, Total (mg/L)	MWell#3	25	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100

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Summary of Descriptive Statistics

Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
Bicarbonate (mg/L)	MWell#3	32	153.2	36.26	6.409	165	115	180	88	220	0
Bromochloromethane (ug/L)	MWell#3	32	0.2344	0.1994	0.03524	0.1	0.1	0.5	0.05	0.55	100
Bromodichloromethane (ug/L)	MWell#3	32	0.2663	0.1802	0.03185	0.235	0.1	0.5	0.05	0.5	75
Bromoform (ug/L)	MWell#3	32	0.3266	0.1666	0.02944	0.25	0.25	0.5	0.05	0.8	100
Bromomethane (ug/L)	MWell#3	32	1.017	1.026	0.1814	0.5	0.25	2.5	0.05	2.5	100
Cadmium, Dissolved (mg/L)	MWell#3	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Cadmium, Total (mg/L)	MWell#3	25	0.000216	0.00005538	0.00001108	0.0002	0.0002	0.0002	0.0002	0.0004	100
Calcium, Dissolved (mg/L)	MWell#3	32	66.5	19.66	3.476	69.5	46	84.5	32	90	0
Calcium, Total (mg/L)	MWell#3	8	79.5	10.46	3.698	82.5	74	88	59	88	0
Carbon Disulfide (ug/L)	MWell#3	32	0.25	0.1934	0.0342	0.15	0.1	0.5	0.05	0.6	100
Carbon Tetrachloride (ug/L)	MWell#3	32	0.2375	0.2052	0.03627	0.1	0.1	0.5	0.05	0.65	100
Carbonate (mg/L)	MWell#3	33	2.5	0	0	2.5	2.5	2.5	2.5	2.5	100
Chloride (mg/L)	MWell#3	32	24.76	14.07	2.487	21.5	12	36	7.6	53	0
Chlorobenzene (ug/L)	MWell#3	32	0.2328	0.197	0.03482	0.1	0.1	0.5	0.05	0.5	100
Chloroethane (ug/L)	MWell#3	32	0.9539	1.062	0.1878	0.25	0.25	2.5	0.125	2.5	100
Chloroform (ug/L)	MWell#3	32	1.789	2.204	0.3897	0.5	0.48	3.75	0.25	6.7	34.38
Chloromethane (ug/L)	MWell#3	32	0.9219	1.087	0.1922	0.25	0.15	2.5	0.05	2.5	100
Chromium, Dissolved (mg/L)	MWell#3	16	0.003363	0.0009084	0.0002271	0.00345	0.00305	0.0041	0.0014	0.0046	0
Chromium, Total (mg/L)	MWell#3	25	0.01674	0.01091	0.002181	0.014	0.0081	0.0265	0.0049	0.048	0
cis-1,2-Dichloroethene (ug/L)	MWell#3	32	0.6566	0.4366	0.07717	0.64	0.1	1.05	0.1	1.3	43.75
cis-1,3-Dichloropropene (ug/L)	MWell#3	32	0.2691	0.1741	0.03077	0.25	0.1	0.5	0.05	0.5	100
Cobalt, Dissolved (mg/L)	MWell#3	16	0.002188	0.001663	0.0004157	0.00165	0.00095	0.00285	0.0005	0.007	0
Cobalt, Total (mg/L)	MWell#3	25	0.003435	0.003174	0.0006348	0.0028	0.000425	0.0059	0.0002	0.0096	20
Conductivity (umhos/cm)	MWell#3	30	501.9	130.5	23.82	520.5	358.9	627	287.2	677	0
Copper, Dissolved (mg/L)	MWell#3	16	0.00105	0.0006501	0.0001625	0.001	0.0005	0.0011	0.0005	0.0032	37.5
Copper, Total (mg/L)	MWell#3	25	0.00342	0.007553	0.001511	0.001	0.001	0.0024	0.0005	0.038	52
Dibromochloromethane (ug/L)	MWell#3	32	0.2406	0.2123	0.03753	0.1	0.1	0.5	0.05	0.75	100
Dibromomethane (ug/L)	MWell#3	32	0.2316	0.1954	0.03454	0.1	0.1	0.5	0.05	0.5	100
Dissolved Oxygen (mg/L)	MWell#3	32	7.376	1.238	0.2189	7.645	6.63	8.45	4.49	9.15	0

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Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
Ethane (ug/L)	MWell#3	32	3.992	1.718	0.3037	5	2.5	5	0.55	5	100
Ethene (ug/L)	MWell#3	32	3.984	1.734	0.3066	5	2.5	5	0.5	5	100
Ethylbenzene (ug/L)	MWell#3	32	0.2311	0.1948	0.03444	0.1	0.1	0.5	0.05	0.5	100
Iodomethane (ug/L)	MWell#3	32	0.9641	1.054	0.1863	0.25	0.25	2.5	0.25	2.5	100
Iron, Dissolved (mg/L)	MWell#3	32	0.2031	0.07064	0.01249	0.25	0.1	0.25	0.1	0.25	100
Iron, Total (mg/L)	MWell#3	8	0.2813	0.08839	0.03125	0.25	0.25	0.25	0.25	0.5	87.5
Lead, Dissolved (mg/L)	MWell#3	16	0.0002412	0.00008899	0.00002225	0.0002	0.0002	0.0002	0.0002	0.00044	81.25
Lead, Total (mg/L)	MWell#3	25	0.0004068	0.0002373	0.00004745	0.0004	0.0002	0.000405	0.0002	0.0012	72
Magnesium, Dissolved (mg/L)	MWell#3	32	12.33	3.5	0.6187	13	8.85	15	5.6	17	0
Magnesium, Total (mg/L)	MWell#3	8	14.88	1.458	0.5154	15	13.5	16	13	17	0
Manganese, Dissolved (mg/L)	MWell#3	32	0.01	0	0	0.01	0.01	0.01	0.01	0.01	100
Manganese, Total (mg/L)	MWell#3	8	0.01	0	0	0.01	0.01	0.01	0.01	0.01	100
Methane (ug/L)	MWell#3	32	0.9891	1.164	0.2059	0.6	0.6	0.6	0.29	5.5	93.75
Methylene Chloride (ug/L)	MWell#3	32	1.291	0.9304	0.1645	1.5	0.25	2.5	0.25	2.5	100
Nickel, Dissolved (mg/L)	MWell#3	16	0.0052	0.004514	0.001128	0.00345	0.003	0.0059	0.0015	0.019	18.75
Nickel, Total (mg/L)	MWell#3	25	0.006764	0.004696	0.0009393	0.0062	0.00355	0.00945	0.0015	0.022	20
Nitrate Nitrogen (mg/L)	MWell#3	32	4.522	2.376	0.42	4.65	2.55	6.8	0.69	8	3.125
pH (none)	MWell#3	32	7.708	0.1717	0.03036	7.695	7.61	7.795	7.38	8.13	0
Potassium, Dissolved (mg/L)	MWell#3	32	6.916	1.083	0.1915	7.1	5.8	7.8	4.6	8.5	0
Potassium, Total (mg/L)	MWell#3	8	7.65	0.8071	0.2854	7.8	7.25	8.1	6.1	8.8	0
Redox (mv)	MWell#3	32	123	99.73	17.63	125	50.7	173.3	-80.8	319	0
Selenium, Dissolved (mg/L)	MWell#3	16	0.001644	0.0004487	0.0001122	0.00175	0.00145	0.0019	0.0005	0.0022	6.25
Selenium, Total (mg/L)	MWell#3	25	0.002868	0.001043	0.0002086	0.0023	0.002	0.004	0.0015	0.004	44
Silver, Dissolved (mg/L)	MWell#3	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Silver, Total (mg/L)	MWell#3	25	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Sodium, Dissolved (mg/L)	MWell#3	32	15.19	2.717	0.4803	15	13	18	10	20	0
Sodium, Total (mg/L)	MWell#3	8	16.5	1.773	0.6268	17	15.5	18	13	18	0
Styrene (ug/L)	MWell#3	32	0.3288	0.1488	0.0263	0.25	0.25	0.5	0.05	0.5	100
Sulfate (mg/L)	MWell#3	32	48.13	21.32	3.769	43	28.5	66	20	84	0

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Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
TDS (mg/L)	MWell#3	32	319.4	96.82	17.12	330	255	400	120	440	0
Temperature (C)	MWell#3	32	21.05	1.695	0.2996	21.58	20.2	22.38	17.3	23.68	0
Tetrachloroethene (ug/L)	MWell#3	32	0.3297	0.1689	0.02986	0.25	0.25	0.5	0.05	0.85	96.88
Thallium, Dissolved (mg/L)	MWell#3	16	0.0005	0	0	0.0005	0.0005	0.0005	0.0005	0.0005	100
Thallium, Total (mg/L)	MWell#3	25	0.0005	0	0	0.0005	0.0005	0.0005	0.0005	0.0005	100
TOC (mg/L)	MWell#3	32	0.8875	0.8875	0.1569	0.5	0.5	1.1	0.45	5.4	59.38
Toluene (ug/L)	MWell#3	32	0.2311	0.1948	0.03444	0.1	0.1	0.5	0.05	0.5	100
Total Suspended Solids (mg/L)	MWell#3	20	3.037	5.404	1.208	1	1	1.65	1	24	80
trans-1,2-Dichloroethene (ug/L)	MWell#3	32	0.2375	0.2052	0.03627	0.1	0.1	0.5	0.05	0.65	100
trans-1,3-Dichloropropene (ug/L)	MWell#3	32	0.2258	0.1911	0.03378	0.1	0.1	0.5	0.05	0.5	100
trans-1,4-Dichloro-2-butene (ug/L)	MWell#3	32	1.575	0.9867	0.1744	1	1	3	0.5	3	100
Trichloroethene (ug/L)	MWell#3	32	0.2478	0.1951	0.03448	0.1	0.1	0.5	0.05	0.6	87.5
Trichlorofluoromethane (ug/L)	MWell#3	32	0.8116	0.5136	0.09079	0.79	0.25	1.3	0.25	1.6	37.5
Vanadium, Dissolved (mg/L)	MWell#3	16	0.01306	0.0007719	0.000193	0.013	0.013	0.0135	0.011	0.014	0
Vanadium, Total (mg/L)	MWell#3	25	0.01432	0.001773	0.0003546	0.014	0.013	0.0155	0.012	0.019	0
Vinyl Acetate (ug/L)	MWell#3	32	1.156	0.937	0.1656	0.5	0.5	2.5	0.25	2.5	100
Vinyl Chloride (ug/L)	MWell#3	32	0.1748	0.2322	0.04106	0.01	0.01	0.5	0.01	0.5	100
Xylenes (ug/L)	MWell#3	32	0.5331	0.4821	0.08523	0.25	0.25	1	0.05	1.5	100
Zinc, Dissolved (mg/L)	MWell#3	16	0.003638	0.001479	0.0003698	0.0035	0.002	0.00465	0.0017	0.0064	31.25
Zinc, Total (mg/L)	MWell#3	25	0.004052	0.001276	0.0002553	0.0035	0.0035	0.00395	0.0035	0.0092	68

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Summary of Descriptive Statistics

Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
1,1,1,2-Tetrachloroethane (ug/L)	MWell#4	35	0.2346	0.1822	0.03079	0.15	0.1	0.5	0.05	0.5	100
1,1,1-Trichloroethane (ug/L)	MWell#4	35	0.2176	0.1874	0.03167	0.1	0.1	0.5	0.05	0.5	100
1,1,2,2-Tetrachloroethane (ug/L)	MWell#4	35	0.2191	0.1889	0.03193	0.1	0.1	0.5	0.05	0.5	100
1,1,2-Trichloroethane (ug/L)	MWell#4	35	0.2153	0.186	0.03144	0.1	0.1	0.5	0.05	0.5	100
1,1-Dichloroethane (ug/L)	MWell#4	35	3.494	0.8516	0.144	3.5	2.8	4	2.1	5.7	0
1,1-Dichloroethene (ug/L)	MWell#4	35	0.2221	0.1902	0.03215	0.1	0.1	0.5	0.05	0.5	77.14
1,2,3-Trichloropropane (ug/L)	MWell#4	35	0.2223	0.1843	0.03115	0.1	0.1	0.5	0.1	0.5	100
1,2-Dibromo-3-chloropropane (ug/L)	MWell#4	35	0.9139	0.2449	0.04139	1	1	1	0.2	1	100
1,2-Dibromoethane (ug/L)	MWell#4	35	0.1816	0.2051	0.03467	0.05	0.05	0.5	0.05	0.5	100
1,2-Dichlorobenzene (ug/L)	MWell#4	35	0.2686	0.2015	0.03406	0.15	0.15	0.5	0.1	0.95	100
1,2-Dichloroethane (ug/L)	MWell#4	35	0.2229	0.1942	0.03282	0.1	0.1	0.5	0.05	0.55	100
1,2-Dichloropropane (ug/L)	MWell#4	35	0.2269	0.1867	0.03157	0.1	0.1	0.5	0.05	0.5	94.29
1,4-Dichlorobenzene (ug/L)	MWell#4	35	0.27	0.2066	0.03492	0.15	0.15	0.5	0.1	1	100
2-Butanone (ug/L)	MWell#4	35	5.357	1.889	0.3193	5	5	7.5	1	7.5	100
2-Hexanone (ug/L)	MWell#4	35	1.55	0.6801	0.115	1.5	1	2.5	0.5	2.5	100
4-Methyl-2-pentanone (ug/L)	MWell#4	35	2.436	0.9041	0.1528	2.5	2.5	2.5	0.25	5	100
Acetone (ug/L)	MWell#4	35	2.894	1.729	0.2923	3	1	5	1	5	97.14
Acrylonitrile (ug/L)	MWell#4	35	3.146	1.318	0.2228	2.5	2.5	5	1	5	100
Alkalinity (mg/L)	MWell#4	35	197.1	19.49	3.294	190	190	210	160	240	0
Ammonia Nitrogen (mg/L)	MWell#4	35	0.1297	0.08651	0.01462	0.1	0.05	0.25	0.025	0.25	97.14
Antimony, Dissolved (mg/L)	MWell#4	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Antimony, Total (mg/L)	MWell#4	28	0.0002143	0.00005245	0.000009913	0.0002	0.0002	0.0002	0.0002	0.0004	100
Arsenic, Dissolved (mg/L)	MWell#4	16	0.004756	0.000278	0.0000695	0.00475	0.0045	0.005	0.0043	0.0052	0
Arsenic, Total (mg/L)	MWell#4	28	0.004532	0.0003732	0.00007053	0.0045	0.0042	0.0048	0.0039	0.0052	0
Barium, Dissolved (mg/L)	MWell#4	16	0.03588	0.002941	0.0007353	0.0365	0.0335	0.038	0.032	0.041	0
Barium, Total (mg/L)	MWell#4	28	0.03843	0.003615	0.0006832	0.037	0.036	0.0405	0.034	0.047	0
Benzene (ug/L)	MWell#4	35	0.2229	0.1942	0.03282	0.1	0.1	0.5	0.05	0.55	100
Beryllium, Dissolved (mg/L)	MWell#4	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Beryllium, Total (mg/L)	MWell#4	28	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100

