~~Ground Water~~Groundwater Monitoring Plan

For

Chemical Waste Management of the Northwest, Inc.

Arlington Facility –– ORD 089 452 353
17629 Cedar Springs Lane
Arlington, Oregon

Standalone ~~Document~~ No. 7

This document is issued by the
Oregon Department of Environmental Quality

~~June 2023~~May 2024

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List of Appendices

1 INTRODUCTION

This Groundwater Monitoring and Reporting Program Plan (referred to herein as the Plan) summarizes the site and regional hydrogeology and presents the groundwater monitoring and data evaluation methodologies for the Chemical Waste Management of the Northwest (CWM) facility (hereinafter referred to as the Facility). As shown on Figure 17-1, the Facility is located in Gilliam County, Oregon, approximately 12 road miles south/southwest of the town of Arlington. A site layout map showing natural features, building locations and the boundaries of the permitted landfill units and surface impoundments is presented on Figure 17-2. This Plan incorporates permanent monitoring elements to provide environmental protection during and after CWM development.

1.1 The program incorporates permanent monitoring elements to provide environmental protection during and after landfill development. Compliance Period

The compliance period during which the ground-water protection standard of 40 CFR 264.92 applies is the number of years equal to the active life of the waste management area (including any waste management activity prior to permitting, and the closure period).

CWM is an existing hazardous waste landfill owned and operated by Chemical Waste Management of the Northwest, Inc.,. (CWMNW), a subsidiary of Waste Management Inc. (WM),, under Permit ORD 089 452 353. (Permit). This Plan applies to both the detection monitoring and compliance monitoring programs (if required) at the Facility and applicable requirements outlined in the Permit. In case of a discrepancy between this Plan and the Permit, the Permit takes precedence.

1.11.2 Overview

This Plan describes the hydrogeologic setting of the Facility, the design of the proposed monitoring network and the basis for its configuration, background, detection, and compliance monitoring frequencies for each monitor point, monitoring parameters, and a sampling and analysis planprogram. This Plan complies with federal requirements for hazardous waste landfills as promulgated under the Subtitle C rules of the Resource and Conservation Recovery Act (RCRA). This Plan also describes requirements for monitoring four past practice units at the Facility under the Toxic Substances Control Act (TSCA) and as part of post-closure care maintenance procedures required by the Facility's operating Permit. This Plan will serve as a guidance document for personnel performing site monitoring during the active life of the Facility and during closure and post-closure periods. Each section of the Plan is introduced in the following paragraphs.

The groundwater -monitoring program at the site is based on the distinct hydrogeologic characteristics of the area and the potential influence of the existing surface impoundments and landfill units on the hydrogeologic system as it exists today and is projected to exist in the future (based on planned additional landfill phases). The geology and hydrogeology of the region and site are discussed in Section 2.0,the Hydrogeologic Setting section.

Section 3.0,The Groundwater Monitoring Program, section presents details of the existing groundwater monitoring parameters, Waste Management Areas (WMAs), Point of Compliance (POC) monitoring well network, and sampling schedule for the Facility.

Section 4.0,The Data Evaluation, section describes the evaluation methods that will be used to assess if detection monitoring criteria (or, if compliance monitoring is required under the Permit, the groundwater concentration limits) are exceeded. This section further includes a discussion regarding verification sampling procedures.

Section 5.0, Purging and Sampling Procedures, describes the methods and procedures that will be followed for purging and sampling monitoring wells at the CWM facility. General guidance for activities pertaining to sample collection, including sample preparation, collection, preservation, shipment, field quality assurance/quality control (QA/QC) procedures, and chain-of-custody are presented in the *Groundwater, Surface Water, and Leachate Sampling Guide* (Appendix A), which has been adapted from WM's equivalent guidance for sites owned and operated by WM. Because the sampling guide in Appendix A is a largely a generic document, it may contain information that is either irrelevant to or inconsistent with the procedures contained in either the Permit or this Groundwater Monitoring Plan. In that case, the requirements of the Permit (first priority) and this Groundwater Monitoring Plan (second priority) supersede the general guidelines presented in Appendix A.

Section 6.0,The Purging and Sampling Procedures section describes the methods and procedures that will be followed for purging and sampling monitoring wells at the Facility.

The Laboratory Analysis Plan, section presents the laboratory analytical methods, analyte reporting limits, laboratory quality control procedures, and quality control samples that will be collected. Section 7.0, Data Quality Review, Reporting, and Record-Keeping, presents data quality review procedures, reporting procedures, and record-keeping measures. Section 8.0, References, lists the technical and regulatory documents cited in this Plan. Appendixes A through E present various supporting materials and references.

The Data Quality Review, Reporting, and Record-Keeping section presents data quality review procedures, reporting procedures, and record-keeping measures.

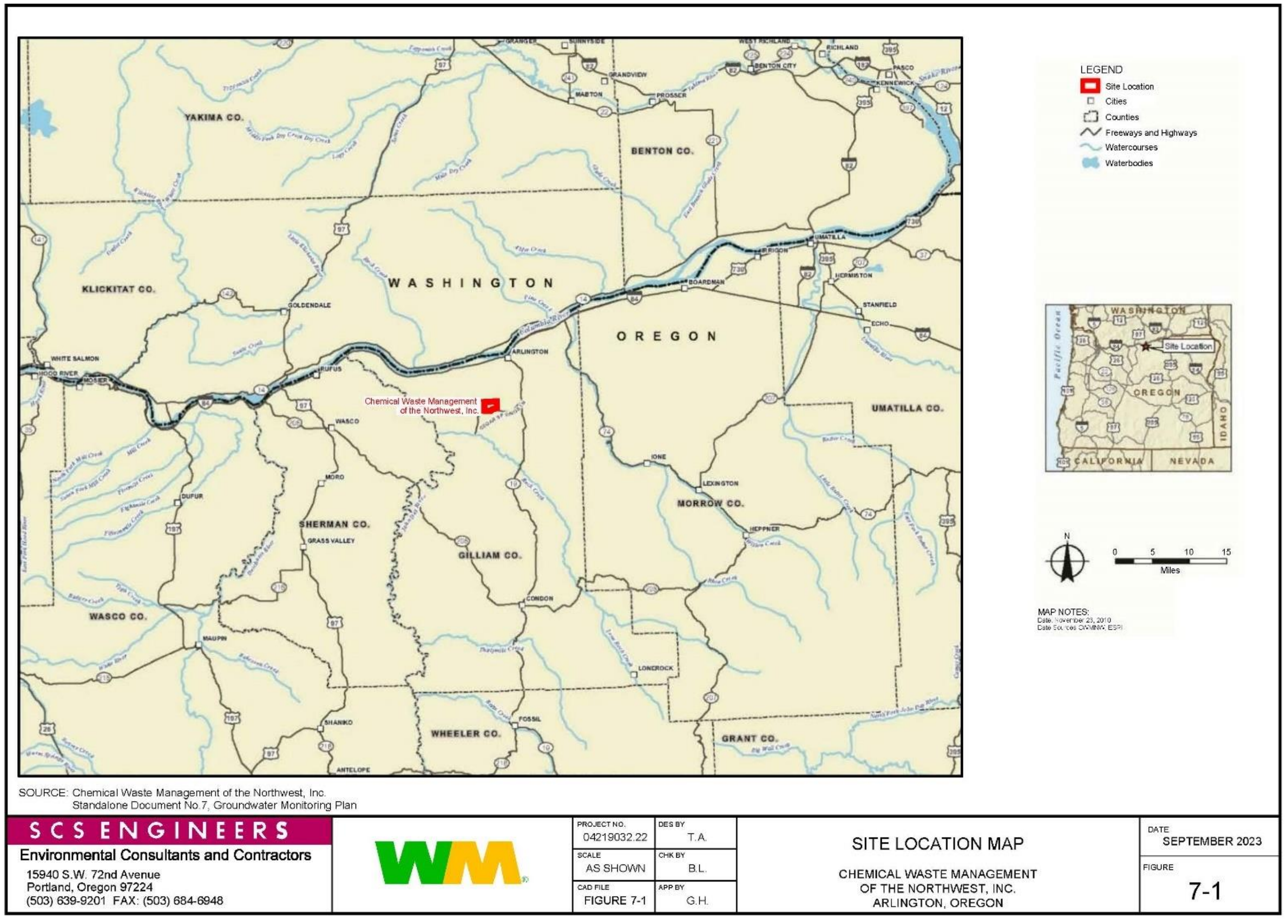
The References section lists the technical and regulatory documents cited in this Plan.

Appendices A through C present supporting field forms, sampling methodology development, an inventory of the current piezometers and monitoring wells and the long-term optimized monitoring wells and piezometer network.

1.21.3 Federal and State-Specific Context

The detection and compliance monitoring efforts outlined in this Plan will be performed to verify attainment of performance objectives for the siteFacility, at appropriate points of compliance, in accordance with the Code of Federal Regulations (CFR), *Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities* (and its revisions), initially promulgated on July 26, 1982 in 40 CFR Part 264 Subpart F (40 CFR §264.90 through 40 CFR §264.101). The regulations include requirements for the location, design, and installation of groundwater monitoring systems and set standards for groundwater sampling and analysis.

RCRA Part BThe Permit No. ORD 089 452 353 (Permit) was jointly issued for the site by the United States Environmental Protection Agency (EPA), the Oregon Environmental Quality Commission, and the Oregon Department of Environmental Quality (DEQ) on March 11, 1988, and reissued on August 10, 2006. Subsequent to issuance of the Permit in 1988, DEQ became fully authorized to administer the Permit.


LEGEND
Site Location
Cities
Counties
Freeways and Highways
Watercourses
Waterbodies
WASHINGTON
OREGON
YAKIMA CO.
BENTON CO.
KLICKITAT CO.
UMATILLA CO.
MORROW CO.
SHERMAN CO.
GILLIAM CO.
WASCO CO.
WHEELER CO.
GRANT CO.
Chemical Waste Management of the Northwest, Inc.
Miles
SOURCE: Chemical Waste Management of the Northwest, Inc.
Standalone Document No.7, Groundwater Monitoring Plan
SCS ENGINEERS
Environmental Consultants and Contractors
15940 S.W. 72nd Avenue
Portland, Oregon 97224
(503) 639-9201 FAX: (503) 684-6948
PROJECT NO. 04219032.22
DES BY T.A.
SCALE AS SHOWN
CHK BY B.L.
CAD FILE FIGURE 7-1
APP BY G.H.
SITE LOCATION MAP
CHEMICAL WASTE MANAGEMENT
OF THE NORTHWEST, INC.
ARLINGTON, OREGON
DATE SEPTEMBER 2023
FIGURE
7-1

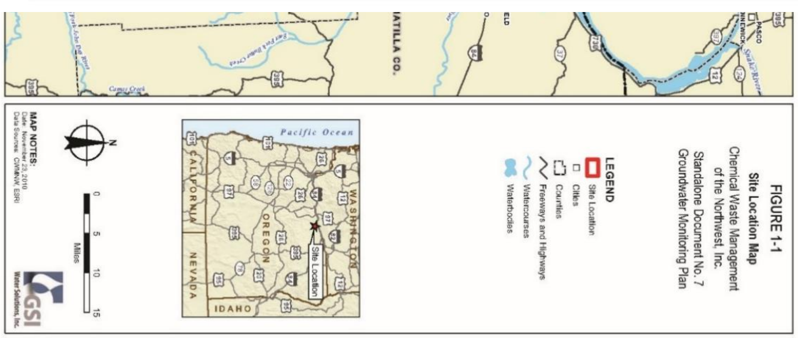
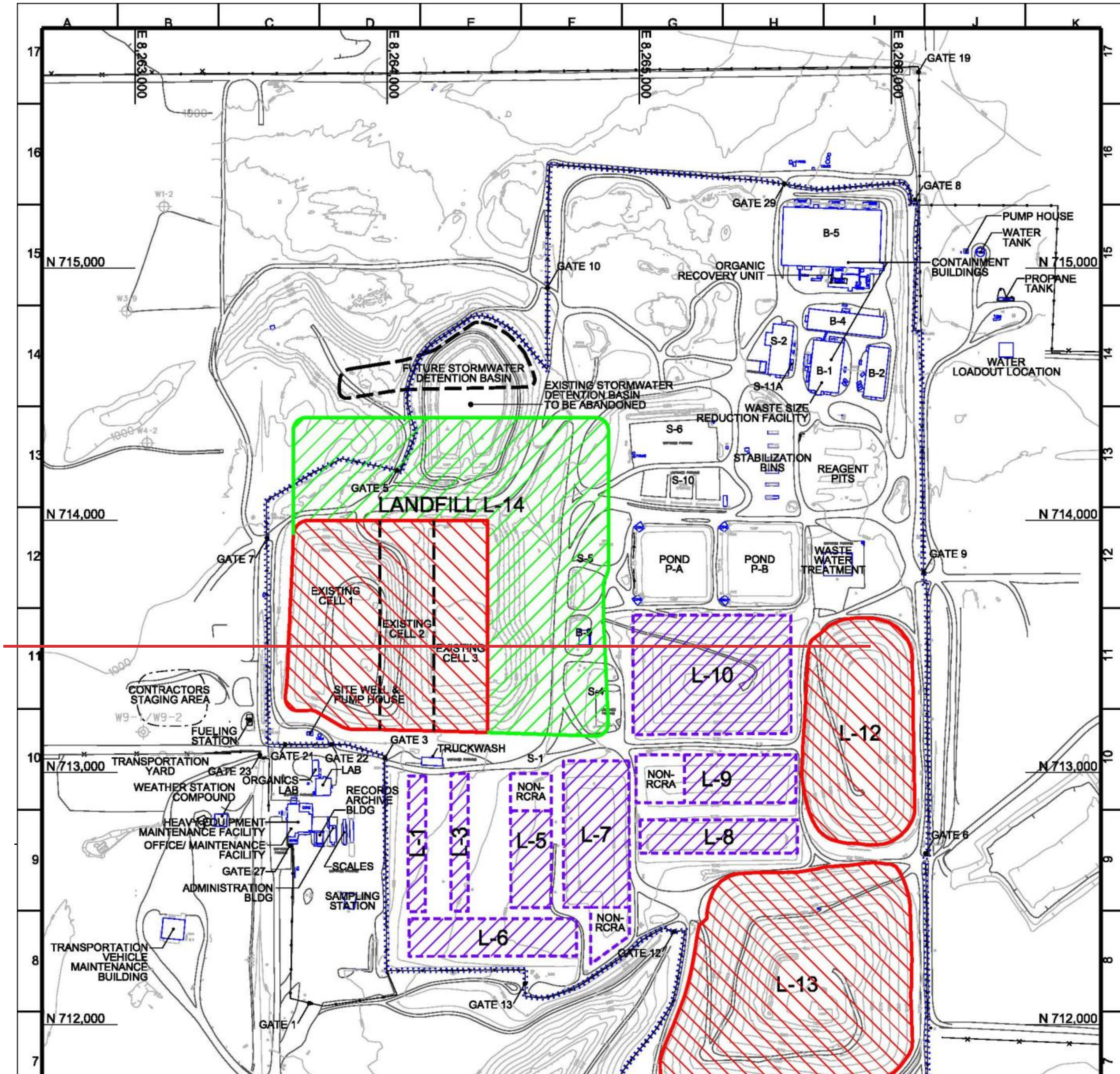


FIGURE 1-1
Site Location Map
Chemical Waste Management
of the Northwest, Inc.
Standalone Document No. 7
Groundwater Monitoring Plan
LEGEND
Site Location
Cities
Counties
Freeways and Highways
Watercourses
Waterbodies
MAP NOTES:
Miles

Figure 17-1 Site Location Map


LANDFILL L-14
FUTURE STORMWATER DETENTION BASIN
EXISTING STORMWATER DETENTION BASIN TO BE ABANDONED
EXISTING CELL 1
EXISTING CELL 2
EXISTING CELL 3
SITE WELL & PUMP HOUSE
L-10
L-12
L-13
L-9
L-8
L-7
L-6
L-5
L-3
L-1
NON-RCRA
POND P-A
POND P-B
WASTE WATER TREATMENT
B-5
B-4
B-1
B-2
S-2
S-11A
S-6
S-10
S-5
S-4
S-1
ORGANIC RECOVERY UNIT
CONTAINMENT BUILDINGS
PUMP HOUSE
WATER TANK
PROPANE TANK
WATER LOADOUT LOCATION
WASTE SIZE REDUCTION FACILITY
STABILIZATION BINS
REAGENT PITS
GATE 19
GATE 8
GATE 29
GATE 10
GATE 5
GATE 7
GATE 9
GATE 3
GATE 21
GATE 22
GATE 23
GATE 27
GATE 6
GATE 12
GATE 13
GATE 1
TRUCKWASH
CONTRACTORS STAGING AREA
FUELING STATION
TRANSPORTATION YARD
WEATHER STATION COMPOUND
ORGANICS LAB
LAB
RECORDS ARCHIVE BLDG
HEAVY EQUIPMENT MAINTENANCE FACILITY
OFFICE/ MAINTENANCE FACILITY
ADMINISTRATION BLDG
SCALES
SAMPLING STATION
TRANSPORTATION VEHICLE MAINTENANCE BUILDING
N 715,000
N 714,000
N 713,000
N 712,000
E 8,263,000
E 8,264,000
E 8,265,000
E 8,266,000

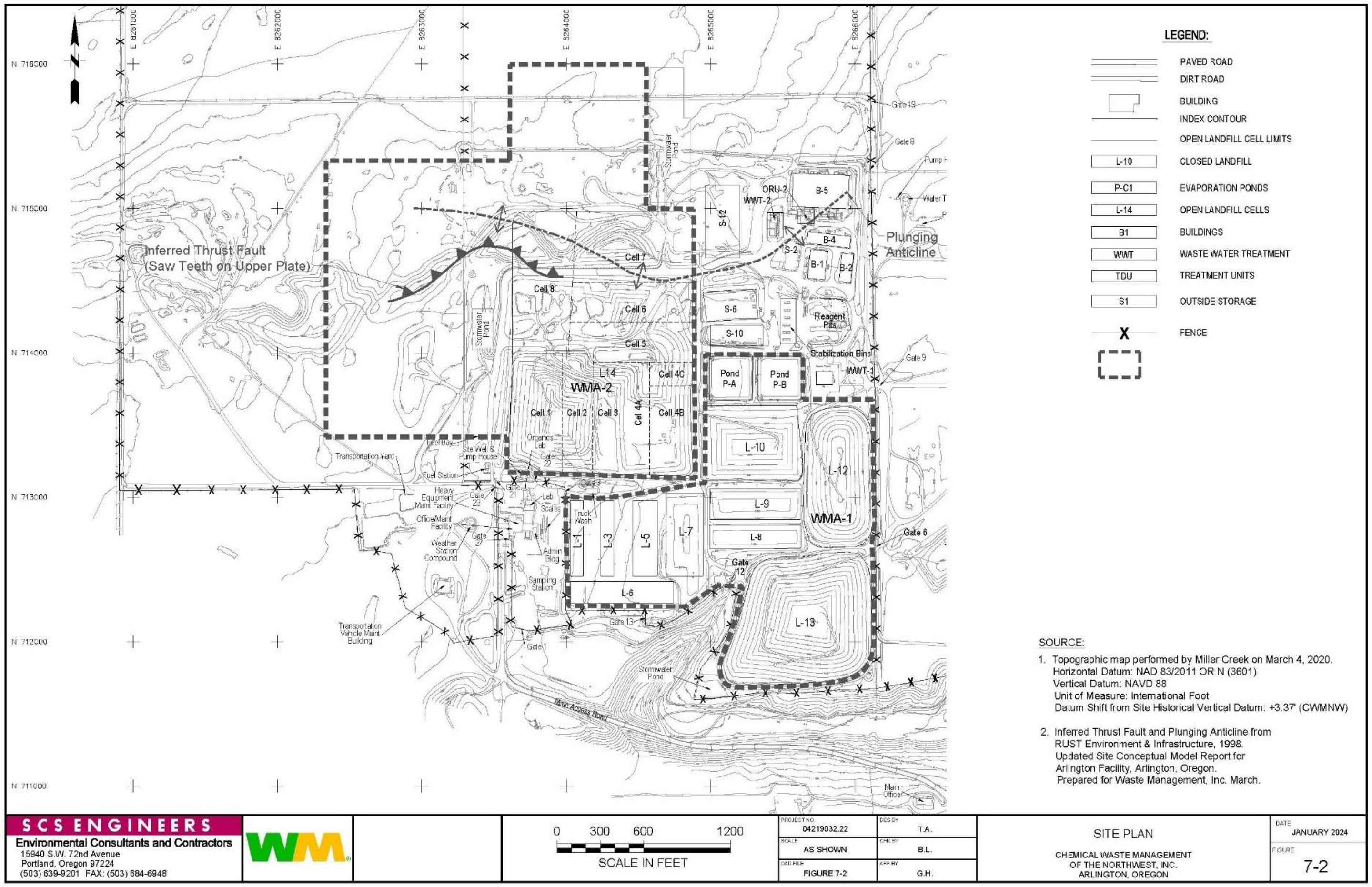


Figure ~~1~~7-2 Site Plan

2 HYDROGEOLOGIC SETTING

As required by 40 CFR §264, a groundwater monitoring system has been designed for Facility landfills and surface impoundments. The groundwater monitoring system designed for the Facility monitors the Selah Member of the Ellensburg Formation (Selah), which contains the uppermost saturated zone beneath the Facility.

The Selah consists of a heterogeneous clayey to sandy siltstone, interlayered with thin to thick, discontinuous sands and clays. The Selah underlies the more permeable sands and gravels of the Alkali Canyon Formation and overlies the Priest Rapids Member of the Wanapum Basalt. (PRB). Potentiometric surfaces within the saturated Selah are spatially variable, due to the low permeability nature of the siltstonefine-grained sediments.

For monitoring purposes,The Alkali Canyon Formation occurs from the surface to depths of approximately 100 feet below ground surface (ft-bgs). The underlying Selah occurs at a depth of approximately 100 ft-bgs and ranges in thickness from approximately 115 to 160 feet beneath the upland plateau where the active area of the CWM facility is located. The lowest 20 to 70 feet of the Selah contains the uppermost saturated zone beneath the facility. Groundwater in the Selah occurs under unconfined to semi-confined conditions at depths generally ranging from 130 to 200 ft-bgs in the upland plateau area. The Priest Rapids Member of the Wanapum Basalt underlies the Selah and occurs at depths of approximately 250 to greater than 325 ft-bgs. Brecciated interflow zones within the Priest Rapids Basalt (PRB) are locally saturated but have low water-yielding capacity due to limited permeability and the compartmentalized character of the saturated zones (CH2M HILL, 2006).

The saturated thickness of the Selah Member has been divided into Upper Level (Level 1) and Lower Level (Level 2) intervals to providefor groundwater samples from the upper (Level 1) and the lower (Level 2) portions of the Selah's saturated thickness.monitoring. Groundwater recharge and flow in the Selah are structurally controlled by an anticline located northin the northern part of the Facility and the Selah's stratigraphic layers and the underlying PRB's structural dip, which is gently toward the southeast. South of the anticline, groundwater in the Level 1 and Level 2 water-bearing zones generally flows toward the southeast (see Figures 7-7A and 7-7B) at a gradient of approximately 0.01015 to 0.03035 foot/foot (ft/ft), and rates of between 0.177 and 56.9 feet per year (ft/yr). Discharge of groundwater occurs predominately through evapotranspiration where the Selah is exposed along the northern bluff of Alkali Canyon within the southern boundary of the Facility (see Figure 7-2).

A more detailed discussion of the Facility hydrogeology can be found in the following documents:

- *Geologic and Hydrogeologic Site Characterization Report, Part B Permit Application*, prepared for Chem-Security Systems, Inc. by Dames and Moore, dated April 1987;
- *Draft Final RCRA Facility Investigation Report for Landfill Units L-9 and L-10*, prepared for Waste Management, Inc. (Arlington, Oregon) by CH2M HILL and Rust Environment and Infrastructure, Inc., dated May 20, 1996;
- *Hydrogeologic Investigation and Engineering Design Report for Landfill L-14, Arlington, Oregon*, prepared for Waste Management, Inc. by Rust Environment and Infrastructure Inc., dated February 1998April 1998a;

- *Updated Site Conceptual Model Report,* prepared for Waste Management, Inc. (Arlington, Oregon) by Rust Environment and Infrastructure, Inc., dated March 1998April 1998b;
- *Agency Review Draft: Analysis of Potential Water Movement from the Selah Member to the Columbia River Basalt Group*, prepared for Waste Management, Inc. by CH2M HILL, dated August 2006; and
- *Updated Hydrogeologic Conceptual Site Model Report,* prepared for Waste Management, Inc. by CH2M HILL, June 2007 (CH2M HILL, 2007a)).

3 GROUNDWATER MONITORING PROGRAM

This section describes the following:

- The groundwater monitoring well network; :
- The constituents to be analyzed for in groundwater samples submitted to the laboratory; the sampling schedule; :
- The program for inspecting monitoring wells and piezometers;:
- The abandonment and decommissioning procedures: and
- The sampling schedule and frequency for monitoring wells under each regulatory program (RCRA and TSCA).

As further described in the sections below, the monitoring network is comprised of two phases: (1) Phase 1 (Phase 1 Monitoring Well Network) section below and (2) long-term optimized (Long Term Optimization of the Groundwater Network) section below. The Phase 1 monitoring network is the current program until the long-term optimized network is established. Facility development, well abandonments/decommissioning, and well installations will dictate when the monitoring network transitions from Phase 1 to the long-term optimized program, and this transition may occur in phases across the Facility.

3.1 Phase 1 Monitoring Well Network

The monitoring program has been developed in accordance with 40 CFR 264 Subpart F and in conjunction with extensive discussions with DEQ and EPA Region X. As agreed upon by these agencies and CWM, the siteFacility is monitored along POCsthe point-of-compliance (POC) that are located along the downgradient side of threethe WMAs, two of which (WMA-1 and WMA-3) are composed of several regulated units. Figure 7-3 1 depicts the WMAs, their associated POCs, and associated monitoring wells. for WMA-1 and WMA-2.

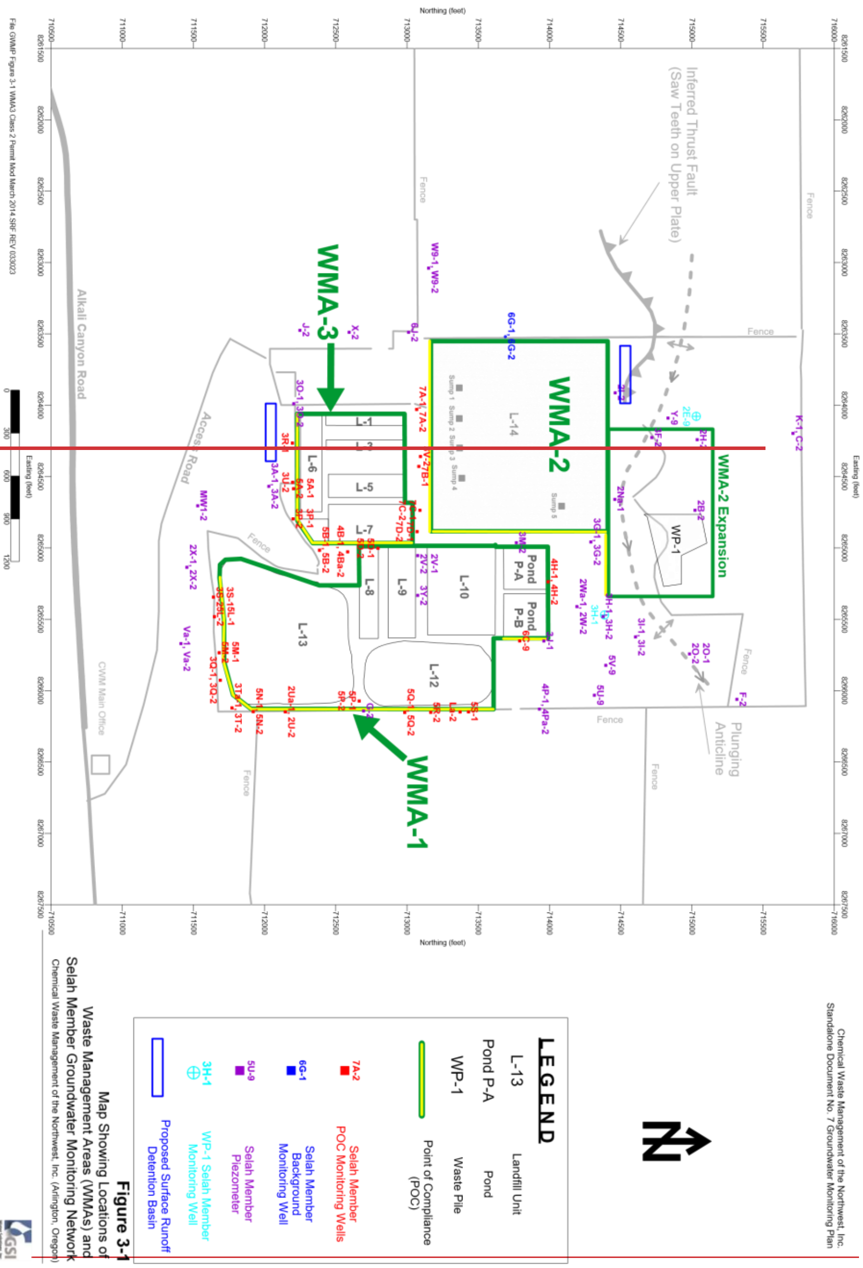
3.1 Monitoring Well Network

Existing and proposed groundwater monitoring Groundwater wells comprising the monitoring well network at the Facility areis designed and maintained to: 1) obtain groundwater samples representative of Level 1 and Level 2 of the Selah aquifer at each point of compliance; and 2) provide an effective means of detection in the event of a release of contaminants from the WMAs. The existing network of piezometers and monitoring wells is also designed and maintained for the purpose of determining water levelgroundwater elevations.

Groundwater The Phase 1 monitoring network at the Facility is monitored by 4616 monitoring wells: two upgradient wells and 44 wells completed in the shallow Selah (Level 1) that are distributed along the three POCs.POC boundaries hydraulically downgradient of WMA-1 and WMA-2 (see Figure 7-3). Table 3-17-11 identifies the relationship between the monitoring wells and the waste management areas.WMA-1 and WMA-2. Details regarding the design of the groundwater detection monitoring program are described by Golder Associates (1987b), CH2M HILL (2004, 2005a, and 2007b) and GSI (2011). It should be noted that additional POC wells may be required if groundwater flow direction(s) north of WMA-2 is not consistent with historical groundwater flow directions in the shallow Selah (i.e., Level 1) due to the potential influence of geologic structure(s) on groundwater flow in this portion of the facility.

PiezometerPiezometers and select POC locations for measuring groundwater elevations are specified in Table 37-2. Figure 3-17-4 shows the locations of the wells where groundwater elevation measurements will be taken (monitoring wells and piezometers). Water level measurements may alsovoluntarily be taken at other existing wells and piezometers not listed in Tables 7-3-1 and 3-27-4/7-5 (not Permit-required) to supplement the water level information that is provided by the wells listed in those tables. The list of wells provided in Table 37-2 is current as of late 2011the date of this Plan and also reflects the outcome of the ongoing well decommissioning activitiesprogram. This list maywill change over time, with DEQ approval, as well network maintenance activities (such as abandoning, decommissioning and, where necessary, replacing wells in the monitoring network) occurs in association with ongoing site maintenance activities and the decommissioning and replacement program outlined in the Well Abandonment Activities section below.

In addition to the monitoring well and piezometer network, a number of otherthere are additional piezometers / wells are maintained at the Facility for possible future uses, such as landfill expansiondevelopment, optional supplemental downgradient and background monitoring, and corrective action, if it becomes necessary. Wells and piezometers at the Facility are inspected annually while water level measurements are being collected and also during purging activities.


WMA-1
WMA-2
WMA-3
WMA-2 Expansion
Inferred Thrust Fault (Saw Teeth on Upper Plate)
Plunging Anticline
Alkali Canyon Road
Access Road
L-14
L-13
L-12
L-10
WP-1
Pond P-A
Pond P-B
LEGEND
L-13 Landfill Unit
Pond P-A Pond
WP-1 Waste Pile
Point of Compliance (POC)
7A-2 Selah Member POC Monitoring Wells
6G-1 Selah Member Background Monitoring Well
5U-9 Selah Member Piezometer
3H-1 WP-1 Selah Member Monitoring Well
Proposed Surface Runoff Detention Basin
Chemical Waste Management of the Northwest, Inc. Standalone Document No. 7 Groundwater Monitoring Plan
Figure 3-1
Map Showing Locations of Waste Management Areas (WMAs) and Selah Member Groundwater Monitoring Network
Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)

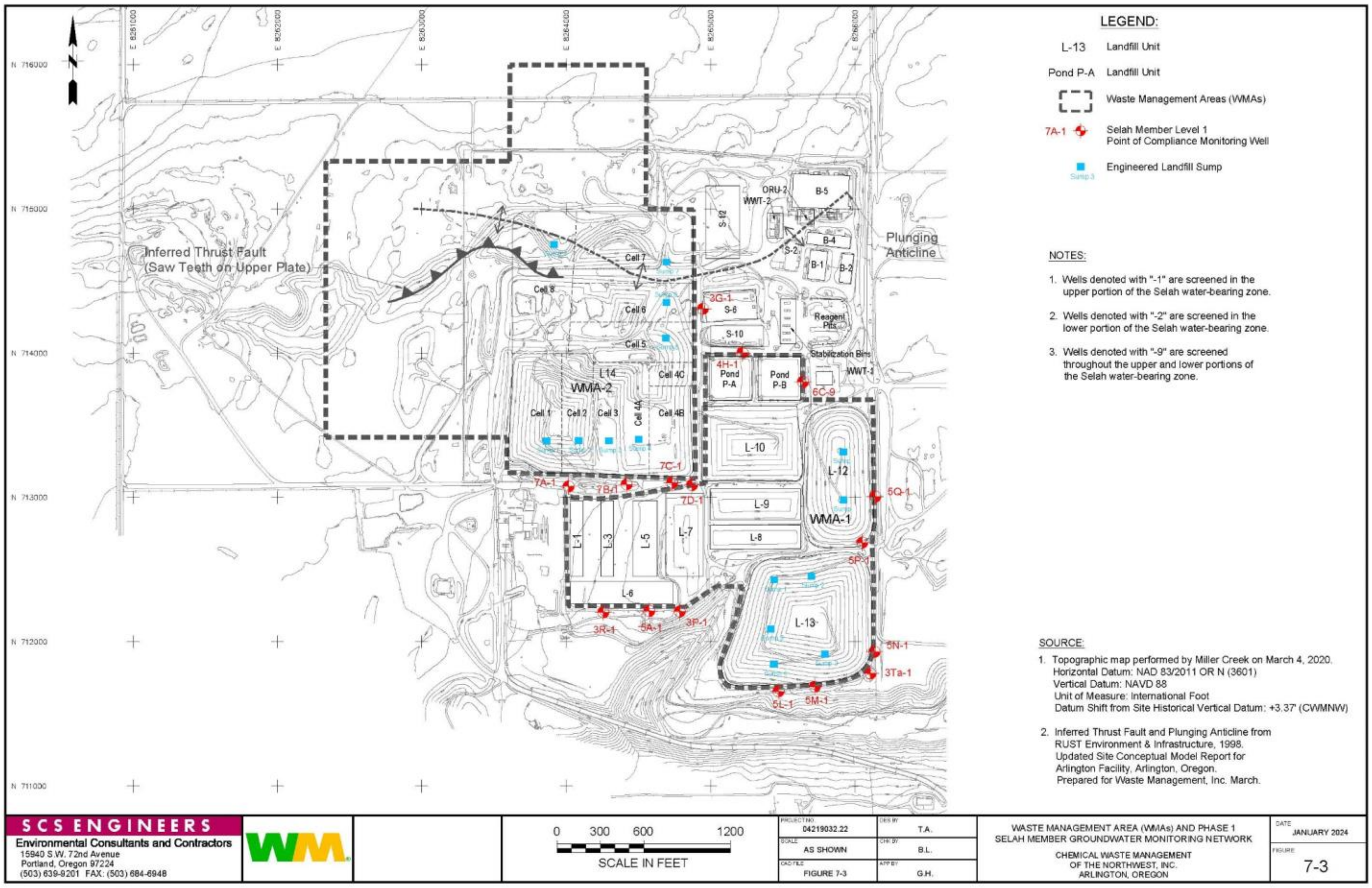


Figure 7-3- Locations of WMAs and Phase 1 Selah Member Groundwater Monitoring Wells ‡ Rev. 10

Table 3-1
Monitoring Well Specifications and Sampling Frequency
Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)

Compliance Point ID	Location [a] Northing	Easting	TOC Elevation (ft) [a,b]	Stickup (ft) [c]	Extn. (ft) [d]	Well Dia. (in)	Well Screen [c] top (ft)	base (ft)	lgth (ft)	Filter Interval [c] top (ft)	base (ft)	lgth (ft)	TSCA Monitoring Frequency	RCRA Monitoring Frequency	Post-Closure Monitoring	Purging and Sampling Method [e]
WASTE MANAGEMENT AREA WMA-1: (Landfill Units L-8, L-9, L-10, L-12, L-13, and Ponds A and B)																
La-2	713381.50	8266135.26	1037.74	2.76	0.00	4	238.01	247.98	9.97	236.96	248.36	11.40	Annual	Annual	Yes	Low-Flow
2Ua-1	712177.95	8266132.81	1031.35	2.30	0.00	4	220.20	235.20	15.00	219.30	235.20	15.90	Annual	Semiannual	Yes	Low-Flow
2U-2	712168.56	8266133.98	1031.39	2.23	0.00	4	260.70	265.70	5.00	255.23	267.23	12.00	Annual	Annual	Yes	Low-Flow
3Q-1	711698.46	8265913.55	1027.28	2.70	0.00	4	222.70	232.70	10.00	221.50	234.40	12.90	Annual	Semiannual	Yes	Low-Flow
3Q-2	711688.30	8265906.11	1027.36	2.39	0.00	4	248.20	258.20	10.00	247.19	259.19	12.00	Annual	Annual	Yes	Low-Flow
3S-1	711649.76	8265331.87	991.57	3.34	0.00	4	183.30	193.30	10.00	182.04	194.34	12.30	Annual	Semiannual	Yes	Low-Flow
3S-2	711649.23	8265321.93	990.86	2.68	0.00	4	206.70	216.70	10.00	205.48	218.08	12.60	Annual	Annual	Yes	Low-Flow
3Ta-1	711780.29	8266107.22	1029.90	2.73	0.00	4	228.30	238.30	10.00	227.13	238.33	11.20	Annual	Semiannual	Yes	Low-Flow
3T-2	711783.71	8266096.76	1030.26	2.53	0.00	4	255.30	265.30	10.00	253.73	265.93	12.20	Annual	Annual	Yes	Low-Flow
5L-1	711656.26	8265469.62	1002.39	3.11	0.00	4	186.71	211.71	25.00	183.11	211.71	28.60	Annual	Semiannual	Yes	Low-Flow
5L-2	711655.68	8265480.21	1002.85	2.84	0.00	4	219.24	225.84	6.60	215.84	225.84	10.00	Annual	Annual	Yes	Low-Flow
5M-1	711689.41	8265721.27	1021.38	2.52	0.00	4	209.02	229.02	20.00	205.52	229.02	23.50	Annual	Semiannual	Yes	Low-Flow
5M-2	711666.90	8265719.81	1019.23	2.52	0.00	4	235.52	245.52	10.00	231.52	246.02	14.50	Annual	Annual	Yes	Low-Flow
5N-1	711930.00	8266133.57	1031.72	2.61	0.00	4	215.11	235.11	20.00	212.11	235.11	23.00	Annual	Semiannual	Yes	Low-Flow
5N-2	711938.57	8266133.94	1031.92	2.88	0.00	4	244.88	260.88	16.00	240.38	260.88	20.50	Annual	Annual	Yes	Low-Flow
5P-1	712673.72	8266058.07	1025.56	2.74	0.00	4	202.70	227.37	24.67	199.44	227.74	28.30	Annual	Semiannual	Yes	Low-Flow
~~5P-2~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~4~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~	~~Annual~~	~~Annual~~	Yes	Low-Flow
5Q-1	712993.93	8266138.51	1035.65	2.82	0.00	4	214.52	231.95	17.43	210.82	232.32	21.50	Annual	Semiannual	Yes	Low-Flow
5Q-2	713005.74	8266139.00	1035.81	2.70	0.00	4	234.96	252.23	17.27	234.10	252.60	18.50	Annual	Annual	Yes	Low-Flow
5R-2	713176.05	8266137.78	1037.33	2.54	0.00	4	243.24	253.04	9.80	242.24	253.44	11.20	Annual	Annual	Yes	Low-Flow
5S-1	713441.01	8266134.93	1037.87	2.72	0.00	4	203.91	223.85	19.94	202.22	224.22	22.00	Annual	Semiannual	Yes	Low-Flow
6C-9	713801.00	8265639.00	1018.66	2.90	0.00	4	187.90	207.90	20.00	184.80	207.90	23.10	Not Required	Semiannual	No	Low-Flow
WASTE MANAGEMENT AREA WMA-2: Landfill Unit L-14/Waste Pile 1																
2E-9	714386.23	8265469.54	1017.96	1.40	0.00	4	174.30	194.30	10.00	168.30	197.40	29.10	Not Required	Semiannual	No	Low-Flow
3H-1	715031.29	8264077.75	1016.62	2.97	0.00	4	176.07	186.07	10.00	175.07	186.27	11.20	Not Required	Semiannual	No	Low-Flow
3V-2	713104.08	8264349.12	1001.26	2.46	0.00	4	188.50	198.50	10.00	187.36	199.56	12.20	Annual	Annual	Yes	Low-Flow
4H-1	714000.38	8265225.41	1021.43	2.40	0.00	4	184.50	199.50	15.00	183.40	200.90	17.50	Annual	Semiannual	Yes	Low-Flow
4H-2	713999.85	8265214.75	1021.29	2.30	0.00	4	194.80	204.80	10.00	191.40	203.60	12.20	Annual	Annual	Yes	Low-Flow
6G-1	713699.93	8263511.11	995.70	2.96	0.00	4	141.76	151.76	10.00	135.96	154.96	19.00	Annual	Semiannual	Yes	Low-Flow
6G-2	713709.26	8263512.21	995.87	3.13	0.00	4	165.13	170.13	5.00	162.13	173.63	11.50	Annual	Semiannual	Yes	Low-Flow
7A-1	713074.69	8264024.77	990.47	2.09	0.00	4	142.19	152.19	10.00	140.09	153.49	13.40	Annual	Semiannual	Yes	Low-Flow
7A-2	713076.45	8264015.95	990.11	2.03	0.00	4	183.13	193.13	10.00	181.03	194.33	13.30	Annual	Annual	Yes	Low-Flow
7B-1	713091.15	8264418.42	1003.59	2.07	0.00	4	158.77	168.77	10.00	155.77	168.87	13.10	Annual	Semiannual	Yes	Low-Flow
7C-1	713103.22	8264745.81	1018.13	2.06	0.00	4	180.26	190.26	10.00	178.16	191.16	13.00	Annual	Semiannual	Yes	Low-Flow
7C-2	713102.18	8264733.31	1017.38	2.09	0.00	4	205.79	215.79	10.00	202.29	216.19	13.90	Annual	Annual	Yes	Low-Flow
7D-1	713082.85	8264881.81	1022.18	1.93	0.00	4	188.23	198.23	10.00	186.13	200.03	13.90	Annual	Semiannual	Yes	Low-Flow
7D-2	713085.44	8264870.37	1021.72	2.04	0.00	4	206.44	216.44	10.00	204.04	217.24	13.20	Annual	Annual	Yes	Low-Flow
WASTE MANAGEMENT AREA WMA-3: (Landfill Units L-1, L-3, L-5, L-6, L-7)																
3P-1	712209.42	8264785.41	1025.84	2.75	16.25	4	207.10	222.10	15.00	206.00	223.10	17.10	Not Required	Semiannual	Yes	Low-Flow
3P-2	712211.09	8264794.07	1026.65	1.12	17.34	4	233.16	243.16	10.00	231.96	244.46	12.50	Not Required	Annual	Yes	Low-Flow
3R-1	712204.75	8264256.48	1010.90	1.82	0.00	4	172.80	182.80	10.00	171.82	182.82	11.00	Not Required	Semiannual	Yes	Low-Flow
3R-2	712204.29	8264266.66	1011.63	2.63	0.00	4	216.00	226.00	10.00	214.13	227.63	13.50	Not Required	Annual	Yes	Low Flow
4B-1	712592.50	8265015.07	1027.88	2.01	11.66	4	203.66	218.66	15.00	202.47	220.17	17.70	Annual	Semiannual	Yes	Low Flow
4Ba-2	712581.78	8265015.06	1028.29	2.26	0.00	5	230.16	240.16	10.00	229.26	241.66	12.40	Annual	Annual	Yes	Low-Flow
5A-1	712212.18	8264574.73	1017.04	2.41	0.00	5	180.96	207.46	26.50	175.49	207.46	31.97	Not Required	Semiannual	Yes	Low-Flow
5A-2	712190.02	8264593.74	1017.41	2.40	0.00	5	221.37	231.56	10.19	217.55	232.75	15.20	Not Required	Annual	Yes	Low-Flow
5B-1	712395.18	8265005.39	1026.36	2.33	0.00	5	190.11	213.47	23.36	184.06	214.23	30.17	Annual	Semiannual	Yes	Low-Flow
5B-2	712321.89	8264986.63	1026.72	2.88	0.00	5	237.43	244.09	6.66	233.03	244.55	11.52	Annual	Annual	Yes	Low-Flow
5D-1	712805.20	8264991.15	1033.34	2.49	3.50	5	196.81	217.13	20.32	189.72	217.13	27.41	Annual	Semiannual	Yes	Low-Flow
5D-2	712825.81	8264994.29	1033.38	2.59	3.31	5	226.90	241.40	14.50	223.88	242.02	18.14	Annual	Annual	Yes	Low-Flow
7E-2	712210.50	8264497.20	1013.94	1.99	0.00	4	211.70	221.70	10.00	211.10	223.00	13.00	Not Required	Annual[f]	Yes	Low Flow

Notes

[a] RUST 1994 Survey; Oregon State Plan, North American Datum 1983-1991
[b] Top of casing elevation relative to mean sea level
[c] Depth below top of casing (calculated from boring logs)
[d] Casing extensions by CWM NW
(calculated from original TOC elevation - 1993 Tenneson resurvey)
[e] All pumps are Well Wizard bladder pumps.
[f] Quarterly for first 2 years of monitoring, then annual
[g] Quarterly for first 2 years of monitoring, then semiannual

~~TABLE 3-1~~Network

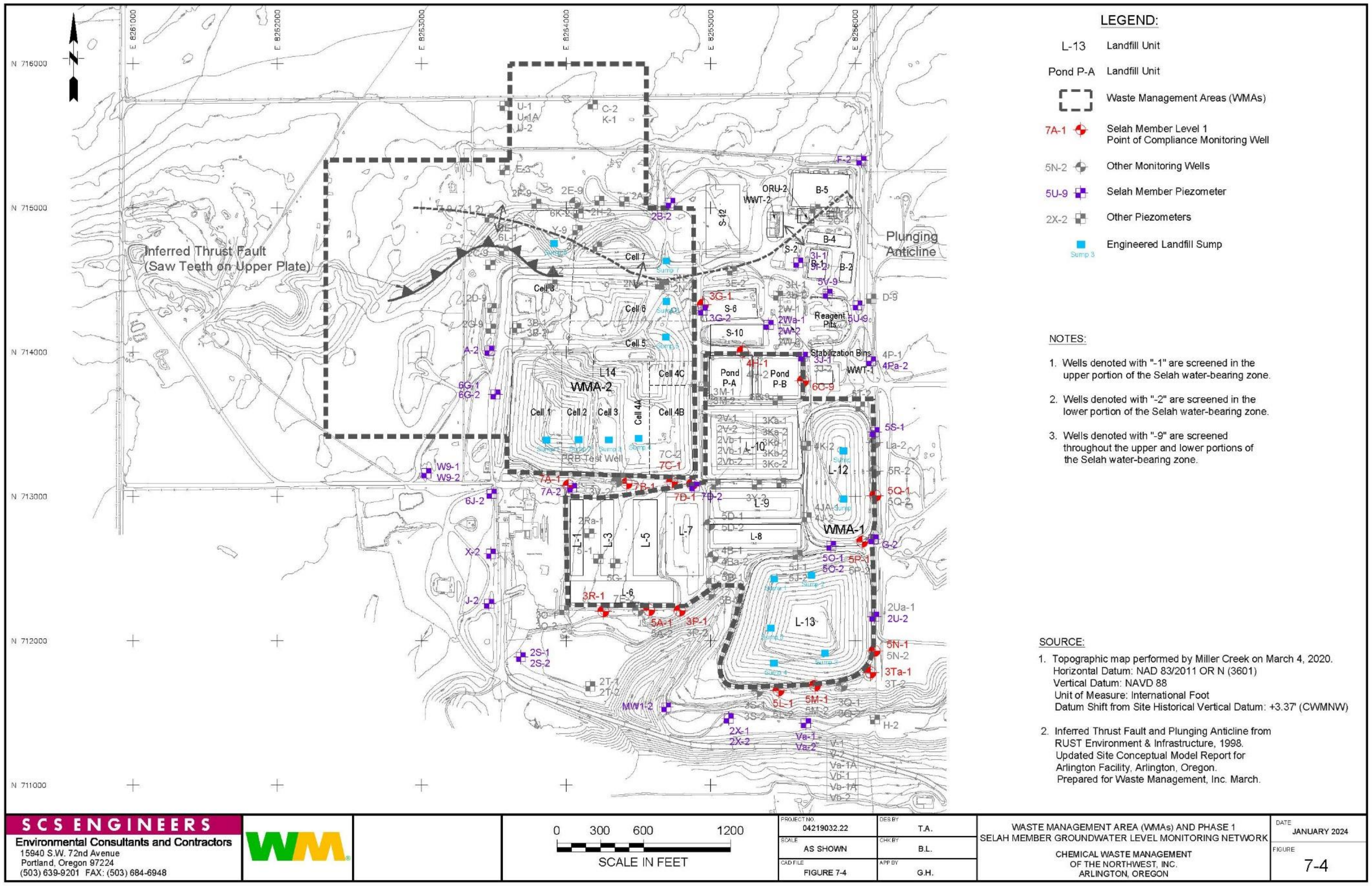

Inferred Thrust Fault
(Saw Teeth on Upper Plate)
Plunging
Anticline
WMA-2
WMA-1
LEGEND:
L-13 Landfill Unit
Pond P-A Landfill Unit
Waste Management Areas (WMAs)
7A-1 Selah Member Level 1
Point of Compliance Monitoring Well
5N-2 Other Monitoring Wells
5U-9 Selah Member Piezometer
2X-2 Other Piezometers
Engineered Landfill Sump
NOTES:
1. Wells denoted with "-1" are screened in the upper portion of the Selah water-bearing zone.
2. Wells denoted with "-2" are screened in the lower portion of the Selah water-bearing zone.
3. Wells denoted with "-9" are screened throughout the upper and lower portions of the Selah water-bearing zone.
SOURCE:
1. Topographic map performed by Miller Creek on March 4, 2020.
Horizontal Datum: NAD 83/2011 OR N (3601)
Vertical Datum: NAVD 88
Unit of Measure: International Foot
Datum Shift from Site Historical Vertical Datum: +3.37' (CWMNW)
2. Inferred Thrust Fault and Plunging Anticline from RUST Environment & Infrastructure, 1998.
Updated Site Conceptual Model Report for Arlington Facility, Arlington, Oregon.
Prepared for Waste Management, Inc. March.
SCS ENGINEERS
Environmental Consultants and Contractors
15940 S.W. 72nd Avenue
Portland, Oregon 97224
(503) 639-9201 FAX: (503) 684-6948
0 300 600 1200
SCALE IN FEET
PROJECT NO. 04219032.22
DES BY T.A.
SCALE AS SHOWN
CHK BY B.L.
CAD FILE FIGURE 7-4
APP BY G.H.
WASTE MANAGEMENT AREA (WMAs) AND PHASE 1
SELAH MEMBER GROUNDWATER LEVEL MONITORING NETWORK
CHEMICAL WASTE MANAGEMENT
OF THE NORTHWEST, INC.
ARLINGTON, OREGON
DATE JANUARY 2024
FIGURE 7-4

Figure 7-4 Locations of WMAs and Monitoring Wells Specifications and Sampling Frequency ‡ Rev. 10Locations for Groundwater Level Monitoring

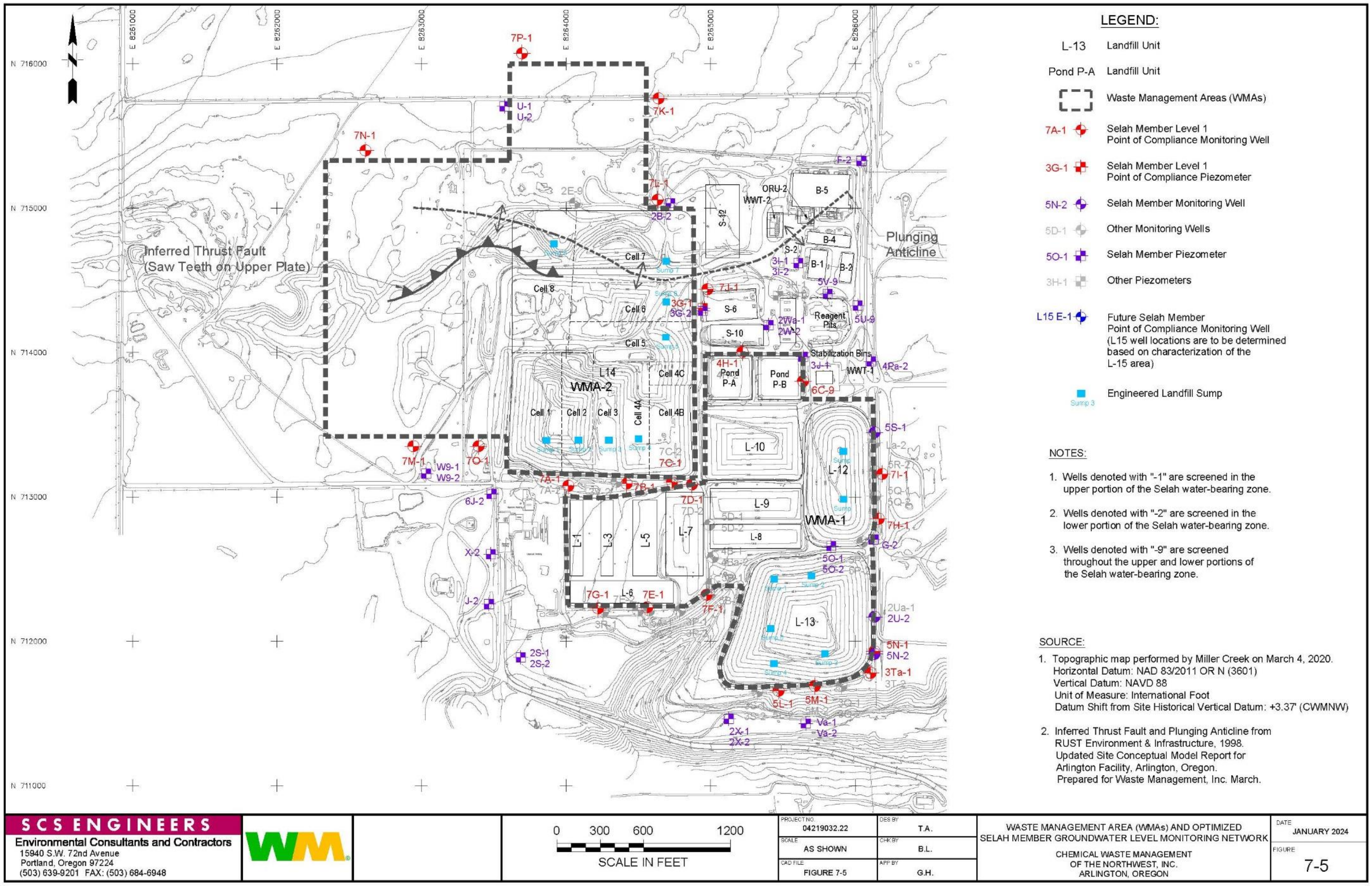


Figure 7-5 Locations of WMAs and Optimized Selah Member Groundwater Monitoring Network