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Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
Bicarbonate (mg/L)	MWell#4	35	197.1	19.49	3.294	190	190	210	160	240	0
Bromochloromethane (ug/L)	MWell#4	35	0.2229	0.1942	0.03282	0.1	0.1	0.5	0.05	0.55	100
Bromodichloromethane (ug/L)	MWell#4	35	0.22	0.1899	0.0321	0.1	0.1	0.5	0.05	0.5	100
Bromoform (ug/L)	MWell#4	35	0.32	0.1605	0.02713	0.25	0.25	0.5	0.05	0.8	100
Bromomethane (ug/L)	MWell#4	35	0.9657	0.995	0.1682	0.5	0.25	2.5	0.05	2.5	100
Cadmium, Dissolved (mg/L)	MWell#4	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Cadmium, Total (mg/L)	MWell#4	28	0.0002143	0.00005245	0.000009913	0.0002	0.0002	0.0002	0.0002	0.0004	100
Calcium, Dissolved (mg/L)	MWell#4	35	65.14	7.674	1.297	64	61	68	50	87	0
Calcium, Total (mg/L)	MWell#4	8	78.25	45.22	15.99	63.5	61.5	64.5	57	190	0
Carbon Disulfide (ug/L)	MWell#4	35	0.2386	0.1887	0.03189	0.15	0.1	0.5	0.05	0.6	100
Carbon Tetrachloride (ug/L)	MWell#4	35	0.2257	0.1998	0.03377	0.1	0.1	0.5	0.05	0.65	100
Carbonate (mg/L)	MWell#4	34	2.5	0	0	2.5	2.5	2.5	2.5	2.5	100
Chloride (mg/L)	MWell#4	35	10.91	1.317	0.2226	11	10	11	8.6	14	0
Chlorobenzene (ug/L)	MWell#4	35	0.2214	0.1919	0.03243	0.1	0.1	0.5	0.05	0.5	100
Chloroethane (ug/L)	MWell#4	35	0.8936	1.034	0.1747	0.25	0.25	2.5	0.125	2.5	100
Chloroform (ug/L)	MWell#4	35	0.4043	0.1227	0.02075	0.46	0.31	0.5	0.14	0.6	31.43
Chloromethane (ug/L)	MWell#4	35	0.8586	1.059	0.179	0.25	0.15	2.5	0.05	2.5	100
Chromium, Dissolved (mg/L)	MWell#4	16	0.001806	0.0005579	0.0001395	0.00165	0.00145	0.002	0.0013	0.0035	0
Chromium, Total (mg/L)	MWell#4	28	0.001986	0.0004844	0.00009154	0.0018	0.0017	0.00215	0.0015	0.0038	0
cis-1,2-Dichloroethene (ug/L)	MWell#4	35	2.516	0.7603	0.1285	2.7	2	2.9	0.05	4.4	2.857
cis-1,3-Dichloropropene (ug/L)	MWell#4	35	0.2631	0.1687	0.02851	0.25	0.1	0.5	0.05	0.5	100
Cobalt, Dissolved (mg/L)	MWell#4	16	0.002163	0.0005584	0.0001396	0.0022	0.00185	0.00255	0.0011	0.003	0
Cobalt, Total (mg/L)	MWell#4	28	0.004329	0.001896	0.0003583	0.00405	0.0031	0.00535	0.0015	0.0088	0
Conductivity (umhos/cm)	MWell#4	32	476	56.78	10.04	466	434	507.6	356	590	0
Copper, Dissolved (mg/L)	MWell#4	16	0.0007375	0.0006281	0.000157	0.0005	0.0005	0.0005	0.0005	0.0029	87.5
Copper, Total (mg/L)	MWell#4	28	0.001411	0.002143	0.0004049	0.001	0.001	0.001	0.0005	0.012	89.29
Dibromochloromethane (ug/L)	MWell#4	35	0.2286	0.2066	0.03492	0.1	0.1	0.5	0.05	0.75	100
Dibromomethane (ug/L)	MWell#4	35	0.2203	0.1903	0.03216	0.1	0.1	0.5	0.05	0.5	100
Dissolved Oxygen (mg/L)	MWell#4	35	3.916	0.5544	0.09371	4.04	3.7	4.3	1.58	4.77	0

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MW-4
September 2011 to June 2020
Summary of Descriptive Statistics

Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
Ethane (ug/L)	MWell#4	35	3.951	1.76	0.2975	5	2.5	5	0.55	5	100
Ethene (ug/L)	MWell#4	35	3.943	1.777	0.3004	5	2.5	5	0.5	5	100
Ethylbenzene (ug/L)	MWell#4	35	0.2199	0.1897	0.03207	0.1	0.1	0.5	0.05	0.5	100
Iodomethane (ug/L)	MWell#4	35	0.9029	1.027	0.1735	0.25	0.25	2.5	0.25	2.5	100
Iron, Dissolved (mg/L)	MWell#4	35	0.2029	0.07065	0.01194	0.25	0.1	0.25	0.1	0.25	100
Iron, Total (mg/L)	MWell#4	8	0.25	0	0	0.25	0.25	0.25	0.25	0.25	100
Lead, Dissolved (mg/L)	MWell#4	16	0.0002562	0.000225	0.00005625	0.0002	0.0002	0.0002	0.0002	0.0011	93.75
Lead, Total (mg/L)	MWell#4	28	0.0002929	0.0001016	0.0000192	0.0002	0.0002	0.0004	0.0002	0.0004	100
Magnesium, Dissolved (mg/L)	MWell#4	35	13.86	1.768	0.2989	14	13	14	11	19	0
Magnesium, Total (mg/L)	MWell#4	8	16.63	9.471	3.348	13.5	13	14	12	40	0
Manganese, Dissolved (mg/L)	MWell#4	35	0.01	0	0	0.01	0.01	0.01	0.01	0.01	100
Manganese, Total (mg/L)	MWell#4	8	0.01225	0.006364	0.00225	0.01	0.01	0.01	0.01	0.028	87.5
Methane (ug/L)	MWell#4	34	0.9191	1.022	0.1753	0.6	0.6	0.6	0.29	5.4	97.06
Methylene Chloride (ug/L)	MWell#4	35	1.266	0.9463	0.1599	1.5	0.25	2.5	0.25	2.5	100
Nickel, Dissolved (mg/L)	MWell#4	16	0.001594	0.000375	0.00009375	0.0015	0.0015	0.0015	0.0015	0.003	93.75
Nickel, Total (mg/L)	MWell#4	28	0.0015	0	0	0.0015	0.0015	0.0015	0.0015	0.0015	100
Nitrate Nitrogen (mg/L)	MWell#4	35	2.434	0.6299	0.1065	2.4	2.2	2.6	0.89	4.7	0
pH (none)	MWell#4	35	7.618	0.1584	0.02677	7.6	7.52	7.69	7.36	8.11	0
Potassium, Dissolved (mg/L)	MWell#4	35	6.294	0.3888	0.06571	6.3	6	6.5	5.2	7.1	0
Potassium, Total (mg/L)	MWell#4	8	7.013	2.03	0.7177	6.35	6.15	6.6	5.9	12	0
Redox (mv)	MWell#4	35	119.9	104.6	17.67	131.6	50	172	-114.5	336	0
Selenium, Dissolved (mg/L)	MWell#4	16	0.0005	0	0	0.0005	0.0005	0.0005	0.0005	0.0005	100
Selenium, Total (mg/L)	MWell#4	28	0.002125	0.001778	0.0003359	0.0005	0.0005	0.004	0.0005	0.004	100
Silver, Dissolved (mg/L)	MWell#4	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Silver, Total (mg/L)	MWell#4	28	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Sodium, Dissolved (mg/L)	MWell#4	35	13.4	0.9762	0.165	13	13	14	12	16	0
Sodium, Total (mg/L)	MWell#4	8	14.38	2.722	0.9625	13.5	13	14	13	21	0
Styrene (ug/L)	MWell#4	35	0.322	0.1438	0.0243	0.25	0.25	0.5	0.05	0.5	100
Sulfate (mg/L)	MWell#4	35	24.14	2.614	0.4418	24	22	26	20	30	0

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Summary of Descriptive Statistics

Constituent Name	Well	N	Mean^1	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
TDS (mg/L)	MWell#4	35	282.3	60.73	10.27	290	270	310	10	360	2.857
Temperature (C)	MWell#4	35	20.24	0.8701	0.1471	20.32	19.55	20.7	18.3	21.6	0
Tetrachloroethene (ug/L)	MWell#4	35	0.3214	0.1651	0.0279	0.25	0.25	0.5	0.05	0.85	100
Thallium, Dissolved (mg/L)	MWell#4	16	0.0005	0	0	0.0005	0.0005	0.0005	0.0005	0.0005	100
Thallium, Total (mg/L)	MWell#4	28	0.0005	0	0	0.0005	0.0005	0.0005	0.0005	0.0005	100
TOC (mg/L)	MWell#4	35	0.8883	2.282	0.3857	0.5	0.5	0.5	0.34	14	94.29
Toluene (ug/L)	MWell#4	35	0.2199	0.1897	0.03207	0.1	0.1	0.5	0.05	0.5	100
Total Suspended Solids (mg/L)	MWell#4	23	1.085	0.2238	0.04667	1	1	1	1	1.65	100
trans-1,2-Dichloroethene (ug/L)	MWell#4	35	0.2257	0.1998	0.03377	0.1	0.1	0.5	0.05	0.65	100
trans-1,3-Dichloropropene (ug/L)	MWell#4	35	0.215	0.1859	0.03143	0.1	0.1	0.5	0.05	0.5	100
trans-1,4-Dichloro-2-butene (ug/L)	MWell#4	35	1.526	0.9562	0.1616	1	1	3	0.5	3	100
Trichloroethene (ug/L)	MWell#4	35	0.2749	0.1723	0.02913	0.23	0.1	0.5	0.05	0.6	60
Trichlorofluoromethane (ug/L)	MWell#4	35	0.8669	0.2379	0.04022	0.9	0.7	1	0.5	1.5	20
Vanadium, Dissolved (mg/L)	MWell#4	16	0.01169	0.0007932	0.0001983	0.012	0.011	0.012	0.01	0.013	0
Vanadium, Total (mg/L)	MWell#4	28	0.01168	0.000863	0.0001631	0.0115	0.011	0.012	0.01	0.013	0
Vinyl Acetate (ug/L)	MWell#4	35	1.107	0.9101	0.1538	0.5	0.5	2.5	0.25	2.5	100
Vinyl Chloride (ug/L)	MWell#4	35	0.1745	0.2177	0.03679	0.042	0.02	0.5	0.01	0.5	54.29
Xylenes (ug/L)	MWell#4	35	0.5089	0.4673	0.07899	0.25	0.25	1	0.05	1.5	100
Zinc, Dissolved (mg/L)	MWell#4	16	0.005044	0.01202	0.003005	0.002	0.0019	0.0029	0.0007	0.05	56.25
Zinc, Total (mg/L)	MWell#4	28	0.003257	0.001148	0.0002169	0.0035	0.00315	0.0035	0.0007	0.0077	92.86

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MW-5
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Summary of Descriptive Statistics

Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
1,1,1,2-Tetrachloroethane (ug/L)	MWell#5	35	0.2346	0.1822	0.03079	0.15	0.1	0.5	0.05	0.5	100
1,1,1-Trichloroethane (ug/L)	MWell#5	35	0.2176	0.1874	0.03167	0.1	0.1	0.5	0.05	0.5	100
1,1,2,2-Tetrachloroethane (ug/L)	MWell#5	35	0.2191	0.1889	0.03193	0.1	0.1	0.5	0.05	0.5	100
1,1,2-Trichloroethane (ug/L)	MWell#5	35	0.2153	0.186	0.03144	0.1	0.1	0.5	0.05	0.5	100
1,1-Dichloroethane (ug/L)	MWell#5	35	6.56	2.025	0.3423	7	5.6	8	0.9	9.2	0
1,1-Dichloroethene (ug/L)	MWell#5	35	0.2593	0.1725	0.02915	0.19	0.1	0.5	0.05	0.5	62.86
1,2,3-Trichloropropane (ug/L)	MWell#5	35	0.2223	0.1843	0.03115	0.1	0.1	0.5	0.1	0.5	100
1,2-Dibromo-3-chloropropane (ug/L)	MWell#5	35	0.9139	0.2449	0.04139	1	1	1	0.2	1	100
1,2-Dibromoethane (ug/L)	MWell#5	35	0.1816	0.2051	0.03467	0.05	0.05	0.5	0.05	0.5	100
1,2-Dichlorobenzene (ug/L)	MWell#5	35	0.2686	0.2015	0.03406	0.15	0.15	0.5	0.1	0.95	100
1,2-Dichloroethane (ug/L)	MWell#5	35	0.6211	0.2564	0.04333	0.61	0.5	0.8	0.05	1.1	34.29
1,2-Dichloropropane (ug/L)	MWell#5	35	0.4306	0.2315	0.03914	0.43	0.32	0.5	0.05	1.2	34.29
1,4-Dichlorobenzene (ug/L)	MWell#5	35	0.27	0.2066	0.03492	0.15	0.15	0.5	0.1	1	100
2-Butanone (ug/L)	MWell#5	35	5.357	1.889	0.3193	5	5	7.5	1	7.5	100
2-Hexanone (ug/L)	MWell#5	35	1.55	0.6801	0.115	1.5	1	2.5	0.5	2.5	100
4-Methyl-2-pentanone (ug/L)	MWell#5	35	2.436	0.9041	0.1528	2.5	2.5	2.5	0.25	5	100
Acetone (ug/L)	MWell#5	35	6.314	19.87	3.358	3	1	5	1	120	91.43
Acrylonitrile (ug/L)	MWell#5	35	3.146	1.318	0.2228	2.5	2.5	5	1	5	100
Alkalinity (mg/L)	MWell#5	35	514	59.42	10.04	510	480	520	420	720	0
Ammonia Nitrogen (mg/L)	MWell#5	35	0.1306	0.08557	0.01446	0.1	0.05	0.25	0.025	0.25	94.29
Antimony, Dissolved (mg/L)	MWell#5	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Antimony, Total (mg/L)	MWell#5	28	0.0002143	0.00005245	0.000009913	0.0002	0.0002	0.0002	0.0002	0.0004	100
Arsenic, Dissolved (mg/L)	MWell#5	16	0.002444	0.0005727	0.0001432	0.0023	0.0022	0.0025	0.0016	0.0043	0
Arsenic, Total (mg/L)	MWell#5	28	0.002482	0.0005403	0.0001021	0.0023	0.0022	0.00265	0.0019	0.0042	0
Barium, Dissolved (mg/L)	MWell#5	16	0.1256	0.01797	0.004493	0.12	0.11	0.135	0.099	0.17	0
Barium, Total (mg/L)	MWell#5	28	0.1204	0.01478	0.002793	0.12	0.11	0.13	0.1	0.16	0
Benzene (ug/L)	MWell#5	35	0.3369	0.1345	0.02273	0.33	0.25	0.5	0.1	0.55	42.86
Beryllium, Dissolved (mg/L)	MWell#5	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Beryllium, Total (mg/L)	MWell#5	28	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100

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Summary of Descriptive Statistics

Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
Bicarbonate (mg/L)	MWell#5	35	514	59.42	10.04	510	480	520	420	720	0
Bromochloromethane (ug/L)	MWell#5	35	0.2229	0.1942	0.03282	0.1	0.1	0.5	0.05	0.55	100
Bromodichloromethane (ug/L)	MWell#5	35	0.22	0.1899	0.0321	0.1	0.1	0.5	0.05	0.5	100
Bromoform (ug/L)	MWell#5	35	0.32	0.1605	0.02713	0.25	0.25	0.5	0.05	0.8	100
Bromomethane (ug/L)	MWell#5	35	0.9657	0.995	0.1682	0.5	0.25	2.5	0.05	2.5	100
Cadmium, Dissolved (mg/L)	MWell#5	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Cadmium, Total (mg/L)	MWell#5	28	0.0002143	0.00005245	0.000009913	0.0002	0.0002	0.0002	0.0002	0.0004	100
Calcium, Dissolved (mg/L)	MWell#5	35	195.7	32.02	5.412	190	180	200	160	300	0
Calcium, Total (mg/L)	MWell#5	8	187.5	16.69	5.901	190	175	200	160	210	0
Carbon Disulfide (ug/L)	MWell#5	35	0.2414	0.1881	0.03179	0.15	0.1	0.5	0.05	0.6	100
Carbon Tetrachloride (ug/L)	MWell#5	35	0.2257	0.1998	0.03377	0.1	0.1	0.5	0.05	0.65	100
Carbonate (mg/L)	MWell#5	34	2.5	0	0	2.5	2.5	2.5	2.5	2.5	100
Chloride (mg/L)	MWell#5	35	45.97	12.38	2.092	44	40	46	32	88	0
Chlorobenzene (ug/L)	MWell#5	35	0.2214	0.1919	0.03243	0.1	0.1	0.5	0.05	0.5	100
Chloroethane (ug/L)	MWell#5	35	0.8936	1.034	0.1747	0.25	0.25	2.5	0.125	2.5	100
Chloroform (ug/L)	MWell#5	35	0.3314	0.2885	0.04877	0.23	0.1	0.5	0.1	1.5	71.43
Chloromethane (ug/L)	MWell#5	35	0.8586	1.059	0.179	0.25	0.15	2.5	0.05	2.5	100
Chromium, Dissolved (mg/L)	MWell#5	16	0.0008625	0.00045	0.0001125	0.0007	0.0005	0.00115	0.0005	0.0019	0
Chromium, Total (mg/L)	MWell#5	28	0.001449	0.0007458	0.0001409	0.0012	0.000905	0.0018	0.0005	0.0036	0
cis-1,2-Dichloroethene (ug/L)	MWell#5	35	28.74	8.015	1.355	30	25	34	4.4	38	0
cis-1,3-Dichloropropene (ug/L)	MWell#5	35	0.2631	0.1687	0.02851	0.25	0.1	0.5	0.05	0.5	100
Cobalt, Dissolved (mg/L)	MWell#5	16	0.0002131	0.0000525	0.00001313	0.0002	0.0002	0.0002	0.0002	0.00041	93.75
Cobalt, Total (mg/L)	MWell#5	28	0.0002618	0.0001766	0.00003337	0.0002	0.0002	0.0002	0.0002	0.00097	85.71
Conductivity (umhos/cm)	MWell#5	32	1291	231.9	41	1209	1150	1367	883	1990	0
Copper, Dissolved (mg/L)	MWell#5	16	0.00155	0.002081	0.0005203	0.00075	0.0005	0.00165	0.0005	0.0087	62.5
Copper, Total (mg/L)	MWell#5	28	0.003479	0.001335	0.0002522	0.0032	0.0025	0.0044	0.001	0.0063	3.571
Dibromochloromethane (ug/L)	MWell#5	35	0.2286	0.2066	0.03492	0.1	0.1	0.5	0.05	0.75	100
Dibromomethane (ug/L)	MWell#5	35	0.2203	0.1903	0.03216	0.1	0.1	0.5	0.05	0.5	100
Dissolved Oxygen (mg/L)	MWell#5	34	0.8465	0.3897	0.06684	0.745	0.605	0.98	0.22	2.01	0

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Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
Ethane (ug/L)	MWell#5	35	3.951	1.76	0.2975	5	2.5	5	0.55	5	100
Ethene (ug/L)	MWell#5	35	3.943	1.777	0.3004	5	2.5	5	0.5	5	100
Ethylbenzene (ug/L)	MWell#5	35	0.2199	0.1897	0.03207	0.1	0.1	0.5	0.05	0.5	100
Iodomethane (ug/L)	MWell#5	35	0.9029	1.027	0.1735	0.25	0.25	2.5	0.25	2.5	100
Iron, Dissolved (mg/L)	MWell#5	35	0.2074	0.06896	0.01166	0.25	0.1	0.25	0.1	0.26	97.14
Iron, Total (mg/L)	MWell#5	8	0.25	0	0	0.25	0.25	0.25	0.25	0.25	100
Lead, Dissolved (mg/L)	MWell#5	16	0.0002794	0.0002546	0.00006364	0.0002	0.0002	0.0002	0.0002	0.0012	87.5
Lead, Total (mg/L)	MWell#5	28	0.0003879	0.0001346	0.00002544	0.0004	0.0003	0.00042	0.0002	0.00069	71.43
Magnesium, Dissolved (mg/L)	MWell#5	35	43.71	8.151	1.378	42	39	44	36	69	0
Magnesium, Total (mg/L)	MWell#5	8	41.38	3.249	1.149	41.5	39.5	43	36	47	0
Manganese, Dissolved (mg/L)	MWell#5	35	0.04677	0.04206	0.007109	0.031	0.027	0.046	0.01	0.21	8.571
Manganese, Total (mg/L)	MWell#5	8	0.02587	0.01086	0.003838	0.0285	0.017	0.033	0.01	0.04	25
Methane (ug/L)	MWell#5	34	1357	715	122.6	1300	725	1850	2.9	2800	0
Methylene Chloride (ug/L)	MWell#5	35	1.28	0.934	0.1579	1.5	0.25	2.5	0.25	2.5	97.14
Nickel, Dissolved (mg/L)	MWell#5	16	0.002106	0.0009405	0.0002351	0.0015	0.0015	0.00315	0.0015	0.0037	68.75
Nickel, Total (mg/L)	MWell#5	28	0.002414	0.001032	0.000195	0.0015	0.0015	0.0035	0.0015	0.0041	53.57
Nitrate Nitrogen (mg/L)	MWell#5	35	10.35	13.33	2.253	4.2	3.1	14	0.1	48	2.857
pH (none)	MWell#5	35	6.716	0.127	0.02147	6.7	6.66	6.75	6.55	7.22	0
Potassium, Dissolved (mg/L)	MWell#5	35	11.94	1.027	0.1737	12	11	12	10	15	0
Potassium, Total (mg/L)	MWell#5	8	12	0.5345	0.189	12	12	12	11	13	0
Redox (mv)	MWell#5	35	-39.13	93.76	15.85	-32	-86	17.3	-275.6	148	0
Selenium, Dissolved (mg/L)	MWell#5	16	0.0005	0	0	0.0005	0.0005	0.0005	0.0005	0.0005	100
Selenium, Total (mg/L)	MWell#5	28	0.002125	0.001778	0.0003359	0.0005	0.0005	0.004	0.0005	0.004	100
Silver, Dissolved (mg/L)	MWell#5	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Silver, Total (mg/L)	MWell#5	28	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Sodium, Dissolved (mg/L)	MWell#5	35	23.17	5.823	0.9843	21	21	22	19	43	0
Sodium, Total (mg/L)	MWell#5	8	21.38	1.408	0.4978	21.5	20.5	22.5	19	23	0
Styrene (ug/L)	MWell#5	35	0.322	0.1438	0.0243	0.25	0.25	0.5	0.05	0.5	100
Sulfate (mg/L)	MWell#5	35	81.34	43.85	7.413	66	57	86	49	260	0

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Summary of Descriptive Statistics

Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
TDS (mg/L)	MWell#5	35	813.1	166.6	28.16	760	740	840	390	1300	0
Temperature (C)	MWell#5	35	23.39	1.617	0.2734	23.5	22.15	24.63	18.8	26	0
Tetrachloroethene (ug/L)	MWell#5	35	12.37	3.553	0.6006	12	9.4	16	4.3	20	0
Thallium, Dissolved (mg/L)	MWell#5	16	0.0005	0	0	0.0005	0.0005	0.0005	0.0005	0.0005	100
Thallium, Total (mg/L)	MWell#5	28	0.0005	0	0	0.0005	0.0005	0.0005	0.0005	0.0005	100
TOC (mg/L)	MWell#5	35	5.131	9.583	1.62	3.5	3	4	2.3	60	0
Toluene (ug/L)	MWell#5	35	0.2199	0.1897	0.03207	0.1	0.1	0.5	0.05	0.5	100
Total Suspended Solids (mg/L)	MWell#5	23	1.174	0.5815	0.1213	1	1	1	1	3.7	95.65
trans-1,2-Dichloroethene (ug/L)	MWell#5	35	0.492	0.1692	0.02859	0.5	0.44	0.61	0.05	0.78	40
trans-1,3-Dichloropropene (ug/L)	MWell#5	35	0.215	0.1859	0.03143	0.1	0.1	0.5	0.05	0.5	100
trans-1,4-Dichloro-2-butene (ug/L)	MWell#5	35	1.526	0.9562	0.1616	1	1	3	0.5	3	100
Trichloroethene (ug/L)	MWell#5	35	5.649	1.556	0.2631	5.9	5	6.5	1.2	8.7	0
Trichlorofluoromethane (ug/L)	MWell#5	35	0.3331	0.1584	0.02678	0.25	0.25	0.5	0.05	0.9	94.29
Vanadium, Dissolved (mg/L)	MWell#5	16	0.007213	0.000487	0.0001217	0.0073	0.00705	0.00745	0.0058	0.008	0
Vanadium, Total (mg/L)	MWell#5	28	0.007604	0.0006973	0.0001318	0.00755	0.00715	0.00805	0.0061	0.0095	0
Vinyl Acetate (ug/L)	MWell#5	35	1.107	0.9101	0.1538	0.5	0.5	2.5	0.25	2.5	100
Vinyl Chloride (ug/L)	MWell#5	35	4.515	2.316	0.3915	4.5	3.3	6.3	0.01	8.3	2.857
Xylenes (ug/L)	MWell#5	35	0.5089	0.4673	0.07899	0.25	0.25	1	0.05	1.5	100
Zinc, Dissolved (mg/L)	MWell#5	16	0.03006	0.00866	0.002165	0.0285	0.026	0.0335	0.015	0.048	0
Zinc, Total (mg/L)	MWell#5	28	0.02371	0.006423	0.001214	0.022	0.0185	0.0275	0.015	0.039	0

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Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
1,1,1,2-Tetrachloroethane (ug/L)	MWell#6	34	0.2371	0.1843	0.03161	0.15	0.1	0.5	0.05	0.5	100
1,1,1-Trichloroethane (ug/L)	MWell#6	34	0.221	0.1891	0.03243	0.1	0.1	0.5	0.05	0.5	100
1,1,2,2-Tetrachloroethane (ug/L)	MWell#6	34	0.2226	0.1906	0.03268	0.1	0.1	0.5	0.05	0.5	100
1,1,2-Trichloroethane (ug/L)	MWell#6	34	0.2187	0.1877	0.03219	0.1	0.1	0.5	0.05	0.5	100
1,1-Dichloroethane (ug/L)	MWell#6	34	6.047	2.495	0.4279	5.7	3.8	7.8	2.7	11	0
1,1-Dichloroethene (ug/L)	MWell#6	34	0.3066	0.1524	0.02613	0.285	0.19	0.5	0.1	0.5	52.94
1,2,3-Trichloropropane (ug/L)	MWell#6	34	0.2259	0.1858	0.03187	0.1	0.1	0.5	0.1	0.5	100
1,2-Dibromo-3-chloropropane (ug/L)	MWell#6	34	0.9113	0.2481	0.04254	1	1	1	0.2	1	100
1,2-Dibromoethane (ug/L)	MWell#6	34	0.1854	0.2069	0.03548	0.05	0.05	0.5	0.05	0.5	100
1,2-Dichlorobenzene (ug/L)	MWell#6	34	0.2721	0.2035	0.03489	0.15	0.15	0.5	0.1	0.95	100
1,2-Dichloroethane (ug/L)	MWell#6	34	0.4797	0.07538	0.01293	0.5	0.425	0.51	0.3	0.65	32.35
1,2-Dichloropropane (ug/L)	MWell#6	34	0.4462	0.1927	0.03305	0.43	0.345	0.5	0.05	1.2	29.41
1,4-Dichlorobenzene (ug/L)	MWell#6	34	0.2735	0.2086	0.03578	0.15	0.15	0.5	0.1	1	100
2-Butanone (ug/L)	MWell#6	34	5.368	1.916	0.3286	5	5	7.5	1	7.5	100
2-Hexanone (ug/L)	MWell#6	34	1.551	0.6902	0.1184	1.5	1	2.5	0.5	2.5	100
4-Methyl-2-pentanone (ug/L)	MWell#6	34	2.434	0.9176	0.1574	2.5	2.5	2.5	0.25	5	100
Acetone (ug/L)	MWell#6	34	2.879	1.758	0.3014	3	1	5	1	5	97.06
Acrylonitrile (ug/L)	MWell#6	34	3.091	1.297	0.2225	2.5	2.5	5	1	5	100
Alkalinity (mg/L)	MWell#6	34	509.1	15.83	2.715	510	500	520	470	540	0
Ammonia Nitrogen (mg/L)	MWell#6	34	0.1378	0.08819	0.01512	0.1	0.05	0.25	0.025	0.25	91.18
Antimony, Dissolved (mg/L)	MWell#6	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Antimony, Total (mg/L)	MWell#6	27	0.0002148	0.00005338	0.00001027	0.0002	0.0002	0.0002	0.0002	0.0004	100
Arsenic, Dissolved (mg/L)	MWell#6	16	0.001794	0.0006159	0.000154	0.0017	0.0016	0.0018	0.0005	0.0036	6.25
Arsenic, Total (mg/L)	MWell#6	27	0.001848	0.0004415	0.00008496	0.0017	0.0016	0.002	0.0012	0.0032	0
Barium, Dissolved (mg/L)	MWell#6	16	0.1038	0.006191	0.001548	0.1	0.1	0.11	0.09	0.11	0
Barium, Total (mg/L)	MWell#6	27	0.09722	0.006658	0.001281	0.099	0.091	0.1	0.084	0.11	0
Benzene (ug/L)	MWell#6	34	0.4488	0.06655	0.01141	0.48	0.38	0.5	0.33	0.56	32.35
Beryllium, Dissolved (mg/L)	MWell#6	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Beryllium, Total (mg/L)	MWell#6	27	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100

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Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
Bicarbonate (mg/L)	MWell#6	34	509.1	15.83	2.715	510	500	520	470	540	0
Bromochloromethane (ug/L)	MWell#6	34	0.2265	0.1959	0.03359	0.1	0.1	0.5	0.05	0.55	100
Bromodichloromethane (ug/L)	MWell#6	34	0.2235	0.1916	0.03286	0.1	0.1	0.5	0.05	0.5	100
Bromoform (ug/L)	MWell#6	34	0.3221	0.1625	0.02786	0.25	0.25	0.5	0.05	0.8	100
Bromomethane (ug/L)	MWell#6	34	0.9868	1.002	0.1719	0.5	0.25	2.5	0.05	2.5	100
Cadmium, Dissolved (mg/L)	MWell#6	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Cadmium, Total (mg/L)	MWell#6	27	0.0002148	0.00005338	0.00001027	0.0002	0.0002	0.0002	0.0002	0.0004	100
Calcium, Dissolved (mg/L)	MWell#6	34	159.1	8.658	1.485	160	150	165	140	180	0
Calcium, Total (mg/L)	MWell#6	8	157.5	8.864	3.134	160	155	160	140	170	0
Carbon Disulfide (ug/L)	MWell#6	34	0.2412	0.1909	0.03274	0.15	0.1	0.5	0.05	0.6	100
Carbon Tetrachloride (ug/L)	MWell#6	34	0.2294	0.2016	0.03457	0.1	0.1	0.5	0.05	0.65	100
Carbonate (mg/L)	MWell#6	33	2.5	0	0	2.5	2.5	2.5	2.5	2.5	100
Chloride (mg/L)	MWell#6	34	19.26	2.005	0.3438	19	17.5	20	15	25	0
Chlorobenzene (ug/L)	MWell#6	34	0.225	0.1936	0.03319	0.1	0.1	0.5	0.05	0.5	100
Chloroethane (ug/L)	MWell#6	34	0.9125	1.043	0.1789	0.25	0.25	2.5	0.125	2.5	100
Chloroform (ug/L)	MWell#6	34	0.2279	0.1986	0.03405	0.1	0.1	0.5	0.05	0.6	100
Chloromethane (ug/L)	MWell#6	34	0.8765	1.07	0.1835	0.25	0.15	2.5	0.05	2.5	100
Chromium, Dissolved (mg/L)	MWell#6	16	0.000375	0.000284	0.000071	0.0002	0.0002	0.0006	0.0002	0.001	68.75
Chromium, Total (mg/L)	MWell#6	27	0.001015	0.001576	0.0003033	0.00071	0.00042	0.00093	0.0002	0.0086	14.81
cis-1,2-Dichloroethene (ug/L)	MWell#6	34	56.44	12.59	2.16	55	49.5	59	44	120	0
cis-1,3-Dichloropropene (ug/L)	MWell#6	34	0.2679	0.1688	0.02895	0.25	0.1	0.5	0.05	0.5	100
Cobalt, Dissolved (mg/L)	MWell#6	16	0.001594	0.001387	0.0003468	0.00135	0.000925	0.0019	0.0002	0.0063	12.5
Cobalt, Total (mg/L)	MWell#6	27	0.002556	0.003166	0.0006092	0.0014	0.0002	0.0034	0.0002	0.013	25.93
Conductivity (umhos/cm)	MWell#6	31	1069	53.11	9.538	1076	1062	1096	816	1135	0
Copper, Dissolved (mg/L)	MWell#6	16	0.001575	0.001326	0.0003316	0.00115	0.00075	0.00195	0.0005	0.0052	31.25
Copper, Total (mg/L)	MWell#6	27	0.001474	0.001274	0.0002452	0.001	0.001	0.002	0.0005	0.0068	62.96
Dibromochloromethane (ug/L)	MWell#6	34	0.2324	0.2085	0.03576	0.1	0.1	0.5	0.05	0.75	100
Dibromomethane (ug/L)	MWell#6	34	0.2238	0.1919	0.03292	0.1	0.1	0.5	0.05	0.5	100
Dissolved Oxygen (mg/L)	MWell#6	33	0.7252	0.3703	0.06446	0.65	0.495	0.845	0.12	2.13	0