Piezometer Locations

Table 3-2 Rev. 107-1

Phase 1 Monitoring Well Program Specifications and Sampling Frequency
Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)

Monitoring Well ID / Compliance Point ID	Location [a] Northing	Location [a] Easting	TOC Elevation [b] (ft) [a,b]	Aquifer Level Stickup (ft) [c]	Extn. (ft) [d]	Well Dia. (in)	Well Screen [c] top (ft)	Well Screen [c] base (ft)	Well Screen [c] lgth (ft)	Filter Interval [c] top (ft)	Filter Interval [c] base (ft)	Filter Interval [c] lgth (ft)	TSCA Monitoring Frequency
K-1 WASTE MANAGEMENT AREA WMA-1: (Landfill Units L-1, L-3, L-5, L-6, L-7, L-8, L-9, L-10, L-12, L-13, and Ponds A and B)									8264181.39 715712.29		1003.48	1	
Va 3P-1	8265656.61 712209.42	711421.45 8264785.41	794.30 1025.84	12.75	16.25	4	207.10	222.10	15.00	206.00	223.10	17.10	Not Required
W9 3R-1	8263032.76 712204.75	8264256.48	1010.90	7131601.82	998.14 0.00	14	172.80	182.80	10.00	171.82	182.82	11.00	Not Required
2Na 3Ta-1	711780.29 8264648.44	8266107.22 714468.80	983.89 1029.90	12.73	0.00	4	228.30	238.30	10.00	227.13	238.33	11.20	Annual
2O 5A-1	712212.18 8265728.62	8264574.73	1017.04	2.41	0.00	5	180.96	207.46	26.50	714993 175.49	1032.92 207.46	131.97	Not Required
5L-1	711656.26	8265469.62	1002.39	3.11	0.00	4	186.71	211.71	25.00	183.11	211.71	28.60	Annual
2Vb 5M-1	711689.41 8265035.42	713079 8265721.27	1021.38	2.52	0.00	4	209.02	229.02	20.00	205.52	229.02	1030.23.50	1Annual
2Wa 5N-1	8265398.81 711930.00	714177.28 8266133.57	1020.03 1031.72	12.61	0.00	4	215.11	235.11	20.00	212.11	235.11	23.00	Annual
2X 5P-1	712673.72	8266058.07	1025.56	2.74	0.00	4	202.70	227.37	24.67	199.44	227.74	8265124.28.30	711463.38 Annual 9
5Q-1	712993.93	8266138.51	1035.65	2.82	0.00	4	214.52	231.95	17.43	210.82	232.32	21.50	Annual
6C-9	713801.00	8265639.00	1018.66	2.90	0.00	4	187.90	207.90	20.00	184.80	207.90	23.10	Not Required
WASTE MANAGEMENT AREA WMA-2: Landfill Unit L-14													
3G-1	714300.29	8264947.14 714300.29	1018.55	1.85	0	4	173.20	183.20	10.00	169.50	183.00	13.50	Annual
3I 4H-1	8265611.36 714000.38	714614.22 8265225.41	1009.28 1021.43	12.40	0.00	4	184.50	199.50	15.00	183.40	200.90	17.50	Annual
7A-1	713074.69	8264024.77	990.47	2.09	0.00	4	142.19	152.19	10.00	140.09	153.49	13.40	Annual
7B-1	713091.15	8264418.42	1003.59	2.07	0.00	4	158.77	168.77	10.00	155.77	168.87	13.10	Annual
3J-1 8265639.57 7C-1	713970.21 713103.22	8264745.81	1019 1018.13	12.06	0.00	4	180.26	190.26	10.00	178.16	191.16	13.00	Annual
3O-1	8263981.08	712213.62	995.17	1									
4P-1	8266115.12	713939.21	1038.98	1									
Y-9 7D-1 8264080.53	713082.85 714843.09	8264881.81	1022.0318	1 & 2.93	0.00	4	188.23	198.23	10.00	186.13	200.03	13.90	Annual
5U-9 Notes: 8266018.49	714324.88	1037.76	1 & 2										
5V-9	8265809.45	714405.50	1029.43	1 & 2									

[a] RUST 1994 Survey; Oregon State Plane SystemNorth, North American Datum 1983-1991

[b] Top of casing elevation relative in feet to mean sea levelhistorical site datum (RUST, 1998)

[c] Depth below top of casing (calculated from boring logs)

[d] Casing extensions by CWM (calculated from original TOC elevation - 1993 Tenneson resurvey)

[e] Semiannual sampling will occur during the spring and fall sampling events every year; annual sampling will occur during the fall sampling event every year

[f] All pumps are Well Wizard bladder pumps

[g] Quarterly for first year of monitoring, then semiannual

[h] Wells associated with L-14will be monitored for PFAS (Table

TABLE3-2 Piezometer Location ±Rev 10TABLE 7-1 Monitoring Wells Specifications and Sampling Frequency

Table 3-2 (cont.) ‡ Rev. 10

PiezometerTable 7-2
Phase 1 Groundwater Elevation Monitoring Locations
Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)

Monitoring Well Location ID	Location [a]		TOC Elevation [b]	Aquifer Selah Member Level [c]	Location Use[d]
	Easting	Northing			
Va-1	8265656.61	711421.45	794.30	1	P
W9-1	8263032.76	713160.82	998.14	1	P
2S-1	8263689.85	711892.18	983.37	1	P
2Wa-1	8265398.81	714177.28	1020.03	1	P
2X-1	8265124.28	711463.38	915.94	1	P
3G-1	8264947.14	714300.29	1018.55	1	MW
3I-1	8265611.36	714614.22	1009.28	1	P
3J-1	8265639.57	713970.21	1019.13	1	P
3P-1	8264785.41	712209.42	1025.84	1	MW
3R-1	8264256.48	712204.75	1010.90	1	MW
3Ta-1	8266107.22	711780.29	1029.90	1	MW
4H-1	8265225.41	714000.38	1021.43	1	MW
5A-1	8264574.73	712212.18	1017.04	1	MW
5S-1	8266134.93	713441.01	1037.87	1	P
5L-1	8265469.62	711656.26	1002.39	1	MW
5M-1	8265721.27	711689.41	1021.38	1	MW
5N-1	8266133.57	711930.00	1031.72	1	MW
5O-1	8265838.39	712657.32	1019.98	1	P
5P-1	8266058.07	712673.72	1025.56	1	MW
5Q-1	8266138.51	712993.93	1035.65	1	MW
6G-1	8263511.11	713699.93	995.70	1	P
7A-1	8264024.77	713074.69	990.47	1	MW
7B-1	8264418.42	713091.15	1003.59	1	MW
7C-1	8264745.81	713103.22	1018.13	1	MW
7D-1	8264881.81	713082.85	1022.18	1	MW
5U-9C-2	8266018.498264187.28	715720714324.88	1004.451037.76	1 & 2	P
5V-9	8265809.45	714405.50	1029.43	1 & 2	P
6C-9	8265639.00	713801.00	1018.66	1 & 2	MW
A-2	8263468.42	714011.17	1009.54	2	P
F-2	8266048.01	715326.01	1048.33	2	P
G-2	8266127.52	712704.47	1024.31	2	P
J-2	8263466.71	712256.68	982.91	2	P
MW1-2	8264694.07	711538.99	930.84	2	P
Va-2	8265662.57	711426.10	912.25	2	P

W9-2	8263032.76	713160.82	998.19	2	P
X-2	8263481.30	712602.86	986.73	2	P
2B-2	8264724.72	715031.73	1008.12	2	P
2H2S-2	8263689.858264231.15	711892.18715047.16	1012.10983.37	2	P
2I2U-2	8266133.988263904.32	712168.56714471.40	970.871031.39	2	P
2O-2	8265728.62	714993.49	1032.95	2	
2V-2	8265043.25	713084.27	1030.23	2	
2W-2	8265398.63	714203.30	1018.37	2	P
2X-2	8265124.28	711463.38	915.95	2	P
3F-2	8264216.78	714729.31	966.97	2	
3G-2	8264947.47	714310.85	1018.31	2	P
3H-2	8265470.60	714396.38	1016.34	2	
3I-2	8265610.45	714624.44	1010.16	2	P
3M-2	8264951.31	713766.84	1022.7	2	
3O-2	8263990.41	712212.00	995.45	2	
3Y-2	8265321.14	713083.81	1030.44	2	
4Pa-2	8266105.95	713933.82	1037.78	2	P
5O-2	8265827.97	712658.15	1019.83	2	P
6G-2	8263511.11	713699.93	995.87	2	P
6J-2	8263481.40	713020.15	994.58	2	P
[a] Rust Survey 1994; Oregon State Plane System; North American Datum 1983-19917A-2	8264015.95	713076.45	990.11	2	P
7D-2	8264870.37	713085.44	1021.72	2	P

Notes:
[a] Coordinates in Oregon State Plane North.
[b] Top of casing (TOC) elevation relative to mean seahistorical site datum (RUST, 1998)
[c] The Selah Member has been divided into the upper level (Level 1) and lower level (Level 2)
[d] P = piezometer; MW = Monitoring Well; Location use is consistent with Appendix C

TABLE 7-2 Piezometer Location

3.2 Wells and Piezometers

Each monitoring well and piezometer at the Facility that is used for monitoring water quality or water levels is completed within the Selah Member. Each monitoring well and piezometer has been given a numeric suffix designation based on the stratigraphic location of the well screen as follows:

"-1" Level 1 - screened at the water table within the Selah;:

"-2" Level 2 - screened at the base of the saturated zone within the Selah;: and

"-9" Level 9 - screened across the entire saturated zone within the Selah.:

Level 3 and 4 wells have been installed in the Priest Rapids Basalt underlying the Selah uppermost aquifer and are not part of the groundwater quality monitoring program for the facility. Two additional types of nomenclature designations have been used to further define the placement of monitoring wells and piezometers at the Facility:

- Monitoring wells and piezometers generally have been installed sequentially in groups or series. The first series of monitoring wells and piezometers installed at the Facility are labeled A through Z (although not inclusively). The second series is labeled 2A through 2Y and so on. The most recent monitoring wells are in the 7th series (wells 7A through 7D) for Landfill L-14. and 7E which replaced POC well 3U-2 downgradient of L-6. Because of a number of well abandonments and the sequencing of various well installation programs, not all alphanumeric characters are used at the site.
- Other lower case letter designations have been added, such as a "-1a" for monitoring a thin "grey clay" interval zone that is present at some locations, and an "a-" for a replacement well. For example:
  - Well 4Ja-1 was completed in Selah Level 1 as a replacement for well 4J-1
  - Well 6G-1a was completed in the grey zone clay and is not a replacement well

Drilling and well construction methods have evolved over the nearly threefour decades of well installation and monitoring at the site. The key documents describing well installation methods are:

- Dames and Moore, 19871987a. *Geologic and Hydrogeologic Site Characterization Report: RCRA Part B Permit Application*. Describes early well installation activities at the site leading up to the original RCRA Part B permit application.
- Golder Associates, 1987. *Ground-Water Monitoring Well Installation Program at Arlington Hazardous Waste Facility, Arlington, Oregon*. Describes installation of eight wells (5D, 5E, 5A-1, 5A-2, 5B-1, 5B-2, 5C-1, and 5C-2) and repair of two wells (3P-1 and 3P-2). Wells 5A-1, 5A-2, 5B-1, 5B-2, 5C-1, 5C-2, 5D, and 5E were subsequently renamed in 1988 to 5L-1, 5L-2, 5M-1, 5M-2, 5N-1, 5N-2, 5U-9, and 5V-9, respectively.
- Golder Associates, 1988. *Installation of Ground Water Monitoring Wells 6B and 6C, Arlington, Oregon.*
- Golder Associates, 1990. *Installation of Eight Groundwater Monitoring Wells at the Arlington Hazardous Waste Facility, Arlington, Oregon: November 2, 1989 to January 9, 1990*. Describes installation of eight wells (5A-1, 5A-2, 5B-1, 5B-2, 5D-1, 5D-2, 5J-1, and 5J-2).

- Sirrine Environmental Consultants, Inc., 1990. *Draft Report: Ground-Water Monitoring Well Installation Program at Arlington Hazardous Waste Facility, Arlington, Oregon*. Describes installation of seven wells (5E-1, 5F-1, 5G-1, 5H-1, 5I-1, 5K-1, and 6F-1,2 [later renamed 6F-9]).
- Shannon and Wilson, Inc., 1990. *Groundwater Monitoring Well 2Ra-1 at the Arlington Treatment, Storage, Disposal Facility, Arlington, Oregon*. Describes replacement of well 2R-1 with well 2Ra-1.
- SEC Donohue, 1992. *Supplemental Ground-Water Monitoring Well Installation Report.* Describes installation of wells 2Qa-2 and 2Na-1 and abandonment of wells 2Q-2 and 2N-1.
- CH2M HILL and RUST Environment & Infrastructure, Inc., 1996. *Draft Final RCRA Facility Investigation Report for Landfill Units L-9 and L-10.* Describes installation of wells 3Kb-1 and 3Kc-2.
- RUST EnvironmentEnvironnent & Infrastructure, Inc., FebruaryApril 1998. *Hydrogeologic Investigation and Engineering Design Report for Landfill L-14, Arlington, Oregon*. Describes installation of ten wells (6G-1, 6G-1A, 6G-2, 6H-2, 6I-1, 6I-1A, 6I-2, 6J-2, 6K-2, and 6L-1).
- CH2M HILL, 2005b. *Landfill Unit L-14 Well Installation Report.* Describes installation of seven wells (7A-1, 7A-2, 7B-1, 7C-1, 7C-2, 7D-1, and 7D-2).
- From 2004 through 2008, CWM conducted a three-phase study of Aspect, 2018. *Detection Monitoring Well 7E-2 Installation Report, Agency Review Draft.* Describes the structural integrityinstallation of each monitoring well, piezometer, and other 7E-2 to replace monitoring well 3U-2

3.3 Well/Piezometer Construction Activities

Monitoring wells at the (detection or compliance if needed) and piezometers for future installation at the Facility. Based on the study's findings (presented shall continue to be constructed as approved by CH2M HILL [2005c, 2005d,the DEQ. A well installation work plan shall be submitted to the DEQ, for approval, for all new and 2008]), CWM and EPA agreed to decommission 24replacement monitoring wells and piezometers at the Facility during . Any replacement monitoring wells or piezometers that may be required shall be installed as close as appropriate and practical to the well or piezometer being taken out of service. If a well or piezometer is to be replaced, it shall be done so within 90 calendar days of being taken out of service, unless the DEQ approves a 5-yearlonger period beginning in 2008. Additional wells have been decommissioned periodically since 2000 because of cell expansion at Landfill Unit L-14. of time. Within 60 calendar days of the installation of a new well or piezometer, a revised version of Table 7-1, 7-2, Figure 7-3, Figure 7-4 and Appendix B and C, as appropriate, shall be provided to the DEQ. Changes in the number, location, depth, or design of wells are subject to permit modification as described in 40 CFR 270.42.

Monitoring wells and piezometers that may be proposed for future installation at the site will continue to be constructed in accordance with WM's Typical Well/Piezometer Construction Standards (Appendix B) and Well Development Standards (Appendix C) and in accordance with Permit Conditions X.B.(2) and XI.B.(2). These standards are consistent with ASTM Standards and are designed to maintain the integrity of the borehole, minimize introduction of extraneous materials, prevent entry of surface water into the annular space of the well, minimize maintenance needs, and provide representative groundwater samples from the monitored groundwater interval. Future monitoring wells / piezometers will also continue to be constructed and installed in accordance with Oregon Water Resources Department Rules OAR 690-240 for monitoring well construction.

Detailed well construction information for the Facility's existing groundwater monitoring wells is presented in Table 3-1.

All new monitoring wells (detection or compliance if needed) and piezometers shall be designed and installed in accordance with Oregon Water Resources Department (OWRD) Oregon Administrative Rule (OAR) 690-240, or a variance will be obtained from the OWRD in situations which warrant deviation from the prescribed standards. All reasonable precautions shall be taken during drilling to prevent cross contamination between hydrogeologic water bearing zones.

3.23.4 Sample Analysis

Specific chemical constituents to be analyzed in the laboratory under the detection monitoring program are those listed in Table X-3 of the 7-11.RCRA Part B Permit. This group of constituents has been selected for analysis as requested by DEQ and EPA because many compounds within this group are synthetic, have high detectability (that is, readily detectable at low reporting limits using standard laboratory methods) and are mobile in the environment, which makes them generally good indicators of a potential release from a WMA. Specific chemical constituents to be analyzed in the laboratory under the compliance monitoring program will be determined in accordance with section X.D.4.d.i and X.D.4.e of the RCRA Part B Permit.(i.e. Appendix IX) is described below.

3.33.5 Groundwater Sampling Schedule

In accordance with the Permit, Detection monitoring willshall be conducted semi-annually at the monitoring locationsfrequency specified in Table 37-1. The timing of the semiannual RCRA groundwater sampling willshall occur in the spring (March through May) and the fall (September through November) of each year. Annual TSCA sampling shall be performed in the fall (September through November) of each year. For all semiannual, annual, and all other groundwater sampling events, the Facility will notify the Department within five (5) working days prior to the sampling event.

When needed, background monitoring (i.e., initial data collection) for a new monitoring well included in the detection monitoring program will typically be performed on a quarterly basis (i.e. winter, spring, summer and fall) for a minimum of four quarters.

3.43.6 Well and Piezometer Inspection Program

Wells and piezometers willshall be inspected annually while water level measurements are being collected and also during purging activities. The condition of each well and its surrounding area willshall be observed and recorded on a well condition inspection form. Information to be documented as part of each well inspection event is discussed in detail in the *Groundwater, Surface Water, and Leachate Sampling Guide* (Appendix A). The inspection form is contained in Appendix D. For piezometers, which are used for water level measurements rather than for water quality monitoring, each entry in the inspection form will be filled out with the exception of the sample equipment type, turbidity, and well yieldA.

All monitoring wells will be sounded every five years to evaluate if silt is accumulating in the wells.

Monitoring wells will be maintained in good working order, making necessary repairs in a timely manner so that sampling activities do not occur outside the sampling timeframes. The Facility will maintain an adequate supply (or have readily available) of replacement parts and repair equipment so that each groundwater sampling event is not unreasonably delayed. Monitoring wells included in the detection and compliance monitoring programs shall be sounded to measure the total depth every five years during a semiannual event to evaluate if silt is accumulating in the wells and as a measure to evaluate borehole integrity. The last depth-sounding event were performed in 2017 and 2022, and the next depth sounding event will be scheduled for 2027 and beyond.

3.53.7 Well Abandonment Activities ‡ Rev. 4

Out of service wells willshall be abandoned and decommissioned as outlined on Table 3-3. The procedures for in general accordance with OAR 690-240 and the current DEQ guidance. Written approval for well or piezometer decommissioning will be obtained from the DEQ prior to completing the work. Within 60 calendar days of completing the work, decommissioning documentation as required by OAR 690-240 and revisions to Table 7-1, Table 7-2, Figure 7-3, Figure 7-4/7-5 and Appendix B and C, as appropriate, will be provided to DEQ.

By written direction from the Department, the Facility will decommission monitoring wells that do not meet the requirements in 40 CFR 264.97(c). In determining whether to issue the written direction, the Department will consider the Facility's evaluation, if any, for whether the monitoring well meets the requirements in 40 CFR 264.97(c).

3.8 Long Term Optimization of the Groundwater Monitoring Network

Many of the existing Facility monitoring wells and piezometers are were installed prior to the development of well construction standards and guidance documents for monitoring well construction by the OWRD and DEQ. While best practices at the time of program development were observed, the existing wells installed and abandoned locations prior to 1996 have developed integrity concerns over time due to the age of the wells and the original construction of the wells. It has been demonstrated that the occurrence of VOCs in groundwater at the Facility is related to the well integrity issues allowing downward vertical migration of soil vapor through the compromised wells, piezometers and aged abandoned boreholes, wells and piezometers at the site (RUST and CH2M HILL, 1996; CH2M HILL, 2008; GSI, 2013, EA Engineering, 2016, SCS, 2020b and SCS 2021).

Additionally, the understanding of the geologic and hydrogeologic conditions at the site has also advanced from additional characterization work, groundwater modeling, recent well installations performed as part of development of the Facility and investigations related to well integrity issues. Specifically it has been demonstrated that: 1) the limited vertical hydraulic conductivity will prevent downward migration to the deeper Selah water bearing zone and to the deeper confined regional Columbia River Basalt aquifers; 2) the limited aerial extent of the Selah Member which is exposed on the Facility property by Alkali Canyon would preclude offsite impacts to ecological and human health receptors hydraulically downgradient of the Facility; and 3) previous evaluation of the beneficial use of the Selah groundwater by CH2M Hill indicates that there are no beneficial uses for Selah groundwater near the facility (2007a).

Given this information, the long-term optimized program incorporates future planned Facility development and more efficiently protects groundwater by doing the following:

- Locating detection monitoring wells at the POC boundary in the uppermost water bearing zone in the Selah hydraulically downgradient of existing and future sump locations in engineered landfills:
- Removing and/or replacing wells in the groundwater monitoring program suspected of well integrity issues, and:
- Designing new wells with a well screen interval that targets the highest yielding portions of the uppermost Selah water bearing zone to improve application of the site-specific purging and sampling methodology developed due to the low-yielding nature of the majority of the existing wells installed prior to 2006.

The long-term optimization program would be performed in a phased approach as the facility develops while continuing to ensure that the Phase 1 groundwater monitoring program for WMA-1 and WMA-2 is effective until the optimization program is completed. The following sections outline the phased approach and implementation of improvements to the current groundwater monitoring program presented in Table 7-3, Table 7-4, Figure 7-6 and Figure 7-4.

3.8.1 Well and Piezometer Abandonment and Decommissioning

To address well integrity concerns, CWM plans a phased approach to abandoning and decommissioning (and in some instances replacing) the ageing detection monitoring wells and piezometers that no longer meet the requirements of a groundwater protection program outlined in the 40 CFR §264 Subpart F.

The 40 CFR §264 Subpart F contains the regulations for groundwater monitoring at permitted hazardous waste land disposal facilities. The 40 CFR §264.97(a) requires that the monitoring program include a sufficient number of wells, screened in the uppermost aquifer that:

- Represent groundwater quality at the POC immediately hydraulically downgradient of the WMA boundary, and:
- Allow for the detection of contamination when hazardous waste or hazardous waste constituents have migrated from the WMA to the uppermost aquifer.

The 40 CFR §264.97(c) requires that wells be cased in a manner that maintains borehole integrity, screened, or perforated and packed with gravel or sand, and the annular space must be sealed above the sampling depth to prevent contamination of samples and the groundwater. CWM has performed multiple investigations that address the well integrity concerns identified at the facility (CH2M HILL, 2005c; CH2M HILL, 2005d; CH2M HILL, 2008; GSI, 2013; EA, 2016; Aspect, 2018).

CWM plans to abandon and decommission a series of wells and piezometers as part of the Facility development and select wells that have identified well integrity issues (Table 7-3). Of the total locations identified for abandonment and decommissioning, some are to accommodate

Facility construction and development and the remaining locations were selected based on the following criteria:

- Proximity to unlined past practice units
- Elevated soil vapor concentrations
- Location relative to WMA boundary (i.e., internal to the WMA)
- Construction date (i.e., prior to 1994)
- History of VOC occurrence
- Previous well integrity evaluation information, specifically physical or geophysical evaluations if available

The abandonment and decommissioning of these wells/piezometers is a more protective approach for maintaining and improving the groundwater monitoring program. 40 CFR §264.97(c) requires that wells be cased in a manner that maintains borehole integrity, screened, or perforated and packed with gravel or sand, and the annular space must be sealed above the sampling depth to prevent contamination of samples and groundwater. The wells/piezometers planned to be abandoned or decommissioned do not meet all of these requirements. The rationale for the abandonment and decommissioning criteria is based on the findings from previous alternative source demonstrations and investigations at the Facility.

The evaluation presented in past investigations has demonstrated that VOC detections is not representative of actual groundwater conditions at the point-of-compliance in the uppermost aquifer as required under 40 CFR § 264.97(a). Consistent with previous findings, the primary source of the VOCs appears to be soil vapor migration through (1) ageing, damaged or insufficient grout seals, and/or ageing or poorly sealed polyvinyl chloride casing of wells/piezometers or (2) previously abandoned boreholes with potentially insufficient grout seals. The preponderance of evidence suggests that the VOCs in groundwater are an artifact of the well installation and construction prior to the development of state regulatory standards for monitoring well construction.

The well decommissioning program will improve the groundwater protection program by removing suspect wells that were constructed prior to development of guidance by the DEQ and OWRD, advancements in well drilling methods and construction and a better understanding of Facility groundwater occurrence and conditions. This program will be performed with the well and piezometer locations of the greatest concern and those in the footprint of Facility development being prioritized for decommissioning first as the Facility is further developed (Table 7-3).

The selected wells will be abandoned and decommissioned in groups presented in Table 7-3; however, CWM may need to adjust the groups and schedule based on Facility development or other considerations to reprioritize the well decommissioning programs. Piezometers and wells not in the current groundwater detection monitoring program will be abandoned by grouting in place after the Part B Permit Renewal approval. Five (3P-1, 3R-1, 5A-1, 5P-1, and 5Q-1) of the Level 1 wells to be abandoned and decommissioned are detection monitoring wells in the Phase 1 groundwater monitoring program that will be replaced (Table 7-4).

The detection monitoring well locations that are in the Phase 1 groundwater monitoring network that are scheduled for replacement will have the new wells installed and sampled for four quarters (background data collection) prior to the abandonment and decommissioning of the detection monitoring wells they are replacing. The schedule may need to be modified to accommodate changes in the site development schedule.

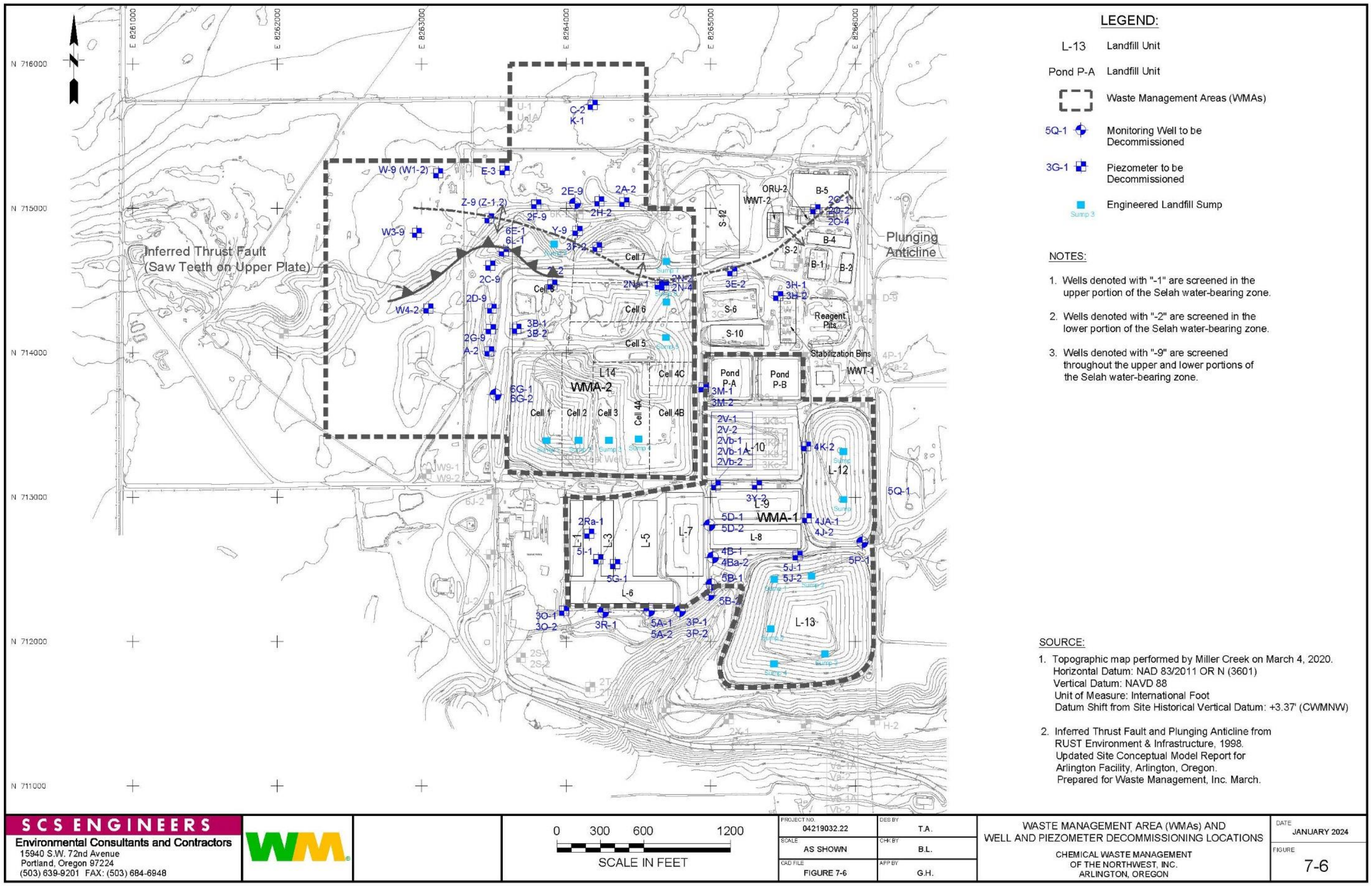


Figure 7-6 Map Showing Locations of WMAs and Well and Piezometer Decommissioning Program

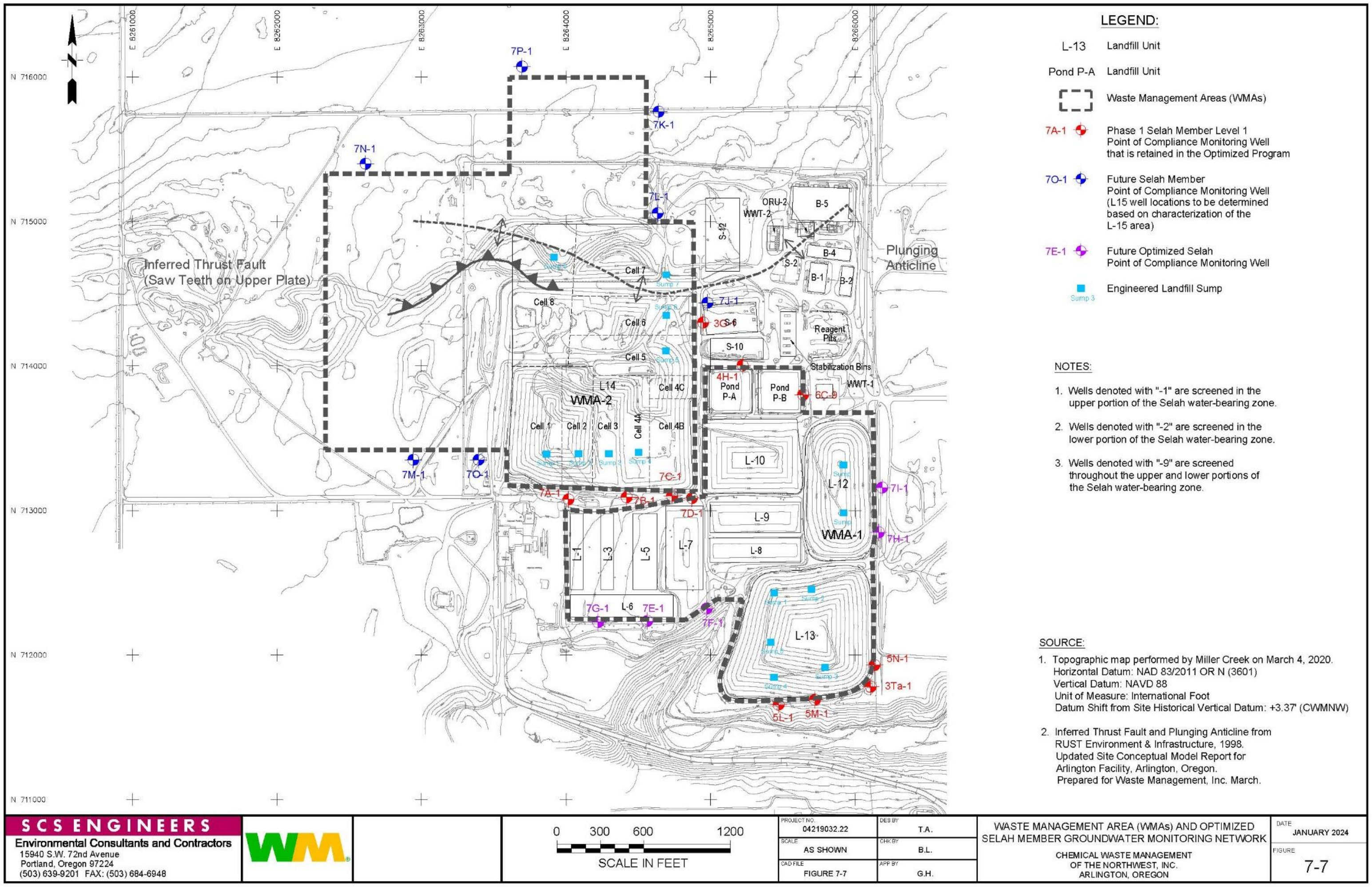
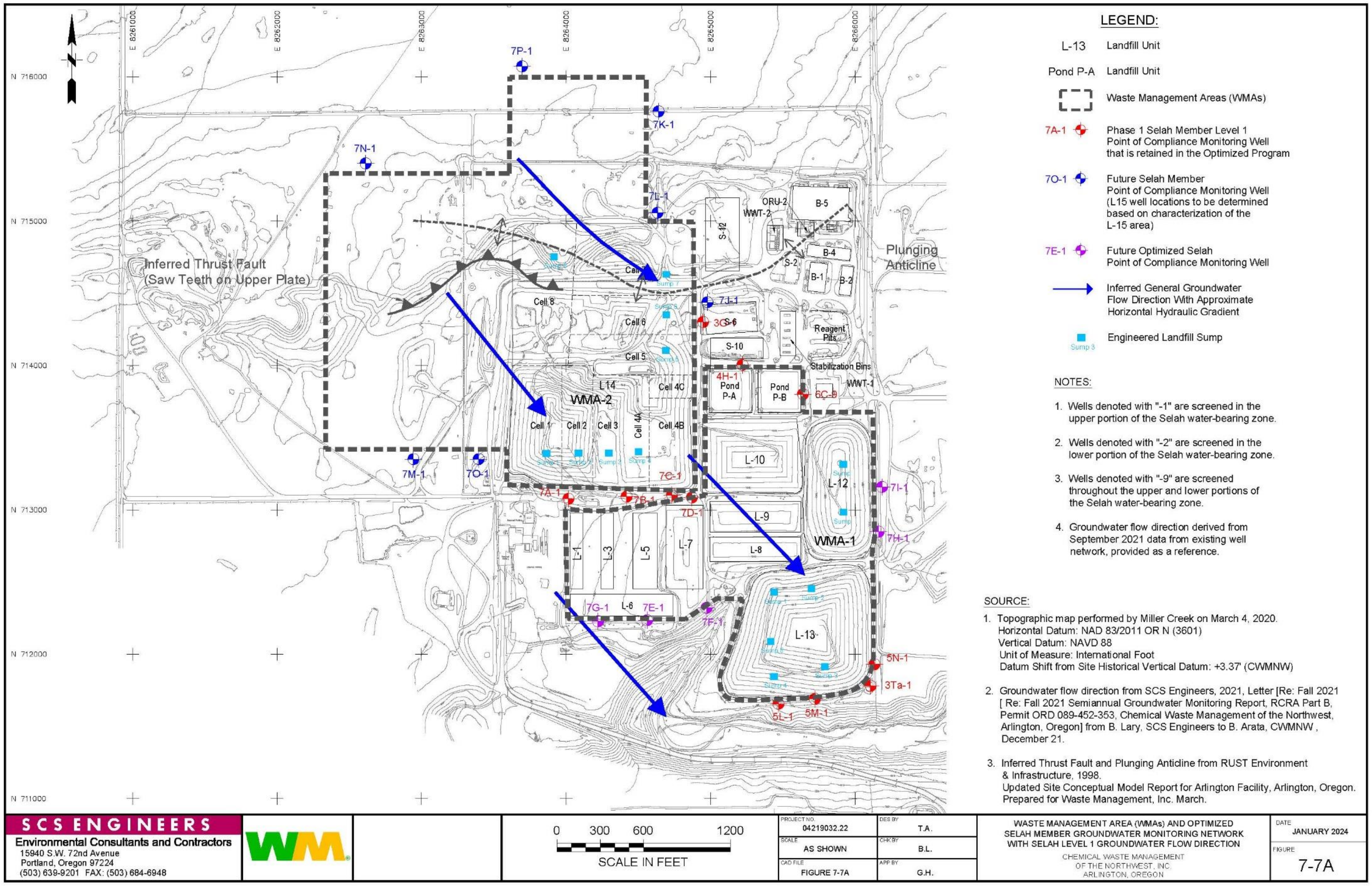


Figure 7-7 Locations of WMAs and Optimized Selah Member Groundwater Monitoring Network



<u>**Figure 7-7A Locations of WMAs and Optimized Selah Member Groundwater Monitoring Network and Level 1 Flow Direction**</u>

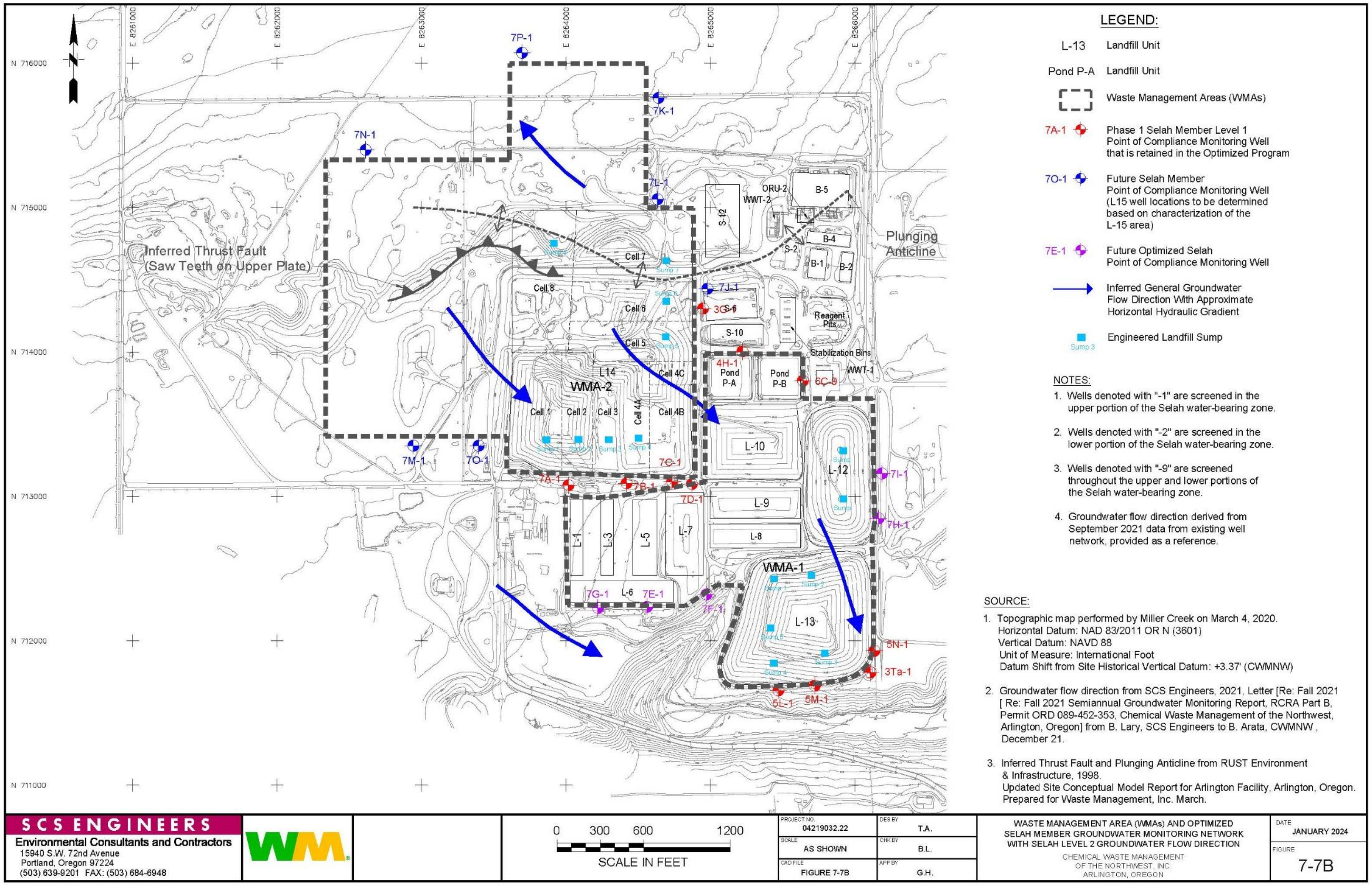


Figure 7-7B Locations of WMAs and Optimized Selah Member Groundwater Monitoring Network and Level 2 Flow Direction

3.8.2 Groundwater Protection Program Optimization

This section outlines the modifications to the groundwater monitoring program during the transition from the Phase 1 program approved as part of the Part B renewal to the optimized groundwater monitoring program. The optimized groundwater monitoring network for all WMAs is shown in Figure 7-7 and summarized in Table 7-4. The site-wide monitoring well and piezometer inventory is shown in Appendix C (Table 7-15).

3.8.3 Detection Monitoring Program Optimization Goals and Summary

Historically, the groundwater protection program at CWM has monitored the upper and lower portion of the Selah water bearing zone (i.e., Level 1 and Level 2) upgradient and downgradient of the WMAs. Previous hydrogeologic characterizations and evaluations of a potential release from the facility identified that the impacts to groundwater would be limited to the uppermost portion of the Selah (CH2M HILL, 2007a, Rust Environmental and Infrastructure, 1998a). More recent vertical and horizontal flow profiling of the Selah using hydrophysical logging methods confirmed that the majority of groundwater flow occurs in the uppermost Selah (Aspect, 2018).

As part of the optimization, the existing Level 1 detection monitoring well locations were evaluated relative to the predominately stable groundwater flow direction in the shallow Selah observed since the site has operated. Based on those observations, CWM will relocate and/or replace five wells (3P-1, 3R-1, 5A-1, 5P-1, and 5Q-1) with new Level 1 POC wells (7E-1 through 7I-1) to be directly hydraulically downgradient of WMA-1 (Table 7-4). The optimized detection monitoring well network locations are shown in Figure 7-7. Replacement detection monitoring well installation will begin after the Part B Permit Renewal or Part B Permit Class III Modification is approved and is summarized in Table 7-4. The schedule may be adjusted based upon site construction and operation activities of the Organics Recovery Unit (ORU) unit or other Facility development activities.

Additionally, the current RCRA detection monitoring program evaluates VOCs for semiannual routine monitoring and PCBs on an annual basis under TSCA. These analytes are anthropogenic and therefore would not be anticipated to occur naturally in groundwater upgradient of the Facility based on historic land uses and hydrogeologic conditions of the Facility. Given this information, the Facility plans to reduce the number of background detection monitoring wells (i.e., upgradient) over time from the Phase 1 program for WMA-1 and WMA-2.

3.8.4 Groundwater Monitoring Program

This section outlines the modifications to the groundwater monitoring program for water level monitoring, the detection monitoring program, and data evaluation as part of the optimization.

3.8.4.1 Water Level Elevation Monitoring

Water levels for piezometers and monitoring wells completed in the Level 1, Level 2 and Level 9 of the Selah for locations listed in Table 7-2 will continue to be monitored on a semiannual basis to evaluate groundwater horizontal and vertical hydraulic gradients, groundwater flow directions, and conditions in the shallow and deeper water-bearing zone. CWM currently monitors additional wells and piezometers completed in Level 1, Level 2 and Level 9 of the Selah and in piezometers completed in Level 3 and Level 4 of the PRB to supplement the list of wells in Table 7-2. The monitoring wells and supplemental piezometers are shown in Figure 7-4.

Groundwater level measurements for each monitoring well are obtained prior to purging the well. In order to minimize the potential for error caused by temporal variations, the Facility shall obtain all water level measurements within as short a time as practicable. On each day that water level measurements are being collected, the barometric pressure shall be recorded and entered into the operating record.

3.8.4.2 Initial Background Data Collection (New or Replacement Wells)

The general groundwater detection monitoring requirements for new or replacement wells under §264.97 allows for the following:

- Determination of groundwater quality at wells that are not hydraulically upgradient of the waste management area where the well can represent the quality of water passing the POC.
- A minimum of four samples taken at intervals that assures an independent sample is obtained based on the uppermost aquifer's properties.
- Application of an alternate sampling procedure proposed by the owner or operator and approved by the Regional Administrator.

On this basis, new and replacement Level 1 detection monitoring wells near WMAs will be sampled for the constituents listed in Table 7-11 on a quarterly basis for four (4) events to establish water quality downgradient of the WMA at the POC. Additionally, new or replacement Level 1 wells will be sampled quarterly for the following indicator parameters: chloride, iron, manganese, phenols, sodium, sulfate, pH, specific conductance, total organic carbon, and total organic halogens. New or replacement wells will transition into the detection monitoring program after completion of the four (4) quarters of background monitoring.

Data will be evaluated using the procedures outlined in Section X.B. of the CWM facility's Permit. The methodology the "Data Evaluation" section below. The application of the site-specific low flow sampling method will be used is in compliance with the Oregon Water Resources Department (OWRD) rules for the construction and maintenance of monitoring wells (Oregon Administrativeto evaluate purging and drawdown criteria outlined and included in Appendix B and Table 7-14 for the detection monitoring network. Table 7-14 will be revised once the well construction and well development is completed and depth-to-water criteria for low flow sampling is determined at each new or replacement detection monitoring well.

3.8.4.3 Groundwater Quality

The current detection-monitoring program evaluates VOCs (see Table 7-1) for semiannual routine monitoring and PCBs on an annual basis. Groundwater sampling will continue to be performed on a semiannual basis for VOCs and on an annual basis for PCBs in the detection monitoring wells using the sampling procedures outlined in the "Purging and Sampling Procedures" section below. The detection monitoring network for long term optimization of the groundwater sampling program is presented in Table 7-4.

3.8.4.4 Data Evaluation

Data evaluation will be performed for the new detection monitoring wells consistent with the approach described below. In existing detection monitoring wells where VOCs were not detected, the detection monitoring criteria is set equal to the reporting limit for each constituent as indicated in Table 7-11 (i.e., alternative statistical approach with the Double Quantification Rule 690-240) and the following additional guidelines:). At locations with historical VOC detections, the criteria (i.e. five times the reporting limit) is described in the “Data Evaluation” section below.

- DEQ guidance document *Groundwater Monitoring Well Drilling, Construction and Decommissioning* (DEQ 1992)
- Waste Management, Inc., Well Decommissioning Standard (September 2000)

The USEPA Unified Guidance (USEPA, 2009) recommends a uniform approach for dealing with monitoring constituents not historically detected in background (e.g., VOCs and other trace organic compounds). The Unified Guidance recommends that the Double Quantification rule be used as an alternate data evaluation protocol, approved by the Regional Administrator. As stated in the guidance, the alternative approach indicates that:

> *A confirmed exceedance is registered if any well-constituent pair in the '100% non-detect' group exhibits quantified measurements (i.e., at or above the reporting limit [RL]) in two consecutive sample and resample events.*

The Unified Guidance refers to the Double Quantification rule as a "quasi-statistical" method with the form of a statistical prediction limit test. As indicated in the Unified Guidance, requiring a verified quantification for previously non-detected constituents should ensure that spurious lab results do not falsely trigger a facility into compliance/assessment monitoring, and will more reliably indicate the true presence of chemicals not previously observed.

Assessment of possible releases shall be made by comparing the reported data from each monitoring event against the detection monitoring criteria. Reported concentrations above these criteria shall be considered possible indications of a release, subject to verification re-sampling and/or demonstration by CWM of an alternative source other than a release from a WMA (as discussed in detail in the sections below. Additional response actions and alternatives are also described in the applicable portions of the "Data Evaluation" section below.

Table 7-3
Monitoring Well and Piezometer Decommissioning Program

~~*Table 3-3 (Rev. 10)*~~
~~*Well Decommissioning Schedule*~~
Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)

Point ID	Northing	Easting	Phase 1 Program Use	Decommission Grouping [1,2]	Replace (Y/N)	Purpose for Decommissioning
2A-2	715043.20	8264402.60	P	TBD	N	In Pond P-C Footprint
2E-9	715031.29	8264077.75	P	TBD	N	In Pond P-C Footprint
2F-9	715028.69	8263793.16	P	TBD	N	In Pond P-C Footprint
2H-2	715047.16	8264231.15	P	TBD	N	In Pond P-C Footprint
2O-1	714993.49	8265728.62	P	TBD	N	In ORU Footprint
2O-2	714993.49	8265728.62	P	TBD	N	In ORU Footprint
2O-4	714981.29	8265732.30	P	TBD	N	In ORU Footprint
E-3	715262.83	8263575.36	P	TBD	N	In Pond P-C Footprint
Y-9	714843.09	8264080.53	P	TBD	N	In L-14 Cell 7 Footprint
K-1	715712.29	8264181.39	P	TBD	N	In Pond P-C Footprint
C-2	715720.88	8264187.28	P	TBD	N	In Pond P-C Footprint
2I-2	714471.40	8263904.32	P	A	N	In L-14 Cell 8 Footprint
2N-2	714456.14	8264678.83	P	A	N	In L-14 Cell 7 Footprint
2N-4	714456.14	8264680.72	P	A	N	In L-14 Cell 7 Footprint
2Na-1	714468.80	8264648.44	P	A	N	In L-14 Cell 7 Footprint
3F-2	714729.31	8264216.78	P	A	N	In L-14 Cell 7 Footprint
3B-1	714166.47	8263657.58	P	A[3]	N	In L-14 Cell 8 Footprint
3B-2	714166.47	8263657.58	P	A[3]	N	In L-14 Cell 8 Footprint
3P-1	712209.42	8264785.41	POC	B	Y	VOC Detections
3H-1	714386.23	8265469.54	P	TBD	N	Old Well, VOC Detections
~~Year~~3H-2	714396.38	8265470.60	P	TBD	N	Old Well ~~Identification~~Near 3H-1
3R-1	712204.75	8264256.48	POC	B	Y	VOC Detections
5A-1	712212.18	8264574.73	POC	B	Y	VOC Detections
5P-1	712673.72	8266058.07	POC	B	Y	Near L-12/L-13
5A-2	712190.02	8264593.74	P	B	N	VOC Detections
5B-1	712395.18	8265005.39	P	B	N	VOC Detections
5D-1	712805.20	8264991.15	P	B	N	VOC Detections
5Q-1	712993.93	8266138.51	POC	B	Y	VOC Detections
3P-2	712211.09	8264794.07	P	C	N	Near L-6
4B-1	712592.50	8265015.07	P	C	N	VOC Detections
4Ba-2	712581.78	8265015.06	P	C	N	Near L-7
5B-2	712321.89	8264986.63	P	C	N	Near L-7
2V-1	713084.27	8265043.25	P	C	N	Near L-9/L-10
2V-2	713084.27	8265043.25	P	D	N	Near L-9/L-10
2Vb-1	713079.27	8265035.42	P	D	N	Near L-9/L-10
2Vb-1A	713079.27	8265035.42	P	D	N	Near L-9/L-10
2Vb-2	713079.27	8265035.42	P	D	N	Near L-9/L-10
3Y-2	713083.81	8265321.14	P	D	N	Near L-9/L-10
4Ja-1	712855.32	8265674.19	P	E	N	Near L-9
4K-2	713352.84	8265659.85	P	E	N	Near L-10
5D-2	712825.81	8264994.29	P	E	N	Near L-7
2Ra-1	712745.10	8264160.51	P	E	N	Near L-1/L-3
5I-1	712568.48	8264225.10	P	E	N	Near L-1/L-3
3O-1	712213.62	8263981.08	P	F	N	Near L-6
3O-2	712212.00	8263990.41	P	F	N	Near L-6
4J-2	712854.68	8265662.98	P	F	N	Near L-9
5G-1	712536.04	8264338.18	P	F	N	Near L-3/L-5
3E-2	712596.08	8265589.94	P	G	N	Near L-8
5J-1	712597.72	8265613.13	P	G	N	Near L-8
5J-2	712596.08	8265589.94	P	G	N	Near L-8
3M-1	713776.95	8264951.00	P	G	N	Near L-10
3M-2	713766.84	8264951.31	P	G	N	Near L-10
W-9 (W1-2)	715243.55	8263114.39	P	TBD	N	In Pond E Area
Z-9 (Z1-2)	714930.86	8263467.78	P	TBD	N	In Pond E Area
W3-9	714830.14	8262967.59	P	TBD	N	In Pond E Area
6E-1	714701.60	8263568.27	P	TBD	N	In Pond E Area
6L-1	714701.10	8263567.17	P	TBD	N	In Pond E Area
2C-9	714603.76	8263478.23	P	TBD	N	In Pond E Area
2D-9	714309.03	8263481.99	P	TBD	N	In Pond D Area
W4-2	714306.44	8263046.87	P	TBD	N	In Pond D Area
2G-9	714163.27	8263478.07	P	TBD	N	In Pond D Area
A-2	714011.17	8263468.42	P	TBD	N	In Pond D Area
6G-1	713699.93	8263511.11	P	TBD	N	In Pond D Area
6G-2	713699.93	8263511.11	P	TBD	N	In Pond D Area

Notes:
P = Piezometer
POC = Point of Compliance Detection Monitoring Well
ORU = Organic Recovery Unit
VOC = Volatile Organic Compound
Coordinates in RUST 1994 Survey; Oregon State Plane North, North American Datum 1983-1991
Each replacement well will be installed and sampled for four quarters prior to closing the original well.

[1] Wells and Piezometers in the footprint of Facility development and/or infrastructure will be abandoned per site development schedules
[2] Grouping are based off qualitative criteria and are shown in decreasing priority from A to G

~~2018~~ ~~2I-2, 2Na-1, 2N-2, 2N-4,~~ [3] Piezometers 3B-1~~,~~ and 3B-2 share the same borehole.

~~Notes:~~

2018 Well decommissioning schedule will be determined by expansion and construction schedule for Cell 5 of Landfill Unit L-14.

TABLE 37-3 Well Decommissioning Program Table

Table 7-4 Point of Compliance Monitoring Well Optimization Program[1] Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)		
Well Designation	**Approximate Optimized Location**	**Phase 1 POC Well Location Being Replaced**
WMA-1 (L-1, L-3, L-5, L-6, L-7, L-9, L-10, L-12, L-13, Ponds P-A and P-B)		
5L-1	South of L-13 Sumps 4,5	--
3Ta-1	Southeast of L-13 Sumps 1,3	--
5M-1	South of L-13 Sumps 1,4,5	--
5N-1	Southeast of L-13 Sump 2	--
6C-9	East of Pond P-B	--
7E-1	South of L-6 Eastside	5A-1
7F-1	Southeast of L-7	3P-1
7G-1	South of L-6 Westside	3R-1
7H-1	Southeast of L-12 Sump S	5P-1
7I-1	Southeast of L-12 Sump N	5Q-1
WMA-2 (L-14, Ponds P-C, P-D and P-E)		
7A-1	East of L-14 Sump 1	--
7B-1	East of L-14 Sump 2	--
7C-1	East of L-14 Sump 3	--
7D-1	East of L-14 Sump 4	--
4H-1	East of L-14 Sump 5	--
3G-1	East of L-14 Sump 6	--
7J-1	East of L-14 Sump 7 and 8	--
7K-1	East of Ponds P-C1 and P-C4	--
7L-1	East of Pond P-C1	--
7M-1	South of Pond P-D4	--
7N-1	North of Pond P-E4	--
7O-1	South of Pond P-D3	--
7P-1	North of Pond P-C4	--

Notes:
[1] After Part B Permit renewal or Part B Permit Class III Modification approval and optimized well network is installed for a WMA.

TABLE 7-4 Point of Compliance Well Optimization Schedule : Rev. 10

Table 7-5
Long Term Optimization Monitoring Well Program Specifications and Sampling Frequency
Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)

Compliance Point ID	Location [a] Northing	Location [a] Easting	TOC Elevation (ft) [a,b]	Stickup (ft) [c]	Extn. (ft) [d]	Well Dia. (in)	Well Screen [c] top (ft)	Well Screen [c] base (ft)	Well Screen [c] lgth (ft)	Filter Interval [c] top (ft)	Filter Interval [c] base (ft)	Filter Interval [c] lgth (ft)	TSCA Monitoring Frequency	RCRA Monitoring Frequency [e]	Post-Closure Monitoring	Purging and Sampling Method [f]
WASTE MANAGEMENT AREA WMA-1 OPTIMIZATION: (Landfill Units L-1, L-3, L-5, L-6, L-7, L-8, L-9, L-10, L-12, L-13, and Ponds A and B)																
5L-1	711656.26	8265469.62	1002.39	3.11	0.00	4	186.71	211.71	25.00	183.11	211.71	28.60	Annual	Semiannual	Yes	Low-Flow
3Ta-1	711780.29	8266107.22	1029.90	2.73	0.00	4	228.30	238.30	10.00	227.13	238.33	11.20	Annual	Semiannual	Yes	Low-Flow
5M-1	711689.41	8265721.27	1021.38	2.52	0.00	4	209.02	229.02	20.00	205.52	229.02	23.50	Annual	Semiannual	Yes	Low-Flow
5N-1	711930.00	8266133.57	1031.72	2.61	0.00	4	215.11	235.11	20.00	212.11	235.11	23.00	Annual	Semiannual	Yes	Low-Flow
6C-9	713801.00	8265639.00	1018.66	2.90	0.00	4	187.90	207.90	20.00	184.80	207.90	23.10	Not Required	Semiannual	No	Low-Flow
7E-1 (5A-1)	712235.08	8264560.98	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Not Required	Semiannual[g,h]	Yes	Low-Flow
7F-1 (3P-1)	712320.40	8264971.13	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Not Required	Semiannual[g,h]	Yes	Low-Flow
7G-1 (3R-1)	712227.33	8264220.48	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Not Required	Semiannual[g,h]	Yes	Low-Flow
7H-1 (5P-1)	712847.81	8266162.89	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Annual	Semiannual[g,h]	Yes	Low-Flow
7I-1 (5Q-1)	713158.05	8266186.11	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Annual	Semiannual[g,h]	Yes	Low-Flow
WASTE MANAGEMENT AREA WMA-2 OPTIMIZATION: (L-14 and Ponds C, Ponds D, and Ponds E)																
3G-1	714300.29	8264947.14	1018.55	1.85	0	4	173.20	183.20	10.00	169.50	183.00	13.50	Annual	Semiannual[g,h]	Yes	Low-Flow
4H-1	714000.38	8265225.41	1021.43	2.40	0.00	4	184.50	199.50	15.00	183.40	200.90	17.50	Annual	Semiannual[g,h]	Yes	Low-Flow
7A-1	713074.69	8264024.77	990.47	2.09	0.00	4	142.19	152.19	10.00	140.09	153.49	13.40	Annual	Semiannual[g,h]	Yes	Low-Flow
7B-1	713091.15	8264418.42	1003.59	2.07	0.00	4	158.77	168.77	10.00	155.77	168.87	13.10	Annual	Semiannual[g,h]	Yes	Low-Flow
7C-1	713103.22	8264745.81	1018.13	2.06	0.00	4	180.26	190.26	10.00	178.16	191.16	13.00	Annual	Semiannual[g,h]	Yes	Low-Flow
7D-1	713082.85	8264881.81	1022.18	1.93	0.00	4	188.23	198.23	10.00	186.13	200.03	13.90	Annual	Semiannual[g,h]	Yes	Low-Flow
7J-1	714437.86	8264977.71	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Annual	Semiannual[g,h]	Yes	Low-Flow
7K-1	715759.80	8264639.97	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Annual	Semiannual	No	Low-Flow
7L-1	715057.53	8264632.36	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Annual	Semiannual	No	Low-Flow
7M-1	713351.29	8262942.99	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Annual	Semiannual	No	Low-Flow
7N-1	715399.36	8262612.04	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Annual	Semiannual	No	Low-Flow
7O-1	713351.29	8263394.39	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Annual	Semiannual	No	Low-Flow
7P-1	716071.81	8263694.96	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Annual	Semiannual	No	Low-Flow
1																

Notes:
Wells in parentheses will be decommissioned and replaced with a new detection monitoring well; TBD = to be determined
[a] RUST 1994 Survey; Oregon State Plane North, North American Datum 1983-1991
[b] Top of casing elevation in feet relative to historical site datum (RUST, 1998)
[c] Depth below top of casing (calculated from boring logs)
[d] Casing extensions by CWM (calculated from original TOC elevation - 1993 Tenneson resurvey)
[e] Semiannual sampling will occur during the spring and fall sampling events every year; annual sampling will occur during the fall sampling event every year
[f] All pumps are Well Wizard bladder pumps or similar
[g] Quarterly for first year of monitoring, then semiannual
[h] Well will be sampled per the list in Table 7-11.

TABLE 7-5 Long Term Optimization Monitoring Well Program Specifications and Sampling Frequency

Table 7-6
Long Term Optimized Groundwater Elevation Monitoring Locations
Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)

Location ID	Location [a]		TOC Elevation [b]	Selah Member Level [c]	Location Use[d]
	Easting	Northing			
Va-1	8265656.61	711421.45	794.30	1	P
W9-1	8263032.76	713160.82	998.14	1	P
2S-1	8263689.85	711892.18	983.37	1	P
2Wa-1	8265398.81	714177.28	1020.03	1	P
2X-1	8265124.28	711463.38	915.94	1	P
3G-1	8264947.14	714300.29	1018.55	1	MW
3I-1	8265611.36	714614.22	1009.28	1	P
3J-1	8265639.57	713970.21	1019.13	1	P
3Ta-1	8266107.22	711780.29	1029.90	1	MW
4H-1	8265225.41	714000.38	1021.43	1	MW
5S-1	8266134.93	713441.01	1037.87	1	P
5L-1	8265469.62	711656.26	1002.39	1	MW
5M-1	8265721.27	711689.41	1021.38	1	MW
5N-1	8266133.57	711930.00	1031.72	1	MW
5O-1	8265838.39	712657.32	1019.98	1	P
7A-1	8264024.77	713074.69	990.47	1	MW
7B-1	8264418.42	713091.15	1003.59	1	MW
7C-1	8264745.81	713103.22	1003.59	1	MW
7D-1	8264881.81	713082.85	1022.18	1	MW
5U-9	8266018.49	714324.88	1037.76	1 & 2	P
5V-9	8265809.45	714405.50	1029.43	1 & 2	P
6C-9	8265639.00	713801.00	1018.66	1 & 2	MW
F-2	8266048.01	715326.01	1048.33	2	P
G-2	8266127.52	712704.47	1024.31	2	P
J-2	8263466.71	712256.68	982.91	2	P
MW1-2	8264694.07	711538.99	930.84	2	P
Va-2	8265662.57	711426.10	912.25	2	P
W9-2	8263032.76	713160.82	998.19	2	P
X-2	8263481.30	712602.86	986.73	2	P
2B-2	8264724.72	715031.73	1008.12	2	P
2S-2	8263689.85	711892.18	983.37	2	P
2U-2	8266133.98	712168.56	1031.39	2	P
2W-2	8265398.63	714203.30	1018.37	2	P
2X-2	8265124.28	711463.38	915.95	2	P
3G-2	8264947.47	714310.85	1018.31	2	P
3I-2	8265610.45	714624.44	1010.16	2	P
4Pa-2	8266105.95	713933.82	1037.78	2	P
5O-2	8265827.97	712658.15	1019.83	2	P
6J-2	8263481.40	713020.15	994.58	2	P
7A-2	8264015.95	713076.45	990.11	2	P
7D-2	8264870.37	713085.44	1021.72	2	P
7E-1	8264560.98	712235.08	TBD	1	MW
7F-1	8264971.13	712320.40	TBD	1	MW
7G-1	8264220.48	712227.33	TBD	1	MW
7H-1	8266162.89	712847.81	TBD	1	MW
7I-1	8266186.11	713158.05	TBD	1	MW

Table 7-6
Long Term Optimized Groundwater Elevation Monitoring Locations
Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)

7J-1	8264977.71	714437.86	TBD	1	MW
7K-1	8264639.97	715759.80	TBD	1	MW
7L-1	8264632.36	715057.53	TBD	1	MW
7M-1	8262942.99	713351.29	TBD	1	MW
7N-1	8262612.04	715399.36	TBD	1	MW
7O-1	8263394.39	713351.29	TBD	1	MW
7P-1	8263694.96	716071.81	TBD	1	MW

Notes:
[a] Oregon State Plane North System
[b] Top of casing (TOC) elevation relative to historical site datum (RUST, 1998)
[c] The Selah Member has been divided into the upper level (Level 1) and lower level (Level 2)
[d] P = piezometer; MW = Monitoring Well; Location use is consistent with Appendix C
[e] L15 E-1 and L15 F -1 will be used solely as piezometers after background monitoring for 4 quarters is completed.

TABLE 7-6 Long Term Groundwater Elevation Locations

4 DATA EVALUATION

The following subsections describe the criteria by which data will be evaluated at the Facility under the RCRA Permit. Section 4.1 describes the detection monitoring program. Section 4.2 describes the compliance monitoring program. Section 4.3 describes verification procedures for detection and compliance monitoring programs. Section 4.4 describes the initial procedures to be used if there is a confirmed exceedance of the detection monitoring. Section 4.5 describes the Appendix IX constituent list. Section 4.6 discusses CWM's option to demonstrate that a source other than a release is responsible for a confirmed exceedance.

4.1 Detection Monitoring Program

The detection monitoring program will consist of evaluating analytical results for regulated constituents listed in Table X-3 of the Permit7-11 for wells located along the point of compliance (POC) of each of the three WMAs described in Section 3.0 and listed in Table 3-1Tables 7-11 and 7-12 of this GWMP. In POC wells where volatile organicPlan, as applicable. Prior to including a new well or replacement well into the groundwater detection monitoring program a minimum of four samples will be collected to establish background conditions for both regulated (i.e., VOCs and PCBs) and non-regulated compounds (VOCs) were not detected prior to 2007, . Background monitoring for emerging non-regulated contaminants per- and polyfluoroalkyl substances (PFAS) will also be performed in detection monitoring wells downgradient of the landfill unit L-14 at the WMA-2 POC.

The detection monitoring criteria is set equal to the current reporting limit (RL) for each constituent listed in Table X-4 of the Permit.7-11. For POC wells with VOCs detected at low concentrations, the detection monitoring criteria was 5 times the reporting limit.

For any VOCs that have been previously detected in detection monitoring wells 4B-1, 5D5Q-1, or 5Q and 7D-1 (Chlorobenzene, Chloromethane;, Dichlorodifluoromethane; , 1,1-Dichloroethane, 1,1 ;,1-Dichloroethene, Methylene chloride;, Naphthalene, Tetrachloroethene;, Toluene; , 1,1,1-Trichloroethane,1,1,1 ; Trichloroethene;, and Trichlorofluoromethane), the detection monitoring criteria will be 5 times the reporting limitslimit (RL) listed in Table X-4 of the Permit.7-11. For any new VOCs detected in detection monitoring wells 4B-1, 5D5Q-1, or 5Q and 7D-1 that are degradation products of the VOCs listed above, the Permittee may add those VOCs to Permit Condition X.D.1.a.new VOCs to the list of compounds that utilize the detection monitoring criteria of 5 times the reporting limit, after Department approval.

Assessment of Of the three listed above, only well 7D-1 is planned to be retained for the long-term optimized detection monitoring program, whereas wells 4B-1 and 5Q-1 are not retained because of known integrity issues. Well 7D-1 was installed in 2006 to monitor downgradient of L-14 Cell 4. Although this well is relatively new compared to the old Facility wells with integrity issues, it is not a replacement well.

A previously accepted investigation in 2020 demonstrated that well 7D-1 was designed/constructed to be cased in a manner that maintains borehole integrity, screened or perforated and packed with gravel or sand, and the annular space sealed above the sampling depth. As such, no well integrity issues are suspected at 7D-1. This investigation demonstrated that the likely pathway of VOCs to groundwater near L-14 Cell 4 is due to the legacy of poorly constructed wells and improperly abandoned wells installed for geologic and hydrogeologic site characterization located near 7D-1 (SCS, 2020b).

The occurrence of VOCs in well 7D-1 are not from the regulated unit (Cell 4 of Landfill L-14) that 7D-1 was intended to monitor. The legacy of historical practices of well construction and abandonment for geotechnical borings and/or piezometers near well 7D-1 are within the radius of influence during sampling, and subsequently effected groundwater quality near well 7D-1. This phenomenon is not anticipated to occur with planned replacement wells. In the event VOCs are detected in planned replacement wells, a similar investigation on the source and occurrence will be performed (e.g., alternative source demonstration).

Evaluation of a significant change in groundwater quality due to a possible ~~releases will~~ release shall be made by comparing the ~~values in Table X-4 of the permit, adjusted as necessary as described above, against~~ reported data from each monitoring event~~.~~ against the detection monitoring criteria described above and shown in Table 7-11. This alternative statistical approach is based on the Double Quantification Rule, and a detection of a VOC(s) above the detection monitoring criteria would trigger follow-up action. Reported concentrations above these ~~values will~~criteria shall be considered possible indications of a release, subject to verification re-sampling and/or ~~demonstration~~an ASD by CWM ~~of some source other than a release as~~ (as allowed by ~~the~~ Permit~~.~~ and discussed further below).

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~~**4.2 Compliance Monitoring Program**~~

~~In case a compliance monitoring program becomes necessary in the future as described in the Permit, the results of analyses obtained pursuant to Permit condition XI.C.1.a. and XI.C.1.b. will be compared to the groundwater concentration limits specified in Section XI of the Permit using the methodology described in Permit condition XI.D.1. The groundwater concentration limits for compliance monitoring include alternate concentration limits (ACLs) developed under 40 CFR §264.94 for VOCs and other constituents listed in Appendix IX of 40 CFR §264 that have available published toxicity information (CH2M HILL, 2007c). Compliance monitoring constituents, if a compliance monitoring program becomes necessary, will be included in Tables XI-2 and XI-3 of the Permit. Groundwater concentration limits for each Appendix IX constituent for which toxicity information is available are listed in Table XI-4. As required by DEQ and EPA Region X, one percent of the aqueous solubility limit for each constituent is the adopted groundwater concentration limit for compliance monitoring except where this value exceeds the alternate concentration limit (ACL) determined in CH2M HILL (2007c). Where one percent of the aqueous solubility limit for a constituent exceeds the ACL, the ACL will be used as the groundwater concentration limit. For constituents where the determined ACL or one percent of aqueous solubility is less than the RL, the adopted groundwater concentration limit is the RL.~~

Results of all analyses, including semiannual analyses, verification analyses, and Appendix IX analyses, shall be submitted to the Department within 45 calendar days after the Facility's receipt of the analytical laboratory's quality-assured data report. In no case shall the period between the last date of sampling and the date of submission to the Department of analytical results exceed 90 calendar days unless a written extension is granted by the Department. The Facility shall document when the analytical laboratory's quality-assured data reports are received. The report submitted to the Department will contain laboratory quality-assured results reported down to the method detection limit (MDL) for the RCRA program (e.g., VOCs), and the reporting limit (RL) as specified in Tables 7-11 and 7-12. The MDL results are for informational purposes and will be discussed in the reports for each sampling event.

~~4.3~~4.2 Verification Procedures for Detection ~~and Compliance~~ Monitoring ~~Programs~~Program

~~If~~ If routine groundwater monitoring results indicate a concentration above the groundwater ~~monitoring results are determined to exceed groundwater~~detection monitoring criteria or ~~to~~ indicate the presence of previously undetected constituents for the relevant monitoring program, ~~a~~the Facility will notify the Department within 7 calendar days after receiving the analytical laboratory's quality-assured data report. If warranted, the notification will include the Facility's plan to perform verification resampling ~~event will be performed after the results have been checked for QA/QC consistency (which is described in Section 7.0, Data Quality Review,~~ . ~~Reporting, and Record-Keeping).~~

~~The procedure to confirm exceedance of the detection monitoring criteria is described in Permit conditions X.D.2. and X.D.3. For the compliance monitoring program, the procedure to confirm exceedance of the groundwater concentration limits is described in Permit conditions XI.D.4. and XI.D.5. For constituents that are detected in Appendix IX samples but are not routinely analyzed in the detection monitoring or compliance monitoring programs, verification sampling procedures are specified in Permit conditions X.D.4.c.i. for the detection monitoring program and XI.C.1.c.i. for the compliance monitoring program.~~

~~The general~~The procedure for verification sampling consists of the following:

- Collect two samples from the affected well(s) within 30 days after receiving the analytical laboratory's quality-assured data report that indicates an exceedance and analyze for the VOC(s) that were above the applicable criteria.
- If neither verification sample confirms the presence of the specific VOC(s) above the applicable criteria, then the ~~applicable~~detection monitoring program will be resumed ~~according to the standard schedule~~with no further action and DEQ will be notified to that ~~effect~~detection monitoring is being resumed; or
- If one or both verification samples confirm the presence of VOCs above the applicable criteria, then DEQ will be notified in writing of this finding ~~in accordance with the requirements of the Permit,~~within 7 days after receipt of the analytical laboratory's quality-assured data report confirming that the applicable criteria have been exceeded. The activities in the "Confirmed Concentration" section below will then be followed.

In no case shall the period between the date of the determination of an exceedance and the date of the submission to the Department of the analytical results for verification sampling performed ~~under Permit Condition X.D.2.~~in this section exceed 135 calendar days unless a written extension is granted by the DEQ.

CWM may ~~opt~~elect to forego verification sampling~~, as provided by Permit conditions X.D.2.c. and X.D.4.c.ii.~~ for the detection monitoring program, and ~~Permit conditions XI.C.1.c.ii. and XI.D.4.c. i. for~~follow the ~~compliance monitoring program. This option is provided~~procedures described in the ~~permit to save CWM additional sample collection and analysis costs in the event that a future increase is significant enough that verification sampling is deemed unnecessary.~~"Confirmed Concentration" section below.

4.44.3 Initial Procedures for a Confirmed Exceedance ofConcentration Above the Detection Monitoring Criteria

If an exceedance ofa concentration above the detection monitoring criteria is confirmed, then Permit condition X.D.4.b. requires that one sample be collected from the affected monitoring well(s) and analyzed for the constituents identified in 40 CFR Part 264 Appendix IX. (Table 7-7 and 7-13). This sample must be collected within 30 calendar days after receipt of the analytical data confirming the exceedance of the detection monitoring criteria. in this plan. If a constituent that is not listed in Table X-3 of the Permit7-1 (Detection Monitoring Program) is detected above the reporting limit in the Appendix IX sample, then a second sample may be collected and analyzed within 30 calendar days [as described in Permit condition X.D.4.c.i.] to confirm the presence of the additional constituent(s). If the Facility chooses not to resample, then the Permittee shall report the concentrations of the additional constituents detected above the applicable detection monitoring criteria to the Department within 7 calendar days after receipt of the analytical laboratory's quality-assured data report for the samples collected under this section.

If the second sampling and analysis is elected to be collected and confirms the presence of new constituents above the applicable criteria, the Facility will report the concentrations of these detected constituents to the Department within 7 calendar days after receipt of the analytical laboratory's quality-assured data report for the second analysis.

Within 90 calendar days after receipt of the analytical laboratory's quality-assured data report for Appendix IX constituents required in this section, the Facility will submit either of the following:

- An application for a permit modification to establish a compliance monitoring program, for the affected monitoring well(s), as specified in 40 CFR 264.98(g)(4), or, if any hazardous constituents are above the groundwater concentration limits, to initiate a corrective action program, as specified in this plan unless the Permittee has submitted a notice of intent under 40 CFR 264.98(g)(4)(iv) to revise the groundwater concentration limits or,
- A report demonstrating that a source other than a regulated unit or the past practice units caused the contamination, or that the detection is an artifact caused by an error in sampling, analysis, or statistical evaluation or natural variation in the groundwater; and in addition, when required by 40 CFR 264.98(h), an application for a permit modification to make any appropriate changes to the detection monitoring program.

4.54.4 Appendix IX Constituent List

In the detection monitoring program, Permit condition X.D.4.b. requires Appendix IX sampling to be conducted if an exceedance of the detection monitoring criteria has been confirmed under Permit Conditions X.D.1. and X.D.2. Permit condition X.D.4.b. specifies that these Appendix IX samples will be analyzed for the constituents identified in 40 CFR Part 264 Appendix IX. Appendix IX sampling is conducted triennially for the compliance monitoring program as specified in Permit condition XI.C.1.c. This Permit condition specifies that these Appendix IX samples will be analyzed for the constituents identified in 40 CFR Part 264 Appendix IX.

In both cases, these Permit conditions and the EPA regulations for constituents listed in Appendix IX of 40 CFR Part 264 will be implemented. TheseIf Appendix IX sampling is required through the process described above or a compliance monitoring program, the

Appendix IX constituents are listed in Table 7-7 (40 CFR Part 264 Appendix IX) and 7-13.

The federal regulations allow Appendix IX sampling to be conducted for a subset of the constituents listed in 40 CFR Part 264 Appendix IX. As discussed previously in Section 4.1, CWMCWMNW has developed groundwater concentration limits for all constituents listed in Appendix IX of 40 CFR §264 that have available published toxicity information (CH2M HILL, 2007c). Consequently, the constituents to be analyzed for Appendix IX sampling activities under Permit conditions X.D.4.b. and XI.C.1.c. will be those listed in Table 4-17-7 and 7-13, which have available agency-derived toxicity factors and, therefore, have groundwater concentration limits as developed by CH2M HILL (2007c).

4.64.5 Demonstration of Source Other Than a Release

The Permit provides CWM the option of The Facility may prepare a report (e.g., alternative source demonstration) demonstrating that an apparent exceedance of monitoring criteria is attributable to a source other than a release from a regulated unit or is the past practice units caused the contamination, or that the detection is an artifact caused by an error or artifact in sampling, analysis, data or statistical evaluation, or natural variation in the groundwater quality. If CWM opts.

When required by 40 CFR 264.98(h), an application for a permit modification to make this demonstration, it will follow the process and timelines established in the Permit for any appropriate changes to the detection monitoring program.

If the Department agrees with the findings of the report, then the detection monitoring (X.D.4.d.ii.) orprogram will resume for the effected monitoring well(s) and constituent(s). After an ASD has been accepted by the Department for an affected monitoring well, the Facility will work in consultation with the Department if monitoring results (e.g., VOC detections) that triggered the ASD reoccur in the same monitoring well. In these instances, verification resampling and conducting additional investigation may not be necessary.

If the Department determines that a report submitted in this section fails to identify a source of contamination other than a regulated unit or past practice unit, or that the detection is an artifact caused by an error in sampling, analysis, or statistical evaluation or natural variation in the ground water, then the Facility will within 60 days of the Department's determination submit an application for a permit modification to establish a compliance monitoring program, as specified in 40 CFR 264.98(g)4, or, if any hazardous constituents are above the groundwater concentration limits, to initiate corrective action unless the Facility has submitted a notice of intent under 40 CFR 264.98(g)(4)(iv) to revise the groundwater concentration limits.

4.6 Compliance Monitoring Program

In case a compliance monitoring program becomes necessary in the future, the results of analyses will be compared to the groundwater concentration limits specified in Table 7-7. The groundwater concentration limits for compliance monitoring include alternate concentration limits (ACLs) developed under 40 CFR §264.94 for VOCs and other constituents listed in Appendix IX of 40 CFR §264 that have available published toxicity information (CH2M HILL, 2007c). (XI.D.6.b.), whichever If compliance monitoring program becomes necessary in the future, the ACLs will be reviewed and updated based on new toxicity information that may be available since 2007, where applicable for each Appendix IX constituent.

If a compliance monitoring program becomes necessary, required constituents and monitoring locations will be included as a revision to this Plan. As required by DEQ and EPA Region X, one percent of the aqueous solubility limit for each constituent is the adopted groundwater concentration limit for compliance monitoring except where this value exceeds the ACL determined in CH2M HILL (2007c). Where one percent of the aqueous solubility limit for a constituent exceeds the ACL, the ACL will be used as the groundwater concentration limit. For constituents where the determined ACL or one percent of aqueous solubility is less than the RL, the adopted groundwater concentration limit is the RL.

4.6.1 Compliance Sampling and Analysis

4.6.1.1 Sampling Schedule

If required, semiannual compliance sampling events will be started and finished in the months of March through May, and September through November, respectively, during each calendar year. The Facility will notify the Department within five (5) working days prior to the sampling event.

If a compliance monitoring becomes necessary, the Facility will annually analyze the groundwater sampled from the compliance monitoring well with the highest total VOC concentration during the previous sampling event for all 40 CFR 264, Appendix IX constituents. Annual sampling shall occur upon the commencement of compliance monitoring and every year thereafter during the compliance period.

If any Appendix IX constituents in the annual event are detected above the applicable detection monitoring criteria and these constituents are not already designated for compliance monitoring, the Facility may resample within 30 calendar days after receipt of the analytical laboratory's quality-assured data report. If the second (resample) analysis confirms the presence of new constituents above the applicable detection monitoring criteria, the Facility shall report the concentrations of these detected constituents to the Department within 7 calendar days after receipt of the analytical laboratory's quality-assured data report for the second (resample) analysis.

If the Facility chooses not to resample, then the Facility will report the concentrations of the additional constituents detected above the applicable detection monitoring criteria to the Department within 7 calendar days after receipt of the analytical laboratory's quality-assured data report for the initial Appendix IX samples collected in the annual event.

The Facility will add any newly identified Appendix IX constituents in the annual event to this Plan, if the concentration is above the applicable detection monitoring criteria and submit the revised Plan (or portions of Plan, e.g., summary table) to the Department for inclusion into the Permit. For any new Appendix IX constituents without a groundwater concentration limit in Table 7-7, the Facility will develop a groundwater concentration limit modifying the Permit in accordance with 40 CFR 270.42.

4.6.1.2 Reporting~~relevant to the circumstance~~

Results of all analyses, including semiannual analyses, annual analyses, verification analyses, and Appendix IX analyses, shall be submitted to the Department within 45 calendar days after receipt of the analytical laboratory's quality-assured data report. In no case shall the period between the last date of sampling and the date of submission to the Department of analytical results exceed 90 calendar days unless the Department approves a longer time period. The Facility will document when the analytical laboratory's quality-assured data reports are received. The report submitted to the Department shall contain laboratory quality-assured results reported down to the method detection limit (MDL), and the reporting limit (RL). The MDL results are for informational purposes and will be discussed in the reports for each sampling event.

Semiannual groundwater monitoring reports shall also include the information listed in the "Reporting" section below.

The Facility will enter all monitoring, testing, and quality-assured analytical data obtained in this section in the operating record.

4.6.2 Verification Procedures for Compliance Monitoring Program

The following procedures will be followed if a compliance monitoring program becomes necessary. Upon a determination of hazardous constituents in any monitoring well exceeding the groundwater concentration limits as specified in Table 7-7, the Facility will:

- Notify the Department of this finding in writing, within 7 calendar days after receipt of the analytical laboratory's quality-assured data report [40 CFR 264.99(h)1]; and,
- Within 30 calendar days after this finding, collect two verification samples from any affected monitoring well(s), and reanalyze the samples for all constituents that exceeded the concentration limits. In no case shall the period between the date of the initial determination of the hazard constituent above the concentration limit and the date of the submission to the Department of the analytical results for the sampling exceed 135 calendar days unless a written extension is granted by the Department.

The Facility may elect to forgo verification sampling activities described above and instead make a demonstration of a source other than a release as described below.

If the analytical laboratory's quality-assured data results from the analyses show that the verification samples do not confirm the detection of hazardous constituents above the concentration limits, the Facility will resume compliance monitoring. No additional action under is needed and the Facility will notify the Department in writing that the compliance monitoring program is being evaluated.resumed.

Table 4-1 Appendix IX Constituent List and Groundwater Concentration Limits					
Hazardous Constituent	CAS[1] Number	Risk Category[2]	RCRA Listing[3]	Groundwater Concentration Limit[4] (mg/L)	Risk-Based Concentration for Cumulative Risk Evaluation[5] (mg/L)

However, if one or both verification samples confirm the detection of constituents above the concentration limits, the Facility will follow the requirements of the "Source Other Than a Release" below.

4.6.3 Demonstration of Source Other Than a Release

The Facility will notify the Department in writing within 7 calendar days of determining that the groundwater concentration limit has been exceeded at any compliance monitoring well as determined in the "Verification Section" above, as appropriate. The notification shall indicate which concentration limits have been exceeded. [40 CFR 264.99(h)(1)] The Permittee shall also follow the requirements specified in the "Corrective Action" section below, as appropriate.

Alternatively, the Facility may submit to the Department a report demonstrating that a source other than a regulated unit or past practice unit caused the exceedance, or that the exceedance is an artifact caused by an error in sampling, analysis, or statistical evaluation or natural variation in the groundwater; and in addition, when required or as provided by 40 CFR 264.99(i), an application for a permit modification to make any appropriate changes to the compliance monitoring program including changes to the groundwater concentration limits for which there was an exceedance. If the Facility has performed verification sampling, then the report shall be submitted within 90 calendar days after the receipt of the analytical laboratory's quality-assured data report. If the Permittee has elected to forgo verification sampling, the report shall then be submitted within 90 calendar days after the receipt of the analytical laboratory's quality-assured data report for the samples collected under the compliance monitoring program.

If the Department determines that a report submitted in accordance with this section fails to identify a source of contamination other than a regulated unit or past practice unit, or that the exceedance is an artifact caused by an error in sampling, analysis, or statistical evaluation or natural variation in the groundwater or that any application for a permit modification to make changes to the groundwater concentration limits for which there was an exceedance has been denied, then the Facility will follow the requirements in the "Corrective Action Process" section if the groundwater concentration limit(s) as specified in in the Compliance Monitoring Program section is exceeded.

4.7 Corrective Action Process

Upon exceedance of the groundwater concentration limit(s), as determined under the process in the "Compliance Monitoring Program" section, the Facility will send a written request to the Department's Eastern Region Environmental Cleanup Manager requesting a meeting. The written request shall be sent within 15 calendar days after the notification date in the demonstration of "Source Other Than A Release" section above or the determination of the Department. The written request will also contain the following information:

- Description of release with information known to date,
- Description of the Facility's obligation to notify the Environmental Cleanup Manager about the release, and
- Description of the Facility's duty to initiate corrective action if any groundwater concentration limit(s) is exceeded.

The Facility shall meet with the Department's Eastern Region Environmental Cleanup Program within 45 calendar days after the date on the written notification unless the Department approves a longer time period. Such a meeting is intended to initiate the development of a corrective action written agreement for the Facility.

4.7.1 Corrective Action Agreement

The Facility will enter into a written agreement with the Department's Eastern Region Environmental Cleanup Program within 180 calendar days after the date on the written notification noted in this section. The agreement shall provide that any corrective action be implemented under OAR 340-122. The agreement shall also provide that in the event of disagreement between the Facility and Department regarding whether any action under the agreement is consistent with or exceeds 40 CFR 264.90 to 264.101, the Facility and Department shall make a good faith effort to resolve the dispute by taking the following actions: a) discussing the dispute between the Facility's Environmental Manager and the Department's Project Manager, b) if necessary, referring the dispute for resolution to the Permittee's Facility Manager and the Department's Cleanup Manager; and c) if necessary, providing each other their respective positions in writing and referring the dispute for resolution by the Department's Eastern Region Administrator, in consultation with the Facility's Market Area Manager.

The agreement entered into shall be processed as a Class 3 Permit modification and shall be considered an enforceable Condition of the Permit.

4.7.2 Revision to Corrective Action Agreement

During the course of the corrective action agreement, the Department may determine it necessary to revise the agreement or corrective action activities conducted under the agreement. Changes to the agreement, or corrective action activities conducted under the agreement that are implemented after the effective date of the Permit may require a modification to the Permit. The Facility shall notify the Department Manager in writing at least 30 days prior to any planned changes to the agreement or corrective action activities conducted under the agreement. Upon notification by the Facility, the Department Manager will determine whether or not a Permit modification will be needed. If a Permit modification is needed, the Manager shall so notify the Facility, and upon receipt of such notice, the Facility shall proceed with a Permit modification in accordance with the procedures set forth in 40 CFR 270.41 and 270.42, incorporated by reference under OAR 340-100-0002 and as modified by OAR -105-0041 and OAR 340-106-0005. In accordance with 40 CFR 270.42(e), as incorporated by reference under OAR 340-100-0002, the Facility may seek, and the Department Manager may grant, temporary authorization to implement changes to the agreement or corrective action activities conducted under the agreement prior to the final approval of a Permit Modification.

4.7.2.1 Compliance With Agreement Revision

The agreement or corrective action activities conducted under the agreement may be modified at any time under the Department's Environmental Cleanup Program authority pursuant to the agreement, provided the Facility complies with the requirements of the "Corrective Action Agreement" section. The Department's Environmental Cleanup Program authority to implement changes to the agreement, or corrective action activities conducted under the agreement, shall not be restricted or hindered by any requirements to modify the Permit. Changes approved under the Department's Environmental Cleanup program authority and implemented by the Permittee shall not be a violation of any condition of the Permit or any requirement to modify the Permit provided the Facility complies with the requirements of the "Corrective Action Agreement" section.

The requirement to modify the Permit to accommodate changes in the agreement or corrective action conducted under the agreement shall not be in any way interpreted or deemed to replace, supersede, supplant, modify, or amend the Permittee's right to dispute resolution under the agreement.

4.7.3 Return to Compliance Monitoring

If, after the conclusion or stabilization of corrective action activities, either the Permittee or the Department determines that the Facility should return to a compliance monitoring program, the Permittee must submit a permit modification request to institute a renewed compliance monitoring program under the Permit.

For any specific compliance monitoring program that has demonstrated an exceedance of the groundwater concentration limit(s), as determined under the process in this plan, the Facility will continue with that specific groundwater compliance monitoring program as specified in this plan until there is a written agreement for corrective action in effect. Unless the corrective action written agreement provides otherwise, the Facility shall continue the groundwater compliance monitoring program as set forth in the "Compliance Monitoring Program" section after the corrective action agreement is in place.

Table 7-7
Appendix IX Constituent List and Groundwater Concentration Limits

Hazardous Constituent	CAS[1] Number	Risk Category[2]	RCRA Listing[3]	Groundwater Concentration Limit[4] (mg/L)	Risk-Based Concentration for Cumulative Risk Evaluation[5] (mg/L)
ORGANIC CONSTITUENTS					
Acenaphthene	83-32-9	Tox	IX	0.0424	1,825
Acetone	67-64-1	Tox	IX	10,000	27,400
Acetophenone	98-86-2	Tox	VIII, IX	61	3,040
Acetonitrile	75-05-8	Tox	VIII, IX	5,150	515
Acrolein	107-02-8	Tox	VIII, IX	2.1	0.2100
Acrylonitrile	107-13-1	C, Tox	VIII, IX	1.915	0.1915
Aldrin	309-00-2	C, Tox	VIII, IX	0.0018	0.0167
Allyl Chloride	107-05-1	Tox	VIII, IX	36	9,125
Aniline	62-53-3	C, Tox	VIII, IX	0.01**	49.8051
Anthracene	120-12-7	Tox	IX	0.01**	9,125
Aramite	140-57-8	C, Tox	VIII, IX	0.001	11.3556
Benzene	71-43-2	C, Tox	VIII, IX	17.5	25
Benzo[a]anthracene	56-55-3	C	VIII, IX	0.01**	0.3889
Benzo[b]fluoranthene	205-99-2	C	VIII, IX	0.01**	0.3889
Benzo[k]fluoranthene	207-08-9	C	VIII, IX	0.01**	3.8889
Benzo[a]pyrene	50-32-8	C	VIII, IX	0.01**	10
Benzyl Alcohol	100-51-6	Tox	IX	429	54,750
Bis(2-Chloroethyl) Ether	111-44-4	C	VIII, IX	0.5006	0.0501
Bis(2-Chloro-1-Methylethyl) Ether	108-60-1	C	VIII, IX	0.0129	0.0013
Bis(2-ethylhexyl) Phthalate (DEHP)	117-81-7	C, Tox	VIII, IX	0.01**	20.2778
Bromodichloromethane	75-27-4	C, Tox	IX	67.4	400
Bromoform	75-25-2	C, Tox	VIII, IX	31	400
Bromomethane	75-83-9	Tox	VIII, IX	152	43.3500
Butyl Benzyl Phthalate	85-68-7	Tox	VIII, IX	0.0269	36,500
Carbon Disulfide	75-15-0	Tox	VIII, IX	11.9	5,214.2857

Table 7-7
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Hazardous Constituent	CAS[1] Number	Risk Category[2]	RCRA Listing[3]	Groundwater Concentration Limit[4] (mg/L)	Risk-Based Concentration for Cumulative Risk Evaluation[5] (mg/L)
Carbon Tetrachloride	56-23-5	C, Tox	VIII, IX	7.93	25
Chlordane	57-74-9	C, Tox	VIII, IX	0.00056	10
Chloroaniline, p- (4-Chloroaniline)	106-47-8	Tox	VIII, IX	53	730
Chlorobenzene	18-90-7	Tox	VIII, IX	4.72	500
Chlorobenzilate	510-15-6	C, Tox	VIII, IX	0.10	1.0514
Chlorodibromomethane (Dibromochloromethane)	124-48-1	C, Tox	IX	26	400
Chloroethane	75-0-3	C, Tox	IX	57	19.75
Chloroform	67-66-3	C, Tox	VIII, IX	79.2	400
Chloromethane	74-87-3	C, Tox	VIII, IX	64.5	11.40
Chloronaphthalene, 2- (beta-Chloronaphthalene)	91-58-7	Tox	VIII, IX	0.12	2,435
Chlorophenol, 2-	95-57-8	Tox	VIII, IX	220	152
Chloroprene (2-Chloro-1,3-Butadiene)	126-99-8	Tox	VIII, IX	220	71.5
Chrysene	218-01-9	C	VIII, IX	0.01**	38.8890
Cresol, o-(2-Methylphenol)	95-48-7	Tox	IX	260	9,125
Cresol, m- (3-Methylphenol)	108-39-4	Tox	IX	180	9,125
Cresol, p- (4-Methylphenol)	106-44-5	Tox	IX	180	915
DDD	72-54-8	C	VIII, IX	0.0009	1.1829
DDE	72-55-9	C	VIII, IX	0.0012	0.835
DDT	50-29-3	C, Tox	VIII, IX	0.00025	0.835
Diallate	2303-16-4	C	VIII, IX	0.14	4.6539
Dibenz[a,h]anthracene	53-70-3	C	VIII, IX	0.01**	0.0389

Table 7-7
Appendix IX Constituent List and Groundwater Concentration Limits

Hazardous Constituent	CAS[1] Number	Risk Category[2]	RCRA Listing[3]	Groundwater Concentration Limit[4] (mg/L)	Risk-Based Concentration for Cumulative Risk Evaluation[5] (mg/L)
Dibenzofuran	132-64-9	Tox	IX	0.031	61
Dibromo-3-Chloropropane, 1,2- (DBCP)	96-12-8	C, Tox	VIII, IX	10.0*	1.0
Dibromoethane, 1,2- (Ethylene Dibromide, EDB)	106-93-4	C,Tox	VIII, IX	2.5	0.25
Dichlorobenzene, 1,2- (o-Dichlorobenzene)	95-50-1	Tox	VIII, IX	1.56	3,000
Dichlorobenzene, 1,3- (m-Dichlorobenzene)	541-73-1	Tox	VIII, IX	1.56	72.5
Dichlorobenzene, 1,4- (p-Dichlorobenzene)	106-46-7	C,Tox	VIII, IX	0.74	375
Dichlorobenzidine, 3,3-	91-94-1	C	VIII, IX	0.05**	0.6309
Dichlorodifluoromethane	75-71-8	Tox	VIII, IX	2.8	1,970
Dichloroethane, 1,1-	75-34-3	Tox	VIII, IX	50.6	3,990
Dichloroethane, 1,2-	107-6-2	C, Tox	VIII, IX	85.2	25
Dichloroethene, 1,1-	75-35-4	Tox	VIII, IX	22.5	35
Dichloroethene, cis-1,2	156-59-2	Tox	---	35	350
Dichloroethene, trans-1,2	156-60-5	Tox	VIII, IX	63	500
Dichlorophenol, 2,4-	120-83-2	Tox	VIII, IX	45	547.5
Dichlorophenoxyacetic Acid, 2,4- (2,4-D)	94-75-7	Tox	VIII, IX	4	350
Dichloropropane, 1,2-	78-87-5	C, Tox	VIII, IX	28	25
Dichloropropane, cis-1,3-	10061-1-5	C, Tox	IX	18.25	1.825
Dichloropropane, trans-1,3-	10061-2-6	C,Tox	IX	18.25	1.825
Dieldrin	60-57-1	C, Tox	VIII, IX	0.00195	0.0177

Table 7-7
Appendix IX Constituent List and Groundwater Concentration Limits

Hazardous Constituent	CAS[1] Number	Risk Category[2]	RCRA Listing[3]	Groundwater Concentration Limit[4] (mg/L)	Risk-Based Concentration for Cumulative Risk Evaluation[5] (mg/L)
Diethyl Phthalate	84-66-2	Tox	VIII, IX	10.80	146,000
Dimethoate	60-51-5	Tox	VIII, IX	238	36.5
Dimethylbenzidine, 3,3'-	119-93-7	C	VIII, IX	1.2343	0.1234
Dimethylphenethylamine, alpha, alpha-	122-09-8	Tox	VIII, IX	180	182.5
Dimethylphenol, 2,4-	105-67-9	Tox	VIII, IX	78.7	3,650
Dimethyl Phthalate	131-11-3	Tox	VIII, IX	42.9	1,825,000
Di-n-Butyl Phthalate (Dibutyl Phthalate)	84-74-2	Tox	VIII, IX	0.112	18,250
Di-n-Octyl Phthalate	117-84-0	Tox	VIII, IX	0.01**	7,300
Dinitrobenzene, 1,3-	99-65-0	Tox	IX	4.69	18.25
Dinitro-o-Cresol, 4,6- (4,6-Dinitro-2-methylphenol)	534-52-1	Tox	VIII, IX	1.28	18.25
Dinitrophenol, 2,4-	51-28-5	Tox	VIII, IX	27.9	365
Dinitrotoluene, 2,4-	121-14-2	Tox	VIII, IX	2.70	365
Dinitrotoluene, 2-6-	606-20-2	Tox	VIII, IX	1.82	182.5
Dinoseb	88-85-7	Tox	VIII, IX	0.52	35
Dioxane, 1,4-	123-91-1	C	VIII, IX	52*	5.2
Diphenylamine	122-39-4	Tox	VIII, IX	0.53	4,565
Disulfoton	298-04-4	Tox	VIII, IX	0.163	7.3
Endrin	72-20-8	Tox	VIII, IX	0.0025	10
Ethylbenzene	100-41-4	Tox	IX	1.69	3,500
Ethyl Methacrylate	97-63-2	Tox	VIII, IX	0.20	2,740
Fluoranthene	206-44-0	Tox	VIII, IX	0.01**	7,300
Fluorene	86-73-7	Tox	IX	0.0198	1,215
HCH alpha (alpha-BHC)	319-84-6	C, Tox	IX	0.05**	0.0451
HCH beta (beta-HCH)	319-85-7	C, Tox	IX	0.05**	0.1577

Table 7-7
Appendix IX Constituent List and Groundwater Concentration Limits

Hazardous Constituent	CAS[1] Number	Risk Category[2]	RCRA Listing[3]	Groundwater Concentration Limit[4] (mg/L)	Risk-Based Concentration for Cumulative Risk Evaluation[5] (mg/L)
HCH gamma (gamma-BHC, Lindane)	58-89-9	C, Tox	VIII, IX	0.068	1.0
Heptachlor	76-44-8	C, Tox	VIII, IX	0.0018	0.25
Heptachlor Epoxide	1024-57-3	C, Tox	VIII, IX	0.002	1.0
Hexachlorobenzene	118-74-1	C, Tox	VIII, IX	0.062	5.0
Hexachlorobutadiene	87-68-3	C, Tox	VIII, IX	0.0323	55
Hexachlorocyclopentadiene	77-47-4	Tox	VIII, IX	0.018	250
Hexachloroethane	67-72-1	C, Tox	VIII, IX	0.50	20.2778
Hexachlorophene	70-30-4	Tox	VIII, IX	1.40	55
Indeno [1,2,3-cd] pyrene	193-39-5	C	VIII, IX	0.01**	0.3889
Isobutyl Alcohol (Isobutanol)	78-83-1	Tox	VIII, IX	850	9,125
Isophorone	78-59-1	C,Tox	IX	120	289.8304
Kepone	143-50-0	C, Tox	VIII, IX	0.3549	0.0355
Methacrylonitrile	126-98-7	Tox	VIII, IX	52	5.2
Methoxychlor	72-43-5	Tox	VIII, IX	0.00045	200
Methyl Ethyl Ketone (2-Butanone)	78-93-3	Tox	VIII, IX	2200	34,840
Methyl Methacrylate	80-62-6	Tox	VIII, IX	141	7,100
Methyl Parathion	298-00-0	Tox	VIII, IX	0.55	4565
Methyl-2-Pentanone, 4-	108-10-1	Tox	IX	190	9,950
Methylene Bromide (Dibromomethane)	74-95-3	Tox	VIII, IX	117	304
Methylene Chloride	75-09-2	C, Tox	VIII, IX	130	25
Naphthalene	91-20-3	Tox	VIII, IX	0.31	31
Nitroaniline, 2-Methyl-5- (5-Nitro-o-toluidine)	99-55-8	C	VIII, IX	86.0269	8.6027

Table 7-7
Appendix IX Constituent List and Groundwater Concentration Limits

Hazardous Constituent	CAS[1] Number	Risk Category[2]	RCRA Listing[3]	Groundwater Concentration Limit[4] (mg/L)	Risk-Based Concentration for Cumulative Risk Evaluation[5] (mg/L)
Nitroaniline, 2- (o-Nitroaniline)	88-74-4	Tox	IX	12.6	550
Nitroaniline, 3- (m-Nitroaniline)	99-09-2	C, Tox	IX	8.90	13.5185
Nitroaniline, 4- (p-Nitroaniline)	100-01-6	C, Tox	VIII, IX	8.0	13.5185
Nitrobenzene	98-95-3	Tox	VIII, IX	20.9	17
Nitrophenol, 4-(p-Nitrophenol)	100-02-7	Tox	VIII, IX	0.0804	1,460
N-Nitrosodi-n-butylamine	924-16-3	C	VIII, IX	0.1030	0.0103
N-Nitroso di-n-propylamine	621-64-7	C	VIII, IX	0.4056	0.0406
N-Nitrosodiethylamine	55-18-5	C	VIII, IX	0.0189	0.0019
N-Nitrosodimethylamine	62-75-9	C, Tox	VIII, IX	0.0557	0.0056
N-Nitrosodiphenylamine	86-30-6	C, Tox	IX	0.351	57.9365
N-Nitroso-N-methylethylamine (N-Nitrosomethylethylamine)	10595-95-6	C	VIII, IX	0.1290	0.0129
N-Nitrosopyrrolidine	930-55-2	C	VIII, IX	1.3519	0.1352
Parathion	56-38-2	Tox	VIII, IX	0.103	1,095
PCB Aroclor 1016	12674-11-2	C, Tox	IX	0.007	2.5
PCB Aroclor 1221	11104-28-2	C, Tox	IX	0.007	2.5
PCB Aroclor 1232	11141-16-5	C, Tox	IX	0.007	2.5
PCB Aroclor 1242	53469-21-9	C, Tox	IX	0.007	2.5
PCB Aroclor 1248	12672-29-6	C, Tox	IX	0.007	2.5
PCB Aroclor 1254	11097-69-1	C, Tox	IX	0.007	2.5

Table 7-7
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Hazardous Constituent	CAS[1] Number	Risk Category[2]	RCRA Listing[3]	Groundwater Concentration Limit[4] (mg/L)	Risk-Based Concentration for Cumulative Risk Evaluation[5] (mg/L)
PCB Aroclor 1260	11096-82-5	C, Tox	IX	0.007	2.5
Pentachlorobenzene	608-93-5	Tox	VIII, IX	2.40	146
Pentachloronitrobenzene	82-68-8	Tox	VIII, IX	0.05**	1.0919
Pentachlorophenol	87-86-5	C, Tox	VIII, IX	19.5	5
Phenol	108-95-2	Tox	VIII, IX	828	54,750
Phenylenediamine, p- (4-Phenylenediamine)	106-50-3	Tox	IX	380	34,675
Phorate	298-02-2	Tox	VIII, IX	0.50	36.5
Pronamide	23950-58-5	Tox	VIII, IX	0.15	13,690
Pyrene	129-00-0	Tox	IX	0.01**	915
Pyridine	110-86-1	Tox	VIII, IX	1,825	182.5
Silvex; 2-(2,4,5-Trichlorophenoxy) Propionic Acid	93-72-1	Tox	VIII, IX	1.40	1,460
Styrene	100-42-5	Tox	IX	3.10	500
T, 2,4,5- (2,4,5-Trichlorophenoxyacetic Acid)	93-76-5	Tox	VIII, IX	2.20	1,825
TCDD 2,3,7,8- (Dioxin)	1746-01-6	C	VIII, IX	0.000193	0.0002
Tetrachlorobenzene, 1,2,4,5-	95-94-3	Tox	VIII, IX	0.003	55
Tetrachloroethane, 1,1,1,2-	630-20-6	C, Tox	VIII, IX	22.0914	2.2091
Tetrachloroethane, 1,1,2,2-	79-34-5	C, Tox	VIII, IX	2.83*	0.283
Tetrachloroethene	127-18-4	C, Tox	VIII, IX	2	25
Tetrachlorophenol, 2,3,4,6-	58-90-2	Tox	VIII, IX	10	5,475

Table 7-7
Appendix IX Constituent List and Groundwater Concentration Limits

Hazardous Constituent	CAS[1] Number	Risk Category[2]	RCRA Listing[3]	Groundwater Concentration Limit[4] (mg/L)	Risk-Based Concentration for Cumulative Risk Evaluation[5] (mg/L)
Tetraethyl Dithiopyrophosphate (Sulfotepp)	3689-24-5	Tox	VIII, IX	0.25	91.5
Toluene	108-88-3	Tox	VIII, IX	5.26	5,000
Toluidine, o-(2-Methylaniline)	95-53-4	C	VIII, IX	11.8287	1.1829
Toxaphene	8001-35-2	C	VIII, IX	0.0074	15
Trichlorobenzene, 1,2,4-	120-82-1	Tox	VIII, IX	3	350
Trichloroethane, 1,1,1-	71-55-6	Tox	VIII, IX	13.3	1,000
Trichloroethane, 1,1,2-	79-0-5	C, Tox	VIII, IX	44.2	25
Trichloroethene	79-1-6	C, Tox	VIII, IX	11	25
Trichlorofluoromethane	75-69-4	Tox	VIII, IX	11	6,441
Trichlorophenol, 2,4,5-	95-95-4	Tox	VIII, IX	12	250
Trichlorophenol, 2,4,6-	88-06-2	C, Tox	VIII, IX	8	18.25
Trichloropropane, 1,2,3-	96-18-4	C, Tox	VIII, IX	0.0818	0.0082
Trinitrobenzene, 1,3,5- (sym-trinitrobenzene)	99-35-4	Tox	VIII, IX	3.50	5,475
Vinyl Acetate	108-05-4	Tox	IX	200	2,060
Vinyl Chloride	75-1-4	C, Tox	VIII, IX	27.6	10
Xylenes	1330-20-7	Tox	IX	1.10	50,000
INORGANIC CONSTITUENTS					
Antimony	7440-36-0	Tox	VIII, IX	300	30
Arsenic	7440-38-2	C, Tox	VIII, IX	500	50
Barium	7440-39-3	Tox	VIII, IX	100,000	10,000
Beryllium	7440-41-7	Tox	VIII, IX	200	20
Cadmium	7440-43-9	Tox	VIII, IX	250	25
Chromium VI	18540-29-9	Tox	IX	5,000	500

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Hazardous Constituent	CAS[1] Number	Risk Category[2]	RCRA Listing[3]	Groundwater Concentration Limit[4] (mg/L)	Risk-Based Concentration for Cumulative Risk Evaluation[5] (mg/L)
Cobalt	7440-48-4	Tox	IX	36,500	3,650
Copper	7440-50-8	Tox	IX	65,000	6,500
Cyanide (free)	57-12-5	Tox	IX	10,000	1,000
Lead	7439-92-1	Tox	VIII, IX	750	75
Mercury	7487-94-7	Tox	VIII, IX	100	10
Nickel	7440-02-0	Tox	VIII, IX	36,500	3,650
Selenium	7782-49-2	Tox	VIII, IX	2,500	250
Silver	7440-22-4	Tox	VIII, IX	9,125	913
Thallium	7440-28-0	Tox	VIII, IX	100	10
Tin	7440-31-5	Tox	IX	1,000,000	109,500
Vanadium	7440-62-2	Tox	IX	1,825	183
Zinc	7440-66-6	Tox	IX	547,500	54,750

Table 7-7
Appendix IX Constituent List and Groundwater Concentration Limits

Hazardous Constituent	CAS[1] Number	Risk Category[2]	RCRA Listing[3]	Groundwater Concentration Limit[4] (mg/L)	Risk-Based Concentration for Cumulative Risk Evaluation[5] (mg/L)

Notes:

[1]CAS = Chemical Abstract Services

[2] C = Carcinogenic; Tox = Noncarcinogenic (i.e., systemic toxicant)

[3]RCRA Listing: VIII = 40 CFR Part 261, Appendix VIII; IX = 40 CFR Part 264, Appendix IX; --- = not listed in Appendix VIII or Appendix IX

[4]These groundwater concentration limits for organic hazardous constituents are based on one percent of the aqueous solubility limit for each hazardous constituent and are used as alternate concentration limits (ACLs) under 40 CFR 264.98. Where one percent of the aqueous solubility limit for a hazardous constituent exceeds the ACL (without the 10 percent safety factor) as determined in *Demonstration Report: Development of Sitewide Alternate Concentration Limits in Groundwater* (CH2M HILL, 2007c), the determined ACL is used (shown with an asterisk * in the table). Also, where one percent of the aqueous solubility limit for a hazardous constituent is less than the reporting limit for the hazardous constituent, the reporting limit is used (shown with two asterisks** in the table). The groundwater concentration limits for inorganic hazardous constituents are the ACLs (without the 10 percent safety factor and capped at one million parts per million where necessary).