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Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
Ethane (ug/L)	MWell#6	34	3.921	1.777	0.3047	5	2.5	5	0.55	5	100
Ethene (ug/L)	MWell#6	34	3.912	1.794	0.3077	5	2.5	5	0.5	5	100
Ethylbenzene (ug/L)	MWell#6	34	0.2234	0.1914	0.03283	0.1	0.1	0.5	0.05	0.5	100
Iodomethane (ug/L)	MWell#6	34	0.9221	1.036	0.1776	0.25	0.25	2.5	0.25	2.5	100
Iron, Dissolved (mg/L)	MWell#6	34	0.2015	0.07123	0.01222	0.25	0.1	0.25	0.1	0.25	100
Iron, Total (mg/L)	MWell#6	8	0.25	0	0	0.25	0.25	0.25	0.25	0.25	100
Lead, Dissolved (mg/L)	MWell#6	16	0.0003075	0.000231	0.00005774	0.0002	0.0002	0.0003	0.0002	0.00099	75
Lead, Total (mg/L)	MWell#6	27	0.0003481	0.0003068	0.00005905	0.0002	0.0002	0.0004	0.0002	0.0018	96.3
Magnesium, Dissolved (mg/L)	MWell#6	34	37.91	1.975	0.3387	38	36.5	39	34	42	0
Magnesium, Total (mg/L)	MWell#6	8	37	3.381	1.195	38	35.5	39	30	41	0
Manganese, Dissolved (mg/L)	MWell#6	34	0.02665	0.01271	0.00218	0.0285	0.01	0.037	0.01	0.05	29.41
Manganese, Total (mg/L)	MWell#6	8	0.02312	0.01149	0.004064	0.0265	0.01	0.0325	0.01	0.037	37.5
Methane (ug/L)	MWell#6	33	3130	1256	218.7	3300	2300	3900	50	5200	0
Methylene Chloride (ug/L)	MWell#6	34	1.239	0.9264	0.1589	1.5	0.25	2.5	0.25	2.5	97.06
Nickel, Dissolved (mg/L)	MWell#6	16	0.0015	0	0	0.0015	0.0015	0.0015	0.0015	0.0015	100
Nickel, Total (mg/L)	MWell#6	27	0.001837	0.001329	0.0002558	0.0015	0.0015	0.0015	0.0015	0.008	92.59
Nitrate Nitrogen (mg/L)	MWell#6	34	1.9	0.79	0.1355	1.9	1.65	2.35	0.1	4.3	5.882
pH (none)	MWell#6	34	6.66	0.2289	0.03925	6.625	6.56	6.665	6.45	7.77	0
Potassium, Dissolved (mg/L)	MWell#6	34	11.71	0.6755	0.1159	12	11	12	10	13	0
Potassium, Total (mg/L)	MWell#6	8	11.56	1.05	0.3713	12	11	12	9.5	13	0
Redox (mv)	MWell#6	34	22.72	118.1	20.25	33.5	-38.6	71.75	-230.2	317	0
Selenium, Dissolved (mg/L)	MWell#6	16	0.0005	0	0	0.0005	0.0005	0.0005	0.0005	0.0005	100
Selenium, Total (mg/L)	MWell#6	27	0.002056	0.001772	0.0003411	0.0005	0.0005	0.004	0.0005	0.004	100
Silver, Dissolved (mg/L)	MWell#6	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Silver, Total (mg/L)	MWell#6	27	0.000213	0.00006736	0.00001296	0.0002	0.0002	0.0002	0.0002	0.00055	96.3
Sodium, Dissolved (mg/L)	MWell#6	34	22.26	1.136	0.1949	22	21.5	23	20	24	0
Sodium, Total (mg/L)	MWell#6	8	23.38	1.996	0.7055	23	22	23.5	22	28	0
Styrene (ug/L)	MWell#6	34	0.3241	0.1454	0.02494	0.25	0.25	0.5	0.05	0.5	100
Sulfate (mg/L)	MWell#6	33	47.3	3.82	0.665	48	43.5	50	41	53	0

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Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
TDS (mg/L)	MWell#6	34	657.4	39.95	6.851	665	650	680	550	720	0
Temperature (C)	MWell#6	34	24.59	2.013	0.3452	24.58	23.04	26.25	20.53	28.5	0
Tetrachloroethene (ug/L)	MWell#6	34	32.5	8.407	1.442	32.5	25.5	38.5	18	48	0
Thallium, Dissolved (mg/L)	MWell#6	16	0.0005	0	0	0.0005	0.0005	0.0005	0.0005	0.0005	100
Thallium, Total (mg/L)	MWell#6	27	0.0005	0	0	0.0005	0.0005	0.0005	0.0005	0.0005	100
TOC (mg/L)	MWell#6	34	3.156	6.883	1.18	2.1	1.7	2.4	0.5	42	2.941
Toluene (ug/L)	MWell#6	34	0.2234	0.1914	0.03283	0.1	0.1	0.5	0.05	0.5	100
Total Suspended Solids (mg/L)	MWell#6	22	1.3	0.6586	0.1404	1	1	1.45	1	3.4	90.91
trans-1,2-Dichloroethene (ug/L)	MWell#6	34	1.938	0.4452	0.07635	1.9	1.6	2.25	1.2	2.9	0
trans-1,3-Dichloropropene (ug/L)	MWell#6	34	0.2184	0.1876	0.03218	0.1	0.1	0.5	0.05	0.5	100
trans-1,4-Dichloro-2-butene (ug/L)	MWell#6	34	1.541	0.9661	0.1657	1	1	3	0.5	3	100
Trichloroethene (ug/L)	MWell#6	34	16.63	3.901	0.669	17	13	19.5	9.4	23	0
Trichlorofluoromethane (ug/L)	MWell#6	34	0.325	0.172	0.0295	0.25	0.25	0.5	0.05	0.9	100
Vanadium, Dissolved (mg/L)	MWell#6	16	0.006619	0.0005231	0.0001308	0.0066	0.00635	0.0069	0.0054	0.0076	0
Vanadium, Total (mg/L)	MWell#6	27	0.006674	0.0006671	0.0001284	0.0068	0.0062	0.0071	0.0045	0.0082	0
Vinyl Acetate (ug/L)	MWell#6	34	1.125	0.9175	0.1574	0.5	0.5	2.5	0.25	2.5	100
Vinyl Chloride (ug/L)	MWell#6	34	3.247	0.8338	0.143	3.2	2.55	3.8	1.8	4.8	0
Xylenes (ug/L)	MWell#6	34	0.5165	0.4721	0.08097	0.25	0.25	1	0.05	1.5	100
Zinc, Dissolved (mg/L)	MWell#6	16	0.006406	0.00348	0.00087	0.0052	0.0041	0.0074	0.002	0.014	12.5
Zinc, Total (mg/L)	MWell#6	27	0.006404	0.004108	0.0007907	0.0041	0.0035	0.0097	0.002	0.018	40.74

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Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
1,1,1,2-Tetrachloroethane (ug/L)	MWell#8	34	0.2268	0.1789	0.03067	0.15	0.1	0.5	0.05	0.5	100
1,1,1-Trichloroethane (ug/L)	MWell#8	34	0.2093	0.1836	0.03148	0.1	0.1	0.5	0.05	0.5	100
1,1,2,2-Tetrachloroethane (ug/L)	MWell#8	34	0.2109	0.1852	0.03176	0.1	0.1	0.5	0.05	0.5	100
1,1,2-Trichloroethane (ug/L)	MWell#8	34	0.2069	0.182	0.03121	0.1	0.1	0.5	0.05	0.5	100
1,1-Dichloroethane (ug/L)	MWell#8	34	0.2221	0.2082	0.03571	0.1	0.1	0.5	0.05	0.8	100
1,1-Dichloroethene (ug/L)	MWell#8	34	0.1957	0.1977	0.0339	0.1	0.05	0.5	0.05	0.5	100
1,2,3-Trichloropropane (ug/L)	MWell#8	34	0.2141	0.1805	0.03096	0.1	0.1	0.5	0.1	0.5	100
1,2-Dibromo-3-chloropropane (ug/L)	MWell#8	34	0.9113	0.2481	0.04254	1	1	1	0.2	1	100
1,2-Dibromoethane (ug/L)	MWell#8	34	0.1722	0.2004	0.03437	0.05	0.05	0.5	0.05	0.5	100
1,2-Dichlorobenzene (ug/L)	MWell#8	34	0.2618	0.2004	0.03437	0.15	0.15	0.5	0.1	0.95	100
1,2-Dichloroethane (ug/L)	MWell#8	34	0.2147	0.1909	0.03274	0.1	0.1	0.5	0.05	0.55	100
1,2-Dichloropropane (ug/L)	MWell#8	34	0.2121	0.1867	0.03202	0.1	0.1	0.5	0.05	0.5	100
1,4-Dichlorobenzene (ug/L)	MWell#8	34	0.2632	0.2057	0.03528	0.15	0.15	0.5	0.1	1	100
2-Butanone (ug/L)	MWell#8	34	5.368	1.916	0.3286	5	5	7.5	1	7.5	100
2-Hexanone (ug/L)	MWell#8	34	1.522	0.6696	0.1148	1.5	1	2.5	0.5	2.5	100
4-Methyl-2-pentanone (ug/L)	MWell#8	34	2.434	0.9176	0.1574	2.5	2.5	2.5	0.25	5	100
Acetone (ug/L)	MWell#8	34	2.818	1.719	0.2947	3	1	5	1	5	97.06
Acrylonitrile (ug/L)	MWell#8	34	3.165	1.333	0.2286	2.5	2.5	5	1	5	100
Alkalinity (mg/L)	MWell#8	34	117.1	7.19	1.233	120	110	120	100	130	0
Ammonia Nitrogen (mg/L)	MWell#8	34	0.1359	0.09348	0.01603	0.1	0.05	0.25	0.025	0.32	97.06
Antimony, Dissolved (mg/L)	MWell#8	15	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Antimony, Total (mg/L)	MWell#8	27	0.0002259	0.00007642	0.00001471	0.0002	0.0002	0.0002	0.0002	0.0005	96.3
Arsenic, Dissolved (mg/L)	MWell#8	15	0.01133	0.0009106	0.0002351	0.011	0.011	0.012	0.0099	0.013	0
Arsenic, Total (mg/L)	MWell#8	27	0.009607	0.0014	0.0002694	0.0097	0.0085	0.011	0.0074	0.012	0
Barium, Dissolved (mg/L)	MWell#8	15	0.04773	0.01383	0.003572	0.044	0.036	0.058	0.031	0.075	0
Barium, Total (mg/L)	MWell#8	27	0.05733	0.02237	0.004305	0.048	0.042	0.081	0.026	0.11	0
Benzene (ug/L)	MWell#8	34	0.2147	0.1909	0.03274	0.1	0.1	0.5	0.05	0.55	100
Beryllium, Dissolved (mg/L)	MWell#8	15	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Beryllium, Total (mg/L)	MWell#8	27	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100

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Constituent Name	Well	N	Mean^1	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
Bicarbonate (mg/L)	MWell#8	34	117.1	7.19	1.233	120	110	120	100	130	0
Bromochloromethane (ug/L)	MWell#8	34	0.2147	0.1909	0.03274	0.1	0.1	0.5	0.05	0.55	100
Bromodichloromethane (ug/L)	MWell#8	34	0.5394	0.1786	0.03062	0.5	0.415	0.675	0.27	1	29.41
Bromoform (ug/L)	MWell#8	34	0.3147	0.1598	0.0274	0.25	0.25	0.5	0.05	0.8	100
Bromomethane (ug/L)	MWell#8	34	0.9206	0.973	0.1669	0.5	0.25	2.5	0.05	2.5	100
Cadmium, Dissolved (mg/L)	MWell#8	15	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Cadmium, Total (mg/L)	MWell#8	27	0.0002148	0.00005338	0.00001027	0.0002	0.0002	0.0002	0.0002	0.0004	100
Calcium, Dissolved (mg/L)	MWell#8	34	77.65	30.69	5.263	68	52	104	41	150	0
Calcium, Total (mg/L)	MWell#8	7	73.29	21.67	8.19	68	52	94	47	98	0
Carbon Disulfide (ug/L)	MWell#8	34	0.2309	0.1859	0.03188	0.15	0.1	0.5	0.05	0.6	100
Carbon Tetrachloride (ug/L)	MWell#8	34	0.2176	0.1969	0.03377	0.1	0.1	0.5	0.05	0.65	100
Carbonate (mg/L)	MWell#8	34	2.5	0	0	2.5	2.5	2.5	2.5	2.5	100
Chloride (mg/L)	MWell#8	34	73.74	48.96	8.396	59	35.5	120	15	170	0
Chlorobenzene (ug/L)	MWell#8	34	0.2132	0.1884	0.03231	0.1	0.1	0.5	0.05	0.5	100
Chloroethane (ug/L)	MWell#8	34	0.8463	1.01	0.1733	0.25	0.25	2.5	0.125	2.5	100
Chloroform (ug/L)	MWell#8	34	8.294	2.778	0.4765	8.6	6	9.8	4.2	15	0
Chloromethane (ug/L)	MWell#8	34	0.8147	1.033	0.1771	0.25	0.15	2.5	0.05	2.5	97.06
Chromium, Dissolved (mg/L)	MWell#8	15	0.00294	0.0008517	0.0002199	0.0027	0.0025	0.0034	0.0017	0.0049	0
Chromium, Total (mg/L)	MWell#8	27	0.009367	0.0117	0.002251	0.0073	0.0047	0.0091	0.0026	0.065	0
cis-1,2-Dichloroethene (ug/L)	MWell#8	34	0.2147	0.1909	0.03274	0.1	0.1	0.5	0.05	0.55	100
cis-1,3-Dichloropropene (ug/L)	MWell#8	34	0.2562	0.166	0.02848	0.25	0.1	0.5	0.05	0.5	100
Cobalt, Dissolved (mg/L)	MWell#8	15	0.000216	0.00006197	0.000016	0.0002	0.0002	0.0002	0.0002	0.00044	93.33
Cobalt, Total (mg/L)	MWell#8	27	0.0002785	0.0003122	0.00006008	0.0002	0.0002	0.0002	0.0002	0.0018	88.89
Conductivity (umhos/cm)	MWell#8	31	635.3	232.9	41.83	568	457	837	344	1131	0
Copper, Dissolved (mg/L)	MWell#8	15	0.00074	0.0004703	0.0001214	0.0005	0.0005	0.001	0.0005	0.002	86.67
Copper, Total (mg/L)	MWell#8	27	0.001959	0.00387	0.0007447	0.001	0.001	0.001	0.0005	0.021	77.78
Dibromochloromethane (ug/L)	MWell#8	34	0.2206	0.2042	0.03501	0.1	0.1	0.5	0.05	0.75	100
Dibromomethane (ug/L)	MWell#8	34	0.2121	0.1867	0.03202	0.1	0.1	0.5	0.05	0.5	100
Dissolved Oxygen (mg/L)	MWell#8	33	8.076	0.8716	0.1517	8.32	7.29	8.84	5.99	9.6	0

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Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
Ethane (ug/L)	MWell#8	34	3.921	1.777	0.3047	5	2.5	5	0.55	5	100
Ethene (ug/L)	MWell#8	34	3.912	1.794	0.3077	5	2.5	5	0.5	5	100
Ethylbenzene (ug/L)	MWell#8	34	0.2116	0.1861	0.03192	0.1	0.1	0.5	0.05	0.5	100
Iodomethane (ug/L)	MWell#8	34	0.8559	1.003	0.172	0.25	0.25	2.5	0.25	2.5	100
Iron, Dissolved (mg/L)	MWell#8	34	0.2015	0.07123	0.01222	0.25	0.1	0.25	0.1	0.25	100
Iron, Total (mg/L)	MWell#8	7	0.3857	0.3591	0.1357	0.25	0.25	0.25	0.25	1.2	85.71
Lead, Dissolved (mg/L)	MWell#8	15	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Lead, Total (mg/L)	MWell#8	27	0.0003204	0.0001456	0.00002802	0.0004	0.0002	0.0004	0.0002	0.00085	96.3
Magnesium, Dissolved (mg/L)	MWell#8	34	15.63	6.172	1.059	14	11	21.5	8	31	0
Magnesium, Total (mg/L)	MWell#8	7	14.93	4.344	1.642	14	11	19	9.5	20	0
Manganese, Dissolved (mg/L)	MWell#8	34	0.01	0	0	0.01	0.01	0.01	0.01	0.01	100
Manganese, Total (mg/L)	MWell#8	7	0.01386	0.01021	0.003857	0.01	0.01	0.01	0.01	0.037	85.71
Methane (ug/L)	MWell#8	34	1.122	1.123	0.1927	0.6	0.6	1.9	0.29	5.4	85.29
Methylene Chloride (ug/L)	MWell#8	34	1.259	0.9596	0.1646	1.5	0.25	2.5	0.25	2.5	100
Nickel, Dissolved (mg/L)	MWell#8	15	0.0039	0.002741	0.0007076	0.0037	0.0015	0.0048	0.0015	0.012	33.33
Nickel, Total (mg/L)	MWell#8	27	0.005967	0.007212	0.001388	0.0049	0.0032	0.0059	0.0015	0.04	18.52
Nitrate Nitrogen (mg/L)	MWell#8	34	11.1	8.037	1.378	8.3	4.65	17.5	2	31	0
pH (none)	MWell#8	34	7.693	0.248	0.04254	7.72	7.55	7.795	7.16	8.72	0
Potassium, Dissolved (mg/L)	MWell#8	34	7.4	1.551	0.266	7.4	6.05	8.95	4.6	10	0
Potassium, Total (mg/L)	MWell#8	7	7.414	1.32	0.4988	6.9	6.2	8.9	5.8	8.9	0
Redox (mv)	MWell#8	34	113.2	108.3	18.57	96.1	45.05	174.2	-84.7	370	0
Selenium, Dissolved (mg/L)	MWell#8	15	0.00252	0.001412	0.0003647	0.0024	0.0015	0.0041	0.0005	0.0046	13.33
Selenium, Total (mg/L)	MWell#8	27	0.003274	0.001085	0.0002089	0.004	0.0024	0.004	0.0005	0.0044	51.85
Silver, Dissolved (mg/L)	MWell#8	15	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Silver, Total (mg/L)	MWell#8	27	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Sodium, Dissolved (mg/L)	MWell#8	34	20.56	5.378	0.9223	19.5	16	25.5	13	34	0
Sodium, Total (mg/L)	MWell#8	7	20.29	3.988	1.507	19	17	24	15	25	0
Styrene (ug/L)	MWell#8	34	0.3168	0.1425	0.02444	0.25	0.25	0.5	0.05	0.5	100
Sulfate (mg/L)	MWell#8	34	49.5	17.01	2.917	45	36	65.5	25	83	0