[5]The risk-based concentrations for the Selah Member are based on the RBC for carcinogenic and non-carcinogenic ACLs, whichever is the lower concentration limit, times the 10 percent safety factor. These values will be used, if compliance monitoring becomes necessary, to assess the cumulative risk posed by detected constituents in groundwater. The values are not artificially capped because doing so would bias the cumulative risk calculation and not allow an accurate evaluation of cumulative risk to be completed.

TABLE 4-17-7 Constituent List & Groundwater Concentration Limits

5 PURGING AND SAMPLING PROCEDURES

Proper sampling procedures are the most important and fundamental aspects of an effective groundwater-monitoring program. Environmental quality sampling at the site will be accomplished by personnel trained in proper sampling protocol, in accordance with WM's *Groundwater, Surface Water, and Leachate Sampling Guide* (Appendix A). This document is generally consistent with Oregon guidance and ASTM standards and is intended to provide guidance to sampling teams. As site conditions change, activities related to monitoring at the site will be periodically reviewed for completeness.

The *Groundwater, Surface Water, and Leachate Sampling Guide* contains general procedures for the following activities:

- Activities Occurring Prior and Subsequent to Sample Collection
- Equipment and Materials
- Decontamination Procedures
- Field Record-Keeping and Comments
- Field Measurements
- Purging Procedures
- Sample Collection
- Preservation, Storage, and Shipment
- Field Chain-of-Custody Record
- Field Information Forms

Site-specific sampling procedures are discussed below. Section 5.1 presents the purging and sampling methodology and procedures to be used at the CWM Facility. Section 5.2 discusses other site-specific details regarding sampling activities.

5.1 Site-Specific Purging and Sampling Methodology I Rev. 6

The Facility's purging and sampling methodology in use at the Facility is a site-specific low-flow sampling procedure that is used at each Facilitymonitoring well where groundwater samples are collected. Following are discussions of The general design of the site-specific low-flow methodology (Section 5.1.1),, and the field procedures that comprise this purging and sampling method (Section 5.1.2).are presented below. The theory, methodology and specific details regarding the development of the site-specific methodology are included in Appendix B.

All new or replacement groundwater sampling pumps shall be dedicated bladder pumps unless the Department approves use of another type of pump or sampling device in writing. The Department's approval for alternative sampling equipment shall not be considered a permit modification.

5.1.1 General Design and Overview

The sampling methodology for the Facility's monitoring wells consists of the following elements:

- Static water levels are first measured at monitoring wells listed in Table 3-1 and at piezometers listed in Table 37-2. during a routine monitoring event. Static water levels are measured again before purging begins at as part of sampling the Facility's monitoring wells. The static water level is recorded on the Field Information Form (FIF). A FIF is contained in Appendix A.

- Groundwater purging and sampling are conducted using dedicated bladder pumps. Purging continues until 90 percent or more of the water that is purged during a 10-minute period consists of water derived from the formation~~ / ~~/sandpack. Once this criterion is met, the well is immediately sampled.

- If the well is too low-yielding to meet the drawdown criterion described in Table 7-8 and Appendix B, then purging is allowed to continue until the water level reaches a pre-determined depth above the pump (tabulated in Appendix ~~E~~B, Table 7-14). The depth at which purging stops for low-yielding wells depends on the amount of screen submergence prior to purging. Specifically, for low-yielding wells where the initial (static) water level is 10 ft or more above the top of the screen, purging stops once the water level is 1 ft above the screen, or earlier if deemed appropriate by the sampling team. For low-yielding wells with less initial screen submergence, purging is allowed to continue until the water level is lowered no more than halfway from the initial (static) water level to the pump intake. Once purging stops at a low-yielding well, the VOC samples ~~will~~shall be collected from that well within the next 48 hours. If the volume of water in the low-yielding well is too low to allow for collection of additional analytes (~~PCBs, ~~Appendix IX constituents, or other analytes), then the VOC samples ~~will~~shall be collected, and the sampling team ~~will~~shall return at a later time during the sampling event (as convenient) to collect the remaining samples. If a sample cannot be collected without exceeding the water level criteria shown in Appendix Table 7-14 during a sampling event and sampling at a depth below the water level criteria is required, the sampling team must document this on the FIF and the deviation from the site-specific sampling method must be explained in the semiannual report for the event.

- Field parameter measurements are recorded on the ~~Field Information Forms (FIFs).~~FIF. Where possible, the purging process continues until field parameters have stabilized. However, if one or more field parameters have not yet stabilized before the drawdown criterion is met, or if the water level drops to the pre-determined depth tabulated in Appendix ~~E~~B, Table 7-14, then the well is sampled before the field parameters stabilize.

A more detailed discussion of the design and implementation of the site-specific sampling methodology is included in Appendix B.

~~A drawdown criteria matrix was developed for field staff to look-up maximum allowed rates of drawdown given the purge rate, well diameter, and water level monitoring frequency. The drawdown criteria are shown in Table 5-1 for purge rates ranging from 0.01 gallons per minute (gpm) to 1 gpm; well diameters of 2, 4, and 5 inches; and water level measurement frequencies of 5 and 10 minutes. For each purge rate, each well diameter, and the two different measurement frequencies, the drawdown criteria were derived by the following calculation methodology:~~

- ~~Calculating the total volume of water purged during a given time interval (5 or 10 minutes);~~

- ~~Calculating 10 percent of the total purge volume; this 10 percent volume is the maximum amount of water during that time interval that is allowed to consist of resident water~~

inside the well casing (i.e., not derived from the formation / sandpack);

- Dividing the 10 percent volume by the horizontal area of the water column inside the well casing to determine the vertical amount of the water column that comprises the 10 percent volume; This water column height equals the maximum amount of water level decline (during a 5- or 10-minute time increment) for which no more than 10 percent of the purged water is comprised of resident water inside the well casing.

By drawing down the water column by no more than this incremental amount during the 5-minute or 10-minute time increment, the site-specific low-flow methodology is designed to provide (1) no more than 10 percent of the purge water from inside the well casing and (2) at least 90 percent of the purge water from the formation / sandpack.

An example of this calculation is shown below for a purge rate of 0.1 gpm, a 10-minute interval between water level measurements, and a 4-inch well diameter:

V_{purge} = Volume purged every 10 minutes = 0.1 gpm * 10 minutes = 1 gallon

$V_{max\text{-}casing}$ = Maximum allowed volume of water from casing during a 10-minute interval
= 10% * 1 gallon = 0.1 gallons
= 0.1 gallons * (12*12*12 inches^3 / ft^3) / (7.481 gallons/ft^3)
= 23.10 inches^3

A = Horizontal area of water column inside well
= π * d^2 / 4 = π * (4 inches)^2 / 4 = (3.14159 * 4) inches^2
= 12.5664 inches^2

H = maximum allowed water level decline during a 10-minute interval
= $V_{max\text{-}casing}$ / A
= 23.10 inches^3 / 12.5664 inches^2
= 1.838 inches
= 0.153 ft, or 0.15 ft when rounding to the nearest 1/100th of a foot

Similarly, for a 5-minute interval instead of a 10-minute interval, the purge rate of 0.1 gpm would result in a maximum allowed drawdown of 0.0765 ft for a 4-inch-diameter well. Because water levels are measured to the nearest 0.01 ft, the calculated drawdown criterion value of 0.0765 ft is rounded to 0.08 ft for the purposes of applying Table 5-1 in the field.

In the case where the formation is too low-yielding to allow the drawdown criteria to be achieved, purging is allowed to continue until the water level is no lower than 1 ft above the well screen (for wells with at least 10 ft of screen submergence prior to purging) or (for wells with less than 10 ft of screen submergence prior to purging) no lower than halfway from the initial (static) water level to the pump intake. (Appendix E identifies these values as the target depth for stopping purging.) For low-yielding wells, these purge depths result in a sufficient volume of water being present in the well to allow VOC samples to be collected. (As shown in Appendix E, the “maximum depth to water” that still provides sufficient sample volume is below the depth at which purging will stop; these “maximum” depths have been calculated from the well diameter; the purge tube diameter; the depth of the pump; and the “sampling volume” that is necessary to evacuate one purge-tube volume, evacuate one bladder volume, fill sample containers, collect a final set of field parameters, and provide additional volume to ensure that these activities can be completed.) For low-yielding wells, the sampling team will remove one purge volume of water before collecting the necessary samples.[1] The depth-to-water criteria will be updated in the future as needed (for example, when new pumps are installed, or when pumps are serviced and their intake depths change).

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APPENDIX F6

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[1] One purge volume of water equals the summed volumes of the purge tube (assumed to be full of water) and the

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pump's bladder (395 milliliters [mL]). See Appendix E. One purge volume will be evacuated before sampling for

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VOCs. If multiple sampling periods are required to collect additional analytes (PCBs, Appendix IX constituents, or

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other analytes), then one purge volume will again be evacuated before collecting the additional analytes.

The target depths for stopping purging (listed in Appendix E) were developed to serve as guidelines for how long to continue purging wells that are low-yielding (i.e., cannot be successfully low-flow sampled). For wells that can be low-flow sampled, the sampling team will attempt to conduct the site-specific low-flow sampling procedure while maintaining the water level above the target depth listed in Appendix E. However, at some wells, this procedure may be feasible only when the water level is lowered below the target depth listed in Appendix E. In such cases, preference will be given to conducting low-flow sampling, rather than stopping the purging process and returning later to the well to collect samples.

Field Procedures

The site-specific low-flow sampling method consists of the following field procedures:

- The well will initially be purged at a rate targeted to be 0.1 gpm (approximately 0.4 liters per minute [L/min]). Purging at this rate will continue until the amount of drawdown in the well is similar to the amount that has occurred historically when low-flow sampling efforts were successful. Select field parameters (pH, temperature, specific conductance, dissolved oxygen [DO], oxidation-reduction potential [ORP], depth to water, total gallons purged, and purge rate) will be measured once during initial evacuation of one purge volume and several times thereafter as described below.
- As the water level approaches the target low-flow water level achieved during previous successful low-flow sampling events, the purge rate will be reduced and purging will continue until the water level meets the drawdown criterion listed in Table 5-1 (for the purge rate and diameter of the well being purged). The depth-to-water (along with the other field parameters) will be recorded at least once every five minutes during this period and at the end of this period. Once the drawdown criterion is achieved, the sample will be collected.
- If the drawdown criterion cannot be achieved at the well, then the sampling team is allowed to purge the water level down to a pre-determined depth as discussed in Section 5.1.1. Appendix E and the Page 2 FIF forms identify the depth by which purging will stop (though purging may stop at a higher water level if deemed appropriate by the sampling team). VOC samples then will be collected within 48 hours of stopping the purging process. The sampling process will begin by first evacuating one purge volume of water; VOC sampling will proceed as soon as this purge volume has been evacuated. If the volume of water in the well is too low to allow for collection of additional analytes (PCBs, Appendix IX constituents, or other analytes), then the samples for VOCs will be collected and the sampling team will return at a later time during the sampling event (as convenient) to collect the remaining samples. If multiple sampling periods are required to collect the additional analytes, then one purge volume will again be evacuated before collecting the additional analytes.

Field parameter measurements that are conducted during purging and sampling will be recorded on the FIFs. Where possible, the purging process will continue until field parameters have stabilized. (Stabilization targets are included on the FIFs.) However, the field parameter measurements will not be used to evaluate stabilization of water quality or to guide decisions regarding the timing of sample collection. Instead, if one or more field parameters have not yet stabilized before the drawdown criterion have been achieved, or if the water level has dropped to the level described in the previous paragraph, then purging will stop and the well will be sampled. Field parameters will also be measured prior to, or at the conclusion of, the sample collection process.

5.2 Other Site-Specific Details

Following are discussions of The following additional site-specific sampling details are discussed below:

- Requirements for evaluating the presence of non-aqueous phase liquids (NAPLs)
- Use of FIFs
- Field parameter anomalies
- Purge water disposal

5.2.1 NAPL Detection

Section XI of the permit requires monitoring for light non-aqueous phase liquids (LNAPLs) and dense non-aqueous phase liquids (DNAPLs) during purging and sampling at compliance monitoring wells if compliance monitoring becomes necessary in the future. In this case, LNAPLs and DNAPLs will be monitored by visual inspection of the purge water and by analyzing (in the laboratory) for their dissolved fraction in monitoring wells completed in the Level 1 and Level 2 water-bearing zones of the Selah Formation.

5.2.25.2.1 Field Information Forms

A site-specific FIF has been prepared for groundwater monitoring activities at this Facility. The form consists of two pages (see Appendix EA). The first page is a basic FIF that is used at other facilities owned by WM. Page 1 of the FIF is to be filled out at wells where groundwaterincludes standard well purging and sampling is occurringinformation. The second page is a form that has been specifically developed for the sampling needs at the CWM Facility. In particular, this second page provides space for the sampling team to document the visual check for NAPL in compliance monitoring wells;to document whether water level recovery is sufficient to allow for sampling; and to record and track other purging and sample collection information.

5.2.35.2.2 Field Parameter Anomalies

Table 5-2 summarizes the Historical ranges of field parameters that have been recorded during prior sampling events at the Facility's wells. (Table 7-9). During purging, the sampling team willshall use Table 5-2the historical ranges as a guide to help identify whether field parameter readings for pH, specific conductance, and temperature are within expected ranges or are anomalous compared with the historical record.. If an anomaly is observed, this willshall be noted on the FIF and identified in the semi-annualsemiannual groundwater monitoring report. Table 7-9 will be updated as new or replacement wells are added to the detection monitoring program.

5.2.45.2.3 Purge Water Disposal I Rev. 6

During purging and sampling, purge water is placed in a 55-gallon drum firmly attached to the sampling trailer. or similar storage container. The purge water is then transferred to the onsite wastewater treatment facility for treatment and disposal.

Table ~~5-1~~7-8

Chemical Waste Management of the Northwest, Inc.

Feet of Allowed Water Level Decline Every 5 Minutes or Every 10 Minutes:

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Low-Flow Sampling With Formation Water Requirement = 90%

Last modified September 2011

Purge Rate (gpm)	Purge Rate (ml/min)	Purge Rate (ounces/min)	During a 5-Minute Interval: Total Volume Pumped During a 5-Minute Interval (Gallons)	During a 5-Minute Interval: Allowable Drawdown (feet) During a 5-Minute Interval: Well Diameter 2 inches	Well Diameter 4 inches	Well Diameter 5 inches	During a 10-Minute Interval: Total Volume Pumped During a 10-Minute Interval (Gallons)	During a 10-Minute Interval: Allowable Drawdown (feet) During a 10-Minute Interval: Well Diameter 2 inches	Well Diameter 4 inches	Well Diameter 5 inches
0.01	37.9	1.28	0.05	0.03	0.01	0.005	0.1	0.06	0.02	0.01
0.02	75.7	2.56	0.1	0.06	0.015	0.010	0.2	0.12	0.03	0.02
0.03	113.6	3.84	0.15	0.09	0.02	0.015	0.3	0.18	0.05	0.03
0.04	151.4	5.12	0.2	0.12	0.03	0.020	0.4	0.25	0.06	0.04
0.05	189.3	6.4	0.25	0.15	0.04	0.025	0.5	0.31	0.08	0.05
0.06	227.1	7.68	0.3	0.18	0.045	0.030	0.6	0.37	0.09	0.06
0.07	265.0	8.96	0.35	0.21	0.05	0.035	0.7	0.43	0.11	0.07
0.08	302.8	10.24	0.4	0.25	0.06	0.040	0.8	0.49	0.12	0.08
0.09	340.7	11.52	0.45	0.28	0.07	0.045	0.9	0.55	0.14	0.09
0.1	378.5	12.8	0.5	0.31	0.08	0.050	1	0.61	0.15	0.10
0.2	757.1	25.6	1	0.61	0.15	0.100	2	1.23	0.31	0.20
0.3	1135.6	38.4	1.5	0.92	0.23	0.145	3	1.84	0.46	0.29
0.4	1514.2	51.2	2	1.23	0.31	0.195	4	2.45	0.61	0.39
0.5	1892.7	64	2.5	1.53	0.38	0.245	5	3.06	0.77	0.49
0.6	2271.2	76.8	3	1.84	0.46	0.295	6	3.68	0.92	0.59
0.7	2649.8	89.6	3.5	2.14	0.54	0.345	7	4.29	1.07	0.69
0.8	3028.3	102.4	4	2.45	0.61	0.390	8	4.9	1.23	0.78
0.9	3406.9	115.2	4.5	2.76	0.69	0.440	9	5.51	1.38	0.88
1.0	3785.4	128.0	5	3.06	0.77	0.490	10	6.13	1.53	0.98

Notes:

gpm = gallons per minute mL = milliliters min = minute
1 gallon = 128 ounces = 3785.412 milliliters

Water level meters are measured to the nearest 100th of a foot

TABLE 7-8 Feet of Allowed Water Level Decline Every 5 Min/10 Min

Table 7-9

DEQ Issued**Historical Well Sampling Data Summary**

TABLE 5-1 Feet of Allowed Water Level Decline Every 5 Min/10 Min

Deleted Cells
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~~Table 5-2~~
~~Historical Well Sampling Data Summary~~
~~Chemical Waste Management of the Northwest, Inc.~~
~~Groundwater Monitoring Plan~~

~~Chemical Waste Management of the Northwest, Inc.~~
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Well Information					Historical Data		
Well ID Number	Monitoring Program	Location Monitored	Well Depth[1]	Elevation At TOC	Temperature (degC)[2]	pH (pH Units)[2]	Specific Conductance (umhos/cm)[2]
La-2	RCRA/TSCA	WMA-1	248.79	1037.74	13.9 – 20.2	7.07 – 7.74	277 – 410
2E-9	RCRA	WMA-2	194.30	1017.96	14.74 – 15.89	7.09 – 7.58	234 – 317
2Ua-1	RCRA/TSCA	WMA-1	234.74	1031.35	12.3 – 19.5	7.02 – 8.27	209 – 343
2U-2	RCRA/TSCA	WMA-1	265.70	1031.39	13.6 – 17.6	6.74 – 7.41	239 – 323
3H-1	RCRA	WMA-2	186.07	1016.62	13.62 – 16.00	7.10 – 7.28	355 – 401
3P-1	RCRA	WMA-3	222.10	1025.84	14.1 – 18.4	6.56 – 8.43	230 – 314
3P-2	RCRA	WMA-3	243.71	1026.65	14.0 – 16.8	6.75 – 9.24	206 – 292
3Q-1	RCRA/TSCA	WMA-1	232.70	1027.28	12.3 – 19.6	7.58 – 8.99	171 – 379
3Q-2	RCRA/TSCA	WMA-1	258.20	1027.36	13.2 – 17.8	7.16 – 8.49	275 – 433
3R-1	RCRA	WMA-3	183.60	1010.9	14.1 – 20.4	7.12 – 8.07	199 – 306
3S-1	RCRA/TSCA	WMA-1	193.30	991.57	16.6 – 23.8	7.02 – 8.16	240 – 380
3S-2	RCRA/TSCA	WMA-1	216.70	990.86	11.2 – 18.4	7.00 – 8.03	252 – 453
3Ta-1	RCRA/TSCA	WMA-1	238.30	1029.9	12.2 – 19.2	7.25 – 8.67	206 – 369
3T-2	RCRA/TSCA	WMA-1	265.30	1030.26	14.3 – 17.4	7.00 – 7.96	280 – 410
3V-2	RCRA	WMA-2	196.28	1001.26	13.3 – 16.9	7.10 – 7.99	201 – 326
4B-1	RCRA/TSCA	WMA-3	216.77	1027.88	15.0 – 16.6	7.31 – 8.34	238 – 388
4Ba-2	RCRA/TSCA	WMA-3	242.30	1028.29	7.1 – 17.9	7.06 – 8.05	217 – 286
4H-1	RCRA/TSCA	WMA-2	199.70	1021.43	13.6 – 20.2	7.49 – 8.16	242 – 378
4H-2	RCRA/TSCA	WMA-2	204.70	1021.29	14.2 – 16.6	7.38 – 7.99	244 – 364
5A-1	RCRA	WMA-3	208.17	1017.04	14.3 – 17.9	6.87 – 8.63	227 – 338
5A-2	RCRA	WMA-3	232.15	1017.41	14.7 – 18.3	6.98 – 7.81	214 – 324
5B-1	RCRA/TSCA	WMA-3	213.96	1026.36	14.2 – 19.6	6.31 – 8.28	208 – 344
5B-2	RCRA/TSCA	WMA-3	244.32	1026.72	14.9 – 18.7	6.68 – 7.78	223 – 416
5D-1	RCRA/TSCA	WMA-3	217.27	1033.34	12.9 – 17.8	7.33 – 8.13	218 – 364
5D-2	RCRA/TSCA	WMA-3	242.24	1033.38	11.7 – 17.2	6.90 – 7.77	205 – 312
5L-1	RCRA/TSCA	WMA-1	211.71	1002.39	12.0 – 17.4	7.35 – 8.63	217 – 345
5L-2	RCRA/TSCA	WMA-1	226.14	1002.85	14.5 – 17.4	6.84 – 8.66	211 – 321
5M-1	RCRA/TSCA	WMA-1	229.69	1021.38	15.5 – 18.0	7.59 – 8.30	237 – 340
5M-2	RCRA/TSCA	WMA-1	245.52	1019.23	14.0 – 17.7	7.24 – 8.11	274 – 353

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~~**TABLE 5-2 Historical Well Sampling Data Summary**~~

Table 5-2 (continued)

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Historical Well Sampling Data Summary

Chemical Waste Management of the Northwest, Inc.
Groundwater Monitoring Plan

Well Information					Historical Data		
Well ID Number	Monitoring Program	Location Monitored	Well Depth[1]	Elevation At TOC	Temperature (degC)[2]	pH (pH Units)[2]	Specific Conductance (umhos/cm)[2]
5N3P-1	RCRA/TSCA	WMA-1	234.90222.1	1031.721025.84	14.8 - 21.61 - 19.2	7.246.56 - 8.7343	230 - 314236 - 355
5N-23R-1	RCRA/TSCA	WMA-1	260.88183.6	1031.921010.9	10.6 - 17.614.1 - 20.4	7.4912 - 8.7907	210 - 405199 - 318
5P3Ta-1	RCRA/TSCA	WMA-1	227.89238.3	1029.91025.56	14.8 - 20.312.2 - 19.2	7.1624 - 8.2267	206 - 369230 - 335
5P-24H-1	RCRA/TSCA	WMA-12	246.98199.7	1024.91021.43	1413.4 - 19.420.2	7.14 - 7.736.16 - 8.30	219 - 330151 - 382
5A-1	RCRA	WMA-1	208.17	1017.04	14.3 - 18.7	6.87 - 8.63	227 - 338
5Q5L-1	RCRA/TSCA	WMA-1	211.71233.01	1002.391035.65	13.812.0 - 19.30	6.94 - 7.9635 - 8.63	245 - 395217 - 345
5M-1	RCRA/TSCA	WMA-1	229.69	1021.38	15.4 - 21.7	7.41 - 8.30	237 - 340
5Q-25N-1	RCRA/TSCA	WMA-1	253.67234.9	1035.811031.72	13.6 - 2014.1 - 21.6	7.22 - 7.9324 - 8.73	236 - 355248 - 389
5R-25P-1	RCRA/TSCA	WMA-1	254.07227.89	1037.331025.56	14.8 - 18.920.3	7.01 - 7.8100 - 8.22	230 - 335252 - 374
5S5Q-1	RCRA/TSCA	WMA-1	233.01224.81	1037.871035.65	9.713.8 - 19.93	6.94 - 7.07 - 7.9296	255158 - 395
6C-9	RCRA	WMA-1	207.909	1018.66	13.8 - 18.2	6.84 - 8.127	240 - 360
6G-1	RCRA/TSCA	Background	149.96	995.70	15.8 – 15.64	7.49 - 7.76	257 - 299
6G-2	RCRA/TSCA	Background	172.63	995.87	16.1 – 16.79	6.25 – 7.09	308 - 366
7A-1	RCRA/TSCA	WMA-2	152.46	990.47	14.5 - 16.217.3	7.296.79 - 8.34	204 - 376
7A-2	RCRA/TSCA	WMA-2	193.39	990.11	14.9 - 16.4	7.16 - 8.54	222 - 371
7B-1	RCRA/TSCA	WMA-2	169.01	1003.59	1514.7 - 17.5 - 16.9	7.2614 - 9.61	325282 - 430

7C-1	RCRA/TSCA	WMA-2	190.45	1018.13	15.413.8 - 17.56	7.186.72 - 8.0318	217 - 391
7C-2	RCRA/TSCA	WMA-2	215.90	1017.38	14.7 - 17.3	7.23 - 8.66	223 - 320
7D-1	RCRA/TSCA	WMA-2	198.606	1022.18	14.4 - 17.06	7.09 - 7.83	255 - 380
7D-2	RCRA/TSCA	WMA-2	216.96	1021.72	7.1 - 16.8	7.38 - 7.85	254 - 425
7E-2	RCRA	WMA-3	223.99	1013.94	11.6	7.6	259.9
Notes:							

degC = degrees Celsius; mumhos/cm = micromhos per centimeter; TOC = top of casing RCRA = Resource Conservation and Recovery Act

[1] Measured from the top of the well casing to the bottom of the sump.
[2] The range of parameter values are representative of the typical range observed at the well but are not intended to be an exhaustive representation of all values measured since the well was constructed.

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TABLE 7-9 Historical Well Sampling Data Summary

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6 LABORATORY ANALYSIS PLAN

This section describes the procedures for completing successful laboratory analyses of the samples that are collected from the site.

6.1 Analytical Laboratory

The analytical laboratories which have been approved by CWMCWMNW for the groundwater - monitoring program include but are not limited to:

Test America**Primary Laboratory:**

Eurofins TestAmerica (Eurofins) Laboratories (Denver)
4955 Yarrow Street
Arvada, CO 80002
(303) 421-6611
527-3272; (716) 691-7991 (Fax)

Test America Laboratories (Buffalo)
10 Hazel Drive
Amherst, NY 14228
; (303) 431-7171 (Fax) (800)

Subcontract Laboratory for Eurofins Denver (PFAS Analysis):
Eurofins, Sacramento
880 Riverside Parkway
West Sacramento, CA 95605
(916) 373-5600

Samples collected at the CWMCWMNW Facility will be sent to the Denver lab unless otherwise requested by CWMCWMNW.

6.2 Program Quality Assurance / Quality Control Procedures

Trip blanks, equipment blanks, and field blanks provide quality assurance/quality control measures for the groundwater monitoring programs at the Facility. Blank samples will be prepared, collected, and handled using the procedures specified in Section 4.2.5 of the *Groundwater, Surface Water, and Leachate Sampling Guide* (Appendix A).program at the Facility. The following blanks will be collected:

- **Trip Blanks.** One trip blank will be included in each cooler shipped to the lab that contains VOC samples. The sample designation will be TB-##, starting with TB-01 for the first trip blank. Trip blanks will be analyzed for VOCs only.
- **Field Blanks.** At least one field blank will be analyzed for the first 10 samples or less. For each groundwater sampling day, at least one field blank sample will be collected for each day of sampling, and for each the first 10 (or less) groundwater samples. If more than 10 samples are collected in a single day, an additional field blank sample will be collected for each subsequent 10 groundwater wells samples, whichever is greater. The field blank will be prepared in the field (at the sampling site) using laboratory-supplied bottles and laboratory-supplied high-pressure liquid chromatography (HPLC) organic-free water. Field blanks for PFAS samples will consist of a field reagent blank of PFAS-free deionized water (DI) mixed with the preservative at the lab. The preserved DI water will be poured into an empty plastic bottle in the field. The sample designation will be FB-##, starting with FB-01 for the first field blank. Field blanks will be analyzed for

VOCs only.

- **Equipment Blanks.** These samples will be collected from non-dedicated and non-disposable sampling equipment that is lowered into a well. One blank will be collected for each piece of non-dedicated equipment that is used during the sampling event. The equipment blank will be prepared in the field (at the sampling site) using laboratory-supplied bottles and laboratory-supplied HPLC organic-free water. The equipment blanks will be collected by pouring the laboratory-supplied water into or over the non-dedicated and non-disposable equipment (after it has been properly decontaminated), then pouring the sample into the equipment blank sample bottles. The sample designation will be EB-##, starting with EB-01 for the first equipment blank. Each equipment blank will be analyzed for the same constituents as those being analyzed in samples collected from the well where the non-dedicated and non-disposable equipment is used. Preservation and filtering requirements for the equipment blank sample will also be the same as for the parent sample collected from the well where the non-dedicated and non-disposable equipment is used.

- **Quality Assurance Duplicate.** One duplicate sample will be collected and submitted for analysis for every 10 samples collected in the field. One of the duplicate samples will be collected from a compliance monitoring well. Duplicate samples will be collected using laboratory-supplied bottles. The sample designation will be DUP-##, starting with DUP-01 for the first duplicate sample. The FIF for the well where a duplicate sample is collected will indicate that a duplicate sample was collected and show the ID for the duplicate sample. Because the FIFs for a sampling event will show where the duplicate samples are taken, the laboratory will not receive the FIFs until at least 7 days after sample receipt. Each duplicate sample will be analyzed for the same constituents as the parent sample. Preservation and filtering requirements for the duplicate sample will also be the same as for the parent sample.

6.3 Laboratory Quality Control Procedures

The quality assurance program for the analytical laboratory, Test AmericaEurofins Laboratories (Denver) is described in their Quality Management Plan (QMP) and their Laboratory Quality Manual (LQM), which are available from CWM upon request. The QMP and LQM describe mechanisms the laboratory employs to ensure that the reported data meet or exceed all applicable EPA and State requirements. These documents describe the laboratory's experience, its organizational structure, and procedures in place to ensure quality of the analytical data. The QMP and LQM outline the samplingsample preparation, analysis, and reporting procedures used by the laboratory. The laboratory is responsible for the implementation of, and adherence to, the quality assurance and quality control requirements outlined in these QA manuals.

Audits are an important component of the quality assurance program at the laboratory. Audits are conducted by the laboratory, by CWM's clients, and by regulatory authorities. Internal system and performance audits are conducted periodically to ensure adherence by all laboratory departments to the QMP, LQM, and standard operating procedures (SOPs) for each analytical method. External audits are conducted by accrediting agencies or states. These reports are transmitted to department managers for review and response. Corrective measures must be taken for findings or deficiencies that are found in an internal or external audit.

Data Quality Reviews (DQR), or equivalent, are requests submitted to the laboratory to formally review results that differ from historical results, or results that exceed certain permit requirements or quality control criteria. The laboratory prepares a formal written response to each DQR explaining the discrepancy. The DQR is the first line of investigation following an inquiry of a potentially anomalous result.

6.4 Analytical Methods

Table 6-17-10 presents the analytical methods to be used by the laboratory for each of the parameters analyzed for in the various monitoring programs conducted at the Facility. The methods listed in Table 6-17-10 are EPA-approved and are fully described in the laboratory's standard operating procedure documents.

Table 6-1 Rev. 6 7-10
Laboratory Analytical Methods

Chemical Constituent	Method Description	Reference Method [a, b]
DETECTION MONITORING		
VOCs	Purge & Trap GC/MS	8260B or equivalent
1,4-Dioxane	Purge & Trap GC/MS	8260 SIM
COMPLIANCE MONITORING		
VOCs	Purge & Trap GC/MS	8260B or equivalent
TSCA MONITORING		
PCBs	GC	8082 or equivalent
APPENDIX IX MONITORING		
VOCs	Purge & Trap GC/MS	8260B or equivalent
Semi-VOCs	GC/MS with Continuous Liquid-Liquid Extraction	8270C or equivalent
Chlorinated Herbicides	GC	8151A or equivalent
Organochlorinated Pesticides	GC	8081A or equivalent
PCBs	GC	8082 or equivalent
Dioxins/Furans	HRGC/LRMS	8280A or equivalent
Dissolved Metals	ICP	6010B or equivalent
Mercury	Manual Cold-Vapor	7470A or equivalent
Total Sulfide	Acid-Soluble and Acid-Insoluble Sulfides: Distillation/Titration	9030B/9034 or equivalent
Total Cyanide	Automated Colorimetric with Offline Distillation	9012A or equivalent
NON -REGULATED SUBSTANCES MONITORING		
PFAS	Isotope Dilution LC/MS/MS or equivalent	537.1 (modified) or 1633 or equivalent

Notes:
GC = gas chromatography; GC/MS = gas chromatography/mass spectrometry; LC /MS/MS= liquid chromatography tandem mass spectrometry; HRGC/LRMS = high resolution gas chromatography/low resolution mass spectrometry
ICP = inductively coupled plasma; PCBs = polychlorinated biphenyls; VOCs = volatile organic compounds; PFAS = per- and polyfluoroalkyl substances

[a] Reference: U.S. EPA, 1986. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846*, 3rd Edition, Update 0.and its updates. Analytical methods provided in this Plan may be substituted provided that the alternate methods are approved for use by the DEQ.

[b] Reference: U.S. EPA, 2020. *Method 537.1 Determination of Selected Per- and Polyflourinated Alkyl Substances in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS). U.S. Environmental Protection Agency, Washington, DC, April 2020.* The modified 537.1 used by the contract analytical laboratory method allows for analysis of additional PFAS compounds for non-potable water and solid matrices. Method 1633 is currently in draft form.

TABLE 6-17-10 Laboratory Analytical Methods

7 DATA QUALITY REVIEW, REPORTING AND RECORD-KEEPING

Prior to submitting a monitoring report to DEQ, several data evaluation, reporting, and record-keeping tasks will be implemented. The following sections describe the evaluation, reporting and record-keeping procedures that are followed upon receipt of the laboratory's analytical report.

7.1 Data Quality Review

Each analytical report received from the laboratory will undergo two levels of data quality assessmentevaluation: initial QA/QC checks, and qualitative data evaluation. These data quality assessmentevaluation procedures are described below.

7.1.1 Initial QA/QC Checks

Before the data are subjected to statistical analysis, the quality control information accompanying the data report from the laboratory will be examined. Relevant quality control data include measures of accuracy (percent recovery), precision (relative percent difference, RPD), and sample contamination (blank determinations). Data that fail one or more of these checks will be flagged for closer evaluation and a DQR. Results of the DQR will be submitted with the analytical data in the routine monitoring report. (See Section 6.3, Laboratory Quality Control Procedures for a general description of a DQR.) A brief summary of these relevant quality control data follows. A more complete description is contained in the laboratory's Quality Management Plan (QMP).

Accuracy defines the relationship between the laboratory's measurement of a sample's concentration and the "true", but unknown concentration of the sample. Because the "true" concentration is unknown, accuracy must be measured indirectly by determining the percent recovery of a sample "spiked" with a known amount of select analytes. This sample, which is called the matrix spike (MS), is analyzed under the same conditions as the groundwater sample and its concentration is determined. Because the MS has a known concentration, itsit's percent recovery can be calculated. It is assumed that the groundwater sample behaves exactly like the MS and thus the "true" concentration of the submitted groundwater sample can be back-calculated. Control criteria for percent recovery are taken from regulatory method requirements.

Precision is the assessment of the variability that can be expected in data that result from the analytical procedures employed. Precision is a measure of the reproducibility that is estimated through duplicate measurements of a matrix spike. Two matrix spike samples are prepared as described above, a MS and a matrix spike duplicate (MSD). Both spikes are analyzed along with the unknownenvironmental sample and the "relative percent difference" (RPD) between the two spikes is determined. Control criteria for RPD are taken from regulatory method requirements.

The potential for sample contamination is assessed by measurements of "blank" samples. Blanks are samples of ultra-pure (HPLC) laboratory water that are not spiked with analytes and are carried through the field sampling and laboratory environments. As discussed in Section 6.2, These samples are known as "lab," "field," "trip," and "equipment" blanks. It is assumed that any constituents that occur in the field or laboratory that might add to the concentration of the constituent reported in the environmental sample will be picked up by the blank samples and measured. If any of the constituents of interest are found in the blank samples, it is an indication of potential contamination of the unknownenvironmental sample.

7.1.2 Qualitative Data Evaluation

Following the initial QA/QC checks, the laboratory data will undergo a second level of review by comparing new results with historical trendsdata to identify (and if necessary flag) visual outliers or other anomalous data. If a clearly anomalous result is found, a DQR will be initiated with the laboratory to ascertain if laboratory error is involved, and field information will be checked for anomalous occurrences or observations that might help to explain an outlier result.

7.2 Data Presentation and Reporting

The results of field and laboratory analyses performed for groundwater samples collected under the *Groundwater Monitoring*this Plan and the Part B Permit will be reported to DEQ. Laboratory data will be presented on laboratory transmittal sheets and will include the following information:

- Sample identification number and date of analysis;:
- Analytical results for the requiredregulated and unregulated sample parameters, as well as results for QA/QC duplicates and test blanks, reported to the Method Detection Limits (MDLs) and to the Reporting Limits (RLs);, which are equivalent numerically to Practical Quantification Limits (PQLs). Reporting limitsRLs for detection monitoring constituents are listed in Table 7-1. Reporting limits11. Target RLs for non-regulated PFAS constituents are listed in Table 7-12. RLs for the complete list of Appendix IX constituents are listed in Table 7-2 ;13:
- Description of analytical procedures and QA/QC protocol; and
- Chain-of-custody form.

Monitoring data will be submitted in semiannual reports that summarize the detection (and if necessary, in the future compliance monitoring) activities that took place during the sampling event. The report will provide the following information:

- A summary of field activities, including the FIFs, the dates of field activities, significant field sampling issues that occurred during the event, and associated corrective actions that were taken. This will include the identity of wells associated with blind duplicate samples, equipment blanks, trip blanks, and field blanks:
- A discussion of groundwater elevations, flow directions, and estimated flow velocities. This information will be presented in the second semiannual monitoring report for each calendar year. This information will include summary tables of the depth to groundwater and corresponding groundwater elevations; graphs of potentiometric levels versus time for monitoring wells with available historical data included in the Phase 1 or long-term optimized program, as applicable; contour maps of groundwater elevations in the Selah Level 1 and Level 2 water-bearing zones for the second (Fall) semiannual water level measurement event; a summary table showing groundwater velocity calculations for Selah Level 1 and Selah Level 2 during the Fall event; and a written review of the adequacy of the groundwater monitoring system relative to observed groundwater flow directions beneath each WMA;
- Summary tables of the analytical results of the detection monitoring program. Concentrations between the RL and MDL will be flagged with a “J” qualifier and identified in the report as estimated values:
- Significant QA/QC issues that were reported by the analytical laboratory, including any corrective action taken:

- Exceedances (if any) of the detection monitoring criteria:
- Exceedances (if any) of groundwater concentration limits that are associated with possible future compliance monitoring programs at the Facility:
- Time-trend graphs of specific conductance, including identifying potentially anomalous measurements:
- Time-trend graphs of VOC concentrations detected above the RL (in the second [Fall] semiannual monitoring report); and
- Recommendations for additional field activities, if any.

As part of the reporting process, analytical results will also be submitted electronically in a format acceptable to DEQ. Other details regarding the reporting requirements (for example, submittal deadlines) are provided in the

Table 7-1 Reporting Limits for Groundwater Samples			
Volatile Organic Constituents (EPA method 8260B)	Reporting Limit (µg/L)	TSCA Constituents (EPA Method 8082)	Reporting Limit (µg/L)

" Reporting" section of this plan.

7.3 Data Record-Keeping Requirements

The laboratory maintains a complete set of records for all samples received for a minimum period of five years as per ORELAP requirements. Laboratory records may be in a paper (logbook) or electronic format such as those maintained in the laboratory information management system (LIMS). The contents include records of sample receipt and acceptance, testing, electronic instrument files, reporting, and sample disposal such that the quality control and testing results may be reconstructed and reviewed upon request. The laboratory will have a record's retention and security policy for access to records. Electronic records will be backed up, stored and remain accessible for the required retention period.

Table 7-11
Reporting Limits for Detection Monitoring Program Groundwater Samples

Volatile Organic Constituents (EPA method 8260B)	Reporting Limit (µg/L)	TSCA Constituents (EPA Method 8082)	Reporting Limit (µg/L)
Acetone	10	Aroclor 1016	1
Benzene	1	Aroclor 1221	1
Bromodichloromethane	1	Aroclor 1232	1
Bromoform	1	Aroclor 1242	1
Bromomethane	2	Aroclor 1248	1
Carbon disulfide	1	Aroclor 1254	1
Carbon tetrachloride	1	Aroclor 1260	1
Chlorobenzene	1		
Chlorodibromomethane	1		
Chloroethane	2		
Chloroform	1		
Chloromethane	2		
Dichlorobenzene, 1,2-	1		
Dichlorobenzene, 1,4-	1		
Dichlorodifluoromethane	2		
Dichloroethane, 1,1-	1		
Dichloroethane, 1,2-	1		
Dichloroethene, 1,1-	1		
Dichloroethene, cis-1,2-	1		
Dichloroethene, trans-1,2-	1		
Dichloropropane, 1,2-	1		
Dichloropropene, cis-1,3-	1		
Dichloropropene, trans-1,3-	1		
~~Dioxane, 1,4-~~	~~20*~~		
Dioxane, 1,4-	20		
Ethyl benzene	1		
Hexachlorobutadiene	1		
MEK (2-butanone)	5		
Methyl-2-pentanone, 4-	5		
Methylene chloride	5		
Naphthalene	1		
Styrene	1		
Tetrachloroethane, 1,1,2,2-	1		
Tetrachloroethene	1		
Toluene	1		
Trichlorobenzene, 1,2,4-	1		
Trichloroethane, 1,1,1-	1		
Trichloroethane, 1,1,2-	1		
Trichloroethene	1		
Trichlorofluoromethane	2		
Vinyl chloride	1		
Xylenes (total)	2		

~~Reporting limits shown in this table assume that no sample dilution is necessary. Actual reporting limits may be higher if dilution is necessary or if blank contamination is detected.~~
~~*1-4 Dioxane detection limit is for 8260 SIM method.~~

Notes: RCRA = Resource Conservation and Recovery Act; TSCA = Toxic Substances Control Act µg/L = micrograms per liter [1] Reporting limits shown in this table assume that no sample dilution is necessary. Actual reporting limits may be higher if dilution is necessary or if blank contamination is detected. Reporting limits shown in this table may change based upon the laboratory's annual verification of method detection limits and assessment of precision and bias.

TABLE 7-111 Reporting Limits for Regulated Groundwater Samples

Table 7-2

List Of Reporting Limits for

Full Appendix IX List of Constituents

Chemical Waste Management of the Northwest, Inc.

Arlington, Oregon

Table 7-12
Reporting Limits for Non-Regulated Groundwater Samples

PFAS Constituents by EPA Method 537.1 (modified)[1] or 1633	Target Reporting Limit (ng/L)[2]
10:2 FTS	2
4:2 FTS	2
6:2 FTS	5
8:2 FTS	2
4,8-dioxa-3H-perfluorononanoic acid (ADONA)	2
F-53B Major	2
F-53B Minor	2
HFPO-DA (GenX)	4
N-ethylperfluorooctanesulfonamidoacetic acid (NEtFOSSA)	5
N-methylperfluorooctanesulfonamidoacetic acid (NMeFOSSA))	5
Perfluorobutanesulfonic acid (PFBS)	2
Perfluorobutanoic acid (PFBA)	5
Perfluorodecanesulfonic acid (PFDS)	2
Perfluorodecanoic acid (PFDA)	2
Perfluorododecanesulfonic acid (PFDoS)	2
Perfluorododecanoic acid (PFDoA)	2
Perfluoroheptanesulfonic Acid (PFHpS)	2
Perfluoroheptanoic acid (PFHpA)	2
Perfluorohexanesulfonic acid (PFHxS)	2
Perfluorohexanoic acid (PFHxA)	2
Perfluoro-n-hexadecanoic acid (PFHxDA)	2
Perfluoro-n-octadecanoic acid (PFODA)	2
Perfluorononanesulfonic acid (PFNS)	2
Perfluorononanoic acid (PFNA)	2
Perfluorooctanesulfonamide (FOSA)	2
Perfluorooctanesulfonic acid (PFOS)	2
Perfluorooctanoic acid (PFOA)	2
Perfluoropentanesulfonic acid (PFPeS)	2
Perfluoropentanoic acid (PFPeA)	2
Perfluorotetradecanoic acid (PFTeA)	2
Perfluorotridecanoic acid (PFTriA)	2
Perfluoroundecanoic acid (PFUnA)	2

Notes:
ng/L = nanograms per liter; PFAS = Per- and Polyflourinated Alkyl Substances

[1]Method 537.1 Determination of Selected Per- and Polyflourinated Alkyl Substances in Drinking Water by Solid Phase Extraction and Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS). U.S. Environmental Protection Agency, Washington, DC, April 2020. The modified 537.1 used by the contract analytical laboratory method allows for analysis of additional PFAS.
[2] Reporting limits shown in this table assume that no sample dilution is necessary. Actual reporting limits may be higher if dilution is necessary or if blank contamination is detected. Reporting limits shown in this table may change based upon the laboratory's annual verification of method detection limits and assessment of precision and bias.

TABLE 7-12 Reporting Limits for Non-Regulated Groundwater Samples

Table 7-13 Full Appendix IX List of Constituents
Chemical Waste Management of the Northwest, Inc. Arlington, Oregon

METHOD #	TEST DESCRIPTION	Units	Reporting Limit
8260B	Acetone	ug/L	10
8260B	Acetonitrile	ug/L	20
8260B	Acrolein	ug/L	20
8260B	Acrylonitrile	ug/L	20
8260B	Benzene	ug/L	1
8260B	Bromodichloromethane	ug/L	1
8260B	Bromoform	ug/L	1
8260B	Bromomethane	ug/L	2
8260B	Carbon disulfife	ug/L	1
8260B	Carbon tetrachloride	ug/L	1
8260B	Chlorobenzene	ug/L	1
8260B	Chloroprene	ug/L	1
8260B	Dibromochloromethane	ug/L	1
8260B	Chloroethane	ug/L	2
8260B	Chloroform	ug/L	1
8260B	Chloromethane	ug/L	2
8260B	Allyl chloride	ug/L	2
8260B	Dibromomethane	ug/L	1
8260B	1,2-Dichlorobenzene	ug/L	1
8260B	1,4-Dichlorobenzene	ug/L	1
8260B	trans-1,4-Dichloro-2-butene	ug/L	1
8260B	Dichlorodifluoromethane	ug/L	2
8260B	1,1-Dichloroethane	ug/L	1
8260B	1,2-Dichloroethane	ug/L	1
8260B	1,1-Dichloroethene	ug/L	1
8260B	cis-1,2-Dichloroethene	ug/L	1
8260B	trans-1,2-Dichloroethene	ug/L	1
8260B	1,2-Dichloropropane	ug/L	1
8260B	cis-1,3-Dichloropropene	ug/L	1
8260B	trans-1,3-Dichloropropene	ug/L	1
8260SIM	1,4-Dioxane (8260SIM)	ug/L	20
8260B	Ethylbenzene	ug/L	1
8260B	Ethyl methacrylate	ug/L	1
8260B	Trichlorofluoromethane	ug/L	2
8260B	Hexachlorobutadiene	ug/L	1
8260B	2-Hexanone	ug/L	5
8260B	Iodomethane	ug/L	1
8260B	Isobutyl alcohol	ug/L	50
8260B	Methacrylonitrile	ug/L	10
8260B	Methylene chloride	ug/L	5
8260B	Methyl methacrylate	ug/L	4
8260B	4-Methyl-2-pentanone	ug/L	5
8260B	Naphthalene	ug/L	1
8260B	Propionitrile	ug/L	10
8260B	Styrene	ug/L	1
8260B	1,1,1,2-Tetrachloroethane	ug/L	1
8260B	1,1,2,2-Tetrachloroethane	ug/L	1
8260B	Tetrachloroethene	ug/L	1
8260B	Toluene	ug/L	1
8260B	1,2,4-Trichlorobenzene	ug/L	1
8260B	1,1,1-Trichloroethane	ug/L	1
8260B	1,1,2-Trichloroethane	ug/L	1
8260B	Trichloroethene	ug/L	1
8260B	1,2,3-Trichloropropane	ug/L	1
8260B	Vinyl acetate	ug/L	2
8260B	Vinyl chloride	ug/L	1
8260B	Xylenes (total)	ug/L	2
8260B	1,2-Dibromo-3-chloropropane (DBCP)	ug/L	2
8260B	1,2-Dibromoethane (EDB)	ug/L	1
8260B	2-Butanone (MEK)	ug/L	5
8270C	Acenaphthene	ug/L	10
8270C	Acenaphthylene	ug/L	10
8270C	Acetophenone	ug/L	10
8270C	2-Acetylaminofluorene	ug/L	100
8270C	4-Aminobiphenyl	ug/L	50
8270C	Aniline	ug/L	10
8270C	Anthracene	ug/L	10
8270C	Benzo(a)anthracene	ug/L	10
8270C	Benzo(b)fluoranthene	ug/L	10
8270C	Benzo(k)fluoranthene	ug/L	10
8270C	Benzo(ghi)perylene	ug/L	10
8270C	Benzo(a)pyrene	ug/L	10
8270C	Benzyl alcohol	ug/L	10
8270C	bis(2-Chloroethoxy)methane	ug/L	10
8270C	bis(2-Chloroethyl) ether	ug/L	10
8270C	bis(2-Ethylhexyl) phthalate	ug/L	10
8270C	4-Bromophenyl phenyl ether	ug/L	10
8270C	Butyl benzyl phthalate	ug/L	10
8270C	4-Chloroaniline	ug/L	10
8270C	4-Chloro-3-methylphenol	ug/L	10
8270C	2-Chloronaphthalene	ug/L	10
8270C	2-Chlorophenol	ug/L	10
8270C	4-Chlorophenyl phenyl ether	ug/L	10

TABLE 7-13 List of Appendix IX Constituents

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Table 7-13 Full Appendix IX List of Constituents (continued)
Chemical Waste Management of the Northwest, Inc. Arlington, Oregon

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TABLE 7-2 List of Reporting Limits of Constituents

Table 7-2 (continued)
List Of Reporting Limits for
Full Appendix IX List of Constituents
Chemical Waste Management of the Northwest, Inc.
Arlington, Oregon

Chemical Waste Management of the Northwest, Inc.
Standalone Document No. 7 Groundwater Monitoring Plan

METHOD #	TEST DESCRIPTION	Units	Reporting Limit
8270C	Chrysene	ug/L	10
8270C	Diallate	ug/L	20
8270C	Dibenz(a,h)anthracene	ug/L	10
8270C	Dibenzofuran	ug/L	10
8270C	Di-n-butyl phthalate	ug/L	10
8270C	1,2-Dichlorobenzene	ug/L	10
8270C	1,3-Dichlorobenzene	ug/L	10
8270C	1,4-Dichlorobenzene	ug/L	10
8270C	3,3'-Dichlorobenzidine	ug/L	50
8270C	2,4-Dichlorophenol	ug/L	10
8270C	2,6-Dichlorophenol	ug/L	10
8270C	Diethyl phthalate	ug/L	10
8270C	Thionazin	ug/L	10
8270C	Dimethoate	ug/L	20
8270C	4-Dimethylaminoazobenzene	ug/L	20
8270C	7,12-Dimethylbenz(a)anthracene	ug/L	20
8270C	3,3'-Dimethylbenzidine	ug/L	20
8270C	2,4-Dimethylphenol	ug/L	10
8270C	Dimethyl phthalate	ug/L	10
8270C	Di-n-octyl phthalate	ug/L	10
8270C	1,3-Dinitrobenzene	ug/L	10
8270C	4,6-Dinitro-2-methylphenol	ug/L	50
8270C	2,4-Dinitrophenol	ug/L	50
8270C	2,4-Dinitrotoluene	ug/L	10
8270C	2,6-Dinitrotoluene	ug/L	10
8270C	Diphenylamine	ug/L	10
8270C	Disulfoton	ug/L	50
8270C	Ethyl methanesulfonate	ug/L	10
8270C	Famphur	ug/L	200
8270C	Fluoranthene	ug/L	10
8270C	Fluorene	ug/L	10
8270C	Hexachlorobenzene	ug/L	10
8270C	Hexachlorobutadiene	ug/L	10
8270C	Hexachlorocyclopentadiene	ug/L	50
8270C	Hexachloroethane	ug/L	10
8270C	Hexachlorophene	ug/L	1000
8270C	Hexachloropropene	ug/L	100
8270C	Indeno(1,2,3-cd)pyrene	ug/L	10
8270C	Isodrin	ug/L	10
8270C	Isophorone	ug/L	10
8270C	Isosafrole	ug/L	20
8270C	Methapyrilene	ug/L	50
8270C	o-Toluidine	ug/L	10
8270C	3-Methylcholanthrene	ug/L	20
8270C	Methyl methanesulfonate	ug/L	10
8270C	2-Methylnaphthalene	ug/L	10
8270C	Methyl parathion	ug/L	50
8270C	2-Methylphenol	ug/L	10
8270C	3-Methylphenol	ug/L	10
8270C	4-Methylphenol	ug/L	10
8270C	Naphthalene	ug/L	10
8270C	1,4-Naphthoquinone	ug/L	50
8270C	1-Naphthylamine	ug/L	10
8270C	2-Naphthylamine	ug/L	10
8270C	2-Nitroaniline	ug/L	50
8270C	3-Nitroaniline	ug/L	50
8270C	4-Nitroaniline	ug/L	50
8270C	Nitrobenzene	ug/L	10
8270C	2-Nitrophenol	ug/L	10
8270C	4-Nitrophenol	ug/L	50
8270C	4-Nitroquinoline-1-oxide	ug/L	100
8270C	N-Nitrosodi-n-butylamine	ug/L	10
8270C	N-Nitrosodiethylamine	ug/L	10
8270C	N-Nitrosodimethylamine	ug/L	10
8270C	N-Nitrosodi-n-propylamine	ug/L	10
8270C	N-Nitrosodiphenylamine	ug/L	10
8270C	N-Nitrosomethylethylamine	ug/L	10
8270C	N-Nitrosomorpholine	ug/L	10
8270C	N-Nitrosopiperidine	ug/L	10
8270C	N-Nitrosopyrrolidine	ug/L	10
8270C	5-Nitro-o-toluidine	ug/L	20
8270C	Parathion	ug/L	50
8270C	Pentachlorobenzene	ug/L	10
8270C	Pentachloroethane	ug/L	50
8270C	Pentachloronitrobenzene	ug/L	50
8270C	Pentachlorophenol	ug/L	50
8270C	Phenacetin	ug/L	20
8270C	Phenanthrene	ug/L	10
8270C	Phenol	ug/L	10
8270C	Phorate	ug/L	50
8270C	2-Picoline	ug/L	20
8270C	Pronamide	ug/L	20
8270C	Pyrene	ug/L	10

8270C	Pyridine	ug/L	20
8270C	Safrole	ug/L	50
8270C	1,2,4,5-Tetrachlorobenzene	ug/L	10
DEQ Issued8270C	2,3,4,6-Tetrachlorophenol	ug/L	This Page is Revision: 250
8270C	Sulfotepp	ug/L	50
8270C	1,2,4-Trichlorobenzene	ug/L	10
8270C	2,4,5-Trichlorophenol	ug/L	10
8270C	2,4,6-Trichlorophenol	ug/L	10
8270C	O,O,O-Triethyl phosphorothioate	ug/L	50
8270C	1,3,5-Trinitrobenzene	ug/L	50
8270C	Chlorobenzilate	ug/L	10
8270C	a,a-Dimethylphenethylamine	ug/L	50
8270C	Aramite	ug/L	20
8270C	4-Phenylenediamine	ug/L	100
8270C	2,2'-oxybis(1-Chloropropane)	ug/L	10
8081A	Aldrin	ug/L	0.05
8081A	alpha-BHC	ug/L	0.05

Table 7-2 (continued)
List Of Reporting Limits for
Full Appendix IX List of Constituents
Chemical Waste Management of the Northwest, Inc.
Arlington, Oregon

Chemical Waste Management of the Northwest, Inc.
Standalone Document No. 7 Groundwater Monitoring Plan

METHOD #	TEST DESCRIPTION	Units	Reporting Limit
8270C	1,2,4,5-Tetrachlorobenzene	ug/L	10
8270C	2,3,4,6-Tetrachlorophenol	ug/L	50
8270C	Sulfotepp	ug/L	50
8270C	1,2,4-Trichlorobenzene	ug/L	10
8270C	2,4,5-Trichlorophenol	ug/L	10
8270C	2,4,6-Trichlorophenol	ug/L	10
8270C	O,O,O-Triethyl phosphorothioate	ug/L	50
8270C	1,3,5-Trinitrobenzene	ug/L	50
8270C	Chlorobenzilate	ug/L	10
8270C	a,a-Dimethylphenethylamine	ug/L	50
8270C	Aramite	ug/L	20
8270C	4-Phenylenediamine	ug/L	100
8270C	2,2'-oxybis(1-Chloropropane)	ug/L	10
8081A	Aldrin	ug/L	0.05
8081A	alpha-BHC	ug/L	0.05
8081A	beta-BHC	ug/L	0.05
8081A	delta-BHC	ug/L	0.05
8081A	gamma-BHC (Lindane)	ug/L	0.05
8081A	Chlordane (technical)	ug/L	0.5
8081A	4,4'-DDD	ug/L	0.05
8081A	4,4'-DDE	ug/L	0.05
8081A	4,4'-DDT	ug/L	0.05
8081A	Diallate	ug/L	1
8081A	Dieldrin	ug/L	0.05
8081A	Endosulfan I	ug/L	0.05
8081A	Endosulfan II	ug/L	0.05
8081A	Endosulfan sulfate	ug/L	0.05
8081A	Endrin	ug/L	0.05
8081A	Endrin aldehyde	ug/L	0.05
8081A	Heptachlor	ug/L	0.05
8081A	Heptachlor epoxide	ug/L	0.05
8081A	Isodrin	ug/L	0.1
8081A	Kepone	ug/L	1
8081A	Methoxychlor	ug/L	0.1
8081A	Toxaphene	ug/L	5
8081A	Chlorobenzilate	ug/L	0.1
8082	Aroclor 1016	ug/L	1
8082	Aroclor 1221	ug/L	1
8082	Aroclor 1232	ug/L	1
8082	Aroclor 1242	ug/L	1
8082	Aroclor 1248	ug/L	1
8082	Aroclor 1254	ug/L	1
8082	Aroclor 1260	ug/L	1
9030B/9034	Total Sulfide	mg/L	4
8151A	2,4-D	ug/L	4
8151A	Dinoseb	ug/L	0.6
8151A	2,4,5-TP (Silvex)	ug/L	1
8151A	2,4,5-T	ug/L	1
6010B	Arsenic, Dissolved	ug/L	10
6010B	Cadmium, Dissolved	ug/L	5
6010B	Chromium, Dissolved	ug/L	10
6010B	Copper, Dissolved	ug/L	10
6010B	Antimony, Dissolved	ug/L	10
6010B	Barium, Dissolved	ug/L	10
6010B	Beryllium, Dissolved	ug/L	5
6010B	Cobalt, Dissolved	ug/L	10
6010B	Lead, Dissolved	ug/L	3
7470A	Mercury, Dissolved	ug/L	0.2
6010B	Silver, Dissolved	ug/L	10
6010B	Thallium, Dissolved	ug/L	10
6010B	Tin, Dissolved	ug/L	100
6010B	Vanadium, Dissolved	ug/L	10
6010B	Zinc, Dissolved	ug/L	20
6010B	Nickel, Dissolved	ug/L	40
6010B	Selenium, Dissolved	ug/L	5
8280A	Total TCDF	ng/L	
8280A	Total PeCDF	ng/L	
8280A	Total HxCDF	ng/L	
8280A	Total TCDD	ng/L	
8280A	2,3,7,8-TCDD	ng/L	
8280A	Total PeCDD	ng/L	
8280A	Total HxCDD	ng/L	
9010A	Total Cyanide	mg/L	0.01
6020	Selenium, Dissolved	ug/L	5

Monitoring data will be submitted in a semiannual report that summarizes the detection and (if necessary in the future) compliance monitoring activities that took place during the sampling event. **Notes:**

mg/L = milligrams per liter
µg/L = micrograms per liter
ng/L = nanograms per liter

[a] Reporting limits shown in this table assume that no sample dilution is necessary. Actual reporting limits may be higher if dilution is necessary or if blank contamination is detected. Reporting limits shown in this table may change based upon the laboratory's annual verification of method detection limits and assessment of precision and bias. For dioxin and furans the reporting limits are determined from the lowest concentration used to calibrate each congener.

The report will provide the following information:

- A summary of field activities, including the FIFs, the dates of field activities, significant field sampling issues that occurred during the event, and associated corrective actions that were taken. This will include the identity of wells associated with blind duplicate samples, equipment blanks, trip blanks, and field blanks;
- A discussion of groundwater elevations, flow directions, and estimated flow velocities. This information will be presented in the second semi-annual monitoring report for each calendar year. This information will include summary tables of the depth to groundwater and corresponding groundwater elevations; graphs of potentiometric levels vs. time for monitoring wells listed in Table 3-1 and piezometers listed in Table 3-2; contour maps of groundwater elevations in the Selah Level 1 and Level 2 water-bearing zones for the second (Fall) semiannual water level measurement event; a summary table showing groundwater velocity calculations for Selah Level 1 and Selah Level 2 during the Fall event; and a written review of the adequacy of the groundwater monitoring system relative to observed groundwater flow directions beneath each Waste Management Area, as described in Permit condition X.C.1.c.;
- Summary tables of the analytical MDL and RL results of the compliance and detection monitoring programs. Concentrations between the RL and MDL will be flagged with a "J" qualifier and identified in the report as estimated values;
- Significant QA/QC issues that were reported by the analytical laboratory, including any corrective action taken;
- Exceedances (if any) of the detection monitoring criteria;
- Exceedances (if any) of groundwater concentration limits that are associated with possible future compliance monitoring programs at the Facility;
- Time-trend graphs of specific conductance, including identifying potentially anomalous measurements;
- Time-trend graphs of VOC concentrations detected above the RL (in the second [Fall] semiannual monitoring report); and
- Recommendations for additional field activities, if any.

As part of the reporting process, analytical results will also be submitted electronically in a format acceptable to DEQ. Other details regarding the reporting requirements (for example, submittal deadlines) are provided in the Permit.

7.3 Data Record-Keeping Requirements

Analytical data are maintained by the laboratory indefinitely. At each stage of a process where a permanent data record is required, the laboratory ensures that security measures are in place to guarantee the integrity of the data. SOPs are in place for computer security, computer data storage and back-up.

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APPENDIX A Groundwater, Surface Water, and Leachate Sampling Guide

GROUNDWATER, SURFACE WATER, AND LEACHATE SAMPLING GUIDE (Adapted for Chemical Waste Management of the Northwest, Inc.) (Arlington, Oregon)

1.0 SAMPLING GUIDE OVERVIEW

This Groundwater, Surface Water, and Leachate Sampling Guide (Guide) represents the general requirements for groundwater, surface water, and leachate sample collection at the Chemical Waste Management of the Northwest, Inc. (CWMNW) facility in Arlington, Oregon. This guide has been developed from a Corporate Guide that Waste Management, Inc. (WM) utilizes at other facilities that it owns and operates. The CWMNW and Corporate guides are derived, in part, from the guidelines set forth in the following ASTM Environmental Standards:

ASTM Standard D1129-90, (1990)	**Terminology Related to Water**
ASTM Standard D3370-82, (1989)	**Standard Practices for Sampling Water**
ASTM Standard D4840-88, (1993)	**Practice for Sampling Chain of Custody Procedures**
ASTM Standard D3694-93, (1993)	**Practices for Preparation of Sample Containers and for Preservation of Organic Constituents**
ASTM Standard D5088-90, (1993)	**Practice for Decontamination of Field Equipment Used at Non-Radioactive Waste Sites**

This Guide is a reference document for the Groundwater Monitoring Plan that has been prepared for the CWMNW facility. This Guide may be supplemented based on site-specific conditions and/or State-specific requirements, which preclude strict adherence to the Guide as described herein. This Guide has been developed for the CWMNW facility by adapting WM's corporate guide to account for known site-specific conditions at CWMNW (in particular, the low groundwater yields of the formation in which monitoring wells are completed). Although the hydrogeologic conditions at CWMNW and the sampling characteristics and requirements for CWMNW facility wells are unique compared to other WM facilities, a concerted effort was made to avoid making wholesale changes to the Corporate Guide while it was being adapted to the CWMNW facility.

The site sampling technician and/or consultant (sampling team) is responsible for the proper collection of samples at groundwater sampling points, piezometers, surface water locations, and leachate sample points at WM facilities. The sampling team must be familiar with the contents of this Guide prior to the initiation of a sampling event. The sampling team is also responsible for ensuring that all sampling requirements described in the site's operating permit, approved monitoring plan (by site or regulator, as applicable), local regulations, and any other associated documents are complied with in full.

Each WM facility will have a designated person responsible for implementing the groundwater-monitoring program. This person may be identified as a Site Manager, Engineering Manager, Compliance Manager, Corporate Hydrogeologist, or other designee. The WM representative should provide oversight to ensure that the final sample results satisfy both WM's minimum requirements and the appropriate State regulatory requirements. It is the responsibility of the sample team leader to confer with the designated representative of WM prior to initiation of sampling. The sampling team is responsible for meeting all safety-related regulatory requirements when sampling groundwater and should meet with the site manager prior to sampling to identify and address any site-specific safety requirements.

It is the WM representative's responsibility to ensure that sampling is conducted as required by any site-specific permits and regulatory requirements, and that those requirements are communicated to the sampling team. It is the sampling teams' responsibility that sampling methodologies and protocol are performed in accordance with the applicable permits, all federal, State, or local regulations, and this Guide.

Questions or comments on the Guide should be directed to the designated WM representative or to the WM Corporate Manager of Hydrogeology that is responsible for oversight at the respective facility(s).

2.0 SAMPLING GUIDE REVIEW REQUIREMENT

This Guide should be reviewed and signed by all sampling team members prior to initiation of routine or special groundwater sampling events at the CWMNW facility. All well construction information and documentation of completed sampling events should be filed and available at the facility. All sampling team members must sign a Signature Page, verifying that they have read and understand this Guide and note any exceptions to the Guide. A copy of the Signature Page is presented in Attachment 1.

Site conditions or site-specific regulatory requirements may necessitate a deviation from the Guide as described herein. Any such deviation from this Guide must be documented by the sampling team leader in coordination with the Engineering Manager, Compliance Manager, or other designated WM representative. The Signature Page requires updating whenever there is a new sampling team, sampling team member, or there are documented changes to sampling program that affect this protocol.

3.0 SAMPLING EQUIPMENT, PRE-SAMPLING PROCEDURES, AND DOCUMENTATION

Before any sampling is performed at the CWMNW facility, a number of preliminary tasks must be completed. These tasks include reviewing the facility's permit and approved site-specific groundwater monitoring plan, identifying well locations and characteristics, verifying the sampling schedule, reviewing the laboratory addenda, identifying the parameters to be analyzed, and identifying sampling point order (i.e. non-impacted wells first). The WM representative is responsible for approving the site-specific laboratory addenda, which details the sampling and analyses required for each event. The laboratory addenda specify the sample point identification, analytical requirements (analytes and methodology and holding times), frequency (i.e. event schedule), and required reporting limits. It is the responsibility of the sampling team to complete all preliminary sampling tasks including coordinating timely sample set delivery from the laboratory, calibrating field meters and equipment, inspecting coolers and bottles sets, initiating Chain-of-Custody records and obtaining the proper Field Logs/Field Information Forms. It is suggested that preparation begin at least two weeks prior to the event to provide the sample team and the analytical laboratory enough time to complete all of the steps addressed in this Guide and to address any problems that may occur. For unplanned or emergency events, contact the laboratory and/or WM for help on abbreviating or special event procedures. A copy of the Special Event Notification Form is presented in Attachment 2.

3.1 Equipment and Materials

All non-dedicated field equipment should be cleaned and/or decontaminated, checked to ensure that it is functioning properly and calibrated before going into the field. Quality Control procedures (e.g. equipment blanks) are discussed in Section 4.2.5.

3.1.1 Pumps

The specific pump used depends on site conditions and type of analyses being performed. Dedicated displacement bladder pumps constructed of Teflon and stainless steel or PVC are preferred for most sampling programs. QED Well Wizard® pumps are the WM requisite sampling system for most sites. However, at the CWMNW facility, electric submersible (Grundfos) and piston (Hydrostar) pumps may also be used as in the past, due to the site-specific hydrogeologic conditions and groundwater monitoring requirements. Pumps without check valves, or other mechanisms to prevent backflow should not be used during purging. A representative of WM should be informed of any well network not utilizing dedicated bladder pumps. <u>It is the WM representative's responsibility to arrange for and/or provide direction for purchase and installation of dedicated pumps.</u>

Placement of the sampling pump is critical for proper sampling. For bladder pumps, the pump inlet should be set as close to the middle of the well screen as possible. For electric submersible and piston pumps, the pump inlet may be set in the lower portion of the screen if this facilitates operation of the pump within its design limits. If requested to install a pump, it is the sampling team's responsibility to ensure that proper quality control procedures are followed when installing a pump and that pumps are not contaminated during installation. Associated documentation is maintained in field notes and/or Field Information Forms (see Section 3.4). The certification tags on each Well Wizard pump should be retained on-site with other site-specific sampling documentation for future reference.

Non-dedicated pumps must only be used on a temporary basis with approval from the designated WM representative. When non-dedicated pumps or sampling devices are used, stringent cleaning procedures must be followed between sampling locations (see Section 3.2). Equipment blanks must also be obtained in accordance with Section 4.2.5 of this Guide.

3.1.2 Bailers

Bailers are only to be used on a temporary basis if no other sampling equipment is available or if otherwise approved by an authorized WM representative (e.g. if there is inadequate volume to use a pump). Bailers should be made of suitable inert materials (such as stainless steel, PVC, or Teflon), when monitoring for organic compounds. Stainless steel or Teflon bailers should be used for such applications as "oily" matrices where ease of cleaning and durability may be a ~~factor. PVC bailers with non-glued joints may also be used. Non-dedica~~ted/reusable bailers shall not be used unless specific approval has been obtained from a WM representative.

When bailers are used, the bailer cord shall be fastened securely to the bailer and shall be constructed of nylon, stainless steel, or polypropylene, and be specifically manufactured for use in the collection of environmental samples. This cord must be new, clean, and in good condition. Rope, twine or other "off-the-shelf" cord shall not be used for securing the bailer. Care should be taken not to excessively disturb the column of water in the well casing. Gently lower the bailer into the well with each cycle. The sampler's knowledge of the depth to water will help in this regard. Attempt to lower the bailer into the water only to the extent necessary to fill or nearly fill the chamber. Avoid submerging the top of the bailer.

When used, non-dedicated bailers must be thoroughly decontaminated (see Section 3.2) and triple-rinsed with deionized water (or laboratory reagent water) before and after sampling at each location. Equipment blanks must also be obtained in accordance with Section 4.2.5 of this Guide.

Dedicated bailers should be rinsed with distilled water prior to beginning purging, but require no additional decontamination.

3.1.3 Sample Coolers and Sample Bottles

The sampling team should confirm shipment and check all sample containers and sample coolers for broken bottles and proper preservatives when received. The designated WM representative is responsible for arranging sample container shipment from the laboratory in a timely manner (at least two weeks in advance) and for ensuring that the laboratory has the correct shipping address/location. The sampling team is also responsible for obtaining proper ice packs (e.g. frozen ice packs) prior to the sampling event. Filtering requirements and bottle type should be corroborated with the site permit and approved Groundwater Monitoring plan. The sampling team must communicate with site personnel to ensure access to the facility before the sampling event so that the event may proceed on schedule, and equipment, sample coolers, and supplies may be checked to verify completeness of bottle order and proper operation of field equipment. (Note: It is important that sample coolers and bottles be stored, transported, and handled in a manner that prevents exposure to solvents, cleaners, gasoline, diesel fuels, exhaust, or other potential contaminants.)

Upon receipt, an inventory of the coolers and bottles and their condition should be noted in field notes and documented on the Field Information Form. Each sample bottle is provided with its own bottle I.D., which refers to the laboratory analyte group, filtering requirements, necessary preservatives, sample point/location, analytical method, and bottle size. This information must be checked, verified, and included on Field Information Forms and Chain-of-Custody records. Should an error occur within the bottle set, the laboratory must be notified immediately.

The laboratory will provide and determine the proper number of sample containers in each sample cooler, unless otherwise specified or requested by the WM representative. The type of bottle will vary depending on the analysis required. With the exception of bottles for Volatile Organic Analyses (VOA), samples requiring preservation in the field will have an associated preservative supplied in separate containers. VOA containers will be pre-preserved at the laboratory. Each sample bottle either is provided with a label or is labeled with a sticker to identify the preservative required. It is the sample team's responsibility to ensure that the appropriate preservatives are added in the field (see Section 7.1). Preservatives must not be added to bottles that do not require them.

Each sample cooler that includes bottles for volatile organic analyses must include a Trip Blank (see Section 4.2.5 of this Guide) unless otherwise specified by the WM representative. When volatile organic analyses have been requested, the sample cooler will contain a Trip Blank regardless of whether a request has been placed for analysis of the Trip Blank. An effort to pack all VOAs in one cooler should be made to reduce trip blank costs. Prior to shipment, the laboratory checks each Trip Blank vial to ensure that it has no air bubbles. If large (i.e. pea-sized) bubbles are present utilize the initial trip blank and note the bubble size on the field information forms.

Empty bottles will be included within the sample cooler for Field Blanks (duplicates and equipment blanks if necessary) analyses (see section 4.2.5). The sampling team should coordinate with the laboratory to identify the number of Field Blanks required for sampling. Duplicates will be analyzed on an as-requested basis only.

The sample cooler will not contain ice packs upon receipt from the laboratory. WM requires the use of frozen ice (wet ice in bags) to maintain sample temperature at the levels required by EPA methods during shipment of samples back to the laboratory. It is the sampler's responsibility to ensure that ice packs are available to cool samples upon collection. Furthermore, the sampling team is responsible to ensure that provisions have been made in advance for those facilities that do not have accommodations to maintain ice packs. In such cases, it is recommended to bring pre-chilled coolers and extra ice packs to the site.

3.2 Decontamination Procedures for Non-Dedicated, Down-Hole Equipment

All non-dedicated, sample-contacting and down-hole equipment must be thoroughly decontaminated prior to its use in sample collection activities. This includes non-dedicated pumps, non-dedicated bailers, groundwater level measurement devices, field parameter measurement devices and non-dedicated filtering apparatuses. Each sample team shall have a water level probe that is dedicated to groundwater monitor well use only. Unless otherwise required, no other non-dedicated downhole equipment should be used during sampling. Under no circumstances shall the groundwater level measuring probe be used to measure other liquid levels (such as leachate or grossly contaminated wells).

Decontamination procedures of down-hole equipment must, at a minimum, consist of washing with a non-phosphate detergent solution followed by a series of rinses (i.e. 2 to 3) with control water (i.e. water of a known chemistry) and one rinse with deionized water. Decontamination of non-dedicated pumps must, at a minimum, consist of circulation of three pump and tubing volumes of clean water through the pump system and all associated discharge tubing at separate stations. A series of three pre-cleaned liquid storage containers will aid in this respect. The first container should contain a non-phosphate detergent solution. The remaining two should consist of water of a known chemistry. Other non-dedicated equipment (e.g. field meters and water level indicators) should be triple rinsed with deionized (DI) water before and after each use.

Equipment Blanks must be collected from non-dedicated purging/sampling equipment following decontamination based on a schedule of one sample for each day of sample collection (see Section 4.2.5). Equipment Blanks will be analyzed for all sample matrices, analytical tests, and equipment configurations.

3.3 Calibration and Use of Meters

The proper measurement and documentation of field analyses are a critical part of the monitoring program. Before going to the field, all equipment must be cleaned and checked for any malfunctions. The sampling team must calibrate all meters each morning before using them in the field following manufacturers' and/or EPA (or appropriate State agency) calibration procedures. In the absence of manufacturer guidelines or where required by regulation (e.g. NPDES Sampling), use the appropriate EPA procedures for equipment calibration (e.g. Standard Methods for Chemical Analysis of Waters and Waste Waters, attached for pH, temperature, turbidity, conductance, and dissolved oxygen). Some field analytical methods and/or regulatory agencies have specific calibration procedures which sampling teams may be required to follow. Sampling teams should verify with the WM representative if such procedures exist.

Equipment calibration shall be conducted daily at a minimum. Calibration solutions must be freshly prepared or bottled from non-expired stock. In the absence of manufacturer or regulatory guidance, field equipment should be calibrated to within +/- 5% of the standard (or 0.1 standard units for pH meters). Calibration of field specific conductance should be verified against a chilled standard to verify temperature compensation. Equipment that fails calibration should be taken out of service and replaced or repaired prior to sampling. It is recommended that calibration checks be conducted periodically (e.g. mid-day and at the end of the day) to document any instrument drift. If there is significant instrument drift (e.g. >10% or 0.2 standard units for pH) then the meters should be recalibrated. In all cases, it is the sampling team's responsibility to ensure proper documentation of all calibration procedures for each sampling event, including calibration methodology (one or two point calibration), calibration measurements, source of standard, standard concentration(s) and expiration date, and any discrepancies.

It is the sampling team's responsibility to document the calibration of field instruments and verify that field instruments are performing within design parameters for the instrument. Sampling should not occur if field instruments are not working properly. Verification of field meter calibration is to be recorded on the Meter Calibration Log, included in Attachment 5. Meter Calibration Logs should be maintained and kept with the Field Information Form and Chain-of-Custody form for each sampling event. These forms may be maintained separately on site as requested by WM.

3.4 Field Record Keeping

Proper chain-of-custody documentation is a crucial part of the monitoring program's quality assurance and quality control (QA/QC). Comprehensive, consistent, and accurate documentation of field tests, measurements, decontamination procedures, meter calibration, and field observations is extremely important.

During each sampling event, the sampling team must fill out two forms: a Field Chain-of-Custody Record and a Field Information Form. The original (white) copy of each form must be sent to the laboratory, but only after the laboratory has issued its final quality-assured data reports for the sampling event. This requirement is necessary in order to ensure that duplicate samples are blind during laboratory analysis. Copies of all forms (e.g. yellow copy) are also to be maintained at the site and/or Region Office for easy reference. Sample teams should keep a copy of the forms (e.g. pink) for their records. Examples of the approved Chain of Custody's and WM Field Information Forms are provided as Attachment 3.

All field notes and forms must be completed with indelible black or blue ballpoint ink only. Pencils and felt-tip pens should not be used. Corrections should be made by striking through the error with a single line, writing in the correction, and dating and initialing the change. White out, erasures, or obliterations are not acceptable and will be brought to the attention of WM by the analytical laboratory.

3.5 Field Notes

3.5.1 Field Information Forms

The Field Information Form contains information regarding site and well conditions, sampling and purging procedures, and field measurements. The Field Information Form must be filled out by the sampling team for each sample point and a copy placed along with the Chain-of-Custody Record in the cooler(s) shipped to the laboratory. At a minimum, the following must be documented on Field Information Forms:

- **Site Information:** Site Name, Site Number (from the WM Representative), and Sample Point
- **Purging Information:** Date, time, elapsed time, water volume in casing (for a 3-volume purge), required purge volume, and actual volume purged

- **Purging and Sampling Equipment:** Dedicated equipment, pump type, tubing material, filter type and size, etc. Use these fields to record when a sample is field filtered, the filtering method, brand name, and the pore size of the filter.
- **Well Data:** Sample point elevation (use State/permit specified datum (e.g. NGVD), depth to water or fluid, and calculated fluid/groundwater elevation are required. Total depth (when required) stickup, and casing diameter and material should also be noted.
- **Stabilization Data:** depth to fluid elevation and field measurements should be recorded to verify parameter stabilization or once per each casing volume for a multiple volume purge.
- **Field Data:** Sample date, and the final field measurements, prior to sampling, should be recorded in this section. Other field parameters such as dissolved oxygen, turbidity, and redox potential (note the unit value) should also be recorded, as necessary.
- **Field Comments:** Field observations should be recorded as noted in Section 3.5.2

The Field Information Form has optional fields for recording parameter stabilization data during minimal drawdown sampling or for recording multiple field measurements as required by sampling protocol (e.g. a 3 volume purge) or by permit. Section 3.5 provides a more detailed discussion on collecting field measurements and Section 4.0 provides more detail for recording purge data.

3.5.2 Comments

The **Field Comments** section of the Field Information Form should include observations such as:

- Problems with condition of the well and/or dedicated equipment, such as a cracked cement pad or surface seal, malfunctioned or missing lock, broken protective casing, ponded water, cracked or bent pump/tubing, well obstructions, etc. WM should be notified immediately if the damage to the well is severe enough to affect sampling.
- Weather conditions: wind direction, speed, upwind activities (ensure that vehicles/gasoline compressors are not upwind of sampling activities), temperature, and barometric pressure (as required by permit or regulation).
- Sample Appearance including odor, color, and turbidity,

  Odor: e.g. rotten eggs, earthy, strong, moderate, slight (do not sniff sample). Describe the characteristics of the odor, do not speculate as to the cause of the odor.

  Color: True "color" is the color after turbidity has been removed, if samples are filtered. True color may be caused by metallic ions, humus, peat, or industrial chemicals. Hold the sample up to the light and describe the true color in as much detail as possible (color charts are acceptable descriptive methods). If samples are not filtered, then color may be a function of turbidity.

  Turbidity: (regardless of whether turbidity measurements are taken):

  - None: sample is clear.
  - Trace: sediment slightly clouds or colors the sample; sediment does not accumulate in the bottle.
  - Moderate: definite cloudiness, sediment accumulates at the bottom of sample bottle.

High: muddy/dark brown appearance.

In general, a turbidity-measuring device should be used and measurements be provided in nephelometric turbidity units (NTU's). Section 4.2.1 provides additional guidance on turbidity.

Record all calculations for purge volumes (see Attachment 4) and temperature conversions. Note when wells are purged dry or why the requisite casing volumes were not removed (not applicable for low flow sampling). Other factors, such as collection of a duplicate sample, field blanks, sample splits with regulatory agencies, potential safety or health hazards (e.g. fire ants, bees, presence of landfill gas in well) should be noted in the comments field. Note whether sampling occurred downwind from site disposal or other activity that could affect sample results. Record the names and affiliations of all observers and have all sampling team members write their name and sign the Field Information Forms.

3.5.3 Sampling Certification

On the bottom of the Field Information Form, the sample team leader must sign the form certifying that the sampling procedures were in accordance with applicable site permits, Federal and State regulations, and Corporate policy as outlined in this Guide and the approved monitoring plan. The person(s) providing the sampling certification assumes full responsibility that the sample process satisfied the above criteria.

3.5.4 Maintenance Conditions at Well

The condition of the well and its surrounding area must be observed and problems and changes recorded on the Well Condition Inspection Form upon arrival at the well location. This form is included in Attachment 3. Conditions that may affect sample integrity, such as a damaged well casing, should also be recorded on the Field Information Form. The following information, at a minimum, should be observed on the Well Condition Inspection Form:

Presence and condition of the well's identification sign,
Whether the well was recently painted,
Whether the well's protective casing is locked and whether the key works,
Well functionality and integrity:

- Physical surroundings (e.g. high weeds, standing water, cleanliness, nearby activities)
- Condition of the bladder pump and appurtenances
- Any obstructions or kinks in the well casing
- Prolonged or excessive turbidity of evacuated water
- Poor recharge during purging
- Any presence of water in the annular space
- Any grease or other unnatural substances on the top of the well or the threaded caps
- Whether the cap fits securely to prevent the introduction of contaminants
- Evidence of natural sources for degradation (e.g. animal or insect parts in the well)
- Well guard post and concrete pad condition
- Any other condition that may be indicative of well maintenance or performance problems

Notify WM immediately of any conditions that would prevent, or preclude sampling or affect sample integrity. Upon completion of the sampling event, provide the Well Condition Inspection Form to the responsible on-site Manager. It is the responsibility of sampling personnel to notify the responsible site manager of well maintenance or well condition problems. If such conditions persist over more than one monitoring event, contact the WM Groundwater Protection Program manager.

3.6 Field Measurements

3.6.1 Static Water Level Measurements

The depth to water and elevation of the water level (MSL or permit/regulatory specified datum (i.e. NVGD)) should be recorded to the nearest hundredth of a foot (i.e. 0.01-ft). Water levels should be collected on the same day prior to purging to produce a representative static groundwater elevation contour map. To alleviate potential errors, previous water level data should be used for comparison purposes during field activities. Water levels are preferably collected prior to purging any well and as close, temporally, as possible, to minimize interference due to drawdown or barometric pressure effects.

3.6.2 Depth of Well Measurements

Biennial total depth measurements are recommended for wells with dedicated pump systems or non-dedicated equipment, or as specified in the facility permit. The total depth of the well should be measured more frequently in wells where there is visible/significant turbidity, or when tampering is noted. However, at CWMNW, the depths of the wells and the use of several types of dedicated pumps makes routine depth sounding difficult. Therefore, the total depth of any given well at CWMNW will be checked whenever the well shows a significant increase in turbidity during groundwater sampling.

The well depth measurements should be compared to the pump intake depths. The pump intake should be located at the middle of the screen or lower, depending on the screen length and well recharge characteristics, maintaining a minimum of two feet (where possible) between the pump intake and the bottom of the well. However, it is the sampling team's responsibility to notify WM if there is suspicion that the pump location within a well is not appropriate for collecting representative samples. The WM representative or designate (i.e. sampling team) is responsible for evaluating and responding to excessive sediment accumulation and/or pump placement adjustments. Total depth measurement can stir up settled solids, so these measurements should be taken AFTER routine sampling is completed or at some time other than the routine sampling event to prevent high bias/false positive results.

3.6.3 Additional Measurements

Well casing stickup length (feet), well casing diameter (inches), and material of construction must be recorded on the Field Information Form. The stickup length should be verified, as required, biennially, or if a change in the immediate surroundings has occurred. The condition of flush-mounted wellhead covers and locks must also be recorded after every sample event. Other items that should be noted include physical alterations to the well, alterations to the surrounding soils and associated drainage, or other notable changes in conditions near the well.

4.0 GROUNDWATER SAMPLING PROCEDURES

4.1 Purging Procedures

After the necessary initial field measurements/observations are made and the depth to water has been determined from every well, the purging process can begin. Purging should begin with wells with the least potential for detections or wells with the lowest historical detections. The designated representative of WM will define the proper method for the disposal of purge water. In some cases, purge water should be discarded to the ground far enough away from the well footing to prevent the possibility of affecting shallow soils or groundwater near the well. Permit conditions or results from previous sampling events may prevent disposal of purge water to the ground. If purge water is deemed degraded by previous testing, it may be necessary to collect all purge water in drums (preferably lined) to dispose of them in the site leachate collection system or other approved manner as defined by WM's Project Manager and State/Local regulation.

The purging procedures described below in Sections 4.1.1 through 4.1.3 are those found in the Corporate sampling guide. As discussed in Section 5.1 of the Groundwater Monitoring Plan for the CWMNW facility, modified versions of the low-flow and traditional purging and sampling procedures described in Sections 4.1.1 through 4.1.3 below will be used at CWMNW. The primary modifications to the low-flow technique at CWMNW are: (a) the total amount of drawdown is not constrained; and (b) the water level may be drawn down into the screen. For the traditional method, the primary modification at CWMNW is that the well can be purged dry (as has been done historically), as the sampling history at the site indicates that several wells are incapable of being low-flow sampled and are also incapable of yielding three casing volumes when using traditional purging methods.

4.1.1 Procedure using Low-Flow/Minimal-Drawdown Purging Techniques

The purpose of using low flow rates during low-flow purging is to avoid mobilization of formation solids. The objective of low-flow purging is to obtain a representative sample, taking into consideration aquifer heterogenieties and site-specific subsurface conditions, without imparting bias due to excessive pump rates. This technique is premised on minimizing drawdown of the aquifer and stabilization of field parameters prior to and during sample collection. Pump flow rates should be selected to approximate the yield of the well, so that a stabilized pumping water level is achieved as quickly as practical, in order to then expedite the stabilization of the indicator parameters.

Minimal-drawdown procedures should consist of evacuating the total volume of groundwater present in the sampling system to clear the well pump, tubing, and flow cell, if used, of any stagnant water left from prior sampling events. In general, a minimum of one (1) volume of the sampling system (i.e. pump, associated tubing, flow cell, etc.), must be purged. The maximum flow rate is determined by pumping at a rate, which allows for stabilization of the water level surface within the well. Field measurements, as described in Section 4.2.2, should be initiated at the start of purging and continued at evenly spaced intervals until stabilization. Measurements of the indicator parameters must be taken at a frequency based on the time it takes to purge one (1) volume of the pump, associated tubing, and flow cell. For example, if the volume of the pump, associated tubing, and flow cell is 500 mL and the well is being purged at 250 mL/minute, the pump, associated tubing, and flow cell will be purged in two (2) minutes. Therefore, measurements must be taken at least two (2) minutes apart.

Once stabilization has been achieved (see Section 4.2), sampling can be conducted at the same rate. Some States have maximum allowable flow rates for certain analyses (i.e. less than 1.0 liter/minute). It is the sampling team's responsibility to ensure that all State and site-specific requirements are followed. If necessary, approval from the regulatory agency should be obtained, prior to implementing minimal-drawdown sampling procedures.

4.1.2 Traditional Purging Methods

When minimal-drawdown techniques are not utilized, monitoring wells should be pumped or bailed prior to sample withdrawal to prevent collection of non-representative stagnant water in a sample. As a general rule, pump or bail a minimum of three times the volume of water standing in the borehole (for moderate-to high-yield formations) and at least one borehole volume (including the filter pack volume, assuming 30% effective porosity, if applicable) for low-yield formations (those with slow recharge), if possible. Well purging should be sufficient to increase the likelihood that the water collected is representative of the groundwater within the formation around the well. Purging should continue, when possible, until field parameters (including pH, temperature, and electrical conductivity) have stabilized (see Section 4.2). Purge volume tables are presented in Attachment 4.

4.1.3 Very Low Yield Sampling Methods

In lithologies where minimal-drawdown or traditional purging methods are not feasible due to very low yields, minimal-purge sampling is a procedure to consider. Minimal-purge sampling involves sampling the water present in the screen zone, with minimal purging and at very low purge rates. However, minimal-purge sampling should generally be avoided under these conditions because the collection of representative samples is problematic. In particular, this sampling procedure is not appropriate where landfill gas may be present in the well since VOCs in the gas will tend to partition to the water phase and bias the sample. If landfill gas is present in the well, an alternate sample collection program should be developed in consultation with the WM Groundwater Protection Program Manager. Approval from both WM and the regulatory agency should be obtained prior to implementing minimal-purge sampling procedures.

When using a dedicated pumping system (as opposed to a specialized sampler), the minimal-purge approach requires the removal of the smallest possible purge volume prior to sampling, generally limited to the volume of the sampling system (pump and tubing). After removing this combined volume, samples are taken from the subsequent water pumped. Since minimal-purge sampling requires the minimum possible disturbance to the water column and surrounding formation, dedicated sampling systems are required for this approach.

The pumping rates used for passive sampling are much lower than for low-flow purging, generally 100 ml/minute or less. Drawdown is expected, since it cannot be avoided. However, it is still advisable to pump at the lowest possible rate to limit drawdown to the extent possible. As with low-flow techniques, the water level in the well should not be lowered below the top of the screen, if possible.

Generally, WM does not recommend sampling a well after purging to dryness; however, it may be acceptable under certain circumstances or where necessary based on site geology and State requirements. If a well is pumped dry, it may result in the sample being compromised by sediment or by water contained in the sand pack, which may be reflective, at least in part, of initial, stagnant conditions. In cases where a well is sampled after purging to dryness, bail or pump the volume of water standing in the well and allow the well to recharge for up to 48 hours or as stipulated by local or State regulation. If there is not sufficient water for sampling then the well should be considered dry for the purpose of sampling. WM should be notified if this condition exists so that appropriate changes to the site monitoring plan can be made. If water is available to partially complete sampling requirements, samplers should confer with WM's Groundwater Protection Program manager and samples may be obtained in the order specified in the approved monitoring plan or as specified by the WM Project Manager. (VOAs should be collected first, followed by the remaining parameters. Do not collect excessively turbid samples. See section 4.2.1). Contact the laboratory for minimum testing volumes for each analyte. If a sample cannot be obtained from a given well which normally provides adequate water for a sample, notify the WM Project Manager immediately and note appropriately on field forms.

4.2 Sampling the Well
The following section describes procedures for collecting samples from wells subsequent to purging activities. Methodologies for the collection of field measurements, field filtered samples, and Field/Equipment and Trip Blanks are also presented.

4.2.1 When Not to Sample
During a sampling event, all scheduled wells must be sampled, except in the following cases:

- If the well has been destroyed or otherwise rendered un-sampleable (e.g. casing broken off or severely bent so as to preclude sampling)
- If the well is dry (see above definition in Section 4.1.3) or frozen
- If the well is new and has not been properly developed (pH, temperature, and specific conductance must be stabilized, turbidity minimized, and drilling effects eliminated from the well)
- If the well has extreme turbidity or very high settleable solids

Turbid groundwater samples are not representative of natural conditions and are a concern during sampling. Wells that consistently yield turbid samples should be replaced or rehabilitated such that low-turbidity samples can be obtained. Pending replacement or rehabilitation of the wells, turbidity should be reduced by allowing solids sufficient time to settle, as allowed by regulation, then collecting samples in a manner that minimizes sample turbidity. Consideration should be made for obtaining both filtered and unfiltered samples in turbid wells. The WM representative should be notified immediately if any well yields excessively turbid samples or if a well cannot be sampled.

4.2.2 Field Measurements
Field measurements must be collected in accordance with all Federal, State or local regulations and/or permit requirements, see Attachment 5, Field Parameter Calibration Procedures. At a

minimum, field measurements for pH, electrical conductivity, and temperature must be collected at each sample point during purging and as required for sampling. It is strongly recommended that dissolved oxygen or redox measurements be collected when using minimal drawdown sampling techniques.

Purging must be continued until the final three consecutive measurements for each parameter agree to within 10% of each other prior to sample collection, or as specified in the approved facility monitoring plan and/or permit (closer agreement for pH (0.1), specific conductivity, (3%), dissolved oxygen (0.2 mg/L) and redox (10 mV) may be required). Measurements should be taken at appropriate intervals (based on total volume to be purged) during the purging process to determine stabilization. Measurements must be recorded on the Field Information Form, during purging. Electronic data from a data logger used in conjunction with a flow cell can be substituted for hand recording data, provided that it is approved by the WM Representative and applicable Regulatory Agency. Multiple pages can also be used when necessary. All extra pages or electronic records must be copied and reported as designated by the WM representative. (In the case of low-flow purging, additional data can be managed electronically or separately). All pH meters must provide a reading to the nearest hundredth [e.g. 7.14]. When field measurement errors occur, a line should be drawn through any error or correction, and the entry initialed and dated. (This applies to all errors, on any of the field forms or chain-of-custody records; see Section 3.3.)

If the values obtained are not within the normal ranges, as indicated on previous Field Information Forms, determine if the readings are the result of inadequate purging, instrument malfunction, or a change in the character of the groundwater. The instruments should be recalibrated. If there appears to be a change in the character of the groundwater, notify the WM Project Manager, who may request that additional samples are collected to ascertain the cause of the abnormal readings. All calibration information must be documented.

Groundwater samples should be collected in the shortest possible time subsequent to purging the well. Exceptions can be made, with WM approval, to allow sediment to settle out in turbid wells. However, such wells may need to be redeveloped prior to the next sampling event. The method to be used for sampling is usually the same as that used for purging, unless otherwise specified by site conditions or regulation.

4.2.3 Sample Filtration

When sample filtration is required, the samples should be filtered in the field. Only with explicit approval from the WM representative, can filtering be performed by the laboratory upon receipt. Field filtering is to be conducted at all WM sites unless otherwise specified by local and/or State regulation, the site permit, or the approved groundwater monitoring plan for the facility. Samples that require filtering must be filtered through a 0.45-micron membrane pressure filter, unless regulatory requirements specify otherwise.

Typically, only samples for dissolved metals analysis require filtration. Regulatory and permit requirements will generally specify whether to analyze, for example, for "total" metals as opposed to "dissolved" metals. WM's policy is to filter all groundwater samples for heavy metals analyses unless otherwise specifically prohibited. Surface water and leachate samples are not filtered unless specifically required by permit. Samples, which have been field filtered must be noted by the sampling team on the field Chain-of-Custody Records in the column labeled "Remarks" (see Section 7.5). Filter size, brand name, and method should also be specified on the Field Information Form (see Section 3.5.1) Specific filtering instructions are included on the Laboratory Contract Addendum, the approved Groundwater Monitoring Plan, and in some cases the site's operating permit. Furthermore, the laboratory should note which samples require filtering on the individual bottle labels and bottle schematics.

It is recommended that all filtration be performed using an in-line filtration system. A minimum of three pump cycles of water must be allowed to pass through the filter before obtaining a sample. A new filter shall be used for each individual sample point and each sampling event. Under no circumstances are filters to be re-used. If samples are collected utilizing bailers, pressure filters are an acceptable method of filtering. The use of vacuum filtration devices is prohibited without approval of the WM Groundwater Protection Program manager. Where in-line filtration is not possible, pre-filtration bottles may be used to transfer the samples to the field filtration device. Pre-filtration bottles must be obtained from the laboratory with the sample coolers and identified at the time of initiating the bottle request. The sampling team must notify the laboratory ahead of time to arrange for sufficient number of extra bottles.

Additional Notes:

- Filtering should always be performed during sample collection while in the field.
- Filters must be 0.45 microns and dedicated for groundwater only. Do not use any filtering apparatus that is used for other procedures such as TCLP.
- Surface water and leachate samples are never filtered unless specifically required by permit.
- Pre-filtration bottles used for pressure filtering, should not be used for more than one well. If re-use is absolutely necessary, pre-filtration bottles must be thoroughly decontaminated between wells in accordance with Section 3.1.4 of this Guide. The use of pre-filtration bottles as transfer vessels must be noted on the Field Chain-of-Custody Record in the "Remarks" column.
- Filtering of preserved samples should never be performed.

4.2.4 Filling Sample Bottles

Sample bottles should be filled directly from the dedicated bladder pump, or filter apparatus with minimal air contact. Volatile Organic Analyses (VOA) and Total Organic Halides (TOX), and alkalinity bottles should be headspace-free (i.e. no air bubbles in the sample bottle).

When filling the sample bottles, the following procedures and precautions should be adhered to:

1. Bottle caps should be removed carefully so that the inside of the cap is not touched. Caps should never be put on the ground. Caps for VOA vials must contain a Teflon lined septum. The Teflon side of the septum must be facing the sample to prevent degradation of the sample through the septum.

2. The sampling team should wear appropriate non-powdered surgical latex or blue nitrile gloves (PVC/vinyl gloves have a potential for trace levels of phthalate or vinyl chloride). Gloves should be changed between wells or on a more frequent basis. Gloves should also be changed any time the sampler leaves the well head area and contacts other equipment, e.g., starting or servicing a compressor or generator.
3. Tubing or hoses from the sampling systems must not touch or be placed in the sample bottles nor should tubing or hoses touch the ground; an empty cooler or stable flat surface placed by the well head can assist in facilitating this requirement.
4. After filtering, sufficient space should be available in the sample bottles for the addition of required preservatives (see Section 7.1 of this Guide). The bottle caps should then be replaced tightly.
5. TOX, alkalinity and VOA vials must be filled so that they are headspace-free. These sample bottles, therefore, need to be slightly overfilled (water tension will maintain a convex water surface in the bottle). The caps for these bottles should be replaced gently, to eliminate any air bubbles in the sample. These bottles must then be checked by inverting them and tapping them sharply with a finger. If any air bubbles appear, open the bottle, add more water, and repeat this process until all air bubbles are gone. Do not empty the bottle and refill it. VOA vials already contain preservatives (see Section 7.1). TOX bottles should have preservative added just prior to sampling, due to the headspace-free requirement. Do not overfill any containers that have been pre-preserved for any reason. Do not add additional preservatives to these bottles.
6. Sample bottles, caps, or septums that fall on the ground should be discarded and new pre-cleaned bottles used. In the event new bottles are not available, before filling the bottle, it must be thoroughly rinsed with sample water before being used. All circumstances regarding dropped caps or bottles, and their subsequent rinsing and use, must be noted on the Field Information Form.
7. The sampling team must collect a sufficient volume of liquid to allow for analysis of all required parameters. In the event that an insufficient volume of water exists for collection of the requisite suite of samples, the sample collection order specified in the site's monitoring plan or as specified by the WM Project Manager should be followed.
8. The sequence of filling bottles should ensure that samples are representative of natural groundwater conditions. This is accomplished by evenly distributing the discharged water (or bailer contents) amongst containers by analyte type (i.e. leachate indicator parameters, metals, major cations/anions, etc). For example, all sample bottles designated for analysis of major cations and anions should be filled prior to proceeding to sample bottles for another analyte type.
9. Under no circumstances should bottles (sample or Pre-filtration) or caps not supplied by the laboratory be used for any sampling.
10. Sample coolers should be present at all sample locations and should be equipped with pre-chilled, double-bagged ice packs for immediate placement of sample bottles subsequent to collection.

4.2.5 Quality Assurance: Trip, Field, Equipment Blanks and Duplicates

Trip Blanks, Field Blanks and Equipment Blanks are used to detect constituents that may be introduced in the field (either from the atmosphere or from sampling equipment), in transit to or from the sampling site, in bottle preparation (Quality Assurance), or sample storage at the laboratory. Duplicates are used to confirm analytical results from a given sample point (Quality Control). Upon return to the laboratory, Trip Blanks, Field Blanks, Equipment Blanks and Duplicates will be analyzed using the same laboratory procedures and methods that are used for the collected field samples.

4.2.5.1 Trip Blanks

Trip Blanks are samples of volatile organic-free, laboratory quality water (e.g. Type II reagent grade) that are prepared at the laboratory. They remain with the sample bottles while in transit to the site, during sampling, and during the return trip to the laboratory. Trip Blank sample bottles are not opened at any time during this process. Trip Blanks are to be reported in the laboratory results as separate samples, using the designations TB- (#) as their sample point designation. If Trip Blank sample bottles are accidentally opened, note this fact on the Field Chain-of-Custody Record.

The frequency of analyses for both trip blanks and field blanks should be in accordance with the facility's permit requirements. If the frequency is not specified, then a minimum of one Trip Blank per cooler (that contains at least one VOA field sample) is recommended for WM sites (or as stated in the approved site groundwater monitoring plan). Generally, each sample cooler that includes groundwater samples for volatile organic analyses should include a Trip Blank; however, this number may be reduced. When volatile organic analyses have been requested, the sample cooler will contain a Trip Blank regardless of whether a request has been placed for analysis of the Trip Blank.

4.2.5.2 Field Blanks

Field Blanks are prepared in the field (at the sampling site), using laboratory-supplied bottles and the deionized or laboratory reagent quality water. Each Field Blank should be prepared by pouring the deionized water into the sample bottles at the location of one of the wells in the sampling program. The well at which the Field Blank is prepared must be identified on the Field Information Form along with any information/observations that may explain any anomalous results (e.g. prevailing winds, upwind sources of potential degradation, etc.). Once a Field Blank is collected, it is handled and shipped in the same manner as the rest of the samples. If filtration is conducted, but not in-line, the de-ionized or laboratory quality water is exposed to air, poured into pre-filtration bottles, filtered as required, and placed in the Field Blank bottles, with the proper preservative subsequently being added.

Field Blank results will be reported as separate samples; use the designations FB- (#) as their sample designation point. The frequency of analyses for both trip blanks and field blanks should be in accordance with the facility's permit requirements. If the frequency is not specified, then a minimum of one Field Blank for every 10 sampled wells, or one Field Blank per day if less than ten wells are sampled, is recommended. Equipment Blanks can be substituted for Field Blanks with WM approval.

4.2.5.3 Equipment Blanks

Equipment Blanks are required for all sampling events where non-dedicated downhole (i.e. portable pumps or bailers) equipment may contact the sample. In some cases, if an Equipment Blanks is required, a Field Blank is not collected to reduce analytical costs. Decontamination procedures for non-dedicated equipment are outlined in Section 3.2 of this document. Equipment Blanks for non-dedicated equipment are collected by pouring the deionized or laboratory reagent quality water into or over the sampling device (e.g., the bailer) after it has been properly decontaminated, then pouring the sample into the Equipment Blank bottles. The well at which the Equipment Blank is prepared must be identified on the Field Information Form along with any information/observations that may explain any anomalous results (e.g., equipment type, prevailing winds, upwind sources of potential degradation, etc.). Equipment Blanks should be filtered if appropriate for the analytical method. Non-dedicated sampling equipment blanks should be analyzed for all analytes. Whether or not the sample is filtered, this water should be placed into the Equipment Blank bottles, and the proper preservative added (as required). As in the case of Field Blanks, VOA sample bottles will be pre-equipped with preservatives.

Equipment Blank results will be reported as separate samples; use the designations EB- (#) as their sample designation point. A minimum of one Equipment Blank for each day that monitor wells are sampled is recommended.

4.2.5.4 Duplicates and Split Samples

Duplicate samples are collected in the field using a matching set of laboratory-supplied bottles and sampling from the selected well on an as-requested basis. Each Duplicate should be sampled by alternating between the regular sample bottles and the duplicate sample bottles, proceeding in the designated sampling order (i.e. VOAs first). Duplicates should not be physically different in color, turbidity, or other physical parameters. The well at which the Duplicate is collected must be identified on the Field Information Form along with any information/observations that may explain any anomalous results (e.g. physical differences between samples, prevailing winds, upwind sources of potential degradation, etc.). All duplicates should be blind (i.e. the well designation is not listed on the chain of custody). Once a duplicate is collected, it is handled and shipped in the same manner as the rest of the samples.

Duplicate results will be reported as separate samples; use the designations DUP- (#) as their sample designation point. Duplicates will be analyzed on request only.

Split Samples are collected when co-sampling of a well is conducted with a third party (i.e. Regulatory Agency or External Consultant). Split Samples should be collected using the same method as a Duplicate, alternating between sample bottles, and proceeding in the designated sampling order. The well at which the Split Sample(s) is collected must be identified on the Field Information Form.

NOTE: When samples are split with regulatory agencies, document appropriately on the Field Information Form the condition of the bottles or preservatives, sample collection methods (if different from the WM Guide), and the selected agency laboratory.

5.0 SURFACE WATER SAMPLE COLLECTION

This section of the Guide is applicable to sampling surface water from sources such as discharge points, rivers, streams, ponds, and lakes. Prior to commencing with surface water sampling activities, Field Information Forms for each sample location should be initiated. The sampler should note any areas of dead or distressed vegetation, odors, discolored water, oily sheen, weather conditions, wind direction, nearby activities, etc. Field measurements for pH, electrical conductivity, and temperature must be collected at each sample point prior to sampling, unless otherwise specified in the approved monitoring plan or on the laboratory information sheets. All results must be recorded on the Field Information Form.

The location of the sample point should be selected with care to ensure that a representative sample of water is obtained for testing. The sample point should be selected to avoid intrusion of bottom sediments into the sample container. Samples collected from shallow depths can readily be obtained by merely submerging the sample container below the water surface. The container mouth or opening should be positioned such that the mouth faces in a downstream direction if flowing water is encountered. The sample container should be lowered into the water while still capped, uncapped under water to allow the sample bottle to fill, and re-capped before removal from the water. Pre-preserved bottles should not be filled by dipping. The sampler should wear gloves, and when necessary, stand in a downstream position to prevent any sources of cross contamination and sediment disturbance.

When sampling consecutive points in streams of flowing water, sampling should begin in the furthest downstream location and proceed in an upstream direction. In separate channels or water bodies, the locations expected to exhibit the greatest impacts should be sampled last. To ensure that the surface water samples are representative, samples should be collected from the center of the stream or body of water when possible, and at mid-depth.

Should samples be collected from a boat, the sampler must take care to avoid collection points where the turbulence caused by the propeller or by the oars has disturbed the characteristics of the water. Such samples should be collected from the lower half of the water column of the surface water body.