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Constituent Name	Well	N	Mean^1	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
TDS (mg/L)	MWell#8	34	417.4	185.4	31.8	375	265	565	10	810	2.941
Temperature (C)	MWell#8	34	21.21	2.042	0.3502	21.44	19.64	23.05	16	24.37	0
Tetrachloroethene (ug/L)	MWell#8	34	0.3162	0.1646	0.02822	0.25	0.25	0.5	0.05	0.85	100
Thallium, Dissolved (mg/L)	MWell#8	15	0.0005	0	0	0.0005	0.0005	0.0005	0.0005	0.0005	100
Thallium, Total (mg/L)	MWell#8	27	0.0005	0	0	0.0005	0.0005	0.0005	0.0005	0.0005	100
TOC (mg/L)	MWell#8	34	1.525	1.461	0.2505	1.35	1.15	1.55	0.5	9.4	14.71
Toluene (ug/L)	MWell#8	34	0.2116	0.1861	0.03192	0.1	0.1	0.5	0.05	0.5	100
Total Suspended Solids (mg/L)	MWell#8	23	1.463	1.652	0.3446	1	1	1	1	8.7	91.3
trans-1,2-Dichloroethene (ug/L)	MWell#8	34	0.2176	0.1969	0.03377	0.1	0.1	0.5	0.05	0.65	100
trans-1,3-Dichloropropene (ug/L)	MWell#8	34	0.2066	0.1819	0.03119	0.1	0.1	0.5	0.05	0.5	100
trans-1,4-Dichloro-2-butene (ug/L)	MWell#8	34	1.482	0.935	0.1604	1	1	3	0.5	3	100
Trichloroethene (ug/L)	MWell#8	34	0.2162	0.1937	0.03323	0.1	0.1	0.5	0.05	0.6	100
Trichlorofluoromethane (ug/L)	MWell#8	34	0.3176	0.1696	0.02909	0.25	0.25	0.5	0.05	0.9	100
Vanadium, Dissolved (mg/L)	MWell#8	15	0.01773	0.002282	0.0005893	0.017	0.016	0.02	0.014	0.022	0
Vanadium, Total (mg/L)	MWell#8	27	0.01593	0.00192	0.0003695	0.016	0.014	0.017	0.013	0.02	0
Vinyl Acetate (ug/L)	MWell#8	34	1.066	0.8904	0.1527	0.5	0.5	2.5	0.25	2.5	100
Vinyl Chloride (ug/L)	MWell#8	34	0.1507	0.2221	0.03809	0.01	0.01	0.5	0.01	0.5	100
Xylenes (ug/L)	MWell#8	34	0.4797	0.4409	0.07561	0.25	0.25	1	0.05	1.5	100
Zinc, Dissolved (mg/L)	MWell#8	15	0.0025	0.0008594	0.0002219	0.002	0.002	0.0034	0.0007	0.0037	53.33
Zinc, Total (mg/L)	MWell#8	27	0.003941	0.001737	0.0003344	0.0035	0.0035	0.0035	0.0016	0.0092	77.78

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Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
1,1,1,2-Tetrachloroethane (ug/L)	MWell#9	35	0.2346	0.1822	0.03079	0.15	0.1	0.5	0.05	0.5	100
1,1,1-Trichloroethane (ug/L)	MWell#9	35	0.2201	0.1856	0.03138	0.1	0.1	0.5	0.05	0.5	97.14
1,1,2,2-Tetrachloroethane (ug/L)	MWell#9	35	0.2191	0.1889	0.03193	0.1	0.1	0.5	0.05	0.5	100
1,1,2-Trichloroethane (ug/L)	MWell#9	35	0.2153	0.186	0.03144	0.1	0.1	0.5	0.05	0.5	100
1,1-Dichloroethane (ug/L)	MWell#9	35	3.049	0.9975	0.1686	3.1	2.3	3.7	1	4.9	0
1,1-Dichloroethene (ug/L)	MWell#9	35	0.2044	0.2014	0.03405	0.1	0.05	0.5	0.05	0.5	100
1,2,3-Trichloropropane (ug/L)	MWell#9	35	0.2223	0.1843	0.03115	0.1	0.1	0.5	0.1	0.5	100
1,2-Dibromo-3-chloropropane (ug/L)	MWell#9	35	0.9139	0.2449	0.04139	1	1	1	0.2	1	100
1,2-Dibromoethane (ug/L)	MWell#9	35	0.1816	0.2051	0.03467	0.05	0.05	0.5	0.05	0.5	100
1,2-Dichlorobenzene (ug/L)	MWell#9	35	0.2686	0.2015	0.03406	0.15	0.15	0.5	0.1	0.95	100
1,2-Dichloroethane (ug/L)	MWell#9	35	0.2229	0.1942	0.03282	0.1	0.1	0.5	0.05	0.55	100
1,2-Dichloropropane (ug/L)	MWell#9	35	0.2203	0.1903	0.03216	0.1	0.1	0.5	0.05	0.5	100
1,4-Dichlorobenzene (ug/L)	MWell#9	35	0.27	0.2066	0.03492	0.15	0.15	0.5	0.1	1	100
2-Butanone (ug/L)	MWell#9	35	5.357	1.889	0.3193	5	5	7.5	1	7.5	100
2-Hexanone (ug/L)	MWell#9	35	1.55	0.6801	0.115	1.5	1	2.5	0.5	2.5	100
4-Methyl-2-pentanone (ug/L)	MWell#9	35	2.436	0.9041	0.1528	2.5	2.5	2.5	0.25	5	100
Acetone (ug/L)	MWell#9	35	2.846	1.758	0.2972	3	1	5	1	5	100
Acrylonitrile (ug/L)	MWell#9	35	3.146	1.318	0.2228	2.5	2.5	5	1	5	100
Alkalinity (mg/L)	MWell#9	35	373.7	41.02	6.934	360	340	400	310	460	0
Ammonia Nitrogen (mg/L)	MWell#9	35	0.1312	0.08751	0.01479	0.1	0.05	0.25	0.05	0.25	94.29
Antimony, Dissolved (mg/L)	MWell#9	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Antimony, Total (mg/L)	MWell#9	28	0.000225	0.00007515	0.0000142	0.0002	0.0002	0.0002	0.0002	0.0005	96.43
Arsenic, Dissolved (mg/L)	MWell#9	16	0.0022	0.0004082	0.0001021	0.0021	0.002	0.00225	0.0016	0.0034	0
Arsenic, Total (mg/L)	MWell#9	28	0.002171	0.0004336	0.00008195	0.0021	0.0019	0.0023	0.0015	0.0035	0
Barium, Dissolved (mg/L)	MWell#9	16	0.075	0.01298	0.003244	0.0715	0.066	0.0805	0.061	0.11	0
Barium, Total (mg/L)	MWell#9	28	0.07911	0.01147	0.002168	0.077	0.0705	0.086	0.064	0.11	0
Benzene (ug/L)	MWell#9	35	0.2229	0.1942	0.03282	0.1	0.1	0.5	0.05	0.55	100
Beryllium, Dissolved (mg/L)	MWell#9	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Beryllium, Total (mg/L)	MWell#9	28	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100

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Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
Bicarbonate (mg/L)	MWell#9	35	373.7	41.02	6.934	360	340	400	310	460	0
Bromochloromethane (ug/L)	MWell#9	35	0.2229	0.1942	0.03282	0.1	0.1	0.5	0.05	0.55	100
Bromodichloromethane (ug/L)	MWell#9	35	0.22	0.1899	0.0321	0.1	0.1	0.5	0.05	0.5	100
Bromoform (ug/L)	MWell#9	35	0.32	0.1605	0.02713	0.25	0.25	0.5	0.05	0.8	100
Bromomethane (ug/L)	MWell#9	35	0.9657	0.995	0.1682	0.5	0.25	2.5	0.05	2.5	100
Cadmium, Dissolved (mg/L)	MWell#9	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Cadmium, Total (mg/L)	MWell#9	28	0.0002143	0.00005245	0.000009913	0.0002	0.0002	0.0002	0.0002	0.0004	100
Calcium, Dissolved (mg/L)	MWell#9	35	132.9	14.47	2.445	130	120	150	110	170	0
Calcium, Total (mg/L)	MWell#9	8	146.3	37.01	13.08	135	120	155	120	230	0
Carbon Disulfide (ug/L)	MWell#9	35	0.2386	0.1887	0.03189	0.15	0.1	0.5	0.05	0.6	100
Carbon Tetrachloride (ug/L)	MWell#9	35	0.2257	0.1998	0.03377	0.1	0.1	0.5	0.05	0.65	100
Carbonate (mg/L)	MWell#9	34	2.5	0	0	2.5	2.5	2.5	2.5	2.5	100
Chloride (mg/L)	MWell#9	35	34.31	12.15	2.054	31	25	42	18	66	0
Chlorobenzene (ug/L)	MWell#9	35	0.2214	0.1919	0.03243	0.1	0.1	0.5	0.05	0.5	100
Chloroethane (ug/L)	MWell#9	35	0.8936	1.034	0.1747	0.25	0.25	2.5	0.125	2.5	100
Chloroform (ug/L)	MWell#9	35	0.342	0.2131	0.03602	0.29	0.22	0.5	0.05	1.2	45.71
Chloromethane (ug/L)	MWell#9	35	0.8586	1.059	0.179	0.25	0.15	2.5	0.05	2.5	100
Chromium, Dissolved (mg/L)	MWell#9	16	0.002438	0.001122	0.0002805	0.00205	0.0015	0.0033	0.0012	0.0048	0
Chromium, Total (mg/L)	MWell#9	28	0.004411	0.002689	0.0005082	0.0032	0.00255	0.00575	0.0017	0.013	0
cis-1,2-Dichloroethene (ug/L)	MWell#9	35	9.014	3.31	0.5595	8.9	6.7	12	1.7	14	0
cis-1,3-Dichloropropene (ug/L)	MWell#9	35	0.2631	0.1687	0.02851	0.25	0.1	0.5	0.05	0.5	100
Cobalt, Dissolved (mg/L)	MWell#9	16	0.0002156	0.0000625	0.00001563	0.0002	0.0002	0.0002	0.0002	0.00045	93.75
Cobalt, Total (mg/L)	MWell#9	28	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Conductivity (umhos/cm)	MWell#9	32	923.1	112.6	19.9	925.5	839	1009	671	1198	0
Copper, Dissolved (mg/L)	MWell#9	16	0.001238	0.000809	0.0002023	0.0011	0.0005	0.00145	0.0005	0.003	37.5
Copper, Total (mg/L)	MWell#9	28	0.001157	0.000508	0.00009601	0.001	0.001	0.001	0.0005	0.0027	78.57
Dibromochloromethane (ug/L)	MWell#9	35	0.2286	0.2066	0.03492	0.1	0.1	0.5	0.05	0.75	100
Dibromomethane (ug/L)	MWell#9	35	0.2203	0.1903	0.03216	0.1	0.1	0.5	0.05	0.5	100
Dissolved Oxygen (mg/L)	MWell#9	34	3.269	0.5684	0.09748	3.155	2.805	3.7	2.35	4.51	0

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Summary of Descriptive Statistics

Constituent Name	Well	N	Mean^1	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
Ethane (ug/L)	MWell#9	35	3.951	1.76	0.2975	5	2.5	5	0.55	5	100
Ethene (ug/L)	MWell#9	35	3.943	1.777	0.3004	5	2.5	5	0.5	5	100
Ethylbenzene (ug/L)	MWell#9	35	0.2199	0.1897	0.03207	0.1	0.1	0.5	0.05	0.5	100
Iodomethane (ug/L)	MWell#9	35	0.9029	1.027	0.1735	0.25	0.25	2.5	0.25	2.5	100
Iron, Dissolved (mg/L)	MWell#9	35	0.2029	0.07065	0.01194	0.25	0.1	0.25	0.1	0.25	100
Iron, Total (mg/L)	MWell#9	8	0.25	0	0	0.25	0.25	0.25	0.25	0.25	100
Lead, Dissolved (mg/L)	MWell#9	16	0.0003006	0.0003105	0.00007762	0.0002	0.0002	0.0002	0.0002	0.0014	87.5
Lead, Total (mg/L)	MWell#9	28	0.0002929	0.0001016	0.0000192	0.0002	0.0002	0.0004	0.0002	0.0004	100
Magnesium, Dissolved (mg/L)	MWell#9	35	29.23	3.291	0.5562	29	27	31	23	39	0
Magnesium, Total (mg/L)	MWell#9	8	31.88	7.019	2.482	30	26.5	34.5	26	47	0
Manganese, Dissolved (mg/L)	MWell#9	35	0.01	0	0	0.01	0.01	0.01	0.01	0.01	100
Manganese, Total (mg/L)	MWell#9	8	0.01137	0.003889	0.001375	0.01	0.01	0.01	0.01	0.021	87.5
Methane (ug/L)	MWell#9	35	1.694	1.688	0.2854	1.2	0.6	2.5	0.6	9.1	60
Methylene Chloride (ug/L)	MWell#9	35	1.266	0.9463	0.1599	1.5	0.25	2.5	0.25	2.5	100
Nickel, Dissolved (mg/L)	MWell#9	16	0.002606	0.001505	0.0003763	0.0015	0.0015	0.0035	0.0015	0.0065	56.25
Nickel, Total (mg/L)	MWell#9	28	0.002575	0.001772	0.0003349	0.0015	0.0015	0.0036	0.0015	0.0077	67.86
Nitrate Nitrogen (mg/L)	MWell#9	35	3.497	1.287	0.2175	3.4	3	4.3	0.1	6.5	5.714
pH (none)	MWell#9	35	6.988	0.1745	0.0295	6.97	6.91	7.03	6.66	7.81	0
Potassium, Dissolved (mg/L)	MWell#9	35	9.034	0.6471	0.1094	9.1	8.6	9.6	7.5	10	0
Potassium, Total (mg/L)	MWell#9	8	9.8	1.557	0.5503	9.4	8.6	10.5	8.4	13	0
Redox (mv)	MWell#9	35	59.92	105.9	17.9	44	27.7	100.9	-154.9	334.8	0
Selenium, Dissolved (mg/L)	MWell#9	16	0.0012	0.0009771	0.0002443	0.0008	0.0005	0.00155	0.0005	0.004	50
Selenium, Total (mg/L)	MWell#9	28	0.002982	0.001655	0.0003128	0.004	0.0013	0.004	0.0005	0.0067	64.29
Silver, Dissolved (mg/L)	MWell#9	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Silver, Total (mg/L)	MWell#9	28	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Sodium, Dissolved (mg/L)	MWell#9	35	24.17	4.355	0.7362	23	20	28	18	33	0
Sodium, Total (mg/L)	MWell#9	8	26.13	5.643	1.995	23.5	22.5	31	20	35	0
Styrene (ug/L)	MWell#9	35	0.322	0.1438	0.0243	0.25	0.25	0.5	0.05	0.5	100
Sulfate (mg/L)	MWell#9	35	58.34	11.46	1.936	58	48	67	42	83	0

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Summary of Descriptive Statistics

Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
TDS (mg/L)	MWell#9	35	569.4	71	12	570	530	600	340	690	0
Temperature (C)	MWell#9	35	20.53	2.601	0.4397	20.73	18.9	22.89	14.2	24.4	0
Tetrachloroethene (ug/L)	MWell#9	35	9.669	1.892	0.3198	10	8.1	11	6.1	13	0
Thallium, Dissolved (mg/L)	MWell#9	16	0.0005	0	0	0.0005	0.0005	0.0005	0.0005	0.0005	100
Thallium, Total (mg/L)	MWell#9	28	0.0005	0	0	0.0005	0.0005	0.0005	0.0005	0.0005	100
TOC (mg/L)	MWell#9	35	2.446	4.302	0.7271	1.8	1.4	2.1	0.5	27	5.714
Toluene (ug/L)	MWell#9	35	0.2199	0.1897	0.03207	0.1	0.1	0.5	0.05	0.5	100
Total Suspended Solids (mg/L)	MWell#9	23	1.122	0.3538	0.07378	1	1	1	1	2.5	100
trans-1,2-Dichloroethene (ug/L)	MWell#9	35	0.3454	0.1505	0.02544	0.33	0.25	0.5	0.05	0.65	42.86
trans-1,3-Dichloropropene (ug/L)	MWell#9	35	0.215	0.1859	0.03143	0.1	0.1	0.5	0.05	0.5	100
trans-1,4-Dichloro-2-butene (ug/L)	MWell#9	35	1.526	0.9562	0.1616	1	1	3	0.5	3	100
Trichloroethene (ug/L)	MWell#9	35	4.08	1.24	0.2096	4.1	3.3	5	1.2	6.8	0
Trichlorofluoromethane (ug/L)	MWell#9	35	0.3229	0.1699	0.02872	0.25	0.25	0.5	0.05	0.9	100
Vanadium, Dissolved (mg/L)	MWell#9	16	0.007263	0.0005795	0.0001449	0.00725	0.00705	0.0074	0.0056	0.0083	0
Vanadium, Total (mg/L)	MWell#9	28	0.007286	0.0005275	0.0000997	0.0073	0.00705	0.00755	0.0058	0.0084	0
Vinyl Acetate (ug/L)	MWell#9	35	1.107	0.9101	0.1538	0.5	0.5	2.5	0.25	2.5	100
Vinyl Chloride (ug/L)	MWell#9	35	0.168	0.2221	0.03754	0.027	0.01	0.5	0.01	0.5	77.14
Xylenes (ug/L)	MWell#9	35	0.5089	0.4673	0.07899	0.25	0.25	1	0.05	1.5	100
Zinc, Dissolved (mg/L)	MWell#9	16	0.005769	0.002583	0.0006457	0.00545	0.00425	0.0067	0.002	0.014	12.5
Zinc, Total (mg/L)	MWell#9	28	0.004564	0.002114	0.0003995	0.0035	0.0035	0.00455	0.0033	0.012	67.86

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MW-10
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Summary of Descriptive Statistics

Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
1,1,1,2-Tetrachloroethane (ug/L)	MWell#10	35	0.2346	0.1822	0.03079	0.15	0.1	0.5	0.05	0.5	100
1,1,1-Trichloroethane (ug/L)	MWell#10	35	0.2176	0.1874	0.03167	0.1	0.1	0.5	0.05	0.5	100
1,1,2,2-Tetrachloroethane (ug/L)	MWell#10	35	0.2191	0.1889	0.03193	0.1	0.1	0.5	0.05	0.5	100
1,1,2-Trichloroethane (ug/L)	MWell#10	35	0.2153	0.186	0.03144	0.1	0.1	0.5	0.05	0.5	100
1,1-Dichloroethane (ug/L)	MWell#10	35	8.874	1.85	0.3128	9	7.5	10	4.8	12	0
1,1-Dichloroethene (ug/L)	MWell#10	35	0.4144	0.1927	0.03257	0.49	0.23	0.5	0.1	0.78	48.57
1,2,3-Trichloropropane (ug/L)	MWell#10	35	0.2223	0.1843	0.03115	0.1	0.1	0.5	0.1	0.5	100
1,2-Dibromo-3-chloropropane (ug/L)	MWell#10	35	0.9139	0.2449	0.04139	1	1	1	0.2	1	100
1,2-Dibromoethane (ug/L)	MWell#10	35	0.1816	0.2051	0.03467	0.05	0.05	0.5	0.05	0.5	100
1,2-Dichlorobenzene (ug/L)	MWell#10	35	0.2686	0.2015	0.03406	0.15	0.15	0.5	0.1	0.95	100
1,2-Dichloroethane (ug/L)	MWell#10	35	0.4791	0.07265	0.01228	0.5	0.42	0.52	0.31	0.61	31.43
1,2-Dichloropropane (ug/L)	MWell#10	35	0.2426	0.179	0.03025	0.16	0.1	0.5	0.05	0.5	80
1,4-Dichlorobenzene (ug/L)	MWell#10	35	0.27	0.2066	0.03492	0.15	0.15	0.5	0.1	1	100
2-Butanone (ug/L)	MWell#10	35	5.357	1.889	0.3193	5	5	7.5	1	7.5	100
2-Hexanone (ug/L)	MWell#10	35	1.55	0.6801	0.115	1.5	1	2.5	0.5	2.5	100
4-Methyl-2-pentanone (ug/L)	MWell#10	35	2.436	0.9041	0.1528	2.5	2.5	2.5	0.25	5	100
Acetone (ug/L)	MWell#10	35	11.59	26.82	4.534	5	1	6.9	1	140	74.29
Acrylonitrile (ug/L)	MWell#10	35	3.146	1.318	0.2228	2.5	2.5	5	1	5	100
Alkalinity (mg/L)	MWell#10	35	626	49.72	8.404	620	590	640	530	760	0
Ammonia Nitrogen (mg/L)	MWell#10	35	0.1598	0.1679	0.02838	0.1	0.05	0.25	0.05	1	91.43
Antimony, Dissolved (mg/L)	MWell#10	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Antimony, Total (mg/L)	MWell#10	28	0.0002143	0.00005245	0.000009913	0.0002	0.0002	0.0002	0.0002	0.0004	100
Arsenic, Dissolved (mg/L)	MWell#10	16	0.001794	0.0007425	0.0001856	0.0016	0.0015	0.0019	0.0005	0.004	6.25
Arsenic, Total (mg/L)	MWell#10	28	0.002086	0.0009312	0.000176	0.0019	0.00155	0.00215	0.0013	0.0056	0
Barium, Dissolved (mg/L)	MWell#10	16	0.1156	0.01031	0.002577	0.115	0.11	0.12	0.1	0.14	0
Barium, Total (mg/L)	MWell#10	28	0.1196	0.01782	0.003368	0.115	0.11	0.13	0.079	0.16	0
Benzene (ug/L)	MWell#10	35	0.6397	0.5653	0.09555	0.41	0.27	0.84	0.1	2	14.29
Beryllium, Dissolved (mg/L)	MWell#10	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Beryllium, Total (mg/L)	MWell#10	28	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100

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Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
Bicarbonate (mg/L)	MWell#10	35	626	49.72	8.404	620	590	640	530	760	0
Bromochloromethane (ug/L)	MWell#10	35	0.2229	0.1942	0.03282	0.1	0.1	0.5	0.05	0.55	100
Bromodichloromethane (ug/L)	MWell#10	35	0.22	0.1899	0.0321	0.1	0.1	0.5	0.05	0.5	100
Bromoform (ug/L)	MWell#10	35	0.32	0.1605	0.02713	0.25	0.25	0.5	0.05	0.8	100
Bromomethane (ug/L)	MWell#10	35	0.9657	0.995	0.1682	0.5	0.25	2.5	0.05	2.5	100
Cadmium, Dissolved (mg/L)	MWell#10	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Cadmium, Total (mg/L)	MWell#10	28	0.0002279	0.00008664	0.00001637	0.0002	0.0002	0.0002	0.0002	0.00058	96.43
Calcium, Dissolved (mg/L)	MWell#10	35	212.9	22.95	3.88	200	200	220	180	280	0
Calcium, Total (mg/L)	MWell#10	8	206.3	20.66	7.304	205	195	225	170	230	0
Carbon Disulfide (ug/L)	MWell#10	35	0.2386	0.1887	0.03189	0.15	0.1	0.5	0.05	0.6	100
Carbon Tetrachloride (ug/L)	MWell#10	35	0.2257	0.1998	0.03377	0.1	0.1	0.5	0.05	0.65	100
Carbonate (mg/L)	MWell#10	34	2.5	0	0	2.5	2.5	2.5	2.5	2.5	100
Chloride (mg/L)	MWell#10	35	31.8	5.88	0.9939	31	29	34	14	50	0
Chlorobenzene (ug/L)	MWell#10	35	0.2214	0.1919	0.03243	0.1	0.1	0.5	0.05	0.5	100
Chloroethane (ug/L)	MWell#10	35	1.096	0.966	0.1633	0.73	0.25	2.5	0.125	2.5	71.43
Chloroform (ug/L)	MWell#10	35	0.8211	0.2695	0.04555	0.73	0.6	1	0.5	1.4	11.43
Chloromethane (ug/L)	MWell#10	35	0.8586	1.059	0.179	0.25	0.15	2.5	0.05	2.5	100
Chromium, Dissolved (mg/L)	MWell#10	16	0.001141	0.0007032	0.0001758	0.000965	0.00074	0.0013	0.00048	0.0035	0
Chromium, Total (mg/L)	MWell#10	28	0.00157	0.001238	0.0002339	0.0012	0.0008	0.0019	0.00043	0.006	0
cis-1,2-Dichloroethene (ug/L)	MWell#10	35	13.95	2.307	0.39	14	12	16	9.3	18	0
cis-1,3-Dichloropropene (ug/L)	MWell#10	35	0.2631	0.1687	0.02851	0.25	0.1	0.5	0.05	0.5	100
Cobalt, Dissolved (mg/L)	MWell#10	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Cobalt, Total (mg/L)	MWell#10	28	0.0002696	0.0001815	0.0000343	0.0002	0.0002	0.0002	0.0002	0.00085	85.71
Conductivity (umhos/cm)	MWell#10	32	1332	128.1	22.65	1325	1245	1390	996	1612	0
Copper, Dissolved (mg/L)	MWell#10	16	0.0006875	0.0004773	0.0001193	0.0005	0.0005	0.0005	0.0005	0.0023	87.5
Copper, Total (mg/L)	MWell#10	28	0.001296	0.000692	0.0001308	0.001	0.001	0.002	0.0005	0.0029	64.29
Dibromochloromethane (ug/L)	MWell#10	35	0.2286	0.2066	0.03492	0.1	0.1	0.5	0.05	0.75	100
Dibromomethane (ug/L)	MWell#10	35	0.2203	0.1903	0.03216	0.1	0.1	0.5	0.05	0.5	100
Dissolved Oxygen (mg/L)	MWell#10	34	0.6726	0.8229	0.1411	0.47	0.32	0.78	0.16	5.01	0

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Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
Ethane (ug/L)	MWell#10	35	3.951	1.76	0.2975	5	2.5	5	0.55	5	100
Ethene (ug/L)	MWell#10	35	3.943	1.777	0.3004	5	2.5	5	0.5	5	100
Ethylbenzene (ug/L)	MWell#10	35	0.2199	0.1897	0.03207	0.1	0.1	0.5	0.05	0.5	100
Iodomethane (ug/L)	MWell#10	35	0.9029	1.027	0.1735	0.25	0.25	2.5	0.25	2.5	100
Iron, Dissolved (mg/L)	MWell#10	35	0.214	0.06938	0.01173	0.25	0.1	0.25	0.1	0.33	94.29
Iron, Total (mg/L)	MWell#10	8	0.2963	0.1308	0.04625	0.25	0.25	0.25	0.25	0.62	87.5
Lead, Dissolved (mg/L)	MWell#10	16	0.0003506	0.0003038	0.00007595	0.0002	0.0002	0.000415	0.0002	0.0013	68.75
Lead, Total (mg/L)	MWell#10	28	0.0002929	0.0001016	0.0000192	0.0002	0.0002	0.0004	0.0002	0.0004	100
Magnesium, Dissolved (mg/L)	MWell#10	35	44.31	5.251	0.8876	43	41	46	36	61	0
Magnesium, Total (mg/L)	MWell#10	8	43	4.899	1.732	43.5	40.5	46.5	34	49	0
Manganese, Dissolved (mg/L)	MWell#10	35	0.03211	0.03627	0.006131	0.023	0.01	0.032	0.01	0.17	31.43
Manganese, Total (mg/L)	MWell#10	8	0.01675	0.007459	0.002637	0.015	0.01	0.0235	0.01	0.027	50
Methane (ug/L)	MWell#10	35	1171	672	113.6	1100	740	1500	23	2600	0
Methylene Chloride (ug/L)	MWell#10	35	5.797	5.722	0.9672	3.7	2.5	6.6	1	23	31.43
Nickel, Dissolved (mg/L)	MWell#10	16	0.001863	0.0007932	0.0001983	0.0015	0.0015	0.0015	0.0015	0.0038	81.25
Nickel, Total (mg/L)	MWell#10	28	0.001807	0.0009321	0.0001762	0.0015	0.0015	0.0015	0.0015	0.0052	89.29
Nitrate Nitrogen (mg/L)	MWell#10	35	3.529	1.516	0.2563	4.1	3	4.5	0.1	5.2	5.714
pH (none)	MWell#10	35	6.655	0.1435	0.02425	6.62	6.58	6.69	6.46	7.25	0
Potassium, Dissolved (mg/L)	MWell#10	35	12.39	0.9773	0.1652	12	12	13	9.6	14	0
Potassium, Total (mg/L)	MWell#10	8	12.25	1.282	0.4532	12.5	11.5	13	10	14	0
Redox (mv)	MWell#10	35	34.12	104.5	17.66	41	5	78	-224.7	275.3	0
Selenium, Dissolved (mg/L)	MWell#10	16	0.0005	0	0	0.0005	0.0005	0.0005	0.0005	0.0005	100
Selenium, Total (mg/L)	MWell#10	28	0.002125	0.001778	0.0003359	0.0005	0.0005	0.004	0.0005	0.004	100
Silver, Dissolved (mg/L)	MWell#10	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Silver, Total (mg/L)	MWell#10	28	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Sodium, Dissolved (mg/L)	MWell#10	35	23.11	2.097	0.3545	23	22	24	18	29	0
Sodium, Total (mg/L)	MWell#10	8	22.13	2.416	0.8543	22.5	21.5	23.5	17	25	0
Styrene (ug/L)	MWell#10	35	0.322	0.1438	0.0243	0.25	0.25	0.5	0.05	0.5	100
Sulfate (mg/L)	MWell#10	35	66.57	11.49	1.942	65	61	72	30	93	0

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Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
TDS (mg/L)	MWell#10	35	830	92.16	15.58	830	790	860	450	1100	0
Temperature (C)	MWell#10	35	23.26	2.08	0.3516	23.9	22.76	24.74	18.14	26.27	0
Tetrachloroethene (ug/L)	MWell#10	35	6.129	1.023	0.1729	6.2	5.3	6.8	4.5	9.1	0
Thallium, Dissolved (mg/L)	MWell#10	16	0.0005	0	0	0.0005	0.0005	0.0005	0.0005	0.0005	100
Thallium, Total (mg/L)	MWell#10	28	0.0005	0	0	0.0005	0.0005	0.0005	0.0005	0.0005	100
TOC (mg/L)	MWell#10	35	5.574	12.67	2.142	3.1	2.8	4.1	0.5	78	2.857
Toluene (ug/L)	MWell#10	35	0.2199	0.1897	0.03207	0.1	0.1	0.5	0.05	0.5	100
Total Suspended Solids (mg/L)	MWell#10	23	1.552	1.137	0.237	1	1	1.65	1	5	86.96
trans-1,2-Dichloroethene (ug/L)	MWell#10	35	0.2837	0.1715	0.02899	0.24	0.1	0.5	0.1	0.65	62.86
trans-1,3-Dichloropropene (ug/L)	MWell#10	35	0.215	0.1859	0.03143	0.1	0.1	0.5	0.05	0.5	100
trans-1,4-Dichloro-2-butene (ug/L)	MWell#10	35	1.526	0.9562	0.1616	1	1	3	0.5	3	100
Trichloroethene (ug/L)	MWell#10	35	3.291	0.3951	0.06678	3.3	3	3.6	2.2	4	0
Trichlorofluoromethane (ug/L)	MWell#10	35	0.3737	0.2069	0.03497	0.25	0.25	0.5	0.25	1.2	88.57
Vanadium, Dissolved (mg/L)	MWell#10	16	0.006919	0.000475	0.0001188	0.007	0.0067	0.0072	0.0057	0.0077	0
Vanadium, Total (mg/L)	MWell#10	28	0.007293	0.001152	0.0002178	0.00725	0.00675	0.00745	0.0055	0.012	0
Vinyl Acetate (ug/L)	MWell#10	35	1.107	0.9101	0.1538	0.5	0.5	2.5	0.25	2.5	100
Vinyl Chloride (ug/L)	MWell#10	35	0.9477	0.6039	0.1021	0.89	0.5	1.3	0.01	2.5	17.14
Xylenes (ug/L)	MWell#10	35	0.5089	0.4673	0.07899	0.25	0.25	1	0.05	1.5	100
Zinc, Dissolved (mg/L)	MWell#10	16	0.008013	0.003566	0.0008916	0.00735	0.00585	0.00925	0.0035	0.018	6.25
Zinc, Total (mg/L)	MWell#10	28	0.007986	0.003252	0.0006146	0.00805	0.0058	0.0093	0.0035	0.017	14.29