Surface water samples are not to be field filtered unless specified under local and/or State regulations or as otherwise stated in the sites operating permit or approved Groundwater Monitoring Plan. Sample filling techniques and preservation should follow those described in Section 4.2.4 and 7.1 of this Guide, respectively.

Some permits, such as NPDES Discharge Permits and/or State and Federal Regulations, have specific methods that are approved for field and laboratory analyses. The program manager should ensure that the sampling program and protocols are in compliance with all permit-specific field methods for storm water sampling (e.g. pH measurements in the field at the time of sampling).

6.0 LEACHATE SAMPLE COLLECTION

This section of the Guide is applicable to sampling fluids from leachate wells, leachate manholes, and/or leachate retention basins. Prior to commencing with leachate sampling activities, Field Information Forms for each sample point should be initiated. Upon arrival at the sample location, the general condition of the sample location and its surroundings should be recorded on the Field Information Form. The sampler should note any obvious odors in the vicinity of the sample point, foaming, discolored surface fluids, weather conditions, wind direction, nearby activities, leachate color, etc.

All leachate sampling equipment must be dedicated to each sample point or must be disposable. Fluid level measuring equipment used at leachate monitoring points should never be used at groundwater monitor points. Leachate fluid levels should be measured prior to sample collection. Field measurements for pH, electrical conductivity, and temperature must be collected at each sample point prior to sampling, unless otherwise specified in the approved monitoring plan or on the laboratory information sheets. All results must be recorded on the Field Information Form. Leachate risers and manholes do not require purging prior to sample collection. Samples should be collected using dedicated pumping equipment or by gently lowering a dedicated or disposable bailer into the sampling location and transferring the collected liquid into the sample bottles. Sample filling techniques are described in Section 4.2.4 of this Guide. Leachate samples are not to be field filtered unless specified under local and/or State regulations or as otherwise stated in the sites Operating Permit or Groundwater Monitoring Plan.

Special care should be taken when preserving leachate samples with acid since a violent reaction may occur. Acid should be added slowly and carefully to the leachate samples to avoid a violent reaction. The pH of the leachate sample should be checked prior to shipment and acid should be added to counter the buffering capacity of leachate when appropriate. The amount of preservative added should be identified on the Chain-of-Custody Records. Sample filling techniques and preservation should follow those described in Section 4.2.4 and 7.1 of this Guide, respectively. Leachate samples should not be placed in the same coolers used for shipping groundwater, residential, water supply well samples, or other typically non-degraded samples.

7.0 SAMPLE PRESERVATION, STORAGE, AND SHIPMENT

7.1 Sample Preservation

In general, sample preservation should be performed in the field (except for pre-preserved VOA vials). Only with explicit approval from the WM representative, can functions be performed by the laboratory upon receipt. Samples are to be preserved immediately after filtering or immediately after sample collection (if samples are not filtered). VOAs, which are allowed no headspace (no air bubbles trapped in the sample), will have proper preservatives included in the sample bottle. TOX sample, which also must be headspace-free, should have preservative added just prior to sample collection and like any pre-preserved container must not be over filled.

Bottles will be provided with preservatives in small, labeled vials and packed in a separate plastic bag and labeled as such, except in cases of VOA vials, which are pre-preserved. If required, the preservatives should be added to the sample bottle after it has been filled with the sample. The sample bottle should be filled to within 1/2 inch of the top of the sample container. Subsequent to filling, the sample shall be properly preserved. Once the preservative has been added and the sample container capped, the sample container should be inverted to ensure complete mixing with the sample. The sample container is not to be shaken. Preservation of the samples may be checked in the field periodically to ensure that the sample is properly preserved.

Unused preservative or unused, pre-preserved sample bottles should be returned to the laboratory for reconditioning or disposal.

7.2 Temperature Control

The sample container and samples should ideally be cooled to 4 degrees Celsius from the time the sample is collected through the time of analysis. Samples should be maintained in temperature-regulated refrigerators, in coolers, or in sample coolers containing double bagged or commercial frozen wet ice packs. It is the sampler's responsibility to ensure that provisions have been made in advance for facilities that do not have accommodations to freeze the wet ice packs. In such cases, it is recommended to bring pre-chilled coolers and extra ice packs to the site. The ice packs should be frozen solid prior to use. It is the sample team leader's responsibility to ensure that the samples are properly cooled during shipment to the laboratory. Blue ice or chemical ice packs should not be used, unless specified or required by the WM Representative or lead Agency.

7.3 Sample Packing and Storage

7.3.1 Checking Sample Designations and Numbers

Prior to packing the sample bottles into the shipment coolers, the sampling team must record the sample designations in the appropriate spaces on the Field Chain-of-Custody Records and Field Information Form. It is important that the proper designations be recorded in the proper space on the form and that they be double-checked before sealing the sample cooler.

All bottles filled from the same sample point at the same time must have identical sample designations (except Field Duplicates). Samples that are split with regulatory agencies should also be checked for consistent sample point designation numbers and for other methods of identification used by the agency.

7.3.2 Sample Packing

After the sample is collected and the preservatives are added (when applicable), the bottles should be capped and placed in the sample cooler. The frozen ice packs should be placed into the sample cooler such that they are not in direct contact with sample bottles. Glass containers should not be packed in contact with each other. Bottle holders/cushions and/or bubble wrap should be used for glass bottles to protect them from potential breakage. Do not overpack the coolers with samples. Do not ship leachate or other highly impacted samples in the same cooler as groundwater or surface water samples.

~~All bottles should be wiped clean with paper towels before placement in~~ the sample cooler. The sample cooler must be kept as clean as possible to minimize the potential for degradation. All bottle caps should be checked to ensure they are tight and will not become loose when inserted in the sample cooler. Bottle caps should not be taped. Labels should be taped only if they are loose, and this should be noted on the Field Information Form or Chain-of-Custody Record.

The Field Chain-of-Custody Records (see Section 7.5) and Field Information Forms must then be reviewed to ensure that they have been completed properly. All original paperwork (white copies) should be placed in a plastic bag, sealed, and placed inside the sample cooler or taped to the inside lid of the cooler. The sampling team should maintain a copy of all Chain-of-Custody documents and Field Information Forms for verification purposes (pink copies). Copies (yellow) should be maintained at the facility.

The sample cooler should be taped and sealed. Custody seals, when provided, should be initialed and dated by the sampling team and placed across the front opening of the cooler. The shipping company should not sign the Chain-of-Custody or the custody seals.

7.3.3 Sample Storage

Samples should be stored at 4 degrees Celsius, in an enclosed cooler or dedicated refrigerator where possible, before shipment to the laboratory for analysis. Samples should be shipped daily to the laboratory to ensure proper temperature control and holding time requirements are met.

7.4 Sample Shipment

Samples must be shipped to the laboratory as soon as possible, such that there is no exceedence of holding times. Due to the extremely short hold and extraction times involved with many of the methods used at WM sites, all samples with short holding times (e.g. nitrates, coliform) shall be shipped on the same day that the samples are collected. It is the sample teams' sole responsibility to ensure expedient delivery of samples to the laboratory, such that the samples arrive at the laboratory at the proper temperature and well within the range of specified holding times.

A member of the sampling team must be appointed to arrange sample pickup and/or transportation to the laboratory. Friday shipment of samples to the laboratory should be avoided to ensure that holding times are not exceeded over a weekend. Delivery requested on Saturday must be noted specifically on the shipping/packing air bill for the courier. The laboratory must be notified at least 48 hours preceding the anticipated delivery. In the event of a holiday, contact the laboratory in advance for shipping instructions.

Sample coolers are to be returned by the sampling team using the laboratory designated shipper and shipping labels (i.e. Airborne, Federal Express, United Parcel Service), unless delivery service by the laboratory specified shipper is not available at the facility. The WM representative and laboratory contact should resolve any return shipping issues (i.e. service, rush service availability) prior to sample delivery. In the absence of such specification, the WM representative should determine the shipment method.

When contacting the courier for transport of a sample, specify the sample cooler contents. Alert the courier to the potential problems of the samples freezing in the winter or ice packs melting in the summer, and note these potential problems on the shipping/packing label. Sample coolers should be received at the laboratory within 24 hours of when the frozen ice packs were placed in the sample cooler (with the exception of Alaska and Hawaii). This is necessary for temperature preservation and to meet required holding times for some analyses. Any necessary delay in shipment of the coolers to the laboratory must be documented on the Field Chain-of-Custody Record, and is the responsibility of the sampling team.

7.5 Sample Chain-of-Custody Record

To help maintain the integrity of the samples, strict chain-of-custody procedures are necessary. These procedures help to ensure that tampering with the samples does not occur. From the time the sample bottles leave the laboratory until the issuance of the analytical laboratory results, the samples and/or sample containers must be in the custody of assigned WM personnel, an assigned consultant, contractor, or the laboratory. In order to maintain the chain-of-custody, the samples must be in sight of the assigned custodian or locked in a tamper-proof location. A written record of sample bottle possession and any transfers of samples must be maintained and documented on the Field Chain-of-Custody Record.

The Sample Chain-of-Custody must contain, at a minimum, the following information:

- Site Name
- Station Numbers (Line No. on COC, ascending order)
- Date Samples are collected (by sample)
- Time Sample Collected (by sample)
- Type of Sample (Composite, Grab, Groundwater, leachate, surface water)
- Number of containers per sample point
- Filtering Requirements (Remarks Column)
- Preservatives (Remarks Column)
- Analysis Required
- Special Remarks (i.e. remittance of sealed coolers via courier) (at base of Form)

The Field Chain-of-Custody Record must further be signed with the date and time for the following activities:

- Receipt of the sample cooler (s)
- Each time the sample cooler is transferred to the custody of another person
- Immediately before sealing the sample cooler for transport to the laboratory. (The form must be signed and enclosed within the cooler in a watertight bag).

Samples from the same sample point that are placed in more than one sample cooler require a Field Chain-of-Custody Record in each sample cooler. Any problems with the sample cooler's contents must also be noted on the form. Upon receipt of the sample cooler by the lab, the condition of the samples, temperature, date, and time are recorded on the Field Chain-of-Custody Record by the log-in personnel receiving the sample coolers. The Field Chain-of-Custody Record indicates by bottle and analysis group whether samples are preserved. The sampling team must record the field filtration, preservative, and any deviations from normal preservation requirements on the Chain-of-Custody Record (the sampling should initial the forms if this information is preprinted on forms provided by the lab). Failure to complete the Field Chain-of-Custody Record will render the resulting data useless. An example of the WM Field Chain of Custody Form is provided as Attachment 3.

8.0 SPECIAL SAMPLE COLLECTION PROTOCOLS

This Guide addresses all routine (reoccurring) sample collection activities at WM Facilities. Non-routine or special sampling is often required to collect further information. The following is a brief outline of procedures that are being developed and will be available in the event of non-routine or special sampling. These procedures will be available from the WM Groundwater Protection Program Manager for the area.

In most all cases the WM Groundwater Protection Program should be notified of special sampling events, as they pertain to non-routine groundwater issues. The events should be conducted under the supervision of the WM Project Manager.

- **Special Event Notification:**
  Use this procedure for one time only or limited event special sampling and resample events. Notify the laboratory in ample time for laboratory response using a Special Event Notification/Bottle Request Form (Attachment 2); provide a copy of the approved form to the sampling team.

- **Field Inspection Forms:**
  Updated forms allowing for collecting low-flow data (attached)

- **WM Environmental Sampling Audit Checklist:**
  Available upon request

- **Low-Flow Sampling:**
  Detailed guidance for low-flow sampling procedures developed in part from EPA and QED guidance. WM has an in-house procedure that is available upon request.

- **Isotope Sampling:**
  Detailed guidance for isotope sampling procedures will be as appropriate for the Method. Protocols should be specified on a case-by-case basis with WM's Groundwater Protection Program manager.

- **WM STANDARD GUIDE for evaluating intra-well gas to water transfer of volatile organic compounds (VOCs) at landfill sites:**
  Available upon request

- **WM STANDARD GUIDE for Monitor Well/Piezometer Development:**
  Available upon request

- **Leak Detection System Monitoring and Evaluation Procedures:**
  White Sheet Pending

ATTACHMENT 1

SIGNATURE PAGE (S)

SIGNATURE PAGE

The following persons have read and agree to follow the WM Sampling Guide. Exceptions to the Guide are to be noted below.

SITE/LOCATION: ________________/___________________
SITE SPECFIC EXCEPTIONS: **Reference:**

____
____
____

SITE/LOCATION: ________________/___________________
SITE SPECFIC EXCEPTIONS: **Reference:**

____
____
____

SITE/LOCATION: ________________/___________________
SITE SPECFIC EXCEPTIONS: **Reference:**

____
____
____

SITE/LOCATION: ________________/___________________
SITE SPECFIC EXCEPTIONS: **Reference:**

____
____
____

SAMPLING TEAM COMPANY	**PROJECT MANAGER**	**SIGNATURE**	**DATE**

1 **SAMPLER NAME**	**SIGNATURE**	**DATE**	3 **SAMPLER NAME**	**SIGNATURE**	**DATE**
2 **SAMPLER NAME**	**SIGNATURE**	**DATE**	4 **SAMPLER NAME**	**SIGNATURE**	**DATE**

WASTE MANAGEMENT	**SIGNATURE**	**DATE**

Multiple copies can be made for additional sites/facilities/samplers. The Sampling Team/Company should notify WM of any changes in field personnel and should forward an updated copy of this signature page prior to going into the field.

ATTACHMENT 2

SPECIAL EVENT NOTIFICATION FORM

WASTE MANAGEMENT, INC
SPECIAL EVENT ADDENDA

NOTIFICATION/BOTTLE REQUEST FORM

Attention:	Fax No.:
Addendum No.:	Event Description: ❑ Verification ❑ Resample ❑ Non-Routine ❑ Other____________________
Date Requested:	Date Bottles Required:
Site: Name: ______________________________ Location: ____________________________	TAT: ❑ 24hr. ❑ 48hr. ❑ 72hr. ❑ 1 week ❑ Standard (21 CD)
Sample Locations:	Parameters Requested:
Send Bottles to: Attn: ____________________ Co.: ____________________ Address: ____________________	
Special Instructions:	
Requested by: __________/__________ Name Signature	Confirmed by: __________/__________ Name Signature
Notes: WM should fax and confirm verbally with Laboratory Contact. Lab should return faxed copy to confirm event.	

ATTACHMENT 3

WELL CONDITION INSPECTION FORM

CHAIN OF CUSTODY FORM

FIELD INFORMATION FORM

WELL CONDITION INSPECTION FORM

Site: ______________________________ Personnel: ______________________________

Date: ______________________________ Page ______ of ______

Well ID	Protective Casing	Well Casing	Label	Lock	Sample Equipment Type	General Turbidity	Well Yield	Comments/Observations *
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No		☐ Clear ☐ Turbid	☐ OK ☐ Inadequate	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No		☐ Clear ☐ Turbid	☐ OK ☐ Inadequate	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No		☐ Clear ☐ Turbid	☐ OK ☐ Inadequate	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No		☐ Clear ☐ Turbid	☐ OK ☐ Inadequate	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No		☐ Clear ☐ Turbid	☐ OK ☐ Inadequate	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No		☐ Clear ☐ Turbid	☐ OK ☐ Inadequate	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No		☐ Clear ☐ Turbid	☐ OK ☐ Inadequate	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No		☐ Clear ☐ Turbid	☐ OK ☐ Inadequate	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No		☐ Clear ☐ Turbid	☐ OK ☐ Inadequate	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No		☐ Clear ☐ Turbid	☐ OK ☐ Inadequate	

* Note ponding water, weep holes, or any other information pertaining to well condition. Provide additional details on listed items.

Return this form to Site Manager and Groundwater Program Manager

WASTE MANAGEMENT

Well Condition Inspection Form

Facility: ______________________ Well/Piezometer Name: ______________________

Evaluator: ______________________ Evaluation Date: ______________________

	Y	N	N/A
Is the well's location appropriately shown on a facility map?			
he well adequately flagged if hard to find?			
Is the well elevation information inscribed at or on the well correct?			
Is the well: ❑ flush with surface? ❑ above ground?			
Is the well free of physical damage?			
Is the well labeled on the inside?			
Is the well labeled on the outside?			
Does the well have protective posts, if necessary?			
Do above ground wells have weep holes at the base of the protective casing?			
Does the area around the well appear clean?			
he casing secure (attempt to move along two perpendicular axes)?			
he surface seal void of differential erosion around and under the base?			
he surface seal free of cracks that might affect the integrity of the seal?			
Is the surface seal sloped to prevent ponding around the well?			
Is the well free from standing or ponded water?			
Is the well locked to prevent unauthorized access?			
Is the protective casing cap void of large gaps which would breach security?			
Is the locking cap free of rust?			
Is there a survey mark on the riser/wellhead assembly cap?			
Is the riser cap vented?			
Is the annular space free of animal/insect nests?			
he annular space appropriately filled with filtering material?			
If a pump, can it be lifted a few inches? (do not test prior to sampling)			
Is the well free of kinks or bends?			

COMMENTS: ____

STL
Committed To Your Success

WASTE MANAGEMENT CHAIN OF CUSTODY

Internal Use Only

Sampler Name:(Print)	Signature:
Site Name:	Spec. Request: AC
Site Location:	Event Name:

STL Sample No.	Client Sample ID	Sampling Date	Sampling Time	MATRIX	COMP / GRAB	8260VOA	T-METALS	D-METALS	CHLORIDE/SULFATE	ALK/CARB/BICARB	NITRATE	HARDNESS							Additional Analysis/Remarks

INDICATE PRESERVATIVE BY USING KEY BELOW (OPTIONAL)
INDICATE CONTAINER BY USING KEY BELOW (OPTIONAL)

RELINQUISHED BY	COMPANY	DATE	TIME	RECEIVED BY	COMPANY	DATE	TIME
RELINQUISHED BY	COMPANY	DATE	TIME	RECEIVED BY	COMPANY	DATE	TIME
RELINQUISHED BY	COMPANY	DATE	TIME	RECEIVED BY	COMPANY	DATE	TIME

Matrix Key
WW = Wastewater
W = Water/Groundwater
S = Soil
SI = Sludge
MS = Miscellaneous Solids
OI = Oil
A = Air
O =

Container Key
1. Plastic
2. VOA Vial
3. Sterile Plastic
4. Amber Glass
5. Widemouth Glass
6. Other

Preservation Key
1. HCl, Cool to 4°
2. H2SO4, Cool to 4°
3. HnO3, Cool to 4°
4. NaOH, Cool to 4°
5. NaOH/Zn Acetate, Cool to 4°
6. Cool to 4°
7. None

COMMENTS

Courier:

Bill of Lading:

FIELD INFORMATION FORM

WASTE MANAGEMENT

Site Name: ____
Site No.: ____ Sample Point: ____ Sample ID

This Waste Management Field Information Form is Required
This form is to be completed, in addition to any State Forms. The Field Form is submitted along with the Chain of Custody Forms that accompany the sample containers (i.e. with the cooler that is returned to the laboratory).

Laboratory Use Only/Lab ID: ____

PURGE INFO

PURGE DATE (MM DD YY)	PURGE TIME (2400 Hr Clock)	ELAPSED HRS (hrs:min)	WATER VOL IN CASING (Gallons)	ACTUAL VOL PURGED (Gallons)	WELL VOLs PURGED

Note: For Passive Sampling, replace "Water Vol in Casing" and "Well Vols Purged" w/ Water Vol in Tubing/Flow Cell and Tubing/Flow Cell Vols Purged. Mark changes, record field data, below.

PURGE/SAMPLE EQUIPMENT

Purging and Sampling Equipment … Dedicated: Y or N

Purging Device ____ A- Submersible Pump, B-Peristaltic Pump, C-QED Bladder Pump, D-Bailer, E-Piston Pump, F-Dipper/Bottle

Sampling Device ____

X-Other: ____

Filter Device: Y or N 0.45 µ or ____ µ (circle or fill in)

Filter Type: ____ A-In-line Disposable, B-Pressure, C-Vacuum, X-Other ____

Sample Tube Type: ____ A-Teflon, B-Stainless Steel, C-PVC, D-Polypropylene, X-Other: ____

WELL DATA

Well Elevation (at TOC) ____ (ft/msl) **Depth to Water (DTW) (from TOC)** ____ (ft) **Groundwater Elevation (site datum, from TOC)** ____ (ft/msl)

Total Well Depth (from TOC) ____ (ft) Stick Up (from ground elevation) ____ (ft) Casing ID ____ (in) Casing Material ____

Note: Total Well Depth, Stick Up, Casing Id, etc. are optional and can be from historical data, unless required by Site/Permit. Well Elevation, DTW, and Groundwater Elevation must be current.

STABILIZATION DATA (Optional)

Sample Time (2400 Hr Clock)	Rate/Unit ____		pH (std)		Conductance (SC/EC) (µmhos/cm @ 25 °C)	Temp. (°C)	Turbidity (ntu)	D.O. (mg/L - ppm)	eH/ORP (mV)	DTW (ft)
		1st		1st						
		2nd		2nd						
		3rd		3rd						
		4th		4th						
Suggested range for 3 consec. readings or note Permit/State requirements:			+/- 0.2		+/- 3%	--	--	+/- 10%	+/- 25 mV	Stabilize

Stabilization Data Fields are Optional *(i.e. complete stabilization readings for parameters required by WM, Site, or State). These fields can be used where four (4) field measurements are required by State/Permit/Site. If a Data Logger or other Electronic format is used, fill in final readings below and submit electronic data separately to Site. If more fields above are needed, use separate sheet or form.*

FIELD DATA

SAMPLE DATE (MM DD YY)	pH (std)	CONDUCTANCE (umhos/cm @ 25°C)	TEMP. (°C)	TURBIDITY (ntu)	DO (mg/L-ppm)	eH/ORP (mV)	Other: ____ Units ____

Final Field Readings are required *(i.e. record field measurements, final stabilized readings, passive sample readings before sampling for all field parameters required by State/Permit/Site.*

FIELD COMMENTS

Sample Appearance: ____ Odor: ____ Color: ____ Other: ____

Weather Conditions (required daily, or as conditions change): Direction/Speed: ____ Outlook: ____ Precipitation: Y or N

Specific Comments (including purge/well volume calculations if required): ____

I certify that sampling procedures were in accordance with applicable EPA, State, and WM protocols (if more than one sampler, all should sign):

Date	Name	Signature	Company
__/__/__			
__/__/__			

DISTRIBUTION: WHITE/ORIGINAL - Stays with Sample, YELLOW - Returned to Client, PINK - Field Copy

Sample Collection / Laboratory Analytical Program

WASTE MANAGEMENT

Site Name: CWMNW - Arlington, OR **Site Number: 530**
Well ID: **Date:**

Monitoring Program (check one):	______RCRA Detection ______RCRA Annual Compliance	______RCRA Semi-Annual Compliance ______TSCA Program
Depth To Water (DTW) Before Sampling (for wells purged dry):	Maximum DTW allowable for sampling VOCs, metals, CN: Enough water to sample? DTW at 48 hours if insufficient water:	

Sample I.D./Time	Number of sample containers	Volume of each container	Bottle Type	Preservative	Field Filtered?	Analytes
	3	40 mL	VOA Vial	HCl	No	VOCs
	1	500 mL	HDPE	HNO_3	Yes	Dissolved Metals
	1	250 mL	HDPE	NaOH	No	Total Cyanide
	2	1 liter	Amber Glass	4 degrees C	No	PCBs
Duplicate I.D./Time						All of the above
Field Blank I.D./Time						All of the above
Equipment Blank I.D./Time						All of the above
VOC Trip Blank I.D./Time		40ml	VOA VIAL	HCL	No	VOCs

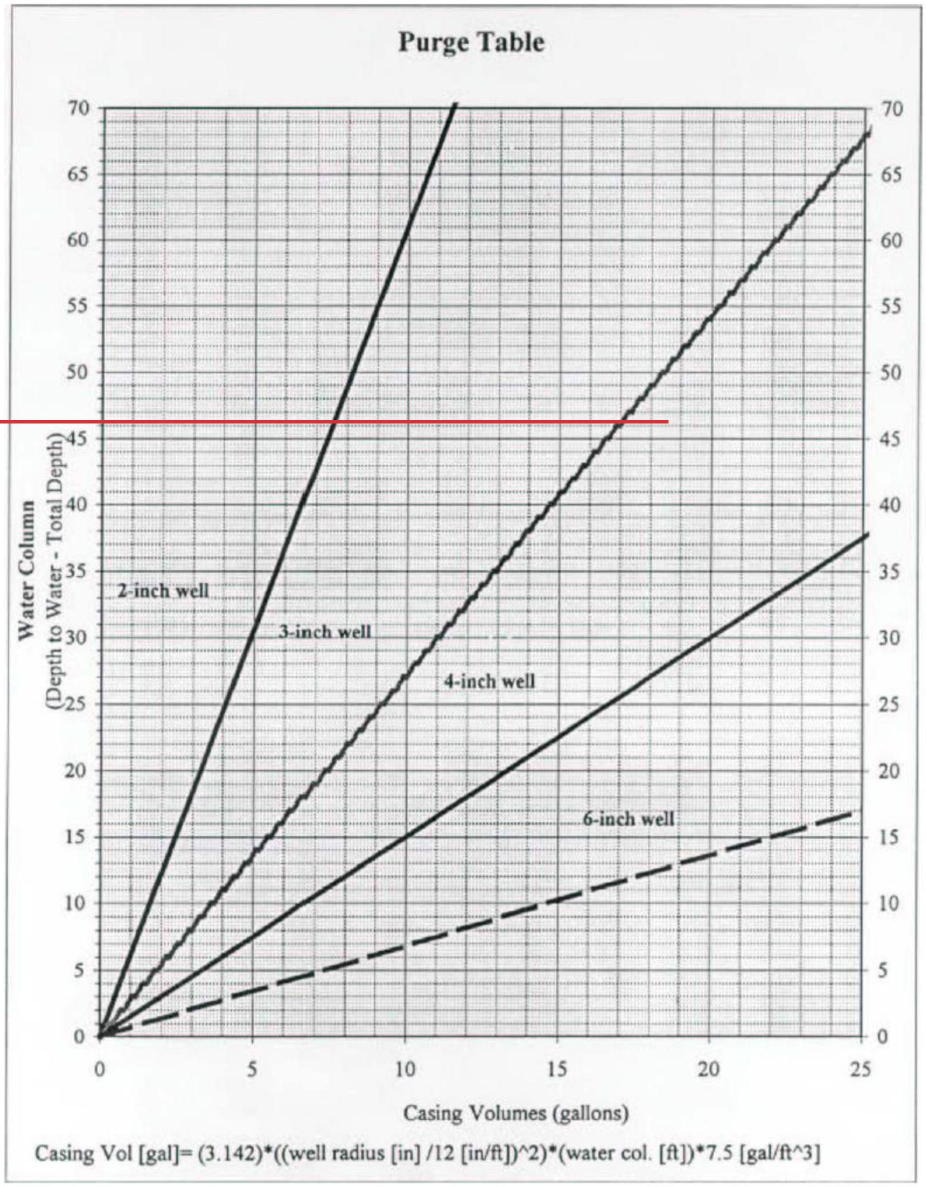
Shipping Method: Hand - Fed Ex - UPS - **Laboratory:** Severn-Trent Laboratories

NAPL observed during purging or sampling?
Depth to water at end of purging or beginning of sampling:
Depth to water at end of sampling:
Comments/Exceptions to Groundwater Monitoring Plan:

Sampler's Name	Sampler's Signature	Company	Date
______________	______________	______________	____/____/____

ATTACHMENT 4

PURGE VOLUME GRAPHS


Purge Table
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Water Column
(Depth to Water - Total Depth)
2-inch well
3-inch well
4-inch well
6-inch well
0
5
10
15
20
25
Casing Volumes (gallons)
Casing Vol [gal]= (3.142)*((well radius [in] /12 [in/ft])^2)*(water col. [ft])*7.5 [gal/ft^3]

ATTACHMENT 5

METER CALIBRATION LOG

FIELD PARAMETER CALIBRATION PROCEDURES

STANDARD METHODS FOR CHEMICAL ANALYSIS OF WATERS AND WASTEWATERS

pH – Method 150.1
Temperature – Method 170.1
Turbidity – Method 180.1
Conductance – Method 120.1
Oxygen, Dissolved – Method 360.1

WASTE MANAGEMENT

METER CALIBRATION LOG

PROJECT NAME:______________________ DATE:______________________

PROJECT NUMBER:______________________ SAMPLER:______________________

MODEL:______________________ SERIAL NO.:______________________

pH METER

Time	pH 10 Buffer Check	pH 7 Buffer Check	pH 4 Buffer Check	Temp of Calibration Soln (°C)

Buffer Lot Numbers: pH 4:__________ pH 7:__________ pH 10:__________

CONDUCTIVITY METER

Temp. of Calibration Soln	Corrected Cond. @ 25°C	*Time*

Calibration Solution Lot Number:__________
Calibration Range for Solution __________

MODEL:__________

REDOX METER

Temp (°C)	E_H Reading (mV)	Time

Calibration Solution Lot Number:__________
Calibration Range for Solution __________

SERIAL NO.:__________

Turbidity Meter

Gel Value (NTU)	Reading (NTU)	Time
0 – 10 range		
0 – 100 range		
0 – 1,000 range		
0 – 10 range		
0 – 100 range		
0 – 1,000 range		

Problems/Corrective Actions:______________________

Signature:______________________ Date:______________________

QC'd By:______________________ Date:______________________

METHOD #: 150.1	Approved for NPDES (Editorial Revision 1978, 1982)
TITLE:	pH (Electrometric)
ANALYTE:	pH
INSTRUMENTATION:	pH Meter
STORET No.	Determined on site 00400 Laboratory 00403

1.0 Scope and Application

1.1 This method is applicable to drinking, surface, and saline waters, domestic and industrial wastes and acid rain (atmospheric deposition).

2.0 Summary of Method

2.1 The pH of a sample is determined electrometrically using either a glass electrode in combination with a reference potential or a combination electrode.

3.0 Sample Handling and Preservation

3.1 Samples should be analyzed as soon as possible preferably in the field at the time of sampling.

3.2 High-purity waters and waters not at equilibrium with the atmosphere are subject to changes when exposed to the atmosphere, therefore the sample containers should be filled completely and kept sealed prior to analysis.

4.0 Interferences

4.1 The glass electrode, in general, is not subject to solution interferences from color, turbidity, colloidal matter, oxidants, reductants or high salinity.

4.2 Sodium error at pH levels greater than 10 can be reduced or eliminated by using a "low sodium error" electrode.

4.3 Coatings of oily material or particulate matter can impair electrode response. These coatings can usually be removed by gentle wiping or detergent washing, followed by distilled water rinsing. An additional treatment with hydrochloric acid (1 + 9) may be necessary to remove any remaining film.

4.4 Temperature effects on the electrometric measurement of pH arise from two sources. The first is caused by the change in electrode output at various temperatures. This interference can be controlled with instruments having temperature compensation or by calibrating the electrode-instrument system at the temperature of the samples. The second source is the change of pH inherent in the sample at various temperatures. This error is sample dependent and cannot be controlled, it should therefore be noted by reporting both the pH and temperature at the time of analysis.

5.0 Apparatus

5.1 pH Meter-laboratory or field model. A wide variety of instruments are commercially available with various specifications and optional equipment.
5.2 Glass electrode.
5.3 Reference electrode-a calomel, silver-silver chloride or other reference electrode of constant potential may be used.
NOTE 1: Combination electrodes incorporating both measuring and reference functions are convenient to use and are available with solid, gel type filling materials that require minimal maintenance.
5.4 Magnetic stirrer and Teflon-coated stirring bar.
5.5 Thermometer or temperature sensor for automatic compensation.

6.0 Reagents

6.1 Primary standard buffer salts are available from the National Bureau of Standards and should be used in situations where extreme accuracy is necessary.
6.1.1 Preparation of reference solutions from these salts require some special precautions and handling[1] such as low conductivity dilution water, drying ovens, and carbon dioxide free purge gas. These solutions should be replaced at least once each month.
6.2 Secondary standard buffers may be prepared from NBS salts or purchase as a solution from commercial vendors. Use of these commercially available solutions, that have been validated by comparison to NBS standards, are recommended for routine use.

7.0 Calibration

7.1 Because of the wide variety of pH meters and accessories, detailed operating procedures cannot be incorporated into this method. Each analyst must be acquainted with the operation of each system and familiar with all instrument functions. Special attention to care of the electrodes is recommended.
7.2 Each instrument/electrode system must be calibrated at a minimum of two points that bracket the expected pH of the samples and are approximately three pH units or more apart.
7.2.1 Various instrument designs may involve use of a "balance" or "standardize" dial and/or a slope adjustment as outlined in the manufacturer's instructions. Repeat adjustments on successive portions of the two buffer solutions as outlined in procedure 8.2 until readings are within 0.05 pH units of the buffer solution value.

8.0 Procedure

8.1 Standardize the meter and electrode system as outlined in Section 7.
8.2 Place the sample or buffer solution in a clean glass beaker using a sufficient volume to cover the sensing elements of the electrodes and to give adequate clearance for the magnetic stirring bar.
8.2.1 If field measurements are being made the electrodes may be immersed

directly in the sample stream to an adequate depth and moved in a manner to insure sufficient sample movement across the electrode sensing element as indicated by drift free (< 0.1 pH) readings.

8.3 If the sample temperature differs by more than 2°C from the buffer solution the measured pH values must be corrected. Instruments are equipped with automatic or manual compensators that electronically adjust for temperature differences. Refer to manufacturer's instructions.

8.4 After rinsing and gently wiping the electrodes, if necessary, immerse them into the sample beaker ar sample stream and stir at a constant rate to provide homogeneity and suspension of solids. Rate of stirring should minimize the air transfer rate at the air water interface of the sample. Note and record sample pH and temperature. Repeat measurement on successive volumes of sample until values differ by less than 0.1 pH units. Two or three volume changes are usually sufficient.

8.5 For acid rain samples it is most important that the magnetic stirrer is not used. Instead, swirl the sample gently for a few seconds after the introduction of the electrode(s). Allow the electrode(s) the equilibrate. The air-water interface should not be disturbed while measurement is being made. If the sample is not in equilibrium with the atmosphere, pH values will change as the dissolved gases are either absorbed or desorbed. Record sample pH and temperature.

9.0 Calculation

9.1 pH meters read directly in pH units. Report pH to the nearest 0.1 unit and temperature to the nearest degree °C.

10.0 Precision and Accuracy

10.1 Forty-four analysts in twenty laboratories analyzed six synthetic water samples containing exact increments of hydrogen-hydroxyl ions, with the following results:

pH Units	Standard Deviation pH Units	Accuracy as Bias, %	Accuracy as Bias, pH Units
3.5	0.10	-0.29	-0.01
3.5	0.11	-0.00	
7.1	0.20	+1.01	+0.07
7.2	0.18	-0.03	-0.002
8.0	0.13	-0.12	-0.01
8.0	0.12	+0.16	+0.01

(FWPCA Method Study 1, Mineral and Physical Analyses)

10.2 In a single laboratory (EMSL), using surface water samples at an average pH of 7.7, the standard deviation was± 0.1.

Bibliography

1. Standard Methods for the Examination of Water and Wastewater, 14th Edition, p 460, (1975).
2. Annual Book of ASTM Standards, Part 31, "Water", Standard D1293-65, p 178 (1976).
3. Peden, M. E. and Skowron, L. M., Ionic Stability of Precipitation Samples, Atmospheric Environment, Vol. 12, pp. 2343-2349, 1978.

METHOD #: 170.1	Approved for NPDES (Issued 1974)
TITLE:	Temperature (Thermometric)
ANALYTE:	Temperature
INSTRUMENTATION:	Thermometer
STORET No.	00010

1.0 Scope and Application

1.1 This method is applicable to drinking, surface, and saline waters, domestic and industrial wastes.

2.0 Summary of Method

2.1 Temperature measurements may be made with any good grade of mercury-filled or dial type centigrade thermometer, or a thermistor.

3.0 Comments

3.1 Measurement device should be routinely checked against a precision thermometer certified by the National Bureau of Standards.

4.0 Precision and Accuracy

4.1 Precision and accuracy for this method have not been determined.

5.0 Reference

5.1 The procedure to be used for this determination is found in: Standard Methods for the Examination of Water and Wastewater, 14th Edition, p 125, Method 212 (1975).

METHOD #: 180.1	Approved for NPDES (Editorial Revision 1974, 1978)
TITLE:	Turbidity (Nephelometric)
ANALYTE:	Turbidity
INSTRUMENTATION:	Turbidimeter
STORET No.	00076

1.0 Scope and Application

1.1 This method is applicable to drinking, surface, and saline waters in the range of turbidity from 0 to 40 nephelometric turbidity units (NTU). Higher values may be obtained with dilution of the sample.

NOTE 1: NTU's are considered comparable to the previously reported Formazin Turbidity Units (FTU) and Jackson Turbidity Units (JTU).

2.0 Summary of Method

2.1 The method is based upon a comparison of the intensity of light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension. The higher the intensity of scattered light, the higher the turbidity. Readings, in NTU's, are made in a nephelometer designed according to specifications outlined in Apparatus. A standard suspension of Formazin, prepared under closely defined conditions, is used to calibrate the instrument.

2.1.1 Formazin polymer is used as the turbidity reference suspension for water because it is more reproducible than other types of standards previously used for turbidity standards.

2.1.2 A commercially available polymer standard is also approved for use for the National Interim Primary Drinking Water Regulations. This standard is identified as AMCO-AEPA-1 available from Amco Standard International, Inc.

3.0 Sample Handling and Preservation

3.1 Preservation of the sample is not practical; analysis should begin as soon as possible. Refrigeration or icing to 4°C, to minimize microbiological decomposition of solids, is recommended.

4.0 Interferences

4.1 The presence of floating debris and coarse sediments which settle out rapidly will give low readings. Finely divided air bubbles will affect the results in a positive manner.

4.2 The presence of true color, that is the color of water which is due to dissolved substances which absorb light, will cause turbidities to be low, although this effect is generally not significant with finished waters.

5.0 Apparatus

5.1 The turbidimeter shall consist of a nephelometer with light source for illuminating the sample and one or more photo-electric detectors with a readout device to indicate the intensity of light scattered at right angles to the path of the incident light. The turbidimeter should be so designed that little stray light reaches the detector in the absence of turbidity and should be free from significant drift after a short warm-up period.

5.2 The sensitivity of the instrument should permit detection of a turbidity difference of 0.02 unit or less in waters having turbidities less than 1 unit. The instrument should measure from 0 to 40 units turbidity. Several ranges will be necessary to obtain both adequate coverage and sufficient sensitivity for low turbidities.

5.3 The sample tubes to be used with the available instrument must be of clear, colorless glass. They should be kept scrupulously clean, both inside and out, and discarded when they become scratched or etched. They must not be handled at all where the light strikes them, but should be provided with sufficient extra length, or with a protective case, so that they may be handled.

5.4 Differences in physical design of turbidimeters will cause differences in measured values for turbidity even though the same suspension isused for calibration. To minimize such differences, the following design criteria should be observed:

5.4.1 Light source: Tungsten lamp operated at a color temperature between 2200-3000 °K.

5.4.2 Distance traversed by incident light and scattered light within the sample tube: Total not to exceed 10 cm.

5.4.3 Detector: Centered at 90° to the incident light path and not to exceed ± 30°C from 90°C. The Detector, and filter system if used, shall have a spectral peak response between 400 and 600 nm.

5.5 The Hach Turbidimeter, Model 2100 and 2100 A, is in wide use and has been found to be reliable; however, other instruments meeting the above design criteria are acceptable.

6.0 Reagents

6.1 Turbidity-free water: Pass distilled water through a 0.45μ pore size membrane filter if such filtered water shows a lower turbidity than the distilled water.

6.2 Stock formazin turbidity suspension: Solution 1: Dissolve 1.00 g hydrazine sulfate, $(NH_2)_2 \bullet H_2SO_4$, in distilled water and dilute to 100 mL in a volumetric flask. Solution 2: Dissolve 10.00 g hexamethylene-tetramine in distilled water and dilute to 100 mL in a volumetric flask. In a 100 mL volumetric flask, mix 5.0 mL Solution 1 with 5.0 mL Solution 2. Allow to stand 24 hours at 25 ± 3°C, then dilute to the mark and mix.

6.3 Standard formazin turbidity suspension: Dilute 10.00 mL stock turbidity suspension to 100 mL with turbidity-free water. The turbidity of this suspension is defined as 40 units. Dilute portions of the standard turbidity suspension with turbidity-free water as required.

6.3.1 A new stock turbidity suspension should be prepared each month. The standard turbidity suspension and dilute turbidity standards should be prepared weekly by dilution of the stock turbidity suspension.

6.4 The AMCO-AEPA-1 standard as supplied requires no preparation or dilution prior to use.

7.0 Procedure

7.1 Turbidimeter calibration: The manufacturer's operating instructions should be followed. Measure standards on the turbidimeter covering the range of interest. If the instrument is already calibrated in standard turbidity units, this procedure will check the accuracy of the calibration scales. At least one standard should be run in each instrument range to be used. Some instruments permit adjustments of sensitivity so that scale values will correspond to turbidities. Reliance on a manufacturer's solid scattering standard for setting overall instrument sensitivity for all ranges is not an acceptable practice unless the turbidimeter has been shown to be free of drift on all ranges. If a pre-calibrated scale is not supplied, then calibration curves should be prepared for each range of the instrument.

7.2 Turbidities less than 40 units: Shake the sample to thoroughly sample into the turbidimeter tube. Read the turbidity directly from the instrument scale or from the appropriate calibration curve.

7.3 Turbidities exceeding 40 units: Dilute the sample with one or more volumes of turbidity-free water until the turbidity falls below 40 units. The turbidity of the original sample is then computed from the turbidity of the diluted sample and the dilution factor. For example, if 5 volumes of turbidity-free water were added to 1 volume of sample, and the diluted sample showed a turbidity of 30 units, then the turbidity of the original sample was 180 units.

7.3.1 The Hach Turbidimeters, Models 2100 and 2100A, are equipped with 5 separate scales: 0-0.2, 0-1.0, 0-100, and 0-1000 NTU. The upper scales are to be used only as indicators of required dilution volumes to reduce readings to less than 40 NTU.

NOTE 2: Comparative work performed in the MDQAR Laboratory indicates a progressive error on sample turbidities in excess of 40 units.

8.0 Calculation

8.1 Multiply sample readings by appropriate dilution to obtain final reading.

8.2 Report results as follows:

NTU	Record to Nearest:
0.0 - 1.0	0.05
1 - 10	0.1
10 - 40	1
40 - 100	5
100 - 400	10
400 - 1000	50
> 1000	100

9.0 Precision and Accuracy

9.1 In a single laboratory (EMSL), using surface water samples at levels of 26, 41, 75 and 180 NTU, the standard deviations were ± 0.60, ± 0.94, ±1.2 and ±4.7 units, respectively.

9.2 Accuracy data are not available at this time.

Bibliography

1. Annual Book of ASTM Standards, Part 31, "Water", Standard D1889-71, p 223 (1976).
2. Standard Methods for the Examination of Water and Wastewater, 14th Edition, p 132, Method 214A, (1975).

METHOD #: 120.1	Approved for NPDES (Editorial Revision 1982)
TITLE:	Conductance (Specific Conductance, *u*mhos at 25°C)
ANALYTE:	Conductance
INSTRUMENTATION:	Conductivity Meter
STORET No.	00095

1.0 Scope and Application

1.1 This method is applicable to drinking, surface, and saline water, domestic and industrial wastes and acid rain (atmospheric deposition).

2.0 Summary of Method

2.1 The specific conductance of a sample is measured by use of a self-contained conductivity meter, Wheatstone bridge-type, or equivalent.
2.2 Samples are preferable analyzed at 25°C. If not, temperature corrections are made and results reported at 25°C.

3.0 Comments

3.1 Instrument must be standardized with KCl solution before daily use.
3.2 Conductivity cell must be kept clean.
3.3 Field measurements with comparable instruments are reliable.
3.4 Temperature variations and corrections represent the largest source of potential error.

4.0 Sample Handling and Preservation

4.1 Analyses can be performed either in the field or laboratory.
4.2 If analysis is not completed within 24 hours of sample collection, sample should be filtered through a 0.45 micron filter and stored at 4°C. Filter and apparatus must be washed with high quality distilled water and pre-rinsed with sample before use.

5.0 Apparatus

5.1 Conductivity bridge, range 1 to 1000 *u*mho per centimeter.
5.2 Conductivity cell, cell constant 1.0 or micro dipping type cell with 1.0 constant. YSI #3403 or equivalent.
5.3 Thermometer

6.0 Reagents

6.1 Standard potassium chloride solutions, 0.01 M: Dissolve 0.7456 gm of pre-dried (2 hour at 105°C) KCl in distilled water and dilute to 1 liter at 25°C.

7.0 Cell Calibration

7.1 The analyst should use the standard potassium chloride solution (6.1) and the table below to check the accuracy of the cell constant and conductivity bridge.

Conductivity 0.01 m KCl

°C	Micromhos/cm
21	1305
22	1332
23	1359
24	1386
25	1413
26	1441
27	1468
28	1496

8.0 Procedure

8.1 Follow the direction of the manufacturer for the operation of the instrument.
8.2 Allow samples to come to room temperature (23 to 27°C), if possible.
8.3 Determine the temperature of samples within 0.5°C. If the temperature of the samples is not 25°C, make temperature correction in accordance with the instruction in Section 9 to convert reading to 25°C.

9.0 Calculation

9.1 These temperature corrections are based on the standard KCl solution.
9.1.1 If the temperature of the sample is below 25°C, add 2% of the reading per degree.
9.1.2 If the temperature is above 25°C, subtract 2% of the reading per degree.
9.2 Report results as Specific Conductance, umhos/cm at 25°C.

10.0 Precision and Accuracy

10.1 Forty-one analysts in 17 laboratories analyzed six synthetic water samples containing increments of inorganic salts, with the following results:

Increment as Specific Conductance	Precision as Standard Deviation	Accuracy as Bias, %	Bias, umhos/cm
100	7.55	-2.02	-2.0
106	8.14	-0.76	-0.8
808	66.1	-3.63	-29.3
848	79.6	-4.54	-38.5
1640	106	-5.36	-87.9
1710	119	-5.08	-86.9

(FWPCA Method Study 1, Mineral and Physical Analyses.)

10.2 In a single laboratory (EMSL) using surface water samples with an average conductivity of 536 *u*mhos/cm at 25°C, the standard deviation was ± 6.

Bibliography

1. The procedure to be used for this determination is found in:
Annual Book of ASTM Standards Part 31, "Water," Standard D1125-64, p. 120 (1976).
2. Standard Methods for the Examination of Water and Wastewater, 14th Edition, p. 71, Method 205 (1975).
3. Instruction Manual for YSI Model 31 Conductivity Bridge.
4. Peden, M. E., and Skowron. "Ionic Stability of Precipitation Samples," Atmospheric Environment, Vol. 12, p. 2343-2344, 1978.

METHOD #: 360.1	Approved for NPDES (Issued 1971)
TITLE:	Oxygen, Dissolved (Membrane Electrode)
ANALYTE:	CAS # O Oxygen 7782-44-7
INSTRUMENTATION:	Probe
STORET No.	00299

1.0 Scope and Application

1.1 The probe method for dissolved oxygen is recommended for those samples containing materials which interfere with the modified Winkler procedure such as sulfite, thiosulfate, polythionate, mercaptans, free chlorine or hypochlorite, organic substances readily hydrolyzed in alkaline solutions, free iodine, intense color or turbidity and biological flocs.

1.2 The probe method is recommended as a substitute for the modified Winkler procedure in monitoring of streams, lakes, outfalls, etc., where it is desired to obtain a continuous record of the dissolved oxygen content of the water under observation.

1.3 The probe method may be used as a substitute for the modified Winkler procedure in BOD determinations

2.0 Summary of Method

2.1 The most common instrumental probes for determination of dissolved oxygen in water are dependent upon electrochemical reactions. Under steady-state conditions, the current or potential can be correlated with DO concentrations. Interfacial dynamics at the probe-sample interface are a factor in probe response and a significant degree of interfacial turbulence is necessary. For precision performance, turbulence should be constant.

3.0 Sample Handling and Preservation

3.1 See 4.1, 4.2, 4.3, 4.4 under Modified Winkler Method (360.2).

4.0 Interferences

4.1 Dissolved organic materials are not known to interfere in the output from dissolved oxygen probes.

4.2 Dissolved inorganic salts are a factor in the performance of dissolved oxygen probe.

4.2.1 Probes with membranes respond to partial pressure of oxygen which in turn is a function of dissolved inorganic salts. Conversion factors for seawater and brackish waters may be calculated from dissolved oxygen saturation versus salinity data. Conversion factors for specific inorganic salts may be developed experimentally. Broad variations in the kinds and concentrations of salts in samples can make the use of a membrane probe difficult.

4.3 Reactive compounds can interfere with the output or the performance of dissolved oxygen probes.

4.3.1 Reactive gases which pass through the membrane probes may interfere. For example, chlorine will depolarize the cathode and cause a high probe-output. Long-term exposures to chlorine will coat the anode with the chloride of the anode metal and eventually desensitize the probe. Alkaline samples in which free chlorine does not exist will not interfere. Hydrogen sulfide will interfere with membrane probes if the applied potential is greater than the half-wave potential of the sulfide ion. If the applied potential is less than the half-wave potential, an interfering reaction will not occur, but coating of the anode with the sulfide of the anode metal can take place.

4.4 Dissolved oxygen probes are temperature sensitive, and temperature compensation is normally provided by the manufacturer. Membrane probes have a temperature coefficient of 4 to 6 percent/°C dependent upon the membrane employed.

5.0 Apparatus

5.1 No specific probe or accessory is especially recommended as superior. However, probes which have been evaluated or are in use and found to be reliable are the Weston & Stack DO Analyzer Model 30, the Yellow Springs Instrument (YSI) Model 54, and the Beckman Fieldlab Oxygen Analyzer.

6.0 Calibration: Follow manufacturer instructions.

7.0 Procedure: Follow manufacturer instructions.

8.0 Calculation Follow manufacturer instructions.

9.0 Precision and Accuracy: Manufacturer's specification claim 0.1 mg/L repeatability with ±1% accuracy.

Bibliography

1. Standard Methods for the Examination of Water and Wastewater, 14th Edition, p 450, Method 422F (1975).

E MANAGEMENT **Well Condition Summary Form**

': ______________________________ Well/Piezometer Name: ______________

:or: ______________________________ Evaluation Date: ____________________

	Y	]
vell's location appropriately shown on a facility map?		
vell adequately flagged if hard to find?		
vell elevation information inscribed at or on the well correct?		
vell: ❑ flush with surface? ❑ above ground?		
vell free of physical damage?		
vell labeled on the inside?		
vell labeled on the outside?		
ıe well have protective posts, if necessary?		
›ve ground wells have weep holes at the base of the protective casing?		
ıe area around the well appear clean?		
:asing secure (attempt to move along two perpendicular axes)?		
;urface seal void of differential erosion around and under the base?		
;urface seal free of cracks that might affect the integrity of the seal?		
;urface seal sloped to prevent ponding around the well?		
vell free from standing or ponded water?		
vell locked to prevent unauthorized access?		
›rotective casing cap void of large gaps which would breach security?		
ocking cap free of rust?		
: a survey mark on the riser/wellhead assembly cap?		
iser cap vented?		
ınnular space free of animal/insect nests?		
ınnular space appropriately filled with filtering material?		
ımp, can it be lifted a few inches? (do not test prior to sampling)		
vell free of kinks or bends?		

[ENTS: ____

ExampleAPPENDIX B – Typical Monitor Well/Piezometer Construction Standard

Waste Management
Typical Monitor Well/Piezometer Construction Standard

1.0 STANDARD REVIEW REQUIREMENT

This Standard should be reviewed and signed by the Site Manager or a designated representative of Waste Management prior to the installation of any groundwater monitor wells or piezometers at Waste Management sites. The review portion of this Standard (Table 1) should be completed and mailed to the designated Waste Management representative and, if necessary, the appropriate Hydrogeology Programs Manager and/or Region Engineering Manager (REM) prior to the commencement of field work. All well information should also be filed at the site and, if necessary, at the regional Waste Management offices. Documentation of the successful installation of each well/piezometer should also be communicated to a designated representative of Waste Management and kept on file at the region and site offices.

Site conditions or local regulatory requirements may necessitate a deviation from the Standard as described herein. For example, installation to ASTM Standards, State Regulations, or State Guidance may be required. Care should be required to ensure that the well completion meets all site-specific specifications. Should such a deviation from this standard be necessary, changes to this Standard must be noted and signed by the Site Manager or a designated representative of Waste Management and coordinated with the appropriate REM prior to well installation.

2.0 OVERVIEW OF STANDARD

This Standard represents the minimum requirements for the installation of monitor wells at Waste Management landfill sites. Typical Waste Management monitor wells shall be constructed of 2-inch diameter, schedule 40, polyvinyl chloride (PVC) casing. This Standard is a guideline that may be supplemented based on site-specific conditions that preclude strict adherence to the Standard as described herein. Any changes to this Standard must be approved by a designated representative of Waste Management. Possible reasons for variation to this Standard include, but are not limited to, unusual site hydrogeologic conditions, deep monitor wells that may require a thicker schedule (i.e., PVC Schedule 80 casing), and State-specific well construction requirements that significantly differ from this Standard. Waste Management typical well constructions are shown in Attachments A and B. It is the responsibility of WM to ensure that proper regulatory approval is obtained prior to well construction and installation.

The consultant and/or the drilling subcontractor is ultimately responsible for the proper construction of Waste Management monitor wells and piezometers. As such, the oversight consultant must be familiar with the contents of this Standard prior to the design of each monitor well/piezometer. The consultant/drilling subcontractor is also responsible for procuring well permits and/or registering all monitor wells as required by State or local regulations. Supporting documentation required for these purposes (e.g., aerial photographs, maps, groundwater gradients, etc.) are to be obtained by the oversight consultant/drilling subcontractor. The REM, or designated project manager/engineer, should provide oversight and make certain that Waste Management receives a quality final product that satisfies both the design and Waste Management minimum standards.

It is Waste Managements' goal that through the use of this and similar Standards, more consistent approaches to groundwater-related work can be realized resulting in more consistent hydrogeology and groundwater quality data.

3.0 WELL CONSTRUCTION MATERIALS

Well construction materials that are described in this Standard include well screen, riser pipe, well head protection, grout mix, gravel pack, filter pack, and bentonite seal. All materials must be new and free from defects. Well screen and riser casing materials must be individually wrapped and factory-certified to be free of contaminants. Well casing string lengths shall be no less than five-foot sections and flush-threaded. O-rings are recommended between sections, as are centralizers. Centralizers are required within the screened section for fine-grained formations (e.g. clays, silts, fine sands, and tills).

Presently, Waste Management will allow the use of 2-inch diameter, Schedule 40 PVC material for wells or piezometers installed to depths up to 250 feet below ground surface (bgs). Wells installed to depths between 250 and 300 feet bgs may be 2-inch or 4-inch (depending on site specific conditions), Schedule 80 PVC. Wells installed below 300 feet bgs must be constructed of 4-inch diameter, Schedule 80 PVC. Piezometers may be constructed of 2-inch diameter casing to any depth, following the PVC Schedule requirements listed above. Regardless of the casing materials used, the casing must be kept under tension during installation (i.e., the weight of the casing must not be supported by the bottom of the borehole).

It is Waste Managements' policy not to allow the introduction of drilling fluids of any kind during well/piezometer drilling and construction unless absolutely necessary. In such cases, the approval of a designated representative of Waste Management must be obtained in writing.

3.1 Well Screen

The typical well screen shall be new, machine-slotted or continuous wrapped 2-inch diameter, schedule 40 PVC, and shall conform to an appropriate standard such as ANSI-ASTM F480-81. Diameter and Schedule rating of the PVC may vary for deep wells/piezometers as discussed in Section 3.0 of this Standard. The screen must be designed with a bottom plug made of the same material as the well screen. The typical screen slot size is 0.010-inch unless the formation and/or the gravel pack may require a different slot size (i.e., in general, the gradation of the gravel pack should have a grain size between the screen slot size and the mean grain size of the water-bearing zone). Finer slot sizes (i.e. 0.006 slot) should be used for fine-grained (e.g. clay, silt, and till) units. The consultant and/or drilling subcontractor shall make the screen selection based on knowledge of the formation materials or site-specific field sieves. A site characterization report is often the best source for formation-specific gradation data. Please refer to Section 3.5 below for general guidelines for the selection of screen slot size and corresponding gravel pack gradation.
The well screen and riser pipe shall be furnished in minimum 5-foot, flush joint, threaded sections (with O-rings). Longer sections can be used when appropriate, but the well casing must be assembled in the borehole. The well screen should withstand all installation, well development, and sampling pressures

without becoming dislodged or damaged. The use of solvent or glue is prohibited.

3.2 Riser Pipe

The riser pipe is that portion of the well casing extending from the screen interval to the ground surface. Riser pipe must be new, flush joint threaded, and will typically be constructed of 2-inch diameter Schedule 40 PVC meeting appropriate specifications (e.g., ASTM D 1785). Schedule 80 PVC may be used for deep wells in accordance with procedures described in Section 3.0 of this Standard. All joints shall be hand-tightened. Glued joints and rivet joints are not permitted. The riser pipe shall be fitted with a water tight top cap constructed of the same material (i.e., PVC). The diameter of the borehole shall be designed to ensure proper placement of annular materials as discussed in Sections 3.4 and 3.5, below.

3.3 Well-Head Protection

Well-head protection for Waste Managements' wells and piezometers shall be provided by installing a steel or anodized aluminum outer casing, protected from vehicle traffic and vandalism, around the upper portion of the well or piezometer. This protection will either be installed flush with the ground surface, or with a stick-up above ground surface. The protector casing shall be installed during initial well construction and immobilized in concrete placed around the outside of the protector casing. The protective casing should be typically about 6- to 10-inches in diameter, but may not be less than four inches larger diameter than the well casing. All casing shall be new and free of interior coatings. No paint shall ever be used. The well protector should be water tight, with a locking lid to prevent unauthorized well access. The protective casing should provide about 10-inches of space between the top of the well casing and the locking protective-casing lid to facilitate sampling equipment. Sampling equipment at Waste Managements' wells will consist of QED® dedicated bladder-type pumps and accessories. The well casing should be centrally positioned within the protective casing.

3.3.1 Stick-up

All wells with a designed stick-up (i.e., the vertical length of the portion of the protective casing which extends above the ground surface) must provide surface protection from tampering or accidental breakage. The well casing should extend approximately 2 to 4 feet above ground surface, and about ten inches below the top of the protective casing. The Waste Management preferred protection material is anodized aluminum, although steel casing may be used if justified by site-specific criteria (no paint shall ever be used). The length of the protective casing must be no less than six feet, and securely seated into the borehole grout material. The depth that the protective casing extends downward into the borehole will depend upon site specific conditions (e.g., temperature fluctuations, geology, etc.), but should be no less than four feet. The base of the protective casing must be surrounded by the borehole grout material which must extend into the annulus of the protective casing at least 4-feet (nominal). It is the responsibility of the well installation contractor to ensure that the protective casing is properly secured.

A 1/4-inch diameter weep hole shall be provided in the casing about six inches above the ground surface to permit water to drain down slope, out of the annular space. In cold climates, this hole will also prevent water from freezing between the well protector and the well casing. Dry bentonite pellets, granules, or chips should be placed in the annular space from the level of the weep hole to below ground level within the protective casing. A ten to twelve inch (minimum) coarse sand or pea gravel (or both) interval should be placed in the annular portion of the protective casing above the dry bentonite pellets and above the weep hole to help prevent entry of insects.

A formed, slightly mounded, 4-inch-thick by three-feet-diameter (nominal) or three-feet-square concrete pad shall be constructed around the base of each stick-up monitor well. The pad should be designed to slope away from the well in all directions to facilitate drainage. The specifications of the concrete material must account for possible temperature fluctuations and/or other factors which might produce cracking or otherwise reduce the quality of the surface seal. The pad should contain sufficient reinforcing steel (mesh or bar) to provide structural integrity. Sonotubes can be used for framing and installation the concrete pad.

Where vehicle traffic presents a threat to the well head, protective posts must be provided around the well. The posts must be made of steel or equivalent-strength material, and must be designed appropriately to provide protection from the specific traffic type of concern. A minimum of three posts, each with a minimum stick-up of three feet, shall be used for this purpose. The installation contractor must ensure that the posts are sized and installed properly.

3.3.2 Flush-Mounted

This detail type is not recommended for any Waste Management sites and should generally be avoided unless site specific conditions necessitate the installation of flush-mounted well head protection. The well casing should be cut two to three inches below the surface grade and a locking, water tight lid consisting of an aluminum (or stronger equivalent) valve box (i.e., vault or manhole) assembly will be installed. The lid assembly shall be centered in a formed, slightly mounded 4-inch thick by nominal three-feet diameter or three-feet-square concrete pad to slope away from the well in all directions. In cases where the well must be located in a roadway, the flush-mounted box must be traffic rated.

An internal cap shall be fitted on top of the riser within the vault or manhole. The cap should be leak-proof so that if the vault or manhole should fill with water, the water will not enter the well casing. Dedicated sampling equipment will be fitted in each well, so adequate space must be provided within the vault.

3.4 Grout Mix

The cement shall be Portland Cement® Type 1 in accordance with ASTM C150, Type 1 or API-10A, Class A. The use of any other cements must be approved by a designated representative of Waste Management prior to its use. Water shall be obtained from an approved source, as designated by Waste Management, based on recommendations by the consultant and/or drilling subcontractor, if necessary. Hydrated lime shall be ASTM C207, Type S and shall not contain air entrainment additives. Bentonite shall be powdered sodium bentonite without additives.

The cement shall be mixed with water in the proportion of five to six gallons of water per sack of cement (i.e., about 94 pounds). Hydrated lime may be substituted for cement up to 10 per cent by volume. Between two and four pounds of bentonite powder shall be added to the mix for each sack of cement used. Grout shall be thoroughly mixed until lumps are eliminated. All grouting lines (i.e., hoses, pipes, drill rods, etc.) shall have an inside diameter of at least 0.50 inches. An acceptable alternative to neat cement grout is the use of high solids bentonite grout (30% by weight) where annular seal integrity is of primary importance. The mixture and placement of high solids bentonite grout is discussed in detail in the WM Well Decommissioning Standard.

Grout shall be injected under pressure using a tremie pipe (or equivalent) to displace water and cuttings from the seal above the screened zone to the top of the borehole. Grout shall be deflected to the sides at the base of the tremie, and continued until clean grout flows from the top of the well hole. The well (and protective casing) should not be disturbed for a period of at least 24 hours after grouting to allow the grout to set and gain strength.

3.5 Gravel Pack (Sand Pack)

The gravel pack (or sand pack) is the material placed around the well screen. This material shall be uniformly graded quartz sand, washed and screened with a particle size at least four times the d-15 size of the formation (i.e., 15 percent of the adjacent, *in situ* soil is finer than the d-15) and no more than four times the d-85 size of the formation (similarly, a guideline of d-30 (70 % retained) multiplied by a factor of between 3 and 6 has been used with good success in fine-grained formations).

For granular formations, it is preferable to utilize sieve analysis data specific to the formation in selecting the appropriate gravel pack and corresponding screen slot size. The gravel pack must be designed so that representative samples can be collected without formation loss (e.g. infiltration of clays, silts, and/or fine sands). In the absence of sieve analysis data or in the case of fine-grained formations (i.e., silts and clays) the following general guidelines should be adhered to:

U.S. Standard Sieve 20-40 gradation sand pack with a 0.010 slot screen:

- To be used when screening fine to coarse sand and gravel includes USCS classifications (SW, SP, GW, and GP).
- U.S. Standard Sieve 40-70 gradation sand pack with a 0.006 slot screen: To be used when screening very fine sand, silts, clays and interbedded formations containing significant fine-grained intervals, includes USCS classifications (SC, SM, ML, CL, CH, GC and GM).

The installation contractor must ensure that the proper sand pack is used based on the site specific hydrogeology and screen opening size.

3.6 Filter Pack (Secondary Sand Seal, optional)

The filter pack (or sand seal) is the layer of material placed in the annular space between the gravel pack and the bentonite seal. The purpose of this interval is to prevent an excessive amount of overlying grout material from penetrating the gravel pack. The filter pack material shall be a uniformly graded sand with 100 percent by weight passing the No. 30 sieve, and less than 2 percent by weight passing the 200 sieve. The decision to use a filter pack interval will be based on site and well specific criteria, including the depth bgs to the gravel pack, adjacent geology, State or local regulations, etc. It is the responsibility of the installation contractor to prevent grout from entering the gravel pack portion of the well.

3.7 Bentonite Seal

The bentonite that is used for the seal shall be pelletized or chipped sodium montmorillonite furnished in sacks or buckets from a commercial source and free of impurities. The diameter of the pellets shall be less than one-fifth the width of the annular space into which they are to be placed to reduce the potential for bridging. This interval is emplaced over the gravel/filter pack interval of the annular space.

3.8 Construction Water

Construction water used in the drilling process, to prepare grout mixtures, and to decontaminate the well screen, riser, and annular sealant injection equipment should be obtained from a source of known chemistry and that does not contain constituents that could compromise the integrity of the well installation. All water (or any other fluid) that is used in the down-hole construction process must be sampled and analyzed for VOCs and/or other parameters sensitive to the site monitoring program. It is the responsibility of the installation contractor to ensure that nothing enters the well during well construction that could affect the results of subsequent groundwater monitoring.

4.0 WELL INSTALLATION

A stable borehole (that was properly logged and visually inspected) must be constructed prior to attempting the installation of well screen and riser materials. If the borehole is caving, the drilling subcontractor at the direction of the consultant shall take steps to stabilize the borehole before attempting installation of the well casing. These steps will often include installing the well materials through driven drill casings or hollow-stem auger flights. Boreholes that are not plumb or are partially obstructed shall be corrected prior to the installation of the well materials. Jetting (i.e., inducing pressurized water flow within the well casing) and/or driving the well screen is not permitted. Centralizers shall be used for off-plumb boreholes or for wells completed at depths of around 100 feet or greater.

4.1 Well Screen

Personnel handling the well screen and riser shall wear new cotton or surgical gloves during installation. To prevent kinking of the threads, no more than 20 feet of screen or riser pipe shall be assembled above ground. Joints shall be tightened by hand. Decontaminated pipe or chain wrenches may not be used, unless absolutely necessary. If these or other tools are used the screen shall be decontaminated prior to final installation.

Typically, Waste Management recommends a 20 foot screen length, where the saturated thickness of the monitored formation is sufficiently thick and homogeneous, unless State Regulations or Guidance dictates otherwise. At a minimum, well screens should be no less than 20 feet in length unless site-specific hydrogeologic or regulatory constraints exist (e.g. thin saturated thickness, till units, steep vertical gradients). Where site specific conditions necessitate, 5 to 10 foot screens are acceptable upon approval of a WM Hydrogeologist. Well screen placement is critical for proper monitoring of the formation and should be carefully evaluated. Wells can be screened either at the water table, or within the formation, based on site-specific hydrogeology and subsurface conditions.

It is the responsibility of the installation contractor to ensure that adequate screen lengths are provided, and that no State or local regulatory constraints are violated.

4.1.1 Water Table Wells

Monitoring wells are typically screened at the water table and allow for seasonal fluctuation of the water table. With water table wells, the well shall be screened a minimum of 2 feet above the projected highest annual groundwater level as determined by either a designated representative of Waste Management or a local consultant familiar with the hydrogeologic conditions at the site. Similarly, the well shall be screened at least 5 feet below the projected lowest annual groundwater level as determined by either a designated representative of Waste Management or a local consultant familiar with the hydrogeologic conditions at the site. Lesser screen lengths are acceptable, with WM approval, where site-specific conditions or regulations dictate. If projected annual groundwater level fluctuations are significant or where drought conditions are anticipated, well screen lengths will necessarily vary to facilitate long-term water-table monitoring. The Typical Groundwater Monitoring Well Construction Standard, Screened at the Water Table, is attached as a figure.

4.1.2 Water Table Wells

In many cases, WM advises screening wells below the water table (submerged screens). Situations where this is necessary include confined units, thick saturated zones with significant vertical gradients, or a potential for cross-contamination associated with landfill gas. State or local approval is required prior to installing wells with submerged screens. Where approved, the top of screen shall be set at least 3 feet below the lowest seasonal groundwater table as determined by either a WM designate or a consultant familiar with site hydrogeologic conditions. Where thick saturated zones are monitored, the screen may be significantly below the top of the water table. In such cases, screen placement should be based on the site-specific geologic conditions. The Groundwater Monitoring Well Construction Standard, Submerged Screen, is attached as a figure.

4.2 Riser Pipe

The riser should be slowly lowered into the borehole (or pushed into the water in the borehole) by hand or using steam-cleaned drill rig apparatus, as necessary, as additional sections of riser are added to the string. If required, the well screen and riser should be ballasted to counteract the tendency of the well screen to float in the borehole. Ballast water should be used only if necessary and only from an approved source from which a sample can be obtained.

Centering disks and seal tamper shall be used to center the well screen and riser pipe in the borehole where centering cannot be assured otherwise. Keeping the well screen and riser pipe centered in the borehole will help to ensure that the gravel pack is emplaced properly and is of consistent thickness. The riser shall extend above grade a minimum of 3 feet where stick-up is required and trimmed to its proper length after the grout is in place. The protective casing (or flush-mounted vault) shall be positioned properly once the well has been grouted to the surface.

The riser pipe/protective casing should not be disturbed until a minimum of 24 hours after grouting is complete. Precautions shall be made to prevent pipe cuttings from entering the riser.

4.3 Placement of the Gravel Pack

The volume of gravel pack that is required to fill the annular space shall be computed and carefully measured out. Computed gravel pack volumes and volumes actually used must be documented in field notes. The gravel pack shall extend a minimum of about three feet above the screen, or a distance of about 20% of the length of the well screen, whichever is greater (ASTM D 5092). The preferred method of emplacement of the gravel pack into the annular space is via a tremie pipe (side discharges), unless consistent and proper placement can be assured using other methods. The method of gravel pack emplacement and verification of proper placement must be fully documented on field information forms. As the gravel pack is placed into the annular space, the tremie pipe (if used) shall be raised accordingly to keep the mouth of the tremie slightly above the upper gravel pack.

If the well casing is emplaced through drill casing or hollow-stem auger, the temporary casing or hollow stem augers shall be withdrawn during annular material emplacement. The lowermost point of the drill casing should be slightly below the upper surface of the annular material in the well hole. The well installation contractor must periodically verify that the gravel pack and seal materials have not bridged. Additional annular materials may need to be added after auger withdrawal from each portion of the borehole.

4.4 Placement of the Filter Pack

When used, the filter pack shall extend a minimum distance of 2 feet within the annular space from the top of the gravel pack. Where appropriate, the filter pack shall be tremied or poured into the annular space to ensure complete and proper emplacement. The Waste Management preferred method of emplacement is via tremie pipe. The filter pack can be eliminated where conditions warrant with the approval of a designated representative of Waste Management. Factors important to the use of a filter pack include the gradation of the gravel pack and the potential for grout intrusion into the gravel pack.

4.5 Placement of the Bentonite Seal

A two to five feet thick bentonite seal shall be emplaced above the gravel pack in the annular space. The specific thickness of the seal shall be based on well-specific criteria or State/local regulatory requirements. Well-specific criteria include the depth to the seal, geology adjacent to the well, depth to groundwater, etc. The bentonite pellets (or chips) shall be carefully measured out and poured into the annular space for hydration. If the bentonite seal is being constructed above the water level in the well hole, five gallons of deionized (or otherwise decontaminated) water shall be poured into the annular space. Alternatively, a neat and lean bentonite slurry may be carefully tremied into the annular space to construct the required seal.

4.6 Grouting the Annular Space

The grout shall be injected via a tremie pipe (side discharging) and pumped trough the pipe until it flows at the surface. The opening of the tremie shall be maintained near the top of the bentonite seal to prevent a large free-fall of grout onto the seal. The temporary casing/augers (if used) shall be removed immediately after the grout has been injected or carefully removed as the grout is emplaced. Concurrent casing removal and injection must ensure that the top of the column of grout is maintained at least several feet above the bottom of the casing to prevent caving. If casing removal does not commence until grout injection is completed, then additional grout shall be poured into the annular space periodically to maintain a continuous column of grout to the ground surface. The well installation contractor must ensure that the grout is emplaced properly and that the integrity of the underlying annular materials is maintained.

4.7 Well-Head Protector

Well-head protection must be provided for all Waste Management monitor wells and piezometers. The preferred construction technique is to provide a three-foot well casing stick-up and associated protection. However, there will be site-specific conditions that may require the use of flush-mounted surface completion. Specifications on the materials of construction are described in Section 3.0.

4.7.1 Well Stick-up (Above Grade)

An anodized aluminum (preferred, although steel may be used as an alternative) well protector shall be set in neat cement and placed in the plumb position extending a minimum of three feet above the ground surface. A minimum clearance between the top of the riser and the well protector of about ten inches shall be maintained to accommodate dedicated sampling equipment. It is the well installation contractor's responsibility to ensure that adequate sampling equipment space at the well head exists. Grout which has overflowed the well hole shall be removed. A 1/4-inch diameter weep hole in the well protector, 6-inches above the ground surface shall be provided to permit water to drain out of the annular space. Dry bentonite pellets shall be placed in the annular space below the level of the weep hole. Coarse sand or pea gravel (or both) shall be placed in the annular space above the dry bentonite pellets and hole to prevent insects from entering through the weep hole. A formed, slightly mounded, 4-inch thick by 3-feet diameter concrete pad shall be constructed around the monitor well to slope away from the well in all directions. The protective casing must be a minimum of six feet in length, and extend into the concrete a minimum of 4 feet (nominal) bgs. It is the responsibility of the well installation contractor to ensure that the protective casing is properly installed. Above grade completions are shown in the Typical Groundwater Monitor Well Construction Standard Figure.

4.7.2 Flush-Mounted Well (At Grade)

If site specific conditions warrant, the well may be completed flush with the land surface. The well casing should be cut two to three inches below the surface grade, or to a depth that will allow the installation of dedicated sampling equipment. A water tight, locking aluminum vault assembly will house the well head. Aluminum is preferred, although other materials may be used if conditions warrant, see Section 3.0, herein. The lid assembly shall be centered in a formed, slightly mounded, 4-inch thick by appropriate diameter concrete pad to slope away from the well in all directions. The proper installation of the flush mounted vault is the responsibility of the well installation contractor.

An internal cap shall be fitted on top of the riser within the vault or manhole. The cap should be leak-proof so that if the vault or manhole should fill with water, the water will not enter the well casing. Space in the well head should be provided for sampling equipment and is the responsibility of the installer. The vault and/or manhole assembly must be traffic-rated if installed in or near a roadway. An example of a Flush Mount Completion is presented with the Attached Figures.

5.0 SURVEYING

The location of the well shall be surveyed to the nearest 0.5 feet. The ground surface elevation and top of well casing (used for measuring water levels) shall also be surveyed to the nearest 0.1 feet and 0.01 feet, respectively, relative to mean sea level. The surveyor should use the site datum. It is recommended that the top of well casing for at least one other monitoring well be surveyed in addition to a datum control point, in at the same time to check for survey accuracy. Surveying shall be performed by a State-licensed surveyor. Waste Management sites should be using a State Plane coordinate system and a national vertical datum.

6.0 WELL COMPLETION RECORDS

Well completion records for a monitor well shall include, at a minimum, the following information:

- Date and time of construction;
- Well designation and map location;
- Name of drilling contractor;
- Name of geologist/hydrogeologist who logged the borehole;
- Drilling method/fluids used, if any;
- Sampling protocol and analytical results of any fluids introduced to the well;
- ~~Well location to nearest 0.5 feet;~~
- Borehole diameter;
- Well depth to nearest 0.1 feet;
- Drilling and lithologic logs;
- Depth to all encountered saturated zones;
- Depth to targeted groundwater zone;
- Casing materials;
- Screen materials, slot size, length, and depth to the nearest 0.1 feet;
- Casing and screen joint type;
- Filter pack material and gradation;
- Sealant materials;
- Surface seal;
- Type of protective well cap;
- Ground surface elevation to nearest 0.1 feet msl;
- Type of protective well casing;
- Top of casing elevation to nearest 0.01 feet msl;
- Final well annulus construction spec.'s (e.g., thickness of gravel pack, seal, etc.);

- Well development data (volume purged, groundwater field parameter results (e.g., specific conductance, pH, temperature, dissolved oxygen, alkalinity, etc.).
- State Permit No. (if required)

The Waste Management Site Manager shall be responsible for maintaining this information on file at the site and distributing copies to the regional Waste Management office.

Waste Management is in the process of developing standard boring log and well construction forms.

TABLE 1
WELL INSTALLATION INFORMATION

(To Be Completed By Site or Region Personnel)

Site Location:____

Site Manager (or designated company representative):
____

Oversight Consultant (including signature - indicates review of Standard):
____
____
____

Drilling Subcontractor:
____

Number of Wells/Piezometers to be Installed:
Wells - ______;
Piezometers - ________

Proposed Well/Piezometer Designations:

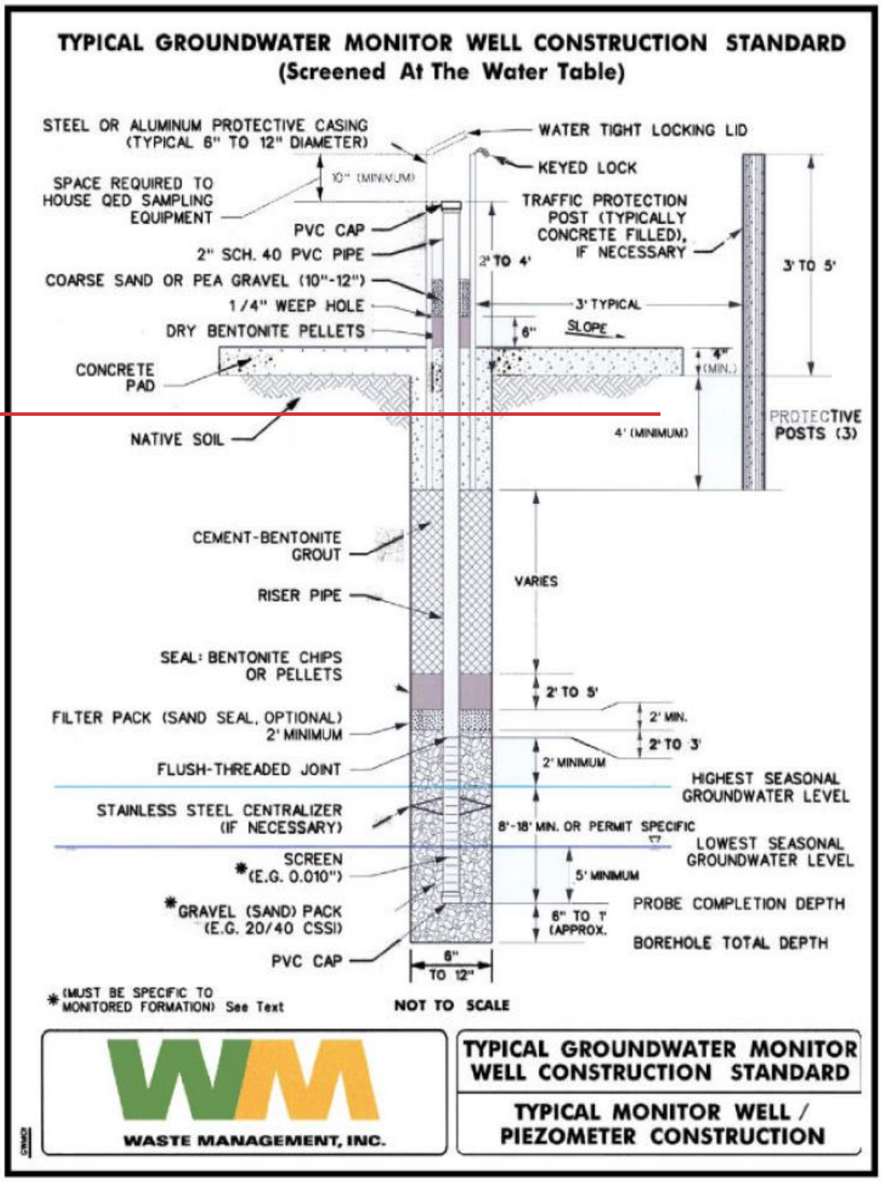
Well/Piezometer Permit Required?
Date: __________; Revision Date(s):

Recommended Variation to the Waste Management Construction Standard (state reasons):

Representative of Waste Management (signature):____

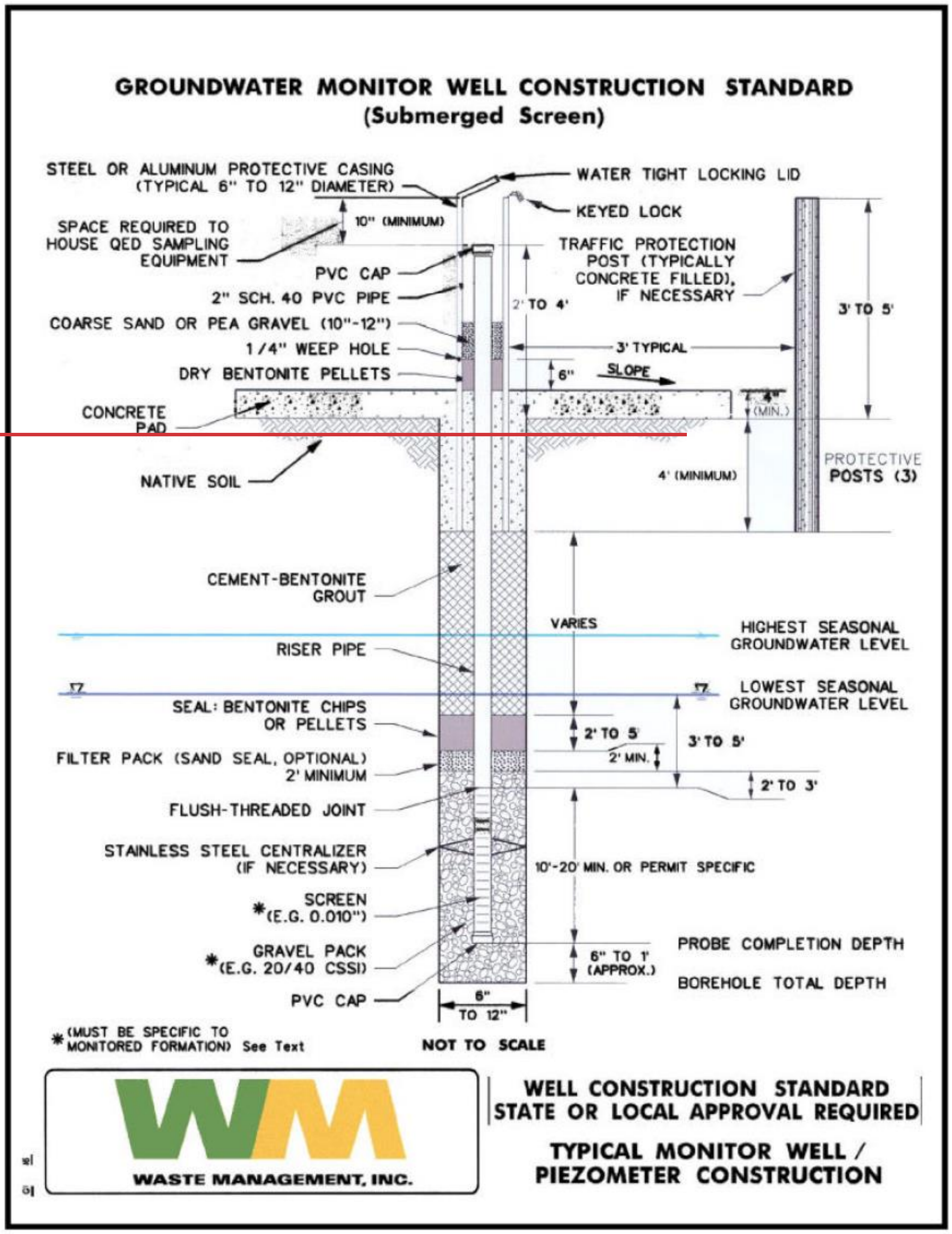
Attachment A

Typical Well Completion Diagram - Screened at Water Table
(Above Grade Completion)


TYPICAL GROUNDWATER MONITOR WELL CONSTRUCTION STANDARD
(Screened At The Water Table)
STEEL OR ALUMINUM PROTECTIVE CASING (TYPICAL 6" TO 12" DIAMETER)
WATER TIGHT LOCKING LID
KEYED LOCK
SPACE REQUIRED TO HOUSE QED SAMPLING EQUIPMENT
10" (MINIMUM)
PVC CAP
2" SCH. 40 PVC PIPE
COARSE SAND OR PEA GRAVEL (10"-12")
1/4" WEEP HOLE
DRY BENTONITE PELLETS
TRAFFIC PROTECTION POST (TYPICALLY CONCRETE FILLED), IF NECESSARY
2' TO 4'
3' TYPICAL
3' TO 5'
6"
SLOPE
4" (MIN.)
CONCRETE PAD
NATIVE SOIL
4' (MINIMUM)
PROTECTIVE POSTS (3)
CEMENT-BENTONITE GROUT
RISER PIPE
VARIES
SEAL: BENTONITE CHIPS OR PELLETS
2' TO 5'
FILTER PACK (SAND SEAL, OPTIONAL) 2' MINIMUM
2' MIN.
2' TO 3'
FLUSH-THREADED JOINT
2' MINIMUM
HIGHEST SEASONAL GROUNDWATER LEVEL
STAINLESS STEEL CENTRALIZER (IF NECESSARY)
8'-18' MIN. OR PERMIT SPECIFIC
LOWEST SEASONAL GROUNDWATER LEVEL
*SCREEN (E.G. 0.010")
5' MINIMUM
PROBE COMPLETION DEPTH
*GRAVEL (SAND) PACK (E.G. 20/40 CSSI)
6" TO 1' (APPROX.
BOREHOLE TOTAL DEPTH
PVC CAP
6" TO 12"
*(MUST BE SPECIFIC TO MONITORED FORMATION) See Text
NOT TO SCALE
WASTE MANAGEMENT, INC.
TYPICAL GROUNDWATER MONITOR WELL CONSTRUCTION STANDARD
TYPICAL MONITOR WELL / PIEZOMETER CONSTRUCTION

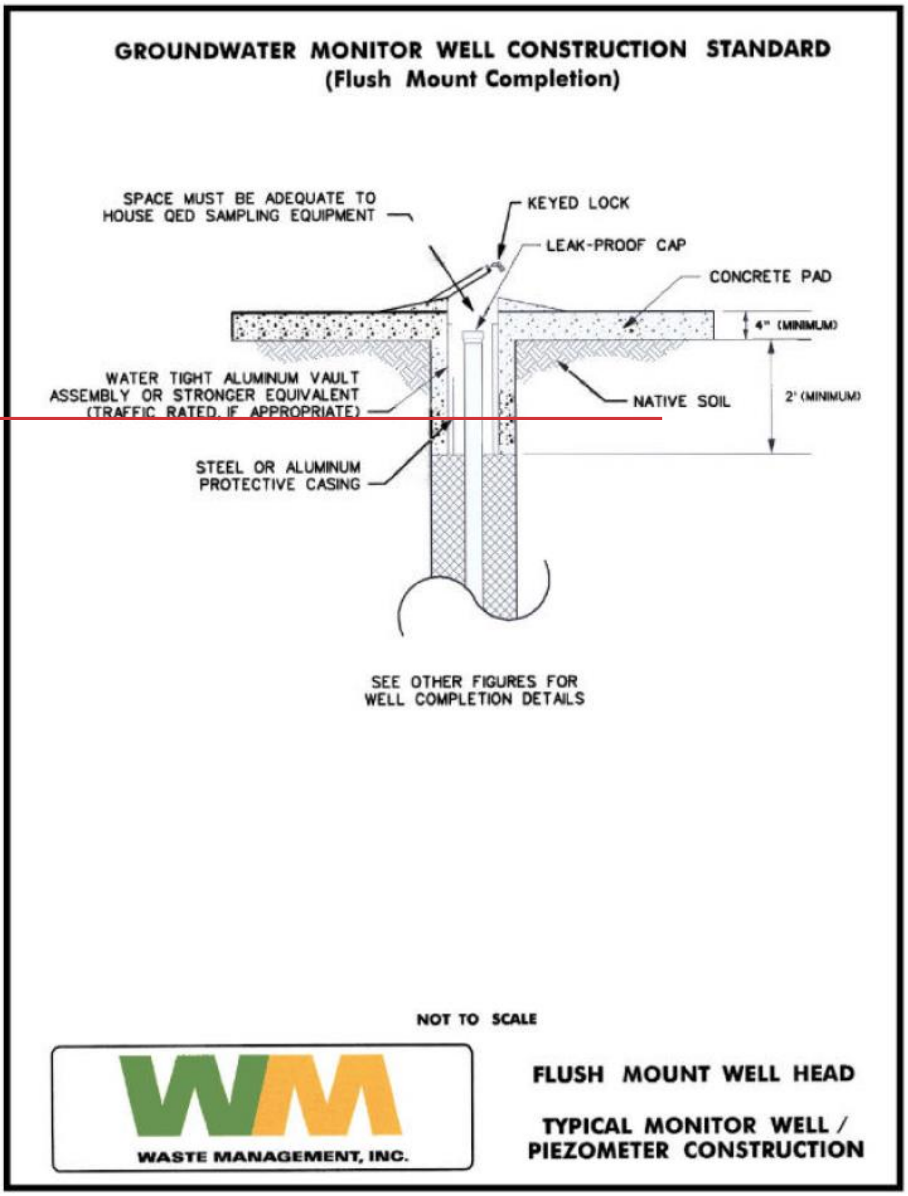
Attachment B

Well Completion Diagram – Submerged Screen
(Above Grade Completion)
(Requires State or Local Approval)


GROUNDWATER MONITOR WELL CONSTRUCTION STANDARD
(Submerged Screen)
STEEL OR ALUMINUM PROTECTIVE CASING (TYPICAL 6" TO 12" DIAMETER)
WATER TIGHT LOCKING LID
KEYED LOCK
SPACE REQUIRED TO HOUSE QED SAMPLING EQUIPMENT
10" (MINIMUM)
TRAFFIC PROTECTION POST (TYPICALLY CONCRETE FILLED), IF NECESSARY
PVC CAP
2" SCH. 40 PVC PIPE
2' TO 4'
3' TO 5'
COARSE SAND OR PEA GRAVEL (10"-12")
1/4" WEEP HOLE
3' TYPICAL
DRY BENTONITE PELLETS
6"
SLOPE
4" (MIN.)
CONCRETE PAD
NATIVE SOIL
4' (MINIMUM)
PROTECTIVE POSTS (3)
CEMENT-BENTONITE GROUT
VARIES
HIGHEST SEASONAL GROUNDWATER LEVEL
RISER PIPE
LOWEST SEASONAL GROUNDWATER LEVEL
SEAL: BENTONITE CHIPS OR PELLETS
2' TO 5'
3' TO 5'
2' MIN.
FILTER PACK (SAND SEAL, OPTIONAL) 2' MINIMUM
2' TO 3'
FLUSH-THREADED JOINT
STAINLESS STEEL CENTRALIZER (IF NECESSARY)
10'-20' MIN. OR PERMIT SPECIFIC
SCREEN
*(E.G. 0.010")
GRAVEL PACK
*(E.G. 20/40 CSSI)
PROBE COMPLETION DEPTH
6" TO 1' (APPROX.)
BOREHOLE TOTAL DEPTH
PVC CAP
6" TO 12"
*(MUST BE SPECIFIC TO MONITORED FORMATION) See Text
NOT TO SCALE
WASTE MANAGEMENT, INC.
WELL CONSTRUCTION STANDARD
STATE OR LOCAL APPROVAL REQUIRED
TYPICAL MONITOR WELL / PIEZOMETER CONSTRUCTION

Attachment C

Below-Grade Well Completion


GROUNDWATER MONITOR WELL CONSTRUCTION STANDARD
(Flush Mount Completion)
SPACE MUST BE ADEQUATE TO HOUSE QED SAMPLING EQUIPMENT
KEYED LOCK
LEAK-PROOF CAP
CONCRETE PAD
4" (MINIMUM)
WATER TIGHT ALUMINUM VAULT ASSEMBLY OR STRONGER EQUIVALENT (TRAFFIC RATED, IF APPROPRIATE)
NATIVE SOIL
2' (MINIMUM)
STEEL OR ALUMINUM PROTECTIVE CASING
SEE OTHER FIGURES FOR WELL COMPLETION DETAILS
NOT TO SCALE
WASTE MANAGEMENT, INC.
FLUSH MOUNT WELL HEAD
TYPICAL MONITOR WELL / PIEZOMETER CONSTRUCTION

APPENDIX C – Monitor Well/Piezometer Development Standard

Waste Management
Monitor Well/Piezometer Development Standard

1.0 STANDARD OVERVIEW

This Standard represents the minimum requirements for the development of monitor wells and piezometers at Waste Management's landfill sites. Well development is designed to minimize groundwater turbidity and suspended solids within the well and to facilitate the introduction of representative formation water into the well. This Standard is a guideline that may be supplemented based on site-specific conditions that preclude strict adherence to the Standard as described herein. Any changes to this Standard must be approved by the Waste Management Director of Hydrogeology and Groundwater Programs or by a designated representative of the company. These changes may include, but are not limited to, unusual site hydrogeologic conditions, deep monitor wells that may require more sophisticated well development procedures, and State-specific well development requirements that significantly differ from this Standard.

The consultant and/or the well development subcontractor is ultimately responsible for the proper development of monitor wells and piezometers at Waste Management facilities. Excessive turbidity or suspended solids content within a well or piezometer must be eliminated or documented as to why high values are unavoidable.

2.0 WELL DEVELOPMENT EQUIPMENT

Wells shall be pumped or otherwise evacuated to produce representative formation water. All pumps and other devices used in well development activities shall be new or properly decontaminated (e.g., steam cleaned, triple rinsed, etc.). If decontaminated equipment is used, at least one equipment blank must be obtained and analyzed for EPA Subtitle D Appendix II organic constituents. Procedures for decontamination of equipment shall be documented in field notes and included in any draft and final report of field activities submitted to Waste Management by the consultant and/or well development subcontractor. Examples of apparatus that are appropriate for monitor well and piezometer development include:

- Submersible Pumps - These pumps include electric motor powered centrifugal or positive displacement pumps which are operated below the water level in the monitor well or piezometer. If a submersible pump is used for well development, it shall be specified to pump for a period of at least 15 minutes without shutting off. The pump shall be capable of being turned on and off instantaneously to create surges in the well. The pump shall be fitted with a check valve.

- Bladder Pumps - These pumps are also termed diaphragm pumps and operate under the cycling of compressed air. Bladder pumps approved for well development shall be capable of pumping at least 1 gallon per minute (gam) continuously when installed in a well, and must have new or verified decontaminated bladder membranes.

- Bailers - Bailers should only be used for well development if other development methods are ineffective (i.e., the rate of well recovery is slow enough where the minimum requirements of the pump cannot be met).

- Compressed Air - This method of pumping (compressed air supplied by an engine-driven compressor equipped with an approved oil trap, filter, and eductor pipe) may be used if 50 percent of the column of water from the well can be evacuated once per minute. An oil-less compressor must be used, and a sample of air introduced into the well must be collected and analyzed for EPA Subtitle D Appendix II organic constituents. Compressed air alone should not be used to develop monitor wells.

- Surge Blocks - Surge Blocks are mechanical devices that force water to flow into and out of a screen. A typical surge block is composed of rubber or leather disks sandwiched between three steel or wooden disks, which are attached to a steel rod that can be placed in a well. The surge block should be positioned in the higher portion of the saturated interval, and worked up and down while slowly lowering the tool to the bottom of the well. Periodically, the tool should be removed from the well so that accumulated sediments can be removed by bailing or other means.

3.0 DEVELOPMENT PROCEDURE

The initial step in the development of a monitor well or piezometer is surging, especially in high-yielding wells. Low-yielding wells will not likely require surging. The consultant and/or the well development subcontractor shall be responsible for making recommendations regarding whether a well needs to be surged for development. Surging induces flow into and out of the gravel pack and native materials in the screened interval.

The simplest method of developing a well is through over-pumping, mechanical surging, and bailing (ASTM D 5092). For example, over-pumping means pumping at a higher rate than the formation will yield, or than will be required during the life of the well. Over-pumping should always be accompanied by mechanical surging of the borehole water to better facilitate the full stabilization of the groundwater zone. Regardless of the well development procedure used, the development work should be started slowly and gently and be increased in vigor as the well is developed.

3.1 High-Yield Wells

A combination of pumping and surging should be utilized in all high-yield wells (i.e., wells that generally will not become de-watered during development activities using a bailer). Typically, high-yield wells are capable of sustaining withdrawal rates of several gallons per minute. Surging shall be accomplished by lowering the surge block into the saturated interval and repeatedly raising and lowering the surge rod. This surging process should be repeated as needed to stabilize the sandpack, as well as dislodge and introduce fines into the well/piezometer. Water and accumulated sediment are removed from the well/piezometer by placing an air-lift apparatus or pump intake at the base of the screened interval and operating the air-lift apparatus or pump. The process shall be continued until the pH, turbidity, temperature, and conductivity readings from the development water stabilizes and until any State-required purge water volumes have been generated (see section 4.0). During the process, the air-lift apparatus or pump intake should be raised and lowered in the well screen so that the water is drawn into the well from all portions of the well screen. Immediately after development procedures are completed, and periodically thereafter as described in Section 5.0, the depth to water and total depth of the well shall be measured and recorded.

3.2 Low-Yield Wells

A bailer development procedure is usually adequate for low-yield wells. Apparatus to be used down-hole including the bailer and the lifting line shall be new or properly decontaminated (e.g., stream cleaned, triple rinsed, etc.). An equipment blank must be collected and analyzed for EPA Subtitle D Appendix II organic constituents if a new bailer is not used. Using a properly decontaminated water-level probe, the depth to water and total depth of well should be measured and recorded prior to development. The bailer and lifting line shall not contact the ground surface. This process should be repeated until at least three times the volume of water in the well-bore (plus any volume that was introduced by drilling and well installation) is removed, and pH, temperature, and specific conductance readings of the water are stabilized (see Section 4.0). Immediately after development procedures are completed, and periodically thereafter as described in Section 5.0, the depth to water and total depth of the well shall be measured and recorded. If the well is bailed dry, water should be allowed to recover within a reasonable period of time (e.g., within 8 hours) and the procedure repeated until three times the volume of water in the well-bore is removed and the pH, temperature, and conductivity readings of the water stabilizes. In all cases, at least two times the entire volume of any fluids used during the drilling process must be removed. If this procedure is anticipated to require more than 24 hours to complete, a designated Waste Management representative should be contacted.

4.0 MONITORING AND DURATION OF DEVELOPMENT PROCEDURES

Prior to initiating development procedures, and periodically through development, depth-to-water measurements shall be collected to the nearest 0.01 foot. Development should not proceed until a minimum of 24 hours following well construction without the approval of the designated Waste Management representative.

Well development activities shall be continued until representative formation water free of the effects of well construction is obtained. Throughout the development process, periodic measurements of turbidity, pH, temperature, and specific conductance shall be collected (field alkalinity and dissolved oxygen are optional field parameters that are useful). Development procedures should continue until each of these parameters have stabilized over three consecutive measurements to within 10 percent, the water is relatively clear (i.e., less than 5 NTUs), and any State-required purge-volume or clarity requirements are met. Unusual observations (e.g., discoloration, foaming, odor) during the development process shall be detailed on a field information form or well development form provided by the consultant and/or well development subcontractor. The actual time needed to produce representative groundwater samples from a monitor well will vary depending on the site-specific hydrogeological conditions. The consultant is responsible for ensuring that the development process is complete and performed to these and any other applicable standards.

Sampling shall be permitted immediately following development only if new or certified clean equipment was used during the development process, and only using a bailer, bladder or submersible pump.

5.0 DEVELOPMENT WATER AND WELL RECOVERY TEST

Development water that is generated during well development procedures shall be handled in either one of two ways:

1. If groundwater is clean as demonstrated by past monitoring events, the development water may be discharged to the ground surface unless State or local requirements restrict such handling of development water. State or local requirements relating to development water disposal shall be followed in all circumstances unless otherwise approved by the designated Waste Management representative.

2. If groundwater is of unknown quality or has known past impacts, the development water shall be discharged into a container(s) and analyzed for EPA Subtitle D Appendix I or other State-required compounds. Based on results of the analysis, water will be disposed of either to the ground surface or in another manner acceptable to the designated Waste Management representative.

The consultant and/or well development contractor is ultimately responsible for the proper handling of development water and must coordinate such activities with the Waste Management Region Environmental Manager (REM) or designee. Procedures for the handling of development water shall be documented in field notes and included in any draft and final report of field activities submitted to Waste Management by the consultant and/or well development subcontractor.

Immediately after well development activities have been completed, well recovery data (water levels) shall be taken at appropriate intervals to produce a representative recovery curve (i.e., no greater than one minute intervals for a period of ten minutes, and then periodically as necessary). These data shall be included in the field notes, along with qualitative or quantitative insights regarding well performance and aquifer parameters. These data will be included in any draft and final report of field activities submitted to Waste Management by the consultant and/or well development subcontractor.

6.0 WELL DEVELOPMENT RECORDS

Well development records shall include, at a minimum, the following information:

- well designation;
- date, time, and duration of development activities;
- development method(s);
- depth of development tubing or pump intake (if used);
- rate and duration of water withdrawal;
- volume of water produced;
- disposal method for development water;
- pH, turbidity, temperature, conductivity, and depth-to-water readings;
- physical description of water produced at several times during the development procedure;
- pre-, during-, and post-development water levels; and,
- well depth.

The Waste Management REM shall be responsible for having this information on file at the site and in the regional office.

APPENDIX D Well Inspection Condition Summary Form

WELL CONDITION INSPECTION FORM

Site: ______________________ Personnel: ______________________

Date: ______________________ Page ____ of ____

Well ID	Protective Casing	Well Casing	Label	Lock	Sample Equipment Type	General Turbidity	Well Yield	Comments/Observations *
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No		☐ Clear ☐ Turbid	☐ OK ☐ Inadequate	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No		☐ Clear ☐ Turbid	☐ OK ☐ Inadequate	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No		☐ Clear ☐ Turbid	☐ OK ☐ Inadequate	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No		☐ Clear ☐ Turbid	☐ OK ☐ Inadequate	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No		☐ Clear ☐ Turbid	☐ OK ☐ Inadequate	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No		☐ Clear ☐ Turbid	☐ OK ☐ Inadequate	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No		☐ Clear ☐ Turbid	☐ OK ☐ Inadequate	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No		☐ Clear ☐ Turbid	☐ OK ☐ Inadequate	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No		☐ Clear ☐ Turbid	☐ OK ☐ Inadequate	
	☐ OK ☐ Damaged	☐ OK ☐ Damaged	☐ OK ☐ Inadequate	☐ Yes ☐ No		☐ Clear ☐ Turbid	☐ OK ☐ Inadequate	

* Note ponding water, weep holes, or any other information pertaining to well condition. Provide additional details on listed items.
Return this form to Site Manager and Groundwater Program Manager

WASTE MANAGEMENT

Well Condition Inspection Form

Facility: ______________________ Well/Piezometer Name: ______________________

Evaluator: ______________________ Evaluation Date: ______________________

	Y	N	N/A
Is the well's location appropriately shown on a facility map?			
he well adequately flagged if hard to find?			
Is the well elevation information inscribed at or on the well correct?			
Is the well: ❑ flush with surface? ~~❑ above ground?~~			
Is the well free of physical damage?			
Is the well labeled on the inside?			
Is the well labeled on the outside?			
Does the well have protective posts, if necessary?			
Do above ground wells have weep holes at the base of the protective casing?			
Does the area around the well appear clean?			
he casing secure (attempt to move along two perpendicular axes)?			
he surface seal void of differential erosion around and under the base?			
he surface seal free of cracks that might affect the integrity of the seal?			
Is the surface seal sloped to prevent ponding around the well?			
Is the well free from standing or ponded water?			
Is the well locked to prevent unauthorized access?			
Is the protective casing cap void of large gaps which would breach security?			
Is the locking cap free of rust?			
Is there a survey mark on the riser/wellhead assembly cap?			
Is the riser cap vented?			
Is the annular space free of animal/insect nests?			
he annular space appropriately filled with filtering material?			
If a pump, can it be lifted a few inches? (do not test prior to sampling)			
Is the well free of kinks or bends?			

COMMENTS: ____

APPENDIX E

FIELD INFORMATION FORM

Site Name: ______ Site No.: ______ Sample Point: ______ Sample ID

This Waste Management Field Information Form is Required
This form is to be completed, in addition to any State Forms. The Field Form is submitted along with the Chain of Custody Forms that accompany the sample containers (i.e. with the cooler that is returned to the laboratory).

Laboratory Use Only/Lab ID: ______

PURGE INFO

PURGE DATE (MM DD YY)	PURGE TIME (2400 Hr Clock)	ELAPSED HRS (hrs:min)	WATER VOL IN CASING (Gallons)	ACTUAL VOL PURGED (Gallons)	WELL VOLs PURGED

Note: For Passive Sampling, replace "Water Vol in Casing" and "Well Vols Purged" w/ Water Vol in Tubing/Flow Cell and Tubing/Flow Cell Vols Purged. Mark changes, record field data, below.

PURGE/SAMPLE EQUIPMENT

Purging and Sampling Equipment … Dedicated: Y or N

Purging Device ___ A- Submersible Pump, B-Peristaltic Pump, C-QED Bladder Pump, D-Bailer, E-Piston Pump, F-Dipper/Bottle

Sampling Device ___

X-Other: ______

Filter Device: Y or N 0.45 µ or ___ µ (circle or fill in)

Filter Type: ___ A-In-line Disposable, B-Pressure, C-Vacuum, X-Other ______

Sample Tube Type: ___ A-Teflon, B-Stainless Steel, C-PVC, D-Polypropylene, X-Other: ______

WELL DATA

Well Elevation (at TOC) ______ (ft/msl) **Depth to Water (DTW) (from TOC)** ______ (ft) **Groundwater Elevation (site datum, from TOC)** ______ (ft/msl)

Total Well Depth (from TOC) ______ (ft) Stick Up (from ground elevation) ______ (ft) Casing ID ______ (in) Casing Material ______

Note: Total Well Depth, Stick Up, Casing Id, etc. are optional and can be from historical data, unless required by Site/Permit. Well Elevation, DTW, and Groundwater Elevation must be current.

STABILIZATION DATA (Optional)

Sample Time (2400 Hr Clock)	Rate/Unit ____	pH (std)	Conductance (SC/EC) (µmhos/cm @ 25 °C)	Temp. (°C)	Turbidity (ntu)	D.O. (mg/L - ppm)	eH/ORP (mV)	DTW (ft)
	1st	1st						
	2nd	2nd						
	3rd	3rd						
	4th	4th						
Suggested range for 3 consec. readings or note Permit/State requirements:		+/- 0.2	+/- 3%	--	--	+/- 10%	+/- 25 mV	Stabilize

Stabilization Data Fields are Optional *(i.e. complete stabilization readings for parameters required by WM, Site, or State). These fields can be used where four (4) field measurements are required by State/Permit/Site. If a Data Logger or other Electronic format is used, fill in final readings below and submit electronic data separately to Site. If more fields above are needed, use separate sheet or form*

FIELD DATA

SAMPLE DATE (MM DD YY)	pH (std)	CONDUCTANCE (umhos/cm @ 25°C)	TEMP. (°C)	TURBIDITY (ntu)	DO (mg/L-ppm)	eH/ORP (mV)	Other: ____ Units ____

Final Field Readings are required *(i.e. record field measurements, final stabilized readings, passive sample readings before sampling for all field parameters required by State/Permit/Site.*

FIELD COMMENTS

Sample Appearance: ______ Odor: ______ Color: ______ Other: ______

Weather Conditions (required daily, or as conditions change): Direction/Speed: ______ Outlook: ______ Precipitation: Y or N

Specific Comments (including purge/well volume calculations if required): ______

______

______

______

______

I certify that sampling procedures were in accordance with applicable EPA, State, and WM protocols (if more than one sampler, all should sign):

Date	Name	Signature	Company
___/___/___			
___/___/___			

DISTRIBUTION: WHITE/ORIGINAL - Stays with Sample, YELLOW - Returned to Client, PINK - Field Copy

Example Field Information ~~Forms and Depth-to-Water Criteria Tables~~Form

FIELD INFORMATION FORM

WASTE MANAGEMENT

Site Name: ____________

Site No.: ____ Sample Point: ____ (Sample ID)

This Waste Management Field Information Form is Required
This form is to be completed, in addition to any State Forms. The Field Form is submitted along with the Chain of Custody Forms that accompany the sample containers (i.e. with the cooler that is returned to the laboratory).

Laboratory Use Only/Lab ID: ____________

PURGE INFO

PURGE DATE (MM DD YY)	PURGE TIME (2400 Hr Clock)	ELAPSED HRS (hrs:min)	WATER VOL IN CASING (Gallons)	ACTUAL VOL PURGED (Gallons)	WELL VOLs PURGED

Note: For Passive Sampling, replace "Water Vol in Casing" and "Well Vols Purged" w/ Water Vol in Tubing/Flow Cell and Tubing/Flow Cell Vols Purged. Mark changes, record field data, below.