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Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
1,1,1,2-Tetrachloroethane (ug/L)	MWell#11 (bg)	35	0.2346	0.1822	0.03079	0.15	0.1	0.5	0.05	0.5	100
1,1,1-Trichloroethane (ug/L)	MWell#11 (bg)	35	0.2176	0.1874	0.03167	0.1	0.1	0.5	0.05	0.5	100
1,1,2,2-Tetrachloroethane (ug/L)	MWell#11 (bg)	35	0.2191	0.1889	0.03193	0.1	0.1	0.5	0.05	0.5	100
1,1,2-Trichloroethane (ug/L)	MWell#11 (bg)	35	0.2153	0.186	0.03144	0.1	0.1	0.5	0.05	0.5	100
1,1-Dichloroethane (ug/L)	MWell#11 (bg)	35	0.23	0.2105	0.03557	0.1	0.1	0.5	0.05	0.8	100
1,1-Dichloroethene (ug/L)	MWell#11 (bg)	35	0.2044	0.2014	0.03405	0.1	0.05	0.5	0.05	0.5	100
1,2,3-Trichloropropane (ug/L)	MWell#11 (bg)	35	0.2223	0.1843	0.03115	0.1	0.1	0.5	0.1	0.5	100
1,2-Dibromo-3-chloropropane (ug/L)	MWell#11 (bg)	35	0.9139	0.2449	0.04139	1	1	1	0.2	1	100
1,2-Dibromoethane (ug/L)	MWell#11 (bg)	35	0.1816	0.2051	0.03467	0.05	0.05	0.5	0.05	0.5	100
1,2-Dichlorobenzene (ug/L)	MWell#11 (bg)	35	0.2686	0.2015	0.03406	0.15	0.15	0.5	0.1	0.95	100
1,2-Dichloroethane (ug/L)	MWell#11 (bg)	35	0.2229	0.1942	0.03282	0.1	0.1	0.5	0.05	0.55	100
1,2-Dichloropropane (ug/L)	MWell#11 (bg)	35	0.2203	0.1903	0.03216	0.1	0.1	0.5	0.05	0.5	100
1,4-Dichlorobenzene (ug/L)	MWell#11 (bg)	35	0.27	0.2066	0.03492	0.15	0.15	0.5	0.1	1	100
2-Butanone (ug/L)	MWell#11 (bg)	35	5.357	1.889	0.3193	5	5	7.5	1	7.5	100
2-Hexanone (ug/L)	MWell#11 (bg)	35	1.55	0.6801	0.115	1.5	1	2.5	0.5	2.5	100
4-Methyl-2-pentanone (ug/L)	MWell#11 (bg)	35	2.436	0.9041	0.1528	2.5	2.5	2.5	0.25	5	100
Acetone (ug/L)	MWell#11 (bg)	35	2.846	1.758	0.2972	3	1	5	1	5	100
Acrylonitrile (ug/L)	MWell#11 (bg)	35	3.146	1.318	0.2228	2.5	2.5	5	1	5	100
Alkalinity (mg/L)	MWell#11 (bg)	35	179.7	12.24	2.07	180	170	190	160	210	0
Ammonia Nitrogen (mg/L)	MWell#11 (bg)	35	0.134	0.09065	0.01532	0.1	0.05	0.25	0.025	0.29	94.29
Antimony, Dissolved (mg/L)	MWell#11 (bg)	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Antimony, Total (mg/L)	MWell#11 (bg)	28	0.0002143	0.00005245	0.000009913	0.0002	0.0002	0.0002	0.0002	0.0004	100
Arsenic, Dissolved (mg/L)	MWell#11 (bg)	16	0.005025	0.0005882	0.0001471	0.00495	0.00465	0.00535	0.0042	0.0064	0
Arsenic, Total (mg/L)	MWell#11 (bg)	28	0.005193	0.001498	0.0002832	0.00485	0.0045	0.0052	0.0042	0.012	0
Barium, Dissolved (mg/L)	MWell#11 (bg)	16	0.08663	0.0168	0.0042	0.0885	0.07	0.1	0.064	0.11	0
Barium, Total (mg/L)	MWell#11 (bg)	28	0.107	0.01338	0.002529	0.11	0.098	0.11	0.087	0.15	0
Benzene (ug/L)	MWell#11 (bg)	35	0.2229	0.1942	0.03282	0.1	0.1	0.5	0.05	0.55	100
Beryllium, Dissolved (mg/L)	MWell#11 (bg)	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Beryllium, Total (mg/L)	MWell#11 (bg)	28	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Bicarbonate (mg/L)	MWell#11 (bg)	35	179.7	12.24	2.07	180	170	190	160	210	0

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Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
Bromochloromethane (ug/L)	MWell#11 (bg)	35	0.2229	0.1942	0.03282	0.1	0.1	0.5	0.05	0.55	100
Bromodichloromethane (ug/L)	MWell#11 (bg)	35	0.22	0.1899	0.0321	0.1	0.1	0.5	0.05	0.5	100
Bromoform (ug/L)	MWell#11 (bg)	35	0.32	0.1605	0.02713	0.25	0.25	0.5	0.05	0.8	100
Bromomethane (ug/L)	MWell#11 (bg)	35	0.9657	0.995	0.1682	0.5	0.25	2.5	0.05	2.5	100
Cadmium, Dissolved (mg/L)	MWell#11 (bg)	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Cadmium, Total (mg/L)	MWell#11 (bg)	28	0.0002143	0.00005245	0.000009913	0.0002	0.0002	0.0002	0.0002	0.0004	100
Calcium, Dissolved (mg/L)	MWell#11 (bg)	35	214.3	59.08	9.986	240	180	260	100	280	0
Calcium, Total (mg/L)	MWell#11 (bg)	8	182.5	34.12	12.06	200	160	205	120	210	0
Carbon Disulfide (ug/L)	MWell#11 (bg)	35	0.2386	0.1887	0.03189	0.15	0.1	0.5	0.05	0.6	100
Carbon Tetrachloride (ug/L)	MWell#11 (bg)	35	0.2257	0.1998	0.03377	0.1	0.1	0.5	0.05	0.65	100
Carbonate (mg/L)	MWell#11 (bg)	34	2.5	0	0	2.5	2.5	2.5	2.5	2.5	100
Chloride (mg/L)	MWell#11 (bg)	35	162.8	75.21	12.71	190	90	230	35	280	0
Chlorobenzene (ug/L)	MWell#11 (bg)	35	0.2214	0.1919	0.03243	0.1	0.1	0.5	0.05	0.5	100
Chloroethane (ug/L)	MWell#11 (bg)	35	0.8936	1.034	0.1747	0.25	0.25	2.5	0.125	2.5	100
Chloroform (ug/L)	MWell#11 (bg)	35	0.2243	0.1968	0.03327	0.1	0.1	0.5	0.05	0.6	100
Chloromethane (ug/L)	MWell#11 (bg)	35	0.8586	1.059	0.179	0.25	0.15	2.5	0.05	2.5	100
Chromium, Dissolved (mg/L)	MWell#11 (bg)	16	0.0044	0.001197	0.0002992	0.00415	0.0036	0.00485	0.0028	0.0073	0
Chromium, Total (mg/L)	MWell#11 (bg)	28	0.0104	0.01302	0.002461	0.00465	0.00355	0.011	0.0028	0.061	0
cis-1,2-Dichloroethene (ug/L)	MWell#11 (bg)	35	0.2229	0.1942	0.03282	0.1	0.1	0.5	0.05	0.55	100
cis-1,3-Dichloropropene (ug/L)	MWell#11 (bg)	35	0.2631	0.1687	0.02851	0.25	0.1	0.5	0.05	0.5	100
Cobalt, Dissolved (mg/L)	MWell#11 (bg)	16	0.0002956	0.0001578	0.00003945	0.0002	0.0002	0.00042	0.0002	0.00067	68.75
Cobalt, Total (mg/L)	MWell#11 (bg)	28	0.0005325	0.0005297	0.0001001	0.0002	0.0002	0.00063	0.0002	0.0025	53.57
Conductivity (umhos/cm)	MWell#11 (bg)	31	1423	348.1	62.51	1459	1138	1710	764	1876	0
Copper, Dissolved (mg/L)	MWell#11 (bg)	16	0.002344	0.001414	0.0003535	0.002	0.0013	0.00325	0.0005	0.005	12.5
Copper, Total (mg/L)	MWell#11 (bg)	28	0.002582	0.002074	0.0003919	0.0021	0.001	0.0035	0.0005	0.0092	42.86
Dibromochloromethane (ug/L)	MWell#11 (bg)	35	0.2286	0.2066	0.03492	0.1	0.1	0.5	0.05	0.75	100
Dibromomethane (ug/L)	MWell#11 (bg)	35	0.2203	0.1903	0.03216	0.1	0.1	0.5	0.05	0.5	100
Dissolved Oxygen (mg/L)	MWell#11 (bg)	34	8.07	0.6436	0.1104	8.115	7.625	8.585	6.7	9.39	0
Ethane (ug/L)	MWell#11 (bg)	35	3.951	1.76	0.2975	5	2.5	5	0.55	5	100
Ethene (ug/L)	MWell#11 (bg)	35	3.943	1.777	0.3004	5	2.5	5	0.5	5	100

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Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
Ethylbenzene (ug/L)	MWell#11 (bg)	35	0.2199	0.1897	0.03207	0.1	0.1	0.5	0.05	0.5	100
Iodomethane (ug/L)	MWell#11 (bg)	35	0.9029	1.027	0.1735	0.25	0.25	2.5	0.25	2.5	100
Iron, Dissolved (mg/L)	MWell#11 (bg)	35	0.2157	0.08975	0.01517	0.25	0.1	0.25	0.1	0.55	97.14
Iron, Total (mg/L)	MWell#11 (bg)	8	0.3813	0.3712	0.1313	0.25	0.25	0.25	0.25	1.3	87.5
Lead, Dissolved (mg/L)	MWell#11 (bg)	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Lead, Total (mg/L)	MWell#11 (bg)	28	0.0003261	0.0001675	0.00003165	0.0003	0.0002	0.0004	0.0002	0.00097	92.86
Magnesium, Dissolved (mg/L)	MWell#11 (bg)	35	42.89	11.98	2.026	48	36	53	21	56	0
Magnesium, Total (mg/L)	MWell#11 (bg)	8	37.5	6.928	2.449	40.5	32	42.5	26	44	0
Manganese, Dissolved (mg/L)	MWell#11 (bg)	35	0.018	0.04733	0.008	0.01	0.01	0.01	0.01	0.29	97.14
Manganese, Total (mg/L)	MWell#11 (bg)	8	0.01262	0.007425	0.002625	0.01	0.01	0.01	0.01	0.031	87.5
Methane (ug/L)	MWell#11 (bg)	35	1.035	1.118	0.1889	0.6	0.6	0.6	0.29	5.4	91.43
Methylene Chloride (ug/L)	MWell#11 (bg)	35	1.266	0.9463	0.1599	1.5	0.25	2.5	0.25	2.5	100
Nickel, Dissolved (mg/L)	MWell#11 (bg)	16	0.005219	0.002686	0.0006716	0.00515	0.00335	0.0074	0.0015	0.0096	18.75
Nickel, Total (mg/L)	MWell#11 (bg)	28	0.005204	0.007262	0.001372	0.0015	0.0015	0.0055	0.0015	0.033	60.71
Nitrate Nitrogen (mg/L)	MWell#11 (bg)	34	31.12	7.057	1.21	34	28	35.5	16	44	0
pH (none)	MWell#11 (bg)	35	7.419	0.1679	0.02837	7.39	7.3	7.47	7.2	8.07	0
Potassium, Dissolved (mg/L)	MWell#11 (bg)	35	11.14	1.518	0.2565	12	11	12	7.5	13	0
Potassium, Total (mg/L)	MWell#11 (bg)	8	10.56	1.32	0.4667	11	9.65	11.5	8.2	12	0
Redox (mv)	MWell#11 (bg)	35	135.1	107.6	18.2	121	72.5	200.9	-99.2	444	0
Selenium, Dissolved (mg/L)	MWell#11 (bg)	16	0.006819	0.002988	0.000747	0.0074	0.0034	0.0094	0.0026	0.011	0
Selenium, Total (mg/L)	MWell#11 (bg)	28	0.007204	0.002979	0.000563	0.0081	0.004	0.00995	0.004	0.012	42.86
Silver, Dissolved (mg/L)	MWell#11 (bg)	16	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Silver, Total (mg/L)	MWell#11 (bg)	28	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Sodium, Dissolved (mg/L)	MWell#11 (bg)	35	19.26	2.726	0.4608	20	17	21	14	24	0
Sodium, Total (mg/L)	MWell#11 (bg)	8	18.5	1.414	0.5	19	17.5	19.5	16	20	0
Styrene (ug/L)	MWell#11 (bg)	35	0.322	0.1438	0.0243	0.25	0.25	0.5	0.05	0.5	100
Sulfate (mg/L)	MWell#11 (bg)	35	228.4	95.45	16.13	230	160	320	69	340	0
TDS (mg/L)	MWell#11 (bg)	35	1064	353.5	59.76	1100	810	1300	510	2300	0
Temperature (C)	MWell#11 (bg)	35	20.81	2.248	0.38	20.93	19.72	22.6	15.15	23.8	0
Tetrachloroethene (ug/L)	MWell#11 (bg)	35	0.3214	0.1651	0.0279	0.25	0.25	0.5	0.05	0.85	100

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Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
Thallium, Dissolved (mg/L)	MWell#11 (bg)	16	0.0005	0	0	0.0005	0.0005	0.0005	0.0005	0.0005	100
Thallium, Total (mg/L)	MWell#11 (bg)	28	0.0005	0	0	0.0005	0.0005	0.0005	0.0005	0.0005	100
TOC (mg/L)	MWell#11 (bg)	35	3.2	2.499	0.4225	2.4	1.8	4	0.5	14	2.857
Toluene (ug/L)	MWell#11 (bg)	35	0.2199	0.1897	0.03207	0.1	0.1	0.5	0.05	0.5	100
Total Suspended Solids (mg/L)	MWell#11 (bg)	23	3.067	5.635	1.175	1	1	1.65	1	23	73.91
trans-1,2-Dichloroethene (ug/L)	MWell#11 (bg)	35	0.2257	0.1998	0.03377	0.1	0.1	0.5	0.05	0.65	100
trans-1,3-Dichloropropene (ug/L)	MWell#11 (bg)	35	0.215	0.1859	0.03143	0.1	0.1	0.5	0.05	0.5	100
trans-1,4-Dichloro-2-butene (ug/L)	MWell#11 (bg)	35	1.526	0.9562	0.1616	1	1	3	0.5	3	100
Trichloroethene (ug/L)	MWell#11 (bg)	35	0.2243	0.1968	0.03327	0.1	0.1	0.5	0.05	0.6	100
Trichlorofluoromethane (ug/L)	MWell#11 (bg)	35	0.3229	0.1699	0.02872	0.25	0.25	0.5	0.05	0.9	100
Vanadium, Dissolved (mg/L)	MWell#11 (bg)	16	0.01016	0.0008869	0.0002217	0.0099	0.0095	0.011	0.0089	0.012	0
Vanadium, Total (mg/L)	MWell#11 (bg)	28	0.01006	0.001029	0.0001944	0.0099	0.00925	0.011	0.008	0.012	0
Vinyl Acetate (ug/L)	MWell#11 (bg)	35	1.107	0.9101	0.1538	0.5	0.5	2.5	0.25	2.5	100
Vinyl Chloride (ug/L)	MWell#11 (bg)	35	0.1607	0.2267	0.03831	0.01	0.01	0.5	0.01	0.5	100
Xylenes (ug/L)	MWell#11 (bg)	35	0.5089	0.4673	0.07899	0.25	0.25	1	0.05	1.5	100
Zinc, Dissolved (mg/L)	MWell#11 (bg)	16	0.00395	0.003161	0.0007901	0.00275	0.002	0.00445	0.0018	0.013	37.5
Zinc, Total (mg/L)	MWell#11 (bg)	28	0.003939	0.001587	0.0003	0.0035	0.0035	0.0035	0.002	0.0088	78.57

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Summary of Descriptive Statistics

Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
1,1,1,2-Tetrachloroethane (ug/L)	MWell#12	7	0.15	0	0	0.15	0.15	0.15	0.15	0.15	100
1,1,1-Trichloroethane (ug/L)	MWell#12	7	0.1	0	0	0.1	0.1	0.1	0.1	0.1	100
1,1,2,2-Tetrachloroethane (ug/L)	MWell#12	7	0.1	0	0	0.1	0.1	0.1	0.1	0.1	100
1,1,2-Trichloroethane (ug/L)	MWell#12	7	0.1	0	0	0.1	0.1	0.1	0.1	0.1	100
1,1-Dichloroethane (ug/L)	MWell#12	7	0.51	0.07118	0.0269	0.5	0.46	0.55	0.44	0.65	0
1,1-Dichloroethene (ug/L)	MWell#12	7	0.1	0	0	0.1	0.1	0.1	0.1	0.1	100
1,2,3-Trichloropropane (ug/L)	MWell#12	7	0.1	0	0	0.1	0.1	0.1	0.1	0.1	100
1,2-Dibromo-3-chloropropane (ug/L)	MWell#12	7	1	0	0	1	1	1	1	1	100
1,2-Dibromoethane (ug/L)	MWell#12	7	0.05	0	0	0.05	0.05	0.05	0.05	0.05	100
1,2-Dichlorobenzene (ug/L)	MWell#12	7	0.15	0	0	0.15	0.15	0.15	0.15	0.15	100
1,2-Dichloroethane (ug/L)	MWell#12	7	0.1	0	0	0.1	0.1	0.1	0.1	0.1	100
1,2-Dichloropropane (ug/L)	MWell#12	7	0.1	0	0	0.1	0.1	0.1	0.1	0.1	100
1,4-Dichlorobenzene (ug/L)	MWell#12	7	0.15	0	0	0.15	0.15	0.15	0.15	0.15	100
2-Butanone (ug/L)	MWell#12	7	5	0	0	5	5	5	5	5	100
2-Hexanone (ug/L)	MWell#12	7	1.5	0	0	1.5	1.5	1.5	1.5	1.5	100
4-Methyl-2-pentanone (ug/L)	MWell#12	7	3.214	1.22	0.4611	2.5	2.5	5	2.5	5	100
Acetone (ug/L)	MWell#12	7	4	1.291	0.488	3	3	5	3	6	85.71
Acrylonitrile (ug/L)	MWell#12	7	5	0	0	5	5	5	5	5	100
Alkalinity (mg/L)	MWell#12	7	138.6	13.45	5.084	140	140	150	110	150	0
Ammonia Nitrogen (mg/L)	MWell#12	7	0.25	0	0	0.25	0.25	0.25	0.25	0.25	100
Antimony, Total (mg/L)	MWell#12	7	0.0005229	0.000447	0.000169	0.0004	0.0002	0.00051	0.0002	0.0015	57.14
Arsenic, Total (mg/L)	MWell#12	7	0.005186	0.001633	0.0006174	0.0049	0.0045	0.0068	0.0027	0.0077	0
Barium, Total (mg/L)	MWell#12	7	0.05843	0.01227	0.004639	0.059	0.049	0.068	0.039	0.077	0
Benzene (ug/L)	MWell#12	7	0.1	0	0	0.1	0.1	0.1	0.1	0.1	100
Beryllium, Total (mg/L)	MWell#12	7	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Bicarbonate (mg/L)	MWell#12	7	138.6	13.45	5.084	140	140	150	110	150	0
Bromochloromethane (ug/L)	MWell#12	7	0.1	0	0	0.1	0.1	0.1	0.1	0.1	100
Bromodichloromethane (ug/L)	MWell#12	7	0.1	0	0	0.1	0.1	0.1	0.1	0.1	100
Bromoform (ug/L)	MWell#12	7	0.25	0	0	0.25	0.25	0.25	0.25	0.25	100

HORN RAPIDS LANDFILL
MW-12
September 2011 to June 2020
Summary of Descriptive Statistics

Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
Bromomethane (ug/L)	MWell#12	7	0.25	0	0	0.25	0.25	0.25	0.25	0.25	100
Cadmium, Total (mg/L)	MWell#12	7	0.0002571	0.00009759	0.00003689	0.0002	0.0002	0.0004	0.0002	0.0004	100
Calcium, Dissolved (mg/L)	MWell#12	7	47.86	5.9	2.23	49	48	51	35	53	0
Carbon Disulfide (ug/L)	MWell#12	7	1.207	2.367	0.8945	0.15	0.15	1.2	0.15	6.5	71.43
Carbon Tetrachloride (ug/L)	MWell#12	7	0.1	0	0	0.1	0.1	0.1	0.1	0.1	100
Carbonate (mg/L)	MWell#12	7	2.5	0	0	2.5	2.5	2.5	2.5	2.5	100
Chloride (mg/L)	MWell#12	7	14.57	1.134	0.4286	14	14	15	14	17	0
Chlorobenzene (ug/L)	MWell#12	7	0.1	0	0	0.1	0.1	0.1	0.1	0.1	100
Chloroethane (ug/L)	MWell#12	7	0.25	0	0	0.25	0.25	0.25	0.25	0.25	100
Chloroform (ug/L)	MWell#12	7	1.243	3.024	1.143	0.1	0.1	0.1	0.1	8.1	85.71
Chloromethane (ug/L)	MWell#12	7	0.25	0	0	0.25	0.25	0.25	0.25	0.25	100
Chromium, Total (mg/L)	MWell#12	7	0.01174	0.007712	0.002915	0.0086	0.0057	0.021	0.0041	0.024	0
cis-1,2-Dichloroethene (ug/L)	MWell#12	7	0.2843	0.03994	0.0151	0.29	0.27	0.31	0.21	0.34	0
cis-1,3-Dichloropropene (ug/L)	MWell#12	7	0.1	0	0	0.1	0.1	0.1	0.1	0.1	100
Cobalt, Total (mg/L)	MWell#12	7	0.0006429	0.0005682	0.0002148	0.0002	0.0002	0.0011	0.0002	0.0015	57.14
Conductivity (umhos/cm)	MWell#12	7	422.7	31.62	11.95	432.8	412.4	444.2	355.4	445.1	0
Copper, Total (mg/L)	MWell#12	7	0.009129	0.005351	0.002023	0.011	0.0035	0.014	0.0022	0.015	0
Dibromochloromethane (ug/L)	MWell#12	7	0.1	0	0	0.1	0.1	0.1	0.1	0.1	100
Dibromomethane (ug/L)	MWell#12	7	0.1	0	0	0.1	0.1	0.1	0.1	0.1	100
Dissolved Oxygen (mg/L)	MWell#12	7	5.283	3.152	1.191	5.21	2.47	8.12	0.29	8.91	0
Ethane (ug/L)	MWell#12	7	1.186	1.682	0.6357	0.55	0.55	0.55	0.55	5	100
Ethene (ug/L)	MWell#12	7	1.143	1.701	0.6429	0.5	0.5	0.5	0.5	5	100
Ethylbenzene (ug/L)	MWell#12	7	0.1	0	0	0.1	0.1	0.1	0.1	0.1	100
Iodomethane (ug/L)	MWell#12	7	0.25	0	0	0.25	0.25	0.25	0.25	0.25	100
Iron, Dissolved (mg/L)	MWell#12	7	0.1429	0.07319	0.02766	0.1	0.1	0.25	0.1	0.25	100
Lead, Total (mg/L)	MWell#12	7	0.0004571	0.0001512	0.00005714	0.0004	0.0004	0.0004	0.0004	0.0008	85.71
Magnesium, Dissolved (mg/L)	MWell#12	7	9.971	1.45	0.548	10	9.9	11	6.9	11	0
Manganese, Dissolved (mg/L)	MWell#12	7	0.092	0.1269	0.04795	0.01	0.01	0.25	0.01	0.3	57.14
Methane (ug/L)	MWell#12	7	3.209	4.28	1.618	0.29	0.29	7.1	0.29	11	57.14

HORN RAPIDS LANDFILL

MW-12

September 2011 to June 2020

Summary of Descriptive Statistics

Constituent Name	Well	N	Mean[1]	Standard Deviation	Standard Error	Median	Lower Quartile	Upper Quartile	Minimum	Maximum	% Non-Detects
Methylene Chloride (ug/L)	MWell#12	7	2.5	0	0	2.5	2.5	2.5	2.5	2.5	100
Nickel, Total (mg/L)	MWell#12	7	0.007029	0.005317	0.00201	0.0052	0.0035	0.014	0.0015	0.015	14.29
Nitrate Nitrogen (mg/L)	MWell#12	7	2.933	1.518	0.5739	3	2	4	0.23	4.9	0
pH (none)	MWell#12	7	7.749	0.1949	0.07366	7.82	7.55	7.88	7.43	7.97	0
Potassium, Dissolved (mg/L)	MWell#12	7	7.843	0.3823	0.1445	7.7	7.5	8.2	7.5	8.5	0
Redox (mv)	MWell#12	7	84.19	151.7	57.32	99.2	21.3	214.8	-202.6	249.5	0
Selenium, Total (mg/L)	MWell#12	7	0.004	0	0	0.004	0.004	0.004	0.004	0.004	100
Silver, Total (mg/L)	MWell#12	7	0.0002	0	0	0.0002	0.0002	0.0002	0.0002	0.0002	100
Sodium, Dissolved (mg/L)	MWell#12	7	23.14	4.059	1.534	21	21	24	21	32	0
Styrene (ug/L)	MWell#12	7	0.3214	0.122	0.04611	0.25	0.25	0.5	0.25	0.5	100
Sulfate (mg/L)	MWell#12	7	35.29	1.604	0.6061	36	35	36	32	37	0
TDS (mg/L)	MWell#12	7	235.7	45.77	17.3	230	180	280	180	300	0
Temperature (C)	MWell#12	7	21.73	2.295	0.8676	22.7	21	23	16.8	23.2	0
Tetrachloroethene (ug/L)	MWell#12	7	0.25	0	0	0.25	0.25	0.25	0.25	0.25	100
Thallium, Total (mg/L)	MWell#12	7	0.0005	0	0	0.0005	0.0005	0.0005	0.0005	0.0005	100
TOC (mg/L)	MWell#12	7	1.881	2.645	0.9996	0.62	0.5	2.7	0.5	7.6	57.14
Toluene (ug/L)	MWell#12	7	0.2114	0.2948	0.1114	0.1	0.1	0.1	0.1	0.88	85.71
Total Suspended Solids (mg/L)	MWell#12	7	20.94	18.01	6.809	11	7.2	41	1	44	14.29
trans-1,2-Dichloroethene (ug/L)	MWell#12	7	0.1	0	0	0.1	0.1	0.1	0.1	0.1	100
trans-1,3-Dichloropropene (ug/L)	MWell#12	7	0.1	0	0	0.1	0.1	0.1	0.1	0.1	100
trans-1,4-Dichloro-2-butene (ug/L)	MWell#12	7	1	0	0	1	1	1	1	1	100
Trichloroethene (ug/L)	MWell#12	7	0.1	0	0	0.1	0.1	0.1	0.1	0.1	100
Trichlorofluoromethane (ug/L)	MWell#12	7	0.25	0	0	0.25	0.25	0.25	0.25	0.25	100
Vanadium, Total (mg/L)	MWell#12	7	0.01043	0.004392	0.00166	0.01	0.01	0.014	0.002	0.016	14.29
Vinyl Acetate (ug/L)	MWell#12	7	0.6786	0.2378	0.08988	0.5	0.5	1	0.5	1	100
Vinyl Chloride (ug/L)	MWell#12	7	0.01	0	0	0.01	0.01	0.01	0.01	0.01	100
Xylenes (ug/L)	MWell#12	7	0.25	0	0	0.25	0.25	0.25	0.25	0.25	100
Zinc, Total (mg/L)	MWell#12	7	0.005943	0.004506	0.001703	0.0035	0.0035	0.0091	0.0035	0.015	71.43

J-3

Background Calculations

1.7
2.9
3
5.5
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Horn Rapids Landfill RI -- Nitrate (mg/L)

MTCA*Stat* 3.0

Number of samples		Uncensored values	
Uncensored	68	Mean	19.65
Censored	0	Lognormal mean	20.46
TOTAL	68	Std. devn.	12.67
		Median	14
		Min.	1.7
		Max.	44

Lognormal distribution? Normal distribution?

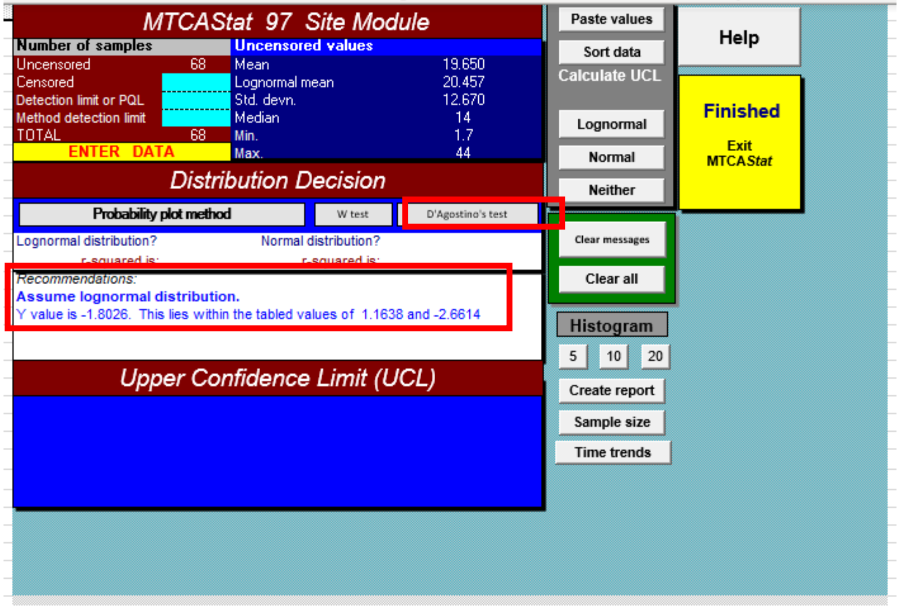
r-squared is: 0.89 r-squared is: 0.86

Recommendations:

Use nonparametric method.

Distribution selection	Enter percentile	Value corresponding to that percentile is:
1	90	43.82
1 = Lognormal	50th	15.26
2 = Normal	4 X 50th	61.02
3 = Nonparametric method		Coefficient of Variation = 0.98

Using D'Agostino's test in MTCAStat97 Site Module, assume lognormal distribution.



Number of samples		Uncensored values	
Uncensored	68	Mean	19.650
Censored		Lognormal mean	20.457
Detection limit or PQL		Std. devn.	12.670
Method detection limit		Median	14
TOTAL	68	Min.	1.7
		Max.	44

Lognormal distribution? Normal distribution?

r-squared is: r-squared is:

Recommendations:

Assume lognormal distribution.

Y value is -1.8026. This lies within the tabled values of 1.1638 and -2.6614

Horn Rapids Landfill RI -- Arsenic, Total (mg/L)

0.0038
0.0038
0.0038
0.0039
0.0039
0.0039
0.0039
0.004
0.0041
0.0041
0.0042
0.0042
0.0042
0.0042
0.0042
0.0042
0.0043
0.0043
0.0044
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0.0046
0.0046
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0.0047
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0.005
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0.005
0.005
0.005
0.0051
0.0052
0.0052
0.0055
0.0055
0.0056
0.0057
0.0058
0.0068
0.0068
0.012

MTCA*Stat* 3.0

Number of samples		Uncensored values	
Uncensored	56	Mean	0.0048
Censored	0	Lognormal mean	0.0048
TOTAL	56	Std. devn.	0.0012
		Median	0.0045
		Min.	0.0038
		Max.	0.012

Lognormal distribution?	Normal distribution?
r-squared is: 0.76	r-squared is: 0.56

Recommendations:

Use nonparametric method.

Distribution selection	Enter percentile	Value corresponding to that percentile is:
3	90	0.0056
1 = Lognormal	50th	0.0045
2 = Normal	4 X 50th	0.0180
3 = Nonparametric method	Coefficient of Variation = N/A	

NOTE: distribution is nonparametric, so maximum used as background

Horn Rapids Landfill RI -- Cobalt, Total (mg/L)

<0.0004
<0.0004
<0.0004
<0.0004
<0.0004
<0.0004
<0.0004
<0.0004
<0.0004
<0.0004
<0.0004
<0.0004
<0.0004
<0.0004
<0.0004
0.00043
0.00045
0.00047
0.00053
0.00057
0.00057
0.00069
0.0009
0.001
0.0012
0.0012
0.0014
0.0025
0.0057
0.0081
0.011
0.012
0.013
0.013
0.016
0.018
0.019
0.022
0.022
0.022
0.024
0.025

MTCA*Stat* 3.0

Number of samples		Uncensored values	
Uncensored	41	Mean	0.018
Censored	15	Lognormal mean	0.031
TOTAL	56	Std. devn.	0.015
		Median	0.018
		Min.	0.00043
		Max.	0.052
Lognormal distribution?		Normal distribution?	
r-squared is:	0.75	r-squared is:	0.96

Recommendations:

Use normal distribution.

Distribution selection	Enter percentile	Value corresponding to that percentile is:
2	80	0.026
1 = Lognormal	50th	0.008
2 = Normal	4 X 50th	0.033
3 = Nonparametric method	Coefficient of Variation = 2.57	