PURGE/SAMPLE EQUIPMENT

Purging and Sampling Equipment … Dedicated: Y or N

Filter Device: Y or N 0.45 µ or ____ µ (circle or fill in)

Purging Device ____ A- Submersible Pump D-Bailer
B-Peristaltic Pump E-Piston Pump
Sampling Device ____ C-QED Bladder Pump F-Dipper/Bottle

X-Other: ____________

Filter Type: ____ A-In-line Disposable C-Vacuum B-Pressure X-Other ____________

Sample Tube Type: ____ A-Teflon C-PVC X-Other: ____________ B-Stainless Steel D-Polypropylene

WELL DATA

Well Elevation (at TOC) ____ (ft/msl) **Depth to Water (DTW) (from TOC)** ____ (ft) **Groundwater Elevation (site datum, from TOC)** ____ (ft/msl)

Total Well Depth (from TOC) ____ (ft) Stick Up (from ground elevation) ____ (ft) Casing ID ____ (in) Casing Material ____

Note: Total Well Depth, Stick Up, Casing Id, etc. are optional and can be from historical data, unless required by Site/Permit. Well Elevation, DTW, and Groundwater Elevation must be current.

STABILIZATION DATA (Optional)

~~Sample Time~~ (2400 Hr Clock)	~~Rate/Unit~~		~~pH~~ (std)		~~Conductance (SC/EC)~~ (µmhos/cm @ 25 °C)	~~Temp.~~ (°C)	~~Turbidity~~ (ntu)	~~D.O.~~ (mg/L - ppm)	eH/ORP (mV)	DTW (ft)
		1st		1st						
		2nd		2nd						
		3rd		3rd						
		4th		4th						
Suggested range for 3 consec. readings or note Permit/State requirements:			+/- 0.2		+/- 3%	--	--	+/- 10%	+/- 25 mV	Stabilize

Stabilization Data Fields are Optional *(i.e. complete stabilization readings for parameters required by WM, Site, or State). These fields can be used where four (4) field measurements are required by State/Permit/Site. If a Data Logger or other Electronic format is used, fill in final readings below and submit electronic data separately to Site.* *If more fields above are needed, use separate sheet or form.*

FIELD DATA

SAMPLE DATE (MM DD YY)	pH (std)	CONDUCTANCE (umhos/cm @ 25°C)	TEMP. (°C)	TURBIDITY (ntu)	DO (mg/L-ppm)	eH/ORP (mV)	Other: ____ Units ____

Final Field Readings are required *(i.e. record field measurements, final stabilized readings, passive sample readings before sampling for all field parameters required by State/Permit/Site.*

FIELD COMMENTS

Sample Appearance: ____________ Odor: ____________ Color: ____________ Other: ____________

Weather Conditions (required daily, or as conditions change): Direction/Speed: ____________ Outlook: ____________ Precipitation: Y or N

Specific Comments (including purge/well volume calculations if required): ____________

I certify that sampling procedures were in accordance with applicable EPA, State, and WM protocols (if more than one sampler, all should sign):

Date	Name	Signature	Company
___/___/___			
___/___/___			

DISTRIBUTION: WHITE/ORIGINAL - Stays with Sample, YELLOW - Returned to Client, PINK - Field Copy

Sample Collection/Laboratory Analytical Program

Site Name: **CWMNW- Arlington, OR** **Site Number: 530**
Well ID: **Date:**

Monitoring Program: __RCRA Detection __RCRA Semi-Annual Compliance __RCRA Annual Compliance __TSCA Program

Sampling Guidance
Controller Settings (in-out-psi-ml/min)
initial flow: low flow:
Target DTW (ft bmp) for switching from initial flow to low flow:
Depth to top of screen (ft bmp):
Target DTW (ft bmp) to stop purging low-yielding wells:
One purge volume (tubing + pump bladder):

Sample ID/Time	Number of Dample Containers	Volume of Each Container	Bottle Type	Preservative	Field Filtered?	Analytes
	3	40 mL	VOA Vial	HCl	No	VOCs
	3	40 mL	VOA Vial	HCl	No	1,4- Dioxane
	2	1 L	Amber Glass	4 degrees C	No	PCBs
Duplicate ID/ Time						All of the Above
Field Blank ID/ Time	3	40 mL	VOA Vial	HCl	No	VOCs
	3	40 mL	VOA Vial	HCl	No	1,4- Dioxane
Equipment Blank ID/Time						All of the Above
VOC Trip Blank ID/ Time	1	40 mL	VOA Vial	HCl	No	VOCs
	1	40 mL	VOA Vial	HCl	No	1,4- Dioxane

Shipping Method: FedEx **Laboratory:** Test America

NAPL observed during purging or sampling?

Depth to water before purging?

Depth to water at end of purging or beginning of sampling?

Depth to water at end of sampling?

Comments/Exceptions to Groundwater Monitoring Plan:

____________________	____________________	____________________	__/__/__
____________________	____________________	____________________	__/__/__
Sampler's Name	**Sampler's Signature**	**Company**	**Date**

~~**Depth-To-Water Criteria For Sampling**~~
~~**(Chemical Waste Management of the Northwest, Inc., Arlington, Oregon)**~~

Well I.D.	Monitoring Program	Required Analytes (Excluding PCBs, Appx IX)	Well Diam. (in.)	Well Casing Area (in2)	Well Casing Area (ft2)	Purge Tube Outer Diam. (in.)	Purge Tube Inner Diam. (in.)	Purge Tube Inner Radius (in.)	Purge Tube Area (in2)	Purge Tube Area (ft2)	Fall 2010 Depth to Static Water (ft) [a]	Top of Screen Depth (ft) [a]	Screen Sub-mergence Prior to Purging (ft)	Well Depth (feet) [a]	Pump Type [c]	Pump Intake Depth (ft) [a,b]	Pump Sub-mergence Prior to Purging (ft)	Purge Tube Volume (gallons)	Pump Bladder Volume (gallons)	Total (One) Purge Volume (gallons)	Total (One) Purge Volume (liters)	Sampling Volume (gallons) [d]	Sampling Volume + One Purge Volume (gallons)	Sampling Volume + One Purge Volume (liters)	Eq. Water Column Height In Well (ft)	Max DTW for Sampling (ft) [a, e]	Is Max DTW Below Top of Screen?	Is Static Water at Least 10 ft Above Top of Screen?	Target DTW for Stopping Purging of Low-Yield Wells [a, f, g]
~~La-2~~	~~Detection~~	~~VOCs~~	~~4~~	~~12.57~~	~~0.087~~	~~0.375~~	~~0.25~~	~~0.125~~	~~0.0491~~	~~0.0003~~	~~201.03~~	~~238.01~~	~~36.98~~	~~248.79~~	~~WW~~	~~243.00~~	~~41.97~~	~~0.62~~	~~0.11~~	~~0.73~~	~~2.8~~	~~0.33~~	~~1.06~~	~~4.1~~	~~1.62~~	~~241.38~~	~~Yes~~	~~Yes~~	~~239.01~~
~~2E-9~~	~~Detection~~	~~VOCs~~	~~4~~	~~12.57~~	~~0.087~~	~~0.375~~	~~0.25~~	~~0.125~~	~~0.0491~~	~~0.0003~~	~~188.48~~	~~174.00~~	~~-14.48~~	~~194.30~~	~~WW~~	~~192.00~~	~~3.52~~	~~0.49~~	~~0.11~~	~~0.60~~	~~2.30~~	~~0.33~~	~~0.93~~	~~3.6~~	~~1.42~~	~~190.58~~	~~Yes~~	~~No~~	~~190.24~~
~~2Ua-1~~	~~Detection~~	~~VOCs~~	~~4~~	~~12.57~~	~~0.087~~	~~0.25~~	~~0.125~~	~~0.0625~~	~~0.0123~~	~~9E-05~~	~~222.15~~	~~220.20~~	~~-1.95~~	~~234.74~~	~~WW~~	~~233.00~~	~~10.85~~	~~0.15~~	~~0.11~~	~~0.26~~	~~1.0~~	~~0.33~~	~~0.59~~	~~2.3~~	~~0.90~~	~~232.10~~	~~Yes~~	~~No~~	~~227.58~~
~~2U-2~~	~~Detection~~	~~VOCs~~	~~4~~	~~12.57~~	~~0.087~~	~~0.375~~	~~0.25~~	~~0.125~~	~~0.0491~~	~~0.0003~~	~~247.32~~	~~260.70~~	~~13.38~~	~~265.70~~	~~WW~~	~~263.00~~	~~15.68~~	~~0.68~~	~~0.11~~	~~0.79~~	~~3.0~~	~~0.33~~	~~1.12~~	~~4.3~~	~~1.72~~	~~261.28~~	~~Yes~~	~~Yes~~	~~261.70~~
~~3H-1~~	~~Detection~~	~~VOCs~~	~~4~~	~~12.57~~	~~0.087~~	~~0.375~~	~~0.25~~	~~0.125~~	~~0.0491~~	~~0.0003~~	~~168.54~~	~~173.10~~	~~4.56~~	~~184.60~~	~~WW~~	~~178.10~~	~~9.56~~	~~0.46~~	~~0.11~~	~~0.57~~	~~2.2~~	~~0.33~~	~~0.90~~	~~3.5~~	~~1.38~~	~~176.72~~	~~Yes~~	~~No~~	~~173.32~~
~~3P-1~~	~~Detection~~	~~VOCs~~	~~4~~	~~12.57~~	~~0.087~~	~~0.375~~	~~0.25~~	~~0.125~~	~~0.0491~~	~~0.0003~~	~~194.33~~	~~207.10~~	~~12.77~~	~~222.10~~	~~WW~~	~~214.60~~	~~20.27~~	~~0.55~~	~~0.11~~	~~0.66~~	~~2.5~~	~~0.33~~	~~0.99~~	~~3.8~~	~~1.52~~	~~213.08~~	~~Yes~~	~~Yes~~	~~208.10~~
~~3P-2~~	~~Detection~~	~~VOCs~~	~~4~~	~~12.57~~	~~0.087~~	~~0.375~~	~~0.25~~	~~0.125~~	~~0.0491~~	~~0.0003~~	~~207.95~~	~~233.16~~	~~25.21~~	~~243.71~~	~~WW~~	~~238.20~~	~~30.25~~	~~0.61~~	~~0.11~~	~~0.72~~	~~2.8~~	~~0.33~~	~~1.05~~	~~4.0~~	~~1.61~~	~~236.59~~	~~Yes~~	~~Yes~~	~~234.16~~
~~3Q-1~~	~~Detection~~	~~VOCs~~	~~4~~	~~12.57~~	~~0.087~~	~~0.375~~	~~0.25~~	~~0.125~~	~~0.0491~~	~~0.0003~~	~~219.70~~	~~222.70~~	~~3.00~~	~~232.70~~	~~WW~~	~~227.70~~	~~8.00~~	~~0.59~~	~~0.11~~	~~0.70~~	~~2.7~~	~~0.33~~	~~1.03~~	~~3.9~~	~~1.58~~	~~226.12~~	~~Yes~~	~~No~~	~~223.70~~
~~3Q-2~~	~~Detection~~	~~VOCs~~	~~4~~	~~12.57~~	~~0.087~~	~~0.375~~	~~0.25~~	~~0.125~~	~~0.0491~~	~~0.0003~~	~~228.59~~	~~248.20~~	~~19.61~~	~~258.20~~	~~WW~~	~~253.20~~	~~24.61~~	~~0.65~~	~~0.11~~	~~0.76~~	~~2.9~~	~~0.33~~	~~1.09~~	~~4.2~~	~~1.67~~	~~251.53~~	~~Yes~~	~~Yes~~	~~249.20~~
~~3R-1~~	~~Detection~~	~~VOCs~~	~~4~~	~~12.57~~	~~0.087~~	~~0.375~~	~~0.25~~	~~0.125~~	~~0.0491~~	~~0.0003~~	~~167.65~~	~~172.80~~	~~5.15~~	~~183.60~~	~~WW~~	~~177.80~~	~~10.15~~	~~0.46~~	~~0.11~~	~~0.57~~	~~2.2~~	~~0.33~~	~~0.90~~	~~3.5~~	~~1.38~~	~~176.42~~	~~Yes~~	~~No~~	~~172.73~~
~~3S-1~~	~~Detection~~	~~VOCs~~	~~4~~	~~12.57~~	~~0.087~~	~~0.375~~	~~0.25~~	~~0.125~~	~~0.0491~~	~~0.0003~~	~~127.10~~	~~183.30~~	~~56.20~~	~~193.30~~	~~WW~~	~~188.30~~	~~61.20~~	~~0.49~~	~~0.11~~	~~0.60~~	~~2.3~~	~~0.33~~	~~0.93~~	~~3.6~~	~~1.42~~	~~186.88~~	~~Yes~~	~~Yes~~	~~184.30~~
~~3S-2~~	~~Detection~~	~~VOCs~~	~~4~~	~~12.57~~	~~0.087~~	~~0.375~~	~~0.25~~	~~0.125~~	~~0.0491~~	~~0.0003~~	~~181.95~~	~~206.70~~	~~24.75~~	~~216.70~~	~~WW~~	~~211.70~~	~~29.75~~	~~0.54~~	~~0.11~~	~~0.65~~	~~2.5~~	~~0.33~~	~~0.98~~	~~3.8~~	~~1.50~~	~~210.20~~	~~Yes~~	~~Yes~~	~~207.70~~
~~3Ta-1~~	~~Detection~~	~~VOCs~~	~~4~~	~~12.57~~	~~0.087~~	~~0.375~~	~~0.25~~	~~0.125~~	~~0.0491~~	~~0.0003~~	~~224.68~~	~~228.30~~	~~3.62~~	~~238.30~~	~~WW~~	~~233.30~~	~~8.62~~	~~0.60~~	~~0.11~~	~~0.71~~	~~2.7~~	~~0.33~~	~~1.04~~	~~4.0~~	~~1.59~~	~~231.71~~	~~Yes~~	~~No~~	~~228.99~~
~~3T-2~~	~~Detection~~	~~VOCs~~	~~4~~	~~12.57~~	~~0.087~~	~~0.375~~	~~0.25~~	~~0.125~~	~~0.0491~~	~~0.0003~~	~~230.73~~	~~255.30~~	~~24.57~~	~~265.30~~	~~WW~~	~~260.30~~	~~29.57~~	~~0.67~~	~~0.11~~	~~0.78~~	~~3.0~~	~~0.33~~	~~1.11~~	~~4.3~~	~~1.70~~	~~258.60~~	~~Yes~~	~~Yes~~	~~256.30~~
~~3V-2~~	~~Detection~~	~~VOCs~~	~~4~~	~~12.57~~	~~0.087~~	~~0.375~~	~~0.25~~	~~0.125~~	~~0.0491~~	~~0.0003~~	~~145.69~~	~~188.50~~	~~42.81~~	~~198.70~~	~~WW~~	~~194.00~~	~~48.31~~	~~0.50~~	~~0.11~~	~~0.61~~	~~2.4~~	~~0.33~~	~~0.94~~	~~3.6~~	~~1.44~~	~~192.56~~	~~Yes~~	~~Yes~~	~~189.50~~
~~4B-1~~	~~Detection~~	~~VOCs~~	~~4~~	~~12.57~~	~~0.087~~	~~0.375~~	~~0.25~~	~~0.125~~	~~0.0491~~	~~0.0003~~	~~193.39~~	~~203.66~~	~~10.27~~	~~216.77~~	~~WW~~	~~211.20~~	~~17.81~~	~~0.54~~	~~0.11~~	~~0.65~~	~~2.5~~	~~0.33~~	~~0.98~~	~~3.8~~	~~1.50~~	~~209.70~~	~~Yes~~	~~Yes~~	~~204.66~~
~~4Ba-2~~	~~Detection~~	~~VOCs~~	~~5~~	~~19.63~~	~~0.136~~	~~0.375~~	~~0.25~~	~~0.125~~	~~0.0491~~	~~0.0003~~	~~194.64~~	~~230.16~~	~~35.52~~	~~242.30~~	~~WW~~	~~235.00~~	~~40.36~~	~~0.60~~	~~0.11~~	~~0.71~~	~~2.7~~	~~0.33~~	~~1.04~~	~~4.0~~	~~1.02~~	~~233.98~~	~~Yes~~	~~Yes~~	~~231.16~~
~~4H-1~~	~~Detection~~	~~VOCs~~	~~4~~	~~12.57~~	~~0.087~~	~~0.375~~	~~0.25~~	~~0.125~~	~~0.0491~~	~~0.0003~~	~~172.93~~	~~184.50~~	~~11.57~~	~~199.70~~	~~WW~~	~~192.00~~	~~19.07~~	~~0.49~~	~~0.11~~	~~0.60~~	~~2.3~~	~~0.33~~	~~0.93~~	~~3.6~~	~~0.00~~	~~192.00~~	~~Yes~~	~~Yes~~	~~185.50~~
~~4H-2~~	~~Detection~~	~~VOCs~~	~~4~~	~~12.57~~	~~0.087~~	~~0.375~~	~~0.25~~	~~0.125~~	~~0.0491~~	~~0.0003~~	~~173.18~~	~~194.80~~	~~21.62~~	~~204.70~~	~~WW~~	~~199.80~~	~~26.62~~	~~0.51~~	~~0.11~~	~~0.62~~	~~2.4~~	~~0.33~~	~~0.95~~	~~3.6~~	~~0.00~~	~~199.80~~	~~Yes~~	~~Yes~~	~~195.80~~

~~[a] Measured from the top of well casing.~~
~~[b] Pump intake depths for Well Wizards are measured or are assumed to be in the middle of the screened portion of the well.~~
~~[c] WW = Well Wizard bladder pump DTW = depth to water ft = feet in = inches VOCs = volatile organic compounds PCBs = polychlorinated biphenyls~~
~~[d] The sampling volume accounts for container volumes, field parameter measurements, and incidental additional purged volumes.~~
~~[e] Calculated assuming that the purge tube is full.~~
~~[f] For the purposes of this calculation, a "low-yield" well is one where the drawdown criterion in the Groundwater Monitoring Plan cannot be achieved during low-flow purging.~~
~~[g] The Target DTW is 1 foot above the top of the screen for wells that have more than 10 feet of submergence prior to purging. For low-yielding wells with less than 10 feet of pre-purging screen submergence, the Target DTW is set at the mid-point between the static water level and the pump intake.~~

~~Depth-To-Water Criteria For Sampling(Chemical Waste Management of the Northwest, Inc., Arl~~

Well I.D. - - -	Monitoring Program - - -	Required Analytes (Excluding PCBs, Appx IX)	Well Diam. (in.) - -	Well Casing Area (in2) -	Well Casing Area (ft2) -	Purge Tube Outer Diam. (in.)	Purge Tube Inner Diam. (in.)	Purge Tube Inner Radius (in.)	Purge Tube Area (in2) -	Purge Tube Area (ft2) -	Fall 2010 Depth to Static Water (ft) [a]	Top of Screen Depth (ft) [a]	Screen Sub-mergence Prior to Purging (ft)	Well Depth (feet) - [a]	Pump Type - - [c]	Pump Intake Depth (ft) [a,b]	Pump Sub-mergence Prior to Purging (ft)	Purge Tube Volume (gallons) -	Pu Blad Volu (gall -
5A-1	Detection	VOCs	5	19.63	0.136	0.375	0.25	0.125	0.0491	0.0003	181.24	180.96	-0.28	208.17	WW	194.20	12.96	0.50	0.1
5A-2	Detection	VOCs	5	19.63	0.136	0.375	0.25	0.125	0.0491	0.0003	200.99	221.37	20.38	232.15	WW	226.50	25.51	0.58	0.1
5B-1	Detection	VOCs	5	19.63	0.136	0.375	0.25	0.125	0.0491	0.0003	194.89	190.11	-4.78	213.96	WW	201.79	6.90	0.52	0.1
5B-2	Detection	VOCs	5	19.63	0.136	0.375	0.25	0.125	0.0491	0.0003	206.34	237.43	31.09	244.32	WW	240.76	34.42	0.62	0.1
5D-1	Detection	VOCs	5	19.63	0.136	0.375	0.25	0.125	0.0491	0.0003	194.73	196.81	2.08	217.27	WW	206.97	12.24	0.53	0.1
5D-2	Detection	VOCs	5	19.63	0.136	0.375	0.25	0.125	0.0491	0.0003	197.25	226.90	29.65	242.24	WW	234.20	36.95	0.60	0.1
5L-1	Detection	VOCs	4	12.57	0.087	0.25	0.17	0.085	0.0227	0.0002	189.48	186.71	-2.77	211.71	WW	199.20	9.72	0.24	0.1
5L-2	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	194.03	219.24	25.21	226.14	WW	222.50	28.47	0.57	0.1
5M-1	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	211.45	209.02	-2.43	229.69	WW	219.02	7.57	0.56	0.1
5M-2	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	218.68	235.52	16.84	245.52	WW	240.50	21.82	0.62	0.1
5N-1	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	224.46	215.11	-9.35	234.90	WW	233.00	8.54	0.60	0.1
5N-2	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	228.12	244.88	16.76	260.88	WW	252.90	24.78	0.65	0.1
5P-1	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	199.69	202.70	3.01	227.89	WW	215.00	15.31	0.55	0.1
5P-2	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	197.45	228.66	31.21	246.98	WW	237.50	40.05	0.61	0.1
5Q-1	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	217.28	214.52	-2.76	233.01	WW	223.00	5.72	0.57	0.1
5Q-2	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	207.20	234.96	27.76	253.67	WW	243.60	36.40	0.63	0.1
5R-2	Detection	VOCs	4	12.57	0.087	0.5	0.375	0.1875	0.1104	0.0008	206.36	243.24	36.88	254.07	WW	248.10	41.74	1.43	0.1
5S-1	Detection	VOCs	4	12.57	0.087	0.25	0.17	0.085	0.0227	0.0002	207.28	203.91	-3.37	224.81	WW	213.90	6.62	0.26	0.1
6C-9	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	173.78	187.90	14.12	207.90	WW	197.90	24.12	0.51	0.1
6G-1	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	124.00	141.76	17.76	149.96	WW	144.26	20.26	0.37	0.1
6G-2	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	137.18	165.13	27.95	172.63	WW	167.63	30.45	0.43	0.1
7A-1	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	123.66	142.19	18.53	152.46	WW	147.19	23.53	0.38	0.1
7A-2	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	134.19	183.13	48.94	193.39	WW	188.13	53.94	0.48	0.1
7B-1	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	145.31	158.77	13.46	169.01	WW	163.77	18.46	0.42	0.1
7C-1	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	166.72	180.26	13.54	190.45	WW	185.26	18.54	0.48	0.1
7C-2	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	164.86	205.79	40.93	215.90	WW	210.79	45.93	0.54	0.1
7D-1	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	174.40	188.23	13.83	198.60	WW	193.23	18.83	0.50	0.1
7D-2	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	181.79	206.44	24.65	216.96	WW	211.44	29.65	0.54	0.1
7E-2	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	TBD	TBD	TBD	TBD	WW	TBD	TBD	TBD	TB

~~[a] Measure~~

~~[b] Pump intake depths for Well Wizards are measured or are assumed to be in the middle of the screened portion of the well.~~
~~[c] WW = Well Wizard bladder pump DTW = depth to water ft = feet in = inches VOCs = volatile organic compounds PCBs = polychlorinated biphenyls~~
~~[d] The sampling volume accounts for container volumes, field parameter measurements, and incidental additional purged volumes.~~
~~[e] Calculated assuming that the purge tube is full.~~
~~[f] For the purposes of this calculation, a "low-yield" well is one where the drawdown criterion in the Groundwater Monitoring Plan cannot be achieved during low-flow purging.~~
~~[g] The Target DTW is 1 foot above the top of the screen for wells that have more than 10 feet of submergence prior to purging. For low-yielding wells with less than 10 feet of pre-purging screen submergence, the Target DTW is set at th~~

Sample Collection/Laboratory Analytical Program

Site Name: **Site Number:**
Well ID: **Date:**

Monitoring Program: ___RCRA Detection ___RCRA Semi-Annual Compliance ___RCRA Annual Compliance ___TSCA Program

Sampling Guidance
Controller Settings (in-out-psi-ml/min)
Initial Flow: Low Flow:
Depth to top of screen (ft bmp):
Maximum DTW (ft bmp) for adequate sample volume:
One purge volume (tubing + pump bladder):

Sample ID/Time	Number of Sample Containers	Volume of Each Container	Bottle Type	Preservative	Field Filtered?	Analytes

Shipping Method: **Laboratory:**

NAPL observed during purging or sampling?
Depth to water before purging?
Depth to water at end of purging or beginning of sampling?
Depth to water at end of sampling?

Comments/Exceptions to Groundwater Monitoring Plan:

________________	________________	______________	__/__/__
Sampler's Name	**Sampler's Signature**	**Company**	**Date**

Example Sample Collection / Lab Analytical Program Form

APPENDIX B

Appendix B Site Specific Low Flow Sampling

Site-Specific Purging and Sampling Methodology

A drawdown criteria matrix was developed for field staff to look-up maximum allowed rates of drawdown given the purge rate, well diameter, and water level monitoring frequency. The drawdown criteria are shown in Table 7-8 for purge rates ranging from 0.01 gallons per minute (gpm) to 1 gpm; well diameters of 2, 4, and 5 inches; and water level measurement frequencies of 5 and 10 minutes. For each purge rate, each well diameter, and the two different measurement frequencies, the drawdown criteria were derived by the following methodology:

- Calculating the total volume of water purged during a given time interval (5 or 10 minutes);
- Calculating 10 percent of the total purge volume. The 10 percent volume is the maximum amount of water during that time interval that is allowed to consist of resident water inside the well casing (i.e., not derived from the formation/sandpack);
- Dividing the 10 percent volume by the horizontal area of the water column inside the well casing to determine the vertical amount of the water column that comprises the 10 percent volume. This water column height equals the maximum amount of water level decline (during a 5- or 10-minute time increment) for which no more than 10 percent of the purged water is comprised of resident water inside the well casing.

By drawing down the water column by no more than this incremental amount during the 5-minute or 10-minute time increment, the site-specific low-flow methodology is designed to provide (1) no more than 10 percent of the purge water from inside the well casing and (2) at least 90 percent of the purge water from the formation/sandpack.

An example of this calculation is shown below for a purge rate of 0.1 gpm, a 10-minute interval between water level measurements, and a 4-inch well diameter:

V_{purge} = Volume purged every 10 minutes = 0.1 gpm * 10 minutes = 1 gallon

$V_{max\text{-}casing}$ = Maximum allowed volume of water from casing during a 10-minute interval
= 10% * 1 gallon = 0.1 gallons
= 0.1 gallons * (12*12*12 inches^3 / ft^3) / (7.481 gallons/ft^3)
= 23.10 inches^3

A = Horizontal area of water column inside well
= $\pi * d^2 / 4 = \pi * (4 \text{ inches})^2 / 4 = (3.14159 * 4)$ inches^2
= 12.5664 inches^2

H = maximum allowed water level decline during a 10-minute interval
= $V_{max\text{-}casing}$ / A
= 23.10 inches^3 / 12.5664 inches^2
= 1.838 inches
= 0.153 ft, or 0.15 ft when rounding to the nearest 1/100th of a foot

Similarly, for a 5-minute interval instead of a 10-minute interval, the purge-rate of 0.1 gpm would result in a maximum allowed drawdown of 0.0765 ft for a 4-inch-diameter well. Because water levels are measured to the nearest 0.01 ft, the calculated drawdown criterion value of 0.0765 ft is rounded to 0.08 ft for the purposes of applying Table 7-8 in the field.

In the case where the formation is too low-yielding to allow the drawdown criteria to be achieved, purging is allowed to continue until the water level is no lower than 1 ft above the well screen (for wells with at least 10 ft of screen submergence prior to purging) or no lower than halfway from the initial (static) water level to the pump intake (for wells with less than 10 ft of screen submergence prior to purging). Table 7-14 identifies these values as the target depth for stopping purging. For low-yielding wells, these purge depths result in a sufficient volume of water being present in the well to allow VOC samples to be collected (Table 7-14). The "maximum depth to water" that still provides sufficient sample volume is below the depth at which purging shall stop. These "maximum" depths have been calculated from the well diameter, the purge tube diameter, the depth of the pump, and the "sampling volume" that is necessary to evacuate one purge-tube volume, evacuate one bladder volume, fill sample containers, collect a final set of field parameters, and provide additional volume to ensure that these activities can be completed. For low-yielding wells, the sampling team shall remove one purge volume of water before collecting the necessary samples. The depth-to-water criteria shall be updated in the future as needed (for example, when new pumps are installed, or when pumps are serviced and their intake depths change).

The target depths for stopping purging (listed in Table 7-14) were developed to serve as guidelines for how long to continue purging wells that are low-yielding (i.e., cannot be successfully low-flow sampled). For wells that can be low-flow sampled, the sampling team shall attempt to conduct the site-specific low-flow sampling procedure while maintaining the water level above the target depth listed in Table 7-14. However, at some wells, this procedure may be feasible only when the water level is lowered below the target depth listed in Table 7-14. In such cases, preference shall be given to conducting low-flow sampling, rather than stopping the purging process and returning later to the well to collect samples.

Field Procedures

The site-specific low-flow sampling method consists of the following field procedures:

- The well shall initially be purged at a rate targeted to be 0.1 gpm (approximately 0.4 liters per minute [L/min]). Purging at this rate shall continue until the amount of drawdown in the well is similar to the amount that has occurred historically when low-flow sampling efforts were successful. Select field parameters (pH, temperature, specific conductance, dissolved oxygen [DO], oxidation-reduction potential [ORP], depth to water, total gallons purged, and purge rate) shall be measured once during initial evacuation of one purge volume and several times thereafter as described below.

- As the water level approaches the target low-flow water level achieved during previous successful low-flow sampling events, the purge rate shall be reduced, and purging shall continue until the water level meets the drawdown criterion listed in Table 7-14 (for the purge rate and diameter of the well being sampled). The depth-to-water (along with the other field parameters) shall be recorded at least once every five minutes during this period and at the end of this period. Once the drawdown criterion is achieved, the sample shall be collected.
- If the drawdown criterion cannot be achieved at the well, then the sampling team is allowed to purge the water level down to a pre-determined depth as discussed below. Table 7-14 identifies the depth by which purging shall stop (although purging may stop at a higher water level if deemed appropriate by the sampling team). VOC samples then shall be collected within 48 hours of stopping the purging process. The sampling process shall begin by first evacuating one purge volume of water; VOC sampling shall proceed as soon as this purge volume has been evacuated. If the volume of water in the well is too low to allow for collection of additional analytes (PCBs, Appendix IX constituents, or other analytes), then the samples for VOCs shall be collected and the sampling team shall return at a later time during the sampling event (as convenient) to collect the remaining samples. If multiple sampling periods are required to collect the additional analytes, then one purge volume shall again be evacuated before collecting the additional analytes.
- If a sample cannot be collected without exceeding the pre-determined depth shown in Table 7-14 during a sampling event and sampling at a depth below the water level is required, the sampling team must document this on the FIF and explained in the semiannual monitoring report for the event.

Field parameter measurements that are conducted during purging and sampling shall be recorded on the FIFs. Where possible, the purging process shall continue until field parameters have stabilized (stabilization targets are included on the FIFs). However, the field parameter measurements shall not be used to evaluate stabilization of water quality or to guide decisions regarding the timing of sample collection. Instead, if one or more field parameters have not yet stabilized before the drawdown criterion have been achieved, or if the water level has dropped to the level described in the previous paragraph, then purging shall stop and the well shall be sampled. Field parameters shall also be measured prior to, or at the conclusion of, the sample collection process.

Sample Preservation, Shipment, and Chain-of-Custody Procedures

Once a sample is collected, it will remain in the custody of the field personnel who collected the sample, or other authorized personnel, until it is shipped to the laboratory. When such a person transfers sample possession to subsequent custodians, he or she will sign and date the chain-of-custody form (COC). Signed and dated custody seals will be placed on coolers before shipment. When the samples are received at the laboratory, the custody seal on the shipping container will be broken and the condition of the samples recorded by the laboratory custodian. COC records will be included in the analytical report prepared by the laboratory. Copies of the COC records will be retained in the project file.

The sample containers will be prepared and provided by the analytical laboratory. Samples will be preserved consistent with analytical method requirements and laboratory recommendations.

The type and size of container used for each analysis and the type of preservative added, if any, will be recorded on the FIF.

Samples will be shipped or delivered by hand to the contract laboratory after completion of each monitoring event. Due to shipping limitations in eastern Oregon, samples are not shipped each day during a monitoring event. The samples are maintained under custody of the field personnel until the completion of each monitoring event.

Packaging and shipment general procedures are as follows:

- Preserve and transport sample containers on ice (or a suitable equivalent) in a sealed, insulated cooler.
- Separate glass bottles in the shipping container with shock-absorbent packaging material to prevent breakage.
- Place a laboratory-supplied trip blank in each cooler containing samples for VOC analysis.

Table 7-14
Depth-To-Water Criteria For Sampling
Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)

Well I.D.	Monitoring Program	Required Analytes (Excluding PCBs, Appx. IX)	Well Diam. (in.)	Well Casing Area (in.^{2})	Well Casing Area (ft.^{2})	Purge Tube Outer Diam. (in.)	Purge Tube Inner Diam. (in.)	Purge Tube Inner Radius (in.)	Purge Tube Area (in.^{2})	Purge Tube Area (ft.^{2})	Fall 2015 Depth to Static Water (ft.) [a]	Top of Screen Depth (ft.) [a]	Screen Submergence Prior to Purging (ft.)	Well Depth (feet) [a]	Pump Type	Pump Intake Depth (ft.) [a,b]	Pump Submergence Prior to Purging (ft)	Purge Tube Volume (gallons)	Pump Bladder Volume (gallons)	Flow-Through Cell Volume (gallons)	Total (One) Purge Volume (gallons)	Total (One) Purge Volume (liters)	Sampling Volume (gallons) [c]	Sampling Volume + One Purge Volume (gallons)	Sampling Volume + One Purge Volume (liters)	Eq. Water Column Height In Well (ft.)	Eq. Water Height In Well If Purge Tube Partially Full (ft) [a] [e]	Target Max DTW for Sampling (ft.) [a, d]	Is Target Max DTW Below Top of Screen?	Is Static Water at Least 10 ft. Above Top of Screen?	Target DTW for Stopping Purging of Low-Yield Wells [a, e, f]
3G-1	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	162.10	175.05	12.95	185.05	WW	180.05	17.95	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3P-1	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	193.20	207.10	13.90	222.10	WW	214.60	21.40	0.55	0.11	0.00	0.66	2.5	0.33	0.99	3.8	1.52	2.19	213.08	Yes	Yes	208.10
3R-1	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	167.43	172.80	5.37	183.60	WW	177.80	10.37	0.46	0.11	0.00	0.57	2.2	0.33	0.90	3.5	1.38	1.91	176.42	Yes	No	172.62
3Ta-1	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	223.93	228.30	4.37	238.30	WW	233.30	9.37	0.60	0.11	0.00	0.71	2.7	0.33	1.04	4.0	1.59	2.34	231.71	Yes	No	228.62
4H-1	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	170.90	184.50	13.60	199.70	WW	192.00	21.10	0.49	0.11	0.00	0.60	2.3	0.33	0.93	3.6	0.00	0.00	192.00	Yes	Yes	185.50
5A-1	Detection	VOCs	5	19.63	0.136	0.375	0.25	0.125	0.0491	0.0003	180.98	180.96	-0.02	208.17	WW	194.20	13.22	0.50	0.11	0.00	0.61	2.4	0.33	0.94	3.6	0.92	1.30	193.28	Yes	No	187.59
5L-1	Detection	VOCs	4	12.57	0.087	0.25	0.17	0.085	0.0227	0.0002	188.62	186.71	-1.91	211.71	WW	199.20	10.58	0.24	0.11	0.00	0.35	1.4	0.33	0.68	2.6	1.04	1.24	198.16	Yes	No	193.91
5M-1	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	210.35	209.02	-1.33	229.69	WW	219.02	8.67	0.56	0.11	0.00	0.67	2.6	0.33	1.00	3.8	1.53	2.22	217.49	Yes	No	214.69
5N-1	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	223.31	215.11	-8.20	234.90	WW	233.00	9.69	0.60	0.11	0.00	0.71	2.7	0.33	1.04	4.0	1.59	2.34	231.41	Yes	No	228.16
5P-1	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	198.29	202.70	4.41	227.89	WW	215.00	16.71	0.55	0.11	0.00	0.66	2.5	0.33	0.99	3.8	1.52	2.19	213.48	Yes	No	206.65
5Q-1	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	216.62	214.52	-2.10	233.01	WW	223.00	6.38	0.57	0.11	0.00	0.68	2.6	0.33	1.01	3.9	1.55	2.25	221.45	Yes	No	219.81
6C-9	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	171.10	187.90	16.80	207.90	WW	197.90	26.80	0.51	0.11	0.00	0.62	2.4	0.33	0.95	3.6	1.46	2.07	196.44	Yes	Yes	188.90
7A-1	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	125.24	142.19	16.95	152.46	WW	147.19	21.95	0.38	0.11	0.00	0.49	1.9	0.33	0.82	3.2	1.26	1.67	145.93	Yes	Yes	143.19
7B-1	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	145.24	158.77	13.53	169.01	WW	163.77	18.53	0.42	0.11	0.00	0.53	2.1	0.33	0.86	3.3	1.32	1.79	162.45	Yes	Yes	159.77
7C-1	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	165.84	180.26	14.42	190.45	WW	185.26	19.42	0.48	0.11	0.00	0.59	2.3	0.33	0.92	3.5	1.41	1.98	183.85	Yes	Yes	181.26
7D-1	Detection	VOCs	4	12.57	0.087	0.375	0.25	0.125	0.0491	0.0003	173.02	188.23	15.21	198.60	WW	193.23	20.21	0.50	0.11	0.00	0.61	2.4	0.33	0.94	3.6	1.44	2.04	191.79	Yes	Yes	189.23

ft = inches; in = inches; DTW = depth to water; PCBs = polychlorinated biphenyls; VOCs = volatile organic compounds; WW = Well Wizard bladder pump

ND = Not Determined, 3G-1 details for purge criteria will be determined once the Well Wizard pumping system is installed and prior to incorporation into the groundwater detection monitoring program.

[a] Measured from the top of casing.

[b] Pump intake depths for Well Wizards are measured or are assumed to be in the middle of the screened portion of the well.

[c] The sampling volume accounts for container volumes, field parameter measurements, and incidental additional purged volumes.

[d] Calculated assuming that the purge tube is full.

[e] For the purposes of this calculation, a "low-yield" well is one where the drawdown criterion in the Groundwater Monitoring Plan cannot be achieved during low-flow purging.

[f] The Target DTW is 1 foot above the top of the screen for wells that have more than 10 feet of submergence prior to purging. For low-yielding wells with less than 10 feet of pre-purging screen submergence, the Target DTW is set at the mid-point between the static water level and the pump intake.

APPENDIX F – All Existing Monitoring Wells and PiezometersC

Appendix F. All Existing Table 7-15 Monitoring Wells and Piezometers

Monitoring Well and Piezometer Inventory Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)

Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)

WellLocation ID	Aquifer	Easting	Northing	Site Area	Current Use
A-2	Selah Level 2	8263468.42	714011.17	BackgroundWest of L-14	P
C-2	Selah Level 2	8264187.28	715720.88	Northern Boundary	P
D-9	Selah Level 1	8266106.95	714337.101	Northeast of Ponds A&B	P
E-3	L3 PR Flowtop	8263575.36	715262.83	North of Anticline	P
F-2	Selah Level 2	8266048.01	715326.01	North of Anticline	P
G-2	Selah Level 2	8266127.52	712704.47	L-12	P
H-2	Selah Level 2	8266139.61	711458.36	Southeast of L-13	P
I-2	Selah Level 2	8265065.70	715023.96	North of Anticline	P
J-2	Selah Level 2	8263466.71	712256.68	West of L-6	P
K-1	Selah Level 1	8264181.39	715712.29	Northern Boundary	P
La-2	Selah Level 2	8266135.26	713381.505	L-12	MWP
MW1-2	Selah Level 2	8264694.07	711538.99	Southwest of L-13	P
U-1	Selah Level 1	8263577.98	715707.38	Northern Boundary	P
U-1A	Selah Level 1	8263570.15	715701.07	Northern Boundary	P
U-2	Selah Level 2	8263577.98	715707.38	Northern Boundary	P
V-1	Selah Level 1	8265658.46	711436.57	South of L-13	P
V-2 (V-9)	Selah Level 1 & 2	8265657.04	711427.01	South of L-13	P
Va-1	Selah Level 1	8265656.61	711421.45	South of L-13	P

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Appendix F. All Existing Table 7-15 Monitoring Wells and Piezometers

Monitoring Well and Piezometer Inventory Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)

Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)

WellLocation ID	Aquifer	Easting	Northing	Site Area	Current Use
Va-1A	Selah Level 1	8265662.57	711426.101	South of L-13	P
Va-2	Selah Level 2	8265662.57	711426.101	South of L-13	P
Vb-1	Selah Level 1	8265647.52	711428.44	South of L-13	P
Vb-1A	Selah Level 1	8265647.52	711428.44	South of L-13	P
Vb-2	Selah Level 2	8265647.52	711428.44	South of L-13	P
W1-1,2 (W-9)	Selah Level 2	8263114.77	715243.55	North of Anticline	P
W3-9	Selah Level 1 & 2	8262967.38	714829.94	Anticline (West)	P
W4-2	Selah Level 2	8263047.93	714306.08	West of L-14	P
W6-2	Selah Level 2	8262045.24	714133.62	West of L-14	P
W9-1	Selah Level 1	8263032.76	713160.82	West of L-14	P
W9-2	Selah Level 2	8263032.76	713160.82	West of L-14	P
X-2	Selah Level 2	8263481.303	712602.86	West of L-1	P
Y-9	Selah Level 1	8264080.53	714843.09	Anticline (West)	P
Z-9	Selah Level 1 & 2	8263467.94	714930.62	Anticline (West)	P
2A-2	Selah Level 2	8264402.606	715043.202	North of Anticline	P
2B-2	Selah Level 2	8264724.72	715031.73	North of Anticline	P
2C-9	Selah Level 1 & 2	8263477.909	714603.25	Thrust Fault	P
2D-9	Selah Level 1 & 2	8263482.02	714308.94	L-14	P

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Appendix F. All Existing Table 7-15 Monitoring Wells and Piezometers

Monitoring Well and Piezometer Inventory Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)

Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)

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WellLocation ID	**Aquifer**	**Easting**	**Northing**	**Site Area**	**Current Use**
2E-9	Selah Level 1 & 2	8264077.75	715031.29	North of Anticline	MWP
2F-9	Selah Level 1 & 2	8263793.16	715028.69	North of Anticline	P
2G-9	Selah Level 1 & 2	8263477.43	714161.63	L-14	P
2H-2	Selah Level 2	8264231.15	715047.16	North of Anticline	P
2I-2	Selah Level 2	8263904.32	714471.404	Thrust Fault	P
2Na-1	Selah Level 1	8264648.44	714468.808	Anticline (Central)	P
2N-2	Selah Level 2	8264678.83	714465.39	Anticline (Central)	P
2N-4	L4 PR Interflow Zone	8264680.72	714456.14	Anticline (Central)	P
2O-1	Selah Level 1	8265728.62	714993.49	Anticline (East)	P
2O-2	Selah Level 2	8265728.62	714993.49	Anticline (East)	P
2O-4	L4 PR Interflow Zone	8265732.303	714981.29	Anticline (East)	P
2Ra-1	Selah Level 1	8264160.51	712745.101	L-1 / L-3	P
2S-1	Selah Level 1	8263689.85	711892.18	Southwest of L-6	P
2S-2	Selah Level 2	8263689.85	711892.18	Southwest of L-6	P
2T-1	Selah Level 1	8264166.01	711686.18	South of L-6	P
2T-2	Selah Level 2	8264166.01	711686.18	South of L-6	P
2Ua-1	Selah Level 1	8266132.81	712177.95	L-13	MWP
2U-2	Selah Level 2	8266133.98	712168.56	L-13	MWP
2U-3	L3 PR Flowtop	8266133.85	712154.49	L-13	P

Appendix F. All Existing Table 7-15 Monitoring Wells and Piezometers
Monitoring Well and Piezometer Inventory Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)
Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)

WellLocation ID	Aquifer	Easting	Northing	Site Area	Current Use
2U-4	L4 PR Interflow Zone	8266135.01	712158.65	L-13	P
2V-1	Selah Level 1	8265043.25	713084.27	L-9 / L-10	P
2V-2	Selah Level 2	8265043.25	713084.27	L-9 / L-10	P
2Vb-1	Selah Level 1	8265035.42	713079.27	L-9 / L-10	P
2Vb-1A	Selah Clay Layer	8265035.42	713079.27	L-9 / L-10	P
2Vb-2	Selah Level 2	8265035.42	713079.27	L-9 / L-10	P
2Wa-1	Selah Level 1	8265398.81	714177.28	North of Ponds A&B	P
2W-1	Selah Level 1	8265399.00	714203.00	North of Ponds A&B	P
2W-2	Selah Level 2	8265398.63	714203.303	North of Ponds A&B	P
2W-3	L3 PR Flowtop	8265399.47	714212.72	North of Ponds A&B	P
2X-1	Selah Level 1	8265124.28	711463.38	South of L-13	P
2X-2	Selah Level 2	8265124.28	711463.38	South of L-13	P
2Y-4	L4 PR Interflow Zone	8265590.54	710739.00	Alkali Canyon Rd	P
3B-1	Selah Level 1	8263657.58	714166.47	Background	P
3B-2	Selah Level 1	8263657.58	714166.47	Background	P
3E-2	Selah Level 2	8265151.91	714563.03	Anticline (East)	P
3F-2	Selah Level 2	8264096.86	714311.92	Anticline (West)	P

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Appendix F. All Existing Table 7-15 Monitoring Wells and Piezometers

Monitoring Well and Piezometer Inventory Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)

Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)

WellLocation ID	Aquifer	Easting	Northing	Site Area	Current Use
3G-1	Selah Level 1	8264947.14	714300.29	Northwest of Ponds A&B	PMW
3G-2	Selah Level 2	8264947.47	714310.85	Northwest of Ponds A&B	P
3H-1	Selah Level 1	8265469.54	714386.23	North of Ponds A&B	MWP
3H-2	Selah Level 2	8265470.606	714396.38	North of Ponds A&B	P
3I-1	Selah Level 1	8265611.36	714614.22	Anticline (East)	P
3I-2	Selah Level 2	8265610.45	714624.44	Anticline (East)	P
3J-1	Selah Level 1	8265639.57	713970.21	Ponds A&B	P
3J-2	Selah Level 2	8265640.93	713980.92	Ponds A&B	P
3Ka-1	Selah Level 1	8265481.89	713113.53	L-9 / L-10	P
3Ka-2	Selah Level 2	8265466.88	713115.28	L-9 / L-10	P
3Kb-1	Selah Level 1	8265511.18	713085.54	L-9 / L-10	P
3Kb-2	Selah Level 2	8265504.63	713074.89	L-9 / L-10	P
3Kc-2	Selah Level 2	8265484.61	713080.44	L-9 / L-10	P
3M-1	Selah Level 1	8264951.00	713776.95	L-14, Ponds A&B	P
3M-2	Selah Level 2	8264951.31	713766.84	L-14, Ponds A&B	P

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Appendix F. All Existing Table 7-15 Monitoring Wells and Piezometers

Monitoring Well and Piezometer Inventory Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)

Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)

WellLocation ID	Aquifer	Easting	Northing	Site Area	Current Use
3O-1	Selah Level 1	8263981.08	712213.62	L-6	P
3O-2	Selah Level 2	8263990.41	712212.00	L-6	P
3P-1	Selah Level 1	8264785.41	712209.42	L-6 / L-7	MW
3P-2	Selah Level 2	8264794.07	712211.09	L-6 / L-7	MWP
3Q-1	Selah Level 1	8265913.55	711698.46	L-13	MWP
3Q-1A	Selah Clay Layer	8265900.48	711699.89	L-13	P
3Q-2	Selah Level 2	8265906.11	711688.303	L-13	MWP
3R-1	Selah Level 1	8264256.48	712204.75	L-6	MW
3S-1	Selah Level 1	8265331.87	711649.76	L-13	MWP
3S-2	Selah Level 2	8265321.93	711649.23	L-13	MWP
3T-1A	Selah Clay Layer	8266099.23	711773.66	L-13	P
3T-2	Selah Level 2	8266096.76	711783.71	L-13	MWP
3Ta-1	Selah Level 1	8266107.22	711780.29	L-13	MW
3V-2	Selah Level 2	8264349.12	713104.08	L-14	MWP
3Y-2	Selah Level 2	8265321.14	713083.81	L-9 / L-10	P
4B-1	Selah Level 1	8265015.07	712592.505	L-7 / L-8	MWP
4Ba-2	Selah Level 2	8265015.06	712581.78	L-7 / L-8	MWP
4H-1	Selah Level 1	8265225.41	714000.38	L-14	MW
4H-2	Selah Level 2	8265214.75	713999.85	L-14	MWP

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Appendix ~~F. All Existing~~ Table 7-15 ~~Monitoring Wells and Piezometers~~

Monitoring Well and Piezometer Inventory ~~Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)~~

Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)

~~Well~~Location ID	Aquifer	Easting	Northing	Site Area	~~Current~~ Use
4Ja-1	Selah Level 1	8265674.19	712855.32	L-9 / L-12	P
4J-2	Selah Level 2	8265662.98	712854.68	L-9 / L-12	P
4K-2	Selah Level 2	8265659.85	713352.84	L-10 / L-12	P
4P-1	Selah Level 1	8266115.12	713939.21	East of Ponds A&B	P
4Pa-2	Selah Level 2	8266105.95	713933.82	East of Ponds A&B	P
5A-1	Selah Level 1	8264574.73	712212.18	L-6	MW
5A-2	Selah Level 2	8264593.74	712190.02	L-6	~~MW~~P
5B-1	Selah Level 1	8265005.39	712395.18	L-7	~~MW~~P
5B-2	Selah Level 2	8264986.63	712321.89	L-7	~~MW~~P
5D-1	Selah Level 1	8264991.15	712805.~~20~~2	L-7/L-8/L-9	~~MW~~P
5D-2	Selah Level 2	8264994.29	712825.81	L-7/L-8/L-9	~~MW~~P
5G-1	Selah Level 1	8264338.18	712536.04	L-3	P
5I-1	Selah Level 1	8264225.~~10~~1	712568.48	L-1 / L-3	P
5J-1	Selah Level 1	8265613.13	712597.72	L-8 / L-13	P
5J-2	Selah Level 2	8265589.94	712596.08	L-8 / L-13	P
5L-1	Selah Level 1	8265469.62	711656.26	L-13	MW
5L-2	Selah Level 2	8265480.21	711655.68	L-13	~~MW~~P
5M-1	Selah Level 2	~~8266133.94~~8265721.27	~~711938.57~~711689.41	L-13	MW

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Appendix F. All Existing Table 7-15 Monitoring Wells and Piezometers
Monitoring Well and Piezometer Inventory Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)
Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)

WellLocation ID	Aquifer	Easting	Northing	Site Area	Current Use
5M-2	Selah Level 2	8265719.81	711666.909	L-13	MWP
5N-1	Selah Level 1	8266133.57	711930.00	L-13	MW
5N-2	Selah Level 2	8266133.94	711938.57	L-13	MWP
5O-1	Selah Level 1	8265838.39	712657.32	L-12 / L-13	P
5O-2	Selah Level 2	8265827.97	712658.15	L-12 / L-13	P
5P-1	Selah Level 1	8266058.07	712673.72	L-12 / L-13	MW
5P-2	Selah Level 2	8266049.02	712686.52	L-12 / L-13	MWP
5Q-1	Selah Level 1	8266138.51	712993.93	L-12	MW
5Q-2	Selah Level 2	8266139.00	713005.74	L-12	MWP
5R-2	Selah Level 2	8266137.78	713176.05	L-12	MWP
5S-1	Selah Level 1	8266134.93	713441.01	L-12	MWP
5T-2	Selah Level 2	8266036.17	713624.07	L-12	P
5U-9	Selah Level 1	8266018.49	714324.88	Northeast of Ponds A&B	P
5V-9	Selah Level 1	8265809.45	714405.505	Northeast of Ponds A&B	P
6B-9	Selah Level 1 & 2	8265465.28	713666.37	Pond B, L-10	P
6C-9	Selah Level 1 & 2	8265639.00	713801.00	Pond B	MW
6G-1	Selah Level 1	8263511.11	713699.93	West of L-	MWP

Appendix ~~F. All Existing~~ Table 7-15 ~~Monitoring Wells and Piezometers~~

Monitoring Well and Piezometer Inventory ~~Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)~~

Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)

~~Well~~Location ID	Aquifer	Easting	Northing	Site Area	~~Current~~ Use
				14~~Background~~	
6G-1A	Selah Level 1	8263511.76	713704.46	West of L-14~~Background~~	P
6G-2	Selah Level 2	8263512.21	713709.26	~~Background~~West of L-14	~~MW~~P
6J-2	Selah Level 2	8263481.~~40~~4	713020.15	Southwest of L-14	P
6K-2	Selah Level 2	8264084.44	714960.38	North of Anticline	P
6L-1	Selah Level 1	8263567.17	714701.~~10~~1	Anticline (West)	P
7A-1	Selah Level 1	8264024.77	713074.69	L-14	MW
7A-2	Selah Level 2	8264015.95	713076.45	L-14	~~MW~~P
7B-1	Selah Level 1	8264418.42	713091.15	L-14	MW
7C-1	Selah Level 1	8264745.81	713103.22	L-14	MW
7C-2	Selah Level 2	8264733.31	713102.18	L-14	~~MW~~P
7D-1	Selah Level 1	8264881.81	713082.85	L-14	MW
7D-2	Selah Level 2	8264870.37	713085.44	L-14	~~MW~~P
7E-2	Selah Level 2	8264530.24	712206.37	L-14	~~MW~~P
PRB Test Well	L4 PR Interflow Zone	8264364~~.00~~	713104~~.00~~	L-14	P
7E-1	Selah Level 1	8264560.98	712235.08	L-6/L-7	MW
7F-1	Selah Level 1	8264971.13	712320.40	L-6/L-7	MW

Appendix F. All Existing Table 7-15 Monitoring Wells and Piezometers

Monitoring Well and Piezometer Inventory Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)

Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)

Well Location ID	Aquifer	Easting	Northing	Site Area	Current Use
7G-1	Selah Level 1	8264220.48	712227.33	South of L-6	MW
7H-1	Selah Level 1	8266162.89	712847.81	East of L-12	MW
7I-1	Selah Level 1	8266186.11	713158.05	East of L-12	MW
7J-1	Selah Level 1	8264977.71	714437.86	East ofL-14 Cell 6	MW
7K-1	Selah Level 1	8264639.97	715759.80	East of Ponds P-C1 and C4	MW
7L-1	Selah Level 1	8264632.36	715057.53	East of Pond P-C1	MW
7M-1	Selah Level 1	8262942.99	713351.29	East of Pond P-D3	MW
7N-1	Selah Level 1	8262612.04	715399.36	North of Pond P-E4	MW
7O-1	Selah Level 1	8263394.39	713351.29	South of Pond P-D3	MW
7P-1	Selah Level 1	8263694.96	716071.81	North of Pond P-C4	MW

Notes:
MW = monitoring well (used for groundwater quality and water level measurements)

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Appendix F. All Existing Table 7-15 Monitoring Wells and Piezometers

Monitoring Well and Piezometer Inventory Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)

Chemical Waste Management of the Northwest, Inc. (Arlington, Oregon)

WellLocation ID	Aquifer	Easting	Northing	Site Area	Current Use

P = piezometer (used for water level measurements only)

TBD = to be determined

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